SIDA

CONTRIBUTIONS TO BOTANY

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THE GENUS *CYBIANTHUS* (MYRSINACEAE) IN ECUADOR AND PERU

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ABSTRACT

The genus *Cybianthus* was revised to provide taxonomic treatments of the Myrsinaceae for *Flora of Peru*, *Catalogue of the Vascular Plants of Ecuador*, and *Flora of Ecuador*. Eight of *Cybianthus*' ten subgenera are represented, and an updated description of the genus, keys to its subgenera and emended descriptions for each are provided. Detailed descriptions of the morphology, anatomy and ecology of the genus are presented. *Cybianthus* subgenus *Iteoides* is relegated to synonymy under subgenus *Microconomorpha*. Within each subgenus, keys, full descriptions, synonymy, distribution, ecology and conservation statuses, local names and uses are given for each species. In addition, specimens are cited for each species, including extralimital ones to show extremes in morphological variation. Thirteen species are relegated to synonymy, nine names are lectotypified, and one, *Conomorpha rigida*, is neotypified. One new combination, *Cybianthus guyanensis* subsp. *pseudoicacoreus*, is made, and *Cybianthus poeppigii* is transferred from subgenus *Cybianthus* to subgenus *Weigeltia*. The following 15 new species are described, illustrated and their phylogenetic relationships are discussed: *Cybianthus anthuriophyllus, C. cenepensis, C. comperuvianus, C. croatii, C. flavovirens, C. fosteri, C. grandezii, C. granulosus, C. huampamiensis, C. incognitus, C. jensonii, C. nestorii, C. pseudolongifolius, C. timanae, C. vasquezii.*

RESUMEN

Al preparar tratamienros taxonómicos sobre la familia Myrsinaceae para los proyectos *Flora del Perú, Catálago de las Plantas Vasculares del Ecuador,* y *Flora del Ecuador*, se llevó a cabo una revisión del género *Cybianthus*. Se encuentra en la región ocho de los diez subgéneros, y se provéen tanto una descripción actualizada para el género como para cada subgénero también. Se presenta descripciones detalladas tratando la morfología, anatomía y ecología del género. Se relega *Cybianthus* subgénero *Iteoides* a la sinonímia bajo subgénero *Microconomorpha*, y se transfiere *Cybianthus poeppigii* del subgénero *Cybianthus* al subgénero *Weigeltia*. Para cada subgénero, se provéen claves, descripciones completas, sinonímia, distribución geográfica y estado actual de su conservación, nombres locales y usos. También se cita colecciones revisadas para cada especie, incluyendo ellas fuera de la región delimitada cuando se muestran variación morfológica significativa. Se relegan 13 especies a la sinonímia, se lectotipifica 9 binomiales y uno, *Conomorpha rigida*, se neotipifica. Se publica la nueva combinacón, *Cybianthus guyanensis* subsp. *pseudoicacoreus*. Se describen, se ilustran y se discuten el parenrezco para 15 especies nuevas, listadas a continuación: *Cybianthus anthuriophyllus, C. cenepensis, C. comperuvianus, C. croatii, C. flavovirens, C. fosteri, C. grandezii, C. granulosus, C. huampamiensis, C. incognitus, C. jensonii, C. nestorii. C. pseudolongifolius, C. timanae, C. vasquezii.*

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INTRODUCTION

The genus *Cybianthus* Martius was cladistically defined by the presence of unique glandular granules at the junction of the corolla tube and lobes by Pipoly (1987). In addition, the unique combination of lateral (axillary) inflorescences, gamosepalous and gamopetalous flowers, and stamens connate by their filaments at least one-fourth their length, and adnate to the corolla tube at least one-third its length (Pipoly 1987, 1992a) allows for practical recognition from herbarium specimens. With this contribution, *Cybianthus* now contains 167 species in ten subgenera. The genus includes species formerly included in the genera *Comomyrsine* Hook. f., *Conomorpha* A. DC., *Correlliana* D'Arcy, *Cybianthopsis* Lundell, *Grammadenia* Benth., *Microconomorpha* Lundell, and *Weigeltia* A. DC. (Pipoly 1987, 1992a). In Ecuador and Peru, 43 species in 8 subgenera are known. Among the species, none are endemic to Ecuador, while 11 are endemic to Peru.

The broad generic concept for *Cybianthus* was first proposed by Agostini (1970) as a precursor to his dissertation (1972); that was followed by the formal transfers and a key to the subgenera (Agostini 1980). Subsequently, while revising subgenus *Grammadenia*, Pipoly (1987) determined that the paleotropical genus *Embelia* Burman f. was the sister group to the entire genus and that it was most parsimonius to include *Grammadenia* within *Cybianthus*. Preparation of taxonomic treatments for the Myrsinaceae in *Flora of Peru*, *Catalogue of the Vascular Plants of Ecuador* and *Flora of Ecuador* revealed that many taxa were new, and much confusion had arisen among the concepts prevalent for taxa already described. Among adjacent countries with significant Amazonian regions, Ecuador and Peru share more species of *Cybianthus* in common than do any other pair of countries. While it would have been desirable to include Colombia to provide a treatment for the entire northwestern South America, the number of additional species endemic to Colombia, or known only from Colombia and Venezuela, would have increased the size of the treatment by fifty percent. Given that it will be some time until a revision of the entire genus for *Flora Neotropica* is complete, the present treatment is intended to serve as a precursor to that monograph and to make the names available for the other aforementioned projects. A revised description of the genus *Cybianthus* follows, including keys and emended descriptions for the eight subgenera occurring in Ecuador and Peru, along with keys to the taxa and full descriptions for each. For each of the fifteen new species described, illustrations are provided, while for all species, full descriptions and synonymy, discussions of distribution, ecology and conservation status, etymology, and when known, local names and uses are elucidated.

MORPHOLOGY

Morphological terms in this treatment follow Lindley (1848) and Pipoly

(1987, 1992a) for the inflorescence, rachis pedicels and floral parts. Description of leaf morphology follows Hickey (1984), trichome description follows Theobald et al. (1984) and basic cell and tissue terminology follow Metcalfe (1984).

Habit and Architecture

The majority of *Cybianthus* species in Ecuador and Peru are large shrubs or small trees to 18 meters tall. Four species are small shrubs or subshrubs (*Cybianthus croatii, C. humilis, C. lineatus, C. nanayensis*) usually under one meter tall. With the exception of two species in subgenus *Grammadenia*, all species are terrestrial. *Cybianthus marginatus* is an obligate epiphyte, while *C. magnus* is a facultative epiphyte, frequently found on large tree trunks, but also known from large rock outcrops.

Most members of *Cybianthus* exhibit Rauh's Model of architecture (Hallé et al. 1978), characterized by a polyaxial, monopodial, rhythmically growing, readily distinguishable trunk, that develops tiers of branches morphogenetically identical to itself. All branches are orthotropic and monopodial, with lateral (axillary) inflorescences that do not affect shoot development. However, two subgenera (*Comomyrsine* and *Triadophora*) exhibit Corner's Model (Hallé et al. 1978), characterized by a single aerial meristem that produces a monoaxial (unbranched) axis on which inflorescences are lateral (axillary). The resulting monocaulous tree is pleionanthic (not hapaxanthic, or monocarpic) and growth is indeterminate. The trunk may grow rhythmically or continuously. Sporadic occurences of this architectural model occur in members of subgenus *Weigeltia*, from the Guianas and eastern Amazonia, however, none of those species are known from Ecuador and Peru.

While conducting fieldwork in Peru, a collection of *Cybianthus kayapii* (Lundell) Pipoly was observed reiterating. In the population observed at Explorama Lodge near Yanamono, (Loreto, Peru) one individual (*Pipoly et al. 12383*), exhibited bayonet reiteration, caused by destruction of the apical meristem of the trunk. The individual bore a reduced staminate inflorescence with flowers slightly larger and more maroon in color than normal, and smaller leaves with shorter petioles. As I have noted elsewhere (Pipoly 1987, 1992a), leaves on the reiterative shoots resemble those of saplings. Variation in inflorescence and floral morphology seen in this Peruvian population is consistent with variation reported in Pipoly (1992a). Therefore, it appears that changes in sex expression are consequent to a reiteration phenomenon, rather than circumstantially associated with it. I postulate that reiterative branches may be hormonally juvenile and as such, are morphogenetically incapable of producing bisexual or pistillate flowers, and produce only sapling leaves until flowering occurs. This process may account for the great variation in leaf morphology and apparent sexual lability often associated with many species of *Cybianthus*. Unfortunately, for individuals of normally dioecious species with monoaxial models, it is not possible to determine if sex change has occurred because no inflorescences are usually observed before the original apical meristem is destroyed, and no inflorescences on other branches are available for comparison. However, precociously flowering individuals of *Cybianthus incognitus* (*P. Barbour 2405*) support the hypothesis. Clearly, pruning experiments *in situ* will be necessary to test this hypothesis.

Branchlets

A branchlet is here defined as the distal 10 cm of any branch. Branchlets may be flexuous, or straight; terete or angular; smooth, verruculose, or verrucose-papillate (Fig. 1A, 1B), glabrous, glandular-papillate (Figs. 1D, 3F, 4F), ferrugineous stipitate-lepidote (Fig. 2A–F), ferrugineous or rufous dendroid-and/or stellate-tomentose (Fig. 3A), rufous sessile furfuraceous lepidote, with a tomentum of malpighiaceous trichomes (Fig. 3D), glandular-granulose, with hydropotes (Fig. 3C), epunctate or rubiginous punctate-lineate, bearing lenticels or not.

Leaves

Species of *Cybianthus*, like all Myrsinaceae, are exstipulate and have simple leaves. The leaves are usually alternate, but may be subopposite or pseudoverticillate, especially in subgenera *Microconomorpha*, *Conomyrsine*, *Weigeltia* and *Cybianthus*. In the majority of species, the leaves are petiolate, but in subgenus *Grammadenia* they are sessile. The ptyxis (the form in which one single leaf is folded on itself in bud) is most often supervolute (Cullen1978), but it has not been adequately studied thus far for each subgenus. The leaf vernation sensu Cullen (1978), is at least analagous with floral aestivation, or the relationship of one leaf to another; in *Cybianthus*, it is in fact, unknown. The leaf blade texture may be membranaceous, chartaceous or coriaceous. The shape is most often elliptic, but may be oblanceolate, lanceolate, obovate, rarely ovate or oblong (*Cybianthus marginatus*). The apex may be acute, acuminate, long-attenuate, rounded, obtuse, or emarginate, without mucro or rarely (subgenera *Grammadenia*, *Conomyrsine*, *Triadophora*) mucronate (Fig. 21). The base is rarely auriculate (subgenus *Grammdenia*) or obtuse approaching auriculate (*Cybianthus grandezii*, *C. kayapii*, *C. anthuriophyllus*) and is usually cuneate, long-attenuate, acute or obtuse, decurrent on the petiole or not. The adaxial surface may be nitid, pallid, or sordid, rarely scrobiculate , pusticulate or pustulate when mature. The blade margin may be regular or irregular, flat inrolled or revolute, entire, or rarely undulate, lobate, crenate or dentate (*Cybianthus pastensis*), densely and minutely serrulate (*C. anthuriophyllus*), or coarsely dentate (*C. schlimii*, some populations of *C. pastensis*, *C. poeppigii*,), or with a very subtle but vascularized vein ending (*C. verticilloides*) opaque, or rarely scarious (all species in

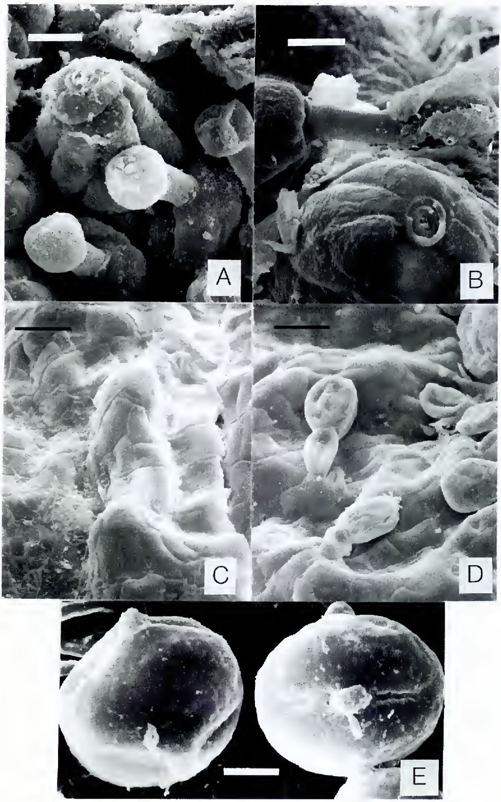

Fig. 1. SEM photos of morphological features in subgenus *Grammadenia*. A. *Cybianthus marginatus* (*Pipoly 6546*), showing verrucose papillae. B. Same, close-up. C, D. *C. lineatus* (*Pipoly et al. 7729*), showing stem surface. D. Glandular papillae. E. *C. costaricanus* subsp. *morii* (*Pipoly 7017*), pollen, equatorial and polar views. (Bars in figs. equal: A. 50 µm, B. 22.2 µm, C, D. 48 µm, E. 12.3 µm) Figure reproduced from Pipoly, 1987.

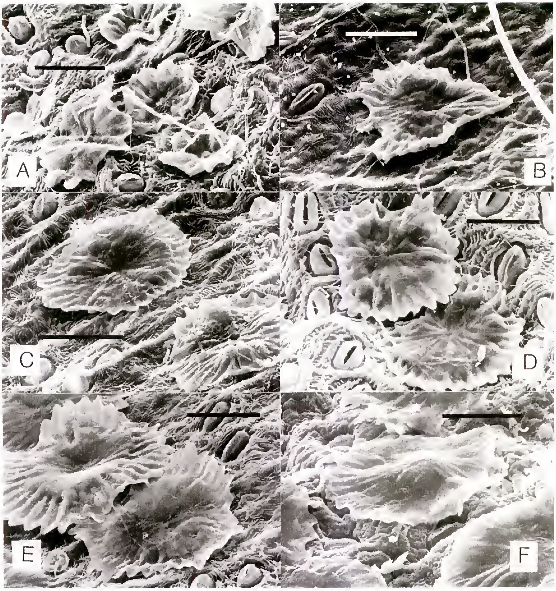

FIG. 2. SEM photos of representative stipitate ferrugineous lepidote scales of subgenus *Conomorpha*. A. *Cybianthus gigantophyllus* (holotype). B. *C. spichigeri* (holotype). C. *C. laetus* (*Dudley 10803*). D. *C. peruvianus* (*Dodson 2821*). E. *C. comperuvianus* (*Killip & Smith 26073*). F. *C. guyanensis* subsp. *pseudoicacoreus* (*Simpson & Schunke 784*). (Bars in Figs. A–F equal: 50 μm).

Cybianthus subgenus *Grammadenia*; *Cybianthus humilis*, and *C. croatii* of *Cybianthus* subgenus *Comomyrsine*).

Leaf punctation and punctate-lineation may be pellucid (translucent), black, orange red, or rubiginous (light red) in color. Punctations as defined by Pipoly (1987) are definded as rounded, lyso-schizogenously formed cavities and are distinguished from punctate-lineations, which are homologous, linear cavities in the leaves. Among taxa bearing non-pellucid punctations or punctate-lineations, all young, undexpanded leaves have orange glands, even if mature leaves have red or black glands. Experiments to determine integrity of punctation color have revealed that it is not a reliable taxonomic character

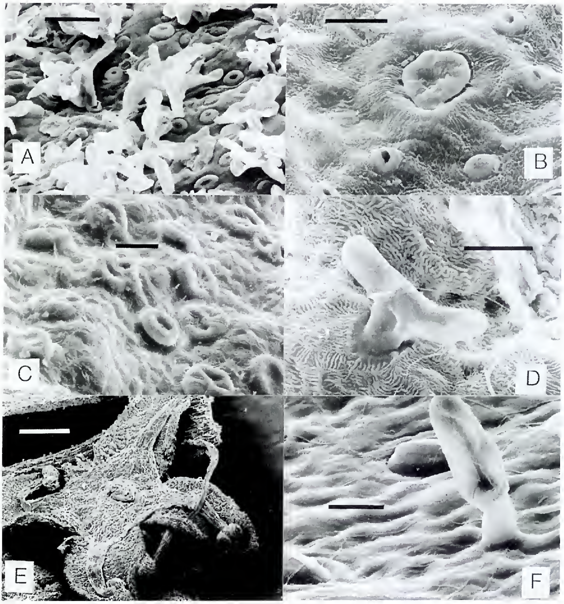

FIG. 3. SEM photos of representative vestiture in subgenera *Laxiflorus*, *Microconomorpha*, *Triadophora* and *Comomyrsine*. A. *Cybianthus fulvopulverulentus* subsp. *magnoliifolius* (*Cowan & Soderstrom 2146*), branchlet, showing stellate trichomes. B. *C. spicatus* (*Maguire & Politi 28064*), showing hydropote in abaxial leaf pit. C. *C. pastensis* (*Killip & García 33886*), branchlet, showing developing hydropotes. D. *C. schlimii* (*Fosberg 20148*), branchlet, showing malpighiaceous trichome. E. *C. kayapii* (holotype) Staminate flower, showing vestigial pistillode, structure of androecium. F. *C. humilis* (*Lehmann s.n.*), showing glandular papillae of abaxial leaf surface. (Bars in Figs. equal: A–C. 50 µm, D & F. 25 µm, E. 0.4 mm).

(Pipoly 1987). The other punctation character states include "conspicuous" versus "inconspicuous," reflecting the ease of viewing the punctation (a reflection of its relative diameter in transverse section), and "prominent" versus "not prominent," which refer to whether the punctation is blister-like or planar, respectively.

The abaxial and/or adaxial surface of the blade may be glabrous, or with a vestiture composed of stipitate ferrugineous lepidote scales (subgenus *Conomorpha*, Fig. 2A-2F), sessile furfuraceous lepidote scales (subgenus *Weigeltia*), dendroid and/or stellate trichomes, translucent glandular-lepidote scales, or with scattered glandular papillae (subgenus *Comomyrsine*, Figs. 3F, 4F), malpighiaceus trichomes (subgenus *Triadophora*, Fig. 3D), or hydropotes (subgenera *Laxiflorus*, *Microconomorpha*, *Grammadenia*, *Comomyrsine*, Figs. 3A, 3C, 4A–E). The adaxial surface is usually glabrescent.

Hydropotes ("water drinkers") were previously thought to be unique to subgenus *Grammdenia* (Pipoly 1987), but have now been found in all species of subgenus *Comomyrsine*. Described by Mayr (1915) and Grüss (1927a, 1927b), hydropotes have been reported for numerous submerged aquatic angiosperms (Fahn 1979; Gessner & Volz 1951). Elegant ultrastructural and autoradiographic studies undertaken by Lüttge (1964) and Lüttge and Krapf (1972) demonstrated the mineral absorptive function of hydropotes. While both subgenera bear these structures, their morphology is strikingly different. The hydropotes of subgenus *Grammdenia* (Fig. 5) consist of five to seven subsidiary cells, a central foot cell, a basal cell, a stalk cell, and up to 12 cells forming a scale-like cap, while those of subgenus *Comomyrsine* consist of five to seven subsidiary cells, a central foot cell, a stalk cell, and up to 12 cells forming a lenticular cap or globose body. In subgenus *Comomyrsine*, the cap cell is formed before elongation of the stalk cell. In *Cybianthus verticilloides* (Fig. 4B), *C. sprucei* (Fig. 4D), and *C. kayapii* (Fig. 4E) the cap consists of a spherical body of cells, while in *C. croatii* (Fig. 4A) and *C. simplex* (Fig. 4C), the cap is lenticular. It is interesting to note that within subgenus *Grammadenia*, the shape of the cap is the same among all species, while in *Comomyrsine*, there are 4 types. The occurrence of hydropotes in subgenus *Laxiflorus*, in pits over the abaxial leaf surface, and in subgenus *Microconomorpha*, under the papillate tomentum of the branchlets, was unknown before the present study. Despite these differences, the structures are homologous, based on position, function and ontogeny. In early ontogeny, a mucilaginous substance accumulates around the base cell (Fig. 7E). Later, the cap breaks off (Fig. 7F), leaving a mucilaginous ring around the broken basal cell (Pipoly 1987, unpubl. data).

Subepidermal fibers, visible as numerous, thin, parallel lineate structures on both surfaces of leaf blades in subgenus *Triadophora* are unique to it. They have recently been shown to be homologous with those of *Clavija* in the Theophrastaceae (Pipoly, unpubl.).

Petioles are present in most taxa, with the notable exception of subgenus *Grammdenia*, where the leaves are sessile. The petioles may be canaliculate, marginate, or canaliculate with margins, trigonal, or rarely subterete, and may be pulvinate (abruptly swollen basally) or gradually tapering basipetally.

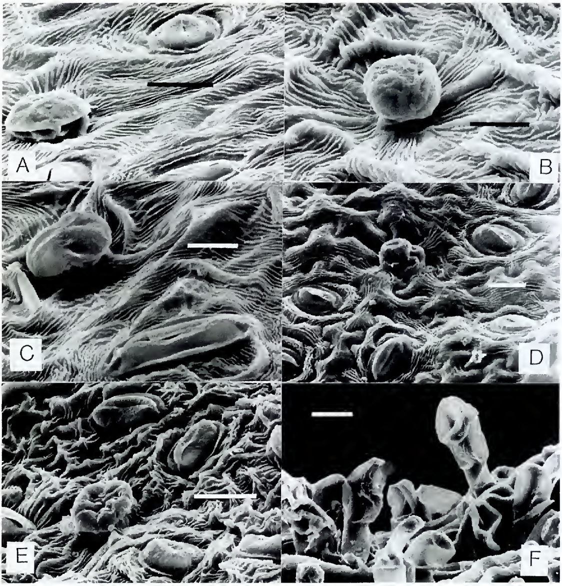

Fig. 4. Representative SEM photos of morphological features in subgenus *Comomyrsine*. A–E, Hydropotes of abaxial leaf surface. A. *Cybianthus croatii* (holotype), showing lenticular cap. B. *C. verticilloides* (holotype), showing globose cap. C. *C. simplex* (*Zak 1350*), showing lenticular cap. D. *C. sprucei* (*Cuatrecasas 15743*), showing globose cap. E. *C. kayapii* (holotype), showing depressed-globose cap (somewhat collapsed). F. *C. kayapii* (holotype), branchlet, showing glandular papilla. (Bars in Figs. equal: A. 25 µm. B. 20 µm. C. 10 µm. D–F, 25 µm).

Cataphylls and Pseudocataphylls

Cataphylls (Fig. 9B) and pseudocataphylls are synapomorphic to subgenera *Comomyrsine* and *Triadophora*, respectively. Earlier (Pipoly 1987), I had mistakenly interpreted them as inflorescence bracts. They may be alternate or pseudoverticillate, alternating with pseudoverticels of leaves, or apparently axillary to them, rigid, chartaceous, or membranaceous, linear-subulate to

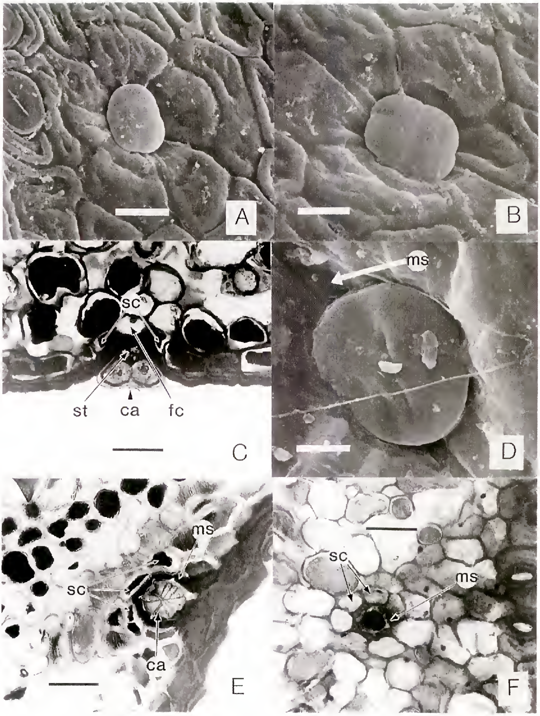

FIG. 5. Ontogeny of hydropotes in subgenus *Grammadenia*. A, B, & D. *Cybianthus costaricanus* subsp. *costaricanus* (*Pipoly 7608*), SEM photos. A. Mature hydropote, cap with at least 8 cells, and with 5 subsidiary cells. B. Younger hydropote, cap with 4 cells, and with 6 subsidiary cells. C. *C. costaricanus* subsp. *morii* (*Pipoly 7017*), longisection of young hydropote, showing subsidiary cells (sc), foot cell (fc), stalk cell (st), cap cell (ca), basal cell not discernible. D. Young hydropote, with 2-celled cap, showing mucilaginous substance (ms). E, F. *C. costaricanus* subsp. *panamensis* (*Pipoly 7056*), paradermal sections. E. Showing mature hydropote, with 12-celled-cap. F. Showing hydropote after cap has broken off. (Bars in Figs. A–F equal: A & C. 28 µm, B. 20 µm, D. 10 µm, E. 36 µm, F. 53 µm. Figure reproduced from Pipoly, 1987.

acicular, rigid to membranous, keeled or flat, apically mucronate or not, prominently punctate or punctate-lineate, glabrous, rufous puberulent, glandular-papillate, bearing hydropotes, or orange lepidote scales, sessile or on a petiole to 2 mm long. Pending further developmental studies, I am distinguishing cataphylls from pseudocataphylls based on the absence of a petiole in the former and its presence in the latter. Within *Cybianthus*, pseudocataphylls are unique to subgenus *Triadophora*, while cataphylls are unique to subgenus *Comomyrsine*. Both pseudocataphylls and cataphylls may be distinguished from an inflorescence bract by the fact that neither of these structures are axillant to an inflorescence, neither are ephemeral, but both occur in pseudowhorls.

Inflorescence and Flowers

The inflorescence in *Cybianthus* is always lateral (axillary), and it may consist of a simple raceme (erect or lax), a subpyramidal or pyramidal panicle (sometimes thyrsoid), a spike, or rarely, a pleiochasium. At times, species with essentially racemose inflorescences may produce a panicle consisting of a pseudoverticel of racemes on a reduced peduncle. In this treatment, an inflorescence is considered spicate if the pedicels are obsolete or less than 0.3 mm long and subspicate if the pedicels are from 0.4–0.8 mm long. In most species, the staminate inflorescence tends to be longer, slightly more lax, and bears greater numbers of flowers. In those species bearing panicles, the staminate ones bear secondary branches of the inflorescence that are longer, more floriferous, and at times, more branched than the pistillate and bisexual panicles.

The inflorescence bracts are early caducous and are rarely seen in the field or on specimens. The secondary branch bracts of panicles are also rarely collected, with the exceptions of subgenera *Comomyrsine* and *Triadophora*. The floral bracts may be membranaceous or chartaceous and are usually persistent in staminate inflorescences, but are at times caducous in pistillate ones. The floral bracts may be glabrous or bear a tomentum either adaxially, abaxially, or on both surfaces. The floral bract apices are acute, attenuate, or acicular, the margins entire or undulate.

The pedicels are cylindrical, clavate, or obconic, and at times accrescent or crassate in fruit. In most species, the pedicels are subtended by an axillant floral bract, but in *Cybianthus kayapii*, it is inserted at about the middle of the pedicel.

Figure 6 illustrates the tremendous variation in floral morphology among members of the genus, along with representative staminate and pistillate flowers from *Embelia*, the paleotropical sister genus of *Cybianthus*. The flowers may be functionally staminate, pistillate or bisexual. Consequently, the plants are normally functionally dioecious, but may also be bisexual or polygamous. Flowers are normally perfect, but in some species of subgenera *Weigeltia*, *Comomyrsine* and *Cybianthus*, the pistillode is often obsolete in the stami-

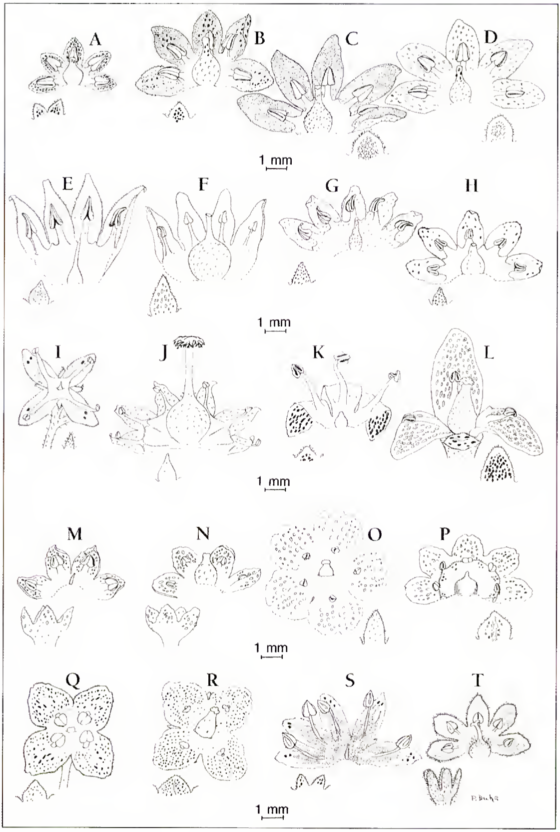

FIG. 6. Representative flowers of *Cybianthus* subgenera and sister genus, *Embelia*, open flowers in anthesis above, calyx lobes below. A–B, Subgenus *Microconomorpha*, (*Cybianthus pastensis*), note monomorphic flowers. A. Staminate flower (*Killip & García 33886*). B. Pistillate flower

nate flowers. The staminate flowers are usually larger than the pistillate ones. The flowers are usually 4 or 5(–6)-merous, but they are 3-merous in subgenus *Triadophora* (Fig. 6K, 6L). The majority of species are homomerous, but *Cybianthus kayapii* has heteromerous flowers, (the calyx 4- and the corolla 5-merous), and in *C. anthuriophyllus*, the calyx 6- and the corolla 5-merous. Either or both whorls of the perianth may be membranaceous, chartaceous, coriaceous or carnose, epunctate, punctate or punctate-lineate. The punctations may be inconspicuous or conspicuous, prominent (raised) or not, pellucid, brown, orange or red. The calyx may be valvate or imbricate, and may be cotyliform, cupuliform or urceolate. The corolla is valvate or imbricate, and may be campanulate, cupuliform, tubiform, infundibuliform, salverform, rotate or subrotate. The stamens and staminodes are similar in morphology, but the staminodes are smaller. The filaments of the stamens and staminodes are partially united at the base to form a conspicuous or inconspicuous, membranaceous, chartaceous or carnose tube, except in subgenus *Cybianthus*, which has a terete or rarely, angulate staminal tube developmentally fused with the corolla tube, the stamens thus appearing epipetalous. In some species, the tube bears lobes (sterile projections of tissue) which alternate with the apically free portion of the filaments. The apically free portions of the filaments may be terete, flat, or absent. The anthers may be dorsifixed, basifixed or versatile. Anthers may be lanceolate, ovate, cuadrate, or deltate, apiculate, acute, truncate or emarginate, the apiculate ones may have the apiculum erect, distally or proximally recurved, glabrous or glandular-papillate. Antherodes of the pistillate flowers are similar to the anthers but reduced insize, and normally devoid of pollen, but occasionally, they may produce copious amounts of abortive pollen (Pipoly 1983a). The connective may be epunctate or prominently punctate, or rarely glandular-papillate. The pollen is tricolporate and psilate (Fig. 1E). The pistillode may be lageniform, conic or obturbinate. The pistil may be obnapiform,

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(*Schultes 3226*). C–D, Subgenus *Stapfia*, (*Cybianthus stapfii*). C. Staminate flower (*Fassett 25706*). D. Pistillate flower (*Cuatrecasas 12293*). E-F, Subgenus *Laxiflorus* (*Cybianthus spicatus*). E. Staminate flower (*Maguire 35525*). F. Pistillate flower (*Prance et al. 3359*). G–H, Subgenus *Conomorpha* (*Cybianthus laurifolius*). G. Staminate flower (*García-Barriga & Jaramillo 19841*). H. Pistillate flower (*Grubb et al. 744*). I–J, Subgenus *Comomyrsine*. I. Staminate flower, *Cybianthus sprucei* (*Cuatrecasas 16272*). J. Pistillate flower, *Cybianthus kayapii* (*Acosta-Solis 5544*). K–L, Subgenus *Triadophora*, (*Cybianthus schlimii*). K. Staminate flower (*Haught 1502*). L. Pistillate flower (*Herrera 1720*). M–N, Subgenus *Weigeltia*, *Cybianthus* sp. nov. M. Staminate flower (*Maas & Westra 4459*). N. Pistillate flower (*Maguire & Fanshawe 40590*). O. Subgenus *Cybianthopsis*, bisexual flower, (*Cybianthus sintenisii, P. Wilson s.n.*). P. Subgenus *Grammadenia*, bisexual flower, (*Cybianthus piresii, Maguire et al. 37052*). Q–R, Subgenus *Cybianthus*, (*Cybianthus goyazensis*). Q. Staminate flower (*Irwin & Soderstrom 5378*). R. Pistillate flower (*Herringer 45*). S-T. *Embelia sp.* S. Staminate flower (*Petelot 3887*). T. Pistillate flower (*C. Wang 76408*). Drawing prepared by Peggy Duke.

conic, ellipsoid, or obturbinate, with a punctiform, or capitate stigma. The stigma is large and capitate, with erose-fimbriate lobes and is caducous in subgenus *Comomyrsine*. The ovary in species from Ecuador and Peru are terete. The placenta may be cotyliform, cupuliform or globose, with 2–4 uniseriate ovules naked or partially immersed. The fruit is a globose or depressed-globose drupe and is one-seeded, with a thick or thin exocarp.

ANATOMY

This treatment is not intended to serve as a monograph of the genus, but a few salient anatomical features may prove useful in identifying sterile material or wood samples. Druses (Pipoly 1987-Fig. 8B–C) are ubiquitous in Myrsinaceae, as are pericyclic fibers (Pipoly 1987, Fig. 8A). All Myrsinaceae have resin ducts (canals) at least in the cortex, and in the field, copious amounts of resin are visible in the canals of the pith and secondary phloem, in freshly cut branchlets, in species of subgenera *Grammadenia* and *Laxiflorus*. Aerenchyma in the cortex of the primary stem is unique to subgenus *Grammdenia* and is found in all species (Fig. 7F), except in *Cybianthus lineatus* (Fig. 7E). The pith in primary stems of subgenus *Weigeltia* is parenchymatous with large, rounded starch grains, while that of *Cybianthus magnus* has angular collenchyma (Pipoly 1987). It is interesting to note that the collencyma of the outer cortex in *Cybianthus magnus* subsp. *asymmetricus* is tangential rather than angular, while that of *C. magnus* subsp. *magnus* is angular (Fig. 8 D–F). All species of *Cybianthus* have cortical vascular bundles, that may be amphicribal (Fig. 7C) or hemiamphicribal (Fig. 7D), with (Fig. 7C) or without (Fig. 7D) accompanying perivascular fibers. Wood of subgenus *Comomyrsine* is notable for its thin-walled vessels (Fig. 9D), while the fiber-tracheids of subgenus *Grammadenia* have walls so thick as to significantly occlude the lumina (Pipoly 1987- Fig. 7C). Also, starch is present in the phloem fibers of subgenus *Comomyrsine* (Fig. 9E, 9F) but not in *Grammdenia*. In leaf anatomy, it is notable that subgenus *Grammadenia* has functionally acrodromous venation. This is due to its unique leaf-node continuum, and consequent primary vascular system (Pipoly 1987-Figs. 7–9; 11–12) where the cathodic and anodic leaf traces are autonomous from each other and from the relevant midrib trace, a system thus far unique among angiosperms. Leaves of subgenus *Triadophora* may be easily recognized by their subepidermal fibers, while those of *Cybianthus lineatus* are unique for their bifacial palisade layer (Pipoly 1987- Fig. 14b).

ECOLOGY

In Ecuador and Peru, species of *Cybianthus* occur in wet or moist, tall *terra firme* forest on laterite, limestone or white sand, seasonally inundated igapó or várzea, premontane humid, wet or pluvial forest on laterite or sandstone,

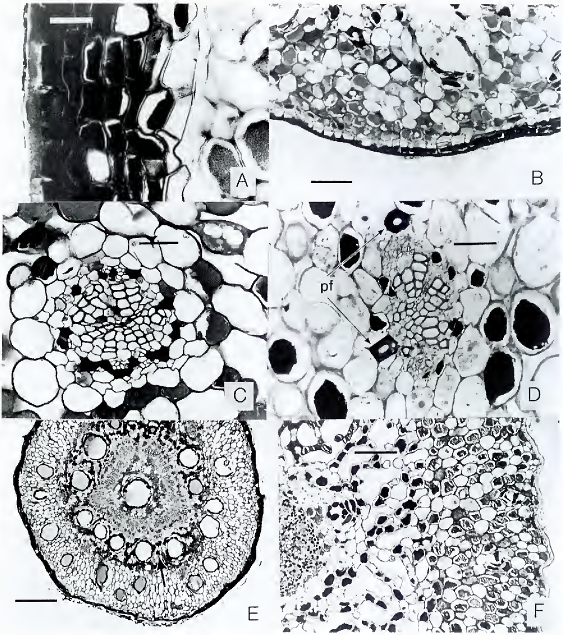

Fig. 7. Primary stem histological features in subgenus *Grammadenia*. A–B. *Cybianthus ptariensis*, (*Pipoly et al. 7133*), periderm formation, showing epidermal cork development. C. *C. marginatus* (*Pipoly 6546*), amphicribal corical bundle without perivascular fibers. D. *C. ptariensis* (*Pipoly et al. 7133*), hemiamphicribal bundle with perivascular fibers (pf). E. *C. lineatus* (*Pipoly 7229*), section showing parenchymarous pith, inner and outer cortex. F. *C. marginatus* (*Pipoly 6546*), section showing aerenchymatous inner cortex; parenchymatous pith and outer cortex. (Bars in Figs. A–F equal to: A. 30 µm, B. 120 µm, C. 48 µm, D. 60 µm, E. 465 µm, F. 120 µm. Figure reproduced from Pipoly, 1987.

cloud forest, elfin forest, montane or subpáramo thickets, or sandstone scrub at high elevation.

The *terra firme* and premontane forest life zones are the richest in endemics, with six and five species, respectively. *Terra firme* is here divided into two

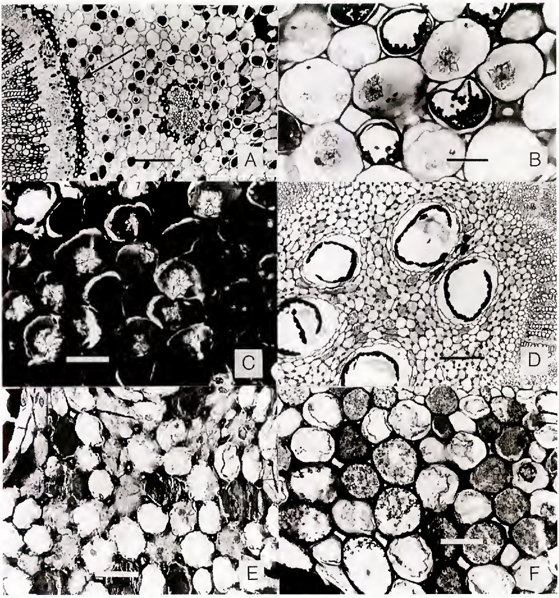

FIG. 8. Primary stem histological features of subgenus *Grammadenia*. A. *C. costaricanus* subsp. *morii* (*Pipoly 7017*), showing pericyclic fibers (arrow). B. *C. costaricanus* subsp. *costaricanus* (*Pipoly 7068*), showing druses in pith. C. *C. costaricanus* subsp. *panamensis* (*Pipoly 7056*), showing druses in pith, using polarized light. D, E. *C. magnus* subsp.*magnus* (*Pipoly 6453*), showing angular pith collenchyma. F. *C. magnus* subsp. *asymmetricus* (*Luteyn, Pipoly et al. 10415*), showing transitional tangential pith collenchyma. (Bars in Figs. A–F equal to: A. 195 µm, B. 45 µm, C. 48 µm, D. 230 µm, E. 74 µm, F. 60 µm.) Figure reproduced from Pipoly, 1987.

edaphic categories, lateritic and white sand (often referred to as "varillal" by Peruvians) and is defined as lowland tall moist or wet forest which is not inundated. The canopy normally reaches 35 meters, with very few emergent individuals. In the lateritic *terra firme*, *Cybianthus kayapii*, *C. schlimii*, *C. pseudolongifolius*, *C. vasquezii*, *C. cenepensis*, *C. grandezii*, *C. fuscus*, *C. jensonii*,

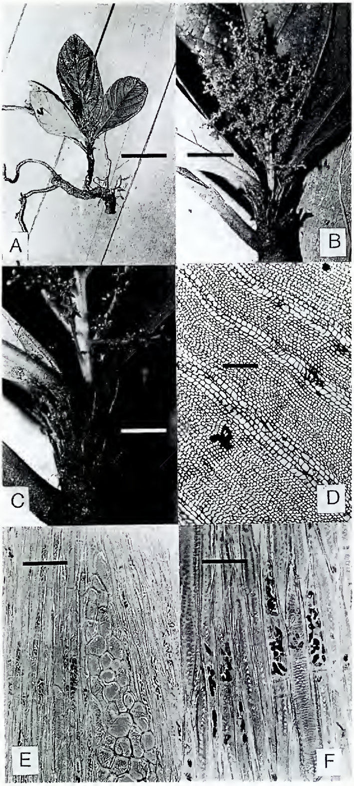

FIG. 9. Morphological and anatomical features of subgenus *Comomyrsine* (*Cybianthus kayapii*, *Pipoly et al. 12490*). A. Habit, showing bayonet reiteration. B. Habit, showing pyramidal, bipinnate panicle and leaf tapering to obtuse base. C. Stem apex, showing cataphylls. D. Transverse wood section, showing thin-walled vessels. E. Tangential wood section, showing rays and phloem fibers-tracheids. F. Phloem fiber-tracheids, showing starch grains. (Bars in Figs. A–F, A. 12.6 cm, B. 2 cm, C. 1 cm, D. 400 µm, E. 100 µm,

and *C. venezuelanus* are found. *Cybianthus kayapii*, *C. schlimii*, and *C. grandezii* are found on steep banks of small creekbeds, *C. cenepensis* and *C. venezuelanus* are ridgetop species, and *C. cenepensis*, *C. jensonii*, *C. vasquezii* and *C. pseudolongifolius* grow along terraces above larger rivers. Vásquez (1997) has described "Irapayal," "Yarinal" and "Supay Chacras" associations within the lateritic *terra firme*, but with so few comparative, quantitative forest inventories completed for both countries, I am not able to precisely list the *Cybianthus* species known from each. The *terra firme* forests on white sand (varillal) are shorter in stature than those on lateritic soils, and generally support lower numbers of lianas. Among the varillal forest types described for Peru, Vásquez (1997) lists "varillal seco," "varillal húmedo" and "chamizal" or "ojo de varillal" associations, only some of which have been noted on label data. However, *Cybianthus peruvianus*, *C. spichigeri*, and *C. gigantophyllus* occur on rolling hills in the varillal forest type. Among those species which occur on steep hillsides near light gaps, *Cybianthus gigantopyllus* is most notable, as it occurs in the ecotonal area between forest gaps and mature forest. *Cybianthus nanayensis*, a subshrub, is frequently found in gaps left by large treefalls in overmature forests, and along trailsides, where it occurs in the rather dense herbaceous stratum. *Cybianthus resinosus*, another inhabitant of the *terra firme* forest on white sand, occurs on terraces above black water rivers in the forest, while *C. nestorii* is found in the more open shrubby "varillal seco" transitional area near the riverbank. *Cybianthus fulvopulverulentus* subsp. *magnoliifolius* typically occurs in campina, or campinarana formations in Brazil, but in Peru it has been collected once in the "varillal seco" an open shrubby area on white sand several hundred meters from a black water riverbank. Unfortunately, no literature directly addressing this forest type is known for Ecuador.

The two forest types subject to inundation have been divided into várzea, flooded by white water, and igapó, flooded by black or black and white water. The other significant difference between these two forest type is that in várzea, the forest is indundated for a much shorter time than that of the igapó. To date, I know of no documentation for occurrences of forests inundated by clear water in Ecuador or Peru, as they are found elsewhere in Amazonia (Brazil, Colombia, Venezuela), but are best developed in Colombia. Three species are known from igapó, with no endemics. *Cybianthus guyanensis* subsp. *pseudoicacoreus* is found in the igapó at its limit with *terra firme*, while *C. penduliflorus* is found well within the igapó and is frequently found in standing water. *Cybianthus spicatus* is found both in igapó and várzea, and exhibits both staminate and pistillate ecotypes, with some exhibiting apparent random variation. It is a broadly ranging polymorphic ochlospecies (sensu Pipoly 1983a) with great morphological variation. The known Peruvian populations, from Huánuco and San Martín, are identical to those found in central Guyana (Pipoly 1983a). The other várzea species, *Cybianthus cyclopetalus*, is known only from Madre de Dios in Peru, and from the Juruá area in Brazil. It grows in the margin of várzea near its junction with the *terra firme* forest. Forest associations within the vázea have been described by Vásquez (1997), but I have been unable to match the corresponding complement of *Cybianthus* species, owing to inadequate label data. The three forest associations present in várzea for Peru include, "barrillal," "restinga" and "bajial." Clearly, more fieldwork is needed to discern foristic differences among these association types.

Premontane forest habitats are found from scarcely above 200 m to nearly 1,000 m. The forest is lower in stature than the *terra firme*, have a greater epiphyte load, and a larger number of lianas. Those on sandstone are distinguished here from those on other soils. On sandstone, three species are found of which one, *Cybianthus timanae*, is endemic. The other species, *Cybianthus comperuvianus*, a new taxon described herein, is known from these forests in Peru, Bolivia and adjacent Brazil. The other premontane forest formation on lateritic soils hosts 9 species, *Cybianthus minutiflorus, C. huampamiensis, C. granulosus, C. poeppigii, C. schlimii, C. peruvianus, C. fosteri,* and *C. venezuelanus* and *C. flavovirens*. Among these, only *Cybianthus venezuelanus, C. poeppigii, C. schlimii* and *C. peruvianus* are not endemic. A surprising new distribution record for *Cybianthus lepidotus*, from Bagua Province, Imaza District, of Amazonas Department, Peru, is recorded here. *Cybianthus lepidotus* was once thought to be a Guayana Higland endemic, but was found in Bolivia in the Maipiri region on the sandstone "laja" formations there (Pipoly 1992a). This kind of disjunction, concomitant with those for species such as *Cybianthus spicatus*, and *Cybianthus lineatus* (see below), support recent thematic map data at NASA, showing that the Ecuadorean/Peruvian area north, slightly east, and immediately south of the Cordillera del Cóndor, contains significant sandstone formations that may constitute "tepuí satellites" (sensu Maguire 1979). Clearly, much more exploration in southeastern Ecuador and northern Peru, should be a high research priority.

There are six species of *Cybianthus* known from cloud forests. *Cybianthus pastensis* and *C. incognitus* are found in areas of high shade and moisture within these forests. Along the margins to the leeward side, in that portion of the Chocó Floristic Province that extends into Ecuador, *Cybianthus cuatrecasasii* may be found, while on the eastern Andean slopes of Peru, *C. laetus* grows in exposed, wind-swept margins of the forest. The lack of records for *Cybianthus laetus* in Ecuador is more likely a collection artifact than a reflection of its rarity, given its occurrence in the Department of Boyacá, Colombia. It is notable that *Cybianthus patensis* and *C. incognitus*, when growing at elevations below 1,000 m, are ridgetop species. *Cybianthus magnus* subsp. *magnus* is an obligate epiphyte in closed cloud forests, growing in the forks of trees or on deep detritis, and shielded from winds.

Elfin forests and montane thickets are transitional formations below the jalca (a formation like a páramo but without species of the Asteraceae subtribe Espletiniae). Elfin forests host considerable numbers of trees and usually have trees up to 5 m tall. The montane thicket (subpáramo) grows in more exposed areas at higher elevations and is dominated by low shrubs and small trees to 2 m, with broad crowns. *Cybianthus marginatus* is found in both of these habitats, but the leaves and stature of the plants are much smaller in the thicket formation. Also, the verrucose papillae of the stem are much more pronounced in the thicket habitats than in plants growing in the elfin forest. *Cybianthus magnus* subsp. *asymmetricus* grows in open montane forests or subpáramo thickets, and elfin forests, where it is subject to exposure to the high winds and rain. Its leaf variation is significant, but it is easily recognized from subspecies *magnus* by the hydropotes of the adaxial leaf surface and orange punctations of leaf, inflorescence and perianth parts and the unique white, then lavender fruits.

Finally, sandstone scrub, called "pajonal," is known thus far only from Peru. It is the formation growing at the highest elevations where Myrsinaceae occur, mostly well over 3,000 m. In these habitats, there are few, small shrubs which rarely exceed 1.5 m tall. *Cybianthus lineatus* is found in this habitat, the first locality for this species outside the contiguous Guayana Highland. No similar habitat has been described in Ecuador, but it may be present in the Cordillera del Cóndor.

TAXONOMIC CONCEPTS, NOTES ON KEYS AND SPECIMEN CITATIONS

My species concept follows that of Wiley (1978, 1981), who defined a species as follows: "An evolutionary species is a single lineage of ancestor-descendant populations which maintains its identity from other such lineages and which has its own evolutionary tendencies and historical fate." My subspecies concept (Pipoly 1987), defines a subspecies as follows: "groups of populations within a single lineage of ancestor-descendant populations that show variation by unique combinations of plesiomorphies, or homoplasic apomorphies, correlated with biogeography and/or ecology. This rank is primarily used to convey information regarding variation in the life histories of these populations and character state differences hypothesized to be the result of this variation. The subspecific rank in no way attempts to predict speciation events."

The keys are artificial and designed to expedite identification of herbarium specimens. An attempt has been made to emphasize vegetative characters to increase the keys' usefulness with sterile material. The numbers appearing before the taxa refer to their respective position in the key; any correlations with phylogenetic relationships are coincidental. Quantitative and qualitative data presented in keys and descriptions for floral parts and bracts were taken from organs rehydrated from herbarium specimens by boiling in water.

Measurements from these range from 10% to 15% greater than those measurements taken directly from dried material. Data regarding stem diameters, inflorescence rachises, pedicels, leaf, and fruit shape were taken from dried herbarium specimens. Extra-Ecuadorean and -Peruvian specimens are cited for all new species and for recent collections of other species used to significantly amplify previously published morphological descriptions (Pipoly 1981, 1983a, 1983b, 1987, 1988, 1991, 1992a, 1993, 1994, 1995, 1996).

A description of the genus *Cybianthus* and a key to its subgenera in Ecuador and Peru are provided below. This description, along with that of the subgenera and species that follow include features found in each taxon as a whole, including those populations and species occurring outside Ecuador and Peru. Phylogenetic studies applicable to species in this treatment may be found in Pipoly (1987) and in the forthcoming *Flora Neotropica* treatment.

TAXONOMIC TREATMENT

Cybianthus Mart., Nov. Gen. Sp. Pl. 3:87. 1831. *nom. et typus cons.*; G. Agostini, Acta Biol. Venez. 10:141. 1980.; Pipoly, Mem. New York Bot. Gard. 43:46. 1987; Pipoly, Ann. Missouri Bot. Gard. 79:913. 1992. Type species: *C. penduliflorus* Martius.

Terrestrial or epiphytic, monoaxial or polyaxial, dioecious, monoecious or polygamous *shrubs or trees* to 15 m tall. *Roots* positively geotropic or diageotropic. *Branchlets* glabrous, glandular-granulose, dendroid- and stellate-tomentose, furfuraceous- or ferrugineous-stipitate-lepidote. *Leaves* sessile or petiolate, alternate, subopposite, or pseudoverticillate, the venation camptodromous or rarely acrodromous; petioles obsolete or when present, canaliculate or marginate, tapering gradually to the base, or abruptly swollen toward the base, here termed "pulvinate." *Inflorescence*: staminate, pistillate, bisexual or polygamous, lateral (axillary), a simple raceme, panicle of racemose or spicate (rarely corymbose) branches, a pleiochasium, or an indeterminate umbel appearing racemose. *Flowers* functionally unisexual or bisexual, 3–6(–7)-merous; calyx cotyliform to cupuliform, the lobes imbricate, valvate or aberrantly contorted, basally connate 1/5–2/3 their length, abaxially glabrous, glandular-granulose, ferrugineous stipitate-lepidote, or translucent-lepidote, adaxially glabrous, epunctate or prominently orange, red or black punctate, the lobes entire to erose-fimbriate, glabrous or glandular-ciliate; corolla rotate, subrotate, cupuliform or campanulate, rarely infundibuliform or salverform, the lobes imbricate or valvate, basally connate 1/5–3/4 their length, abaxially glabrous, glandular-granulose, or ferrugineous stipitate-lepidote, adaxially glandular-granulose at least at the junction of the tube and lobe, the margin entire to erose-denticulate, glabrous, glandular-granulose or rufous glandular-papillate; stamens and staminodes adnate to corolla tube at least 2/3 their length, the filaments variously connate to form a tube, the staminal tube adnate to the corolla tube or at times developmentally fused with it (thus the stamens appearing epipetalous), bearing fleshy lobes alternate with the apically free portions of the filaments or not, the anthers erect or distally curved, ovate, widely ovate, or triangular, basifixed or dorsifixed, apically acute, rounded, truncate, emarginate or minutely apiculate, the apiculum erect, proximally or distally curved, basally truncate, cordate, or rarely hastate, deshiscent by apicaly pores, confluent apical pores (birimose), or by wide or narrow longitudinal slits; pollen tricolporate, psilate; staminodes morophologically similar to the stamens but greatly reduced in size, the antherodes at times producing abortive pollen; pistl obnapiform, ellipsoid, umbonate or obturbinate, the ovary sparsely to densely translucent glandular-lepidote, the style glabrous, the stigma capitate, capitate-lobate, or punctiform, persistent or early caducous, the placenta free-central, carnose, umbonate or globose, the ovules campylotropous (1–)2–5(–7), uni- or biseriate; pistillode conic, lageniform, obturbinate or irregularly shaped vestigial pistillode, the pistillode hollow or bearing a sterile placenta, rarely absent. *Fruit* drupaceous, 1(–2)-seeded, the endosperm translucent, non-starchy, the embryo small, linear, flexuous, erect or curved, longitudinal or transverse, the cotyledons not well-developed.

Distribution.—One hundred sixty-seven species; Nicaragua, Costa Rica south through Panama to the Andes southward to Bolivia, from Colombia eastward across Venezuela and Brazil and the Guianas, then southeastward to the Atlantic coastal forests of SE Brazil.

Ecology.—Members of *Cybianthus* are principally riparian, occurring only in primary forests or rarely in somewhat disturbed ones, and thus, may serve as indicators of environmental quality. Throughout the range of the genus, its members are known from wet tepuí savannas, moist scrub, cloud and elfin forests (including "ceja de selva"), subpáramo thickets, montane, premontane, pluvial, wet and moist forests, páramo, jalca, igapó, várzea, varillal, campinas, campo rupestre, restinga, cerrado, and caatinga vegetation types. In Ecuador and Peru, the majority of the species occur in lowland and premontane forests at the junction of Hylaea and the eastern slopes of the Andean Cordillera (see ECOLOGY section).

Cybianthus is most closely related to the paleotropical lianous genus *Embelia* (Pipoly 1987), and cladistically defined by the unique glandular-granules at the corolla lobe and tube junction. For practical purposes of identification, the combination of lateral racemes or spikes, or racemose or spicate panicles, and filaments which are shorter than the corolla, connate at least 1/4 their length, and adnate to the corolla at least 1/3 its length, allows for easy recognition.

KEY TO SUBGENERA OF *CYBIANTHUS* IN ECUADOR AND PERU

1. Corolla cotyliform, cupuliform, campanulate, or rarely salverform; anthers longer than wide, distally recurved, apically acute or minutely apiculate.

2. Branchlets glabrous or glandular-granulose; anthers dehiscent by narrow longitudinal slits .... **I. Microconomorpha**
2. Branchlets ferrugineous tomentose or stipitate-lepidote; anthers dehiscent by wide longitudinal slits.
    3. Branchlets and calyx ferrugineous stipitate-lepidote; abaxial corolla surface glabrous near margin .... **II. Conomorpha**
    3. Branchlets ferrugineous tomentose, calyx glandular-granulose or glabrous, rarely ferrugineous tomentose; abaxial corolla surface glandular-granulose near margin. .... **III. Laxiflorus**

1. Corolla rotate to subrotate; anthers wider than long, erect, apically rounded to truncateor emarginate.
    4. Petioles abruptly swollen basally; anthers dorsifixed, longitudinally dehiscent.
        5. Plants monoaxial; anthers erect, not versatile.
            6. Stem glandular papillate, at times with hydropotes, bearing cataphylls apically and at times, alternating with the leaves; leaves without subepidermal fibers; flowers 4- or 5 -merous; corolla lobes epunctate or inconspicuously pellucid or orange punctate, glandular-granulose within; stigma large, capitate-lobate, early caducous, the lobe margins fimbriate .... **IV. Comomyrsine**
            6. Stem with malpighiaceous hairs, without cataphylls, but at times with aborted leaves (pseudocataphylls); leaves with numerous paallel subepidermal fibers (most easily seen adaxially); flowers 3-merous; corolla lobes prominently black punctate, maculate, glabrous within except at lobe and tube junction; stigma small, capitate-lobate, persistent, the lobe margins entire .... **V. Triadophora**
        5. Plants polyaxial; anthers versatile .... **VI. Weigeltia**
    4. Petioles obsolete or not abruptly swollen basally; anthers basifixed, poricidally dehiscent.
        7. Leaves sessile, apically mucronate, basally auriculate, the margins scarious; staminal tube merely adnate to corolla tube .... **VII. Grammadenia**
        7. Leaves petiolate, apically acute, acuminate or caudate, basally acute, attenuate or cuneate, the margins opaque; staminal tube developmentally fused to corolla tube, the stamens thus appearing epipetalous .... **VIII. Cybianthus**

I. Cybianthus subgenus Microconomorpha (Mez) G. Agostini, Acta Biol. Venez. 10:150. 1980; Pipoly, Wrightia 7:235. 1983. *Conomorpha* A. DC. subgenus *Microconomorpha* Mez in Engl., Pflanzenr. IV. 236(Heft 9):251. 1902. *Microconomorpha* (Mez) Lundell, Wrightia 5:349. 1977. Type Species: *Conomorpha verticillata* Zahlbr., Ann. K.K. Naturhist. Hofmus. 7:3. 1892, *non* Mez (1902). = *Cybianthus pastensis* (Mez) G. Agostini (lectotype: Agostini, Acta Biol. Venez. 10:150. 1980).

Cybianthus Mart. subgenus **Iteoides** G. Agostini, syn. nov., Acta Biol. Venez. 10:148. 1980. Type Species: *Badula iteoides* Benth., Pl. Hartw. 217. 1896. *Conomorpha iteoides* (Benth.) Mez in Engl., Pflanzenr. IV. 236(Heft 9): 254:1902. Type Species: *Cybianthus iteoides* (Benth.) G. Agostini, Acta Biol. Venez. 10:149. 1980.

Terrestrial monoecious, dioecous or polygamous *shrubs or small trees*. *Bark* smooth to slightly fissured, light brown, thin. *Root* positively geotropic. *Trunk* distinguishable, leptocaulous, the growth dynamics following Rauh's

Architectural Model (Hallé et al. 1978). *Branchlets* thin, terete, densely ferrugineous glandular-granulose, the granules often stipitate. *Cataphylls and pseudocataphylls* absent. *Leaves* pseudoverticillate; blades petiolate, often with translucent glandular lepidote scales. *Inflorescence* a simple raceme or bipinnate panicle, staminate, pistillate, or polygamous, the peduncle 1–4 cm long, densely glandular-granulose; inflorescence and floral bracts, perianth and pistil bearing prominently raised red or black punctations; inflorescence bracts large, often foliaceous and persistent; floral bracts linear-lanceolate, the margins glandular-ciliate, caducous, the pedicels erect, accrescent in fruit. *Staminate, pistillate and bisexual flowers* monomorphic (similar in shape), the staminate the largest, the pistillate the smallest in size, white to yellowish-green, (4–)5(–6)-merous; calyx cotyliform, the lobes valvate, the margins densely glandular-ciliate; corolla cotyliform to campanulate, the lobes imbricate, glabrous without except glandular-granulose near the margin, glandular-granulose over the entire surface within; stamens and staminodes with a conspicuous staminal tube, the apically free portions one to three times longer than the anthers, the anthers elongate-triangular to ovate, prominently curved distally, apically obtuse to apiculate, basally cordate to hastate, dorsifixed 1/3 to more than 1/2 length from base, dehiscent by narrow longitudinal slits, the staminodes producing abortive pollen grains; pistil in pistillate and bisexual flowers obturbinate, the ovary densely translucent-lepidote, the style thick, truncate, the style punctiform, the placenta umbonate, bearing 3–4 uniseriate ovules immersed in placental tissue, but exposed apically by placental pores; pistillode similar to pistil but reduced in size, hollow or bearing 2 abortive ovules. *Fruit* drupaceous, 1-seeded, the exocarp thin, prominently black punctate.

Subgenus *Microconomorpha* contains 5 species, of which one, *Cybianthus pastensis* (Mez) G. Agostini, is known from Ecuador and Peru. I earlier indicated that there was no evidence to support subgenus *Iteoides* as a separate entity (Pipoly 1987), so it is treated here in synonymy under subgenus *Microconomorpha*.

1. **Cybianthus pastensis** (Mez) G. Agostini (Fig. 3c), Acta Biol. Venez. 10:151. 1980. *Conomorpha pastensis* Mez in Engl., Pflanzenr. IV. 236(Heft 9):252. 1902. *Microconomorpha pastensis* (Mez) Lundell, Wrightia 5:349. 1977. TYPE: COLOMBIA. NARIÑO: "Páramo de Purugai, Prov. de Pasto," 2,500 m, 1866 (stam. fl), *J. Triana 2585* (LECTOTYPE (Pipoly 1983a): W; ISOLECTOTYPES: C, COL, G, P).

Myrsine verticillata C. Presl, Reliq. Haenk. 2:64. 1835. *Conomorpha verticillata* (C. Presl) Mez in Engl., Pflanzenr. IV. 236(Heft 9):252. 1902, *non* Zahlbr. (1892). *Conomorpha preslii* J.F. Macbr., Candollea 5:398. 1934. *Microconomorpha verticillata* (C. Presl) Lundell, Wrightia 5:349. 1977. TYPE: PERU. HUÁNUCO: without further locality, without date, (stam. fl.), *T. Haenke 98* (LECTOTYPE (Pipoly 1983a): PR; ISOLECTOTYPES: HAL, W). *Non Cybianthus verticillatus* (Vell.) G. Agostini, Acta Biol. Venez. 10:168. 1980.

Conomorpha verticillata Zahlbr., Ann. K. K. Naturhist. Hofmus. 7:3. 1892, *non* C. Presl

(1835) *Conomorpha jelskii* Mez in Engl., Pflanzenr. IV. 236(Heft 9):251. 1902, *nom. superfl. Conomorpha preslii* J.F. Macbr. var. *jelskii* (Mez) J.F. Macbr., Field Mus. Nat. Hist., Bot. Ser. 13:201. 1959. *Microconomorpha jelskii* (Mez) Lundell, Wrightia 5:349. 1977. TYPE: PERU. CAJAMARCA: Cutervo, Apr. 1879 (stam. fl.), *C. von Jelski 11* (HOLOTYPE: W; photo and fragment, F, F Neg. 31980).

Conomorpha dentata Mez in Engl., Pflanzenr. IV. 236(Heft 9):252. 1902. *Microconomorpha dentata* (Mez) Lundell, Wrightia 5:349. 1977. TYPE: ECUADOR. PICHINCHA: In cordillera from Quito to Tungurahua, 2,000–3,000 m, 1857–9 (stam. & bisex. fl.), *R. Spruce 5175* (LECTOTYPE (Pipoly 1983a): K; ISOLECTOTYPES: BM, BP, C, CGE, GH, GOET, LD, LE, F Neg. 22956).

Conomorpha quercifolia Mez in Engl., Pflanzenr. IV. 236(Heft 9):253. 1902. *Microconomorpha quercifolia* (Mez) Lundell, Wrightia 5:349. 1977. TYPE: PERU: without locality, without date (stam. fl.), *J. Pavón s.n.* (LECTOTYPE (Pipoly 1983a): G).

Conomorpha panamensis Lundell, Wrightia 5:290. 1976. *Microconomorpha panamensis* (Lundell) Lundell, Wrightia 5:349. 1977. *Cybianthus morii* G. Agostini, Acta Biol. Venez. 10:154. 1980. TYPE: PANAMA. CHIRIQUÍ: Cerro Pando, on continental divide and Panama-Costa Rica border, ca. 16 km W of Hato del Volcán, 2,000–2,482 m, 20 Jul 1975 (stam. fl.), *S. Mori & A. Bolten 7292* (HOLOTYPE: LL-TEX; ISOTYPE: MO).

Shrub or tree to 6 m tall. *Branchlets* and inflorescence densely ferrugineous glandular-papillose, the branchlets angulate to prominently ridged, (1.5–) 2–3 mm diam. *Leaves* pseudoverticillate; blades membranaceous to coriaceous, narrowly oblanceolate to oblong or obovate, (3.0–)6.5–14.5(–21.0) cm long, (1.2–)2–4.5(–6.8) cm wide, apically attenutate, acute or acuminate, basally cuneate, not decurrent on the petiole, prominently punctate and minutely ferrugineous stipitate-papillose above and below, the midrib impressed above, raised below, the secondary veins 7–15 pairs, prominently raised below, the margin undulate, lobate, crenate or dentate, rarely subentire; petioles marginate, (0.2–)0.5–2(–2.7) cm long, densely glandular-papillose. *Staminate, pistillate or polygamous inflorescence*: monomorphic, erect or lax, a simple raceme, 1.8–5.5 cm long, the rachis thin to thick, densely glandular-papillose; inflorescence bracts chartaceous, obovate to elliptic, (4.3–)6–11 mm long, 3–7 mm wide, apically acute to acuminate, basally cuneate, densely and prominently red punctate; floral bracts chartaceous, linear-lanceolate, (0.8–)1.4–2.2(–7) mm long, 0.6–0.8 mm wide, apically attenuate, caducous; pedicels cylindrical, (1.3–)2–7(–7.5) mm long, densely glandular-papillose. *Flowers* (4–)5-merous, white to yellowish-green; calyx chartaceous, shallowly cotyliform, (0.6–)0.8–1.1(–1.5) mm long, unequally divided, the tube 0.2–0.5 mm long, the lobes suborbicular to very widely ovate, (0.4–) 0.6–1 mm long and wide, rounded to acute apically, glabrous, densely and very prominently orange or black punctate, the margin subentire to erose-dentate, densely glandular-ciliate; corolla chartaceous, cotyliform, 2–2.6(–3.6) mm long, the tube 0.2–0.3 mm long, the lobes ovate to narrowly ovate, 1.7–2.3(–2.8) mm long, 0.8–1.3(–1.5) mm wide, highly reflexed at anthesis, apically rounded to obtuse, prominently orange or black punctate; stamens and staminodes 1–1.6(–2.5) mm long, the staminal and staminodial tube 0.7–1.8 mm long, the apically free portions of the filaments 0.3–0.7 mm long, the anthers elongate-triangular, 0.6–1.2 mm long, apically obtuse, basally hastate, the connective red punctate ventrally and dorsally, dorsifixed ca. 1/3 to slightly less than 1/2 from base; pistil and pistillode 1.2–1.8 mm long, the ovary (0.6–)0.8–1 mm long, 1–1.3 mm diam., densely translucent glandular-lepidote, the style thick, 0.5–0.8 mm long, the stigma punctiform, the pistillode hollow or containing one abortive ovule. *Fruit* globose, green, then red, then black at maturity, 3–4 mm diam. when dried exocarp thin, prominently pellucid punctate.

Distribution.—Costa Rica to Colombia, southward to Peru, from 1,500–3,200 m elevation.

Ecology and conservation status.—*Cybianthus pastensis* is known from premontane and montane pluvial and cloud forests, and at elfin forest margins. Populations in areas exposed to winds have more coriaceous leaves and shorter stature, frequently as small as one meter in height. The wetter the habitat, the more membranaceous the leaves become, and the longer the inflorescences. Fieldwork in Colombia has shown that populations may contain six individuals per hectare, and that the population rapidly dwindles in areas of disturbance. Owing to population dynamics thus far observed, *Cybianthus pastensis* should be considered threatened.

Etymology.—The specific epithet refers to the area from which the type specimen was collected, near the city of Pasto, Department of Nariño, Colombia.

Representative specimens examined. **COLOMBIA. Antioquia:** Mpio. Urrao, Parque Nacional Natural "Las Orquídeas," Vereda Calles, Permanent Premontane Rainforest Inventory Plot, right bank of Río Calles, 06° 32' N, 76° 19' W, 1,450–1,500 m, 29 Nov 1993 (fr), *J. Pipoly, A. Cogollo et al. 17322* (BRIT, COL, JAUM, MO), limits of Parque Las Orquídeas, left bank of Río Calles, 1,450–1,500 m, 30 Nov 1993 (ster.), *J. Pipoly, A. Cogollo et al. 17376* (BRIT, JAUM, MO); near limit of Parque Las Orquídeas, Alto de Palmitas, ca. 1 km from INDERENA Cabaña Calles, 1,300–1,400 m, 1 Dec 1993 (ster.), *J. Pipoly, A. Cogollo et al. 17505, 17523* (BRIT, JAUM, MO), 2 Dec 1993 (fl bud), *J. Pipoly, A. Cogollo et al. 17534* (BRIT, COL, JAUM, MO), Right bank of Río Calles, 1,350–1,450 m, 7 Dec 1993 (stam. fl), *J. Pipoly et al. 17881* (BRIT, COL, JAUM, MO); Along trail to Finca La Quince, above Urrao, 06° 30' N, 76° 10' W, 2,500–2,800 m, 21 Nov 1988 (stam. fl), *G. McPherson et al. 13212* (BRIT, HUA, MO); Mpio. Frontino, Región de Murrí, ca. 13 km from Nutibara, 06° 40' N, 76° 20' W, 2,000 m, 9 Dec 1988 (pist. fl, fr), *G. McPherson et al. 13397* (BRIT, HUA, MO). **Norte de Santander:** San Antonio, W of Cali, near summit of Cordillera Occidental, 1,9800- 2,350 m, 26 Feb–2 Mar 1939 (stam. fl), *E. Killip & A. Garcia 33886* (A, S, US). **ECUADOR. Azuay:** Chiguinda, on E slopes of cordillera E of Sigsig, 03° 12' S, 78° 36' W, 1,600–1,800 m, 1889 (stam. fl), *F. Lehmann 5143* (K-2 sheets). **Carchi:** Páramo de Achupallas, 01° 46' S, 78° 33' W, 2,000–3,000 m, 1899 (stam. fl), *F. Lehmann 6202* (K-2 sheets); From Prima Vera about 6 hrs. hike up Río Gualchan Drainage to Nilo Ortiz' shelter, 00° 50' N, 77° 72' W, 1,930–2,200 m, 7–8 Jun 1993 (fl bud), *J. Bradford et al. 55* (BRIT, MO, QCNE). **Loja:** Cerro Bangala, ca. 10 km E of Yangana, 2,500–2,700 m, 18 Oct 1988 (pist. fl, fr), *G. Harling 25313* (GB), (stam. fl), *G. Harling 25334* (GB); Cantón

Loja, Carretera Loja-Zamora, at high point, 03° 58' S, 79° 04' W, 2,400–2,600 m, 23 Dec 1991 (pist. fl), *D. Rubio et al. 2252* (BRIT, MO, QCNE); Loja, 3,500 m, 1 Dec 1876 (stam. fl), *E. André 4551* (F, K, NY); Divide between Quebrada Jipirú and E fork of Río Zamora, W slope of Cordillera de Zamora (El Cóndor), 9 km E of Loja, 04° 00' S, 79° 06' W, 2,700 m, 19 Feb 1945 (stam. fl), *F.R. Fosberg & M. Giler 23119* (NY, US); Loma de Loro, 6 km S of Saraguro, on Rd. to Loja, 3,200 m, 11 Feb 1985 (stam. fl), *G. Harling & L. Andersson 21594* (AAU, S); Saraguro-Loja Rd., km 12.4, turnoff toward Fierro Urco, Km 3.8–7.1, 03° 42' 33" S, 79° 18' 03" W, 3,120–3,390 m, 7 Dec 1994 (pist. fl), *P. Jørgensen et al. 1297* (BRIT, LOJA, QCA, QCNE); W slope of Nudo de Sabanilla, ca. 8 km above Yangana on Rd. to Valladolid, 2,300–2,500 m, 2 Apr 1985 (bisex. fl, fr), *G. Harling & L. Andersson 23540* (GB); Cerro Toledo, Rd. to La Torre, ca. 7 km SE of Yangana, 2,500 m, 7 Apr 1985 (stam. fl), *G. Harling & L. Andersson 23842* (GB). **Morona-Santiago:** Between Campanas and Arenillas, along Río Tintas, 10 leagues SE of El Pan, 2,195 m, 13 Jul 1943 (stam. fl), *J. Steyermark 53642* (F, NY); Above Mirador, 2,375 m, 9 Sep 1943 (stam. fl), *J. Steyermark 53897* (F, NY). **Napo:** 10 km W of Cuyuja, along Quito-Lago Agrio Rd., 00° 25' S, 78° 00' W, 2,700 m, 31 Apr 1983 (stam. fl), *H. Balslev 4295* (AAU, QCA); Salcedo-Napo Rd., 2,390–2,590 m, 7 Feb 1977 (fr), *J. Brandbyge 42095* (AAU, QCA); E of Borja, Cerro Antisana, 28 Jul 1960 (stam. fl), *P. Grubb et al. 1073* (OXF, NY); Sta. Barbara Scumbios, 00° 22' S, 77° 10' W, 2,700 m, 10–15 Feb 1959 (stam. fl), *L. Holm-Nielsen 6818* (AAU, QCA); 8–12 km ESE of Sta. Barbara, 00° 40' N, 77° 30' W, 2,780–2,880 m, 11 Jan 1985 (stam. fl), *J. Luteyn & E. Cottón 11011* (GB, QCA, NY, VEN); Paso de Guamani, Río Chalpi, at bridge on Papallacta-Baeza Rd.., 2,800 m, 6 May 1967 (stam. fl), *B. Sparre 15940* (GB); Cantón Quijos, Sierra Azul (Agrícola Industrial Río Aragón), 00° 40' S, 77° 55' W, 2,300 m, 2 May 1992 (fr), *A. Álvarez et al. 381* (BRIT, MO, QCNE), (fr), *A. Álvarez et al. 412* (BRIT, MO, QCNE), Campamento Estero Chico, 00° 41' S, 77° 56' W, 2,500 m, 18 Jun 1992 (fr), *A. Álvarez et al. 490* (BRIT, MO, QCNE); Sierra Azul, Cordillera de Huacamayos, 00° 41' S, 77° 54' W, 2,500–2,700 m. 10 Feb 1994 (fr), *A. Álvarez et al.1330* (BRIT, MO, QCNE). **Tungurahua:** On Patate-Triunfo Rd., 01° 18' S, 78° 25' W, 2,950 m, 5 Nov 1983 (stam. fl), *J. Brandbyge & A. Barfod 42506* (AAU, QCA, QNA, S). **Zamora-Chinchipe:** Rd. from Loja to Zamora, km 14, 00° 04' S, 79° 09' W, 2,750–2,770 m, 19–20 Apr 1973 (stam. fl), *L. Holm-Nielsen et al. 3965* (AAU, QCA). **PERU. Amazonas:** Prov. Luya, Camporredondo-Tullanya, trail to Cerro Huicsocunga, 2,350 m, 3 Sep. 1989 (fl), *C. Díaz & J. Campos 3711* (MO, USM); Parte alta de las Montañas de Galeras, 2,000–2,500 m, 20 Jun 1991 (fl bud), *C. Díaz et al. 4448* (BRIT, MO, USM). **Ayacucho:** Prov. La Mar, E massif of Cordillera Central, opposing the Cordillera Vilcabamba between Tambo San Miguel, Ayna and Hacienda Luisiana, 12° 45' S, 73° 53' W, ca. 30 km SW of Hacienda and Río Apurimac, 21 Aug 1968 (bisex. fl), *T. Dudley 11915* (F, NA, US). **Cajamarca:** Prov. Cutervo, 10 km NW of Socota, 3,200 m, 10 Dec 1938 (stam. fl.), *H. Stork & X. Horton 10134* (F); San Andrés de Cutervo, Parque Nacional de Cutervo, "Jalca," trail to Laguna "El Pileo," 2,680 m, 15 Mar 1989 (fl, fr), *C. Díaz et al. 3330* (AMAZ, MO, USM); Prov. Jaén, E side of Cordillera E of Huancabamba, 2,400-2,600 m, Apr 1942 (fr), *A. Weberbauer 6099* (F, GH, US). **Huánuco:** Prov. Pachitea, region of Pucallpa, W part of Sirá Mountains and adjacent lowland, ca. 26–28 km ESE from Puerto Inca, 09° 25' S, 74° 43' W, 2,210 m, 15 Aug 1988 (stam. fl), *B. Wallnöfer 11-16888* (BRIT, MO, W, WU, USM); SW slope of Río Llulla Pichís Watershed, on the ascent of Cerros del Sirá, top of first cumbre between camp 4 (Peligroso) and camp 5 (Tábano), 1,680 m, 31 Jul 1969 (ster.), *T. Dudley 13513* (NA). **Lima:** Prov. Lima, Lima, without date (fr), *J. Pavón s.n.* (K). **Madre de Dios:** Prov. Manú, Cerro de Pantiacolla, Río Plotoa, 10–15 km NNW of Shintuya, 12°35' S, 71°18' W, 1,000–1,400 m, 15 Dec. 1985 (fr), *R. Foster et al. 10860* (F, MO, USM).

Cybianthus pastensis may be easily recognized by its pseudoverticillate leaves with variously serrate or incised margins, the very fine inflorescence rachis and minute flowers, and the stipitate papillae of the branchlets, leaves, petioles and inflorescence rachises. The prominent ridges of older branchlets and the swollen pseudoverticels of leaf scars are also distinctive.

II. Cybianthus subgenus **Conomorpha** (A. DC.) G. Agostini, Acta Biol. Venez. 10:150. 1980; Pipoly, Ann. Missouri Bot. Gard. 79:908–957. 1992. *Conomorpha* A. DC., Trans. Linn. Soc. London, Bot., 17:102. 1834; *Conomorpha* sect. *Euconomorpha* Miq., Stirp. Surinam. Select. 111. 1850; *Conomorpha* subgenus *Euconomorpha* Mez in Engl., Pflanzenr. IV. 236(Heft 9):254. 1902. TYPE SPECIES: *Conomorpha oblongifolia* A. DC. = *Cybianthus oblongifolius* (A. DC.) G. Agostini (LECTOTYPE: by Agostini, Acta Biol. Venez. 10:151. 1980).

Conomorpha sect. *Aconomorpha* Miq. in Mart., Fl. Bras. 10:304. 1856. TYPE SPECIES: *Conomorpha heterantha* Benth. (LECTOTYPE: Agostini, Acta Biol. Venez. 10:151. 1980)= *Cybianthus guyanensis* (A. DC.) Miq. subsp. *guyanensis*.

Terrestrial dioecious, bisexual, polygamous, or rarely, monoecius *shrubs or trees*. *Roots* positively geotropic. *Bark* smooth or fissured, brown, or beige, rarely with significant amounts of cork. *Trunk* distinguishable, leptocaulous, the growth dynamics following Rauh's or rarely, Aubréville's Architectural Model (Hallé et al. 1978). *Branchlets* thin to moderately thick, terete or ridged, densely to moderately covered with ferrugineous stipitate-lepidote scales, the scales at times appressed, rarely glabrescent. *Cataphylls* and pseudocataphylls absent. *Leaves* alternate, rarely approaching pseudoverticillate (*C. peruvianus*), petiolate, covered with ferrugineous stipitate lepidote scales, often glabrescent above; petioles canaliculate, marginate, or rarely winged. *Inflorescence* racemose, spicate or paniculate, the panicles with racemose branches, rarely a solitary flower; inflorescence bract small, lanceolate, early caducous; rachis erect or lax, straight or rarely tortuous, ferrugineous stipitate-lepidote; floral bracts deltate, lanceolate or ovate, ferrugineous stipitate-lepidote, inserted at the base of the pedicel; pedicels cylindrical, at times clavate in fruit or absent, erect, apically recurved, pendent, or nodding, at times accrescent in fruit. *Flowers* unisexual, rarely bisexual, dimorphic, (3–)4–5(–6)-merous; calyx cotyliform, cupuliform, crateriform, urceolate or patelliform, the lobes valvate, epunctate or with prominent (raised and blisterlike), conspicuous (readily visible buy flat), or inconspicuous brown, red or black punctations, the margin entire, rarely crenulate or erose; corolla campanulate to cupuliform, rarely salverform or tubiform, the lobes erect or reflexed, rarely cucullate, valvate or imbricate, ferrugineous stipitate-lepidote or glabrous and epunctate or prominently, conspicuously or inconspicuously pellucid, brown, or black punctate without, at times with a narrow line of glandular-granules along the margin, glandular-granulose within, the margins entire or rarely crenulate, glabrous or rarely glandular-granulose; staminodes resembling stamens but reduced in size, the tube conspicuous or inconspicuous, adnate to the corolla, lobate or elobate, the anthers ovate or triangular-ovate, rarely linear-lanceolate, rarely deltate, usually recurved distally, rarely erect, apically acute, or apiculate, rarely rounded, the apiculum dorsally, rarely proximally recurved or erect, the base cordate, dorsifixed from near base to subversatile, the connective punctate or not; pistillode conic to lageniform, rarely absent, translucent-lepidote or glabrous, hollow; pistil obnapiform, rarely conic, the ovary globose, lobed or with an apical apophysis, the style short, the stigma capitate-lobate, 2–3-lobed or punctiform; placenta cupuliform or cotyliform, the ovules 2–4. *Fruit* subglobose, one(–two)-seeded.

Cybianthus subgenus *Conomorpha* contains 44 species, 10 of which have been recorded from Ecuador and Peru.

KEY TO SPECIES OF *CYBIANTHUS* SUBGENUS *CONOMORPHA*

1. Branchlets with erect stipitate ferrugineous lepidote scales, their margins not appressed; leaf blades subbullate to bullate, the secondary veins somewhat to deeply impressed above, prominently raised below; corolla infundibuliform or tubiform, or appearing so in bud.
    2. Branchlets flexuous, 4–5 mm diam.; leaf blades perpuncticulose above, sparsely lepidote below, the secondary veins 22–26 pairs, the margin irregular; inflorescence tortuous, pinnately to bipinnately paniculate; corolla lobes prominently keeled, rugose without; anthers ventrally recurved. .... **2. C. gigantophyllus**
    2. Branchlets straight, 2–3 mm diam.; leaf blades not perpuncticulose above, ensely lepidote below, the secondary veins 8–19 pairs, the margin regular; inflorescence erect, a simple raceme or poorly formed panicle consisring of basally clustered racemes; corolla lobes flat, smooth or verrruculose without; anthers dorsally recurved.
        3. Secondary veins 12–16; staminal tube epunctate; pedicels cylindric; calyx cotyliform; corolla membranaceous, infundibuliform, verruculose without; fruit smooth, 3.5–4.5 mm diam.; plants of premontane pluvial forests, subpáramo thickets and upper pluvial cloud forests, 1,000 1,960 m elevation. .... **3. C. occigranatensis**
        3. Secondary veins 8–12; staminal tube punctate; pedicels obconic; calyx urceolate; corolla carnose, tubiform, smooth without; fruit costate, 7–15 mm diam.; plants of white sands or on sandstone, 150–180 (–1,500) m elevation .... **4. C. spichigeri**
1. Branchlets with appressed ferrugineous lepidote scales, the margins appressed; leaf blades not subbullate or bullate, the secondary veins planar or slightly raised above, barely discernible or slightly raised below; corolla campanulate to cupuliform.
    4. Leaf blades coriaceous, rarely chartaceous, the margins subrevolute to revolute.
        5. Leaf blades densely and prominently pustulate at maturity above, the secondary veins 24–28 pairs, inconspicuous below; inflorescence spicate (2–)6–16 cm long; flowers subsessile, the pedicels 0.2–0.6 mm long; calyx deeply cupuliform. .... **5. C. lepidotus**
        5. Leaf blades essencially smooth or sparsely pusticulate at maturity above,

the secondary veins 14–25 pairs, prominently raised below; inflorescence a raceme or panicle with 2–4 racemes branching from base, (2–)3–7 (–8) cm long; flowers pedicellate, the pedicels (0.5–)0.9–1.5 mm long; calyx cotyliform.

6. Branchlets subterete, 2–3 mm diam; leaf blades 1.2–2(–2.5) cm wide, smooth above; petioles 5–7(–10) mm long; staminate calyx carnose, 1.2–1.8 mm long; staminate corolla carnose, densely lepidote without, the scales overlapping, 3.2–3.4 mm long, the tube equal to the staminal tube, the lobes symmetric; anthers ovate; fruit with fleshy exocarp; plants of montane and cloud forests on sandstone. .... **6. C. laetus**

6. Branchlets terete, 3–4 mm diam.; leaf blades (2.6–)3.5–5 cm wide, pusticulate above; petioles 10–15 mm long; staminate calyx chartaceous, 0.8–1.2 mm long; staminate corolla chartaceous, glabrous or sparsely lepidote without, the scales not overlapping, 2.0–2.6 mm long, the tube shorter than the staminal tube, the lobes asymmetric; anthers linear-lanceolate; fruit with thin exocarp; plants of lowland and lower montane forests on white sands. .... **7. C. peruvianus**

4. Leaf blades chartaceous to membranaceous, the margins flat.

7. Leaf blades membranaceous to subchartaceous; petioles 5–10(–12) mm long; inflorescence a simple raceme or rarely 2-branched at base, 1–3 cm long; corolla salverform or campanulate; fruit globose.

8. Branchlets angulate, 1.5–2 mm diam.; corolla salverform, the staminate 2.2–2.6 mm; plants of premontane forests on sandstone and limestone, (244–)400–1,200 m elevation. .... **8. C. comperuvianus**

8. Branchlets terete, 2–3 mm diam.; corolla campanulate, the staminate, 2.8–3.2 mm; plants of lowland igapó forests, 90–240(–700) m elevation. .... **9. C. guyanensis subsp. pseudoicacoreus**

7. Leaf blades chartaceous; petioles (10–)13–17(–22) mm long; inflorescene a panicle with 2–8 racemes branched from base, 4–8 cm long; corolla chartaceous, infundibuliform or cotyliform; fruit depressed-globose.

9. Branchlets, petioles, abaxial leaf blades, inflorescence and calyx lobes moderately to densely lepidote, but the not scales overlapping; leaf blades smooth above at maturity; corolla cotyliform, the lobes oblong to oblanceolate, flat, smooth without, conspicuously black punctate, apically acuminate; staminal and staminodial tube chartaceous, conspicuous; anthers and antherodes obcordate, the apiculum distally recurved; pistillode conic; pistil lageniform .... **10. C. timanae**

9. Branchlets, petioles, abaxial leaf blades, inflorescence and calyx lobes moderately to densely lepidote, the scales overlapping; leaf blades pustulate above at maturity; corolla infundibuliform, the lobes ovate, verruculose without, inconspicuously brown punctate, apically rounded; staminal and staminodial tube membranaceous, inconspicuous; anthers ovate, antherodes subdeltate, the apiculum proximally inflexed; pistillode lageniform; pistil obnapiform .... **11. C. cuatrecasasii**

2. Cybianthus gigantophyllus Pipoly, **(Fig. 2A, 10)**. Candollea 46:41. 1991. Type: PERU. San Martín: Pumayacu, between Balsapuerto and Moyobamba, 600–1,200

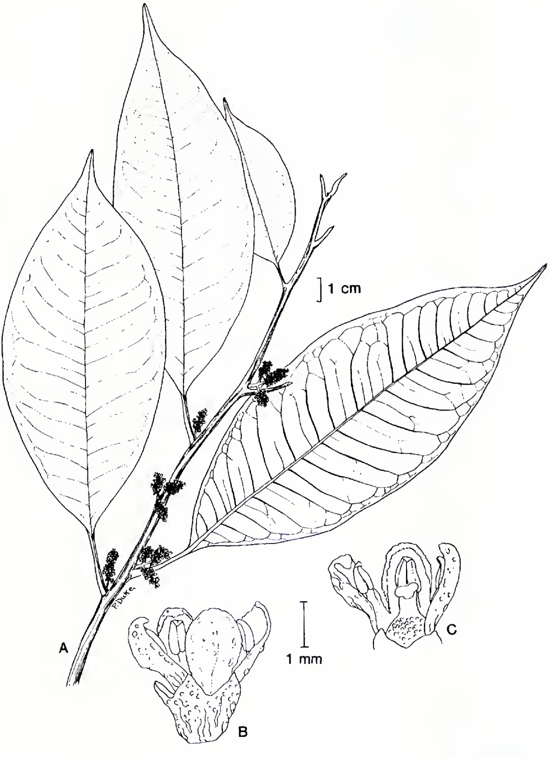

Fig. 10. *Cybianthus gigantophyllus* Pipoly. A. Habit, showing flexuous branchlet, paniculate inflorescences. B. Pistillate flower, showing urceolate calyx and crenulate corolla lobe margins. C. Pistillate flower with one corolla lobe removed, showing cucullate corolla lobe apices, proximally recurved antherodes, and capitate, lobed stigma. A–D, drawn from holotype, by Peggy Duke. Figure reproduced from Pipoly, 1991.

m, Aug–Sep 1933 (pist. fl), *G. Klug 3165* (HOLOTYPE: US; ISOTYPES: F, G-2 sheets, GH-2 sheets, MO, NY, US).

Tree to 4 m tall. *Branchlets* flexuous, prominently ribbed, 4–5 mm diam., moderately lepidote. *Leaves* alternate; blades chartaceous, elliptic, (15.5)17–27 cm long, (5.9–)7–9.1 cm wide, apically long-acuminate, the acumen 1.2–3.5(–4) cm long, pustulate, perpuncticulose and glabrous above, sparsely lepidote below, midrib slightly depressed above, prominently raised below, the secondary veins 22–26 pairs, slightly depressed above, prominently raised below, the margin irregular, flat, entire; petioles canaliculate, thick, (1.6–) 2.7–4 cm long, ca. 3 mm diam., sparsely lepidote, prominently ridged below. *Staminate inflorescence*: unknown. *Pistillate inflorescence*: a pinnate to bipinnate panicle, 1.5–2.5 cm long, tortuous, the branches spicate, moderately lepidote; peduncle 0.3–0.5 cm long, floral bracts carnose, deltate, 0.8–0.9 mm long and wide, apically acute, margin crenulate basally, densely lepidote above and below; pedicels obsolete. *Pistillate flowers* 4-merous; calyx carnose, urceolate, 1.6–1.8 mm long, the tube 0.9–1 mm long, the lobes widely triangular, 0.5–0.7 mm long, 1–1.2 mm wide, apically acuminate-apiculate, the margin regular, entire, lepidote; corolla carnose, campanulate, 2.7–3.1 mm long, the tube 0.2–0.3 mm long, the lobes erect, 2.5–3 mm long, apically rounded to obtuse, prominently cucullate, abaxially carinate, apically rugose and glandular-granulose along the margins without, inconspicuously black punctate, the margin glandular-granulose, erose-crenulate; staminodes 2.3–2.5 mm long, the staminodial tube membranous, inconspicuous, 0.2–0.3 mm long, elobate, glabrous, the apical free portions of the filaments 1.2–1.3 mm long, flat, the anthers ovate, 0.8–1 mm long, 0.6–0.8 mm wide, apiculate, the apiculum ventrally recurved, basally cordate, the connective epunctate; pistil obturbinate, 1.8–2 mm long, 1–1.3 mm diam., the ovary 1.4–1.6 mm long, the stigma capitate, 3–5-lobed, the placenta cupuliform, ovules 3, erect, the upper portions exposed. *Fruit* globose, 4–5 mm long and in diam., exocarp thin, black, inconspicuously pellucid punctate.

Distribution.—*Cybianthus gigantophyllus* is known from the headwaters of the ríos Marañon and Huallaga in San Martín, and the Iquitos area, along the Ríos Napo, Nanay and Amazonas in Loreto, at 130–500 m elevation.

Ecology and conservation status.—*Cybianthus gigantophyllus* occurs in primary *terra firme* forests, and on white sands (varillal) of lowland Peruvian Amazonia. Given increasing pressure from deforestation, it should be considered threatened.

Etymology.—The specific epithet refers to the leaf size, one of the largest known for the subgenus.

Local names.—Peru: "ukushnum," "wewé," "yakúsnum," "yakúshnum" (Aguaruna).

Representative specimens examined. PERU. Amazonas: Prov. Bagua, Dtto. Imaza, Comunidad Aguarana de Putuim (CAMPOU), anexo Yamayakat, Monte Alto de Putuim, 450 m, 25 Aug 1994 (fl bud), *C. Díaz et al. 7007* (BRIT, HUT, MO, USM); Quebrada Chichijam Entsa, Río Cenepa, 130 m, 7 Jun 1973 (fr), *E. Ancuash 580* (AMAZ, MO, NY); Vicinity Huampami, 5 km E of Valdivia, 04° 30' S, 73° 30' W, 200–500 m, 12 Aug 1978 (fr), *E. Ancuash 1437* (AMAZ, BRIT, MO, NY, US). Loreto: Maquisapa, Upper Río Nanay, Jul 1929 (fr), *Ll. Williams 1182* (F); Prov. Maynas, Dtto. Sta. María de Nanay, Casería Mishana, halfway between Iquitos and Sta. María de Nanay, 03° 50' S, 73° 30' W, 130 m, 25 Feb 1979 (ster.), *A. Gentry & J. Aronson 25044* (AMAZ, MO); Dtto. Las Amazonas, Quebrada Yanamono, Explornapo Tourist Camp, above mouth of Río Napo on Río Amazonas, 9 Nov 1979 (ster.), *A. Gentry et al. 27952* (AMAZ, MO), 25 km NE of Iquitos, along Río Amazonas, southern perimeter path, 110 m, 27 Sep 1990 (ster.), *J. Pipoly et al. 12497* (AMAZ, BRIT, MO, US, USM), 03° 20' S, 72° 55' W, 100–140 m, 15 Feb 1991 (ster.), *J. Pipoly et al. 13028* (AMAZ, BRIT, MO, USM), 03° 28' S, 72° 50' W, 106 m, 15 May 1989 (ster.), *R. Vásquez et al. 12108* (AMAZ, MO, USM); Explornapo Tourist Camp, near Sucusari, along Río Napo, 03°20' S, 72°55' W, 100–140 m, 22 Feb 1991 (ster.), *J. Pipoly et al. 13284* (AMAZ, BRIT, MO, USM), 23 Feb 1991 (ster.), *J. Pipoly et al. 13423* (AMAZ, BRIT, MO), (ster.), *J. Pipoly et al. 13426* (AMAZ, BRIT, MO, USM), 1 Mar 1991 (ster.), *J. Pipoly et al. 13931* (AMAZ, BRIT, MO, USM).

Cybianthus gigantophyllus is most closely related to *C. occigranatensis* (Cuatrec.) G. Agostini and *C. spichigeri* Pipoly. However, the large, flat leaves, long petioles, and tortuous panicles allow for easy recognition. In the original description (Pipoly 1991), I described the pistillate corolla as tubular, when it is, in fact, campanulate. When the flower is in bud, the corolla appears tubular as it longitudinally extends above the calyx, then it gradually opens, with cucullate apices. Within the tall *terra firme* forests on lateritic soils, it may be found above the flood line along small creekbeds.

3. **Cybianthus occigranatensis** (Cuatrec.) G. Agostini, Acta Biol. Venez. 10:155. 1980. *Conomorpha occigranatensis* Cuatrec., Revista Acad. Colomb. Ci. Exact. 8(31):320. 1951. Type: COLOMBIA. Valle Del Cauca: Cordillera Occidental, W slope, Río Digua River Basin, left bank of Río San Juan, around Queremál region, small stream at km 51, 1,540–1,650 m, (stam. fl), *J. Cuatrecasas 23734* (holotype: F; isotype: COL).

Shrub or small tree to 4 m tall. *Branchlets* straight, subterete, 2–3 mm diam., densely lepidote. *Leaves* alternate; blades membranaceous, elliptic to obovate, (4–)7.5–14(–21) cm long, (2.5–)4–5(–7) cm wide, apically acuminate, the acumen 1.2–1.5(–3.0) cm long, basally acute, decurrent on the petiole, the midrib impressed above, prominently raised below, the secondary veins 8–12 pairs, deeply impressed above, prominently raised below, the leaf strongly bullate, adaxial surface smooth, densely lepidote when young, becoming pusticulate and sparsely lepidote or glabrous with age, abaxial surface densely lepidote, but the scales not overlapping; petioles canaliculate, 1.0–1.5(–1.8) cm long, densely lepidote, persistent. *Staminate inflorescence* a raceme or a panicle with 1–3 branches from the base, 4–8 cm long; peduncle, rachis, branches and pedicels densely lepidote; peduncle 0.1–0.4 mm long; floral bracts membranceous, ovate, shorter than the pedicels, 0.7–1.1 mm long; 0.4–0.5 mm wide, apically acute, densely lepidote abaxially, the margin entire; pedicels cylindric, thin, 1.5–6 mm long. *Staminate flowers* 4-merous; calyx carnose, cotyliform, 0.8–1.0 mm long, the tube 0.2–0.3 mm long, the lobes triangular to deltate, 0.5–0.9 mm long, 0.4–0.8 mm wide, apically attenuate to an acute or round tip, sparsely lepidote without, glabrous within, conspicuously brown punctate, the margin lepidote; corolla membranaceous, campanulate, 2.4–2.7 mm long, the tube 0.7–0.8 mm long, the lobes ovate, 1.6–1.8 mm long, 1.0–1.3 mm wide, apically attenuate to a round tip, verruculose without, smooth within, sparsely lepidote without toward apex, apically glandular-granulose within and along margins, conspicuously brown punctate, the margins entire; stamens 1.8–1.9 mm long, the filaments 2.6–2.8 mm long, the tube membranaceous, inconspicuous, adnate to the corolla tube, elobate, the apically free portions 0.2–0.3 mm long, the anthers triangular, 0.8–1.0 mm long, 0.5–0.6 mm wide, apically attenuate to an acute , dorsally reflexed tip, basally cordate, dorsifixed just above base, the connective dark, prominently brown punctate; pistillode lageniform, 1.3–1.5 mm long, densely translucent glandular-lepidote near the base. *Bisexual and pistillate inflorescence:* as in staminate but only rarely branched from base, 4–6 cm long; peduncle 0.1–0.3 cm long; floral bracts 0.5–0.8 mm long; pedicels 1.5–3.5 mm long. *Bisexual and pistillate flowers* as in staminate but calyx 0.8–1.1 mm long, the tube 0.3–0.6 mm long, the lobes deltate to oblate, 0.4–0.6 mm long, 0.8–1 mm wide; the margin irregular, entire; corolla as in staminate but 2.4–2.6 mm long, the tube 1.0–1.1 mm long, the lobes ovate, 1.4–1.6 mm long, 0.8–1.1 mm wide. *Bisexual flowers* with stamens 1.6–1.8 mm long, the tube 1.0–1.2 mm long, the apically free portions of filaments 0.2–0.3 mm long, the anthers 0.5–0.8 mm long, pistillode 1.5–1.8 mm long. *Pistillate flowers* with staminodes 1.6–1.8 mm long, the tube 1.0–1.2 mm long, the apically free portion of filaments 0.1–0.2 mm long, the antherodes 0.5–0.7 mm long; pistil obnapiform, 2.4–2.6 mm long, the ovary 1.1–1.2 mm long, 1.1–1.2 mm diam., the style 1.0 mm long, the stigma capitate, 2-lobed, to 0.2 mm long, the ovules 2–4, buried in the placenta below apical pores. *Fruit* globose, 2.5–4 mm long, 3.5–4.5 mm diam., the endocarp smooth, the aril scanty and adnate to both seed and endocarp, the embryo straight, ca. 3 mm long.

Distribution.—Panama (Darién), Colombia (Cordillera Occidental) and Ecuador (Esmeralda, Napo, Santiago-Zamora, Sucumbios), at 1,000–1,960 m elevation.

Ecology and conservation status.—*Cybianthus occigranatensis* occurs in premontane pluvial forests, subpáramo thickets and in upper pluvial cloud forests. Based on my observations of populations in subpáramo thickets at the Antioquia/

Chocó interface in the Cordillera Occidental of Colombia, this species tolerates disturbance well as long as the soil is not compacted. It is retricted to areas where rainfall exceeds 5,000 mm annually. At this time, the species does not seem to be threatened.

Etymology.—The specific epithet refers to its principal range of distribution, the Cordillera Occidental of Colombia and adjacent Ecuador.

Specimens examined. **PANAMA. Darién:** S slope of westermost summit of Cerro Tacaracuna, massif between Pucro base camp and Tacaracuna summit camp, 1,400–1,600 m, 21 Jul 1976 (stam. fl), *A. Gentry et al. 16867* (COL, LL-TEX, MO, PMA). **COLOMBIA. Antioquia:** Mcpio Frontino, km 13 Nutibara-La Blanquita Rd., Región de Murrí, Alto de Cuevas, 06° 44' N, 76° 23' W, 1,990 m, 6 Nov 1988 (fl bud), *J. Zarucchi et al. 7201* (BRIT, HUA, MO); Mpio. Frontino, Vereda Venados, Parque Nacional Las Orquídeas, secror Dos Bocas, confluence of Río Venados and Río Calles, 06° 34' N, 76° 30' W, 29 Oc 1986 (stam. fl), *R. Callejas et al. 2737* (HUA, MO); Mpio. San Luís, Autopista Medellín-Santafé de Bogorá, sector Río Samaná, Rd. toward Vereda La Josefina, 18 Dec 1982 (stam. fl), *A. Cogollo & C. Estrada 296* (COL, JAUM, MO); Mpio. Urrao, Parque Nacional Las Orquídeas, Vereda Calles, Permanent Premontane Rainforest Inventory Plot, right bank of Río Calles, 06° 32' N, 76° 19' W, 1,450 m, 26 Nov 1993 (ster.), *J. Pipoly, A. Cogollo et al. 17159* (BRIT, JAUM, MO), 27 Nov 1993 (ster.), *J. Pipoly, A. Cogollo et al. 17182* (BRIT, JAUM, MO), Range NW of Cabaña de Calles, 1,450 m, 28 Nov 1993 (ster.), *A. Cogollo et al. 7529* (BRIT, JAUM, MO), 1,450–1,500 m, 28 Nov 1993 (ster.), *J. Pipoly et al. 17253* (BRIT, JAUM, MO), (ster.), *J. Pipoly et al. 17281* (BRIT, JAUM, MO), 7 Dec 1993 (ster.), *J. Pipoly et al. 17871* (BRIT, JAUM, MO), 9 Dec 1993 (fl. bud), *J. Pipoly et al. 17979* (BRIT, JAUM, MO), Vereda Calles, Alto de Palmitas, ca. 1 km from Cabaña de Calles, 1,700–1,750 m, 2 Dec 1993 (ster.), *J. Pipoly et al. 17542* (BRIT, JAUM, MO). **Chocó:** Mpio. Itsmina, Quebrada Raspadura, berween Raspadura and Quibdó, split of Río Atrato and Río San Juan drainage basins, ca. 05° 15' N, 76° 38'W, 18 Apr 1979 (fr), *E. Forero & R. Jaramillo 5307* (COL, MO); Serranía del Darién, along Colombian/Panamanian border, 1,400 m, 20 Jul 1976 (sram. fl, bisex. fl), *A. Gentry, H. León & L. Forero 16842* (COL, MO); without locality, 1866 (fr), *J. Triana 2589* (G). **Huila:** Río Suaza, SW of Alejandría, 1,670 m, 23 Aug 1944 (stam. fl), *E. Little 8532* (COL, US). **Quindío:** Mariquita, 1866 (sram. fl), *J. Triana 2562* (P). **Valle Del Cauca:** Cordillera Central, 5 km N of Darién along Rd. toward La Guajira, Upper Río Calima, 03° 58' N, 76° 28' W, 1,550–1,700 m, 24 Jan 1986 (fl bud), *B. Stein & L. McDade 3284* (BRIT, HUA, MO); Finca Zungara, Corregimiento La Divisora, crest of Cordillera Occidental, W of Cali, 6 km N of Cali-Buenaventura Hwy, 03° 32' N, 76° 35' W, 1,960 m, 12 Dec 1985 (ster.), *A. Gentry et al. 53167* (COL, MO, US), 24 Mar 1986 (fr), *A. Gentry et al. 53551* (COL, MO, US); Río Digua Drainage Basin, Piedra de Moler, 900–1,180 m, 20 Ocr 1943 (pisr. fl, fr), *J. Cuatrecasas 14918* (COL-2 sheets, F); Río Sanquininí, La Laguna, 1,250–1,400 m, 10 Dec 1943 (sram. fl), *J. Cuatrecasas 15658* (COL, F, US); Monre La Guardia, La Carbonera Range, between Las Brisas and Albán, 1,950–2,000 m, 16 Oct 1946 (stam. fl), *J. Cuatrecasas 22131* (COL, F, US, VEN); San Antonio, W of Cali, 1,900–2,350 m, 26 Feb 1939 (stam. fl), *E. Killip & A. García 33898* (A, BM, COL, F, NY, US); La Cumbre, 7 May 1922 (stam. fl), *F. Pennell 5147* (GH, K, NY, US). **ECUADOR. Esmeraldas:** San Lorenzo Cantón, Reserva Étnica Awá, Parroquia Alto Tambo, Centro de la Unión, Cañon del Río Mira, 00° 52' N, 78° 26' W, 250 m, 22 Mar 1993 (fr), *C. & M. Aulestia 1313* (BRIT, MO, QCNE). Napo: Carretera Nueva, Cotundo-Coca, 1,130 m, 5 Aug 1984 (pist. fl, fr), *C. Dodson et al. 15115* (MO); Cantón Archidona, 150 m NE of Caserío of Huamaní, right side of Carretera Hollín-Loreto, 00° 43' S, 77° 36' W, 1,200 m, 9 Sep 1988 (fr), *F. Hurtado & D. Neill 235* (MO, QCNE), Cordillera de Guacamayos, Rd. to Archidona, Río

Hollín Pequeño, primary forest on 90° slopes, 00° 38' S, 77° 48' W, 1,900 m, Aug 1990 (stam. fl), *W. Palacios & E. Freire 4899* (BRIT, MO, QCA); Cantón El Chaco, Right margin of Río Quijos, Finca "La Ave Brava," of Segundo Pacheco, 00° 12' S, 77° 39' W, 1,800-1,900 m, 7-10 Sep 1990 (fr), *W. Palacios 5394* (BRIT, MO, QCNE); S slope of Volcán Reventador, left bank of Río Reventador, between Rd. and trail to crater, 00° 07' S, 77° 36' W, 1,600–1,850 m, 11 Oct 1990 (stam. fl), *W. Palacios 6176* (BRIT, MO, QCNE), (stam. fl), *W. Palacios 6187* (BRIT, MO, QCNE), (fr), *W. Palacios 6218* (BRIT, MO, QCNE); Proyecto Hidroeléctrico Coca, Punto ST4; right margin of Río Quijos, ca. 10 km S of Reventador, 00° 11' S, 77° 39' W, 1,500 m, 3–5 Oct 1990 (pist. fl), *W. Palacios 5815* (BRIT, MO, QCNE), 08° 08' S, 77° 30' W, 1,450 m, 6–10 Oct 1990 (pist. fl), *W. Palacios 6040* (BRIT, MO, QCNE); Yasuní National Park, Maxus Rd and pipeline construction project, km 15, 00° 31' S, 76° 32' W, 250 m, 30 Jun 1994 (bud) *N. Pitman 461* (BRIT, MO). **Santiago-Zamora:** Between Campanas and Arenillas, along Río Tintas, 10 leagues SE of El Pan, 2,195 m, 13 Jul 1943 (stam. fl), *J. Steyermark 53550* (NY). **Sucumbios:** Sendero toward Volcán el Reventador from km 100 of Baeza-Lago Agrio Hwy, 1,900 m, 7 Oct 1990 (stam. fl), *J. Jaramillo & E. Grijalva 12988* (QCA).

Cybianthus occigranatensis is most closely related to *C. timanae* Pipoly, but is easily distinguished by the fewer secondary veins of the coriaceous leaf blades, the campanulate corolla with verrucose, prominently black punctate lobes and attenuate apices, and obnapiform pistil. The population from Alto de Cuevas in Antioquia, Colombia, has by far the largest leaves of any population of this species known thus far. Further study of the population biologies of *Cybianthus montanus* (Lundell) G. Agostini from Panama, *C. occigranatensis*, and *C. timanae* will be necessary to fully resolve the precise relationships and microecological roles each plays in montane wet and pluvial forests.

4. **Cybianthus spichigeri** Pipoly, Candollea 46:43. 1991. **(Fig. 2B, 11).** TYPE: PERU. LORETO: Prov. Requena, Trocha al Ajuajal, 2 km from Centro Forestal Jenaro Jerrera, right bank of Río Ucayali, 15 Feb 1982 (stam. fl, fr), *R. Spichiger & F. Encarnación 1224* (HOLOTYPE: US; ISOTYPES: AMAZ, G, MO).

Tree to 15 m tall. *Branchlets* thin, straight, terete, 2–3 mm diam., densely lepidote. *Leaves* alternate; blades chartaceous, elliptic to narrowly oblanceolate, (10–)15–20 cm long, (3–)5.2–6.5(–7.2) cm wide, apically caudate-acuminate, the acumen 1.9–2.3 cm long, basally acutish to obtuse, not decurrent on the petiole, bullate, the midrib and secondary veins strongly impressed above, prominently raised below, smooth and inconspicuously to promiently pellucid punctate above, moderately lepidote below, the margin essentially flat, but very slightly inrolled at the very margin; petioles canaliculate, (1–) 1.2–2 cm long, densely lepidote. *Staminate inflorescence*: a pyramidal pinnate pannicle, 1–4.5 cm long, 1–3 cm wide, peduncle 0.3–1 cm long; branch bracts chartaceous, linear-subulate, 0.6–1 mm long, 0.1–0.2 mm wide, apically attenuate, densely lepidote; pedicels cylindrical, (0.8–)1–1.5 mm long. *Staminate flowers* 4–5-merous, carnose; calyx suburceolate, 1.3–1.5 mm long, the tube 0.3–0.5 mm long, the lobes deltate, ca. 1 mm long and wide, apically acute,

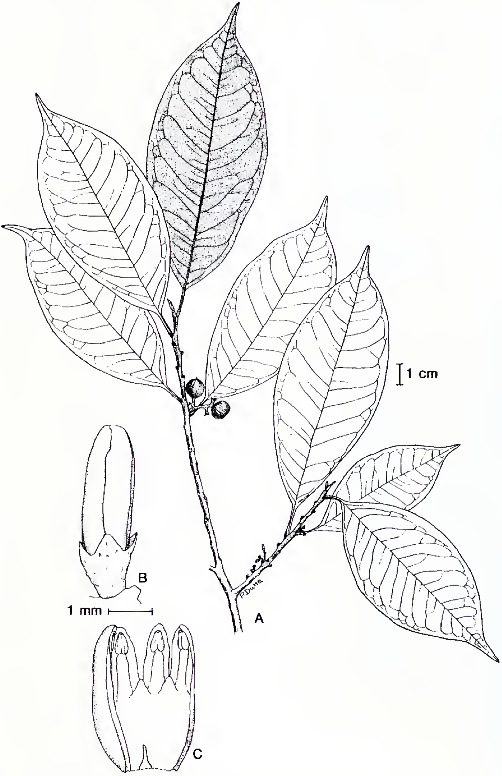

FIG. 11. *Cybianthus spichigeri* Pipoly. A. Habit, showing minute inflorescences and large, costate fruits. B. Staminate flower in bud, showing suburceolate calyx and tubiform corolla. C. Staminate flower, showing long, prominently lobate staminal tube, cucullate corolla lobes, proximally recurved anthers. A–C, drawn from holotype, by Peggy Duke. Figure reproduced from Pipoly, 1991.

sparsely lepidote, prominently rugose, with one prominent brown punctation per lobe, the margins irregular, entire, sparsely lepidote; corolla tubiform, 2.4–2.8 mm long, the tube ca. 0.5 mm long, the lobes oblong, 1.9–2.9 mm long, 0.9–1.1 mm wide, apically acute, prominently cucullate, with only a few, scattered scales without, glandular-granulose within, the margin entire, glandular-granulose; stamens 2.2–2.4 mm long, the tube carnose, conspicuous, 1–1.4 mm long, lobate, the lobes 0.1–0.2 mm long alternating with the filaments, the apex of the tube and lobes punctate, the apically free filaments, 0.9–1.3 mm long, the anthers deltate, 0.5–0.7 mm long and wide, apically apiculate, the apiculum slightly proximally recurved, basally cordate, the connective dorsally punctate with small brown dots forming a triangle along connective margin; pistillode conic, 0.5–0.7 mm long, 0.2–0.3 mm wide, hollow, glabrous, the style conspicuously brown punctate, the stigma punctiform. *Pistillate and polygamous inflorescence*: a raceme, occasionally a poorly formed panicle of 1–3 racemes branched from base, 0.4–1.5 cm long, densely lepidote, tardily glabrescent; peduncle 0.1–0.4 mm long; floral bracts chartaceous, ovate, 0.8–1 mm long, 0.3–0.5 mm wide, apically attenuate, densely lepidote; pedicels obconic, (0.8–)1.5–2.5(–3) mm long, to 1.2 mm diam. apically in fruit, densely lepidote. *Pistillate flowers* as in staminate but calyx 1.0–1.2 mm long, the tube 0.4–0.5 mm long, the lobes 0.6–0.7 mm long and wide, staminodes and pistil unknown. *Fruit* depressed-globose, 0.7–0.8 cm long, 0.7–1.5 cm wide, prominently costate longitudinally, the exocarp costate, inconspicuously pellucid punctate.

Distribution.—Principally known from forests along the ríos Ucayali, Marañon and Napo Drainage Basin complex, Loreto, Peru, with one disjunct population in nearby Morona-Santiago, Ecuador, 150–180 (–1,500) m elevation.

Ecology and conservation status.—*Cybianthus spichigeri* is known from only a handful of specimens, but is locally quite common. Not enough is known of the population biology to categorize its conservation status, but its frequency in forest study plots of the Jenaro Herrera Reserve in Peru suggest it is reproducing and may not be in imminent danger. *Cybianthus spichigeri* is a varillal or premontante sandstone species in Peru, and in Ecuador it is known only from premontane sandstones. Occurrence of this species in the Cerros del Sirá, Peru, reinforces the concept that those mountains contain many unusual populations of otherwise lowland Amazonian plants.

Etymology.—The epithet commemorates Rudolphe Spichiger, Director of the Conservatoire et Jardin Botaniques, Chambesy, Geneve, Switzerland. Dr. Spichiger has devoted much of his career to study of global change, conservation of biodiversity, and systematics of the genus *Ilex*. Under his leadership, the Jardin has maintained active research programs in Paraguay, Peru, Madagascar, and throughout Europe.

Representative specimens examined. **ECUADOR. Morona-Santiago:** Cordillera del Cóndor, Cuangos, 20 km E of Gualaquiza, near disputed Peru-Ecuador border, 03° 29' S, 78° 14' W, 1,500 m, 18 Jul 1993 (ster.), *A. Gentry 80096* (BRIT, MO, QCNE), 1,470 m, 19 Jul 1993 (infl. bud), *A. Gentry 80179* (BRIT, MO, QCNE). **PERU. Huánuco:** Prov. Pachitea, region of Pucallpa, W part of "Sirá Mountains," and adjacent lowland, ca. 24 km SE to 26 km ESE of Puerto Inca, from beginning of rainforest to Campamento Pato Rojo, 09° 27' S, 74° 46' W, 1,380 m, 31 Jan 1988 (fl bud), *W. Morawetz & B. Wallnöfer 14-31188* (BRIT, W, WU). **Loreto:** Prov. Maynas, Allpahuayo, IIAP Station, 04°10' S, 73°30' W, 150 m, 13 Nov 1984 (fr), *R. Vásquez et al. 5911* (AMAZ, MO, NY), 6 Jun 1985 (fr), *R. Vásquez et al. 6588* (AMAZ, MO, NY); Río Nanay, Mishana, 30 km SW of Iquitos, 03° 55' S, 73° 35' W, 150 m, 19 Aug 1978 (fr), *R. Foster 4226* (MO, NY, USM), 16 May 1981 (fr), *R. Vásquez & J. Criollo 1801* (AMAZ, MO, NY), 20 Jan 1985 (fr), *R. Vásquez & N. Jaramillo 6137* (AMAZ, MO, NY). Prov. Requena, Reserva Forestal Jenaro Herrera, 04°55' S, 73°45' W, along Río Ucayali, 120 m, 1980 (stam. fl), *R. Marmillod 9-R-137* (G, US), 1980 (bud), *R. Marmillod 4-R-90*, 10 Jun. 1982 (fr), *R. Spichiger et al. 1973* (G, US), 24 Feb. 1987 (ster.), *A. Gentry et al. 56531* (AMAZ, MO); Aguajal, 3 km from Centro Forestal Jenaro Herrera, right margin Río Ucayali, 18 May 1982 (fr), *F. Encarnación 26105* (AMAZ, MO), 22 May 1982 (fr), *F. Encarnación 26200* (AMAZ, MO, NY, US); Arboretum, Centro Forestal Jenaro Herrera, 180 m, 13 Nov 1981 (fr, stam. fl), *R. Spichiger & F. Encarnación 1027* (AMAZ, G, MO, US).

Cybianthus spichigeri is unique within subgenus *Conomorpha* because of its costate fruits. In addition, the subbullate leaf blades, punctate staminal tube, obconic pedicels, and polygamous inflorescences are also exceedingly rare characters that allow for easy recognition. Since its description (Pipoly 1991), an entirely staminate specimen (*R. Marmillod 9-R-137*) has been located. While the staminate inflorescence structure is quite different from that of the polygamous one, flowers of both are identical. The occurrence of this taxon three times in one inventory conducted at the Jenaro Herrera Reserve indicate that the relative frequency of reproductive individuals would permit a study of the breeding system and population biology for this most unusual taxon.

5. **Cybianthus lepidotus** (Gleason) G. Agostini, Bol. Soc. Venez. Ci. Nat. 22:388. 1976. *Conomorpha lepidota* Gleason, Bull. Torrey Bot. Club 58:446. 1931. Type: VENEZUELA. Territorio Federal Amazonas: Summit of Mt. Duida, 1,500 m, Aug 1928–Mar 1929 (pist. fl), *G. H. H. Tate 741* (holotype: NY, F Neg. 040832; isotype: US).

Conomorpha curvivenia Gleason, Bull. Torrey Bot. Club 58:444. 1931. Type: VENEZUELA. Territorio Federal Amazonas: Mt. Duida, 1,260 m, Aug 1928–Mar 1929 (stam. fl), *G. H. H. Tate 927* (holotype: NY; isotype: US).

Conomorpha lepidota Gleason f. *acutata* Steyerm., Fieldiana, Bot. 28:465. 1953. Type: VENEZUELA. Territorio Federal Amazonas: Cerro Duida, 2 Dec 1944 (fr), *J. Steyermark 58265* (holotype: F; isotype: NY).

Shrub or small tree to 6 m tall. *Branchlets* straight, terete, 2-2.5 mm diam., densely lepidote. *Leaves* alternate; blades elliptic to narrowly elliptic, chartaceous to coriaceous, (3.1-)5-15 cm long, 1.6–6 cm wide, apically acuminate, the acumen 0.3–2.0 cm long, basally acute to obtuse, midrib depressed above, prominently raised below, the secondary veins 24–28, inconspicuous above and below, pustulate and densely lepidote above at first, glabrescent, densely lepidote below, the scales not overlapping, inconspicuously pellucid punctate, the margin entire, subrevolute to revolute; petioles thin, marginate, 1.0–2.5 cm long, densely lepidote. *Staminate inflorescence* a spike, rarely two subsessile spikes, (2–)6–16 cm long, 8–15-flowered, peduncle, pedicels, and axis densely lepidote, the scales not overlapping; peduncle (0.2–)0.5–0.8 mm long; floral bracts ovate to widely ovate, chartaceous, 0.5–0.6 mm long, 0.3–0.4 mm wide, apically acute, densely lepidote adaxially, the margin entire, glabrous. *Staminate flowers* (4–)5-merous; calyx cupuliform, carnose, 0.9–1.2 mm long, the tube 0.2–0.4 mm long, the lobes deltate to ovate-triangular, 0.6–0.8 mm long and wide, apically acute or acuminate, rarely obtuse, attenuate to a rounded tip, conspicuously brown punctate, the margin entire, lepidote; corolla cupuliform, carnose, 1.5–2.5 mm long, the tube 0.5–1.0 mm long, the lobes ovate to broadly ovate, 1.2–1.7 mm long, 0.7–0.9 mm wide, apically attenuate to a round, cucullate tip, at times with a few, scattered lepidote scales without, glabrous without, glandular-granulose within over the entire surface, punctations brown, submarginal, the margin entire, glabrous; stamens 1.5–1.6 mm long, adnate 0.5–1.0 mm to corolla tube, the staminal tube 0.3–0.4 mm long, carnose, bearing lobes alternating with the apically free portions of the filaments 0.1–0.2 mm long, the filaments flat, 0.3–0.4 mm long, erect, glabrous, the anthers dorsifixed less than 1/4 from base, ovate-triangular, 0.6–0.7 mm long, 0.4–0.5 mm wide, apically attenuate to a rounded tip, basally cordate, slightly dorsally reflexed, the connective epunctate; pistillode lageniform, 1.1–1.2 mm long, hollow, costate basally, sparingly translucent lepidote, pellucid-punctate. *Pistillate inflorescence* as in staminate but a spike, (2–)6–16 cm long, 6–10-flowered; peduncle 0.6–0.8 mm long; floral bracts 0.5–0.6 mm long, 0.3–0.4 mm wide. *Pistillate flowers* as in staminate, but staminodes 1.2–1.3 mm long, adnate 0.5–1.0 mm to corolla tube, the staminodial tube 0.5–0.6 mm long, carnose, bearing lobes alternating with the apically free portions of the filaments 0.1–0.2 mm long, those apical portions flat, 0.3–0.4 mm long, erect, glabrous, the antherodes dorsifixed less than 1/4 from base, deltate, 0.7–0.8 mm long and wide, apically attenuate to a rounded tip, basally cordate, slightly dorsally reflexed, the connective epunctate; pistil pyriform, 1.4–1.5 mm long, the ovary 1–1.2 diam., the style not differentiated, the stigma punctiform, the placenta patelliform, bearing 2(–3) naked ovules. *Fruit* globose, purple at maturity, 0.5–1.0 cm long, 0.6–1.0 cm diam., the endocarp smooth, the embryo curved, 3.5–4.0 mm long.

Distribution.—Guayana Highland of Venezuela and Brazil, and sandstone formations in Bolivia and Peru (reported for the first time here), 600–2,300 m in Venezuela, 850–950 m in Bolivia, and 760–850 m in Peru.

Ecology and conservation status.—*Cybianthus lepidotus* is restricted to large cloud forest formations in transition zones between sandstone and diabasic intrusions. It is often associated with species of *Erythroxylum*, which are also edaphic endemics. It is a widespread, but locally infrequent species and therefore, should be considered threatened.

Etymology.—The epithet refers to the densely lepidote vestiture of the vegetative and floral parts of the plant.

Specimens examined. **PERU. Amazonas:** Prov. Bagua, Dtto. Imaza, Comunidad Aguaruna Putuim, anexo Yamayakat, SW of Putuim, 760–850 m, 26 Sep 1994 (stam. fl), *C. Díaz et al. 7252* (BRIT, HUT, MO, USM). **BOLIVIA. La Paz:** Prov. Nor Yungas, valley of Río Coroico, Sacramento, 10 km NE of Chuspipata on Coroico Rd., 27 Jan 1984 (ster.), *A. Gentry & J. Solomon 44668* (MO), 4 km NE (above) Inabuara, 13.5 km above San Pedro, 1,530–1,560 m, 22 Jan 1984 (stam. fl), *A. Gentry & J. Solomon 44407* (MO); Prov. Larecaja, Maipiri, 6 Nov 1926–28 Feb 1927 (stam. fl), *O. Buchtien 1758* (HBG, NY, US), Copacabana, 10 km S of Maipiri, 850–950 m, 8 Oct–15 Nov 1939 (fr), *B. Krukoff 10987* (A, K, MICH, MO, NY, UC, US).

Cybianthus lepidotus, restricted to sizeable cloud forests in transition zones between sandstone and diabasic intrusions, is most easily recognized by its long, lax spikes. When sterile, it may be confused with *Cybianthus roraimae* (Steyerm.) G. Agost., but may be easily distinguished by the branchlets 2–2.5 (not 3.5–4.5) mm in diameter. It may also be confused with *Cybianthus punctatus* (Mez) G. Agost. and *C. cardonae* G. Agost. For a discussion of the differences between these taxa in sterile condition, see Pipoly (1992a).

The area of Bolivia in which this species has been collected is of biogeographic interest because it also supports several other Guayana Highland taxa in the Ericaceae and Clusiaceae. Its new discovery in Bagua Province of Amazonas, Peru, reinforces thematic map data from satellite imagery that indicated tepuí-like vegetation could be expected in the area. It is interesting that *C. Díaz et al. 7252* from Peru, and *B. Krukoff 10987* from Bolivia, are qualitatively and quantitatively identical to specimens of *Cybianthus lepidotus* from Cerro Duida, Amazonas, Venezuela.

6. Cybianthus laetus (Mez) G. Agostini (**Fig. 2C**), Acta Biol. Venez. 10:153. 1980. *Conomorpha laeta* Mez in Engl., Pflanzenr. IV. 236(Heft 9):259. 1902. TYPE: PERU. AMAZONAS: Taulia, without elevation or date (stam. fl.), *A. Matthews 1561* (HOLOTYPE: K; ISOTYPE: K).

Shrub or small tree to 2 m tall. *Branchlets* straight, subterete, 2–3 mm diam., densely lepidote. *Leaves* alternate; blades coriaceous, obovate, 3–8(–12) cm long, 1.2–2(–5.0) cm wide, apically acute or short-acuminate, basally cuneate, decurrent on the petiole, midrib depressed above, prominently raised below, the secondary veins 14–18 pairs, planar above, conspicuous below, glabrous and smooth above at maturity, densely lepidote below, the margin revolute; petioles marginate, 0.5–1 cm long, densely lepidote. *Staminate inflorescence*: a raceme or panicle with 2 racemose branches from base, 2–3 cm long; rachis, and pedicels densely lepidote; peduncle 0.1–0.3 cm long; pedicels cylindrical, 0.9–1.5 mm long; floral bracts chartaceous, narrowly ovate, 1–2 mm long, densely lepidote adaxially. *Staminate flowers* 4-merous; calyx carnose, cotyliform, 1.2–1.8 mm long, sparsely to densely lepidote without, glabrous within, the tube 0.2–0.3 mm long, the lobes triangular to deltate, 0.8–1 mm long, 0.6–0.8 mm wide, apically attenuate to a rounded tip, inconspicuously pellucid punctate, the margin entire, lepidote; corolla carnose, campanulate, 3.2–3.4 mm long, the tube 1.8–2 mm long, densely lepidote without, the scales overlapping, glabrous within, the lobes ovate or ovate-triangular, 0.8–0.9 mm long, 0.3–0.4 mm wide, symmetric, apically attenuate to a rounded tip, inconspicuosly pellucid punctate, densely lepidote without, glandular-granulose within, the margin entire, glandular-granulose; stamens 2.6–2.7 mm long, the tube carnose, conspicuous, equalling the corolla tube, 1.8–2 mm long, lobate, the lobes alternating with the filaments ca. 0.1 mm long, the apically free portions of the filaments flat, 0.1–0.2 mm long, the anthers dorsifixed, ovate, 0.6–0.9 mm long, 1.8–1.9 mm wide, somewhat curved distally, apically apiculate to subapiculate, basally cordate, the connective inconspicuously brown punctate; pistillode conic, 1.5–2 mm long, translucent glandular-lepidote basally, hollow. *Pistillate inflorescence*: as in staminate but 3–3.5 cm long; peduncle 0.1–0.4 cm long; pedicels cylindrical, 0.9–1.5 mm long; floral bracts chartaceous, linear-lanceolate, 1.3–1.5 mm long, densely lepidote adaxially. *Pistillate flowers* as in staminate but calyx 1.2–1.4 mm long, sparsely to densely lepidote without, glabrous within, the tube ca. 0.2 mm long, the lobes deltate, 1–1.2 mm long and wide, apically attenuate to a rounded tip, inconspicuously pellucid punctate, the margin entire, lepidote; corolla, staminodes and pistil unknown. *Fruit* globose, 5–8 mm long and in diam., exocarp carnose, black.

Distribution.—Eastern slopes of the Andes, Colombia, Peru and Bolivia, 1,980–2,850 m.

Ecology and conservation status.—The species occurs in primary cloud forest, a life zone being cleared rapidly for cultivation throughout the Andes, which may account for the paucity of collections. Within subgenus *Conomorpha*, *Cybianthus laetus* is the species most in danger of extinction.

Etymology.—The specific epithet is Latin for "cheerful or bright," and probably refers to the plant's aesthetically pleasing appearance, having the same general form as many species of *Vaccinium*, *Myrsine dependens*, other Ericaceae, and other diminutive Andean shrubs. The thick juicy exocarp is said to be very tasty although slightly acidic (T. Dudley, pers. comm.).

Representative specimens examined. **COLOMBIA. Boyaca:** Arcabuco, NE of town, 2,650 m, 11 Nov 1965 (stam. fl), *L. Uribe s.n.*(COL); Sierra Nevada del Cocuy, path from Laguna to Cobugón, near Alto del Oso, 2,900 m, 27 Aug 1958 (stam. fl), *P. Grubb et al. 744* (K). **PERU. Amazonas:** Prov. Luya, Drto. Camporredondo, Anexo Tullanya, between Pájaco Tigre and Palma, 06° 04' 35" S, 78° 21' 45" W, 2,500–2,600 m, 9 Dec 1996 (fr), *J. Campos et al. 3161* (BRIT, HUT, MO, USM); Along Rd. E of Chachapoyas between Pipos and Molinopampa, 06°15' S, 77°40' W, 1,980–2,340 m, 14 Feb 1985 (pist. fl, fr), *J. Luteyn & E. Cotton 11414* (NY, TEX, US, USM); E of Chachapoyas, 2,000 m, without date (stam. fl), *A. Weberbauer 4354* (G). **Cusco:** Prov. La Convención, Cordillera Vilcabamba, 12° 37' S, 73° 32' W, ceja and cumbre, 2,550 m, 3 Jul 1968 (pist. bud), *T. Dudley 10690* (F, NA, USM), 5 Jul 1968 (pist. fl, fr), *T. Dudley 10803* (F, NA, USM). **Huánuco:** Prov. Huánuco, Carpish Hills, trail to summit from W entrance, 2,700–2,850 m, 09° 42' S, 76° 05' W, 2 Mar 1985 (stam. fl.), *B. Stein & C. Todzia 2292* (MO, USM).

Cybianthus laetus is easily recognized by its small leaves, short petioles, subsessile anthers and thick, juicy exocarp. It is known outside of Peru from only two other collections, one from the department of Boyacá, Colombia and the other from Nor Yungas, Bolivia. A recent collection from Luya Province in western Peru (*J. Campos et al. 3161*) is referred here because of its thin, angulate branchlets, and the thick exocarp of its fruits, despite the larger, thinner leaves. It is expected in Ecuador, in either Napo or Santiago-Zamora Provinces.

7. **Cybianthus peruvianus** (A. DC.) Miq. (**Fig. 2D**) in Mart., Fl. Bras. 10:298. 1856. *Conomorpha peruviana* A. DC. , Ann. Sci. Nat., Bot. ser 2, 16:92. 1841. *Peckia peruviana* (A. DC.) Kuntze, Revis. Gen. Pl. 402. 1891. Type: PERU. Amazonas: Moyobamba, 1838 (stam. fl), *A. Mathews s.n.* (holotype: G-DC; isotypes: G, G-BOIS, GH, K).

Conomorpha weberbaueri Mez, Repert. Spec. Nov. Regni Veg. 3:101. 1906. Type: PERU. Loreto: In mountains near Moyobamba, 1,300 m, 28 Aug 1904 (stam. fl), *A. Weberbauer 4668* (holotype: B-destroyed; Lectotype, here designated: F).

Shrub or small tree to 16 m tall. *Branchlets* straight, terete, 3–5 mm diam., densely lepidote. *Leaves* alternate, at times approaching pseudoverticillate at some nodes; blades coriaceous, elliptic to obovate, 7–12.7 cm long, (2.6–) 3.5–5 cm wide, apically acuminate, the acumen 1.2–1.6 cm long, basally acute to obtuse, decurrent on the petiole, midrib depressed above, prominently raised below, the secondary veins 10–25 pairs, prominently raised below, densely lepidote at first, then pusticulate above at maturity, sparsely lepidote below, the margin revolute; petioles canaliculate, 1–1.5 cm long, densely lepidote. *Staminate inflorescence*: a panicle with 1–4 racemes branching from the base, (2–)3–8 cm long; peduncle, rachis and pedicels densely lepidote; peduncle 0.1–0.2 cm long; floral bracts chartaceous, ovate, 0.7–1 mm long, 0.5–0.6 mm wide, apically attenuate, densely lepdote abaxially; pedicels cylindrical, 0.5–1(–1.2) mm long. *Staminate flowers* 4–5-merous; calyx green, cotyliform, 0.8–1.2 mm long, lepidote without, glabrous within, the tube 0.3–0.4 mm long, the lobes ovate to deltate, 0.7–0.8 mm long, 0.5–0.8 mm wide, apically attenuate to a rounded tip, the margin lepidote, inconspicuously brown punctate; corolla translucent green, chartaceous, campanulate, 2–2.6 mm long, the tube 0.6–1.2 mm long, glabrous or sparsely lepidote externally, glabrous internally, the lobes ovate to narrowly ovate, 1.2–1.8 mm long, 0.5–1.1 mm wide, asymmetric, apically rounded or attenuate to a rounded tip, sparsely lepidote externally, the scales not overlapping, sparsely glandular-granulose internally, inconspicuously brown punctate, the margin glandular-granulose; stamens 1.4–2 mm long, the tube chartaceous, conspicuous, longer than the corolla tube, 0.8–1.2 mm long, elobate, the apically free portions of the filaments 0.2–0.4 mm long, the anthers linear-lanceolate, 0.7–0.9 mm long, 0.2–0.3 mm wide, somewhat recurved distally, attenuate to a round or acute tip, the connective conspicuously brown punctate; pistillode obclaviform, 1–1.5 mm long, translucent glandular-lepidote basally. *Pistillate inflorescence*: like the staminate but, 2–7 cm long; peduncle 0.1–0.2 cm long; floral bracts 0.7–1 mm long, 0.4–0.5 mm wide; pedicels 0.2–0.5 mm long. *Pistillate flowers* as in staminate but calyx 0.9–1.1 mm long, the tube 0.3–0.7 mm long, the lobes deltate, 0.5–0.6 mm long, 0.4–0.5 mm wide, apically subacute to obtuse; corolla 1.3–1.7 mm long, the tube 0.2–0.3 mm long, the lobes ovate, 1–1.4 mm long, 0.7–0.9 mm wide, apically obtuse; staminodes 1–1.2 mm long, the tube longer than the corolla tube, 0.3–0.4 mm long, the apically free portions of the filaments 0.2–0.3 mm long, the antherodes 0.6–0.7 mm long, 0.2–0.3 mm wide, pistil obnapiform, 1.3–1.4 mm long, 1–1.1 mm diam., the ovary 0.6–0.7 mm long, translucent glandular-lepidote basally, the style 0.5–0.6 mm long, conspicuously brown punctate, the stigma punctiform, the placenta globose, ovules 3, apically exposed. *Fruit* subglobose, 0.3–0.8 mm long, 0.4–0.9 mm diam., the exocarp thin, black.

Distribution.—Amazonian Ecuador through Peru to Bolivia, at 122–1,500 m elevation.

Ecology and conservation status.—*Cybianthus peruvianus* occurs on the eastern slopes of the Andes in moist or wet lowland and premontane forests on white sands, especially in transition zones, where brownish sand-clay mixtures occur.

Etymology.—The epithet refers to the type locality, in (Moyobamba) Peru.

Local name.—Peru: "Tarrafa caspi." (Quichua), "uchi yacushnum" (Aguaruna).

Representative specimens examined. **ECUADOR. Napo:** Cantón Aguarico, Reserva Faunística Cuyabeno, Laguna Zancudo Cocha (Iriparí), SE side of Laguna, 00° 33' S, 75° 32' W, 230 m, 28 Sep 1991 (fr), *W. Palacios et al. 7761* (BRIT, MO, QCNE); Cantón Orellana, Sector Huashito, 20 km N of Coca, PALMORIENTE property, 00° 20' S, 77° 05' W, 250 m, 3–21 Nov 1989 (fr), *E. Guidiño 137* (BRIT, MO, QCNE); Sendero ro Palma Roja, 28 Apr 1986 (stam. fl), *J. Jaramillo 8522* (QCA). **Zamora-Chinchipe:** Cantón Nangaritza Campamento Miazi, along Río Nangaritza, 900 m, 19 Feb 1994 (fr), *H. van der Werff et al. 13280* (BRIT, MO, QCNE); Hill above military post, 04° 18' S, 78° 40' W, 1,000 m, *D. Neill & W.*

Palacios 9615 (BRIT, MO, QCNE), 04° 16' S, 78° 42' W, 970 m, 20 Oct 1991 (fr), *W. Palacios et al. 8486* (BRIT, COL, MO, QCNE). **PERU**. **Amazonas:** Along Río Marañon, near confluence with Río Santiago, 1924 (stam. fl.), *G. Tessmann 3525* (B, G); Prov. Bagua, Dtto. Imaza, NE region of Río Marañon Drainage Basin, Comunidad Kampaenza, along Quebrada Shimutaz, Río Marañon, 04° 55' S, 78° 19' W, 320 m, 9 Sep 1994 (pist. fl, fr), *N. Jaramillo et al. 436* (AMAZ, BRIT, HUT, MO, USM), 09 Oct 1995 (fr), *N. Jaramillo & D. Chamik 813* (AMAZ, BRIT, MO, USM); Comunidad Aguaruna de Putuim (CAMPOU), anexo Yamayakat, Monte Alto de Putuim, 450 m, 25 Aug 1994 (fr), *C. Díaz et al. 6993* (BRIT, HUT, MO, USM), 660-760 m, 21 Sep 1994 (stam. fl), *C. Díaz et al. 7170* (BRIT, MO, USM); Cerros de Putuim, 05° 03' 20" S, 78° 20' 23" W, 350 m, 13 Jun 1996 (fr), *R. Vásquez et al. 21131*. **Huánuco:** Prov. Pachitea, region of Pucallpa, W part of Sirá Mountains and adjacent lowland, 20-24 km SE of Puerto Inca, Campamento Oro, 09° 29' S, 74° 50' W, to Campamento Sirá, 800 m, 17 Jul 1988 (stam. fl), *W. Morawetz & B. Wallnöfer 22-19188* (BRIT, W, WU). **Loreto:** Prov. Loreto, Nauta, 04° 32' S, 73° 35' W, 160 m, 2 Jun 1984 (fr), *R. Vásquez & N. Jaramillo 5060* (AMAZ, MO, USM); Zúngaru Cocha, 15 km SE of Iquitos, 9 Sep 1964 (stam. fl), *C. Dodson 2821* (AMAZ, MO, US, USM); Prov. Maynas, Moropón, lower Río Nanay above Bellavista, 29 Aug 1968 (fr), *S. McDaniel 10942* (AMAZ, IEB, MO); Tamishiyacu, Quebrada Blanco Biol. Station, Camp II, Quebrada Blanco, Tahuayo River, 04° 23' S, 73° 17' W, 4 Apr 1985 (fr), *J. Castro 27* (AMAZ, MO, US, USM); Dtto. Iquitos, Hwy to Sto. Tomás, path in front of "Chaparal" chicken farm, 140 m, 16 Dec 1983 (stam. fl), *M. Rimachi 7232* (AMAZ, IBE, MO, US); Estación Experimental IIAP Allpahuayo, 21 km S of Iquitos,04° 10' S, 73° 30' W, 160 m, 18 Sep 1990 (ster.), *J. Pipoly et al. 12112* (AMAZ, MO, US, USM), 220 m, 19 Sep 1990 (stam. fl), *J. Pipoly et al. 12210* (AMAZ, MO, NY, USM); Dtto. Sta. María de Nanay, 10 km W of Caserío Mishana, in Cocha Yaramá Reserve, 03° 55' S, 73° 35' W, 130 m, 14 Mar 1991 (ster.), *J. Pipoly et al. 14994* (AMAZ, MO, US, USM), (ster.), *J. Pipoly et al. 14997* (AMAZ, MO, USM); Mishana, along Río Nanay, 03° 51' S, 73° 32' W, 150 m, 22 Apr 1986 (stam. bud), *R. Vásquez et al. 7503* (AMAZ, MO, US, USM), 8 Sep 1990 (fr), *R. Vásquez et al. 14335* (AMAZ, BISH, F, MO, NY, TEX, US, USM); Mishana,0 3° 52' S, 73° 30' W, 140 m, 4 Jan 1983 (fr), *A. Gentry et al. 39040* (AMAZ, MO, USM); Dtto. Iquitos, Puerto Almendras, Arboretum Ciencias de Ingeniería Forestal, UNAP, 03° 48' S, 73° 25' W, 122m, 4 Sep 1992 (ster.), *C. Grández et al. 4711* (AMAZ, BRIT, MO, USM), Puerto Almendras, along Río Nanay, 03° 45' S, 73° 25' W, 122 m, 30 Oct 1984 (fr), *R. Vásquez & N. Jaramillo 5867* (AMAZ, MO, NY, USM), 29 May 1986 (fr), *R. Vázquez & N. Jaramillo 7570* (AMAZ, MO, US, USM), 30 May 1986 (stam. bud), *R. Vásquez & N. Jaramillo 7587* (AMAZ, MO, US, USM); Quistococha, IMARPE tract, along Rd. 13 km from Iquitos, 14 Jul 1976 (fr), *F. Encarnación 864* (AMAZ, US); Prov. Requena, Dtto. Sapuena, Jenaro Herrera, Río Ucayali, 04° 55' S, 73° 40' W, 160 m, 16 Aug 1994 (stam. fl), *R. Ortíz et al. 98* (AMAZ, BRIT, MO, USM). **Madre de Dios:** Prov. Tambopata, Santuario Nacional Pampas del Heath, Quebrada Palma Real Grande, 12° 57' 11" S, 68° 54' 48" W, 210 m, 21 Apr 1996 (fr), *M. Aguilar & D. Castro 623* (BRIT, MO, USM), Puesto Enahuipa, 12° 39' 23" S, 68° 44' 13" W, 210 m, 25 Apr 1996 (fr), *M. Aguilar & D. Castro 655* (BRIT, MO, USM). **San Martín:** Prov. San Martín, trail to television antenna, km 17.5 of Tarapoto-Yurimaguas Rd., 2.5 km N of Cataratas de Ahuashiyacu, 06° 27' S, 76° 21' W, 850–1,200 m, 7 Sep 1986 (pist. fl, fr), *S. Knapp 8290* (MO, US, USM).

Cybianthus peruvianus is most closely related to *C. comperuvianus* Pipoly (herein described), but may be recognized by its longer, canaliculate petioles, revolute leaf margins, shorter pedicels, asymmetric, lepidote corolla lobes, and linear-lanceolate anthers. Field studies near Iquitos have shown

FIG. 12. *Cybianthus comperuvianus* Pipoly. A. Habit, showing inflorescence of racemes or malformed panicles. B. Staminate flower and axillant bract, showing floral densely lepidote floral bract as long as pedicel, and lepidote calyx margins. C. Opened staminate flower, showing staminal tube longer than apical free portions of the filaments, lobes glandular-granulose adaxially and crenulate margins. A–C, drawn from holotype, by Linny Heagy.

it is a ridgetop species in the lowlands, with a density of approximately 2–4 individuals per hectare.

8. **Cybianthus comperuvianus** Pipoly, sp. nov. (**Fig. 2E, 12**). Type: BRAZIL. Mato Grosso: Sta. Anna da Chapada, 1903 (stam. fl), *G. Malme 3483* (holotype: S; isotypes: G, GH, R, S).

Cybianthus comperuvianus Agostini ex Pipoly in Killeen et al., Guia Arb. Boliv. 570. 1993. *nom. nud.* Agostini (1972) provided the first description of this species in his dissertation, but never published it. I subsequently annotated herbarium specimens with the name, fully intending to publish it, but it was still not validly published when it appeared in *Guia de Arboles de Bolivia,* without Latin description or reference to type. Presumably, the name was obtained by them based on herbarium determinations, and thus a *nomen nudum* and invalid. Validation of the name is effected here,with the citation of holotype above and the Latin diagnosis, and accompanying description, provided below.

Species haec cum *C. peruviano* saepenumero confusus est, sed laminis membranaceis (non coriaceis), secus margines planis (nec revolutis), petiolis marginatis (non canaliculatis) 0.5–1 (nec 1–1.5) longis, pedicellis 1.5–2.5 (non 0.7–1.0) mm longis, corollis staminaribus salverformibus (non campanularis) statim diagnoscenda.

Shrub or small tree to 6 m tall. *Branchlets* angulate, 1.5–2 mm diam., densely lepidote. *Leaves* alternate; membranaceous, elliptic, narrowly elliptic, to obovate, 9–13(–17) cm long, 3–5(–6) cm wide, apically acuminate, basally acute, decurrent on the petiole, the midrib slightly depressed above, prominently raised below, pusticulate above, densely lepidote below, the secondary veins 20–30 pairs, the margin flat; petioles marginate, 0.5–1 cm long, densely lepidote. *Staminate inflorescence*: a raceme, rarely a malformed panicle with 2 branches from the base, 1–3 cm long; peduncle 0.1–0.5 cm long; floral bracts membranaceous, ovate, 1.3–1.5(–2.0) mm long, ca. 0.6 mm wide, subglabrous, sparsely lepidote above and densely lepidote below, apically acute, slightly shorter than or as long as the pedicels, entire; pedicels cylindrical, 1.2–2.5 mm long, sparsely lepidote. *Staminate flowers* whitish-green, 4(–5)-merous, membranaceous; calyx cupuliform, 1–1.2 mm long, the tube 0.3–0.6 mm long, the lobes triangular to deltate, 0.6–1 mm long, 0.5–0.7 mm wide, apically attenuate to a rounded tip, sparsely lepidote without, glabrous within, conspicuously brown punctate, the margin entire, sparsely ferrugineous-lepidote; corolla salverform, 2.2–2.6 mm long, the tube 1–1.2 mm long, the lobes ovate to ovate-triangular, 1.2–1.6 mm long, 0.8–1 mm wide, apically rounded or attenuate to a rounded tip, glabrous without, glandular-granulose throughout within, the margin minutely crenulate, glandular-granulose, conspicuously brown punctate; stamens 1.8–2.2 mm long, adnate 1.2–1.5 mm to corolla tube, staminal tube 1.6–1.9 mm long, elobate, longer than the apically free portions of the filaments 0.2–0.3 mm long, the anthers deltate to triangular, slightly distally curved, 0.7–0.8 mm long, 0.5–0.6 mm wide, apically apiculate, basally broadly cordate, the connective inconspicuously brown punctate; pistillode lageniform, 1.0–1.2 mm long, 0.3–0.4 mm wide, the ovary 0.4–0.5 mm long, densely translucent glandular-lepidote near base, the style 0.5–0.6 mm long, the stigma punctiform. *Pistillate* inflorescence as in staminate but pedicel 1.5–2.5 mm long. *Pistillate flowers* as in staminate but calyx 1.0–1.2 mm long, the tube 0.3–0.6 mm long, the lobes deltate, 0.6–1 mm long and wide, corolla, staminodes and pistil unknown. *Fruit* globose, 5–7 mm long, 6–8 mm diam.

Distribution.—Ecuador southward to Bolivia and adjacent Brazil, 400–1,200 m elevation.

Ecology and conservation status.—*Cybianthus comperuvianus* occurs in primary premontane forests on sandstone and limestone, in relatively sparse populations (teste collectore). Therefore, it should be considered threatened.

Etymology.—The specific epithet refers to the fact that *Cybianthus comperuvianus* has long been confused with *C. peruvianus*.

Local name.—Peru: "wewe" (Jívaro); "uchi apikna" (Huambisa); "Cumalilla" (Spanish).

PARATYPES. **ECUADOR. Morona-Santiago:** Sitio La Planada, 01° 46' S, 77° 57' W, 900 m, 21 Sep 1993 (stam. fl), *W. Palacios 11407* (BRIT, MO, QCNE). **PERU. Amazonas:** Near Yucui Entsa, 6 hrs. from Camino de Kusu, 300 m, 11 Mar 1973 (fr), *R. Kayap 558* (MO, NY, USM), (fr), *E. Ancuash 93* (AMAZ, BRIT, F, LL-TEX, MO, NY, US, USM); Quebrada Huampami, Tseasim, near Nayumpim, 244 m, 3 Apr 1973 (fr), *E. Ancuash 141* (AMAZ, F, LL-TEX, MO, US, USM); Quebrada Yutui Entsa, 305 m, 12 Apr 1973 (fr), *E. Ancuash 220* (AMAZ, F, LL-TEX, MO, US); Prov. Bagua, Dtto. Imaza, NE Region of Río Marañon Drainage Basin, Comunidad de Yamayakat, Río Marañon, 04° 55' S, 78° 19' W, 320 m, 8 Aug 1994 (stam. fl), *N. Jaramillo et al. 321* (BRIT, HUT, MO, USM). **Ayacucho:** Tambillo, Toche Colorado, 27 Jul. 1878 (fr), *C. Jelski 360* (PR, W). **Huánuco:** E of Tingo María, 5 Oct. 1972 (stam. fl.), *T. Croat 21194* (F, USM, MO); Agua Blanca, trail to Monzón, 9 Feb 1966 (stam. fl.), *J. Schunke 1049* (AMES, MO, NY, S, USM, VEN); vicinity Rondos, 24 Mar. 1962 (stam. fl.), *J. Schunke 5881* (F, US, USM); Prov. Pachitea, region of Pucallpa, W part of Sirá Mountains and adjacent lowland, 20-24 km SE of Puerto Inca, Campamento Oro, 09° 29' S, 74° 50' W, to Campamento Sirá, 800 m, 17 Jul 1988 (stam. fl), *B. Wallnöfer 12-17788* (BRIT, MO, W, WU), 30 Aug 1988 (fr), *W. Morawetz & B. Wallnöfer 13-30888* (BRIT, W, WU), from Campamento Sirá, 09° 28' S, 74° 47' W, SE to valley of Río Negro, 650 m, 11 Aug 1988 (fr), *W. Morawetz & B. Wallnöfer 113-11888* (BRIT, MO, W, WU). **Junín:** E of Quimirí Bridge, near La Merced, 800–1,300 m, 1 Mar 1929 (stam. fl.), *E. Killip & A. C. Smith 24011* (F, NY, US); La Merced, Hacienda Schunke, 27 Aug–1 Sep 1923 (stam. fl.), *J. Macbride 5677* (F); Pichís Trail, San Nicolás, 1,100 m, 4 Jul 1929 (stam. fl.), *E. Killip & A. C. Smith 26073* (F, NY, US), Sta. Rosa, 625–900 m, 6 Jul 1929 (stam. fl.), *26168* (BM, F, NY, US, USM); Puerto Yessup, 400 m, 10 Jul 1929 (stam. fl.), *E. Killip & A. C. Smith 26286* (NY, US); Puerto Bermudez, 375 m, 14 Jul 1929 (stam. fl.), *E. Killip & A. C. Smith 26464* (NY, US), *26548* (NY, US), *26563* (NY, US). **Pasco:** Prov. Oxapampa, Pichís Valley, San Matias Ridge, 10–12 km SW of Puerto Bermudez, above Sta. Rosa de Chirís, trail to Loma Linda, 10° 20' S, 75° 00' W, 500 m, 29 Sep 1982 (fr), *R. Foster et al. 8962* (F, MO, USM). **Puno:** Below San Gabón on Río San Gabón, 500–1,000 m, 17–24 Jul 1978 (stam. bud), *M. Dillon et al. 1219* (BRIT, F, MO, USM). **San Martín:** Prov. Mariscal Cáceres, Dtto. Tocache Nuevo, Palo Blanco near Fundo de Manuel Aranjo, 700–800 m, 1

Mar 1979 (fr), *J. Schunke 10895* (AMAZ, BRIT, F, MO, NY, US); without specific locality, 1778–1788 (stam. fl.), *Ruíz L. & J. Pavón 5/36* (F, MA). **BOLIVIA. La Paz:** Mapiri Region, 1926 (stam. fl.), *O. Buchtien 1753* (F, GH, HBG, NY, US); Tuiri, near Mapiri, 490–750 m, Sep 1939 (stam. fl.), *B. Krukoff 10930* (A, G, GH, MO, MICH, NY, S, U, UC, US). **Santa Cruz:** Velasco; Parque Nacional Noel Kempff Mercado, Campamento las Gamas, 14° 48' 41" S, 60° 23' 45" W, 850 m, 26 Mar 1993 (fr), *L. Arroyo & K. Keill 164* (BRIT, MO, USZ); Campamento Huanchaca, 13° 54' S, 60° 48' W, 650 m, 17 May 1994 (stam. fl), *L. Arroyo et al. 674* (BRIT, MO, USZ). **BRAZIL. Mato Grosso:** Mpio. Cuiabá, Burity, NE of Cuiabá, 750 m, Jul 1927 (stam. fl.), *B. Collenette 113* (NY); Chapada dos Guimrães, Cachoeira Véu de Noiva, do Rio Coxipozinho, 15° 30' S, 55° 45' W, 21 Oct. 1985 (fr), *J. Pirani 1326* (INPA, MG, NY, SP), 720 m, 16 Oct 1973 (fr), *G. Prance et al. 19075* (AAU, F, INPA, K, MG, NY, K, S, SP, U, US); Sta. Anna da Chapada, 1902 (stam. fl), *G. Malme 2048* (S, UPS), 1903 (fr), *G. Malme 3483* (G, GH, R, S), 1827 (stam. fl.), *L. Riedel 959* (LE, NY, US), 1902 (fr), *A. Robert 322* (BM). **Rondônia:** 1 km NE of Ariquemes, Porto Vehlo-Cuiabá Hwy., 13 Aug 1968 (fr), *E. Forero & L. Wrigley 7035* (MG, MO, NY).

Cybianthus comperuvianus was first recognized as a novelty by Agostini (1972). Despite the fact that over 25 years has past since its first recognition, pistillate flowers are still unknown, reinforcing the concept that within the genus they are ephemeral (Pipoly 1983a, 1992). *Cybianthus comperuvianus* is most closely related to *C. peruvianus* but is easily distinguished by its long pedicels, salverform staminate corolla, and membranaceous leaves.

9. **Cybianthus guyanensis** (A. DC.) Miq. in Mart. subsp. **pseudoicacoreus** (Miq. in Mart.) Pipoly, comb. et stat. nov. (**Fig. 2F**). *Ardisia pseudoicacorea* Miq. in Mart., Fl. Bras. 10:284. 1856. *Conomorpha pseudoicacorea* (Miq. in Mart.) Mez in Engl., Pflanzenr. IV. 236(Heft 9):261. 1902. *Cybianthus pseudoicacoreus* (Miq. in Mart.) G. Agostini, Acta Biol. Venez. 10:155. 1980. TYPE: BRAZIL. Amazonas: In forest near Rio Japurá, Jan 1820 (pist. fl, fr), *C. Martius s.n.* (lectotype, here designated: M; isolectotype: M).

Shrub or tree to 7 m tall. *Branchlets* terete, 2–3 mm diam., densley lepidote. *Leaves* alternate; blades membranaceous to chartaceous, narrowly obovate to elliptic, symmetric, (8–)9–12(–18.5) cm long, 3–4.5(–5.7) cm wide, apically abruptly acuminate to caudate, the acumen 1–2 cm long, basally cuneate, decurrent on the petiole, midrib flat or slightly depressed on the upper surface, prominently raised below, the secondary veins 12–25 pairs, pustulate above, sparsely lepidote below, the margin flat; petioles canaliculate, 0.5–0.8(–1.5) cm long, densely lepidote. *Staminate inflorescence*: a raceme or panicle with 1–2 branches from base, 1–3 cm long; peduncle, rachis and pedicels densely lepidote; peduncle 0.1–0.2 mm long; floral bracts chartaceous, narrowly ovate, longer than the pedicels, 1.3–1.5 mm long, 0.2–0.3 mm wide, apically attenuate, densely lepidote abaxially; pedicels cylindrical, 1–1.2 mm long. *Staminate flowers* 4-merous; calyx carnose, subcupuliform, 1–1.2 mm long, sparsely lepidote without, glabrous within, the tube 0.3–0.4 mm long, the lobes triangular, 0.8–1(–1.2) mm long, 0.5–0.7 mm wide, apically attenuate to a rounded tip, conspicuously brown punctate, the margin lepidote;

corolla carnose, campanulate, 2.8–3.2 mm long, the tube 1.2–1.8 mm long, glabrous, the lobes ovate, 1.3–1.8 mm long, 0.8–1 mm wide, erect to spreading, apically attenuate to a round tip, prominently or conspicously brown punctate, sparsely lepidote without, densely glandular-granulose on the upper half within, the margin entire, glandular-granulose; stamens 2.2–2.6 mm long, the staminal tube conspicuous, carnose, 1.2–1.6 mm long, lobate, the lobes to 0.2 mm long, the apically free portions of the filaments 0.4–0.6(–7) mm long, the anthers triangular, 0.7–0.9 mm long, 0.4–0.5 mm wide, slightly distally recurved, dehiscent by narrow introrse slits, apically attentuate to an apiculate tip, basally cordate, the connective inconspicuously brown punctate; pistillode elongate, conic, 1.2–1.8 mm long, densely translucent glandular-lepidote basally. *Pistillate inflorescence* as in staminate but 1–3 cm long; floral bracts 1–1.3 mm long, ca. 0.2 mm wide; pedicels 0.6–0.9 mm long. *Pistillate flowers* as in staminate but calyx ca. 1 mm long, the tube 0.1–0.2 mm long, the lobes 0.8–1 mm long, 0.4–0.6 mm wide; corolla, staminodes and pistil unknown. *Fruit* subglobose, 4–6 mm long, 5–7 mm diam., exocarp thin, pellucid punctate.

Distribution.—Venezuela, Ecuador, Peru, Amazonian Brazil, and reported here for the first time from Bolivia, from 70–700 m.

Ecology and conservation status.—*Cybianthus guyanensis* subsp. *pseudoicacoreus* inhabits igapó forests of South-Central and Western Amazonia. It occurs in these forests on deep white sands just below the floodline. It is periodically inundated, but not for long periods. Quantitative fieldwork in Peru has shown it occurs in populations of 8–10 individuals > 2.5 cm DBH per hectare.

Etymology.—The subspecific epithet refers to the growth habit of the plant, somewhat reminiscent of *Ardisia* (subgenus *Icacorea*) *guyanensis* (Aublet) Mez.

Representative specimens examined. **ECUADOR**. **Napo:** Cantón Aguarico Reserva Étnica Huaorani, Maxus Oil Hwy., km 60–61, S of Río Tivacuno, 00° 51' S, 76° 26' W, 250 m, 21–25 Oct 1993 (fr), *M. Aulestia & J. Andi 925;* Maxus Petroleum pipeline Rd., km 68, 10 km SW of Río Tivacuno, 00° 49' S, 76° 26' W, 240 m, 13 Dec 1993 (fr), *D. Neill et al. 10303* (BRIT, MO, QCNE). (BRIT, MO, QCNE); Estación Experimental INIAP-Payamino, 5 km NE of Coca, 00° 26' S, 77° 01' W, 250 m, 18–26 Feb 1986 (fr), *W. Palacios et al. 1040* (MO, NY, QAME), (stam. fl), *W. Palacios et al. 1050* (MO, NY, QAME), 00° 25' S, 77° 00' W, 250 m, 29 Nov 1986 (fr), *D. Neill 7494* (MO, QAME); Parque Nacional Yasuní, Lagunas de Garza Cocha, shore of Río Garza, 01° 01' S, 75° 47' W, 200 m, 22 Sep 1997 (fr), *C. Cerón & N. Gallo 5063* (MO, QCNE), trail behind the house, 850 m, 27 Apr 1986 (fr), *J. Jaramillo 8501* (QCA). **PERU**. **Loreto:** Prov. Maynas, Iquitos, *G. Tessmann 3650* (NY), 100 m, 3–11 Aug 1929 (fr), *E. Killip & A. C. Smith 27005* (F, NY, US); Mishuyacu, near Iquitos, 100 m, 1930 (stam. fl), *G. Klug 1412* (F), Feb 1932 (fr), *G. Klug 2565* (F, NY), 24 Sep 1929 (stam. fl), *E. Killip & A. C. Smith 29871*; Dtto. Alto Nanay, trail leading N from N end of Sta. María de Nanay, 5 Mar 1968 (stam. fl.), *D. Simpson & J. Schunke 784* (F, US); Dtto. Indiana, Explorama Lodge, halfway between Indiana and mouth of Río Napo, 03° 28' S, 72° 50' W, 130 m, 26 Jun 1983 (fr), *A. Gentry et al. 42183* (AMAZ, MO), Far end of Bushmaster Trail, 140 m, 5 Jan 1991 (ster.), *A. Gentry et al. 72129* (AMAZ, MO, US, USM), Explorama Lodge, near Yanamono, 25 km NE of Iquitos, 03° 30' S, 72° 50' W, 106 m, 24 Nov 1981 (fr), *R. Vásquez & N. Jaramillo 2703* (AMAZ, MO, US, USM), Perimeter path at southern boundary of reserve, 110 m, 27 Sep 1990 (ster.), *J. Pipoly et al. 12492* (AMAZ, MO, US, USM), 03° 28' S, 72° 52' W, 106 m, 15 Apr 1992 (fl bud), *R. Vásquez & N. Jaramillo 18240* (AMAZ, BRIT, MO,USM); Dtto. Iquitos, Allpahuayo, Estación Experimental del IIAP, 04° 10' S, 73° 30' W, 150–180 m, 3 Nov 1990 (fr), *R. Vásquez & N. Jaramillo 14545* (AMAZ, BRIT, MO, USM)8 Nov 1990 (ster.), *R. Vásquez & N. Jaramillo 15016* (AMAZ, MO, US, USM); Puerto Almendras, 2 Jul 1992 (fr), *R. Rueda & J. Ruíz 597* (AMAZ, BRIT, MO); PuertoAlmendras, Arboretum Colegion Ingenería Forestal UNAP, 03° 48' S, 73° 25' W, 122 m, 4 Sep 1992 (ster.), *C. Grández et al. 4487* (AMAZ, BRIT, MO, USM); Dtto. Las Amazonas, Quebrada Sucusari, 03° 15' S, 72° 55' W, 140 m, 11 Aug 1994 (stam. fl), *R. Ortíz et al. 74* (AMAZ, BRIT, MO, USM); Dtto. Sta. María de Nanay, Mishana, 03° 55' S, 73° 35' W, 90 m, 1 Oct 1990 (ster.), *J. Pipoly et al. 12706* (AMAZ, MO, USM). **Madre de Dios:** Prov. Manu, Cerro de Pantiacolla, Río Palotoa, 10–15 km NNW of Shintuya, 12° 35' S, 71° 18' W, 650–700 m, 13 Dec 1985 (ster.), *R. Foster et al. 10993* (F, NY, USM); Prov. Tambopata, Santuario Nacional Pampas del Heath, Río Heath, 12° 39' 23" S, 68° 44' 13" W, 210 m, 5 Jun 1996 (stam. fl), *M. Aguilar & D. Castro 805* (BRIT, MO, USM). **BOLIVIA. Santa Cruz:** Dtto. Velasco, Parque Nacional Noel Kempff Mercado, Campamento La Torre, 13° 39' 20" S, 60° 49' 08" W, 200 m, 24 Nov 1993 (fr), *L. Arroyo et al. 510* (BRIT, MO, USZ).

Cybianthus guyanensis subsp. *pseudoicacoreus* is one of three subspecies. The species is defined by the autapomorphic contorted anthers of the stamens and staminodes (Pipoly 1992a). The three subspecies may be separated in the following key.

1. Leaf blades symmetric; calyx subcupuliform; corolla chartaceous or carnose, the lobes erect to spreading; apically free portions of the filaments shorter than the anthers; anthers narrowly triangular or ovate-triangular, apically apiculate, dehiscent by narrow, introrse slits.
    2. Petioles canaliculate and winged, (1–)1.5–1.9(–2.3) cm long; staminate peduncle 0.2–0.5 cm long; floral bracts shorter than the pedicels, 0.7–0.8 mm long; pedicels 0.5–1 mm long; corolla chartaceous, 2.3–2.6 mm long, the lobes elliptic; staminal tube 0.9–1.1 mm long; apically free portions of the filaments 0.2–0.4 mm long. .... subsp. **guyanensis**
    2. Petioles canaliculate, 0.5–0.8(–1.5) cm long; staminate peduncle 0.1–0.2 cm long; floral bractslonger than the pedicels, 1.3–1.5 mm long; pedicels 1–1.2 mm long; corolla carnose, 2.8–3.2 mm long, the lobes ovate; staminal tube 1.2–1.6 mm long; apically free portions of the filaments 0.4–0.6 (7) mm long .... subsp. **pseudoicacoreus**
1. Leaf blades asymmetric; calyx cotyliform; corolla membranaceous, the lobes reflexed-recurved; apically free portions of the filaments longer than the anthers; anthers ovate, apically acute, dehiscent by wide, sublatrorse slits. .... subsp. **multipunctatus**

Cybianthus subspecies *multipunctatus* (A. DC.) Pipoly is distributed in eastern Amazonia and the Guianas in premontane forests on lateritic and white sands of the Roraima Superimposed Sediments, while subsp. *guyanensis* is located principally in central Amazonia in igapó forests (Pipoly 1992a). Subspe-

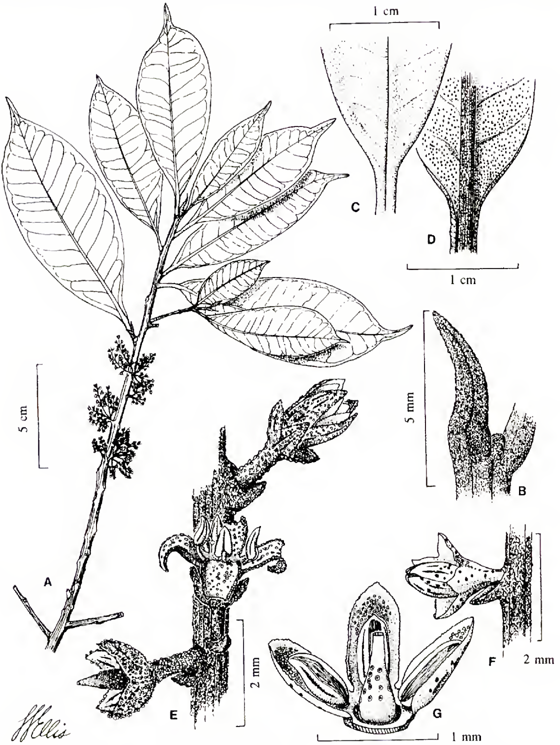

FIG. 13. *Cybianthus timanae* Pipoly. A. Habit, showing paniculate inflorescences. B. Branchlet apex. C. Adaxial leaf surface, showing midrib slightly raised but canaliculate. D. Abaxial leaf surface, showing lepidote scales and prominently raised midrib. E. Section of raceme, showing coriaceous, deltate floral bracts, cotyliform calices, obcordate anthers with distally recurved apiculae. F. Pistillate flower bud. G. Pistillate corolla with one lobe removed, showing lageniform pistil and subsessile antherodes. A–E, drawn from holotype. F–G, drawn from *Timaná 1047*. Figure drawn by Linda Ellis.

cies *pseudoicacoreus* is distributed south-central and western Amazonia, along banks of smaller streams on deep white sands. Subspecies *pseudoicacoreus* and *guyanensis* are sympatric only in central Brazilian Amazonia, and differences in their ecology are not known in sufficient detail. In Ecuador and Peru, subspecies *pseudoicacoreus* may be most easily confused with *C. comperuvianus* Pipoly, but may be recognized by the thicker branchlets, longer floral bracts, and carnose perianth.

10. Cybianthus timanae Pipoly, sp. nov. (**Fig. 13**). Type: PERU. Junín: Prov. Satipo, Gran Pajonal, Mapati, ca. 12 km SW of Chequitavo, 10° 45' S, 74° 23' W, 1,300 m, 7 Apr 1984 (stam. fl), *D. Smith 6782* (holotype: MO; isotypes: BRIT, US, USM).

Propter ramulos graciles angulatos, laminas ellipticas vel oblanceolatas, ad apices acuminatas ad bases acutas, inflorescentiam paniculatam, calycem cotyliformem, necnon tubum staminarem staminodiaremque inconspicuo, *C. occigranatensi* arcte affinis, sed ab ea nerviis secundariis 16–40 (non 8–12)-jugis, perianthiis chartaceis (non coriaceis), corolla cotyliformi (non campanulata), lobis corollinis laevibus (non verrucosis), ad apices acuminatis (nec attenuatis), conspicue (nec incounspicue) atro-punctatis, pistilo lageniformi (nec obnapiformi) perfacile separabilis.

Subshrub to 1 m tall. *Branchlets* angulate, 2–2.5 mm diam., densely lepidote. *Leaves* alternate; blades chartaceous, elliptic to oblanceolate, (8–) 9.5–15(–19) cm long, (2.7–)3–5.5(–6.5) cm wide, apically abruptly acuminate, caudate, the acumen 1–2.2 cm long, basally acute, decurrent on the petiole, smooth and nitid above, pallid and moderately lepidote below, midrib slightly raised and canaliculate above, not decurrent on the petiole, prominently raised below, secondary veins 16–40, brochidodromous, planar to somewhat impressed above, not bullate, the margin flat, entire; petioles canaliculate, (1.3–)1.5–2(–2.2) cm long, glabrous above, densely lepidote below. *Staminate inflorescence*: a panicle of 2–8 racemes branched from base, (3–)4–6(–7) cm long; peduncle 3–7 mm long; rachis densely lepidote; floral bracts coriaceous, deltate, 0.6–0.8 mm long and wide, apically acute, somewhat cucullate, densely lepidote above and below, the margin entire; pedicels cylindrical, 1–2.5 mm long, densely lepidote. *Staminate flowers* 4-merous, cream; calyx chartaceous, cotyliform, 0.7–1 mm long, the tube ca. 0.2–0.3 mm long, the lobes ovate-triangular, 0.5–0.7 mm long, 0.3–0.4 mm wide, apically acute, moderately lepidote, the margin entire, somewhat involute; corolla chartaceous, cotyliform, 2–2.4 mm long, the tube ca. 0.2 mm long, the lobes oblanceolate, 1.8–2.2 mm long, 0.8–1 mm wide, apically subacuminate, sparsely lepidote apically near margin, prominently black punctate and punctate-lineate without, densely glandular-granulose throughout within, the margin glabrous, entire; stamens 1.4–1.6 mm long, the tube conspicuous, chartaceous, 0.1–0.2 mm long, elobate, the apically free portions of the filaments terete, 0.4–0.6 mm long, the anthers obcordate, 0.6–0.7 mm long, 0.3–0.4 mm wide, apically apiculate, anther and apiculum distally recurved, the connective prominently black punctate dorsally; pistillode conic, 1.2–1.4 mm long, 0.3–0.4 mm wide, hollow, densely translucent glandular-lepidote. *Pistillate inflorescence* as in staminate, but (1–)1.5–3 cm long; peduncle 2–4 mm long; floral bracts 0.4–0.6 mm long and wide; pedicels obconic, 0.6–0.9 mm long, sparsely lepidote, conspicuously black punctate. *Pistillate flowers* as in staminate but translucent green; calyx 0.7–0.9 mm long, the tube ca. 0.2 mm long, the lobes 0.5–0.7 mm long, 0.3–0.4 mm wide, sparsely lepidote, corolla 1.2–1.5 mm long, the tube ca. 0.2 mm long, the lobes oblong to oblanceolate, 0.9–1.3 mm long, 0.4–0.6 mm wide, apically obtuse to subacuminate; staminodes 0.6–0.8 mm long, the tube conspicuous, chartaceous, ca. 0.1 mm long, the antherodes subsessile, 0.6–0.7 mm long, 0.3–0.4 mm wide; pistil lageniform, 1.2–1.4 mm long, 0.3–0.4 mm wide, hollow, densely translucent glandular-lepidote, the ovules 2–3, partially immersed on the placenta. *Fruit* slightly depressed-globose, 4.5–5.5 mm long, 5.5–7.5 mm diam., the exocarp thin, black at maturity.

Distribution.—Southeastern Ecuador to Cusco Peru, at 720–1,300 m elevation.

Ecology and conservation status.—*Cybianthus timanae* usually occurs in wet premontane forest on sandstone soils. The restricted distribution of *Cybianthus timanae* indicates it should be considered a threatened species.

Etymology.—The species is named for Martín Timaná de la Flor, former Peruvian Field Associate of the Missouri Botanical Garden, and currently a graduate student at the University of Texas at Austin. Martín is specializing in the systematics of high altitude Caryophyllaceae.

PARATYPES. **ECUADOR. Zamora-Chinchipe:** Nangaritza Cantón; lower slopes of Cordillera del Cóndor, above Pachicutza, Río Nangaritza Valley, 04° 07' S, 78° 38' W, 1,000–1,200 m, 6 Dec 1990 (fr), *D. Neill & W. Palacios 9556* (BRIT, MO, QCNE); Río Nangartiza, Shaime, confluence of Rios Nangaritza and Numpatakaime, 04° 20' S, 78° 40' W, 1,000 m, 7 Dec 1990 (fr), *D. Neill 9602* (BRIT, MO, QCNE); Pachicutza, Rd. to Hito, Cordillera del Cóndor, 04° 07' S, 78° 37' W, 1,000–1,100 m, 19 Oct 1991 (pist. fl bud), *W. Palacios et al. 8346* (BRIT, COL, MO, QCNE), 20 Oct 1991 (stam. fl), *W. Palacios et al. 8407* (BRIT, COL, MO, PORT, QCNE, USM); Parroquia Pachicutza, NE of military camp, 900 m, 6 Dec 1990 (fr), *J. Jaramillo & E. Grijalva 13419* (COL, QCA). **PERU. Cajamarca:** Cutervo National Park, 12 km NE of San Andrés de Cutervo, Transect 3, 06° 10' S, 78° 40' W, 2,230 m, 10 Sep 1991 (ster.), *A. Gentry et al. 74630* (BRIT, MO, USM). **Cusco:** Prov. Quispicanchi, Camanti, Maniri, along trail parallel to Río Maniri to Quebrada Garrote, 13°17'S, 70°48'W, 720 m, 17 Oct 1990 (pist. fl), *M. Timaná 1047* (BRIT, CUZ, MO, US, USM).

Cybianthus timanae is most closely related to *C. occigranatensis* (Cuatrec.) G. Agostini, but may be easily separated by its more numerous secondary veins, chartaceous perianth parts, cotyliform corolla with smooth, conspicuously black punctate, acuminate lobes, and lageniform pistil. The involute calyx lobes and the obconic pedicels of the pistillate flowers are also extremely rare within the subgenus.

FIG. 14. *Cybianthus cuatrecasasii* Pipoly. A. Habit, showing irregularly shaped, basally branched panicles. B. Staminate flower, habit, showing cotyliform calyx, infundibuliform corolla. C. Opened staminate flower, showing inconspicuous staminal tube and lageniform pistillode. D. Opened pistillate flower, showing obnapiform pistil and subsessile antherodes. A–C, drawn from holotype. D, drawn from *A. Gentry et al. 53960*. Figure drawn by Juan Pinzón.

11. Cybianthus cuatrecasasii Pipoly (Fig. 14), Caldasia 18(3):285. 1996. TYPE: COLOMBIA. HUILA: Municipio La Plata, Vereda Agua Bonita, Finca Merenberg, cerca del Cementerio (Jardín Botánico), 22 Abr 1982 (stam. fl) *J. H. Torres 1054* (HOLOTYPE: COL).

Dioecious *tree* to 6 m tall. *Branchlets* narrowly angulate, 3–4 mm diam., densely appressed-lepidote, the scale margins frequently overlapping. *Leaves* alternate; blades chartaceous, elliptic or oblanceolate, 8–20 cm long, 3.5–6.5(–6.9) cm wide, apically acuminate, the acumen (0.5–)1.0–1.5(–2.0) cm long, basally acute, slightly decurrent on the petiole, midrib impressed above, prominently raised below, the secondary veins 26–34 pairs, inconspicuous above, prominently raised below, sparsely lepidote above at first, then pustulate and glabrescent, densely appressed-lepidote below with margins fimbriate and overlapping, the blade margin flat, entire; petioles canaliculate, (1.0)1.3–1.7(–2.0) cm long, densely appressed-lepidote. *Staminate inflorescence:* an irregular panicle with 2–4 basal branches, 4–8 cm long; peduncle, rachis and pedicels densely lepidote; peduncle 0.1–0.4 cm long; floral bracts chartaceous, triangular, subequalling the pedicels, 1.2–1.5 mm long, ca. 0.6 mm wide, apically attentuate, densely lepidote below, the margin entire, glabrous; pedicels cylindric, 1.0–1.5 mm long. *Staminate flowers* 4-merous; calyx carnose, cotyliform, 1.3–1.4 mm long, the tube 0.2–0.4 mm long, the lobes triangular or ovate-triangular, 1.0–1.2 mm long, 0.6–0.9 mm wide, apically attenuate, conspicuously brown punctate, the margin entire, regular, with few scales; corolla chartaceous, infundibuliform, 3.0–3.5 mm long, the tube 1.2–1.3 mm long the lobes ovate, 2.0–2.2 mm long, 1.0–1.2 mm wide, apically rounded, carinate medially, densely lepidote without and along the margins, glandular-granulose toward the apex and along the margins within, inconspicuously brown punctate, the margins regular, entire; stamens 2.5–3 mm long, the staminal tube membranaceous, inconspicuous, 1.2–1.3 mm long, hyaline, elobate, glabrous, the apically distinct filaments adnate to the corolla lobe above the staminal tube 0.3–0.5 mm and apically free 0.1–0.3 mm, glabrous, the anthers ovate, 0.8–1.0 mm long, 0.5–0.6 mm wide, distally reflexed, apically apiculate, the apiculum slightly inflexed, basally cordate, the connective dark, eglandular; pistillode lageniform, 1.6–1.8 mm long, densely glandular-lepidote basally. *Pistillate inflorescence*: as in the staminate except a simple raceme, 4.4–10 cm long; peduncle 0.2–0.5 cm long; floral bracts lanceolate, 1.2–1.5 mm long, 0.3–0.4 mm wide; pedicels 0.7–1.3 mm long, incrassate in fruit. *Pistillate flowers* similar to the staminate except calyx 1.4–1.7 mm long, the tube 0.2–0.4 mm long, the lobes ovate, 1.3–1.5 mm long, 0.6–1.2 mm wide; corolla 3.5–4.0 mm long, the tube 0.9–1.1 mm long, the lobes elliptic, 2.7–3.1 mm long, 0.9–1.3 mm wide, apically acute; staminodes similar to stamens but 3.0–3.2 mm long, the staminodial tube 1.0 mm long, the apically free portion of the filaments adnate to corolla lobes 1.3–1.5 mm and apically free ca. 0.1 mm, the antherodes subdeltate, 0.8–1.1 mm long and wide, (always longer than wide), apically acute, basally sagittate; pistil obnapiform, 1.8–2.0 mm long, the ovary 0.9–1.0 mm long, 1.2–1.5 mm diam., densely translucent glandular-lepidote, the style 0.9–1.1 mm long, the stigma bilobate, not capitate, the placenta deeply cupuliform, the ovules 2, deeply embedded in the placenta below apical pores. *Fruit* drupaceous, depressed-globose, 4–6 mm long, 6–8 mm diám., the endocarp smooth, the embryo erect, 3 mm long.

Distribution.—Cybianthus cuatrecasasii occurs in the Western Cordillera of Colombia in the Department of Antioquia, in the Central Cordillera near the Macizo Colombiano, in the Departments of Huila and Cauca, and in the Western Cordillera of adjacent Ecuador, with disjunct populations in the Province of Santiago-Zamora, and Zamora-Chinchipe, Ecuador, from (1,200–)1,960–2,850 m elevation.

Ecology and conservation status.—Cybianthus cuatrecasasii occurs along the margins of primary cloud forests and along small watercourses. The population from Antioquia, Colombia is rare because it is from premontane pluvial forest, and has leaves much shorter than normal. Because it is known only from primary forests, it should be considered threatened.

Etymology.—This species is named to honor the late José Cuatrecasas, prodigious field botanist, monographer of many plant families, and ardent student of the Colombian flora. Don José freely offered his advice and assistance to all who asked, despite his limited time and numerous projects.

Specimens examined. **COLOMBIA**. **Antioquia:** Mpio. San Luís, Piedra de Castrillón, 3–4 hours by foot S of town, 06° 01' N, 75° 01' W, 1,500–1,700 m, 8 May 1989 (fl bud), *D. Daly et al. 5926* (HUA, MO, NY, US). **Huila:** Cordillera Central, E slope, Finca Merenberg, km 101 of La Plata-Popayán Rd., 13 km E of Sta. Letícia, 02° 15' N, 76° 12' W, 2,300 m, 24 Mar 1986 (fl bud), *B. Stein 3721* (BRIT, MO); Cordillera entre cuencas de los ríos Guarapas y Guachicas, arriba de Palestina, al SW de Pitalito, 2,000–2,300 m, 6 Feb 1943 (stam. fl), *F.R. Fosberg 19969* (NY, US); Finca Merenberg, E de Volcán Puracé, cerca de la zona limítrofe con Cauca, 02° 26' N, 76° 12' W, 2,300 m, 1 Apr 1986 (bud), *A. Gentry et al. 53881* (COL, MO, US), 3 Apr 1986 (pist. fl, fr), *A. Gentry et al. 53960* (COL, MO, US); 15 km NE de Algeciras, cerca del Campamento La Gironda, 2,400–2,850 m, 26 Mar 1944 (stam. fl) *E. Little 7481* (COL, NY, US); Mpio. San José de Isnos, Vereda El Hornito, 1,960–2,000 m, 23 Jul 1980 (stam. fl), *G. Lozano 3366* (COL); Mpio. La Argentina, arriba de Finca Palmira, 2,100 m, 26 Sep 1984 (fl bud), *G. Lozano et al. 4133* (COL). **Cauca:** Moscopán, margen del Río San José, La Chorrera de Candelaria, 2,100–2,350 m, 1 Feb 1947 (fr), *J. Cuatrecasas 23583* (COL, F, NY, US); Cuenca del Río La Plata, 43 km SE de Popayán, 2,160 m, 26 Nov 1944 (stam. fl), *F.R. Fosberg 22376* (NY, US). **ECUADOR**. **Santiago-Zamora:** along Quebrada Honda, vicinity of Rancho Achupallas, 2,500–2,700 m, 10 Oct 1943 (stam. fl), *J. Steyermark 54552* (NY). **Zamora-Chinchipe:** Hill ca. 2 km downstream from Campamento Shaime along Río Nangaritza, 900 m, 15 Feb 1994 (fr), *H. van der Werff 13074* (BRIT, MO, QCNE).

Cybianthus cuatrescasasii is unique within subgenus *Conomorpha* because of its infundibuliform corolla and subapical portions of the filaments adnate to the corolla lobe. The overlapping covering scales of the abaxial leaf surface, branchlets and inflorescence rachis is found otherwise only in *Cybianthus crotonoides* (Mez) G. Agostini, a species endemic to the Guayana Highland. This species has been confused with *Cybianthus peruvianus* (Mez) G. Agostini, but is easily separated from it by the infundibuliform corolla, long pedicels and eglandular connectives. *Cybianthus cuatrecasasii* is closely related to *C. laetus* (Mez) G. Agostini and *C. occigranatensis* (Cuatrec.) G. Agostini, from which it is easily distinguished by its infundibuliform corolla, apical portions of the filaments adnate to the corolla and lack of lobes on the staminal and staminodial tubes.

III. Cybianthus subgenus **Laxiflorus** G. Agostini, Acta Biol. Venez. 10:144. 1980; Pipoly, Brittonia 35:61–80. 1983. *Conomorpha* section *Conomorphida* Miq., Stirp. Surinam Select. 111. 1851, *pro parte*. *Conomorpha* subgenus *Euconomorpha* Mez in Engl., Pflanzenr. IV. 236(Heft 9):254. 1902. *pro parte minore*. TYPE SPECIES. *Conomorpha laxiflora* (Mart.) A. DC. = *Cybianthus spicatus* (H. B. K.) G. Agostini. (LECTOTYPE: by Agostini, Acta Biol. Venez. 10:144. 1980).

Terrestrial dioecious *shrubs or small trees*. *Roots* positively geotropic. *Trunk* distinguishable, leptocaulous, the growth dynamics following Rauh's Architectural Model (Hallé et al. 1978). *Branchlets* tomentose, with dendroid or stellate ferrugineous trichomes or both. *Cataphylls* and pseudocataphylls absent. *Leaves* alternate, petiolate, tomentose, glabrescent. *Inflorescence* a simple raceme or rarely a spike, the peduncle 0.1–0.5 cm long, the staminate rachis tortuous or lax, the pistillate rigid and erect or rarely lax. *Flowers* 4- or 5-merous; calyx cotyliform, valvate, epunctate, inconspicuously pellucid or conspicuously brown or orange punctate, glabrous, tomentose, or glandular-granulose, rarely bearing translucent glandular scales, the margins glandular-ciliate; corolla campanulate, the lobes valvate, glandular-granulose only along margins without, but over the entire surface within, epunctate or inconspicuously pellucid or conspicuously brown or orange punctate, and punctate-lineate, medially and basally glabrous, glandular-granulose or with a few stellate trichomes; stamens and staminodes with filaments basally connate into a conspicuous or inconspicuous tube, the tube elobate or bearing small lobes alternate with the apically free filaments, the anthers elongate, triangular, distally curved, rarely erect, dorsifixed 1/4–1/2 from base, apically acute, basally cordate, dehiscent by wide longitudinal slits; staminodes resembling stamens but reduced in size, the sterile anthers without pollen or at times producing abortive pollen; pistil obnapiform, the ovary translucent glandular-lepidote, the style short, truncate with a punctiform stigma; pistillode lageniform, the ovary translucent glandular-lepidote, hollow the style elongate and curved apically, the nonfunctional stigma capitate. *Fruit* drupaceous, one-seeded, the exocarp thin.

Cybianthus subgenus *Laxiflorus* contains 6 species, 3 of which have been recorded from Peru. To date, none are known from Ecuador, but we may expect *Cybianthus spicatus* (Kunth) G. Agostini in sandstone areas in the Cordillera del Cóndor area.

KEY TO SPECIES OF *CYBIANTHUS* SUBGENUS *LAXIFLORUS*

1. Inflorescence rachis black punctate; calyx lobes coriaceous, deltate, medially carinate, basally rugose; fruit depressed-globose, broader than long; large trees to 18 m tall, *terra firme* "varillal seco" [dry, on white sand] forests. .... **12. C. nestorii**
1. Inflorescence rachis epunctate; calyx lobes chartaceous, widely to narrowly ovate-triangular, medially thicked but flat; basally smooth; fruit globose, as broad as long; shrubs or small trees to 10(–12) m tall; riparian gallery forests, either periodically flooded (várzea or igapó) or "varillal húmedo" [wet, white or brown sand] forests.
    2. Leaf blades chartaceous, the tertiary veins prominently raised above; calyx lobes longer than broad; staminal and staminodial tubes inconspicuous; receptacle or pedicel or both enlgarged in fruit; seasonally inundated forests (várzea or igapó) .... **13. C. spicatus**
    2. Leaf blades coriaceous, the tertiary veins not visible from above; calyx lobes broader than long; staminal and staminodial tubes conspicuous; neither receptacle nor pedicel enlarged in fruit; forests with poor drainage on sand, but non-inundating, ("varillal húmedo") .... **14. C. fulvopulverulentus subsp. magnoliifolius**

12. Cybianthus nestorii Pipoly, sp. nov. (**Fig. 15**). TYPE: PERU. LORETO: Prov. Maynas, Mishana, on Río Nanay, 03° 55' S, 73° 35' W, 150 m, 20 Jan 1985, *R. Vásquez & N. Jaramillo 6122* (HOLOTYPE: MO; ISOTYPES: AMAZ, F, NY, US, USM).

Ob folia coriacea, rhachides inflorescentiares atro-punctato-lineatos, lobis calycinis deltatos inter se aequilatos coriaceosque, *C. deltato* valde arcte affinis sed ab ea habitu arboreo (non fruticoso) usque ad 18 (non 3) m, laminis anguste ellipticis vel anguste oblanceolatis vel anguste oblongis (non obovatis) 9.5–18(–28), (nec 3.2–4.4) cm longis, 3.2–4.6 (nec 1.7–2.8) cm latis, inflorescentiis 5–7 (non 1–4.2) cm longis, lobis calycinis 1.8–2 (non 1.3–1.7) mm longis, carinatisque (nec planisque) denique secus marginem minute erosis (nec undulatis), statim separabilis.

Tree to 18 m tall. *Branchlets* terete, 5–7(–15) mm diam., appressed ferrugineous dendroid tomentose. *Leaves* alternate; blades thinly coriaceous, narrowly elliptic to narrowly oblanceolate, rarely narrowly oblong, (9.5–) 11.5–14(–18) cm long, (3.2–)4–6 cm wide, apically obtuse, emarginate, rounded or acute, basally acute to attenuate, decurrent on the petiole, glabrous and nitid above, glabrous and nitid but pallid below, midrib slightly raised above, prominently raised below, decurrent through length of petiole above and below, the secondary veins (14–)20–47 pairs, prominulous (slightly raised) above and below, inconspicuously pellucid punctate and punctate lineate below, the margin entire, glabrous, revolute; petioles marginate, (2.2–)2.5–3.2(–3.7) cm long, glabrous. *Staminate inflorescence*: unknown. *Pistillate inflorescence*: an erect raceme, 5–7 cm long, the rachis black punctate-lineate, ferrugineous glandular-granulose, glabrescent; floral bracts coriaceous, linear, minute, 1–1.1 mm long, 0.2–0.3 mm wide, apically acute, densely glandular-granulose below, glabrescent, the margin glandular-cili-

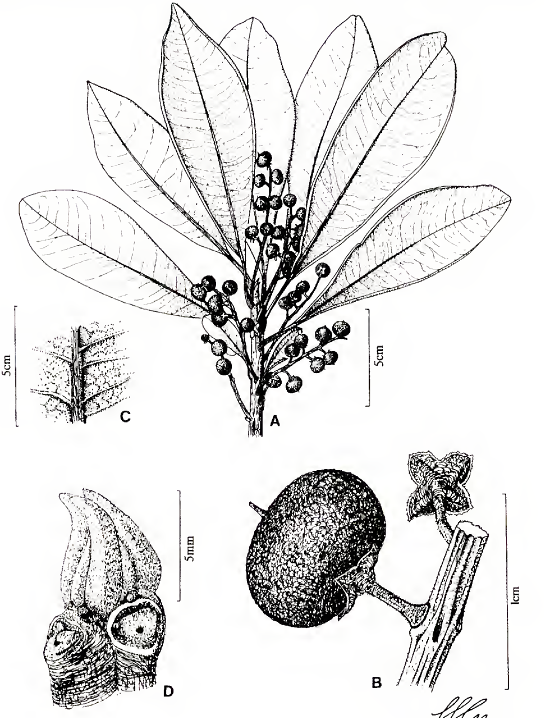

FIG. 15. *Cybianthus nestorii* Pipoly. A. Habit, showing depressed-globose fruits and leaf blades with prominulous secondary veins and revolute margins. B. Portion of infructescence, showing depressed-globose fruit and carinate, rugose calyx lobes with erose, sparsely glandular-ciliolate margins. C. Abaxial leaf surface, showing prominently raised midrib and prominulous secondary veins. D. Branchlet apex, showing appressed dendroid tomentum. A–D, drawn from holotype, by Linda Ellis.

ate; fruiting pedicels cylindrical, 2–4 mm long, densely glandular-granulose, minutely black punctate apically. *Pistillate flowers* unknown; fruiting calyx coriaceous, 1.8–2 mm long, the tube 0.3–0.5 mm long, the lobes deltate, 1.3–1.6 mm long, 1.4–1.7 mm wide, apically acute, medially carintae, rugose basally, the margin minutely erose, sparsely glandular-ciliolate; corolla, staminodes and pistil unknown. *Fruit* depressed-globose, 4–6 mm long, 6–8 mm diam., black at maturity, inconspicuously pellucid punctate.

Distribution.—Known only from the Río Nanay Drainage Basin, Maynas Province, Department of Loreto, Peru, at 150 m elevation.

Ecology and conservation status.—*Cybianthus nestorii* occurs in "varillal seco" habitats, consisting of tall *terra firme* (non-inudating), relatively dry forest on deep white sands. It is a rare species and thus, should be considered threatened.

Etymology.—It is a pleasure to dedicate this species to Nestor Jaramillo, of Iquitos, Peru, prodigious collector, and authority on plant collecting in tropical forests. Nestor, with his supervisor, Rodolfo Vásquez, form one of the most formidable botanical exploration teams in South American botany.

Paratypes: **PERU. Loreto:** Prov. Maynas, Dtto. Iquitos, Puerto Almendras, UNAP, Tree No. 324, Tree inventory, 03° 48' S, 73° 25' W, 122 m, 17 Jan 1993 (ster.), *C. Grández, N. Jaramillo et al. 5321* (BRIT, MO, UNAP), Tree No. 373 (ster.), *C. Grández, N. Jaramillo et al. 5370* (BRIT, MO, UNAP, USM); Tree No. 651 (ster.), *C. Grández, N. Jaramillo et al. 5642* (BRIT, MO, UNAP).

Cybianthus nestorii is unique within the subgenus because of its autapomorphic depressed-globose fruits and carinate calyx lobes. Other characters which readily seaparate it from its closest relative, *Cybianthus deltatus* Pipoly, of the Río Guainía drainage basin of Venezuela, include its much larger arborescent habit, larger elliptic to narrowly oblanceolate leaves, longer inflorescences, and longer, minutely erose calyx lobes.

13. **Cybianthus spicatus** (Kunth) G. Agostini (**Fig. 3B**), Acta Biol. Venez. 10:146. 1980. *Myrsine spicata* Kunth in H.B.K., Nov. Gen. Sp. 3:250. 1818. *Conomorpha spicata* (Kunth) Mez in Engl., Pflanzenr. IV. 236(Heft 9):259. 1902. Type: VENEZUELA. Territorio Federal Amazonas: In inundated area along the Río Atabapo, without date (stam. fl), *A. von Humboldt & A. Bonpland 1096* (holotype: P-BON; isotype: B-destr.).

Wallenia laxiflora Mart., Nov. Gen. Sp. Pl. 3:89. 1829. *Conomorpha laxiflora* (Mart.) A. DC., Trans. Linn. Soc. London, Bot. 17:102. 1834. Type: BRAZIL. Amazonas: Prov. Rio Negro, "In sylvis Japurensibus," Jan 1826 (stam. fl), *C. Martius s.n.* (lectotype by Pipoly 1983b: M; isolectotype: CGE).

Conomorpha laxiflora var. *longifolia* Miq. in Mart., Fl. Bras. 10:302. 1856. Type: BRAZIL. Amazonas: Prov. Rio Negro, vicinity Barra [Manaos], Dec–Mar 1850–51 (stam. fl), *R. Spruce 1040* (lectotype, here designated: M; isolectotypes, CGE, GH, GOET, K, LD, LE, OXF, U).

Conomorpha laxiflora var. *latifolia* Miq. in Mart., Fl. Bras. 10:303. 1856. *Conomorpha latifolia* (Miq. in Mart.) Mez in Engl., Pflanzenr. IV. 236(Heft 9):255. 1902. Type: VENEZUELA.

[GUYANA]. 1839 (stam. fl), *R. Schomburgk 1002* (LECTOTYPE by Pipoly 1983b: G; ISOLECTOTYPE: CGE).

Conomorpha candolleana Mez in Engl., Pflanzenr. IV. 236(Heft 9): 256. 1902. TYPE: VENEZUELA. [GUYANA]. 1840 (stam. fl), *R. Schomburgk 885* (HOLOTYPE: B-destroyed; fragment at F; LECTOTYPE, here designated: G; ISOLECTOTYPES: CGE, GH, K-2 sheets, US, W).

Conomorpha grandiflora Mez in Engl., Pflanzenr. IV. 236(Heft 9):258. 1902. TYPE: BRAZIL.AMAZONAS: Rio Negro, above Moureira, Dec 1851 (stam. fl.), *R. Spruce 1946* (HOLOTYPE: B- destroyed; LECTOTYPE, here designated: K; ISOLECTOTYPES: CGE, GH, GOET, LD, LE, NY, OXF).

Conomorpha glaucorubens Mez in Engl., Pflanzenr. IV. 236(Heft 9):260. 1902. TYPE: BRAZIL. AMAZONAS: Rio Negro, about 00° 30' S, 64° 00' W, 24 Jun 1874 (stam. fl), *J. Trail 508* (HOLOTYPE: K).

Conomorpha madeirensis A.C. Smith, J. Arnold Arbor. 20:300. 1931. TYPE: BRAZIL. AMAZONAS: Municipality of Humaytá, between Monte Cristo and Sta. Victoria on Rio Ipixuna, 15–17 Nov 1934 (stam. fl), *B. Krukoff 7240* (HOLOTYPE: NY; ISOTYPES: A, F, M, MAD-Y, MICH, MO, S, US).

Conomorpha gracilis A.C. Smith, Bull. Torrey Bot. Club 67:295. 1940. TYPE: GUYANA. Arubaru River, Kako Territory, Upper Mazaruni drainage, 600 m, 2 Feb 1939 (stam. fl), *A. Pinkus 181* (HOLOTYPE: NY; ISOTYPES: BR, F, GH, M, MO, NY, S, US).

Shrub or small tree to 12 m tall. *Branchlets* thin to moderately thick, (3.5–)4–8(–20) mm diam., appressed to floccose-dendroid and stellate ferruginеous tomentose, the stellate hairs often appearing furfuraceous, glabrescent. *Leaves* alternate; blades thinly coriaceous to chartaceous, to membranaceous, ovate, elliptic, obovate or rarely oblanceolate, (4.5–)6–17.5(–21) cm long, 2.9–8(–11.5) cm wide, apically acute, rounded, obtuse or rarely emarginate, basally acute to cuneate, glabrous, pustulate and often nitid above, sparsely ferruginеous puberulent and minutely glandular-lepidote below, the midrib, secondary and tertiary veins prominently raised above and below, the midrib decurrent to the base of the petiole, pellucid or black punctations obscure below, the margin slightly revolute, entire; petioles distinctly marginate, (1–)1.5–3.2(–4) cm long, stellate and dendroid ferruginеous tomentose, early glabrescent. *Staminate inflorescence*: a simple raceme, lax, (3–)6–9(–12.5) cm long, the rachis epunctate, glandular-granulose with scattered stellate and dendroid ferruginеous trichomes, glabrate; floral bracts chartaceous, linear-lanceolate, 0.7–1.7(–2.2) mm long, densely ferruginеous tomentose, early caducous; pedicels cylindrical, 0.9–2.1(–3) mm long, glabrous to densely glandular-granulose. *Staminate flowers* (4–)5-merous, chartaceous, cream to yellow, with a sweet odor; calyx shallowly cotyliform, 1.5–2.5 mm long, the tube 0.3–0.6 mm long, glandular-granulose at first, glabrescent, the lobes ovate or ovate-triangular, (1.2–)1.4–2 mm long, 0.9–1.3 mm wide, acute to abruptly acuminate apically, somewhat cordate basally, prominently thickened medially, conspicuously punctate, the margins mostly entire, but occasionally erose apically, glandular-ciliate; corolla campanulate, 3.6–4.8 mm long, the tube 1–1.2 mm long, the lobes ovate, 2.1–3.4 mm long, 1.2–

2.6 mm wide, slightly reflexed at anthesis, obtuse to acute apically, epunctate or conspicuously brown punctate; stamens 1.6–2.2 mm long, the tube membranaceous, inconspicuous, 1–1.5 mm long, the apically free portions of the filaments 0.3–0.55 mm long, the anthers elongate-triangular, 0.7–1.2 mm long, 0.2–0.3 mm wide, dorsifixed ca. 1/3 from base, apically acute, basally cordate, distally recurved, the connective inconspicuously brown punctate; pistillode lageniform, 1.3–1.8 mm long, the ovary 0.6–0.9 mm long, 0.5–0.75 mm diam., densely translucent glandular-lepidote, the style elongate, 0.8–1.3 mm long, slightly curved apically, the stigma capitate, 0.1–0.2 mm long. *Pistillate inflorescence* as in staminate, erect, (3.3–)4.5–13(–17.5) cm long; floral bracts 0.5–2.4 mm long; pedicels 1.3–1.8 mm long, accrescent in fruit to 3.1 mm long, the receptacle or pedicel or both incrassate in fruit. *Pistillate flowers* as in staminate but chartaceous, yellow; calyx cotyliform, 1.3–1.9 mm long, the tube 0.6–0.9 mm long, the lobes widely to narrowly ovate, 1.1–1.7 mm long, 0.9–1.5 mm wide, erect, sparsely brown punctate, prominently thickened below, the margins entire or occasionally erose apically; corolla 2.7–3.5 mm long, the tube 0.7–0.9 mm long, the lobes 1.6–2.7 mm long; staminodes as in stamens but 1.6–2.1 mm long, the tube chartaceous, conspicuous, 0.7–1.1 mm long, the apically free portions of the filaments 0.3–0.5 mm long, the antherodes 0.6–0.9 mm long, 0.2–0.3 mm wide, at times producing abortive pollen; pistil obnapiform, 1.6–2.2 mm long, the ovary 0.8–1.2 mm long, 0.9–1.2 mm diam., densely translucent glandular-lepidote, the placenta cupuliform, ovules 4, partially imbedded, the stigma capitate, 0.1–0.2 mm long. *Fruit* globose, 2.5–6 mm long and in diam., prominently black punctate-lineate, with a few persistent lepidote glandular scales below the usually persistent style base, green then purple, then black.

Distribution.—Venezuela, Colombia, Peru, Brazil and Guyana, in inundated forests (várzea and igapó), from 100–400 m.

Ecology and conservation status.—*Cybianthus spicatus* is restricted to primary riparian habitats on white sandy soils. It is common in igapó and várzea, but the latter only when sufficient quantities of sand exist, a mixed várzea type. While it is a widespread species, it is sensitive to soil compaction, and should be considered threatened.

Etymology.—The epithet refers to the inflorescence shape, which is a raceme bearing flowers on short pedicels, thus appearing spicate.

Representative specimens examined. **PERU**. **Huánuco**: Cerros del Sirá, SW slope of the Río Lulla Pichís, 1190 m, 12 Jul. 1969 (fr), *J. Wolffe 12295* (F, NA); 100 m, 22 Jul 1969 (fr), *T. Dudley 13124* (F, NA); Prov. Pachitea, region of Pucallpa, W part of Sirá Mountains and adjacent lowland, ca 24 km SE to 26 km ESE of Puerto Inca, next to Campamento Pato Rojo, 09° 27' S, 74° 46' W, 1,000 m, 27 Jan 1988 (pist. fl), *W. Morawetz & B. Wallnöfer 12-27188* (BRIT, MO, W, WU), 1,320 m, 1 May 1988 (fr), *B. Wallnöfer 111-1588* (BRIT, W, WU), 1,230 m, 13 Jun 1988 (fr), *B. Wallnöfer 112-13688* (BRIT, W, WU). **San Martín**:

Lamas, on old trail from San Antonio de Cumbasa, S of Shapajilla, upper slopes of Cerro Isco, 06° 22' S, 76° 23' W, 600–800 m, 5 Oct 1986 (bud), *S. Knapp et al. 8514*, (fr), *S. Knapp et al. 8517* (MO, US, USM).

Cybianthus spicatus is a polymorphic ochlospecies, sensu White (1962), Prance (1972) and Pipoly (1983a), with many semi-isolated populations throughout the Amazon and eastern Guayana Floristic Province (Maguire 1979). These localized populations have produced several seemingly distinct ecotypes, resulting in overdescription. Collections of *Cybianthus spicatus* from Peru match the type of *Conomorpha gracilis* A. C. Smith, described from Guyana, in every detail. Fieldwork conducted in Guyana, Venezuela, Brazil and Peru since my earlier treatment (Pipoly 1983a), where I discuss the four ecotypes present within the species, and the synonymy rationale, has confirmed the concept that *Cybianthus spicatus* is a polymorphic ochlospecies.

Steyermark (1981) discussed the fact that Richard Schomburgk's collections attributed to Guyana are now known to be from Venezuela.

14. **Cybianthus fulvopulverulentus** (Mez) G. Agostini subsp. **magnoliifolius** (Mez) Pipoly (**Fig. 3A**), Brittonia 35:72. 1983. *Conomorpha magnoliifolia* Mez in Engl., Pflanzenr. IV. 236(Heft 9):258. 1902. *Cybianthus magnoliifolius* (Mez) G. Agostini, Acta Biol. Venez. 10:146. 1980. TYPE: SURINAME. without locality, (stam. fl), *H. Kegel 244* (LECTOTYPE by Pipoly 1983a: GOET).

Conomorpha rigida Mez, Repert. Spec. Nov. Regni Veg. 16:420. 1920. syn. nov. TYPE: BRAZIL. AMAZONAS: "Hylaea," without date (fr), *E. Ule 8722* (HOLOTYPE: B-destr., F Neg. 4831). Despite searches of herbaria housing significant Ule collections, no duplicates of the type have been located. Therefore, I select a neotype herewith: TYPE: GUYANA [BRITISH GUIANA]. Orealla Savanna, Corentyne River, Sep 1879 (fr), *E. Imthurn B/9* (NEOTYPE here designated: K; ISONEOTYPE: BRG). The neotype was annotated by Mez in 1901, but was not mentioned in the protologue.

Shrub or tree to 10 m tall. *Branchlets* mostly thick, (3–)5.2–12 mm diam., glabrate or densely stellate and dendroid ferrugineous tomentose and glandular-granulose, at times glabrescent. *Leaves* alternate, at times clustered and approaching pseudoverticillate; blades coriaceous, elliptic, oblanceolate, ovate or obovate, 7.2–21.7 cm long, (2.2–)3.6–9.5(–17.1) cm wide, apically obtuse, acute, rounded or emarginate, basally obtuse to acute (rarely acuminate), sparsely pitted with superimposed glandular lepidote scales and glabrous or glandular-granulose, at times sparsely ferrugineous tomentose above and below, glabrescent, epunctate, the margin entire and revolute; petioles marginate, (1.3–)1.6–4.2(–4.6) cm long, ferrugineous tomentose, and glandular-granulose, glabrescent. *Staminate inflorescence*: a simple, tortuous raceme, rarely lax, (3.6–)4.5–15 cm long, the rachis maroon, opaque, glandular-granulose or with a few scattered dendroid ferrugineous trichomes, glabrescent; floral bracts chartaceous, linear-lanceolate, 0.8–3.6 mm long, ca. 0.1–0.2 mm wide, densely ferrugineous tomentose, caducous; pedicels cylindrical, (0.2–)2.9–3.6 mm long, densely glandular-granulose, glabrescent. *Staminate flowers* 4- or 5-merous, chartaceous, white, cream or yellow; calyx deeply cotyliform, 0.9–2.6 mm long, densely glandular-granulose then glabrescent, the tube 0.3–0.7 mm long, unequally divided, the lobes chartaceous, ovate to ovate-triangular, 0.6–1.9 mm long, 1.1–2.4 mm wide, obtuse to acute or acuminate apically, prominently orange punctate, densely ferrugineous tomentose and ferrugineous glandular-granulose or partially glabrescent or ferrugineous glandular-granulose and then sometimes totally glabrescent, the margins extremely undulate, entire, densely glandular-ciliate; corolla campanulate, (2.8–)3.3–4.7(–5.5) mm long, the tube (0.6–)0.9–1.4(–1.7) mm long, the lobes ovate, (2–)2.2–3.1(–4) mm long, (1.2–)1.5–2.4(–2.8) mm wide, the lobes highly reflexed at anthesis, obtuse to acute apically, conspicously orange punctate and punctate-lineate, at times scattered ferrugineous trichomes before anthesis without, the margin entire; stamens (2.4–)2.8–3.4 (–3.8) mm long, the staminal tube 0.8–1.1 mm long, the apically free portions of the filaments 0.6–0.9 mm long, the anthers elongate-triangular, (0.8–)1–1.4 mm long, apically acute, basally cordate, dorsifixed ca. 1/4 from base, distally recurved or rarely and aberrantly erect; pistillode (1.6–)1.9–2.5 mm long, the ovary 0.7–1.1 mm long, 0.7–1.2(–1.4) mm diam., densely translucent glandular-lepidote, the style elongate, curved, 1–1.6 mm long, the stigma 0.1–0.2 mm long. *Pistillate inflorescence* as in staminate but erect (3–)4–11.4 cm long, the rachis green then red; floral bracts 0.7–2.9 mm long, ca. 0.1–0.2 mm wide; pedicels cylindrical, (0.2–)0.6–1.5(–2) mm long. *Pistillate flowers* as in staminate but dull yellow to brown; calyx 1.2–2.6 mm long, the tube 0.4–0.7(–1) mm long, the lobes 0.7–2 mm long, 1.3–2.4 mm wide; corolla (2.7–)3.2–3.5(–4) mm long, the tube 0.6–1.2 mm long, the lobes 2–2.3(–2.6) mm long, 1.1–1.5 mm wide; staminodes as in stamens but 2.4–2.9 mm long, the staminodial tube 0.7–0.9 mm long, the apically free portions of the filaments 0.7 mm long, the antherodes triangular, 0.6–0.9 mm long; pistil obnapiform, 1.9–2.5(–3) mm long, the ovary (0.7–)0.9–1.6 mm long, (0.7–)1.3–1.7(–2.2) mm diam., densely translucent glandular-lepidote, the style thick, (0.4–)0.6–0.9(–1.3) mm long, the stigma pseudocapitate, very minutely 4-lobed, up to 0.3 mm long. *Fruit* globose, 3–9 mm long and in diam., green, then red, then black, inconspicuously pellucid punctate.

Distribution.—Venezuela, Guyana, Surinam, French Guiana, Brazil (Amazonas, Roraima, Pará, Mato Grosso) and reported here for the first time from Peru and Bolivia 50–500(–850) m.

Ecology and conservation status.—*Cybianthus fulvopulverulentus* subsp. *magnoliifolius* is extremely common in wet tepuí savannas, but is rare in Peru in varillal húmedo (wet sandy, non-inundating) habitats. It is anticipated, but has not yet been collected, in Ecuador.

Etymology.—The epithet, 'fulvopulverulentus' refers to the rusty tomentum of the species, forming a powdery like vestiture on the adaxial leaf surface, caducous as the leaf matures. The subspecific epithet refers to the shape and shiny adaxial leaf surface, giving the general impression of a *Magnolia* leaf.

Specimens examined. **PERU. Loreto:** Prov. Maynas, Iquitos, Nina rumi-Río Nanay, 03° 48' S, 73° 25' W, 122 m, 5 Mar 1987 (bud), *R. Vásquez et al. 8905* (AMAZ, MO, US, USM). **BOLIVIA. Santa Cruz:** Prov. Velasco, Parque Nacional Noel Kempff Mercado, Campamento Huanchaca I, 3.35 km from Río Pauserna, 13° 56' 01" S, 60° 49' 30" W, 600 m, 22 May 1994 (fr), *L. Arroyo et al. 738* (BRIT, MO, USZ), 26 Jul 1995 (pist. fl), *T. Killeen et al. 7528* (BRIT, MO, USZ), (stam. fl), *T. Killeen et al. 7530* (BRIT, MO, USZ), 850 m, 3 Nov 1995 (fr), *A. Rodríguez & J. Surubí 669* (BRIT, MO, USZ).

Specimens cited here are the first known from Peru and Bolivia. Those collections represent remarkable disjunctions, the closest population known heretofore occurring approximately one degree north of the Rio Negro in southern Venezuela near the Brazilian frontier, or halfway across Brazil to the east, on Serra do Cachimbo, state of Mato Grosso. To date, no specimens are known from Ecuador.

In my previous treatment (Pipoly 1983a), I included *Conomorpha rigida* in the synonymy of *Cybianthus fulvopulverulentus* (Mez) G. Agostini subsp. *fulvopulverulentus*. The type at Berlin had been destroyed and I synonymized it based on the description and photo. However, the discovery of two duplicates of the Imthurn gathering annotated by Mez permitted neotypification of the name with the Kew specimen and its inclusion here. Populations represented by this collection differ from the type of subspecies *magnoliifolius* only in their diminutive stature and vegetative parts.

IV. Cybianthus subgenus **Comomyrsine** (Hook. f.) G. Agostini, Acta Biol. Venez. 10:162 1980. *Comomyrsine* Hook. f. *in* Benth. & Hook., Gen. Pl. 2:643. 1876; *Weigeltia* A. DC. subgenus *Comomyrsine* (Hook. f.) Mez *in* Engl., Pflanzenr. IV. 236(Heft 9):290. 1902. Pax *in* Engl. & Prantl, Nat. Pflanzenfam. IV, 1:92. 1897; J.F. Macbr., Field Mus. Nat. Hist., Bot. Ser. 13 (5, 1):175. 1959. TYPE SPECIES: *Cybianthus sprucei* (Hook. f.) G. Agostini (LECTOTYPE: by D'Arcy, Ann. Missouri Bot. Gard. 60:445. 1973.)

Terrestrial, erect, monoaxial *subshrubs or treelets* to 2(–5) m tall. *Roots* positively geotropic. *Bark* mostly brown, smooth, longitudinally fissured or transversely checked. *Trunk* distinguishable, leptocaulous, monoaxial, following morphogenetic dynamics of Corner's Architectural Model (Hallé et al. 1978), growth rythmic. *Stems* terete distally, sparingly to densely glandular-papillate, at times with rufous hydropotes or orange glandular lepidote scales, without lenticels. *Cataphylls* alternate or pseudoverticillate, alternating with pseudoverticels of leaves, or apparently axillary to them, linear-subulate to acicular, rigid to membranous, keeled or flat, prominently punctate or punctate-lineate, glabrous, glandular-papillate, bearing hydropotes, or orange lepidote scales. *Leaves* pseudoverticillate or alternate, apically acute to rounded, often mucronulate, basally symmetric or asymmetric, acute, obtuse, or tapering, rarely auriculate, the venation camptodromous, to brochidodromous, apically acute or attenute to rarely rounded, mucronulate or not, basally acute, cuneate, or rarely obtuse, at times subauriculate, symmetric or asymmetric, black or pellucid punctate, bearing hydropoten, at times with orange glandular lepidote scales or glandular papillae, the margin opaque or scarious, entire, subentire, undulate and sparse dentate or pectinate-dentate, flat or inrolled, the teeth vascularized or not; petioles pulvinate (basally swollen), canaliculate, except rarely marginate distally. *Inflorescence* pinnately to tripinnately paniculate, (rarely reduced to a pseudoraceme), pyramidal to columnar, the branches spicate or racemose (rarely glomerulate); inflorescence bract linear-subulate, indistinguishable from the cataphylls; branch bracts membranous, linear, subulate; floral bracts linear-lanceolate, subulate, subtending or rarely on the pedicel, variously punctate, glandular-papillate or glabrous; pedicels terete, thin, or obsolete. *Flowers* unisexual or bisexual, 4–5(–6)-merous, homomerous or heteromerous; calyx cotyliform, at times unequally divided, the lobes valvate, spreading, linear-subulate or rarely subdeltate, apically acute, attenuate or rarely premorse, pellucid to black punctate, the margin entire or erose-serrulate, glabrous or glandular-ciliate; corolla rotate to subrotate, the lobes valvate, linear-subulate, apically acute, rounded or attenuate, essentially glabrous without, densely glandular-granulose throughout within, pellucid or black punctate, the margin irregular, entire; stamens and staminodes similar, the staminodes reduced in size, partially connate to form a conspicuous or inconspicuous tube, at times bearing lobes alternating with apically free filaments, the tube adnate to the corolla, at times so as to mimic epipetalous stamens, the apically free portions of the filaments terete or flat, glabrous or glandular-granulose, the anthers dorsifixed, as wide or wider than long, apically rounded, obtuse or emarginate, basally cordate to deeply cordate, dehiscent by wide longitudinal slites; pistillode lageniform, clavate or conic, hollow, or entirely absent; pistil obpyriform, subglobose, obturbinate or clavate, the ovary terete, sparsely to densely translucent glandular lepidote, glandular-papillate or glabrous, the placenta umbonate, 2–3(–4)-ovulate, the ovules immersed in the placenta ca. 1/2 their length, the style short or vestigial, the stigma large, capitate, the margin lacinate, the lacinae with large lobes, the stigma early caducous. *Fruit* globose to depressed-globose, the exocarp sometimes fleshy, the mesocarp and endocarp stony, black or pellucid punctate, one-seeded, the testa corrugate, the embryo cylindrical, transverse.

Distribution.—From the Darién of Panama southward through the Andes of Colombia, Ecuador, Peru and Bolivia to Rondônia, Brazil, at elevations of sea level–2,200 m elevation.

Ecology.—Members of *Cybianthus* subgenus *Comomyrsine* occupy the forest floor, growing in sheltered areas under cliffs, and in other shady areas. The monoaxial stems are weak and break easily when trampled. They are extremely sensitive to soil compaction and occur mostly in areas where leaf litter accumulates.

Pipoly (1987) demonstrated that *Cybianthus* subgenus *Comomyrsine* is most closely related to subgenus *Triadophora* by the monoaxial habit. The cataphylls of *Comomyrsine* without petiolar structures, as opposed to the petiolate pseudocataphylls found in subgenus *Triadophora*, serve to further distinguish *Comomyrsine.* Likewise, the caducous, oversized stigma with lacinate lobes is unique to subgenus *Comomyrsine.* The subgenus contains 8 species, of which 7 occur in Ecuador and Peru.

KEY TO SPECIES OF *CYBIANTHUS* SUBGENUS *COMOMYRSINE*

1. Leaves 5.7–29 cm long; stems less than 1 cm diameter.

2. Stems apices bearing orange hydropotes; leaf blades linear-lanceolate, 1.6–4.0 cm wide, the margin repand to undulate; petioles 0.6–1.0 cm long; inflorescence pseudoracemose, the flowers glomerulate. .... **15. C. verticilloides**

2. Stem apices bearing rufous glandular-papillate or with rufous hydropotes; leaf blades ovate, obovate, oblanceolate, elliptic, or oblong, (4.0–), 10–22(–30) cm wide, the margin regular, entire or minutely straight-serrulate; petioles (1.0–)1.5–5(–21) cm long; inflorescence pyramidal-bipinnate paniculate, or a columnar thyrsoid panicle, never a pseudoraceme, the flowers spicate, corymbose, or rarely cymose.

3. Stem apices sparsely glandular-papillate, bearing rufous hydropotes; leaf bases broadly rounded, the margins scarious; petioles progressively longer acropetally along the stem, 2.0–4.5 cm long; inflorescence paniculate, the flowers corymbose; pedicels 1.0–2.5 mm long; sepals deltate; petals cucullate apically, the margin glandular-granulose; filaments glabrous. .... **16. C. croatii**

3. Stem apices densely glandular papillate, without hydropotes; leaf bases acute, to acute with a rounded base, the margins opaque; petioles subequal along stem, slightly shorter acropetally, 1.6–2.0 cm long; inflorescence pinnately paniculate, the flowers spicate or racemose; pedicels absent; sepals ovate-lanceolate; petals flat, the margin glabrous; filaments glandular granulose. .... **17. C. humilis**

1. Leaves (16–)31–105 cm long; stems 1–5 cm diameter.

4. Leaves oblong to elliptic, apically rounded or rarely acute, not mucronulate, basally abruptly acute to broadly rounded; petioles ((2.5–)5 cm long; flowers homomerous, 4– or 5-merous.

5. Shrub or tree to 5 m tall; inflorescence a pyramidal panicle, the branches spicate, the flowers sessile to subsessile; leaf base symmetric; cataphylls (2.5–) 3.5–5.0 cm long. .... **18. C. sprucei**

5. Semi-woody shrubs to 1(–3.5) m tall; inflorescence a columnar, thyrsoid panicle, the branches racemose, the flowers on pedicels 2.3–5.0 mm long; leaf base asymmetric; cataphylls 0.6–2.5 cm long. .... **19. C. simplex**

4. Leaves oblanceolate, apically acute, mucronulate, basally gradually tapered on the petiole, often subauriculate; petioles 1.5–2 cm long; flowers heteromerous, the calyx 5–6-lobed, the corolla 4–5-lobed.

6. Leaves chartaceous, 31–55 cm long, the margin flat, entire; cataphylls

1.5–4.0(–4.5) cm long; calyx lobes delrate, the margin glabrous; corolla carnose. .... **20. C. kayapii**

6. Leaves coriaceous, longer than 55–125cm, the margin inrolled, densely and minutely serrulare; cataphylls 4.0–6.5 cm long; calyx lobes linear-subulate, the margin densely glandular-granulose; corolla membranaceous. .... **21. C. anthuriophyllus**

15. Cybianthus verticilloides (Cuatrec.) G. Agostini (**Fig. 4B**), Acta Biol. Venez. 10:165. 1980. *Weigeltia verticilloides* Cuatrec., Revista Acad. Colomb. Ci. Exact. 8(31):327. 1951. Type: COLOMBIA. Valle del Cauca: Río Cali riverbed, between Quebrada de Juntas and El Recreo, 2,070-2,260 m, 7 Jul 1946 (stam. fl), *J. Cuatrecasas 21981* (holotype: F; isotype: COL).

Shrub to 1 m tall. *Stem* terete, 5–8 mm diam., sparingly rufous glandular-papillate and bearing orange hydropotes, early glabrescent, the bark horizontally checked. *Cataphylls* chartaceous, subulate, (1.2–)1.5–2.1 mm long, 0.9–2.1 mm wide, flat, apically long-attenuate, basally somewhat decurrent, sparingly glandular-papillate and orange lepidote above and below, black punctate. *Leaves* pseudoverticillate; blades chartaceous, linear-lanceolate, 12–20 cm long, 1.6–4.0 cm wide, apically long-attenuate, basally acute, greyish-green above and pallid green below when fresh (teste Cuatrec.), sparingly rufous glandular-papillate and orange lepidote above and below at first, persistent only below, inconspicuously pellucid-punctate, midrib planar above, prominent below, the secondary veins 8–12 pairs, prominent below, the margin inrolled except revolute basally, undulate to a vascularized blunt tooth at nerve end, translucent throughout its length but not scarious; petioles canalicualte, 0.6–1.0 cm long, 0.5–1.0 mm diam., glabrous, swollen basally at point of attachment. *Staminate Inflorescence:* a pseudoraceme, 10–12 cm long; peduncle ca. 1 cm long, the rachis glandular-papillate, the flowers glomerulate; inflorescence branch bracts membranous, subulate, 5.5–7.0 mm long, 1.2–2.0 mm wide, minutely glandular-papillose publerulent, glabrescent, prominently black lineate-punctate, the margin entire; floral bracts similar to branch bracts except 0.9–2.0 mm long, 0.2–0.5 mm wide; pedicels obsolete to cylindrical to 1.3 mm long, prominently black punctate. *Staminate flowers* 5–6-merous, lilac; calyx membranaceous, subcotyliform, 1.5–2.3 mm long, unequally divided, the tube to 0.2 mm long, the lobes linear-lanceolate, subulate, 1.3–2.0 mm long, 0.4–0.7 mm wide, apically long-attenuate, flat, epunctate, glabrous, the margin irregular, entire, glabrous; corolla rotate, chartaceous, 2.5–4.0 mm long,the tube opaque, 0.8–1.5 mm long, the lobes hyaline, ovate, 2.1–3.0 mm long, 1.4–1.9 mm wide, reflexed 180°, apically acute to rounded, moderately glandular-granulose throughout within except densely so along margin, glabrous without, epunctate, the margin irregular, entire; stamens 3.0–3.5 mm long, the tube 0.8–1.5 mm long,epunctate, elobate, glabrous, the apically free portions of the filaments thick (base of filament as wide as anther), terete, glabrous, 1.5–2.0 mm long, ventrally reflexed apically, the anthers subglobose, wider than long, 0.3-0.5 mm long and wide, apically rounded to obtuse, basally barely cordulate, the connective prominately black punctate dorsally; pistillode ovoid, ca. 0.9-1.3 mm long, 0.6-0.8 mm diam. *Pistillate inflorescence* resembling staminate, but 4.5–6.5 cm long, the glomerules mostly reduced or a single flower; branch bracts and floral bracts identical, membranous, sublate, 2.8–4.0 mm long, 0.7–1.0 mm wide, sparsely glandular-papillate, prominently black punctate, the margin erose; pedicels (1.5–)1.8–3.2 mm long. *Pistillate flowers* as in staminate but white; calyx chartaceous, cotyliform, 2.2–2.7 mm long, hyaline, the tube 0.3–0.4 mm long, the lobes 1.9–2.3 mm long, 0.7–1.1 mm wide, apically attenuate, at times rufous-papillate apically; corolla rotate, 2.5–3.2 mm long, the tube 0.9–1.0 mm long, the lobes widely ovate, 1.6–2.2 mm long,1.2–1.5 mm wide, apically rounded to acutish, glandular-granulose within and along margin, the margin regular; staminodes similar to stamens but 1.6–1.9 mm long, the tube 0.9–1.0 mm long, the apically free portions of the filaments terete, 0.7–0.9 mm long, the antherodes globose, often malformed, 0.2–0.3 mm long, 0.3–0.4 mm wide, apically obtuse, basally obtuse to rounded or cordulate, the connective prominently black punctate ventrally; pistil obpyriform, 2.1–2.5 mm long, 1.2–1.6 mm diam, the ovary 1.6–1.8 mm long, translucent-lepidote, glandular-papillate, prominently black punctate, style 0.5–0.7 mm long, the stigma capitate, 4–5-lobed, each lobe lacinate, to 0.6 mm long, the placenta deeply cupuliform, 2 ovulate. *Fruit* globose, 7–7.5 mm long and diam., prominently black punctate, exocarp thin.

Distribution.—Previously considered endemic to the Western Cordillera of the Andes, on the cliffs (Farallones) of Cali, in the Department of Valle, Colombia, at 1,900–2,600 m, but reported for the first time here from Napo, Ecuador, at 200 m elevation.

Ecology and conservation status.—*Cybianthus verticilloides* is a rare species in lowland and premontane forest, growing near watercourses. Given that it has well-known uses, *C. verticilloides* might be suitable for cultivation. However, at present nothing is known regarding its natural population dynamics. Given the rapid urban development around Cali, and its apparent rarity in Ecuador, this species should be considered endangered.

Etymology.—The specific epithet refers to the strikingly pseudoverticillate phyllotaxis.

Local names and uses.—Colombia: "verticilado" (Spanish); Ecuador: "Carnerupachapanga," "Yanacarneru" (Quichua), "Carnero Negro" (Spanish). Used to get rid of small fish in the urinary tract that cause bleeding and pain.

Specimens examined. **COLOMBIA. Valle del Cauca:** Río Cali riverbed, above Río Pichindé, El Robal, 2,640 m, 25 Jul 1946 (fr), *J. Cuatrecasas 21721* (COL, F); Peñas Blancas, 2,200 m, 9 May 1940 (stam. fl), *A. Figueroa 875* (COL,US); Río Tuluá, 1,200 m, without date (pist. fl), *J. Duque-Jaramillo 4022* (COL); El Silencio, Yanaconas, 1,900–2,200 m, 28 Feb 1939 (pist. fl), *E. Killip & H. Garcia 33802* (COL, US); Farallones de Cali, 1,800 m, Oct 1883 (pist. fl), *F. Lehmann 3027* (K, US); km 18-20, Cali-Buenaventura Hwy, entering near Finca Zingara, summit of the Cordillera Occidental, 1,500-2,000 m, 28 Feb 1988 (fr), *H. van der Werff & I. Cabrera 15786* (COL, MO, VALLE). **ECUADOR. Napo:** Río Napo, S bank a few km below Itaya, 00° 28' S, 76° 33' W, 200 m, 20 Aug 1982 (ster.) *H. Balslev & Santos Dea 2850* (QCA).

Cybianthus verticilloides appears to be most closely related to *C. goudotianus*, by the synapomorphic vascularized leaf teeth. However, *C. verticilloides* is defined by the autapomorphic horizontally checked bark, the orange hydropotes of the branchlets, and the linear-lanceolate leaf shape.

16. **Cybianthus croatii** Pipoly, sp. nov. (**Fig. 4A, 16**). TYPE: ECUADOR. PASTAZA: Along Rd. between Diez de Agosto and Atajuno, 18 km NE of main Puyo-Macas Rd., 8.2 km NE of Diez de Agosto, 01° 27' S, 77° 51' W, 970 m, 4 May 1984 (stam. fl), *T. Croat 59009* (HOLOTYPE: MO).

Quoad habitum deminutum petiolos brevistipitatos et laminas chartaceas, *C. humilem* valde cognatum, sed ab ea basibus laminaribus obtusis vel rotundatis (non acutis) inflorescentiis paniculatis cum ramulis floriferis corymbosis (nec tripinnati- paniculatis cum ramulis floriferis spicatis vel racemosis) petalis ad apicem cucullatis (nec planis) ad marginem glandulari-papillosis (nec glabris) filamentis glabris (nec glandulari-granulosis) antherarum connectivis manifeste punctatis (nec epunctatis) prompte cognoscitur.

Subshrub to ca. 15 cm tall. *Stem* terete, ca. 4 mm diam., bearing rufous hydropotes and sparingly glandular-papillate. *Leaves* alternate; blades chartaceous, ovate to elliptic, 5.7–14 cm long, 4.0–7.5 cm wide, apically acute, the tip mucronulate, basally obtuse to rounded slightly decurrent on the petiole, bearing rufous hydropoten above and below, midrib slightly impressed distally, slightly raised proximally above, prominent below, the secondary veins 4–9 pairs, barely visible above, prominent below, without collecting vein, the margin scarious, subentire or entire; petiole deeply canaliculate, decurrent on stem, at times appearing to form a small sheath, (1.5–)2.0–4.5 cm long, 0.2–0.3 cm diam., increasing in length acropetally along stem. *Cataphylls* membranaceous, alternate, subulate, 6–12 mm long, 0.6–1.2 mm wide, located just below center of internode, psuedoverticillate, apically acicular, keeled, conspicuously black punctate-lineate, bearing hydropoten and glandular papillae. *Inflorescence bract* subulate, 3.9–4.0 mm long, 2.0–3.0 mm wide. *Staminate inflorescence:* supraaxillary, paniculate, 1.2–3.5 cm long, appearing succulent, the branches racemose, the rachis densely glandular-papillate; peduncle 0.5–1.0 cm long; inflorescence branch bracts linear-lanceolate, 1.8–2.2 mm long, 0.4–0.6 mm wide, conspicuously punctate, glandular-papillate; floral bracts subtending and equal to the pedicels, 1.0–2.5 mm long. *Staminate flowers* homomerous, 4-merous, green; calyx cotyliform, membranaceous, 1.2–1.5 mm long, more or less equally divided, hyaline, the tube 0.2–0.3

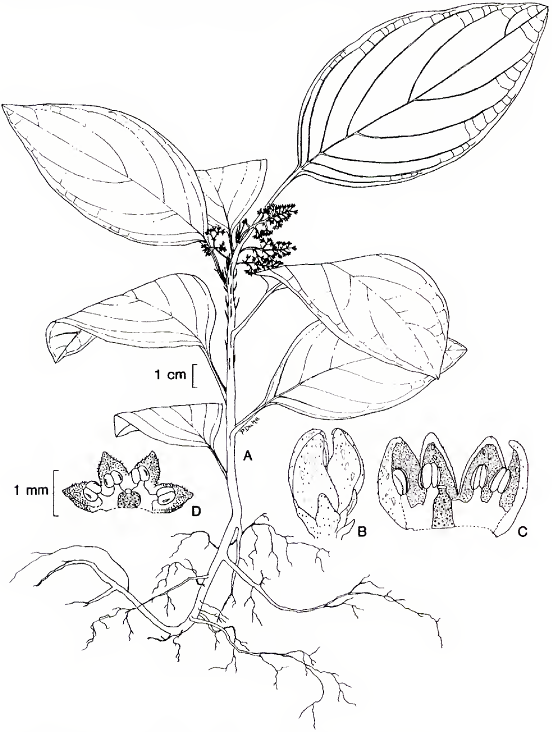

FIG. 16. *Cybianthus croatii* Pipoly. A. Habit, showing stem with small, acicular cataphylls, acropetally longer petioles, and supraaxillary inflorescences. B. Staminate flower bud, showing sparsely glandular-papillate, cotyliform calyx. C. Open staminate corolla, showing cucullate lobe apices, suborbicular anthers and conic pisrillode. D. Open pistillate corolla, showing oblate antherodes, subglobose pistil. A–C, drawn from holotype. D, drawn from *L. Albert de Escobar 3744*. Figure drawn by Peggy Duke.

mm long, the lobes deltate, 1.0–1.2 mm long and wide, apically acute to somewhat acuminate, prominately black punctate, sparsely glandular-papillate without, the margin irregular, entire, glandular-papillate at first, glabrescent; corolla subrotate, carnose, 2.4–2.7 mm long, the tube 0.7–0.8 mm long, translucent, the lobes opaque, oblong, 1.7–2.1 mm long, 0.9–1.0 mm wide, apically rounded to obtuse, cucullate, sparingly glandular-papillate without, densely glandular-granulose within, prominently black punctate without, especially at apex, the margin entire, glandular-granulose; stamens 2.5–2.6 mm long, the tube conspcuous, carnose, 0.7–0.8 mm long, subtruncate, the apically free portions of the filaments terete, 0.9–1.0 mm long, epunctate, glabrous, erect except slightly recurved ventrally at point of attachment to anther, the anthers suborbicular, 0.7–0.8 mm long and wide, apically rounded, deeply cordate basally, the connective epunctate ventrally, prominently black punctate dorsally; pistillode conic, 1.3 mm long, 0.7 mm wide, densely translucent-lepidote, conspicuously black punctate, hollow. *Pistillate inflorescence:* as staminate, but 2.5–3.5 cm long; pedicels 0.6–1.1 mm long. *Pistillate flowers* as in staminate but calyx 1.3–1.5 mm long, equally divided, the tube 0.2–0.3 mm long, the lobes triangular, 0.9–1.2 mm long, 0.5–0.7 mm wide, apically acuminate, sparsely glandular-papillate along margin without; corolla subcampanulate, the lobes 1.3–1.5 mm long, the tube to 0.2 mm long, the lobes suborbicular, 1.1–1.3 mm long, 1.0–1.1 mm wide, apically rounded to obtuse, minutely glandular-granulose along margin without and throughout; staminodes as in stamens but 0.9–1.0 mm long, the tube, ca. 0.2 mm long, the apically free portions of the filaments 0.2–0.3 mm long, the antherodes oblate, 0.4–0.5 mm long, 0.5–0.6 mm wide, apically truncate, basally obtuse, the connective prominently black punctate ventrally; pistil subglobosel, 0.6–0.7 mm long and diam., densely translucent-lepidote, conspicuously black punctate, the placenta deeply cupuliform, bearing 2 ovules, the style barely discernible, to 0.1 mm long, stignma subcapitate, the margin lacinate, early caducous. *Fruit* unknown.

Distribution.—Known only from the type (Ecuador) and from Antioquia, Colombia, at 970–2,440 m elevation..

Ecology and conservation status.—*Cybianthus croatii* occurs in premontane and montane wet forest, where it is locally common in protected areas near forest margins. Because of its restricted habitat, it is presumed to be threatened.

Etymology.—It is with great pleasure that I dedicate this species to Thomas B. Croat, pre-eminent authority on the systematics of Neotropical Araceae, indefatigable collector, gentleman, scholar, and the P. A. Schulze Curator of Botany at the Missouri Botanical Garden. During the tropical botany course I took from him in Costa Rica in 1977, I was first shown and became intrigued with the systematics and populaton biology of the Myrsinaceae.

PARATYPE: COLOMBIA. Antioquia: Mpio. Caldas, above town, Finca La Zarza, 2,440 m, 2 Feb 1984 (pist. fl), *L. Albert de Escobar et al. 3744* (HUA, US).

Cybianthus croatii is the smallest myrsinaceous shrub that exhibits Corner's Model (Hallé et al. 1978). It is interesting to note that with each successive pseudowhorl of cataphylls, an inflorescence is produced, followed by a larger leaf with a longer petiole. This species appears to be most closely related to another diminutive plant, *C. humilis*, known only from the Department of Antioquia, Colombia and adjacent Chocó, and from Ecuador. The synapomorphy which defines the *Cybianthus humilis-C. croatii* clade is the scarious leaf margin, known elsewhere only in subgenus *Grammadenia* (Pipoly 1987, unpubl. data). However, because that subgenus occurs on the other side of the generic cladogram presented by Pipoly (1987), it is most parsimonius to hypothesize that the margin has arisen independently in these distant lineages. The pistillode is present in both of these species, and I have chosen to postulate that this represents a reversal because it is the most parsimonius conclusion. *Cybianthus croatii* is defined by the autapomorphic rufous stem hydropotes and the acropetally longer petioles. Despite the fact that the distribution of this species entirely overlaps that of *C. humilis*, it appears that *C. croatii* is restricted to montane and cloud forests, where *C. humilis* is restricted to premontane pluvial forests and subpáramo thickers. This is yet another example of sister species in altitudinally adjacent habitats, already reported in *Cybianthus* subgenus *Laxiflorus* (Pipoly 1983) *C.* subgenus *Microconomorpha* (Pipoly 1983b) and *C.* subgenus *Conomorpha* (Pipoly 1992a). Whether this supports the concept of speciation by peripheral isolation (parapatric) is unknown. Futher studies of the respective population biologies of the subgenus are needed.

17. **Cybianthus humilis** (Mez) G. Agostini (**Fig. 3F**), Acta. Biol. Venez. 10:163. 1980. *Weigeltia humilis* Mez in Engl., Pflanzenr. IV. 236(Heft 9):291. 1902. TYPE: ECUADOR. Without locality, 1896 (stam. fl), *A. Sodiro 100/14* (HOLOTYPE: B-destr., F Neg. 4856; LECTOTYPE, here designated: COLOMBIA. ANTIOQUIA: 2,650–2,800 m, 1 Apr 1880 (stam. fl), *W. Kalbreyer 1534* (K). Although Mez (1902) did not specifically mention the Sodiro collection as the type, he cited the Sodiro and the Kalbreyer specimens in the protologue. However, the F photograph clearly shows that a drawing of a dissection accompanies the Sodiro specimen, while that of Kalbreyer does not, suggesting that the Sodiro specimen formed the principal element upon which the description was based. Unfortunately, no duplicates of that Sodiro collecton have been located. Mez also annotated the Kalbreyer sheet at K, and thus I designate it as the lectotype.

Conomyrsine sodiroana Mez, Bull. Herb. Boissier, 2 ser 5:535. 1905. syn. nov. *Cybianthus sodiroanus* (Mez) G. Agostini, Acta Biol. Venez. 10:163. 1980. TYPE: ECUADOR. ATACATZO. Jan 1902 (stam. fl), *A. Sodiro 100/2* (HOLOTYPE: B-destr.; LECTOTYPE, here designated: P).

Subshrub to 25 cm tall. *Stem* terete, 3.5–4.0 mm diam., densely glandular-papillate, early glabrescent. *Cataphylls* in alternating nodes with leaves, membranaceous, subulate, 10–13 mm long, 1.7–2.6 mm wide, apically long-attenuate, keeled, midrib prominent below, prominently black punctate and lineate-punctate, glandular-papillate, glabrescent, the margin opaque, flat, entire. *Leaves* subopposite; blades chartaceous, elliptic to narrowly elliptic, 15–20(–27) mm long, (4.0–)7.0–8.5 cm wide, apically acute to subacuminate, terminating in an inconspicuous mucro, basally acute, bearing hydropoten above and below, inconspicuously pellucid punctate, midrib somewhat impressed above, prominent below, the secondary veins 6–11 pairs, slightly impressed abive or not, prominently raised below, not united by a submarginal collecting vein, the margin entire, opaque, subrevolute; petioles canaliculate, thin, 1.0–2.0 cm long, 2.0–2.5 mm diam., glabrous, not decurrent on the stem. *Inflorescence bracts* similar to cataphylls, but 1.2–1.3 mm long, 1.5–2.2 mm wide. *Staminate inflorescence:* a bipinnate panicle, 3.5–15(–19) cm long, the rachis densely glandular-papillate, the branches spicate or rarely racemose, appearing subglomerulate apically; inflorescence branch bracts membranaceous, subulate, 3–4.5 mm long, 0.3–0.5 mm wide, densely and prominently black punctate-lineate, sparingly papillate; pedicels essentially obsolete, to 0.3(–2) mm long; floral bract membranaceous, ovate, asymmetric, 2.3–2.8 mm long, 0.9–1.2 mm wide, apically abruptly acuminate, medially keeled, epunctate, the margin erose, stipitate glandular-papillate. *Staminate flowers* 4–5-merous; calyx membranaceous, cotyliform, 1.5–2.0 mm long, tube 0.2–0.3 mm long, the lobes ovate to lanceolate, 1.3–1.7 mm long, 0.5–1.3 mm wide, unequally divided, apically acuminate to acute and often erose or premorse, glandular papillose-puberulent without, the margin erose, glabrous; corolla chartaceous, appearing subrotate, 3.7–4.5 mm long, the tube 1.1–1.5 mm long, the lobes linear-lanceolate to oblong, 2.4–3.2 mm long, 1.0–1.5 mm wide, often unequal, apically long-attenuate to obtuse, moderately rufous gladular-granulose throughout within, sparsely glandular-papillate without, hyaline, the margin entire, glabrous; stamens 3.0–3.9 mm long, the tube 1.1–1.5 mm long, coriaceous, conspicuous, sparsely glandular-grandulose, elobate, the apically free portions of the filaments basally as wide or wider than anther, then tapering apically, 1.9–2.4 mm long, terete, glandular-granulose, the anthers oblate, 0.4–0.5 mm long, 0.6–0.7 mm wide, apically truncate, basally subcordate, the connective epunctate; pistillode glabrous lagenform, 1.4–1.6 mm long, 0.8–1.0 mm wide, the stigma punctiform. *Pistillate inflorescence:* as in the staminate but 7–10 cm long, 4–6 cm wide; inflorescence branch bracts 2.5–3.5 mm long, 0.2–0.3 mm wide; peduncle 1–2.5 cm long; floral bracts 1–1.5 mm long; pedicels obsolete. *Pistillate flowers* unknown; fruiting calyx as in staminate but 1.3–1.5 mm long, the tube ca. 0.2–0.3 mm long, the lobes 1.1–1.2 mm long, 0.2–0.3 mm wide. *Fruit* globose, reddish-purple when fresh, 4–6 mm long and diam. when dried, the exocarp thin, conspicuously pellucid punctate.

Distribution.—Known only from Colombia and Ecuador, at 1,450–2,700 m elevation.

Ecology and conservation status.—*Cybianthus humilis* grows in deep shade among rocks at the margins of premontane pluvial forests. Populations I observed in Colombia grew only in undisturbed areas with deep shade, leaf litter and organic humus. Because of the apparently restricted habitat, this species should be considered threatened.

Etymology.—The specific epithet refers to the low habit of the plant.

Local names and uses.—Colombia (Chocó): "Hierba del palo grande." Ground to make crude syrups; syrup applied externally to cure cuts, taken internally to cure internal infections, clean the stomach and against chills. Given that it is a shade species, the common name probably refers to its frequency in shaded areas near large trees.

Specimens examined. **COLOMBIA. Antioquia:** Mpio. Urrao, Parque Nacional Las Orquídeas, Vereda Calles, permanent inventory for premontane pluvial forest, right bank of Río Calles, 06° 32' N, 76° 19' W, 1,450 m, 27 Nov 1993 (fr), *J. Pipoly et al. 17186* (COL, JAUM, MO), 1,450–1,500 m, 29 Nov 1993 (fr), *J. Pipoly et al. 17361* (COL, JAUM, MO); without locality and date, (stam. fl), *F. Lehmann s.n.* (F, K). **Chocó:** Mpio. de Quibdó, Corregimiento San Francisco Ichó, Quebrada Caledonia along Caledonia Rd., 9 Apr 1987 (ster.), *F. García & J. Echavarría 259-A* (COL, CHOCO, MO). **Nariño:** Mpio. Barbacoas, Corregimiento Ortíz y Zamora, Vereda El Barro, Reserva Natural Río Ñambí, ca. 5 km W de Altaquer, faldas occidentales de la Cordillera Occidental, 01° 18' N, 78° 08' W, 1,350–1,400 m, 3 Sep 1997 (ster.), *J. Pipoly, A. Cogollo. et al. 21240* (BRIT, FMB, JAUM, PSO). **Quindío:** Mpio. De Salento, Estación Navarco, Alto San Ignacio, 2,850 m, 23 Nov 1990 (stam. fl), *P. Franco et al. 3204* (COL, MO). **Risaralda:** Mpio. Sta. Rosa, Camino de Herradura etre Termales y Páramo Sta. Rosa, Cordillera Central, vertiente Occidental, Hacienda El Margarital, 2,500 m, 18 Aug 1980 (fr), *J. Idrobo et al. 9671* (COL, MO). **ECUADOR. Napo:** Cantón El Chaco, Proyecto Hidroeléctrico Coca, Punto ST3, right bank of Río Quijos, ca. 10 km S of Reventador, 1,500 m, 3–5 Oct 1990 (fr), *W. Palacios 5950* (MO, QCNE). **Pichincha:** Cantón Quito; Parroquia Calacalí, Reserva Geobotánica Pululahua, 00° 01' N, 78° 35' W, 1,800–2,000 m, 29 Jul 1989 (stam. fl), *C. Cerón 7184* (MO, QCNA); Mindó, 26 Jun 1876 (stam. fl), *E. André 3819* (K).

Cybianthus humilis is most closely related to *C. croatii*, by virtue of its synapomorphic scarious leaf margin. The autapomorphies that distinguish *C. humilis* from all other species of the subgenus include the premorse apices of the calyx lobes, the unequal corolla division, and the oblate anther shape.

18. **Cybianthus sprucei** (Hook. f.) G. Agostini, Acta Biol. Venez. 10(2):164. 1980. *Comomyrsine sprucei* Hook. f. *in* Benth. *et* Hook., Gen. Pl. 2:644. 1876. *Weigeltia sprucei* (Hook. f.) Mez in Engl., Pflanzenr. IV. 236(Heft 9):291. 1902. Type: ECUADOR. [Chimborazo: W slopes of Volcan Chimborazo, 17 Jun 1860] (stam. fl), *R. Spruce 6144* (holotype, K-2 sheets). Note: label on specimen does not indicate place or date. Information was derived by comments regarding habit, etc. on the label which matched data given in Spruce (1880).

Weigeltia panamensis Standl., Publ. Field Mus. Nat. Hist, Bot. Ser. 22:164. 1940. syn. nov. *Cybianthus panamensis* (Standl.) G. Agostini, Acta Biol. Venez. 10:163. 1980. Type:

PANAMA. DARIÉN: Cana, Cuasi Trail, Drto. Cheijana, 1000 m, 10 Mar 1940 (stam. fl), *M. E. Terry & R. A. Terry 1490* (HOLOTYPE: F-2 sheets; ISOTYPES: A, MO).

Weigeltia purpurea Cuatrec., Revista Acad. Colomb. Ci. Exact. 8(31):326. 1951. TYPE: COLOMBIA. VALLE DEL CAUCA: Bahía de Buenaventura, Quebrada de San Joaquín, 0–10 m, 21 Feb 1946 (stam. fl), *J. Cuatrecasas 19892* (HOLOTYPE: F; ISOTYPE: COL).

Shrub to tree to 5 m, flowering from less than 1 m. *Stem* terete, 1.3–2.5 cm diam. below uppermost leaves, swollen at nodes, semi-woody, glandular-papillate-puberulent, glabrescent. *Cataphylls* few, alternate, coriaceous, subulate, (2.5–)3.0–5.0 cm long, 2–4 mm wide, strongly keeled, densely glandular-papillose-puberulent, glabrescent, consipuously black punctate, the margin opaque, regular, entire. *Leaves* pseudoverticillate; blades chartaceous, widely oblong to elliptic, rarely widely obovate, (26–)31–75 cm long, (6.5–) 10–30 cm wide, apically rounded, obtuse or rarely acutish, not mucronulate, basally abruptly subcuneate, asymetric, slightly decurrent on petiole, bearing a few hydropoten above, moderately rufous glandular-papillate and with a moderate number of hydropoten below, prominently red or black puctate, the margin regular, opaque, entire; petioles stiff, (2.5–)5.0–14(–23) cm long, 0.3–0.9 cm diam., slightly to moderately canaliculate, swollen basally, sparingly glandular-papillate, glabrescent. *Staminate Inflorescence:* a pyramidal bipinnate thyrsoid panicle, 9–16.5(–19) cm long, 9–17(–22) cm wide, the branches subspicate, the rachis densely glandular-papillose-puberulent; peduncle 0.5–2.0 cm long; inflorescence branch bracts chartaceous, linear-lanceolate, 8.5–12.9 mm long, 0.6–0.9 mm wide, apically narrowly acute, conspicuously black punctate, densely glandular-papillate, gabrescent, flat, the margin opaque, regular, entire; floral bracts membraneous, linear, 1.5–2.0(–2.5) mm long, 0.5–0.6 mm wide, subulate, hyaline, densely glandular-papillose puberulent, the margin entire, glandular-papillate; pedicels obsolete to 0.2 mm long. *Staminate flowers* homomerous, 4-merous, coriaceous, subsessile, racemose, 4–5-merous, white in bud, green in anthesis, then crimson; calyx coriaceous, subcotyliform, unequally divided, 0.9–1.1 mm long, the tube 0.1–0.2 mm long, the lobes linear-lanceolate, 0.7–0.9 mm long, 0.2–0.5 mm wide, apically subulate, keeled, brown punctate-lineate or punctate medially, sparsely glandular-papillate, the margin irregular, subentire to erose, densely glandular-ciliate; corolla subrotate, 2.0–2.9 mm long, the tube 0.2–0.3mm long, the lobes narrowly ovate to lanceolate, (1.7–)1.9–2.3(–2.6) mm long, 0.9–1.0(–1.5) mm wide, reflexed 135° from tube at anthesis, apically attenuate, densely glandular-granulose throughout within and along margin within and without, inconspicuously pellucid punctate, the margin entire, somewhat irregular, densely glandular-granulose; stamens exserted to slightly shorter than the corolla lobe, 1.6–2.2 mm long, the tube ca. 0.5 mm long, conspicuous, coriaceous, taller than the corolla tube, elobate, opaque, epunctate, glabrous, the apically free portions of the filaments terete, thicker than the anthers, 0.8–1.6 mm long, ventrally recurved at anthesis, epunctate, glabrous, the anthers subglobose, ca. 0.3 mm long, 0.4–0.5 mm wide, apically rounded, basally cordulate, dorsifixed near base so as to appear basifixed, the connective prominently red or black punctate dorsally; pistillode normally absent, occasionally conic, to 1 mm long, 0.3 mm wide, densely translucent-lepidote. *Pistillate inflorescence* resembling staminate in all features, but smaller, 2.5–3.5(–13) cm long, 3.5–8.0(–12.5) cm wide; peduncle 0.5–1.5 cm long; inflorescence branch bracts 3.0–3.5(–5.0) mm long, to 0.6 mm wide, at times somewhat cucullate; floral bracts 2.0–2.6 mm long, ca. 0.5 mm wide, pedicels virtually obsolete, or cylindrical to 0.1 mm long in flower, accrescent and incrassate to 2.0 mm long, 1.0–1.5 mm diam. in fruit. *Pistillate flowers* as in staminate, forming a condensed spike on the inflorescence branches; calyx subcupuliform, 1.2–1.4 mm long; the tube to 0.1–0.2 mm long, the lobes 0.9–1.1 mm long, 0.9–1.0 mm wide, widely ovate, apically acute; corolla rotate, 2.7–2.9 mm long, the tube 0.6–0.7 mm long, the lobes oblong to elliptic, 2.0–2.2 mm long, 0.9–1.0 mm wide, apically acute; staminodes 1.5–1.6 mm long, the tube 1.0–1.1 mm long, the apically free portions of the filaments 0.4–0.5 mm long, the antherodes malformed, 0.2–0.3 mm long, 0.3–0.4 mm wide; pistil obturbinate, 1.5–1.6 mm long, densely translucent-lepidote and prominently pellucid punctate, the style obsolete, the stigma capitate, 0.2–0.3 mm long, subsessile, 4–many-lobed, the lobes 1.3–2.3 mm long, viscid, bright crimson, the placenta ovoid, the ovules 2, born on side of placenta. *Fruit* subglobose, 5.0–9.0 mm long, 9–14 mm diam., fleshy, the exocarp thick, orange at maturity, prominently black punctate. *Bisexual Inflorenscence* resembling staminate in all features except: 3.7–14.5 cm long, 2.5–12.5 cm wide; inflorescence branch bracts and floral bracts and pedicels as in pistillate. *Bisexual flowers* spicate, less crowded than in the pistillate, more crowded than staminate; calyx cotyliform, (4–)5-parted, 1.0–1.2 mm long, the tube ca. 0.2 mm long, the lobes narrowly ovate to narrowly triangular, 0.8–1.0 mm long, 0.3–0.4 mm wide, apically acute to narrowly acute; corolla 4-lobed, rotate, 2.0–2.7 mm long, the tube ca. 0.3 mm long, the lobes oblong, 1.7–2.4 mm long, 0.9–1.2 mm wide, apically acute; stamens 1.2–1.5 mm long, the tube ca. 0.5 mm long, the apically free portions of the filaments 0.6–0.7 mm long, the anthers oblate, 0.3–0.4 mm long, ca. 0.5 mm wide; pistil as in pistillate flowers except 1.2–1.4 mm long, the ovary 1.0–1.1 mm long, 0.7–0.9 mm diam., the style short, 0.1–0.2 mm long, the stigma capitate, to 0.2 mm long, the lobes 0.9–1.1 mm long, the placenta ellipsoid, the ovules 2–3, borne on side of placenta. *Bisexual fruit* subglobose, as in pistillate, but 4–5 mm long, 5–7 mm diam.

Distribution.—From Darién, Panama to Loreto, Peru, from 0–1,700 m elevation.

Ecology and conservation status.—*Cybianthus sprucei* is a ridgetop species, occurring in premontane wet and rainforests and also in lowland forests on forest margins of exposed hilltops. This species, as opposed to its closest congener, *Cybianthus simplex*, occurs in areas of high incident light for at least part of the day. Because *Cybianthus sprucei* continues to reproduce in spite of mild forest intervention, it is not considered threatened or endangered.

Etymology.—This species was named in honor of Richard Spruce, ardent collector and student of the Andean and Amazonian flora.

Local names and uses.—Colombia: "margoandre," "Tunda" Spanish (Valle del Cauca, Colombia); Ecuador: "urcu tahucu" (Quichua); ground and a vapor bath is taken to "send evil away" and to treat body pains, headaches, internal colds; Peru: "kurúp" (Jívaro); the root is mashed and boiled, and the decoction is drunk to "strengthen" the body.

Specimens examined. **PANAMA. Darién:** Cerro Pirré, 10–20 Jul 1977 (bisex. fl, fr), *J. Folsom 4544* (MO, PMA); on ridge of Cerro Pirré, 08° 00' N, 77° 45' W, 1,000–1,080 m, 14 Sep 1989 (fr), *G. McPherson 14066* (BRIT, MO). **COLOMBIA. Cauca:** Río Micay, en Guayabal, 5–20 m, 25 Feb 1943 (pist. fr), *J. Cuatrecasas 14138* (COL, F, US); Distrito Cauca, El Tambo, 900 m, Apr 1937 (stam. fl), *K. von Sneidern 1615* (S). **Chocó:** Along Rd. between Quibdó and Medellín, Km 207.5, 0–200 m, 18 Dec 1980 (pist. fl, fr), *T. Croat & A. Cogollo 52257* (COL, JAUM, MO); Alto del Buey, 1,200–1,800 m, 8 Jan 1973 (pist. fl, fr), *A. Gentry & E. Forero 7317* (COL, F, MO). **Nariño:** La Guayacana, Funes, 24 Jun 1951 (stam. fl), *R. Castañeda 2873* (COL, F); Ricaurte, 1,300 m; 18 Apr 1941 (bisex. fl), *K. von Sneidern A612 bis* (S); Reserva Natural La Planada, 7 km above Chucunés on Rd. between Tuquerres and Ricaurte, along Sendero La Vieja, 01° 06' N, 77° 54' W, 1,780–1850 m, 7 Mar 1990 (fr), *T. Croat 71155* (MO, PSO). **Valle del Cauca:** Pacific coast, Río Naya, Puerto Merizalde, 5–20 m, 22 Feb 1943 (bisex. fl), *J. Cuatrecasas 14053* (COL, F); Río Yurumanguí, 550 m, 28 Jan–10 Feb 1944 (pist. fl, fr), *J. Cuatrecasas 15743* (COL, F, US); Río Calima, Chocó region, La Trojita, 5–50 m, 20 Feb 1944 (stam., pist. fl-sheets mixed), *J. Cuatrecasas 16272* (COL, F, US); Río Cajambre, Barco, 5–80 m, 30 Apr 1944 (fr), *J. Cuatrecasas 17625* (COL, F, US); Bajo Calima, 15 km N of Buenaventura, Cartón de Colombia concession, Juanchacho region, 03° 56' N, 77° 08' W, 500 m, 27 Mar 1986 (stam. fl), *A. Gentry et al. 53713* (COL, MO), Concesión Pulpapel/Buenaventura, 03° 55' N, 77° 00' W, 100 m, 7 Mar 1985 (fr), *M. Monsalve 767* (COL, CUVC, MO), 19 Mar 1985 (stam. fl), *M. Monsalve 790* (CUVC, MO), 21 Mar 1985 (stam. fl), *M. Monsalve 797* (CUVC, MO), 12 Mar 1986 (stam. bud), *M. Monsalve 981* (CUVC, MO), 24 Aug 1986 (fr), *M. Monsalve 1124* (CUVC, MO); Bahia de Malaga, near mouth of Quebrada La Sierpe,0 4° 00' N, 77° 15' W, 0–20 m, 17 Feb 1983 (stam. fl), *A. Gentry et al. 40453* (COL, MO); 18 km E of Buenaventura, 50 m, 14 Feb 1939 (fr), *E. Killip & H. García 33279* (BM, COL, NY, US), Buenaventura, Jun 1901 (pist. fl, fr) *F. Lehmann B. T. 651* (K, NY). **Putumayo:** Umbria, 00° 54' N, 76° 10' W, 325 m, Jan–Feb 1931 (stam. fl), *G. Klug 2108* (US). **ECUADOR. Bolívar :** Along first 15 km of Chillanes-El Tambo, 2,400 m, 18 Jul 1991 (stam. fl), *H. van der Werff et al. 12430* (BRIT, MO, QCNE); along Rd. Chillanes-San Pablo, 6 km outside Chillanes, 2,600 m, 21 Jul 1991 (fr), *H. van der Werff et al.l 12561* (MO, QCNE). **Morona-Santiago:** 15 km N of Macas, Rd to Rio Upano, 02° 07' S, 78 °08' W, 1250 m, 20 Feb 1987 (bisex. fl), *J. Bohlin et al. 1493* (GB); Cordillera de Cutucu, W slopes along trail from Logrono to Yaupi, 02° 46' S, 78° 06' W, 1,200 m, 10 Nov 1976 (stam. fl), *M. Maddison et al. 3204* (US). **Napo:** Cantón Archidona, Carretera Hollín-Loreto, Río Huataraco, 2 hrs walk from Guagua Sumaco, 00° 43' S, 77° 32' W, 800–1,000 m, 23–30 Aug 1989 (stam. fl), *C. Cerón & M. Factos 7648* (MO, QCNE); Cantón Orellana, Reserva Florística El Chuncho, 5 km N of Coca, 00° 25' S, 77° 01' W, 250 m, 23 May 1993 (fr), *W. Palacios 10680* (MO, QCNE), El Chuncho, el Payamino, Estación Experimental INIAP-Napo, 5 km NW of Coca, 00° 30' S, 77° 01' W, 250 m, 12 Oct 1987 (stam. fl), *C. Cerón 2494* (MO, QCNE); Cantón Tena, Mishualli, junction of Rios Mishualli and Napo,01° 03' S, 77° 41' W, 500 m, 13–14 Aug 1979 (fr), *L. Holm-Nielson 19295* (AAU); Estación Biológica Jatun Sacha, along S bank of Río Napo, 1 km E of Puerto Misahualli, 00° 04' S, 77° 36' W, 450 m, 1 Apr 1992 (fr), *T. Croat 73352* (MO, QCNE), 8 km E of Puerto Mishualli, 01° 04' S, 77° 36' W, 400 m, 14 Aug 1989 (ster.), *C. Cerón 7409* (MO, QCNE), 22 Sep 1989 (stam. fl), *W. Palacios 4471* (MO, QCNE), 16 Mar 1991 (fr), *D. Neill 9813* (BRIT, F, MO, QCNE); Río Blanco Comunidad, headwaters of Río Huambuno, 6 km NNW of Ahuano, 01° 44' S, 77° 44' W, 440 m, 18 Jul–9 Aug 1990 (fr), *E. Kohn 1311* (MO). **PERU. Amazonas:** Prov. Bagua, Yamayakat, trail to Putuim, 04° 55' S, 78° 19' W, 500 m, 17 Oct 1996 (stam. fl), *R. Vásquez & N. Jaramillo 20318* (AMAZ, BRIT, MO). **Loreto:** Prov. Loreto, Pampa Hermosa and vicinity, Río Corrientes, 1 km S of junction with Río Macusari, 03° 15' S, 75° 50' W, 160 m, 3–20 Dec 1985 (stam. fl), *W. Lewis et al. 10180* (BRIT, MO, USM).

Cybianthus sprucei was misinterpreted by Mez, and confused with *C. simplex* (Mez 1902). From there, *Weigeltia panamensis* was described based primarily on subtle differences and geography. Finally, Cuatrecasas described *Weigeltia purpurea* from the Chocó floristic region of Colombia, notable only for its narrower leaves, the secondary veins more arcuate, and some quantitative floral characteristics.

Cybianthus sprucei is most closely related to *C. simplex* because of the homomerous flowers, long petioles and non-mucronulate leaf apices. However, *Cybianthus sprucei* may easily be separated from *C. simplex* because of its arborescent habit, pyramidal panicle with spicate branches, symmetric leaf base and longer cataphylls.

19. **Cybianthus simplex** (Hook. f.) G. Agostini (**Fig. 4C**), Acta Biol. Venez. 10:163. 1980. *Comomyrsine simplex* Hook. f. *in* Benth. & Hook., Gen. Pl. 2:644. 1876. *Weigeltia simplex* (Hook. f.) Mez *in* Engl., Pflanzenr IV. 236(Heft 9): 290. 1902. TYPE: ECUADOR. CHIMBORAZO: At foot of Volcán Chimborazo, 760 m, Aug 1860 (pist. fl, fr), *R. Spruce 6143* (HOLOTYPE: K-2 sheets).

Weigeltia chamaephyta Diels, Notizbl. Bot. Gart. Berlin-Dahlem 15:383. 1941. syn. nov. *Cybianthus chamaephyta* (Diels) G. Agostini, Acta Biol. Venez. 10:163. 1980. TYPE: ECUADOR. PASTAZA: Mera, 1,200 m, 15 Nov 1938 (stam. fl), *H. Schultze-Rhonhof 2983* (HOLOTYPE: B-destr.; no isotype found). I defer neotypification until material has been regathered from the type locality or an adjacent one.

Semi-woody subshrub to 1(–3.5) m tall. *Stem* terete, 1–5 cm diam., sparsely glandular-papillate, glabrescent. *Cataphylls* few, spirally arranged in internodal areas, coriaceous, subulate, 6.5–26.5 mm long, 1.12–1.7 mm wide, keeled, densely and prominently black punctate and punctate-lineate, sparsely glandular-papillate, the margin flat, entire. *Leaves* pseudoverticillate; blades membranaceous, elliptic to oblong, (34.5–)38–46.5(–80) cm long, (12.5–)

13.5–18.5(–32.5) cm wide, apically broadly acute or rounded to a short acumen, rarely acute, basally asymmetric,broadly rounded or rarely abruptly acute, slightly decurrent on the petiole, hydropotes few above, numerous below, often sparsely glandular-papillate below, conspicuously black punctate, the margin irregular, hyaline when juvenile, opaque at maturity, flat, entire; petioles rigid, deeply canaliculate, 7–17(–21) cm long, 4–6 mm diam., slightly marginate at junctions of the blade, expanded basally and slightly decurrent on stem, sparsely glandular-papillate, glabrescent. *Inflorescence bracts* membranaceous, linear-lanceolate, 17–25 mm long, 2–4 mm wide, apically long-attenuate, hyaline, densely and prominently black punctate-lineate, the margin irregular, entire; peduncle (1.2–)2.4–4.5 cm long. *Staminate inflorescence:* a thyrsoid panicle (columnar) 11–28(–54) cm long, bi- or tripinnate, the primary branches subopposite, each branch pyramidal-paniculate, the flowers racemose; inflorescence branch bracts linear-lanceolate, subulate, (50–)61–72 mm long, 0.5–1.3 mm wide, apically long-attenuate, medially keeled, hyaline, glandular-papillose throughout, the margin entire; floral bracts early caducous; pedicels 2.3–3(–5) mm long, glandular-papillate and -ciliolate. *Staminate flowers* 5-merous, green to greenish-white when fresh; calyx membranaceous, subcotyliform, 1.1–1.4 mm long, equally divided, the tube 0.2 mm long, the lobes lanceolate to lanceolate-subulate, apically narowly acute to long-attenuate, hyaline, epunctate, the margin erose-dentate; corolla coriaceous, rotate, 2.2–3.1 mm long, the tube 0.3–0.7 mm long, the lobes linear-lanceolate, 1.5–2.6 mm long, 0.9–1.1 mm wide, reflexed distally 180° from the tube, the apically subulate, densely glandular-granulose throughout within and along the margin, epunctate, the margin regular, entire; stamens 1.0–2.3 mm long, the tube conspicuous, coriaceous, 0.3–0.7 mm long, the apically free portions of the filaments terete, as wide as the anthers, 1.0–1.1 mm long, ventrally recurved, the anthers connivent at first, subglobose, 0.4–0.5 mm long, 0.5–0.6 mm wide, apically rounded, basally cordulate, dorsifixed just above the base, the connective prominently black punctate dorsally; pistillode absent. *Pistillate inflorescence:* as in staminate but 16–30 cm long; inflorescence branch bracts ovate-subulate, 4.5–7 mm long, 1.5–2 mm wide, the margin irregular, erose; floral bracts membranaceous, linear-subulate, 1.6–2 mm long, 0.4–0.6 mm wide, apically long-attenuate, densely glandular-papillose puberulent, the margin irregular-entire; pedicel terete, 1–10 mm long, translucent, glandular-puberulent. *Pistillate flowers* green; calyx coriaceous, 0.6–1 mm long, unequally divided, the tube 0.2–0.3 mm long, the lobes ovate to widely ovate, 0.4–0.7 mm long and wide, apically acute, often moderately glandular-papillate without, the margin irregular, erose; corolla 1.5–1.7 mm long, the tube 0.4–0.5 mm long, the lobes oblong, 1.0–1.2 mm long, 0.7–0.8 mm wide, apically acute, reflexed 135°

from tube, glandular-papillate without; staminodes 0.8–1.2 mm long, the tube inconspicuous, membranaceous, 0.4–0.5 mm long, glabrous, elobate, the apically free portions of the filaments 0.3–0.4 mm long, the antherodes subglobose, 0.2 mm long, 0.3 mm wide, apically rounded, basally cordulate; pistil subglobose, 0.8–1.1 mm long, the ovary 0.6–0.8 mm long, 1.0–1.2 mm diam., densely translucent-lepidote, the style short, thick, 0.1 mm long, 0.7 mm diam., the stigma capitate, the margin lacinate, with numerous lobules to 0.2 mm long, the placenta umbonate, the ovules 3, exposed apically 1/3 their length on the placenta. *Fruit* subglobose, 4–5 mm long, 5–8 mm diam., red, exocarp somewhat thick, juicy, prominently black punctate.

Distribution.—Endemic to the slopes of the Western Cordillera of the Andes in Colombia and Ecuador, 60–2,200 m.

Ecology and conservation status.—*Cybianthus simplex* occurs in premontane wet and rainforests, occasionally in the understory of ridgetops forests. This species occurs in deep shade under the shrub stratum of the forest. It occurs more frequently in primary forest wet enough to maintain *Chusquea* populations, but can survive in disturbed forests as long as the shrub and *Chusquea* populations exist. Because of its habitat flexibility, it is not considered threatened or endangered.

Etymology.—The epithet "simplex" refers to the monoaxial habit of the species.

Specimens examined. **COLOMBIA**. **Nariño:** Mpio. Barbacoas, Corregimiento Ortíz y Zamora, Vereda El Barro, Reserva Natural Río Ñambí, ca. 5 km W de Altaquer, faldas occidentales de la Cordillera Occidental, 01° 18' N, 78° 08' W, 1,350–1,400 m, 1 Sep 1997 (stam. fl), *J. Pipoly, A. Cogollo, et al. 21026 , 21046, 21051, 21055*_(BRIT, FMB, JAUM, PSO), 2 Sep 1997 (bisex. fl), *J. Pipoly, A. Cogollo et al. 21109*_(BRIT, JAUM, PSO), (ster.)*J. Pipoly, A. Cogollo et al. 21131, 21148* (BRIT, PSO), (pist. fl, fr), *J. Pipoly, A. Cogollo et al. 21173* (BRIT, FMB, JAUM, PSO), 1,490–1,500 m, 4 Sep 1997 (stam. fl), *J. Pipoly, A. Cogollo et al. 21294* (BRIT, FMB, JAUM, PSO), (pist. fl), *J. Pipoly, A. Cogollo et al. 21296* (BRIT, FMB, JAUM, PSO), 1,350–1,400 m, 5 Sep 1997 (stam. fl), *J. Pipoly, A. Cogollo et al. 21326* (BRIT, JAUM, PSO), (ster.), *J. Pipoly, A. Cogollo et al. 21328* (BRIT, JAUM, PSO),1,350–1,145 m, 6 Sep 1997 (ster.), *J. Pipoly, A. Cogollo et al. 21417 (BRIT, FMB, JAUM),* 7 Sep 1997 (fr), *J. Pipoly, A. Cogollo et al. 21469, 21471,* 1,450–1,500 m, 8 Sep 1997 (stam. fl), *J. Pipoly, A. Cogollo et al. 21520* (BRIT, FMB, JAUM, PSO), (ster.), *J. Pipoly, A. Cogollo et al. 21524* (BRIT, JAUM, PSO); along trail from main Pasto-Tumaco Rd. to Río Ñambí, departing main Rd. at Escuela Mixta El Mirador, 7 km W of Altaquer, 01° 18' N, 78° 04' W, 1,100 m, 26 Feb 1992 (fr), *T. Croat 72394* (JAUM, MO); Corregimiento Altaquer, Vereda el Barro, Reserva Natural Río Ñambí, W slope, W Cordillera, 01° 18' N, 78° 08' W, near Cabaña Fundación FELCA, 1,325 m, 11 Dec 1993 (fr), *J. Betancur et al. 4857* (COL, MO); La Planada, Finca Salazar, 7 km above Ricaurte, 01° 08' N, 77° 58' W, 1,750 m, 29 Nov 1981 (pist. fl, fr), *A. Gentry et al. 35188* (BRIT, COL, MO, US); La Planada, S of Ricaurte, 7 km from Tumaco-Pasto Rd., 01° 10' N, 77° 58' W, 1,800 m, 24 Jul 1986 (stam. fl), *A. Gentry et al. 55053* (MO, PSO); trail to Hondón, 6-12 km SW of La Planada, 01° 04' N, 78° 02' W, 1,750-1,800 m, 5 Jan 1988 (fl bud), *O. de Benavides & R. Keating 60411* (MO, PSO); Valley of Río Guiza, Rd. from El Espino to Tumaco, ca. 21 km W of

Ricaurte, 01° 15' N, 78° 07' W, 1,000 m, 7 Dec 1988 (stam. fl), *B. Hammel 17150* (JAUM, MO). **ECUADOR. Bolívar:** Hacienda Changuil, LA 16; 02° 06' S, 79° 10' W, 500 m, 17 Aug 1995 (stam. fl), *X. Cornejo & C. Bonifaz 4339* (GUAY, MO). **Carchi:** Prominent hillcrest directly N of Lita, on N side of Río Mira, E of Río Baboso, W-facing slope, 00° 53' N, 78° 27' W, 760 m, 7 Aug 1994 (ster.), *B. Boyle 3473* (MO, QCNE), Steep N-facing slope S of Baboso, S side of Río Baboso, 00° 53' N, 78° 27' W, 750 m, 11 Aug 1994 (ster), *B. Boyle 3599* (MO, QCNE); Río Blanco drainage above Chical, tributary of Río San Juan, 12 km W of Maldonado, 1300–1500 m, 25 Sep 1979 (bisex. fl), *A. Gentry & G. Shupp 26565* (MO, QCNE); Cantón Tulcán, Parroquia Tobar Donoso, Reserva Indígena Awá, Centro El Baboso, 00° 53' N, 78° 25' W, 1,800 m, 17–27 Aug 1992 (stam. fl), *G. Tipaz et al. 1709* (BRIT, MO, QCNE), (stam. fl), *G. Tipaz et al. 1886* (MO, QCNE), (fr), *G. Tipaz et al. 1924* (MO, QCNE); 6 km above Maldonado, just below Puente de Palo, 00° 54' N, 78° 06' W, 2,275 m, 23 May 1993 (stam. fl), *B. Boyle & J. Bradford 1878* (MO, QCNE); Trail from Paílon to Gualpi Chicó, Reserva Indígena Awá, 1.5 km past Río Blanco, 00° 51' N, 78° 16' W, 1,000–1,450 m, 14 Jan 1988 (stam. fl), *W. Hoover et al. 2456* (MO, QCNE); SE Trail, Gualpi Chicó area of Awá Reserve, 00° 58' N, 78° 16' W, 1,330 m, 19 Jan 1988 (pist. fl, fr), *W. Hoover et al. 2809* (MO, QCNE); Trail along ridge and forest slope to NW of Awá encampment, Gualpi Chicó area near Finca Rodríguez, 00° 58' N, 78° 16' W, 1,258–1,323 m, 19 Jan 1988 (fr), *W Hoover et al. 3358* (MO, QCNE). Cotopaxi: Río Guarapa, ca. 20 km NW of El Corazón, 250 m, 19 Jun 1967 (stam. fl), *B. Sparre 17091* (S), 20 Jun 1967 (pist. fl), *B. Sparre 17081* (S). **El Oro:** 11 km W of Las Piñas on new Rd. to Sta. Rosa, 850 m, 8 Oct 1979 (stam. fl), *C. Dodson et al. 9101* (MO, SEL); Hacienda Buenaventura, 12 km W of Las Piñas on Rd. to Machala, 03° 48' S, 79° 46' W, 1,000 m, 1 Mar 1991 (stam. fl), *M. Kessler 2601* (GOET, MO); New Rd. Saracay-Balzas-Velacruz, ca. 8 km SE of Saracay, 400 m, 30 Apr 1980 (stam. fl), *G. Harling & L. Andersson 18778* (GB). **Guayas:** Cordillera Chogón-Colonche, Cerro Los Pontones; 01° 44' S, 08° 40' W, 500 m, 2 Jul 1994 (stam. fl), *X. Cornejo & C. Bonifaz 2979* (GUAY, MO). **Loja:** Tierra Colorada, 1 km E of Landara, 8 km E of Mercadillo, 04° 02' S, 79° 57' W, 1,500 m, 9 Feb 1991 (pist. fl, fr), *M. Kessler 2401* (BRIT, GOET). **Manabí:** Machalilla National Park, zona de San Sebastián, 01° 36' S, 80° 42' W, 600–700 m, 21 Jan 1991 (fr), *A. Gentry et al. 72499* (MO, QCNE). **Pichincha:** Quito-San Juan Chiriboga-Sto. Domingo de los Colorados Rd., Branch km 59, 18 km NW of Rd., 1,700–2,000 m, 27 Sep 1986 (bud), *V. Zak 1350* (MO, US); Quito-Aloag-Sto. Dominigo de los Colorados, km 94, 10 km S of Rd., W slopes of Volcán El Corazón, 00° 21' 30 "S, 78° 51' 15" W, 1,300–1,500 m, 25 Dec 1986 (fr), *V. Zak 1545* (MO, US); 15 ha. Patch of forest in Cooperativa Sta. Marta No. 2, along Río Verde, 2 km SE of Sto. Domingo de Los Colorados, 530 m, 5 Feb 1979 (fr), *C. Dodson et al. 7597* (MO, SEL); Reserva Florística-Ecológica "Río Guajalito," Km 59, Quito-Santo Domingo de los Colorados, 3.5 km NE of Rd., lower slopes of Volcán Pichincha, 00° 13' 53" S, 78° 48' 10" W, 1,800–2,200 m, 28 Dec 1985 (fr), *J. Jaramillo 8298* (MO, QCA); Cantón Quito, Parroquia Nanegal, Reserva Maquipucuna, along Inca Trail to Río Tulambí, ca. 5 airline km SE of Nanegal, 00° 07' N, 78° 38' W, 1,350 m, 15 Sep 1989 (fr), *G. Webster & P. Delprete 27594* (DAV, QCA), along trail between Río Umachaca and Río Tulambí, 00° 07.5' N, 78° 38.5' W, 1,200–1,300 m, 7 Jul 1990 (fr), *G. Webster et al. 27795* (DAV, QCA); Montañas de Maquipucuna, Cerro Sosa, 00° 0.5' N, 78° 37' W, 1,950 m, 3 Jul 1991 (fr), *G. Webster 28702* (DAV, QCA), 1,750 m, 3 Jul 1991 (stam. fl), *G. Webster et al. 28710* (DAV, QCA), on ridge between Base Camps 1 & 2, 00° 5.5' N, 78° 37' W, 1,800–1,900 m, 6–7 Jul 1991 (fr), *G. Webster & B. Castro 28769* (DAV, MO, QCA); along Río Umachaca near Hacienda El Carmen, 00° 07–7.5' N, 78° 38' W, 1,250 m, 6–7 Jul 1991 (fr), *G. Webster et al. 28796* (DAV, QCA). **Quininde:** Bilsa Biological Reserve, Montañas de Mache, 35 km W of Quinindé, 5 km W of Sta. Isabela, SE ridge trail, 00° 21' N, 79° 44' W, 400–600 m, 21

Sep 1994 (stam. fl), *N. Pitman et al. 688* (MO, QCNE), 5 Dec 1994 (fr), *N. Pitman 993* (MO, QCNE), Along Dogala and Invaders Trails, 00° 21' N, 79° 44' W, 400–600 m, 2 Jan 1995 (fr), *N. Pitman 1161* (MO, QCNE). **Province unknown:** without locality, Sep 1896 (pist. fl), *J. Sodiro 100/12* (B-destr., F Neg 4859).

This species has often been confused with *Cybianthus sprucei*, owing to variation in leaf morphology and inflorescence size. However, recent field studies conducted at the Río Ñambí Natural Reserve of Nariño, Colombia, have revealed that juvenile individuals have obtuse to somewhat broadly rounded, asymmetric leaf bases with long petioles, while mature individuals have tapering, asymmetric leaf bases. The confusion was due, in part, to precociously flowering individuals, detectable by their extremely small flowers, or to reiterative shoots, detectable by the renewal shoot visible below the "bayonet", that bears juvenile leaves and pink flowers. While the largest individuals of *Cybianthus simplex* may approach the size of many *C. sprucei*, the large pith of the stem in the former renders them extremely weak, and the stems may easily be snapped by hand, while the pith of *C. sprucei* is relatively smaller, and the stems can be bent without snapping in the field.

Cybianthus simplex is most closely related to *C. sprucei*, but may be separated from it by the columnar, thyrsoid panicles with racemose branches, the pedicellate flowers, asymmetric leaf base and shorter cataphylls. Populations corresponding to the type of *Weigeltia chamaephyta* differ from the type of *C. simplex* in floral structure, directly attributable to the fact that the former is based on a pistillate, and the latter a staminate collection. However, the autapomorphic columnar thyrsoid panicle leaves no doubt that they are synonymous. Because no further collections have been made in the region from which the type was collected, I defer neotypification until collections from that area are available.

20. **Cybianthus kayapii** (Lundell) Pipoly, comb. nov. (**Figs. 3E, 4F, 6J, 9A–F**). *Weigeltia kayapii* Lundell, Wrightia 6:118. 1980. TYPE: PERU. AMAZONAS: Camino de chichijam, entsa, 300 m, 2 May 1973 (fr), *R. Kayap 723* (HOLOTYPE: MO; ISOTYPE: LL-TEX).

Monoaxial treelet to 1(–2) m tall. *Stems* terete, (0.6–)1–1.7 cm diam., glandular-papillate at first, glabrescent. *Cataphylls* alternate in a high spiral, coriaceous, subulate, 15–45 mm long, 0.5–2(–3.5) mm wide. *Leaves* pseudoverticillate; blades chartaceous, oblanceolate to oblanceolate-oblong, (22–)31.3–55.5 cm long, 8.5–19.6(–23) cm wide, apically acute or broadly rounded to a small acutish tip, mucronate, the mucron to 0.5 mm long, the blade gradually tapering to an abruptly obtuse base appearing auriculate, to 1.5 cm wide, midrib slightly raised above, prominently raised below, the secondary veins 12–16 pairs, with prominent marginal and submarginal collecting veins, slightly sunken above, prominently raised below, glabrous above, with rufous hydropoten below; petiole deeply canaliculate, 1–2 cm long, ca. 3.5–

4 mm diam., densely glandular-papillate adaxially. *Staminate inflorescence*: a pyramidal, bipinnate panicle, (3–)5.5–29 cm long, 5–15(–26) cm wide, the branches racemose, densely glandular-papillate, succulent, then drying hyaline; peduncle 3–5.5 cm long; branch bracts membranaceous, subulate, 6.5–8 mm long, 0.5–1.5 mm wide; pedicels cylindrical, 1.2–1.8 mm long, sparsely glandular-papillate, glabrescent; floral bracts membranaceous, subulate, inserted on the pedicel about at middle, longer than the pedicel, 1.5–2.5 mm long, 0.1–0.2 mm wide, hyaline, densely glandular-papillate, the margin entire. *Staminate flowers* pink, heteromerous, the calyx 5-merous, the corolla 4-merous; calyx deeply membranaceous, cupuliform, 0.9–1.1 mm long, the tube 0.1–0.2 mm long, unequally divided, the lobes deltate to subdeltate, 0.6–0.9 mm long, 0.2–0.7 mm wide, highly reflexed at anthesis, apically acute, epunctate, hyaline, densely glandular-papillate, the margin glabrous, entire; corolla carnose, subrotate to rotate, 2–3 mm long, the tube 0.5–0.8 mm long, the lobes ovate, 1.5–2 mm long, 1.1–1.6 mm wide, apically acute, distally recurved 90° from tube axis at anthesis, opaque, densely glandular-granulose within and along margin, sparsely glandular-papillate along margins without, epunctate or sparingly and inconspicuously pellucid punctate, the margin entire; stamens 2.2–2.9 mm long, subequal to corolla lobe or exserted, the tube conspicuous, carnose, 0.5–0.8 mm long, hyaline, glabrous, elobate, the apically free portions of the filaments terete, 1.6–2.2 mm long, free from corolla, proximally recurved, the anther oblate, 0.3–0.5 mm long, 0.5–0.8 mm wide, always wider than long, apically emarginate to retuse, basally widely cordate, the connective prominently black punctate dorsally, conspicuously black punctate ventrally; pistillode absent or to 1 mm long, 0.1–0.3 mm wide, densely glandular-papillate. *Pistillate inflorescence* as in staminate but 6.5–9(–10.5) cm long, erect, not succulent, opaque, densely glandular-papillate; peduncle 1–2 cm long; branch bracts 2–3 mm long, 0.2–0.3 mm wide; pedicels subobsolete or cylindrical, to 1.2 mm long, incrassate and accrescent in fruit to 1.5 mm long; floral bracts inserted on pedicel, longer than the pedicel, 1–1.3 mm long, 0.2–0.3 mm wide. *Pistillate flowers* as in staminate but pink to pinkish-white; calyx 0.9–1.2 mm long, the lobes unequally divided, the smaller linear-lanceolate, 0.8–0.9 mm long, 0.3–0.4 mm wide, the larger deltate, 1.0–1.1 mm long and wide; corolla rotate, 2.6–2.9 mm long, the tube 0.9–1 mm long, the lobes elliptic, 1.7–2.0 mm long, 0.6–0.7 mm wide, reflexed at anthesis, distally recurved 180° from tube axis, glabrous without, sparsely glandular-granulose within, the margin slightly irregular; staminodes very poorly developed, 1.2–1.5 mm long, the tube 0.9–1.0 mm long, the apically free portions of the filaments 0.3–0.6 mm long when developed, recurved proximally, the anthers badly formed, at times consisting of 2–3 prominently punctate glands at filament apex, or otherwise as in the stamens, ovate to subglobose, 0.2–0.3 mm long,

0.3–0.4 mm wide, apically irregular, obtuse, emarginate or retuse, basally cordate, the connective when distinguishable prominently black punctate dorsally, conspicuously punctate ventrally; pistil clavate to lageniform, 3–3.5 mm long, the ovary 0.9–1.1 mm long, 1.2–1.5 mm diam., densely papillate, the style 2.1–2.4 mm long, the stigma large, capitate, with 4 principal lobes, each irregularly lacinate-lobulate, early caducous, the placenta deeply cupuliform, the ovules 2, buried for 1/2 their length. *Fruit* depressed-globose, 5–6 mm long, 7–9 mm wide, prominently black punctate, the exocarp thin. *Bisexual inflorescence*: as in staminate but 4–13 cm long. *Bisexual flowers* as in staminate flowers but calyx 1.1–1.9 mm long, the tube 0.2–0.3 mm long, the lobes unequally divided, deltate to elliptic, the smaller 0.6–0.7 mm long and wide, the larger 0.9–1.6 mm long, 0.5–0.6 mm wide, otherwise as in pistillate flowers; corolla 2.6–2.8 mm long, the tube ca. 0.6 mm long, the lobes narrowly ovate, 2.0–2.2 mm long, 1.2–1.3 mm wide, recurved distally 90° from tube, sparsely glandular-granulose within, glandular-papillate along the margin; stamens as in staminate flower, but 2.2–2.7 mm long, always slightly shorter than corolla tube, the tube ca. 0.6 mm long, the apically free portions of the filaments 2.0–2.2 mm long, the anthers widely ovate, ca. 0.3 mm long, 0.5–0.6 mm wide, apically obtuse to emarginate, basally widely cordate; pistil 2.7–2.9 mm long, the ovary 0.8–0.9 mm long, 0.6–0.7 mm diam., densely glandular-papillate, the placenta deeply cupuliform, the ovules 2, buried for 1/2 length. *Bisexual fruit* depressed-globose, 5–6 mm long, 6–7 mm wide, prominently black punctate, the exocarp thin.

Distribution.—Colombia (Amazonas, Chocó, Nariño, Valle del Cauca,), Ecuador (Chimborazo, Napo and Pichincha), Peru (Amazonas, Loreto, San Martín) and Brazil (Acre), growing at sea level–2,530 m elevation.

Ecology and conservation status.—*Cybianthus kayapii* is locally common in small populations at the high water line in primary "tahuampa" habitats (várzea forest), along white water rivers, or rarely in premontane habitats along the edge of pools fed by creeks. The species is not known to be cultivated and occurs only in areas where deep leaf litter and alluvial deposits are left after flooding action. It appears that the species can easily be destroyed by soil compaction as a result of trampling, and thus, it should be considered threatened.

Etymology.—The epithet commemorates Rubio Kayap, an indigenous Aguaruna Peruvian plant collector who worked with Brent Berlin, known for his great knowledge of Amazonian flora and ethnobotany.

Local names and uses.—Colombia: "Hierba de palo grande"(Spanish). Ground in crude syrups to cure cuts, internal infections, to clean the uterus and the stomach. Ecuador: "putush" (Shuar). Used against intestinal parasites and for chronic rectal bleeding (colo-rectal carcinoma °); 10 lbs. of root boiled in 8 liters of water, down to one liter; 8 cc given as enema before bed; useful for "dysentery." Peru: "mantaya," "kugkuima muspari" (Aguaruna); used to disinfect dog and insect bites; "napi tsuake" (Huambisa). Brazil: used in curare cf. *B. Krukoff 7663*.

Representative specimens examined. **COLOMBIA. Amazonas:** Mpio. Leticia, Parque Nacional Natural Amacayacu, Centro Administrativo Mata-matá, trail to Amacayacu, km 4, 03° 47' S, 70° 15' W, 120 m, 25 Sep 1991 (stam. fl), *A. Rudas & A. Prieto 3147* (COL, FMB, MO), 110–120 m, 28 Oct 1991 (fl bud), *J. Pipoly & J. Murillo 15483* (COL, FMB, MO), Quebrada de Agua Pudre, ca. 1.5 km NE of junction with Río Amacayacu, permanent inventory plot, 200–220 m, 11 Nov 1991 (ster.), *J. Pipoly et al. 15896* (COL, FMB, MO), 15 Nov 1991 (stam. fl), *J. Pipoly et al. 16075* (COL, FMB, MO); Río Loretoyacu, 100 m, Oct 1946 (bisex. fl), *R. E. Schultes & G. Black 8427* (US). **Chocó:** Bahía de Solano, 13–18 Apr 1982 (pist. fl, fr), *R. Dressler 6036* (COL, FLAS, MO); Mpio. de Quibdó, Corregimiento San Francisco Ichó, Quebrada Caledonia along Caledonia Rd., 9 Apr 1987 (ster.), *F. García & J. Echavarría 259-A* (COL, CHOCO, MO). **Nariño:** Mpio. Ricaurte, Reserva Natural La Planada, 1,800 m, 13 Nov 1993 (fr), *C. Restrepo 723* (BRIT, MO, PSO); La Planada, Finca Salaazar, 7 km above Ricaurte, 01° 08' N, 77° 58' W, 1,750 m, 27 Nov 1981 (fr), *A. Gentry et al. 35062* (MO, PSO). **Nariño:** Mpio. Barbacoas, Corregimiento Ortíz y Zamora, Vereda El Barro, Reserva Natural Río Ñambí, ca. 5 km W de Altaquer, faldas occidentales de la Cordillera Occidental, 01° 18' N, 78° 08' W, 1,350–1,400 m, 3 Sep 1997 (ster.), *J. Pipoly, A. Cogollo, et al. 21241* (BRIT, FMB, JAUM, PSO). **Valle del Cauca:** Río Calima, región del Chocó, La Trojita, 5–50 m, 20 Feb 1944 (stam. fl), *J. Cuatrecasas 16272* (COL, F, US); Mpio. El Cairo, Cerro del Inglés, summit, Cordillera Occidental, Serranía de los Paraguas, limit Valle/Chocó, El Cairo-Río Blanco Hwy, 1 hour in jeep from El Cairo, 2,400 m, 1 Jan 1987 (pist. fl), *P. Silverstone-Sopkin et al. 2871* (CUVC). **ECUADOR. Carchi:** Cantón Tulcán, Parroquia Tobar Donoso, Reserva Indígena Awá, Centro El Baboso, 00° 53' N, 78° 25' W, 1,800 m, 17–27 Aug 1992 (stam. fl), *G. Tipaz et al. 1706* (MO, QCNE). **Esmeraldas:** Cantón San Lorenzo, Parroquia Ricaurte, Reserva Indígena Awá, Comunidad Balsareño, Río Palabí, 01° 09' N, 78° 31' W, 100 m, 15–29 Apr 1991 (fl bud), *D. Rubio & C. Quelal 1335* (MO, QCNE). **Chimborazo:** Cordillera Occidental, "El Carmen," Sibambe, 2,450 m, 22 Aug 1943 (pist. fl), *M. Acosta-Solís 5544* (F, QCNA); on slopes of Chimborazo Volcano, (pist. fl, fr), *A. Sodiro 100/14* (B, destr., QA?, n.v.). **Morona-Santiago:** Basin of Río Morona, Río Mangosiza, Nayumbime, 45 km SE of Sucua (by air), 200 m S of Don Luís Najamte's house, ca. 02° 43' S, 77° 38' W, 300 m, 27 Feb 1990 (fr), *C. Limbach 140* (QCA, NY). **Napo:** Antisana, Shinguipino Forest, between Ríos Napo and Tena, 8 km SE of Tena, 01° 00' S, 77° 50' W, 450 m, 17 Sep 1960 (stam. fl), *P. Grubb et al. 1633* (K, NY); Cantón Archidona, Carretera Hollín-Loreto, Río Huataraco, 2 hrs by foot from Guagua Sumaco, 00° 43' S, 77° 32' W, 800–1,000 m, 23–30 Aug 1989 (fl bud), *C. Cerón & M. Factos 7641* (MO, QCNE); Cantón Tena, 17 Oct 1939 (stam. fl), *E. Asplund 9396* (S); 3 km E of Caserío Huamaní, N of Carretera Hollín-Loreto, 00° 43' S, 77° 36' W, 1,200 m, 17 Sep 1988 (fr), *F. Hurtado & A. Alvarado 503* (MO, QCNE). **Pichincha:** Along Rd. from Tandayapa to Mindó, 10 km from Tandayapa, 2,530 m, 16 Dec 1979 (fr), *T. Croat 49361* (MO, QCNA). **PERU. Amazonas:** Prov. Bagua, Dtto. Imaza, Comunidad Aguaruna de Kampaentza (PUJAIM), property of Juan Mayán, 740 m, 6 Oct 1994 (pist. fl), *C. Díaz et al. 7265* (BRIT, HUT, MO, USM); Prov. Condorcanqui, Drto. El Cenepa, NE region of Marañon Drainage Basin, Río Cenepa, Comunidad Tutino, 04° 33' S, 78° 10' W, 350 m, 21 Nov 1993 (pist. fl, fr), *R. Vásquez et al. 18395* (AMAZ, BRIT, HUT, MO, USM); Río Cenepa, vicinity of Huampami, ca. 5 km E of Chavez Valdívia, 04° 30' S, 78° 30' W, Quebrada Chigkishinuk, 10 Apr 1973 (fr), *E. Ancuash 211* (MO), 11 Aug 1978 (pist. fl), *E. Ancuash 1405* (MO); Trail one day walk from Huampami to Shaim, creek running into Nahim, 600 m, 27 Nov 1972

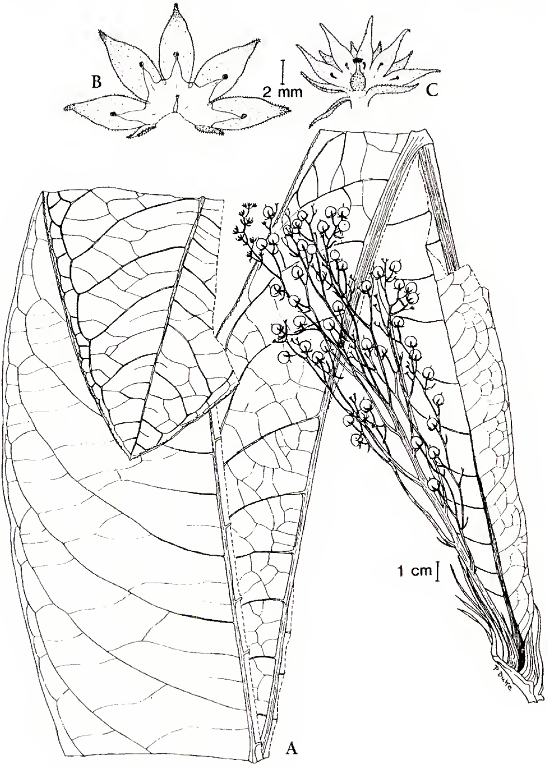

FIG. 17. *Cybianthus anthuriophyllus* Pipoly. A. Habit, showing pleiochasium with sympodial branches. B. Staminate flower, showing lanceolate-subulate corolla lobes, elobate staminal tube, and conic, vestigial pistillode. C. Pistillate flower, showing attenuate-acicular calyx lobes and obturbinate pistil. A, C, drawn from holotype. B, drawn from *Bravo & Gomez 49*. Figure drawn by Peggy Duke.

(stam. fl), *B. Berlin 393* (MO); Río Santiago, W bank, 400 m beyond La Poza, 180 m, without date (fr), *F. Domínguez 147* (MO); 800 m beyond Caterpiza, 200 m, 4 Sep 1979 (fr), *V. Huashikat 356* (MO), 10 Sep 1979 (stam. fl), *V. Huashikat 507* (MO), 12 Sep 1979 (bisex. fl), *V. Huashikat 581* (MO); 26 Mar 1980 (fr), *S. Tunquí 1110* (MO). **Loreto:** Prov. Maynas, Explorama Lodge, near Yanamono, between. Indiana and mouth of Río Napo 03° 28' S, 72° 50' W, 103 m, 27 Jun 1983 (fr), *Gentry et al. 42247* (AMAZ, MO, NY), 106 m, 15 Apr 1985 (fr), *R. Vásquez & N. Jaramillo 6325* (AMAZ, MO), 28 Sep 1988 (stam. fl), *R. Vásquez & N. Jaramillo 11100* (AMAZ, MO)11 Jul 1990 (fr), *R. Vásquez & N. Jaramillo 14092* (AMAZ, MO, US), 25 km NE of Iquitos, along Río Amazonas, 90 m, 03° 30' S, 72° 50' W, 26 Sep 1990 (stam. fl), *J. Pipoly et al. 12383* (AMAZ, MO), along S border trail, 110 m, 27 Sep 1990 (stam. fl), *J. Pipoly et al. 12490* (AMAZ, MO, NY, US, USM), (stam. fl), *J. Pipoly et al. 12541* (AMAZ, MO, US, USM); Prov. Alto Amazonas, N slopes of Cerros Camapaquíz at Pongo de Manseriche, right bank of Río Marañon, 300–550 m, 19–21 Oct 1962 (stam. fl), *J. Wurdack 2324* (US, USM). **San Martín:** Pongo de Cainarachi, Río Cainarachi, tributary of Río Huallaga, 230 m, Sep–Oct 1962 (stam. fl-except specimen at S-bisex. fl), *G. Klug 2691* (A, F, GH, K, MO, NY, S, US). **BRAZIL. Acre:** Cruzeiro do Sul, Rios Juruá and Moa, 8 km above Cachoeira Grande, 07° 30' S, 73° 30' W, 27 Apr 1971 (fr), *G. Prance et al. P12555* (IAN, MG, NY). **Amazonas:** Basin of Rio Javarí, Mpio. São Paulo de Olivença, near Esperança, Dec 1935 (fr), *B. Krukoff 7663* (NY, U).

Cybianthus kayapii may be confused with *C. sprucei* (Hook. f.) G. Agostini, but may be recognized by the shorter petioles, heteromerous flowers and mucronate leaf apices. However, the leaf blades with mucronulate apices and subauriculate bases, and heteromerous flowers indicate *Cybianthus kayapii* is more closely related to *C. anthuriophyllus*. From *Cybianthus anthuriophyllus, C. kayapii* may be separated by the much smaller, flat, entire leaves with entire margins, the deltate calyx lobes with entire margins, and the carnose corolla.

21. **Cybianthus anthuriophyllus** Pipoly, sp. nov. (**Fig. 17**). Type: ECUADOR. Napo: Cantón Gonzalo Pizarro, Río Tigre, affluent of Río Dashino, entering from 73 km of Rd. from Lumbaque to El Reventador, 10 km S of Lumbaque, 00° 05' S, 77° 24' W, 900–1,100 m, 18–21 Feb 1987 (pist. fl, fr), *W. Palacios & D. Neill 1584* (holotype: US; isotypes: K, MO, QCNE).

Ob folia oblanceolata ab lamina ad petiolum gradatim contracto, a primo intuitu cum *C. kayapi* confusa est, sed ab ea marginibus laminaribus revolutis serrulatisque (nec integerrimis planisque) inflorescentiis 28 (non 8–15) cm longis, pleiochasia cum ramulis floriferis cymosis (nec bipinnatipaniculatis cum ramulis floriferis racemosis) lobulis calycinis subulatis (nec ovatis) praeclare distat.

Monoaxial treelet to 0.6 m tall. *Stems* terete, weakly woody, ca. 2 cm diam., sparsely glandular-papillate, glabrescent. *Cataphylls* tightly pseudoverticillate, coriaceous, linear-subulate, 4.0–6.5 cm long, 0.3–0.6 cm wide, densely and prominently punctate-lineate, sparingly glandular-papillate, glabrescent. *Leaves* pseudoverticillate, erect; blades coriaceous, narrowly lanceolate, (56–) 104–110cm long, (14.5–)17–22 cm wide, apically broadly rounded or rounded to a minute abrupt submucronate acumen 2 mm long, the blade gradually tapering to the petiole, almost obtusish basally, midrib slightly raised above, prominently raised below, the secondary veins ca. 42 pairs, impressed above, prominently raised below, nitid and epunctate above, purple (when fresh), inconspicuously punctate and papillate-puberulent below, the papillae erect, rufous, the margin thin, opaque, inrolled, prominently straight-serrulate, the teeth alternatively larger and smaller (ca. 1 mm and 0.5 mm long, respectively); petiole deeply canaliculate, thick, ca. 1.5 cm long, 0.8 cm diam., sparingly glandular-papillate. *Staminate inflorescence*: a pyramidal thyrsoid panicle, ca. 16 cm long, 23 cm wide, the branches pseduoracemose (sympodial), the rachis densely glandular-papillate, the peduncles longer below, shorter above; inflorescence branch bracts linear-lanceolate, 7–9 mm long, 2–3 mm wide, apically attenuate-acicular, sparsely glandular-papillate, the margin entire; floral bracts acerose, 2–3 mm long, 0.4–0.8 mm wide; pedicels 1.0–2.5 mm long, angular, thin, the longer pedicels in the lower portion of the inflorescence, the shorter ones above, densely glandular-papillate, the papillae persistent. *Staminate flowers* heteromerous, membranaceous, hyaline, the calyx (5–)6-merous, the corolla 5-merous; calyx subcotyliform 3.7–4.7 mm long, 0.4–0.7 mm wide, apically acuminate-acicular, prominently keeled, the keel thickened hyaline, epunctate, sparsely glandular-papillate except densely so along the margin, the margin entire; corolla subrotate, 7.4–10 mm long, the tube 0.7–0.9 mm long, the lobes lanceolate-subulate, 6.3–9 mm long, 2.7–3.2 mm wide, the apically long-acuminate, highly reflexed, sparsely glandular-papillate without, very sparsely glandular-granulose within above the junction within tube the margins densely glandular-papillate, entire; stamens 2.2–4.1 mm long, the staminal tube conspicuous, coriaceous, 1.4–1.8 mm long, glabrous, elobate, the apically free portions of the filaments ventrally recurved, 0.8–0.9 mm long, flat, glabrous, the anthers ovate, 0.3–0.4 mm long and wide, apically and basally emarginate, dorsifixed less than _ length, the connectives prominently black punctate ventrally and dorsally; pistillode conic, vestigial–0.8 mm long or absent. *Pistillate inflorescence* a pleiochasium, with branches cymose (sympodial), the rachis densely glandular-papillate, the peduncles 1–3 cm long, longer below, shorter above; inflorescence bracts resembling cataphylls but smaller, 1.3–1.6 cm long, 1.0–1.3 mm wide, conspicuously punctate-lineate; inflorescence branch bracts linear-lanceolate, 1.2–1.5 mm long, 0.2–0.4 mm wide, apically attenuate-acicular, sparsely glandular-papillate, the margin entire; floral bracts acerose, longer than the pedicels, 0.5–1.0 cm long; pedicels angular, thin, 1.2–7.5 mm long, the longer pedicels in the lower portion of the inflorescence, densely glandular-papillate, the papillae persistent. *Pistillate flowers* as in staminate but calyx 6-merous, (2.1–)3–4.1 mm long, the tube 0.3–0.7 mm long, 0.5–1.0 mm wide, apically long-attenuate-acicular; corolla (from dried remnants) subrotate, hyaline, 5.0–7.1 mm long, the tube 1.0–1.3 mm long, the lobes linear-subulate, 4.0–5.8 mm long, 1.1–1.5 mm wide at base, apically subulate, highly reflexed, twisted and distally recurved at anthesis; staminodia 1.2–1.3 mm long, the staminodial tube 0.9–1.2 mm long bearing well-developed lobes alternate with the apically free filaments, the filaments 0.3–1.1 mm long, flat, glabrous, the antherodes malformed, mostly consisting of undifferentiated tissue surrounding prominent black punctations or suborbicular and 0.1–0.5 mm long, 0.1–0.6 mm wide, always wider than long, apically emarginate, dorsifixed slightly less than _ length, the connectives prominently black punctate dorsally; pistil obturbinate, 2.5–3.0 mm long, the ovary 1.0–1.5 mm long, 0.8–1.3 mm wide, densely papillate and prominently black punctate, the style 1.3–1.7 mm long, densely glandular-papillate, the stigma large, capitate, lobes, the lobes lacinate, each lobe to 0.4 mm long, early caducous, the placenta widely conic, bearing 4 uniseriate, exposed ovules, the ovules on the periphery of the placenta. *Bisexual fruit* pink, globose, 4–6 mm long and diam., the punctation prominent, brown when fresh (teste coll.), red or black upon drying, the exocarp thin.

Distribution.—Amazonian ("Oriente") Ecuador and adjacent Peru (Loreto), 160–300(–1,100) m elevation.

Ecology and conservation status.—*Cybianthus anthuriophyllus* grows in primary tropical wet forest and premontane wet forest on *terra firme* above the high water contour. It is found in primary forest as well as in secondary, but it is not known whether the plant is cultivated in secondary forest situations. At this time, the species can be considered locally common but not threatened.

Etymology.—The specific epithet refers to the unique shape of the adult leaves, held erect *in vivo* and reminiscent of *Anthurium crassinervium* (Araceae).

Local names and uses:—Ecuador: "namákuk" (Achuar Jívaro); "Acuarí" (dialect unknown); "challuo panga" (Quichua). Peru: "kutúkupish," "takushia," "mutúpash," "kurúp" (Mayna Jivaro), "sierra panga" (Quichua). Leaves crushed and used as a fish poison(*W. Lewis et al. 14051*); inner stem is scraped and an infusion given to dogs to drink to improve their hunting abilities and to enhance their stamina (*W. Lewis et al. 11153);* stem is scraped and its juice put into a dog's nose to produce sneezing (*W. Lewis et al. 10475*), or to "make it an attack dog against thieves" (*Lewis et al. 12853*).

Paratypes. **ECUADOR. Napo:** Cuyabeno-Punta Arenilla; Sep 1981 (stam. fl), *E. Bravo & P. Gómez 49* (QCA); Canton Orellana, Yasuní National Park, Maxus Rd. and pipline construction project km 10, 00° 29' S, 76° 34' W, 250 m, 29 Jun 1994 (fr), *N. Pitman 448* (MO, QCNE). **Pastaza:** Kapawí (Amuntaí), río Pastaza; Village area, 02° 31' S, 76° 48' W, 235 m, 25–29 Jul 1989 (ster.), *W. Lewis et al. 14051* (MO). **PERU. Loreto:** Prov. Alto Amazonas, Puranchim, Río Sinchiyacu, 02° 50' S, 76° 55' W, 200 m, 3–7 Dec 1988 (ster.), *W. Lewis et al. 14390* (MO); Washintsa and vicinity, Río Huasaqa, 03° 20' S, 76° 20' W, 185 m, 16–26 Jun 1986 (ster.), *W. Lewis et al. 11153* (MO); Prov. Loreto: Nueva Jerusalem and vicinity, Río Macusari, 02° 55' S, 76° 15' W, 220–300 m, 29 Dec 1985–3 Jan 1986 (fr), *W. Lewis et al. 10475* (MO); Pampa Hermosa and vicinity, Río Corrientes, 1 km S of junction with Río Mucusari, 03° 15' S, 75° 50' W, 160 m, 3–20 Dec 1985 (stam. fl), *W. Lewis et al. 10340* (MO); Vista Alegre, Río Tigre, 02° 40' S, 75° 35' W, 240 m, 17 Mar 1987 (ster.), *W. Lewis et al. 12853* (MO).

Cybianthus anthuriophyllus is unique within subgenus *Comomyrsine* by its small, marginal pectinate leaf serrations and pleiochasial inflorescence, appearing paniculate, but with sympodial primary and secondary branches, and thus, cymose. The leaves appear subsessile, with the blade gradually tapering to the deeply canaliculate petiole, a feature found otherwise only in its closest congener, *Cybianthus kayapii*. However, *Cybianthus anthuriphyllus* is clearly distinct from *C. kayapii* because of the inrolled, pectinate-serrulate leaf blade margin, the much longer, pleiochasial inflorescence, and subulate calyx lobes. The extremely long cataphylls are the best developed in the subgenus.

V. **Cybianthus** subgenus **Triadophora** (Mez) G. Agostini, Acta Biol. Venez. 10:164. 1980. *Weigeltia* subgenus *Triadophora* Mez in Engl., Pflanzenr. IV. 236(Heft 9):291. 1902. TYPE SPECIES. *Weigeltia schlimii* (Hook. f.) Mez in Engl. = *Cybianthus schlimii* (Hook. f.) G. Agostini.

Correlliana D'Arcy, Ann. Missouri Bot. Gard 60:442. 1973. TYPE SPECIES. *Correlliana spectabilis* (Standl.) D'Arcy = *Cybianthus schlimii* (Hooker f.) G. Agostini.

As here interpreted, *Cybianthus* subgenus *Triadophora* is monotypic. Its only species, *C. schlimii*, is easily recognized by its monoaxial habit and autapomorphic rufous glandular tomentum of malpigiaceous trichomes, leaf blades with subepidermal fibers and pseudocataphylls (here defined as petiolate cataphylls). The first full description of *Cybianthus schlimii* is provided, along with complete synonymy and complete exsiccatae for Ecuador and Peru, and representative ones for other areas.

22. **Cybianthus schlimii** (Hook. f.) G. Agostini (**Fig. 3D, 6K, 6L**), Acta Biol. Venez. 10:165. 1980. *Comomyrsine schlimii* Hook. f. in Benth. & Hook., Gen. Pl. 2:644. 1876. *Weigeltia schlimii* (Hook. f.) Mez in Engl., Pflanzenr. IV. 236(Heft 9):291. 1902. *Correlliana schlimii* (Hook. f.) D'Arcy, Ann. Missouri Bot. Gard 60:443. 1973. TYPE: COLOMBIA. META: Llano de San Martín, 300 m, Jan 1856 (stam. fl), *J. Triana 7594* (HOLOTYPE: K; ISOTYPES: COL, LE, MA, P).

Weigeltia multiflora A.C. Smith., Bull. Torrey Bot. Club 60:387. 1933. syn. nov. *Correlliana multiflora* (A. C. Sm.) D'Arcy, Ann. Missouri Bot. Gard 60:445. 1973. (A. C. Sm.) G. Agostini, Acta Biol. Venez. 10:165. 1980. TYPE: BRAZIL. MATO GROSSO: Near Tabajara, upper Rio Machado, 23 Nov 1931 (stam. fl), *B. A. Krukoff 1388* (HOLOTYPE: NY; ISOTYPE: A).

Ardisia spectabilis Standl., Publ. Field Mus. Nat. Hist. Bot. Ser. 18:893. 1938. syn. nov. *Weigeltia spectabilis* (Standl.) Lundell, Wrightia 4:169. 1971. *Correlliana spectabilis* (Standl.) D'Arcy, Ann. Missouri Bot. Gard. 60:443. 1973. *Cybianthus spectabilis* (Standl.) G. Agostini, Acta Biol. Venez. 10:165. 1980. TYPE: COSTA RICA. ALAJUELA: Cataratas (Los Angeles) de San Ramón, Apr 1935 (stam. fl), *A. Brenes 20530* (HOLOTYPE: F; ISOTYPES: CR, F).

Weigeltia triandra Aspl., Bot. Not. 1939:802. 1939. TYPE: COLOMBIA. CAUCA: Near Distrito El Tambo, 900 m, 31 Jul 1936 (stam. fl), *K. von Sneidern 919* (HOLOTYPE: S).

Weigeltia schlimii (Hook. f.) Mez var. *intermedia* Moldenke, Phytologia 2:242. 1947. TYPE: COLOMBIA. VALLE DEL CAUCA: Pacific coast, Río Cajambre, San Isidro, 5–100 m, 2–5 May 1944 (stam. fl), *J. Cuatrecasas 17312* (HOLOTYPE: NY; ISOTYPES: COL, F-2 sheets).

Monoaxial tree to 5 m. *Stem* terete, 0.8–2.0 cm diam., the wood dense, minutely rufous glandular appressed tomentose, the trichomes malpighiaceous, early glabrescent. *Pseudocataphylls* produced only irregularly, chartaceous, subulate, ca. 2.0–3.0 cm long, 0.5–1.0 cm wide, apically acute, mucronate, densely rufous puberulent, black lineate-punctate, the margin entire; petiole subobsolete, to 0.2 cm long. *Leaves* tightly pseudoverticillate; blades chartaceous, elliptic, oblong or oblanceolate, 25–65 cm long, 5.5–20 cm wide, apically acute or subacuminate, mucronulate, the mucro often sclerified, the acumen 0.5–3.0 cm long, base long-attenuate, the blade decurrent on the upper portion of the petiole, midrib slightly elevated above, prominent below, the secondary veins 9–13 pairs, prominent, the marginal veins loop connected, conspicuously striolate by subepidermal fibers, these visible above and below, sparsely rufous puberulent above, moderately puberulent below, at times glabrescent, hydropotes absent, sparsely to densely punctate or lineate-punctate below, the margin opaque, irregular, entire to roughly serrate; petioles canaliculate, 1.0–3.0(–10) cm long, 0.5–1.0 cm diam., abruptly swollen basally, puberulent, glabrescent. *Staminate Inflorescence* a pinnate or bipinnate columnar panicle 13–40 cm long, 3–20 cm wide, the rachis densely glandular-papillate and rufous puberulent, the flowering branches racemose; peduncle 8–15 cm long; inflorescence bract chartaceous, ovate, 9–15 mm long, 2.4–4.5 mm wide, apically acute, densely rufous glandular puberulent, conspicuously black punctate and lineate-punctate, the margin opaque, entire; inflorescence branch bracts membranaceous, linear, 10–13 mm long, 1.9–2.1 mm wide, apically narrowly acute, mucronulate, minutely rufous puberulent, orange furfuraceous lepidote, densely and conspicuously black lineate-punctate, the margin opaque, entire; floral bracts membranaceous, subulate, 0.8–1.3 mm long, 0.2–0.4 mm wide, sparsely rufous puberulent, the margin entire; pedicel terete, 2.0–4.5 mm long, prominently black punctate, densely papillate and rufous puberulent. *Staminate flowers* 3(–4)-merous, light purple, then dull yellow; calyx chartaceous, cupuliform, 0.9–1.8 mm long, the tube 0.3 mm long, the lobes subdeltate, 0.7–1.6 mm long, 0.9–1.2 mm wide, apically acute, densely rufous puberulent, glabrescent, densely and prominently black punctate, the margin flat, wide, hyaline, densely ciliolate, the cilia often caducous; corolla rotate, chartaceous, 3.0–5.0 mm long, the tube hyaline, 0.8–1.0 mm long, the lobes elliptic or oblong, 2.2–4.0 mm long, 1.6–2.2 mm wide, apically obtuse to rounded, subcucullate, involute, distally recurved 180° relative to tube, sparsely rufous puberulent without, very sparsely glandular-granulose within basally, often glabrescent, very densely and prominently black punctate except margin hyaline, irregular, glabrous, entire; stamens 2.4–3.5 mm long, the tube membranaceous, inconspicuous, 0.8–1.0 mm long, hyaline, epunctate, glabrous, elobate, the apically free portions of the filaments 1.8–2.3 mm long, sparsely or epunctate, sparsely rufous puberulent at first, glabrescent, the connective prominently punctate, or inconspicuously so, the punctation orange, red or black, the anthers cordate, 0.5–0.6 mm long, 0.7–1.0 mm wide, apically subacute to rounded, base deeply cordate, dorsifixed at point less than 1/5 distance from apex; pistillode none or conic, to 1.0 mm long, densely and prominently black punctate and rufous papillate. *Pistillate inflorescence* as in staminate but more columnar, (3.5–)8.0–18.5 cm long, (2.0–)3.5–6.0 cm wide, the branches subcorymbose to rarely racemose; peduncle 1.5–6.8 cm long; inflorescence bract ovate to elliptic, 4.5–12 mm long, 1.9–4.0 mm wide, conspicuously black punctate; inflorescence branch bracts 5–15 mm long, 0.5–2.5 mm wide; floral bracts 0.9–2.0 mm long, 0.3–0.6 mm wide; pedicels terete, 2.0–4.0 mm long, accrescent to 5.0 mm long and incrassate to 2.0 mm diam. in fruit. *Pistillate flowers* as in staminate but 3-merous, calyx purple, corolla yellow; calyx subcotyliform, 1.8–2.0 mm long, the tube 0.2–0.3 mm long, the lobes subdeltate to widely ovate, 1.6–1.8 mm long, 1.6–2.2 mm wide, apically acute, the margin slightly erose, conspicuously long glandular-ciliate, the cilia often caducous; corolla 4.2–5.0 mm long, the tube 0.3–0.5 mm long, the lobes oblong, 3.2–4.5 mm long, 2.3–2.6 mm wide, apically obtuse, somewhat cucullate, reflexed ca. 45° from tube axis, densely puberulent without, sparingly glandular-granulose basally within; staminodes to 2.5 mm long, the tube membranaceous, inconspicuous, to 0.5 mm long, the filaments adnate to corolla lobe ca. 0.5 mm long, then apically free to 1.0 mm long, thick, terete, rarely punctate, the antherodes cordate, ca. 0.6 mm long, 0.7–0.8 mm wide, apically acute to apiculate, base widely cordate, the connective punctate, prominently or not; pistil clavate to obnapiform, 4.0–5.2 mm long, the ovary 1.8 mm long, 0.5–1.6 mm wide, prominently black punctate and rufous puberulent, the style to 1.3 mm long, densely rufous puberulent, the stigma capitate to lobed, 3(–4)–lobed, the placenta deeply cupuliform, bearing 2 ovules exposed apically. *Fruit* globose, 1.0–1.3 cm long, 1.0–2.0 cm diam., at maturity, the exocarp bright orange to red-orange, prominently black punctate.

Distribution.—From the Atlantic Slope (Dpto. Río San Juan) Nicaragua, to state of Pando, Bolivia and adjacent Amazonia of Brazil, 0–1,800 m.

Ecology and conservation status.—*Cybianthus schlimii* occurs in a variety of habitats, from lowland to premontane tropical moist, wet and pluvial forest. It is locally common, but restricted to primary forest. Therefore, it should be considered threatened.

Etymology.—The species is named for Louis Joseph Schlim, a Belgian plant collector working for J.J. Linden in Brussels, who collected extensively around

Caracas to the Venezuelan Andes, and from there, to the grasslands of Meta and the Sabana de Santafé de Bogota, Colombia, during the period 1841-1852. Schlim also collected with Nicolas Funck later in Venezuela.

Local names and uses.—Peru: "napi tsuake" (Huambisa).

Representative specimens examined. **NICARAGUA. Río San Juan:** El Relos, midpoint between El Castillo and Delta de San Juan, 0–50 m, 23 Mar 1961 (stam. fl), *G. Bunting & L. Licht 775* (F, NY). **COSTA RICA. Alajuela:** 15 km NW of Arenal by air, 2 km NW of Nuevo Arenal on Rd. to Tilarán, then 3 km NE on Rd. to San Rafael de Guatuso, then 2 km W on Rd. to Finca Cote, 10° 34' N, 84° 54' W, 700 m, SE side of Lago Cote, 30 Apr 1983 (fr), *R. Liesner et al. 15093* (CR, MO, WIS). **Heredia:** Zona Protectora, N slopes of Volcán Barba. betweem Río Peje and Río Guacimo, along Quebrada Cantarana, 300–400 m, 18 Jan 1983 (stam. fl), *M. Grayum & G. Shatz 3170* (CR, DUKE, MO); Finca La Selva, Río Puerto Viejo 2 km E of jct with Río Sarapaquí, 10° 26' N, 84° 00' W, 100 m, 14–17 Jun 1968 (stam. fl), *W. Burger & R. Stolze 5803* (CR, F, MO, NY). **Limón:** Near Finca Castilla, 30 m, 24 July 1936 (ster), *C. Dodge & V. Goerger 9283* (F, M0). **San José:** Estación Carrillo, Cañon del Río Sucio, 450–700 m, 12 Nov 1983 (pist. fl), *I. Chacón & G. Herrera 1720* (CAS, CR, MO, NY). **PANAMA. Bocas del Toro:** Cerro Bonyíc, above Quebrada Hurón, 180–400 m, 13 Apr 1968 (fr), *J. Kirkbride & J. Duke 610* (MO). **Colón:** Base of Cerro Bruja, along Río Escandaloso, above Mina Boquerón, No. 2, 47.5 km from Transisthmian Hwy on Rd. to Salamanca, 09° 50' N, 79° 32 'W, 10–200 m, 18 Mar 1982 (stam. fl), *S. Knapp & W. J. Kress 4282* (MO, NY, PMA). **Darién:** Río Tuquesa, Tuquesa Mining Co. camp, Charco Peje, 250 m, 7 Jul 1975 (stam. fl), *S. Mori 7015* (MO, SCZ). **Panamá:** Cerro Campana, 800 m, 22 Jun 1967 (fr), *T. Croat 17167* (MO). **San Blas:** Trail from Río Estadí to Cerro Banega, 300–530 m, 09° 23' N, 78° 51' W, 21 Dec 1985 (stam. fl), *G. de Nevers & H. Herrera 6642* (CAS, MO, PMA). **COLOMBIA. Antioquia:** 6 km E of Guapa, 53 km S of Turbo, 240 m, 13 May 1945 (stam. fl), *0. Haught 4660* (US); Mpio. Anorí, Corregimiento de Providencia, Buenos Aires, 500–600 m, 4 Feb 1972 (fr), *D. Soejarto 3205* (HUA, MO, NY); Vicinity Planta Providencia, 26 km S, 23 km W (by air) of Zaragoza, 07° 13' N, 75° 03' W, valley of Río Anorí between Dos Bocas and Anorí, 1 Jun 1976 (fr), *J. Shepard 323* (COL, WIS); Vicinity Medellín, 20 Aug 1927 (stam. fl), *R. Toro 356* (MEDEL, NY); Medellín-Bogotá Hwy, sector Río Samaná-Río Claro-San Luís, 400–1,000 m, 24 Aug 1982 (fr), *J. Hernández & S. Hoyos 483* (COL, HUA); Mpio. Urrao, Boundary of Parque Nacional Natural Las Orquídeas, Vereda Calles, Permanent Inventory, Premontane Rainforest, left bank of Río Calles, 06° 32' N, 76° 19' W, 1,450–1,500 m, 30 Nov 1993 (ster.), *J. Pipoly et al. 17406* (BRIT, JAUM, MO). **Boyacá:** Region of Cerro Chapón, extreme W part of Boyacá, NW of Bogotá, 2,300 m, 31 Jul 1932 (fr), *A. Lawrence 370* (A, NY, S); El Umbo region, 1,000 m, 12 Oct 1932 (stam. fl), *A. Lawrence 530* (A, BM, F, G, GH, MO, NY, S, U, UC, US). **Chocó:** Mpio. Quibdó, Quebrada La Platina, Hwy to Medellín, 25 Sep 1983 (fr), *L. Arias et al. 134* (MO); Mpio. San José del Palmar, along Río Torito (affluent of Río Habita), W slopes, 850– 950 m, 15 Mar 1980 (fr), *E. Forero et al. 7350* , 16 Mar 1980 (fl bud), *E. Forero et al. 7393* (COL, MO), Vereda Portachuelo, Hacienda Barro Blanco, 1,350 m, 15 Jan 1983 (fr), *P. Franco et al. 1325* (COL); Río Mecana, ca. 10 km E of Mecana, 06° 15' N, 77° 25' W, 100 m, 7 Mar 1983 (stam. fl), *A. Gentry & A. Juncosa 41072* (COL, MO, JAUM), 710–880 m, 8 Jan 1984 (stam. fl), *A. Juncosa 1769* (COL, MO, JAUM); Mpio. Novita, vereda Curundo, left bank, Río Ingara, 550 m, 1 Dec 1983 (fr), *P. Franco et al. 1059* (COL); Río Nuquí, 400 m, 25 Jan 1947 (stam. fl), *0. Haught 5479* (COL, US); La Mojarra, upriver from Istmina, 05° 12' N, 76° 37' W, 30-60 m, 5 Nov 1983 (fr), *A. Juncosa 1255* (COL, JAUM, MO, NY); S of Río Condoto, between Quebrada Guarapo and Mandinga, 120–180 m, 22–28 Apr 1939 (fr), *E. Killip 35675* (COL, US). **Cundinamarca:** Cordillera

Bogotá, 2,000 m, Sep 1855 (fr), *J. Triana 4* (BM). **Meta:** Near Salitre, 6 Jan 1876 (stam. fl), *E. André 1151*, 7 Jan 1876 (ster), *E. André s.n.* (K); Caño Tigre, between Caño Aguas Claras and Caño Grande, 4.5 km SW of Villavicencio, 04° 07' N, 73° 39' W, 500–550 m, 24 Feb 1943 (pist. fl), *F.R. Fosberg 20148* (COL, US); Llano de San Martín, (stam. fl, pist. fl mixed), *H. Karsten s.n.* (LE-2 sheets). **Nariño:** Mpio. Barbacoas, Corregimiento Ortíz y Zamora, Vereda El Barro, Reserva Natural Río Ñambí, ca. 5 km W de Altaquer, faldas occidentales de la Cordillera Occidental, 01° 18' N, 78° 08' W, 1,350–1,400 m, 1 Sep 1997 (stam. fl), *J. Pipoly, A. Cogollo, et al. 21095* (BRIT, FMB, JAUM, PSO), *21144, 21149*, 1,450–1,500 m, 2 Sep 1997 (fr), *J. Pipoly, A. Cogollo et al. 21483* 1250–1,350 m, 8 Dec 1997 (fr), *J. Pipoly, A. Cogollo et al. 21598* (BRIT, JAUM, PSO). **Norte de Santander:** Ocaña, 1200 m, May 1846-52 (stam. fl), *L. Schlim 686* (BR-3 sheets, F-2 sheets, G-BOIS-2 sheets, G-DEL, MA-2 sheets). **Santander:** 8 km SE of Barrancabermeja, Río Opón, 200 m, 28 Aug 1954 (stam. fl), *R. Castañeda 4746* (COL), vicinity Barrancabermeja, between Ríos Sogamoso and Colorado, 100–500 m, S of Río Sogamoso, Camp Mesa, 8 Jan 1935 (stam. fl), *O. Haught 1502* (A, COL, F, NY, US). **Valle del Cauca:** Cordillera Occidental, W slope, along Río Sanquininí, left side, La Laguna, 1,250–1,400 m, 13 Dec 1943 (stam. fl), *J. Cuatrecasas 15474* (VALLE); Bahía Málaga, Quebrada Algeria, new Rd. to military base,0 4° 02' N, 77° 22' W, 50 m, *A. Gentry et al. 53326* (COL, MO, US); Bank of Río Digua, Río San Juan, below Queremal, to the right of river between km 52 and 53, 1300–1500 m, 19 Mar 1947 (fr), *J. Cuatrecasas 23855* (COL, F-3 sheets); Calima Dam, 1600-1700 m, 17 Sep 1966 (stam.) *S. Espinal 2109* (MO, VALLE). Without locality, date, (stam. fl), *J. Mutis 449* (MA), *2919* (MA), *3907, 5102a* (MA, US), *Warscewicz s.n.* (B-destr., Photo-F Neg. 4858). **ECUADOR. Carchi:** Trail along plain above Tovar-Donoso and Río Guape, 01° 10' N, 78° 18–31' W, 280-450 m, 18 Feb 1984 (stam. fl), *W. Hoover 1194* (MO), SE Trail, Gualpi Chicó Area of Awá Reserve, near encampment, 00° 58' N, 78° 16' W, 1,330 m, 19 Jan 1988 (stam. fl), *W. Hoover et al. 2815* (MO, QCNE), Gualpi Medio Community, Awá Reserve, 900 m, 21 May 1992 (bud), *C. Quelal et al. 764* (MO, QCNE) El Pailón, 45 km below Maldonado, along path to Tobar Donoso, 800 m, 1 Dec 1979 (fr), *M. Madison & L. Besse 7201* (AAU, F, QCNE, SEL); Cantón Tulcán, Reserva Indígena Awá, Parroquía Tobar Donoso, sector El Baboso, 00° 53' N, 78° 20' W, 1,600 m, 3 Oct 1991 (fl, fr), *G. Tipaz et al. 260* (BRIT, MO, QCNE), (fr), *311* (BRIT, MO, QCNE), Centro El Baboso, 00° 53' N, 78° 25' W, 1,800 m, 17–27 Aug 1992 (fr), *G. Tipaz et al. 1950* (BRIT, F, MO, QCNE). **Esmeraldas:** Cantón San Lorenzo, Reserva Indígena Awá, Cañon del Río Mira, 10 km W of Alto Tambo, Comunidad "La Unión," 01° 02' N, 78° 26' W, 250 m, 16–26 Mar 1991 (fr), *D. Rubio et al. 1262* (MO, QCNE). **Sucumbíos:** Cantón Lago Agrio, Reserva Cuyabeno, Laguna Grande, Near NEOTROPIC Cabins, 00° 00' S, 76° 11' W, 230 m, 15 Nov 1991 (stam. fl), *W. Palacios et al. 9269* (BRIT, MO, QCNE). **Zamora-Chinchipe:** Cantón Nangaritza, Valle del Río Nangaritza, Miazi, 04° 18' S, 78° 40' W, 1,200 m, 10 Dec 1990 (pist. fl), *W. Palacios 6734* (BRIT, MO, QCNE), Behind military camp, 04° 16' S, 78° 42' W, 970 m, 20 Oct 1991 (stam. fl), *W. Palacios et al. 8483* (BRIT, MO, QCNE). **PERU. Amazonas:** Camino de chichijam, entsa, 180–250 m, 2 May 1973 (stam. fl), *R. Kayap 728* (MO); Valle del Rio Santiago, 03° 50' S, 77° 40' W, Quebrada Caterpiza, 2–3 km behind Caterpiza, 200 m, 4 Jan 1980 (stam. fl), *S. Tunquí 549* (MO). **Loreto:** Prov. Maynas, Guarnición Pijuayal, near Pebas, 130 m, 7 Sep 1988 9stam. fl), *C. Díaz et al. 566* (MO). **Ucayali:** Prov. Padre Abad, Boquerón del Padre Abad, 400 m, 20 May 1969 (fr), *J. Schunke 3068* (F-2 sheets, US, USM). **BRAZIL. Amazonas:** Mpio. Humaytá, on plateau between Rio Livramento & Rio Ipixuna, 7–18 Nov 1934 (stam. fl), *B. Krukoff 7290* (A, NY, S, U); São Paulo de Olivença, near Esperança, Dec 1935 (ster.), *B. Krukoff 7663* (K, NY), Behind São Paulo de Olivença, 16 Aug 1973 (fr), *E. Lleras et al. P17315* (GB, INPA, MG, NY); km 500, Manaus-Humaytá Rd., 17 Sep 1980 (stam. fl), *S. Lowrie et al. 52* (INPA, MG, NY). **Mato Grosso:** Near Tabajara, upper Rio Machado, Nov–Dec 1931 (stam. fl), *B. Krukoff 1377* (A, NY). **Rondônia:** São Lourenço, cassiterite mine, 20 km N of S. Lourenço on Rd. to "A Macisa" Mine, 15 Jul 1979 (stam. fl), *C. Calderón et al. 2852* (INPA, US). **BOLIVIA. Pando:** W bank of Rio Madeira, 3 km above Abuna, 13 Nov 1968 (stam. fl), *G. Prance et al. 8388* (LPB, MG, INPA, NY).

The "pseudocataphylls" referred to in the description are poorly developed and do not occur in a regular phyllotactic spiral as is found in subgenus *Comomyrsine*. Likewise, their morphology is essentially that of a leaf arrested at different stages of development, and as such, do not have a distinctive morphology.

Northern populations from Nicaragua and Costa Rica corresponding to the type of *C. spectabilis* (as *Ardisia spectabilis*) differ in their smaller flowers and anther connectives sometimes eglandular, a feature which is more a function of ecotype then anything else. Eglandular anthers and entire leaves may be found in very lowland wet forest populations in the Darién of Panama, and the Chocó of Colombia.

The type of *Weigeltia multiflora* A.C. Sm. represents populations whose inflorescences are less branched (although the duplicates of the type collection vary in that regard) and the largest flowers of the species. They, like many of the Panamanian populations, have entire leaves and are otherwise inseparable from the type of *Weigeltia triandra* Asplund.

The collections of Kayap from Amazonian Peru are referred to this species, despite their longer petioles.

VI. Cybianthus subgenus **Weigeltia** (A. DC.) G. Agostini, Acta Biol. Venez. 10:156. 1980. *Weigeltia* A. DC., Trans. Linn. Soc. London, Bot. 17:102. 1834. *Cybianthus* sect. *Weigeltia* (A. DC.) Miq. *in* Mart., Fl. Bras. 10:299. 1856. Type Species: *Salvadora surnamensis* Spreng. Tent 7. 1828. =*Cybianthus surinamensis* (Spreng.) G. Agostini.

Polyaxial dioecious or rarely, monoecious *shrubs or small trees*. *Roots* positively geotropic. *Trunk* distinguishable, growth dynamics following Rauh's Architectural Model (in ours), rarely Corner's Model (not in Ecuador or Peru) *sensu* Hallé et al. (1978). *Bark* grey to beige, thick, vertically fissured. *Branchlets* sessile furfuraceous lepidote or rarely, rufous tomentose, often glabrescent Cataphylls and pseudocataphylls absent. *Leaves* alternate, rarely subopposite, with minute sessile rufous furfuraceous lepidote scales abaxially. *Inflorescence* a pinnate or bipinnate panicle, rarely a simple raceme; peduncle 0.5–2 cm long. *Flowers* 4- rarely 5-merous; calyx valvate, crenate or rarely entire, glabrous or rarely glandular-ciliolate, punctations red or black, prominent or not; corolla rotate to subrotate, the lobes imbricate, glandular-granulose only at the junction with the corolla tube, the punctations red or black, conspicuous, or rarely, prominent; stamens and staminodes united to form an inconspicuous or conspicuous tube, the tube without lobes alternating with the apically free filaments, the filaments one to three times longer than the anthers, terete, and recurved proximally, the anthers subglobose, or widely ovoid, versatile, apically acute to emarginate, basally widely cordate, dehiscent by wide longitudinal slits, the connectives mostly prominently red or black punctate; pistil conic, pyriform or obturbinate, the ovary translucent glandular-lepidote or glabrous, the style capitate-lobate, the lobes entire; pistillode minutely conic, or at times, absent. *Fruit* globose or depressed-globose.

Cybianthus subgenus *Weigeltia* contains approximately 46 species in South America and the Caribbean. Five species are known from Ecuador and Peru; they are restricted to the lowlands and premontane forests on the lower slopes of the Western Cordillera in Ecuador and the Eastern Cordillera in Ecuador and Peru.

KEY TO SPECIES OF *CYBIANTHUS* SUBGENUS *WEIGELTIA*

1. Inflorescence bipinnately paniculate; petioles canaliculate; staminate flowers with stamens shorter than corolla.
  2. Branchlets terete; leaf blades apically long attenuate-subulate, basally long-attenuate.
    3. Branchlets 2.5–4 mm diam., minutely rufous-lepidote; leaves pseudoverticillate, the blades membranaceous, prominently black punctate-lineate below, margins subentire to obtusely serrate; petioles 0.5–1.5 cm long; calyx membranaceous, 1–1.3 mm long, the lobes obtuse, prominently punctate, glandular-ciliate along the margin. .... **23. C. poeppigii**
    3. Branchlets 5.5–6 mm diam., minutely ferrugineous tomentellous; leaves alternate, the blades chartaceous, minutely and prominently puncticulose below, margins entire; petioles 2–3.5 cm long; calyx chartaceous, 0.7–1 mm long, the lobes acuminate, epunctate, glabrous along the margin. .... **24. C. pseudolongifolius**
  2. Branchlets angulate or winged; leaf blades apically acute or short-acuminate, basally acute or cuneate.
    4. Branchlets angulate, 8–10 mm diam., conspicuously rubiginous punctate-lineate; leaf blades coriaceous, conspicuously rubiginous punctate-lineate below; petioles 2.5–3 cm long; staminate calyx membranaceous, 1.4–1.6 mm long, the lobes apically acute; staminate corolla membranaceous, 2.3–2.5 mm long; stamens 1.8–2 mm long. .... **25. C. vasquezii**
    4. Branchlets winged, (2.5–3–)5–6 mm diam., epunctate; leaf blades chartaceous, inconspicuously pellucid punctate; petioles 2–2.5 cm long; staminate calyx chartaceous, 1–1.2 mm long, the lobes apically subacuminate; staminate corolla chartaceous, 1.2–1.3 mm long; stamens 1–1.1 mm long. .... **26. C. cenepensis**
1. Inflorescence racemose; petioles marginate; staminate flowers with stamens exserted or equalling corolla. .... **27. C. nanayensis**

23. Cybianthus poeppigii Mez in Engl., Pflanzenr. IV. 236(Heft 9):218. 1902. TYPE: PERU. LORETO: Prov. Maynas. Tocache, without elevation, without date, (stam. fl), *E. Poeppig s.n.* (HOLOTYPE: W).

Weigeltia albiflora A. C. Sm., Amer. J. Bot. 27:546. 1940, **syn. nov.** *Cybianthus albiflorus* (A.C. Sm.) G. Agostini, Acta Biol. Venez. 10:157. 1980. TYPE: COLOMBIA. CHOCÓ: Andagoya, 70–110 m, 20–30 Apr 1939 (stam. fl), *E. Killip 35372* (HOLOTYPE: NY; ISOTYPES: A, BM, US-2 sheets).

Cybianthus gentryi Lundell, Wrightia 5:195. 1975, syn. nov. TYPE: COLOMBIA. CHOCÓ: Cerro Malí, on border with Panama, 1,200–1,400 m, 17 Jan 1975 (stam. fl), *A. Gentry & S. Mori 13709* (HOLOTYPE: LL; ISOTYPE: MO).

Shrub or small tree to 4(–7) m tall. *Branchlets* thin, terete, 2.5–3.5(–4) mm diam., minutely rufous-lepidote. *Leaves* in loose pseudoverticels; blades membranaceous, elliptic, oblanceolate, lanceolate or rarely obovate, (6–)6.8–18.5(–24) cm long, (2.2–)3.5–6.5(–8.5) cm wide, apically acuminate to subacuminate-attenuate, basally cuneate to acute, not decurrent on the petiole, midrib depressed above, prominently raised below, the secondary veins 7–12(–14) pairs, rufous lepidote above and below early glabrescent above, tardily glabrescent below, sparsely black punctate and densely black punctate-lineate below, the margin flat, subentire to obtusely serrate; petioles canaliculate, 0.5–1.5 mm long, minutely rufous-lepidote. *Staminate and pistillate inflorescences* monomorphic, bipinnately paniculate, somewhat pyramidal, sometimes malformed and appearing racemose, 8–15 cm long, 8–10 cm wide, the rachis densely glandular-papillate, the flowers racemose; inflorescence bracts unknown; floral bracts membranous, linear-lanceolate, 1–2.5(–3.5) mm long, 0.3–0.8(–1.2) mm wide, apically attenuate, densely glandular-papillate, epunctate, the margin glandular-ciliate; pedicels cylindrical, (0.7–)1.6–1.9(–2.5) mm long, densely glandular-papillate. *Staminate flowers* 4-merous, yellow or yellowish-green; calyx membranaceous, cotyliform, 0.8–1.3 mm long, the tube 0.2–0.3 mm long, glabrous, the lobes widely ovate to suborbicular, (0.6–)1 mm long, (0.5–)0.6–1 mm wide, apically obtuse, prominently punctate, the margin hyaline, irregular, erose-serrulate apically, densely glandular-ciliate; corolla membranaceous, rotate, (1.7–)1.8–2.2(–2.6) mm long, the tube (0.3–)0.4–0.6 mm long, glabrous without, glandular-granulose within, the lobes suborbicular, (0.9–)1.2–1.6(–2) mm long, (0.8–)1.2–1.7(–2) mm wide, apically obtuse, prominently punctate, glabrous without, glandular-granulose medially at stamen base within, the margin hyaline, irregular, erose; stamens (1–)1.4–1.6 mm long, the tube inconspicuous, hyaline, (0.3–)0.4–0.6 mm long, densely glandlar-granulose within, the apically free portions of the filaments (0.3–)0.4–0.5 mm long, the anthers ovate-triangular, 0.3–0.4 mm long, 0.2–0.3 mm wide, apically rounded, basally obtuse, the connective epunctate; pistillode conic, 0.3–0.4 mm long, densely rufous glandular-papillate. *Pistillate flowers* as in staminate, but calyx 1–1.3 mm long, the tube 0.2–0.3 mm long, the lobes deltate to widely elliptic, 0.8–1 mm long and wide, the margin opaque; corolla 2–2.3 mm long, the tube, 0.6–0.7 mm long, the lobes 1.4–1.6 mm long, 0.6–0.7 mm wide, glandular-granulose within above filament junction with tube, the margin often erose; staminodes resembling stamens but 1–1.3 mm long, the staminodial tube ca. 0.6 mm long, the apically free portions of the filaments to 0.3 mm long, the antherodes suborbicular, to 0.2 mm long and wide; pistil obnapiform, 1.2–1.3 mm long, the ovary 0.8–0.9 mm long, 0.3–0.5 mm wide, densely translucent-lepidote, the style 0.3–0.4 mm long, the stigma bilobed, the lobes decurrent, ca. 0.4 mm long. *Fruit* depressed-globose, 3.5–4.5 mm long, 4.5–6 mm diam. when dried, red, then black at maturity, inconspicuously punctate, exocarp thin.

Distribuiton.—Known from the easternmost Darién of Panama south to Amazonian Peru and Brazil, 100–1,800 m.

Ecology and conservation status.—*Cybianthus poeppigii* is a broad ranging polymorphic ochlospecies, occurring in primary premontane wet and pluvial forests, from the transition zone with lowland forests, to the transition zone to cloud forests. Recent fieldwork in the Cordillera Occidental of Colombia has shown it is a conspicuous element of primary pluvial premontane forests, with a density of approximately 20 individuals per hectare, clustered mostly along the margin of the windward side of the forest, and along streambanks above the high water level. While locally common, its restricted primary habitat verifies its threatened status.

Etymology.—The specific epithet honors Eduard F. Poeppig (1798-1868), professor at Leipzig, explorer and plant collector, who made numerous valuable contributions to our knowledge of the Peruvian Amazon Basin.

Representative specimens examined. **PANAMA. Darién:** Serranía del Darién, Panama/Colombia frontier, Cerro Tacaracuna, Cerro Mali, summit, 1,400 m, 17 Jan 1975 (stam. fl), *A. Gentry & S. Mori 13665* (LL-TEX, MO-2 sheets), W ridge, Cerro Tacaracuna, 1,800–1,850 m, 31 Jan 1975 (fr), *A. Gentry & S. Mori 14023* (COL, LL-TEX, MO-2 sheets); Serranía de Pirré, Cerro Pirré, above Cana Gold Mine between Ríos Cana and Escucha Ruido, 1,000–1,310 m, 27 Jul 1976 (stam. fl), *T. Croat 37785* (LL-TEX, MO, NY, PMA), SW ridge leading to Alturas de Nique, Panama/Colombia border, 1,100–1,200 m, 30 Dec 1980 (stam. fl), *R. Hartman 12401, 12461* (MO). **COLOMBIA. Antioquia:** Mpio. De Anorí, Corregimiento Providencia, Río Anorí Valley, between Dos Bocas and Anorí, 400–900 m, 24–31 May 1973 (fr), *D. Soejarto et al. 4090* (A, COL, F, HUA, MO); Mpio. Sonsón, Río Verde region, Hacienda "La Soledad," 1,430–1,800 m, 21 Jan 1947 (stam. fl), *G. Gutierrez 1186* (F, MEDEL, MO, UC); Mpio. San Carlos, Corregimiento Alto de Samaná, Vereda Miraflores, 820–900 m, 15 Jun 1989 (stam. fl), *R. Fonnegra et al. 3076* (BRIT, HUA). Mpio. Urrao, Parque Nacional Natural Las Orquídeas, Vereda Calles, Permanent Inventory, right bank, Río Calles, 06° 32' N, 76° 19' W, 1,450 m, 27 Nov 1993 (ster.), *J. Pipoly et al. 17183* (BRIT, JAUM, MO), 1,450–1,500 m, 29 Nov 1993 (ster. seedling), *J. Pipoly et al. 17360* (BRIT, JAUM, MO). **Chocó:** Mpio. San José del Palmar, vereda "El Tabor," 1,540 m, 18 Jan 1983 (pist. fl), *P. Franco et al. 1469* (COL). **Vaupés:** Río Pacoa (tributary of Río Apapóris), 00° 20' N, 71° 20' W, 300 m, 7–12 Feb 1952 (pist. fl), *R. Schultes & I. Cabrera 15423* (COL, GH, US). **ECUADOR. Morona-Santiago:** Macuma, 50 km N of Macas, 21 Mar 1973 (pist. fl), *H. Lugo 3633* (GB); Río Cuyes and Boboiza-Gualaquiza Rd., 03° 25' S, 78° 35' W, 800 m, 1 Nov 1986 (stam. fl), *W. Palacios 1466* (MO, US). **Napo:** Between Tena and Napo. 1 Jan

1940 (stam. fl), *E. Asplund 10209* (S), 7 Jan 1940 (stam. fl), *E. Asplund 10302* (S); Tena, 400 m, 3 Apr 1935 (stam. fl), *Y. Mexia 7206* (NY, UC, US); Reserva Biológica Jatun Sacha, 8 km from Puerto Misahualló, right bank, Río Napo, 01° 04' S, 77° 36' W, 450 m, *C. Cerón 2585* (MO, QCNE). **Pastaza:** Mera, 1,100 m, (stam. fl), *E. Asplund 18717* (S), 1,500 m 29 Dec 1958 (stam. fl), *G. Harling et al. 9764* (GB); Loracachi, on path to Lagartococha, 01° 38' S, 75° 58' W, 25 May 1980 (fr) *J. Jaramillo et al. 30984* (AAU, QCA), 31 May 1980 (fr), *31579* (AAU, QCA). **Tungurahua:** Río Negro, 1,200 m, 13 Mar 1980 (pist. fl), *G. Harling & L. Andersson 17255* (GB); 10 km E of Paquisha, 1,400–1,500 m, 13 Apr 1985 (stam. fl), *G. Harling & L. Andersson 24097* (GB). **PERU. Amazonas:** Río Santiago, 3 km behind Caterpiza, 14 Nov 1979 (fr), *V. Huashikat 1248* (MO, NY); Tingo María, 25 Jul 1940 (stam. fl), *E. Asplund 12497* (S). **Pasco:** Prov. Oxapampa, Cabeza de Mono, Palcazu Valley, 10° 20' S, 75° 18' W, 320 m, 11 Jun 1983 (fr), *A. Gentry et al. 41880* (MO); Ozuz to Río Lobo, 10° 19' S, 75° 16' W, 400–500 m, 10 May 1985 (fr), *R. Foster & B. d'Achille 10013* (F). **San Martin:** Quebrada de Haquisha (right margin Río Huallaga), Prov. Mariscal Caceres, Dtto. Tochache Nuevo, 400–500 m, 1 Jul 1974 (stam. fl), *J. Schunke 7106* (MO, NY). **BRAZIL. Amazonas:** Near Juruá, Dec 1900 (stam. fl), *E. Ule 5160* (HBG).

Cybianthus poeppigii was mistakenly placed by Agostini (1980) in subgenus *Cybianthus*, but the versatile, dorsifixed anthers clearly place it in subgenus *Weigeltia.* I had reported earlier (Pipoly 1983a) that *Cybianthus albiflorus*, its synonym, was closely related to *C. lawrencei* Moldenke. However, the bipinnate inflorescences with racemose flowers, stamens shorter than the corolla and usually long petioles indicate that *Cybianthus poeppigii* is more closey related to *C. longifolius* Miq., a vicariant species of the southwestern Amazon Basin of Brazil and adjacent Bolivia. The glandular granules of the staminal and staminodial tubes represent a unique (autapomorphic) character state within the genus.

The holotype of *Cybianthus poeppigii* is staminate, as are those of its taxonomic synonyms. The type of *Weigeltia albiflora* (*Cybianthus albiflorus*) represents populations with entire, irregularly margined leaves, but is otherwise qualitatively identical with that of *C. poeppigi*. Likewise, the type of *Cybianthus gentryi* Lundell represents isolated montane populations of the Darién/Chocó regions, and exhibits more notable lineate-punctations, much smaller leaves, and abbreviated inflorescences. According to annotations by Killip at US, description of another taxon was at one time contemplated, based on the fact that the populations of this species from near Tena, Ecuador, have roughly serrate leaf margins.

24. **Cybianthus pseudolongifolius** Pipoly, sp. nov. **(Fig. 18).** TYPE: PERU. PASCO: Prov. Oxapampa, Palcazu Valley, Cabeza de Mono, 5–6 km W of Iscosacín 10° 12' S, 75° 14' W, 325 m, 13–19 Apr 1983 (fr), *D. Smith 3808* (HOLOTYPE: MO; ISOTYPES: US, USM).

Quoad folia magna chartacea, inflorescentias bipinnatipaniculatas, pedicellos cylindricos, lobos calycinis ovatos, ca. 1/3 connatos, petiolos canaliculatos *C. longifolio* arcte accedens, sed ab ea ramulis teretibus (non angulatis), 5.5–6 (non 3.5–4) mm diammetris, laminis anguste oblanceolatis (non ellipticis vel lanceolatis) desuper sordidis (non nitidis) ad apices longi-

Fig. 18. *Cybianthus pseudolongifolius* Pipoly. A. Habit, showing bipinnate panicles. B. Peduncle and axillant leaf, showing canaliculate petiole. C. Detail of prominently puncticulose abaxial leaf surface. D. Pedicel, calyx and fruit, showing hyaline and erose calyx lobes. A & C, drawn from isotype; B & D, drawn from holotype. Figure drawn by Linda Ellis.

attenuatis et subulatis (nec acutis vel acuminatis) ad bases longi-attenuatis (nec acutis), inflorescentiis 8–13 (non 15–20) cm longis, pedicellis 2.8–3 (nec 0.6–1) mm longis necnon fructibus depresso-globosis (nec globosis) atque minute cosatis (nec laevibuss) perfacile discenda.

Treelet to 3 m tall. *Branchlets* terete, 5.5–6 mm diam., densely and minutely ferrugineous tomentellous. *Leaves* alternate; blades chartaceous, narrowly oblanceolate, (22–)26.5–33(–36.5) cm long, (5–)6.5–8.5 cm wide, apically long attenuate, subulate, basally long-attenuate, decurrent on the petiole, sordid and glabrous above, pallid, minutely and prominently pellucid puncticulose and minutely ferrugineous puberulent below, midrib slightly raised above, prominently raised below, the secondary veins 13–18 pairs, the margin entire, glabrous, flat; petioles canaliculate, (2–)2.5–3(–3.5) cm long, glabrous above, minutely ferrugineous puberulent below. *Staminate inflorescence*: unknown. *Pistillate inflorescence*: a lax bipinnate panicle, 8–13 cm long, 1.5–4 cm wide, densely ferrugineous puberulent, glabrescent; secondary inflorescence bracts unknown; floral bracts unknown; pedicels cylindrical, 2.8–3 mm long, densely ferrugineous puberulent; *Pistillate flowers* unknown; fruiting calyx chartaceous, cotyliform, 0.7–1 mm long, the tube 0.3–0.4 mm long, the lobes ovate, 0.5–0.7 mm long, 0.5–0.6 mm wide, apically acuminate, densely and prominently red punctate, the margin hyaline, erose, epunctate, glabrous. *Fruit* depressed-globose, 3–4 mm long, 5–6 mm diam., inconspicuously pellucid punctate, minutely longitudinally costate.

Distribution.—Known only from the type.

Ecology and conservation status.—*Cybianthus pseudolongifolius* appears to be restricted to the lowland primary forest of the eastern Andean slopes. The Oxapampa Province of Pasco is home to numerous Peruvian endemics, and it would not be surprising if the species was of extremely limited distribution or endemic. With only one specimen known, no determination can be made of its true conservation status.

Etymology.—The specific epithet refers to its general likeness to *Cybianthus longifolius* Miq., a lowland black water river species from Amazonian Brazil and Venezuela.

Cybianthus pseudolongifolius is most closely related to *C. longifolius*, but differs by its terete branchlets, 5.5–6 mm in diameter, narrowly oblanceolate leaf blades that are sordid above, long-attenuate and subulate apically and long-attenuate basally, longer inflorescences, much longer pedicels and depressed-globose, minutely costate fruits. The Oxapampa region of Pasco contains a number of endemic species and disjunct taxa and as such, is one of the most important underexplored areas in Peru.

25. **Cybianthus vasquezii** Pipoly, sp. nov. (**Fig. 19**). TYPE: PERU. LORETO: Prov. Alto Amazonas, Capahuari Norte, 02° 45' S, 76° 25' W, 220 m, 7 Jun 1981 (stam. fl), *R. Vásquez & N. Jaramillo 1993* (HOLOTYPE: MO; ISOTYPES: AMAZ, BRIT, F, NY, US, USM).

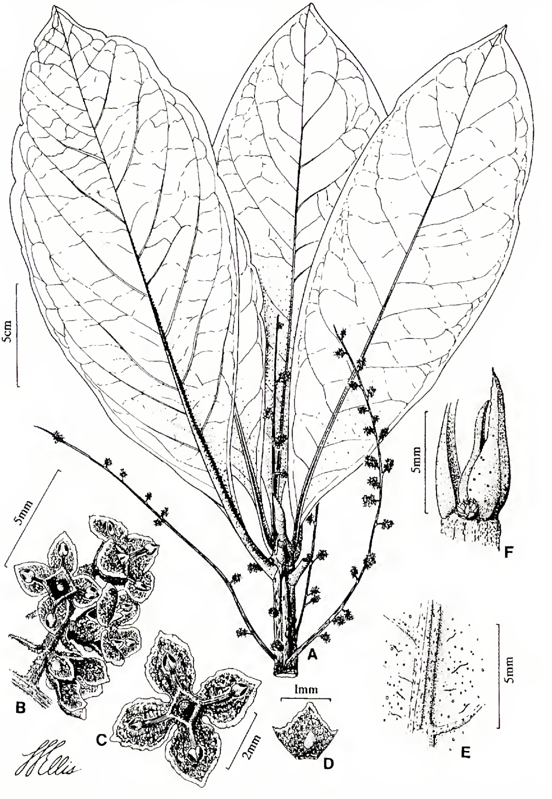

FIG. 19. *Cybianthus vasquezii* Pipoly. A. Habit, showing angulate, punctate-lineate branchlet. B. Inflorescence branch, showing racemose-glomerulate floral arrangement. C. Open corolla. D. Abaxial calyx lobe surface. E. Abaxial leaf surface, showing minute furufuraceous scales and prominent punctate-lineations. F. Branchlet apex. A–F, drawn by Linda Ellis, from holotype.

Propter ramulos crassos manifeste angulatos, folia coriacea subter pallida ad apices subacuminata ad bases acuta, petiolos canaliculatos, inflorescentias anguste bipinnatipaniculatas, ramulos inflorescentiares dense spicatos vel glomerulatos lobos calycines grosse crenatos *C. potiaeo* valde affinis sed ab ea ramulis rubiginoso-punctato-lineatis (non epunctatis), folia pseudoverticillata (non alterna), laminis oblanceolatis (nec ellipticis), (9–)10–13(–15.3) (nec 6.5–8) cm latis, petiolis 2.5–3 (nec 1.5–2) cm longis, inflorescentiis 12–25 (non 3–6) cm longis, corollae lobis ovatis (non ellipticis) ad apices acute rotundatis (nec emarginatis) ad bases abrupte constrictis (nec rectis), secus margines grosse crenatis (nec integerrimis) confeste separabilis.

Terrestrial dioecious *tree* to 8 m tall. *Branchlets* angulate, 8–10 mm diam., densely and minutely rubiginous furfuraceous-lepidote, conspicuously rubiginous punctate-lineate below. *Leaves* pseudoverticillate; blades coriaceous, oblanceolate, (21–)26–34.5 cm long, (6.5–)9–12.2 cm wide, apically acute to subacuminate, basally acute, decurrent on the petiole 4–7 mm, glabrous above, very minutely rubiginous furfuraceous-lepidote below, the midrib slightly raised above, prominently raised and rubiginous punctate-lineate below, the secondary veins 7–10 pairs, slightly impressed above, prominently raised below, the margin entire, flat; petioles canaliculate, 2.5–3 cm long, swollen below to 0.5–0.7 cm diam. basally, rubiginous furfuraceous-lepidote at first, early glabrescent, conspicuously rubiginous punctate-lineate. *Staminate inflorescence*: a bipinnate panicle (12–)14–17.5(–25) cm long, 2–3 cm wide; peduncle (1–)2–3.5 cm long; secondary inflorescence bracts chartaceous, linear, 2–3 mm long, 0.3–0.6 mm wide, apically attenuate, densely glandular-papillate, the margin entire; branches racemose-glomerulate (0.5–)1–1.5 cm long; floral bracts membranaceous, linear, 1.6–1.8 mm long, 0.3–0.4 mm wide, apically attenuate, densely rubiginous puberulent; pedicels cylindrical, 0.3–0.5 mm long, glabrescent. *Staminate flowers* 4-merous, pink; calyx membranaceous, cotyliform, 1.4–1.6 mm long, the tube ca. 0.2 mm long, the lobes ovate, 1.2–1.4 mm long, 1–1.1 mm wide, apically acute, sparsely and inconspicuously orange punctate, glabrous, the margin coarsely crenulate, glabrous; corolla membranaceous, subrotate, 2.3–2.5 mm long, the tube 0.2–0.3 mm long, densely glandular-granulose, the lobes ovate, 2–2.3 mm long, 1.7–1.8 mm wide, apically acutely rounded, abruptly constricted basally, inconspicuously orange punctate without, sparsely gladular-granulose behind the base of the filaments, the margin hyaline, coarsely crenate, glabrous; stamens 1.8–2 mm long, the tube carnose, squarrose, 0.2–0.3 mm long, the filaments terete, 1.1–1.2 mm long, slightly curved proximally, the anthers ovate, 0.5–0.6 mm long, 0.6–0.7 mm wide, apically rounded, basally cordate, the connectives inconspicuously orange punctate dorsally; pistillode obturbinate, 0.5 mm long, 0.6 mm diam., the stigma truncate, minutely lobed. *Pistillate inflorescence* as in staminate but (3.5–)5.5–9.5 cm long, the branches glomerulate. *Pistillate flowers* as in staminate but red, except white on corolla lobe apices; calyx obconic, 1.3–1.7 mm long, the tube 0.6–0.8 mm long, the lobes very widely ovate to suborbicular, 0.7–

1.2 mm long, 0.8–1.2 mm wide, apically broadly rounded, corolla 2.3–2.7 mm long, the tube 0.6–0.8 mm long, the lobes suborbicular, 1.5–1.7 mm long, 1.5–1.8 mm wide, the margin irregular, hyaline, staminodial tube 1–1.3 mm long, the apically free portions of the filaments 0.4–0.5 mm long, the antherodes 0.3–0.4 mm long and wide; pistil obnapiform, 2.2–2.4 mm long, 1.3–1.5 mm diam, the ovary 1.3–1.5 mm long, the style thick, 1.1–1.3 mm long, the stigma capitate, 4-lobed, the lobes recurved, the placenta deeply cupuliform, the ovules 2–3, imbedded. *Fruit* unknown.

Distribution.—Known only from the Department of Loreto, in Alto Amazonas and Loreto Provinces, Peru, at 160–220 m elevation.

Ecology and conservation status.—Cybianthus vasquezii occurs in primary *terra firme* lowland forest, with scattered white sand areas. Label data do not allow determination of whether this species occurs on the laterite or on the sands. Because it is known only from two gatherings, its conservation status is unknown. However, its importance as a tonic in Mayna Jívaro culture may indicate it is locally common.

Etymology.—It gives me great pleasure to dedicate this species to a great friend and colleague, Ing. Rodolfo Vásquez Martínez, Assistant Curator and Director of the Flora of Peru Program of the Missouri Botanical Garden. Vásquez is an indefatigable collector, a forestry engineer, dendrologist, taxonomist and author of numerous publications on uses of Peruvian forest products, economic plants of the Peruvian Amazon, and *Florula of the Biological Reserves of Iquitos*. He is a taxonomic authority on *Caraipa* and Myristicaceae of the Amazon Basin.

Local names and uses.—Peru: "sésa," "kurúp" (Mayna Jívaro). The sap is extracted and a juice is drunk to "improve hunting ability."

PARATYPE: PERU. **Loreto:** Prov. Loreto, Pampa Hermosa and vicinity, Río Corrientes, 1 km S of junction with Río Macusari, 03° 15' S, 75° 50' W, 160 m, 3–20 Dec 1985 (pist. fl), *W. Lewis et al. 10306* (BRIT, MO).

Cybianthus vasquezii is most closely related to *C. potiaei* of the eastern Amazon Basin (French Guiana and Brazil (Amapá, Bahía), but is easily recognized by the conspicuously rubiginous punctate-lineate branchlets, larger pseudoverticillate, oblanceolate leaves, longer petioles and inflorescences, ovate, apically rounded corolla lobes that are abruptly constricted basally, and coarsely crenate along the margins.

26. Cybianthus cenepensis Pipoly, sp. nov. (**Fig. 20**). TYPE: PERU. AMAZONAS: Río Cenepa, vicinity Huampami, ca. 5 km E of Chávez Valdívia, 04° 30' S, 78° 30 W, 200–250 m, 12 Aug 1978 (stam. fl), *A. Kujikat 265* (HOLOTYPE: MO; ISOTYPES: F, MO, NY, US, USM).

Ob folia chartacea oblanceolata ad apices acuminata ad bases cuneata, petiolos canalicuatos, inflorescentias anguste bipinnatipaniculatas, ad *C. buchtieni* valde affinis sed ab ea ramulis alatis (nec laevibus), petiolis 2–2.5 (non 1.5–1.8) cm longis, lobis calycinis late ovatis (nec

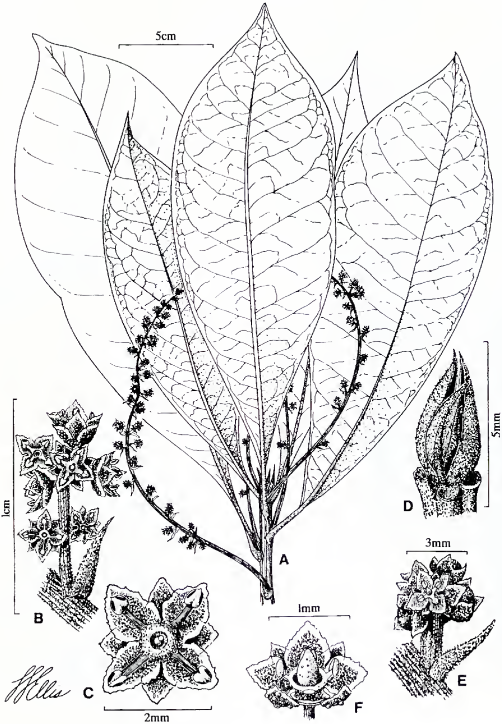

FIG. 20. *Cybianthus cenepensis* Pipoly. A. Habit, showing winged branchlets. B. Staminate inflorescence branch, showing secondary inflorescence branch bracts. C. Staminate flower, showing stamens subequal to corolla lobes, conspicuous square staminal tube, and coarsely crenate corolla lobes. D. Pistillate flower, showing ellipsoid pistil. E. Pistillate inflorescence branch, showing dense spike appearing glomerulate. D. Branchlet apex, showing puberulent vestiture. A drawn from holotype. B–D, drawn from *Ancuash 522*. E–F, drawn from *Kujikat 306*. Figure drawn by Linda Ellis.

lineari-lanceolatis), grosse crenatis (nec integerrimis), lobis corollinis grosse crenatis (nec enteris) denique antheris ad apices acutis (nec rotundatis) ad bases cordatis (nec obtusis) perfacile distinguitur.

Treelet to 2 m tall. *Branchlets* prominently longitudinally ridged, the ridges forming small, rounded wings, (2.5–3–)5–6 mm diam., sparsely rufous puberulent, glabrescent. *Leaves* alternate; blades chartaceous, oblanceolate, (13.7–)18.5–23(–26.2) cm long, (4–)6–10 cm wide, apically acuminate, basally cuneate, glabrous above, sparsely rufous puberulent below, glabrescent, inconspicuously pellucid punctate, the margin entire, flat; petioles canaliculate, 2–2.5 cm long, sparsely rufous puberulent, glabrescent. *Staminate inflorescence* a lax bipinnate panicle, 14–18 cm long, 1–1.7 cm wide, the rachis densely rufous papillate; secondary inflorescence bracts chartaceous, linear-lanceolate, 4–4.5 mm long, 1–1.2 mm wide, apically subulate, densely rufous tomentellous, the margin irregular, entire; inflorescence branches 3–8 mm long, the flowers densely subspicate, appearing glomerulate; floral bracts chartaceous, linear, 1–1.2 mm long, 0.1–0.2 mm wide, apically subulare, densely glandular-papillate, the margin crenulate, glabrous; pedicels cylindrical, 0.2–0.3 mm long, densely glandular-papillate. *Staminate flowers* 4-merous, chartaceous, brownish-purple, 1.6–1.8 mm long; calyx cotyliform, 1–1.2 mm long, the tube 0.3–0.4 mm long, the lobes broadly ovate, 0.7–0.8 mm long, 0.6–0.7 mm wide, apically acute, prominently brown punctate, the margin hyaline, coarsely crenate, glabrous; corolla subrotate, 1.2–1.3 mm long, the tube ca. 0.1 mm long, densely glandular-granulose within, the lobes widely ovate, 1–1.2 mm long, 0.8–1 mm wide, apically subacuminate, glabrous and inconspicuously orange punctate without, glabrous within except under the filaments, the margin hyaline, coarsely crenate, glabrous; stamens subequalling the corolla lobes, 1–1.1 mm long, the tube conspicuous, carnose, square, 0.1–0.2 mm long, densely glandular-granulose, the filaments 0.6–0.7 mm long, the anthers ovate, 0.3–0.4 mm long, 0.4–0.5 mm wide, apically acute, basally cordate, the connective inconspicuously orange punctate; pistillode obturbinate, 0.1–0.2 mm long, 0.2–0.3 mm diam., hollow, glabrous. *Pistillate inflorescence* as in staminate but 12–14 cm long, 0.8–1.0 cm wide; secondary inflorescence bracts 3.8–4.1 mm long, 0.8–1 mm wide; inflorescence branches 3.5–6 mm long; floral bracts 1–1.2 mm long, 0.1–0.2 mm wide; pedicels 0.2–0.3 mm long. *Pistillate flowers* as in staminate but white, 1.1–1.4 mm long; calyx 0.6–0.8 mm long, the tube 0.1–0.2 mm long, the lobes 0.5–0.6 mm long, 0.3–0.4 mm wide; corolla 0.7–0.8 mm long, the tube ca. 0.1 mm long, the lobes 0.6–0.7 mm long, 0.5–0.6 mm wide; staminodes much sorter than the corolla lobes, 0.3–0.4 mm long, the tube conspicuous, carnose, circular, ca. 0.1 mm long, the filaments ca. 0.1 mm long, the anthers 0.2–0.3 mm long, 0.1–0.2 mm wide; pistil ellipsoid, 0.5–0.6 mm long, 0.2–0.3 mm diam., the style 4-lobed, the lobes curved distally, placenta subobose, bearing 4 partially immersed ovules. *Fruit* globose, 6–7 mm long and in diam., prominently red punctate.

Distribution.—Known only from the Río Cenepa Drainage Basin, Amazonas, Peru, 200–250 m elevation, and from one disjunct population from Napo, Ecuador, very close to the Colombian border.

Ecology and conservation status.—*Cybianthus cenepensis* inhabits várzea forests in the Amazon of Ecuador and Peru. Despite lack of collections, it is known that the Napo and the Cenepa Rivers are shallower than many with their same volume, thus giving them strong currents. Aside from the need for much more exploration at the edge of the Amazon Basin in Ecuador and Peru, perhaps the strong current of these rivers makes the dynamics of their adjacent várzea forests different from others in Amazonia. At this time, the conservation status of this species is unknown.

Etymology.—The specific epithet refers to the region of Peru from which the type was collected, the Río Cenepa Drainage Basin of the Alto Amazonas Province, Amazonas Department, Peru.

Local names and uses.—Peru: "sauka" (Huambisa).

PARATYPES. **ECUADOR. Napo:** Cantón Orellana, Yasuní National Park, Maxus Rd. and pipeline construction project, km 15, 01° 31' S, 76° 32' W, 250 m, 30 Jun 1994 (bud), *N. Pitman 461* (BRIT, MO, QCNE); Río Yasuní, periodically inundated forest ca. 80 km upriver from Nuevo Rocafuerte, 225 m, 17 Sep 1977 (fr), *R. Foster 3708* (F, QCA). **PERU. Amazonas:** Quebrada Sasa, Río Cenepa, 250 m, 2 Jun 1973 (stam. fl), *E. Ancuash 522* (MO, USM); Río Cenepa, vicinity of Huampami, ca. 5 km E of Chávez Valdívia, ca. 4° 30' S, 78° 30' W, 200–250 m, 12 Aug 1978 (pist. fl), *A Kujikat 306* (F, MO, USM); Quebrada Chigki Shiunk, 4° 30' S, 78° 30' W, 11 Aug 1978 (bud), *E. Ancuash 1412* (MO, USM).

Cybianthus cenepensis is closely related to *C. buchtieni* Pax of the Mapiri region in Bolivia. However, *Cybianthus cenepensis* is easily recognized by its winged branchlets, petioles 2–2.5 cm long, widely ovate and coarsely crenate calyx lobes, coarsely crenate corolla lobes, and anthers with acute apices and cordate bases. The ellipsoid pistil is also unique within the subgenus.

27. **Cybianthus nanayensis** (J.F. Macbr.) G. Agostini, Acta Biol. Venez. 10:160. 1980. *Weigeltia nanayensis* J.F. Macbr., Field Mus. Nat. Hist., Bot. Ser. 11:33. 1931. TYPE: PERU. LORETO: Lower Río Nanay, 4 Jun 1929 (stam. fl), *Ll. Williams 658* (HOLOTYPE: F; fragment, G).

Weigeltia silvestris J.F. Macbr., Candollea 6:16. 1934. syn. nov. *Cybianthus silvestris* (J.F. Macbr.) G. Agostini, Acta. Biol. Venez. 10:163. 1980. TYPE: PERU. LORETO: Mishuyacu, near Iquitos, Dec 1929 (stam. fl), *G. Klug 724* (HOLOTYPE: F; ISOTYPES: NY, US).

Conomorpha dubia J.F. Macbr., Candollea 6:17. 1934. syn. nov. *Cybianthus dubius* (J.F. Macbr.) G. Agostini, Acta Biol. Venez. 10:158. 1980. TYPE: PERU. LORETO: Mishuyacu, near Iquitos, 24–28 Sep 1929 (pist. fl, fr), *A. Killip & A. Smith 29906* (HOLOTYPE: F; ISOTYPES: NY, US) [erroneously cited as *G. Klug 29906*].

Conomorpha loretensis Lundell, Wrightia 6:113. 1980. syn. nov. *Cybianthus loretensis* (Lundell) Pipoly, Brittonia 33:496. 1981. TYPE: PERU. LORETO: Quistococha, near Iquitos, 18 Nov 1977 (stam. fl), *A. Gentry 20763* (HOLOTYPE: LL-TEX; ISOTYPES: F, MO, NY).

Subshrub to shrub to 0.5(–1.5) m tall. *Branchlets* 0.2–0.5 cm thick, smooth, rufous-lepidote. *Leaves* in loose pseudoverticels; blades chartaceous to subcoriaceous, elliptic, lanceolate or oblanceolate, (7–)11–18(–25.5) cm long, (2.9–)3.5–7.5(–10) cm, apically acute to acuminate, basally acute to cuneate, midrib depressed above, prominently raised below, the secondary veins 7–16 pairs, glabrous above, sparsely and minutely rufous-lepidote below, puncticulate, the margin flat, entire; petioles marginate, (0.6–)0.9–1.5 cm long, glabrous. *Inflorescences* monomorphic, a simple raceme or rarely with a second, malformed basal branch, (1.5–)3–9.5(–14.5) cm long, the rachis densely glandular-papillate; floral bracts membranaceous, linear-lanceolate, 0.2–1.2 mm long, 0.1–0.2 mm wide, the apically long-attenuate, sparsely glandular-papillate, the margin glandular-ciliate, entire; pedicels cylindrical, (0.7–)1–1.5(–2) mm long, densely glandular-papillate. *Staminate flowers*: white to cream, 4-merous, chartaceous; calyx cotyliform, 1–1.3 mm long, the tube ca. 0.1 mm long, the lobes widely ovate to deltate, 0.9–1.2 mm long, 0.8–1.2 mm wide, apically acute to acuminate, medially thickened and prominently black punctate, glabrous, the margin hyaline, irregular, densely glandular-ciliolate; corolla rotate, 1.9–2.3 mm long, the tube 0.6–0.8 mm long, the lobes widely ovate to ovate, 1.3–1.6 mm long, 1.2–1.4 mm wide, apically acute to rounded, subentire or apically notched, medially thickened and prominently black punctate, glabrous without, glandular-granulose within at junction of tube and lobe, the margin hyaline, irregular, glabrous; stamens 2.2–2.5 mm long, exserted or rarely subequal to corolla, the staminal tube carnose, conspicuous, 0.5–0.7 mm long, subtruncate between the filaments, the apically free portions of the filaments terete, (1.2–) 1.4–2 mm long, the anthers widely ovate, 0.32–0.36 mm long, apically rounded to obtuse, basally cordulate, the connective prominently punctate dorsally; pistillode vestigial, obclavate or tubiform, 0.7–0.8 mm long, sparsely translucent glandular-lepidote, hollow. *Pistillate flowers* as in staminate but beige to brown; calyx 2–2.1 mm long, the tube 0.1–0.2 mm long, the lobes 1.9–2 mm long, 1.9–2 mm wide; corolla cotyliform, 1.9–2 mm long, the tube 0.5–0.6 mm long, the lobes widely ovate, 1.2–1.4 mm long, 1.3–1.4 mm wide, apically acute to acuminate; staminodes resembling stamens, 1.2–1.3 mm long, the staminodial tube 0.5–0.6 mm long, the filaments 0.4–0.5 mm long, the antherodes subquadrate, ca. 0.2 mm long and wide, apically obtuse, basally truncate; pistil ellipsoid, 1.4–1.6 mm long, the ovary 1–1.2 mm long, 1.1–1.2 mm diam., densely translucent glandular-lepidote, the placenta cupuliform, ovules 2, partially immersed, the style trunctae, 0.3–0.4 mm long, the stigma punctiform. *Fruit* depressed-globose, 4.5–5.5 mm long, 5.5–6.5(–7) mm diam., yellow when fresh, prominently black punctate.

Distribution.—Endemic to the tall moist forests on white sands of the Peruvian Amazon, primarily from the Iquitos area, 100–160 m.

Ecology and conservation status.—*Cybianthus nanayensis* is locally common, and thrives in gaps left by large treefalls in overmature forests, and along the margins of forest margins and paths, where it occurs in a rather dense herbaceous layer. However, it does not tolerate compacted soils. With decreasing quantitites of habitat owing to logging pressures, the species should be considered threatened. As a gap species growing on nutrient deficient soils, and with very attractive fruits, *Cybianthus nanayensis* shows great promise as a potentially marketable horticultural plant.

Etymology.—The epithet takes its name from the river basin where it occurs, the Nanay River.

Representarive specimens examined. **PERU. Loreto:** Prov. Loreto, Nauta, 04°32' S, 73°35' W, 160 m, 2 Jun 1984 (stam. fl), *R. Vásquez & N. Jaramillo 5075* (AMAZ, MO, NY), (fr), *R. Vásquez & N. Jaramillo 5086* (AMAZ, MO); Prov. Maynas, Allpahuayo, IIAP Experimental Station, 04° 10' S, 73° 30' W, 120 m, 20 Sep 1990 (fr), *J. Pipoly et al. 12263* (AMAZ, MO, USM), 15 Aug 1990 (fr), *R. Vásquez & N. Jaramillo 14204* (AMAZ, MO, US, USM), 10 Oct 1990 (stam. fl), *R. Vásquez & N. Jaramillo 14465* (AMAZ, MO); Laguna Quistococha, 15 km SW of Iquitos, 8 Jul 1977 (stam. fl), *J. Solomon 3466* (LL-TEX, MO); Mishiana, 30 km SW of Iquitos, Callicebus Biological Reserve, Río Nanay, 4 km S of Mishana, 19 Aug 1978 (stam. fl), *R. Foster 4243* (AMAZ, F), 16 Aug 1980 (stam. fl), *4327* (F-2 sheets); Vicinity Mishana, between Río Nanay and Río Itaya, 130 m, 29 Nov 1977 (fr), *A. Gentry et al. 21033* (F, MO); Berween Iquitos and Sra. María de Nanay, 180 m, 31 May 1978 (stam. fl), *A. Gentry et al. 22367* (AMAZ, F, MO); 03° 50' S, 73° 30' W, 25 Feb 1981 (fr), *A. Gentry et el. 31479* (AMAZ, MO), 31 Dec. 1982 (mixed- stam. fl, fr), *A. Gentry & L. Emmons 38776* (MO-2 sheets), 5 Aug 1990 (fr), *R. Vásquez et al. 14161* (AMAZ, MO, USM); Río Nanay, May–Jun 1929 (stam. fl), *Ll. Williams 657* (F); Mishuyacu, near Iquitos, 100 m, Oct–Nov 1929 (stam. fl), *G. Klug 304* (F), May–Jun 1930 (stam. fl), *G. Klug 1355* (F); 6 Oct. 1982 (stam. bud), *R. Vásquez & N. Jaramillo 3261* (MO), 20 Jan 1985 (stam. fl), *6125* (MO); Puerto. Almendras, 03° 48' S, 73° 25' W, 122 m, 4 Jan. 1986 (pist. fl), *R. Vásquez & N. Jaramillo 7070* (AMAZ, MO), 30 May (stam. bud), *7593* (MO), 20 Oct. 1986 (fr), *8073* (AMAZ, MO); Roca Fuerte (Momón), Oct-Nov 1984 (stam. fl), *R. Vásquez & N. Jaramillo 5241*. **Madre de Dios:** Prov. Tambopata, Tambopata Reserve, Río Tambopata at mouth of Río D'Orbigny, 250 m, 6 Mar 1981 (fr), *A. Gentry & K. Young 32025* (AMAZ, MO, NY).

Agostini (1980) had not seen the type specimen of *Weigeltia silvestris* and included it in *Cybianthus* subgenus *Comomyrsine*, probably due to matching with a herbarium misidentification of a specimen of *Cybianthus kayapii* (Lundell) Pipoly as *Weigeltia silvestris* in NY. I previously recognized *Cybianthus dubius* and *C. loretensis* as distinct taxa (Pipoly 1981) on the basis of quantiative characters, and had not seen the type of *C. silvestris*. The exserted stamens and obclavate or tubiform pistillode of the staminate flowers, and truncate style with punctiform stigma in the pistillate flowers are unique features within the subgenus.

Populations corresponding to the type of *Weigeltia silvestris* have slightly larger leaves, but are otherwise indistinguishable from the type of *Weigeltia nanayensis*. The type of *Conomorpha dubia* is notable only for differences attributable to the fact that it is a pistillate fruiting specimen. Fieldwork in Peru has shown that populations corresponding to the type of *Conomorpha loretensis* grow in full sun, and consequently have narrower leaves with longer petioles than those of the type of *Weigeltia nanayensis*.

VII. **Cybianthus** subgenus **Grammadenia** (Benth.) Pipoly, Mem. New York Bot. Gard. 43:47. 1987. *Grammadenia* Benth., Pl. Hartw. 218. 1846. Type Species: *Grammadenia marginata* Benth. = *Cybianthus marginatus* (Benth.) Pipoly.

Erect or pendent, evergreen, terrestrial, epiphytic or epipetric dioecious, bisexual, dioecious or monoecious *shrubs or small trees*. *Roots* diageotropic. *Bark* mostly smooth, gray or sometimes brown, cracking transversely on older parts. *Trunks* distinguishable, normally more or less terete, leptocaulous or rarely pachycaulous basally, growth dynamics corresponding to Rauh's Model (Hallé et al. 1978). *Branchlets* thin to moderately thick, terete or ridged, smooth to verruculose to verrucose, glabrous or rarely glandular-papillate apically, glandular-papillate at first in the leaf axils then glabrescent, without lenticels. Cataphylls and pseudocataphylls absent. *Leaves* alternate, supervolute, exstipulate, sessile, acrodromous, apically obtuse-mucronate, basally auriculate, subamplexicaul, minutely glandular-papillate along midrib above, glabrescent, glabrous below, hydropotes few or absent above, numerous below, the margins hyaline, membranaceous, prominently punctate and punctate-lineate, entire or minutely crenulate to denticulate; petioles absent. *Inflorescence* monomorphic, simple, axillary raceme, at times reduced to appear dichasial; inflorescence bract broadly ovate to deltate, acute, prominently punctate, the margins entire to erose, early caducous; rachis terete, straight or flexuous, minutely glandular-papillate, glabrescent; floral bracts solitary, at pedicel base, ovate to lanceolate, persistent; pedicels cylindrical to clavate, minutely glandular-papillate, glabrescent, accrescent in fruit. *Flowers* unisexual or bisexual, (4–)5–6(–7)-merous; perianth lobes imbricate or quincuncial or rarely and aberrantly dextrorsely contorted, promiently, conspicuously or inconspicuously punctate and punctate-lineate; calyx cotyliform, the lobes erect, at times reflexed in fruit, the margins irregular or regular, entire or minutely crenulate, glabrous or glandular-ciliate; corolla rotate, bearing a ring of glandular granules at the junction of tube and lobe, the lobes glabrous without, glabrous or rarely glandular-granulose and smooth or rugose within, the margins regular or irregular, entire or minutely crenulate; stamens and staminodes similar, connate to form a conspicuous, membranaceous or carnose tube adnate to the corolla tube, elobate or with minute lobes alternating with the anthers, the anthers and antherodes basifixed, sessile or on minute apically free filaments, quadrate or ovate, apically emarginate or rounded, basally truncate, dehiscent by apical birimose pores, usually dorsally and rarely ventrally punctate; pistil and pistillode similar, obnapiform, ellipsoid or umbonate, the ovary terete, lobed or costate, sparsely to densely translucent-lepidote, the placenta umbonate, (1–)2–3(–4) ovulate, the ovules half-immersed in the basal placenta, uniseriate or biseriate, the style short, truncate, the stigma punctiform. *Fruit* drupaceous, depressed globose, obovoid, or ellipsoid, the exocarp sometimes fleshy, the mesocarp and endocarp stony, prominently punctate-lineate, white, lavender or purple-black at maturity, one seeded, the testa corrugate, the embryo cylindrical, transverse.

A subgenus of 7 species, in the Lesser Antilles, in Mesoamerica from northern Costa Rica through Panama, in the Andes from Venezuela to southern Peru, east through the Guayana Highland and to the Serranía de Turumiquire, Anzoátegui, Venezuela. In Ecuador, two species occur. In Peru, 3 species have been recorded, of which one, *Cybianthus lineatus* (Benth.) Pipoly, formerly thought to be a Guayana Highland endemic (Pipoly 1987) is reported for the first time here.

KEY TO THE SPECIES OF *CYBIANTHUS* SUBGENUS *GRAMMADENIA*

1. Branchlets verruculose- to verrucose-papillate or red glandular-papillate; leaves coriaceous, symmetrical; inflorescence erect, flexuous; perianth coriaceous; epipetric or terrestrial shrubs or trees of lagunas in páramos and elfin forests or in "jalca" or "pajonal" alpine savannas.
    2. Epipetric shrub or tree to 6 m tall; trunk leptocaulous; branchlets verruculose- to verrucose-papillate, prominently ridged, rugose when dried; leaves oblong, elliptic or lanceolate, (1.1–)1.4–2(–2.5)cm wide; fruit ovoid, then ellipsoid at maturity; plants of páramos or elfin forests. .... **28. C. marginatus**
    2. Terrestrial shrub to 1.5 m tall; trunk pachycaulous; branchlets red glandular-papillate, terete, smooth when dried; leaves oblanceolate, (0.4–)0.6–1(–1.2) cm wide; fruit obovoid throughout development; plants of jalca or pajonal alpine savannas. .... **29. C. lineatus**
1. Branchlets smooth, glabrous; leaves chartaceous, asymmetrical; inflorescence lax, straight; perianth chartaceous; epiphytic shrub or tree in cloud forests below subpáramos or facultative epiphytes in montane and elfin forests. .... **30. C. magnus**
    3. Leaves not bearing hydropoten above, conspicuously black punctate and punctate-lineate below; inflorescence rachis black punctate-lineate; perianth whitish-green, prominently black punctate and punctate-lineate; anthers ovate, rounded apically; branchlets 4–7 mm diam.; fruit purple-black at maturity. .... **30a. C. magnus** subsp. **magnus**
    3. Leaves bearing hydropoten above, at least proximally, inconspicuously pellucid to orange punctate; inflorescence rachis orange punctate-lineate; perianth maroon to purple, rarely white (then pistillate), prominently orange-punctate; anthers quadrate, emarginate apically; branchlets 2.5–3.5(–4.0) mm diam.; fruit white, then lavender at maturity. .... **30b. C. magnus** subsp. **asymmetricus**

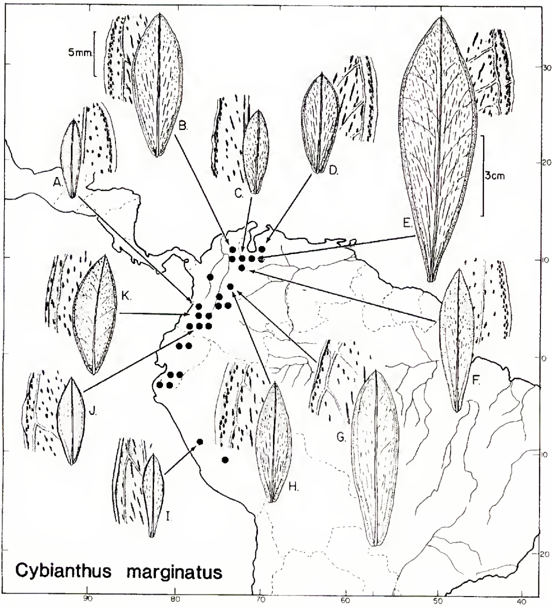

FIG. 21. Pictorialized distribution of *C. marginatus*. A-K, Variation in leaf shape, marginal venarion and punctation; note prominent apical mucron, sessile leaf base typical of subgenus *Grammadenia*. A-K, drawn from: A. *Cuatrecasas 21805*, B. *Pipoly 6954*, C. *Pipoly 6539*, D. *Liesner 8038*, E. *Luteyn 9032*, F. *Steyermark 100867*, G. *Mason 13730*, H. *Pipoly 6975* , I. *Pearce 250*, J. *Lehmann 599*, K. *Luteyn 10175*. Figure from Pipoly, 1987, drawn by Bobbi Angell.

28. Cybianthus marginatus (Benth.) Pipoly, (**Fig. 1A,B, 7C,F, 21**). Mem. New York Bot. Gard. 43:60. 1987. *Grammadenia marginata* Benth., Pl. Hartw. 218. 1846. TYPE: COLOMBIA. CAUCA: Near Pirayo, 3,636 m, 1843 (bisex. fl), *C. Hartweg 1200* (HOLOTYPE: K; ISOTYPES: BM, E, G-BOISS, G-DEL, LD, OXF, P, W-2 sheets).

Grammadenia lehmannii Mez in Engl., Pflanzenr. IV. 236(Heft 9): 231. 1902. TYPE: COLOMBIA. TOLIMA: Altos de Otesas, 3,300 m, 11 Jan 1883, (bisex. fl), *F. Lehmann 2399* (LECTOTYPE by Pipoly 1987: G; ISOLECTOTYPES: LE, US).

Grammadenia alpina Mez in Engl., Pflanzenr. IV. 236(Heft 9):231. 1902. TYPE: VENEZUELA. Andes of Trujillo and Mérida, 1,212–4,390 m, 1842 (bisex. fl), *J. Linden 447* (LECTOTYPE by Pipoly 1987: P; ISOLECTOTYPES: BM-2 sheets, BR, G, G-DEL, G-BOISS, K, OXF, S, VEN).

Grammadenia pastensis Mez in Engl., Pflanzenr. IV. 236(Heft 9):232. 1902. TYPE: COLOMBIA. NARIÑO: W cordillera of Pasto, 3,000–3,200 m, 20 Feb 1881 (bisex. fl), *F. Lehmann 599* (HOLOTYPE: G; ISOTYPES: BM, LE).

Grammadenia nitida Mez in Engl., Pflanzenr. IV. 236(Heft 9):232. 1902. TYPE: PERU. HUÁNUCO: Pozuzo, 2,131–2,727 m, 1863 (bisex. fl, fr), *R. Pearce 250* (HOLOTYPE: K).

Grammadenia weberbaueri Mez, Repert. Spec. Nov. Regni Veg. 16:418. 1920. TYPE: PERU. CAJAMARCA: Jaén, cordillera E of Huancabamba, E slopes, 2,400–2,500 m, Apr 1912 (bisex. fl), *A. Weberbauer 6121* (LECTOTYPE by Pipoly 1987: GH; ISOLECTOTYPE: F).

Grammmadenia hexamera Pittier, J. Wash. Acad. Sci. 21:140. 1931. TYPE: VENEZUELA. MÉRIDA: Tabay, 2,500–3,000 m, 18 Sep 1930 (bisex. fl), *W. Gehriger 471* (HOLOTYPE: VEN; ISOTYPES: A, F, G, NY, PH).

Grammadenia andicola Cuatrec., Revista Acad. Colomb. Ci. Exact. 8(31):321. 1951. TYPE: COLOMBIA. VALLE: Cordillera Occidental, Los Farallones, NW slope, Quebrada Las Nieves, below El Diamante, 2,900 m, 30 Jul 1946 (bisex. fl, fr), *J. Cuatrecasas 21805* (LECTOTYPE by Pipoly 1987: F; ISOLECTOTYPES: F, COL 2-sheets, U, US).

Epiphytic *shrub or small tree* to 6 m, the trunk leptocaulous. *Branchlets* prominently ridged, 3–4(–5) mm diam., verruculose- to verrucose-papillate, rugose when dried, glabrous. *Leaves* coriaceous, symmetrical, oblong, elliptic or lanceolate, (3–)3.5–6(–6.5) cm long, (1.1–)1.4–2(–2.5) cm wide, apically acute to obtuse, mucronulate, basally acute, auriculate, nitid above, pallid below, prominently punctate and punctate-lineate, the margin entire, revolute. *Inflorescence* erect, the rachis flexuous, slender, (1–)1.3–2(–3.2) cm long, densely black punctate-lineate; floral bracts widely ovate to deltate, (0.8–)1.2–1.5(–1.8) mm long, 0.8–1.4(–1.8) mm wide, apically acute, the margin entire; pedicels (1–)1.5–2 mm long. *Flowers* coriaceous, 5(–7)-merous; calyx 1.1–2.1 mm long, the tube ca. 0.1 mm long, the lobes deltate, (1–)1.5–2 mm long, (1.2–)1.3–1.5(–2) mm long, apically acute, prominently and densely punctate and punctate-lineate, the margins minutely crenulate, glabrous to minutely ciliolate at first apically; corolla (2–)2.2–3 mm long, the lobes widely ovate, (1–)1.2–2 mm long, (1.2–)1.5–2(–2.5) mm wide, obtuse to rounded, glabrous without, glandular-granulose within basally, densely and prominently punctate medially, the margin entire; staminal tube carnose, 0.6–0.8(–1) mm long, the anthers sessile, alternate with fleshy lobes to 0.2 mm long, quadrate, 0.4–0.7 mm long and wide, apically rounded, basally truncate, the connective prominently punctate dorsally; pistil obnapiform, (0.9–)1.2–1.5 mm long and (0.8–)1.2–1.6 mm diam., the ovary (0.4–)0.6–1 mm long, glabrous to sparingly translucen glandular-lepidote, ovules 2(–4), uni- or biseriate, the style 0.3–0.5 mm long, epunctate. *Fruit* somewhat ovoid, then ellipsoid at maturity, 4.5–5(–6) mm long, (2.5–)3–4 mm diam., white, then purple-black at maturity, the punctations red-black, prominent.

Distribution.—*Cybianthus marginatus* is the most common species of the subgenus, occurring throughout the Andes from Venezuela to Peru, 2,000–3,400 m.

Ecology and conservation status.—This species occurs in large populations on rocks above lagunas in páramos in northern Ecuador and along watercourses in paramoid elfin forests, and "ceja" formations in the remainder of Ecuador and Peru. As long as there are remnant páramo formations, or elfin forests, there will be populations of *Cybianthus marginatus*. However, in some instances, soil compaction due to overgrazing by sheep can render the soil uninhabitable for this species.

Etymology.—The specific epithet refers to the scarious leaf margin, made conspicous by the coriaceous texture. In addition, this aspect is made more conspicuous by the prominent submarginal vein of many populations.

Representative specimens examined. **ECUADOR. Azuay:** "Oriente" border, Páramo del Castillo, crest of E cordillera on trail between Sevilla de Oro and Méndez, 2,727–3,333 m, 18 Aug 1945 (fl, fr), *W. Camp E-4809* (NY, VEN); Río Collay, Huagarancha S of El Pan, 2,650–3,290 m, 6 Jul 1943 (fl), *J. Steyermark 53354* (NY). **carchi:** Peak of Cerro Golondrinas, 00° 51' 12" N, 78° 08' 21" W, 3070 m, 24 Jul 1994 (fr), *B. Boyle et al. 3373* (BRIT, MO, QCNE); Cantón Montufar, Loma El Corazón, Bretaña, SE of Mariscal Sucre, Río Minas, 00° 35' N, 77° 42' W, 3,150 m, 22–23 Dec 1992 (fl, fr), *W. Palacios & G. Tipaz 10569* (BRIT, MO, QCNE). **Imbabura:** Cordillera Oriental, Camp Arelán, E of Volcán Cayambe, 2,803 m, 21 Jul 1944 (fl, fr), *W. Drew E-351* (MSC); Ridge just S of Río Clavadero, along trail to Río San Pedro, E of Cayambe, 2,893 m, 27 Jul 1944 (fl, fr), *I. Wiggins 10484* (DS, US). **Loja:** Saraguro-Loja, Km 12.4, turnoff toward Fierro Urco, Km 2.5–2,7, 03° 41' 05" S, 79° 17' 20" W, 3,150–3,300 m, 7 Dec 1994 (fl), *P. Jørgensen et al. 1278* (BRIT, LOJA, MO, QCA, QCNE); Páramos de Saraguro, 10 km S of Saraguro, 3,050 m, 2 Jan 1979 (fl), *J. Luteyn et al. 6647* (NY, QCA). **Zamora-Chinchipe:** border, crest of Cordillera Orienral, 2,840 m, 28 Jan 1984 (fl), *J. Luteyn & E. Cotton 11295* (NY, QCA); W slopes of Cordillera del Cóndor and NW slopes of Nudo de Sabanillas, around Tambo Cachiyacu, ca. 2 km SE of Yangana, 2,000–3,000 m, 19 Oct 1943 (fl, fr), *J. Steyermark 54800* (NY, U); S of El Playón de San Francisco, slopes of Cerro Mirador, 3,300–3,600 m, 29 Dec 1980 (fl, fr), *L. Holm-Nielsen et al. 29949* (AAU), *J. Jarmillo et al. 3929* (AAU, QCA). **PERU. Amazonas:** Prov. Luyas, Drto. Camporredondo, Anexo Tullanaya, Cerro Wicsocunga, 06° 05' 35" S, 78° 19' 56" W, 3,075 m, 7 Dec 1996 (pist. fl), *J. & L. Campos 3121* (BRIT, MO, USM). **Cajamarca:** Jaén, SW of Querocotillo, 3,150 m, Aug 1915 (bisex. fl, fr), *A. Weberbauer 7168* (F, G, GH). **Cusco:** La Convención, 2,800 m, 9 Jul 1968 (bisex. fl, fr), *T. Dudley 10910* (NA), 10 Jul 1968 (bisex. fl, fr), *T. Dudley 10922* (F, NA), *T. Dudley 10931B* (F, NA). **Huánuco:** Prov. Huánuco, 45 km on rd. from Huánuco to Tingo María, trail on S side of Carpish Tunnel, 09° 42' S, 76° 05' W, 2,400 m, 3 Mar 1985 (bisex. fl), *C. Todzia & B. Stein 2740* (F, TEX, USM).

As was stated previously (Pipoly 1987), *Cybianthus marginatus* is most closely related to *C. lineatus* (Benth.) Pipoly, previously known only from the contiguous Guayana Floristic Province, because of its (synapomorphic) flexous inflorescences and biseriate ovules. However, *Cybianthus marginatus* is easily distinguished from *C. lineatus* by its glabrous, ridged, verrucose-papillate branchlers, oblong, elliptic or ovate leaves, obnapiform pistil and ellipsoid fruits. The verrucose-papillate branchlets, leaf and fruit shape are unique (autapomorphic) features within the subgenus.

Cybianthus marginatus is the most variable species of the subgenus, containing one-third of the names attributed to *Grammadenia* as taxonomic synonyms. Variation in leaf size and punctation and quantitative floral variation have led to much overdescription. A full discussion of synonymy and variation was provided by Pipoly (1987). *Cybianthus marginatus* is most closely related to *C. lineatus* by virtue of its flexuous inflorescences and biseriate ovules. However, *Cybianthus marginatus* is easily distinguished from *C. lineatus* by the glabrous, ridged, verruose-papillate branchlets, oblong, elliptic or ovate leaves, obnapiform pistil and ellipsoid fruits.

29. **Cybianthus lineatus** (Benth.) Pipoly (**Fig. 7E**), Mem. New York Bot. Gard. 43:64. 1987. *Grammadenia lineata* Bentham, Pl. Hartw. 218. 1846. TYPE: VENEZUELA. ["GUYANA"]. BOLÍVAR: Savannas near Roraima, 1843 (bisex. fl, fr), *R. Schomburgk 647/992* (HOLOTYPE: K; ISOTYPES: B, BM, G-DC, G-DEL, P, U, W-2 sheets).

Terrestrial *shrub* to 1.5 m tall, the trunk pachycaulous. *Branchlets* terete, (2.5–)3–4(–6) mm diam., densely red glandular-papillate apically. *Leaves* coriaceous, symmetrical, oblanceolate, (1.2–)1.6–3(–3.9) cm long, (0.4–)0.6–1(–1.2) cm wide, apically acute, basally subauriculate, the margin flat. *Inflorescence* erect, flexuous, at times reduced to a simple dichasium, 0.6–1.0(–2.5) cm long, sparingly glandular-papillate; floral bracts widely ovate, 0.8–1.1 mm long, 1.1–1.4 mm wide, apically acute, the margin entire, glabrous. *Flowers* chartaceous, 5–6(–7)-merous; calyx 1.1–1.6 mm long, the tube ca. 0.1 mm long, the lobes wide-triangular to deltate, (0.8–)1–1.5 mm long, (0.7–)1–1.2(–1.4) mm wide, apically acute, conspicuously black punctate and punctate-lineate, the margins entire, glandular-ciliolate; corolla (1.8–)2–2.5(–3) mm long, the lobes widely ovate, (1–)1.3–1.6(–2) mm long, (1–)1.3–1.7(–2) mm wide, obtuse to emarginate, inconspicuously punctate medially, the margins irregular, entire; staminal tube carnose, conspicuous, (0.6–)0.8–1 mm long, the anthers sessile, alternate with prominent fleshy lobes, quadrate, 0.4–0.6 mm long and wide, apically rounded, prominently black punctate dorsally; pistil ellipsoid, (0.9–)1–1.2(–1.4) mm long, (0.8–)1–1.3 mm diam., the ovary 0.8–1 mm long, glabrous to translucent glandular-lepidote apically, ovules 2–3, when more than 2, biseriate, the style (0.1–)0.2(–0.3) mm long, glabrous. *Fruit* obovoid, (3–)4–5 mm long, (2–)2.5–3 mm diam., purple, than black at maturity, the punctations green, prominent.

Distribution.—Formerly thought to be endemic to the Guayana Highland, in open savannas on tepuí summits throughout Pantepuí (Mayr & Phelps 1967), at 1,400–2,850 m elevation, but now known elsewhere only from the collection cited below.

Ecology and conservation status.—*Cybianthus lineatus* grows in fully exposed, dry montane "shrub savannas" (Huber 1995) in shallow sand over sandstone throughout Pantepuí. Its occurrence in Pajonal ("jalca") vegetation in Peru gives reason to expect it in other places, especially in the Cordillera del Cóndor along the Ecuadorean/Peruvian border. Unfortunately, recent civil unrest has prohibited collection in that area. In the majority of the range for the species, *Cybianthus lineatus* is not threatened.

Etymology.—The specific epithet refers to the numerous and prominent punctate-lineations of the abaxial leaf surface.

Specimen examined. **PERU**. **Pasco:** Oxapampa Prov., Cerro Pajonal, 29 km from Oxapampa, 2,680 m, *D. Smith & Foster 2509* (F, MO, USM).

Cybianthus lineatus is most closely related to *C. marginatus* (Benth.) Pipoly, by virtue of its flexuous inflorescence and biseriate ovules (Pipoly 1987). However, *Cybianthus lineatus* may be easily recognized by its pachycaulous trunk, densely red glandular-papillate branchlet apices, ellipsoid pistil and obovoid fruits. It is the only species in the subgenus with parenchyma instead of aerenchyma in the cortex, the only one with bifacial palisade layers in the leaf, and the only one with a pachycaulous trunk. None of these morphological peculiarities are unexpected given its drier, wind-swept habitat.

30. Cybianthus magnus (Mez) Pipoly, Mem. New York Bot. Gard. 43:55. 1987.

Facultative epiphytic *shrub or tree* to 7 m tall. *Branchlets* terete, smooth, glabrous. *Leaves* chartaceous, asymmetrical, narrowly oblanceolate, oblanceolate or narrowly obovate, (4.5–)5.2–15 cm long, (1.0–)2.1–5.2 cm wide, apically acute to abruptly acuminate, tapering abruptly or gradually to base, bearing hydropotes above or not, conspicuously black punctate and punctate-lineate or inconspicuously pellucid to orange punctate below, the margins entire, flat, or subrevolute. *Inflorescence* lax, straight, (1.5–)2–8(–11.5) cm long, slender, densely glandular-granulose and papillate, prominently black punctate-lineate or conspicuously orange to brown punctate-lineate; floral bracts ovate, widely ovate or deltate, (0.7–)1.1–2.2 mm long, (0.6–)1.3–2 mm wide, apically acute to acuminate, prominently black or orange punctate and punctate-lineate, the margins erose and glandular-ciliate; pedicels 1.0–2.2(–5.5) mm long in flower, the smaller ones accrescent to 4(–6) mm long in fruit. *Flowers* chartaceous, 5(–6)-merous, whitish-green or pink to maroon; calyx lobes widely ovate to delatate, (0.8–)1–1.5(–2) mm long, (0.8–)1–2.1 mm wide, apically acute to acuminate, prominently black punctate and punctate-lineate or orange to brown punctate, the margins erose to fimbriate and densely glandular-ciliate; corolla (1.7–)2–2.6(–3) mm long, the staminate and bisexual maroon, the pistillate white, the lobes widely ovate, 1.1–1.6(–2.2) mm long, (0.9–)1.1–2.6 mm wide, apically obtuse to emarginate, rugose medially within, densely and prominently black punctate and punctate-lineate or orange to brown punctate, the margins irregular, entire; staminal tube membranaceous, (0.4–)0.7–1(–1.2) mm long, lobate, the lobes 0.1–0.2 mm long, the anthers sessile, alternate with the lobes, ovate to quadrate, (0.3–)0.4–0.6 mm long, 0.4–0.6(–7) mm wide, apically rounded or emarginate, the connectives epunctate ventrally, prominently black or orange punctate dorsally; pistil obnapiform, 1–1.2 mm long, 0.9–1.5 mm diam., the ovary 0.6–0.9(–1.3) mm long, densely translucent glandular-lepidote, the ovules 2–4(–5), uniseriate, the style 0.3–0.5(–0.7) mm long, glabrous. *Fruit* obovoid, 2.5–3.5 mm long, 2–3 mm diam. when dried, pink, then purple-black or white, then lavender at maturity, prominently black punctate-lineate or orange punctate and punctate-lineate when dried.

Distribution.—*Cybianthus magnus* occurs in the Andes of Venezuela southward to Peru as an epiphyte in the cloud forest zone below subpáramo thickets and as a facultative epiphyte in montane and elfin "ceja" forests, from 1,100–3,500 m. It is also known from the Serranía de Turumiquire, in the states of Monagas, Sucre and Anzoátegui, Venezuela, at 2,000–2,400 m.

Etymology.—The specific epithet refers both to the large, branchlets, often appearing succulent, as well as the large leaf size found in some populations.

As shown by Pipoly (1987) *Cybianthus magnus* is most closely related to *C. parasiticus* (Sw.) Pipoly from the Lesser Antilles by its chartaceous corolla rugose medially within, asymmetrical leaves, and obovoid fruits, but is easily separated from it by its erose and fimbriate calyx lobes, lobate staminal tube and sessile anthers. *Cybianthus magnus* superficially resembles *C. marginatus* (Benth.) Pipoly, but may be easily separated by its subsucculent smooth stems, and obovoid fruits

Both subspecies are known from Ecuador and Peru, with one region of apparent sympatry on the eastern slopes of the Cordillera Oriental in Ecuador and adjacent northern Peru. However, they appear to be separated by habitat. In Ecuador and Peru, subspecies *magnus* appears to be restricted to closed cloud forests, while subspecies *asymmetricus* is found in open montane forest and elfin ("ceja") forest. The salient features of each are summarized below.

30a. **Cybianthus magnus** (Mez) Pipoly subsp. **magnus (Fig. 8E)**. Mem. New York Bot. Gard. 43:56. 1987. *Grammadenia magna* Mez in Engl., Pflanzenr. IV. 236(Heft 9):231. 1902. Type: COLOMBIA. Santander del Norte: Ocaña to Pamplona, 2,000–2,500 m, 4 Mar 1879 (fl), *W. Kalbreyer 1087* (holotype: K).

Grammadenia oxygyna Cuatrec., Revista Acad. Colomb. Ci. Exact 8:321. 1951. Type: COLOMBIA. Valle del Cauca: Cordillera Occidental, W slope, bank of Río Digua, left side, Piedra de Moler, 900–1,100 m, 20 Aug 1943 (fl, fr), *J. Cuatrecasas 14947* (lectotype by Pipoly (1987): F, NY Neg 12136; isolectotypes:COL-3 sheets, F, U, US).

Facultative epiphytic *shrub* or *tree* to 7 m tall, 7–15(–30) cm diam., the canopy often bowl-shaped. *Branchlets* (4.0–)5.0–7.0 mm diam. *Leaves* not bearing hydropotes above, conspicuously black punctate and punctate-lineate below. *Inflorescence* rachis prominently black punctate and punctate-lineate. *Flowers* with perianth whitish-green, prominently black punctate and punctate-lineate; anthers ovate, rounded apically, the connectives prominently black punctate dorsally. *Fruit* purple-black at maturity, prominently black punctate-lineate when dried.

Distribution.—Subspecies *magnus* occurs from the Serranía de Turumiquire (states of Anzoátegui, Monagas, Sucre), and in the Andes, from Venezuela southward through Colombia to and Ecuador to Peru.

Ecology and conservation status.—Subspecies *magnus* occurs as an epiphyte in closed cloud forests, especially those below subpáramo thickets. It is a relatively rare, but widely distributed subspecies, and is increasingly endangered owing to habitat destruction.

Etymology.—The epithet refers to the leaf size and stem succulence, a novelty within the subgenus.

Specimens examined. **ECUADOR. Loja:** Between Nudo de Sabanillas and Río Cachiyacu at Tambo Cachiyacu, 3,000–3,500 m, 17 Oct 1943 (fr), *J. Steyermark 53584* (NY). **Zamora-Chinchipe:** Nangaritza Cantón, ridge crest of Cordillera del Cóndor, above Pachicutza, on disputed Peru-Ecuador border, 04° 06' S, 78° 35' W, 1,800 m, 5 Dec 1990 (stam. fl), *D. Neill & W. Palacios 9518* (MO, QCNE). **PERU. Cajamarca:** Prov. San Ignacio, path at the border of "La Unión," 2,200 m, 1 Nov 1995 (stam. fl), *C. Díaz & A. Torres 7805* (BRIT, MO, USM).

30b. Cybianthus magnus (Mez) Pipoly subsp. **asymmetricus** (Mez) Pipoly **(Fig. 8F)**, Mem. New York Bot. Gard. 43:57. 1987. *Grammdenia asymmetrica* Mez, Bull. Herb. Boissier sér 2, 5:246. 1905. TYPE: PERU. LORETO: Cerro de Ponasa, 1,300 m, Mar 1903 (fr), *E. Ule 6792* (LECTOTYPE by Pipoly 1987: HBG; ISOLECTOTYPES: F, G, K, L).

Grammadenia macrocarpa Lundell, Wrightia 5:292. 1976. TYPE: ECUADOR. NAPO: 17 km W of Lumbaque, 70–73 km W of Lago Agrio, 1,130 m, 4 Nov 1974 (bisex. fl, fr), *A. Gentry 12419* (HOLOTYPE: LL-TEX; ISOTYPES: MO, S).

Facultative epiphytic *shrub* to 2 m tall, 7 m diam., the canopy open, conical. *Branchlets* 2.5–3.5(–4.0) mm diam. *Leaves* bearing hydropotes above at least proximally, inconspicuously pellucid to orange punctate below. *Inflorescence* rachis conspicuously orange to brown punctate-lineate. *Flowers* with calyx greenish-pink, the staminate and bisexial with corolla maroon, the pistillate with corolla white and prominently orange punctate and punctate-lineate lobes; anthers quadrate, apically emarginate, the connectives prominently orange punctate dorsally. *Fruit* white, then lavender at maturity, prominently orange punctate and punctate-lineate when dried.

Distribution.—*Cybianthus magnus* subsp. *asymmetricus* occurs as an obligate epiphyte, growing on detritis in open montane forests and elfin forests, from the Darién of Panama to Cusco, Peru, from 1,000–2,000(–2,700) m.

Ecology and conservation status.—Subspecies *asymmetricus* grows as an obligate epiphyte, growing on rocks with deep organic detritis and large, moss-covered trees. With increasing levels of disturbance, it is being threatened.

Etymology.—The epithet refers to the asymmetric shape of the leaf blades.

Specimens examined. **ECUADOR. Carchi:** Cantón Tulcán, Parroquia Tobar Donoso, Reserva Indígena Awá, Centro El Baboso, 00° 53' N, 78° 25' W, 1,800 m, 17–27 Aug 1992 (fr), *G. Tipaz et al. 1741* (BRIT, MO, QCNE); Parroquia el Chicál, Centro San Marcos, 01° 06' N, 78° 14' W, 900-1,100 m, 20-30 Apr 1993 (fl), *P. Méndez et al. 341* (BRIT, MO); Cerro Golondrinas, valley bottom ca. 1.5 km NNE of summit, 00° 51' 52" N, 78° 08' 10" W, 2,750 m, 25 Jul 1994 (stam. fl), *B. Boyle et al. 3450* (BRIT, QCNE, MO). **PERU. Amazonas:** Prov. Bagua, Imaza, Nuevo Samaria (anexo de UVT), 18 Mar 1995 *C. Díaz et al. 7585* (BRIT, HUT, MO, USM). **Cusco:** La Convención, Cordillera Vilcabamba, ca. 1/2 way between Camps 2 1/2 and 3, 1,980 m, 1 Jul 1968 (bisex. fl, fr), *T. Dudley 10668* (F, NA), 1,800 m, 24 Jul 1968 (bisex. fl, fr), *T. Dudley 11324* (NA). **Huánuco:** Prov. Pachitea, region of Pucallpa, W part of Sirá Mountains and adjacent lowland, ca 24 km SE to 26 km ESE of Puerto Inca, next to Campamento Pato Rojo, 09° 27' S, 74° 46' W, and along crest after Campamento Peligroso1,600 m, 14 Apr 1988 (fr), *B. Wallnöfer 18-14488* (BRIT, MO, W, WU). **Pasco:** Oxapampa, Cordillera Yanachaga, Cerro Pajonal, chacos, 12 km SE of Oxapampa, 2,700–2,800 m, 7 Oct 1983 (bisex. fl), *R. Foster 9013* (MO, NY, USM).

Cybianthus magnus subsp. *asymmetricus* is notable for its stems with angular collenchyma in the pith, well-developed aerenchyma in the inner cortex, and tangential collenchyma in the outer cortex. It is separated from subspecies *magnus* by its inconspicuous or orange punctate leaves, orange punctate-lineate inflorescence rachis and perianth, quadrate, emarginate anthers and open montane and elfin forest habitat.

Grammadenia macrocarpa Lundell is notable only for its large, bright orange fruits and smaller flowers. I examined one fruit from each of the isotypes of *G. macrocarpa* and found an insect larva in each one, accounting for the size and peculiar morphology.

VIII. **Cybianthus** Mart. subgenus **Cybianthus**. *Cybianthus* sect. *Eucybianthus* Miq. in Mart., Fl. Bras. 10:292. 1856. *Cybianthus* sect. *Cybianthoides* Miq. in Mart. Fl. Bras. 10:292. 1856. Type Species. *Cybianthus penduliflorus* Mart.

Peckia Vell., Fl. Flum. 1:51. 1825., *nom. rej.*

Terrestrial dioecious *shrubs or small trees*. *Roots* positively geotropic. *Bark* mostly smooth, gray or sometimes brown, cracking longitudinally on older parts. *Trunks* distinguishable, normally more or less terete, leptocaulous, growth dynamics corresponding to Rauh's Model (Hallé et al. 1978). *Branchlets* thin to moderately thick, terete, trigonal, or ridged, rufous stellate or dendroid tomentose or rarely, with rufous, subsessile covering lepidote scales. Cataphylls and pseudocataphylls absent. *Leaves* alternate, or pseudoverticillate, supervolute, exstipulate, petiolate; blades epunctate or variously black or red punctate, the punctations at times prominent. *Inflorescence* a simple, lateral (axillary) raceme; peduncle 1–5 mm long, the rachis straight, minutely rufous glandular-papillate, glandular-granulose or lepidote, glabrescent or persistent; floral bracts solitary, at pedicel basally, ovate to lanceolate, persistent; pedicels cylindrical to clavate, or obconic, minutely glandular-papillate, glandular-granulose or lepidote, accrescent in fruit. *Flowers* unisexual or bisexual, 4-merous; perianth lobes imbricate or rarely valvate, prominently, conspicuously or inconspicuously punctate and/or punctate-lineate; calyx cotyliform, the lobes erect, at times reflexed in fruit, the margins irregular or regular, entire or minutely crenulate, glandular-ciliate; corolla rotate, to subrotate, the tube short, glabrous or glandular-granulose, at times papillate, the lobes glabrous without, glandular-granulose and/or glandular-papillate throughout within, the margins regular or irregular, entire or minutely crenulate, glabrous, glandular-granulose or papillate along the margins; stamens and staminodes similar, developmentally adnate to the corolla tube to form an inconspicuous tube, the stamens thus appearing epipetalous, apical free portion of the filaments present or absent, when present up to 3 times longer than the anthers, the anthers basifixed, appearing sessile or on minute apically free filaments, quadrate or ovate, apically emarginate, rounded, acute, apiculate or truncate, basally truncate or subcordate, dehiscent by apical pores, the pores at times confluent, the connective epunctate or conspicuously or prominently punctate, at times glandular-papillate; pistil and pistillode similar, conic, ellipsoid, or rarely, obturbinate, the ovary terete, lobed or costate, sparsely to densely translucent-lepidote, the placenta subglobose, (1–)2–3(–4) ovulate, the ovules half-immersed in the basal placenta, uniseriate or biseriate, the style long-attenuate, the stigma punctiform, lobed or capitate-lobed. *Fruit* drupaceous, depressed globose, the exocarp sometimes fleshy, the mesocarp and endocarp stony, prominently punctate-lineate, white, red or purple-black at maturity, one seeded, the testa corrugate, the embryo cylindrical, transverse.

A subgenus of 50 species in tropical South America, with the largest concentration of species in the Amazon Basin and adjacent Guianas, Planalto and coastal Brazil. Subgenus *Cybianthus* is by far the most complicated taxonomic group within the genus and is known from rather incomplete material. Collection of more material is hampered by the fact that the populations studied heretofore have revealed population densities lower than any other subgenus. So far, 13 species are known from Ecuador and Peru, but with additional collections, we may expect to find *Cybianthus lanceolatus* Pax, and/or *Cybianthus psychotriifolius* (Rusby) Mez, both from nearby Bolivia, in southern Peru.

KEY TO SPECIES OF *CYBIANTHUS* SUBGENUS *CYBIANTHUS*

1. Branchlets subterete to angulate.
   2. Inflorescence spicate or subspicate; calyx lobes inconspicuously or prominently orange punctate; petioles pulvinate basally.

3. Leaf blades inconspicuously pellucid punctate below; calyx lobes chartaceous or carnose, rounded or acute apically.

4. Branchlets 4–6 mm diam.; leaf blades coriaceous, nitid above; petioles 2.2–3 cm long; inflorescence spicate, the pedicels obsolete to 0.4 mm long; calyx lobes chartaceous, deltate, the margin entire, undulate, glabrous. .... **31. C. incognitus**

4. Branchlet 2–3.9 mm diam.; leaf blades membranaceous, dull above; petioles 1.7–2 cm long; inflorescence subspicate, the pedicels 0.6–0.9 mm long; calyx lobes carnose, ovate, the margin crenulate, glandular-ciliate. .... **32. C. minutiflorus**

3. Leaf blades perpuncticulose below; calyx lobes membranaceous, subacuminate apically. .... **33. C. huampamiensis**

2. Inflorescence racemose; calyx lobes densely and prominently black punctate or epunctate; petioles tapered, not pulvinate basally.

5. Leaves alternate; calyx lobes acute apically, the margins hyaline; anther apically rounded, obtuse or acute apically, the pores not confluent.

6. Pedicels 1.9–2.2 mm long; flowers erect; calyx carnose, 0.8–1.1 mm long, the lobes ovate, abruptly constricted basally, densely and prominently black punctate, the margin irregularly serrate, punctate-lineate, glabrous. .... **34. C. granulosus**

6. Pedicels 2.5–3.5 mm long; flowers nodding; calyx membranaceous, 1.5–1.9 mm long, the lobes deltate to triangular, not constricted basally, epunctate, the margin entire, epunctate, minutely glandular-ciliolate. .... **35. C. flavovirens**

5. Leaves pseudoverticillate; calyx lobes rounded apically, the margins opaque; anthers truncate apically, the pores confluent. .... **36. C. venezuelanus**

1. Branchlets terete.

7. Branchlets thick, (6–)7–10 mm in diameter.

8. Leaf blades subacuminate apically; calyx membranaceous or chartaceous, the lobes acute or acuminate.

9. Leaf blades nitid and perpuncticulose above, 12–13.5 cm wide, the secondary veins prominently raised above and below, basally truncate, auriculate; petioles 0.5–1.4 cm long; pedicels 0.3–0.5 mm long. .... **37. C. grandezii**

9. Leaf blades sordid and epunctate above, 2.1–5 cm wide, the secondary veins deeply impressed above, prominently raised below, basally cuneate; petioles 2.1–5 cm long; pedicels 0.8–1.4 mm long. .... **38. C. jensonii**

8. Leaf blades abruptly acuminate apically; calyx coriaceous, the lobes rounded. .... **39. C. fosteri**

7. Branchlets thin, 1.5–3.5 mm in diameter.

10. Leaf blades apically subacuminate to acuminate; calyx lobes acuminate or attentuate, the margin erose, short glandular-ciliate.

11. Leaf blades chartaceous to coriaceous, somewhat to very nitid above and below, the midrib raised above, decurrent to base of petiole; petioles short-pulvinate basally.

12. Leaf blades elliptic, (4–)5.5–7(–10.8) cm wide, apically long-acuminate, basally cuneate, the tertiary veins prominently raised, inconspicuously pellucid-punctate below; petioles canaliculate; pedicels cylindrical in fruit. .... **40. C. resinosus**

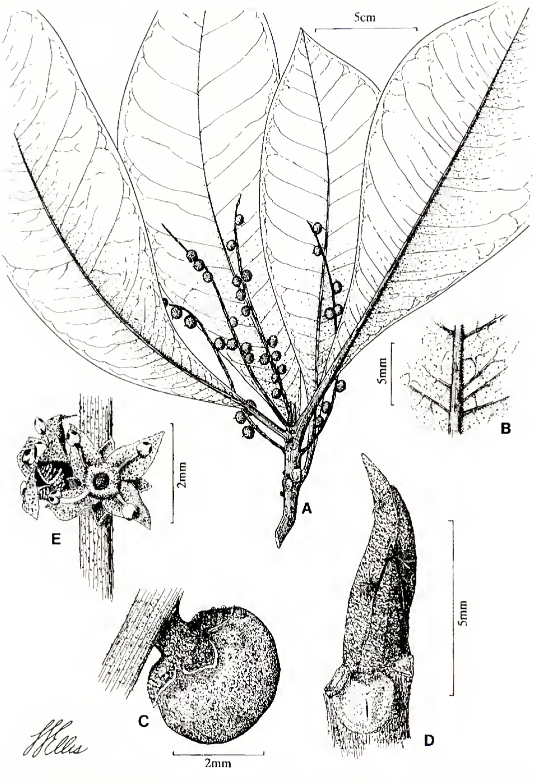

Fig. 22. *Cybianthus incognitus* Pipoly. A. Habit, showing trigonal branchlet. B. Abaxial leaf surface, showing minute scales. C. Portion of infructescence, showing deltate calyx lobes with entire margins. D. Branchlet apex, showing dendroid and stellate tomentum. E. Portion of staminate spike, showing conspicuous staminal tube, and obcordate anthers with subapical non-confluent pores. A, B, D, drawn from *Gentry et al. 22911*. C, drawn from *Barbour 2567*. E, drawn from holotype, by Linda Ellis.

12. Leaf blades very narrowly oblanceolate or oblong, 2–4(–5) cm wide, apically and basally long-attenuate, the tertiary veins inconspicuous, conspicuously black or red punctate and punctate lineate below; petioles marginate; pedicels obconic in fruit. .... 41.C. fuscus

11. Leaf blades chartaceous, dull green above and below, the midrib impressed above, not decurrent on the petiole; petioles gradually tapering to base, without pulvinus.............................. 42. C. cyclopetalus

10. Leaf blades apically acute; calyx lobes obtuse, the margin crenulate, long ciliate. .... 43. C. penduliflorus

31. Cybianthus incognitus Pipoly, sp. nov. (**Fig. 22**). Type: PERU. Amazonas: Río Santiago Valley, 03° 50' S, 77° 40' W, Quebrada Caterpiza, 2–3 km from Caterpiza settlement, primary forest, 200 m, tree 9 m tall, 12 Dec 1979 (stam. fl), *S. Tunquí 289* (holotype: MO; isotypes: USM, NY).

Ob folia coriacea oblanceolata desuper nitida subter pallida anthera filamenta 3-plo breviores *C. prieuro* valde arcte affinis sed ab ea petiolis canaliculatis (nec marginatis), ramulis adpresse dendroideo- et stellato- (nec erecte dendroideo-) tomentellis, pedicellis 0–0.4 (non 0.8–1.4) mm longis, lobis calycinis inconspicue pellucido- (non manifeste atro-) punctatis, lobisw corollinis ovatis (nec suborbicularis) pistillodio globoso (nec conico) denique fructu laevi statim recognitur.

Tree to 9 m tall, at times flowering precociously (*P. Barbour 2405*). *Branchlets* subterete to trigonal, 4–6 mm diam., appressed rufous dendroid and stellate tomentose. *Leaves* pseudoverticillate; blades coriaceous, oblanceolate, (16–)20–25(–31) cm long, (5–)6.5–8.5(–10) cm wide, apically acuminate, basally cuneate, decurrent on the petiole, nitid above, pallid below, the midrib slightly impressed above, prominently raised below, the secondary veins 9–12(–15) pairs, slightly raised above, prominently raised below, nitid above, pallid and minutely rubiginous lepidote below, the pellucid punctations inconspicuous, the margin entire, irregular, flat; petioles canaliculate 2.2–3 cm long, pulvinate, sparsely pubescent at first, glabrescent. *Staminate inflorescence*: an erect, dense spike, (6–)8–9.5 cm long, the rachis green, sparsely dendroid pubescent, glabrescent; floral bracts lanceolate, 0.5–1 mm long, apically attenuate, sparsely pubescent, early caducous; pedicels obsolete to stoutly cylindrical, 0–0.4 mm long, glabrate. *Staminate flowers* 4-merous, yellow, chartaceous; calyx cotyliform, 0.6–0.9 mm long, the tube 0.2 mm long, the lobes deltate, 0.4–0.7 mm long and wide, apically acute, inconspicuously pellucid punctate, the margins scarious, entire, epunctate, undulate, glabrous; corolla subrotate, 1.4–1.6 mm long, the tube 0.2–0.3 mm long, the lobes ovate, 1.2–1.4 mm long, 0.4–0.6 mm wide, apically acute, glabrous without, densely glandular-granulose within, inconspicuously pellucid punctate, the margin opaque, densely glandular-granulose, entire; stamens 1–1.2 mm long, the tube ca. 0.2 mm long, the filaments terete, 0.5–0.6 mm long, slightly reflexed proximally, the anthers obcordate, 0.3–0.4 mm long, apically apiculate, basally cordate, dehiscent by small, subapical, ovate, non-confluent pores, the pores extending less than 1/2 anther length, the connective epunctate, densely and minutely rubiginous glandular-granulose dorsally; pistillode broadly subglobose, ca. 0.2 mm long, 0.4 mm diam., densely yellow glandular-papillate. *Pistillate inflorescence* as in staminate but 9–12 cm long; floral bracts lanceloate, 0.2–0.5 mm long, glabrate; pedicels obsolete to 0.4 mm long, glabrate. *Pistillate flowers* as in staminate, but calyx 0.6–0.9 mm long, the tube 0.2 mm long, the lobes 0.4–0.7 mm long and wide, the margins opaque, entire; corolla, staminodes and pistil unknown. *Fruit* dark purple at maturity, globose, 0.4–0.5 mm long, 0.4–0.6 mm diam., smooth, incospicuously pellucid punctate.

Distribution.—Upper Río Santiago Valley and adjacent Serranía de Bagua, Amazonas, 200–2,000 m, and Maynas Province, Loreto, Peru, along the Río Napo, at 120 m elevation.

Ecology and conservation status.—*Cybianthus incognitus* is mostly a ridgetop species in the cloud forests of Amazonas Department, occurring infrequently near the forest margin. The Upper Río Santiago Valley and adjacent Serranía de Bagua are known for their endemic species (Pipoly 1992b). However, one surprising collection was noted at 120 m elevation, from Caserío de Urcumiraño, in Maynas Province of Loreto Department, where vegetation normally associated with much higher altitudes occurs on the tops of undulating hills. Much more fieldwork will be required to better understand forest dynamics at the western limits of the Peruvian Amazon with the foothills of the Andes.

Etymology.—The specific epithet refers to the fact that the plant was misidentified even to family for nearly twenty years, and was finally identified only when a flowering specimen was matched with the other fruiting specimens. The densely spicate infructescences with numerous fruits were heretofore unknown in the genus.

PARATYPES. **PERU. Amazonas:** Prov. Bagua, 12 km E of La Peca, cloud forest, 1700 m, 20 Jun 1978 (fr), *P. Barbour 2405* (AMAZ, F, MO, USM), 29 Jun 1978 (fr), *P. Barbour 2567* (AMAZ, BRIT, F, MO, NY, US); Ca. 12–18 km E of La Peca in Serranía de Bagua, cloud foresr, 1,800–1,950 m, 14 Jun 1978 (fr), *A. Gentry et al. 22859* (F, MO, USM), *A. Gentry et al. 22911* (F, MO, USM). **Loreto:** Río Napo near entrance to Isla Inayuga, 20 Sep 1972 (fr), *T. Croat 20528* (AMAZ, MO, USM); Caserio de Urcumiraño, Río Napo, 2 hours along trail from village to forest, 120 m, 8 Oct 1979 (stam. fl), *C. Díaz & N. Jaramillo 1474* (AMAZ, BRIT, MO, USM).

Cybianthus incognitus is appears to be most closely related to *Cybianthus prieurii* A. DC. of the Guianas, Venezuela and Brazil, because of the oblanceolate, highly nitid coriaceous leaf blades and the filaments three times longer than the anthers. However, *Cybianthus incognitus* is separated from *C. prieurii* by its canaliculate petioles, dendroid and stellate tomentose branchlets, sessile to subsessile flowers (spicate inflorescences), inconspicuously pellucid-punctate calyx lobes, ovate corolla lobes, globose pistillode and smooth fruits. *Cybianthus incognitus* is unique within the subgenus by virtue of its densely spicate inflorescences, dendroid and stellate tomentum of the branchlets and inconspicuosly punctate calyx lobes.

32. **Cybianthus minutiflorus** Mez, Repert. Spec. Nov. Regni Veg. 3:102. 1906. TYPE: PERU. LORETO: near Rioja, W of Moyobamba, 800–900 m, 8 Sep 1904 (pist. fl, fr), *A. Weberbauer 4699* (HOLOTYPE: B -destr.; fragment, F; LECTOTYPE, here designated: F). Because the fragment at F contains floral and leaf material, and leave no doubt as to the identity of the species, in the absence of other duplicates, it is most appropriate to select this "clastotype" (a fragment taken with permission) as the lectotype.

Tree to 3 m tall. *Branchlets* angulate, 4.5–6 mm diam., densely rufous stellate-tomentose, glabrescent. *Leaves* alternate; blades membranaceous, widely (rarely narrowly) oblanceolate, (14–)19–28(–40) cm long, (4–)9–12(–15) cm wide, apically acuminate, the acumen 1–1.5 cm long, basally cuneate, midrib slightly raised above, prominently raised and densely rufous tomentulose below, the secondary veins (9–)12–21 pairs, slightly raised above, prominently raised and sparsely rufous tomentulose below, smooth and glabrous above at maturity, sparsely rufous puberulent below, conspicuously pellucid punctate, the margin entire, flat; petioles canaliculate, 1.7–2 cm long, somewhat pulvinate, glabrous above, rufous tomentulose below, glabrescent. *Staminate inflorescence* a simple, erect raceme, 4.5–9 cm long, the rachis densely rufous stellate-tomentose; floral bracts linear-lanceolate, 1–1.2 mm long, 0.2–0.3 mm wide, apically attenuate, densely tomentose above and below, the margin entire; pedicels cylindrical, 0.6–0.9 mm long, densely tomentose, persistent. *Staminate flowers* pale yellow; calyx carnose, cotyliform, 0.6–0.8 mm long, the tube ca. 0.1 mm long, the lobes widely triangular, 0.5–0.7 mm long, 0.7–0.9 mm wide, apically acute, densely and prominently orange punctate, sparsely rufous puberulent, the margin irregular, opaque, somewhat crenulate, minutely glandular-ciliolate; corolla carnose, subrotate, 1.2–1.4 mm long, the tube 0.3–0.4 mm long, the lobes widely triangular, 0.9–1.1 mm long, 1.1–1.2 mm wide, apically obtuse, densely and prominently orange punctate medially without, densely glandular-granulose medially and above anther within, the margin opaque, glandular-granulose, entire; stamens apparently sessile at corolla tube apically, the anthers widely obcordate, 0.4–0.5 mm long, 0.7–0.9 mm wide, apically acute, basally cordate, the thecae moderately yellow glandular-granulose, the connective prominently red punctate; pistillode conic, 0.3–0.4 mm long, 0.1–0.2 mm diam., the stigma glandular-papillate. *Pistillate inflorescence* as in staminate but (4–)8–13 cm long; floral bracts 0.6–1 mm long, 0.1–0.2 mm wide, apically attenuate, densely tomentose above and below, the margin entire; pedicels 0.6–0.8 mm long, accrescent in fruit to 1.8 mm long. *Pistillate flowers* as in staminate but green; calyx 0.8–1 mm long, the tube ca. 0.1 mm long, the lobes 0.7–0.9 mm long, 0.9–1 mm wide; corolla 1–1.2 mm long, the tube 0.2–0.3 mm long, the lobes 0.8–1.0 mm long, 1–1.1 mm wide; staminodes as in stamens but antherodes obcordate, 0.2–0.3 mm long, 0.2–0.3 mm wide; pistil cylindrical, 0.6–1 mm long, 0.2–0.3 mm diam., the ovary angular, 0.3–0.4 mm long, the style 0.3–0.6 mm long, the stigma subcapitate, 4-lobed, the placenta cotyliform, ovules 2, naked. *Fruit* depressed-globose, 2.5–3.5 mm long, 4.5–5.5 mm diam., inconspicuously pellucid punctate, the exocarp thin. *Bisexual inflorescence* in staminate but 2–3(–5) cm long, the rachis moderately tomentose; floral bracts, 0.6–0.9 mm long, 0.1–0.2 mm wide; pedicels 0.6–0.7 mm long. *Bisexual flowers* green; calyx 0.7–8 mm long, the tube ca. 0.1 mm long, the lobes 0.6–0.7 mm long and wide; corolla 1.3–1.4 mm long, the tube 0.2–0.3 mm long, the lobes 1.1–1.2 mm long, 1–1.1 mm wide; stamens identical to pistillate staminodes, but thecae full of pollen; pistil almost indistinguishable from pistillate flower except the stigma subcapitate, 3–4-lobed, ovule 1, naked. *Fruit* (from bisexual flower) unknown.

Distribution.—Endemic to the eastern slopes of the Andes and adjacent Amazonian Hylaea of Peru and adjacent Bolivia, 100–1200 m.

Ecology and conservation status.—*Cybianthus minutiflorus* occurs in primary tall wet forest and premontane forest, on well drained white sands, known as varillal in Peru. These pockets of sandstone often alternate with rolling lateritic hills in the foothills of the eastern Andean slopes and adjacent Amazonia. The lowland forests where *Cybianthus minutiflorus* is occurs are also notable for their numerous lianas. *Cybianthus minutiflorus* is a rare species and should be considered threatened.

Etymology.—The specific epithet refers to the extremely small flowers, some of the smallest in the subgenus.

Local names and uses.—Peru: "takú kaspi" (Mayna Jívaro); leaves are boiled in water and the decoction drunk to treat stomach ache.

Specimens examined. **PERU. Amazonas:** Prov. Bagua, Dtto. Imaza, Cerros de Putuim, 05° 03' 20" S. 78° 20' 23" W, 350 m, 15 Jun 1996 (stam. fl), *R. Vásquez et al. 21187* (AMAZ, MO). Prov. Condorcanqui, Dtto. El Cenepa, NE region of Marañon Drainage Basin, Río Cenepa, Comunidad Tutino, 04° 33' S, 78° 10' W, 750 m, 22 Nov 1993 (fr), *R. Vasquez et al. 18520* (BRIT, HUT, MO, USM). **Cusco:** Quipicanchi Prov., Camantí, Manirí, along Río Manirí and along the trail to Quebrada Garrote, 13° 71' S, 70° 45' W, 720 m, 8 Sep 1990 (bud), *M. Timaná 922* (CUZ, MO, USM). **Huánuco:** Río Llulla Pichís watershed, Cerros del Sirá, 1,290 m, 17 Jul 1969 (fr), *J. Wolfe 12346* (F, NA, US). **Loreto:** Prov. Loreto, Pampa Hermosa and vicinity, Río Corrientes, 1 km S of junction with Río Macusari, 03° 15' S, 75° 50' W, 160 m, 3–20 Dec 1985 (fr), *W. Lewis et al. 10312* (BRIT, MO); Prov. Maynas, Dtto. Las Amazonas, Explornapo Camp, near Sucusari, along Río Napo, 03° 20' S, 72° 55' W, 100–140 m, 3 Mar 1991 (ster.), *J. Pipoly et al. 14174* (MO, UNAP); Dtto. Iquitos, Allpahuayo (IIAP), Permanent inventory, 04° 10' S, 73° 30' W, 150 m, 25 Mar 1992 (ster.), *R. Vásquez et al. 18163* (BRIT, MO, UNAP). **Pasco:** Oxapampa, Rd. in construction between Oxapampa and Villa Rica, km 7, 10° 37' S, 75° 20' W, 2,100 m, 4 Jan

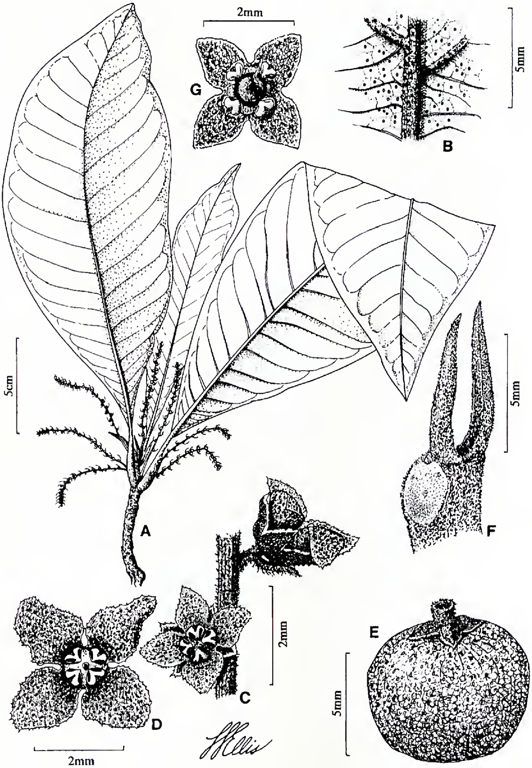

Fig. 23. *Cybianthus huampamiensis* Pipoly. A. Habit, showing pulvinate petioles. B. Abaxial, densely perpuncticulose leaf surface. C. Portion of staminate inflorescence, showing subspicate habit, and calyx erose-dentate and glandular-ciliate. D. Staminate flower, showing abruptly constricted corolla lobe base. E. Fruit and calyx. F. Branchlet apex. G. Pistillate flower, showing constricted corolla lobe base. A–B, drawn from *Kayap 783*. C–D, drawn from *Kayap 982*. E–G, drawn from *Kayap 933*. Figure drawn by Linda Ellis.

1984 (bisex. fl), *R. Foster et al. 7817* (F, MO, USM); Oxapampa, Pichís Valley, San Matias Ridge, 10–12 km SW of Puerto Bermúdez, above Sta. Rosa de Chivis, trail to Loma Linda, 10° 20' S, 75° 00' W, 1,000 m, 29 Sep 1982 (fr), *R. Foster 8624* (F, MO, USM), (stam. fl), *R. Foster 8981* (BRIT, MO, F, NY, US, USM). **San Martín:** Chazuta, Río Huallaga, 260 m, Mar 1935 (stam. fl), *G. Klug 3981* (F, MO, S, US); Prov. Mariscal Caceres, Drto. Tocache Nuevo, Isla de Pucunchu, right bank of Río Huallaga, 3 Apr 1971 (fr), *J. Schunke 4779* (F, MO, NY, US); W of bridge, 700–800 m, 16 Dec 1971 (fr), *J. Schunke 5737* (F, NY, MO, US). **Ucayali:** Prov. Coronel Portillo, Plantación Margarita, near Loreto border, 1,500–1,600 m, 14 Aug 1946 (fr), *R. Ferreyra 1040* (US, USM). **BOLIVIA. Pando:** Prov. Madre de Dios, Mobil Oil Site, 12° 10' S, 67° 15' W, 170 m, 20–25 Aug 1992 (fr), *T. Killeen 4449* (BRIT, LPB, MO).

Cybianthus minutiflorus is most closely related to *C. granulosus* Pipoly by its densely rufous furfuraceous-lepidote branchlets, erect, carnose, densely and prominently black punctate perianth, and sessile anthers. However, the flat petioles, subacuminate leaf apices, short pedicels, opaque, crenulate and epunctate margins of the calyx lobes, and emarginate anthers easily distinguish *Cybianthus minutiflorus*.

33. Cybianthus huampamiensis Pipoly, sp. nov. (**Fig. 23**). TYPE: PERU. AMAZONAS: Quebrada chigkan entsa, Río Cenepa, 300 m, 9 Jun 1973 (stam. fl), *E. Ancuash 588* (HOLOTYPE: MO; ISOTYPES: NY, USM).

Propter folia elliptica lanceolata vel oblanceolata, longipetiolata equilaterale vel inequilaterale secus margines irregulares, rhachides inflorescentiares graciles, flores erectes deminutosque, necnon frutos minores, ad aspectu primo intuito *C. resinoso* arcte similans sed ab ea laminis membranaceis (non tenuiter coriaceis), utrinque sordidis (nec nitidis) subter manifeste prominenteque atro-perpuncticulosis (nec epunctatis), petiolis (1.5–)2–2.5 (non 0.5–1.4) cm longis, lobis calycinis translucentibus (non opacis) acuminatis (nec rotundatis), lobis corollinis extus glandulari-granulosis (non glabris) acutis vel rotundatis (nec obtusis vel emarginatis) denique fructibus luteis (non atris) permanifeste distinguitur.

Tree to 3(–6) m tall. *Branchlets* subterete to angulate, (3.5–)4–5 mm diam., densely rufous tomentose, glabrescent. *Leaves* pseudoverticillate; blades membranaceous, elliptic lanceolate or rarely, oblanceolate, (12–)16–25(–31) cm long, (5.2–)7–9(–12) cm wide, apically long-acuminate, basally acute, not decurrent on the petiole, dull green above, pallid below, midrib impressed above, prominently raised below, the secondary veins 12–18 pairs, prominently raised below, glabrous above rufous puberulent below along the veins, prominently and densely perpuncticulose below, the margin entire, irregular, flat; petiole slightly canaliculate distally or flat, 2–2.5 mm long, thick and pulvinate, densely rufous puberulent at first, glabrescent. *Staminate inflorescence* a lax, simple, subspicate raceme, (5–)10–(18) cm long, sparsely rufous puberulent; floral bracts linear-lanceolate, 1–1.3 mm long, apically attenuate, densely rufous publerulent abaxially, the margin erose, persistent; pedicels cylindrical 0.8–0.9 mm long, densely rufous pubescent, glabrescent. *Staminate flowers* yellowish to orange; calyx membranaceous, cotyliform, translucent, 1.2–1.4 mm long, the tube ca. 0.2 mm long, the lobes ovate, 1–1.2 mm long, 0.6–0.8 mm wide, apically subacuminate, densely and prominently orange punctate, glabrous, the margin hyaline, prominently erose-dentate, sparsely glandular-ciliate; corolla chartaceous, subrotate, 2.0–2.4 mm long, the tube 0.4–0.5 mm long, the lobes ovate, 1.6–1.9 mm long, 1.2–1.4 mm wide, apically acute to rounded, sparsely glandular-granulose without and densely so throughout within, densely and prominently orange punctate, flat, the margin scarious, erose-denticulate and glandular-granulose; anthers apparently sessile at junction of corolla tube and lobe, very widely ovate, 0.4–0.5 mm long, 0.6–0.8 mm wide, apically obtuse to rounded, dehiscent by apical confluent pores extending ca. 2/3 length of anther, the connective epunctate, densely rubiginous glandular-papillate dorsally; pistillode conic, ca. 0.2–0.3 mm long and diam., hollow, glandular-papillate. *Pistillate inflorescence* as in staminate but (5–)7–9(–14) cm long, densely rufous puberulent at first, glabrescent; pedicel 0.4–0.5 mm long. *Pistillate flowers* as in staminate but yellowish to orange; calyx 1–1.2 mm long, the tube ca. 0.2 mm long, the lobes 0.8–1 mm long, 0.4–0.5 mm wide; corolla 1.8–2.2 mm long, the tube 0.3–0.4 mm long, the lobes 1.5–1.7 mm long, 1.1–1.4 mm wide; staminodes as in stamens but antherodes 0.3–0.4 mm long, 0.5–0.6 mm wide, apically rounded to acute; pistil conic, ca. 1.3 mm long, the ovary 0.5–0.6 mm long 0.6–0.8 mm diam., translucent glandular lepidote, the style short, to 0.2 mm long, the stigma 4-lobate, the lobes distally curved, glandular-papillate. *Fruit* yellow, subglobose, 4–6 mm long, 5–8 mm diam. inconspicuously pellucid punctate.

Distribution.—Endemic to the Río Marañon, Río Cenepa and Río Santiago drainage basins in the northwest corner of the Department of Amazonas, Peru, 200–550(–1,850) m.

Ecology and conservation status.—*Cybianthus huampamiensis* occurs in the foothills of the premontane and lowland wet forest of the most underexplored area of the Peruvian Hylaea/Andean interface. Given that the region is a border area, and therefore, a priority for development, this species should be considered.

Etymology.—The epithet describes the place where the many of the collections were made, the Haumpami area of the Río Cenepa Drainage Basin.

Paratypes. **PERU. Amazonas:** Prov. Bagua; ca. 12–18 trail km E of La Peca, Serranía de Bagua, 1,800–1,950 m, 14 Jun 1978 (fr), *A. Gentry et al. 22859* (F, MO, USM); Río Cenepa, Quebrada tujushik entsa, 330 m, 18 Apr 1973 (fr), *E. Ancuash 274* (MO, USM); along Río Cenepa, 350 m, 3 May 1973 (fr), *E. Ancuash 303* (MO, USM); Río Cenepa, Quebrada Idayua entsa, 400 m, 16 May 1973 (fr), *E. Ancuash 392* (BRIT, F, LL-TEX, MO, US, USM); Río Cenepa, Quebrada Wampusik entsa, 5 Aug 1974 (stam. fl), *E. Ancuash 731* (MO-2 sheets, USM); Río Cenepa, Quebrada Cikan Inci, 250–330 m, 1 Jan 1973 (stam. fl), *B. Berlin 779* (MO, USM); 10 km N of Quebrada Huampami, 200–250 m, 24 Jul 1974 (stam. fl), *B. Berlin 1760* (MO, USM); Quebrada Chigkui Shinuki Cenepa, 250 m, 11 Apr 1973 (fr), *R. Kayap 618* (MO, USM), 23 May 1973 (stam. fl), *R. Kayap 783* (MO, NY, USM);

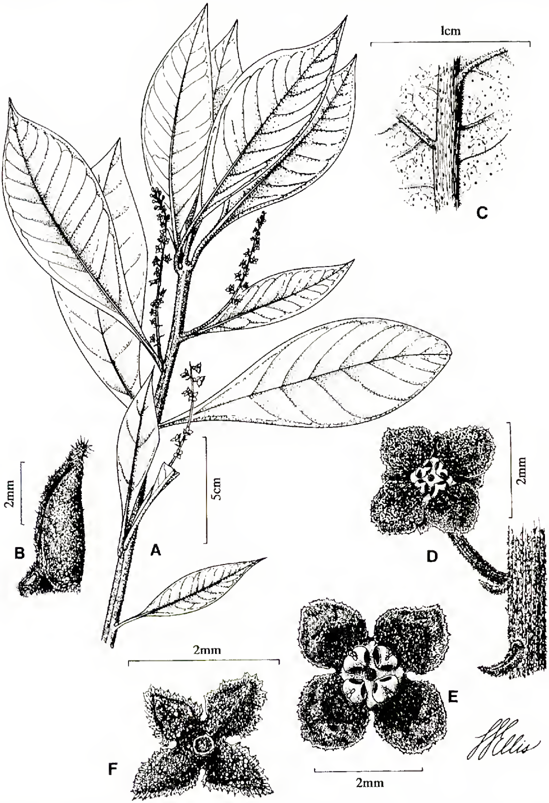

FIG. 24. *Cybianthus granulosus* Pipoly. A. Habit. B. Branchlet apex. C. Abaxial leaf surface, showing minutely rufous lepidote indumentum. D. Staminate flower. E. Staminate corolla. F. Staminate calyx. A–C, drawn from holotype. D–F, drawn from *V. Huashikat 1221*. Figure drawn by Linda Ellis.

Quebrada Etseketai, Río Cenepa, 250 m, 31 May 1973 (fr), *R. Kayap 856* (MO, USM); Quebrada Wampushik entsa, 330 m, 13 Jun 1973 (pist. fl, fr), *R. Kayap 933* (F, LL-TEX, MO, NY, USM); Huampami, Río Cenepa, 200 m, 15 Jun 1973 (stam. fl), *R. Kayap 982* (LL-TEX, MO, NY, USM); Río Cenepa, vicinity Huampami, ca. 5 km E of Chávez Valdívia, 04° 30' S, 78° 30' W, 200–250 m, 31 Jul. 1978 (fr), *A. Kujikat 50* (LL-TEX, MO, NY, USM), 12 Aug. 1978 (fr), *A. Kujikat 291* (MO, NY, USM), 15 Aug. 1978 (fr), *A. Kujikat 395* (MO, USM); Mouth of Río Santiago, without date (stam. fl), *G. Tessmann 4439* (NY); Río Santiago Valley, 03° 50' S, 77° 40' W, Quebrada Caterpiza, 2–3 km from Caterpiza, 200 m, 28 Dec 1979 (stam. fl), *S. Tunquí 488* (MO, NY, USM); Dtto. Imaza, Quebrada Kuzú, 1 hour walk from Comunidad de Cunchim, 370 m, 21 Jul 1994 (fr), *C. Díaz et al. 6930* (BRIT, HUT, MO, USM); Río Marañon Drainage Basin, Comunidad de Yamayakat, Río Marañon, 04° 55' S, 78° 19' W, 600 m, 28 Jan 1995 (fr), *E. Rodríguez 283* (BRIT, HUT, MO, USM), Quebrada Kusu-Chapi, 04° 55' S, 78° 19' W, 550 m, Feb 1995 (stam. fl), *R. Vásquez et al. 20045* (BRIT, HUT, MO), 320 m, 11 Mar 1996 (stam. fl), *N. Jaramillo et al. 1351* (BRIT, HUT, MO).

Cybianthus huampamiensis may at once be distinguished from all other species of the subgenus by its translucent calyx, externally glandular-granulose corolla and yellow fruit. This species is one of many endemic taxa known from this most underexplored area at the junction of the eastern Andean slopes with the Amazon Basin in northern Peru.

34. **Cybianthus granulosus** Pipoly, sp. nov. (**Fig. 24**). Type: PERU. Amazonas: Río Santiago Valley, 03° 50' S, 77° 40' W, Quebrada Caterpiza, 2–3 km from Caterpiza settlement, primary forest, 200 m, treelet 2 m tall, fls. brownish-green, 28 Nov 1979 (stam. fl), *S. Tunquí 161* (holotype: MO; isotype: NY).

Quoad folia alterna chartacea ad apices acuminata ad bases cuneataque, ramulos dense rufo-furfuraceo-lepidotos, flores erectos, carnosos, dense manifesteque atro maculatos, antheras sessiles, ad *C. minutifloro* valde affinis sed ab ea petiolis canaliculatis (non planis) laminis abrupte largo- (non sub-) acuminatis, pedicellis 1.5–2.5 (nec 0.5–1) mm longis, lobis calycinis secus margines hyalinis (non opacis) serratis (nec crenulatis) punctato-lineatis (nec epunctatis) lobis corollinis secus marginis erosis (nec integerrimis) antheris acutis (nec emarginatis) facile cognoscitur.

Treelet to 3 m tall. *Branchlets* angulate, 2–4 mm diam., densely rufous furfuraceous lepidote. *Leaves* alternate; blades chartaceous, elliptic to narrowly oblanceolate, (9–)11–15(–18) cm long, (3–)4–5(–6) cm wide, apically abruptly acuminate, basally cuneate, densely rufous lepidote (appearing granulose) above and below at first, glabrate above, somewhat persistent below, midrib impressed above, prominently raised below, the secondary veins 8–12 pairs, impressed above, prominently raised below, inconspicuously pellucid punctate, the margin entire; petioles canaliculate, 1.5–1.8 cm long, glabrescent above, densely lepidote below. *Staminate inflorescence* a simple raceme, (4–) 6–9(–10)cm long, the rachis and pedicels densely rufous furfuraceous lepidote; floral bracts carnose, linear lanceolate, 0.8–1.2 mm long, apically long-attenuate, the margin entire, densely lepidote; pedicels cylindrical, 1.9–2.2 mm long. *Staminate flowers* erect, 4-merous, carnose, subrotate, brownish-green;

calyx 0.8–1.1 mm long, the tube 0.1–0.2 mm long, the lobes ovate, 0.7–0.9 mm long, 0.8–0.8 mm wide, apically acute, abruptly constricted basally, densely and prominently black punctate, moderately rufous lepidote, glabrescent, the margin hyaline, conspicuously black punctate-lineate, irregularly serrate, glabrous; corolla subrotate, 1.6–1.8 mm long, the tube 0.3–0.4 mm long, square, glabrous, the lobes suborbicular, 1.3–1.4 mm long and wide, emarginate apically, abruptly constricted basally, densely and prominently black punctate, sparsely rufous lepidote without, glabrescent, densely glandular-granulose throughout within, the margin erose; anthers sessile at apex of corolla tube, thus appearing epipetalous, the tube 0.3–0.4 mm long, glabrous, the anthers widely cuadrate, 0.3–0.4 mm long, 0.6–0.7 mm wide, apically acute, basally truncate, dehiscent by large subapical, ovate pores, the pores not confluent, extending ca. 3/4 anther length, the connectives densely and prominently red or black punctate; pistillode conic, 0.2–0.3 mm long, sparsely glandular-lepidote. *Pistillate inflorescence* unknown. *Fruit* unknown.

Distribution.—Endemic to the upper Río Santiago Valley, in the Department of Amazonas, Peru, 180–200 m.

Ecology and conservation status.—*Cybianthus granulosus* inhabits wet premontane forests above the Río Santiago valley, which together with the Río Cenepa, comprise a region now known to be host to a number of endemic species. Given that it is most likely endemic, and not at all well-known, its conservation status cannot be determined at this time.

Etymology.—The specific epithet refers to the densely rufous lepidote tomentum, which appears granulose when examined superficially.

PARATYPES. **PERU. Amazonas:** Prov. Bagua, Dtto. Imaza, Comunidad Aguaruna Putuim, Anexo Yamayakat, Zonas Altas de Putuim, "Campou," 700 m, 18 Jan 1996 (fr), *C. Díaz et al. 7649A* (BRIT, HUT, MO, USM); Río Santiago, 3 km from Caterpiza, 180 m, 12 Nov 1979 (stam. fl), *V. Huashikat 1221* (MO, USM); Valle del Río Santiago, 65 km N of Pinglo, Quebrada Caterpiza, 2–3 km from Caterpiza, 200 m, 19 Sep 1977 (bud), *V. Huashikat* 677 (MO, USM), 28 Nov 1979 (stam. fl), *V. Huashikat 1422* (MO, USM).

Cybianthus granulosus is most closely related to *C. minutiflorus* Mez by virtue of its alternate, chartaceous leaf blades with acuminate apices and cuneate bases, densely rufous furfuraceous-lepdidote branchles, flowers with carnose texture, densely and prominently black punctate, and sessile anthers. However, *Cybianthus granulosus* is easily separated from *C. minutiflorus* by the abruptly long-acuminate leaf apices, canaliculate petioles, the hyaline, serrate, and punctate-lineate calyx margins, the erose corolla margins, acute anthers, and pedicels 1.5–2.5 mm long.

35. **Cybianthus flavovirens** Pipoly, sp. nov. (**Fig. 25**). TYPE: PERU. SAN MARTÍN: Prov. Mariscal Cáceres, Dtto. Tocaché Nuevo, Palo Blanco near Fundo de Manuel

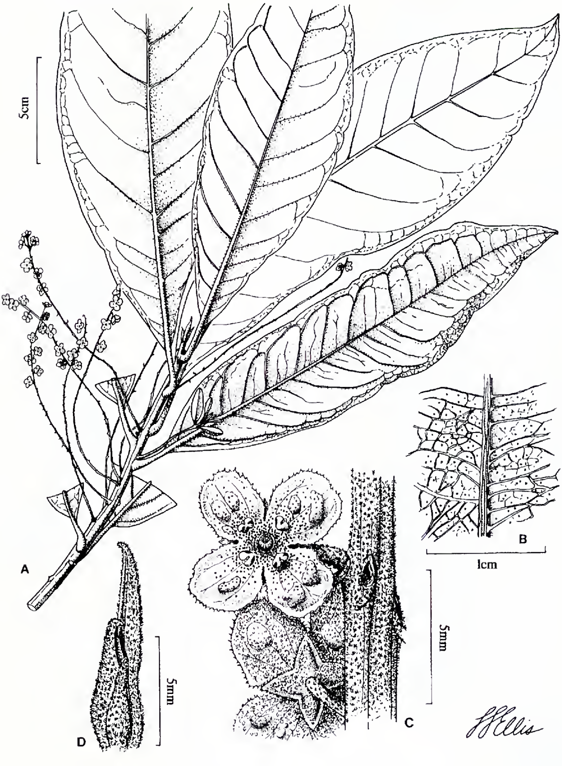

Fig. 25. *Cybianthus flavovirens* Pipoly. A. Habit, showing angulate branchlets and gradually tapering petioles. B. Abaxial leaf surface, showing sparse, rufous stellate tomentum. C. Section of inflorescence, showing nodding flowers, widely deltate calyx lobes and corolla with lobes constricted basally, prominent veins, and pusticulare surface. D. Branchlet, showing rufous stellate tomentum. A–D, drawn from holotype, by Linda Ellis.

Aranjo, 700–800 m, 1 Mar 1979 (stam. fl), *J. Schunke 10883* (HOLOTYPE: MO; ISOTYPES: AMAZ, BRIT, F, TEX, US, USM).

Propter ramulos angulatos, petiolos gradate angustatos, inflorescentiam racemosam, flores nutantes, antheras sessilia, *C. venezuelano* valde arcte affinis, sed ab ea lobis calycinis membranaceis (non carnosis) acutis (nec rorundatis) secus marginis hyalinis (nec opacis), antheris obtusis vel subacutis (non truncatis), porisque separatis (nec confluentibus), denique lobis corollinis membranaceis (non carnosis) pusticulatis (nec planis) truncatis vel emarginarisque (nec acutisque) praeclare distat.

Tree to 4 m tall. *Branchlets* lightly angulate, 2.5–3.5 mm diam., densely rufous stellate-tomentose. *Leaves* alternate; blades chartaceous, elliptic, (12.5–)19–30(–32) cm long, (4–)6–10 cm wide, apically subacuminate to acuminate, the acumen 0.5–2 cm long, basally attenuate, decurrent on the distal end of the petiole, midrib somewhat elevated but canaliculate above, not decurrent on petiole, prominently raised and densely rufous tomenose below, the secondary veins 10–16 pairs, dull green above, pallid green below, pellucid punctate above and below, sparsely rufous stellate-puberulent below, the margin entire, opaque, regular, flat; petioles semiterete (1.6–)2–2.5 cm, flat above, tapered, slightly thickend basally, not pulvinate, glabrous above, sparsely rufous pubescent below, glabrescent. *Staminate inflorescence* a lax raceme (7.5–)13–19(–40) cm long, the rachis and pedicels moderately rufous tomentellous, glabrescent; floral bracts linear-lanceolate, 1.1–1.5 mm long, 0.1–0.2 mm wide, apically attenuate, densely rufous tomentellous below, glabrescent, the margin entire; pedicels cylindrical, 2.5–3.5 mm long at anthesis, erect in bud, nodding in anthesis. *Staminate flowers* 4-merous, membranaceous, nodding, bright yellow-green; calyx cotyliform, 1.5–1.9 mm long, the tube 0.6–0.8 mm long, the lobes widely deltate to triangular, 1.1–1.3 mm long and wide, apically acute, epunctate, medially thickened, sparsely rufous puberulent, glabrescent, the margin hyaline, epunctate, entire, minutely glandular-ciliolate; corolla subrotate, 2.8–3 mm long, the tube 0.5–0.8 mm long, glabrous without, densely glandular-granulose within, the lobes suborbicular to oblate, 1.5–2.2 mm long, 2.2–2.6 mm wide, apically truncate to slightly emarginate, contracted basally, translucent, the three veins conspicuous, glabrous without, prominently pusticulate and sparsely glandular-granulose above but densely so toward base within, the margin opaque, sparsely glandular-granulose, entire; stamens apparently sessile at junction of corolla lobes and tube, the anthers sessile, very widely ovate-obcordate, 0.4–0.6 mm long, 0.5–0.8 mm wide, apically obtuse to subacute, basally cordate, the pores widely ovate, extending 1/2–3/4 anther length, separate (not confluent), the connective epunctate, minutely red glandular-papillate; pistillode costate, subglobose, 0.8–1 mm long, 0.6–0.7 mm wide, hollow, the stigma capitate, densely yellow glandular-papilalte. *Pistillate inflorescence*: unknown. *Fruit* unknown.

Distribution.—Endemic to the junction of the westernmost Amazon Basin (Hylaea) with the foothills of the Peruvian Andes, from 100–800 m elevation.

Ecology and conservation status.—*Cybianthus flavovirens* occurs in lowland moist forests on *terra firme*. These forests are drier than sites with the same general physiognomy farther to the north in Amazonas and Loreto. The few sporadic collections may be the result of underexploration rather than rarity, but owing to increasing pressure to cut forests for farming, this species should be considered threatened.

Etymology.—The epithet refers to the bright yellow-green corolla, a unique feature in the subgenus.

PARATYPES. **PERU. Huánuco:** Villa Isabel, Río Cuchara, 20 Sep 1961 (stam. fl), *J. Schunke 5667* (F, K, MO, US, USM). **Loreto:** Mishuyacu, near Iquitos, 100 m, Oct–Nov 1929 (stam. fl), *G. Klug 285* (F, US), (stam. fl), *G. Klug 367* (F, US). **Pasco:** Prov. Oxapampa, Palcazu Valley, Cabeza de Mono, 5–6 km W of Iscosacín, 10° 12' S, 75° 14' W, 14–15 Apr 1983 (stam. fl), *D. Smith 3709* (MO, US, USM); Prov. Pasco, Palcazu Valley, Selva Central, Cerro de Pasco, Proyecto Especial Pichís–Palcazu, IND, 09° 50' S, 68° 00'W, 300–600 m, 13 Oct 1987 (stam. fl), *G. Hartshorn et al. 2996* (BRIT, MO, USM).

Cybianthus flavovirens is a member of a complex of taxa related to *C. venezuelanus* Mez, as evidenced by the angulate branches, gradually tapered petioles, nodding flowers, and sessile anthers. However, *C. flavovirens* is easily recognized by its membranaceous perianth, acute calyx lobes with opaque margins, pusticulate, bright yellow-green corolla lobes with truncate or emarginate apices, and obtuse or subacute anthers with separate pores. This species has been confused with *Cybianthus cyclopetalus*. However, *Cybianthus flavovirens* may easily be separated from that species by its angulate branchlets, racemose inflorescences, large, yellow flowers, and deltate to triangular calyx lobes.

36. **Cybianthus venezuelanus** Mez in Engl., Pflanzenr. IV. 236(Heft 9):221. 1902. TYPE: VENEZUELA. LARA: Barquisimero, San Felipe, 600 m, Jun 1846 (stam. fl), *N. Funck & L. Schlim 678* (LECTOTYPE, here designated: G-BOIS; ISOLECTOTYPES: BM, BR, G, LD, P, W).

Peckia purpurea Rusby, Bull. New York Bot. Gard. 4:405. 1907. TYPE: BOLIVIA. Without locality data, (stam. fl), *A.M. Bang 2048* (HOLOTYPE: NY).

Cybianthus egensis Mez in Engl., Pflanzenr. IV. 236(Heft 9):222. 1902. syn. nov. TYPE: BRAZIL. AMAZONAS: Near Ega [Teffe], Sep 1831 (stam. fl), *E. Poeppig 2567* (HOLOTYPE: W, F Neg. 31997; ISOTYPE: W) .

Cybianthus brownii Gleason, Bull. Torrey Bot. Club 53:293. 1926. syn nov. TYPE: GUYANA [BRITISH GUIANA]. Tumatumari, 18 Jun–8 Jul 1921 (stam. fl), *H. Gleason 159* (HOLOTYPE: NY; ISOTYPE: K).

Tree to 5 m tall. *Branchlets* angulate, (2.5–)3.5–5 mm diam., densely rufous tomentose. *Leaves* pseudoverticillate; blades chartaceous, oblanceolate to elliptic, (10–)17–27(–34) cm long, (3–)6–9(–11) cm wide, apically acute to acuminate, basally acute, slightly decurrent on the petiole, midrib slightly raised above, prominently raised below, the secondary veins 10–13 pairs, rufous puberulent and smooth above, glabrescent, sparsely rufous puberulent below, concentrated along the midrib and secondary veins, inconspicuously pellucid punctate, the margin flat, entire; petioles slightly canaliculate, (15–)20–25(–30) mm long, tapered, densely and minutely stellate rufous stellate puberulent. *Staminate inflorescence*: an erect, simple raceme, (7.5–)10.5–18(–23) cm long, sparsely rufous stellate puberulent; peduncle 1–3 cm long; floral bracts coriaceous, lanceolate, 0.5–0.7 mm long, 0.2–0.3 mm wide, apically subulate, densely rufous stellate puberulent, the margin entire; pedicels cylindrical, 2.1–2.7 mm long, sparsely rufous stellate puberulent, glabrescent. *Staminate flowers* 4-merous, carnose, nodding, green; calyx cotyliform, 0.9–1.1 mm long, the tube ca. 0.1 mm long, the lobes widely ovate, 0.8–1 mm long, 0.9–1 mm wide, apically rounded, densely rufous stellate puberulent, sparsely and prominently black punctate, the margin opaque, coarsely serrulate, densely glandular-ciliolate; corolla carnose, subrotate, 1.6–1.8 mm long, the tube quadrate, 0.5–0.6 mm long, glabrous, the lobes widely triangular, 1.1–1.3 mm long, 1.5–1.7 mm wide, reflexed in anthesis, apically acute, dorsally recurved, prominently and densely black punctate and glabrous without, densely glandular granulose throughout within, the margin slightly revolute, densely glandular-granulose; staminal tube inconspicuous, hyaline, membranous, 0.5–0.6 mm long, adnate to corolla tube, anthers apparently sessile, cuadrate, 0.3–0.4 mm long, 0.5–0.6 mm wide, apically truncate, basally truncate, leaning proximally at anthesis, the connective prominently punctate dorsally, rufous glandular-papillate apically; pistillode obsolete or conical, 0.4–0.5 mm long, 0.1–0.2 mm wide, hollow, glabrous. *Pistillate inflorescence* as in staminate but (4.5–)8.5–10(–13) cm long; peduncle 1–2.5 cm long; floral bracts 0.5–0.7 mm long, 0.2–0.3 mm wide; pedicels 0.9–1.2 mm long. *Pistillate flowers* as in staminate but calyx 0.8–1.2 mm long, the tube ca. 0.2 mm long, the lobes 0.6–0.8 mm long, 0.9–1.1 mm wide; corolla 1.2–1.4 mm long, the tube 0.4–0.5 mm long, the lobes 0.7–0.9 mm long, 1.1–1.2 mm wide; staminodial as in staminal tube, 0.4–0.5 mm long, adnate to corolla tube, the antherodes 0.2–0.3 mm long, 0.4–0.5 mm wide; pistil obturbinate, 0.5–0.6 mm long, 0.3–0.4 mm wide, glabrous, the ovules 2–3, partially imbedded in the placenta. *Fruit* globose, 5–7(–9) mm diam., black at maturity, the exocarp thick, juicy.

Distribution.—In moist forests rimming the Amazon Basin, from Guyana through Venezuela to the Andes of Colombia southward to Bolivia, 100–1,000(–2,000) m. It is also known from the Chocó Floristic Province of Colombia, and may be expected in that corresponding region of Ecuador. The Bolivian specimens cited below represent new distribution records.

Ecology and conservation status.—*Cybianthus venezuelanus* is common in lowland and premontane moist forests, and occasionally in premontane pluvial forests. It is locally common and appears to do well in light gaps and forest margins, thus, it should not be considered threatened.

Etymology.—The epithet refers to the the country from which the type was collected, Venezuela.

Representative specimens examined. **ECUADOR. Zamora-Chinchipe:** Nangaritza Cantón, Pachicutza, Camino al Hito, Cordillera del Cóndor, 04° 07' S, 78° 37' W, 1,000–1,100 m, 19 Oct 1991 (fr), *W. Palacios et al. 8313* (BRIT, MO, QCNE). **PERU. Huánuco:** Prov. Leoncio Prado, Dtto. Rupa Rupa, Ynti, Rd. to Río Rondos, 750 m, 24 Mar 1972 (stam. fl), *J. Schunke 5308* (AMAZ, F, G, MO, NY, US, USM). **Loreto:** Prov Maynas, Mishuyacu, near Iquitos, 100 m, Oct–Nov 1929 (stam. fl), *G. Klug 94* (F, NY, US); Peña Negra, near Iquitos, 100 m, 20 Oct 1979 (bud), *F. Ayala 2102* (AMAZ, MO, USM); Quebrada Orejón, Purma, 29 Oct 1980 (fr), *F. Ayala et al. 2814* (AMAZ, MO, US, USM); Pumayacu, between Balsapuerto and Moyobamba, 600–1,200 m, Aug–Sep 1933 (stam. fl), *G. Klug 3188* (F, G, MO, NY, S, US). **Madre de Dios:** Prov. Tambopata, Tambopata Wildlife Reserve, 30 km S of Puerto Maldonado, 12° 15' S, 69° 17' W, 260 m, 14 Nov 1984 (stam. fl), *H. Young et al. 179* (MO, US, USM); Tambopata Tourist Camp at junction of Ríos Tambopata and La Torre, 12° 49' S, 69° 43' W, 280 m, 22 Jul 1985 (ster.), *A. Gentry et al. 51083* (CUZ, MO, USM), 27 Jul 1985 (ster.), *A. Gentry et al. 51400* (CUZ, MO, US, USM). **BOLIVIA. Santa Cruz:** Prov. Florida, Parque Nacional Amboro, Sta. Rosa de Lima, 5–8 km N of Cerca a La Cumbre, on path to La Playa, 17° 49.5' S, 64° 16' W, 2,000–2,100 m, 3–5 May 1993 (fr), *I. Vargas et al. 2248* (BRIT, MO, USZ)

The perianth of the lectotype of *Cybianthus venezuelanus*, with dense and prominent black punctations, the truncate sessile anthers, large oblanceolate chartaceous leaves, and short pedicels match the collections cited here. *Cybianthus venezuelanus*, as treated here, is a polymorphic ochlospecies with many regional variants. The type of *Cybianthus brownii* Gleason varies only in its shorter pedicels and longer corolla lobes. Likewise, the type of *Cybianthus egensis* Mez, in bud, has correspondingly shorter pedicels and corollas. *Cybianthus venezuelanus* is easily recognized by the angulate branchlets, pseudoverticillate leaves, rounded calyx lobes with opaque margins, and truncate anthers with confluent pores. Its distribution, which rims the Amazon Basin, is unusual in the Myrsinaceae but is common in other families, such as the Piperaceae (R. Callejas, pers. comm.).

37. Cybianthus grandezii Pipoly, sp. nov. **(Fig. 26).** Type: PERU. Loreto: Prov. Maynas, Quebrada Yanayacu, entering from Aucayo, 25 Aug 1990 (stam. fl), *C. Grández, S. Vásquez & M. Flores 1824* (holotype: MO; isotypes: AMAZ, US).

Quoad folia magna chartacea nervos secundarios tertiariosque laminares praeclare utrinque conspicua ad bases gradatim descrescentiaque necnon petiolos pulvinatos *C. jensoni* valde affinis sed ab ea laminis ad bases obtusis auriculatisque (non cuneatis) manifeste desuper perpuncticulosis (nec epunctatis) desuper nitidus (nec sordidis) nerviis secundariis 18–24 (non 24–30) -jugis, 12–13.5 (non 6.5–9) cm latis, petiolis 0.5–1.4 (non 2.1–5) cm longis, pedicellis 0.3–0.5 (non 0.8–1.4) mm longis, bracteis florinis pedicellis 3 (non 6–7)-plo longiores statim cognoscitur.

Shrub to 2 m tall. *Branchlets* terete, ca. 10 mm diam., rufous-lepidote.

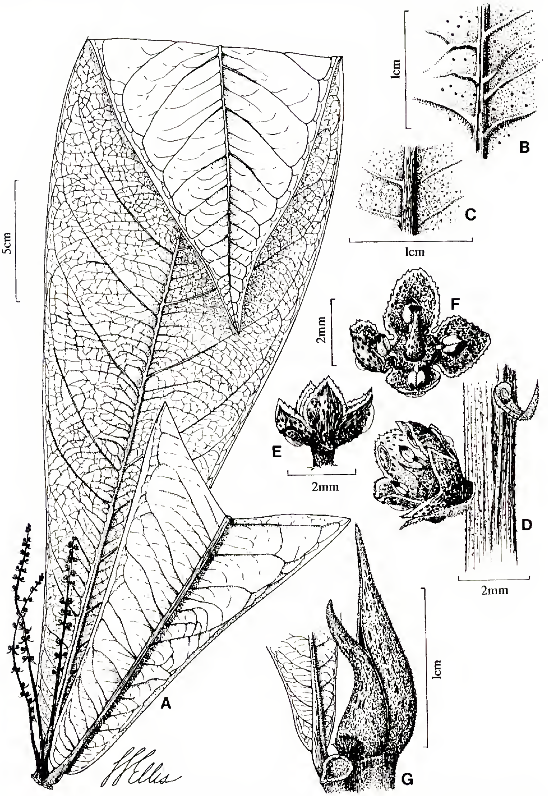

FIG. 26. *Cybianthus grandezii* Pipoly. A. Habit, showing basally truncate and somewhat auriculate leaf bases. B. Adaxial, prominently perpuncticulose surface. C. Abaxial, minutely rufous lepidote surface. D. Portion of inflorescence. E. Pistillate calyx, showing pustulate, black punctate lobes with hyaline, erose-sertulate margins. F. Pistillate corolla, showing pustulate abaxial surface. G. Branchlet apex. A–G, drawn from holotype by Linda Ellis.

Leaves alternate; blades chartaceous, oblanceolate, 34–36 cm long, 12–13.2 cm wide, apically subacuminate, basally truncate and appearing auriculate, nitid above, pallid below, glabrous, and prominently black perpuncticulose above, sparsely and minutely rufous-lepidote below, the midrib raised and canaliculate above, prominently raised, black punctate-lineate and densely rufous-lepidote below, the secondary veins 18–24 pairs, loop-connected submarginally, the margin entire; petioles canaliculate, (0.5–)1–1.4 mm long, 0.4–0.6 mm diam., pulvinate, densely lepidote. *Staminate inflorescence* unknown. *Pistillate inflorescence* an erect, straight simple raceme, (8.5–)11–14 cm long; peduncle 1–3 cm long; the rachis green, densely red glandular-papillate, black punctate-lineate; floral bracts membranaceous, linear-lanceolate, 1.8–2 mm long, densely rufous lepidote; pedicels obconic, 0.5–1 mm long, densely glandular-papillate. *Pistillate flowers* chartaceous, creamish-white; calyx cotyliform, 1.8–2 mm long, the tube ca. 0.5 mm long, the lobes widely ovate, 1.3–1.5 mm long, 1.1–1.2 mm wide, apically acute, densely and prominently black punctate, prominently translucent pustulate, the margin hyaline, irregular, erose-serrulate, epunctate, glabrous; corolla subrotate, 2.2–2.4 mm long, the tube ca. 0.5 mm long, the lobes very widely ovate 1.7–1.9 mm long and wide, apically rounded, densely and prominently black punctate and translucent pustulate without, glandular-granulose throughout and prominently black punctate within, the margin hyaline, epunctate, minutely erose- crenulate, glabrous; staminodes 1.1–1.2 mm long, staminal tube conspicuous, carnose, 0.4–0.5 mm long, elobate, densely glandular-papillate, the filaments terete, proximally curved, 0.2–0.3 mm long, the sterile anthers ovate, 0.5–0.6 mm long, and wide, the apically apiculate, dehiscent by terminal confluent pores ca. 3/4 length, the connective prominently black punctate; pistil obturbinate, 1.5–1.6 mm long, 0.5–0.6 mm diam., densely and prominently black punctate, translucent glandular-lepidote, the ovary 0.5–0.6 mm long, the style 0.8–0.9 mm long, the stigma bilobed, the lobes to 0.1 mm long, distally curved, the placenta subglobose, with 2–4 ovules partially embedded. *Fruit* globose, 8–10 mm long and in diam., the exocarp thick, juicy, purple-black at maturity.

Distribution.—Known only from Maynas Province, Dept. of Loreto, Peru, at up to 125 m elevation; presumably endemic.

Ecology and conservation status.—*Cybianthus grandezii* is restricted to primary lowland most upland *terra firme* forest over red lateritic clays. Label data indicate it is rare, and given the valuable timber present in that forest type, this species should be considered threatened.

Etymology.—It is indeed a pleasure to dedicate this species to Biól. César Grandez, professor of biology at the Universidad Nacional de la Amazonía Peruana (UNAP), Iquitos, and authority on the systematics of Peruvian Flacourtiaceae. César is an ardent field worker, an excellent teacher and herbarium curator.

PARATYPE: **PERU. Loreto:** Prov. Maynas, Drto. Fernando Lores, Panguana, 125 m, 6 Aug 1991 (fr), *S. McDaniel & M. Rimachi 31219* (MO, IBE).

Cybianthus grandezii is closely related to *C. jensonii* Pipoly, but is easily recognized by its subsessile leaves with truncate bases. The perpuncticulose and nitid adaxial leaf surface, and secondary veins raised prominently above and below are also distinctive.

38. Cybianthus jensonii Pipoly, sp. nov. (**Fig. 27**). TYPE: PERU. LORETO: PROV. Alto Amazonas: Andoas, Río Pastaza near Ecuadorean border, 02° 48' S, 76° 28' W, 210 m, 14 Aug 1980 (fr), *A. Gentry, R. Vásquez & N. Jaramillo 29700* (HOLOTYPE: MO; ISOTYPES: AMAZ, NY, USM).

Quoad folia magna chartacea nervos laminares secundarios tertiariosque praeclare utrinque conspicua ad bases gradatim aqdescrescentia petiolosque pulvinatos *C. grandezi* valde affinis sed ab ea laminis ad bases cuneatis (nec obtusis auriculatisque) epunctatis (non manifeste desuper perpuncticulosis) desuper sordidis (non nitidis) nerviis secundariis 24–30 (non 18–24)-jugis, 6.5–9 (nec 12–13.5) cm latis, petiolis 2.1–5 (non 0.5–1.4) cm longis, pedicellis 0.8–1.4 (non 0.3–0.5) mm longis bracteis florinis pedicellis 6–7 (non 3)-plo longiores statim cognoscitur.

Treelet to 4 m tall. *Branchlets* terete, 7–9 mm diam., lenticellate, the bark vertically ridged, densely rufous tomentose. *Leaves* alternate; blades membranaceous, oblanceolate, 33–49 cm long, 6.5–9 cm wide, apically subacuminate, basally long-attenuate, dull green above and below, the veins 24–30 pairs, bullate above, prominently raised below, the tertiary areoles prominently raised below; glabrate above, moderately rubiginous furfuraceous lepidote and sparsely pellucid punctate below, the margin entire, decurrent, gradually tapering to the petiole; petioles marginate, 2.1–5 cm long, to 0.5 cm thick, glabrous, abruptly pulvinate, the pulvinus 1.3–2 cm above petiole base. *Staminate inflorescence*: a simple, lax, axillary raceme 6.5–8 cm in bud; the rachis, bracts and pedicels densely rufous tomentose; floral bracts membranaceous, linear-lanceolate, 3–4 mm long, 0.3–0.4 mm wide, apically subulate, the margin entire; pedicels cylindrical, 0.8–1.4 mm long, glabrescent. *Staminate flowers* 4-merous; calyx membranaceous, cotyliform, 1.4–1.6 mm long, the tube 0.2–0.4 mm long, the lobes widely ovate, 1–1.3 mm long, 1.2–1.5 mm wide, apically acuminate, densely and prominently black punctate, sparsely rufous pubescent, the margin hyaline, flat, erose, epunctate; corolla (in bud) subrotate, membranaceous, to 1.2–1.5 mm long, the lobes ovate, apically obtuse, densely and prominently black punctate, glabrous without, sparsely glandular-granulose within, the margin hyaline, flat, erose, epunctate, glabrous; stamens appearing epipetalous, the anthers sessile at the junction of corolla tube and lobe, deltoid, ca. 0.7 mm long and wide, dehiscent by subapical pores, the connectives red punctate medially; pistillode, conic, hollow, ca. 0.5 mm long and 0.2 mm diam. *Pistillate inflorescence* as in staminate but 3–6(–7.2) cm long; floral bracts 1–1.6 mm long, 0.2–0.4 mm wide, apically long-attenuate; fruiting pedicels incrassate, 0.7–0.9 mm long, to 1.5 mm

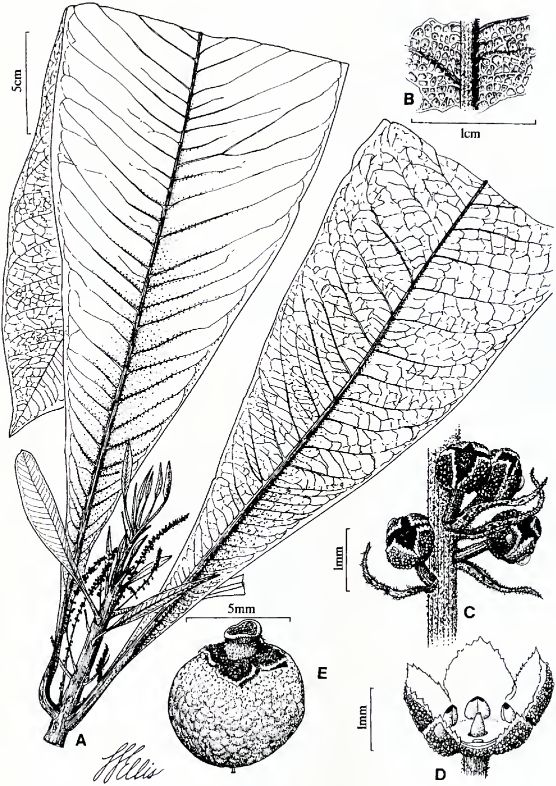

FIG. 27. *Cybianthus jensonii* Pipoly. A. Habit, showing long-attenuate leaf bases. B. Abaxial leaf surface with prominently defined areoles. C. Portion of staminate inflorescence in bud. D. Open staminate bud. E. Pedicel, calyx and fruit. A–D, drawn from *Gentry et al. 55708*. E, drawn from *Croat 19485*. Figure drawn by Linda Ellis.

diam. *Pistillate flowers* as in staminate, calyx 1.4–1.6 mm long, the tube 0.2–0.4 mm long, the lobes 1–1.3 mm long, 1.2–1.5 mm wide; corolla, staminodes and pistil unknown. *Fruit* depressed-globose, orange, 5–6 mm long, 6–7 mm diam., smooth, prominently pellucid punctate.

Distribution.—Endemic to lateritic slopes above riparian areas in the Department of Loreto, Provinces of Alto Amazonas and Maynas, in the northern Amazon Basin of Peru, 130–210 m.

Ecology and conservation status.—This species occurs in primary lowland tropical várzea forest margin. It is surely a rare species, given the recent massive collection effort at the sites during the *Florula of the Biological Reserves of Iquitos* project (Vásquez 1997), during which the species was not relocated at the Explorama Inn (Indiana) site. Given its rarity, this species should be considered threatened.

Etymology.—I dedicate this species to Peter Jenson, President of Explorama Tours, conservationist and principal promoter of ecotourism in the Peruvian Amazon. Much of our knowledge regarding the biology of tropical ecosystems in the Peruvian Amazon would not have been discovered were it not for Peter and his associates' enthusiastic support, generosity and hospitality at the company's biological reserves (Explorama Inn, Explorama Lodge, and Explornapo Camp) which now serve as long-term ecological study sites. Explorama Tours' properties, with their combination of research, public education and collaboration with local communities and tourism, serves as the most successful model for tropical ecotourism known.

PARATYPES. PERU. Loreto: Prov. Maynas, Explorama Inn, 2 km W of Indiana on Río Amazonas, 03° 30' S, 73° 02' W, 130 m, 12 Feb 1987 (stam. bud), *A. Gentry et al. 55708* (AMAZ, MO); Varadero de Mazán from Río Amazonas to Río Napo, 22 Aug 1972 (fr), *T. Croat 19485* (AMAZ, MO, NY, USM).

Cybianthus jensonii is most closely related to *C. grandezii* Pipoly, but easily recognized by its long-attenuate leaf bases, epunctate, pallid abaxial leaf surfaces, the secondary veins 24–30 pairs, narrower leaves with much longer petioles, subobsolete pedicels 0.8–1.4 mm long, and longer floral bracts.

39. **Cybianthus fosteri** Pipoly, sp. nov. (**Fig. 28**). TYPE: PERU. MADRE DE DIOS: Prov. Manú, Atalaya, vicinity Hacienda Amazonia, 2–3 km W of village, across Río Alto Madre, 12° 55' S, 71° 12' W, forested ridge, 600–900 m, 7 Dec 1983 (stam. fl), *R. Foster & T. Wachter 7254* (HOLOTYPE: MO; ISOTYPES: F, NY, USM).

Ob folia pseudoverticillata magna chartacea longipetiolata abrupte acuminataque, inflorescentia longiracemosa, flores nutantes, coriaceosque, antheras sessiles manifeste necnon dorso punctatas, *C. venezuelano* valde affinis sed ab ea ramulis teretes (non angulatis), foliis pseudoverticillatis (non alternis), laminis denseque manifeste atro-punctatis et omnino prominens (non parceqe plane subter atro lineato-punctatis) petiolatis canaliculatis (non marginatis ad bases abrupte crassis (nec gracilis) lobis corollinis interius pustulatis (non planis), antheris ad apices rotundatis (non truncatis) poris separatis (non confluentibus) praeclare distat.

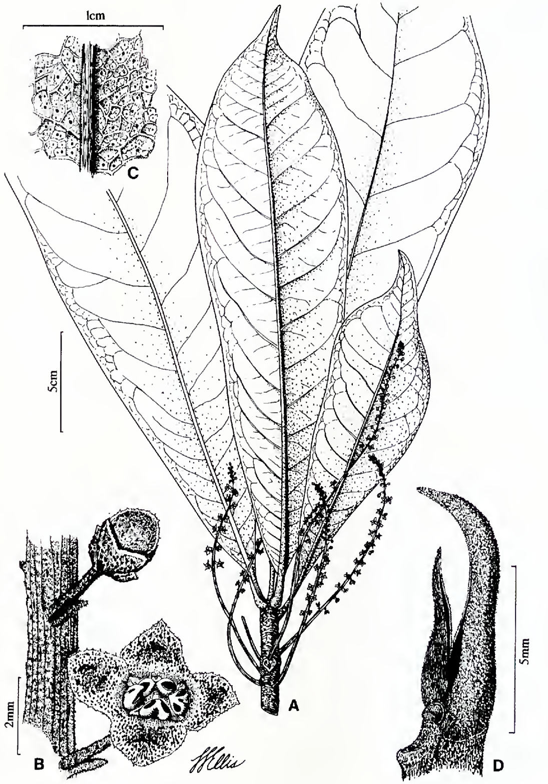

FIG. 28. *Cybianthus fosteri* Pipoly. A. Habit, showing terete branchlets and pseudoverticillate phyllotaxy. B. Portion of staminate inflorescence, showing pustulate corolla and apicallly rounded anthers with separate (not birimose) pores. C. Abaxial leaf surface detail, showing punctations and sparse puberulence. D. Branchlet apex, showing tomentum. A–D, drawn from holotype, by Linda Ellis.

Tree to 5 m tall. *Branchlets* terete, (6–)7–9 mm diam., densely ferrugineous tomentose. *Leaves* pseudoverticillate; blades chartaceous, oblanceolate, (26–) 28–34 cm long, 5.5–9(–10) cm wide, apically abruptly acuminate, basally long attenuate, midrib somewhat elevated above, prominently raised below, the secondary veins 11–18 pairs, dull green above, pallid below, prominently black punctate above and below, sparsely rufous puberulent below, the margin entire, regular, flat; petioles canaliculate, 1.6–2 cm, pulvinate, ferrugineous tomentose, glabrescent. *Staminate inflorescence* a lax raceme 8–12 cm long, moderately rufous lepidote, glabrescent; floral bracts lanceolate, 2–3 mm long, 0.8–1.1 mm wide, apically acute, densely rufous lepidote; pedicels cylindrical, 3.5–5 mm long at anthesis erect in bud, nodding in anthesis, densely rufous lepidote. *Staminate flowers* 4-merous, coriaceous, nodding, pale green; calyx cotyliform, 1.2–1.3 mm long, the tube 0.5–0.6 mm long, the lobes widely ovate, 0.7–0.8 mm long, 1.1–1.2 mm wide, apically rounded, densely and prominently black punctate, sparsely rufous lepidote, glabrescent, the margin stramineous, opaque, epunctate, erose-fimbriate, glabrous; corolla subrotate, 2–2.5 mm long, the tube 0.5–0.6 mm long, glabrous, the lobes widely ovate, 2–2.1 mm long, 1.4–1.6 mm wide, apically acute, densely and prominently black punctate, sparsely rufous lepidote without, glabrescent, prominently pustulate and densely glandular-granulose throughout within, the margin stramineous, erose, glandular-granulose; stamens apparently sessile at junction of corolla lobes and tube, the anthers sessile, very widely ovate, 0.5–0.6 mm long, 0.8–0.9 mm wide, apically rounded, basally truncate, the pores widely ovate, extending 1/2–3/4 anther length, separate (not confluent), the connective prominently red punctate; pistillode subglobose, 0.7–0.8 mm long, 0.3–0.4 mm wide, hollow, densely glandular-lepidote. *Pistillate inflorescence* as in staminate but erect, 3–5 cm long; floral bracts 2–3 mm long, 0.8–1.1 mm wide; pedicels 2.5–4 mm long in fruit. *Pistillate flowers* as in staminate but calyx 0.8–1 mm long, the tube 0.2–0.3 mm long, the lobes 0.5–0.7 mm long, 0.9–1.1 mm wide; corolla, staminodes and pistil unknown. *Fruit* globose, 6–8 mm long and diam., red at maturity.

Distribution.—Known only from the type locality, presumably endemic.

Ecology and conservation status.—*Cybianthus fosteri* is endemic to one area of the Manú Biosphere Reserve and National Park, one of the largest in South America. It is a ridgetop species in lowland topical most forest. Given the extension of the Reserve and the species narrow range, it should not be considered threatened at this time.

Etymology.—This species is dedicated to Robin Foster, of the Smithsonian Tropical Research Institute and a research associate of the Field Museum of Natural History. Robin has served as one of the co-founders of the Rapid Assessment Protocol, and is an expert on the reproductive biology of *Tachigali* (including *Sclerolobium*) of the Fabaceae.

Paratype: PERU. **Madre de Dios**: Prov. Manú, Atalaya, vicinity Hacienda Amazonia, 2–3 km W of village, across Río Alto Madre, 12° 55' S, 71° 12' W, 600–900 m, 7 Dec 1983 (fr), *R. Foster & T. Wachter 7242* (BRIT, F, MO, NY, USM).

Cybianthus fosteri is closely related to *Cybianthus venezuelanus*, but is easily recognized by its terete branchlets, pseudoverticillate leaves prominently and densely black punctate above and below, canaliculate petioles, pustulate corolla lobes, and rounded anthers with separate (not birimose) pores. The pustulate corolla lobes are unique within the genus.

40. **Cybianthus resinosus** Mez in Engl., Pflanzenr. IV. 236(Heft 9):219. 1902. Type: PERU. Loreto: Prov. Maynas, near Yurimaguas, without date (fr), *E. Poeppig 2428* (holotype: W; isotype: P).

Tree to 15 m tall. *Branchlets* 2.5–3.5 mm diam., densely ferrugineous dendroid-tomentose at first, glabrescent. *Leaves* pseudoverticillate; blades thinly coriaceous, elliptic, (11–)15–21(–26) cm long, (4–)5.5–7(–10.8) cm wide, apically long-acuminate, the acumen 0.8–1.5(–2) cm long, basally cuneate, decurrent on the petiole, midrib prominently elevated above and below, decurrent to petiole base, the secondary veins (9–)11–16(–18) pairs, nitid and glabrous above and below, inconspicuously pellucid-punctate (not visible when dried), the margin entire, irregular, flat, entire; petioles canaliculate, 1–2(–3) cm long, tapered, densely ferrugineous dendroid-tomentose, glabrescent. *Staminate inflorescence* a lax, simple raceme, 11–15 cm long, sparsely rufous stellate puberulent; peduncle 0.9–1(–1.8) cm long; floral bracts chartaceous, linear, 1–1.2 mm long, 0.2–0.3 mm wide, apically subulate, densely rufous stellate puberulent above and below, the margin entire, early caducous; pedicels cylindrical, 2.1–1.7 mm long, sparsely puberulent, glabrescent. *Staminate flowers* 4-merous, membranaceous, nodding, greyish-brown; calyx cotyliform, 0.9–1 mm long, the tube 0.1–0.2 mm long, the lobes widely ovate, 0.6–0.8 mm long, 0.9–1.2 mm wide, apically acuminate, sparsely rufous stellate puberulent, densely and prominently black punctate, the margin hyaline, erose, short glandular-ciliate; corolla subrotate, translucent, 1.6–1.8 mm long, the tube cylindrical, 0.3–0.5 mm long, the lobes very widely ovate, 1.2–1.5 mm long, 1.5–1.8 mm wide, flat, apically obtuse, densely and prominently black punctate and glabrous without, densely glandular-granulose and pusticulate within, the margin irregular, glandular-granulose, entire; stamens 0.7–0.9 mm long, the tube inconspicuous, membranaceous, 0.3–0.5 mm long, sessile, the anthers cuadrate, 0.2–0.3 mm long, 0.5–0.6 mm wide, apically truncate, translucent, glabrous, the connective prominently red punctate dorsally; pistillode cylindrical, 0.3–0.5 mm long, 0.2–0.3 mm diam., hollow, densely punctate, glabrous, the stigma 3-lobed. *Pistillate inflorescence* as in staminate but (1–)1.5–5 cm long; peduncle (0.3–)0.5–1(–1.5) cm long; floral bracts 0.6–1 mm long, 0.1–0.2 mm wide; pedicels slightly obconical, 0.7–1.1 mm long, erect in fruit. *Pistillate flowers* as in staminate but 1–1.2 mm long, the tube 0.2–0.3 mm long, the lobes 0.8–0.9 mm long, 1–1.2 mm wide; corolla 1.3–1.5 mm long, the tube 0.3–0.5 mm long, the lobes 0.8–1 mm long, 1.1–1.5 mm wide; staminodes as in stamens but 0.4–0.6 mm long, the tube 0.3–0.5 mm long, the antherodes ca. 0.1 mm long, 0.2–0.3 mm wide; pistil obturbinate, 0.4–0.6 mm long, and in diameter, the style very short, the stigma 3-lobed, the placenta cotyliform, bearing 2 apically exposed ovules. *Fruit* globose, 5–7 mm diam. at maturity, exocarp black, juicy, edible at maturity. *Bisexual inflorescence* as in pistillate but a lax, simple raceme, or rarely a poorly formed panicle, 5–8(–10) cm long; peduncle 0.5–1 cm long; floral bracts 1–1.2 mm long, 0.2–0.3 mm wide; pedicels 1.2–1.5 mm long. *Bisexual flowers* as in pistillate, but stamens as in staminate, 0.5–0.8 mm long, the tube 0.2–0.3 mm long, the anthers ca. 0.3–0.5 mm long, 0.4–0.5 mm wide; pistil as in pistillate, conical, 0.4–0.6 mm long, and in diam. *Bisexual fruit* globose, 4–6 mm diam. at maturity, exocarp reddish-black, thin.

Distribution.—Once thought to be endemic to the Iquitos area of Loreto, Peru, *Cybianthus resinosus* is now known (reported for the first time here), from the Chocó of Colombia, Amazonian Ecuador, Venezuela, with one disjunct population in French Guiana (*Oldeman 3272*) growing at 100–200(–1,300) m elevation.

Ecology and conservation status.—*Cybianthus resinosus* is restricted to primary non-inundated forests on white sand (varillal). While it is locally abundant, it should be considered threatened due to increasing habitat loss. The Ecuadorean and Venezuelan populations are unusual because they occur in premontane pluvial forest and wet forest on lower tepui talus slopes (on sandstone) respectively, each containing numerous lowland elements. It may be expected in the Río Cenepa-Río Santiago Drainage Basins, of Amazonas, Peru, an area known to show the same environments with numerous pockets of sandstone.

Etymology.—The specific epithet refers to the highly nitid adaxial leaf surface, giving it a lacquered, resinous appearance.

Specimens examined. **COLOMBIA. Valle del Cauca:** Bajo Calima Concession, ca. 25 km NW of Buenaventura, 9 km NW of San Isidro intersection on "Canalete," near gate, 5–45° slopes, 03° 59' N, 77° 08' W, 50 m, 13 Jul 1988 (ster.), *D. Faber-Langendoen & J. Hurtado 1757* (CUVC, MO). **VENEZUELA. Territorio Federal Amazonas:** Dept. Atabapo, base of cliff and forest below slope of Cerro Huachamacari, 03° 39' N, 65° 43' W, 1,000–1,300 m, 5 Mar 1985 (stam. fl), *R. Liesner 18302* (BRIT, MO, VEN). **ECUADOR. Napo:** Cantón El Chaco, Río Granadillo, Campamento de INECEL, "Codo Alto," 00° 08' S, 77° 28' W, 1,300 m, 13–15 Sep 1990 (fr), *W. Palacios 5589* (MO, QCNE). **PERU. Huánuco:** Prov. Pachitea, region of Pucallpa, W part of Sirá Mountains and adjacent lowland, ca. 24 km SE to 26 km ESE of Puerto Inca, from Campamento Sirá, 09° 28' S, 74° 47' W, SE to valley of Río Negro, 750 m, 29 May 1988 (fr), *B. Wallnöfer 14-29588* (BRIT, MO, W, WU). **Loreto:** Prov. Maynas, Iquitos, May 1925 (stam. fl), *G. Tessmann 5145* (NY); Casería

Mishana, 30 km SW of Iquitos, Callicebus Biological Reserve, 4 km S of Mishana, 19 Aug 1980 (stam. fl), *R. Foster 4404* (F-2 sheets, NY); Mishana, 16 Aug. 1978 (pist. fl, fr), *J. Ramírez 17* (AMAZ, MO); Mishana, Río Nanay, 03° 50' S, 73° 30' W, 140 m, 16 Aug 1978 (fr), *J. Ramírez 132* (AMAZ, MO); Mishana, along Río Nanay, 03° 55' S, 73° 35' W, 150 m, 20 Jan 1985 (fr), *R. Vásquez & N. Jaramillo 6126* (AMAZ, MO, NY); Allpahuayo, Estación IIAP, 04° 10' S, 73° 30' W, 150 m, 5 Jun 1985 (bud), *R. Vásquez et al. 6551* (AMAZ, BRIT, MO, NY), 29 May 1990 (fr) *R. Vásquez et al. 13764* (AMAZ, MO, USM), 16 Aug 1990 (pist. fl, fr), *R. Vásquez & N. Jaramillo 14224* (AMAZ, BRIT, F, MO, NY, TEX, US, USM), 4 Dec 1990 (fr), *R. Vásquez & N. Jaramillo 15237* (AMAZ, BRIT, F, MO, US, USM), 150–180 m, 29 May 1991 (ster.), *R. Vásquez & N. Jaramillo 16681* (AMAZ, BRIT, MO, USM), 150 m, 23 Mar 1992 (ster.), *R. Vásquez et al. 17996* (AMAZ, BRIT, MO, USM); Allpahuayo, ca. 26 km along Iquitos-Nauta Rd., 130 m, 25 Aug 1988 (fr), *H. van der Werff 10273* (AMAZ, MO); Mishuyacu, near Iquitos, 100 m, Sep 24–28 1929 (fr), *E. Killip & A. Smith 29873* (F, US), May–Jun 1930 (bisex. fl), *G. Klug 1384* (F, NY, US); Quistococha, 200 m, 27 May 1978 (pist. fl, fr), *A. Gentry & N. Jaramillo 22314* (AMAZ, MO); Altura de Piña Negra, SW of Iquitos, ca. 3–4 km past Quisrococha, 200 m, 19 Nov 1975 (fr); Caserío de Urcumiraño, Río Napo, path from settlement to tall forest, 120 m, 8 Oct 1979 (fr), *C. Díaz & N. Jaramillo 1486* (MO, NY); Peña Blanca, on Río Itaya, 110 m, 19 Sep 1929 (fr), *E. Killip & A. Smith 29672* (F, US); Between Yurimaguas and Balsapuerto (lower Río Huallaga basin), 135–150 m, 26–31 Aug 1929 (fr) *E. Killip & A. Smith 28110* (F, NY, US); Prov. Requena, Dtto. Sapuena, Jenaro Herrera, Río Ucayali, 04° 55' S, 73° 40' W, 160 m, 16 Aug 1994 (stam. fl), *R. Ortíz et al. 101* (AMAZ, BRIT, MO); without locality, except "in Peruvia subandina, without date (fr), *E. Poeppig s.n.* (L).

Cybianthus resinosus is most closely related to *C. penduliflorus* Mart., but is easily separated from it by the inconspicuously punctate leaves, longer pedicels, flat corolla lobes and calyx lobes with acuminate apices and erose, short-ciliate margins. The adaxial prominently raised midrib decurrent to the petiole base is unique within the subgenus. The fruit of *Cybianthus resinosus* is also smaller, black and has a thick exocarp, and it inhabits *terra firme* forests on white sand whereas *C. penduliflorus* is an igapó species.

41. **Cybianthus fuscus** Mart., Flora 259. 1841. Type: BRAZIL. Mato Grosso: "Prope rivum Cochim in Cujaba," May (pist. fl), *P. da Silva Manso s.n.* (holotype: M)

Shrub or small tree to 3 m tall. *Branchlets* terete, 2–3 mm diam., densely dendroid and stellate rufous glandular-tomentose, tardily glabrescent. *Leaves* pseudoverticillate; blades chartaceous to coriaceous, very narrowly oblanceolate or very narrowly oblong, (13–)16–25(–30) cm long, 2–4(–6) cm wide, apically long acuminate-attenuate, the attenuated portion 1–2 cm long, terminating in a minute rounded tip, basally long acuminate-attenuate, the attenuated portion 1.5–2 cm long, giving the petioles appearance of being longer, fully decurrent on petiole to pulvinus; midrib prominently elevated above, decurrent to petiole base, the secondary veins 12–25 pairs, somewhat to deeply impressed, the leaf appearing subbullate to bullate above, prominently raised and loop-connected below, somewhat nitid and glabrous above, pallid, rufous papillate and conspicuously black punctate and punctate-lineate below, the margin entire, flat, glabrous; petioles somewhat marginate, 5–10(–12) mm long, with a basal pulvinus. *Staminate inflorescence*: a lax raceme (2.5–)5–8(–19) cm long; peduncle 0.8–1.5 cm long; floral bracts chartaceous, linear, 1.2–1.5 mm long, 0.3 mm wide, apically subulate, densely and prominently rufous papillate; pedicels 3.5–5 mm long, densely papillate . *Staminate flowers* chartaceous, 4-merous; calyx cotyliform, 0.8–1(–1.8) mm long, the tube ca. 0.2 mm long, the lobes very broadly ovate or linear-lanceolate, 0.5–0.8(–1.6) mm long, 0.6–0.8 mm wide, apically acute to acuminate to attenuate, medially thickened, densely and prominently red and black punctate medially, with a few scattered rufous papillae, the margin scarious, highly erose, densely glandular-ciliate; corolla subrotate, 2–2.3 mm long, the tube 0.6–0.8 mm long, the lobes suborbicular, unequally divided, 1.4–1.6 mm long, 1.3–1.7 mm wide, apically broadly rounded, densely and prominently orange punctate without, densely glandular-granulose throughout within, the margin often revolute at maturity, irregular, entire, glandular-granulose; stamens ca. 1 mm long, the filaments developmentally fused to the corolla tube for their entire length (the stamens appearing epipetalous), 0.6–0.8 mm long, the anthers very widely ovate, 0.4–0.5 mm long and wide, the apically acute, basally cordate, apically dehiscent by terminal pores, confluent at anthesis, ventrally sparsely rufous papillate basally, dorsally densely rufous papillate and sparsely but prominently orange punctate; pistillode absent or highly reduced, ca. 0.5 mm long. *Pistillate inflorescence* as in staminate but 3–10(–14) cm long; peduncle 6–10 mm long; pedicels 1.5–4 mm long. *Pistillate flowers* as in staminate but 0.7–0.9 mm long, the tube ca. 0.1 mm long, the lobes oblate, 0.6–0.8 mm long, 1–1.2 mm wide; corolla as in staminate but 1.4–1.8 mm long, the tube ca. 0.5 mm long, the lobes ovate to suborbicular, 1.1–1.7 mm long, 1.0–1.2 mm wide, the staminodes resembling stamens but with antherodes 0.3–0.4 mm long and wide; pistil ellipsoid, 1–1.2 mm long, 0.6–0.8 mm diam., the stigma capitate, 3–4-lobed, densely translucent glandular-lepidote, ovules 2–3, immersed in the placenta. Fruit globose, 5–7 mm long and diam. at maturity, densely and prominently punctate, with a few persistent translucent lepidote scales.

Distribution.—As here recognized, *Cybianthus fuscus* occurs from the Guianas, to Venezuela, Colombia, Ecuador, Peru, Bolivia, and their corresponding frontiers with Brazil. *Cybianthus fuscus* rims the Amazon Basin, from 100–200 m elevation. As stated earlier, this is an infrequent distribution, as in *Cybianthus venezuelanus*.

Ecology and conservation status.—*Cybianthus fuscus* occurs in primary forest on *terra firme*, especially on steep slopes, near water courses. It is a locally infrequent element of the understory but does not appear to be threatened at this time.

Etymology.—The epithet refers to the color of the tomentum of the branchlets, pedicels and calyx.

Representative specimens examined. **ECUADOR. Napo:** Small area of non-inundated forest, ca. 60 km upriver from Nuevo Rocafuerte, 13 Sep 1977 (fr), *R. Foster 3618* (F, USM). **PERU. Loreto:** Prov. Alto Amazonas, Capahuari Sur (Petroleum Camp), 02° 51' S, 76° 20' W, 200 m, 25 Mar 1982 (fr), *R. Vásquez et al. 3065* (AMAZ, MO, US); Prov. Maynas, Río Yavari, Petropolis, 3 km from Río Amazonas, 8 Sep 1976 (fr), *J. Revilla 1302* (AMAZ, BRIT, MO); 15 km from roadside along Rd. between UNAP Agricultural Experiment area and Escuela Forestal Vivero, 9 Feb 1968 (pist. fl), *D. Simpson & J. Schunke 647* (F, USM); Puerto Almendras, 03° 45' S, 73° 25' W, 122 m, 7 Dec 1982 (pist. fl), *R. Vásquez & N. Jaramillo 3511* (AMAZ, MO, NY).

Cybianthus fuscus is a widely defined, infrequent, but widely distributed species, and is most variable with regard to leaf size and inflorescence stature. Populations in Ecuador and Peru are almost identical to specimens known from the Guianas, Bolivia, and Brazil in the northeast portion of Amazonas state, near the border of Territorio do Roraima. Populations matching the type have leaves much smaller than the Ecuadorean and Peruvian populations do, and are more like those of the SE Amazon Basin. While Cuiabá is located at the northern extreme of the Pantanal Region, it is not entirely clear where the exact type locality was. If the type locality in what was Cuiabá Province, was north of the Chapada dos Parecis, then it would be at the headwaters of the Rio Juruena or Rio Teles Pires, both of which dump into the Rio Tapajos, then to the Rio Amazonas. If the locality was west of Cuiabá, toward the Bolivian border, streams there form part of the headwaters of the Rio Mamasé, a branch of the Rio Madeiras, which empties into the Amazonas near Manaus. In either case, the type locality would be at the very edge of the Amazon Basin *sensu stricto* and it would not be surprising to see the species in other parts ot the Basin. Therefore, while populations from the type locality are slightly smaller in stature, the leaves are more chartaceous, and the inflorescences shorter, there is good evidence to show that they are part of a large polymorphic ochlospecies complex, of which the populations in Ecuador and Peru represent a commonly encountered morphotype. The same pattern of variation seen in this species is seen in many Piperaceae (R. Callejas, pers. comm.).

Cybianthus fuscus appears to be closely related to *C. cuneifolius* Mart. (including *C. indecorus* Mez), a vicariant species from SE Brazil. The unique indument, pedicels obconic in fruit, and striking leaves with very long and attenuate apices and bases allow for easy recognition of *Cybianthus fuscus*.

42. Cybianthus cyclopetalus Mez, Bull. Herb. Boissier, Ser. 2, 5:533. 1905.

Type: BRAZIL. Amazonas: near Juruá, Miry, Sep 1903 (stam. fl), *E. Ule 5840* (holotype: B -destr.; lectotype, here designated: HBG; isolectotypes: G, K, MG).

Shrub to 1.5 m tall. *Branchlets* terete, 1.5–2.5 mm diam., densely rufous stellate tomentulose, the tomentum appressed. *Leaves* loosely pseudoverticillate; blades chartaceous, elliptic to oblanceolate, (9.5–)12.5–16(–20.5) cm long, 3.5–5(–7) cm wide, apically subacuminate to acuminate, basally cuneate, decurrent throughout petiole length, midrib depressed above, prominently raised below, decurrent to base of petiole, the secondary veins 10–15 pairs, dull and glabrous above, dull and sparsely rufous puberulent below, concentrated along the midrib and the secondary veins, prominently perpuncticulose and black punctate-lineate, the margin slightly revolute upon drying, irregular, entire; petioles marginate and canaliculate, (1–)1.5–2(–3) cm long, tapered, sparsely stellate rufous puberulent, glabrescent. *Staminate inflorescence* an erect, simple raceme, (4–)9–13 cm long, sparsely rufous stellate puberulent; peduncle (0.6–)0.8–1(–1.3) cm long; floral bracts coriaceous, linear-lanceolate, 1.3–1.5 mm long, 0.2–0.3 mm wide, apically attentuate to a rounded tip, glabrous above, densely and minutely rufous stellate tomentulose below, the margin glabrous, entire; pedicels cylindrical, 3.7–5 mm long, sparsely rufous stellate tomentulose, glabrescent. *Staminate flowers* 4-merous, coriaceous, nodding, green; calyx 0.9–1.1 mm long, the tube 0.2–0.3 mm long, the lobes linear-lanceolate, 0.7–0.8 mm long, 0.2–0.3 mm wide basally, apically long-attenuate, densely and prominently red and black punctate, sparsely rufous stellate puberulent, glabrescent, the margin irregular, erose, minutely ciliolate; corolla subrotate, 1.5–1.8 mm long, the tube 0.6–0.7 mm long, the lobes very widely ovate, 0.9–1.1 mm long, 1.3–1.7 mm wide, apically emarginate, densely and prominently red and black punctate, glabrous without, densely glandular-granulose througout within, the margin irregular, entire, flat, densely glandular-granulose; staminal tube inconspicuous, adnate to corolla throughout, 0.6–0.7 mm long, the filaments short, thick, 0.1–0.2 mm long, glabrous, the anthers widely ovate, 0.5–0.6 mm long, 0.4–0.5 mm wide, apically and basally trunctae, the connective epunctate, glabrous; pistillode subglobose, 0.3–0.4 mm long, 0.3–0.4 mm diam., hollow, densely translucent glandular-lepidote, the stigma obsolete. *Pistillate inflorescence* as in staminate but 4–6.5 cm long; peduncle 1–1.5 cm long; floral bracts 0.9–1.1 mm long, 0.1–0.2 mm wide; pedicels 1.5–2.5 mm long. *Pistillate flowers* as in staminate but calyx 0.8–1 mm long, the tube 0.1–0.2 mm long, the lobes, 0.7–0.8 mm long, 0.1–0.2 mm wide basally; corolla, staminodes and pistil unknown. *Fruit* globose, 0.3–0.5 mm long and wide, green, exocarp thin, red punctate.

Distribution.—*Cybianthus cyclopetalus* is restricted to the western Amazon Basin of Brazil and southeastern Peru, to 290 m elevation.

Ecology and conservation status.—This species is retricted to várzea or "tahuampa" habitats, subject to inundation. Rapid development along the rivers in the Amazon Basin changes its flow and may effect these populations. Therefore, it should be considered threatened.

Etymology.—The specific epithet refers to the very widely ovate petals of the species.

Representative specimens examined. **PERU. Madre de Dios:** Prov. Tambopata, Tambopata Wildlife Reserve, 30 km S of Puerto Maldonado, 12° 15' S, 69° 17' W, 260 m, 9 Nov 1984 (stam. fl), *H. Young et al. 146* (MO, US); Tambopata Reserve, at mouth of Río Orbigny, 12° 50' S, 69° 17' W, 250 m, 6 Mar 1981 (fr), *A. Gentry & K. Young 32028* (MO, USM); Along trail from large laguna at end of Swamp Trail, Explorer's Inn, near confluence of Río Tambopata and Río La Torre, Reserva Tambopata, 12° 50' S, 69° 20' W, 39 km SW of Puerto Maldonado, 14 Oct 1985 (stam. fl), *S. Smith et al. 738* (US), (stam. fl), *D. Bell 101* (US); Explorer's Inn, Permanent Plots, Tambopata Reserve, 12° 50' S, 69° 17' W, 290 m, 18 Sep 1994 (stam. fl), *R. Vásquez et al. 19132* (AMAZ, BRIT, CUZ, MO) .

Cybianthus cyclopetalus is most closely related to *C. resinosus* Mez, but can immediately be separated from it by the thinner branchlets, dull, chartaceous leaves, and the unique linear-lanceolate calyx lobes with long attenuate apices.

43. **Cybianthus penduliflorus** Mart., Nov. Gen. Sp. Pl. 3:87. 1831 [1829]. *Cybianthus pendulinus* A. DC., Trans. Linn. Soc. London, Bot. 17:104. 1834 [orth. var.]. *Cybianthus pendiflorus* A. DC., Prodr. 8:117. 1844 [orth. var.]. TYPE: BRAZIL. AMAZONAS: Prov. Rio Negro, near Ega, 170 m, without date, (stam. fl), *C. Martius s.n.* (HOLOTYPE: M).

Cybianthus macrophyllus Miq. in Mart., Fl. Bras. 10:292. 1856. Pl. 36. syn. nov. *Peckia macrophylla* (Miq. in Mart.) Kuntze, Revis. Gen. Pl. 2:402. 1891. TYPE: BRAZIL. AMAZONAS: Near Ega, without date, (pist. fl), *E. Poeppig 2709* (LECTOTYPE, here designated: W).

Shrub or small *tree* to 4 m tall. *Branchlets* terete, 2.5–3.5 mm diam., stellate rufuous tomentose, glabrescent. *Leaves* alternate; blades chartaceous, elliptic to oblanceolate, (8–)10.5–19(–28.4) cm long, apically acute, basally broadly acute, slightly decurrent on the petiole, midrib raised above and below, the secondary veins (10–)12–15(–23) pairs, nitid above, pallid below, glabrous, densely black punctate, the margin flat, entire or bearing a few rough serrulations; petioles semiterete, (0.5–)0.8–1.2(–1.5) cm long, tapered, glabrous. *Staminte inflorescence* a lax, simple raceme (8–)10–14(–20) cm long, densely rufous puberulent; peduncle (0.5–)1–1.2(–1.5) cm long; floral bracts membranaceous, linear-lanceolate, 1–1.2 mm long, 0.1–0.2 mm wide, apically attenuate, densely rufous puberulent, the margin entire; pedicels cylindrical, 1–2(–2.5) mm long, densely rufous puberulent, glabrescent. *Staminate flowers* 4-merous, erect, membranaceous green; calyx cotyliform, 0.8–1.1 mm long, the tube 0.1–0.3 mm long, the lobes ovate, 0.4–0.6 mm long, 0.6–0.9 mm wide, apically obtuse, densely and prominently black punctate, the margin crenulate, long glandular-ciliate; corolla subrotate, 1.2–1.5 mm long, the tube 0.3–0.4 mm long, the lobes very widely ovate, 0.9–1.2 mm long, 1.2–1.5 mm wide, apically obtuse to rounded, densely and prominently black punctate, glabrous without, densely glandular-granulose throughout within, the margin involute, densely glandular-granulose, entire; stamens 0.7–0.9 mm long, the tube completely adnate to corolla tube, 0.3–0.4 mm long, the anthers ovate, 0.4–0.5 mm long, 0.3–0.4 mm wide, apically acute to obtuse, basally cordate, the connective prominently black punctate dorsally; pistillode obsolete. *Pistillate inflorescence* as in staminate but (2.5–)4–8(–11) cm long; peduncle (0.3–)0.5–1 cm long; floral bracts 1–1.2 mm long, 0.2–0.3 mm wide; pedicels 0.2–0.5 mm long. *Pistillate flowers* as in staminate but calyx 1.2–1.5 mm long, the tube 0.3–0.4 mm long, the lobes widely ovate, 0.9–1.2 mm long, 1.2–1.5 mm wide, apically rounded, corolla and staminodes unknown; pistil conical, 1.2–1.3 mm long, 0.9–1.1 mm wide, the stigma 4-lobed, the placenta cotyliform, ovules 4, naked. *Fruit* 6–10 mm long and in diam., the exocarp thin, densely black punctate. *Bisexual inflorescence*: as in staminate but 6–15 cm long; peduncle 0.8–1.2 cm long; floral bracts 1–1.2 mm long, 0.1–0.2 mm wide; pedicels 1–1.2 mm long. *Bisexual flowers* as in staminate but calyx 0.7–1 mm long, the tube 0.1–0.2 mm long, the lobes 0.6–0.9 mm long, 0.5–0.8 mm wide; corolla 1.2–1.5 mm long, the tube 0.3–0.4 mm long, the lobes very widely ovate, 0.9–1.2 mm long, 1.2–1.5 mm wide, the margin involute, densely glandular-granulose, entire; stamens 0.7–0.9 mm long, the tube completely adnate to corolla tube, 0.3–0.4 mm long, the anthers ovate, 0.3–0.4 mm long, 0.3–0.4 mm wide, apically acute to obtuse, basally cordate, the connective prominently black punctate dorsally; pistil conical, 0.9–1.1 mm long, 0.7–0.9 mm diam., the style 4-lobed, the placenta cotyliform, ovules 3, naked. *Bisexual fruit* globose, 4–6 mm long and in diam., the exocarp thin, pellucid punctate.

Distribution.—*Cybianthus penduliflorus* is known from Brazil, Peru and Bolivia, 100–200 m. The species is not known from Ecuador, but may be expected anywhere the habitat is appropriate within the Ecuadorean Amazon.

Ecology and conservation status.—*Cybianthus penduliflorus* is endemic to igapó habitats, and withstands flooding. As a small shrub, it grows on riverbanks and on hummocks, behind *Triplaris* (Polygonaceae) and other shoreline plants. At this time, it is not considered threatened.

Etymology.—The specific epithet refers to the lax habit of the inflorescence, pendent in the field.

Representative specimens examined. **PERU**. **Loreto:** Prov. Maynas, Quistococha, 100 m, 1 Feb 1979 (fr), *F. Ayala 1623* (AMAZ, MO), Quistococha, 00° 45' S, 73° 15' W, 122 m, 27 Aug 1987 (stam. fl), *R. Vásquez & N. Jaramillo 9461* (AMAZ, MO, USM); Lower Río Momón, tributary of Río Nanay, near Iquitos, 8 Dec 1979 (bud), *A. Jones & C. Davidson 9717* (AMAZ, CAS, MO), Near Momoncillo, 16 Nov 1976 (stam. fl), *J. Revilla 1826* (AMAZ, F, MO); Dtto. Iquitos, caserío near Nina Rumi, on Río Nanay, 23 Feb 1976 (fr), *J. Revilla 187* (AMAZ, F, MO, USM); Vicinity of Iquitos, 10 Sep- 12 Oct 1976 (bud), *J. Revilla 1442* (AMAZ, BRIT, MO, USM); Morona Cocha, near Iquitos, 100 m, 14 Dec 1962 (fr), *J. Schunke 6268* (AMAZ, F, MO, UCLA, US, USM); Puerto Almendras, 03° 48' S, 73° 25' W, 122 m, 17 Aug 1983 (bud), *R. Vásquez & N. Jaramillo 4285* (AMAZ, MO, NY, USM); Nauta, Quebrada Saragoza, 04° 29' S, 73° 35' W, 150 m, 10 Jan 1988 (fr), *R. Vásquez & N. Jaramillo 10339* (AMAZ, MO, US, USM); Iquitos and vicinity, 11 Oct 1929 (bud), *Ll. Williams 3676* (F). **BOLIVIA**. **Santa Cruz:** Velasco Prov., Campamento El Refugio, along Río Paragúa, SE of the house, 14° 46' 09" S, 61° 02' 11" W, 240 m, 11 Oct 1994 (fl bud), *R. Guillén & G. Salvatierra 2290* (BRIT, MO, USZ); Campamento La Toledo, 1,000 m E of the house, 14° 42' S, 61° 09' W, 160 m, 21 Oct 1994 (stam. fl), *R. Guillén & R. Choré 2459* (BRIT, MO, USZ), 1 km W of camp, on canoe route to Campamento Toledo, 14° 45' 51" S, 61° 02' 22" W, 30 Jan 1995 (fr), *R. Guillén et al. 3114* (BRIT, MO, USZ).

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REFERENCES

Agostini, G. 1970. Notes on Myrsinaceae I. The generic assignment of *Conomorpha sodiroana* Mez, *Ardisia ambigua* Mart, and related species. Phytologia 20:401–403.

————. 1972. A revision of the genus *Cybianthus* subgenus *Conomorpha* (Myrsinaceae). Ph. D. Thesis. The City University of New York, New York.

————. 1980. Una nueva clasificación del género *Cybianthus* (Myrsinaceae). Acta Biol. Venez. 10:129–185.

CULLEN, J. 1978. A preliminary survey of ptyxis (vernation) in the Angiosperms. Notes Royal Bot. Gard. Edinburgh 37:161–214.

FAHN, A. 1979. Secretory tissues in plants. Academic Press. New York.

GESSNER, F. & G. Volz. 1951. Die kuticula der hydropoten von *Nymphaea*. Planta 39:171–174.

GRÜSS, J. 1972a. Die lufrblätter der Nymphaeaceen. Ber. Deutsch. Bot. Ges. 45:454–458.

__________. 1972b. Die Haustoren der Nymphaeaceen. Ber. Deutsch. Bot. Ges. 45:459–466.

HALLÉ, F., R.A. OLDEMAN, and P.B. TOMLINSON. 1978. Tropical trees and forests. An architectural analysis. Springer-Verlag. New York.

HICKEY, L. 1984. A revised classification of the architecture of dicotyledonous leaves. In: C.R. Metcalfe and L. Chalk, eds. Anatomy of the Dictyledons. Vol. 1. Systematic Anatomy of Leaf and Stem, With a Brief History of the Subject. Clarendon Press. Oxford, U.K. Pp. 25–39.

HUBER, O. 1995. Vegetation. In: J. Steyermark, P. Berry, and B. Holst, eds. Flora of the Venezuelan Guayana. Vol. 1. Introduction. Missouri Botanical Garden and Timber Press. St. Louis. Pp. 97–160.

LINDLEY, J. 1848. Illustrated dictionary of botanical terms. Excerpt from illustrated dictionary of botanical terms by John Lindley. {Reprint, With an Introduction by Alice Eastwood, Stanford University, School of Earth Sciences, 1964}.

LÜTTGE, U. 1964. Mikroautoradiographische untersuchungen über die funktion der hydropoten von *Nymphaea*. Protoplasma 59:157–162.

__________. and G. KRAPF. 1972. Die Ultrastruktur der *Nymphaea*-hydropoten in zuzmmenhang mit ihrer. Funktion als salztransporierende Drüsen. Cytobiologie 1:121–131.

MACBRIDE, J.F. 1931. Spermatophytes, mostly Peruvian. III. Publ. Field Mus. Nat. Hist., Bot. Ser. 11 (1): 1-36.

MAGUIRE, B. 1979. Guayana, region of the Roraima Sandstone Formarion. In: K. Larsen and L.B. Holm-Nielsen, eds. Tropical Botany. Academic Press. London. Pp. 223-238.

MAYR, E. and W.H. PHELPS. 1967. The origin of the bird fauna of the South American highlands. Bull. Amer. Mus. Nat. Hist. 136:273–327.

MAYR, F. 1915. Hydroporen an wasser-und-sumpf-pflanzen. Beih. Bot. Centralbl. 32:278–371.

METCALFE, C.R. 1984. Some basic types of cells and tissues. In: C. R. Metcalfe and L. Chalk, eds. Anatomy of the dicryledons. Vol. 1. Systematic anatomy of leaf and stem, With a Brief History of the Subjecr. Clarendon Press. Oxford, U. K. Pp. 54–62.

MEZ, C. 1902. Myrsinaceae. In: A. Engler, ed. Das Pflanzenreich 9 (IV, 236):1–437.

PIPOLY, J. 1981. Contributions toward a monograph of *Cybianthus* (Myrsinaceae): I. Subgenus *Iteoides* and the identity of *Conomorpha loretensis*. Brittonia 33:491–493.

__________. 1983a. Contributions toward a monograph of *Cybianthus* (Myrsinaceae): III. A revision of subgenus *Laxiflorus*. Brittonia 35:61–80.

__________. 1983b. Contributions toward a monograph of *Cybianthus* (Myrsinaceae): IV. Notes on subgenera *Stapfia* and *Microconomorpha*. Wrightia 7:235–244.

__________. 1987. A systematic revision of the genus *Cybianthus* subgenus *Grammadenia* (Myrsinaceae). Mem. New York Bot. Gard. 43:1–76.

__________. 1988. Contribuciones para una monografía del género *Cybianthus* (Myrsinaceae) V. Dos especies nuevas de la Guayana venezolana. Ernsria 50:32–40.

__________. 1991. New specfies of *Cybianthus* subgenus *Conomorpha* from Amazonian Peru. Candollea 46:41–45.

__________. 1992a. The genus *Cybianthus* subgenus *Conomorpha* (Myrsinaceae) in Guayana. Ann. Missouri Bot. Gard. 79:908–957.

__________. 1992b. Notes on the genus *Myrsine* (Myrsinaceae) in Peru. Novon 2:392–407.

__________. 1993. Notes on *Cybianthus* subgenus *Cybianthus* (Myrsinaceae) in southeastern Brazil. Novon 3:459–462.

———. 1994. Notes on the genus *Cybianthus* subgenus *Cybianthus* (Myrsinaceae) in Colombian Amazonia. Sida 16:333–339.

———. 1996. Notas sobre el género *Cybianthus* (Myrsinaceae) en Colombia y Panamá. Caldasia. 18(3):285–294.

——— and Y.B. Harvey. 1995. Myrsinaceae. In: B. Stannard, ed. Flora of the Pico das Almas, Chapada Diamantina, Bahia, Brazil. Royal Botanic Gardens, Kew, U.K. Pp. 487–491.

Prance, G. 1982. Forest refuges: Evidence from woody angiosperms. In: G. Prance, ed. Biological Diversification in the Tropics. Columbia University Press, New York. Pp. 137–156.

Spruce, R. 1880. Notes of a botanist on the Amazon & the Andes. MacMillian & Co., Ltd., London, 1908. 2 vols.

Steyermark, J. 1981. Erroneous citation of Venezuelan localities. Taxon 30:816–817.

Theobald, W.L., J. Krahulik, and R. Rollins. 1984. Trichome description and classification. In: C.R. Metcalfe and L. Chalk, eds. Anatomy of the Dictyledons. Vol. 1. Systematic Anatomy of Leaf and Stem, With a Brief History of the Subject. Clarendon Press. Oxford, U.K. Pp. 40–53.

Vásquez, R. 1997. Flórula de las Reservas Biológicos de Iquitos, Peru. Monogr. Syst. Bot. Missouri Bot. Gard. 63.

White, F. 1962. Geographic variation and speciation in Africa with particular reference to *Diospyros*. In: D. Nichols, ed. Taxonomy and geography. The Systematics Association Publ. No. 4, London. Pp. 71–103.

Wiley, E. 1978. The evolutionary species concept reconsidered. Syst. Zool. 27:17–26.

———. 1981. Phylogenetics: The theory and practice of phylogenetic systematics. J Wiley & Sons, New York.

NUMERICAL LIST OF *CYBIANTHUS* TAXA

1. Cybianthus pastensis
2. C. gigantophyllus
3. C. occigranatensis
4. C. spichigeri
5. C. lepidotus
6. C. laetus
7. C. peruvianus
8. C. comperuvianus
9. C. guyanensis subsp. pseudoicacoreus
10. C. timanae
11. C. cuatrecasasii
12. C. nestorii
13. C. spicatus
14. C. fulvopulverulentus subsp. magnoliifolius
15. C. verticilloides
16. C. croatii
17. C. humilis
18. C. sprucei
19. C. simplex
20. C. kayapii
21. C. anthuriophyllus
22. C. schlimii
23. C. poeppigii
24. C. pseudolongifolius
25. C. vasquezii
26. C. cenepensis
27. C. nanayensis
28. C. marginatus
29. C. lineatus
30. C. magnus

30a. C. magnus subsp. magnus

30b. C. magnus subsp. asymmetricus

31. C. incognitus
32. C. minutiflorus
33. C. huampamiensis
34. C. granulosus
35. C. flavovirens
36. C. venezuelanus
37. C. grandezii
38. C. jensonii
39. C. fosteri
40. C. resinosus
41. C. fuscus
42. C. cyclopetalus
43. C. penduliflorus

LIST OF EXSICCATAE

Figures in parentheses refer to numbers from the numerical list of taxa. Collection numbers in **boldface** type indicate type specimens.

Acosta-Solis, M. 5544 (20); Aguilar, M. & D. Castro 623 (7); 655 (7); 805 (9); Albert de Escobar, L. et al. 3744 (16); Álvarez, A. et al. 381 (1); 412 (1); 490 (1); 1330 (1); **Ancuash, E.** 93 (8); 141 (8); 211 (20); 220 (8); 274 (33); 392 (33); 522 (26); 580 (2); **588 (33)**; 731 (33); 1405 (20); 1412 (26); 1437 (2); André, E. s.n. (22); 1151 (22); 3819 (17); 4551 (1); Arias, L. et al. 134 (22); Arroyo, L. & K. Keill 164 (8); Arroyo, L. et al. 510 (9); 674 (8); Asplund E. 9396 (20); 10209 (23); Asplund, E. 10302 (23); 12497 (23); 18717 (23); Aulestia, C. & M. 1313 (3); Aulestia, M. & J. Andi 925 (9); Ayala, F. 1623 (43); 2102 (36); Ayala, F. et al. 2814 (36).

Balslev, H. 4295 (1); Balslev, H. & Santos Dea 2850 (15); **Bang, M. 2048 (36)**; Barbour, P. 2405 (31); Barbour, P. 2567 (31); Bell, D. 101 (42); Berlin, B. 393 (20); 1760 (33); 779 (33); Betancur, J. et al.4857 (19); Bohlin, J. et al. 1493 (18); Boyle, B. 3473 (19); 3599 (19); Boyle, B. & J. Bradford 1878 (19); Boyle, B. et al. 3373 (28); 3450 (30b); Bradford, J. et al. 55 (1); Brandbyge, J. 42095 (1); Brandbyge, J. & Barford, A. 42506 (1); Bravo, E. & P. Gómez 49 (21); **Brenes, A.** 20530 (22); Buchtein, O. 1753 (8); 1758 (5); Bunting, G. & L. Licht 775 (22); Burger, W. & R. Stolze 5803 (22).

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Encarnación, F. 864 (7); 26200 (4); Espinal, S. 2109 (22).

Faber-Langendoen, D. & J. Hurtadn 1757 (40); Ferreyra, R. 1040 (32); Figueroa, A. 875 (15); Folsom, J. 4544 (18); Fonnegra, R. et al. 3076 (23); Forero, E. & L. Wrigley 7035 (8); 1325 (22); Forero, E. et al. 7350 (22); Fosberg, F. R. 19969 (11); 20148 (22); 22376 (11); Fosberg, F. R. & Giler, M. 23119 (1); Foster, R. 3618 (41); 3708 (26); 4226 (4); 4243 (27); 4327 (27); 4404 (40); 7817 (32); 8624 (32); 8981 (32); 9013 (30b); **Foster, R. & T. Watcher** 7242 (39); **7254 (39)**; Foster, R. & B. d'Achille 10013 (23); Foster, R. 8962 (8); 10860 (1); 10993 (9); Franco, P. et al. 1059 (22); Franco, P. et al. 3204 (17); 15423 (23); **Funck, N. & L. Schlim 678 (36).**

García, F. & J. Echavarría 259-A (20); García, F. & J. Echavarría 259-A (17); **Gehriger, W. 471 (28)**; **Gentry, A. 12419 (30b)**; **20763 (27)**; 80096 (4); Genrry, A. & J. Aronson 25044 (2); Gentry, A. & L. Emmons 38776 (27); Gentry, A. & E. Forero 7317 (18); Gentry, A. & N. Jaramillo 22134 (40); Gentry, A. & A. Juncosa 41702 (22); **Gentry, A. & S. Mori** 13665 (23); **13709 (23)**; 14023 (23); Gentry, A. & G. Shupp 26565 (19); Gentry, A. & J. Solomon 44407 (5); 44668 (5); Gentry, A. & K. Young 32025 (27); 2028 (42); **Gentry, A. et al.**16842 (3); 16867 (3); 21033 (27); 22367 (27); 22859 (33); 22859 (31); **22911 (31)**; 27952 (2); **29700 (38)**; 31479 (27); 35062 (20); 35188 (19); 39040 (7); 40453 (18); 41880 (23); 42183 (9); 42247 (20); 51083 (36); 51400 (36); 53167 (3); 53326 (22); 53717 (18); 53881 (11); 53960 (11); 55053 (19); 55708 (38); 72129 (9); 72499 (19); 74630 (10); 80179 (4); 56531 (4); 53551 (3); **Gleason, H. 159 (36)**; **Grández, C. et al. 1824 (37)**; 4487 (9); 4711 (7); 5321 (12); 5370 (12); 5642 (12); Grayum, M. & G. Shatz 3170 (22); Grubb, P. et al. 744

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Macbride, J. 5677 (8); Maddison, M. & L. Besse 7201 (22); Maddison, M. et al. 3204 (18); Malme, G. 2048 (8); 3483 (8); **Malme, G. 3483 (8); Manso da Silva, P. s.n.** (41); Marmillod, R. 4-R-90 (4); R-137 (4); **Martius, C. von s.n. (43) s.n.-1820 (9); s.n.-1826 (13); Mathews, A. s.n. (7); 1561 (6);** McDaniel, S. 10942 (7); McDaniel, S. & M. Rimachi 31219 (37); McPherson, G. et al. 13212 (1); 13397 (1); Monsalve, M. 790 (18); 797 (18); 1124 (18); Morawetz, W. & B. Wallnöfer 12-27188 (13); 13-11888 (8); 13–30888 (8); 14-31188 (4); 22-19188 (7); Mori, S. 7015 (22); **Mori, S. & A. Bolten 7292** (1); Mutis, J. 449 (22); 2919 (22); 3907 (22); 5102 A (22).

Neill, D. 7494 (9); 9602 (10); 9813 (18); Neill, D. & W. Palacios 9518 (30a); 9556 (10); 9615 (7); Neill, D. et al. 10303 (9).

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(7); 14997 (7); 15896 (20); 16075 (20); 17183 (23); 17186 (17); 17253 (3); 17281 (3); 17360 (23); 17361 (17); 17406 (22); 17542 (3); 17871 (3); 17979 (3); Pirani, J. 1326 (8); Pitman, N. 688 (19); 993 (19); 1161 (19); **Poeppig, E.** s.n. (40); 2428 (40); 2567 (36); 2709 (43); Prance, G. et al. 8388 (22); P12555 (20); 19075 (8).

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Tate, G. H. H. 741 (5); 927 (5); **Terry, M. & R.** 1490 (18); Tessman, G. 5145 (40); 3525 (7); 3650 (9); 4493 (33); Timaná, M. 1047 (10); 922 (32); Tipaz, G. et al. 260 (22); 1706 (20); 1709 (19); 1741 (30b); 1886 (19); 1950 (22); Todzia, C. & B. Stein 27410 (28); Toro, R. 356 (22); **Torres, J. H.** 1054 (11); **Trail, J.** 508 (13); **Triana, J.** 4 (22); 2562 (3); 2585 (1); 2589 (3); 7594 (22); **Tunquí, S.** 161 (34); 289 (31); 488 (33); 549 (22); Ule, E. 5160 (23); 5840 (42); 6792 (30b).

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Young, H. et al. 146 (42); Young, K. et al. 179 (36).

Zak, V. 1350 (19); 1545 (19); Zarucchi, J. et al.7201 (3)

NEW FLOWERING PLANTS FROM SOUTHERN NEW IRELAND, PAPUA NEW GUINEA

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ABSTRACT

Botanical exploration of the Hans Meyer Range in southern New Ireland revealed the existence of two previously unknown taxa in the families Rubiaceae and Corsiaceae. The novelties, *Psychotria osiana* Takeuchi & Pipoly, (Rubiaceae) and *Corsia purpurata* var. *wiakabui* Takeuchi & Pipoly (Corsiaceae) are described and illustrated. Taxonomic and ecological notes are also provided for the new taxa.

ABSTRACT (MELANESIAN TOK PISIN)

Wanpela wok bus long sait bilong botani ibin kamap long ol lain maunten bilong Hans Meyer, Niu Iland Province, long yia 1994. Dispela wokbus o stadi ibin kamapim tupela niupela samting. Wanpela em sotpela diwai bilong famili Rubiaisi. Namba tu em wanpela liklik gras nating bilong famili Korsiasi. Tupela igat nem olsem: *Psychotria osiana* na *Corsia purpurata* var. *wiakabui*. Dispela stori i tok klia na soim tu sampela piksa bilong tupela.

INTRODUCTION

Papua New Guinea (PNG) is one of only four countries on earth projected as retaining most of its original forest cover by the end of this century (Suzuki 1993). Unfortunately, it is also among the least known floristic areas within the Malesian region (Conn 1994; Johns 1995). In the recent multiagency Conservation Needs Assessment (CNA), 17 localities of primary conservation significance were identified for Papuasian forest environments (Beehler 1993). Southern New Ireland was one of the enumerated sites considered vital to biodiversity preservation and in critical need of current information. As a direct consequence of the CNA evaluation, a biological assessment expedition was organized by Conservation International and the Papua New Guinea Department of Environment and Conservation (DEC) in January–February 1994. A multidisciplinary compilation of results from that survey has been prepared as a Rapid Assessment Protocol (RAP) Working Paper by Conservation International (Beehler, in press). Orchid specimens from the Hans Meyer trip were previously reviewed in a separate specialist account (Howcroft 1994). Two new taxa discerned during general examination of the expedition's botanical gatherings are described here.

RUBIACEAE

Psychotria osiana Takeuchi & Pipoly, sp. nov. (**Fig. 1**). TYPE: PAPUA NEW GUINEA. NEW IRELAND: Hans Meyer Range, pond next to 'Lake Camp,' 04° 27.205' S, 152° 56.489' E, 1,175 m, 29 Jan 1994 (fl, fr), *W. Takeuchi & J. Wiakabu 9650* (HOLOTYPE: LAE; ISOTYPES: A, BRIT, K, L).

Quoad stipula elongata calyptrataque, stipula ab laminis juvenibus rumpentes, *P. lelanoides* valde arcte affinis, sed ab ea inflorescentiis trichotomiis reducisque (non monotomiis elongatisque), floribus verticellatis (non alternatis) praeditis, laminis secus costis furfuraceo-lepidotis (non glabris) denique petalis desuper papillosis (non glabris) statim cognoscitur.

Shrub or small tree to 7 m height, 8 cm dbh. *Stem* straight, isodiametric, basal swell absent; outer bark brown, smooth, slash and sapwood stramineous to pale yellow. *Branchlets* terete, 2–3 mm diam., pale brown, slightly compressed at the summit, laxly pilose at apical nodes otherwise glabrescent. *Stipules* sheathing, calyptrate, caducous, translucent whitish-green, glabrous, to 5.5 cm long and 6 mm wide. *Leaves* opposite, usually conferted; blades coriaceous, elliptic, 10–13 cm long, 3–4 cm wide, apically acuminate, basally attenuate, the margin entire, adaxially nitid and glabrous, abaxially light green and furfuraceous-tomentose along the midrib, the midrib prominulous on both sides, more elevated beneath; the secondary veins 10–13 oblique lateral pairs, excurrently arcuate and usually closing submarginally, the tertiary reticulum lax, irregular, bifacially raised; petioles adaxially plane, 10–20 mm long, glabrous. *Inflorescence* a sessile, terminal, pinnate panicle, rupturing through the stipule, trichotomous (with three principal branches at base), the branches with flowers racemose, the primary rachis to 2 cm long, greenish, somewhat angulate, laxly pilose at nodes, internodes subglabrous or puberulent; floral bracts inconspicuous, not persisting; pedicels 1–3 mm long. *Flowers* opposed or in verticels, 5-merous, entirely glabrous, apparently isomorphic; calyx broadly cupuliform, .5 mm long, 1–2 mm wide, limb denticulate; corolla tubular, 3 mm long and obtusely cylindrical in bud, the lobes chartaceous, corniculate, elliptic to ovate, 1.5 mm long, 1 mm wide, spreading or reflexing at anthesis, adaxially papillose; stamens erect, epipetalous; filaments 1.5 mm long, adnate to the corolline sinuses or slightly below. the anthers basifixed, oblongoid, 0.7 mm long, 0.2 mm wide, apically and basally emarginate; ovary umbonate, channelled, bilocular, the style bifid, slightly exserted, the stigmatic lobes spreading and tuberculate. *Drupelet* subglobose, 5–8 mm diam., epicarp glabrous; pyrenes 2, not dorsally ridged, approximately planoconvex, flat on the commissural face, often with one pyrene aborted or reduced; endosperm ruminate.

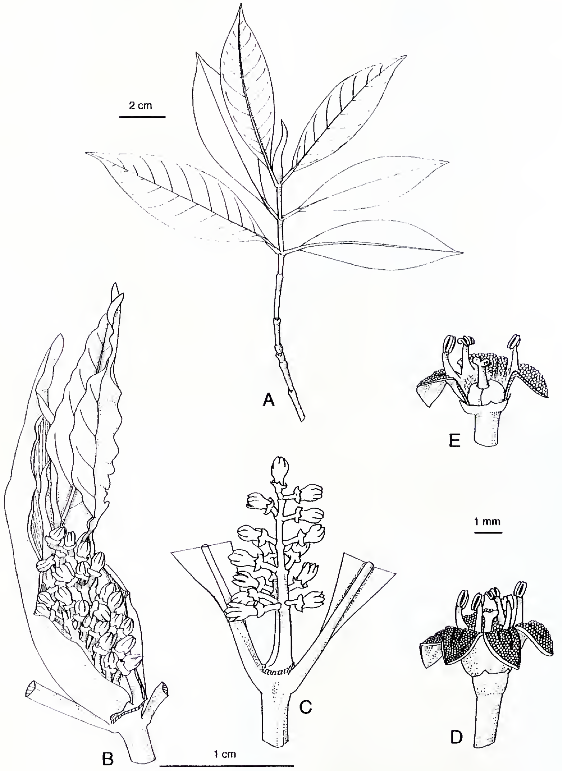

FIG. 1. *Psychotria osiana* Takeuchi & Pipoly. A.Branchlet. B. Developing inflorescence emerging through stipule. C. Inflorescence; showing main rachis and part of the second rachis in back. Third axis deleted for clarity. D. Flower at anthesis; petals reflexing. E. Partially dissected flower. A–D drawn from holotype.

Distribution and ecology.—Known only from mossy montane forest in the Hans Meyer Range of southern New Ireland. Occurring as a seral element in gap phase regeneration among mature growth premontane forest stands, and along forest margins.

Etymology.—It is a great pleasure to dedicate this species to Dr. Osia Gideon, Deputy Director of the Papua New Guinea Forest Research Institute and a specialist in Papuasian Rubiaceae and Zingiberaceae, for his relentless efforts to document the rich, largely autochthonous, flora of New Guinea.

PARATYPE: PAPUA NEW GUINEA. NEW IRELAND: Hans Meyer Range, pond next to 'Lake Camp,' 04° 27.205' S, 152° 56.489' E, 1,175 m, 27 Jan 1994 (fl, fr), *W. Takeuchi & J. Wiakabu 9560* (A, BRIT, K, L, LAE).

Papuasian *Psychotria* were first revised by Valeton (1927) and the nonclimbing representatives more recently treated by Sohmer (1988). Infrageneric relationships are still poorly understood due to the taxonomic difficulty of the genus and the absence of regionally-based studies. However a number of informal species groups have been recognized by Sohmer from macroscopic features such as stipule form and inflorescence structure.

Psychotria osiana is characterized by a contracted trichotomous inflorescence (i.e., with 3 rachises branched at the base), flowers opposed or verticelled along the main axes, leaf blades with abaxially furfuraceous-tomentose midribs, completely glabrous flowers, and petals adaxially papillose. The corolline papillae are apparent in fresh or rehydrated material, but less so *in sicco*.

A total of 17 species of Papuasian *Psychotria* have sheathing stipules of the sort present in *Psychotiria osiana*. Developing inflorescences and young leaves emerge by rupturing through the stipule, which subsequently disintegrates or falls away intact. The combination of calyptrate (sheathing) stipules and a trichotomous inflorescence occurs in only two species: *P. leleanoides* Sohmer and *P. lorentzii* Valeton. *Psychotria osiana* is clearly related to *P. leleanoides*, (a species from New Britain and the Solomon Islands), but is distinguishable from it by the leaf indumentum and the entirely glabrous flowers with papillate corolla. Judging from elevational distributions, *Psychotria osiana* is the montane sister species to *P. leleanoides*, the latter being primarily a lowland taxon from elevations below 200 m (Sohmer 1988).

CORSIACEAE

Corsia purpurata L.O. Williams var. **wiakabui**, Takeuchi & Pipoly, var. nov. (**Fig. 2**). TYPE: PAPUA NEW GUINEA. NEW IRELAND: Hans Meyer Range, pond next to 'Lake Camp,' 04° 27.205' S, 152° 56.489' E, 1,175 m, 28 Jan 1994 (fl, fr), *W. Takeuchi & J. Wiakabu 9611* (HOLOTYPE: LAE, in spirit).

Ad Corsia purpuratam var. purpuratam accedens sed ab ea labello acuminato nec ad basem extendens praeclare distat.

Terrestrial herb to 13 cm height, sciophytic, erect, all parts glabrous and

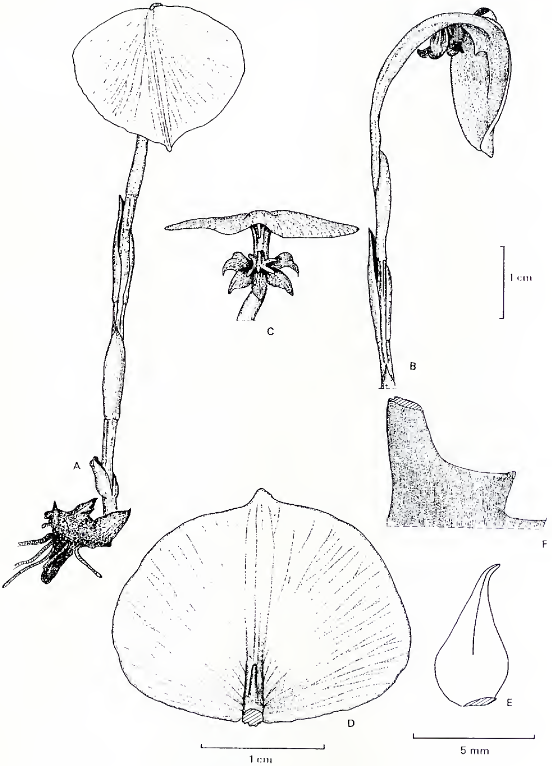

Fig. 2. *Corsia purpurata* L.O. Williams var. *wiakabui* Takeuchi & Pipoly var. nov. A. Habit, dorsal view. B. Habit, lateral view. C. Frontal aspect, petals and lateral sepals. D. Median sepal. E. Petal. F. Basal callosity, from side. A–F drawn from holotype.

dull reddish-brown. *Stems* terete, weakly sulcate, the nodes distant. *Leaves* 4–5, spirally arranged, acroscopic, base sheathing; lamina linear-acuminate, conduplicate or with margins broadly revolute, chartaceous, 9–17 mm long, 4–6 mm wide, to 6-nerval, sometimes apiculate; venation visible as dark lines, not raised on either side. *Flowers* solitary, terminal on the unbranched stem, bisexual; median sepal flabellate, symmetrical, 16–19 mm long, 20–23 mm wide, nodding at anthesis, unguiculate, bluntly acuminate at the apex; the basal callosity linear, narrowly raised by 4 mm above the plane of the 'labellum,' summit corniculate, base abruptly truncate at the claw; median sepal 12-veined, the veins parallelodromous, diverging mainly from the proximal half of the sepal, once or several times furcate before the margin; petals and lateral sepals isomorphic, basiscopic and incurved, costate, lanceolate, 4 mm long, 3 mm wide, acumen 1.5 mm long; stamens 6, in 2 whorls opposite the perianth segments; filaments resembling the style, 0.6–0.7 mm long; the anther cells 2, oblongoid, 1.2 mm long; style simple, cylindrical, ca. 1 mm long. *Fruit* not seen.

Distribution and ecology.—Known only from the type locality in the Hans Meyer Range on New Ireland. *Corsia purpurata* var. *wiakabui* occurs infrequently in mature-growth, primary premontane forest, on its floor, covered by leaf duff. This new variety was encountered as a population flushing after recent rains and thereafter evanescent; all individuals were seen in comparable maturational states.

Etymology.—The new variety is dedicated to Joseph Wiakabu; botanist, explorer-collector, and colleague from the Papua New Guinea National Herbarium.

PARATYPE: PAPUA NEW GUINEA. NEW IRELAND: Hans Meyer Range, slopes above river valley on the ascent from Mandih lake, 04° 26' S, 152° 59' E, 750 m, 10 Aug 1975, *M.J.S. Sands et al. 2091* (K, LAE).

Corsia was revised by van Royen (1972) in a monograph based on 45 exsiccatae numbers, an average of less than 2 collections per species. The limited number of specimens available for study is due to population rarity, the inconspicuous habit of the plants, an ephemeral phenology, and the preference for sheltered microsites in forest where ambient light conditions favor concealment. Van Royen (ibid.) commented that encounters with *Corsia* are often of a fortuitous nature; occasioned by understory sun flecks falling on the plants in a certain way by chance. There is no doubt that the genus is rarely found by collectors. The intervening years since the initial revision has seen little increase in availability of specimens, nor is the situation likely to improve dramatically in the future. The difficulty of botanizing purposefully for *Corsia* discourages the sort of field-based studies necessary for understanding the morphological variation between populations.

According to van Royen's (1972) conspectus, *Corsia* is a saprophytic genus with 25 species distributed through New Guinea, the Bismarck Archipelago, the Solomon Islands, and Australia. Most of the species are narrowly defined endemics of montane forest habitats, and appear to be restricted to specific mountains. On the basis of the venation and basal callosity of the median sepal, the new taxon is related to *C. purpurata* var. *purpurata,* but is distinguishable by the flabellate 'labellum' with acuminate apex and the base truncate rather than extended.

The type locality for var. *waikabui* is floristically depauperate in comparison to similar habitats from mainland New Guinea, and is disproportionately composed of epiphytic or nonendemic species (Takeuchi and Wiakabu, in press). Depauperate levels of biological diversity in this montane environment was also reported by zoological specialists participating in the New Ireland survey (Beehler in press, passim). The expedition's collective findings are consistent with a supposition that the cloudy uplands of southern New Ireland are of geologically recent origin. In view of the multidisciplinary results from the recent survey, it is unlikely that future exploration of the Hans Meyer Range will yield significant numbers of additional novelties.

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Neville Howcroft prepared the illustration of *Corsia purpurata* var. *wiakabui* and Taik Iwagu the illustration of *Psychotria osiana*, which we gratefully acknowledge.

REFERENCES

BEEHLER, B.M. (ed.). 1993. Papua New Guinea conservation needs assessment, vol. 2. Corporate Press, Inc., Landover, Maryland.

BEEHLER, B. (ed.). In press. Rapid Assessment Program Working Papers, No. 10. A biodiversity assessment of southern New Ireland, Papua New Guinea. Conservation International. Washington, DC.

CONN, B.J. 1994. Documentation of the flora of New Guinea. In C.-I Peng and C.H. Chou, eds. Biodiversity and terrestrial ecosystems. Institute Bot., Acad. Sinica Monogr. 14:123–156.

HOWCROFT, N.H.S. 1994. Orchid collections from New Ireland. Orchid Res. Bull 3. Papua New Guinea Forest Research Institute.

JOHNS, R.J. 1995. Malesia–an introduction. Bot. Mag. 12:52–62.

ROYEN, P. VAN. 1972. Sertulum Papuanum 17. Corsiaceae of New Guinea and surrounding areas. Webbia 27:223–255.

SOHMER, S.H. 1988. The nonclimbing species of the genus *Psychotria* (Rubiaceae) in New Guinea and the Bismarck Archipelago. Bishop Mus. Bull. Bot. 1:1–339.

SUZUKI, D. 1993. Time for a change. Allen and Unwin, St. Leonards.

TAKEUCHI, W. and J. WIAKABU. In press. A transect-based floristic reconnaissance of sourhern New Ireland. In B. Beehler, ed. A biodiversiry assessment of southern New Ireland, Papua New Guinea. Rapid Assessment Program Working Papers 10, Conservation International, Washingron, D.C.

VALETON, T. 1927. Die Rubiaceae von Papuasien. II. Zweiter Teil: Coffeoideae. Bor. Jahrb. 61:32–163.

THREE NEW SPECIES OF *CRATAEGUS* (ROSACEAE) FROM WESTERN NORTH AMERICA: *C. OKENNONII, C. OKANAGANENSIS* AND *C. PHIPPSII*

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ABSTRACT

Three new species of *Crataegus*, *C. okennonii* J.B. Phipps (from series *Douglasianae*), *C. okanaganensis* J.B. Phipps & O'Kennnon (from the newly described series *Purpureofructi* J.B. Phipps & O'Kennon), and *C. phippsii* O'Kennon (near series *Molles*) are described from western North America. All are striking, widespread taxa with a substantial number of records.

KEY WORDS: Taxonomy, *Crataegus*, Rosaceae, new species

RESUMEN

Tres nuevas especies de *Crataegus*, *C. okennonii* J.B. Phipps (de la serie *Douglasianae*), *C. okanaganensis* J.B. Phipps & O'Kennnon (de la nueva serie descrita *Purpureofructi* J.B. Phipps & O'Kennon), y *C. phippsii* O'Kennon (próximo a la serie *Molles*) se describen del oeste de Norte América. Todos son taxa sorprendentes y de amplia difusión con un sustancial número de citas.

Recent fieldwork with R.J. O'Kennon of Fort Worth, Texas in the American states west of the Rocky Mountains and in British Columbia for the first author's revision of the red-fruited *Crataegi* (Phipps 1998) of this region has serendipitously uncovered three new species of hawthorn. The first, *Crataegus okennonii*, a new purplish-fruited taxon of ser. *Douglasianae* (Rehd. ex Sarg.) Rehd., striking and obvious in the field, is also usually easily resolved in the herbarium. *Crataegus okanaganensis*, rarely collected before our studies, is also a striking new taxon with brilliant red (late August) to deep purple (late September) fruit. It is accorded a new series, *Pupureofructi*, together with the long-described and long-overlooked *C. williamsii* Eggl. The third new species, *C. phippsii*, though first collected as far back as 1908, remained otherwise unnoticed until our fieldwork. It is a very distinct purple-fruited species related to series *Molles*.

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One of the reasons that these new *Crataegus* species west of the Rocky Mountains have been overlooked has been the failure of nearly all collectors to take note of fruit color (Phipps 1998). Each of the following species is quite distinct in this respect and we therefore take the opportunity to present color plates of the three species illustrating this point. Hawthorns are considered to have mostly black or red fruit. The discovery of these three extends the number of those which are burgundy to deep purple at some stage in their development. Another feature emerging from this work are new centers of diversity for western North American *Crataegus* appearing in the northern Okanagan of British Columbia and northwest Montana.

A further reason that these taxa have been overlooked is that in the Pacific Northwest region (to nw Montana) and British Columbia where they occur there has been a belief that generally, only one red-fruited native species, *C. 'columbiana* Howell,' one black-fruited native taxon, *C. douglasii* Lindl. (incl. *C. suksdorfii* (Sarg.) Kruschke) and one introduced red-fruited taxon (*C. monogyna* Jacq.) occurred. This belief has persisted (Phipps 1998) in spite of the widespread presence in this region of *C. macracantha* Lodd. ex Loud. In view of this lack of taxonomic inattention, including the disappearance from the floristic literature of the distinctive *C. williamsii*, it is perhaps not surprising that earlier botanists did not recognize potential new taxa in this region. Consequently, we take this opportunity of reviewing the main western North American species (west of the Rocky Mountains) in a numerical taxonomic analysis. This analysis uses one synthetic OTU per taxon, each described from typical material over 38 morphological characters (Table 1) of the kind commonly used in *Crataegus* taxonomy. The eleven native species generally recognized in the west are all present, together with *C. monogyna*, a useful outgroup, and five species from east of the Rocky Mountains (*C. mollis* (Torr. & A. Gray) Scheele, *C. submollis* Sarg., *C. brachyacantha* Sarg. & Engelm., *C. schuettei* Ashe and *C. punctata* Jacq.) to give structure and scale. Also the three new taxa described in this paper are included. A dendrogram was prepared by NT-SYS using the options taxonomic distance and unweighted pair-group arithmetic averaging. The results (Fig. 1) place *C. monogyna* and *C. punctata* outside all the other species. Among results of general interest, varieties (*C. chrysocarpa* Ashe var. *chrysocarpa* and *C. c. var. piperi* (Britton) Kruschke) cluster at about the 0.6 level while distinct species cluster at the 0.8 or greater level, e.g. *C. schuettei* and *C. wootoniana* Eggl. (series *Tenuifoliae*), *C. suksdorfii* and *C. douglasii* (series *Douglasianae*) and *C. erythropoda* Ashe and *C. rivularis* Nutt. (series *Cerrones*). Other pertinent results are discussed under the new taxa described in this paper.

TAXON DESCRIPTIONS

1. **Crataegus okennonii** J.B. Phipps, sp. nov. (**Fig. 2**). TYPE. CANADA.

TABLE 1. The 38 characters scored for the numerical taxonomic analysis.

Plant, general
1. Plant habit
2. Bark type
3. Branch arrangement

Thorns and Twigs
4. Thorns: indeterminate present?
5. Thorns: length
6. Thorns: curvature
7. Thorns, color: browns
8. Thorns, color: gray
9. Twigs, 1 yr old, color; browns
10. Twigs, 1 yr old, color; gray

Leaf
11. Lamina: length
12. Lamina: length/breadth
13. Lamina: position of widest part
14. Lamina: venation, number
15. Lamina: veins to sinuses
16. Lamina: lobe number
17. Lamina: lobe shape
18. Lamina: max. sinus depth (LII)
19. Lamina: abaxial pubescence, young
20. Petiole: glands
21. Leaf teeth: glands

Inflorescence
22. Flower: number
23. Pedicel: pubescence
24. Anthesis time

Flower
25. Diameter
26. Calyx lobes: margins
27. Stamen: no.
28. Anther: color
29. Style: number

Fruit
30. Fruit: color, month before full ripeness
31. Fruit: color at full ripeness
32. Fruit: shape, 1
33. Fruit: shape, 2
34. Fruit: pubescence
35. Fruit: calyx orientation
36. Fruit: length (height)
37. Pyrenes: lateral faces

Autumnal foliage
38. Color

BRITISH COLUMBIA: Okanagan Valley, E side of 97A 0.5 mi N of intersection with 97, scrubby slopes with long cleared area, 50°21'N, 119°15'W, 19 Aug 1994, *Phipps, J.B. & O'Kennon, R.J. 6998* (HOLOTYPE: UWO; ISOTYPES: BRIT, CAN, TRT, US).

Frutices grandes vel arbores parvae, plerumque trunco uno, ad 10 m alti, spinosi; ramuli unius anni nitentes atro-castanei, ramuli veteriores brunneo-cinerei; spinae plerumque < 2.0 cm longae, crassae, plus minusve recurvatae, in juventute brunnae nitenter. Folia decidua; petioli plerumque 1–2 cm longi; laminae 4–6 cm longae, ellipticae vel late-ellipticae, interdum aliquantum anguste ovatae vel rhombeae, paribus 4 venarum secondariarum longiorum vel aliquando non-lobatae vel vix-lobatae vel vadositer 2–3(–4) lobatae per latus, marginibus serratis, ± coriaceae, in maturitate tenuiter appresso-pubescentes supra, subter ± glabrae venis exceptis, colore autumnali prunino ad carmineum vel pallide carmineum. Inflorescentiae 12–20 floratae, bracteolis parvis caducis glandulo-marginatis, glabrae vel raro pubescentes. Flores 15–20 mm diam.; hypanthium glabrum extrinsecus; lobi calycis 3 mm longi, obscure glanduloso-marginati; petala ± circularia; stamina 10–12, antheris pallide roseis; carpelli et styla 3–4. Fructus ampulliformo-orbiculares, ca 10 mm diam., triste-purpurei vel nigri subinde in maturitate, in mense Augusto rubro-vinosi vel spadiceo-castanei, reliquiis calycis parvis; pyrenae 3–4, vadositer sulcatae dorsaliter, lateribus cum foveis vel interdum planis.

Large bushes or small trees, usually single-trunked, up to 10 m tall, thorny; one year old twigs deep shining mahogany, older branches gray/brown; thorns usually < 2.0 cm long, stout, slightly recurved, shiny brown when young. Leaves deciduous; petioles usually 1–2 cm long; blades elliptic to broad-

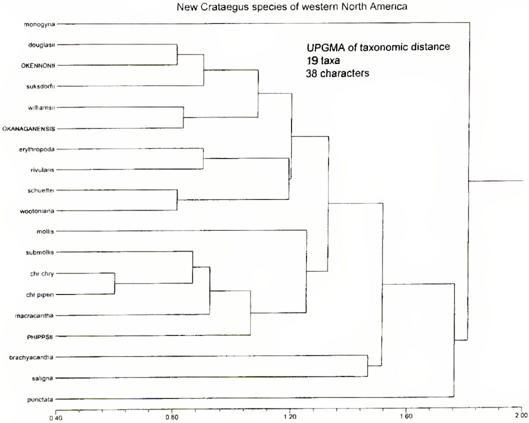

FIG. 1. Dendrogram of western North American *Crataegus* taxa showing relationships of species described in this paper. Newly described taxa in capitals. See text for more information.

elliptic, sometimes somewhat narrow ovate or rhombic, 4–6 cm long, with four pairs of longer secondary veins, barely lobed to shallowly 2–3(–4) lobed, the margins also serrate, somewhat coriaceous, at maturity finely appressed-pubescent above, below ± glabrous except on the veins; autumnal color plum to crimson or light crimson. Inflorescences 12–20 flowered, with small caducous gland-margined bracteoles, glabrous to rarely shortly pubescent. Flowers 15–20 mm diam.; the hypanthium externally glabrous; calyx lobes 3 mm long, obscurely gland-margined; petals ± circular; stamens 10–12, anthers pale pink; carpels and styles 3–4. Fruit ± ampulliform-orbicular, ca. 10 mm diam., dull-purple or occasionally black at full maturity, red-burgundy to chestnut or reddish-brown in August, calyx remnants small; nutlets 3–4, shallowly grooved dorsally, sides variably eroded or sometimes plane.

Distribution.—*Crataegus okennonii* is fairly common in southern interior British Columbia and the eastern half of northern Washington, ranging to Idaho and nw Montana (Fig. 3), usually along streams or other sources of water. It is a tall distinctive plant, usually with a straight trunk, easily recognized in the field both in flower and in fruit. This new species is most closely related to *C. douglasii*, sens. str., from which it differs in fruit shape

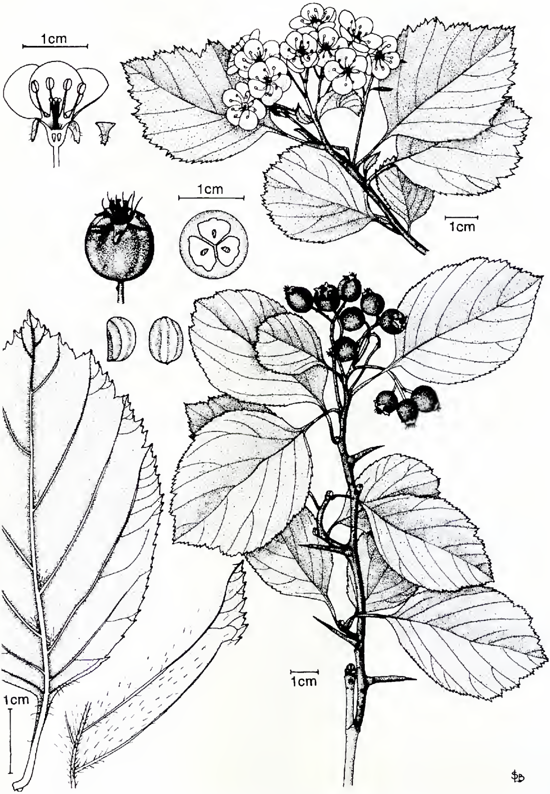

FIG. 2. Line drawing of *C. okennonii* J.B. Phipps. Inflorescence, flowers and parts from *Phipps* 6959 (UWO); infructescence, fruit and parts from *Phipps* 6991, 6995 *and O'Kennon* (UWO). Scale bars = 1 cm.

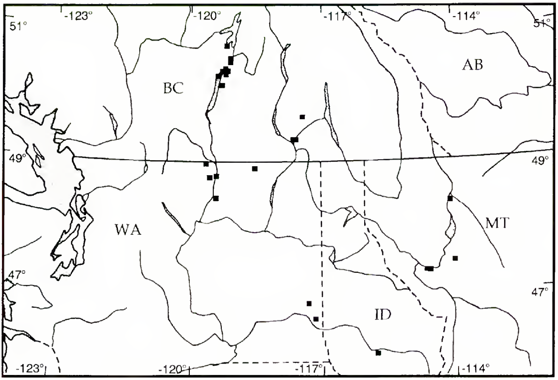

FIG. 3. Distribution map of *C. okennonii* J.B. Phipps.

and color, flower size, color of mature leaves (often yellowish-green), habit, thorn length, leaf shape and autumnal color of foliage.

Crataegus okennonii is one of a small group of 'black-fruited' (fruit ± black at full maturity) species comprising series *Douglasianae* (Rehd. ex Sarg.) Rehd. which I restrict to *C. douglasii* Lindl., its immediate relative *C. suksdorfii* and the new species described here. A greatly widened concept of *C. douglasii* which includes *C. saligna* Greene and *C. rivularis* is advocated by Welsh (1982) and Holmgren (1997) but in my opinion this cannot stand up due to many significant differences in leaf-shape, venation type, bark and thorn type. Moreover intermediates do not exist between *saligna-rivularis* and *douglasii-okennonii-suksdorfii*. Difficulties for the broad concept are also emphasized by the fact that *C. saligna* (called *C. douglasii* Lindl. var. *duchesnensis* Welsh by Holmgren) has 20 stamens and cream anthers, contrary to the Intermountain Flora. I am (JBP, 199X) therefore placing *C. saligna* and *C. rivularis* in a different grouping.

Crataegus okennonii is a clearly defined segregate of *C. douglasii* differing by a considerable number of correlated characters of which thorn length (the shortest in series *Douglasianae*) and flower size (largest in the series) are the most unambiguous. The following couplet separates *C. okennonii* from the restricted interpretation of typical *C. douglasii* as found in western Canada and the adjacent United States.

1. Usually tree-like with a straight trunk, 5–10 m tall; young twigs deep glossy purple-brown; thorns usually 1.5–2 cm long; flowers ca. 15–20 mm diam.; fruit crimson lake or chestnut-colored in late August, becoming deep plum-black at maturity, not bloomy, broadly ampulliform; autumnal foliage usually crimson, plum or pale shades of same; styles and nutlets usually 3. .... C. okennonii

1. Usually bushy, though often large, not conspicuously single or straight-trunked, 3–8 m tall; thorns often longer, to 2.5(–3) cm long; young twigs mid to deep glossy brown, only occasionally as dark as *C. okennonii*; flowers often 12–15 mm in diam.; fruit variably colored in late August though never chestnut, shape ellipsoid or suborbicular; autumnal foliage color often bronzy, not consistently ± crimson or paler; styles and nutlets 3–5. .... C. douglasii

The differences between *C. okennonii* and a somewhat restricted *C. douglasii* are not by any means large but recognition at the specific level is also supported by the numerical analysis (Fig. 1), the lack of intermediates among good quality specimens both in the field and herbarium and the consequent immediacy of recognition. A more elaborate comparison with *C. douglasii* in which detailed leaf shape comparisons will be used may be expected consequent on the publication of R. Dotterer and T.A. Dickinson's detailed biosystematic studies of *C. okennonii* and *C. douglasii*.

It is possible that *C. okennonii* is the same as *C. douglasii* f. *badia* Sarg. (1907), a taxon in which the fruit is described as "chestnut", certainly not a common color in ripening fruit of section *Douglasii*. However, some of the unripe fruit of *C. okennonii* seen by us certainly was the color of reddish-brown, highly polished, shoe leather. Piper, the original collector of forma *badia*, variously described the fruit as brown, dark shining brown, chestnut, etc. Forma *badia* is a taxon systematically disregarded in the floristic literature. Both color changes during the ripening of western North American *Crataegus* fruit and the final color of the autumnal foliage have been poorly understood (Phipps 1997) as taxonomic characters so we wish to record them here. *Crataegus douglasii* fruit is shown in Figures 4d and 4e. The latter, photographed in August, illustrates the black, pendant, ellipsoid fruit while the other is another British Columbia specimen showing plenty of bloom. Figures 4a–4c illustrate *C. okennonii*, plate 4a showing the late August "chestnut" color while Figure 4b is a later version of the same color. Figure 4c shows the final, near ripe color, in late September, close to that of *C. douglasii*. The foliage is frequently a distinctive bright pale crimson color in late September as is shown in Figure 4f. Variation in leaf form of *C. okennonii* tends to fall into two classes, both illustrated in Figure 2, there being a broader, somewhat rhombo-deltoid, distinctly lobed form (Fig. 4a) and a more elliptic or narrow-ovate, shallowly lobed shape (Fig. 4b). *Crataegus okennonii* also bears conspicuous, expanding, caducous, coral-red bud scales.

I (J.B.P.) am pleased to name this distinctive and handsome new species

FIG. 4. *Crataegus okennonii* compared with *C. douglasii*: a) *C. okennonii* showing remarkable chestnut-coloured fruit, Kelowna, BC, 18 Aug 1995; b) *C. okennonii*, form with pale foliage, note ampulliform fruit, northern Okanagan, BC, 20 Aug 1995; c) *C. okennonii* with some fruit close to the final purple-black color, northern Okanagan, BC, 19 Aug 1995; d) *C. douglasii* showing full ripe color and a high bloom, northern Okanagan, BC, 19 Aug 1995; e) full ripe color of *C. douglasii* with ellipsoidal fruit, northern Okanagan, BC, 19 Aug 1995; f) *C. okennonii* showing typical cerise color of full ripe foliage; JBP in foreground; Palmer Lake, Washington State, 28 Sep 1993.

after Robert (Bob) J. O'Kennon whose companionship and critical abilities as a field botanist helped to make this discovery possible. It is intriguing that so widely distributed a taxon, of which we are able to cite 36 specimens, has remained undetected for so long.

Additional specimens examined: **CANADA. BRITISH COLUMBIA:** Northern Okanagan, Spallumcheen Municipality, Powerhouse Rd., E side, near Stardel Drive, alt. ca. 1350 ft, 50°27'N, 119°09'W, bush, 4.5 m tall, ± erect; fruit deep plum/chestnut, ellipsoid-turbinate, 19 Aug 1995, *J.B. Phipps 7164* (UBC, UWO); Okanagan Valley, Oyama, ca. 0.5 mi E of E end of spit, alt. ca. 1320 ft, 50°07'N, 119°21'W, hedgeline on clay soil, bush 5 m tall, fruit plum-purple, turbinate, 17 Aug 1995, *J.B. Phipps 7158* (UWO); Castlegar, Selkirk College grounds, towards bottom of slope beyond beehives, scrubby area, 49°19'N, 117°38'W, alt 950 ft, tree 6 m tall; stamens 5, anthers pale pink, buds forced til 10 May, then 10 stamens seen, 06 May 1994, *J.B. Phipps 6928* (BRIT, CAN, DAO, TRT, UBC, UWO, US); Okanagan Valley, Westside Rd., ca. 9 mi W of jct. with 97 and ± due opposite Vernon, wooded edges on west of road, 50°15'N, 119°27'W, ca. 1200 ft, tree, 5 m tall, fruit smallish, bright red-burgundy, 19 Aug 1994, *Phipps, J.B. & O'Kennon, R.J. 6990* (CAN, TRT, UBC, UWO); Northern Okanagan, Hwy 97, E side, between Westside Rd. and Silver Creek Rd., alt.1800 ft, equals JBP 6969, beautiful 7 m tree, 50°23'N, 119°17'W, convex light yellow-green foliage, fruit light red, turning to burgundy, roundish, fatter at base, glossy, 19 Aug 1994, *Phipps, J.B. & O'Kennon, R.J. 6995* (BRIT, UWO); Salmon Arm, large hawthorn pasture just N of railroad and W of central business section, alt. ca. 1900 ft, 50°43'N, 119°16'W; bush, 4.5 m tall, fruit burgundy, locally frequent, (equals JBP 6959); 20 Aug 1994, *Phipps, J.B. & O'Kennon, R.J. 7027* (CAN, TRT, UBC, UWO); Okanagan Valley, Westside Rd., ca. 9 mi W of jct. with 97 and ± due opposite Vernon on E side of road, fenceline 50°15'N, 119°27'W; 7 m multitrunked tree, fruit burgundy, alt. ca. 1200 ft,19 Aug 1994, *Phipps, J.B. & O'Kennon, R.J. 6991* (BRIT, CAN, TRT, UWO); Okanagan Valley, NNE of Vernon at jct. 97/97A, scrubby hillside E side of road, 26 Sep 1993, *J.B. Phipps and R.J. O'Kennon 6821* (BRIT, UWO). Pass Creek Rd., N of Castlegar, 1.3 mi along, mesic grassy slopes, alt. ca. 1800 ft, 49°19'N, 117°40'W, bush, 4 m tall, fruit reddish-burgundy (somewhat 'chestnut'–ROK), 23 Aug 1994, *Phipps, J.B. & O'Kennon, R.J. 7056* (TRT, UWO); Castlegar, Selkirk College, path behind beehives towards river edge, open woodland-scrub, alt. 950 ft, 49°19'N, 117°38'W, tree, 20 ft tall, reddish-purple foliage, dark purple, ± round fruit, 20 stamens, 26 Sep 1993, *Phipps, J.B. & O'Kennon, R.J. 6824* (UWO); Slocan Valley, S of Slocan, above swamp along small road off Hwy. 6 & just N of Perry Siding across river, 49°40'N, 117°30'W, hedges and brushy slopes, alt. 1775 ft, bush 6 m tall, fruit red-burgundy, 22 Aug 1994, *Phipps, J.B. & O'Kennon, R.J. 7047* (UWO); NNW of Vernon on W side Rd about 2.5–3 km SW of intersection of 97 & 97A, alt. 450 ft, 50°20'N, 119°20'W, back of field on west side of road, bush 5 m tall, 24 Sep 1993, *Phipps, J.B. & O'Kennon, R.J. 6785* (UWO); Okanagan Valley, Hwy. #97, ca. 2 mi S of Silver Creek Rd. exit, (200 m S of 'road narrows' sign), (100 m S of JBP 6968), 50°23'N, 119°17'W, alt 1800 ft, in cut-over forest, young tree 7 m tall, 11 May 1994, *J.B. Phipps 6969* (BRIT, TRT, UWO); Okanagan Valley, ca. 8 km NNE of center of Vernon, Pleasant Valley Rd., behind Vowle's residence, hedge at S boundary of Burke's PYO, 50°18'N, 119°14'W, alt. 380 m, dense, broad, mature hedge, dominant species, 3.7 m bush, 10 pink anthers, thorns long for species, 2 May 1994, *J.B. Phipps 6879* (UWO); Salmon Arm, large hawthorn pasture, just N of railroad and W of central business center; 50°43'N, 119°16'W, alt. 1900 ft, bush, 5 m tall, 10 stamens, pink anthers, 10 May 1994, *J.B. Phipps 6959* (TRT, UBC, UWO, V); Okanagan Valley, Newport Beach campsite on W side Rd., approx. due NW of Vernon, end of parking lot, S end of camp, 50°20'N, 119°22'W, below trees, alt. 1140 ft, tree 5 m tall, erect habit, burgundy fruit, short thorns, 19 Aug 1994, *Phipps, J.B. & O'Kennon, R.J. 6988* (BRIT, DAO, UBC, UWO, V); NNE of Vernon, S of jct. of 97 and 97A just N of Baker Hogg Rd., bottom of hill, 50°21'N, 119°15'W, alt. 350 m, 4 m bush, purplish fruit, 23 Sep 1993, *Phipps, J.B. & O'Kennon, R.J. 6821* (UWO); Okanagan Valley, E side of 97, half mi N of intersection with 97; scrubby slopes with long cleared area, 50°21'N, 119°15'W, most abundant species here, bush 6 m tall, red fruit; 19 Aug 1994, *Phipps, J.B. & O'Kennon, R.J. 6999* (UWO); Castlegar, grassy floodplain ENE of Selkirk College, dense hawthorn thickets on banks of old oxbow, alt. 950 m, 49°19'N,117°38'W, tree, 9 m tall, foliage elliptical, slightly lobed, purple, fruit globose, dark purple, ?=20 stamens, 27 Sep 1993, *Phipps, J.B. & O'Kennon, R.J. 6827* (CAN, ID, MONTU, TRT, UBC, UWO, US);

Northern Okanagan, ca. 1 mi S of Enderby, gravel driveway to NE starting at Indian Cemetery, alt. 1300 ft, 50°31'N, 119°08'W, bush, 4 m tall, fruit burgundy, only one here, 20 Aug 1994, *Phipps, J.B. & O'Kennon, R.J. 7006* (UWO).

U.S.A. IDAHO. Idaho Co.: US 12, ca. 10 road mi E of Kooskia, bank at back of field, N side of road, with large hawthorns, 46°07'N, 115°50'W, alt. 1550 ft, tree, 9 m tall, fruit burgundy, 26 Aug 1994, *Phipps, J.B. & O'Kennon, R.J. 7089* (UWO). **MONTANA. Flathead Co.:** Few mi E of Columbia Falls, at dead end of Mt.Creek Rd. (off Berne Rd.), on fenceline opposite Shoal 330 sign, 48°22'N, 114°08'W, alt.3000 ft, bush, 2 m tall, 08 May 1994, *J.B. Phipps 6935* (UWO). **Lake Co.:** Route 211, ca. 4 mi S of Ronan, nr. MP 44, at farm entrance, driveway through pasture, near scenic turnout, alt. 3030 ft, 47°28'N, 114°06'W, grove of hawthorns on bank S side of driveway, 20 ft apple-like tree, reddish foliage, black orbicular fruit, 28 Sep 1993, *Phipps. J.B. & O'Kennon. R.J. 6841* (UWO); Rte. 93, ca. 4 mi S of Ronan, near Milepost 44, near scenic turnout, one of group on S side of farm drive, 47°28'N, 114°06'W, alt. 3030 ft, tree 5 m tall, quite large buds forced 'til 11 May, stamens 10, anthers pink, (equals JBP 6841), 08 May 1994, *J.B. Phipps 6940* (BRIT, MONTU, TRT, UWO, US). **Sanders Co.:** Route 200, 30 mi W of 93 on N side of road above Flathead R., in group of hawthorns, alt. 2840 ft, 47°19'N, 114°43'W tree, 11 m tall, ± orbicular, black fruit, 29 Sep 1993, *Phipps, J.B. & O'Kennon. R.J. 6858* (BRIT, CAN, DAO, MO, UWO, V); Route 200, 50.6 km W of jct. with US 93, group of hawthorns above Flathead R., 47°19'N, 114°43'W, alt. 2840 ft, tree 9 m tall, stamens 10, anthers pale pink,(=JBP & RO'K 6955), 09 May 1994, *J.B. Phipps 6955* (UWO); Route 200, 25 mi W of 93 on N side of road above Flathead R., in long hawthorn hedge, alt. 2845 ft, 47°19'N, 114°38'W, bush 6 m tall with spheroidal burgundy fruit, 29 Sep 1993, *Phipps, J.B. & O'Kennon, R.J. 6857* (UWO); Route 200, exactly 42.6 km W of jct. with US 93, long hawthorn hedge, above Flathead River, 47°19'N, 114'38'W, alt. 2840 ft, (equals JBP & RO'K 6857), 09 May 1994, *J.B. Phipps 6953* (BRIT, MO, MONTU, UWO). **WASHINGTON. Ferry Co.:** Hwy. 21, ca. 3 km SW of Danville, alt. ca. 500 m, 48°59'N, 118°31'W, marshy roadside with trees and scrub, tree, 7 m tall, fruit burgundy, (*C. douglasii* very common here), 23 Aug 1995, *J.B. Phipps 7174* (UWO). **Okanogan Co.:** Chopaka Rd., 3 km directly NW of Palmer Lake, open thicket, low rocky slopes, edge of floodplain, alt. 340 m, 48°56'N, 119°41'W, tree, 5.5 m tall, fruit plum-red to burgundy, 28 Aug 1994, *Phipps, J.B. & O'Kennon, R.J. 7105* (UBC, UWO, WS); Okanogan Valley, W side road about 7 km N of Tonasket, huge hawthorn stand along riverside, ca. 975 ft, 48°44'N, 119°25'W; bush, 6 m tall, crimson foliage, no fruit, 3 Sep 1993, *Phipps, J.B. & O'Kennon, R.J. 6865* (UWO); Sinlahekin Valley, ca. 5 mi S of Loomis, in depression near roadside, alt. 450 m, 48°45'N, 119°37'W, bush, 4 m tall, black fruit, 28 Aug 1994, *Phipps. J.B. & O'Kennon, R.J. 7109* (UWO); ca. 6 km NE of Omak, dense hedges in valley-bottom among farm lands, alt. 250 m, 48°27'N, 119°28'W, dense bush, 4 m tall, fruit red, changing from orange, 28 Aug 1994, *Phipps. J.B. & O'Kennon. R.J. 7100* (UWO). **Whitman Co.:** US 195 along Spring Flat Creek few mi S of Colfax at MP 35.3, alt. ca. 775 m, 46°51'N, 117°21'W, tree, 6 m tall, fruit plum-red (some approaching chestnut), group of same, 28 Aug 1994, *Phipps, J.B. & O'Kennon, R.J. 7099* (UWO); 66 Staley Rd., 1 km NE of Chambers, alt. 775 m, dry roadside, young tree in front yard of Harold Bough, 46°39'N, 117°11'W, bush, 4 m tall, fruit shrivelled, 27 Aug 1994, *Phipps, J.B. & O'Kennon, R.J. 7096* (UWO).

2. **Crataegus okanaganensis** J.B. Phipps & O'Kennon, sp. nov. (**Fig. 5**). TYPE: CANADA. BRITISH COLUMBIA: Rough grass with hawthorns on Hwy. 97 near entrance to Kelowna airport, alt. 1800 ft, equals JBP 6907, bush, 4 m tall, fruit, slightly dull and deep red, ± ellipsoid, 17 Aug 1994, *Phipps, J.B. & O'Kennon, R.J. 6974* (HOLOTYPE: UWO; ISOTYPES: CAN, TRT, UBC, US).

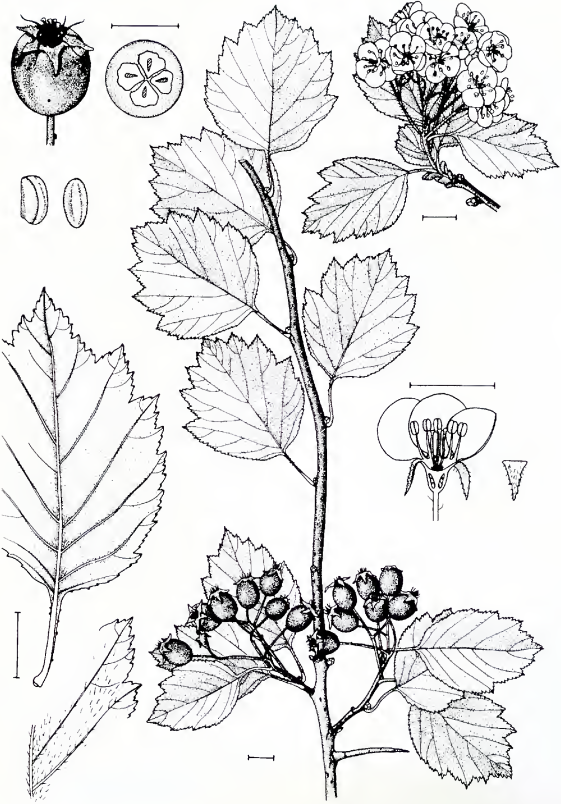

FIG. 5. Line drawing of *C. okanaganensis* J.B. Phipps and O'Kennon. Inflorescence and flower parts from *Phipps 6929* (UWO); infructescence and fruit parts from *Phipps & O'Kennon 7002* and *6975* (UWO); and sterile shoot from *Phipps 6894a* (UWO). Scale bars = 1 cm.

Frutex, 3–6 m altus, ramuli unius anni mediocriter brunnei vel atrobrunnei, in juventute sparsim pubescentes; spinae validae, 2–4 cm longae, in juventute nitenter atrobrunneae, recurvatae. Folia decidua, petiolata; petioli 1–2 cm longi, sparsim pubescentes, eglandulares vel cum glandulis nigribus in juventute (Creston); laminae 3.5–6 cm longae, ovatae vel ovato-rhombeae, aliquando late ellipticae vel anguste ovatae, lobis 3–4 ± acutis, marginibus subtiliter dentatis, venis 4–5 per latus, aliquantum impressis supra, in juventute dense appresso-pilosis, pilis attritis in maturitate, subter pubescentes praecipue in venis, coriaceae, super nitentes praesertim in juventute, crescentes rubrae, aeneae in autumno. Inflorescentia panicula convexa, 10–20 florata; ramuli varie villosi, glandulo-maculati, bracteolis linearibus caducis glandulo-marginatis. Flores 12–15 mm diam., conspicue cupuliformes in juventute; hypanthium externe villosum solo basale vel glabrum omnino; lobi calycis anguste triangulares, 3–4 mm longi, marginibus glandularibus, abaxiale cum pilis paucis; petala ± circularia, alba; stamina 10, antheris albis vel raro pallide roseis; carpelli et styli 2–3(–4). Fructus 8 mm diam., plerumque urceolatus, glaber, coccineus in juventute sed in maturitatem coloris vini vel atropurpureus (raro fere niger), si in conditione bona cum lobis calycis longis insigne erectopatentibus (sed aliquanto brevioribus vel reflexis); pyrenae 2–3, dorsaliter sulcatae, lateribus ± planis, paulo pinguibus vel paulo erosis.

Bush, 3–6 m tall; 1 year old twigs mid to dark brown; young shoots thinly pubescent; thorns stout, 2–4 cm long, shiny deep brown when young, recurved. Foliage deciduous, petiolate; petioles 1–2 cm long, thinly pubescent, eglandular or with small black glands when young (as at Creston, B.C.); blades 3.5–6 cm long, ovate to ovate-rombic, or less commonly broad elliptical to narrow-ovate, with 3–4 sharp lobes per side, margins finely double toothed, 4–5 veins per side, somewhat impressed above, densely appressed hairy when young above, this abrading with age, pubescent principally on the veins beneath, somewhat coriaceous, glossy above especially when young, expanding leaves reddish, the fall colour bronze. Inflorescence a domed panicle, 10–20 flowered, the branches variably villous, gland-dotted, with caducous linear, gland-margined bracteoles. Flowers 12–15 mm diam, notably cup-shaped when young; hypanthium externally villous only at base or completely glabrous; calyx lobes narrow triangular, 3–4 mm long, the margins glandular, abaxially with a few hairs; petals ± circular, white; stamens 10, anthers ivory or occasionally very pale pink; carpels and styles 2–3(–4). Fruit 8 mm diam., generally flask-shaped, glabrous, red when young but later burgundy to deep purple (occasionally almost black), when in good condition with strikingly long erecto-patent calyx lobes but these sometimes shorter or reflexed; nutlets 2–3, dorsally sulcate, their sides flat, a little plump, or shallowly eroded.

Distribution.—Widely distributed and common from the Okanagan valley of southern British Columbia and northern Washington to northern Idaho (Fig. 6). This is an extraordinarily handsome hawthorn in late August and early September.

Crataegus okanaganensis in similar to *C. williamsii* of northwest Montana as illustrated by the numerical analysis (Fig. 1) but with more glossy foliage

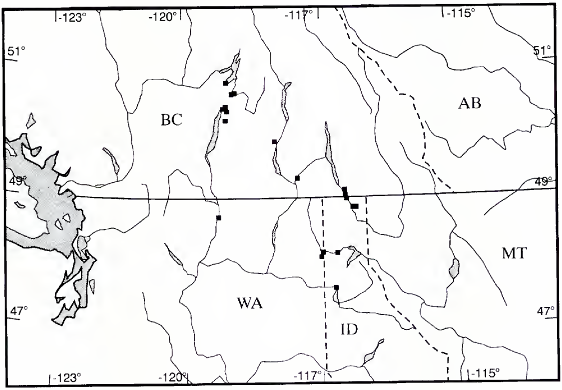

Fig. 6. Distribution of *C. okanaganensis* J.B. Phipps and O'Kennon.

of a much more coriaceous texture and the color usually yellowish-green in mid-season, the blades a little broader and the lobes usually less sharp, thorns generally stouter, different anther color, and mature fruits deep purple (Fig. 9d) instead of sometimes blood or deep red; the young fruit is a brilliant red (Fig. 9e) at the stage when *C. williamsii* may be pale to deeper dull red. The color change from brilliant red (late August) to a deep dull purple (late September) is nearly unique among *Crataegus* species. In northern Idaho at 2300 ft, *C. okanaganensis* flowered in 1994 a good week before *C. williamsii* at the same altitude in northwest Montana. Otherwise identical material with five stamens is occasionally found. *Crataegus okanaganensis* was repeatedly collected in the 1980s in Idaho by Fred Johnson though without recognition.

The two taxa may of ser. *Purpureofructi* be separated as follows:

1. Fresh anthers white or cream; inflorescence branches thinly to moderately hairy; hypanthium usually glabrous; leaves coriaceous (Idaho and west). .... C. okanaganensis

1. Fresh anthers bright pink; inflorescence branches densely hairy; lower part of hypanthium densely hairy; leaves thin (nw Montana). .... C. williamsii

Additional specimens examined: **CANADA. BRITISH COLUMBIA:** Okanagan Valley, Westside Rd. NW of Vernon, ca. 2 km S of intersection with 97, 1450 ft, hedges on both sides of road, 03 May 1994, *Phipps, J.B. 6900* (UWO); ca. 1.2 mi E of Enderby on road to Mabel Lake between 200 m & 25 m W of "Autobody collision & repairs" sign, alt. 1275 ft, hedgerow, bush, 3 m tall, fruit burgundy, 20 Aug 1994, *Phipps, J.B. & O'Kennon, R.J. 7016* (UWO); Rough grass with hawthorns on Hwy. 97 near entrance to Kelowna airport, S side of Airport Dr., alt. 1800 ft, bush 6 m tall, fruit red, slightly deep and dull, ± ellipsoid, 17 Aug 1994, *Phipps, J.B. & O'Kennon, R.J. 6975* (UBC, UWO); ca. 8 km NNE of Vernon center at Burke's Pick-your-own on Pleasant Valley Rd., bottom of roadside, 407 m; 5 m bush, dull burgundy, ellipsoid fruit, 24 Sep 1993, *Phipps, J.B. & O'Kennon, R.J. 6777* (BRIT, MONTU, UWO, WS); Shuswap Valley, just E of Enderby, across bridge, S side of rd. on mound by roadside depression, alt. ca. 1250 ft, bush, 5 m tall, 10 stamens, in bud, 05 May 1994, *Phipps, J.B. 6912* (UWO); Okanagan Valley, ca. 9 km N of center of Vernon off E side of 97, just S of jct. with 97A & just N of Baker Hogg Road, alt. 350 m, hawthorn thickets to N side of long cleared ride, bush, 5 m tall, 10 white anthers, 03 May 1994, *Phipps, J.B. 6894* (UWO); Okanagan Valley, ca. 9 km N of center of Vernon off E side of 97, just S of jct. with 97A & just N of Baker Hogg Road, alt. 350 m, hawthorn (mainly) thickets to N side of long cleared ride, bush, 5 m tall,10 white anthers, 03 May 1994, *Phipps, J.B. 6894a* (UWO); Shuswap Valley, ca. 2.8 km E of Enderby on Kingfisher Rd., on hedgerow S side of road opposite house with wooden fence, N side, alt.1280 ft, bush, 4 m tall, possibly = JBP & RO'K 6812, foliage somewhat reddish, stamens 10, cream anthers, 05 May 1994, *Phipps, J.B. 6921* (BRIT, UWO); ca. 1.2 mi E of Enderby on road to Mabel Lake between 200 m & 25 m W of "Autobody collision & repairs" sign, alt. 1275 ft, hedgerow, bush, 5 m tall, fruit reddish burgundy, 20 Aug 1994, *Phipps, J.B. & O'Kennon, R.J. 7017* (UBC, UWO); Salmon Arm, large hawthorn pasture just N of railroad and W of central business section, alt. ca. 1900 ft, bush, 3.5 m tall, opposite building with blue strip, flowers very cup-shaped, anthers 10, very pale pink, 11 May 1994, *Phipps, J.B. 6966* (BRIT, CAN, UWO); E side of 97A 0.5 mi N of intersection with 97, scrubby slopes with long cleared area, bush, 5 m tall, scarlet fruit, 19 Aug 1994, *Phipps, J.B. & O'Kennon, R.J. 7000* (UWO); Okanagan Valley, about 8 km NNE of center of Vernon, Pleasant Valley Rd., behind Vowle's residence, hedge at S boundary of Burke's PYO, alt. ca. 380 m, dense, broad mature hedge, bush, 3 m tall, nearest top of hedgerow, 10 anthers, ivory, 02 May 1994, *Phipps, J.B. 6882* (DAO, UBC, UWO); Castlegar, near Selkirk College, left-hand slope towards bottom of Rosedale Rd., alt. 970 ft, scrubby area, bush 2.5 m tall, prob. =JBP & RO'K 6826, stamens 10, anthers white, 06 May 1994, *Phipps, J.B. 6929* (BRIT, TRT, UBC, UWO); Okanagan Valley, Westside Rd. NW of Vernon, ca. 2 km S of intersection with 97, 1450 ft, hedges on both sides of road, 03 May 1994, *Phipps, J.B. 6901* (UWO); Okanagan Valley, west side of hwy. at entrance to Kelowna airport, alt. 1800 ft, open scrub, bush, 4 m tall, stamens 10, anthers ivory to palest pink, 05 May 1994, *Phipps, J.B. 6907* (BRIT, TRT, UBC, UWO); West side of hwy. 21, just N of, and in view of, Canada Customs post, roadside/forest edge, 2200 ft, tall, 5 m bush, 27 Sep 1993, *J.B. Phipps, J.B. & O'Kennon, R.J. 6832* (ID, UWO); NNW of Vernon on Westside Rd., ca. 2.5 km SW of intersection of 97 and 97A, hedges along roadside, back of field, W side of rd., bush, 5 m tall with purple shrivelled fruit, 24 Sep 1993, *Phipps, J.B. & O'Kennon, R.J. 6788* (CAN, TRT, UBC, UWO); E side of hwy. 21, ca. 250 m S of Creston Ferry Rd. to Hood Rd., this species very common here, 1970 ft, dense bush, 3.5 m tall, ellipsoid, burgundy fruit, 27 Sep 1993, *Phipps, J.B. & O'Kennon, R.J. 6831* (ID, MO, UWO); E side of hwy. 21, immediately S of jct. with BC 3, north of Creston, alt. 1850 ft, scrubby bank, 2.5 m tall bush, fruit shrivelled, black, 27 Sep 1993, *Phipps, J.B. & O'Kennon, R.J. 6830* (UWO); Castlegar, edge of Campus Rd. off Frank Beinder Rd., grassy slopes with scattered hawthorns, bush, 3 m, lvs sharply lobed, abundant burgundy fruit, 27 Sep 1993; *Phipps, J.B. & O'Kennon, R.J. 6826* (BRIT, UBC, UWO, US); Larry Calder property, E of 97 about 9 km NNE of Vernon, scrubby partly cleared hillside, 475 m, bush, 4 m, reddish foliage, fruit a good purple, 26 Sep 1993, *Phipps, J.B. & O'Kennon, R.J. 6819* (UWO); Kalamalka Prov. Park, S of Vernon, within 200 m of yellow gate, at parking lot, dampish depression, ca. 1375 ft, common, multistemmed bush, fruit oblong-orbicular, burgundy, 24 Sep 1993, *Phipps, J.B. & O'Kennon, R.J. 6798* (BRIT, UWO); NNW of Vernon on Westside Rd., ca. 2.5–3 km SW of intersection of 97 and 97A, hedges along roadside, back of field, 5 m bush with purple fruit, 24 Sep 1993, *Phipps, J.B. & O'Kennon, R.J. 6791* (UWO); E side of hwy. 21, immediately S of jct. with BC3, north of Creston, scrubby banks, 1850 ft, 2.5 m bush, leaves green turning purple, ellipsoid, burgundy fruit, 27 Sep 1993, *Phipps, J.B. & O'Kennon, R.J. 6828* (UWO, V); N of Creston, E side of Hwy. 21, grassy banks with hawthorns on top, just S of junction with Hwy. 3, alt. 1850 ft, bush, 2.5 m tall, stamens 10, anthers white, equals JBP & RO'K 6828, 07 May 1994, *Phipps, J.B. 6930* (UWO); Salmon Arm, large hawthorn pasture just N of railroad and west of central business section, alt. ca. 1900 ft, bush, 3.5 m tall, fruit bright red, equals JBP 6966, 20 Aug 1994, *Phipps, J.B. & O'Kennon, R.J. 7024* (BRIT, TRT, UWO); E side of 97A 0.5 mi N of intersection with 97, scrubby slopes with long cleared area, young plant on south side of site, scarlet fruit, 19 Aug 1994, *Phipps, J.B. & O'Kennon, R.J. 7001* (UWO); E side of 97A 0.5 mi N of intersection with 97, scrubby slopes with long cleared area, young plant on south end of site, scarlet fruit, 19 Aug 1994, *Phipps, J.B. & O'Kennon, R.J. 7002* (UWO); Hwy. 6 ca. 6 road mi W of Fauquier, west of Arrow Lake in Inookalin Valley, along fenceline in farmland, alfalfa fields, alt. 475 m, bush, 4 m tall, fruit bright red, 22 Aug 1994, *Phipps, J.B. & O'Kennon, R.J. 7045a* (UBC, UWO); Okanagan Valley NNE of Vernon, Pleasant Valley Rd., hedge behind Vowle's residence, E end boundary fence with Burke's P-Y-O, alt. 380 m, bush 3 m tall, fruit large, plump, purple-red, hairy, with stout erect calyx lobes, 19 Aug 1994, *Phipps, J.B. & O'Kennon, R.J. 6996* (UBC, UWO); Slocan Valley, S of Slocan, above swamp crossing river along small road off Hwy. 6 & just N of Perry Siding, hedges and brushy slopes, alt. 1775 ft, bush, 5 m tall, fruit bright red, 22 Aug 1994, *Phipps, J.B. & O'Kennon, R.J. 7048* (UWO); Shuswap Valley, just E of Enderby, across bridge, E side of road, 200 m N of gate, alt. ca. 1250 ft, level open field, growing along roadside across from cattle feeder, 4 m tall, fresh anthers cream, 15 May 1995, *Donovan, L.S. & D. 2741* (UWO); Shuswap Valley, just E of Enderby, across bridge, E side of road, alt. ca. 1250 ft, level open field, growing along roadside across from cattle feeder, 2.5 m tall, fresh anthers cream, 15 May 1995, *Donovan, L.S. & D. 2744* (UWO); Okanagan Valley, Kelowna, service road at W side of airport, alt. ca. 1250 ft, fenceline, bush 3 m tall; fruit brilliant red, ellipsoid, 17 Aug 1995, *Phipps, J.B. 7155* (UWO); Okanagan Valley, Oyama, ca. 0.5 mi E of E end of spit, alt. ca. 1320 ft, hedgeline on clay soil, bush, 4 m tall, fruit ellipsoid, red, 17 Aug 1995, *Phipps, J.B. 7157* (UWO); Okanagan Valley, Oyama, ca. 0.5 mi E of E end of spit, alt. ca. 1320 ft, hedgeline on clay soil, bush, 4 m tall, fruit ellipsoid, 17 Aug 1995, *Phipps, J.B. 7159* (UWO).

U.S.A. IDAHO. Bonner Co.: Lower Priest River, river bank, alt. 660 m., scarlet fruit, 07 Aug 1897, *Leiberg, John B. 2857* (OSC); Pend Oreille R. across from Oldtown, N of bridge, Secrion 24,T56N, R6W, scrub just above high water mark, dominated by *C. columbiana*, 2000 ft, 07 Aug 1986, *Johnson, Fred 86126* (IDF); Leclede, Riley Creek, 8 mi E of Priest R. at Pend Oreille R. (Albenai Falls Reservoir) T56N, R3W sec.30, riparian fringe along reservoir climax forest, gentle slope, common, 12 Aug 1988, *Johnson, F. 88079* (IDF); Pend Oreille R. across from Oldtown, N of bridge, T56N R6W S24, 2000 ft, shrub fringe just above high water mark, abundant, 07 Aug 1986, *Johnson, Fred 86126* (ID (#93728); 6 mi E of Priest R, along Albenai Falls Reservoir in T56N, R4W sec. 34&35, riparian fringe, 1900 ft, common, 12 Aug 1988, *Johnson, F. 88082* (IDF); Section 28,T56N, R3W along Pend Oreille R. reservoir, roadside fringe of trees/shrubs by hayfield, many thornless trees, height to 15 ft, 07 Aug 1986, *Johnson, F. 86124* (ID, IDF). **Boundary Co.:** US 95, about 5 km S of jct. with Idaho 1 & S of turnout on right below tall conifers, alt. 2250 ft, on E plowed field backed by steep rocky, treed slope, dense bush, 3 m tall, stamens 10, anthers ivory, 08 May 1994, *Phipps, J.B. 6932* (ID, UWO); US 95, ca. 5 km S of jct. with Idaho 1 & slightly S of turnout on right below tall conifers, alt. 2250 ft, on E plowed field backed by steep rocky, treed slope, dense bush, 3 m tall, stamens 10, 07 May 1994, *Phipps, J.B. 6933* (ID, UWO, WS); US 95 2 mi S of jct. with Idaho 1, W side of road, roadside, 27 Sep 1993, *Phipps, J.B. & O'Kennon, R.J. 6834* (UWO); 2.6 mi S of jct. US 95 & Hwy. 1, in T64N, R1E sec.28 (SE of Copeland), roadside shrub fringe, 2200 ft, gentle slope, 18 ft tall x 22 ft wide, 5 main stems 3–5, possible escape, no farms near, 12 Aug 1998, *Johnson, F. 88072* (IDF). **Kootenai Co.:** floodplain of Spokane R. at Coeur d'Alene, 1/4 mi W of US 95, grassy meadow with scattered trees, no slope, open, 2000 ft, rare with *C. douglasii*, 10 Jun 1982, *Johnson, F.D.* (IDF (#860418)); Spokane River, 1/4 mi E of Washington border, 2100 ft, among granitic rocks and sand, shrubs to 3 m, 01 Aug 1986, *Johnson, F. 8644* (ID (#93729)); Coeur d'Alene, 20 Jun 1930, *Rust, J.H.* (ID), 20 Jun 1930; floodplain of Spokane R. at Coeur d'Alene, 1/4 mi W of US 95, grassy meadow with scattered tree/shrubs, elev. 2000 ft, 10 Jun 1982, *Johnson, Fred* (ID (#93730)); floodplain of Spokane R., at Coeur d'Alene, 1/4 mi W of US 95, grassy meadow with scattered trees & shrubs, no slope, open, 2000 ft, 16 Jun 1981, *Johnson, F.D.* (IDF). **WASHINGTON. Okanogan Co.:** Westside Rd. ca. 7 km N of Tonasket, 975 ft, along riverside, 7 m bush, smaller leaves, burgundy fruit, 30 Sep 1993, *Phipps, J.B. & O'Kennon, R.J. 6868* (UWO); Westside Rd. about 4 km N of Tonasket, alt. 975 ft, bush 5 m tall, riverside hawthorn thicket with a few poplars, fruit ± erect, lake-red, broad-elliptic, 23 Aug 1995, *Phipps, J.B. 7175* (UWO, WS). **Spokane Co.:** Spokane, damp places, *Suksdorf, W.N. 919* (WS), Aug 1889. **Whitman Co.:** Pullman, *Piper, C.V.* (CAS), May 1902; Westend; 1800 ft, spring 1976, *May, R. 91* (RMV).

ENGLAND: cult. Surrey, Kew, Royal Botanic Gardens; Kew #197-67, 19728; 22 May 1985, *Phipps, J.B. 5651*.

The discovery of *C. okanaganensis* and its clear relationship to *C. williamsii* merit the creation of a new series, as follows:

Series Purpureofructi J.B. Phipps & O'Kennon, ser. nov. TYPE: *C. okanaganensis* J.B. Phipps and O'Kennon.

Frutices, plerumque grandes, vel arbores parvae; spinae mediocres in longitudine (2–4 cm longae). Folia plerumque ± coriacea (praeter *C. williamsii*), laminae plerumque ± rhombeae, (vel eliptico-oblongae vel rhombo-ovatae), plerumque lobis 3–4 brevibus patentibus per latus. Inflorescentia 10–25 florata. Flores mediocres (10–15 mm) diam; stamina 5–10; carpelli et styli 2–4. Fructus coccineus, plerumque clare coccineus in Augusto exeunte, in maturitate Septembri exeunte fierens sanguineus vel atropurpureus, orbicularis vel ampulliformis; pyrenis 3–4, lateribus erosis vel planis.

Bushes, usually large, to small trees; thorns medium in length (2–4 cm). Leaves generally ± coriaceous (except *C. williamsii*), blades usually ± rhombic (to elliptic-oblong or rhomb-ovate), usually with 3–4 short outward-pointing lobes per side. Inflorescences 10–25 flowered; flowers not large (10–15 mm diam.); stamens 5–10; carpels and styles 2–4. Fruit red, usually brilliant red in late August, becoming deep blood-red to dark purple at maturity, orbicular to flask shaped; pyrenes 3–4, sides eroded or plane.

Distribution.—A distinctive series with two known species and perhaps a couple of others found from the interior Pacific Northwest and southern British Columbia to northwestern Montana. *Crataegus wiliamsii* was originally placed in series *Rotundifoliae* by Eggleston but the ellipsoid fruit, long calyx lobes in fruit, dark-colored twigs and somewhat erose nutlets suggest a different affinity. Our numerical analysis (Fig. 1) indicates no relationship whatever to *C. chrysocarpa* in ser. *Rotundifoliae.*

3. **Crataegus phippsii** O'Kennon, sp. nov. (**Fig.** 7). Type: CANADA. British Columbia: Okanagan Valley, Pleasant Valley Rd., ca. 8 km NNE of Vernon center, bush, 4 m tall, fruit red, 24 Sep 1993, *Phipps, J.B. and O'Kennon, R.J. 6780* (holotype: UWO; isotypes: BRIT, CAN, TRT, US, WS).

Arbor vel frutex magnus, 5–6(–7) m alta, trunco uno dominante sed aliquanto cum surculis; ramuli unius anni atropurpurei/-brunnei, veteres atrocinenerei; in juventute dense et breviter pubescens; spinae aliquantum sparsae, atrobrunneae vel nigrae, leviter recurvatae, aliquantum tenues, 2–4 cm. longae. Folia decidua, petiolata; petioli 1.5–2.0 cm longi, pubescentes; laminae 4–8 cm longae (sed ad 10 cm vel plus in blastis elongationis), late ellipticae vel ovatae vel deltoideo-ovatae, lobis fere 3 ± vadositer obtusis vel late angulatis per latus, marginibus breve dentatis; ca. 4 (–5) venis secondariis per latus, supra breviter appresso-pubescentes subter breviter pubescentes praecipue in venis, aliquantum coriaceae postea. Inflorescentia panicula depressa, 6–12 florata; ramuli dense breviter-tomentosi, bracteolati; bracteoli lineares glandulo-marginati. Flores 15–22 mm diam.; hypanthium externe brevirer tomentosum; lobi calycis late triangulares, ca. 5 mm longi, abaxiale pubescentes praecipue proximale, marginibus glandulo-laciniatis; petala ± circularia; stamina 10, antheris roseis pallide; styli carpellique 2–4, stigmatis capitatis. Fructus 12 mm diam., breve-pubescentes, maturentes ab coccineo ad pruneo-purpureum vel nigrum, ± orbiculares vel late urceolati, lobis calycis reflexis; pyrenae 3, vadositer sulcatae dorsale, lateribus planis.

Tree or large bush, 5–6(–7) m tall, with main trunk, but sometimes suckering; 1 year old twigs dark purple-brown, older dark gray, young shoots densely short pubescent; thorns somewhat sparse, deep brown to black, slightly recurved, somewhat thin, 2–4 cm long. Foliage deciduous, petiolate; petioles 1.5–2.0 cm long, pubescent; blades 4–8 cm long (but on shoots of elongation to 10 cm or more), broadly elliptic to ovate or broad deltoid-ovate, with about 3 ± shallow rounded to broadly angled lobes per side, the margins short-dentate; about 4–5 secondary veins per side, shortly appressed hairy above, shortly hairy especially along the veins below, somewhat coriaceous later. Inflorescence a 6–12-flowered flattened panicle, the branches densely short-tomentose, bracteolate, the bracteoles linear, gland-margined. Flowers 15–22 mm diam; hypanthium externally densely tomentose; calyx lobes broad-triangular, ca. 5 mm long, pubescent abaxially, especially below, the margins glandular–laciniate; petals ± circular; stamens 10, anthers pale pink; inside of hypanthial cup mostly glabrous, bristly at center; carpels and styles 2–4, the stigmas capitate. Fruit 12 mm diam., short-hairy, ripening through shades of red to plum-purple to black in colour, ± orbicular to broadly flask-shaped, pubescent, with reflexed calyx lobes; nutlets 3, shallowly dorsally ridged, lateral walls ± plane.

Distribution.—This species is not so common as the other two described

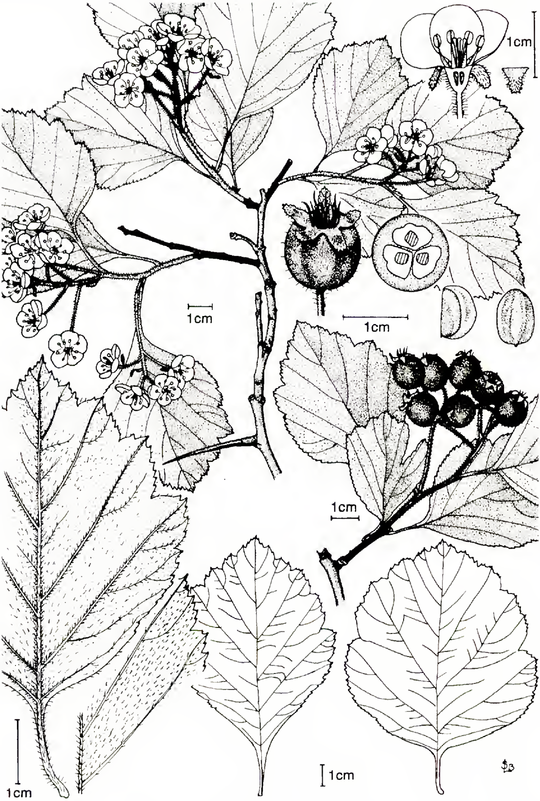

FIG. 7. Line drawing of *C. phippsii* O'Kennon. Inflorescence flowers and parts from *Phipps 6891* (UWO); infructescence, fruit and parts from *Phipps 6780 and O'Kennon* (UWO); two smaller isolated leaves from *Phipps 6780 and O'Kennon* (UWO); magnified leaf (bottom left) from *Phipps 6891* (UWO). Scale bars = 1 cm.

in this paper but is nevertheless widespread and has been found at fourteen localities ranging from the Okanagan Valley of southern British Columbia and northern Washington to the Flathead Valley of Montana (Fig. 8). We have never found it numerous at any site.

Crataegus phippsii is one of the most distinctive species of hawthorn to have been found in North America in recent decades and does not appear to be closely similar to any other known in the west, a feature emphasized in Figure 1. It is a large hawthorn, reminiscent of *C. mollis*, the latter a common species of the interior of the continent, in foliage, habit and pubescence while in its red (Fig. 9a) changing to purple (Fig. 9b) to black fruit it is similar to a number of mostly previously undescribed species of the Pacific Northwest and British Columbia. The foliage colours attractively in autumn (Fig. 9b, 9f). The mature bark sometimes flakes off in longitudinal strips, an unusual feature in hawthorns (Fig. 9c).

Crataegus phippsii was first collected by B.T. Butler (nos. *521–523*) in 1908 and these specimens were cited by Eggleston (1909) in his protologue for *C. williamsii*. The many differences from *C. williamsii*, however, show that *C. phippsii* in not in this affinity. That Eggleston thought it somewhat distinct is shown by his annotations on the sheets of "var. *ovata*," a name, however, never published. Beyond this brief glimpse of notoriety, the present species, very striking to the present authors, remained totally overlooked until our collections of recent years.

The large, broad leaves with rounded lobes and hairiness of all parts suggests an affinity with series *Molles*. Superficially, it most nearly resembles the local species *C. noelensis* Sarg. of Missouri, a taxon which, however, has not been seen for many years. A combination of stamen number, anther color, foliage size and shape, and fruit color are the main characters distinguishing the species in the *Molles* group as shown in the following key. For convenience, I am including *C. greggiana* in this key although it is now placed in ser. *Greggianae*.

KEY TO *C. PHIPPSII* AND MEMBERS OF SERIES MOLLES

1. Foliage small, on short shoots mainly 4 cm long.
    2. Flowers 1–1.5 cm diam.; stamens usually 10. .... **C. greggiana**
    2. Flowers ca. 2 cm diam.; stamens 20. .... **C. lanuginosa**
1. Foliage larger, on short shoots generally 5–8 cm long.
    3. Anthers pink.
        4. Stamens 5–10.
            5. Fully ripe fruit orange-red; leaves ± unlobed. .... **C. noelensis**
            5. Fully ripe fruit deep purple to black; leaves evidently lobed. .... **C. phippsii**
        4. Stamens 20.
            6. Fruit red. .... **C. texana**
            6. Fruit yellow. .... **C. viburnifolia, C. kellogii**
    3. Anthers white to cream.

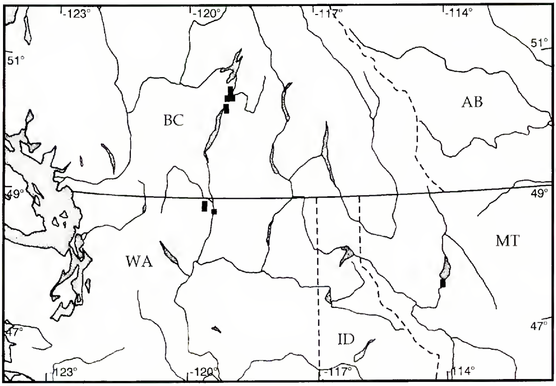

FIG. 8. Distribution map of *C. phippsii* O'Kennon.

7. Stamens 20. .... **C. mollis**

7. Stamens 10. .... **C. submollis**, sens. lat.

Additional Specimens examined: **CANADA. BRITISH COLUMBIA:** Okanagan Valley, 8 km NNE of center of Vernon, Pleasant Valley Rd., behind Vowle's residence, hedge at S boundary of Burke's PYO, dense, broad mature hedgeline, bush 4 m, commencing flowering, 7-8 pale pink anthers, 02 May 1994, *Phipps, J.B 6878* (BRIT, CAN, TRT, UBC, UWO, US); Okanagan Valley, 8 km NNE of center of Vernon, Pleasant Valley Rd., behind Vowle's residence, hedge at S boundary of Burke's PYO, dense, broad mature hedgeline, bush 4 m, foliage glossy, pedicels hairy, 10 pink anrhers, 02 May 1994, *Phipps, J.B. 6880* (CAN, TRT, UBC, UWO); Okanagan Valley, rough, scrubby slope above dirt road NW-bound into O'Keefe Ranch, opposite L. & A. Cross Rd. off 97A, alt. 1290 ft a.s.l., stamens 10, anthers light pink, equals JBP & RO'K 6803, 03 May 1994, *Phipps, J.B. 6891* (UBC, UWO, WS); ca. 10 km N of Vernon center, on dirt road N-bound into O'Keefe Ranch off Hwy. 97A at L.& A. Cross Rd., dry rocky hillside, suckering clump of trees to 5 m, 25 ft across, bark coarse, plated, peeling, fruit purple, 25 Sep 1993, *Phipps, J.B. & O'Kennon, R.J. 6803* (CAN, UWO); Pleasant Valley Rd. ca. 8 km NNE of Vernon Center, southern boundary hedge of Burke's PYO behind Vowles' residence, alt. ca. 380 m, dense, broad mature hedgeline of *Crataegus*, bush 4 m tall, fruit deep red, 24 Sep 1993, *Phipps, J.B. & O'Kennon, R.J. 6780* (BRIT, CAN, MO, UWO); ca. 5 km NNE of Enderby, on E-W rd. between Shuswap R. and Hwy. 97A, long hedgerows, alt. ca. 1375 ft, bush, 5 m tall, fruit red, 21 Aug 1994, *Phipps, J.B. & O'Kennon, R.J. 7038* (UWO); ca. 3 km NE of Enderby on road to Sicamous (Hwy. 97A), bottom of scrubby slope on east side, alt. ca. 1400 ft, clump of 5 m bushes, reddish fruit, 21 Aug 1994, *Phipps, J.B. & O'Kennon, R.J. 7037* (DAO, UWO); ca. 5 km ENE of Armsrrong on E-W aligned rd. just ENE of Armstrong airporr, hedgerows, S side of road, alr. 1450 ft, bush 5 m tall, 21 Aug 1994, *Phipps, J.B. & O'Kennon, R.J. 7041*

FIG. 9. Various pictures of *C. phippsii* O'Kennon and *C. okanaganensis* J.B. Phipps & O'Kennon: a) typical reddish late August fruit color of *C. phippsii*, northern Okanagan, BC, 19 Aug 1995; b) typical later September fruit color of *C. phippsii* with fall foliage color beginning, northern Okanagan, BC, 24 Sep 1993; c) trunks of *C. phippsii* showing shredding bark, shores of Palmer Lake, Washington, late Aug. 1994; d) full ripe fruit color of *C. okanaganensis*, Westside Rd., nr. Vernon, BC, 24 Sep 1993; e) late August fruit color of *C. okanaganensis*, nr. Kelowna, BC, 17 Aug 1995; f) R.J. O'Kennon holding fruiting branch, Palmer Lake, Okanagan Co., WA, 01 Oct 1993; note fall foliage.

(UWO); ca. 6 km N of Armstrong, branch of Deep Creek, thickets, primarily *C. douglasii*, in narrow flood-plain, alt. 1450 ft, tree 4 m tall, fruit red, 21 Aug 1994, *Phipps, J.B. & O'Kennon, R.J. 7034a* (UWO); ca. 3 km NW of Armstrong, N-S road parallel to Schubert Rd. and to the W of it, E side, alone by telephone pole, alt. ca. 1400 ft a.s.l., bush 3.5 m tall, dark green leaves, dull reddish fruit, 21 Aug 1994, *Phipps, J.B. & O'Kennon, R.J. 7033* (BRIT, UBC, UWO).

U.S.A. MONTANA. Flathead Co.: about 0.5 km along Tower Rd. off US 93, near SW corner of Flathead Lake, hawthorn thicket along trail, rear of small field, alt. 2950 ft, equals JBP 7078, bush 7 m tall, overtopping all others, at popcorn, anthers pink, 20 May 1997, *Phipps, J.B. & O'Kennon, R.J. 7591 (*MONTU, UWO). **Lake Co.:** Hwy. 93, mipost 63.4, Tower Rd., (major pablillo), 2.0 mi. NW of Polson Bridge, 8–(11–12)–14 flowers, 10 pink anthers, leaves hairy, shaggy, in green bud stage (forced), 18 May 1995, *O'Kennon, R.J. 13156* (UWO); Flathead Lake, SW border, 29 Aug 1908, *Butler, B.T. 522* (NY); Rocky Point Road NW of Polson at 1.7 mi N of hwy 93 and 0.3 mi NE of Jim's Road, alt. 2920 ft, extensive thickets near lakeshore behind new housing, bush, 5 m tall, fruit orbicular, reddening, 25 Aug 1994, *Phipps, J.B. & O'Kennon, R.J. 7080* (BRIT, ID, MO, MONTU, UWO); Flathead Lake, SW border, 19 Aug 1908, *Butler, B.T. 523* (NY); Flathead Lane, off Tower Rd., off hwy 93 few mi NW of Polson, thickets along creek back of field, alt. 3050 ft, tree 5 m tall, fruit partly deep oxblood, partly paler, 25 Aug 1994; *Phipps, J.B. & O'Kennon, R.J. 7078* (DAO, MONTU, UWO, US); Flathead Lake, SW border, 19 Aug 1908, *Butler, B.T. 521* (NY). **WASHINGTON: Okanogan Co.:** Palmer Lake, N side., open hawthorn thicket at upper level of pebble beach at picnic spot/campsite, just E of Chopata Lodge, small tree, 6 m tall, mostly finished flowering, stamens 10, anthers pale pink in bud, =JBP & RO'K 6874, 04 May 1994, *Phipps, J.B. 6904* (ID, MO, UWO, WS); W of US 97 on crossroad at Ellisford, in floodplain to S side of road, bush, 7 m tall, anthers 10, pale pink, equals JBP & RO'K 6876, 04 May 1994, *Phipps, J.B. 6906* (US, UWO, WS); Palmer Lake, N side, open hawthorn thicket at upper beach level on campsite just E of Chopata Lodge, alt. 1150 ft, fine tree, 7 m tall, burgundy fruit; 30 Sep 1993, *Phipps, J.B. & O'Kennon, R.J. 6874* (DAO, ID, MO, UWO, WS; E shores of Palmer Lake, 0.7 mi S of campsite at N end, thickets, alt. 355 m, bush, 4.5 m tall, deep plum-red fruit, 28 Aug 1994, *Phipps, J.B. & O'Kennon, R.J. 7108* (BRIT, ID, UWO, WS); Okanogan Valley, cross-road at Ellisford, alt. 950 ft, bush 7 m tall in field in floodplain, S side of road, fruit blackish, 01 Oct 1993, *Phipps, J.B. & O'Kennon, R.J. 6876* (UWO, WS).

ACKNOWLEDGMENTS

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REFERENCES

EGGLESTON, W.W. 1909. New North American *Crataegi*. Bull. Torrey. Bot. Club 36:639–642.

HOLMGREN, N.H. 1997. Rosaceae. In: A. Cronquist, et al., eds. Intermountain Flora, vol. 3A. New York Botanical Garden, Bronx.

PHIPPS, J.B. 199x. Taxonomic and nomenclatural problems in black and burgundy-fruited *Crataegus* (Rosaceae) species: *C. erythropoda*, *C. rivularis* and *C. saligna*. Sida, submitted.

PHIPPS, J.B. 1998. Introduction to the red-fruited hawthorns (*Crataegus*, Rosaceae) of western North America. Canad. J. Bot. 76(in press).

SARGENT, C.S. 1907. The black-fruited hawthorns of western North America. Bot. Gaz. 44:64–66.

WELSH, S.L. 1987. Rosaceae. In: A Utah Flora. Great Basin Naturalist Mem. 9:520–543.

BOOK REVIEW

ANNE HUTCHINGS, and ALAN HAXTON SCOTT, GILLIAN LEWIS, and ANTHONY CUNNINGHAM. 1996. **Zulu Medicinal Plants: An Inventory.** (ISBN 0-86980-893-1, pbk; ISBN 0-86980-923-7, hbk). University of Natal Press, Private Bag X01, Scottsville 3209, Republic of South Africa, in association with University of Zululand and National Botanical Institute. Exclusive distributor: International Specialized Book Services, Inc., 5804 N.E. Hassalo Street, Portland, OR 97213-3644, U.S.A. (503) 287-3093; FAX (503) 280-8832. $110.00. 450 pp.

The subtitle understates the amount of information in this tightly organized compendium of information about plant used by Zulu traditional healers. The authors have chosen to arrange their entries in phylogenetic order to facilitate comparisons between related plants. As this publication deals exclusively with plants of southern Africa, the classification follows that used in the National Herbarium. Genus numbers reflect the standards used in herbaria arranged in the Englerian system with additional standards for ferns and grasses. These are referenced in the introduction.

The entry for each species includes geographical distribution, a short description, local names in English, Afrikaans and Zulu followed by documented use by Zulu healers and then those referring to use by other groups in southern Africa. Physiological effects, Chemical constituents and biological properties are added where information is available. These gaps will tease and stimulate further research conducted, it is hoped, under the ethical and legal codes protecting intellectual property rights.

There is a wealth of information not only on the medicinal uses of these plants, but by the social and cultural uses too. These range from love potions to charms against lightning and incense to invoke the goodwill of ancestors. However, the authors do warn readers not to experiment!

For those who do not own a copy of Watt and Breyer-Brandwijk's 1962 edition *the Medicinal and Poisonous plants of Southern and Eastern Africa* this book is a must. For those fortunate to own a copy this will be a valuable supplement, for at least a third of the 1032 species mentioned here are new.

With the worldwide renewal of interest in natural products this book has a huge potential readership. In each foreword, we are reminded of the value, and ephemeral nature, of traditional knowledge. This book makes it less likely we will lose the traditional ethnobotanical knowledge of the Zulu nation.—*Fiona Norris*

TAXONOMIC CLARIFICATION OF *ATRIPLEX NUTTALLII* (CHENOPODIACEAE) AND ITS NEAR RELATIVES

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ABSTRACT

In 1874 Sereno Watson described *Atriplex nuttallii* as a new species, citing his number 981 collection, made in 1868 from northern Nevada, as a representative. His collection consisted of three plants each collected from a separate population all mounted on one sheet. One is *A. canescens*, two are the new species, *A. nuttallii.* Failure to recognize the original collection and collection site of *A. nuttallii* has resulted in assignment of the name *A. nuttallii* to several different *Atriplex* species in western North America. However, by using quantitative as well as qualitative differences, *A. nuttallii* is readily distinguished from its near relatives *A. cuneata*, *A. falcata*, *A. gardneri*, and *A. tridentata*. The principal distinguishing features include plant size and habit, leaf dimensions, fruiting-bract size and shape, fruiting bract appendages, chromosome number, saponin content, flavonol content, dates of anthesis, and geographic distribution.

RESUMEN

En 1874 Sereno Watson describió *Atriplex nuttallii* como nueva especie, citando su recolección número 981, hecha en el norte del estado de Nevada, E.E.U.U., como representativa. Consiste esta recolección en tres plantas, de distintos lugares pero colocadas todas en un mismo pliego de herbario. Una de ellas es *A. canescens* y dos son de la nueva especie, *A. nuttalli.* El no darse cuenta los botánicos de la colecta original y su lugar de origen ha tenido como consecuencia la aplicación del nombre de *Atriplex nuttallii* a varias otras especies de *Atriplex* del oeste de Norte América. Sin embargo, usando tanto características cuantitativas como cualitativas, se distingue fácilmente *A. nuttallii* de las especies afines, *A. cuneata*, *A. falcata*, *A. gardneri*, y *A. tridentata*. Las características de mayor utilidad son la altura de la planta, las dimensiones de la hoja, la forma y tamaño de las brácteas fructíferas, sus apéndices, el numero de cromosomas, contenido de saponinas, contenido de flavonoides, fecha de antesis, y la distribución geográfica.

INTRODUCTION

In 1874, Sereno Watson described *Atriplex nuttallii* as new (Watson 1874) and listed his collection number 981, obtained in 1868 in northern Nevada, as a representative of the species. This collection consists of three plants

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collected at different times in separate locations in northern Nevada, all mounted on one herbarium sheet (GH!) (Fig. 1), and each labeled by Watson as *Obione canescens* Moq. The plant on the right is *A. canescens* (Pursh) Nutt. collected in June, 1868, in Unionville Valley, Pershing County, Nevada. The other two are *A. nuttallii*. The middle plant, which appears to have been broken and folded back, was collected in September, 1868, in Thousand Springs Valley, Elko County, Nevada. The plant on the left was collected in July 1868 in Reese Valley, Lander County, Nevada. Currently there are still extensive populations of these species in the valleys where Watson collected them.

As shown in Figure 1, several botanists have recognized differences between these three plants and have provided annotations for them. In 1951, Grant D. Brown annotated the plant on the right as *Atriplex canescens* (Pursh) Nutt. In 1962, C.A. Hanson annotated the plants on the left and right as *Atriplex bonnevillensis* Hanson and the central one as *Atriplex falcata* (Jones) Standley. In 1972, I.J. Bassett and C.W. Crompton annotated the plant on the right as *Atriplex canescens*, the central one as *A. nuttallii* var. *falcata*, and designated on the annotation label, the left specimen as the lectotype of *Atriplex nuttallii* S. Watson. Later, McNeil et al. (1983) designated as the lectotype of *A. nuttallii*, a specimen collected in Saskatchewan, Canada, by Bourgeau (*s.n.*), in 1857, and included by Watson among 10 other collectors of *A. nuttallii*, in addition to *Watson 981*. However, as directed in the International Code of Botanical Nomenclature, Article 9.9 (Greuter et al. 1994), — " when the material designated as type is found to belong to more than one taxon, a lectotype — may be designated," and, as described in Article 7.5 of the 1988 edition of the code (Greuter et al. 1988), "A lectotype is a specimen or illustration selected from the original material to serve as a nomenclatural type when no holotype was designated at the time of publication —. When two or more specimens have been designated as types by the author ... the lectotype must be chosen from among them." Since Watson listed in the protologue, his number 981 as a representative of the new species, he ostensibly considered it typical and, since this collection consists of three specimens, one of them must be chosen as the lectotype. Consequently, the lectotype of *Atriplex nuttallii* is the specimen on the left (GH) as annotated by Bassett and Crompton in 1972. The designation by McNeil et al. of a specimen collected in Saskatchewan, Canada as the lectotype of *A. nuttallii*, was therefore unnecessary. The illustration in Bassett et al. (1983) of the Saskatchewan plants, is representative of a diploid *A. gardneri* (Moquin-Tandon) Hall & Clements which is common throughout southern Alberta, southern Saskatchewan and northern Montana but very different from *A. nuttallii* of northern Nevada. In his protologue, Watson de-

FIG. 1. *Atriplex nuttallii.* The lectotype of *Atriplex nuttallii* (*Watson 981*, upper left corner) collected in Reese Valley, Lander County, Nevada, July 1868. The central element is *A. nuttallii* collected in Thousand Springs Valley, Elko County, Nevada, September, 1868. The specimen on the right is *Atriplex canescens* collected in Unionville Valley, Pershing County, Nevada, June 1868.

scribes *A. nuttallii* as being 1–2 feet high. This is the stature of the *A. nuttallii* plants in the populations he collected in northern Nevada (Table 1) but not *A. gardneri* plants which are mostly 6–12 inches tall, nor *A. canescens* plants which are seldom less than 30 inches in height. The Saskatchewan plant illustrated in Bassett et al. (1983) appears to be ca 12 inches in height.

In the botany treatment of the King expedition (Watson 1871), Torrey provided identification for Watson's collections and Watson provided the descriptions (footnote, page 287). Referring to *Watson 981*, Torrey identified it as *Obione canescens* Moq. and Watson applied that name to each of the three plants. Watson's description of the collection specifically referred to his number 981 and indicated that "most of the specimens have nearly or quite wingless fruit. Others have the bracts considerably dilated, though still less than is frequently the case (982)," indicating that he recognized it as being anomalous, quite unlike other *Obione* (*Atriplex*) *canescens* plants. As shown in Figure 2, there is considerable variation in the fruiting-bract characteristics of plants in the Reese Valley population, with none being truly 4-winged.

Since Watson, following Torrey's identification, labelled each of the three specimens (*Watson 981*), *Obione canescens*, he apparently assumed the variation he saw in the populations in northern Nevada to be representative of the variation displayed by *Atriplex* shrubs throughout western United States. This is confirmed in his later description of *A. nuttallii* (Watson 1874) wherein he lists *Atriplex canescens* Nuttall, not of James, *Obione canescens* Moq., and *Atriplex Gordoni* Hook. as synonyms and gives its distribution as "from the Saskatchewan to Colorado and Northern Nevada."

This broad interpretation by Watson appears to have been the initiation of a series of misconceptions concerning the geographic distribution of *A. nuttallii* that we interpret to be confined to northern Nevada and northwestern Utah (Fig. 3). Standley (1916) listed the type locality of *A. nuttallii* as "on the denuded hills of the Missouri River, about 15 miles below the confluence of the White River, South Dakota." Since this is the location given by Nuttall (1818) as the type locality of *Atriplex canescens* (Pursh) Nutt., Standley clearly confused the two. Furthermore, this locality for *Atriplex canescens* (*Calligonium canescens* Pursh) invites correction because its origin given by Pursh (1814) is "in the plains of the Missouri River, near the Big Bend" which is several kilometers upstream from the confluence of the White River.

Standley (1916) also mistakenly listed the distribution of *A. nuttallii* as "alkaline plains and hillsides, Manitoba and Saskatchewan to northern Utah, Colorado and western Nebraska" without mentioning Reese Valley and Thousand Springs Valley in northern Nevada.

Fig. 2. Fruiting-bracts of six randomly selected plants of *Atriplex nuttallii* from a population in Reese Valley, ca 1 km west of Battle Mountain, Lander Co., Nevada. Each row across represents one individual. Bar = 15 mm.

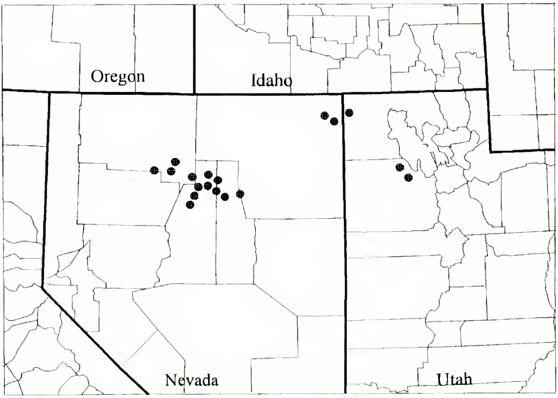

Fig. 3. Distribution of known populations of *Atriplex nuttallii*.

Hall and Clements (1923) likewise failed to include the type locality of *A. nuttallii* in their description of the distribution of *A. nuttallii* as "Saskatchewan and South Dakota to western Nebraska, New Mexico, Arizona, northwestern California, eastern Washington, and Alberta."

Recently, Basset et al. (1983) cited the distribution of *A. nuttallii* as "from the Peace River District of Alberta to Manitoba. In the United States specimens have been found as far south as Colorado." Clearly this does not refer to the *A. nuttallii* described by Watson from Nevada.

The failure to identify the original collection site of *A. nuttallii* in all references has caused considerable misunderstanding of its identity and has resulted in the assignment of this binomial to most of the suffrutescent shrub species of *Atriplex* in western North America. Ulbricht (1934) listed *A. nuttallii* S. Wats., *A. buxifolia* Rydb., *A. cuneata* A. Nelson, *A. eremicola* Osterh., *A. falcata* Standley, *A. gordonii* Hook., *A. neomexicana* Standley, *A. oblanceolata* Rydb., *A. pabularis* A. Nelson and *A. tridentata* Kuntze as synonyms of *Obione gardneri* Moq. (*Atriplex gardneri* [Moq.] Standley). Hall and Clements (1923) treat *A. buxifolia*, *A. cuneata*, *A. eremicola*, *A. falcata*, *A. gardneri*, *A. pabularis* and *A. tridentata* as subspecies of *nuttallii*.

Standley (1916) listed eight species as close relatives of *A. nuttallii* (Series Nuttallianae): *A. buxifolia*, *A. cuneata*, *A. falcata*, *A. gardneri*, *A. neomexicana*, *A. oblanceolata*, *A. pringlei* Standley, and *A. tridentata*. As suggested by Hall and Clements (1923), *A. pringlei* appears to be an insignificant variant of *A. acanthocarpa* (Torr.) S. Wats and *A. oblanceolata* is non-distinguishable from *A. gardneri*. *A. neomexicana* is a common reoccurring hybrid between *A. cuneata* and *A. confertifolia* (Torr. & Frem.) S. Wats. (Hanson 1962) and *A. buxifolia* is synonymous with *A. gardneri*. The remaining four species, *A. cuneata*, *A. falcata*, *A. gardneri*, and *A. tridentata*, were treated by Hall and Clements (1923) as subspecies of *A. nuttallii*. Since they and *A. nuttallii* are clearly distinct phenotypically (Pope 1976, Tables 1, 2, Fig. 4) and geographically (Figs. 3, 5–8) we consider them best treated as separate species as proposed by Standley (1916).

Because Watson listed *A. gordoni* (*A. gardneri*) as a synonym of *A. nuttallii*, Hanson (1962) argued that the epithet *nuttallii* was superfluous and hence illegitimate and that *A. gardneri* was the correct name for Watson's *A. nuttallii*. This view was later accepted by Pope (1976) Stutz (1978), Stutz et al. (1979), and Welsh (1984). However, as noted by McNeil et al. (1983), the listing of *A. gordoni* (*A. gardneri*) as a synonym of *A. nuttallii* was accompanied by a question mark and is therefore not a legitimate synonym and, according to the Code, Article 55.2, note 1, (Greuter et al. 1994) the epithet *nuttallii* is therefore not nomenclaturally superfluous.

As discussed by McNeil et al. (1983) the other synonyms of *A. nuttallii* listed by Watson: (*Atriplex canescens* Nuttall, and *Obione canescens* Moq.), are also not legitimate synonyms.

MATERIALS AND METHODS

To better define *A. nuttallii* and its near relatives, herbarium specimens of the suffrutescent *Atriplex* species of western North America were examined in several herbaria (BRY, CAS, GH, MO, NY, PH, RM, RSA, US, UC) and specimens were collected and studied from the original collection sites of each of the species included in the study (except *A. gardneri* for which the exact location is not known). In addition, morphological measurements, saponin production, flavonoid content, and cytological studies were made of plants in several populations of each species. The morphological measurements included fruiting-bract characteristics, plant height and width, and leaf length and width. Chromosome counts were obtained from plants in several populations of each species (Figs. 5–8). In some cases the counts were obtained from root tips squashed in aceto-carmine stain, but most were from aceto-carmine squashes of pollen-mother-cells derived from anthers fixed in 5% acetic acid and stored under refrigeration. Saponin content was determined by hemolysis of red blood-cells as described by Sanderson et al. (1987). Flavonoid content was determined by paper chromatography as described by Sanderson and Stutz (1984).

Table 1. Plant and leaf characterisrics of *Atriplex nuttallii* and its near relatives. Measurements were obtained from 20 plants in each population. Diploid *A. cuneata* is not included because of extensive between-population variation. N = number of populations. Data = mean with coefficient of variation in parentheses. Values in each column with the same letter are not significantly different ($p<.05$).

		Plant			Leaf		
Taxon	N	Height (cm)	Width (cm)[a]	Volume (dm^3)[b]	Length (mm)	Width (mm)	l/w
A. nuttallii(6x)	9	32.6(0.41)^{A}	47.4(0.39)^{A}	101.5(0.94)^{A}	24.1(0.33)^{A}	4.0(0.21)^{B}	6.0(0.22)^{A}
A. cuneata(4x)	31	12.8(0.31)^{B}	51.2(0.33)^{A}	41.3(0.88)^{AB}	20.9(0.22)^{A}	8.3(0.28)^{A}	2.6(0.19)^{BC}
A. falcata(2x)	12	12.9(0.44)^{B}	24.6(0.31)^{B}	9.4(0.74)^{B}	23.7(0.58)^{A}	3.6(0.41)^{B}	6.5(0.23)^{A}
A. gardneri(2x)	6	9.8(0.52)^{B}	48.9(0.11)^{AB}	25.2(0.76)^{AB}	19.9(0.09)^{A}	3.8(0.21)^{B}	5.4(0.11)^{AD}
A. gardneri(4x)	8	10.9(0.59)^{B}	49.8(0.44)^{A}	42.3(1.45)^{AB}	19.4(0.19)^{A}	5.3(0.28)^{B}	3.8(0.18)^{BCD}
A. tridentata(6x)	13	23.9(0.38)^{A}	41.8(0.46)^{AB}	63.8(1.25)^{AB}	28.7(0.53)^{A}	4.1(0.33)^{B}	6.79(0.28)^{A}

[a] Width of *A. tridentata* does not include root sprouts.

[b] Volume = height × (width)^2

TABLE 2. Fruiting-bract characteristics of *Atriplex nuttallii* and its near relatives. Measurements were made on 20 fruits from several randomly selected plants in each sampled population. Diploid *A. cuneata* is not included because of extensive between-population variation. N = number of populations. Data = mean with coefficient of variation in parentheses. Values in each column with the same letter are not significantly different ($p<.05$).

		Fruiting-bract						
Taxon	N	Length (mm)	Width (mm)	l/w	Volume (mm^2)[a]	Apex[b]	No. of Terminal Teeth	Appendages[c]
A. nuttallii(6x)	10	4.5(0.10)^{B}	3.0(0.07)^{BCD}	1.6(0.14)^{AB}	39.0(0.15)^{B}	2.4(0.07)^{B}	3.2(0.24)^{B}	2.0(0.14)^{B}
A. cuneata(4x)	15	6.1(0.16)^{A}	5.0(0.22)^{A}	1.3(0.14)^{C}	165.3(0.59)^{A}	1.8(0.19)^{C}	3.6(0.24)^{B}	3.9(0.17)^{A}
A. falcata(2x)	12	4.6(0.19)^{B}	2.6(0.14)^{D}	1.8(0.10)^{A}	32.0(0.48)^{B}	3.0(0.00)^{A}	1.0(0.00)^{C}	2.0(0.27)^{B}
A. gardneri(2x)	7	3.1(0.14)^{C}	2.5(0.21)^{D}	1.3(0.17)^{BC}	19.7(0.45)^{B}	1.7(0.19)^{C}	4.64(0.46)^{B}	1.4(0.19)^{B}
A. gardneri(4x)	10	4.2(0.21)^{BC}	3.0(0.31)^{BCD}	1.5(0.12)^{BC}	45.1(1.12)^{B}	1.5(0.05)^{C}	3.8(0.12)^{B}	1.9(0.37)^{B}
A. tridentata(6x)	13	4.6(0.12)^{B}	3.9(0.16)^{BC}	1.2(0.15)^{C}	72.6(0.39)^{B}	2.6(0.15)^{B}	8.5(0.45)^{A}	2.0(0.49)^{B}

[a] Volume = length × $(\text{width})^2$.

[b] Prominence of central apical tooth was scored 0 to 3 with central tooth absent = 0, small = 1, conspicuous = 2, prominent = 3.

[c] Number of lateral appendages was scored 0 to 5 with no appendages = 0, numerous appendages = 5.

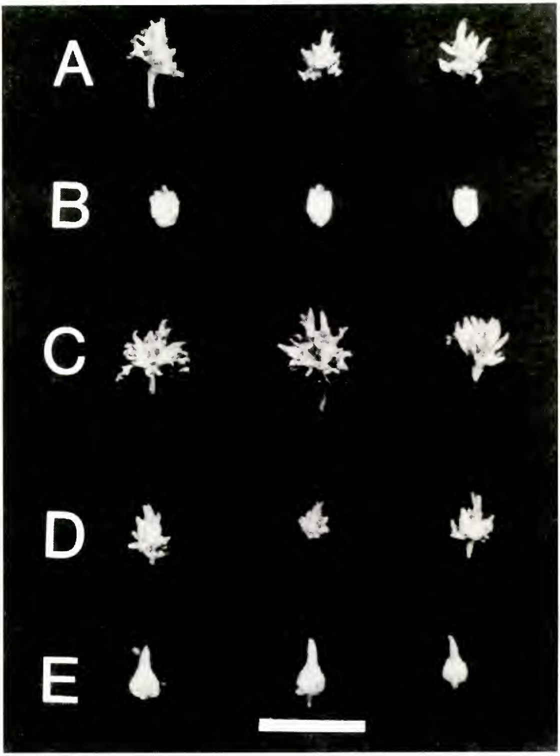

FIG. 4. Fruiting bracts of *Atriplex nuttallii* and its near relatives. A, *A. nuttallii*. B, *A. tridentata*. C, *A. cuneata*. D, *A. gardneri*. E, *A. falcata*. Although there is considerable variation in the fruiting bracts of plants within and between populations, those shown are fairly representative of each species. Collection sites for those shown are: *A. nuttallii*, 1 km W of Battle Mountain, Lander Co.: Nevada; *A. tridentata*, Rush Valley, Tooele Co.: Utah; *A. cuneata*, Navajo Mine lease site, ca 10 km SW of Farmington, San Juan Co.: New Mexico; *A. gardneri*, ca 10 km S of Bridger, Uinta Co.: Wyoming; *A. falcata*, ca 5 km N of Ontario, Malheur Co.: Oregon. Bar = 15 mm.

RESULTS AND DISCUSSION

Probably because they are dioecious and wind-pollinated, most of the shrubby species of *Atriplex* in North America are unusually rich genetically and can often be best defined by quantitative, in addition to available qualitative, attributes. This is particularly true for *A. nuttallii* and its relatives. As shown in Figures 3, 5–8 and Tables 1–4, although *A. nuttallii* and each of its near relatives can usually be distinguished from each other by some qualitative differences, when combined with differences in quantitative attributes and geographic distributions, they are quite distinct.

Atriplex nuttallii S. Watson, Proc. Amer. Acad. Arts 9:116.1874. LECTOTYPE: NEVADA: Reese Valley, Jul 1868, *Watson 981* (GH!).

Phenotypically, *A. nuttallii* appears to be most closely related to *A. tridentata*. Although highly variable in *A. nuttallii* (Fig. 2), most fruiting bracts of both taxa have multiple, terminal, marginal teeth. Both have oblong or oblanceolate leaves and occupy similar habitats (primarily saline bottomlands). Both are hexaploids ($2n = 54$) (a few tetraploid populations of *A. tridentata* have also been found). *A. nuttallii* differs from *A. tridentata* in being taller statured (30–60 cm vs 10–30 cm) (Table 1), woodier, and more phenotypically variable. Much of its variation appears to be the result of hybridization and subsequent introgression from other species, including *A. tridentata* with which it is often sympatric. Plants of *A. tridentata* do not produce saponins whereas some plants of *A. nuttallii* do, some do not (Table 3). *A. tridentata* usually shows aggressive root-sprouting whereas *A. nuttallii* is distinctly caespitose with numerous (60–120), slender (1–3 mm in diameter), woody stems emerging from a single woody crown, 10–50 cm in diameter. Geographically, *A. tridentata* is common in northern Utah, southwestern Wyoming, northwestern Colorado and northeastern Nevada (Fig. 8); *A. nuttallii* appears to be restricted to the alkaline valleys in northern Nevada and northwestern Utah (Fig. 3).

Atriplex cuneata A. Nelson, Bot. Gaz. 34:357.1902. TYPE: UTAH. EMERY CO.: Emery, alt. 7,000 ft, 1894, *M.E. Jones 5443* (HOLOTYPE: US!; ISOTYPES: MO! NY! RSA!).

Atriplex oblanceolata Rydb., Bull. Torrey Bot. Club 31:403. 1904. TYPE: COLORADO: Delta, 3 Sep 1897, *J.H. Cowen 4071* (HOLOTYPE: US!; ISOTYPE: GH!).

Populations of *A. cuneata* are restricted primarily to eastern Utah, western Colorado and northwestern New Mexico (Fig. 5). In many places they constitute the dominant vegetation on thousands of acres. The common name of *A. cuneata*, "Castle-Valley clover," connotes its value as a range plant, partly because it is both palatable and nutritious for livestock and wildlife and partly because, were it not there, there would apparently be nothing at all,

TABLE 3. Cytology, saponin production, flavonoid production, and geographic distribution of *Atriplex nuttallii* and its near relatives. The number of plants examined is in parenthesis.

Taxon	$2n$	Saponins	Flavonols		Geographic Distribution	Date of
	Chrom. #	s	6-MeO	3-MeO		Anthesis
A. nuttallii	54 (11)	+,- (11)	+	- (21)	valleys in n NV and nw UT	Jun–Jul
A. cuneata	36 (126)	- (69)	+	- (43)	e UT, w CO, nw NM	Apr–May
A. cuneata	18(87)	-(72)	-	+(62)	e UT, w CO, nw NM	Apr–May
A. falcata	18 (115)	+ (74)	-	+,- (66)	s ID, n UT, sw WY, n NV, s OR, nw CA	May–Jun
A. gardneri	18 (183)	+,- (32)	-	+ (31)	MT, WY, AB, SK	May–Jun
A. gardneri	36 (250)	+,- (63)	+	- (40)	MT, WY, AB, SK	May–Jun
A. tridentata	54 (257)	- (111)	+	- (105)	n UT, n NV, s WY, s ID, nw CO	Jul–Aug

TABLE 4. Key to *Atriplex nuttallii* and its near relatives [Series Nuttallianae of Standley (1916) consisting of species in which the plants are low-statured (less than 6 dm), suffrutescent, perennial, dioecious, shrubs. Leaves are densely furfuraceous, alternate, entire, with Kranz-type anatomy. Fruiting bracts are 2—6 mm long, 2—5 mm broad, usually longer than broad and usually appendaged.]

- 1. Leaves linear, length more than 5 times the width
  - 2. Root-sprouting extensive—*A. tridentata*
  - 2. Root-sprouting none or minimal
    - 3. Stems 50 or more from a woody crown, each 30—80 cm long—*A. nuttallii*
    - 3. Stems single or few, each less than 30 cm long—*A. falcata*
- 1. Leaves ovate to oblong, length less than 5 times the width
  - 2. Fruiting bracts globose, 3–5 mm long with numerous flattened appendages—*A. cuneata*
  - 2. Fruiting bracts elliptical to ovoid, 1–3 mm long with few appendages—*A. gardneri*

of forage value. This is conspicuous in many places where populations of *A. cuneata* terminate abruptly against clay slopes that are completely devoid of vegetation. It is also evident in sites where populations of *A. cuneata* have experienced large-scale "die-back" and remain empty until repopulated by new *A. cuneata* plants.

Atriplex cuneata is mostly tetraploid but throughout its range there are several morphologically distinct diploid populations (Fig. 5). The variation present in disjunct populations of tetraploid *A. cuneata* is probably the result of introgression from these diploids, or in some cases, tetraploid *A. cuneata* may have originated polyphyletically from different diploid ancestors.

Atriplex cuneata plants are mostly caespitose and erect with no evidence of root-sprouting or layering. Their fruiting-bracts are usually much larger than the fruiting bracts of *A. gardneri* (Table 2) and are covered with numerous lateral appendages (Table 2, Fig. 4). They are usually free of saponins, with exceptions only in populations in which introgressive hybridization from other species is suspected. Tetraploid *A. cuneata* plants test positively for the presence of 6-methoxy flavonols and negatively for the presence of 3-methoxy flavonals. In contrast, diploid *A. cuneata* plants test negatively for the presence of 6-methoxy flavonols and positively for the presence of 3-methoxy flavonols (Table 3).

Atriplex falcata (M.E. Jones) Standley, N. Amer. Fl. 21:68. 1916. TYPE: IDAHO. WASHINGTON CO.: Weiser, alt. 2,000 ft, 7 Jul 1899, *M.E. Jones s.n.* (HOLOTYPE: RSA!; ISOTYPE: UC!).

Populations of *A. falcata* are sporadically common in southern Oregon, northeastern California, northern Nevada, northern Utah, southwestern Wyoming and southern Idaho (Fig. 6). It is mostly diploid ($2n=18$), but occasional tetraploid populations occur (Pope 1976).

Phenotypically, *A. falcata* is most easily recognized by its small stature (ca. 13 cm tall × 25 cm broad), small, linear leaves (ca. 24 mm long × 4 mm wide), and small fruiting bracts (ca. 4.5 mm long × 2.5 mm wide),

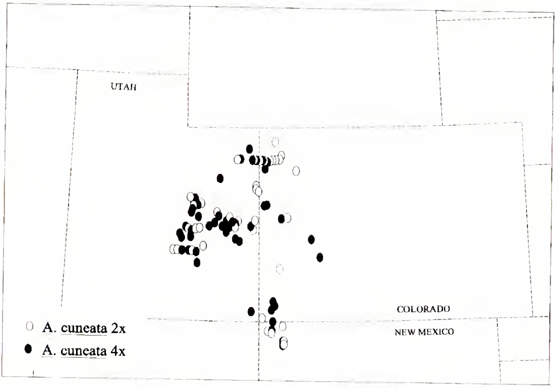

FIG. 5. Geographic distribution of chromosome counts of plants of diploid ($2n=18$) and tetraploid ($2n=36$) *Atriplex cuneata*.

usually without appendages, and terminating in a distinct, acute, central apex (Tables 1, 2, Fig. 4).

The leaves of *A. falcata* produce abundant saponins (Table 3), a trait that can be useful in field identification either by blowing bubbles in a water emulsion of leaves or by tasting a leaf as it is chewed. When saponins are present, bubbles form readily in a leaf-emulsion and the leaves have a distinctly bitter taste. Both of these tests are positive for *A. falcata* leaves, negative for leaves of *A. tridentata* plants with which *A. falcata* plants are sometimes confused. *A. falcata* plants are also readily distinguished from *A. tridentata* plants by their rooting habit: *A. tridentata* plants are vigorous root-sprouters, whereas *A. falcata* plants are caespitose with a single prominent taproot. Also, *A. falcata* plants produce flowers and fruits early in the spring (May–June) whereas *A. tridentata* plants flower and set fruit mostly in mid to late summer (July–August) (Table 3).

Atriplex gardneri (Moq.) Standley, N. Amer. Fl. 21:66. 1916. TYPE: [State?]. La Platte River [date?], *Gordon 250* (HOLOTYPE: GH!, fragments).

Obione gardneri Moq. in DC, Prod. 13:114. 1849.

Populations of *A. gardneri* (2x, 4x) dominate thousands of acres of clay slopes and swales throughout much of southern and eastern Wyoming, central and eastern Montana, western North and South Dakota, southern Alberta,

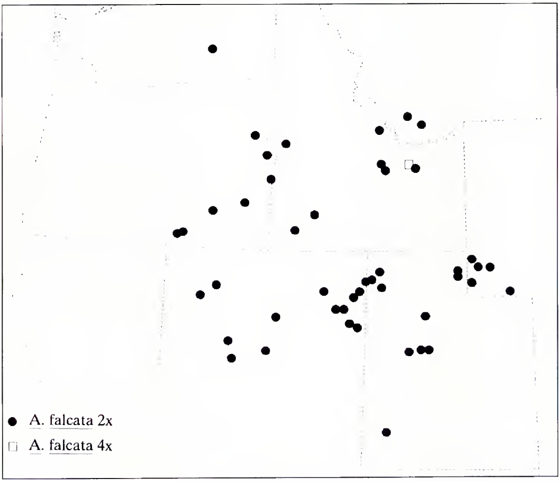

FIG. 6. Geographic distribution of chromosome counts of plants of diploid ($2n=18$) and tetraploid ($2n=36$) *Atriplex falcata*.

and southern Saskatchewan (Fig. 7). Most populations are tetraploid but diploid ones are common. In southern Alberta, southern Saskatchewan and north-central Montana, diploid plants can usually be distinguished from tetraploid plants by their smaller stature, smaller, thinner leaves, finer-textured, less woody stems and smaller fruiting bracts. However, throughout most of the saline deserts of Wyoming and southern Montana, diploid and tetraploid plants are phenotypically very similar although both show considerable phenotypic variation both within and between populations. Chromosome counts of plants in populations bordering Interstate Highway 80 in southern Wyoming, showed a preponderance of tetraploids west of the Continental Divide and a preponderance of diploids to the east (Fig. 9). However, no conspicuous ecological differences were evident between the sites occupied by tetraploids and diploids, nor was it possible to consistently distinguish diploids from tetraploids, phenotypically. This was true for plants in natural populations as well as garden-grown specimens. They are, however, clearly distinguishable by flavonoid differences: tetraploids

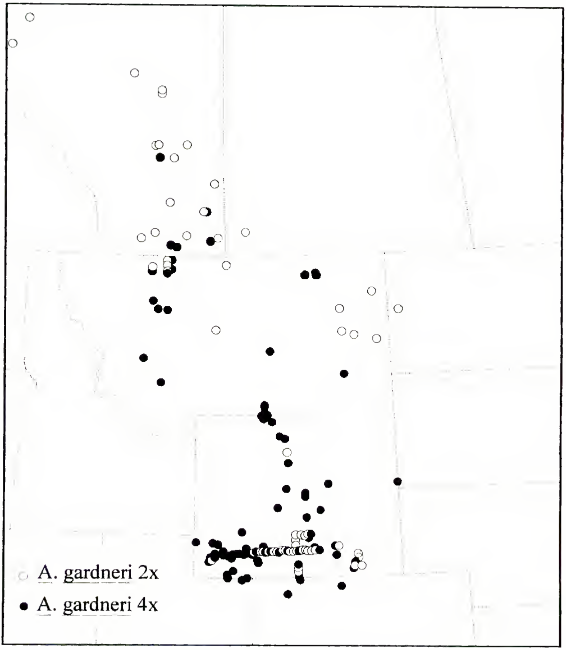

FIG. 7. Geographic distribution of chromosome counts of plants of diploid ($2n=18$) and tetraploid ($2n=36$) *Atriplex gardneri*.

always produce 6-methoxy flavonols, diploids do not; diploids produce 3-methoxy flavonols, tetraploids do not (Table 3). Although both diploids and tetraploids sporadically produce saponins (Table 3), diploids are most often heavy producers, tetraploids usually produce little or none.

Atriplex gardneri plants are short-statured, mostly 4–10 cm in height, (Table 1), but are often more than 80 cm in diameter. The plants are caespitose, arising from a single deep taproot but often show considerable layering. Their fruiting-bracts are usually smaller (ca. 3–4 mm) and have fewer lateral appendages than those of most near relatives (Table 2, Fig. 4).

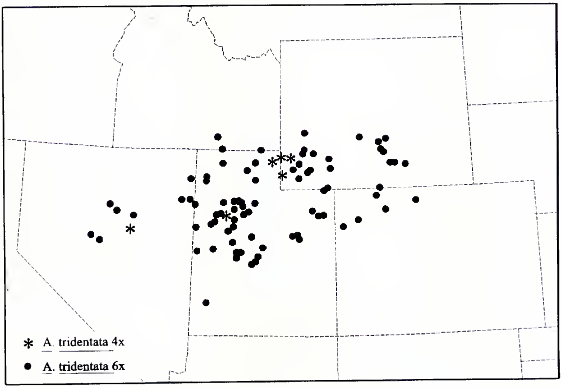

FIG. 8. Geographic distribution of chromosome counts of plants of terraploid ($2n=36$) and hexaploid ($2n=54$) *Atriplex tridentata*.

Atriplex tridentata Kuntze, Revis. Gen. Pl. 2:546. 1891. TYPE: UTAH: Corinne, 1874, *D.E.O. Kuntze 3084* (HOLOTYPE: NY!).

Two chromosome races of *Atriplex tridentata* have been found: tetraploid ($2n=36$) and hexaploid ($2n=54$). Hexaploids are, by far, the most common, occurring throughout much of western United States and in most of the valley bottoms in Utah and Nevada that were recently occupied by Pleistocene lakes (Fig.8). Only three major tetraploid populations are known: one in Juab County, Utah, one in Eureka County, Nevada, and one in Lincoln County, southwestern Wyoming (Fig. 8). Although tetraploid and hexaploid *A. tridentata* are to some extent, morphologically distinct, the differences do not appear to be sufficient to warrant designation as separate taxa.

Atriplex tridentata differs from other *Atriplex* species in several features, including linear to oblong, furfuraceous leaves, fruiting bracts with conspicuous terminal, marginal teeth (Fig. 4), late-flowering habit (July-August), and vigorous root-sprouting. *A. tridentata* plants are mostly herbaceous above ground with a few slender stems growing erect from woody underground crowns and roots.

The extent of root-sprouting in *A. tridentata* plants is often made conspicuous by its dioecious flowering habit. By noting its flowers, the extent of a single male or single female plant may be easily determined. In some cases individual plants have been found to occupy more than 200 m^2. Sometimes

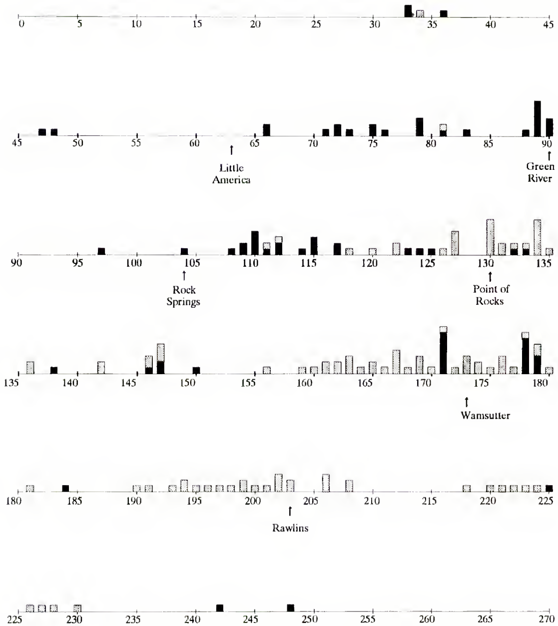

FIG. 9. Distribution of diploid and tetraploid populations of *Atriplex gardneri* alongside Interstate highway 80 in southern Wyoming from the Utah border (mile 0) to near Elk Mountain Wyoming. Chromosome counts were made on plants at each mile marker, when available. Stippled bars = diploids, black bars = tetraploids.

a single plant forms a complete carpet in which there are no other plants; at other times the root-sprouting carries a plant around and between plants of other species.

Possibly because of its low saponin content (Table 3), its root-sprouting habit and predominantly herbaceous tissues, *A. tridentata* is often regarded favorably by ranchers as forage for livestock (personal reports).

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The authors thank Dr. Richard W. Spellenberg and Dr. Ronald L. Hartman for numerous helpful suggestions, Broken Hill Proprietory Minerals and Brigham Young University for financial assistance and the curators of the following herbaria for loans of specimens and access to their collections: BRY, CAS, GH, MO, NY, PH, RM, RSA, UC and US.

REFERENCES

Bassett, I.J., C.W. Crompton, J. Mcneill, and P.M. Taschereau. 1983. The genus *Atriplex* (Chenopodiaceae) in Canada. Monograph No. 31. Communications Branch, Agriculture Canada, Ottawa.

Greuter, W., H.M. Burdet, W.G. Chaloner, V. Demonlin, R. Grolle, D.L. Hawksworth, D.H. Nicholson, P.C. Silva, F.A. Stafleu, E.G. Voss, and J. McNeil. 1988. International code of botanical nomenclature. Adopted by the fourteenth International Botanical Congress, Berlin, July-August 1987. Regnum Veg. 118.

__________, F.R. Barrie, H.M. Burdet, W.G. Chaloner, V. Demoulin, D.L. Hawksworth, P.M. Jorgensen, D.H. Nicolsen, P.C. Silva, P. Trehane, and J. McNeill. 1994. International code of botanical nomenclature (Tokyo Code). Adopted by the fifteenth International Botanical Congress, Yokohama, August-September 1993. Regnum Veg. 131.

Hall, H.M. and F.E. Clements. 1923. The phylogenetic method in taxonomy. Carnegie Institution of Washington Publication No. 326.

Hanson, C.A. 1962. Perennial *Atriplex* of Utah and the northern deserts. Thesis. Brigham Young University, Provo, Utah.

McNeil, J., I.J. Bassett, C.W. Crompton, and P.M. . 1983. Taxonomic and nomenclatural notes on *Atriplex* L. (Chenopodiaceae). Taxon 32: 549-556.

Nuttall, T. 1818. The genera of North American plants. Vol. 1. Philadelphia. D. Heartr.

Pope, C.L. 1976. A phylogenetic study of the suffrutescent shrubs in the genus *Atriplex*. Ph.D. Dissertation, Brigham Young University, Provo, UT.

Pursh, F.T. 1814. Florae Americae Septentrionalis. Vol. II. London. White, Cocchrane and Company.

Sanderson, S.C., and H.C. Stutz. 1984. Flavonoid aglycones of diploid and polyploid *Atriplex confertifolia*. In: A.R. Tiedemann, E.D. McArthur, H.C. Stutz, R. Stevens, and K.L. Johnson, K.L. (compilers). Proc. symposium on the biology of *Atriplex* and related chenopods. Provo, UT.

__________, R.L. Pendleton, E.D. Mcarthur, and K.T. Harper. 1987. Saponin effect on small mammal forage preference in a planting of *Atriplex canescens*. In: F.J. Provenza, J.T. Flinders and E.D. McArthur (compilers), Proc. Symposium on Plant-Herbivore Interactions. USDA Forest Service General Technical Report INT-222, 74–77. Ogden, UT.

Standley, P.C. 1916. Chenopodiales. North American Flora 21(1). New York. New York Botanical Garden.

Stutz, H.C. 1978. Explosive evolution of perennial *Atriplex* in western America. In: K.T. Harper and J.I. Reveal, organizers. Intermountain biogeography: A symposium. Great Basin Naturalist Mem.. 2:161–168.

__________, C.L. Pope, and S.C. Sanderson. 1979. Evolutionary studies of *Atriplex*: Adaptive products from the natural hybrid 6N *A. tridentata* _ 4N *A. canescens*. Amer. J. Bot. 66:1181–1193.

ULBRICH, E. 1934. Chenopodiaceae. In: A. Engler and K. Prantl, eds. Die Natürlichen Pflanzenfamilien. Ed. 2. 16C:379–584. Engelmann, Leipzig.

WATSON, S. 1871. Botany. In: C. King. Report of geological exploration of the fortieth parallel. Volume V. U.S. Government Printing Press, Washington, D.C.

__________. 1874. A revision of the North American Chenopodiaceae. Proc. Amer. Acad. Arts. 9:82–126.

WELSH, S.L. 1984. Utah flora: Chenopodiaceae. Great Basin Naturalist 44:183–209.

FLAVONOIDS IN *STROPHOSTYLES* SPECIES AND THE RELATED GENUS *DOLICHOPSIS* (PHASEOLINAE, FABACEAE): DISTRIBUTION AND PHYLOGENETIC SIGNIFICANCE

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ABSTRACT

Strophostyles Elliott is the only genus within the Phaseolinae with a center of distribution in the United States. It comprises three species, namely *S. helvula* (L.) Elliott, *S. umbellata* (Willd.) Britton, and *S. leiosperma* (Torrey & A. Gray) Piper, and it is considered as allied to *Dolichopsis* Hassler, a monotypic genus endemic to South America. This study analyses the leaf flavonoid content from the three *Strophostyles* species and *Dolichopsis paraguariensis* Hassler with the aim of examining the phylogenetic relationships among taxa. We isolated 38 glycosides based on kaempferol, quercetin and isorhamnetin. All *Strophostyles* species were characterized by the presence of isorhamnetin glycosides. However, *S. leiosperma* showed a distinctive profile while *S. helvula* and *S. umbellata* clustered together. In contrast, *D. paraguariensis* lacked isorhamnetin-based compounds. A cladistic analysis of flavonoid plus morphological data supported *Strophostyles* monophyly and showed *S. leiosperma* as the sister taxon of the clade *S. helvula*-*S. umbellata*.

RESUMEN

Strophostyles Elliott es el único género de las Phaseolinae con un centro de distribución en los Estados Unidos. Comprende tres especies: *S. helvula* (L.) Elliott, *S. umbellata* (Willd.) Britton y *S. leiosperma* (Torrey & A. Gray) Piper, y se considera afín a *Dolichopsis* Hassler, un género monotípico endémico de Sudamérica. Este estudio analiza el contenido de flavonoides foliares en las tres especies de *Strophostyles* y en *Dolichopsis paraguariensis* Hassler con el objeto de examinar las relaciones filogenéticas entre estos taxa. Se aislaron 38 glicósidos de kaempferol, quercetina e isoramnetina. Todas las especies de *Strophostyles* se caracterizaron por la presencia de glicósidos de isoramnetina. Sin embargo, *S. leiosperma* mostró un perfil distintivo mientras que *S. helvula* and *S. umbellata* se agruparon juntas. Por el contrario, *D. paraguariensis* no sintetizó compuestos basados en la isoramnetina. Un análisis cladístico conjunto de los datos de flavonoides y caracteres morfológicos apoyó la monofilia del género y mostró a *S. leiosperma* como el taxón hermano del clado *S. helvula*-*S. umbellata*.

INTRODUCTION

Strophostyles Elliott is the only genus within the Phaseolinae with a center of distribution in the United States. Its current taxonomic treatment follows the original generic concept (Elliott 1822), but it was previously

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associated with unrelated species and reduced to a section of *Phaseolus* (de Candolle 1825; Bentham 1837, 1865) until it was restored as a separate genus including three species (Britton & Brown 1897; Piper 1926). A set of characters precludes merging *Strophostyles* with *Phaseolus*, namely erect style (not coiled), lack of hooked hairs, pedicels shorter than the calyx, and nodes of the inflorescence somewhat swollen (Maréchal et al. 1978). Moreover, *Strophostyles* plants can be recognized by their nearly asymmetric flowers arranged in subumbellate inflorescences, bracts and bracteoles persisting through seed maturation, cylindrical seeds (often pubescent), and linear pods.

Strophostyles has also been considered as allied to *Dolichopsis* Hassler (Maréchal et al. 1978; Lackey 1983). Nevertheless, both genera are easily distinguishable by many characters and their quite distinct geographical distributions. The monotypic genus *Dolichopsis*[1] resembles *Strophostyles* mainly in floral morphology (purplish corolla, keel with a not curved to somewhat curved beak, style slightly thickened distally, and stigma terminal oblique) and general appearance, but it is unlike the latter in having symmetric flowers clustered in elongate pseudoracemes and the unique fruit traits such as oblong, very flat pods with oblong seeds implanted through a very long funicle and with the hilum perpendicular to the placenta. The geographic range of *Dolichopsis* is Paraguay and Argentina, in South America, while *Strophostyles* occurs throughout eastern USA, eastern Canada up to south of Quebec and extreme northeastern Mexico.

Phytochemical data on *Strophostyles* species are scanty and include the absence of both leuco-anthocyanins (Baudet 1978) and canavanine (Lackey 1977), and a recent report of flavonoids (Williams et al. 1995). In this study, we expanded on the survey of foliar flavonoids by considering a larger number of samples of the three *Strophostyles* species, i.e. *S. helvula*, *S. umbellata* and *S. leiosperma*, and we added *Dolichopsis paraguariensis* for comparison.

MATERIALS AND METHODS

We analyzed the constitutive flavonoids present in the leaves of herbarium specimens belonging to the three *Strophostyles* species and *Dolichopsis paraguariensis*. Samples (100–200 mg) were powdered and extracted under reflux with 80% methanol (x 3). Concentrated methanolic extracts were two-dimensionally chromatographed on paper (BAW/ 15% acetic acid). Compounds were identified by standard methods (Mabry et al. 1970; Markham 1982). These included complete and controlled (3 min.) acid hydrolysis, enzymatic hydrolysis (ß-glucosidase), co-chromatography with authentic markers and UV-Vis spec-

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[1] *Dolichopsis* was a genus with two species, *D. paraguariensis* and *D. monticola* (Lackey 1983, Lewis 1991), but recently Delgado Salinas & Lewis (1997) created the new genus *Oryxis* where they placed *D. monticola*. Therefore, *D. paraguariensis* has became the unique representative of the genus.

troscopy. Glucosides were separated from their galactosidic analogues by TLC in the appropriate system according to Budzianowski (1991).

Plant material.—Specimens were provided by the Instituto de Botánica Darwinion Herbarium (SI), San Isidro, and the Centro de Estudios Farmacológicos y Botánicos Herbarium (BACP), Buenos Aires.

Strophostyles helvula (L.) Elliott

U.S.A. **Arkansas. Jefferson Co.:** Arkansas river bottoms, 220 ft, 17 Sep 1937, *Demaree 16245* (SI). **Illinois. Mc Donough Co.:** Argykle Lake, near Colchester, 2 Aug 1958, *Jones 22335* (SI). **Iowa. Dickinson Co.:** N shore of Spirit Lake, sand (older beach), 5 Aug 1913, *Sinek 14...* (number illegible) (SI). **Mississippi. Harrison Co.:** near the coast on sand, 6 Jan 1951, *Demaree 30675* (SI); Ship Island, P.O. Biloxi, in stabilized sand, moist, long trailing, *Demaree 31059* (SI). **Virginia. Prince George Co.:** rich alluvial thicket back of sand-beach of James River, Jordan Point, SE Virginia, 16 Sep 1938, *Fernald & Long 9353* (SI). *Unknown locality*:[Flora of the Western Reserve] 15 Aug 1897, *G.B. Aschcroft, Berea O. s.n.* (SI).

Strophostyles leiosperma (Torrey & A. Gray) Piper

U.S.A. **Oklahoma:** 5 mi NW of Breckenridge, 25 Jul 1941, *Gephardt 747* (SI). **Woods Co.:** in waste place, hard soil, near Alva, 24 Sep 1913, *Stevens 2824* (SI). **Texas. Smith Co.:** Amigo, neglected sandy field, 10–17 Aug 1945, *Moore, Jr. 995* (SI). **Morris Co.:** Aug 1891, *Carleton 420* (SI).

Strophostyles umbellata (Willd.) Britton

U.S.A. **Virginia. Greensville Co.:** dry pine and oak woods, about 1 mi N of Skipper's, 14–15 Jul 1938, *Fernald & Long 8737* (SI).

Dolichopsis paraguariensis Hassler

ARGENTINA. **Entre Ríos:** Depto. La Paz, R 126, desvío a Ombúes, borde camino, 31 Jan 1981, fl. azul-violáceo, *Troncoso de Burkart & Bacigalupo 3096* (SI). PARAGUAY. **Depto. Pte. Hayes:** Estancia Loma Pyta, 23° 40'S, 59° 35'W, 2 Apr 1974, enredadera casi rastrera, fl. violáceas, crece en pastizal, n.v. 'kekleichetas,' *Arenas 544* (BACP). **Depto. Boquerón:** Misión Santa Rosa, 21° 45'S, 61° 35'W, Feb 1981, enredadera, fl. violáceas, crece en pajonal, n.v. 'ceihlowéy', *Arenas 1726* (BACP).

Data analysis.—A cluster analysis was performed on flavonoid data of 15 herbarium specimens. Similarity matrix was measured using Jaccard's coefficient and a dendrogram was constructed applying the unweigthed pair-group method of arithmetic averages (UPGMA). All calculations were done using NT-SYS program (Rohlf 1993).

A cladistic analysis of the flavonoid data plus a set of morphological characters was carried out according to the maximum parsimony principle. Outgroup criterion was used for character polarization. *Vigna adenantha* was chosen as the external group which flavonoid data were obtained following the methods above mentioned (Pelotto, unpublished manuscript). For flavonoids, character states that occurred in the outgroup were scored as 0 and those in the ingroup (*D. paraguariensis* and the three *Strophostyles* species) were scored as 1 (see Appendix, Tables A and B). Morphological data were gathered from the literature and included some multistate characters that were treated as non-additive (see Appendix, Tables A and C). Cladograms were calculated using the implicit enumeration routine (i.e.*) of the program Hennig86 (Farris 1988) with all characters equally weighted.

RESULTS AND DISCUSSION

Chromatographic properties of the identified flavonoid glycosides and its distribution in *Strophostyles* species and *D. paraguariensis* are shown in Tables 1 and 2, respectively. All detected compounds were O-glycosides of flavonols with sugars attached at positions 3 and 7 of the aglicone skeleton. This pattern of glycosilation is very common among the Phaseolinae (Zallocchi & Pomilio 1994; Williams et al. 1995, Pelotto unpublished manuscript).

All three *Strophostyles* species produced glycosides based on the methylated flavonol isorhamnetin plus kaempferol and quercetin. Notwithstanding *S. helvula* and *S. umbellata* showed very similar chromatographic patterns, while the flavonoid profile of *S. leiosperma* was quite distinctive. No rhamnosides were detected in *S. leiosperma* and it only shared the presence of monoglycosides with the other two species. Based on a three-sample analysis within a flavonoid survey of the Phaseolinae, Williams et. al (1995) have also reported the occurrence of isorhamnetin glycosides in *Strophostyles* species and noticed the same interspecific differences. In contrast with our results, Williams and co-workers isolated fewer compounds and did not detect kaempferol glycosides from leaves, although they did from stems and/or flowers.

In turn, *Dolichopsis paraguariensis* samples were characterized by the presence of kaempferol and quercetin glycosides, lacking isorhamnetin. Noticeably, Paraguayan samples contained only kaempferol glycosides while Argentinean one had kaempferol plus quercetin glycosides. However, in a previous work (Zallocchi et al. 1995) both kaempferol and quercetin glycosides were reported from one sample of *D. paraguariensis* from Paraguay, but of the eight flavonol glycosides the authors identified only rutin and kaempferol-3-O-rutinoside were also present in our samples. These differences may be due to the fact that Zallocchi and co-workers analyzed a whole plant extract and therefore their results are difficult to compare with ours.

After the cluster analysis *S. helvula* and *S. umbellata* are closer to *D. paraguariensis* than to *S. leiosperma* (Fig. 1). This is because *S. helvula* and *S. umbellata* have more glycosides (based on kaempferol and quercetin) in common with *D. paraguariensis* than with *S. leiosperma*, even though *D. paraguariensis* does not produce isorhamnetin glycosides.

Cladistic analysis resulted in two most parsimonious trees (length, L = 35, consistency index, CI =91, retention index, RI =70. Fig. 2). Both cladograms support *Strophostyles* monophyly but differ in the depicted relationships among *Strophostyles* species. One tree (Fig. 2.A) shows *S. helvula* and *S. leiosperma* as being sibling species, but this hypothesis needs the parallel gain of the characters 19, 22 and 31 on the *S. umbellata* and *S. helvula* branches. The other tree (Fig. 2.B) supports the clade *S. umbellata-S. helvula*

Table 1. Chromatographic characteristics of the identified compounds.

SPOT	IDENTITY	COLOUR[†]		Rf (× 100)	
		UV	+ NH3	BAW	15% aa
1	K-3-O-glucoside + K-3-O-galactoside	DP	Y	69	45
2	K-7-O-glucoside + K-7-O-galactoside	Y	Y	45	15
3	K-3-O-rutinoside + K-3-O-robinobioside	DP	Y	52	54
4	K-3-O-diglucoside + K-3-O-digalactoside	DP	Y	33.5	61.5
5	K-3,7-O-diglucoside	DP	Y	29	70
6	K-3-O-rutinoside-7-O-glucoside + K-3-O-robinobioside-7-O-glucoside	DP	Y	24	75
7	K-3,7-O-triglucoside	DP	Y	3	82
8	K-3,7-O-triglycoside (glu + rha + gal)[‡]	DP	Y	4	80
9	Q-3-O-glucoside + Q-3-O-galactoside	DP	Y	56	39
10	Q-7-O-glucoside + Q-7-O-galactoside	Y	YO	27	9
11	Q-3-O-rutinoside + Q-3-O-robinobioside	DP	Y	40	51
12	Q-3-O-diglucoside + Q-3-O-digalactoside	DP	Y	26	52
13	Q-3,7-O-diglucoside	DP	Y	23	63
14	Q-3-O-rutinoside-7-O-glucoside + Q-3-O-robinobioside-7-O-glucoside	DP	Y	15	70
15	Q-3,7-O-triglucoside	DP	Y	3	78
16	Q-3,7-O-triglycoside (glu + rha + gal)	DP	Yo	5	79
17	IR-3-O-glucoside + IR-3-O-galactoside	DP	Y	56	42
18	IR-7-O-glucoside + IR-7-O-galactoside	Y	Y	38	10
19	IR-3-O-rutinoside + IR-3-O-robinobioside	DP	Y	40	54
20	IR-3-O-diglucoside + IR-3-O-digalactoside	DP	Y	29	58
21	IR-3,7-O-diglucoside	DP	Y	25	68
22	IR-3-O-rutinoside-7-O-glucoside + IR-3-O-robinobioside-7-O-glucoside	DP	Y	19	74
23	IR-3,7-O-triglucoside	DP	Y	3	80

[†] DP: deep purple, Y: yellow, YO: yellow-orange

[‡] glu: glucose, rha: rhamnose, gal: galactose

and requires three reversions (characters 1, 9 and 17). This scenario is preferable to that portrayed on Fig. 2.A since a mutation lost is a more probable event than the homoplastic acquisition of isorhamnetin glycosides. Even more, if we suppose reversal of characters 1, 9 and 17 on the *S. umbellata* branch as being a consequence of sampling error (undersampling), the cladogram becomes shorter with only 32 steps (CI= 100, RI= 100) and the unique solution of a similar analysis. Thus, we consider the tree depicted on Figure 2.B a more plausible ingroup phylogeny.

Flavonoid evolution shows methylation of the flavonol skeleton as an advanced character shared by all *Strophostyles* species and the absence of rhamnosides in *S. leiosperma* as an (aut)apomorphic loss.

Morphological traits are congruent with flavonoid data. Subumbellate inflorescence (character 24), persistent bracts and bracteoles (character 26), linear, terete pods (character 27) and seed pubescence (character 28) support *Strophostyles* monophyly, and are correlated with isorhamnetin monoglycoside production (characters 17 and 18). *Strophostyles helvula* strongly resembles

TABLE 2. Glycoside distribution in the analyzed samples. Compounds are numbered according to Table 1. K: kaempferol glycosides; Q: quercetin glycosides; IR: isorhamnetin glycosides; +: present; -: absent.

	K								Q								IR						
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
S. helvula																							
Jones 22335	-	+	+	-	-	+	-	-	-	+	+	-	-	+	-	-	-	+	+	-	-	+	-
Simek 14...	+	+	+	-	-	+	-	-	+	+	+	-	-	+	-	+	+	+	+	-	-	+	-
Aschroft & Berea s.n.	+	+	+	-	-	+	-	-	+	+	+	-	-	+	-	+	+	+	+	-	-	+	-
Demaree 30675	+	+	+	-	-	+	-	-	+	+	+	-	-	+	-	+	+	+	+	-	-	+	-
Demaree 16245	-	+	-	-	-	+	-	-	-	+	-	-	-	+	-	+	-	+	-	-	-	+	-
Demaree 31059	+	+	+	-	-	+	-	-	+	+	+	-	-	+	-	+	+	+	+	-	-	+	-
Fernald & Long 9353	-	+	+	-	-	+	-	-	-	+	+	-	-	+	-	+	-	+	+	-	-	+	-
S. umbellata																							
Fernald & Long 8737	-	+	+	-	-	+	-	-	-	+	+	-	-	+	-	+	-	+	+	-	-	+	-
S. leiosperma																							
Moore Jr. 995	+	+	-	-	+	-	-	-	+	+	-	-	+	-	-	-	+	+	-	-	+	-	-
Carleton 420	+	-	-	+	+	-	+	-	+	-	-	+	+	-	+	-	+	-	-	+	+	-	+
Gephardt 747	+	-	-	+	+	-	+	-	+	-	-	+	+	-	+	-	+	-	-	+	+	-	+
Stevens 2824	+	-	-	+	+	-	+	-	+	-	-	+	+	-	+	-	+	-	-	+	+	-	+
D. paraguariensis																							
Arenas 1726	-	+	+	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Arenas 544	-	+	+	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Troncoso & Bacigalupo 3096	-	+	+	-	-	+	-	+	-	+	+	-	-	+	-	+	-	-	-	-	-	-	-

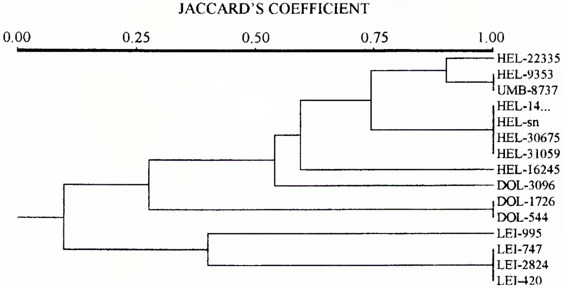

FIG. 1. Dendrogram of the *Strophostyles* and *Dolichopsis* specimens constructed from a similarity matrix (Jaccard's coefficient) using the UPGMA method. Cophenetic correlation coefficient, r = 0.969

S. umbellata, except for its more lobed leaflets and larger pods and seeds. *Strophostyles leiosperma* is rather different from the other two species because of the smaller flowers (character 25) arranged in more pauciflorous inflorescences and its seeds glabrous and shining at maturity (character 29).

Similarly, both *S. helvula* and *S. umbellata* are more widespread and northerly distributed, with the first species reaching Canada, while *S. leiosperma* has a more limited distribution ranging from south of the United States to the extreme northeastern of Mexico (Britton & Brown 1897, Maréchal et al. 1978). Species divergence at chemical and morphological level also correlates with their ecological features; *S. helvula* and *S. umbellata* mostly grow in more mesic sites, while *S. leiosperma* is adapted to live into more xeric habitats.

Regarding the evolution of the growth form, overlapping this character onto our preferred topology suggests that annual growth would have evolved independently in both *S. leiosperma* and *S. helvula*, whereas perennation would be the plesiomorphic state shared by *D. paraguariensis* and *S. umbellata*.

In summary, universal occurrence of isorhamnetin-based compounds in *Strophostyles* species is a good chemical character in defining generic monophyly while individual glycosides are useful characters to trace species evolution. Within the Phaseolinae isorhamnetin glycosides have sporadically been recorded in four *Phaseolus* species (Pelotto, unpublished manuscript) and some *Vigna* and *Macroptilium* species (Zallocchi & Pomilio 1994; Williams et al. 1995). This fact suggests that flavonol methylation has appeared several times in the tribe, making it a valuable phylogenetic marker at the infrageneric level.

Beyond this contribution, flavonoid data from the related genera *Oxyrhynchus* and *Oryxis* are wanting for a complete view of this little group of American species around *Vigna*.

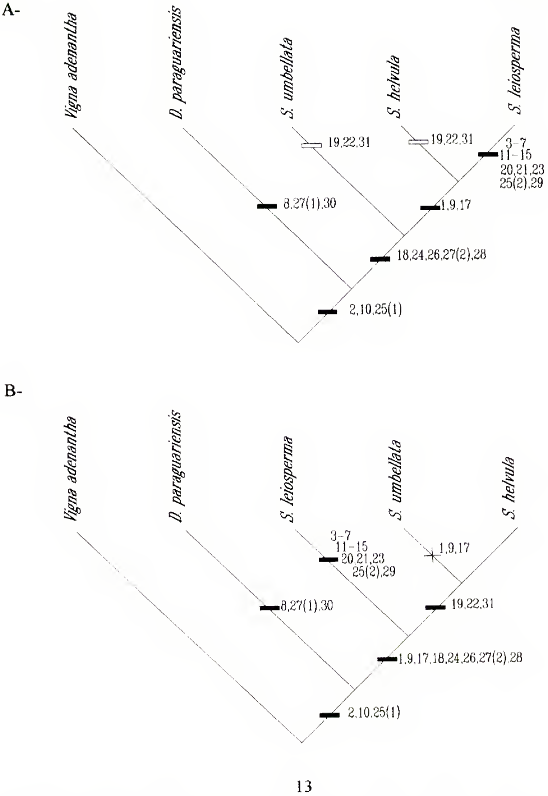

FIG. 2. The two most parsimonious trees (L = 35) generared using the data matrix (see Appendix, Table A) and *Vigna adenantha* as outgroup. Characters are mapped on the trees as follows: solid bar = non-homoplasious apomorphy, clear bar = homoplasious apomorphy, and cross = reversal. Numbers on the right of the character symbols stand for character numbers (and character state).

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We thank the curators of the Instituto de Botánica Darwinion Herbarium (SI) and the Centro de Estudios Farmacológicos y Botánicos Herbarium (BACP) for providing the plant material, and CONICET for financial support. We are also grateful to two anonymous reviewers for suggestions that improved the earlier manuscript.

APPENDIXES

Table A. Data matrix for the cladistic analysis including both flavonoid (characters 1–15, 17–23, codified according to Table B) and morphological (characters 24–31, codified according to Table C) data sets and using *Vigna adenantha* as outgroup.

	character number																													
Taxon	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Vigna adenantha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	?	0	0
D. paraguariensis	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	?	1	0
S. helvula	1	1	0	0	0	0	0	0	1	1	0	0	0	0	0	1	1	1	0	0	1	0	1	1	1	2	1	0	0	1
S. umbellata	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	0	0	1	0	1	1	1	2	1	0	0	1
S. leiosperma	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	0	1	1	0	1	1	2	1	2	1	1	0	0

Table B. Flavonoids. Character numbers are as in Table 1. Character 16 was not included because no hypothesis about homology can be made on a partially identified compound.

Character states

1. 0= absent, 1= present
2. 0= absent, 1= present
3. 0= present, 1= absent
4. 0= absent, 1= present
5. 0= absent, 1= present
6. 0= present, 1= absent
7. 0= absent, 1= present
8. 0= absent, 1= present
9. 0= absent, 1= present
10. 0= absent, 1= present
11. 0= present, 1= absent
12. 0= absent, 1= present
13. 0= absent, 1= present
14. 0= present, 1= absent
15. 0= absent, 1= present
17. 0= absent, 1= present
18. 0= absent, 1= present
19. 0= absent, 1= present
20. 0= absent, 1= present
21. 0= absent, 1= present
22. 0= absent, 1= present
23. 0= absent, 1= present

Table C. Morphological characters, states and polarities.

character	states
24. inflorescence	0= pseudoracemose; 1= subumbellate
25. flower size	0= great (> 20 mm); 1= medium (7-15 mm); 2= small (< 7 mm)
26. bract and bracteole	0= persisting no longer anthesis; 1= persisting through seed maturation
27. pods	0= linear, compressed; 1= oblong, very flat, with false cellulosic septa; 2= linear, cylindrical
28. seed coat	0= smooth; 1= pubescent
29. seed pubescence	?= inapplicable; 0= persisting in mature seeds; 1= absent from mature seeds
30. hilum	0= parallel to the placenta; 1= perpendicular to the placenta
31. leaflets	0= entire; 1= lobed to somewhat lobed at base

REFERENCES

BAUDET, J.C. 1978. Prodrome d'une classification générique des Papilionaceae—Phaseoleae. Bull. Jard. Bot. Belg. 48:183–220.

BENTHAM, G. 1837. Commentationes de leguminosarum generibus. J.P Sollinger, Vienna.

Bentham, G. 1865. Leguminosae. In: Bentham, G & Hooker, J.D. Genera Plantarum 1:434–600.

BRITTON, N.L. and A. BROWN. 1897. An illustrated flora of the northern United States, Canada and the British Possessions. Vol. II. Charles Scribner's Sons. New York.

BUDZIANOWSKI, J. 1991. Separation of flavonoid glucosides from their galactosidic analogues by thin-layer chromatography. J. Chromatography 540:469–474.

DE CANDOLLE, A.P. 1825. Prodomus systematics naturalis regni vegetabilis Vol. 2. Paris, Strasboutg, London.

DELGADO SALINAS, A. and G.P. LEWIS. 1997. *Oryxis*, a new genus in tribe Phaseoleae (Leguminosae: Papilionoideae) from Brazil. Kew Bull. 52:221–225.

ELLIOTT, S. 1822. A sketch of the botany of South Carolina and Georgia. 2:229.

FARRIS, J.S. 1988. Hennig86 version 1.5. Program and software documentation. Published by the author, Port Jefferson Station, New York.

LACKEY, J.A. 1977. A revised classification of the tribe Phaseoleae (Leguminosae-Papilionoideae) and its relation to canavanine distribution. J. Linn. Soc., Bot. 74:163–178.

LACKEY, J.A. 1983. A review of generic concepts in American Phaseolinae (Fabaceae, Faboideae). Iselya 2:21–64.

LEWIS, G.P. 1991. A new combination in *Dolichopsis* (Leguminosae: Papilionoideae). Kew Bull. 46:354.

MABRY, T.J., K.R. MARKHAM, and M.B. THOMAS. 1970. The systematic identification of flavonoids. Springer Verlag, New York.

MARÉCHAL, R., J.M. MASCHERPA, and F. STAINIER. 1978. Etude taxonomique d'un groupe complexe d'espèces des genres *Phaseolus* et *Vigna* (Papilionaceae) sur la base de données morphologiques et polliniques, traiteés par l'analyse informatique. Boissiera 28:1–273.

MARKHAM, K.R. 1982. Techniques of flavonoid identification. Biological Techniques Series. Academic Press. London.

PIPER, C. V. 1926. Studies in American Phaseolineae. Contr. U.S. Natl. Herb. 22:663–701.

ROHLF, F.J. 1993. NTSYS-pc. Numerical taxonomy and multivariate analysis system, version 1.8. Exeter Software, Setauket, N.Y.

WILLIAMS, C.A., J.C. ONYILAGHA, and J.B. HARBORNE. 1995. Flavonoid profiles in leaves, flowers and stems of forty-nine members of the Phaseolinae. Biochem. Syst. Ecol. 23:655–667.

ZALLOCCHI, E.M. and A.B. POMILIO. 1994. Evolution of flavonoids in the Phaseolinae. Phytochemistry 37:449–453.

ZALLOCCHI, E.M., A.B. POMILIO, and R.A. PALACIOS. 1995. Estudio quimiotaxonómico de la subtribu Phaseolinae (Phaseoleae-Papilionoideae-Leguminosae)—III: Flavonoides de las especies argentinas de los géneros *Phaseolus* y *Dolichopsis*. Darwiniana 33:135–148.

RUELLIA JIMULCENSIS (ACANTHACEAE), A NEW SPECIES FROM THE CHIHUAHUAN DESERT AREA, MEXICO

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ABSTRACT

Ruellia jimulcensis Villarreal sp. nov., from the Jimulco mountains area (southwestern Coahuila and northeast Durango), is described and illustrated. It is similar to *R. occidentalis* (Gray) Tharp and Barkley, and recognized by its relatively smaller flowers, shorter corolla basal tube and its distribution.

RESUMEN

Ruellia jimulcensis Villarreal sp. nov. del área de las montañas de Jimulco (suroeste de Coahuila y noreste de Durango), es descrita e ilustrada. Es similar a *R. occidentalis* (Gray) Tharp y Barkley, y se reconoce por sus flores más pequeñas, tubo basal de la corola más corto y su distribución.

KEY WORDS: Acanthaceae, *Ruellia*, Coahuila, Flora of México.

Ruellia, a tropical and subtropical genus of about 200 species is represented in the Chihuahuan Desert Region by six species (Henrickson & Johnston, in press). A new species is proposed as part of the study of the Flora of Coahuila.

Ruellia jimulcensis Villarreal, sp. nov. (Fig. 1). TYPE: MEXICO. COAHUILA: Mpio. Torreón, Sierra de Jimulco, mina San José, vereda hacia la cima, 103° 13' W, 25° 08'N. Matorral con *Bonetiella anomala*, *Agave lechuguilla*, *Acacia berlandieri*, *Flourensia*, *Hechtia*, *Spiraea* y *Aralia*, 1800–1850 m, 10 Ago 1994, *J.A. Villarreal Q. 7781 y M.A. Carranza*. (HOLOTYPE: MEXU; ISOTYPES: ANSM, ENCB, TEX).

Ruellia occidentalis (Gray) Tharp & Barkley similis sed differt flores plus brevis, corolla tubis plus brevis, calyx lobis longius quam corolla tubis; flores cleistogamous absens et differt distributio.

Perennial herb from clustered fibrous roots; stems erect to ascending 30–50 cm tall, densely glandular pubescent with straight hairs about 1 mm long; the internodes 4–10 cm long; leaves with petioles 6–30 mm long, blades broadly ovate to obovate, 3–10 cm long, 2–8 cm broad, the base obtuse to rounded, briefly decurrent along the petiole, apex obtuse to acute, the margin entire to undulate-crisped, both surfaces viscid with abundant glandular hairs, the dried leaves usually green-yellowish; flowers in dichasia and terminal thyrsoid panicles 5–20 cm long, to 10 cm broad, strongly

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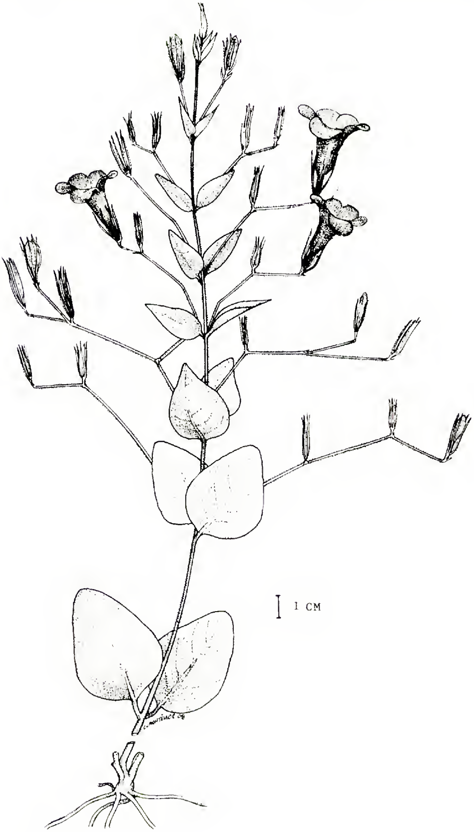

Fig. 1. *Ruellia jimulcensis*, a complete plant.

glandular-pubescent; peduncles ascending; calyx lobes 15–25 mm long, linear attenuate, united at the very base, 1.0–1.2 mm broad at the base, unequal, strongly glandular pubescent; corolla funnelform, bluish-purple 30–40 mm long, the basal tube 8–12 mm long, the broadly campanulate throat 15–20 mm long, the lobes 8–14 mm long, almost as broad, erose; cleistogamous flowers absent; stamens didymanous, borne at the distal portion of the corolla tube, free filaments 4–10 mm long; anthers 3–4 mm long; style 15–20 mm long; fruit ellipsoid 12–20 mm long, 3–4 mm broad, glandular pubescent; seeds 10–12, circular to oblate, 2.0–3.0 mm long, narrowly winged to the apex, brownish, covered with dense apressed trichomes.

Additional specimens examined: **MEXICO. Coahuila:** Mpio. de Torreón, Sierra de Jimulco, proximidades al ejido Trinidad, 25° 08' N, 103° 22' W, Matorral de *Agave lechuguilla*, *Bouteloua ramosa*, *Caesalpinia sessiliflora*, *Jatropha* y *Yucca*, ladera rocosa, 1900–2000 m, 25 Ago 1983, *J.A. Villarreal 4387, M.A. Carranza y A. Rodríguez* (ANSM); Sierra de Jimulco, mina San José, 25° 08' N, 103° 13' W, Matorral desértico, 1800–1850 m, 11 Oct 1993, *M.A. Carranza 1951 y J. Noriega* (ANSM); ca. 54 air km SSE of Torreon in canyon above Estacion Otto in SW side of Sierra de Jimulco near Mina San Jose, in limestone area with *Acacia*, *Celtis*, *Viguiera*, *Parthenium*, *Jatropha*, *Trixis*, *Fouquieria*, *Yucca*, 25° 04' N, 103° 13' W, 1850 m, 12 Sep 1980, *J. Henrickson & P. Bekey 18504* (TEX). **Durango:** Mpio. de Cuencamé, Sierra El Rosario, camino a la estación de microondas Sapioris, carr. 49, 30 km al SE de Lerdo, 25° 24'N, 103° 43' W, Matorral de *Acacia crassifolia*, *Viguiera stenoloba*, *Bursera schlendentali*, *Opuntia imbricata* y *Fouquieria splendens*, 1750–1800 m, 16 Ago 1991, *J.A. Villarreal 6243 y M.A. Carranza* (ANSM); Estacion de microondas Sapioris, ca. 30 km SW of Gomez Palacio on Hwy to Durango 25° 24'30" N, 103° 43' W, matorral desertico microfilo, 1400–1500 m, 25 Mar 1973, *M.C. Johnston, T.L. Wendt & F. Chiang 10409* (TEX); just SSE of Estacon Microondas Sapioris, abour 20 km NW of Estacion Chocolate, 25° 25' N, 103° 43' W, 1450–1500 m, 14 Aug 1973, *M.C. Johnston. T.L. Wendt. F. Chiang & J. Henrickson 12210* (TEX); Microondas Sapioris, along cobblestone road which departs from Hwy 40 N of Estacion Chocolate, ca 15 air mi (25 km) W-SW of Torreon, 25° 25' N, 103° 42' W, *Tecoma stans*, *Agave lechuguilla*, *Euphorbia antisyphilitica* and diverse cacti, 1300 m, 30 Jul 1991, *M. Mayfield, A. Hempel & A. Jack 1093* (TEX); Mexico Hwy 40, 25 mi SW of Lerdo, 6 nov 1964, *D. Flyr 251* (TEX); Mpio. de Lerdo, 4 mi sourhwest of Chocolate, route 31, growing beneth *Prosopis* on clay flat in valley, 23 Jul 1958, *D.S. Correll & I.M. Johnston 20008* (TEX); ca. 4 mi SW of Ciudad Lerdo along Hwy 40 to Zacatecas, on limestone hillside with *Larrea*, *Jatropha*, *Acacia*, *Opuntia*, *Agave* etc., 25° 31' N, 103° 32' W, 1200 m, 21 Sep 1978, *J. Henrickson & E. Lee 17474* (TEX).

Ruellia jimulcensis is found on sandy hillsides and dry canyons at elevations of 1200–2000 m, in xeric shrublands at the complex of mountains near Sierra de Jimulco and Sierra del Rosario.

The new species has leaf blades broadly ovate, obtuse to rounded at the base as *R. occidentalis* and often with strongly stipitate glandular trichomes covering the stems and inflorescence. It differs in its flowers 3–4 cm long, the basal tube of the corolla 8–12 mm long, the calyx lobes longer than the basal tube, the cleistogamous flowers unknown and its distribution, as marked in the key below. Tharp and Barkley (1949) gave the name *R. occidentalis* var. *ferrisae* to a specimen from the mountains near Monterrey, Nuevo León which is recognized by Henrickson and Johnston (in press) by this name for the specimens described here. The type specimen from the Monterrey area has oblong-obovate leaf blades, lacks stipitate glands on stem and leaves and flower dimensions that better fit with *R. nudiflora*, a common species in Monterrey area. The populations of the proposed species grow allopatrically in an isolated area at the southwestern corner of the Chihuahuan Desert Region while most of the related species are distributed in the eastern Sierra Madre Oriental (Turner 1991).

The three species of *Ruellia* previously mentioned can be separated by the following key:

1. Leaf blades ovate to elliptic-obovate, mostly less than 3 cm wide, sparsely to moderately pubescent; lower internodes puberulent to glabrate .... **R. nudiflora**
1. Leaf blades broadly ovate to subdeltoid, 4–7(–9) cm wide, usually densely pubescent; lower internodes with abundant stipitate glands 2
    2. Flowers (chasmogamous) 4.5–5.5(–6.5) cm long; basal tube of the corolla 2.5–3.5 cm long, longer than the calyx lobes; cleistogamous flowers (smaller than the chasmogamous) frecuently located in the lower nodes; se Texas, ne Mexico (e Coah, ne N.L., Tamps, ne Ver.) .... **R. occidentalis**
    2. Flowers 3.5–4.0 cm long; basal tube of the corolla 8–12 mm long, shorter than the calyx lobes; cleistogamous flowers absent; sw Coahuila and ne Durango .... **R. jimulcensis**

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REFERENCES

HENRICKSON, J. and M.C. JOHNSTON. (in press). A flora of the Chihuahuan Desert region. (*Ruellia*). Los Angeles, California. 2:1151–1155.

THARP, B.C. and F. BARKLEY. 1949. Genus *Ruellia* in Texas. Amer. Midland Nat. 42:1–86.

TURNER, B.L. 1991. Texas species of *Ruellia* (Acanthaceae). Phytologia 71:281–299.

UNA NUEVA ESPECIE DE *AGAVE*, SUBGENERO *LITTAEA* (AGAVACEAE) DE GUERRERO Y OAXACA, MEXICO

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RESUMEN

Se describe e ilustra *Agave gracilis* de los estados de Guerrero y Oaxaca, México. La especie pertenece al grupo *Striatae* Baker, del subgénero *Littaea* (Tagliabue) Baker, y muestra similitudes con *A. dasylirioides* Jacobi & Bouché.

ABSTRACT

Agave gracilis from Guerrero and Oaxaca, Mexico, is described and illustrated. The species is a member of group *Striatae* Baker, subgenus *Littaea* (Tagliabue) Baker. It is similar to *A. dasylirioides* Jacobi & Bouché.

Las exploraciones botánicas recientes realizadas en los estados de Guerrero y Oaxaca, México, revelaron la existencia de una nueva especie de *Agave*, perteneciente al subgénero *Littaea* (Tagliabue) Baker, grupo *Striatae* Baker, de la familia Agavaceae. El grupo *Striatae* es endémico de México y los cinco taxa que lo conforman se caracterizan por presentar hojas estriadas, lineares, con el margen serrulado, flores campanuladas o cilíndricas con el tubo bien desarrollado y ovario sin cuello que se proyecta hacia el interior del tubo (Gentry 1982).

Agave gracilis García-Mend. & E. Martínez, sp. nov. (**Fig.** 1). Tipo: MEXICO. Guerrero: Municipio de Tlapa, El Salado, 8 km al N de Tlapa, camino a Huamuxtitlán, selva baja caducifolia, 990 m, 16 Nov 1982 (fls), *E. Martínez et al. 2639* (holotipo: MEXU; isotipos: BRIT, ENCB, K, MO).

Plantae perennes, caespitosae. Folia 40–60 × 0.4–0.9 cm, linearia, striata, margine subtiliter denticulata, glauca vel viridi-glauca. Flores campanulati 2–2.2(–2.5) cm longi, tubo 3–4 mm longo, 5–7 mm lato; filamenta 2.7–3 cm, longa, in apice tubi inserta; ovarium collo carens, in tubi interiorem projectum; capsulae globosae 9–10 × 8–9 mm.

Plantas perennes, cespitosas, con troncos rastreros de hasta 1 m de largo; rosetas hemisféricas, compactas, 50–80 cm de diámetro, 50–60 cm de alto.

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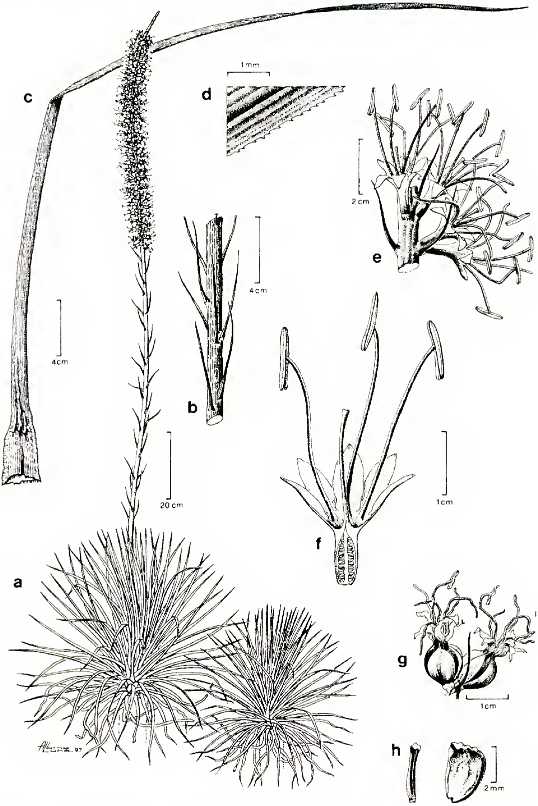

FIG. 1. *Agave gracilis*. a) planta completa con inflorescencia, b) brácteas superiores del pedúnculo, c) hoja, d) detalle del margen de la hoja, e) flores pareadas en la inflorescencia, f) flor disectada, g) cápsulas, h) semillas. Ilustración basada en los especímenes *E. Martínez et al., 2639 y A. García-Mendoza y L. de la Rosa 6508.*

Hojas más de 100 por roseta, 40–70 cm de largo, 0.4–0.9 cm de ancho en la parte media, ensanchándose en la base hasta 1–1.5 cm, lineares, estriadas, planas, flexibles, glaucas o verde-glaucas, subcoriáceas; margen finamente denticulado, amarillento; espina 3–6(–8) mm de largo, débil, de color pardo-rojizo. Inflorescencia de 1.8–2 m de largo, erecta o ligeramente inclinada, espiga en el cuarto superior o mitad superior del pedúnculo, brácteas del pedúnculo 5–15 cm de largo, 2–4 mm de ancho en la base, disminuyendo en tamaño hacia el ápice, lineares, pardas, débiles, sin espina o ésta apenas marcada; brácteas florales 2–3.5 cm de largo, 1–2 mm de ancho, lineares, pardas, persistentes, más largas que las flores. Flores 2–2.2(–2.5) cm de largo, campanuladas, verdes, con el ápice de los tépalos rojizo-oscuros; pedicelos 1 mm de largo, alargándose a 2 mm durante la fructificación; ovario 7–10 mm de largo, 2–4 mm de ancho, cilíndrico, sin cuello, glabro o glabrescente, penetrando ligeramente en el tubo del perianto, éste de 3–4 mm de largo, 5–7 mm de ancho; tépalos 0.9–1.1 cm de largo, 2.5–3.5(–4.5) mm de ancho, oblongos; filamentos 2.7–3 cm de largo, insertos en el ápice del tubo; anteras 7–9 mm de largo, 1 mm de ancho, céntricas, rojizas. Cápsulas 9–10 mm de largo, 8–9 mm de ancho, globosas, pardo-oscuras, con el perianto, estambres y estilo de la flor persistentes. Semillas 3–3.5 mm de largo, 2–2.5 mm de ancho, engrosadas en el lado curvo, negras.

Paratipos: **MEXICO. Guerrero:** Municipio de Atlixtac, 1 km al O de Santa Isabel, 30 km al E de Chilapa, carr. a Tlapa, 25 Nov 1989 (fl), *J.L. Contreras 2651, 2652* (FCME); Municipio de Tlapa, río El Salado en su unión con el río Tlapaneco, 8 km al N de Tlapa, carr. a Huamuxtitlán, 7 May 1997 (fr), *A. García-Mendoza y L. de la Rosa 6508, 6511, 6514* (ENCB, MEXU); Municipio de Zumpango del Río, Xocohite, Xochipala, 23 Abr 1993 (fr), *A. Gómez s.n.* (MEXU). **Oaxaca:** Distrito de Huajuapan, El Boquerón, cañon del río Mixteco, 5 km al N de Tonalá, 13 Ago 1993, *A. García-Mendoza y F. Palma 5811* (MEXU).

La especie aquí descrita se localiza en la cuenca intermedia del río Balsas, en los estados de Guerrero y Oaxaca. Seguramente su distribución se extiende hacia otros afluentes del río y posiblemente más allá, siendo quizá, la planta señalada por Ullrich (1990) para el cerro Yucuyú en el Distrito de Tlaxiaco, Oaxaca. *Agave gracilis* crece en laderas y barrancas abruptas, sobre suelos derivados de rocas calizas, entre los 850 y 1300 m snm. Habita preferentemente en las selvas bajas caducifolias y su ecotonía con los bosques de *Quercus-Pinus*. Algunos de los géneros frecuentes con los que convive son: *Acacia*, *Agave*, *Bursera*, *Euphorbia*, *Hechtia*, *Ficus*, *Forchhammeria*, *Neobuxbaumia* y *Pachycereus*.

Agave gracilis presenta similitudes morfológicas con *Agave dasylirioides* Jacobi & Bouché, especie de la que se diferencia por su hábito cespitoso, roseta más reducida en tamaño, hojas más cortas y angostas, inflorescencia erecta o ligeramente inclinada y flores más pequeñas; las cápsulas globosas y de tamaño más reducido contrastan con las cápsulas oblongas y más grandes

TABLA 1. Comparación de algunas características morfológicas entre *Agave gracilis* y *A. dasylirioides*.

Carácter	*Agave gracilis*	*Agave dasylirioides*
Plantas	cespitosas	solitarias
Tronco	hasta 1m, rastrero	hasta 1.5 m, rastrero
Diámetro de la roseta	50–80 cm	100–200 cm
Tamaño de hojas	40–70 × 0.4–0.9 cm	(40–)60–100 × 2–3.8 cm
Color de hojas	glaucas o verde-glaucas	verdes o verde-glaucas
Inflorescencia	1.8–2 m, erecta o ligeramente inclinada	(1.5–)2–2.6 m, arqueada
Longitud de flores	2–2.2(–2.5) cm	(2.6–)3–3.5 cm
Tubo de la flor	3–4 × 5–7 mm	(8–)10–15 × (8–)12–16 mm
Tamaño de filamentos	2.7–3 cm	3.5–5 cm
Inserción de filamentos	ápice del tubo	mitad del tubo
Cápsulas	9–10 × 8–9 mm, globosas	(10–) 15–20 × 6–9 mm, oblongas
Semillas	3–3.5 × 2–2.5 mm	3–4 × 2.5–3 mm

de *A. dasylirioides*; asi mismo, las semillas son de tamaño menor en *A. gracilis*. Una comparación de los caracteres más sobresalientes de ambas especies se presenta en la Tabla 1. Las medidas de *A. dasylirioides* se tomaron en parte de Gentry (1982) y se ampliaron de acuerdo con observaciones propias. Ambas especies habitan en la cuenca del río Balsas, pero *A. dasylirioides* ocupa la parte alta, más húmeda y fría, entre los 1900 y 2500 m snm, sobre laderas con suelos derivados de rocas volcánicas, en bosques de *Quercus-Pinus* con *Alnus, Arbutus*, *Clethra*, *Cremnophila*, *Garrya*, *Hechtia* y *Salvia*. La época de floración de las dos especies se presenta en los meses de octubre y noviembre.

El epíteto específico se refiere al carácter esbelto de la planta.

AGRADECIMIENTOS

Agradecemos la revisión del manuscrito a Raquel Galván, Susan Verhoek, Wendy Hodgson y Fernando Chiang. La descripción latina fue hecha por el último autor. La ilustración es aportación de Albino Luna.

REFERENCIAS

GENTRY, H.S. 1982. Agaves of Continental North America. University of Arizona Press, Tucson.

ULLRICH, B. 1990. Ein neuer Standort für *Agave dasylirioides* Jacobi & Bouché in Oaxaca. Kakteen Sukk. 41(8):164–166.

A NEW SPECIES OF *MANDEVILLA* (APOCYNACEAE) FROM JALISCO, MEXICO

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ABSTRACT

In preparation for a forthcoming treatment of the Apocynaceae of Mexico, a routine examination of herbarium specimens revealed the following new species, *Mandevilla pringlei* J.K. Williams, sp. nov. The new species is distinct from other members of its alliance (sect. Torosae) in having subsessile leaves and larger peduncles and flowers. In addition, *Mandevilla apocynifolia* (A. Gray) Woodson is here presented to be a synonym of *M. foliosa* (Müll. Arg.) Hemsl.

RESUMEN

En la preparación de un próximo tratamiento de las Apocynaceae de México, un examen de rutina de los especímenes de herbario reveló la nueva especie siguiente, *Mandevilla pringlei* J.K. Williams, sp. nov. La nueva especie se distingue de otros miembros de su alianza (sect. Torosae) por tener hojas subsésiles, y pedúnculos y flores más grandes. Además, *Mandevilla apocynifolia* (A. Gray) Woodson se presenta aquí como un sinónimo de *M. foliosa* (Müll. Arg.) Hemsl.

KEY WORDS: Apocynaceae, *Mandevilla*, Jalisco, Mexico

Mandevilla pringlei J.K. Willliams sp. nov., **(Fig. 1)**. TYPE: MEXICO. JALISCO: Río Blanco, near Guadalajara, 22 Jul 1902, *C.G. Pringle 11357* (HOLOTYPE: US!).

Mandevilla foliosa (Müll. Arg.) Hemsl. affinis sed foliis subsessilis petiolis 2–3 mm longis (vice 10–18 mm in M. foliosa), pedunculis longioribus (7–10 cm vice 0.3–1.2 cm) lobis corollae longioribus latioribusque (12–15 × 10–14 mm vice 5–8 × 2–4 mm) plantis suffrutescentibus (vice lignosibus ramificantibusque).

Suffrutescent herbs to 0.4 m tall, stems pubescent. Leaves 3–7 cm long, opposite, subsessile, pubescent; petioles 2–3 mm long; blades 3–7 cm long, 1.8–2.5 cm wide at middle, ovate-elliptic, apex acute, base sub-cordate, with 2–4 glands at apex of petiole on upper side. Inflorescence lateral, indeterminate, racemose, with 2–10 flowers; peduncles 7–10 cm long, pubescent; bracts 4–6 mm long, narrowly triangular to lanceolate, straight; pedicels 10–17 mm long, pubescent, occasionally twisted. Sepals 5, basally fused, 5–7 mm long, ca 0.5 mm wide, narrowly triangular to lanceolate, straight, pubescent. Corolla salverform, yellow; tube 11–18 mm long, constricted at mouth, lower half internally glabrous, upper half internally pubescent; lobes 12–15 mm long, 10–14 mm wide, obovate, acuminate, occasionally equal in length to the tube but always greater than half its length, spread-

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C. G. PRINGLE,
PLANTÆ MEXICANÆ.
~~1888~~ —
11357
STATE OF JALISCO—
Rio Blanco Near Guadalajara
22, July, 1902.

FIG. 1. Holotype of *Mandevilla pringlei* J.K. Williams.

ing, pubescent. Stamens 3–4 mm long; filaments ca 0.5 mm long, pubescent, straight; anthers ca 3 mm long, bases sagittate with blunt lobes. Pistils 7–11 mm long; style 5–7 mm long, glabrous; ovary ovoid, ca 1 mm long, glabrous; pistil head pentagonal, 2–3 mm long. Nectaries 5, as long as to slightly shorter than ovary. Mature follicles unknown, immature follicles fused at apex, pubescent.

Additional specimens examined: **MEXICO.** Jalisco: Mpio. Mazamitla, Fraccionamiento Los Cazos, to the S of Mazamitla, 9 Jul 1995, *Machuca 7351* (TEX); Cerro Viejo, S face, above Zapotitan de Hidalgo, a village 1 mi N of Hwy MEX 15, ca 25 mi due S, or 45 road mi from Guadalajara, base of mountain in open meadow just E of trail, alt 1890 m, 27 Jun 1956, *D. P. Gregory* & *G. Eiten 223* (P, SMU); Huejotitan, Jul 1912, *Diguet s.n.* (P).

Distribution.—Mandevilla pringlei is known only from five collections made from the Pine-Oak forest near Guadalajara, Jalisco, Mexico.

The new species honors Cyrus Guernsey Pringle (1838–1911) prominent collector of the Mexican flora, and whose collections led to many a new species in the Apocynaceae, and other families.

All specimens are with flowers and buds, *Machuca 7351* is also with fruit but the fruits are extremely immature, only 5 mm in length. The closest relative of *Mandevilla pringlei*, *M. foliosa* (Müll. Arg.) Hemsl., has an average follicle length of 10 cm.

It should be noted that according to Pringle's diary (Davis 1936, p. 199) on the days prior to and after his collections made on July 22, 1902 he was collecting numbers in the 8600 series. This, however, is in contrast to the type collection of *M. pringlei* which is numbered *11357*. The diary, however, does specifically state that Pringle was collecting along the Río Blanco, the type locality of *M. pringlei*, on July 22, 1902. In the numerical listing of Pringle's collections (ibid) the number *11357* is used twice. One listing is for *E. apocynifolia* A. Gray (= *M. foliosa* see below) the second is for an unidentified species of Asclepiadaceae. In the absence of a thorough explanation of Pringle's numerical system it is reasonable to assume that the collection number of the above type specimen is simply an error in numbering.

To date the most taxonomically thorough investigation of *Mandevilla* remains Woodson's (1933) revision. Infrageneric relations are at present moderately unclear, however, Woodson provided both subgeneric and sectional divisions which remain undisputed.

Mandevilla pringlei is a member of subgenus *Mandevilla* (as evidenced by the lack of glands along the midrib of the upper surface of the leaves) where it relates to section *Torosae*, evidenced by its suffrutescent habit and non-twinning stems (Woodson 1933). *Mandevilla pringlei* is most closely related *to M. foliosa*, sharing with it an erect habit (opposed to the trailing habits *of M. karwinskii* (Müll. Arg.) Hemsl. and *M. torosa* (Jacq.) Woodson) and hav-

FIG. 2. Comparision of flowers. A. *Mandevilla foliosa* (Müll. Arg.) Hemsl. (*V. Funk 2766*, TEX). B. *Mandevilla pringlei* J.K. Williams (*P. Gregory & G. Eiten 223*, SMU). Black bar represents 3 cm.

ing leaves with an average length greater than 5 cm (vs. 2–5 cm of *M. mexicana* (Müll. Arg.) Woodson). *Mandevilla pringlei* differs from *M. foliosa* in a number of floral and habit characters that are contrasted below:

1. Branching shrubs to 1.5 m tall; leaves petiolate, petioles 10–18 mm long; peduncles 0.3–1.2 cm long; corolla lobes 5–8 (10) mm long, 2–4 mm wide, up to but not exceeding half the length of corolla tube (Fig. 2a); stems, leaf blades, inflorescence, and fruit glabrous or pubescent, but midrib of leaves always pubescent; midrib hairs linear lanceolate 0.15–0.3 mm long (Fig. 3a); throughout Mexico .... **M. foliosa**

1. Suffrutescent herbs to 0.4 m tall; leaves subsessile, petioles 2–3 mm long; peduncles 7–10 cm long; corolla lobes 12–15 mm long, 10–14 mm wide, half or more the length of the corolla tube (Fig. 2b); stems, leaves, inflorescence and fruit pubescent; midrib hairs triangular, 0.1–0.15 mm long (Fig. 3b); Jalisco .... **M. pringlei**

In the most recent keys to the species of *Mandevilla* (Woodson 1933, 1938), *M. pringlei* keys out to *M. apocynifolia* (A. Gray) Woodson (BASIONYM: *Echites apocynifolia*). In fact, Woodson (1933) cites the type of *M. pringlei* as a specimen of *M. apocynifolia*. An examination of an isotype of *M. apocynifolia* (*Palmer 734*; HOLOTYPE: GH; ISOTYPE: NY!), however, reveals that it is a synonym of *M. foliosa* (*Ghiebreght s.n.*; HOLOTYPE: G n.v., photo-holotype F! MO!). Although the type of *M. apocynifolia* is without flowers, it is evident that the sheet represents a specimen of *M. foliosa* due to its branching, petiolate leaves, glabrous stems and fruits, and linear-lanceolate midrib hairs. *Mandevilla foliosa* has both glabrous and pubescent-stemmed populations scattered throughout its range. However, in the region of Jalisco where the type of *M. apocynifolia* was collected the populations have consistently glabrous stems and fruits.

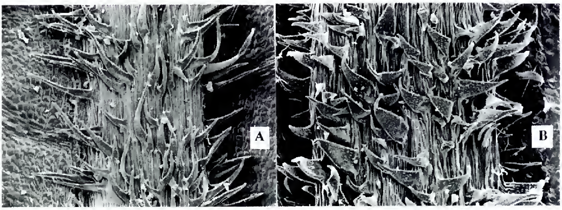

Fig. 3. Scanning electron micrographs of *Mandevilla* midribs of leaf undersurface showing the length and shape of midrib hairs. A. *Mandevilla foliosa* (Müll. Arg.) Hemsl. (*R. King* & *T. Soderstrom 4632*, TEX). B. *Mandevilla pringlei* J.K. Williams (*Machuca 7351*, TEX). White bar on both photos represents 0.1 mm. Microphotographs made by the author using a Phillips 515 SEM (Cell Resource Center, University of Texas Austin).

ACKNOWLEDGMENTS

I would like to thank Paul Fryxell for providing the Latin diagnosis and to him and Billie Turner for reviewing the original manuscript. Thanks is also extended to the curators of F, MO, NY, P, SMU, TEX and US for allowing me the opportunity to observe their specimens. I would also like to credit the staff of the Cell Research Center (University of Texas at Austin) for allowing me access to their scanning electron microscope.

REFERENCES

Davis, H.B. 1936. Life and work of Cyrus Guernsey Pringle. Univ. Vermont, Burlington.

Woodson, R.E., Jr. 1933. *Mandevilla*: In: Studies in the Apocynaceae IV. Ann. Missouri Bot. Gard. 20:645–777.

————. 1938. *Mandevilla*. In: N.L. Britton et al., eds. N. Amer. Fl. 29:645–777.

BOOKS RECEIVED

FAUTIN, DAPHNE GAIL, DOUGLAS J. FUTUYMA, and FRANCES C. JAMES, eds. 1996. **Annual Review of Ecology and Systematics. Volume 27.** (ISBN 0-8243-1427-1, hbk). Annual Reviews Inc., 4139 El Camino Way, P.O. Box 10139, Palo Alto, CA 94303-0139. $52.00. 648 pp.

There is quite a mix of articles reviewing the fields of ecology and systematics for 1996. A total of 20 articles are presented followed by a Subject Index, Cumulative Index of Contributing Authors, and a Cumulative Index of Chapter Titles, Volumes 23-27. The contents are as follows: Early history and progress of women ecologists: Emphasis upon research contributions. Forest Canopies: Methods, hypotheses, and future directions. Extinction by hybridization and introgression. Evolutionary significance of resource polymorphisms in fish, amphibians, and birds. Management of the Spotted Owl: A case history in conservation biology. Trouble on oiled waters: lessons from the Exxon Valdez Oil Spill. Evolutionary significance of local genetic differentiation. Rates of molecular evolution: Phylogenetic issues and applications. Herbivory and plant defenses in tropical forests. Mechanisms creating community structure across a freshwater habitat gradient. Natural freezing survival in animals. Demographic and genetic models in conservation biology. Gene trees, species trees, and systematics. Incidence and consequences of inherited environmental effects. Recruitment and the local dynamics of open marine populations. When does morphology matter? Adaptive evolution of photoreceptors and visual pigments in vertebrates. Microbial biodiversity: Domains and Kingdoms. The geographic range: Size, shape, boundaries, and internal structure.

JAMES STUBBENDIECK, STEPHAN L. HATCH, AND CHARLES H. BUTTERFIELD. 1997. **North American Range Plants.** Fifth edition. (ISBN 0-8032-9243-0, pbk). University of Nebraska Press, 312 North 14th Street, Lincoln, NE 68588-0484. (402) 472-3581. $25.00. 501 pp. Illustrated.

"The 200 species in this book were selected because of their abundance, desirability, or noxious properties. The list of plants was developed over a nearly 40-year period by coaches of range plant identification teams and faculty from the colleges and universities with range management programs. The formal list is now rhe Master Plant List for the International Range Plant Identification Contest sponsored by the Society for Range Management (1839 York Street, Denver, CO 80206)." Each species is treated with the following information: Tribe, species, common name, life span, origin, and season, followed by more detailed information on Inflorescence Characteristics, Vegetative Characteristics, Growth Characteristics, Forage Value, and Habitat. An illustration and range map are provided for each plant.

A NEW COMBINATION IN MEXICAN *MANDEVILLA* (APOCYNACEAE)

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ABSTRACT

In preparation for a forthcoming treatment of the Apocynaceae of Mexico, it was discovered that *Echites holosericea* of Sessé & Moç. has priority over the species *Mandevilla sertuligera* Woodson and *M. syrinx* Woodson, accordingly *Mandevilla holosericea* (Sessé & Moç.) J.K. Williams comb. nov. is here proposed.

RESUMEN

En la preparación de un próximo tratamiento de las Apocynaceae de México, se descubrió que *Echites holosericea* Sessé & Moç. tiene prioridad sobre *Mandevilla sertuligera* Woodson y *M. syrinx* Woodson, como consecuencia se propone *Mandevilla holosericea* (Sessé & Moç.) J.K. Williams comb. nov.

Mandevilla holosericea (Sessé & Moç.) J.K. Williams, comb. nov. BASIONYM: *Echites holosericea* Sessé & Moç., Fl. Mex. (ed. 2) 45. 1894. TYPE: MEXICO. MICHOACAN: "Ahualulci sylvis," Oct 1787–1795, *Sessé & Moçiño 5073* (HOLOTYPE: MA!; ISOTYPE: F!).

Mandevilla syrinx Woodson, Ann. Missouri Bot. Gard. 19:53. 1932. TYPE: MEXICO. JALISCO: barranca of Tequila, 8 Oct 1893, *Pringle 5422* (HOLOTYPE: MO n.v.).

Mandevilla sertuligera Woodson, Ann. Missouri Bot. Gard. 19:383. 1932. TYPE: MEXICO. MICHOACAN: rocky hills, Coru Station, 23 Jan 1907, *Pringle 13890* (HOLOTYPE: US!).

Representative specimens. **MEXICO.** JALISCO: baranca near Guadalajara, Jun 1886, *Palmer 98* (US). **MEXICO:** San Lucas, district Temascaltepec, 28 Nov 1933, *Hinton 5274*(US); San Lucas, district Temascaltepec, 26 Dec 1933, *Hinton 7176* (US); Dist. Temascaltepec, Volcan, 1410 m, 9 Aug 1932, *Hinton 1295* (US). **MICHOACAN:** rock-fields, Coru Station, 15 Oct 1904, *Pringle 13106* (TEX, US-2 specimens). **MORELOS:** lava beds near Cuernavaca, 500 ft, 23 Jun 1896, *Pringle 6329* (US). **OAXACA:** 5 km E of Tamazulapan, road to Chilapa, district of Teposcolula, 1800 m, 7 Jun 1985, *Mendoza et al. 1467* (NY).

Sessé and Moçiño (1887, 1894) described 19 species of *Echites* and the types for a majority of these names have not been located. In preparation of a forthcoming treatment of the Apocynaceae of Mexico, the author studied the collections of "*Echites* "of Sessé and Moçiño during July 1995 at the Madrid herbarium (MA), and from material borrowed from the Field Museum (F) during December 1996 in order to locate and observe the types of their *Echites* species. These observations revealed the following novelty.

The type of the species *Echites holosericea* Sessé and Moç. has up until now

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FIG. 1. Holotype of *Echites holosericea* Sessé & Moç.

not been formally identified and presented. The typification of *E. holosericea* has been made difficult because there are no specimens so labeled among the Sessé and Moçiño collections at F or MA. Many of the posthumously-published species names of Sessé and Moçiño are not the same ones that are written on the specimen labels (Fuertes & Fryxell 1993). Sessé and Moçiño (1894) described the species as having opposite subcordate leaves with rusty red-white tomentum covering all parts of the plant and white flowers with a hairy tube arranged in a compact raceme. Only one specimen (Fig. 1) in the Sessé and Moçiño collections matches this description. This specimen was labeled by them as "*Echites tubulosa* N". The name *E. tubulosa* was never validly published by them, however, the letter "N "after the name indicates Sessé and Moçiño considered this specimen to be a new species (Fuertes & Fryxell, 1993). Since only one specimen matches the description of *Echites holosericea* and has a letter "N "on the label it is considered here to be the holotype of *E. holosericea*.

In 1936, while the Sessé and Moçiño collections were on loan to F (McVaugh 1980), the specimen disscussed above was identified by Woodson as *Mandevilla sertuligera* Woodson. This identification was later confirmed by the present author. With the presentation of the above type it becomes evident that the of Sessé and Moçiño name has priority over Woodson's. A new combination is thus required and is accordingly made above.

The closest relative of *Mandevilla holosericea* is believed to be *M. syrinx* Woodson. The two species appear to have a close resemblance to one another. Indeed, there are two sheets of the same collection (*Pringle 13106*, US) that Woodson annotated differently, one sheet he annotated *M. sertuligera* and the other *M. syrinx*. Woodson (1938) keyed *M. sertuligera* apart from *M. syrinx* by its corymbose inflorescence (vs. racemose) and sepals 4–6 mm long (vs. 2–3 mm). Both Pringle specimens key more favorably to *M. sertuligera* (now *M. holosericea*). At present I have only observed paratypes of *M. syrinx* (having been unsuccessful at locating the type at MO), I am inclined, however, to recognize the two species as undifferentiated and regard them both as a synonym of *M. holosericea*.

REFERENCES

FUERTES, J. and P.A. FRYXELL. 1993. Types of names of New World Malvaceae of Lagasca, Ortega and Sessé and Moçiño. Taxon 42:345–354.

MCVAUGH, R. 1980. Botanical results of the Sessé and Moçiño expedition (1787–1803). II. The icones florae Mexicanae. Contr. Univ. Michigan Herb. 14:99–140.

SESSÉ, M. and J.M. MOÇIÑO 1887. Flora Mexicana. México.

__________. 1894. Flora Mexicana, ed. 2. México.

WOODSON, R.E., JR. 1938. Apocynaceae. In: N.L. Britton et al., eds. North American flora. New York Botanical Garden, New York. 29:103–192.

BOOKS RECEIVED

FAUTIN, DAPHNE GAIL, DOUGLAS J. FUTUYMA, AND FRANCES C. JAMES, eds. 1997. **Annual Review of Ecology and Systematics. Volume 28.** (ISBN 0-8243-1427-1, hbk). Annual Reviews Inc., 4139 El Camino Way, P.O. Box 10139, Palo Alto, CA 94303-0139. $60.00. 712 pp.

Volume 28 is the usual variety of papers reviewing the fields of ecology and systematics. The following list of 25 articles reflects the diversity of contributions in this 1997 Annual Review. Contents: Molecular population genetics of social insects. Evolution of eusociality in termites. Evolutionary genetics and genetic variation of haplodiploids and x-linked genes. Dissecting global diversity patterns: Examples from the Ordovician Radiation. A comparison of alternative strategies for estimating gene flow from genetic markers. The evolution of morphological diversity. Insect mouthparts: Ascertaining the paleobiology of insect feeding strategies. Haldane's Rule. Echinoderm larve and phylogeny. Preserving the information content of species: Genetic diversity, phylogeny, and conservation worth. Theoretical and empirical examination of density-dependent selection. Toward an integration of landscape and food web ecology: The dynamics of spatially subsidized food webs. Settlement of marine organisms in flow. Species richness of parasite assemblages: Evolution and patterns. Hybrid origins of plant species. Evolutionary genetics of life cycles. Phylogeny estimation and hypothesis testing using maximum likelihood. Species turnover and the regulation of trophic structure, Extinction vulnerability and selectivity: Combining ecological and paleontological views. Tree-grass interactions in savannas. Plant competition underground. Male and female alternative reproductive behaviors in fishes: A new approach using intersexual dynamics. The role of hybridization and introgression in the diversification of animals. The ecology of interfaces: Riparian zones. Allometry for sexual size dimorphism: Pattern and process in the coevolution of body size in males and females.

The usual indexes follow: Subject Index, Cumulative Index of Contributing Authors, and a Cumulative Index of Chapter Titles, Volumes 24-28.

JANICK, JULES, ed. 1997. **Plant Breeding Reviews.** Volume 15. (ISBN 0-471-18904-9, hbk). John Wiley & Sons, Inc., 605 Third Avenue, New York, NY 10158-0012. $145.00. 395 pp.

This volume of Plant Breeding Reviews is dedicated to Arnel R. Hallauer, scientist, maize breeder, and quantitative geneticist. The contents start with a dedication to Dr. Hallauer: 1) Dedication: Arnel R. Hallauer, Scientist, Maize Breeder, Quantitative geneticist. The remaining eight chapters cover a variety of areas in plant breeding. Contents: 2) Molecules involved in self-incompatibility in flowering plants. 3) Genetic mosaics and plant improvement. 4) Quantitative trait loci: Separating, pyramiding, and cloning. 5) Doubled haploid breeding in cereals. 6) Spelt: Agronomy, genetics, and breeding. 7) Cowpea breeding. 8) Recurrent selection in soybean. 9) Gene action and plant breeding. All of this followed by a Subject Index, Cumulative Subject Index and a Cumulative Contributor Index for volumes 1-15.

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TRACHYPOGON MAYAËNSIS (POACEAE: ANDROPOGONEAE): A NEW SPECIES FROM BELIZE

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ABSTRACT

Trachypogon mayaënsis, a new species from the Maya Mountains in Belize, is described and illustrated. A key is provided to separate it from other species in Central America. *Trachypogon mayaënsis* is readily distinguished from other Central American species by its annual life cycle, height, leaf blade length and width, and prominent and conspicuous sheath auricles/ligules, that can reach to 6 cm in length.

RESUMEN

Se describe y ilustra una especie nueva, *Trachypogon mayaënsis*, de las montañas Maya de Belize. Se presenta una clave para separarla de las otras especies Centro-americanas. *T. mayaënsis* se distingue fácilmente de ortras especies Centro-americanas por su ciclo de vida anual, altura, longitud y anchura de las láminas foliares, sus lígulas con aurículas prominentes y conspicuas, y que pueden llegar hasta 6 cm de largo.

Trachypogon, a genus of approximately six species, is found in tropical and subtropical America and Africa (Dávila 1994). Two species are found in Central America: *T. spicatus* (C. von Linné) K.E.O. Kuntze and *T. vestitus* N. Andersson. *Trachypogon spicatus* [syns. = *T. montufari* (K. Kunth) C. Nees von Esenbeck; *Trachypogon palmeri* Nash; *T. plumosus* (F. von Humboldt & A. Bonpland ex C. von Willdenow) C. Nees von Esenbeck; and *T. secundus* (J. Presl) F. Lamson-Scribner] is found from southern Texas in the United States to Argentina, and in Africa. *Trachypogon vestitus* is found from Honduras to Brazil. A collection of *Trachypogon* was made in the Maya Mountains in Belize that could not be assigned to any known species and is here described as new.

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Trachypogon mayaënsis Wipff & S.D. Jones, sp. nov. (**Fig. 1**). TYPUS: BELIZE. CAYO DISTRICT: 1.7 mi SE from the entrance gate inside Mountain Pine Ridge (SSW of Belmopan) in the Maya Mountains, disturbed mountain pine forest, associates: *Pinus*, *Andropogon*, *Panicum*, *Axonopus*, *Scleria*, *Diodia*, and *Aristida*; occasional, 19 Jan 1994, *S.D. Jones 10489 & R. Oliver* (HOLOTYPE: MICH; ISOTYPES: BRCH, MO, US).

Gramen annuum caespitosum, culmis (1.59–)1.95–2.10 m altis; auriculis (3–)4–5(–6) cm longis (auriculae ligulae adnatae); folia laminis (30–)43–61 cm longis; inflorescentia 9–30 cm longa.

Plants (1.59–)1.95–2.10 m tall, robust annual, densely cespitose, erect. *Leaves* cauline (measurements taken from mid-culm leaves); *nodes* ca. 11, appressed pubescent with trichomes to 2 mm long, rooting at lower nodes; *sheaths* with ascending to appressed scattered trichomes or glabrous, when pubescent, trichomes 1.3–5.5 mm long, becoming denser at apex of sheath; *collar* glabrous; *sheath auricles* (3–)4–5(–6) cm long, erect and adnate to the ligules, appressed pubescent or glabrous; *ligules* (3–)4–5(–6) cm long, membranous, firm, brown, veined, appressed pubescent attenuate, adnate to the sheath auricles; *blades* (30–)43–61 cm long, 6–7.5 mm wide (measurements taken from mid-culm leaves), flat, apically long attenuate and basally long cuneate with the basal portion becoming involute, antrorsely scaberulous on both surfaces, margins antrorsely scabrous. *Inflorescence* 9–30 cm long, a spicate raceme or a panicle with two racemose branches; *central axis* of spicate raceme or the racemose branches (if a panicle) short pubescent, internodes 3–4 mm long (in middle); one pedicellate spikelet terminating spicate raceme or branch. *Spikelets* paired, one (lower spikelet) of each pair short pedicellate, persistent, awnless, staminate, dorsally compressed; other spikelet (upper spikelet) of pair, longer-pedicellate, deciduous, perfect-flowered, awned, nearly terete. Florets without paleas. LOWER (SHORT PEDICELLED) SPIKELETS: staminate, sometimes with a vestigial ovary present; the lower spikelet either absent or rudimentary in the lowest 4–5 pairs of spikelets in the inflorescence or racemose branch. *Pedicels* 1–2 mm long, pubescent. *Spikelets* 6.5–7.6 mm long, 1–1.6 mm wide, pubescent; *first glumes* 6.5–7.6 mm long, 1–1.6 mm wide, 9–11-veined, coriaceous, partially enclosing rest of spikelet, narrowly elliptic, sparsely to densely short pubescent, keeled, the keels strigose-ciliate, apex bifid, the teeth 0.2–0.3 mm long; *second glumes* 6.5–7.6 mm long, ca. 1.4 mm wide, 3-veined, narrowly elliptic, the margins overlapping, ciliate; *Lower Floret*: *lemmas* 5.2–5.5 mm long; 0-veined, hyaline, ciliate on margins; *paleas* absent. *Upper Floret*: *lemmas* 4.7–4.9 mm long; 3-veined, hyaline, ciliate on upper margins; *paleas* absent. UPPER (LONG PEDICELLED) SPIKELETS: perfect flowered, awned. *Pedicels* 2.5–3.1 mm long, pubescent. *Spikelets* (including callus) 9.5–10.6 mm long, 1–1.4 mm wide, pubescent; *callus*, at base of spikelet, 1.8–2.0 mm long, pubescent with trichomes to 3.0 mm long; *first glumes* 7.5–8.5 mm long, 1–1.4 wide,

FIG. 1. *Trachypogon mayaënsis* [*S.D. Jones 10489 & R. Oliver* (BRCH)]. A. Habit (bar equals 5 cm). B. Section of culm showing the auricle/ligule (bar equals 1 cm).

9–11-veined, coriaceous, margins involute and partially enclosing rest of spikelet, elliptic, densely short pubescent throughout, lateral veins near apex strigulose, apex rounded and ciliolate; *second glumes* 7.7–8.9 mm long, 0.9–1.3 mm wide, 3-veined, coriaceous, narrowly elliptic, sparsely pubescent between veins; upper margins overlapping and ciliate, apex broadly acute and ciliate; *Lower Floret*: neuter (i.e. without reproductive structures); *lemmas* 6.5–7.3 mm long, 1.1–1.2 mm wide, 2-veined, hyaline, ciliate on upper margins, apex truncate and ciliate; *paleas* absent. *Upper Floret*: perfect; *lemmas* 6–6.9 mm long, 0.7–1.0 mm wide; glabrous, the lower 1/3 is 3-veined, hyaline and easily tearing, the upper 2/3 is 0-veined, subcoriaceous to coriaceous and flattened, turning into a terete awn; *awn* 38–50.5 mm long, twice geniculate, pubescent from base to second bend; *paleas* absent. *Stamens* 3, anthers ca. 3.8 mm long, 1–1.1 mm wide. *Chromosome number* unknown.

Etymology.—The specific epithet refers to the Maya Mountain Range in Belize.

Phenology.—November–February.

Distribution.—Known from the Maya Mountains in the Cayo District of Belize and from the state of Oaxaca in México.

Additional specimens examined: **BELIZE.** Cayo District: Rio Privacion, Mountain Pine Ridge, 26 Feb 1931, *H.H. Bartlett 11785* (MICH). **MÉXICO.** Oaxaca: District of Tuxtepe; Chiltepec and vicinity, alt. ca. 200 m, 15 Nov 1941, *G. Martínez Calderón 812* (MICH).

KEY TO THE SPECIES OF *TRACHYPOGON* IN CENTRAL AMERICA

(Modified from Dávila 1994)

1. Plants robust annuals, 1.6–2.10 m tall; auricles/ligules (3–)4–6 cm long; leaf blades (30–)43–61 cm long, 6–7.5 mm wide .... **T. mayaënsis**

1. Plants perennial, less than 1.5 m tall; auricles/ligules 2(–5) cm long or less; leaf blades less than 30 cm long, 1–5 mm wide 2

    2. Plants glabrous or rarely with basal sheath sparsely pubescent; inflorescence a spicate raceme, rarely a panicle with two racemose branches ..... **T. spicatus**

    2. Plants with sheaths and blades conspicuously pubescent; inflorescence a panicle with 3 (rarely 2) racemose branches or rarely a spicate raceme .... **T. vestitus**

The closest relative of *Trachypogon mayaënsis* is probably *T. spicatus*, from which it differs by the characters given in the above key; *Trachypogon palmeri* Nash (=*T. spicatus*) is the name given to longer liguled forms of *T. spicatus* in Mexico. There is also a taxon in Brazil with long ligules, *T. macroglossus* Trinius, but this taxon is perennial with very narrow, involute leaf blades.

Seeds of *T. mayaënsis* were planted in the greenhouse, of the five plants to germinate, only one survived the transplanting to a larger container. Once the plant flowered, it began to branch at the lower aerial nodes (typical of annuals), but eventually the entire plant died and there were no new tillers produced from rootstock. This was also observed in the field. The original material was collected in November 1994, but when we returned to the same site in June 1995, there was no sign of this taxon, though the other associated perennial grasses were still present.

ACKNOWLEDGMENTS

We thank Paul A. Fryxell (TEX) and Tony A. Reznicek (MICH) for their assistance with the Latin diagnosis and review of the manuscript; Paul A. Fryxell (TEX) for providing the Spanish translation of the abstract and Tony A. Reznicek (MICH) for loaning specimens of *Trachypogon*; and Guy L. Nesom (SHST) thank for his initial review of the Latin description. We would also like to thank Kelly Allred (NMSU) Gerrit Davidse (MO), W.E. Fox, III (formerly at TAES), Gretchen D. Jones (USDA, AWPMRU) and Paul Peterson (US) for their review and suggestions. We would like to acknowledge the generosity of the late Royce L. Oliver (BRIT) for making the collecting trip to Belize possible; his generosity is greatly appreciated. We would also like to acknowledge Ben Shaw for the illustration.

REFERENCES

Dávila, P. 1994. *Trachypogon* Nees. In. G. Davidse, M. Sousa S., and A.O. Chater, eds. Flora Mesoamericana, Vol. 6, Alismataceae a Cyperaceae. Universidad Nacional Autónoma de México, México City, México. Pp. 380–381.

BOOKS RECEIVED

HOLM, LEROY, JERRY DOLL, ERIC HOLM, JUAN PANCHO, and JAMES HERBERGER. 1997. **World Weeds: Natural Histories and Distribution.** (ISBN 0-471-04701-5, cloth). John Wiley & Sons, Inc., 605 Third Avenue, New York, NY 10158-0012, U.S.A. $195.00. 1129 pp. Illustrated.

The authors have presented most of the known biology of each species, maps of their distribution in more than 100 countries, illustrations designed to help with identification, and an index of common names, and a bibliography of 3300 references to lead students and researchers to further details that are contained in the principal papers. From the cover: "The culmination of four decades of global research, World Weeds presents comprehensive and up-to-date information on over 100 weeds-addressing recent changes in such areas as crop tillage methods, herbicide use, and agricultural runoff. This monumental work, featuring a wealth of original data from the authors, provides extensive coverage of the know biology of each species. Each entry contains a full botanical description, plus important details on habitat requirements and distribution, seed production, ecology, physiology, crop impact, and more." It is generously supplied with excellent line drawings.

HODGSON, GEOFFREY M. 1995. **Economics and Biology.** (The International Library of Critical Writings in Economics). (ISBN 1-85898-050-X, hbk). Edward Elgar Publishing Limited, England and Edward Elgar Company, Old Post Road, Brookfield, VT 05036, U.S.A. $189.95. 606 pp.

The International Library of Critical Writings in Economics series is an essential reference source for students, researchers and lecturers in economics. Economics and Biology is number 50 in the series. There are six parts each divided into several chapters. Part I: Biological and Mechanical Analogies. Part II: Economics and Sociobiology. Part III: Classical Economics and the Darwinian Revolution. Part IV: Alfred Marshall and Economic Biology. Part V: Evolution, Optimization and Rationality. Part VI: Biology and Modern Economics. A name index follows.

TAXONOMY OF THE *SPOROBOLUS FLORIDANUS* COMPLEX (POACEAE: SPOROBOLINAE)

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ABSTRACT

The *Sporobolus floridanus* complex is defined to include five North American species. Keys, descriptions, distributions, illustrations, and habitat information are provided for: *S. curtissii, S. floridanus, S. silveanus, S. teretifolius*, and a new member of the complex from North Carolina, South Carolina, and eastern Georgia, *Sporobolus pinetorum* Weakley and P. M. Peterson. A lectotype is chosen for *S. floridanus*. The taxonomic and ecological relationships of these five species, as well as the related *S. junceus* and *S. heterolepis*, are compared and discussed. *Sporobolus curtissii, S. floridanus, S. pinetorum, S. silveanus,* and *S. teretifolius* are all relatively narrow endemics of various portions of the southeastern Coastal Plain. Each of these five species is the locally dominant or codominant grass in fire-maintained pinelands with open canopies of *Pinus palustris, P. serotina,* and/or *P. elliottii* var. *elliottii*. The geographic distributions and many ecological requirements of the *S. curtissii, S. floridanus, S. pinetorum, and S. teretifolius* overlap, but they can be separated on a hydrologic gradient.

RESUMEN

El complejo *Sporobolus floridanus* es definido para incluir cinco especies de Norte America. Se proporcionan claves, descripciones, distribución, ilustraciones, e información del hábitat para: *S. curtissii, S. floridanus, S. silveanus, S. teretifolius*, y un nuevo miembro del complejo de Carolina del Norte, Carolina del Sur y del este de Georgia, *Sporobolus pinetorum* Weakley & P.M. Peterson. Un lectotipo es escogido para *S. floridanus*. Las relaciones taxonómicas y ecológicas de estas cinco especies, asi como de las especies afines *S. junceus y S. heterolepis*, son comparadas y discutidas. *Sporobolus curtissii, S. floridanus, S. pinetorum, S. silveanus*, y *S. teretifolius* son todas relativamente endémicas restringidas a varias partes del sureste de la llanura costera. Cada una de las cinco especies, es el pasto localmente dominante o codominate en terrenos de pinos mantenidos por quemas con dosel abierto de *Pinus palustris, P. serotina*, y/o *P. elliottii* var. *elliottii*. La distribución geográfica y muchos de los requerimientos ecológicos de *S. curtissii, S. floridanus, S. pinetorum*, y *S. teretifolius* se solapan, pero pueden ser separados en base a un gradiente hidrológico.

Sporobolus R. Br. is a worldwide genus of approximately 160 species occurring in the tropics, subtropics, and warm temperate regions (Clayton &

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Renvoize 1986). In the New World the genus is represented by approximately 45 species that generally occur on disturbed habitats, i.e., roadside to open prairies and savannas (Peterson et al. 1995, 1997; Peterson et al., in press). *Sporobolus* is characterized by having spikelets with one floret, 1-veined lemmas, fruits with free pericarps, and ligules with a line of hairs. These characteristics also are found in two other genera, *Calamovilfa* (A. Gray) Hack. and *Crypsis* W.T. Aiton. These three genera seem to share a common ancestor and are the only New World members included in the subtribe Sporobolinae (Chloridoideae: Eragrostideae).

The species of *Sporobolus* occurring in the southeastern United States form a heterogeneous assemblage that may be informally divided into groups based on characteristics of the inflorescence, spikelet, plant longevity, and general aspect. One of these groups, characterized as long-lived, perennial, clump-forming species, with open panicle inflorescences and relatively large spikelets, consists of *S. floridanus* Chapman, *S. curtissii* (Vasey ex Beal) Small ex Scribner, *S. teretifolius* Harper, *S. silveanus* Swallen, *S. pinetorum* Weakley & P.M. Peterson (a new species described here), and, more peripherally, *S. junceus* (P. Beauvois) Kunth and *S. heterolepis* (A. Gray) A. Gray. In the course of conducting conservation, taxonomic, ecological, and herbarium studies in the southeastern United States, it has become apparent that this group is poorly understood and has been much confused by earlier authors, current collectors, and field workers. As a consequence, an overlooked species has remained unnamed. We will try to clarify this situation with a detailed discussion of the five members of what we call the *S. floridanus* complex (*S. floridanus, S. curtissii, S. teretifolius, S. silveanus,* and *S. pinetorum*), with less detailed discussion of *S. junceus* and *S. heterolepis*.

TAXONOMIC HISTORY

Because of the general similarities of the taxa in the *Sporobolus floridanus* complex, there has been widespread confusion about their circumscription and distribution, and much erroneous information can be found in earlier systematic treatments and in the ecological literature, and numerous herbarium specimens are misidentified. A review of previous treatments of the complex and its closest relatives will help define problems resolved in this paper.

The two morphologically peripheral taxa were the first to be named. The species currently known as *S. junceus* was described by Beauvois in 1812 in *Heleochloa*, and transferred to *Sporobolus* by Kunth in 1829. *Sporobolus heterolepis* was first described as *Vilfa heterolepis* by A. Gray in 1835, and transferred by Gray to *Sporobolus* in 1848.

The first of the core members of the *S. floridanus* complex was named by Chapman (1860) as *S. floridanus*. It is fairly well characterized in his description:

> "S. **floridanus**, n. sp. Panicle diffuse, large; spikelets (purplish) on long hair-like stalks; glumes acute, the lower one barely shorter than the obtuse paleae, the upper a third longer; leaves rather rigid, flat, pungent, very rough on the edges–Low pine barrens, Middle and West Florida. September.–Culm 2–4 feet high. Leaves 1–2 feet long. Panicle 1–1.5 feet long" (Chapman 1860, 1883, 1897).

The description, the location in Florida, and specimens collected by Chapman at the time make the identity of *S. floridanus* clear. The only species occurring in Florida likely to be confused with *S. floridanus* would be *S. curtissii*, but it is contradicated by various parts of Chapman's description, especially the "panicle ... large," the markedly unequal glumes, the rough-edged leaves, and the length of the blades and the panicle. No type specimen was cited, however, and we lectotypify *S. floridanus* below.

The next to be named was *S. curtissii*, as *S. floridanus* var. *curtissii* (Beal 1896). A year later, Lamson-Scribner elevated the taxon to specific rank (Lamson-Scribner 1897). The distribution of *S. floridanus* was given as "moist pine barrens near the coast, North Carolina to western Florida," apparently on the basis of G. McCarthy's specimen at US (cited below) from Wilmington, North Carolina, which is actually *S. pinetorum*. We know of no specimens of *S. floridanus* from locations north of southern South Carolina.

Harper (1901) made a characteristically idiosyncratic addition to information on the group with his collection of *S. floridanus* in Sumter Co., Georgia, about which he commented "not definitely known outside of Florida before." He elaborated on the roughness of the leaves mentioned by Chapman and stated "I made some tests of their strength. A leaf from the first collection (no. 547) 5.5 mm. wide, not twisted, and perfectly dry, sustained a weight of 27 pounds without breaking."

In 1906, Harper described *S. teretifolius* from collections in Georgia, commenting that it is "a frequent and characteristic inhabitant of moist pine-barrens in the Altamaha Grit region," and that "it is unmistakable when seen in the field" (Harper 1906). He provides excellent and clear character differences between *S. teretifolius, S. curtissii*, and *S. floridanus*, as well as an excellent illustration of the highly distinctive leaf cross-section.

The first two editions of J.K. Small's flora (1903, 1913) treated *S. curtissii* and *S. floridanus*, and gave generally accurate information about morphology, habitat, and distribution. *Sporobolus floridanus* was stated as occurring in "Georgia and northern Florida," and *S. curtissii* was found in "Georgia, Florida, and Alabama." Small then added *S. teretifolius* (Small 1933). The habitat of all three species was given as "moist pinelands, Coastal Plain," with distributions of "Fla. and Ga" for *S. floridanus*, "Fla. to N.C." for *S. curtissii*, and "Ga." for *S. teretifolius*. The extension of the distribution of *S. curtissii* to North Carolina was apparently based on North Carolina specimens of *S. pinetorum* misidentified as *S. curtissii*. In his key, Small (1933) distinguished the three species as follows:

Leaf-blades narrowly involute .... *S. teretifolius*
Leaf blades flat.
  Pedicels appressed to the branches: leaf-blades about 1 mm wide .... *S. curtissii*
  Pedicels spreading: leaf-blades 2-4 mm wide .... *S. floridanus*

Although this key generally serves to distinguish the three species, it has been, in part, responsible for continued taxonomic confusion about the three species and a fourth, *S. pinetorum*. The blades of *S. teretifolius* are anatomically oval, not involute; the blades of *S. curtissii*, *S. floridanus*, and *S. pinetorum* are flat, becoming involute when dry, either during drought conditions in the field, or as a result of drying for herbarium specimens. The narrow blades of *S. curtissii* and *S. pinetorum* usually fold when dried in a plant press. Specimens of *S. curtissii* and *S. pinetorum* often have involute blades that superficially resemble those of *S. teretifolius*. A second problem with the key involves the width of the blade; both *S. curtissii* and *S. pinetorum* have blades regularly reaching and sometimes exceeding 2 mm in width (when flat), and *S. floridanus* characteristically has a leaf blade 3–10 mm wide (though the very narrowest blade on a plant may be as narrow as 2 mm wide). Therefore, specimens of *S. curtissii* and the heretofore unnamed *S. pinetorum* have often been incorrectly identified as *S. teretifolius* (by taking the first lead) or *S. floridanus* (by correctly taking the second lead in the first couplet, but then incorrectly choosing the second lead in the second couplet by placing too much emphasis on a blade width of ca. 2 mm).

Hitchcock (1935) treated *S. floridanus* ("low pine barrens, Georgia and Florida"), *S. curtissii* ("dry pine barrens, North Carolina, Georgia, and Florida"), and *S. teretifolius* ("moist pine barrens, Georgia"). Once again, the inclusion of North Carolina in the distribution of *S. curtissii* was apparently based on miss identification of specimens of *S. pinetorum*.

Blomquist's (1948) book on the grasses of North Carolina treated all material of this complex in North Carolina as *S. curtissii*, but states "According to Swallen (1941) the North Carolina plants assigned to this species may belong to *S. floridanus* Chapm." As will be seen below, neither species has been documented for North Carolina; instead, North Carolina is within the distribution of *S. pinetorum* (undescribed at the time and in some ways generally intermediate in characteristics) and *S. teretifolius* (not collected in North Carolina until 1991).

Swallen (1941) added *S. silveanus* to the group, based on material from eastern Texas. Its distribution in Texas and the western Gulf Coastal Plain of Louisiana makes it allopatric relative to other members of the *S. floridanus* complex. Swallen contrasted it with *S. floridanus* and *S. teretifolius*, yet various characters (such as the appressed and larger spikelets) suggest a closer relationship to *S. curtissii*. It also seems to show a clearer connection to *S. heterolepis* than do other members of the *S. floridanus* complex, a relationship which seems especially plausible given its proximity to *S. heterolepis* and its habitat preferences for barrens with prairie affinities.

Hitchcock and Chase (1950) provided the only treatment to date with as many as four of the species in the complex: *S. floridanus* ("low pine barrens, North Carolina to Florida"), *S. curtissii* ("dry pine barrens, North Carolina to Florida"), *S. teretifolius* ("moist pine barrens, North Carolina and Georgia"), and *S. silveanus* ("open woods, western Louisiana and eastern Texas"). The attribution of *S. floridanus*, *S. curtissii*, and *S. teretifolius* to North Carolina are all based on misidentifications of *S. pinetorum*. This is because of the generally intermediate morphology of *S. pinetorum*, and because the key was not constructed very carefully for even the then-known members of the group. Among the problems are that *S. silveanus* (which has markedly appressed spikelets) can only be reached by following the lead for "spikelets not appressed, the branches and pedicels somewhat spreading"; *S. floridanus* is separated from *S. silveanus* by having glumes "about equal" rather than "unequal," when they actually have similarly subequal first glume to second glume ratios; *S. teretifolius* is separated from *S. floridanus* by the accurate but often mis-interpreted "blades terete vs. blades flat or folded" character; and *S. curtissii* is separated from the others by a subjective and difficult to interpret couplet about pedicel length and orientation.

Radford et al. (1964), by contrast, recognized only one species (*S. teretifolius*) in the complex as occurring in North Carolina and South Carolina. Unfortunately, all material seen by them was actually the undescribed *S. pinetorum*. Radford et al. (1968) added *S. floridanus* (alleged to occur in pinelands in Lancaster County, South Carolina) and attributed *S. teretifolius* to "savannahs" in thirteen counties in southern North Carolina and northern South Carolina. Their key distinguished *S. teretifolius* from *S. floridanus* by "blades terete or subterete" vs. "blades flat or folded." All material seen by them was actually *S. pinetorum*, often with narrow folded blades so as to superficially mimic *S. teretifolius*. Additionally, many of the county records are based on misidentified specimens of *Calamovilfa brevipilis* (Torrey) Scribner, and likewise specimens supposedly documenting county record distributions for *Calamovilfa brevipilis* are in many cases actually *Sporobolus pinetorum*. In truth, both *Sporobolus pinetorum* and *Calamovilfa brevipilis* occur (or formerly occurred) in most or all counties in southeastern North Carolina and in the adjacent counties of South Carolina.

Godfrey and Wooten's (1979) manual of southeastern United States wetland plants treated only *S. floridanus* and *S. curtissii*, inexplicably omitting *S. teretifolius* (which occupies wetter habitats than *S. curtissii*) and *S. silveanus* (which occurs in wetland situations in Louisiana, part of the geographic range of their flora). Because of this, their treatment is of limited value in understanding this group.

Brown (1993) addressed confusion between *S. silveanus*, the most western species in the complex, and *S. heterolepis*, resulting in the deletion of *S. heterolepis* from the floras of Texas and Louisiana, and the addition of *S. silveanus* to the flora of Oklahoma.

SYSTEMATIC TREATMENT

KEY TO THE SPECIES

1. Panicle branches distinctly whorled at lower nodes .... **S. junceus**
1. Panicle branches single at lower nodes (though a few branches may be irregularly approximate in pairs or threes) 2
    2. First glume scaberulous, subulate above an expanded base; spikelets gray to nearly black; base of plant relatively fibrous; grain spherical; plants of rocky barrens and prairies of physiographic provinces inland from the Coastal Plain .... **S. heterolepis**
    2. First glume glabrous, linear-lanceolate to lanceolate, the base not abruptly expanded; spikelets purplish (fading tan); base of plant smooth and hard, made up of the indurated leaf bases; grain oblong (when present, usually abortive); plants primarily of pine savannas and seeps of the Coastal Plain of North Carolina, South Carolina, Georgia, Florida, Alabama, Louisiana, and Texas, but extending further inland in southern Oklahoma and eastern Texas 3
        3. Blades terete or subterete (wiry), 0.5–1.2 mm wide, oval in cross-section (deeper than wide), sometimes irregularly channeled for portions of their lengths (but lacking any flat portion), margins smooth, distal portions often curling and twisted; pedicels with scattered ascending hairs .... **5. S. teretifolius**
        3. Blades flat, 0.8–10 mm wide, flat or V-shaped in cross-section (much wider than deep), with free margins their entire length, margins scaberulous (glabrous to scaberulous in *S. curtissii*), distal portions normally stiff and straight (note that the blades of the narrower-leaved species can appear superficially wiry); pedicels without scattered ascending hairs, either glabrous to scaberulous or scabrous 4
            4. Lower glume usually as long or longer than the upper glume with lower/upper ratio averaging 0.90–1.15; culms 30–80(–90) cm tall; panicle 10–25 cm long; pedicels 0.5–4(–8) mm long, appressed, usually shorter than the spikelet; leaves less than 30 cm long, smooth on the margins .... **1. S. curtissii**
            4. Lower glume usually shorter than the upper glume with a lower/upper ratio averaging 0.60–0.90; culms (30–)45–200(–250) cm tall; panicle 15–50 cm long; pedicels 2–22 mm long, spreading or appressed; leaves mostly more than 30 cm long, scaberulous on the margins 5
                5. Pedicels appressed; lemmas 4.4–6.5 mm long, purple; anthers 3.5–5 mm long; blades 1–2.5 mm wide and bluish-green; plants known west of the Mississippi River .... **4. S. silveanus**

5. Pedicels spreading; lemmas 3–4.3 mm long, purplish-brown; anthers 2–3.4 mm long; blades either wider than 2.5 mm, or dark green; plants from east of the Mississippi River 6
   6. Blades (2–)3–10 mm wide, bluish-green; panicles (18–)30–50 cm long, 4–15 cm wide; lower/upper glume length ratio averaging 0.75–0.90; plants from southern South Carolina, Georgia, eastern Alabama, and northwestern Florida .... 2. **S. floridanus**
   6. Blades 1.2–2(–3) mm wide, dark green; panicles 15–30 cm long, 2–6 cm wide; lower/upper glume length ratio averaging 0.60–0.80; plants from eastern North Carolina, northern South Carolina, and eastern Georgia .... 3. **S. pinetorum**

1. **Sporobolus curtissii** (Vasey ex Beal) Small ex Scribn., U.S.D.A. Div. Agrostol. Bull. 7:142. 1897. (**Figs. 1, j; 2**). *Sporobolus floridanus* var. *curtissii* Vasey ex Beal, Grass. N. Amer. 2:290. 1896. TYPE: U.S.A. FLORIDA: 1883, *Curtiss s.n.* (HOLOTYPE: MSC; ISOTYPE: US-556876!).

Caespitose perennials. Culms 30–80(–90) cm tall, erect, nodes all basal; base diameter 1–2 mm, flattened; internodes glabrous. Sheaths glabrous to appressed hairy, hairs up to 4 mm long; base shiny and endurated; margins hyaline; summit with a tuft of hairs, hairs up to 4 mm long. Ligules 0.2–0.6 mm long, a line of hairs. Blades 5–22(–28) cm long, 0.8–2(–2.2) mm wide, flat to folded or involute, green, remaining green well into winter, mostly glabrous above and below; base densely pilose on upper surface, white to grayish hairs up to 4 mm long; margins glabrous to scaberulous. Panicles 10–25 cm long, 2–10(–13) cm wide, mostly open, contracted when immature, pyramidal to ovate; main axis glabrous to scaberulous; pulvini in axils of primary branches glabrous or occasionally hairy; primary branches 2–9(–10) cm long, ascending to spreading 10–80° from culm axis, not floriferous on lower 1/3; secondary branches mostly appressed; pedicels 0.5–4(–8) mm long, usually shorter than spikelet, appressed, glabrous. Spikelets 3.5–6(–6.6) mm long, purplish-brown. Glumes (2.9–)3.5–6(–6.6) mm long, linear-lanceolate, membranous, 1-veined, equal to subequal; ratio of lower/upper glume length 0.90–1.15(-1.33); lower (2.9–)3.5–6.2 mm long, apex acuminate; upper 3.2–6.6 mm long, apex acuminate. Lemmas 3.4–4.5 mm long, ovate to lanceolate, membranous, 1-veined, glabrous; apex acute. Paleas 3.4–4.5 mm long, ovate, membranous, glabrous; apex acute. Stamens 3, anthers 1.5–2.8 mm long, yellow to purplish. Grains 1.1–1.4 mm long, fusiform, reddish-brown.

Common name.—Curtiss' dropseed.

Distribution and habitat.—Eastern South Carolina south to central peninsular Florida, west to Florida Panhandle. Mesic to dry-mesic pine woodlands, in soils seasonally saturated at the surface or rather well-drained throughout the year, usually under *Pinus palustris*, and sometimes also with *Quercus spp.*; 0–100 m. *Sporobolus curtissii* characteristically occurs in the following Na-

FIG. 1. A–E. *Sporobolus pinetorum* (based on *Weakley s.n.*, 31 Aug 1993). A. Habit. B. Ligule. C. Spikelet. D. Pistil and stamens. E. Blade, lateral view. F. *Sporobolus teretifolius* (*Weakley & Schafale s.n.*, 16 Jul 1991). F. Blade, transverse section. G. *Sporobolus silveanus* (*Waller & Bauml 3128*). G. Four spikelets on a branch of the inflorescence. H, I. *Sporobolus floridanus* (*Curtiss 4054*). H. Spikelet. I. Blade, abaxial view. J. *Sporobolus curtissii* (*Duncan 7855*). J. Spikelet.

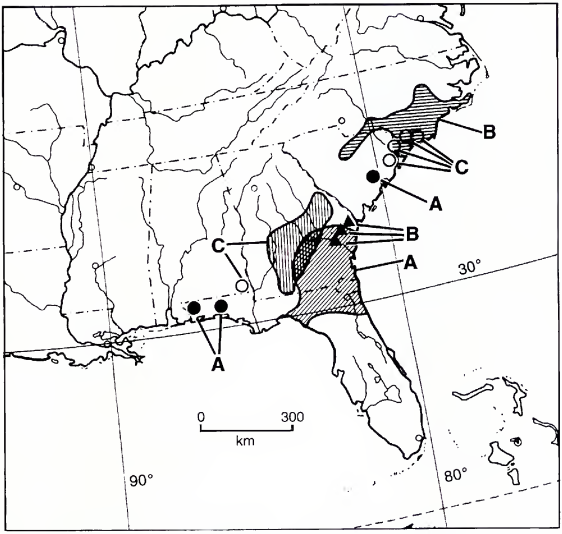

FIG. 2. Geographic distribution of *Sporobolus curtissii* (A), *Sporobolus pinetorum* (B), and *Sporobolus teretifolius* (C).

tional Vegetation Classification plant associations: *Pinus palustris/Serenoa repens–Vaccinium myrsinites/Aristida beyrichiana–Sporobolus curtissii* Woodland; *Pinus palustris/Quercus incana–Quercus stellata/Aristida beyrichiana–Sporobolus junceus–Nolina georgiana* Woodland; *Pinus palustris–(Pinus elliottii* var. *elliottii)/Sporobolus pinetorum–Aster reticulatus–(Sporobolus curtissii)* Woodland (Weakley et al. 1998). Flowering July to November (or less typically at other seasons if stimulated by fire).

Comments.—When fertile, *S. curtissii* is readily distinguished by the short-pediceled, appressed spikelets, and by the large lower glume. Vegetatively, *S. curtissii* is distinctive in its short leaf blades and tendency to have glabrous leaf margins. Post-fire foliage tends to be narrow, stiff, and erect, while unburned plants produce leaves that are shorter, wider, and laxer. It occupies drier habitats than *S. floridanus, S. teretifolius*, and *S. pinetorum*, though it can be found in mixed populations with all three species.

Representative specimens. **FLORIDA. Alachua Co.:** Gainesville, *Combs s.n.* (GH). **Baker Co.:** Olustee Experimental Forest, Olustee, 9 Jun 1936, *Watkins 1* (US). **Bradford Co.:** (FLAS). **Clay Co.:** 7 mi NW of Middleburg, abundant on peaty pond pine savanna, 28 Jul 1967, *McDaniel 9541* (BRIT/VDB, GA). **Columbia Co.:** Lake City, 11–19 Jul 1895, *Nash 2213* (GA, GH, NCU, US). **Duval Co.:** moist pine barrens near Jacksonville, 6 Aug & 13 Nov 1894, *Curtiss 5181* (GA, GH, US). **Manatee Co.:** 1996, *McMillan 1534* (NCU). **Okaloosa Co.:** (reported in Clewell 1985). **Orange Co.:** Grasmere, 23 Sep 1898, *Combs & Baker 1127* (US). **Polk Co.:** 1996, *McMillan 1534*, (NCU). **Putnam Co.:** E of Palatka, open field, 26 Oct 1940, *Silveus 6737* (US). **St. Lucie Co.:** dry pine barrens, Fort Pierce, 25 June 1939, *Silveus 4429* (DUKE). **Taylor Co.:** wet pine flatwoods, 1979, *Godfrey 77245* (GA). **GEORGIA. Berrien Co.:** Alapa Experimental Range, 2 mi S of Alapa, dominant (reported by Lemon 1949); **Brantley Co.:** moist open pinelands 1.5 mi W of Nahunta, 1953, *Duncan 17036* (GH). **Bryan Co.:** Fort Stewart, 1996, *McMillan 1061, 1064, 1065* (NCU). **Charlton Co.:** Camp Cornelia, 1902, *Ricker 932* (GH, US). **Clinch Co.:** pine barrens, Okifionokee [sic] pocket, 8 Oct 1938, *Eyles 396* (DUKE). **Coffee Co.:** 5 mi south of Ocmulgee River, 18 May 1954, *Cooley 2780* (US). **Cook Co.:** 2.7 mi NE of Barney on Ga. 76, 7 Nov 1993, *Sorrie 7786* (NCU). **Dougherty Co.:** dry sand, fossil dunes, East Albany, 30 Aug 1947, Thorne 6441 (GA). **Echols Co.:** longleaf pine–palmetto flatwoods near Ga. 94, 17 Aug 1967, Clewell 2624 (FSU). **Glynn Co.:** 1996, *McMillan 1082, 1082a* (NCU). **Liberty Co.:** Fort Stewart, 1996, *McMillan 1068, 1074, 1075* (NCU). **Long Co.:** 1996, *McMillan 1048, 1048a* (NCU). **Lowndes Co.:** S of Melrose, 4 Sep 1902, *Harper 1603* (GH, US). **Tattnall Co.:** 1996, *McMillan 1081* (NCU). **Toombs Co.:** 13 Dec 1993, *Sorrie & Weakley 7801* (GA). **Wayne Co.:** 1 mile S of Jesup, 1947, *Duncan 7855* (GA, GH, FLAS, US). **SOUTH CAROLINA. Berkeley Co.:** Francis Marion National Forest, 21 Jul 1994, *Sorrie 8075* (NCU); locally dominant, growing in dense and obviously quite old tussocks in gummy longleaf/loblolly flatwoods W of Tiger Corner, 30 May 1995, *McMillan & Kjellmark 1015* (NCU, USCH), 24 Jul 1996, *McMillan 1748* (CLEMS, NCU, USCH).

2. **Sporobolus floridanus** Chapm., Fl. South. U.S. 550. 1860. (**Figs. 1, h, i; 3**). TYPE: U.S.A. FLORIDA. Franklin Co.: Apalachicola, *Chapman s.n.* (LECTOTYPE, here designated: NY, bar code, 00127474!; ISOLECTOTYPE: US-998263!).

Robust caespitose perennials. Culms (40–)100–200(–250) cm tall, erect, nodes all basal; base diameter 1.5–6 mm, flattened; internodes glabrous. Sheaths glabrous to appressed hairy, hairs up to 5 mm long; base shiny and endurated; margins hyaline; summit with a tuft of hairs, hairs up to 6 mm long. Ligules 0.2–0.7 mm long, a line of hairs. Blades (10–)25–50 cm long, (2–)3–10 mm wide, flat to folded, pale bluish-green and yellowing in age, mostly glabrous above and below; base often sparsely hairy, hairs up to 6 mm long; margins scaberulous. Panicles (18–)30–50 cm long, 4–15 cm wide, mostly open, contracted when immature, pyramidal to ovate; main axis scabrous; pulvini in axils of primary branches hairy or glabrous; primary branches 4–15 cm long, ascending to spreading 10–90? from culm axis, not floriferous on lower 1/3; secondary branches ascending to spreading; pedicels 2–14 mm long, usually longer than spikelet, spreading, scaberulous. Spikelets (3.7) 4–6 mm long, purplish-brown. Glumes (2.5–)2.8–5.7 mm long, linear-lanceolate, membranous, 1-veined, subequal; ratio of lower/upper glume length (0.60–)0.75–0.90(–0.94); lower 2.5–5.1 mm long, apex acuminate;

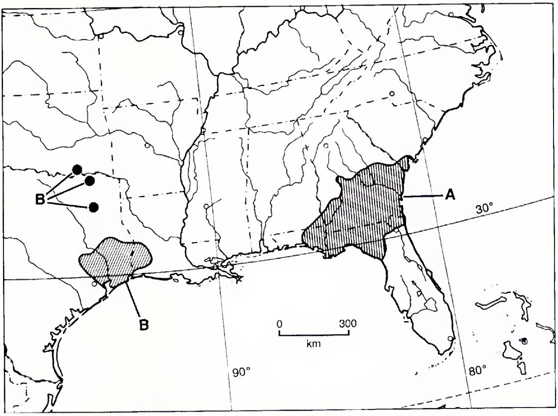

FIG. 3. Geographic distriburion of *Sporobolus floridanus* (A) and *Sporobolus silveanus* (B).

upper 3.7–5.7 mm long, apex acuminate to acute. Lemmas 3–4 mm long, ovate to lanceolate, membranous, 1-veined, glabrous; apex acute. Paleas 3–4 mm long, ovate, membranous, glabrous; apex obtuse to truncate, rarely minutely bifid. Stamens 3, anthers 2–3.1 mm long, purplish. Grains 1.7–2 mm long, fusiform, reddish-brown.

Common name.—Florida dropseed.

Distribution and habitat.—Southeastern South Carolina south to northern peninsular Florida, west to Florida Panhandle. Wet to wet-mesic pine woodlands, in soils semi-permanently to seasonally saturated at the surface, and even in places where water may pond for weeks, usually under *Pinus elliottii* var. *elliottii, Pinus palustris,* or *Taxodium ascendens* Brongn., and also in seepage bogs, treeless swales, and depressional wetlands in pineland landscapes; 0–100 m. *Sporobolus floridanus* characteristically occurs in the following National Vegetation Classification plant associations: *Pinus palustris–Pinus elliottii* var. *elliottii/Ctenium aromaticum–Aristida beyrichiana–Sporobolus floridanus* Woodland; *Pinus palustris–Pinus elliottii* var. *elliottii/Styrax americanus* var. *pulverulentus/Sporobolus floridanus* Woodland (Weakley et al. 1998). Flowering July to November (or less typically at other seasons if stimulated by fire).

Comments.—This is a common and conspicuous grass within its range, and is often a dominant to codominant component of wet pinelands. The wide leaves with distinctly bluish cast are distinctive in this species.

Representative specimens. **ALABAMA. Houston Co.:** (Gunn, pers. comm). **FLORIDA: Dixie Co.:** flatwoods near Hines, 26 Aug 1937, *West et al. 88-174* (FLAS, US). **Duval Co.:** moist pine barrens, neat Jacksonville, Oct 1894, *Curtiss 3378* (GA, GH, NCU). **Franklin Co.:** pine-turkey oak woodland [likely a wetland inclusion in or near this habitat], 1 mile from bridge over Ochlochonee Bay, 14 Jul 1954, *Ford 3124* (US). **Gulf Co.:** St. Joe, open pineland, 5 Oct 1940, *Silveus 6498* (US). **Levy Co.:** Ellzen [or Ellzey], flatwoods, infrequent, 3 Sep 1898, *Combs 818* (US). **Liberty Co.:** *Anderson 12303* (FSU). **Madison Co.:** 1955, *Godfrey 54004* (DUKE, FSU, GH). **Wakulla Co.:** St. Marks Refuge, *Sorrie 7785* (NCU). **Walton Co.:** de Funiak Springs, 1898, *Combs 446* (GH). **GEORGIA. Baker Co.:** Jones Ecological Research Station, Ichauway Plantation, Jack Baker Woods, 17 Aug 1995, *McMillan, Kjellmark, & Drew 1110* (USCH). **Berrien Co.:** Forest Experiment Station, 5 mi NE of Tifton, open pine woods, moist sandy soil, 1943, *Biswell & Lemon PL-270* (FLAS, and reported in Lemon 1949). **Brooks Co.:** wet seepage area in upland pine woods, 1.4 mi N of Morven, 6 Sep 1967, *Faircloth & Faircloth 4829* (GA, NCU). **Bulloch Co.:** , 20 April 1994, *Sorrie 7859* (GA, NCU). **Cook Co.:** 4 mi SE of Adel, open pine forest, 27 Jun 1957, *Pohl 7636* (GH). **Dooly Co.:** open partially drained cypress pond, on W side of railroad, 2.7 mi SSE of Unadilla, 31 Jul 1953, *Harper, Humphrey, & Duncan 16839* (GA). **Echols Co.:** open pine-palmetto flatwoods on the E side of the Alapaha River, 3.6 mi S of Mayday, 21 Oct 1967, *Faircloth 4978* (GA, NCU). **Lanier Co.:** open pine woodland alongside US 221, 2.5 mi WSW of Lakeland, 12 Oct 1967, *Faircloth 4950* (GA, NCU). **Long Co.:** disturbed pocosin, 6.3 mi W of 301 on Ga. 261, 6 Oct 1962, *Bozeman & Radford 1964* (NCU). **Lowndes Co.:** open longleaf pine forest on level terrain 5 mi E of Valdosta, 12 Oct 1963, *Duncan 22210* (GA). **Sumter Co.:** moist pine barrens, 31 Aug 1900, *Harper 547* (GH). **Tattnall Co.:** common in slash pine flatwoods clearing, ca. 2 mi S of Glenville, 11 Sep 1972, *Godfrey 72107* (FSU, NCU). **SOUTH CAROLINA. Jasper Co.:** dominant on mesic to wet *Pinus elliottii*/*P. palustris* savanna on Rains series sandy loam with Paxville fine loamy inclusions, 28 Jun 1995, *McMillan & Kjellmark 1035* (CLEMS, NCU, USCH).

3. Sporobolus pinetorum Weakley & P.M. Peterson, sp. nov. (**Figs. 1, a–e; 2**). TYPE: U.S.A. NORTH CAROLINA. Cumberland Co.: Fort Bragg Army Base, Macridge Danger Zone, ecotonal seepages and moist swales in upland *Pinus palustris* savannas *Weakley s.n.*, 31 Aug 1993 (HOLOTYPE: US!; ISOTYPE: NCU!).

A *S. floridani* laminis foliorum 1.2–2(–3) mm latis atrovirentibus, inflorescentis15–30 cm latis, culmis 45–120 cm altis, ratione longitudinus glumarum inferiorum/superiorum 0.60–0.80, recedit.

Caespitose perennials. Culms (30–)45–120(–180) cm tall, erect, nodes all basal; base diameter 1–3 mm, flattened; internodes glabrous. Sheaths glabrous to appressed hairy, hairs up to 4 mm long; base shiny and endurated; margins hyaline; summit with a tuft of hairs, hairs up to 4 mm long. Ligules 0.2–0.6 mm long, a line of hairs. Blades 20–50 cm long, 1.2–2(–3) mm wide, flat to folded or involute, dark green, remaining green well into winter, mostly glabrous above and below; base often sparsely hairy, hairs up to 4 mm long; margins scaberulous. Panicles 15–30 cm long, 2–6 cm wide, mostly open, contracted when immature, pyramidal to ovate; main axis scaberulous; pulvini in axils of primary branches hairy or glabrous; primary branches 2–8 cm long, ascending to spreading 0–50° from culm axis, not floriferous on lower 1/3; secondary branches ascending to spreading; pedicels 2–22 mm long, usually longer than the spikelet, spreading, scaberulous. Spikelets 3.5–6.5 mm long, purplish-brown. Glumes 2.4–6.5 mm long, linear-lanceolate, membranous, 1–veined, subequal to unequal; ratio of lower/upper glume length (0.58–)0.60–0.80(–0.83); lower 2.4–4.5 mm long, apex acuminate; upper (3.5–)4–6(–6.5) mm long, apex acuminate to acute. Lemmas 3.4–4.3 mm long, ovate to lanceolate, membranous, 1-veined, glabrous; apex acute. Paleas 3.4–4.4 mm long, ovate, membranous, glabrous; apex obtuse to truncate, often bifid with teeth up to 0.4 mm long. Stamens 3, anthers 2.5–3.4 mm long, purplish. Grains 1.8–2.2 mm long, fusiform, brown.

Common name.—Carolina dropseed.

Distribution and habitat.—Eastern North Carolina south to northern South Carolina; and disjunct in eastern Georgia. Wet to moist pine woodlands, in soils seasonally to semi-permanently saturated, usually under *Pinus palustris* and *Pinus serotina*, also sometimes associated with *Taxodium ascendens* and (in Georgia) *Pinus elliottii* var. *elliottii*. *Sporobolus pinetorum* characteristically occurs in the following National Vegetation Classification plant associations: *Pinus palustris–(Pinus elliottii* var. *elliottii)/Sporobolus pinetorum–Aster reticulatus–Sporobolus curtissii* Woodland; *Pinus palustris–Pinus elliottii* var. *elliottii/Styrax americanus* var. *pulverulentus/Sporobolus floridanus* Woodland; *Pinus palustris–Pinus serotina/Sporobolus pinetorum–Aristida stricta–Eryngium integrifolium* Woodland; *Pinus palustris–Pinus serotina/Sporobolus pinetorum–Ctenium aromaticum–Eriocaulon decangulare* var. *decangulare* Woodland; *Pinus elliottii* var. *elliottii–Taxodium ascendens/Hypericum brachyphyllum / Sporobolus pinetorum–Dichanthelium scabriusculum* Woodland (Weakley et al. 1998). July to November (or less typically at other seasons if stimulated by fire).

Comments.—This species has been overlooked until now because its overall morphology places it centrally in the complex, allowing it to be variously confounded with *S. floridanus*, *S. curtissii*, and *S. teretifolius*. Despite its "intermediate gestalt," it has a unique combination of characters that warrant taxonomic recognition. Moreover, it occurs in mixed populations with *S. floridanus* (in eastern Georgia), *S. curtissii* (in eastern Georgia), and *S. teretifolius* (in southeastern North Carolina), and in these situations the taxa are easily distinguishable and show no signs of intermediacy or hybridization. *Sporobolus pinetorum* is locally abundant in seasonally saturated pinelands within its range; because it does not typically flower except following fire, casual field observers have often overlooked its presence and misidentified it as *Aristida stricta*.

Specimens examined. **GEORGIA. Chatham Co.:** pineland, Ogeechee Canal, 4 Aug 1939, *Eyles 6447* (US). **Liberty Co.:** in ecotone of *Pinus palustris/Aristida beyrichiana* flatwoods and *Taxodium ascendens* drain, 1995, *McMillan 1967* (NCU); codominant with *Sporobolus curtissii* in mesic longleaf pine/saw palmetto flatwoods on Fort Stewart Military Reservation sec. A-5, 4 Sep 1995, *McMillan, Kjellmark, & Thompson 1171* (USCH); **Long Co.:** infrequent to rare on mesic longleaf pine savanna and pond cypress depression ecotone on Leesfield series soil transition, Fort Stewart Military Reservation on RSPAC in sect. D-12, 4 Sep 1995, *McMillan, Kjellmark, & Thompson 1170* (USCH). **NORTH CAROLINA. Bladen Co.:** dry savanna 10 mi N of White Lake, 8 Oct 1944, *Blomquist 13617* (DUKE); flat pine woods, 6.4 mi ESE of Ammon on road to Garland, 19 Oct 1957, *Ahles 37439* (NCU). **Brunswick Co.:** low burned savanna on W side of road to Ft. Caswell, near junction of Sawdust Trail, 1938, *Blomquist 10448* (GH, US); burnt longleaf pine–live oak area near inland waterway bridge, Long Beach road, 29 Oct 1950, *Boyce & Godfrey 1602* (NCSC); Southport–Supply, savanna, 23 Aug 1930, *Blomquist 97* (DUKE, PH); Southport–Supply, savanna, 31 Aug 1931, *Blomquist 6672* (DUKE, US); Pireway, savanna, 4 Aug 1933, *Schallert s.n.* (US); shrubby area in pine barrens, Boiling Springs Lakes subdivision, about 2 mi N of jct. of NC 87 & 133, off rte. 133 (N of Southport), 24 Oct 1962, *Terrell & Smith 3697* (NCU); plowed fire lane through a bog, Orton, 28 Sep 1941, *Godfrey10053* (NCU). **Columbus Co.:** cut over pine savanna to E of Co. road, 2.6 mi straight NW of Nakissa [sic; probably Nakina], 17 Oct 1958, *Bell 15739* (NCU); Schulkens Savanna, 1.7 mi W of Old Dock, 17 Jul 1991, *Weakley, Schafale, & LeBlond s.n.* (NCU, US). **Cumberland Co.:** Fort Bragg Army Base, Macridge Danger Zone, ecotonal seepages and moist swales in upland Pinus palustris savannas, 31 Aug 1993, *Weakley s.n.* (US, NCU). **Duplin Co.:** transition near Kenansville, 14 May 1925, *n. c.* (NCSC); burned savanna between Clinton and Seven Springs, 7 Jul 1946, *Blomquist 13936* (DUKE); field woodland border, 0.3 mile NW of Pin Hook, 2 Aug 1957, *Ahles & Leisner 33175* (NCU). **Greene Co.:** savanna 1.1 mi SE of Jason, 1958, *Radford 40402* (FLAS). **Harnett Co.:** 16 Nov 1992, *Sorrie 7116* (NCU). **Hoke Co.:** 7 Oct 1991, *Sorrie 5945* (NCU); 9 Oct 1991, *Sorrie 5959* (NCU); 25 Nov 1991, *Sorrie 6101* (NCU); 28 Sep 1992, *Sorrie 7007* (NCU). **Jones Co.:** savanna, 1.2 mi SSW of Pleasant Hill, 9 Sep 1958, *Radford 39935* (NCU); savanna, 3 mi SE of Pink Hill, 9 Sep 1958, *Radford 39838* (NCU); savanna, 4.3 mi WNW of Hargetts Store, 18 Jul 1958, *Radford 36898*, (GA, GH, NCU). **Lenoir Co.:** pine forest, near NC 11, 1 mile N of Pink Hill, 24 Oct 1957, *Radford 31655* (NCU). **New Hanover Co.:** Wilmington, 1885, *McCarthy s.n.* (US). **Onslow Co.:** Folkstone, 3 Aug 1939, *Silveus 4856* (US); savanna, 9.6 mi N of Hollyridge, 27 Jul 1957, *Ahles & Leisner 32690* (NCU); Camp Lejeune, 23 Sep 1990, *Sorrie, Weakley, LeBlond 5282* (GH); , 5 Sep 1991, *Churchill 91-170* (BRIT/VDB); cut-over savanna about 10 mi NW of Holly Ridge toward Maple Hill, common, 16 Aug 1967, *Wilbur 9432* (DUKE); W side of US 17, 0.6 mi S of fire tower, Jun 1991, *Weakley & Peet s.n.* (US). **Pender Co.:** 30 Aug. 1991, *Sorrie & LeBlond 5889* (GH, NCU). **Richmond Co.:** seep in powerline west of NC 177, 12 Sep 1993, *Sorrie 7679* (NCU); Sandhills Game Land, 28 Oct 1997, *Sorrie 9621* (GA, GH, NCU, US). **Robeson Co.:** woodland border, 2 mi N of Allenton, 21 Jun 1957, *Ahles & Haesloop 29011* (NCU). **Sampson Co.:** pine savanna, 1.3 mi SE of junction US 421 and 701 on US 421 (SSE of Clinton), 8 Aug 1957, *Ahles & Leisner 33702* (NCU). **Scotland Co.:** 8.3 mi SSE of Hoffman, 11 Oct 1959, *McNeely 916* (NCU); 4 Sep 1994, *Sorrie 8187* (NCU). **[no Co.]:** in Oriente Carolina Septentrionalis, locis paludosis [in eastern North Carolina, boggy places], Aug 1885, *McCarthy s.n.* (NCU, PH, US). **SOUTH CAROLINA. Berkeley Co.:** Jun 1998, *Peet & McMillan 6841* (NCU). **Chesterfield Co.:** cleared, burned-over shrub bog in the Sandhills 1 mile W of McBee, 7 Sep 1939, *Godfrey 8052* (DUKE, GH, NCSC, PH, US); savanna, Montrose near US 52, 29 Sep 1956, *Radford 18667* (NCU);

sandhill, 1.3 mi SW of Patrick near US 1, 29 Sep 1956, *Radford 18761* (NCU); Sandhills National Wildlife Refuge, 16 Apr 1992, *Sorrie et al. 6246* (USCH); Sandhills National Wildlife Refuge, 1995, *Pittman s.n.* (US); Hudsonia Flat, 6 Oct 1993, *Sorrie 7746* (NCU).

4. **Sporobolus silveanus** Swallen, J. Wash. Acad. Sci. 31:350. 1941. (**Figs. 1, g; 3**). TYPE: U.S.A. TEXAS. Orange Co.: 10 mi NE of Orange on U.S. 90, 30 Sep 1940, *Silveus 6441* (HOLOTYPE: US-1817963!; ISOTYPES: US-1867557!, US-2209343!).

Densely caespitose perennials. Culms 70–120 cm tall, erect, nodes sometimes visible, mostly basal; base diameter 1.5–4.5 mm, rounded or flattened; internodes glabrous. Sheaths mostly glabrous to appressed hairy, hairs up to 4 mm long; base shiny and endurated; margins hyaline; summit with a tuft of hairs, hairs up to 4 mm long. Ligules 0.2–0.8 mm long, a line of hairs. Blades 15–52 cm long, 1–2.5 mm wide, flat to folded or involute, bluish-green, glabrous above and below; margins scaberulous. Panicles 21–50 cm long, 5–12(–15) cm wide, open and few flowered; pyramidal to ovate; main axis scabrous; pulvini in the axils of primary branches glabrous; primary branches 6–20 cm long, ascending and loosely spreading 20–50? from culm axis, not floriferous on lower 1/4–1/2; secondary branches appressed to loosely spreading; pedicels 3–8(–14) mm long, longer or shorter than spikelet, mostly appressed, scabrous. Spikelets 4.5–7(–7.2) mm long, purplish. Glumes 3–7 mm long, linear-lanceolate to lanceolate, membranous, 1-veined, subequal to unequal, ratio of lower/upper glume length 0.6–0.9; lower 3–4.6 mm long, apex acuminate; upper 4–7.2 mm long, often appearing 3-veined with lateral folds that resemble veins; apex acuminate. Lemmas 4.4–6.5 mm long, lanceolate, membranous, 1-veined, glabrous; margins often hyaline; apex acuminate to acute. Paleas 4.5–6.7 mm long, lanceolate, membranous, glabrous; apex obtuse to truncate, minutely erose. Stamens 3, anthers 3.5–5 mm long, purplish. Grains 1.8–2.5 mm long, obovoid, laterally compressed, light brownish.

Common name.—Silveus dropseed.

Distribution and habitat.—Western Louisiana west to eastern Texas and north to southeastern Oklahoma. Wet to mesic pine woodlands under *Pinus palustris*, also in adjoining glade and barren openings, and in blackland prairies, 5–200 m. *Sporobolus silveanus* characteristically occurs in the following National Vegetation Classification plant associations: *Pinus palustris/Sporobolus silveanus–Muhlenbergia capillaris –Liatris pycnostachya* var. *lasiophylla* Woodland; *Sporobolus silveanus–Carex meadii* Herbaceous Vegetation; *Sporobolus silveanus–Tridens strictus* Herbaceous Vegetation (Weakley et al. 1998). Flowering July to November (or less typically at other seasons if stimulated by fire).

Comments.—There has been some confusion between this species and *S. heterolepis*. Allen (1992) and Thomas and Allen (1993) reported *S. silveanus* from Calcasieu Parish, Louisiana, and *S. heterolepis* from Allen Parish and/or Calcasieu Parish, but all specimens are actually *S. silveanus*. Similarly, both

S. silveanus and *S. heterolepis* have been historically reported from eastern Texas (Correll and Johnston 1970; Gould 1975; Johnston 1990; Hatch et al. 1990). Brown (1993) determined all material from Texas and Louisiana to be *S. silveanus*, and reported *S. silveanus* as a state record for Oklahoma, a conclusion followed by Taylor and Taylor (1994) and Jones et al. (1997). *Sporobolus silveanus* has a bluish color in the field, and closely resembles *Muhlenbergia expansa* (Poir.) Trin., with which it often grows.

Representative specimens. **LOUISIANA. Allen Parish:** longleaf pine woods, W of Kinder, 20 Oct 1940, *Brown et al. 5717* (LSU). **Calcasieu Parish:** 5 mi S of Starks, 1949, *Swallen 10511* (GH). **OKLAHOMA. Bryan Co.:** prairie near Durant, 21 Oct 1953, *Jessee s.n.* (OKLA). **TEXAS. Angelina Co.:** longleaf pine uplands of the proposed Graham Creek Wilderness, 8.8 mi S of Zavalla on US 69 and E on FR 314, 22 Sep 1979, *Nixon & Ward 9659* (ASTC). **Brazos Co.:** along highway 6, 12 mi S of College Station, 8 Oct 1969, *Leonard 250* (TAES); **Galveston Co.:** on 14th street one block W of Ave. I (FM 517), 19 Sep 1974, *Waller & Bauml 3128* (SBSC, TAES, TEX). **Hardin Co.:** pine forest border, 6 mi SW of Kountze, 15 Oct 1964, *Gould 11028* (BRIT/SMU, TAES, TEX, US). **Harris Co.:** Red Bluff Road, 1.5 mi W of SH 146, NW of Seabrook, 18 Sep 1974, *Waller & Bauml 3128* (GH, TAES, TEX, US). **Jasper Co.:** SE of Zavalla on US 63, 1.6 mi SE of the Plum Ridge Road, 29 Aug 1978, *Marietta & Nixon 486* (ASTC, TEX). **Lamar Co.:** "Tridens Prairie" 7 mi W of Paris at intersection of highway 82 and FR 32, *Collins s.n.*, Nov 1971 (LL, TAES, TEX). **Newton Co.:** 16 mi N of Newton, 11 Oct 1934, *Parks & Cory 10832* (TAES). **Orange Co.:** open woods about 10 mi NE of Orange, 30 Sep 1940, *Silveus 6441* (US). **Rains Co.:** in fine sandy clay between RR and highway, 3.5 mi NW of Point, 12 Sep 1948, *Shinners 10239* (BRIT/SMU). **Tyler Co.:** longleaf pine grassland, 6.5 mi E of Chester on route 1745 then left 3 mi to xeric Oligocene outcrop, 19 Oct 1967, *Correll 35172* (LL). **Van Zandt Co.:** sands, Wills Point, 15 Oct 1903, *Reverchon 3484* (US).

5. **Sporobolus teretifolius** R.M. Harper, Bull. Torrey Bot. Club 33:229. 1906. (**Figs. 1, f; 2**). TYPE: U.S.A. GEORGIA: Colquitt Co.: S of Moultrie, 20 Sep 1902, *Harper 1642* (HOLOTYPE: NY; ISOTYPE: US-431954!).

Caespitose perennials. Culms (20–)35–80(–100) cm tall, erect, wiry, nodes all basal; base diameter 1–2 mm, flattened; internodes glabrous. Sheaths glabrous to appressed hairy, hairs up to 4 mm long; base shiny and endurated; margins hyaline; summit with a tuft of contorted hairs, hairs up to 4 mm long. Ligules 0.2–0.4 mm long, a line of hairs. Blades (10–)25–54 cm long, 0.5–1.2 mm wide, tightly involute or terete, green to yellowish-green, senescing or turning tan in late autumn, glabrous above and below; base often sparsely hairy, hairs up to 3 mm long. Panicles 10–26 cm long, 1–9 cm wide, mostly open to somewhat contracted when immature, narrowly pyramidal to ovate; main axis scabrous; pulvini in axils of primary branches often hairy; primary branches 1–8 cm long, ascending to spreading 0–40° from culm axis, not floriferous on lower 1/3; pedicels 3–18 mm long, longer than spikelet, usually spreading, with scattered ascending hairs. Spikelets 4–5.6 mm long, purplish-brown. Glumes 2–5.6 mm long, linear-lanceolate, membranous, 1-veined, unequal, ratio of lower/upper glume length (0.53–)0.55–0.70(–

0.77); lower 2–3.8 mm long, apex acuminate; upper 4–5.6 mm long, apex acuminate. Lemmas 3.4–4.4 mm long, ovate, membranous, 1-veined, glabrous; apex acute. Paleas 3.3–4.4 mm long, ovate, membranous, glabrous; apex acute. Stamens 3, anthers 1.5–2.6 mm long, purplish. Grains not seen.

Common name.—Wireleaf dropseed.

Distribution and habitat.—Southeastern North Carolina south to southern Georgia, west to extreme southeastern Alabama. Wet to moist pine woodlands, under *Pinus serotina, Pinus elliottii* var. *elliottii*, and *Pinus palustris*, in soils; 10–150 m. *Sporobolus teretifolius* characteristically occurs in the following National Vegetation Classification plant associations: *Pinus palustris–Pinus serotina/Magnolia virginiana/Sporobolus teretifolius–Carex striata* Woodland (Weakley et al. 1998) and others not yet described. Flowering July to November (or less typically at other seasons if stimulated by fire).

Comments.—The terete leaves (well figured by Harper 1906) are distinctive. Dry blades (either on dried specimens or in nature under dry field conditions) of the other eastern species with narrow blades (*S. curtissii, S. pinetorum*) can superficially resemble those of *S. teretifolius*, and have caused confusion. *Sporobolus curtissii*, however, has much shorter blades and generally occurs in drier habitats, and the blades of *S. pinetorum* have distinctly rough margins (best felt by running ones finger along the blade towards its base, or seen at 10° or greater magnification).

Representative specimens. **ALABAMA. Houston Co.:** James Hughes pitcher plant bog, 1.5–2.0 mi NE of Cottonwood, burned annually, 4 Aug 1996, *MacDonald 9835* (IBE). **GEORGIA. Berrien Co.:** very broad powerline on N side of route 76, about 1.7 mi SW of Nashville, 27 Oct 1994, *Sorrie s.n.* (NCU). **Bulloch Co.:** sloping moist pine barrens, about 7 mi NW of Statesboro, 12 Sep 1954, *Harper 4309* (GA). **Candler Co.:** about 3.25 mi W of Metter on Srillmore Road, ecotone on E side of a N-S swampy tributary of Sams Creek, S side of road, 22 Apr 1994, *Sorrie & Stowell s.n.* (NCU). **Coffee Co.:** rather dry pine-barrens near Douglas, upper Eocene overlaid by Lafayette and Columbia, 22 Sep 1900, *Harper 677* (NY). **Colquitt Co.:** moist pine barrens near Moultrie, 20 Sep 1902, *Harper 1642* (GA, NY, US. **Cook Co.:** low seepage area (pitcher plant bog) alongside GA 76, 2.7 mi NE of Barney, 21 Sep 1965, *Faircloth & O'Neal 2994* (GA). **Dodge Co.:** reported without precise location by Harper (1906). **Dooly Co.:** reported without precise location by Harper (1906). **Emanuel Co.:** moist mown margin of GA 57 just NW of milepost 5, S side of road, at edge of shrubby ecotone of the W side of Flat Creek, NW of Swainsboro, 6 May 1994, *Sorrie s.n.* (NCU). **Screven Co.:** E side of US 301 at South Fork Ogeechee Creek (milepost 7), S of Sylvania, 25 Oct 1994, *Sorrie s.n.* (NCU). **Thomas Co.:** Greenwood Plantation, Thomasville, damp peaty soil bordering a *Magnolia virginiana–Nyssa biflora* drainage, area burned June 1985, 23 Oct 1985, *Gholson, Godfrey, Komarek, & Baker 11522* (GA). **Tift Co.:** Vicinity of Irby P.O. (Cycloneta Station), 28 Jul 1890, *Tracy s.n.* (NY) [note that present Tift Co. was part of Irwin Co. at the time of Tracy's collection]. **Toombs Co.:** among a colony of pitcher plants, 3 mi N of Lyons, 28 Jul 1961, *Banks s.n.* (GA). **Turner Co.:** seepage slope flanking route 32, W side of Little Sand Creek, 25 Aug 1994, *Sorrie s.n.* (NCU). **Wheeler Co.:** moist pine barrens, 2 mi W of Alamo, Plummer sandy loam, *Pullen & Plummer 881* (GA). **NORTH CAROLINA. Brunswick Co.:** Camp Branch Savanna remnant, just N of SR 1335, ca. 1.2 mi E of its junction with SR 1334, back edge of savanna, near fire ditch at ecotone to pocosiny swamp, 16 Jul 1991, *Weakley & Schafale s.n.* (US). **Columbus Co.**: Old Dock Savanna, south of SR 1928, ca. 0.9 mile W of Old Dock, then south on logging road ca. 0.3 mi, 15 Jul 1991, *Weakley & Schafale s.n.* (US). **SOUTH CAROLINA. Georgetown Co.**: pine savanna in Bates Hill Plantation, ca. 4.0 km SE of the US 701/SC 261 intersection, 5 Sep 1989, *Taggart s.n.* (USCH). **Horry Co.**: along powerline, situated between Mose Swamp and Grass Bay, take SC 109 ca. 2 mi NW of Baker Crossroads, then W and intersect with Santee Cooper Power right-of-way, 22 Sep 1992, *Pittman & Jordan s.n.* (USCH). **Kershaw Co.**: mesic slope, SC 28-102, 2.8 mi N of SC 12, 29 Sep 1958, *Duke 2979* (NCU).

RELATIONSHIPS WITHIN *SPOROBULUS*

Stapf (1898), Bor (1960), Clayton et al. (1974), and Baaijens and Veldkamp (1991) have suggested infrageneric classifications in *Sporobolus* based primarily or strictly on Old World species, and a more worldwide classification is still lacking. Based on possession of an open or contracted panicle, caespitose perennial lifeform, non-whorled branch insertion, intravaginal new shoot initiation, and first glume shorter or as long as the second Pilger (1956) erected group four in subgenus *Sporobolus*. He further divided group four into two smaller groups α & ß. *Sporobolus heterolepis*, *S. floridanus*. *S. teretifolius*, and *S. lasiophyllus* Pilg. are members of Pilger's "ß" group. We agree with Pilger's assessment that *S. heterolepis*, *S. floridanus*, and *S. teretifolius* appear to be closely related. However, *S. lasiophyllus* has a few unique characteristics, such as its strictly basal leaves with sheath bases that are densely lanate and thickened, and its plumbeous to dark-brownish spikelets.

Small (1933) divided *Sporobolus* of the southeastern United States into seven groups, which are not considered validly published because their rank was not indicated. He placed *S. junceus* [as "*S. gracilis* (Trin.) Merr."], *S. floridanus*, *S. curtissii*, and *S. teretifolius* in "*Graciles*," distinguished by perennial, bunchgrass habit, large (more than 3 mm long), purplish to brown spikelets, and glumes unequal, the second as long as the floret. *Sporobolus heterolepis* was not known by Small to occur in his "flora area," so it is unknown whether he would have placed this with "*Graciles*" or not.

We informally recognize the *S. floridanus* complex, consisting of five species (*S. curtissii*, *S. floridanus*, *S. pinetorum*, *S. silveanus*, and *S. teretifolius*) with very similar morphological features and generally similar ecological requirements (primarily restricted to pine savannas on the Coastal Plain). All five species exhibit the following characteristics: caespitose perennials; basal sheaths shiny and endurated (apparently as "fire-proofing"); panicles open at maturity, with ascending panicle branches, pyramidal to ovate, primary branches not floriferous on lower 1/3; spikelets purplish-brown to purplish; lower glume linear-lanceolate to lanceolate, apex acuminate; grain fusiform to obovoid. Additionally, all five species occupy fire-maintained pinelands of the southeastern Coastal Plain, and produce culms only following removal of foliage by fire (or rarely, by mechanical disturbance) [Weakley 1998].

The *S. floridanus* complex appears to have its closest affinities with two pairs of species: 1. *S. heterolepis* and *S. interruptus* Vasey, and 2. *S. junceus* and *S. purpurascens* (Swartz) Hamilton. *Sporoblus heterolepis* and *S. interruptus* appear to be sibling species, *S. heterolepis* being widely distributed in central North America, and extending as an uncommon disjunct into eastern North America, and *S. interruptus* being endemic in northern Arizona. They share several characters which distinguish them from the *S. floridanus* complex: spikelets plumbeous (vs. purplish fading to tan), grains globose (vs. elongate and laterally flattened), scaberulous lower glumes (vs. glabrous), and fibrous sheath bases (vs. shiny and indurated). *Sporobolus heterolepis* appears to be particularly closely related to *S. silveanus*, the most western of the *S. floridanus* complex, and the one most likely to have been geographically and ecologically in contact with *S. heterolepis* in recent times. Ecologically, *S. heterolepis* is a species of glades, prairies, and barrens, usually overmafic, ultramafic or calcareous rock outcrops in the interior, "hard rock" physiographic provinces of central North America (extending as a rare disjunct east to and occasionally beyond the Blue Ridge Mountains), as well as on loess and glacial tills.

Sporobolus junceus and *S. purpurascens* also appear to be siblings, *S. junceus* being a species primarily of the southeastern United States Coastal Plain (from southeastern Virginia west to eastern Texas), but extending inland to adjacent provinces, while *S. purpurascens* is distributed in southern Texas, Mexico, the West Indies, and into tropical America. They share several characters which distinguish them from the *S. floridanus* complex: panicle branches distinctly whorled in well-marked verticils (vs. panicle branches alternate or sometimes irregularly paired or approximate) and spikelets smaller (3.0–3.8 mm long vs. 3.5–7.2 mm long).

DISTRIBUTION AND ECOLOGY

Sporobolus curtissii, S. floridanus, S. pinetorum, S. silveanus, and *S. teretifolius* are all relatively narrow endemics of various portions of the southeastern Coastal Plain (Figs. 2, 3). Each of these five species is the locally dominant or codominant grass in fire-maintained pinelands with open canopies of *Pinus palustris, P. serotina,* and/or *P. elliottii* var. *elliottii* (Weakley et al. 1998). The geographic distributions and many ecological requirements of the four more eastern species overlap, but they can be separated based on a hydrologic gradient. Understanding the differing but overlapping distributions and ecological niches of the species within the group provides an important basis for the systematic treatment.

The five species of the complex share a set of apparent adaptations to the fire-maintained habitats in which they occur. All have the basal sheaths thickened and cartilaginous, tightly investing the growing tips of the rhizomes, and protecting it from damage or destruction by fire. This is a conspicuous feature of herbarium specimens (if not removed by overzealous preparation), appearing as a stramineous, shining, thickened (almost bulbous) base of the plant. The bases of *Calamovilfa brevipilis* and *Calamovilfa curtissii* (Vasey) Scribn. are very similar. Species of the *S. floridanus* complex re-sprout quickly following fire, with green leaf material protruding beyond the blackened basal sheaths within days following fire. Like other southeasrern bunchgrasses adapted to fire-maintained pinelands, including *Calamovilfa brevipilis, C. curtissii, Aristida stricta, A. beyrichiana,* and *Ctenium aromaticum*, all five *Sporobolus* species generally produce culms only after having their leaves removed by fire, although they will sometimes flower in response to mechanical disturbance. For this reason, nearly all herbarium specimens have the upper portions of the basal sheaths conspicuously blackened.

General exclusion of fire from much of the pineland habitat of the five species of the *S. floridanus* complex, combined with their flowering only in response to fire, means that the species are often overlooked or misidentified, and that they are severely under-represented in herbaria despite their local abundance. The four narrower-bladed species, *S. pinetorum, S. curtissii, S. teretifolius,* and *S. silveanus*, are often actively or passively misidentified as other sympatric pineland bunchgrasses, such as *Aristida stricta, A. beyrichiana,* or *Muhlenbergia expansa*. Entire savannas of a hundred hectares or more dominated by *S. pinetorum* have been assumed to be "longleaf pine/wiregrass," though in reality *Aristida stricta* may be completely absent. For this reason, it is important that field biologists become familiar with the vegetative characters which allow recognition of these taxa in sterile condition.

The complex reaches its greatest diversity in the Coastal Plain of Georgia, where *S. floridanus, S. curtissii, S. teretifolius*, and *S. pinetorum* are all found, and co-occur in various combinations of two and three species, along with the related *S. junceus*. *Sporobolus silveanus* is the only species of the complex thar is fully allopatric, and the only one that occurs west of the Mississippi River. In southeastern North Carolina, *S. pinetorum* and *S. teretifolius* occur in wet pinelands dominated by mixtures of *Pinus palustris*, *Pinus serotina*, and *Taxodium ascendens*. They generally co-occur with other savanna bunchgrasses, notably *Ctenium aromaticum, Calamovilfa brevipilis, Muhlenbergia expansa*, and *Aristida stricta*. *Sporobolus teretifolius* is restricted to the wettest pine savannas, usually so wet as to exclude *Aristida stricta*, and it may be the sole dominant, or codominant with *S. pinetorum, Ctenium aromaticum*, and *Muhlenbergia expansa*. Slightly less wet savannas have varying mixtures of *S. pinetorum, Aristida stricta, Muhlenbergia expansa*, and *Ctenium aromaticum*. A similar composition, though often with substantial *Calamovilfa brevipilis* as well, is seen in sandhill/pocosin ecotones in the inner Coastal Plain.

A general hydrologic gradient of the five species and the sympatric *S. junceus* would be (from wetter to drier) *S. floridanus, S. teretifolius, S. pinetorum, S. silveanus, S. curtissii, S. junceus. Sporobolus floridanus* is restricted to habitats which are saturated at least seasonally (and often semi-permanently) and may even have shallow ponds for weeks or even months. The other species are generally intolerant of ponds for more than a few days. *Sporobolus teretifolius* occurs in habitats with semi-permanent to seasonal saturation, whereas *S. pinetorum* occurs in habitats with seasonal saturation. *Sporobolus silveanus* and *S. curtissii* occur in a range of sites, from seasonally saturated to sites which are rarely saturated at the surface for periods of short duration only, and may range up to rather well-drained (though not xeric) sites. *Sporobolus junceus* strictly occupies well-drained sites, ranging into truly xeric, sandhill situations, where it reaches its greatest abundance.

Sprobolus floridanus generally occupies the wettest habitats of the complex. Particularly towards the edges of its distribution, it is generally found in very wet situations, often where water stands for periods of time, often in seepage bogs or swales, and generally associated with *Pinus elliottii* var. *elliottii* and *Taxodium ascendens*. Near the center of its distribution, especially in the eastern portion of the Florida panhandle, *S. floridanus* ranges into less wet habitats, and occurs in "mesic flatwoods." Where its distribution overlaps with *S. pinetorum, S. curtissii*, and *S. teretifolius*, it can occur (with clumps side by side), but it clearly ranges ecologically into wetter sites and avoids drier sites.

The four eastern species in the *S. floridanus* complex commonly co-occur in pineland landscapes, and sometimes occur in mixed populations, with individuals of various species intermixed. In these circumstances, the various species are always readily distinguishable by morphological characters. No intermediates or likely hybrids have been seen. None of these species has been investigated cytologically.

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REFERENCES

ALLEN, C.M. 1992. Grasses of Louisiana. Second ed. Cajun Prairie Habitat Preservation Society, Eunice, Louisiana. Pp. 272–283.

ANDERSON, M., P. BOURGERON, M. BRYER, R. CRAWFORD, L. ENGLEKING, D. FABER-LANGENDOEN, M. GALLYOUN, D.H. GROSSMAN, K. GOODIN, S. LANDAAL, K. METZLER, K.D. PATTERSON, M. PYNE, M. REID, L. SNEDDON, and A.S. WEAKLEY. 1998. International classification of ecological communities: terresrrial vegetation of the United States. Volume II: list of vegetation types. The Nature Conservancy, Arlington, VA.

BAAIJENS, G.J. and J.F. VELDKAMP. 1991. *Sporobolus* (Gramineae) in Malesia. Blumea 35:393–458.

BEAL, W.J. 1896. Grasses of North America. Henry Holt and Company, New York. Pp. 282–306.

BEAUVOIS, P.B. 1812. Essai d'une nouvelle Agrostographie, ou nouveaus genres des Graminées, avec figures représentant les caractères de tous les genres. Pp. 24, 147, 164.

BLOMQUIST, H.L. 1948. The grasses of North Carolina. Duke University Press, Durham, NC. Pp. 91–96.

BOR, N.L. 1960. Poideae-Sporoboleae. In: The grasses of Burma, Ceylon, India and Pakistan. Pergamon Press, London. Pp. 622–636)

BROWN, L.E. 1993. The deletion of *S. heterolepis* (Poaceae) from the Texas and Louisiana floras, and the addition of *S. silveanus* to the Oklahoma flora. Phytologia 74:371–381.

CHAPMAN, A.W. 1860. Flora of the southern United States. Ivison, Phinney, & Co., New York, NY.

________. 1883. Flora of the southern United States. Ivison, Blakeman, Taylor, & Co., New York, NY. P. 550.

________. 1897. Flora of the southern United States. Cambridge Botanical Supply Co., Cambridge, MA. Pp. 597–598.

CLAYTON, W.D., S.M. PHILIPS, and S.A. RENVOIZE. 1974. *Sporobolus.* In: R.M. Polhill, ed. Gramineae (part2), Flora of tropical east Africa. Crown Agents, London. Pp. 353–388.

________ and S.A. Renvoize. 1986. Genera graminum. Grasses of the world. Her Majesty's Stationary Office, London. Pp. 224–228.

CLEWELL, A.F. 1985. Guide ro the vascular plants of the Florida panhandle. Florida State University Press, Tallahassee. Pp. 163–164.

CORRELL, D.S., and M.C. JOHNSTON. 1970. Manual of the vascular plants of Texas. Texas Research Foundation, Renner, Texas. Pp. 217–223.

GODFREY, R.K. and J.W. WOOTEN. 1979. Aquatic and wetland plants of southeastern United States: Monocotyledons. University of Georgia Press, Athens. Pp. 193–197.

GOULD, F.W. 1975. The grasses of Texas. Texas A&M Press, College Station. Pp. 286–311.

GRAY, A. 1835. North American Gramineae and Cyperaceae, part 2. Ann. Lyceum Nat. Hist. New York 3:233.

________. 1848. A manual of the botany of the Northern United States, Edition 1. James Monroe and Company, Boston. Pp. 576.

GROSSMAN, D.H., D. FABER-LANGENDOEN, A.S. WEAKLEY, M. ANDERSON, P. BOURGERON, R. CRAWFORD, K. GOODIN, S. LANDAAL, K. METZLER, K.D. PATTERSON, M. PYNE, M. REID, and L. SNEDDON. 1998. International classification of ecological communities: Terrestrial vegetation of the United States. Volume I: The national vegetation vlassification standard. The Nature Conservancy, Arlington, VA.

HARPER, R.M. 1901. On a collection of plants made in Georgia in the summer of 1900.

Bull. Torrey Bot. Club 28:454–484.

__________. 1906. Some new or otherwise noteworthy plants from the coastal plain of Georgia. Bull. Torrey Bot. Club 33:229–245.

Hatch, S.L., K.N. Gandhi, and L.E. Brown. 1990. Checklist of the vascular plants of Texas. Texas Agric. Exp. Sta. MP-1655. Pp. 31–32.

Hitchcock, A.S. 1935. Manual of the grasses of the United States. U.S.D.A. Misc. Publ. 200:392–403.

__________, and A. Chase. 1950. Manual of the grasses of the United States, second edition. U.S.D.A. Misc. Publi. 200:413–432.

Johnston, M.C. 1990. The vascular plants of Texas. A list, up-dating the manual of the vascular plants of Texas. Second edition. Published by the author, Austin, Texas. Pp. 10–11.

Jones, S.B., Jr., and N.C. Coile. 1988. The distribution of the vascular flora of Georgia. Dept. of Botany, Univ. of Georgia, Athens. Pp. 47–48.

Jones, S.D., J.K. Wipff, and P.M. Montgomery. 1997. Vascular plants of Texas. A comprehensive checklist including synonymy, bibliography, and index. Univ. of Texas Press, Austin, Texas. P. 261.

Kunth, K.S. 1829. Révision des Graminées. In: F.H.A. Humboldt and A.J.A. Bonpland, eds. Voyage aux régions equinoctiales du Noveau Continent, fait 1799–1804, partie 6, Botanique, sect. 6. P. 68.

Lamson-Scribner, F. 1897. American grasses (illustrated). U.S.D.A. Bull. 7:140–143.

Lemon, P. C. 1949. Successional responses of herbs in the longleaf-slash pine forest after fire. Ecology 30:35–145.

Peterson, P.M., S.L. Hatch, and A.S. Weakley (In Press). *Sporobolus*. In: M.E. Barkworth, K.M. Capels, and L.A. Vorobik, eds. Manual of grasses for the Continental United States and Canada. Dept. Agric. Misc. Publ.

__________, R.D. Webster, and J. Valdes-Reyna. 1995. Subtribal classification of the New World Eragrostideae (Poaceae: Chloridoideae). Sida 16:529–544.

__________. 1997. Genera of New World Eragrostideae (Poaceae: Chloridoideae). Smithsonian Contr. Bot. 87:1–50.

Pilger, R. 1956. Sporobolinae. In H. Melchior and E. Werdermann, eds. Gramineae II, Unterfamilien: Micraiodeae, Eragrostideae, Oryzoideae, Olyroideae. Die Natürlichen Pflanzenfamilien, second ed. 14d:53–67.

Radford, A.E., H.E. Ahles, and C.R. Bell. 1964. Guide to the vascular flora of the Carolinas. University of North Carolina Book Exchange, Chapel Hill. P. 68.

__________. 1968. Manual of the vascular flora of the Carolinas. University of North Carolina Press, Chapel Hill. Pp. 104–106.

Schafale, M.P., and A.S. Weakley. 1990. Classification of the natural communities of North Carolina, third approximation. North Carolina Natural Heritage Program, Raleigh.

Small, J.K. 1903. Flora of the southeastern United States. Published by the author. New York, NY.

__________. 1913. Flora of the southeastern United States. Second edition. Published by the author. New York, NY. Pp. 122–125.

__________. 1933. Manual of the southeastern flora. Univ. of North Carolina Press, Chapel Hill. Pp. 100–103.

Stapf, O. 1898. Gramineae. In: W.T. Thiselton-Dyer. Flora Capensis 7:315, 578–589. London.

Swallen, J.R. 1941. New United States grasses. J. Wash. Acad. Sci. 31: 348–355.

Taylor, R.J., and C.E.S. Taylor. 1994. An annotated list of the ferns, fern allies, gymnosperms and flowering plants of Oklahoma. Third edition. Published by the authors, Durant, Oklahoma. P. 26.

THOMAS, R.D., and C.M. ALLEN. 1993. Atlas of the vascular flora of Louisiana. Volume 1: Ferns & fern allies, conifers, and monocotyledons. Louisiana Department of Wildlife and Fisheries, Natural Heritage Program, Baton Rouge, Louisiana. Pp. 163–166.

WEAKLEY, A.S. 1998. Flora of the Carolinas and Virginia. Working draft of May 1998. The Nature Conservancy, Southeast Regional Office, Chapel Hill, NC. Pp. 20.61–20.63.

__________, K.D. PATTERSON, S. LANDAAL, M. PYNE, and OTHERS (compilers). 1998. International classification of ecological communities: terrestrial vegetation of the southeastern United States. Working draft of March 1998. The Nature Conservancy, Southeast Regional Office, Chapel Hill, NC.

CARYOPSIS MORPHOLOGY OF *LEPTOCHLOA* SENSU LATO (POACEAE, CHLORIDOIDEAE)

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ABSTRACT

Caryopsis morphology of the grass genus *Leptochloa* was studied regarding the necessity of some authors for segregating *Diplachne*. The data do not support the separation of *Diplachne* from *Leptochloa* based on a putative bimodal distribution of dorsal and lateral cross-sectional compression. The presence or absence of a prominent sulcus and the relative adnation of the pericarp are the only attributes sufficiently distinct to warrant use as phylogenetic markers. However, variations in surface texture and color can be useful regionally as diagnostic characters at the species level.

KEY WORDS: caryopsis, *Leptochloa*, *Diplachne*, morphology, systematics, Poaceae, Chloridoideae.

RESUMEN

Se estudió la morfología del cariópside del género *Leptochloa* dada la supuesta necesidad de algunos autores de segregar *Diplachne*. Los datos no apoyan la separación de *Diplachne* y *Leptochloa* basada en una supuesta distribución bimodal de la compresión dorsal y en sección transversal lateral. La presencia o ausencia de un surco prominente y la adnación relativa del pericarpo son los únicos atributos suficientemente diferentes para justificar su uso como marcadores filogenéticos. Sin embargo, las variaciones en textura y color de la superficie pueden ser útiles regionalmente como caracteres diagnósticos a nivel específico.

INTRODUCTION

The genus *Leptochloa* P. Beauv. s.l. (including *Diplachne* P. Beauv.) has been the subject of numerous regional systematic studies due to its wide geographic distribution and the relative abundance of herbarium specimens (Hitchcock 1903; Parodi 1927; McNeill 1979; Lazarides 1980; Phillips 1982; Nowack 1994; Nicora 1995). These authors (and others) have disagreed as to whether *Diplachne* should be segregated from *Leptochloa*, thereby mirroring

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the differing opinions of two worldwide generic summaries of grasses (Clayton & Renvoize 1986; Watson & Dallwitz 1992). A frequently cited source of evidence to support the segregation of *Diplachne* has been differences in caryopsis features.

Parodi (1927) apparently was the first to examine cross-sectional shapes critically. He partitioned four neotropical species into *Diplachne* or *Leptochloa* based on relative compression (dorsal or lateral) of the caryopsis, and the presence or absence of a hilar groove. He suggested that *Leptochloa chloridiformis* was aberrant in *Leptochloa* because of its lack of a hilar groove (Parodi, l.c.).

Valls (1978) studied the systematic affinities of *Leptochloa dubia* in relation to the generic boundaries of *Leptochloa*. He illustrated cross-sectional profiles and profiles from the embryonic and hilar sides for seven species. The figures revealed a gradation in cross-sectional profile from nearly round in *Diplachne caudata* to somewhat triangular in *Leptochloa virgata* and *L. scabra*, to relatively flattened in *L. fascicularis* (Valls, l.c.: 103). He also concluded that a hilar depression was a tenuous systematic feature. Despite somewhat limited sampling, his results suggested strongly that caryopsis features intergrade too thoroughly to split *Leptochloa* unambiguously into two genera, although he acknowledged that "some grouping of species can be achieved on the basis of caryopsis type" (Valls, l.c.: 105). Unfortunately, his results were never formally published and have not been cited by subsequent authors.

McNeill (1979: 401) and Nicora (1995: 233) repeated almost verbatim the observations of Parodi (1927) without adducing additional data or citing the work of Valls (1978). Lazarides (1980) observed that Australian species generally could be segregated into *Leptochloa* or *Diplachne* on the basis of caryopsis shape, with the exception of *Leptochloa digitata*, with its flattened shape. Phillips (1982: 144) agreed with Parodi (1927) regarding the utility of caryopsis shape for splitting the genera, but noted exceptions in *Diplachne caudata*, *Leptochloa obtusiflora*, and *L. longa*. Nowack (1994) provided a cursory review of caryopsis shapes for Malesian taxa and concluded that the differences set forth by Parodi (1927) were insufficient to permit recognition of segregate genera.

Based on a recent monographic treatment (Snow 1997), *Leptochloa* (including *Diplachne*) represents forty taxa, with one species, *L. monticola* Chase, being of dubious inclusion (Valls 1978; Snow 1996). Prior to this study, relatively few taxa had been examined critically for variation in features of the caryopsis, and much systematic weight had been placed on the meagre observations that existed. In light of lingering debates about generic boundaries between *Leptochloa* and *Diplachne* (Jacobs 1987) and the emphasis previous authors placed on the utility of the caryopsis to segregate these genera, a survey of all currently recognized taxa of *Leptochloa* was undertaken to evaluate whether features of the caryopsis could be useful as phylogenetic markers.

MATERIALS AND METHODS

Caryopses of all currently recognized taxa in *Leptochloa* (Snow 1997) were removed directly from herbarium specimens (Appendix 1), placed under a Nikon SMZ-U dissecting microscope with camera lucida attachment, and the profiles were traced by hand. *Cypholepis yemenicus* was included because it resembles *L. eleusine* and *L. obtusiflora* in several respects (Snow 1996), and was used as an outgroup in preliminary cladistic studies of *Leptochloa* (Snow 1997; see also van den Borre & Watson 1997). In most cases a minimum of three specimens were examined for variation (Appendix 1). The following features were observed: 1) caryopsis shape when viewed from the hilar side ("hilar profile"); 2) caryopsis shape when viewed from a cross-section taken at midpoint with the hilar side oriented above ("cross sectional profile"); 3) the presence or absence of a sulcus or other depression on the hilar side when viewed in cross-section; 4) ornamentation on the outer coat (perisperm); 5) relative adnation of the perisperm to the endosperm, and 6) color of the grain. To standardize the sampled developmental stage, caryopses were selected from spikelets in which florets were beginning to disarticulate, a condition that assures their maturity. In virtually all cases the caryopses from the lowermost floret in the spikelets were selected.

For the sake of precision, descriptive terminology of shapes follows that of the Systematics Association (1962), whereas that of surface ornamentation follows Murley (1951). Given that shape is a continuously varying character, these typologies might not account for the observed and often subtle variations in shape. For example, a caryopsis might have an intermediate elliptic shape of 2.5:1, which is absent from the diagram. Nonetheless, after initial analyses, the diagram shapes appeared adequate to standardize and summarize the majority of both hilar profile and cross-sectional shapes. With respect to cross-sectional shapes, I accounted for the absence of sharp edges by prefixing the terms "obtriangular" (3:2), "shallowly obtriangular" (3:2), and "shallowly obdeltate" with the word "rounded," which more accurately depicts their shapes. To account for concave inflections of the hilar surface (always oriented above, Fig. 2) I used the terms "sulcus" and "depression," depending on the degree of concavity. As used here, a sulcus is a vertical or nearly vertically walled groove; a depression refers to any gradual concavity, and will be further modified by the terms shallow, moderate, deep, narrow, and broad. These subjective terms were deemed necessary to describe the observed variation.

RESULTS

The hilar profile for most species was some variation of obovate or elliptic (Fig. 1; Table 1). Only four taxa had ovate hilar profiles (*L. fusca* subsp.

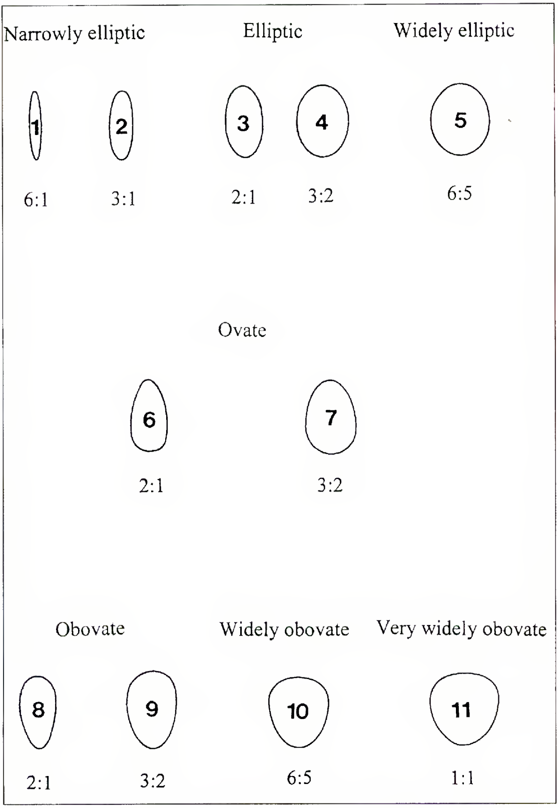

FIG. 1. Hilar profiles of caryopses observed for *Leptochloa*. The apex is oriented above.

Table 1. Variation in hilar profiles and cross-sectional shapes of the caryopsis in *Leptochloa* s. l. The numbers following each taxon reflect observed variation: numbers to the left of the double bar (||) indicate hilar profile shapes (see Fig. 1); those to the right of the double bar reflect cross-sectional shapes (Fig. 2).. Hence, 2,3,8 || 2,9 would indicate a taxon having narrowly elliptic (3:1), elliptic (2:1), and obovate (2:1) hilar profiles, and oblate and depressed obovate (2:3) cross-sectional shapes. Taxa with an asterisk (*) indicate those previously placed in *Diplachne* by some authors.

Leptochloa aquatica 3,9,10 || 8,9,12
L. caudata *1,2,8 || 2
L. chinensis 8,9 || 2,9
L. chloridiformis 2 || 7
L. coerulescens 8,9 || 2,8
L. decipiens subsp. asthenes 3,8 || 2,8,9
L. decipiens subsp. decipiens 3 || 9
L. decipiens subsp. peacockii 3,8 || 3,9
L. digitata 2,3,8 || 8,12
L. divaricarissima 3 || 2,9
L. dubia* 2,3,11 || 8
L. eleusine* 3,8,9 || 8,12
L. fusca subsp. fascicularis* 3,8 || 4
L. fusca subsp. fusca* 9 || 4,8
L. fusca susbsp. muelleri* 3,9 || 4,8
L. fusca subsp. uninervia* 3,7,8 || 4
L. gigantea* 3,6,8 || 8
L. longa 3,8 || 9
L. ligulata 3,4 || 2,7
L. malayana* 3 || 9,11
L. marquisensis 2,3,6 || 9,10
L. monticola* 3,8 || 4,8
L. nealleyi 4,9 || 2,9
L. neesii 5,10 || 1
L. obtusiflora 3 || 8
L. panicea subsp. brachiata 3,4 || 10,13
L. panicea subps. mucronata 3 || 1,2,8
L. panicea subsp. panicea 7 || 1,2
L. panicoides* 3,4 || 8
L. rupestris 3 || 10
L. scabra* 2,3 || 9
L. southwoodii 3,4,8 || 1,2
L. squarrosa 2 || 5,11
L. srilankensis 3 || 9,10,11
L. tectoneticola* 2 || 8
L. uniflora 2,6 || 6,7
L. virgata 2,3,6 || 6,7,11,12,13
L. viscida* 3,8 || 4
L. xerophila 3 || 2
Cypholepis yemenicus 4 || 8,9

uninervia, *L. gigantea*, *L. uniflora*, *L. virgata*). The widest was the very widely elliptic shape of a few specimens of *L. dubia*. The thinnest was the narrowly elliptic (3:1) shape expressed by some specimens of *L. caudata*, *L. chloridiformis*, *L. dubia*, *L. digitata*, *L. scabra*, *L. squarrosa*, *L. uniflora*, and *L. virgata* (the lattermost sensu lato, including *L. barbata* and *L. procera* sensu Nicora 1995). Many species were variable, for example having both elliptic (2:1) and obovate (2:1) shapes. Not surprisingly, the greatest variation in hilar profile shape occurred in widespread species such as *L. dubia* and *L. virgata*.

The cross-sectional shape was considerably more variable than hilar profile shape (Fig. 2). Overall, the observed variation ranged from dorsally compressed through circular (no compression) to laterally compressed (Fig. 2). Most taxa had only slight to moderate degrees of lateral or dorsal compression. As with hilar profiles, many taxa showed infraspecific variation in cross-sectional shapes (Table 1). Some specimens of *L. neesii* appeared circular, whereas others were oblate (Table 1). The greatest degree of dorsal compression was expressed by the depressed obovate (1:2) and transversely elliptic (1:2) shapes. With some modifications, these shapes accounted for some or all of the variation of many species (Table 1). The highest degrees of lateral compression were the obovate (3:2), rounded shallowly obdeltate

(5:6), and rounded shallowly obtriangular shapes. Only *L. squarrosa* was obovate (with a moderate hilar depression), whereas some representatives of *L. virgata* were both rounded shallowly obdeltate (5:6) or rounded shallowly obtriangular (2:3).

A distinct sulcus was present only for *L. rupestris* and *L. uniflora*, although a number of taxa had depressions of varying extent on the hilar surface (see Discussion).

The surface of the pericarp varied from smooth to variously rugose. The following were at least occasionally somewhat rugose: *L. chloridiformis*, *L. decipiens* subsp. *decipiens*, *L. divaricatissima*, *L. gigantea*, *L. longa*, *L. malayana*, *L. monticola*, *L. nealleyi*, *L. neesii*, *L. obtusiflora*, *L. scabra*, *L. southwoodii*, *L. uniflora*. Whereas a smooth pericarp was consistent for many taxa, those that expressed the rugose condition did so irregularly.

Species with a weakly adnate pericarp (detaching soon after placement in water at room temperature) included *L. chloridiformis*, *L. dubia*, *L. eleusine*, *L. fusca* subspecies *fusca*, *fascicularis*, *uninervia*, and *L. obtusiflora*.

The color of the caryopsis varied from very light brown to dark reddish or very dark brown, but most were an intermediate shade. *Leptochloa longa*, *L. obtusiflora*, and *L. squarrosa* were usually dark brown. *Leptochloa monticola*, a species of dubious inclusion in the genus (Clayton & Renvoize 1986; Valls 1978; Snow 1996, 1997), was usually a dark reddish brown.

DISCUSSION

This simple study of caryopsis morphology has revealed more variation within and between taxa of *Leptochloa* than previously recognized (Parodi 1927; McNeill 1979; McVaugh 1983; Nowack 1994; Nicora 1995). With two exceptions, features of the caryopsis appear to be of little value in *Leptochloa* as phylogenetic markers, although some are of diagnostic value in keys. These results contrast with those of a recent study in Triticeae, which suggested caryopsis morphology was of systematic value at the tribal level (Terrell & Peterson 1993).

Parodi's (1927) study was limited to four species in *Leptochloa* and one in *Gouinia* Fourn., which represents only ten percent of *Leptochloa* as currently circumscribed (Snow 1997). Another disconcerting aspect was his lack of voucher specimens and uncertain depth of sampling within taxa, although this study does not contradict the profiles of the species he illustrated. Overall, Parodi's sampling underestimated considerably the variation in cross-sectional shape in *Leptochloa*. This study has revealed nearly continuous variation in cross-sectional shape, from dorsally compressed and non-compressed (circular or oblate) to various degrees of lateral compression. The bimodal compression (lateral or dorsal) of caryopses in *Leptochloa* recognized by Parodi

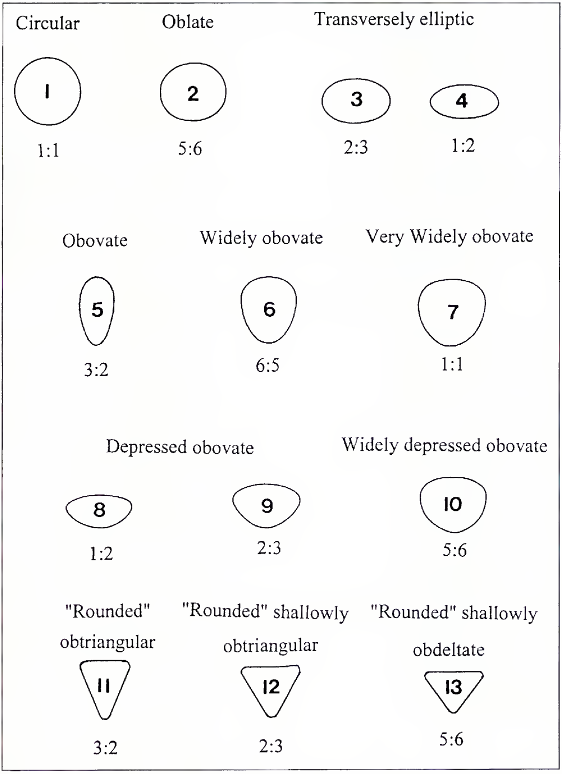

Fig. 2. Cross sectional shapes of caryopses observed for *Leptochloa*. The hilar side is oriented above.

(1927) simply does not exist for the genus as a whole. As such, variation in caryopsis cross-sectional morphology cannot by itself be invoked as a generic-level character to segregate *Diplachne.*

The caryopsis profile as viewed from the hilar side ranges continuously from narrowly elliptic through ovate to obovate and very widely obovate (Fig. 1). Whereas the extremes of variation can be useful as diagnostic features between some taxa, the continuous variation makes the hilar profile useless as a phylogenetic marker (Stevens 1991).

Various degrees of concavity occur on the hilar side. Broad, shallow depressions (not illustrated) characterize certain taxa fairly well, such as *Leptochloa eleusine*, *L. longa*, and *L. obtusiflora*. Taxa showing this feature irregularly were *Leptochloa chinensis*, *L. dubia*, and the related *Cypholephis yemenicus*. Shallow, relatively narrow depressions (not illustrated) occur in other taxa, although less consistently; these included *L. chloridiformis*, *L.decipiens* subsp. *decipiens*, *L. digitata*, *L. squarrosa*, and *L. virgata*. At best, the degree of concavity is useful only as a diagnostic character in regional keys. However, a prominent sulcus, characterized by its vertical or nearly vertical walls, was a consistent character for *L. rupestris* and *L. uniflora*, and is one of only two characters I consider sufficiently distinct and consistent to be phylogenetically useful.

The relative adnation of the pericarp is the second character of the caryopsis useful for phylogenetic inference. It is well known that the pericarp is only weakly adnate to the endosperm in some species of *Leptochloa* (Izaguirre & Laguardia 1987; Watson & Dallwitz 1992) and some related genera, such as *Eragrostis* Wolf (Lazarides 1997). In such taxa the pericarp will dissociate from the endosperm quickly when placed in water at room temperature.

Most species in *Leptochloa* have a smooth outer texture. A few can be rugose, although this feature was unreliable within taxa. For example, a coarse but sparsely rugose surface generally, but not always, characterizes *Leptochloa panicea* subspecies *panicea* and *mucronata* (sensu Snow 1998a, but not sensu Nowack 1994), which helps to distinguish these from the widespread *L. panicea* subsp. *brachiata* (Snow 1998a; formerly known as *L. filiformis* or *L. mucronata* {Snow & Davidse 1993}).

As the color of the caryopsis often varies with the degree of maturity, only mature specimens should be evaluated for this attribute. Except as a diagnostic feature in keys, in which a few species are dark brown, color is of minimal systematic value in *Leptochloa*.

I return now to cross sectional shape, which has been discussed extensively regarding the separation of *Diplachne* from *Leptochloa* (Parodi 1927; McNeill 1979; Phillips 1982; Nicora 1995). As mentioned above, the perceived bimodality of lateral and dorsal compression discussed by Parodi (1927) has been invoked to segregate *Diplachne* from *Leptochloa*. The results of this study firmly reject such a notion, given the nearly continuous variation of cross-sectional hilar profiles (Fig. 1).

It also has been suggested that the presence or absence of a distinct keel on the lemma is positively correlated with cross-sectional shape, and is a means by which the genera can be separated (Parodi 1927; McNeill 1979; Nicora 1995). It is true that some taxa with a dorsally compressed caryopsis have flat lemmas at maturity, as for example *L. fusca* subsp. *muelleri*. However, others have little or no such positive correlation. Mature fruits of *L. neesii* can be round or nearly so in cross section, yet still be borne within a keeled lemma (e.g., *Langfield* 285, CANB). This is also true for some specimens of *L. ligulata*, *L. nealleyi*, *L. panicea* subsp. *panicea*, and *L. southwoodii*. Preliminary cladistic studies have failed to consistently group together taxa having dorsally flattened caryopses (Snow 1997).

This study upholds and strengthens the unpublished work of Valls (1978), who concluded that variation in caryopsis shape was too great to support the recognition of *Diplachne*. In particular, the data herein have revealed nearly continuous variation in cross-sectional shape, ranging from dorsal compression through circular to various degrees of lateral compression (Table 1; Fig. 2). The lateral/dorsal compression dichotomy of Parodi (1927) simply does not exist for *Leptochloa*. Moreover, a nearly identical range of cross-sectional shapes can exist in closely related genera, as illustrated in a recent revision of Australian *Eragrostis* (Lazarides 1997: 176).

The most general observation to emerge from this and other detailed anatomical and morphological studies of grasses (Dávila & Clark 1990; Ellis & Linder 1992; Snow 1996; Lazarides 1997) is that broader sampling regimes generally reveal additional variation not encountered in narrower surveys. Such variation cannot be ignored. Future studies therefore should seek both breadth and depth of sampling in order to minimize the chances of incompletely characterizing variation. Underestimates of variation leads to errors in the diagnosis of taxon boundaries and in the accuracy of inferring phylogenetic relationships, the latter being the very basis by which we make and support our classifications.

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APPENDIX 1

Voucher specimens and herbarium of origin (acronyms follow Holmgren et al. 1990); those lacking herbarium designation are housed at MO. For new combinations and new species in *Leptochloa* see Snow 1998a, b and Snow and Simon 1997.

Leptochloa aquatica Scribn. & Merr.: *Hitchcock 7004* (US); *Pringle 6664* (US); *Soderstrom 650* (US); *McVaugh 19124* (US): *Snow 6623*.

L. caudata (K. Schum.) N. Snow: *Van Someren AH9575* (US); *Snowden 1429* (US); *Bogdan 130* (UC).

L. chinensis (L.) Nees: *Snow et al. 6980*; *Kasim 254* (K); *Poore 440* (K); *Davidse 7471* (K,MO); *Clayton 5644* (K).

L. chloridiformis (Hack. ex Stuck.) Parodi: *Birabén 179* (LP); *Silveus 622* (MICH); *Pedersen 3471* (US); *Pedersen 2662* (US).

L. coerulescens Steud.: *Adam 17175*; *Adam 14030*; *Adam 5094*.

L. decipiens (R. Br.) Stapf ex Maiden subsp. *asthenes* (Roem. & Schult.) N. Snow: *Snow & Simon 7272*; *Snow & Simon 7327*; *Snow & Simon 7335*; *Crisp et al. 2710* (MEL); *Thompson & Sharpe HUG115* (BRI); *Hubbard 5098* (K).

L. decipiens subsp. *decipiens*: *Snow et al. 7247*; *Snow & Simon 7328*; *Snow & Simon 7334*; *Blake 22548* (CANB); *Roe s.n.* (MEL, accession 234696); *Lazarides 5634* (US); *Regan s.n.* (CANB).

L. decipiens subsp. *peacockii* (Maiden & Betche) N. Snow: *Snow & Simon 7323*; *Snow & Simon 7329*; *Snow & Simon 7330*; *Snow & Simon 7336*; *Purdie 315D* (BRI); *Boorman s.n.* (G, accession 8227-86); *Johnson 713* (CANB).

L. digitata (R. Br.) Domin: *Snow et al. 7224*; *Snow et al. 7235*; *Snow et al. 7246*; *Burbidge 5326* (CANB); *Blake 11506* (CANB); *Blake 6320* (CANB); *Walter & Walter 2590* (B).

L. divaricatissima S. T. Blake: *Snow et al. 7228*; *Snow et al. 7233*; *Snow et al. 7236*; *Snow et al. 7241*; *Lloyd 979* (CANB); *Blake 7747* (BRI).

L. dubia (Kunth) Nees: *Snow 5865*; *Warnock 46783* (NCU); *Kral 51801*; *Mearns 1213* (US); *Hernández & Mathus N-2066* (GH); *Gould 12183* (K); *Castillon 43560* (GH).

L. eleusine (Nees) T. A. Cope & N. Snow: *Snow et al. 6941*; *Snow & Burgoyne 6954*; *Snow & Burgoyne 6963*; *Snow et al. 6982*; *Schweickerdt 1896* (PRE); *Guy & Ward 7* (PRE); *Drège s.n.* (S, accession 93/194); *Extension Officer 16419* (PRE).

L. fusca (L.) Kunth subsp. *fusca*: *Snow et al. 7215*; *Snow et al. 7216*; *Snow et al. 7222; Snow et al. 7232*; *Snow et al. 7234*; *Snow et al. 7237*; *Tracy 9297* (GH); *Fry s.n.* (GH).

L. fusca subsp. *fascicularis* (Lam.) N. Snow: *Snow 5786A*; *Snow 5800*; *Snow 5804*; *Snow 5809H*; *Snow 5811A*; *Snow & Koster 5824*; *Snow & Koster 5840*; *Snow 5841*; *Snow 5842*; *Snow 5896*; *Snow 5900*; *Snow 5901-B*; *Snow 5901-E*; *Snow 5903*; *Fraser 631* (MICH); *Pringle 9595* (MEXU); *Swallen 4265* (BAA); *Wooton s.n.* (BAA).

L. fusca subsp. *muelleri* (Benth.) N. Snow: *Latz 11* (BRI); *Maconochie 13433* (BRI); *Must 487* (CANB).

L. fusca subsp. *uninervia* (J. Presl) N. Snow: *Snow & Prinzie 6484*; *Snow & Prinzie 6567*; *Snow & Prinzie 6568*; *Snow 6598*.

L. gigantea (Launert) T. A. Cope & N. Snow: *Smith 4126* (PRE); *Smith 1387* (BRI).

L. ligulata Lazarides: *Snow & Simon 7324*; *Snow 7402*; *Story & Yapp 25* (CANB).

L. longa Griseb.: *Davidse 2612*; *Soderstrom 1073* (US); *Hitchcock 10377* (US).

L. malayana (C. E. Hubb.) Jansen ex Veldkamp: *Yacob 25883* (P).

L. marquisensis (F. Br.) P. M. Peterson & Judw.: *Perlman 14919*; *Perlman 15064*.

L. monticola Chase: *Holdridge 1955* (US); *Ekman H11874* (US).

L. nealleyi Vasey: *Snow 5793B*; *Snow 5805A*; *Snow 5920*; *Cory 20298* (GH); *Waller & Bauml 3096* (GH); *Johnston 4872* (MICH).

L. neesii (Thwaites) Benth.: *Snow & Simon 7378*; *Snow & Simon 7384*; *Davidse & Sumithraarachchi 9180* (MO,US); *White 8894* (US).

L. obtusiflora Hochst.: *Milne-Redhead & Taylor 7297* (B); *Greenway 10666*

L. panicea (Retz.) Ohwi subsp. *panicea*: *Reekmans 4982* (B); *Ahmad s.n.* (B, accesssion 175193-120); *Hitchcock 19474* (US); *Field & Loew 6B* (US); *Backer 35094* (US).

L. panicea subsp. *brachiata* (Steud.) N. Snow: *Snow 5905*; *Snow 5910A*; *Snow & Prinzie 6529C*; *Snow & Prinzie 6558*; *Snow 6654*; *Snow 6672-A*.

L. panicea subsp. *mucronata* (Michx.) Nowack: *Snow 5847A*

L. panicoides (J. Presl) Hitchc.: *Snow 5792A*; *Snow 5810A*; *Snow 6622*; *Jacob 511* (NCU); *Francoer & Williams 47* (ENCB); *McDaniel & Rimachi 18020*.

L. rupestris C. E. Hubb.: *Wood 2848* (BM); *Wood s.n.* (K); *Gilbert & Phillips 8874* (K).

L. scabra Nees: *Snow 5788*; *Snow 5791A*; *Snow 5810A*; *McKenzie & Urbatsch 160* (NY); *Nee 31921* (NY); *Burger & Liesner 6938* (NY).

L. southwoodii N. Snow & B. K. Simon: *Snow & Simon 7350*; *Snow & Simon 7362*.

L. squarrosa Pilg.: *Greenway 2764* (P); *Schlieben 6940* (P); *Milne-Redhead & Taylor 7301* (B).

L. srilankensis N. Snow: *Davidse & Sumithraarachchi 9066* (K); *Fosberg et al. 50835* (CANB); *Clayton 5591* (TAES).

L. tectoneticola (Backer) Jansen ex Veldkamp: *Poilane 15394* (P); *Smitinand 3418* (CANB); *Kerr 20633* (K).

L. uniflora Hochst. in A. Rich.: *Trimens 28* (US); *Rains 67* (US); *Thollon 4093* (US).

L. virgata (L.) P. Beauv.: *Pohl & Davidse 10603* (UC); *Burkart 22139* (SI); *Meza 12*; *Swallen 3109* (US); *Bröckmann 18660* (BAA).

L. viscida (Scribn.) Beal: *Snow 6597*; *Ruíz s.n.* (ENCB); *Palmer 1789* (GH); *Goodding & Lusher 139-45* (NY).

L. xerophila P. M. Peterson & Judw.: *Hallé 2098* (P).

Cypholepis yemencicus (Schweinf.) Chiov.: *Bally & Melville 15783*; *Verdcourt 3275*.

REFERENCES

Clayton, W.D. and S.A. Renvoize. 1986. Genera graminum: Grasses of the world. Kew Bull. Addit. Ser. 13.

Dávila, P. and L.G. Clark. 1990. Scanning electron microscopy survey of leaf epidermis of *Sorghastrum* (Poaceae: Andropogoneae). Amer. J. Bot. 80:1444–1454.

Ellis, R.P. and H.P. Linder. 1992. Atlas of the leaf anatomy in *Pentaschistis*. Mem. Bot. Surv. S. Africa 60.

Hitchcock, A.S. 1903. North American species of *Leptochloa*. U.S.D.A Bull. Pl. Industr. Publ. 13:1–21.

Holmgren, P.K., N.H. Holmgren and L.C. Barnett. 1990. Index herbariorum. Part I: The herbaria of the world. Eighth Edition. Regnum Veg. 120.

Izaguirre, P. and A. Laguardia. 1987. Un nuevo enfoque hacia la definicion del fruto de las gramineas. Uruguay Fac. Agron. Bol. Invest. 3:1–15.

Jacobs, S.W.L. 1987. Systematics of the chloridoid grasses. In: T.R. Soderstrom, K.W. Hilu, C.S. Campbell, and M.E. Barkworth, eds. Grass systematics and evolution. Smithsonian Institution Press, Washington, D.C. Pp. 277–286.

Lazarides, M. 1980. The genus *Leptochloa* Beauv. (Poaceae, Eragrostideae) in Australia and Papua New Guinea. Brunonia 3:247–269.

___________. 1997 A revision of *Eragrostis* (Eragrostideae, Eleusininae, Poaceae) in Australia. Aust. Syst. Bot. 10:77–187.

McNeill, G. 1979. *Diplachne* and *Leptochloa* (Poaceae) in North America. Brittonia 31:399–404.

McVaugh, R. 1983. Gramineae. Vol. 14. Flora Novo-Galaciana: A descriptive account of the vascular plants of western Mexico, W. R. Anderson, editor. The University of Michigan Press, Ann Arbor.

Murley, M.R. 1951. Seeds of the Cruciferae of northeastern America. Amer. Midl. Naturalist 46:1–81.

Nicora, E.G. 1995. Los géneros *Diplachne* y *Leptochloa* (Gramineae, Eragrosteae) de la Argentina y países limítrofes. Darwiniana 33:233–256.

Nowack, R. 1994. Revision of *Leptochloa* Beauv. (incl. *Diplachne* Beauv.) (Poaceae) in Malesia. Rheedea 4:79–92.

Parodi, L.R. 1927. Revisión de las gramíneas argentinas del género *Diplachne*. Revista Fac. Agron. Veterin. 6: 21-43.

Phillips, S.M. 1982. A numerical analysis of Eragrostideae (Gramineae). Kew Bull. 37:133–168.

Snow, N. 1996. The phylogenetic utility of lemmatal micromorphology in *Leptochloa* and related genera in subtribe Eleusininae (Poaceae, Chloridoideae, Eragrostideae). Ann. Missouri Bot. Garden 83:504–529.

____________. 1997. Phylogeny and Systematics of *Leptochloa* P. Beauv. sensu lato (Poaceae, Chloridoideae). Ph.D. dissertation, Washington University, St. Louis, Missouri.

____________. 1998a. Nomenclatural changes in *Leptochloa* P. Beauvois sensu lato (Poaceae, Chloridoideae). Novon 8:77–80.

____________. 1998b. A new species of *Leptochloa* (Poaceae, Chloridoideae) from Sri Lanka. Novon 8:183–186.

Snow, N. and G. Davidse. 1993. *Leptochloa mucronata* (Michx.) Kunth is the correct name for *Leptochloa filiformis* (Poaceae). Taxon 42:413–417.

____________, B.K. Simon. 1997. *Leptochloa southwoodii* (Poaceae, Chloridoideae), a new species from south-east Queensland. Austrobaileya 5:132–143.

Stevens, P.F. 1991. Character states, continuous variation, and phylogenetic analysis: A review. Syst. Bot. 16:553–583.

Systematics Association Committee for Descriptive Biological Terminology. 1962. I. Terminology of simple symmetrical plane shapes (chart 1). Taxon 11:145–156.

Terrell, E.E. and P.M. Peterson. 1993. Caryopsis morphology and classification in the Triticeae (Pooideae: Poaceae). Smithsonian Contr. Bot. 83.

Valls, J.F.M. 1978. A biosystematic study of *Leptochloa* with special emphasis on *Leptochloa dubia* (Gramineae: Chloridoideae). Ph.D. dissertation, Texas A & M University, College Station.

Van den Borre, A. and L. Watson. 1997. On the classification of the Chloridoideae (Poaceae). Australian Syst.Bot.10:491–531.

Veldkamp, J.F. 1971. Notes on Malesian grasses V. New species and combinations in *Pheidochloa*, *Hyparrhenia* and *Leptochloa*. Blumea 19:64.

Watson, L. and M.J. Dallwitz. 1992. The grass genera of the world. C.A.B. International.

XANTHOSTEMON FRUTICOSUS (MYRTACEAE), A NEW SPECIES FROM THE PHILIPPINES

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ABSTRACT

A new species of *Xanthostemon, X. fruticosus,* presently known only from the Palanan Wilderness in Isabela Province, Luzon, is described and its relationships discussed.

RESUMEN

Una nueva especie de *Xanthostemon, X. fruticosus,* en la actualidad solamente conocida de la Palanan Wilderness en la provincia de Isabela es descrita y sus relaciones con otras especies discutidas.

Xanthostemon is a genus of around 45 species that occurs in Australia, New Caledonia, the Solomon Islands, Papua New Guinea, Indonesia (Irian Jaya, the Moluccas and Sulawesi) and the Philippines. In the Philippines, only four species have been named and there has been little published on the taxonomy of the genus since Merrill (1952) clarified the application of the names *X. speciosus* and *X. verdugonianus.*

In 1991, a preliminary inventory of the Palanan Wilderness was undertaken as a joint project of Conservation International, Leiden University and the Isabela State University. A report of this inventory is given by Co and Tan (1992). One of the vegetation types encountered was a low scrub that occurred on ultrabasic substrate and was dominated by a shrubby *Xanthostemon* species with large, right red flowers. This has proven to be an undescribed species, most closely related to *X. verdugonianus* and is here described as *X. fruticosus.*

Xanthostemon fruticosus Peter G. Wilson & L. Co, sp. nov. (**Fig. 1**). Type: PHILIPPINES. Luzon Island. Isabela Prov.: Aubarede Peninsula, Lanay Spring, ca. 17 km NNW of Palanan Point, 25 May 1991, *Leonardo Co 3583* (holotype: A; isotypes: PNH, PUH, CAHUP, ISB, L, KEP, US, K, CANB).

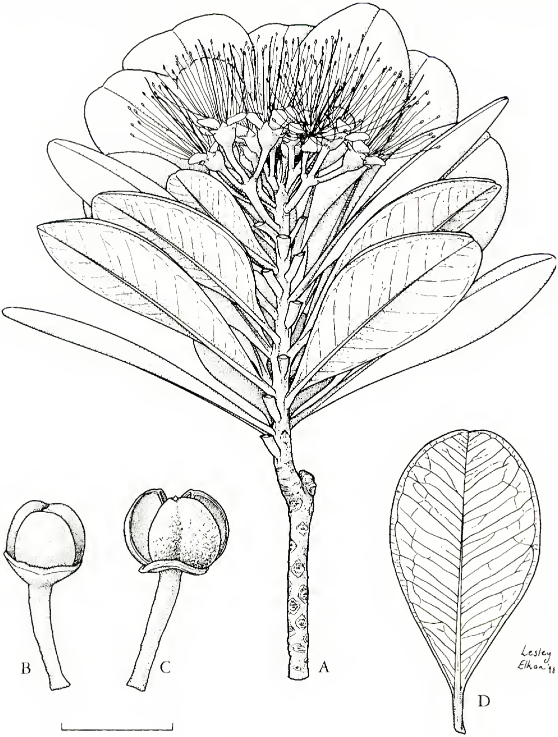

FIG. 1. *Xanthostemon fruticosus* Peter G. Wilson & L. Co. A. Habit B. Immature fruit showing neatly circumscissile hypanthium. C. Open, mature fruit. D. Detail of leaf showing venation. All from holotype. Scale bar: A, D=3 cm; B, C=1 cm.

Xanthostemon verdugiano hypanthio circumscisso valde affinis sed habitu fruticoso foliis floribusque maioribus pedicellis pedunculisque longioribus et petalis roseis differt.

Shrub ca. 1 m high; young shoots sparsely appressed-hairy, glabrescent. *Leaves* spirally arranged; petiole 7–10 mm long, 2.5–3 mm wide; lamina obovate, 6–8 cm long, 3.5–4 cm wide, length:breadth ratio 1.6–2.1:1, coriaceous, apex rounded and emarginate; oil glands numerous. *Inflorescences* crowded toward the apex of seasonal growth unit, subtended by slightly reduced foliage leaves, axillary, the apical bud apparently always growing on (i.e. shoot auxotelic). Unit inflorescences triads; peduncles 5–9 mm long, the upper ones shorter giving a corymb-like appearance to the flowering shoot; pedicels 6.5–10 mm long. Hypanthium cup-shaped, 5–6 mm in diameter, 4–5 mm deep, exceeding the summit of the ovary, ±glabrous. *Petals* 5, pink, oblong to obovate, 5.5–8 mm long, 3.5–6.8 mm wide. *Sepals* 5, ±equal, 2–2.7 mm long, 2.5–3.8 mm wide, ±triangular, apex obtuse to rounded. *Stamens* red ±equally spaced, ca. 22 in a single series around the rim of the hypanthium; filaments 22–25 mm long; anthers 1.2–1.5 mm long, connective broad with one large gland at the apex and 2–5 other, smaller glands. *Ovary* partly inferior, (2–)3-locular, glabrous. Style 30–35 mm long, extending 3–5 mm beyond the stamens; stigma as wide as or slightly narrower than the style, flat. *Fruit* depressed-globular, ca. 8 mm diameter, ca. 6.5 mm high, broadly lobed at each loculus; hypanthium neatly circumscissile 1.5–2 mm above the base, the remnant ±flattened under the capsule. Placentas rod-like, horizontal. Seeds not seen.

Distribution.—Known only from the type locality.

Ecology.—*Xanthostemon fruticosus* has been found near the coast in a low scrub community occuring on exposed sites on soils derived from an ultrabasic substrate. It is the dominant component of this community type at Lanay which also includes a number of other genera of spreadiing or erect shrubs (Co & Tan 1992).

Conservation status.—Apparently rare. Only recorded from one of four ultrabasic sites visited in this part of north-eastern Luzon. Ultrabasic areas are very marginal for agriculture but are potentially subject to applications for nickel mining. As a wilderness, the region does have legal status as a 'Protected Area' but this may not be an impediment to mining.

Etymology.—The epithet is derived from the Latin, *fruticosus,* shrubby, referring to the distinctive habit, a characteristic that distinguishes it from the related *X. verdugonianus*.

The red-flowered *X. speciosus* Merr. From Palawan and nearby islands has a broader, dish-shaped hypanthium with distinct vesicles and is thus not closely related to the new species but belongs with *X. confertiflorus* (Sulawesi) and *X. youngii* (north-eastern Australia) in sect. *Vesicaria* of Gugerli (1940).

Xanthostemon speciosus is usually a tree of 5 meters or more but small trees or shrubs of only 1 meter or so in height have been recorded (e.g. *Co 3032*, A, PUH, KEP).

Xanthostemon fruticosus is closely related to *X. verdugonianus* which it resembles in having red flowers with a circumscissile hypanthium. *Xanthostemon verdugonianus* is a tree up to 26 m high that ranges from north-eastern Mindanao to Sibuyan Island, the latter being over 500 km south of the Palanan area. Despite its range, *X. verdugonianus* has a very limited habitat and is much sought-after for its durable timber, making it a threatened species (Yao & Ulep 1981, 1983).

The neatly circumscissile hypanthium appears to be unique to this pair of species. Two species in New Caledonia have hypanthia that split and are irregularly circumscissile but these are members of an endemic group of taxa with bullate leaves (sect. *Bullata* of Gugerli 1940) and do not appear to be closely related to the Philippine species.

The species may be distinguished as follows:

1. Shrub ca. 1 m tall; lamina 6–8 cm long, 3.5–4 cm wide; petiole 7–10 mm long; petals pink. .... **X. fruticosus**
1. Tree to 26 m tall; lamina 3–7 cm long, 1–3.5 mm; petiole 4–7 mm long; petals red. .... **X. verdugonianus**

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REFERENCES

CO, L.L. and B.C. TAN. 1992. Botanical exploration in Palanan Wilderness, Isabela Province, the Philippines: first report. Fl. Males. Bull. 11:49–53.

GUGERLI, K. 1940. Monographie der Myrtaceengattung *Xanthostemon*. Repert. Spec. Nov. Regni Veg. Beih. 120:1–149.

MERRILL, E.D. 1952. Notes on *Xanthostemon* F. Mueller and *Kjellbergiodendron* Burret. J. Arnold Arbor. 33:150–165.

YAO, C.E. and E.V. ULEP. 1981, Mangkono in Babatngon. Canopy 7:5.

YAO, C.E. and E.V. ULEP. 1983. More on Mangkono. Canopy 9:6–7.

SEASONAL CHANGES IN CONCENTRATION AND DISTRIBUTION OF HEAVY METALS IN CREOSOTEBUSH, *LARREA TRIDENTATA* (ZYGOPHYLLACEAE), TISSUES IN THE EL PASO, TX/CIUDAD JUAREZ, MEXICO AREA

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ABSTRACT

We compared seasonal changes in concentrations of four elements, arsenic, cadmium, copper and lead, in samples of various tissues of creosotebush collected in the El Paso, USA/ Ciudad Juarez, Mexico region during 1980–81 and 1994–95. Levels in leaf tissue changed seasonally, with concentrations dropping in the spring and late fall, corresponding to the time of leaf drop in the plant. This suggests that most of the heavy metals were simply deposited on the surface of leaves, although data are presented which indicate that internal tissues also have significant levels of heavy metals. These seasonal cycles were less pronounced in the most recent samples. Levels of all four elements in cresotebush were significantly high in the region, as compared to a distant control area. Concentrations of most elements dropped below detection limits within 12 to 30 km from areas of highest concentration. Densities of native Chihuahuan Desert flora and lichens are low in the area, suggesting an apparent negative impact of industrial pollution on the local vegetation. Cadmium and lead levels in creosotebush tissues have dropped over the past 15 years, suggesting that enforcement and strengthening of environmental laws has reduced the air pollution levels in the El Paso area.

RESUMEN

Comparamos los cambios estacionales de las concentraciones de 4 elementos, arsénico, cadmio, cobre y plomo, en muestras de varios tejidos de gobernadora colectados en el área de El Paso y Ciudad Juárez, México durante 1980–81 y 1994–95. Se encontró un cambio estacional de los metales con las concentraciones disminuyendo en la primavera y otoño, que coresponden al momento de la caida de las hojas de la planta. Esto sugiere que hay deposición de los elementos en la superficie de las hojas, aunque presentamos datos de que hay acumulación de metales en los tejidos interiores. Estos ciclos estacionales están menos pronunciados en los últimos años. Los niveles de los elementos son altos en la región, pero están concentrados en un área entre 12 y 30 kilómetros del área con concentraciones más altas. Las densidades de la flora y líquenes en el área son bajas, sugiriendo un impacto negativo de la polución industrial en la vegetación local. Los niveles de cadmio y plomo en los tejidos

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ha disminuido en los últimos 15 años, lo que sugiere que la aplicación de las leyes medioambientales ha reducido los niveles de polución en el área de El Paso.

The El Paso/Cd. Juarez area is one of the many regions along the United States/Mexico border which suffers from environmental contamination. The area has been subjected to heavy industrial activity, including smelting and hydrocarbon refining, for over 100 years. This has resulted in an accumulation of heavy metals, especially lead, cadmium, copper and zinc in the local soils (Barnes 1993; Ndame 1993). Arsenic contamination has been previously documented to occur in this region of west Texas (Shields 1991).

These elements and their compounds can cause medical problems in humans and other animals (Elbahri & Benromdane 1991; Louekari et al. 1991). Negative effects of heavy metals on plants have been documented (D'itri 1982; Fernandes & Henriques 1991), including the prevention of the uptake of potassium and phosphorous by roots. Moreover, copper may damage chlorophyll and increase the potency of fungal diseases (Connell & Miller 1984). These effects may eliminate some plant species, with concomitant increases in the abundances of others, thus changing plant community structure. Plants may tolerate heavy metal contamination (Connell & Miller 1984) by excluding metals from sensitive tissues, modifying metabolic pathways to prevent damage or assembling specific enzymes to detoxify heavy metals. The specific effects of heavy metals on the flora of the northern Chihuahuan Desert have not been documented, but Worthington (1989) previously reported a reduction in species richness in native plants in this area, presumably the result of such contamination.

In this investigation, tissues of the dominant Chihuahuan Desert shrub, Larrea tridentata were analyzed, to document continued heavy metal contamination in western Texas. This work is part of a larger study on the effects of heavy metal contamination on the flora and fauna of the northern Chihuahuan Desert and the investigation of bioaccumulation into higher trophic levels.

MATERIALS AND METHODS

We selected a site on the campus of the University of Texas (UTEP) in western El Paso to follow seasonal change in heavy metal concentrations in creosotebush. The site is located within 2 km of a local smelter, which appears to be a point source for the high concentrations of heavy metals in the area. Four elements were included in the analysis: Arsenic, Cadmium, Copper and Lead. Additional sites used to determine the distribution of heavy metals in creosotebush tissues in the region included 62 sampling areas near the border in the United States and six in Mexico within 10 km of the border and of the smelter, of which 52 yielded creosotebush specimens (five replicate bushes at each site). Sites were selected which had native Chihuahuan Desert vegetation located at least 50 meters away from any road. Preliminary analyses showed higher levels of lead next to roadways, which decreased to background levels within a few meters, an effect also noted by Motto et al. (1970), Gratani et al. (1992) and Lebreton and Thevenot (1992).

Leaves were stripped, and twigs were cut from the plants. Roots and trunk tissues were also harvested from plants. Tissues were placed in numbered paper bags and returned to the laboratory. The samples were further cleaned, removing all foreign matter, but were not washed. Bark and exterior tissues were carefully removed from pieces of trunks, to avoid contamination of internal tissues. Tissues from 1980–1981 were collected North of the Education Building on the UTEP campus, as part of another study (Freeman 1982). The tissues were ground and stored dry in glass vials until they were analyzed in 1994. Tissues from 1994–1995 were collected throughout the season from five specific bushes, located in Charlie Davis Park, on the campus of UTEP. This allowed a comparison of the percentages of heavy metals in the tissues of each of the five creosote bushes.

Approximately 20 grams of tissue were placed in a crucible and muffled for three days at 425°C. This relatively low temperature was selected to avoid vaporizing the four elements or their salts (based on the recommendations of Dr. Jim Rayon and Dr. Ken Dodson of the Environmental Protection Agency). After ashing, 100 mg of ash were dissolved in 20 ml of 14% nitric acid (V:V), without filtering. Reagent grade acid and double glass distilled water were used for all solutions. Samples were prepared and stored in glass scintillation vials with polypropylene-lined caps.

Samples were analyzed on a Beckman SpectraSpan 6 direct current plasma atomic emission spectrograph (DCP-AES). We followed the protocol of EPA method 6010 for the inductively coupled plasma emission spectrometer (US EPA 1986). Three of the wavelengths used are those recommended by EPA: 193.696 nm for arsenic, 213.598 nm for copper, and 220.353 nm for lead. The fourth wavelength, 228.802 nm, was substituted for the cadmium analysis to achieve the lowest detection limit. The DCP was calibrated with prepared standard solutions such that the linear calibration curve had an R^2 of at least 0.995. The samples were analyzed by DCP three times and reported the mean and standard deviation of these readings. If the relative standard deviation was greater than 3%, the sample was reanalyzed. Blanks, duplicate samples and prepared standards (spiked samples) were analyzed at least once every ten samples for quality assurance/quality control. Cadmium concentrations in the samples collected in 1994–1995 were close to or below the limits of detection and therefore we have not presented them. After analysis, the DCP solution values were converted to ppm in the original ash. The detection limits in the ash for this study were 200 parts per million (ppm) for arsenic, 11 ppm for cadmium, 85 ppm for copper and 130 ppm for lead.

Data were plotted with SURFER (Golden Software Inc., Golden Colorado), using the grid method with inverse squared distances and the surface module (Keckler 1995).

RESULTS AND DISCUSSION

Seasonal changes.—Levels of all four elements varied seasonally during both time periods (Fig. 1). Levels were high in the winter and showed a small drop in the spring when there is a combination of minor leaf drop and strong spring winds. The levels increased during the summer, especially during the early sampling period (Figs. 1a, b, c), but later showed a large drop during the fall when creosote lose a large proportion of their leaves (Mackay et al. 1987). Concentrations increased again during the winter months, especially during 1980–1981. Levels of heavy metals were lower in the 1994–1995 samples (Fig. 1d & f). Cadmium and lead were both approximately 4 times higher in 1980–1981, suggesting that enforcement and strengthening of environmental laws has reduced the air pollution levels in the El Paso area.

Seasonal changes in concentrations of all metals during both sampling periods were statistically significant (Table 1). The first harmonics from Fourier analysis of the means (Little & Hills 1972), corresponding to the seasonal effect, were significant for all years, although the patterns were more pronounced during the first sampling period (Fig. 1) and had correspondingly higher F values (Table 1). Other harmonics were statistically significant in 1980–1981, showing the importance of leaf drop in lowering heavy metal concentrations during these years, although there was no pattern in which harmonic was significant after the first. The lack of significance of higher harmonics during the second sampling period suggests that leaf drop was not significant in reducing heavy metal content during those years.

Contamination of tissues.—It appears that large amounts of the heavy metals arsenic, copper and lead are deposited on the leaves, but heavy metals are also incorporated into the tissues of this plant (Fig. 2). Large concentrations of all three elements were found in the roots. The trunks also had high concentrations of the three elements, which were present in the internal tissues as well. The branches and the leaves also had high concentrations of the three elements. These data suggest that heavy metals may be deposited on the outside of the plant, but is also taken up by the roots and incorporated into the woody tissue.

Heavy metal geographical distribution: Levels of the four elements (arsenic, cadmium, copper and lead) in creosotebush ash were elevated adjacent to the United States/Mexico border on the west side of El Paso (Fig.

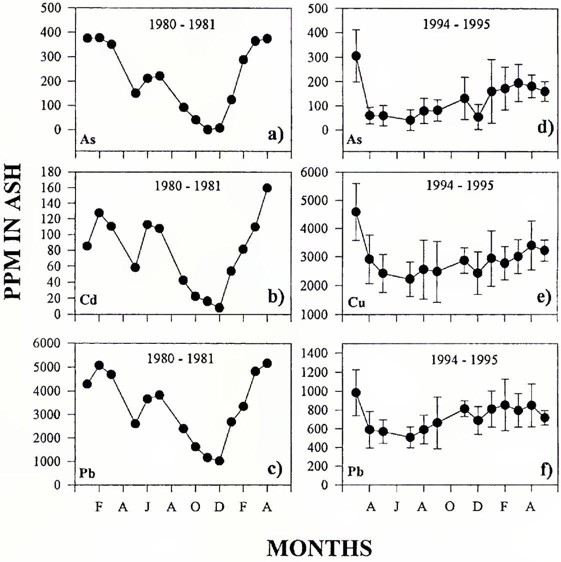

FIG. 1: Seasonal changes in heavy metal concentrations in the leaves of the creosotebush, Larrea tridentata during 1980–1981 and 1994–1995. The gap in 1994–1995 is due to lost samples. Error bars represent standard error of the mean, and are not included in a, b, and c as many of the data points are based on a single sample. The months are abbreviated by a single letter on the x axis.

3). Levels of cadmium were as high as 190 ppm in ash, those of copper reached 5200 ppm and lead levels were as high as 1200 ppm (Fig. 3, note that the surfaces in the figures are close to average values and do not extend to these extreme values). The highest levels of the three elements were recorded on the east side of Mount Cristo Rey (Peak 1 in Fig. 3a), on a small mesa west of McNutt Road (Peak 2 in Fig. 3a), and on the UTEP campus (Peak 3 in Fig. 3a). Levels of all three elements were lower on the southwest side of Mount Cristo Rey, perhaps due to a wind-shadow effect. Levels of all three elements rapidly decreased to the east and fell below detection limits at distances of between 12 and 30 km (Fig. 3).

TABLE 1. Results of Fourier Analysis (Little & Hills 1972) of the periodic functions in Figure 1. Means were used in the analysis.

Source	df	Mean Squares	F Values
Arsenic, 1980–1981			
First harmonic	2	108121.6	22.2^{***}
error	12	4880.5	
Second harmonic	2	9086.0	2.2 ns
error	10	4039.4	
Third harmonic	2	10400.7	4.2^{*}
error	8	2449.1	
Fourth harmonic	2	5426.9	3.7 ns
error	6	1456.5	
Fifth harmonic	2	1361.7	0.9 ns
error	4	1503.8	
Cadmium, 1980–1981			
First harmonic	2	8798.9	9.4^{**}
error	12	940.7	
Second harmonic	2	2910.9	5.3^{*}
error	10	546.7	
Third harmonic	2	28.6	0 ns
error	8	676.3	
Fourth harmonic	2	1051.9	1.9 ns
error	6	551.1	
Fifth harmonic	2	1627.3	125.5^{***}
error	4	13.0	
Lead, 1980–1981			
First harmonic	2	12113720.8	19.9^{***}
error	12	608560.6	
Second harmonic	2	1801911.0	4.9^{*}
error	10	369890.5	
Third harmonic	2	292706.7	0.8 ns
error	8	389186.5	
Fourth harmonic	2	423497.9	1.1 ns
error	6	377749.3	
Fifth harmonic	2	732260.3	3.7 ns
error	4	200493.9	
Arsenic, 1994–1995			
First harmonic	2	19826.3	5.9^{*}
error	12	3362.4	
Second harmonic	2	1159.2	0.3 ns
error	10	3991.7	
Third harmonic	2	5697.3	1.7 ns
error	8	3309.7	
Fourth harmonic	2	1123.4	0.2 ns
error	6	4733.9	
Fifth harmonic	2	6111.7	3.1 ns
error	4	1978.4	

TABLE 1. continued.

Source	df	Mean Squares	F Values
		Arsenic, 1980–1981	
		Copper, 1994–1995	
First harmonic	2	1168398.7	5.0*
error	12	232963.0	
Second harmonic	2	352562.1	1.8 ns
error	10	198791.8	
Third harmonic	2	231261.4	1.2 ns
error	8	185804.0	
Fourth harmonic	2	118186.9	0.5 ns
error	6	230882.1	
Fifth harmonic	2	267145.6	1.7 ns
error	4	158355.2	
		Lead, 1994–1995	
First harmonic	2	68884.3	7.1*
error	12	9648.9	
Second harmonic	2	8773.5	0.9 ns
error	10	9899.0	
Third harmonic	2	8648.6	0.8 ns
error	8	10399.2	
Fourth harmonic	2	2035.2	0.1 ns
error	6	15975.2	
Fifth harmonic	2	15531.3	0.9 ns
error	4	16863.0	

* = F value of harmonic significant at 0.05 level, ** = F significant at 0.01 level, *** = F significant at 0.001 level, ns = F value not significant.

The areas with the highest values of As, Cu, Cd, and Pb in creosotebush (peaks 1–3, Fig. 3) coincide with the sites of the highest concentrations of heavy metals in the soils (Barnes 1993; Ndame 1993) and in fluff grass (MacKay et al. 1998). In this locale, Pb in the soils exceeds the EPA TCLP (Toxicity Characteristics Leaching Procedures) regulatory limit at a number of sites, and Cd is reported quite close to the limit. The spatial correspondence between elevated metal levels in the soil and the flora is not unexpected. The mechanism of uptake of heavy metals by creosotebush remains to be elucidated.

Densities of native Chihuahuan Desert flora and lichens are low in the area (Worthington 1989, MacKay et al. in prep.), suggesting an apparent negative impact of industrial pollution on the local vegetation. The specific effects of heavy metals on the flora of the northern Chihuahuan Desert are currently being documented. The demonstrated reduction in species richness in native plants in this area is presumably the result of heavy metal contamination from the smelter. These effects may eliminate some species and increase the abundance of others.

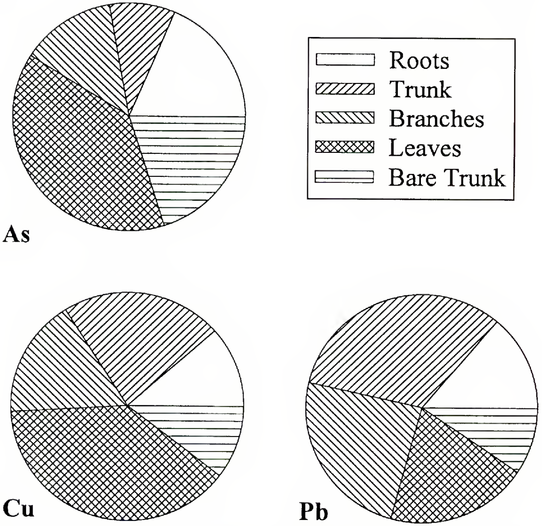

FIG. 2: The distributions of lead, arsenic and copper in specific tissues of the creosotebush from Charlie Davis park on the University of Texas, El Paso campus, El Paso, TX.

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REFERENCES

BARNES, B. 1993. An evaluation of metals concentrations in surficial soils, El Paso County, Texas. Unpublished Master's Thesis, University of Texas at El Paso.

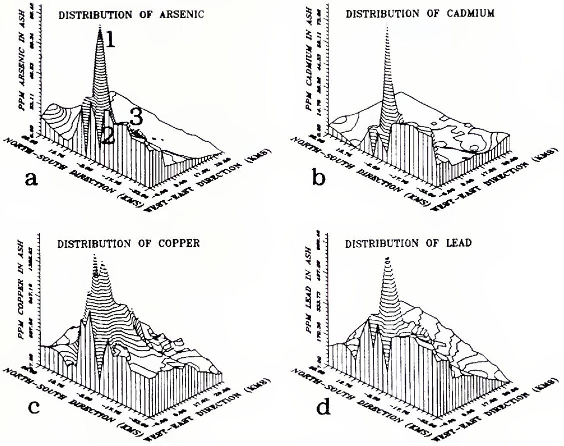

Fig. 3: The distribution of arsenic, cadmium, copper and lead in the El Paso/Ciudad Juárez area. Charley Davis Park on the UTEP campus is located at the origin in the x-y coordinate system (0,0). Peak one corresponds to the east side of Mount Cristo Rey, Peak 2 to a mesa above (west of) McNutt Road and Peak 3 is on the UTEP campus. Detection limits were 200 ppm for arsenic, 11.2 ppm for cadmium, 84 ppm for copper and 132 ppm for lead.

Connell, D.W. and G.J. Miller. 1984. Chemistry and ecotoxicology of pollution. John Wiley and Sons, New York.

D'itri, F.M. 1982. Acid precipitation: effects on ecological systems. Ann Arbor Science, Ann Arbor, MI.

Elbahri, L. and S. Benromdane. 1991. Arsenic poisoning in livestock. Veterinary Human Toxicol. 33:259–264.

Fernandes, J.C. and F.S. Henriques. 1991. Biochemical, physiological and structural effects of excess copper in plants. Bot. Rev. 57:246–262.

Freeman, C.E. 1982. Seasonal variation in leaf nitrogen in creosotebush (*Larrea tridentata* {DC.} Cov.: Zygophyllaceae). SouthW. Naturalist 27:354–356.

Gratani, L., S. Taglioni, and M.F. Crescente. 1992. The accumulation of lead in agricultural soil and vegetation along a highway. Chemosphere 24:941–949.

Keckler, D. 1995. Surfer for Windows, Ver 6.01, Golden Software, Inc., Golden Colorado.

Lebreton, L. and D.R. Thevenot. 1992 Pollution metallique relargable par les aerosols d'origine autoroutiere. Environ. Technol. 13:35–44.

Little, T.M. and F. Hills. 1972. Statistical methods in agricultural research. Agric. Ext. Service, Univ. California.

Louekari, K., S. Valkonen, S. Pousi, and L. Virtanen. 1991. Estimated dietary intake of lead and cadmium and their concentration in blood. Sci. Total Environ. 105:87–99.

Mackay, W.P., S. Silva, S. Loring, and W. Whitford. 1987. The role of subterranean termites in the decomposition of above ground creosotebush litter. Sociobiology 13:235–239.

Mackay, W.P., L. De La Rosa, M. Zavala, P. Shelton, J. Gardea, R. Mena, N. Pingitore, and G. Crawford. 1998. The distribution of heavy metal contamination in the El Paso, TX/Ciudad Juarez, Mexico area, using fluff grass, *Erioneuron pulchellum*, as an indicator organism. Proc. Chih. Desert Res. Inst. (In Press).

Motto H.L., R.H. Daines, D.M. Chilko, and C.K. Motto. 1970. Lead in soils and plants: its relationship to traffic volume and proximity to highways. Environ. Sci. Technol. 4:231–237.

Ndame, E.C. 1993. Heavy metals in soils in the vicinity of the University of Texas at El Paso campus (El Paso, Texas). Unpubl. Master's Thesis, University of Texas, El Paso.

Shields, J. 1991. Ambient air arsenic levels along the Texas - Mexico border. J. Air Waste Manag. Assoc. 41:827–831.

US Environmental Protection Agency. 1986. Test methods for evaluating solid waste (third edition). Washington, D.C.

Worthington, R.D. 1989. Effects of El Paso pollutants on the lichen, moss, and winter annual flora on andesite rock formations. In: P. Ganster and H. Walter, eds. Environmental hazards and bioresource management in the United States/Mexico borderlands, UCLA Latin American Center Publications. Los Angeles. Pp. 105–115.

NEW PLANT RECORDS FOR DOMINICA, LESSER ANTILLES

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ABSTRACT

Twenty-six vascular plant species are reported here for the flora of Dominica, in the Lesser Antilles. These include two pteridophytes, 13 monocotyledons, and 11 dicotyledons. Four of these species are reported as new to the Lesser Antilles: *Marsilea polycarpa* Hook. & Grev., *Diplacrum capitatum* (Willd.) Boeck., *Rhynchospora racemosa* Wright ex Sauvalle, and *Pharus lappulaceus* Aubl.

RESUMEN

Se citan 26 plantas vasculares adicionales para la flora de Dominica en las Antillas Menores. Estas especies incluyen dos pteridófitos, 13 monocotiledóneas y 11 dicotiledóneas. Cuatro de estas especies se presentan como nuevas para la flora de las Antillas Menores: *Marsilea polycarpa* Hook. & Grev., *Diplacrum capitatum* (Willd.) Boeck., *Rhynchospora racemosa* Wright ex Sauvalle, y *Pharus lappulaceus* Aubl.

INTRODUCTION

Dominica is a volcanic island located between the French islands of Guadeloupe and Martinique in the Lesser Antilles. It is about 45 km long and 24 km wide. While it is a small island (1088 sq. km), it presents a diversity of habitats along altitudinal and moisture gradients because of its rugged mountainous topography. Several of the mountain peaks exceed 1200 m (Morne Diablotins 1433 m, Morne Trois Pitons 1402 m, Morne Watt 1242 m, Morne Anglais 1223 m). Water is abundant on the upper slopes of the mountains (e.g. at Freshwater Lake, 8459 mm of rain/yr. has been recorded) but rainfall on the western (Caribbean) coast is severely restricted by a rain shadow (< 2000 mm/yr.) and a dry scrub forest prevails. Severe damage caused by hurricanes and agriculture has also provided opportunities for opportunistic species, increasing the diversity. The coastline is very steep, and the

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cliffs generally continue precipitously into the ocean. Level land is primarily restricted to river deltas in a few narrow bands near the coast, where most citizens live.

Botanically, Dominica is rather well-known. The dicotyledonous flora was treated by Nicolson (1991) who estimated a vascular flora of 1226 species. The most recent treatment of its pteridophytes and monocots was Howard's six volume *Flora of the Lesser Antilles* (1974, 1977, 1979, 1988, 1989a, 1989b) which included detailed distribution notes within that region, and treated the dicots as well. Whitefoord (1989) added 40 phanerogams and six ferns to the flora. This paper reports twenty-six vascular plant species newly discovered and vouchered for Dominica.

METHODS

The plants reported here as new to Dominica were discovered during the period 1990–1997. Approximately 2000 collections were made by the first author for the purpose of assembling a reference herbarium at the Springfield Estate, formerly called the Archbold Tropical Research Center after the late John Archbold who donated the property to Clemson University in 1989. The Springfield Estate is currently leased from Clemson University by a Dominican non-government organization, the Springfield Centre for Environmental Protection, Research, and Education (SCEPTRE). The herbarium there has been informally designated with the acronym "atrc." Specimens donated by several other collectors have also been incorporated into the herbarium.

Collections (2005 numbers) have been made on Dominica during eight visits to the island by Hill as follows: 20 March–26 March 1990 (collection numbers *21230–21379*), 4 March–23 March 1991 (*22009–22179*), 26 July–5 August 1992 (*23924–24171*), 5 March–16 March 1993 (*24612–24847*, w/J. Gable & B. Dorsey), 7 December–19 December 1993 (*25309–25563*, w/I.Renne & D.Bradshaw), 28 May–6 June 1994 (*25610–25872*), 24 May–9 June 1996 (*27861–28262*), and 23 February 1997–14 March 1997 (*28868–29109*, w/L.R. Phillippe). Sets of specimens have been deposited primarily in the Dominican herbarium (atrc), Clemson University (CLEMS), the Illinois Natural History Survey (ILLS), and the Smithsonian Institution (US). Additional duplicates have been distributed to herbaria cited after the individual specimens.

New records of species generally considered to be indigenous to the Lesser Antilles (according to Howard 1974, 1977, 1979, 1988, 1989a, 1989b) are reported here. Some may have actually been introduced to Dominica by human activities, but direct evidence is lacking.

ANNOTATED PLANT LIST

PTERIDOPHYTES

HYMENOPHYLLACEAE

Trichomanes crinitum Sw. An epiphyte similar to *Trichomanes crispum* L. but differing in its lobed or pinnatifid, not entire, pinnae. Its general distribution is northern South America to Jamaica, and it has been reported from Guadeloupe, St. Vincent, and Grenada in the Lesser Antilles. We thank A.R. Smith for the identification.

St. George Parish: elfin forest on windswept ridge between Breakfast River and Valley of Desolation, 6 Mar 1997, *Hill & Phillippe 29070*, (atrc, ILLS, UC).

MARSILEACEAE

Marsilea polycarpa Hook. & Grev. A trailing perennial of temporary ponds, this species of northern South America has not been previously reported in the Lesser Antilles. It has several globose sporocarps arranged and attached in a linear fashion on the frond stipes rather than the single basal sporocarp seen in most other species of the genus. Neither the genus nor family have been previously reported from Dominica.

St. Andrew Parish: locally abundant in and around temporary ponds at E end of Melville Hall Airport, Londonderry Bay, 23 Feb 1997, *Hill & Phillippe 28868* (atrc, BRIT, ILLS, MO, NY, UC, VT).

FLOWERING PLANTS

LILIOPSIDA

AGAVACEAE

Agave dussiana Trel. The century plants are seldom collected, and none were reported from Dominica by Howard (1979). This species, which is endemic to the Lesser Antilles, is very conspicuous in the dry scrub on the dry rocky hills of the NW coast of Dominica in areas of very low rainfall, growing mostly with cacti. Previous collections are known from St. Barts, Antigua, Montserrat, Guadeloupe, and Martinique.

St. Joseph Parish: Morne Raquette (Rachette), Au Piton Road, 18 Dec 1993, *Hill 25524* (atrc, NY). **St. Peter Parish:** Clement James' property, Anse à Liane trail to coast, 0.9 km N of Colihaut, 2 Mar 1997, *Hill & Phillippe 28988* (atrc, BRIT, ILLS, MO, NY, TAES, USF, VT).

CYPERACEAE

Diplacrum capitatum (Willd.) Boeck. This species is rather common in Venezuela and ranges from Panama to Bolivia as well. This appears to be the first record from the Lesser Antilles. Howard (1979) listed only *Diplacrum longifolium* (Griseb.) C.B. Clarke ex Dur. & Schinz. for the Lesser Antilles, from St. Paul Parish, Dominica. We thank M. Strong for the identification.

St. Joseph Parish: Imperial Highway, Central Forest Reserve, Dleu Gommier area, 6 Jun 1994, *Hill 25864* (atrc, NY, US, USF).

Fimbristylis cymosa R. Br. subsp. *spathacea* (Roth) T. Koyama. This is a characteristic, wiry-leaved and tough-rooted, sedge of the windswept flats of the E and NE coasts of Dominica. Pantropical in distribution, it has been collected previously on most of the Lesser Antilles, including Guadeloupe and Martinique.

St. Andrew Parish: roadside 0.5 mi N of Melville Hall Airport, Londonderry Estate, 16 Mar 1993, *Hill 24842* (atrc, CLEMS, MO, NY, TAES, USF).

Rhynchospora racemosa Wright ex Sauvalle. This is the first report of this species for the Lesser Antilles. It is relatively common in the Greater Antilles. We thank M. Strong for the identification.

St. Peter Parish: Morne Espagnol, from Coastal Highway to summit, 4 Aug 1992, *Hill 24149* (CLEMS, NY).

ORCHIDACEAE

Brachionidium parvum Cogn. This tiny epiphyte of the upper montane rainforests was previously known from Venezuela and from Guadeloupe, Martinique, and Grenada in the Lesser Antilles. It was to be expected in Dominica but probably has been overlooked because of its small size (< 5 cm tall). We thank D. Nicolson for the identification.

St. Peter Parish: NW side of Morne Diablotins peak, elfin forest, 6 Mar 1993, *Hill 24647* (atrc, CLEMS). **St. George Parish:** Laudat, ca. 1 km W of Titou Gorge, 4 Jun 1996, *Hill 28177* (atrc, ILLS, USF).

POACEAE

Ichnanthus nemorosus (Sw.) Doell. var. *swartzii* K.E.Rogers. Generally distributed in the Antilles and Trinidad, this trailing rainforest species has been collected previously on St. Kitts, Nevis, Montserrat, Martinique, St. Vincent, and Grenada in the Lesser Antilles.

St. George Parish: Morne Anglais trail to summit, S of Giraudel, 2 Jun 1996, *Hill 28124* (atrc, ILLS).

Isachne angustifolia Nash. This thicket-forming grass which often climbs over other plants has been known previously from Puerto Rico, and from Guadeloupe, Martinique and St. Kitts in the Lesser Antilles. The new record is an expected range extension. We thank G. Davidse for the identification.

St. George Parish: Morne Anglais trail at summit, S of Giraudel, 2 Jun 1996, *Hill 28077* (atrc, ILLS, TAES).

Isachne arundinacea (Sw.) Griseb. This is another clambering grass of exposed wet mountain slopes, and its general range is Jamaica to Trinidad S to Bolivia and N to Mexico. In the Lesser Antilles it has been previously collected on St. Kitts, Guadeloupe, and Grenada. We thank G. Davidse for the identification.

St. Paul Parish: trail to summit of Morne Trois Pitons, N side, just NE of Pont Cassé, 9 Dec 1993, *Hill 25340* (atrc, MO, VT).

Leptochloa virgata (L.) Beauv. A very widely distributed grass which ranges from the southern United States through the Caribbean and Central America to South America. It has been collected on many of the Lesser Antilles, including nearby Marie Galante and Martinique, and was to be expected on Dominica.

St. Peter Parish: Clement James' property, Anse à Liane trail to coast, 0.9 km N of Colihaut, 26 Feb 1997, *Hill & Phillippe 28962* (atrc, ILLS, MO, TAES).

Pharus lappulaceus Aubl. This wide-ranging, wide-leaved grass is found in forests from the Caribbean and Central America to southern South America. Howard (1979) noted the similar *P. glaber* Kunth from Dominica. We thank T.S. Filgueiras for the identification.

St. Mark Parish: Petit Coulibri, Morne Fous, 15 Mar 1993, *Hill 24796* (atrc, CLEMS).

Phragmites australis (Cav.) Trin. ex Steud. Probably due to the general lack of suitable habitat, the common reed has not previously been collected on Dominica. Otherwise, it is widespread in both tropical and temperate portions of the world, and has been collected previously in the Lesser Antilles on Guadeloupe, Martinique, and St. Lucia.

St. John Parish: marsh at N side of Coconut Beach Hotel, Prince Rupert Bay, Portsmouth, 29 May 1996, *Hill 27993* (atrc, ILLS).

Spartina patens (Ait.) Muhl. This grass, usually found in salt marshes and flats along the coast, was a surprising find in Dominica where these habitats are essentially lacking. The species generally ranges from the E coast of North America from Quebec to Mexico, Central America, and the Caribbean. In the Lesser Antilles it has been collected previously on St. Martin, Antigua, and Guadeloupe. We thank D. Nicolson for the identification.

St. Andrew Parish: just N of the mouth of the Londonderry (Tweed) River, Londonderry Estate, coastal rock ledges, 14 Dec 1993, *Hill & James 25475A* (atrc, VT).

Urochloa plantaginea (Link) Webster. Often reported as *Brachiaria plantaginea* (Link) Hitchc., this grass of unstable areas ranges widely from Mexico and the Caribbean to Brazil and Bolivia. As with *Phragmites*, it may be a recent introduction, though Dominica falls within its general range. It has been previously collected in the Lesser Antilles only on St. Lucia. We thank T.S. Filgueiras for the identification.

St. Paul Parish: Morne Daniel Road, Canefield, 10 Mar 1993, *24701* (atrc, CLEMS).

MAGNOLIOPSIDA

COMBRETACEAE

Conocarpus erecta L. The button mangrove (buttonwood) is widely distributed in the American tropics along the coasts of Florida, USA, S through

Mexico and Central America to the Caribbean and tropical South America and it has also been collected in West Africa. Buttonwood has been found on nearly all of the other Lesser Antilles. Hodge (1964) noted: "the common genera of mangrove (*Rhizophora*, *Avicennia*, *Laguncularia*, and *Conocarpus*) are absent from Dominica, a fact easily accounted for by the lack of sufficient lowland sites on an island where the coastline is very precipitous." Diligent searching by Arlington James and other members of the Division of Forestry and Wildlife have resulted in the verification of the occurrence on Dominica of three of these genera, two of which (*Avicennia* and *Conocarpus*) are reported here as new. Of the four genera listed by Hodge, only *Rhizophora* has not yet been found on Dominica. *Laguncularia* was reported by Nicolson (1991). Only one individual of *Conocarpus* has been found.

St. Andrew Parish: Ballyboo Beach, Batibou Bay, Hampstead, 14 Dec 1993, *Hill & James 25454*. (atrc, CLEMS).

CONVOLVULACEAE

Convolvulus nodiflorus Desr. This species is widespread in dry scrub in the West Indies, Central and South America. It has previously been collected on the majority of the Lesser Antilles, including nearby Guadeloupe and Martinique, and was to be expected on Dominica. We thank D. Nicolson for the identification.

St. Joseph Parish: Morne Raquette (Rachette), Au Piton Road, 18 Dec 1993, *Hill 25526* (atrc, GH, MO, NY, US, USF). **St. Peter Parish:** S of Morne Espagnol between Bioche and Colihaut, coastal highway, 7 Jun 1996, *Hill 28248* (atrc, MO, US).

EUPHORBIACEAE

Euphorbia balbisii Boiss. A species endemic to the Lesser Antilles, also known as *Chamaesyce balbisii* (Boiss.) Millsp., *E. balbisii* was previously known only from Barbuda, Antigua, Guadeloupe, and La Désirade. It is a prostrate species of wind-swept salt-sprayed coastal cliffs in Dominica.

St. Andrew Parish: Woodford Hill Estate, just E of Pte. La Soie E of an old quarry, 14 Dec 1993, *Hill & James 25464* (atrc, NY).

FABACEAE

Dalbergia monetaria L.f. Generally distributed from Jamaica to tropical South America, Howard (1988) reported that the species previously had been collected in Guadeloupe, Martinique, and St. Vincent. Vélez (1957) reported this species as present on Dominica, but Nicolson (1991) dismissed this as a misidentification. Differing from *D. ecastaphyllum* (L.) Taubert (which is common on Dominica and has unifoliolate leaves) by its pinnately compound leaves (3–5 leaflets), it is rather common locally along the banks of the Indian river. The identification was confirmed by V. Rudd (SFV).

St. John Parish: Indian River banks, Portsmouth, 5 Mar 1997, *Hill & Phillippe 29056* (atrc, BRIT, ILLS, MO, NY, US, USF, VT).

MALVACEAE

Sida jamaicensis L. This wide-ranging species is known from Mexico, the Caribbean, Central America, and northern South America. In the Lesser Antilles it has previously been collected on St. Barts, Antigua, Montserrat, Guadeloupe, and Les Saintes in the dry scrub forests. We thank Paul Fryxell for the identification.

St. Joseph Parish: Morne Raquette (Rachette), Au Piton Road, 4 Jun 1994, *Hill 25808* (atrc, NY, TEX, USF).

NYMPHAEACEAE

Nymphaea amazonum C.Mart. & Zucc. This night-flowering water lily ranges throughout the Caribbean and from Mexico to southern Brazil. It previously has been collected in Guadeloupe, Marie Galante, Martinique and St. Lucia in the Lesser Antilles. Suitable habitat for the species is very scarce on the island. We thank J. Wiersema for the identification.

St. Andrew Parish: roadside 0.5 mi N of Melville Hall Airport, Londonderry Estate, 16 Mar 1993, *Hill 24844* (atrc, CLEMS).

OLEACEAE

Forestiera segregata (Jacq.) Krug & Urb. Another new discovery in the dry scrub forests of western Dominica, this species ranges from the coastal SE USA, S to the Lesser Antilles. It has been collected previously on Anguilla, Barbuda, Antigua, La Désirade, and Marie Galante in the Lesser Antilles. We thank A. Goldberg and D. Nicolson (US) for the determination.

St. Joseph Parish: Morne Raquette (Rachette), Au Piton Road, 18 Dec 1993, *Hill 25550* (atrc, GH, NY, US).

RUBIACEAE

Randia nitida (H.B.K) DC. This spiny coastal shrub is distributed from Mexico to South America and the Caribbean. In the Lesser Antilles it has been reported from Martinique, St. Lucia, St. Vincent, and Grenada. It is distinguished from the more frequent *R. aculeata* L. by its flower size (3–3.8 cm vs. 2 cm long in *R. aculeata*) and fruit size (3.2–5 cm vs. 1–1.2 cm long in *R. aculeata*). We thank D. Nicolson (US) for the identification.

St. Paul Parish: Rodney's Rock on the coast, Hertford Estate, 13 Dec 1993, *Hill 25425* (atrc).

RUTACEAE

Pilocarpus racemosus Vahl. This Caribbean endemic ranges from Cuba to the Lesser Antilles. It has been collected previously on Montserrat, Guadeloupe, and Martinique in the Lesser Antilles and was to be expected on Dominica. It is restricted to windswept coastal forests and is associated with the palm *Rhyticocos* on the N coast of Dominica. We thank D. Nicolson for the identification.

St. Andrew Parish: cliffs at W side of Ballyboo Beach, Batibou Bay, Hampstead, 16 Mar 1993, *Hill 24823* (atrc, CLEMS, NY, TAES, US, USF); same locality, 14 Dec 1993, *Hill & James 25453* (CLEMS).

VERBENACEAE

Avicennia germinans (L.) L. The black mangrove was a particularly interesting find on Dominica. While it was thought to be absent by previous authors (see comments under *Conocarpus*, above) it was located by the second author in recent years at several places, the most unusual one in elevated cliffside sedge-dominated seeps on the NE coast of the island. Other populations are restricted to a few square meters of level land at the mouth of small rivers. Like *Conocarpus*, *Avicennia* is widely distributed along coasts from Florida and Texas, USA, to northern South America. It has been found on nearly all of the other Lesser Antilles.

St. David Parish: mouth of the Ouayaperi River, Corossol Beach, 0.6 km N of La Plaine, 12 Dec 1993, *Hill 25390* (atrc, CLEMS, BRIT, ILLS, MO, NY, US, USF, VT). **St. Andrew Parish:** Woodford Hill Estate, just E of Pte. La Soie E of an old quarry in sedge seeps, 14 Dec 1993, *Hill & James 25469* (atrc); mouth of Eden River, Eden Estate, S of Crompton Point, 14 Dec 1993, *Hill & James 25473* (atrc, GH, NY, US, USF).

VITACEAE

Cissus obovata M. Vahl. A vine endemic to the Caribbean, *C. obovata* is easily distinguished from the more common *C. verticillata* (L.) Nicolson & Jarvis by its trifoliolate rather than simple leaves. It ranges from Cuba, S to the northern Lesser Antilles. Collections previously have been made in the Lesser Antilles on St. Martin, St. Barts, and Barbuda.

St. George Parish: head of trail to Trafalgar Falls, Trafalgar E of hydroelectric facility, 25 May 1996, *Hill 27871* (atrc).

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REFERENCES

Hodge, W.H. 1954. Flora of Dominica, B.W.I. Part 1, Lloydia, 17:1–238.

Howard, R.A. 1974. Flora of the Lesser Antilles, Leeward and Windward Islands: Orchidaceae. Arnold Arboretum, Harvard University, Cambridge, MA.

Howard, R.A. 1977. Flora of the Lesser Antilles, Leeward and Windward Islands: Volume 2 Pteridophyta. Arnold Arboretum, Harvard University, Cambridge, MA.

Howard, R.A. 1979. Flora of the Lesser Antilles, Leeward and Windward Islands: Volume 3 Monocotyledoneae. Arnold Arboretum, Harvard University, Cambridge, MA.

Howard, R.A. 1988. Flora of the Lesser Antilles, Leeward and Windward Islands: Volume 4 Dicotyledoneae–Part 1. Arnold Arboretum, Harvard University, Cambridge, MA.

Howard, R.A. 1989a. Flora of the Lesser Antilles, Leeward and Windward Islands: Volume 5 Dicotyledoneae–Part 2. Arnold Arboretum, Harvard University, Cambridge, MA.

Howard, R.A. 1989b. Flora of the Lesser Antilles, Leeward and Windward Islands: Volume 6 Dicotyledoneae–Part 3. Arnold Arboretum, Harvard Univetsity, Cambridge, MA.

Nicolson, D.H. 1991. Flora of Dominica, Part 2: Dicotyledoneae. Smiths. Contr. Bot. 77:1–274.

Vélez, I. 1957. Herbaceous angiosperms of the Lesser Antilles. San Germán, Puerto Rico.

Whitefoord, C. 1989. Recent plant collections from Dominica. J. Arnold Arbor. 70:143–152.

A NEW ADDER'S-TONGUE (*OPHIOGLOSSUM:* OPHIOGLOSSACEAE) FOR NORTH AMERICA

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ABSTRACT

The widespread Old World adder's-tongue, *Ophioglossum polyphyllum* A. Br. is reported for the first time in North America. Formerly confused with *O. engelmannii* Prantl, we now recognize as *O. polyphyllum* collections from U.S.A. (Texas and Arizona) and Mexico (Hidalgo, Oaxaca, San Luis Potosí, and Zacatecas). The earliest confirmed collection was in 1874. The two species are keyed out and illustrated, and specimens of *O. polyphyllum* are listed. The known county distribution of the species in Texas is mapped, and the habitat and phenology are briefly described.

RESUMEN

La lengua de serpiente del Viejo Mundo, muy frecuente, *Ophioglossum polyphyllum* A. Br. se cita por primera vez en Norte América. Previamente confundida con *O. engelmannii* Prantl, reconocemos ahora como *O. polyphyllum* colectas de E.E.U.U. (Texas y Arizona) y Mexico (Hidalgo, Oaxaca, San Luis Potosí, y Zacatecas). La primera colecta confirmada fue en 1874. Se ofrece una clave de identificación y se ilustran las dos especies, y se listan los especímenes de *O. polyphyllum*. Se cartografía la distribución conocida por condados en Texas, y se describen brevemente el hábitat y la fenología.

The adder's-tongues, *Ophioglossum* (Ophioglossaceae) are a small group of striking and unusual species, with the highest known chromosome numbers in the plant kingdom. The gametophytes are subterranean, the roots lack root hairs, and the leaf is made up of two parts: the sterile blade portion (trophophore) and the spore-bearing portion (sporophore). The trophophore has complex reticulate venation and is believed to be phyllodial in origin (Wagner 1979). The sporangia are deeply sunken in the apical portion of the sporophore. There are probably as many as 35 species worldwide but two areas, India and Africa, seem to be regions of maximum diversity. Many of the species occur in open arid sites and remain underground until seasonal or sporadic rains stimulate the leaves to push up through the soil and

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grow to full size before discharging the spores. In America north of Mexico seven terrestrial species are traditionally recognized: *Ophioglossum pusillum* Raf., *O. vulgatum* L., *O. californicum* Prantl, *O. nudicaule* L.f., *O. petiolatum* Hook., *O. crotalophoroides* Walter, and *O. engelmannii* Prantl. However, we have recently discovered another species heretofore unknown from the New World. We originally interpreted the plants in question as a narrow form of *O. engelmannii* (Zech & Manning 1996), but subsequent study reveals a number of differences from that species, and we now identify it confidently as *O. polyphyllum* A. Br. The earliest collection was in 1874. Clausen's monograph (1938) does not even recognize this species anywhere in the world; he merely synonymized it with *O. vulgatum*. Nevertheless, we have come a long way taxonomically from the first half of this century, not only in regard to Ophioglossaceae, but Lycopodiaceae, Isoëtaceae, Thelypteridaceae, and many other pteridophyte groups. Lellinger's (1985) manual of North America pteridophytes does not list *O. polyphyllum*, nor does Flora North America north of Mexico (Wagner & Wagner 1993).

This species has an enormous range: Africa, Asia (e.g., S. China, India), Polynesia (e.g. Hawaii), and now North America. It is probably made up of a number of subspecies, but these are held together by a set of distinctive characters, described below. There is no question that it is most closely related to *O. engelmannii*. Its main point of resemblance involves the venation pattern in which the major areoles include minor areoles, a condition commonly referred to as bireticulate. In most species the major areoles of adder's-tongues possess only free included veinlets that themselves do not interconnect. Large specimens of *O. nudicaule* (the form known as *O. ellipticum* Hook. & Grev.) usually possess bireticulate veins (Wagner et al. 1984), as does the Old World *O. costatum* A. Br. (Burrows 1996). Both *Ophioglossum vulgatum* and *O. reticulatum* show a tendency toward bireticulation, but the relatively few areoles are coarser and more open. The very fine bireticulation in *O. engelmannii* and *O. polyphyllum* is quite distinctive.

Ophioglossum engelmannii is apparently a strictly New World taxon, and limited to North America, including Mexico, and Central America. It is commonly referred to as "Limestone adder's-tongue" for its tendency to grow on soil layers above limestone. In the United States it usually appears during and after rains, but it may reappear in the same places during later high precipitation periods. Dean P. Whittier of Vanderbilt University has actually forced a new "brood" of leaves to form in late summer by watering a site where the plants normally appear only in the spring (pers. comm.).

A key to the two species is presented below. To see the venation of a dried specimen more clearly, a drop of 95% alcohol placed on the laminar surface will, after soaking in, clear the leaf temporarily and will not damage the specimen. Collectors should be warned not to break off or remove the characteristic elongate brown leaf sheaths that surround the green leaf bases: collecting can be accomplished best by carefully digging up the specimens. This has the added advantage of showing the roots, and their numbers and relative sizes.

Roots 25(15–30),thinner, mostly 0.6(0.3–0.9) mm thick, yellow to dark brown, commonly somewhat crooked (dried); persistent old leaf bases numerous, 5 (2–9); trophophore narrowly ovate, attenuate proximally and distally, length/width 4, 4.8(3.2–7.7) × 1.2(0.7–1.9) cm; sporangial clusters 1.8(0.6–2.6) × 0.25(0.2 –0.3) cm; apicula 1.0(0.3–1.8) mm. .... **O. polyphyllum**

Roots 15(6–24), thicker, 0.9–1.1(0.3–2.0) mm, often darker or blackish, usually straight (dried); persistent old leaf bases few 2(1–4); trophophore broadly ovate to oblong, length/width = 3, 6.0(4.5–8.5) × 2.0(1.5–2.5); sporangial clusters 2.5(2.0–4.0) × 0.25(0.2–0.4) cm; apicula 0.6(0.0–1.3) mm. .... **O. engelmannii** (Fig. 1)

The county distribution of *Ophioglossum polyphyllum* in Texas is shown in Figure 2 (triangles) in comparison with *O. engelmanni* (dots). The map shows a dramatic difference in range between the two species. Most of the collections of *O. polyphyllum* were made along U.S. Highway 90 or on roads nearby: in Brewster County near Alpine and Marathon; in Jeff Davis County near Valentine; and in Presidio County near Marfa. On the basis of our experience, we believe that an effort ought to be made to explore much further afield in other Texas (as well as New Mexico and Arizona) counties, e.g., Hudspeth, Culberson, Reeves, Ward, Pecos, and Terrell in Texas, and also areas to the south in Mexico (e.g., Coahuila, Chihuahua, and Sonora states and southwardly adjacent states).

There are many reasons why *O. polyphyllum* was not heretofore collected, among the most important being its occurrence among grasses, the shape of the leaf resembling some monocots, and especially the very short period of appearance above ground, which after strong rains probably rarely exceeds two weeks, the latter week presenting only dying straw colored and withered blades.

Plants are found in shallow ditches and troughs along the roadsides (Fig. 3). The adjacent landscape is open rangeland. While no plant species occur consistently with *O. polyphyllum*, the two most prevalent are the grasses *Buchlöe dactyloides* and *Bouteloua curtipendula*. Other, less consistent associates are *Bouteloua gracilis, Chloris verticillata, Hilaria mutica, Panicum obtusatum,* and *Bothriochloa* sp. Among the forbs are *Asclepias oenotheroides, Berlandiera lyrata, Cirsium texanum, Cooperia drummondii, Croton* Pottaii, *Engelmannia pinnatifida, Ratibida columnaris,* and *Thymophylla* sp. The vegetation is typical Chihuahuan Desert grassland, and includes such cactus genera as *Coryphantha*, *Echinocereus*, and *Opuntia*. The substrate involves various clays that are usually deep and allu-

FIG. 1. A semi-diagrammatic comparison of *O. polyphyllum* (left) and *O. engelmannii* (right). Scale bar = 2 cm.

vial. Plants within adder's-tongue colonies vary from several to hundreds. Vegetative reproduction is accomplished by horizontal roots, the proliferations producing plantlets as far as ten centimeters from the genet.

Our records outside of Texas are very few, and all were previously identified as *O. engelmannii*. In Arizona it was found in "mesas around the Mustang Mts." The habitats in Mexico (what little is recorded on the labels) appear to be more or less similar to those in Texas. The Rollins and Tryon collection listed below was found in "clay soil over limestone, in shade of small arborescent *Opuntia* in *Larrea* and *Prosopis* desert," and the Reeder et

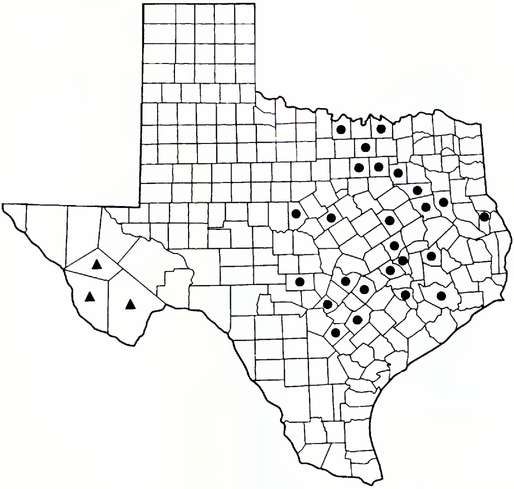

FIG. 2. Presently confirmed county records in Texas for *O. polyphyllum* (triangles) and O. *engelmannii* (dots).

al. collection in "thorn savannah in the open among *Euchloë dactyloides* and *Bouteloua stolonifera*." The Pringle and Purpus Mexican collections lack habitat data.

Collection citations: U.S.A. **ARIZONA:** Mustang Mountains, 13 Sep, *C. G. Pringle* in 1884, (GRAY). **TEXAS.** (Collections made along Hwy 90 and deposited in SRSC, unless otherwise indicated. **Brewster Co.:** 5.5 mi E of Marathon N of Hwy 90, 7 Jun 1995, *Manning 896*; 5.9 mi W of Marathon S of Hwy 90, 20 Jun 1995, *Manning 897*; 6.5 mi E of Alpine S of Hwy 90, 8 Jul 1995, *Manning 914*; 12 mi W of Marathon S of Hwy 90, 5 Jul 1995, *Manning s.n.*; 6.5 mi W of Marathon N of Hwy 90, 24 Jun 1996, *Manning 959*; 5.7 mi E of Marathon, 11 Jun 1995, *A.M. Powell & S.A. Powell 6085*; 6.0 mi E of Marathon N of Hwy 90, 13 Jun 1997, *Manning 1013*; 17 Jun 1997, *Manning & Zech 1017A* (MICH); 24 Jun 1997, *Manning & Zech 1017B* (MICH); 6.2 mi E of Marathon S of Hwy 90, 14 Jul 1997, *Hansen et al. 40*; 6.3 mi S of Brewster/Pecos Co. line, 30 Jun 1997, *Manning 1034*. **Jeff Davis Co.:** 7.8 mi W of Valentine E of Hwy 90, 11 Jul 1995, *Manning 915*; 25 Jun 1997, *Manning & Zech 1020* (MICH); 0.2 mi SE of 505/166 jct. on loop 166, 14 Aug 1971, *Keil 1699* (GRAY); 25 Jun 1997, *Manning & Zech 1031* (MICH). **Presidio Co.:** 0.1 mi E of Marfa, 26 Jul 1995, *Manning 925*.

FIG. 3. Habitat of *O. polyphyllum* in shallow roadside ditch. TX: Jeff Davis Co., along loop 166.

MEXICO. Hidalgo: Hill, near El Gallo, 7000 ft, 17 Aug 1902 *C.G. Pringle* (GH). **Oaxaca:** Los Maranjos, vicinity of San Luis Tultitlanapa, Puebla, near Oaxaca, May 1908, *C.A. Purpus 3152* (GH). **San Luis Potosí:** 15 mi NE of San Luis Potosí, 6500 ft, 4 Sep 1961, *J.R. Reeder, C.G. Reeder, & T.R. Soderstrom 3300* (GH). Zacatecas: 32 mi N of Fresnillo, 25 Nov 1958, 7000 ft, *R.C. Rollins and R.M. Tryon* (GH).

There is no easily projected certainty about when the plants will appear. Continuous drought will prevent the leaves from expanding and extending above the soil. However, the best months in general are June and July, whenever several rains occur. Apparently, chance rainy periods at any other time, however, will bring forth an "out-of-season" growth, and we now have records from May, August, September, October, November, and December. Our impression is that *O. polyphyllum* "lies in wait" for rain, emerges through tightly compacted soil that has been softened by the water, and then has a fairly short time span to reproduce and disperse spores. However, based upon greenhouse observations, even when water availability is not a factor, trophophores will tend to die back following spore production and dispersal.

It should be noted that *O. polyphyllum* is ecologically a "loner," in the sense that it does not occur microsympatrically along with other species of *Ophioglossum* (or *Botrychium*). Other Ophioglossaceae are noted for forming "genus communities," members of the same or closely related genera that co-occur syntopically (Wagner & Wagner 1983). To illustrate the usual situation, in the United States in the region from the Carolinas to Arkansas and southward, we find *O. nudicaule, O. crotalophoroides*, and *O. petiolatum* (plus the ophioglossaceous *Botrychium biternatum* and *B. lunarioides*) together in the same habitat, sometimes side by side and intermixed with each other. But this is evidently not the case with *O. polyphyllum* according to Burrows (1996) who writes that in Africa *O. polyphyllum* is "The one species of *Ophioglossum* that is rarely found as a component of genus communities."

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REFERENCES

BURROWS, J.E. 1996. The genus *Ophioglossum* L. in southern central Africa. In: J.M. CAMUS, M. GIBBY, and R.J. JOHNS, eds. Pteridological Perspectives. Royal Bot Gard. Kew. Pp.329–336.

CLAUSEN, R.T. 1938. A monograph of the Ophioglossaceae. Mem. Torrey Bot. Club. 19:1–177.

CLUTE, W. 1901. Our ferns in their haunts. F. Stokes Co. NY.

LELLINGER, D.B. 1985. A field manual of the ferns & fern allies of the United States & Canada. Smithsonian Institution Press, Washington, DC.

WAGNER, W.H. 1979. Reticulate veins in the systematics of modern ferns. Taxon 28:87–95.

WAGNER, W.H., C.M. ALLEN, and G.P. LANDRY. 1984. *Ophioglossum ellipticum* Hook. & Grev. in Louisiana and the taxonomy of *O. nudicaule* L. f. Castanea 49:99–110.

WAGNER, W.H. and F.S. WAGNER. 1983. Genus communities as a systematic tool in the study of New World *Botrychium* (Ophioglossaceae). Taxon 32:51–63.

WAGNER, W.H. and F.S. WAGNER. 1993. Ophioglossaceae C. Agardh. Adder's-tongue Family. In: Flora of North America Editorial Committee, eds. 1993+. Flora of North America north of Mexico, 3+ vols. New York and Oxford. Vol. 2, pp. 85–106.

ZECH, J.C. and P.R. MANNING. 1996. *Ophioglossum engelmannii* in Trans-Pecos, Texas. Amer. Fern J. 86:102.

NOTES ON THE FLORA OF TEXAS WITH ADDITIONS AND OTHER SIGNIFICANT RECORDS

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ABSTRACT

The following 15 taxa are documented new to Texas: *Alternanthera sessilis*, *Cyperus eragrostis*, *Urochloa ramosa*, *Lindernia crustacea*, *Phyllanthus fraternus*, *Stellaria parva*, *Alysicarpus vaginalis*, *Cardamine debilis*, *Rhynchospora debilis*, *Lilaeopsis chinensis*, *Rumex paraguayensis*, *Saccharum coarctatum*, *Utricularia foliosa*, *Polygonum meisnerianum*, and *Cuscuta polygonorum*. Significant new collections records are provided for five: *Scirpus cubense*, *Polygonum cespitosum*, *Phyllanthus niruri*, *Ludwigia microcarpa*, and *Armoracia lacustris*. Data are presented to question the presence of *Eleocharis compressa* in Texas. Taxa are listed alphabetically by family, genus, and species with annotations and citation of voucher specimens.

RESUMEN

Los siguientes 15 taxa se citan como nuevos para Texas: *Alternanthera sessilis*, *Cyperus eragrostis*, *Urochloa ramosa*, *Lindernia crustacea*, *Phyllanthus fraternus*, *Stellaria parva*, *Alysicarpus vaginalis*, *Cardamine debilis*, *Rhynchospora debilis*, *Lilaeopsis chinensis*, *Rumex paraguayensis*, *Saccharum coarctatum*, *Utricularia foliosa*, *Polygonum meisnerianum*, y *Cuscuta polygonorum*. Se ofrecen nuevas citas importantes para cinco: *Scirpus cubense*, *Polygonum cespitosum*, *Phyllanthus niruri*, *Ludwigia microcarpa*, y *Armoracia lacustris*. Se presentan datos para cuestionar la presencia de *Eleocharis compressa* en Texas. Los taxa están listados alfabéticamente por familia, género, y especie con anotaciones y citas de los pliegos testigo.

INTRODUCTION

Floristic work in the Houston area has resulted in a mimeographed plant checklist for: Brazos Bend State Park, Fort Bend County by Larry E. Brown, Frank Gregg, and Kay Lewis; Davis Hill State Natural Area, Liberty County by Larry E. Brown, Charles D. Peterson, and Joe Liggio; and the entire Houston area (Harris and adjacent counties) by Larry E. Brown. In addition, the present authors have just completed a plant checklist for the Trinity River National

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Wildlife Refuge, Liberty County. This work coupled with plants sent to the SBSC herbarium for identification has revealed a number of plants new to Texas and significant new records for others. Some of these records were provided to Stanley D. Jones prior to the publication of his book, *Vascular Plants of Texas* (Jones et al. 1997). Here we give data to support inclusion of these plants in this new publication.

Unless otherwise indicated, all collections cited in this paper are in the Spring Branch Science Center Herbarium (SBSC), Houston, Texas. Duplicates of some collections are at TEX or TAES. Herbarium acronyms follow Holmgren et al.(1990).

AMARANTHACEAE

Alternanthera sessilis (L.) DC.—A few plants of this pantropical and federal noxious weed were found growing in the bottomland of the Trinity River in the Davis Hill State Natural Area; 4 Jul 1994, *Brown 18040*. Clewell (1985) reported it for Escambia County in the Florida Panhandle and Thomas and Allen (1996) mapped it for ten, mostly central, Louisiana parishes. Nelson et al.(1997) reported it new for South Carolina and cited published reports for its occurrence in Alabama and Mississippi. The key in Mears (1977) can distinguish the Texas species of *Alternanthera*, including *A. sessilis*.

APIACEAE

Lilaeopsis chinensis (L.) Kuntze—Affolter (1985) mapped this species along the Atlantic and Gulf Coast from Nova Scotia south to Florida and westward along the Gulf Coast to Louisiana (one collection). Thomas and Allen (1996) mapped it for eight coastal parishes west to Vermillion Parish. The only Texas collection is from Galveston Bay below the Abshire House in the Abshire Wildlife Management Area at Smith Point, Chambers County, 7 May 1993, *Brown 16926*. These plants were submerged at high tide and exposed during low tide.

BRASSICACEAE

Armoracia lacustris (A. Gray) Al-Shehbaz & Bates (lake cress)—Correll and Johnston (1970) did not report this white flowered aquatic crucifer for Texas. The first record appears to be in Al-Shehbaz and Bates (1987) where it is mapped in Tyler County. We found it to be infrequent in standing water in the Davis Hill State Natural Area, Liberty County (31 May 1996, *Brown & Liggio 19172*) and in the bottomland of the Trinity River National Wildlife Refuge, Liberty County (26 Apr 1997, *Brown & Marcus 20262*). These plants produced numerous flowers but had poor fruit development. Molecular studies based upon DNA (Les 1994) indicate that lake cress should be placed into a monotypic genus *Neobeckia* as *N. aquatica* (Eaton) Greene and that the cause for a poor seed set is suggested by the discovery of a triploid chromosome number of $2n = 28$ (Les et al. 1995).

Cardamine debilis D. Don—Plants tentatively identified as this non-native species have been collected in and around nurseries, greenhouses, and yards in the Houston area. These are similar to the native *C. pennsylvanica* Willd. and another introduced species mostly present in the norteast U.S. and Canada, *C. flexuosa* Withering. Rollins (1993) separated *C. debilis* from the other two species by its fibrillose roots and fruits <1 mm wide. Botanists may wish to reexamine their collections, especially those identified as *C. pennsylvanica*, to see if they may fit the description of *C. debilis*. It also would be helpful to search for additional characters to separate these three similar species. Lipscomb (1978) cited the Shinners collection as a voucher for the presence of *C. pennsylvanica* in Texas.

Voucher specimens: **Dallas Co.**: weed under lath, mostly along walks in clay, Northaven Gardens, north Dallas, 6 Nov 1960, *Shinners 29154* (TEX). **Dewitt Co.**: in Sandies Creek, 2 mi E of Westhoff, 5 Mar 1995, *D. Muschalek s.n.* (SBSC). **Galveston Co.**: weed in nursery in Kemah, 1 Apr 1975, *Waller & Bauml 3460* (TEX). **Harris Co.**: weed around the greenhouse in the Mercer Arboretum and Botanical Gardens, off of Aldine Westfield Rd, 1 Nov 1997, *Brown 21715* (SBSC); growing in pots at the Edith Moore Sanctuary off of Memorial Avenue in Houston, 27 Mar 1992, *Brown 15868* (SBSC); weed at edge of San Jacinto Bldg at HCCS Central College, 1300 Holman Street in Houston, 25 Nov 1997, *Brown 21742*, (SBSC).

CARYOPHYLLACEAE

Stellaria parva Pedersen—Landry et al. (1988) reported this chickweed new to North America from Acadia and Jeff Davis Parishes in Louisiana. Landry et al.(1989) provided a more complete discussion of its presence in Louisiana and cited an additional collection from St. Landry Parish. Thomas and Allen (1996) added Lafayette Parish to the Louisiana distribution. We discovered this species on a few disturbed sandy sites in the Trinity River National Wildlife Refuge, Liberty County, 11 Mar 1997, *Brown & Marcus 20104*; 6 Apr 1997, *Brown & Marcus 20216*. Since the original description is from Argentina in 1961 and the first Louisiana collection is in 1966, Landry et al. (1989) suggest it may have arrived in Louisiana and Argentina from an unknown native source. However, they failed to note that Pedersen (1961) in the protologue reported collections from Argentina and Paraguay in 1869 and 1872 and up to 1957.

CUSCUTACEAE (CONVOLVULACEAE)

Cuscuta polygonorum Engelmann—Correll and Johnston (1970), Hatch et al.(1990), Johnston (1990), and Jones et al. (1997) all include this dodder for Texas, apparently from Yuncker (in Lundell 1943), who included it fide Small. Even though Small (1933) gave its range from Maryland to Texas, the first Louisiana collection of it was in 1979 with a second collection in 1981 (Gandhi & Thomas 1983; Gandhi et al. 1987). The first Texas collection appears to be from Brazos County where it was growing on smartweed in the first bottomland along Highway 30, east of the Highway 6 bypass of Bryan/College Station, Sep 1996, *Cheatham, Marshall & Jones s.n.*

CYPERACEAE

Cyperus eragrostis Lam.—Tucker (1987, 1994) reported that this species has become naturalized in southeastern Texas but he cited no collections nor furnished details about its status in Texas. Tucker (1987) indicated it is native to the Pacific Coast of the U.S., a waif in South Carolina, and naturalized in southern Europe. It is similar to *C. ochraceus* Vahl and may be under this name in other Texas herbaria. The key in Denton (1978) can separate these two taxa and other similar species. The larger number of collections from LaPorte near the Barbours Cut Terminal of the Port of Houston suggest it may have arrived in the Houston area by ship.

Voucher specimens: **Galveston Co.:** ca. 100 m from Gulf of Mexico on East Beach in Galveston, 11 Jul 1981, *Kessler 4621* (TAES). **Harris Co.:** in roadside ditch of Battleground Rd, ca. 0.5 mi S of Hwy 225,18 Jun 1983, *Brown 7207* (SBSC); in the Marshall Tract of the Compaq Computer Corp at the intersection of Hwy 249 and Louetta Rd, S of Tomball, 23 May 1992, *Brown 16104* (SBSC); weedy plants in the Park Harbor development along Barker-Cypress Rd N of Addicks Reservoir, W of Houston, May 1994, collector unknown (SBSC); a single plant in a prairie at end of Ramsey Rd, S of Keith Rd, E of Beltway 8 in Pasadena, 1 Jun 1994, *Brown 17952* (SBSC); small population on verge of Barbours Cut Rd between hwy 146 and Barbours Cut Terminal on Galveston Bay in LaPorte, 16 Jun 1994, *Brown 18022* (SBSC); frequent in ditch along Hwy 146 on W side across from entrance to Batbours Cut Rd in LaPorte, 27 Jun 1994, *Brown 18023* (SBSC); weedy plant at the Texas Parks and Wildlife Department office, near business Hwy 146 in LaPorte, 24 Jan 1995, *Brown 18403* (SBSC); in low waste areas along Southern Pacific Railroad Tracts just E of Hwy 146 in LaPorte, S of the Baytown Tunnel and Bridge complex, 19 July 1995, *Brown 18689b* (SBSC).

Eleocharis compressa Sullivan—Correll and Johnston (1970) separate *E. compressa* and *E. acutisquamata* Buckley. by the wider compressed culms in *E. compressa* and the more narrow non-compressed culms in *E. acutisquamata*. Further, they reported *E. compressa* only for San Augustine County in East Texas and restricted *E. acutisquamata* to the Edwards Plateau, the north cental, and southeast (Refugio County) portions of the state. In addition, they indicated (page 275) that they are probably conspecific which is suggested by the overlapping culms width measurements used to separate them in their key. We were unable to borrow Texas and non-Texas material of both entities from TEX for they are out on loan to S. Galen Smith for the Flora of North America project. However, in a survey of collections at SBSC and ASTC, we found only specimens referable to *E. acutisquamata* Buckley in East Texas (San Augustine and Sabine counties). From the specimens available to us, both entities can be readily separated by the nearly round culms (7–9 angled) of *E. acutisquamata* that are up to 25 cm tall and 0.5 mm wide in contrast to the flat culms of *E. compressa* that are up to 42 cm tall and 2 mm wide.

Rhynchospora debilis Gale—Gale (1944) described this taxon as a new species and noted its similarity to *R. fascicularis* (Michx.) Vahl. Both of these species were growing together at the edge of Galveston Bay on a sandy bench below the bluff next to the Abshire House in the Abshire Wildlife Management Area at Smith Point, Chambers County, 7 May 1993, *Brown 16932*; 27 May 1996, *Brown & Liggio 19138*. Here they may be distinguished by the taller (≥ 35 cm), thicker culms (≥ 1.5 mm wide at culm base), and flat leaves (≥ 1.0 mm wide) of *R. fascicularis* in contrast to the shorter (ca. 15 cm) filiform culms (≤ 1 mm wide at culm base) and filiform leaves (≤ 0.5 wide) of *R. debilis.*

Scirpus cubensis Poeppig & Kunth [*Oxycaryum cubense* (Poeppig & Kunth) Lye]—The first Texas collection of this sedge was in 1958 from Eagle Nest Lake in Brazoria County, *Hotchkiss 7653* (TEX). The second Texas collection is from Fort Bend County where is was somewhat frequent in a floating mat of vegetation in Elm Lake at Brazos Bend State Park, 7 Nov 1997, *Brown 21737*. Thomas and Allen (1993) mapped it for eight central and eastern Louisiana parishes, none near the Texas border.

EUPHORBIACEAE

Phyllanthus fraternus G.L. Webster—The first Texas collection is from downtown Houston growing on bare ground among planted shrubs; 17 Sep 1995, *Brown 18753*. Webster (1970) indicated it is native to Pakistan and India and sporadically introduced into Africa and America. He cited only three U.S. collections, one from an abandoned field in Seminole County, Florida, and the other two from New Orleans, Louisiana (including the first U.S. collection). It is now mapped for nine Louisiana parishes mostly in the New Orleans area (Thomas & Allen 1996). It may also expand its range in the Houston area.

Phyllanthus niruri L. subsp. *lathyroides* (Kunth) G.L. Webster—Correll and Johnston (1970) indicated this taxon may be extinct in Texas (the only U.S. records for this widespread tropical American species are from Texas) for they reported it only from the Ottine Swamp in Gonzales County, probably based upon the 1935 Tharp collection at TEX. The only collections since 1935 are the following.

Dewitt Co.: a group of plants ca. 2 ft tall, on sand under bridge on Thomaston Rd, W of Hwy 87 along the Guadalupe River, ca. 2 mi W of Thomaston Community, 11 Oct 1994, *Muschalek s.n.*(SBSC). **Fayette Co.:** S bank of the Colorado River at foot of bluff, N of Monument Hill State Historic Site, 11 Oct 1987, *Carr 7867* (TEX).

The only known U.S. collections are two in the nineteenth century by Wright, one of which is from the Colorado River bottomland, the one in 1935 by Tharp, and the two recent ones reported here.

FABACEAE

Alysicarpus vaginalis (L.) DC.—Isely (1990) mentions this native from the Old World tropics as occurring in Texas. He has examined Fabaceae collections at TEX and probably discovered this Hardin County specimen, 4 mi S of Kountze along roadside, 22 Sep 1960, *McLeod s.n.* We have collected plants of this legume along a pipeline right-of-way in the Trinity River National Wildlife Refuge, Liberty County, 13 Oct 1996, *Brown & Marcus 19731*.

LENTIBULARIACEAE

Utricularia foliosa L.—This large flowered, robust, floating bladderwort was not reported for Texas by Correll and Johnston (1970), possibly because Small (1933) indicated that it ranged from Florida to Louisiana. The first report seems to be in Taylor (1989), where it is listed for North Carolina, Georgia, Florida, Mississippi, Louisiana, and Texas. However, Taylor does not indicate its distribution in Texas nor provide specimen citations. The majority of the TEX and LL specimens were identified as the robust *U. vulgaris* L. Taylor (1989) considers the North American representatives of *U. vulgaris* a distinct species, *U. macrorhiza* Le Conte, and indicates its absence from eastern Texas and most of the southeastern U.S. Coastal Plain.

Voucher specimens: **Brazoria Co.:** floating aquatic in water in the Brazoria National Wildlife Refuge S of Angleton, 26 Apr 1992, *Brown 16020* (SBSC); Muldoon Club between Austin Bayou and Danbury, 19 May 1971, *Fleetwood 10029* (TEX). **Chambers Co.:** present in Anahuac National Wildlife, Jul 1990, *Neaville s.n.*(SBSC). **Fort Bend Co.:** Brazos Bend State Park in 40 Acre Lake beside dike between 40 Acre Lake and Pilant Lake, May 1994, *Gregg s.n.*(SBSC); 29 May 1993, *Gregg s.n.* (SBSC). **Hardin Co.:** 28 Jun 1952, *Tharp & Tyson s.n.*(TEX); Ariola Rd, S of Kountze, home of Jack Lloyd, 9 May 1957, *Whitehouse 32581* (TEX). Henderson Co.: Code Lake, 27 May 1940, *Siegler 2000* (TEX). **Jefferson Co.:** floating in canal along rd,4 mi N of Port Authur, 19 Jul 1946, *Correll 13357* (LL); J.D. Murphree Wildlife Mangement Area, 1–10 mi SW of Port Arthur, Big Hill Bayou, submerged, 20 Oct 1966, *West 127* (TEX). **Liberty Co.:** floating on water in bayou about 7 mi E of Cleveland, Rte. 321, 12 Sep 1968, *Correll 36458* (LL).

ONAGRACEAE

Ludwigia microcarpa Michx.—Bridges and Orzell (1989) reported this species new to Texas from two roadside collections in Hardin County. They state these collections are within former extensive wetland pine savannahs on the Montgomery and Beaumont Formations of the Pleistocene Epoch. A new county collection, perhaps from a younger formation, is from Chambers County where it was frequent along the sandy roadside of Highway 562 ca. 2.8 mi east of the road to Robbins Point Park, 27 May 1996, *Brown & Liggio 19132*.

The following collections at SBSC complete the documentation of this species in Texas. These roadside collections suggest it may be spreading westward via highways.

Voucher specimens: **Hardin Co.:** frequent in a dry roadside ditch along hwy 69/287 ca. 1 mi N of Kountze, associated with *Rhynchospora divergens* and *Fuirena breviseta*, 2 Aug 1986, *Brown 10581*; frequent in a roadside ditch at edge of a sandy acid area along Hwy 770, ca.

0.4 mi W of intersection with Hwy 1003 between Saratoga and Kountze, 16 Aug 1986, *Brown 10641*; on acid sandy soil with many bog plants along Hwy 421 ca. 3 mi E of intersection with Hwy 326 N of Sour Lake, 9 Jun 1996, *Brown 19202*.

POACEAE

Saccharum coarctatum (Fern.) R. Webster—Webster and Shaw (1995) did not consider the presence (*Erianthus*) or absence (*Saccharum*) of an upper lemma awn sufficient to separate these two genera. They, therefore, merged *Erianthus* under *Saccharum* and made the appropriate combinations under *Saccharum*. They did not cite any Texas collections of *S. coarctatum*, possibly because they did not examine sufficient material from Texas herbaria (the only Texas herbarium cited is BRIT). The following collections at SBSC document its presence in the state. The senior author first identifed these plants as *E. brevibarbis* Michx. and then annotated them to *S. brevibarbis* (Michx.) Pers. var. *brevibarbis*. Joseph K. Wipff, then at TAES, identified them to *S. coarctatum*.

Voucher specimens: **Liberty Co.**: tall plants in moist ditch along Hwy 90, 5.4 mi E of Hwy 61 in Devers, 25 Sep 1993, *Brown 17493*; tall plants with brownish inflorescence along Hwy 90, 4.9 mi E of Hwy 61 in Devers, 7 Nov 1994, *Brown 17618*. **Tyler Co.**: large colony on low moist acid soil within Kirby State Forest off of Hwy 69, S of Warren, 8 Oct 1983, *Brown 6674*.

Urochloa ramosa (L.) Webster [*Panicum ramosum* L.; *Bachiaria ramosa* (L.) Stapf]—This native of tropical Asia has been planted in Texas and other states for erosion control and wildlife food but has not been included in any Texas floristic publications. It is reported for 31 Louisiana Parishes (Allen 1992). An adventive Texas collection is from Chambers County where it was growing at the edge of the Highway 1663 bridge over Whites Bayou northeast of Hankamer, 25 Sep 1993, *Brown 17488*.

POLYGONACEAE

Polygonum cespitosum Blume—Carr and Hernandez (1993) reported this Asian species new to Texas (first collection from Jasper County in 1992) using the spelling *caespitosum*. We are following the spelling in Kartesz (1994). We discovered this species on moist to dry disturbed sites in the Trinity River National Wildlife Refuge. Here the reddish flowers stand out in contrast to the whitish flowers of *P. hydropiperoides* Michx. and other similar species.

Voucher specimens: **Liberty Co.**: 15 Sep 1996, *Brown 19701*; 13 Oct 1996, *Brown & Marcus 19732*; 9 Nov 1996, *Brown 19787*; 21 May 1997, *Brown 20445*. The following two collections, previously identified as *P. persicaria* L., are at TAES: **Galveston Co.**: Galveston Island State Park, 15 May 1997, *Rosen 0316*. **Liberty Co.**: ca. 4.5 mi S of Dayton along Hwy 146, 21 Oct 1987, *Nixon 16050*.

Additional state collections may be masquerading under this name in other Texas herbaria.

Polygonum meisnerianum Cham. & Schlecht. var. *beyrichianum* (Cham. & Schlecht.) Meisn.—Correll and Johnston (1970) indicated this species has been reported for Texas but saw no specimens. Park (1988) also saw no Texas collections but reported U.S. collections from Florida and South Carolina and from Plaquemines and St. Tammany Parishes in Louisiana. The only Texas collection known to us is from Orange County where it was growing in a slight swale under a canopy of Chinese tallow trees adjacent to a fallow rice field near Nederland, *Knowles s.n.* The senior author originally identified this specimen as *P. sagittatum* L. and additional collections may be filed under this name in Texas herbaria.

Rumex paraguayensis Parodi—This native of southern South America (naturalized in Florida and Louisiana) is now in Texas (Chambers County, present in the East Unit of the Anahuac National Wildlife Refuge off of Hwy 1985, SE of Anahuac, Spring 1991, *Neville 274*). The key in Godfrey and Wooten (1981) can separate this species from *R. obovatus* Danser, a similar naturalized South American species in northern Florida and Louisiana. Thieret (1969) reported both species new to North America and speculated that *R. obovatus* almost certainly occurs in Texas because one collection of it was made within 150 feet of the Texas border. However, based on Godfrey and Wooten's key, our specimen is *R. paraguayensis*.

SCROPHULARIACEAE

Lindernia crustacea (L.) F. Muell.—This Indo-Malaya native ranges in the U.S. from South Carolina, south to Florida, and along the Gulf Coastal Plain to Louisiana (Godfrey & Wooten 1981). Vincent (1982) mapped it for 15, mostly south central and eastern, Louisiana Parishes. He indicated it is spreading westward and that it may eventually appear in East Texas. We found this short blue flowered species on two disturbed sites in the Trinity River National Wildlife Refuge, Librty County, 29 Sep 1996, *Brown & Marcus 19703*; 13 July 1997, *Brown 20581*.

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REFERENCES

Affolter, J.M. 1985. A monograph of the genus *Lilaeopsis* (Umbelliferae). Syst. Bot. Monogr. 6:1–140.

Allen, C.A. 1992. Grasses of Louisiana. Second ed. Cajun Prairie Habitat Preservation Society. Eunice, LA.

Al-Shehbaz, I.A. and V. Bates. 1987. *Armoracia lacustris* (Brassicaceae), the correct name for the North American lake cress. J. Arnold Arbor. 68:357–359.

Bridges, E.L. and S.L. Orzell. 1989. Additions and noteworthy vascular plant collections from Texas and Louisiana, with historical, ecological and geographical notes. Phytologia 66:12–69.

Carr, B. and D. Hernandez. 1993. *Polygonum caespitosum* var. *longisetum* (Polygonaceae) new to Texas. Sida 15:656.

Clewell, A.F. 1985. Guide to the vascular plants of the Florida Panhandle. Univ. Presses of Florida, Tallahassee.

Correll, D.S. and M.C. Johnston. 1970. Manual of the vascular plants of Texas. Texas Research Foundation, Renner, TX.

Denton, M.F. 1978. A taxonomic treatment of the Luzulae group of *Cyperus*. Contr. Univ. Michigan Herb. 11:197–271.

Gale, S. 1944. *Rhynchospora*, section *Eurhynchospora*, in Canada, the United States and the West Indies. Rhodora 46:88–134, 159–197, 207–249, 255–278.

Gandhi, K.N. and R.D. Thomas. 1983. *Cuscuta polgonorum* Engelm. new to Louisiana and comments about its antestaminal scales. Phytologia 53:181–186.

Gandhi, K.N., R.D. Thomas, and S.L. Hatch. 1987. Cuscutaceae of Louisiana. Sida 12:361–379.

Godfrey, R.K. and J.W. Wooten. 1981. Aquatic and wetland plants of southeastern United States, dicotyledons. Univ. of Georgia Press, Athens.

Hatch, S.L., K.N. Gandhi, and L.E. Brown. 1990. Checklist of the vascular plants of Texas. Agric. Exp. Sta. MP-1655. College Station, TX.

Holmgren, P.K., N.H. Holmgren, and L.C. Barnett. 1990. Index Herbariorum. Eight ed. New York Botanical Garden, Bronx.

Isely, D. 1990. Vascular flora of the southeastern United States, Vol.3(2), Leguminosae (Fabaceae). Univ. of North Carolina Press, Chapel Hill.

Johnston, M.C. 1990. The vascular plants of Texas, a list up-dating the manual of the vascular plants of Texas. Second ed. Privately published by the author. Austin, TX.

Jones, S.D., J.K. Wipff, and P.M. Montgomery. 1997. Vascular plants of Texas. A comprehensive checklist including synonymy, bibliography, and index. University of Texas Press, Austin.

Kartesz, J.T. 1994. A synonymized checklist of the vascular flora of the United States, Canada, and Greenland. 2nd ed. vol.1, Checklist. Timber Press, Portland, OR.

Landry, G.P., W.D. Reese, and C.M. Allen. 1988. *Stellaria parva* Pederson new to North America. Phytologia 64:497.

Landry, G.P., W.D. Reese, and K. Vincent. 1989. *Stellaria parva* Pederson (Caryophyllaceae) in North America. Sida 13:373–375.

Les, D.H. 1994. Molecular systematics and taxonomy of lake cress (*Neobeckia aquatica*, Brassicaceae), an imperiled aquatic mustard. Aquatic Bot. 49:149–165.

________, G.J. Anderson, and M.A. Cleland. 1995. Sterility in the North American lake cress *Neobeckia aquatica* (Brassicaceae): inferences from chromosome number. Rhodora 97:185–200.

LIPSCOMB, B.L. 1978. Additions to the Texas flora. Sida 7:392–394.

LUNDELL, C.L. 1943. Flora of Texas, vol. 3, part II. Southern Methodist Univ. Press. Dallas, TX.

MEARS, J.A. 1977. The nomenclature and type collections of the widespread taxa of *Alternanthera* (Amaranthaceae). Proc. Acad. Nat. Sci. Philadelphia 129:1–21.

NELSON, J.B., K.B. KELLY, JR., and A.C. MOORE. 1997. Noteworthy collections, South Carolina. Castanea 62:283–288.

PARK, CHONG-WOOK. 1988. Taxonomy of *Polygonum* section *Echinocaulon* (Polygonaceae). Mem. New York Bot. Gard. 47:1–81.

PEDERSEN, T.M. 1961. New species of *Hydrocleis*, *Scirpus*, and *Stellaria*. Bot. Tidsskr. 57:38–48.

ROLLINS, R.C. 1993. The Cruciferae of continental North America. Stanford Univ. Press, Stanford, CA.

SMALL, J.K. 1933. Manual of the southeastern flora. Privately published by the author. New York, NY.

TAYLOR, P. 1989. The genus *Utricularia*-a taxonomic monograph. Kew Bull. 14:1–724.

THIERET, J.W. 1969. *Rumex obovatus* and *Rumex paraguayensis* (Polygonaceae) in Louisiana: new to North America. Sida 3:445–446.

THOMAS, R.D. and C.M. ALLEN. 1993. Atlas of the vascular flora of Louisiana. Vol. I: ferns and fern allies, conifers, and monocotyledons. Louisiana Department of Wildlife & Fisheries, Baton Rouge.

THOMAS, R.D. and C.M. ALLEN. 1996. Atlas of the vascular flora of Louisiana. Vol. II: dicotyledons, Acanthaceae–Euphorbiaceae. Louisiana Department of Wildlife & Fisheries, Baton Rouge.

TUCKER, G.C. 1987. The genera of Cyperaceae in the southeastern United States. J. Arnold Arbor. 68:361–445.

TUCKER, G.C. 1994. Revision of the Mexican species of *Cyperus* (Cyperaceae). Syst. Bot. Monogr. 43:1–213.

WEBSTER, G.L. 1970. A revision of *Phyllanthus* (Euphorbiaceae) in the continental United States. Brittonia 22:44–76.

WEBSTER, R.D. and R.B. SHAW. 1995. Taxonomy of the native North American species of *Saccharum* (Poaceae: Andropogoneae). Sida 16:551–580

VINCENT, K.A. 1982. Scrophulariaceae of Louisiana, M.S. Thesis. The University of Southwestern Louisiana, Lafayette.

CYPERUS FUSCUS (CYPERACEAE), NEW TO MISSOURI AND NEVADA, WITH COMMENTS ON ITS OCCURRENCE IN NORTH AMERICA

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ABSTRACT

Field and herbarium studies have documented *Cyperus fuscus* as new for Missouri and Nevada. Localities, habitat data, lists of associated species, description, illustrations, photo of habit, and discussion of weedy potential are presented.

RESUMEN

Los estudios de campo y de herbario han documentado *Cyperus fuscus* como nuevo para Missouri y Nevada. Se aportan localidades, datos del hábitat, listas de especies asociadas, descripción, ilustraciones, foto del hábito, y discusión de su potencial como mala hierba.

INTRODUCTION

Cyperus fuscus L. [section *Fusci* (Kunth) Clarke] is native to Eurasia and the Mediterranean Region of northern Africa, extending from Greenland and Iceland to China south to Spain, Iran, Egypt, Algeria, and northern India (Kükenthal 1936; Tutin et al. 1980). The common name for this species has been listed as "galingale," "brown galingale," or "black galingale" (Weedon & Stephens 1969). It apparently was first discovered in North America based on specimens collected by Herbert A. Young along Revere Beach in Essex County, Massachusetts in 1877 (Knowlton et al. 1911; McGivney 1938). *Cyperus fuscus* was subsequently documented in California (McGivney

1938; Tucker 1993), Connecticut (McGivney 1938; Dowhan 1979; Tucker 1995), Maryland, (Kükenthal 1936), Nebraska (Weedon & Stephens 1969; Kolstad 1986; Rolfsmeier 1995), New Jersey (Britton 1886; McGivney 1938), Pennsylvania (Rhoads & Klein 1993), South Dakota (Weedon & Stephens 1969), and Virginia (Hitchcock & Standley 1919; Kolstad 1986; Tucker 1987). Although the species has also been recorded for New York (e.g., Weedon & Stephens 1969; Kolstad 1986), no specimens have been located and the only ones so identified were actually *C. diandrus* Torr. (Mitchell & Tucker 1997). Although *C. fuscus* has been present on the North American Continent since at least 1877, its spread apparently has been slow, and outside of brief accounts related to its increase in distribution, there has been little attention given to it in the New World literature.

Given the great attention to new records of *Cyperus* in North America by Charles Bryson, Richard Carter, Stanley Jones, Barney Lipscomb, Gordon Tucker, and others in the last 20 years (e.g., Lipscomb 1978, 1980; Tyndall 1983; Carter et al. 1987; Carr 1988; Carter 1988; Sundell & Thomas 1988; Carter & Bryson 1991; Webb et al. 1991; Bryson & Carter 1992; Jones et al. 1993; Bryson & Carter 1994; Tucker 1994; Bryson et al. 1996; Carter et al. 1996), it is interesting and somewhat amazing that the species has not been discovered at more localities throughout the United States, especially as Weedon and Stephens (1969) noted that it was a weed of rice fields in the Old World. Outside the United States, the species has been discovered in Canada (Gillett 1970), but it has not been found in Mexico (Tucker 1994) or Central America (Tucker 1983).

DESCRIPTION

The following is a description of *C. fuscus* based on Kükenthal (1936), McGivney (1938), Fernald (1950), Kolstad (1986), and our observations. *Cyperus fuscus* (Figs. 1, 2): a caespitose annual with few to numerous culms and reddish-brown fibrous roots; culms upright, inclined, or decumbent, 2–30 (rarely 50) cm long, 1.3–3.0 mm thick, smooth, flaccid, and triangular in cross-section; 2–4 basal leaves per culm, 1–25 cm long, 1–4 mm wide, flat, flaccid, and minutely scabrous toward the acute apex; 2 or 3 leaf-like bracts subtend each inflorescence, varying in length, 2–25 cm long, 1–3(–5) mm wide, spreading, flat, flaccid, and minutely scabrous toward the acute apex; 6–24(–80) densely or loosely congested spikelets per spike; spikelets 8–18(–40) flowered, 3–8(–12) mm long, 1–1.5 mm wide, linear, and compressed; rachillas 0.3 mm wide, 0.2 mm thick, dark brown, straight or slightly curved, and wingless; scales (sometimes called "glumes") subtending the flowers 0.8–1.2 mm long, 0.8–1.5 mm wide, broader than long, 3-nerved, tan or light brown at the center with narrowly hyaline margins, and the

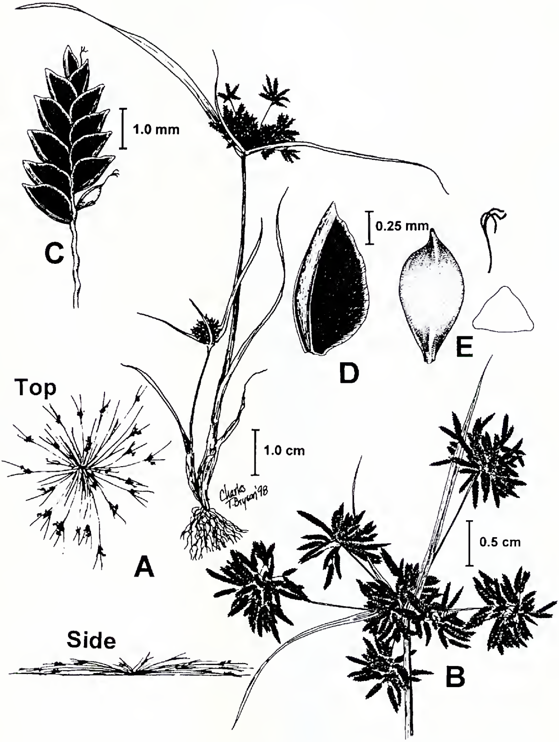

Fig. 1. *Cyperus fuscus*. A. Habit (top and side views of clump and side view of two erect plants). B. Inflorescence. C. Spikelet. D. Scale. E. Achene (including cross-sectional view and side view of 3-cleft style). (Based on *McKenzie 1802 with Jacobs*; *McKenzie 1804*; *McKenzie 1807 with Jacobs and Johnson*; illustrated by Charles T. Bryson).

surfaces primarily dark reddish-brown to purple; the tips minutely apiculate; achenes 0.9–1.1 mm long, 0.4–0.5 mm wide, gray to almost white, trigonous, and narrowly ovoid; styles 0.4–0.6 mm long, 3-cleft, and not persistent; stamens 2 per flower, 0.7–0.8 mm long; anthers 0.4–0.5 mm long, tan or yellowish, and linear oblong.

BIOLOGY, ECOLOGY, AND DISTRIBUTION

On 9 September 1997, while conducting a search for state-listed species of *Cyperus*, *Schoenoplectus*, and *Lipocarpha* along mudflats of the Missouri River in Cooper County, McKenzie and Jacobs discovered a population of *Cyperus* sp. unfamiliar to them. This *Cyperus* was semiprostrate with the culms radiating like spokes in a wheel and leaning mostly horizontal to the ground (Fig. 2). The most diagnostic features of the sedge were its dark purple to reddish-brown scales, its strongly triangular stems, its bright rusty red roots, its small spikelets, and its pale, trigonous achenes. Specimens were subsequently determined as *Cyperus fuscus*. McKenzie and Jacobs returned to the site on 28 September 1997 and counted 110 plants scattered along the silty mudflats and shoreline of the Missouri River, associated with the following species: *Ammania coccinea* Rottb., *Cyperus diandrus* Torrey, *C. erythrorhizos* Muhl., *C. odoratus* L., *C. squarrosus* L. (*C. aristatus* Rottb.; *C. inflexus* Muhlenb.), *Eclipta prostrata* (L.) L., *Eragrostis hypnoides* (Lam.) Britton, Sterns, & Pogg., *Fimbristylis vahlii* (Lam.) Link, *Leucospora multifida* (Michx.) Nutt., *Lipocarpha micrantha* (Vahl) G. Tucker, *Polygonum* spp. and *Ranunculus scleratus* L. Although the majority of plants were in full sunlight, some extended into the partial shade of the developing seedlings of *Salix* spp. and *Populus deltoides* Bartram ex Marshall.

Subsequent to this discovery, McKenzie and Jacobs were asked by Rhett Johnson of the Missouri Department of Conservation to identify an unknown specimen of *Cyperus* that had been collected from another site along the Missouri River in adjacent Howard County, approximately 32 km WNW of the original discovery site. McKenzie and Jacobs identified the specimen as *C. fuscus* and visited the site with Johnson on 11 October 1997, where they counted approximately 70 plants scattered along moist, sandy and silty flats adjacent to a chute that been formed during the 1995 flood of the Missouri River.

Because the discovery of *C. fuscus* in two adjacent counties along the Missouri River suggested that the species could be widely distributed along the river, Jacobs searched locations downstream of the original discovery site and discovered it in Boone, Callaway, and Cole counties. A lack of time due to the season's first killing frosts prevented additional searches in other counties bordering the Missouri River. With the exception of *Fimbristylis vahlii*, associated plants at the second, third, fourth, and fifth sites were mostly identical to those previously mentioned for the original discovery site.

Fig 2. Photograph of *Cyperus fuscus* taken from Lisbon Bottoms, Big Muddy National Fish and Wildlife Refuge, Howard Co., Missouri, 11 Oct 1997 (photographed by Paul M. McKenzie).

Although the initial North American discovery of *C. fuscus* in Massachusetts was apparently along a sandy beach, many subsequent records along the Atlantic seaboard were associated with "ballast sand" (Britton 1886), or "waste ground, ballast, and wharf areas" (Rhoads & Klein 1993). The Connecticut record comes from a "sandy river shore" (Tucker 1995) and habitat for the species in California has been reported as "damp, disturbed soil, receding shorelines, and puddles" (Tucker 1993). In the Midwest, the initial discoveries of this sedge were made along "wet open sandy flats" of the South Platte River in Lincoln County, Nebraska and "wet sandy clay soil" along the banks of the Keya Paha River in Tripp County, South Dakota (Weedon & Stephens 1969). The accounts by Britton (1886) and Rhoads and Klein (1993) suggest that *C. fuscus* was initially introduced to the New England coast accidentally via achenes that were in ship ballast water that originated in Europe. Introductions into other areas of the country, however, are more difficult to assess. It is possible that waterfowl were responsible for the species' introduction into Nebraska, South Dakota, and elsewhere. Dunn and Knauer (1975) postulated that waterfowl were responsible for the introductions of *Cyperus flavicomus* Mich. [*C. albomarginatus* (C. Martius & Schrader ex Nees) Steudel], *Fimbristylis miliacea* (L.) Vahl, and *Aeschynomone indica* L. into the Mingo National Wildlife Refuge in southeastern Missouri.

While the source of introduction of *C. fuscus* into Missouri is unknown, the recent and apparent widespread distribution of this sedge along the Missouri River suggests that the species may have become established soon after the 1993 or 1995 floods. At the original discovery site in Cooper County, plants were located at the spot where a large levee break had occurred in 1995. Rolfsmeier (1995) reported that the two Nebraska records of *C. fuscus* were from separate locations along the Platte River. Because the Platte River empties into the Missouri River, and the Keya Paha eventually does the same, it is feasible that Nebraska or South Dakota may have been the seed source for the Missouri populations that became established along the Missouri River following the 1993 and/or 1995 floods. This introduction may be due to soil movement and sedimentation within the Missouri River floodplain.

Rice growers in the United States should be alerted to the potential of this sedge becoming a troublesome weed. Holm et al. (1979) listed *C. fuscus* as a principal weed in Portugal and as occurring in Afghanistan and Israel. Based on the rapid and aggressive spread of its relative *Cyperus difformis* L. in North American rice fields (Lipscomb 1980; Tyndall 1983; Bryson et al. 1996), and because *C. fuscus* is a rice weed in the Old World (Weedon & Stephens 1969; Mingyuan & Dehu 1970; Holm et al. 1979), this species should be looked for in rice producing areas of Arkansas, California, Louisiana, Mississippi, Missouri, Tennessee, and Texas.

Due to the combination of its semiprostrate habit with the culms radiating like spokes in a wheel (Fig. 2), its dark purple to reddish-brown scales, its strongly triangular stems, its bright rusty red roots, its small spikelets, and its pale (almost white), trigonous achenes, this *Cyperus* is unlikely to be confused with any other North American member of the genus. The conspicuous rusty red roots and small trigonous achenes are similar to *C. erythrorhizos*, but the dark purplish scales, strongly triangular stems, apiculate achenes, and stamen number (2 vs. 3 in *C. erythrorhizos*) easily distinguish it from that species. The purplish-tinged scales of *C. fuscus* are somewhat reminiscent of the scales of *C. diandrus*, *C. bipartitus* Torrey, or *C. flavicomus*. It can easily be separated from *C. diandrus* and *C. bipartitus* by its trigonous vs. lenticular achenes, and by its smaller (ca. 1.0 mm vs. 1.8 mm) scales. It differs from *C. flavicomus* by its flattened vs. erect habit, by the lack of white margins on the scales, and by its trigonous vs. lenticular achenes.

The authors noted that bruised fresh and herbarium material of *C. fuscus* possesses a fragrance similar to, but not as strong as, *C. squarrosus* or *C. setigerus* Torr. & Hook. Steyermark (1963) described this odor as that of slippery elm (*Ulmus rubra* Muhl.). Bruhl (1995) stated that "(i)n a few genera of Cyperaceae, a fenugreek (*Trigonella foenum-graecum*) odour is readily detectable in fresh and (especially) herbarium material."

There is apparently some disagreement in the literature regarding the number of stamens of each floret of *C. fuscus*. In the *Flora of the Great Plains* (Kolstad 1986), two stamens are given in the key but three in the species account. One (McGivney 1938), rarely two (Kükenthal 1936), or two (Tutin et al. 1980) stamens are also cited elsewhere in the literature. George Yatskievych (Missouri Botanical Garden, pers. comm.) examined all voucher specimens from Missouri and noted that florets had only two stamens.

Given the apparent rapid spread of this species along the Missouri River in Missouri and the weedy nature of many *Cyperus* in the Old World, it is likely that this species will be discovered with sufficient effort at other Midwest locations and possibly elsewhere in North America. While studying *Cyperus* specimens at the Missouri Botanical Garden in 1988, Carter discovered a misidentified specimen of *C. fuscus* from western Nevada that originally was determined as *C. acuminatus* Torr. & Hook. The "exposed mudflat" habitat at the Nevada site is apparently similar to that in the San Joaquin Valley of adjacent California described by Tucker (1993). *Cyperus fuscus* was not listed by Cronquist et al. (1977) in the *Intermountain Flora*, nor in Kartesz's (1987) dissertation on the *Flora of Nevada*. As with California, Missouri, Nebraska, and South Dakota, waterfowl may have been responsible for the introduction of achenes of *C. fuscus* into Nevada. The following data provide documentation for *C. fuscus* in Missouri and Nevada with herbarium abbreviations following Holmgren et al. (1990), except ctb (pers. herb. of Charles T. Bryson).

Voucher specimens: U.S.A. **Missouri. Cooper Co.:** Big Muddy National Fish and Wildlife Refuge-Overton Bottoms, ca. 1.9 mi NW of Overton, T49NR15WSect.31SESENW1/4, Rocheport 7.5' Quad., 9 Sep 1997, *McKenzie 1802 with Brad Jacobs* (ctb, EIU, MO, SWSL, VSC); *Jacobs 97-67 with Paul McKenzie* (MO); 28 Sep 1997, *McKenzie 1804 with Brad Jacobs* (ctb, MICH, SWSL, UMO); **Howard Co.:** Big Muddy National Fish and Wildlife Refuge-Lisbon Bottoms, ca. 1.5 mi NW of Lisbon, T50NR18WSect. 18, Arrow Rock 7.5' Quad., 11 Oct 1997, *McKenzie 1807 with Brad Jacobs and Rhett Johnson* (ctb, MICH, MO, SWSL, UMN, UMO, VDB, VSC); *Jacobs 97-40 with Paul McKenzie and Rhett Johnson* (ctb, MO, MICH, SWSL, UMN, UMO). **Boone Co.:** McBaine, W of Columbia waste water treatment lagoon # 3, T47NR13WSect. 7SWSESW1/4, Hunstdale 7.5' Quad., 13 Oct 1997, *Jacobs 97-37 with Tim Smith* (MO, UMN, UMO). **Callaway Co.:** North Jefferson City, along N side of the Missouri River, approximately 400–500 m downstream from the Jefferson City bridge over the Missouri River, T44N R11WSect. 15SWSW1/4, Jefferson City 7.5' Quad., 14 Oct 1997, *Jacobs 97-38* (ctb, MO, UMO), *Jacobs 97-44 with Chris Dietrich* (MO). **Cole Co.:** Jefferson City, along the S edge of the Missouri River, approximately 400-500 m downstream from the Jefferson City Bridge over the Missouri River, just W of Wears Creek, T44NR11WSect. 7NENE1/4, Jefferson City 7.5' Quad., 15 Oct 1997, *Jacobs 97-39* (MO, NEMO, UMO); *Jacobs 97-46* (MO). **Nevada. Lyon Co.:** Lahontan Reservoir, mudflats at the SE end of the reservoir, T17NR26ESect.8, 4150 ft, plants growing on exposed mudflats, 1 Sep 1981, *Tiehm 6769* (MO).

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REFERENCES

BRITTON, N.L. 1886. A preliminary list of N.A. species of *Cyperus*, with descriptions of new forms. Bull. Torrey Bot. Club 13:205–216.

BRUHL, J.J. 1995. Sedge genera of the world: relationships and a new classification of the Cyperaceae. Austral. Syst. Bot. 8:125–305.

BRYSON, C.T. and R. CARTER. 1992. Notes on *Cyperus* and *Kyllinga* (Cyperaceae) in Mississippi with records of six species new to the state. Sida 15:119–124.

BRYSON, C.T. and R. CARTER. 1994. Notes on *Carex*, *Cyperus*, and *Kyllinga* (Cyperaceae) in Mississippi with records of eight species previously unreported to the state. Sida 16:171–182.

BRYSON, C.T., J.R. MACDONALD, R. Carter, and S.D. Jones. 1996. Noteworthy *Carex*, *Cyperus*, *Eleocharis*, *Kyllinga*, and *Oxycaryum* (Cyperaceae) from Alabama, Arkansas, Georgia, Louisiana, Mississippi, North Carolina, Tennessee, and Texas. Sida 17:501–518.

CARR, B. 1988. *Cyperus difformis* L. (Cyperaceae) new to Texas. Sida 13:255–256.

CARTER, R. 1988. *Cyperus hystricinus* (Cyperaceae) new to Florida. Sida 13:118–119.

CARTER, R. and C.T. BRYSON. 1991. A report of *Cyperus grayioides* and *Cyperus retroflexus* (Cyperaceae) new to Missouri and notes on other selected Missouri *Cyperus*. Sida 14:475–481.

CARTER, R., C.T. BRYSON, and B.L. LIPSCOMB. 1987. *Cyperus uniflorus* (Cyperaceae) east of the Mississippi River. Sida 12:250.

CARTER, R., R.L. MEARS, K.C. BURKS, and C.T. BRYSON. 1996. A report of four exotic *Cyperus* (Cyperaceae) species new to Florida, U.S.A. Sida 17:275–281.

CRONQUIST, A., A.H. HOLMGREN, N.H. HOLMGREN, J.L. REVEAL, and P.K. HOLMGREN. 1997. Intermountain flora. Vol. 6. Columbia University Press. New York.

DOWHAN, J.J. 1979. Preliminary checklist of the vascular flora of Connecticut. State geological and natural history survey of Connecticut. Dept. of Env. Protection–Nat. Resources Center Rept. of Investigations No. 8.

DUNN, D.B. and D.F. KNAUER. 1975. Plant introductions by waterfowl to Mingo National Wildlife Refuge Missouri. Trans. Missouri Acad. of Sci. 9:27–28.

FERNALD, M.L. 1950. Gray's manual of botany. 8th ed. D. Van Nostrand Co., New York.

GILLETT, J.M. 1970. *Cyperus fuscus* L.–new to Canada. Canad. Field Nat. 85:190.

HITCHCOCK, A.S. and P.C. STANDLEY. 1919. Flora of the District of Columbia and vicinity. Contr. U.S. Natl. Herb. 21:1–329, pl. 1–42.

HOLM, L, J.V. PANCHO, J.P. HERBERGER, and D.L. PLUCKNETT. 1979. A geographical atlas of world weeds. John Wiley and Sons, New York.

HOLMGREN, P.K., N.H. HOLMGREN, and L.C. BARNERTT, eds. 1990. Index Herbariorum. Part 1: The herbaria of the world, 8th ed. New York Botanical Garden, Bronx, New York.

JONES, S.D., A.A. REZNICEK, and G.D. JONES. 1993. *Cyperus setigerus* (Cyperaceae), new for New Mexcio. Sida 15:655.

Kartesz, J.T. 1987. A flora of Nevada. Unpublished Ph.D. dissertation, University of Nevada, Reno.

Knowlton, C.H., J.A. Cushman, W. Deane, and A.K. Harrison. 1911. Reports on the flora of Boston District-VIII. Rhodora 13:27–29.

Kolstad, K.O. 1986. Cyperaceae. In: R.L. McGregor, Coordinator; T.M. Barkley, R.E. Brooks, and E.K. Schofield, eds. Flora of the Great Plains. University Press of Kansas, Lawrence. Pp. 1059–1113.

Kükenthal, G. 1936. Cyperaceae-Scirpoideae-Cypereae. In: L. Diels, ed. Pflanzenreich IV. 20(Heft) 101:1–671.

Lipscomb, B.L. 1978. *Cyperus surinamensis* (Cyperaceae): new to Arkansas, Kansas, and Oklahoma. Sida 7:307.

Lipscomb, B.L. 1980. *Cyperus difformis* L. (Cyperaceae) in North America. Sida 8:320–327.

McGivney, M.V. 1938. A revision of the subgenus *Eucyperus* found in the United States. Cathol.Univ. Amer. Biol. Ser. 26:1–74.

Mingyuan, X. and M. Dehu. 1970. Farmland weeds in China: a collection of coloured illustrated plates. Agricultural Publishing House. Beijing, China.

Mitchell, R.S. and G.C. Tucker. 1997. Revised checklist of New York State plants. New York State Museum Bulletin 490.

Rhoads, A.F. and W.M. Klein, Jr. 1993. The vascular flora of Pennsylvania–annotated checklist and atlas. American Philosophical Society, Philadelphia.

Rolfsmeier, S.B. 1995. Keys and distributional maps for Nebraska Cyperaceae, Part 1: *Bulbostylis*, *Cyperus*, *Dulichium*, *Eleocharis*, *Eriophorum*, *Fimbristylis*, *Fuirena*, *Lipocarpha*, and *Scirpus*. Trans. Nebraska Acad. Sci. 22:27–42.

Sundell, E. and R.D. Thomas. 1988. Four new records of *Cyperus* (Cyperaceae) in Arkansas. Sida 13:259–261.

Steyermark, J.A. 1963. Flora of Missouri. Iowa State University Press, Ames, Iowa.

Tucker, G.C. 1983. The taxonomy of *Cyperus* (Cyperaceae) in Costa Rica and Panama. Syst. Bot. Mongr. 43:1–85.

Tucker, G.C. 1987. The genera of Cyperaceae in the southeastern United States. J. Arnold Arbor. 68:361–445.

Tucker, G.C. 1993. *Cyperus*. In: J.C. Hickman, ed. The Jepson manual: Higher plants of California. University of California Press, Berkeley. Pp. 1138–1141.

Tucker, G.C. 1994. Revision of the Mexican Species of *Cyperus* (Cyperaceae). Syst. Bot. Mongr. 43:1–213.

Tucker, G.C. 1995. The vascular flora of southeastern Connecticut. Mem. Connecticut Bot. Soc. 3:1–205.

Tutin, T.G., V.H. Heywood, N.A. Burges, D.M. Moore, D.H. Valentine, S.M. Walters, and D.A. Webb, eds. 1980. *Flora Europaea*-Volume 5, Alismataceae to Orchidaceae (Monocotyledons). Cambridge University Press, Cambridge.

Tyndall, R.W. 1983. Distribution of *Cyperus difformis* L. (Cyperaceae) in the southeastern United States. Castanea 48:277–280.

Webb, D.H., W.M. Dennis, and T.S. Patrick. 1991. Distribution and naturalization of *Cyperus brevifolioides* (Cyperaceae) in eastern United States. Sida 9:188–190.

Weedon, R.R. and H.A. Stephens. 1969. *Cyperus fuscus* in Nebraska and South Dakota. Rhodora 71:433.

THE USE OF ANIMAL-DISPERSED SEEDS AND FRUITS IN FORENSIC BOTANY

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ABSTRACT

A specific case of the forensic use of animal-dispersed propagules is presented, and it is suggested that this type of evidence deserves wider utilization by the law enforcement community. Animal dispersed seeds and fruits are ubiquitous, often cling tenaciously to clothes or other materials worn or used by suspects, and are small and frequently go unnoticed. Furthermore, their identification is relatively inexpensive and technically straightforward, and their presentation as evidence is visually and intuitively obvious, making it ideal for the courtroom. It is also suggested that forensic botany is an excellent topic to use as a case study in college botany or biology classes because of its inherent interest and integrative nature. In order to facilitate such usage, a brief review of some aspects of forensic botany is presented including references to pertinent literature.

RESUMEN

Se presenta un caso específico de propágulos diseminados por animales en uso forense, y se sugiere que este tipo de evidencia puede tener mayor utilización en varios aspectos legales. Las semillas y frutos dispersados por animales están por todas partes, a menudo se enganchan tenazmente a las ropas u otros materiales llevados o usados por sospechosos, y por ser pequeños pasan frecuentemente inadvertidos. además, su identificación es relativamente barata y técnicamente sencilla, y su presentación como prueba es obvia visual e intuitivamente, convirtiéndose en ideal para los juicios. Se sugiere también que la botánica forense es un tema excelente para ser usado como caso práctico en las clases de biología por su interés inherente y naturaleza integrativa. Para facilitar ese uso se hace una breve revisión de algunos aspectos de la botánica forense incluyendo las referencias bibliográficas pertinentes.

The use of plants in justice and legal systems is thousands of years old, probably beginning in such ways as trials by ordeal (Talalaj et al. 1991; Mabberley 1997). In these cases, suspects were forced to eat poisonous plants and guilt or innocence was determined by survival. Presumably, this was based on a psychological effect of guilt on the vomiting reflex—supposedly, innocent individuals would expel the poisonous material, while the

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guilty would retain the poison and thus die; the efficacy of such a technique is obviously questionable. The use of plant material as evidence has also appeared in fictional works, such as the series of books by Ellis Peters about the medieval Welsh monk/herbalist/sleuth, Brother Cadfael (Whiteman 1995) and the works by H.C. Bailey about the detective, Reginald Fortune (Bailey 1936, 1943).

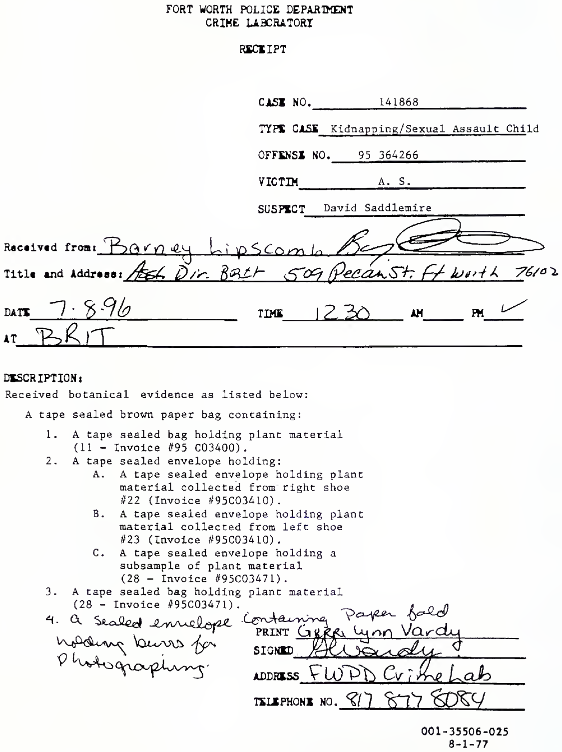
The modern use of plants as evidence in a court case dates to the famous 1930s Lindbergh kidnapping case in which the son of Charles and Anne Morrow Lindbergh was kidnapped and murdered. Largely through evidence provided by botanist Arthur Koehler, Bruno Hauptmann was convicted of the crime in 1935. Koehler demonstrated that the ladder used in the kidnapping was built in part from wood taken from the attic of Hauptmann's residence (Tippo & Stern 1977; Baden 1983; Haag 1983; Lane et al. 1990; Graham 1997). Koehler's evidence included identification of the wood based on anatomical characteristics, matching of annual growth rings, and unique markings made on the wood by tools including a lumber yard planer and a hand plane. Detailed accounts of the botanical evidence including photographs and graphics can be found in Tippo and Stern (1977), Haag (1983), and Graham (1997). Graham (1997) gave an extensive list of references. This was a landmark case, not only because it lead to the formation of federal kidnapping laws (Bock & Norris 1997), but also because the obvious value of the evidence provided by Koehler set the stage for future forensic uses of botanical information.

Since that time, there have been numerous other examples of forensic botany (and other biological disciplines such as entomology—e.g., Rozen and Eickwort 1997). The use of plant fragments, pollen grains or fungal spores, plant trichomes (hairs), anatomical evidence from indigestible cell wall material from the stomach contents of crime victims, molecular evidence utilizing DNA, and ecological evidence useful in locating hidden graves, crime sites, or dating when a crime occurred are just a few examples (Bock et al. 1988; Lane et al. 1990; Mestel 1993; Yoon 1993; Blaney 1995; Bates et al. 1997; Bock & Norris 1997; Graham 1997; Lewis 1997; Lindell 1997). The following specific cases show some of the diversity in the field of botanical forensics. Lane et al. (1990) discussed a rape case in which leaves and bark fragments were found in the pants cuffs of a suspect. The material had gotten into his cuffs while he was climbing a tree to gain access to a window of the victim's house. His claim, that the victim had let him in through a door, did not match the botanical evidence. Another example used by Lane et al. (1990) involved a child abuse case. The parents claimed that the child had been fed fruit cocktail just prior to dying. However, their story was contradicted when his stomach contents showed no evidence of the anatomically characteristic materials expected from such a meal (e.g., stone cells from pears or needle-shaped crystals from pineapples). In the case of a 1989 plane crash near Ruidoso, New Mexico, it was alleged that an engine design flaw had allowed particulate matter (pollen) to build up in the engine and cause the crash. However, it was shown that since the pollen was in fresh condition and had normal cytoplasm and cell walls as seen by electron microscopy, it could not have been exposed to the high temperatures present during engine operation or in the post-crash fire that distorted even aluminum. Further, the pollen was that of insect-pollinated plants found near the storage site of the plane wreckage; such pollen grains are unlikely to be found in any quantity in the atmosphere. Based on the evidence from forensic palynology, it was concluded that the pollen had gotten into the wreckage post-crash during several months of storage and therefore had nothing to do with the accident (Blaney 1995; Brunk 1997; Graham 1997; Lewis 1997). A final example is the use of molecular evidence linking a murder suspect to a palo verde tree (*Parkinsonia aculeata* L., Fabaceae) at an Arizona crime site where he allegedly dumped the body of a victim. Plant geneticist Tim Helentjaris of the University of Arizona demonstrated that two seed pods found in the suspect's truck came from a specific palo verde tree scraped by the suspect's truck at the crime scene. This example is important because it was the first in which plant DNA was used in a criminal case (Mestel 1993; Yoon 1993). Overviews of forensic botany were provided by Lane et al. (1990) in the general science literature and by Bock and Norris (1997) in the forensic science literature.

Our interest in this topic has developed over the course of a number of years during which as plant taxonomists we have been called upon numerous times by poison centers, hospitals, and law enforcement agencies to identify plants or their fragments. We agree with Bock and Norris (1997) that forensic botany is a resource underutilized by the law enforcement community. Further, we believe that forensic botany can be very effectively used in botany or biology courses to show the importance, applicability, and integrative nature of botany. Because forensic botany cuts across all botanical disciplines and because a given case may require many research approaches and techniques, it is a discipline that can stress the integrative nature of botany and science as a whole. Additionally, it is an excellent topic to use in emphasizing problem solving and critical thinking skills. The purpose of the present article is thus two-fold. First, based on our successful use of such information in college teaching, we want to provide in an easily accessible botanical journal a brief review of forensic botany and appropriate references in order to encourage further such usage. Second, we present a specific case of the forensic use of animal-dispersed propagules and suggest that this type of evidence has the potential to be more widely used in criminal investigations.

On July 12, 1995, a sleeping two year old girl was pulled from the first floor window of an apartment in Fort Worth, Texas. The child was sexually molested, but fortunately was found alive about three hours later in a weedy area several hundred meters from where she was abducted. Assorted evidence was used in the case including fingerprints and DNA from semen. However, the easily understandable botanical evidence was an important factor in convincing the jury of the suspect's guilt. Because the Botanical Research Institute of Texas (BRIT) is a well known source of botanical information in the local community, we were contacted by the district attorney's office to identify tiny plant fragments taken from the shoelaces of the suspect. In addition, we were provided with a bag of assorted plant material that had been collected from the crime scene where the child was left (Fig. 1). Upon opening the evidence envelope, we immediately recognized the ca. 4 mm long plant fragments as single-seeded mericarps from a member of the Apiaceae (carrot family). Using a dissecting scope and authenticated specimens in the Botanical Research Institute of Texas herbarium, these were identified as mericarps of *Torilis arvensis* (Huds.) Link, an introduced species commonly known as hedge parsley. The bag of material from the crime scene was then examined and a mature, fruit-bearing plant of hedge parsley was found. Under a dissecting scope, the small mericarps of this species (Fig. 2) are very distinctive. They are densely covered with bristles tipped with microscopic barbs that enhance their attachment to fur or clothing. They also have several very characteristic lines of closely appressed hairs between the bristles. Large photographs of mericarps from both the suspect's shoelaces and the crime scene (Fig. 3) were presented in court by one of us (BLL). Like fingerprints, this was distinctive visual evidence, more easily understood than the scientifically sound but conceptually complex evidence provided by molecular techniques such as DNA analysis. Because the suspect could have possibly picked up the mericarps from some other location, the botanical evidence alone would not have been sufficient for a conviction. However, it firmly linked the suspect with the crime site and in combination with other evidence was successfully utilized by prosecutors Sharon McLauchlin and Larry Thompson and criminal investigator Dennis Timmons. The suspect, David Noel Saddlemire, was convicted of aggravated kidnapping with the jury taking only 55 minutes to reach their verdict (Fig. 4). He was subsequently sentenced to 99 years in the Texas state prison system.

Ectozoochory, the transport of a diaspore or propagule on the outside of an animal, is a common mechanism of dispersal among flowering plants (van der Pjil 1982). While there are various types of diaspores (e.g., vegetative bulbils, fragments of the parent plant), the most common types are seeds, whole fruits, or fruit segments (e.g., mericarps as in the above example). Various methods of attachment are known, ranging from viscous



FORT WORTH POLICE DEPARTMENT
CRIME LABORATORY

RECEIPT

CASE NO. 141868

TYPE CASE Kidnapping/Sexual Assault Child

OFFENSE NO. 95 364266

VICTIM A. S.

SUSPECT David Saddlemire

Received from: Barney Lipscomb

Title and Address: Asst. Dir. BRIT 509 Pecan St. Ft Worth 76102

DATE 7·8·96 TIME 1230 AM ___ PM ✓

AT BRIT

DESCRIPTION:

Received botanical evidence as listed below:

A tape sealed brown paper bag containing:

1. A tape sealed bag holding plant material (11 - Invoice #95 C03400).
2. A tape sealed envelope holding:
    - A. A tape sealed envelope holding plant material collected from right shoe #22 (Invoice #95C03410).
    - B. A tape sealed envelope holding plant material collected from left shoe #23 (Invoice #95C03410).
    - C. A tape sealed envelope holding a subsample of plant material (28 - Invoice #95C03471).
3. A tape sealed bag holding plant material (28 - Invoice #95C03471).
4. a Sealed envelope containing Paper fold holding burrs for Photographing.

PRINT Gerri Lynn Vardy

SIGNED GVardy

ADDRESS FWPD Crime Lab

TELEPHONE NO. 817 877 8084

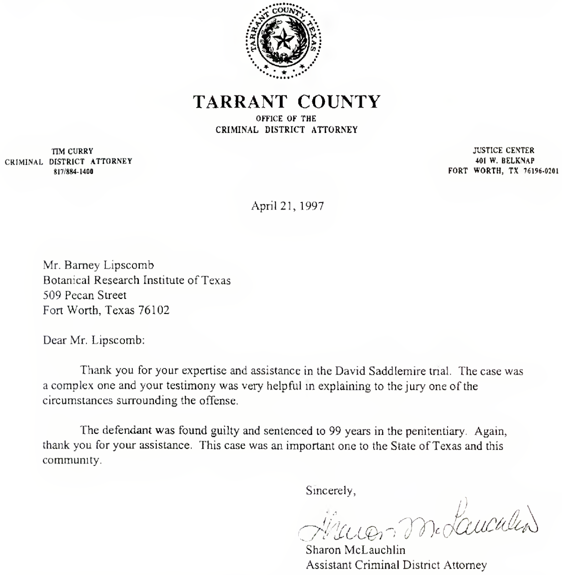
001-35506-025
8-1-77

Fig. 1. Receipt of botanical evidence from the Fort Worth Police Department Crime Laboratory.

FIG. 2. *Torilis arvensis*. A) habit; B) flower; C) fruit showing mericarps with uncinate bristles; D) cross-section of fruit (drawn by Linny Heagy).

FIG. 3. Photographs of mericarps from both the suspect's shoelaces and the crime scene (Photos by Larry A. Reynolds, courtesy of Tarrant County Medical Examiner).

or mucilaginous substances that cause the propagule to stick to the dispersal agent, to very sharp, barbed or recurved hooks, spines, or awns (van der Pjil 1982). We believe that many of these examples are potentially valuable to law enforcement agencies. From many field trips both for research and with students, it has been our experience that it is rare to return from the field without attached plant material either on the clothes, in pant cuffs, on socks, or embedded in shoelaces. Some of these are merely annoying, while others (e.g., *Aristida* species—threeawn grasses) are extremely irritating when penetrating socks or pants. Many of these seeds or fruits frequently get transferred to the interior of cars on carpeting or upholstery. One does not have to go far from the sidewalk to encounter such plant materials. Because many abundant weedy species are animal-dispersed, yards, abandoned lots, and virtually any weedy or disturbed site will have some such species. Because these plant materials are so frequently encountered and because different plant species are found predominantly in specific habitats and during particular seasons, they are potentially valuable sources of evidence that can link suspects with crime scenes both spatially and temporally. Also, many (e.g., tiny fruit segments of some Apiaceae or tiny fruits of some grasses)



TARRANT COUNTY
OFFICE OF THE
CRIMINAL DISTRICT ATTORNEY

TIM CURRY
CRIMINAL DISTRICT ATTORNEY
817/884-1400

JUSTICE CENTER
401 W. BELKNAP
FORT WORTH, TX 76196-0201

April 21, 1997

Mr. Barney Lipscomb
Botanical Research Institute of Texas
509 Pecan Street
Fort Worth, Texas 76102

Dear Mr. Lipscomb:

Thank you for your expertise and assistance in the David Saddlemire trial. The case was a complex one and your testimony was very helpful in explaining to the jury one of the circumstances surrounding the offense.

The defendant was found guilty and sentenced to 99 years in the penitentiary. Again, thank you for your assistance. This case was an important one to the State of Texas and this community.

Sincerely,

Sharon McLauchlin

Sharon McLauchlin
Assistant Criminal District Attorney

FIG. 4. Letter from Tarrant County Office of the Criminal District Attorney confirming the jury conviction of David Noel Saddlemire.

become deeply imbedded in cloth or carpeting, go virtually unnoticed, and often remain attached even after repeated washings or other types of cleaning. Further, seeds and fruits are easily and inexpensively identified by trained botanists using nothing more than a 10X hand lens or inexpensive dissecting scope, taxonomic literature, appropriate illustrations, and herbarium specimens. While molecular forensic techniques can potentially provide very definitive information, they are much more expensive, require sophisticated laboratory facilities, and are less intuitively obvious for courtroom presentation.

Sometimes the attachment of ectozoochorous propagules can be quite tenacious. This means that they could be attached to a perpetrator's clothing for a very long time, or even enter the flesh. The following are specific examples from mammals that illustrate the point. Sharp-pointed structures such as fruits or awns can penetrate the mouth or other tissues of livestock (and have to be extracted by pliers) or even become subcutaneous and require surgical removal. Veterinarians (John Brakebill, Larry Edwards, Ken Lawrence, pers. comm.) indicate that it is not uncommon to find grassburs (*Cenchrus* species), awns (e.g., from *Hordeum* species—foxtail) or the pointed fruits of needle, spear, or threeawn grasses (*Nassella* or *Aristida* species) in animals. For example, in North Central Texas, *Cenchrus* burs are often found embedded between the toes of dogs and grass fruits are known to penetrate buccal tissues including the tongue causing serious problems (Ken Lawrence, pers. comm.). Perhaps more striking is the ability of the sharp fruits of needle grass (apparently, *Nassella leucotricha* (Trin. & Rupr.) Barkworth [formerly known as *Stipa leucotricha* Trin. & Rupr.]—commonly called winter grass, Texas winter grass, spear grass, or Texas needle grass) to deeply penetrate flesh. These can become subcutaneous and require surgical removal; for example, they can enter between the toes of dogs and sometimes migrate long distances subcutaneously causing draining tracts that will not heal until the fruit is removed (Larry Edwards, pers. comm.). The most extreme case we are aware of involved a fruit that penetrated through the skin and then the chest wall of a dog, eventually becoming embedded in a lung and causing a fatal case of pneumonia (John Brakebill, pers. comm.). Also tenacious are the spiny fruits of *Tribulus terrestris* L., puncture vine, of the Zygophyllaceae. These are very painful to both animal and human feet, damage even tires, and are occasionally fatal to livestock if eaten (Correll & Johnston 1970); it would not be surprising to find them attached to various objects and possibly even the tires of a suspect's vehicle.

Locally in North Central Texas, we believe *Soliva pterosperma* (Juss.) Less., lawn burweed, (Asteraceae) collected from a soccer field near Arlington, Tarrant Co. (1995), was possibly spread from eastern Texas by athletic shoes; its fruit is easily, and painfully, attached by its persistent, spine-like style (Diggs et al., forthcoming). Such propagules could remain attached to a suspect's clothing or shoes for long periods of time. Other Asteraceae are well-known as being animal-dispersed with the pappus of many species being modified into an attachment structure. The retrorsely barbed awns of *Bidens* species, beggar's ticks, are strikingly effective. In another composite genus, *Xanthium*, cocklebur, the surface of the bur is conspicuously covered with stiff, hooked prickles ca. 5 mm long and the bur is also terminated by two prominent spines. The attachment of the hooked prickles to clothing or shoelaces is very effective and they can also easily penetrate human skin. The hooks are strikingly reminiscent of velcro. According to the VELCRO® Industries homepage (www.velcro.com), in the early 1940s, a Swiss inventor, George de Mestral, after a walk noticed "cockleburrs" [presumably *Xanthium*] on his dog and his pants. He examined the hooked prickles under a microscope and derived the idea for the well known two-sided fastener—one side with stiff, cocklebur-like "hooks" and the other side with soft "loops" like the cloth of his pants. The word velcro comes from the French words *velours*, velvet, and *croché*, hooked.

While some of the examples above were presented to show the tenacity with which diaspores attach, commonly the seeds or fruits are small and merely cling to the fur, feathers, feet, beak, etc. of the dispersal agent with little or no adverse effect. Because they are often small and inconspicuous, they may be particularly valuable from the forensic standpoint. A well known such member of the Fabaceae (legume family) is the genus *Desmodium*, tickseeds. The fruits or loments are jointed and break apart into 1-seeded flat segments that are the dispersal units; they easily attach to hair or clothing. In North Central Texas for example, there are 12 members of this genus, a number of them occupying rather specific habitats (Diggs et al., forthcoming). Other well known examples are the numerous Apiaceae that have small schizocarps (a fruit that splits between carpels into one-seeded portions called mericarps) whose mericarps are covered with bristles or hairs and become readily attached to many surfaces. These are particularly well known to owners of long-haired dogs because large numbers of the mericarps become entangled in the fur—sometimes the situation is so severe that the only recourse is to shave the dog. The final example given here is the legume genus *Medicago*, commonly known as bur-clovers. There are numerous introduced species of this genus, many of which have prickly fruits. These fruits can be somewhat larger than those mentioned previously, but are still effective at attaching to dispersal agents. Numerous other examples could be given which have potential use forensically. Fortunately, most are easily identified by experienced field botanists because such researchers have encountered them many times on their own clothing or equipment.

Other less obvious diaspores could also be potentially useful. For example, at the present time, several invasive aquatic species (e.g., *Hydrilla verticillata* (L.f.) Royle, in the Hydrocharitaceae) are spreading in North Central Texas, apparently by power boats transporting vegetative propagules (plant fragments). In areas of the country where there are numerous relatively new reservoirs and where the distributions of many aquatics, especially introduced species, are spotty, plant material of a given species could easily be used in linking a suspect with a given body of water.

SUMMARY

Forensic botany is a developing discipline that potentially has broader applicability than is seen at present. Technically simple, visually obvious, easily understood, and inexpensive methods such as the use of animal-dispersed seeds and fruits are particularly worthy of further consideration. Because of the inherent interest in criminal cases, the potential for emphasizing problem solving and critical thinking skills, and the integrative nature of the subject, forensic botany is a field that can be useful in botany and biology education.

ACKNOWLEDGMENTS

We would like to thank our colleagues at various law enforcement agencies, poison centers, and hospitals for their cooperation and hard work. Special thanks to Dennis Timmons, Criminal Investigator of the Tarrant County Office of the Criminal District Attorney, and Larry A. Reynolds, Forensic Photographer, for the photographs, which are used courtesy of the Tarrant County Medical Examiner. Thanks also to John Brakebill, D.V.M., Larry Edwards, D.V.M., and Ken Lawrence, D.V.M., veterinarians in Sherman, Texas, John Lanzalotti, M.D. and Bill Vande Water, BSI, for information on fictional uses of plants as evidence, and Kenna Pirkle, an Austin College student, whose Plant Biology class paper on forensic botany prompted us to write this manuscript. Linny Heagy provided the illustration of *Torilis arvensis*.

REFERENCES

Baden, M.M. 1983. Plenary session: The Lindbergh kidnapping revisited: Forensic sciences then and now. J. Forensic Sci. 8:1035–1037.

Bailey, H.C. 1936. A clue for Mr. Fortune: Reggie at his best. The Sun Dial Press, Garden City, NY.

————. 1943. The thistle down. Ellery Queen's Mystery Magazine 4:5–15.

Bates, D.M., G.J. Anderson, and R.D. Lee. 1997. Forensic botany: Trichome evidence. J. Forensic Sci. 42:380–386.

Blaney, C. 1995. Who ya gonna call? Bioscience 45:746–747.

Bock, J.H., M. Lane, and D. Norris. 1988. Identifying plant food cells in gastric contents for use in forensic investigations—a laboratory manual. U.S. Department of Justice, National Institute of Justice, Washington, D.C.

Bock, J.H. and D.O. Norris. 1997. Forensic botany: An under-utilized resource. J. Forensic Sci. 42:364–367.

Brunk, S.K. 1997. The Ruidoso plane crash—the background and the trial verdict. J. Forensic Sci. 42:378–379.

Correll, D.S. and M.C. Johnston. 1970. Manual of the vascular plants of Texas. Texas Research Foundation, Renner.

Diggs, G.M. Jr., B.L. Lipscomb, and R.J. O'Kennon. Shinners & Mahler's illustrated plants of North Central Texas. To be published in late 1998 by the Botanical Research Institute of Texas, Fort Worth.

Graham, A. 1997. Forensic palynology and the Ruidoso, New Mexico plane crash—the pollen evidence II. J. Forensic Science 42:391–393.

Graham, S.A. 1997. Anatomy of the Lindbergh kidnapping. J. Forensic Sci. 42:368–377.

Haag, L.C. 1983. The investigation of the Lindbergh kidnapping case. J. Forensic Sci. 8:1044–1048.

Hornan, J.J. 1983. The investigation of the Lindbergh kidnapping case. J. Forensic Sci. 8:1040–1043

Lane, M.A., L.C. Anderson, T.M. Barkley, J.H. Bock, E.M. Gifford, D.W. Hall, D.O. Norris, T.L. Rost, and W.L. Stern. 1990. Forensic botany. Bioscience 40:34–39.

Lewis, W.H. 1997. Pollen composition in a crashed plane's engine. J. Forensic Sci. 42:387–390.

Lindell, C.M. 1997. Field sampling and chemical analysis. J. Forensic Sci. 42:398–400.

Mabberley, D.J. 1987. The planr book, a portable dictionary of the higher plants. Reprinted wirh correcrions in 1989. Cambridge Univ. Press, Cambridge, United Kingdom.

———. 1997. The plant book, a portable dictionary of the higher plants, 2nd ed. Cambridge Univ. Press, Cambridge, Unired Kingdom.

Mestel, R. 1993. Murder trial features tree's genetic fingerprint. New Scientist 138:6.

Rozen, J.G. Jr. and G.C. Eickwort. 1997. The entomological evidence. J. Forensic Sci. 42:394–397.

Talalaj, S., D. Talalaj, and J. Talalaj. 1991. The strangest plants in the world. Hill of Content Publishing Co., Melbourne, Australia.

Tippo, O. and W.L. Stern. 1977. Humanistic botany. W.W. Norton & Co., New York.

van Der Pijl, L. 1982. Principles of dispersal in higher plants. Springer-Verlag, Berlin.

Whiteman, R. 1995. The Cadfael companion: The world of Brother Cadfael. Mysterious Press Books, New York.

Yoon, C.K. 1993. Botanical witness for the prosecution. Science 260:894–895.

NOTES

GLAUCIUM CORNICULATUM (PAPAVERACEAE) IN TEXAS

In May 1993, the senior author was informed by her friends, Don and Jo Robison, about an unusual population of wildflowers growing on their ranch. The population has been growing in the same field since the early 1960s when it first appeared with a cultivated batch of cotton seed (D. Robison, pers. comm.). The cotton was eventually replaced with sorghum alum and other grasses in order to graze cattle and the plant has continued to remain despite grazing upon by cattle during periods of severe drought.

Thousands of these individuals were observed by the senior author growing in a sandy field. The majority of the plants, however, were toward the end of their blooming period and had already developed their fruits (long linear capsules full of tiny black seeds). The senior author took the plant to be a poppy, however, one that she was unfamiliar with.

This plant was later identified as *Glaucium corniculatum* (L.) Rudolph by the junior author by comparison with herbarium collections at TEX. Fortunately, there was already a collection (*O'Kennon & Cheatham s.n.*) of *Glaucium* from Texas. This specimen, however, was incorrectly identified (as *G. flavum*, a perennial species with yellow petals and glabrous capsules).

In the years since 1993, Texas experienced a drought and few, if any, of the *Glaucium* in the Garza population had bloomed, preventing further observations by the senior author. In April 1997 sufficient rains brought the *Glaucium* population to bloom allowing the senior author to both observe and photograph (Fig. 1) the population. Later, perhaps as a result of the rains, a third population of *Glaucium* was brought to the attention of the junior author (Bill Henderson, pers. comm.). This population was collected at the Balcones Canyonlands National Refuge. An estimated 100 plants were observed growing in a circular area of about 30 feet in diameter. Two individuals were blooming and five were in fruit, but the majority of the plants were in a juvenile phase too young to flower.

The genus *Glaucium* is native to Southern Europe, the Mediterranean, Hungary and South Central Russia. It has become adventive in California, Kansas, Montana, Nevada, New York, Oregon and Pennsylvania (Barkley 1986; Hickman 1993; Kiger 1997). It is immediately distinguished from other Texas genera in the Papaveraceae by its fruits which are straight, unribbed, linear, capsules up to 25 cm long. *Glaucium corniculatum* is a wholly pubescent annual, 30–40 cm tall, caulescent, with clear yellow sap, cauline deeply pinnate unprickled leaves, inflorescence of a solitary flower that has two free sepals and four petals. The petals are a vivid scarlet color, two of them are wider than the other but all are of equal length (3–4 cm). At the base of each petal is a purple pattern that extends toward the tip about 1/3 the length. The pattern is oval, 10 mm wide and lined with a creamy feather-like design (Fig. 1).

Although collected in Texas as early as 1986 (*Keeney 5906*) and recently reported in Texas (Jones et al. 1997), and North America (Kiger 1997), *Glaucium corniculatum* has yet to be officially documented in the state. Presented here is an updated key to the genera of Papaveraceae in Texas, a listing of known voucher specimens, and a photo of the flower (Fig. 1).

Below is a revised key to the genera of Papaveraceae in the Manual of the vascular plants of Texas (Correll & Johnston 1970).

1. Acaulescent herbs; petals 8 or more, not crumpled in the bud; stigmas over the valves of the capsule. .... **Sanguinaria**
1. Caulescent herbs or (of subacaulescent) confined to the Trans-Pecos; petals 4 to 6, mostly crumpled in the bud; stigmas over the placentae. 2
    2. Perianth and stamens borne on the rim of the hypanthiumlike expansion of the receptacle; sepals united into a calyptra; fruit conspicuously ribbed. .... **Eschscholzia**
    2. Perianth and stamens strictly hypogynous; sepals not united into a calyptra; fruit not ribbed. 3
        3. Herbage prickly; flowers on short pedicels; capsule dehiscing from the apex by 4 to 6 valves. .... **Argemone**
        3. Herbage not prickly; flowers on long pedicels. 4
            4. Stigmatic disk present; capsules short and turgid, to 5 cm long, dehiscing by means of small openings just beneath the truncate summit. .... **Papaver**
            4. Stigmatic disk absent; capsules linear up to 25 cm long, dehiscing longitudinally from the apex. .... **Glaucium**

Glaucium corniculatum (L.) Rudolph, Fl. Jen., 13. 1781. *Chelidonium corniculatum* L., Sp. Pl. 1:56. 1753.

Voucher specimens. **TEXAS. Garza Co.:** community of Justiceburg, on Farm Rd. 3519 on the way to Lake Alan Henry, Don and Jo Robison Ranch, SE corner of Garza Co., ca. 3 mi from Kent Co. line, in field on N side of dirt road, 10 May 1993, *Kirkpatrick s.n.* (TEX). **Kerr Co.:** W of Hunt on TX 39, dry creek bed on N side of road, 2 May 1993, *O'Kennon & Cheatham s.n.* (TEX). **Travis Co.:** Balcones Canyonlands National Refuge, 0.2 mi along dirt road NE from intersection with Cow Creek road, dirt road is 3.4 mi N along Cow Creek Road from 1431, just after large yellow house (30° 33' 50" N, 98° 07' 70" W), 3 May 1997, *J.K. Williams et al. 150* (TEX). **San Saba Co.:** along the Cherokee Creek on the William Clark farm at Bend, on the edge of an over grazed field, 11 May 1986, *Keeney 5906* (BRIT); SE of the William Clark house on the east side of the Cherokee Creek at Bend (1654 plants presenr), 9 May 1987, *Keeney 6642* (BRIT).

The following partial list of species from the Travis county population

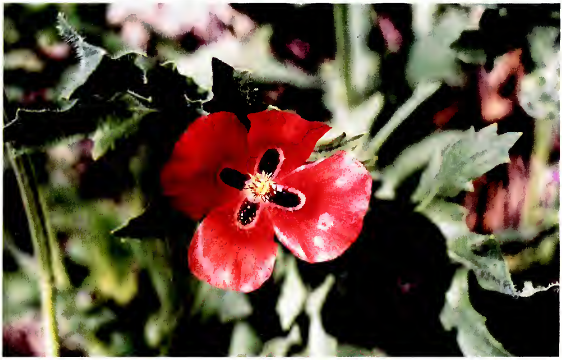


FIG. 1. Photo of *Glaucium corniculatum* (L.) J.H. Rudolph. Photo by Z. Kirkpatrick.

emphasizes the weedy nature of the vegetation at this site: *Argemone albiflora* Hornem., *Buglossoides arvense* (L.) I.M. Johnston*, *Callirhoe involucrata* (Torr.) A. Gray, *Centaurea melitensis* L.*, *Cirsium texanum* Buckl., *Convolvulus equitans* Benth., *Cucurbita foetidissima* Kunth, Evax sp., *Gaura calcicola* Raven & Gregory, *Glandularia bipinnatifida* (Nutt.) Umber, *Lamium amplexicaule* L.*, *Lepidium virginicum* L., *Marrubium vulgare* L.*, *Medicago lupulina* L.*, Hill., *Oenothera trilobata* Nutt., *Physalis cinarescens* (Dunal) A. Hitch., *Plantago rhodospermum* Dcne., *Rapistrum rugosum* (L.) All.*, *Ratibida columnaris* (Sims.) D. Don., *Salvia farinacea* Benth., *Verbena halei* Small. * = naturalized species.

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REFERENCES

BARKLEY, T.M., ed. 1986. Flora of the Great Plains. University Press of Kansas, Lawrence.

CORRELL, D.S. and M.C. JOHNSTON. 1970. Manual of the vascular plants of Texas. Texas Research Foundation, Renner, Texas.

HICKMAN, J.C., ed. 1993. The Jepson manual: Higher plants of California. University of California Press, Berkeley.

JONES, S., J. WIPFF, and P.M. MONTGOMERY, 1997. Vascular plants of Texas: A comprehensive checklist including synonymy, bibliography, and index. University of Texas Press, Austin.

KIGER, R.W. 1997. *Glaucium*. In: Flora North America Editorial Committee, eds. Flora of North America: Volume 3. Magnoliophyta: Magnoliidae and Hamamelidae. Oxford University Press, Oxford. Pp. 302–304.

HOVENIA DULCIS (RHAMNACEAE) NATURALIZED IN CENTRAL TEXAS

In the late summer of 1997 an unusual tree about 12 m tall was observed at the base of a high limestone cliff above Town Lake on the Colorado River in Austin. It had alternate leaves with prominent veins, and appeared to have strange fruiting structures high on the branches, these structures apparently deformed with galls. The tree was identified as a member of the Rhamnaceae based on the characteristic three-carpellate fruit with a remnant disk at the base, very similar to *Colubrina*. Comparison with the Rhamnaceae collection at TEX revealed the tree to be *Hovenia dulcis* Thunberg (Fig. 1), the Chinese raisin tree, which is known to be cultivated in Texas (Jones et al. 1997). Mabberley (1997) suggested *Hovenia* to be of close affinity to *Colubrina*, while recent work by Richardson (unpublished data) suggest that it is more closely-allied with *Ziziphus*. What appeared to be galls are actually peduncles that swell naturally as the fruit develops.

This species is native to mesic forests in China and was introduced into India and Japan for its edible peduncles (Hooker 1872; Rehder 1940; Roxburgh 1975; Sargent 1916). In China the swollen peduncles of the cymose inflorescences have long been used medicinally "to offset the effects of over-indulgence in wine" (Sargent 1916). The peduncles are especially palatable after frost when they redden and the juice sweetens with pear-like flavor (Mabberly 1990; Reich 1991). The fruit itself is not edible.

This tree is known for its cold-hardiness and is cultivated in USDA climate zone 5, with minimum temperatures of -20°F (Dirr 1990; Staff of the L.H. Bailey Hortorium 1976), the equivalent of Milwaukee, WI or Binghamton, NY. It is therefore surprising to find it naturalized in Austin, TX, an area that is much warmer, and more importantly, significantly drier than much of zone 5. The locality where it grows in Austin is a cool, moist microclimate, at the base of a cliff of Edwards limestone and dolomite perhaps 40 m high, facing directly to the northeast. This cliff reaches almost to lake level, except for a very short but steep talus slope of boulders and loamy soil. Vegetation growing at the base of this northeast-facing cliff is almost completely protected from mid-day and afternoon sun, and the presence of a body of water surely modifies the microclimate further. Further exploration via boat several weeks later resulted in the discovery of a larger tree perhaps 100 m upstream, and a smaller tree perhaps 100 m downstream, both at the base of the same cliff. Flowering specimens were later collected in May 1998 from the first tree discovered.

It is possible that this small population of *H. dulcis* is descended from cultivated specimens that existed at the University of Texas College of Pharmacy

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FIG. 1. Fruiting branch of *Hovenia dulcis* Thunb., showing capsules and swollen peduncles. Bar = 1 cm.

Drug Garden, the only other specimens known from the Austin area. Prior to the mid-1940s this garden existed about four miles to the north-east of the collection site, and was subsequently abandoned and never reconstructed (Beryl Simpson, pers. comm.). Two specimens exist at TEX from this garden, dated 1940 and 1946. It is possible that while *H. dulcis* was cultivated in this garden, birds ate the fruit, roosted on the cliffs and trees by the river, and defecated the seed to the forest soil far below. Until the early 1960's this portion of the Colorado river was still free-flowing, and large stretches of loamier soil, which is preferred by *H. dulcis* (Dirr 1990; Staff of the L.H. Bailey Hortorium 1976), likely existed. When Town Lake was created in the early 1960's, perhaps a much larger population of this species was submerged and destroyed, leaving only a small number of individuals growing near the top of the appropriate habitat. During further explorations, no seedlings were observed, and seedling success is probably quite low because numerous other species compete for space on this very thin ribbon of land. Furthermore, the majority of fruiting branches overhang the water, so most fruit falls directly to the bottom of the lake. Similar habitats exist within the region, so it is possible that *H. dulcis* occurs unobserved elsewhere.

Voucher specimens: **TEXAS. Travis Co.:** tree 40 ft tall, growing at the base of a high, NE-facing limestone cliff along the edge of Town Lake, with *Cornus drummondii, Platanus occidentalis*, and *Smilax bona-nox*, across the lake from the boat ramp at the University of Texas Brackenridge Field Lab, Austin, 30 Sep 1997, *D. Goldman with J. Crutchfield 1105* (BH, BRIT, TEX); same locality but with flowers, 29 May 1998, *D. Goldman with P. Griffith 1200* (BH, BRIT, TEX).

Other specimens examined: **TEXAS. Travis Co.:** cultivated, Austin, 16 Sep 1940, *C.C. Albers s.n.* (TEX); ex cultivation; Drug Garden, University of Texas, 24 May 1946, *C.C. Albers 46ph060* (TEX).

Thanks is given to John Crutchfield and Patrick Griffith for their assistance in obtaining specimens of this plant, and Hobbes Goldman, Beryl Simpson, Billie Turner, Justin Williams, and Tom Wendt for their assistance with the manuscript.—*Douglas H. Goldman, Department of Botany, University of Texas, Austin, TX 78713-7640, U.S.A.*

REFERENCES

DIRR, M.A. 1990. Manual of woody landscape plants: Their identification, ornamental characteristics, culture, propagation and uses. Fourth edition. Stipes Publishing, Champaign.

HOOKER, J.D. 1872. The flora of British India, part 1. L. Reeve & CO., London.

JONES, S.D., J.K. WIPFF, and P.M. MONTGOMERY. 1997. Vascular plants of Texas. A comprehensive checklist. University of Texas Press, Austin.

MABBERLEY, D.J. 1997. The plant book. Second edition. Cambridge University Press, Cambridge.

REHDER, A. 1940. Manual of cultivated trees and shrubs. Macmillan Publishing Co., New York.

REICH, L. 1991. Uncommon fruits worthy of attention. Addison-Wesley, Reading.

ROXBURGH, W. 1824. Flora Indica. Reprinted by Oriole Editions, 1975, New York.

SARGENT, C. S. 1916. Plantae Wilsonianae, vol 2. Cambridge University Press, Cambridge.

STAFF OF THE L.H. BAILEY HORTORIUM. 1976. Hortus third. Macmillan Publishing Co., New York.

HABRANTHUS TUBISPATHUS (LILIACEAE) NEW TO THE FLORA OF ALABAMA

The Copper Lily *Habranthus tubispathus* (L'Her.) Traub was first collected in Alabama in the northeast part of the city of Troy in Pike County on 15 July 1988 during field work for a Flora of Pike County. This species was then collected in the community of China Grove in the northern part of Pike County on 17 July 1995 and in rural western Bullock County near the area referred to as High Ridge on 12 July 1996. A fourth site southwest of the city of Troy in Pike County was discovered in August of 1997 (Fig. 1). These are the first records of this species from Alabama, and the second record of this species in North America outside of Texas and Louisiana according to Holmes and Wells (1980) and Burkhalter (1984).

Habranthus tubispathus (L'Her.) Traub (Liliaceae), also known as *Zephyranthes texana* Herbert or *Habranthus texanus* (Herbert) Herbert ex Steud., is a scapose perennial from a small bulb. Each 10–20 cm scape bears a single yellowish-orange flower produced during the summer months, usually following a rain. The leaves are linear, 3–5 mm wide and up to 25 cm in length, and appear in autumn and wither by early spring. The fruit is ovoid and three lobed containing numerous flat, black papery seed at maturity. The genus *Habranthus* is separated from the genus *Zephyranthes* by Sealy (1937) based upon the filaments of *Habranthus* being of four lengths and the anthers affixed at the middle, while in *Zephyranthes* the filaments are of alternate lengths and the anthers affixed below the middle.

In the city of Troy, Copper Lily is found growing in lawns, along side walks, in a city softball field, a grass parking lot, and a cemetery. All of the sites are to some degree disturbed and other vegetation consists primarily of mixed grasses (predominately *Cynodon dactylon* (L.) Pers., *Paspalum notatum* Fluegge, and *Eremochloa ophiuroides* (Munro) Hack.) and other bulb species (*Ipheion uniflorum* (Lindley) Raf., *Allium bivalve* (L.) Kuntze, and *Allium canadense* L.). Copper Lily is so abundant there that in some lawns it forms a complete ground cover when in foliage. The soils are sandy and well drained. Flowering of Copper Lily is most common in July, August, and September, when periods of drought are broken by summer thunder showers. The foliage appears in late autumn, usually in October, and remains green throughout the winter. The total area occupied by Copper Lily in Troy is about three to five acres, and extends in a unbroken population for 276 meters along Three Notch Street.

In China Grove and in the High Ridge area Copper Lily is found on roadsides and in lawns. It is associated with many of the same species as the population in Troy, with *Cynodon dactylon* (L.) Pers. and *Paspalum notatum* Fluegge

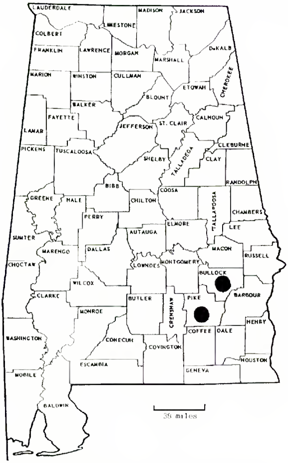

FIG. 1. Map of Alabama with locations of Pike and Bullock counties.

predominating. The soils in China Grove and in High Ridge are coarse sands and the sites tend to be xeric. Undisturbed areas nearby support a dwarf oak-lichen sandhill community. The population in China Grove extends for 301 meters along Pike County Highway 37 and the High Ridge population extends for 142 meters along Bullock County Highways 7 and 14. Estimates of total population size are three acres for China Grove and two acres for High Ridge.

The fourth population is located about eight miles southwest of Troy near Goshen. It is also found on a roadside and extends for 75 m along Pike County Highway 25. The soil is sandy and the main associate at this site is *Paspalum notatum* Fluegge. This is the smallest population, covering approximately one-half acre.

Monitoring of a planted population of copper lily for five years revealed that the seed generally fell within 15 cm of the parent plant and that seedlings were readily produced. Seedlings generally flowered for the first time in their third year of growth without special care.

Holmes and Wells (1980) reinforced the suggestion of H.H. Hume (Sealey 1937) that the distribution of Copper Lily in North America was the result of human activity. They speculated that the distribution of the Copper Lily in North America was most likely the result of traveling Spanish missionaries as all of the Texas and Louisiana populations are near the sites of Spanish missions. As there is no record of a Spanish mission ever having been located in Troy or in Pike county, it is most likely that the species reached Alabama by other means. Historical records of the Troy-Pike county area reveal that in 1865 a man by the name of William Murphree left Troy and moved to Walker County, Texas. In letters to his mother, Murphree states that he is enclosing seeds for her to plant. In other records Mrs. Murphree is noted for planting many of the decorative plants in Troy at that time. The Murphrees lived on Three Notch Street in Troy, the site of the largest Copper Lily population reported above. Walker County, Texas, where Mr. Murphree moved is listed by Holmes and Wells as a place where Copper Lily was collected (1980). We therefore speculate that Copper Lily was introduced into Alabama by the Murphree family from populations in Walker County, Texas. As all of the sites reported above are old communities, it is likely that Mrs. Murphree shared the plant with friends or relatives nearby.

Voucher specimens: **ALABAMA: Bullock Co.**: T13N R21–22E sect. 36–31, intersection of Bullock Co. Hwy 7 and 14 and un-numbered dirt road, high ridge, roadsides and lawns, full sun, deep dry sandy soil, abundant, 12 Jul 1996, *A.R. Diamond 10413* (AUA). **Pike Co.**: T10N R21E sect. 29, Troy, U.S. Hwy 29 (Three Notch Street), north of down town at Knox Field, abundant along sidewalks and road, lawns, and vacant lots, full sun, sand or clay soil, flowered after shower during drought, no leaves seen, 15 Jul 1988, *A.R. Diamond 5210* (AUA); T12N R21E sect. 9, China Grove, just east of Pike Co. Hwy 7, roadside, full sun, dry sandy soil, common, 17 Jul 1995, *A.R. Diamond 9691* (AUA); T9N R20E sect. 6, Pike County Hwy 25, 0.2 mi S of U.S. Hwy 29, ca. 75 m along the west side of the road, full sun, flowers yellow, 3 Oct 1997, *A.R. Diamond 11131* (AUA).

Duplicates will be distributed at a later date.—*Alvin R. Diamond, Jr., Charles P. Chapman, and Jim Brummett, Department of Biology, Troy State University, Troy, AL 36082, U.S.A.*

REFERENCES

BURKHALTER, J.R. 1984. Additions to the vascular flora of Florida. Castanea 49:181.

HOLMES, W.C. and C.J. WELLS. 1980. The distribution of *Habranthus tubispathus* (L'Her.) Traub in South America and North America- Texas and Louisiana. Sida 8:328–333.

SEALY, J.R. 1937. *Zephyranthes*, *Pyrolirion*, *Habranthus* and *Hippeastrum*. J. Royal Hort. Soc. 62:195–209.

PLANTAGO CORONOPUS (PLANTAGINACEAE) NEW TO TEXAS

Plantago coronopus L., native to Europe and the Mediterranean area (Chater & Cartier 1976), was reported as naturalized in California (Dempster 1993). In the eastern United States it has been variously described as rarely adventive on ballast heaps at seaports (Gleason 1952), occurring sporadically about ports without persisting (Fernald 1950), and as a repeated introduction in ballast that does not become established (Gleason & Cronquist 1991). It was not reported in standard floras of the southeastern United States (e.g., Small 1913; Radford et al. 1968), or in the floras of Missouri (Steyermark 1963), New Mexico (Martin & Hutchins 1981), Great Plains (McGregor & Brooks 1986), Arkansas (Smith 1994), Oklahoma (Taylor & Taylor 1994), or Texas (Correll & Johnston 1970). It was also not included in more recent works on Texas plants such as Hatch et al. (1990) or Jones et al. (1997), nor was it listed by Rosatti (1984) in his treatment of Plantaginaceae for the Generic Flora of the Southeastern United States.

As part of the collecting effort for the forthcoming *Shinners & Mahler's Illustrated Flora of North Central Texas* (Diggs et al., forthcoming), a collection made in 1998 in Fort Worth (Tarrant County) is apparently the first documented occurrence of this species for Texas.

Voucher specimen: **TEXAS. Tarrant Co.:** weedy area in landscape, 301 Crestwood, Fort Worth, 24 May 1998, *O'Kennon 14221* (BRIT).

At the collection locality numerous individuals were observed as landscape weeds and other individuals were observed in nearby weedy areas. The mode of introduction is unclear, but seeds were possibly introduced with landscape plants. Introduction could also have occurred through spread from intentional cultivation. Since 1997, seeds of *Plantago coronopus* have been offered by Johnny's Selected Seed Company for the specialty salad green market under the name "Minutina" or "Erba stella" and, until recently, seeds were sold by the Ornamental Edibles Seed Company as an "edible landscape plant." Other north central Texas populations have not been found and it is unclear whether the species will become more widely established. However, some individuals were very robust, with one having 65 inflorescences. Also, the species is self-compatible (Delden et al. 1992) and is tolerant to drought, soil compaction, and competition (Mook et al. 1992). The seeds are highly viable and germinate well in soils with low moisture content (Blom 1992).

This species, commonly known as buck-horn plantain, differs from all other plantains occurring in Texas in having deeply pinnately lobed leaves, short hairs on the corolla tubes, and 3- or 4-locular capsules. Other members of the genus occurring in the state have leaves entire or with few teeth or shallow lobes, corolla tubes glabrous, and 2-locular capsules.

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FIG. 1. Habit of *Plantago coronopus* (with permission from Gleason 1952).

Plantago coronopus (Fig. 1) can be recognized by the following description (Butcher 1961; Gleason 1952; Chater & Cartier 1976; Dempster 1993; Rahn 1996): Pubescent annual or biennial with a taproot and leaves in a basal rosette; leaves closely spreading on the ground or ascending, linear to lanceolate in outline, 4–25 cm long, with spreading-ascending, acute, ± linear lobes, the lobes sometimes toothed or lobed; inflorescences sometimes numerous, 5–50 cm long including the leafless, densely hairy peduncle terminated by a narrowly cylindric, dense spike to ca. 12.5 cm long; bracts usually not surpassing the flowers, broadly scarious-margined at base, the keel prolonged into an acuminate tip; corolla tubes covered with short hairs; petals acute; stamens 4; capsules 3- or 4-locular; seeds 3–5 per capsule, dimorphic, one per locule, ca. 1.5 mm long, and one smaller than the others, ca. 0.5 mm long, occurring in an upper compartment in the ovary on the abaxial side; flowering late Apr–Sep.

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REFERENCES

BLOM, C.W.P.M. 1992. Ecology of *Plantago* populations: Germination and establishment. In: P.J.C. Kuiper & M. Bos, eds. *Plantago*: A Multidisciplinary Study. Pp. 88–97. Springer-Verlag, Berlin, Heidelberg, New York.

BUTCHER, R.W. 1961. A new illustrated British flora. Leonard Hill Books Limited, London, England, U. K.

CORRELL, D.S. and M.C. JOHNSTON. 1970. Manual of the vascular plants of Texas. Texas Research Foundation, Renner.

CHATER, A.O. and D. CARTIER. 1976. *Plantago*. In: T.G. Tutin, V.H. Heywood, N.A. Burges, D.M. Moore, D.H. Valentine, S.M. Walters, and D.A. Webb, eds. Flora Europaea 4:38–44.

DELDEN, W. VAN, H. VAN DIJK, and K. WOLFF. 1992. The genetics of *Plantago* species. In: P.J.C. Kuiper and M. Bos, eds. *Plantago*: A multidisciplinary study. Pp. 295–309. Springer-Verlag, Berlin, Heidelberg, New York.

DEMPSTER, L.T. 1993. Plantaginaceae. In: J.C.Hickman, ed. The Jepson manual, higher plants of California. Pp. 820–821. Univ. of California Press, Berkeley.

DIGGS, G.M. Jr., B.L. LIPSCOMB, and R.J. O'KENNON. Shinners & Mahler's illustrated flora of North Central Texas. To be published in late 1998 by the Botanical Research Institute of Texas, Fort Worth.

FERNALD, M.L. 1950. Gray's manual of botany, 8th ed. Reprinted 1987. Dioscorides Press, Portland, OR.

GLEASON, H.A. 1952. The new Britton and Brown illustrated flora of the northeastern United States and adjacent Canada, 3 vols. New York Botanical Garden, Bronx.

__________ and CRONQUIST, A. 1991. Manual of the vascular plants of northeastern United States and adjacent Canada, 2nd ed. Van Nostrand Reinhold Company, New York.

HATCH, S.L., K.N. GANDHI, and L.E. BROWN. 1990. Checklist of the vascular plants of Texas. Texas Agric. Exp. Sta. Misc. Publ. 1655:1–158.

JONES, S.D., J.K. WIPFF, and P.M. MONTGOMERY. 1997. Vascular plants of Texas: A comprehensive checklist including synonymy, bibliography, and index. Univ. of Texas Press, Austin.

MARTIN, W.C. and C.R. HUTCHINS. 1981. A flora of New Mexico, 2 vols. J. Cramer, Germany.

MCGREGOR, R.L. and R.E. BROOKS. 1986. Plantaginaceae. In: Great Plains Flora Association. Flora of the Great Plains. Pp. 742–747. Univ. Press of Kansas, Lawrence.

MOOK, J.H., J. HAECK, J. VAN DER TOORN, and P.H. VAN TIENDEREN. 1992. Ecology of *Plantago* populations: The demographic structure of populations. In: P.J.C. Kuiper and M. Bos, eds. *Plantago*: A multidisciplinary study. Pp. 69–87. Springer-Verlag, Berlin, Heidelberg, New York.

RADFORD, A.E., H.E. AHLES, and C.R. BELL. 1968. Manual of the vascular flora of the Carolinas. The Univ. of North Carolina Press, Chapel Hill.

RAHN, K. 1996. A phylogenetic study of the Plantaginaceae. J. Linn. Soc., Bot. 120: 145–198.

ROSATTI, T.J. 1984. The Plantaginaceae in the southeastern United States. J. Arnold Arbor. 65: 533–562.

SMALL, J.K. 1913. Flora of the southeastern United States, 2nd ed. Published by the author, New York.

SMITH, E.B. 1994. Keys to the flora of Arkansas. Univ. of Arkansas Press, Fayetteville.

STEYERMARK, J.A. 1963. Flora of Missouri. The Iowa State Univ. Press, Ames.

TAYLOR, R.J. and C.E.S. TAYLOR. 1994. An annotated list of the ferns, fern allies, gymnosperms and flowering plants of Oklahoma, 3rd ed. Southeastern Oklahoma State Univ., Durant.

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PTERIS VITTATA (PTERIDACEAE), A NEW FERN FOR TEXAS

Pteris vittata L., commonly known as ladder brake, Chinese brake, or Chinese ladder brake, is an Asian native well known as an escape from cultivation in coastal areas of the southeastern United States. The species was not included in Small's 1903 or 1913 treatments of the southeastern flora. Small later (1938) treated the species as *Pycnodoria vittata* (L.) Small, indicating that it had been collected in Florida many years previously and that during the 1930s it was abundant at several Florida localities (e.g., Everglades). He also indicated that it was established in Alabama, Louisiana, the West Indies, and South America. Currently, *Pteris vittata* is common in southern Florida where it can be found in almost every habitat with exposed limestone (e.g., pinelands) and on a variety of man-made calcareous substrates (e.g., sidewalks, buildings, old masonry) (Nauman 1993). Radford et al. (1968) cited a South Carolina record and noted that it was a rare escape. Nauman (1993) mapped the species as occurring from southern South Carolina south to Florida and west to eastern Louisiana; he also showed isolated occurrences in southern California and the District of Columbia.

Pteris vittata was not included in the Texas flora by Correll (1956, 1966), Correll and Johnston (1970), Stanford (1976), Hatch et al. (1990), or Jones et al. (1997), nor has it been reported from Oklahoma (Taylor & Taylor 1994). It is now known from Texas based on the following collection:

Voucher collection: **Texas. San Saba Co.:** ca. 3 mi N of Bend, on the Edwards Plateau, growing from a limestone boulder with *Adiantum capillus-veneris* L. at edge of Rough Creek (tributary of the Colorado River), 6 Nov 1987, *J.W. Stanford 5308* (BRIT, HPC, SPLT).

Subsequent flooding has destroyed the site. The identification was confirmed by Jim Blassingame (South Plains College, Levelland, TX).

Of the five *Pteris* species in the United States (most occurrences are in the southeastern part of the country), four are introduced and one, *P. bahamensis* (J. Agardh) Fée, is native to south Florida (Nauman 1993). Besides *P. vittata*, only *P. multifida* Poir. (spider brake, Chinese brake, Huguenot fern), is known from Texas. This widely cultivated native of China is naturalized in east and southeast Texas and the Rio Grande Valley (Correll & Johnston 1970; Hatch et al. 1990). The deeply palmately 3-divided pinnae (at least some) of *P. multifida* are quite distinctive.

Pteris vittata can be recognized and distinguished as follows: stems short-creeping, stout, densely scaly; leaves clustered, strictly 1-pinnate (the pinnae without lobes or divisions), 0.3–1 m long including petiole; pinnae 12–20(–30) pairs per leaf, linear-lanceolate to linear-attenuate, 2–18 cm long, 4–9 mm wide, long-attenuate or sharply acute apically, asymmetrically cordate to widened or truncate basally; serrulate marginally; distal pinnae conspicuously

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longer than proximal pinnae (leaf blades thus oblanceolate in outline) with the terminal pinna typically longest; petioles and often rachises densely scaly; sori usually of a continuous narrow band near the margins of the abaxial surface of the pinnae (thus most of the abaxial blade surface exposed) (Long & Lakela 1971; Nauman 1993; Smith & Lemieux 1993). The species is a tetraploid, with $2n = 116$ (Nauman 1993). An illustration and a detailed description are available in Small (1938). A recent treatment of *Pteris*, including a key to taxa occurring in the United States and an illustration of *P. vittata*, can be found in Nauman (1993).

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REFERENCES

CORRELL, D.S. 1956. Ferns and fern allies of Texas. Texas Research Foundation, Renner.

————. 1966. Pteridophyta. In: C.L. Lundell, ed. Flora of Texas 1:3—121. Texas Research Foundation, Renner.

———— and M.C. JOHNSTON. 1970. Manual of the vascular plants of Texas. Texas Research Foundation, Renner.

HATCH, S.L., K.N. GANDHI, and L.E. BROWN. 1990. Checklist of the vascular plants of Texas. Texas Agric. Exp. Sta. Misc. Publ. 1655:1–158.

JONES, S.D., J.K. WIPFF, and P.M. MONTGOMERY. 1997. Vascular plants of Texas: A comprehensive checklist including synonymy, bibliography, and index. Univ. of Texas Press, Austin.

LONG, R.W. and O. LAKELA. 1971. A flora of tropical Florida. Univ. of Miami Press, Coral Gables, FL.

NAUMAN, C.E. 1993. *Pteris*. In: Flora of North America Editorial Committee, eds. Fl. North Amer. 2:132–135. Oxford Univ. Press, New York and Oxford.

RADFORD, A.E., H.E. AHLES, and C.R. BELL. 1968. Manual of the vascular flora of the Carolinas. The Univ. of North Carolina Press, Chapel Hill.

SMALL, J.K. 1903. Flora of the southeastern United States. Published by the author, New York.

————. 1913. Flora of the southeastern United States, 2nd ed. Published by the author, New York.

————. 1938. Ferns of the southeastern United States. The Science Press Printing Co., Lancaster, PA.

SMITH, A.R. and T. LEMIEUX. 1993. Pteridaceae. In: J.C. Hickman, ed. The Jepson manual, higher plants of California. Pp. 439–441. Univ. of California Press, Berkeley.

STANFORD, J.W. 1976. Keys to the vascular plants of the Texas Edwards Plateau and adjacent areas. Published by the author, Brownwood, TX.

TAYLOR, R.J. and C.E.S. TAYLOR. 1994. An annotated list of the ferns, fern allies, gymnosperms and flowering plants of Oklahoma, 3rd ed. Southeastern Oklahoma State University, Durant.

LYCIANTHES ASARIFOLIA (SOLANACEAE) NEW AND WEEDY IN TEXAS

In July of 1997 an unknown plant was collected in Houston and sent to Texas A&M for identification. It proved to be *Lycianthes asarifolia* (Kunth & Bouché) Bitter, a member of the Solanaceae native to South America. This species has been previously known in North America only from New Orleans, Louisiana (Darwin & Feibelman 1991). De Rojas and D'Arcy (1997) incorrectly cited that collection as being from Texas.

This species is recognizable by its prostrate habit, having slender stolons that root at every node. The leaves are strongly cordate, entire, and long-petioled. Sometimes a second leaf is produced at non-flowering nodes: if the primary leaf is relatively large, the second leaf is usually small and often stipule-like; when the primary leaf is relatively small, the second is often nearly the same size. The flowers are white, rotate, and ca. 1.5 cm broad. The yellow anthers are connivent around the style and poricidally dehiscent. The fruit is an edible reddish-orange berry ca. 1.3 cm in diameter, closely subtended by the truncate calyx. Plants are self-infertile (Dean 1997). A good illustration can be found in the article by De Rojas and D'Arcy and images of the Houston plants can be seen at Texas A&M's Bioinformatics Working Group Image Gallery page (http://www.csdl.tamu.edu/FLORA/imaxxsol.htm). Note that the leaves of the Houston plants are nearly all rounded apically rather than pointed as in the article illustration.

A visit to the collection site revealed that this plant has overrun several residential yards in Houston, forming a dense, attractive ground cover in shaded areas. It is apparently reproducing both vegetatively and sexually, for numerous flowers and immature fruits were seen in early December 1997 and mature fruits were collected in March 1998. (Darwin and Feibelman found no fruit in the Louisiana population and none has since been seen on plants grown from cuttings taken from that population.) The authors also suspect that propagules are being carried from yard to yard on the equipment of landscape maintenance companies. The exact time and point of introduction is not known, but the population has been in existence for three or more years. Residents' attempts to control the plant by hand-pulling, mowing, herbicide application, and removal of infested sod have proved unsuccessful. It appears to be tolerant of Houston's winter weather and suffers only partial dieback during the hottest summer days. Should this plant become established in nearby Memorial Park (a large, wooded area), it could be nearly impossible to eradicate. Herbicide trials were begun in one of the Houston yards in March of 1998. After two rounds of tests, no treatment has provided complete control, and treatments which have weakened the *Lycianthes* have also damaged the surrounding turf.

It is possible that this plant could become a noxious weed in southern Texas. The USDA Animal and Plant Health Inspection Service is conducting a formal risk assessment. (The Louisiana Department of Agriculture has considered surveying for the plant in the New Orleans area.) The authors encourage identification, documentation, and destruction of any new colonies subsequently discovered. Should other populations of this plant be found, please contact one of the authors.

Voucher specimen: U.S.A. **TEXAS. Harris** Co.: Houston, shaded residential yard of 502 Lindenwood, with *Quercus virginiana, Pinus, Stenotaphrum secundatum*, and *Trachelospermum* in moist sandy loam, 6 Dec 1997, *Mary Ketchersid 120697-A* (BH, BRIT, MO, NO, NY, TAES, TAMU, TEX, US, WAVI).

We thank Michael Nee (NY) for his assistance in identifying this plant.

—*Monique Dubrule Reed, Biology Department, Texas A&M University, College Station, TX 77843-3258, U.S.A. and Mary Ketchersid, Agricultural and Environmental Safety, Texas Agricultural Extension Service, College Station, TX 77843-2488, U.S.A.*

REFERENCES

DARWIN, S.P and T. FEIBELMAN. 1991. *Lycianthes asarifolia* (Solanaceae) new to North America. Sida 14:605–606.

DEAN, E. 1997. Personal communication. Dr. Dean studies the taxonomy of *Lycianthes* at the University of California-Davis.

DE ROJAS, C.E. and W.G. D'ARCY. 1997. The genus *Lycianthes* (Solanaceae) in Venezuela. Ann. Missouri Bot. Gard. 84:167–200.

FIRST REPORT OF THE GENUS *BURMEISTERA* (CAMPANULACEAE) FROM HONDURAS

Burmeistera Triana (Campanulaceae: Lobelioideae) is a genus of 96 species endemic to the Neotropics (Lammers 1998); it was last monographed by Wimmer (1943). The genus is closely related to two other Neotropical endemics, *Centropogon* C. Presl and *Siphocampylus* Pohl (Pepper et al. 1997; Lammers 1998). All are large robust plants (herbaceous or suffruticose perennials, shrubs, subshrubs, or lianas) with large flowers (corollas averaging 30–60 mm long or more) borne singly in the axils of the upper leaves or aggregated into terminal bracteate or foliose (sometimes corymbiform) racemes; the tube of the corolla is neither fenestrate nor cleft dorsally and if the lobes are dimorphic, it is the two dorsal ones that are the larger. *Burmeistera* is distinguished from its allies by its combination of usually ebracteolate pedicels, green or yellow corolla often suffused with maroon or purple, large falcate or reflexed dorsal corolla lobes, the wide open orifice of the anther tube, baccate often inflated fruit, and oblong to fusiform seeds much longer than broad.

Most of the species of *Burmeistera* are found in montane areas from Costa Rica to Ecuador. At the southern limits of this range, two Ecuadorean species extend south into Peru (Stein 1987). At the northern end, a single species is known to occur north of Costa Rica: *Burmeistera virescens* (Benth.) Benth. & Hook. ex Hemsl. It has been reported (McVaugh 1943; Wimmer 1943; Nash 1976) only from Guatemala, where it occurs in the departments of Alta Verapaz, Baja Verapaz, Huehuetenango, Quezaltenango, San Marcos, and Suchitepéquez. This is a disjunction from its congeners of nearly 700 km. That gap has been narrowed, however, by the discovery of this same species in central Honduras. This is the first report of any member of *Burmeistera* from that nation.

Voucher specimen: **HONDURAS. Depto. Olancho:** Parque Nacional la Muralla, trail above Visitors' Center, ca. 14 km above La Union, 15°05'N 86°40'W, in dense high primary *Quercus* forest, 1400 m, 27 Oct 1996, *P.J.M. Maas & H. Maas 8441* (U).

The new locality in Honduras is approximately 350 km east of the nearest conspecific populations in Guatemala. The *Quercus*-dominated primary forest there was quite rich in epiphytes, including *Pleurothallis tuerckheimii* Schlecht. (Orchidaceae), *Columnea rubrecaulis* Standl. (Gesneriaceae), and *Peperomia hoffmannii* C. DC. (Piperaceae). Understory shrubs included *Besleria solanoides* Kunth (Gesneriaceae), *Monnina ferreyrae* Taylor (Polygalaceae), *Tournefortia* sp. (Boraginaceae), scandent *Sphyrospermum majus* Griseb. (Ericaceae), and a treelet species of *Clethra* (Clethraceae). Species found in the herbaceous layer were *Psilochilus macrophyllus* (Lindl.) Ames (Orchidaceae), *Renealmia mexicana* Klotzsch ex Peterson (Zingiberaceae), *Smilacina* sp. (Asparagaceae), *Spigelia* sp. (Spigeliaceae), the saprophyte *Gymnosiphon suaveolens* (Karst.) Urb. (Burmanniaceae), and the root-parasite *Monotropa uniflora* L. (Monotropaceae). Adjacent patches of secondary forest contained small trees of *Saurauia veraguensis* Seem. (Actinidiaceae), shrubs of *Triumfetta speciosa* Seem. (Tiliaceae), and the herbs *Canna tuerckheimii* Kraenzl. (Cannaceae) and *Hydrocotyle mexicana* Cham. & Schlecht. (Apiaceae).

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REFERENCES

LAMMERS, T.G. 1998. Review of the Neotropical endemics *Burmeistera*, *Centropogon*, and *Siphocampylus* (Campanulaceae: Lobelioideae), with description of eighteen new species and a new section. Brittonia 50:233–262.

MCVAUGH, R. 1943. Campanulaceae (Lobelioideae). N. Amer. Fl. 32A:1–134.

NASH, D.L. 1976. Campanulaceae. In: Flora of Guatemala, parr IX, no. 4. Field Mus. Nat. Hist., Bot. Ser. 24:276–431.

PEPPER, A.S.-R., M.H.G. GUSTAFSSON, and V.A. ALBERT. 1997. Molecular systematics of Neotropical Lobelioideae (Campanulaceae), with emphasis on *Burmeistera, Centropogon,* and *Siphocampylus,* and the utility of fruir and floral characrers in lobelioid classification [abstract]. Amer. J. Bot. 84(6, Suppl.):222.

STEIN, B.A. 1987. Synopsis of the genus *Burmeistera* (Campanulaceae: Lobelioideae) in Peru. Ann. Missouri Bot. Gard. 74:494–496.

WIMMER, F.E. 1943. Campanulaceae-Lobelioideae, I. Teil. In: R. Mansfeld, ed. Das Pflanzenreich, IV.276b. Verlag Wilhelm Engelmann, Leipzig.

TRIRAPHIS MOLLIS (POACEAE: ARUNDINEAE) A SPECIES REPORTED NEW TO THE UNITED STATES

Prior to this report the occurrence of *Triraphis* and *T. mollis* R. Br. (purple plumegrass) in naturalized populations was not documented in the United States (Chase 1951; Correll & Johnston 1970; Gould 1975; Hatch et al. 1990; Kartesz 1994; Jones et al. 1997). Specimens of this taxon were first collected in naturalized populations by William Godwin on 15 Mar 1993 in Dimmit County. Since the original U.S. collection, William E. Fox III collected the species in the same area on 1 May 1996.

Cultivated specimens collected from an experiment station in Biloxi, Mississippi were located in TAES. However, specimens have not been located that were from escaped or naturalized populations. TROPICOS has reported this species as being present in the U.S. because of a listing by the U.S. Department of Agriculture in their "National List of Scientific Plant Names" (U.S.D.A. 1982). In that U.S.D.A. publication, the distribution was not listed because the plant species was not naturalized.

The species was identified to genus using Clayton and Renvoize (1986) and to species using Simon (1993). The identification was then verified using the Tracy Herbarium (TAES) plant specimens from Australia and specimens from U.S. National Herbarium (US). Lazarides (1970) reported the grass to be grazed in Australia, but stated that it appeared to be less valuable than many short-lived perennials. Clayton and Renvoize (1986) reported the genus to be allied with *Neyraudia* because of gross morphology and the slender microhairs.

Superficially, *T. mollis* resembles *Aristida*. However, upon examination of the spikelets with a dissecting microscope the following observations become apparent. Spikelets have several florets with the reduced floret apical. Also the lemmas are 3-veined, 3-awned. The lemma awns are extensions of the 3-veins of the lemmas. In *T. mollis*, the central lemma awn originates from the lemma apex and lateral awns below and on both sides of the central awn, whereas in *Aristida* the lemma awns originate from a column or the lemma apex and branch from a common point of origin.

Triraphis mollis R.Br., Prodr. Fl. Nov. Holl. 185. 1810. (**Fig. 1**).

Caespitose perennial. Culms to 50 cm tall, erect to ascending, unbranched; nodes glabrous, purplish black; internodes solid. Leaves mostly basal; sheaths glabrous, rounded, margins free; auricles minute; ligules a fringe of hairs about 1 mm long; blades 6–17 cm long, 1–2 mm wide, flat becoming involute, glabrous. Panicles 7–20 cm long, 8–15 mm wide (excluding awns), contracted, somewhat interrupted, purplish tinged. Spikelets 4–12 mm long,

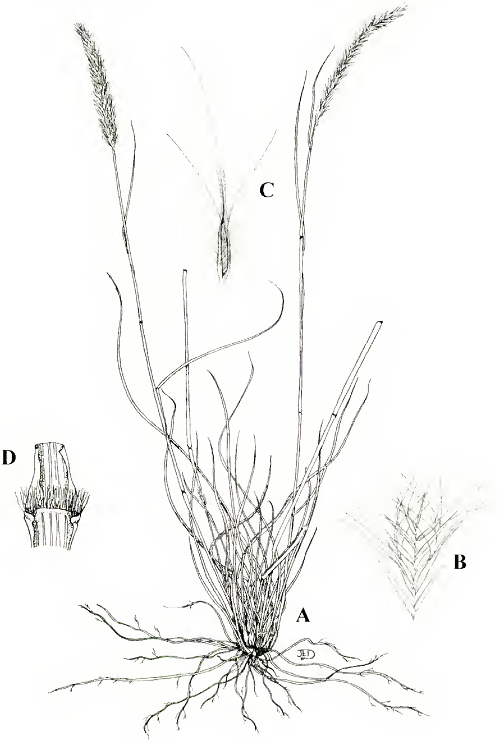

FIG. 1. *Triraphis mollis*. A. habit; B. spikelet, glumes separated from florets; C. floret, palea view with lemma margin and the associated hairs; and D. ligule.

crowded, pedicellate, laterally compressed, disarticulation above glumes and between florets; florets 4–10, callus bearded, reduced florets 1–2 and apical. Glumes subequal (not consistent in which glume is longer), 1-veined, hyaline, shorter than spikelets, awnless; first glumes 3.5–5 mm long; second glumes 4–5.5 mm long; lowermost lemmas 4–5 mm long, 3-veined and 3-awned, deeply bifid with teeth to 1 mm long, membranous, median vein awns 6–9 mm long from between teeth of bifid apex; lateral vein awns 5.5–7 mm long, divergent; lateral veins with long pilose hairs (hairs occasionally on the lemma body); lowermost paleas 2–2.5 mm long, 2-keeled, hyaline, glabrous to scaberulous. Stamens 3; anthers 0.2–0.3 mm long, yellow.

Collection localities were characterized by deep sandy soils of the Brystal Fine Sandy Loam (Stevens & Arriaga 1985). Historically, well drained sandy soils derived from Carrizo Sandstone were called Norfolk Fine Sand (Carter 1931). These soils are derived from parent material in the Carrizo Sands Formation. Carrizo Sand has been shown to have hygroscopic properties that ameliorate the effects of a xeric climate and consequently influence its plant formation (McBryde 1933).

Specimens examined: **AUSTRALIA. New South Wales:** Sydney; 18??, *J. Maiden s.n.* (TAES). **Northern Territory:** Simpson Desert, ca 15 km N of Andado Homestead (250 km SE of Alice Springs), 11 Jul 1968 *J. Weber 958* (TAES). **Queensland-Warrego District:** Charleville, cemetery, Oct-Nov 1945, *M. Clemens s.n.* (TAES).

UNITED STATES. Texas-Dimmit Co.: 14 mi NW of Carrizo Springs on Cometa Road, near sandy dirt road between Cometa and Hwy 277, 15 Mar 1993 *W. Godwin s.n.* (TAES); 13 mi W of Carrizo Springs, 2 mi W of FM 393 along Hwy 277, then 2 mi N on Cometa Road, along W side of road, 1 May 1996 *W.E. Fox III, 548A* (TAES). Associated with *Pappophorum, Pennisetum, Setaria, Acacia* and *Prosopis.*

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—Stephan L. Hatch, William E. Fox III, and John E. Dawson III, S.M. Tracy Herbarium, Department of Rangeland Ecology and Management, Texas A&M University, College Station, TX 77843-2126 U.S.A.; and William B. Godwin, Department of Entomology, Texas A&M University, College Station, TX 77843-2475 U.S.A.

REFERENCES

CARTER, W.T. 1931. The soils of Texas. Texas Agric. Exp. Sta. Bull. 431.

CHASE, A. 1951. Hitchcock's manual of the grasses of the United States, 2nd. ed., U.S.D.A. Misc. Publ. No. 200. U.S. Government Printing Office, Washington, D.C.

CLAYTON, W.D. and S.A. RENVOIZE. 1986. Genera graminum, grasses of the world. Kew Bull. Addit. Ser. XIII. Her Majesty's Stationary Office, London.

CORRELL, D.S. and M.C. JOHNSTON. 1970. Manual of the vascular plants of Texas. Texas Research Foundation, Renner.

GOULD, F.W. 1975. The grasses of Texas. Texas A&M University Press, College Station.

HATCH, S.L., K.N. GANDHI, and L.E. BROWN. 1990. Checklist of the vascular plants of Texas. Texas Agric. Exp. Sta. Bull. MP-1655.

JONES, S.D., J.K. WIPFF, and P.M. MONTGOMERY. 1997. Vascular plants of Texas, a comprehensive checklist including synonymy, bibliography and index. University of Texas Press, Austin.

KARTESZ, J. 1994. A synonymized checklist of the vascular flora of the United States, Canada and Greenland. Univ. of North Carolina Press, Chapel Hill.

LAZARIDES, M. 1970. The grasses of central Australia. Australian Natl. Univ. Press, Canberra.

MCBRYDE, J.B. 1933. The vegetation and habitat factors of the Carrizo Sands. Ecological Monogr. 3:247–297.

SIMON, B.K. 1993. A key to Australian grasses. Queensland Department of Primary Industries, Brisbane, Australia.

STEVENS, J.W. and D. ARRIAGA. 1985. Soil survey of Dimmit and Zavala counties, Texas. U.S.D.A.–S.C.S and Texas Agricultural Experiment Station.

PRIORITY OF THE NAME *AGALINIS HARPERI* (SCROPHULARIACEAE) OVER THE NAMES *AGALINIS DELICATULA* AND *AGALINIS PINETORUM*

This paper is part of an ongoing study by the author of the vascular plant genus *Agalinis* along the Gulf Coastal Plain. The objective of this note is to clarify one of the many nomenclatural difficulties associated with North American species of this genus.

Pennell (1913) described three species of *Agalinis* from Florida: *A. delicatula, A. harperi*, and *A. pinetorum*. These species have recently been shown to be conspecific (Canne-Hilliker and Kampny 1991). Later, in 1929, Pennell reduced *A. delicatula* to a variety of *A. pinetorum* as *A. pinetorum* var. *delicatula* (Pennell) Pennell, considering it to be a weak variety at best and stating in his description that it was "Of doubtful rank" (Pennell 1929). In their study, Canne-Hilliker and Kampny (1991) concluded that that all three names represented one species and and chose *A. harperi* for this complex. Kartesz (1994), although apparently aware of the work of Canne-Hilliker and Kampny, chose instead to combine the two species under the name *A. pinetorum*. Although Pennell later recognized the name *Agalinis pinetorum* var. *delicatula* (Pennell) Pennell at the varietal rank, it must still be taken into account for nomenclatural purposes because the name *A. delicatula* has equal priority with *A. pinetorum* (Pennell 1913).

The name *Agalinis harperi* and a brief description of the species first appeared in the *Flora of Miami*, published in 1913 (Small 1913), in which Pennell prepared the treatment of *Agalinis*. On 13 August 1913, the August issue of *Bulletin of the Torrey Botanical Club* was published, and in this issue Pennell published for the first time the description of *A. delicatula* and *A. pinetorum* (Pennell 1913). It is clear that Pennell realized that Small's flora had appeared (or would appear) before the August 1913 publication of the *Bulletin*, this is because he (p. 426) noted that *A. harperi* was first described in the *Flora of Miami*. But due to the fact that Small published the *Flora of Miami* himself, I have been unable to determine an exact publication date for it. However, in accordance with Art. 31.1 of the Code (Greuter et al. 1994), *A. harperi* was effectively published prior to publication of the 13 August 1913 issue of *Bulletin of the Torrey Botanical Club*. The valid publication date is fulfilled in two ways in accordance with Articles 29.1 and 31.1 of the Code:

1. The preface of Small's *Flora of Miami* is dated 26 April 1913 (Small 1913); this is the only exact date found in the flora. According to Art. 31.1 of the Code, in the absence of any other evidence validating the date of a work, the earliest date indicating publication is to be accepted as the

correct publication date.

2. In a 1997 communication with John F. Reed, Director of the LuEsther T. Mertz Library at the New York Botanical Garden, I was able to verify that the publication of Small's *Flora of Miami* did in fact precede the 13 August 1913 publication date of *Bulletin of the Torrey Botanical Club*–a copy of Small's Flora of Miami at the New York Botanical Garden's library is date-stamped 21 June 1913. Thus, publication of *Agalinis harperi* in Small's *Flora of Miami* obviously preceded the 13 August 1913 publication of *A. delicatula* and *A. pinetorum* in the *Bulletin*. The valid name for this species and its synonyms is as follows:

Agalinis harperi Pennell, in Small, Flora of Miami, 176. 1913.

Agalinis delicatula Pennell, Bull. Torrey Bot. Club 40:425. 1913. *Agalinis pinetorum* var. *delicatula* (Pennell) Pennell, Proc. Acad. Nat. Sci. Philadelphia 81:172-173. 1929. *Gerardia pulchella* var. *delicatula* (Pennell) Pennell, Acad. Nat. Sci. Philadelphia Monogr. 1:441. 1935.

A. pinetorum Pennell, Bull. Torrey Bot. Club 40:424-425. 1913.

Gerardia harperi (Pennell) Pennell, Acad. Nat. Sci. Philadelphia Monogr. 1:441. 1935.

G. pulchella (Pennell) Pennell, Acad. Nat. Sci. Philadelphia Monogr. 1:440. 1935.

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REFERENCES

CANNE-HILLIKER, J.M. and C.M. KAMPNY. 1991. Taxonomic significance of leaf and stem anatomy of *Agalinis* (Scrophulariaceae) from the U.S.A. and Canada. Canad. J. Bot. 69:1935-1950.

GREUTER, W., F.R. BURDET, W.G. CHALONER, V. DEMOULIN, D.L. HAWKSWORTH, P.M. JØRGENSEN, D.H. NICOLSON, P.C. SILVA, P. TREHANE, and J. MCNEIL. 1994. International code of botanical nomenclature (Tokyo Code) adopted by the Fifteenth International Botanical Congress, Yokohama, August-September 1993. Regnum Veg. 131.

KARTESZ, J.T. 1994. A synonymized checklist of the vascular flora of the United States, Canada, and Greenland, 2d ed. Timber Press, Portland. 2 vols.

PENNELL, F.W. 1913. Studies in the Agalinanae, a subtribe of the Rhinanthaceae II. Species of the Atlantic coastal plain. Bull. Torrey Bot. Club 40:401-439.

PENNELL, F.W. 1929. *Agalinis* and allies in North America-II. Proc. Acad. Natl. Sci. Philadelphia 81:11-249.

PENNELL, F.W. 1935. The Scrophulariaceae of eastern temperate North America. Acad. Nat. Sci. Philadelphia Monogr. 1:419-476.

SMALL, J.K. 1913. Flora of Miami. Published by the author, New York.

HEINZ DIETRICH LUBRECHT (1908-1997), BOTANICAL BOOKSELLER AND FRIEND

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Heinz (Harry) Dietrich Lubrecht, age 88, well known botanical and natural history bookseller, antiquarian book expert, appraiser, and former executive of the publishing company, Stechert-Hafner, died 12 November 1997, at the Columbia Presbyterian Hospital, New York City, after suffering a stroke. Harry, as he was affectionately known by friends, colleagues, and family, devoted nearly 70 years to the scholarly book trade, particularly in botany and natural history. In 1974 he established Lubrecht & Cramer, Booksellers and Publishers, currently located in Port Jervis, NY. His high standards of business, steadfast honesty, and breadth of knowledge of botanical literature earned him national and international respect as a bookman. With the passing of Harry Lubrecht the botanical and bookselling community has lost a faithful friend and serious scholar.

Born 2 December 1908, in Reutlinger, Germany, Harry was the son of Adolph August Karl Friederich Wilhelm and Sophie Amalie (Grueninger) Lubrecht. His father, an architect, was the son of Lutheran Pastor Adolph Lubrecht and Emma Karoline Kuebel. His mother, well-educated and adept in three foreign languages, was the daughter of Johann Matthaus Grueninger, Professor of Mathematics in the Reutlinger Hochschule, and Sophie Kaemerer. When Harry was five, his parents separated. Subsequently, Harry, his mother, and two sisters moved to Stuttgart to live in an aunt's apartment home. He attended Friedrich Eugens Oberrealschule and completed Hochschule in Stuttgart. Throughout his school years Harry was an avid reader. In order to ensure enrollment at his school, Harry secured an annual scholarship by placing in the top five of his class.

Upon graduation at age 17, Harry became an apprentice in Brueninger's department store as part of his continued schooling. His flare for business was well recognized by the store's management and in three years he earned the salary of a regular employee. Refusing to join the Nazi party, he was compelled to leave Germany. Harry emigrated to the United States where his Uncle Christian Grueninger, the mayor of Valhalla, NY, would sponsor him. Arriving in America on 15 May 1928, he soon found a job as a grave

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digger at the local cemetery in Mt. Kensico, NY. When this seasonal work concluded that fall, Harry looked for employment in New York City. In October 1928, G.E. Stechert & Co.,[1] well-known international book firm, hired him at a weekly salary of $14.00. The stage was thus set for a distinguished, life-long career in the book world, a profession practiced by ancestors on two sides of his family. Some of the Kuebels were medieval scribes, the book "publishers" of their time. In the early nineteenth century two Lubrecht brothers, Heinrich and August Adolph, separately developed careers as booksellers in Heilbronn and Blaubeuren, Germany. In the mid-nineteenth century August's son, Karl Theobold, emigrated from Blaubeuren to Brooklyn, NY. Here he Anglicized his name to Charles T. and founded with his cousin the publishing company Haasis and Lubrecht.

At Stechert Harry advanced from his initial position as billing clerk to assistant manager of the Antiquarian Department (April 1936). He was a natural for this job as he was familiar with German, French, Latin, and Greek. His facility for languages assisted him in compiling book catalogs and understanding the contents of many scientific books, especially those in German, acquired by the company. Since his immediate boss lacked significant experience in the antiquarian book market, Harry enjoyed the freedom and breadth to develop the antiquarian department about which topic he read widely. Under his supervision the process of searching for and supplying out-of-print books was significantly accelerated (Anonymous 1952). Among Harry's promotions were to: Chief of Reference and Customer Service, G.E. Stechert & Co. (spring 1945); Division Chief, Antiquarian and Out-of-Print Department, Stechert-Hafner, Inc. (fall 1951); Vice-President and Editor, Hafner Publishing Co. (January 1955); and Vice President, Macmillan Publishing Co.-Hafner Publishing Division (1969).

After conducting a four-year study on subject publishing, Harry concluded that few firms published books on botany. Through Harry's efforts a new subsidiary called Stechert-Hafner Service Agency was established in 1960. Botanists and natural historians are fortunate to have had Harry's

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[1] A brief chronology of this book firm provides an historical perspective. Stechert & Wolff, founded on 1 September 1872, was renamed Gustav E. Stechert (1876), G.E. Stechert (1897), and G.E. Stechert & Co. (1904). On 1 October 1946, the G.E. Stechert partnership was dissolved and Stechert-Hafner, Inc. (SH) was created with its publishing and reprinting activities transferred to the newly established Hafner Publishing Co. In 1960 Stechert-Hafner Service Agency was established as a subsidiary of SH. Crowell Collier Macmillan, Inc. (now Macmillan, Inc.) acquired SH and its subsidiaries (1969). Beginning January 1974, the corporate name, Stechert Macmillan, Inc., became effective. By 1980 Macmillan, Inc. was divided into three parts of which Macmillan Publishing Co., Inc. contained the division now called Hafner Press.

Harry Lubrecht making a presentation at the Botanical Society of America Meeting, Historical Section, held at The Ohio State University, Columbus, 11 August 1987. Photo Courtesy Ronald L. Stuckey.

wisdom in developing this subsidiary. This new division served scholarly, scientific and botanical societies by selling their publications and distributing scientific and botanical books for European publishers on a large scale. The Agency distributed publications for the New York Botanical Garden, Missouri Botanical Garden, Texas Research Foundation, and the Hunt Botanical Library (Anonymous 1972). During the 1960s and 1970s Harry also focussed attention on reprinting book classics in botany within the Hafner Publishing Co. Among the reprint series issued were the Classica Botanica Americana (CBA) titles by such eighteenth and nineteenth century luminaries as Humphry Marshall, John Torrey & Asa Gray, C. S. Rafinesque, Stephen Elliott, Thomas Nuttall, and William Darlington. Joseph Ewan, historian of botany, proposed this series and wrote a bibliographical commentary for each of the reprinted books (Ewan 1967). Ironically, these facsimile reprints, as well as many others produced by Hafner, have become as rare as the originals themselves. The rarity of these volumes was due in part to their limited printing, high demand by scholars, and the destruction of remaining stock when Crowell Collier Macmillan, Inc. purchased Stechert-Hafner and its subsidiaries in May 1969.

After this corporate change Harry chose to direct the Publishing Division. He could not, however, abandon his interest in and passion for rare and out-of-print books. Using a substantial part of his lunch hour, he would work in the Antiquarian Department at noon time. Through his voluntary work, a veritable labor of love, Harry raised impressive revenues for the firm.

While at Stechert, Harry especially enjoyed appraising private collections for purchase. He was instrumental in acquiring an outstanding mathematics library in 1937, besides many other collections. Representing his company, Harry participated in the First Antiquarian Book Fair in the United States, sponsored by the Antiquarian Booksellers' Association of America and held in New York City (4–9 April 1960). Confident that the fair would be successful, he prepared an attractive catalog (#277) of rare books, the first ever issued from the Stechert-Hafner Antiquarian Department (Anonymous 1960). One of his career highlights was the discovery of 11 first editions of the works of Linnaeus in a Paris bookshop. These books had an additional historical value since they were annotated by the French botanist and explorer Michel Adanson (1727–1806), noted for his work on the natural classification of plants (Lubrecht 1986).

Harry compiled numerous book catalogs covering general topics, Greek and Latin authors, and natural history. Although no longer in print, his catalog (#353), "Early American Botanical Works with a Miscellany of Other Botanical Rarities" (Lubrecht 1967), provides an historical survey of early classics in North American botany. This booklet, the result of five years of searching (Anonymous 1967), contains an introduction (pp. 3–5) by Harry, an annotated list of 217 botanical titles offered for sale, and a section (pp. 55–60), "Reference Tools for Botany," by Joseph Ewan. The Missouri Botanical Garden plans to issue a facsimile reprint of this item as a keepsake of the XVI International Botanical Congress to be held at the Garden in St. Louis (August 1999). Through the enthusiastic support of Harry, Hafner Publishing Co. published and assisted in the production of "A Short History of Botany in the United States," edited by Joseph Ewan (1969). This book was distributed at the XI International Botanical Congress in Seattle, WA, August/September 1969.

Harry retired from Stechert Macmillan on 30 November 1973 and then briefly compiled catalogs for Jack N. Bartfield, an antiquarian bookseller of New York City. In December 1974 Harry founded his own business, Lubrecht & Cramer, Booksellers and Publishers, which was later incorporated (August 1983). Joerg Cramer (deceased 4 June 1985), a German publisher, specialized in reprinting classical botanical books, many of which Hafner had distributed in the United States. Harry's wife Anne, and later his son Charles, assisted in the business, originally carried out from their country home in Forestburgh, NY, and dealing predominantly with new, scholarly books, mostly in botany and natural history. The company is also a distributor for Koeltz Scientific Books, Gustav Fischer Verlag, and J. Cramer. Although his bookselling company primarily was concerned with new titles, Harry continued his profound interests in rare books and the appraisal of libraries. Among the botanical collections that he appraised were those of Carroll W. Dodge, the New York Horticultural Society, Emanuel D. and Ann W. Rudolph, William C. Steere, and R. Gordon Wasson. The remarkable Rudolph Library of 53,000 volumes of botany and natural history books has since been donated to The Ohio State University Libraries (Stuessy et al. 1997).

For more than two decades Harry and Anne Lubrecht featured booksale tables at botanical and scientific meetings and regional mycological forays. Their service was known not only for the sale of books, typically sold at a special discount for meeting and foray attendees, but also for their congenial and knowledgeable conversations. Harry captivated customers with his storehouse of botanical and bibliographical knowledge. He and his wife regularly attended the annual meetings of the Council on Botanical and Horticultural Libraries, Inc., and national and international book fairs. Concerning the latter, he attended 49 annual exhibits of the Frankfurt Book Fair in Germany.

Harry was a modest and caring person, yet he forthrightly and candidly expressed his opinions. I remember him also for many reminiscences of his book trade career and the botanists with whom he associated. With a rich background of experience and strong sense of the book market, Harry successfully introduced the quality paperback, also known as the softbound, to the scholarly book trade. Among the first in his field, he adopted photo-offset printing as the process for producing reprints. Even when this was not widely practiced, Harry encouraged minority hiring and developed a staff fluent in numerous languages. He held membership in the American Antiquarian Booksellers' Association, American Institute of Biological Sciences (AIBS), Council on Botanical and Horticultural Libraries, Inc., International Association for Plant Taxonomy, Mycological Society of America, New York Botanical Garden, North American Mycological Association, and Old Book Table (NY). Harry became a U.S. citizen on 14 December 1936. As a member of the Lutheran Church, he was a deacon during the 1960s and early 1970s. Among his honors was a Special Service Award from the Mycological Society of America presented at the annual meeting of the AIBS, San Antonio, TX, August 1991.

Harry's successful life was shared with his wife Anne (Johanne Marie Ficke) whom he married on 2 October 1937. Harry is survived by his wife Anne; two sons, Peter Thomas Lubrecht, Sr., a retired teacher of Drama and English and presently Artistic Director of Brundage Park Playhouse, of Randolph, NJ, and Charles Frederick Lubrecht, co-manager of Lubrecht & Cramer, of Montgomery, NY; three grandsons: Peter T. Lubrecht, Jr., Christopher C. Lubrecht, and Bryan Leone. Harry's two sisters, Ilse and Ruth Lubrecht, predeceased him. Funeral services were held 15 November 1997 in St. Peter's Lutheran Church, Port Jervis and cremation took place at the H. G. Smith Crematory, Stroudsburg, PA. Interment of his ashes will take place at the Forestburgh Cemetery. As a tribute to Harry, a memorial program in celebration of his life will be held at The New York Botanical Garden in the fall 1998. Memorial contributions may be sent to The LuEsther T. Mertz Library, New York Botanical Garden, 200th Street and Southern Boulevard, Bronx, NY 10458.

ACKNOWLEDGMENTS

I am grateful for information on Harry that Anne, Charles, and Peter Lubrecht provided. Ronald L. Stuckey suggested this biographical essay and supplied the photograph. The aforementioned individuals and Rogers McVaugh read the manuscript and made constructive suggestions for changes in the text. Additional information on Harry was obtained from a feature column on bookmen (C[hernofsky] 1986).

REFERENCES

Anonymous. 1952. Out-of-Print Department expands. Stechert-Hafner Book News 6(6):88.

________. 1960. First Antiquarian Book Fair in America. Antiquarian Bookman 25(18):1703–1706.

________. 1967. Early American botany catalog. Stechert-Hafner Book News 22(1):6.

________. 1972. 100 years [of] serving libraries. Stechert-Hafner Book News 26(5):41–43.

C[hernofsky], J.L. 1986. Lubrecht spans two eras of bookselling history. AB Bookman's Weekly 78(5):357–358.

Ewan, J. (ed.). 1967. Classica Botanica Americana, pp. 38-40, In [H. Lubrecht], Early American Botanical Works with a Miscellany of Other Botanical Rarities. Stechert-Hafner, Inc., New York.

________. 1969. A Short History of Botany in the United States. Hafner Publishing Co., New York and London.

[Lubrecht, H.]. 1967. Early American Botanical Works with a Miscellany of Other Botanical Rarities. Stechert-Hafner, Inc., New York.

________. 1986. Peregrinations of a rare-bookdealer in Europe. AB Bookman's Weekly 78(10):808, 810.

Stuessy, T.F., R.L. Stuckey, W.L. Boomgaarden, and W.R. Burk. 1997. Botanical libraries and herbaria in North America. 2. The Rudolph natural history library and its acquisition by The Ohio State University. Taxon 46:643–648.

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ARNOGLOSSUM ALBUM (ASTERACEAE): NEW SPECIES FROM NORTHERN FLORIDA

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ABSTRACT

The new species *Arnoglossum album* is described. Its phyllaries have prominently winged keels—a feature shared with *A. diversifolium*, *A. floridanum*, *A. plantagineum*, and *A. sulcatum*. Comparisons among members of this closely knit assemblage include morphology, phenology, ecological setting, and range, and a key is provided to distinguish the species.

RESUMEN

Se describe una especie nueva *Arnoglossum album*. Sus filarios tienen quillas aladas prominentes—una característica que comparte con *A. diversifolium*, *A. floridanum*, *A. plantagineum*, y *A. sulcatum*. Las comparaciones entre miembros de este conjunto fuertemente reticulado incluye morfología, fenología, características ecológicas y areal. Se ofrece una clave para diferenciar las especies.

Species of the tussilaginoid *Arnoglossum*, commonly called "Indian Plantains," were formerly placed in the heterogeneous "*Cacalia*" (Kral & Godfrey 1958; Cronquist 1978; Pippen 1978), but, because *Cacalia* is now typified by a species of the senecionoid European genus "*Adenostyles*" and because generic circumscriptions are now more narrowly drawn, *Arnoglossum* is considered distinct by many recent authors (Robinson 1974, 1980; Jeffrey 1979, 1992; Godfrey & Wooten 1981; Wetter 1983; Funk 1985; Brummitt 1992). *Arnoglossum* has three species with extensive ranges in the eastern United States [*A. atriplicifolium* (L.) H. Robins. and *A. reniforme* (Hook.) H. Robins.] or southeastern United States [*A. ovatum* (Walt.) H. Robins.] and one from the central part of the country [*A. plantagineum* Raf.]. The remaining three species have more limited ranges, one as a Florida endemic [*A. floridanum* (A. Gray) H. Robins.] and the others with ranges barely extending from Florida into neighboring states [*A. diversifolium* (Torr. & A. Gray) H. Robins. and *A. sulcatum* (Fern.) H. Robins.]. The latter four species (i.e., *A. plantagineum* and "the Florida group") are similar in having phyllaries with keels that are strongly winged. The new species described below is now added to this assemblage with winged phyllaries.

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MATERIALS AND METHODS

Fresh and dried materials were processed as described by Anderson (1994). Heads from at least five different collections per species were dissected and measured for involucral and floral quantitative data. Living plants of the five species under study were propagated from seed or as transplants in a greenhouse or common garden in Tallahassee, Florida. Vouchers of seedlings, plants at various stages of development, and all cited specimens are deposited at FSU unless noted otherwise.

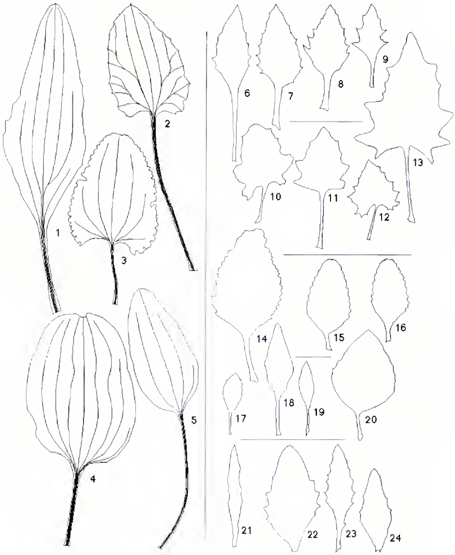
SPECIES DESCRIPTION

Arnoglossum album L.C. Anderson, sp. nov. **(Figs. 1, 6–9).** TYPE: U.S.A. FLORIDA. BAY CO.: locally common in acidic, poorly drained sandy soil of open, wet savanna with *Sarracenia flava*, *Rhynchospora*, *Rhexia*, and *Polygala* spp. just E of Rte 77 on N side of Southport, T2S, R14W, NE1/4 of SE1/4 Sec 21, 6 Jun 1995, *L.C. Anderson 15555* (HOLOTYPE: NY!; ISOTYPES: BRIT! FSU! MO! US!).

Herbae perennes plerumque 8–10 dm alta. Folia basalia 20–63 cm longa, 5–16 cm lata, longe petiolata, laminis late ovatis vel anguste oblongo-lanceolatis, vernis lateralibus principalibus per 2–4 cm supra basin laminae ad venam mediam arcte parallelis dein divergentibus. Folia caulina pauca, 7–26 cm longa, petiolata, serrata, foliis superioribus reductis sessilibusque. Capitula in cymis corymbosis disposita, involucris 10–13.4 mm longis, phyllariis albis carinis prominenter alatis. Corollae albae, 9–10.5 mm longae.

Essentially glabrous cespitose herbs. Stems (5–)8–10(–10.5) dm tall, light green, strongly ridged. Basal (radical) leaves (20–)30–55(–63) cm long overall, 5–10(–16) cm wide, long petiolate, (10–)15–18(–34) cm, blades broadly ovate to narrowly oblong-lanceolate, margins entire, shallowly sinuate, or rarely serrulate-denticulate, bases attenuate, apices rounded, mucronulate, basally disposed lateral veins appressed to the midrib 2–4 cm then abruptly extending toward the leaf margins; cauline leaves few, blades (7–)12–18(–26) cm long overall, (2.5–)4–5(–6) cm wide, petioles (1–)4–5(–12) cm long, ovate, bases cuneate, apices acuminate, serrately toothed, upper leaves reduced in size and sessile. Inflorescence compound, freely branched, ± flat-topped, with heads crowded in corymbose cymes. Heads 5-flowered; involucres 10–12.5(–13.4) mm long, cylindric, phyllaries 5, chalky white, margins hyaline, keels prominently winged (the wings rising 1–1.5(–2.0) mm from the phyllaries with margins sinuate to erose and reduced apically). Receptacles with short central cusp. Corollas white, rarely tinged with pink, 9–10.5 mm long, veins 10, tube 5–6.4 mm, throat 0.2–1.0 mm, lobes 2.9–3.8 mm, lanceolate; anthers 2.5–2.6 mm long, collars cylindrical; styles 11.8–12.5 mm long, style branches 1.5–1.7 mm long, stylopodium immersed in nectary; achenes glabrous, 4.2–5 mm long, cylindric to narrowly clavate, carpopodium cells erect, pappus white, 6–7 mm long. $n = 25$.

Distribution.—Endemic to Bay and Gulf counties of Florida in poorly



Figs. 1–24. Representative leaves of selected *Arnoglossum* species, all at 1/6 full size. Figs. 1–5. Radical leaves showing major venation. Fig. 1. *A. album* with appressed lateral veins, *Anderson 15600*, Bay Co., FL. Fig. 2. *A. diversifolium*, *Anderson 13414*, Levy Co., FL. Fig. 3. *A. floridanum*, *Anderson 12165*, Taylor Co., FL. Fig. 4. *A. plantagineum*, *Anderson 12166*, Riley Co., KS. Fig. 5. *A. sulcatum*, *Anderson 16035*, Santa Rosa Co., FL. Figs. 6–24. Outlines of cauline leaves (major venation similar to respective radical leaves). Figs. 6–9. *A. album*. Fig. 6. *Anderson 12137*, Gulf Co., FL. Figs. 7–8. *Anderson 15600*, Bay Co., FL. Fig. 9. *Anderson 13432*, Gulf Co., FL. Figs. 10–13. *A. diversifolium*. Fig. 10. *Anderson 13475*, Levy Co., FL. Figs. 11, 13. *Anderson 13478*, Putnam Co., FL. Fig. 12. *McDaniel 9059*, Houston Co., AL. Figs. 14–15. *A. floridanum*. Fig. 14. *Anderson 12160*, Taylor Co., FL. Figs. 15–16. *Anderson 12077*, Clay Co., FL. Figs. 17–20. *A. plantagineum*. Fig. 17. *Mehrhoff 12299* (CONN), Bruce Co., Ontario Prov., Canada. Fig. 18. *Anderson 11991*, Loundes Co., AL. Fig. 19. *Bryson 9861*, Oktibbeha Co., MS. Fig. 20. *Anderson 11968*, Tangipohoa Par., LA. Figs. 21–24. *A. sulcatum*. Fig. 21. *McDaniel 7978*, Geneva Co., AL. Fig. 22. *Anderson 12342*, Leon Co., FL. Fig. 23. *Anderson 16058*, Walton Co., FL. Fig. 24. *Anderson 16057*, Walton Co., FL.

drained, acidic (pH 5–6), loamy sands (with 0.35–1.7% organic matter) of wet savannas, open pinewoods, and most frequently the ecotone between the two, often in close association with several of the following: *Aletris lutea*, *Aristida beyrichiana*, *Asclepias longifolia*, *A. michauxii*, *A. viridula*, *Aster eryngiifolius*, *Cleistes bifaria*, *Drosera capillaris*, *Eriocaulon compressum*, *Hypericum gymnanthum*, *Lachnanthes caroliniana*, *Lachnocaulon anceps*, *Lobelia floridana*, *Ludwigia linifolia*, *L. microcarpa*, *L. virgata*, *Marshallia tenuifolia*, *Oxypolis greenmanii*, *Panicum rigidulum*, *Physostegia godfreyi*, *Platanthera nivea*, *Polygala balduinii*, *P. cruciata*, *P. ramosa*, *Rhexia lutea*, *Rhynchospora ciliaris*, *R. curtisii*, *R. fascicularis*, *R. filifolia*, *R. globularis*, *R. oligantha*, *R. pusilla*, *R. rariflora*, *R. wrightiana*, *Rudbeckia graminifolia*, *Ruellia noctiflora*, *Sabatia bartramii*, *S. campanulata*, *Sarracenia flava*, *Scutellaria floridana*, *Tofieldia racemosa*, *Verbesina chapmanii*, *Xyris ambigua*, *X. baldwiniana*, and *X. elliotii*. The woody associates (less frequent) include: *Cyrilla racemiflora*, *Hypericum cistifolium*, *H. exile*, *H. reductum*, *Ilex coriacea*, *I. vomitoria*, *Magnolia virginiana*, *Myrica cerifera*, *Nyssa ursina*, and *Pinus elliottii*. Flowers June to mid-July.

Representative specimens examined. U.S.A. **FLORIDA. Bay Co.**: type locality, *L.C. Anderson 15529* (FSU), 20 Jun 1995, *L.C. Anderson 15600* (FSU, MO, NY), 20 Jun 1995, *L.C. Anderson 15601* (FSU), *L.C. Anderson 15708* (FSU); S side County Rd 2300, 1.9 mi W of Rte 77, 1.5 air mi NW of Southport, 13 Jun 1995, *L.C. Anderson 15577* (FSU); 0.5 mi E of Burnt Mills Creek bridge on S side of Rte 388, 1.9 mi W of Rte 77, 1.5 air mi WNW of Southport, 13 Jun 1995, *L.C. Anderson 15581* (FSU). **Gulf Co.**: 5.3 mi S of Rte 22 on E side of Daniels Rd near Wetappo Creek, ca. 5.5 air mi WSW of Wewa- hitchka, *L.C. Anderson 11642* (FSU), *L.C. Anderson 11673* (2), *L.C. Anderson 11934* (FSU), *L.C. Anderson 12137* (BRIT, FSU, GH, MO, NY, US), *L.C. Anderson 12138* (FSU), *L.C. Anderson 13421* (FSU), 5.2 mi S of Rte 22 on W side Daniels Rd, *L.C. Anderson 11950* (FSU), *L.C. Anderson 12171* (FSU).

DISCUSSION

The Indian plantains with winged phyllaries form a closely related alliance of species. They differ from each other in several floral features as summarized in Table 1. The longest involucres occur in *A. floridanum*, and the shortest in *A. sulcatum*. Phyllaries in *A. album* have prominent wings proximally that become highly reduced apically, whereas in all other species the wings are shorter in height but ± equally developed for the length of the bract (often broadest apically). *Arnoglossum album* also has the whitest phyllaries; in the other species they are more greenish-white.

Corollas of *A. album* are white, rarely tinged with pink; in the other species they are white, light lavender, or ochroleucous (more greenish-white or yellowish-white in *A. floridanum* and sometimes more pinkish in *A. diversifolium*). Corollas are generally longest in *A. floridanum* and shortest in *A. sulcatum*, but not as short as reported by Pippen (1978) and Cronquist (1980). In all species the corolla tubes are relatively long and the throats below the lobes

TABLE 1. Size floral features (in mm) of "winged" *Arnoglossum* species.

Taxon	Involucre length	Corolla length	Tube width	Lobe length
A. album	10.0–13.4	9.0–10.5	0.9–1.0	2.9–3.8
A. diversifolium	10.2–11.0	9.1–10.2	0.8–0.9	3.1–3.5
A. floridanum	11.0–14.8	9.8–12.2	0.8–0.9	2.8–4.1
A. plantagineum	9.8–12.8	9.2–11.4	0.7–0.8	3.1–3.6
A. sulcatum	8.5–9.9	7.8–9.6	0.6–0.7	2.7–3.4

very short. The tube widths are greatest in *A. album* and most slender in *A. sulcatum.* Carpopodial cells of the achenes in *A. album* are generally erect, whereas they are procumbent in *A. plantagineum.* Cell shape varies somewhat within a given population because of differing stages of achene maturity. Robinson and Brettell (1973) suggested carpopodial structure was an excellent character for distinguishing genera in the Senecioneae; they recorded procumbent carpopodial cells for *Mesadenia* (i.e., *Arnoglossum*). Wetter (1983) found considerable variation in this and other micromorphological characters and questioned their value as generic markers.

Vegetatively, *A. album* looks most like *A. plantagineum,* and that species is probably its closest relative. The two differ in seedling morphology. Cotyledons of *A. album* are 1–1.5 cm long and 9–12 mm wide (± orbicular), whereas they are 3–4.5 cm long and 8–9 mm wide (spatulate-oblanceolate) in *A. plantagineum.*

The five species differ more in leaf morphology than they do in floral features (Figs. 1–24). Basal leaves of *A. album* have distinctive venation. The principal lateral veins are appressed and closely parallel the midvein into the blade for a few centimeters and then spread abruptly toward the leaf margins (Fig. 1). This feature of appressed lateral veins is also found in the related *Yermo xanthocephalus* of Wyoming. In the other *Arnoglossum* species, the lateral veins spread immediately at the base of the blade (Figs. 2–5).

Relative length of the petiole on radical leaves is often used in keys to the species (Kral & Godfrey 1958; Pippen 1978; Cronquist 1980). This feature is correlated to habitat preferences of the species. Generally, *A. diversifolium* and *A. sulcatum* grow in deep shade, and their radical leaves have long petioles (Figs. 2, 5). *Arnoglossum floridanum* usually grows in full sun, and its radical leaves have short petioles (Fig. 3). Petiole lengths are more variable in radical leaves of *A. album* and *A. plantagineum.* These two species often grow in savannas or prairies. Their petiole lengths are related to the density of grass and other vegetation near the plants; plants from the same seed source that were grown in different shade or vegetation densities in my garden produced short-petioled leaves in sunnier or less crowded situations and longer petioles in shaded or crowded conditions.

Cauline leaves of *A. diversifolium* (Figs. 10–13) are petiolate and basally truncated or cordate; they are petiolate and rounded to broadly cuneate in *A. album* (Figs. 6–9), *A. floridanum* (Figs. 14–16), and *A. plantagineum* (Figs. 17–20), whereas they are ± sessile and more narrowly cuneate in *A. sulcatum* (Figs. 21–24). Cauline leaves of *A. diversifolium* are deltoid-hastate in outline and dentately toothed. They tend to be ovate, serrately lobed, and acute in *A. album*; ovate-oblong, crenulate, and obtuse or rounded in *A. floridanum*; ovate to lanceolate or narrowly spatulate, entire or serrulate, and acute in *A. plantagineum*; and ovate to rhombic or narrowly lanceolate, sparsely serrate-dentate, and acute to obtuse in *A. sulcatum*.

Arnoglossum plantagineum has the greatest geographical range among the five species (east Texas, Louisiana, and the black soil belt of Alabama north through Kansas and Ohio to southern Minnesota, Michigan, and Ontario, Canada); it occurs mainly in calcareous, tall-grass prairie (Pippen & Chapman 1986), but minor habitats include glades, fens, and pine-oak woodlands. *Arnoglossum floridanum* occurs in well-drained sands in open pine-scrub oak, dry flatwoods, and old fields from Duval and Madison through peninsular Florida south to Highlands and Manatee counties.

The other three species occur mainly in the Florida panhandle. *Arnoglossum diversifolium* occurs in river swamps and wet hammocks and is the most wide-ranging of these three; it has a few populations in southern Alabama and southwestern Georgia, ranges from Walton County to Leon County in the panhandle, and has disjunct populations in Putnam, Volusia, and Levy counties, Florida. *Arnoglossum sulcatum* occupies shaded acid bogs or swamps; it occurs sporadically in extreme southern Alabama and southwestern Georgia and from Escambia to Leon Counties of the Florida panhandle. *Arnoglossum album* is restricted to Bay and Gulf Counties of the Florida panhandle; the only other species of the group that occurs in those counties is *A. sulcatum*, but it has different habitat preferences and phenology.

Flowering time in *Arnoglossum plantagineum* is clinal from south to north; the plants blooming in late April in southern Louisiana to early August in Minnesota and Michigan (Pippen & Chapman 1986). A reverse cline exists for *A. diversifolium*; it blooms in the Florida panhandle from May to early July (same period for *A. floridanum*), whereas, to the south, in Levy County (where it is sympatric with *Hasteola robertiorum*) *A. diversifolium* blooms from mid-August through September. *Arnoglossum album* blooms from June to mid-July, and *A. sulcatum* is the latest to bloom (September to October).

The new species, *A. album*, is distinguished from all of its immediate relatives by the following features: it is geographically isolated from all other species except *A. sulcatum*, and it is totally separated from *A. sulcatum* by habitat and phenology; basal leaf venation is distinctive; cauline leaves are most similar to those of *A. sulcatum*, but they are generally narrower and sessile in *A. sulcatum*; its involucres and corollas appear whiter than those of the other species; the wings of the phyllaries are higher proximally and attenuated and distally, whereas wings are lower in height overall and evenly raised along the keel or somewhat higher distally in the others; the phyllary wings have erose margins distally in *A. album*, and wing margins are entire or sinuate in the other species; and the corolla tubes are wider than those in any other species in the group.

KEY TO THE FIVE SPECIES OF *ARNOGLOSSUM* WITH WINGED PHYLLARIES

Most keys to species of *Arnoglossum* include significant habitat and phenological data. The following key uses only morphological features.

1. Blades of radical leaves truncate, ovate to cordate-ovate, sparsely denticulate; lower cauline leaves deltoid-hastate, dentately toothed........ **A. diversifolium**
1. Blades of radical leaves ovate to ovate-oblong, entire, sinuate or crenate; lower cauline leaves ovate, entire, crenulate or serrately toothed.
    2. Phyllaries with prominently winged keels, wings highest at base, erose; radical leaves with lateral veins appressed to midveins for 2–4 cm then spreading. ....**A. album**
    2. Phyllaries with keels ± evenly winged throughout or highest apically, entire or sinuate; radical leaves with lateral veins diverging from base of blade.
        3. Involucres and corollas mostly over 11 mm and 10 mm long, respectively; cauline leaves crenulate. ....**A. floridanum**
        3. Involucres and corollas mostly shorter; leaves entire or sparsely serrulate.
            4. Involucres mostly over 10 mm long, corollas over 9 mm; cauline leaves at midstem rounded to petiolate base. ....**A. plantagineum**
            4. Involucres less than 10 mm long, corollas 8–9(–9.6) mm; cauline leaves at midstem broadly cuneate and sessile............................**A. sulcatum**

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REFERENCES

ANDERSON, L.C. 1994. A revision of *Hasteola* (Asteraceae) in the New World. Syst. Bot. 19:211–219.

BRUMMITT, R.K. 1992. Vascular plant families and genera. Kew: Royal Botanic Gardens.

CRONQUIST, A. 1978. Compositae, tribe Senecioneae. N. Amer. Flora, ser. II, 10:14–16.

______. 1980. Vascular plants of the southeastern United States. Vol. 1. Asteraceae. Univ.

of North Carolina Press, Chapel Hill.

FUNK, V.A. 1985. Cladistics and generic concepts in the Compositae. Taxon 34:72–80.

GODFREY, R.K., and J.W. WOOTEN. 1981. Aquatic and wetland plants of the southeastern United States. Dicotyledons. Univ. of Georgia Press, Athens.

JEFFREY, C. 1979. Generic and sectional limits in *Senecio* (Compositae): II. Evaluation of some recent studies. Kew Bull. 34:49–58.

_____. 1992. The tribe Senecioneae (Compositae) in the Mascarene Islands with an annotated world check-list of the genera of the tribe. Kew Bull. 74:49–109.

KRAL, R., and R.K. GODFREY. 1958. Synopsis of the Florida species of *Cacalia* (Compositae). Quart. J. Florida Acad. Sci. 21:193–206.

PIPPEN, R.W. 1978. *Cacalia*. N. Amer. Flora, series II, 10:151–159.

_____ and K.A. CHAPMAN. 1986. Comparison of morphological characters between regional habitats of *Cacalia plantaginea* (Asteraceae). In: G.K. Clanby and P.N. Pemble, eds. Proceedings of the 9th North American Prairie Conference. Tri-college University Center for Environmental Studies, Fargo, ND.

ROBINSON, H. 1974. Studies in the Senecioneae (Asteraceae). VI. The genus *Arnoglossum*. Phytologia 28:294–295.

_____. 1980. *Arnoglossum reniforme* (Hook.) H.Robins., comb. nov. Phytologia 46:441.

_____ and R.D. Brettell. 1973. Studies in the Senecioneae (Asteraceae). IV. The genera *Mesadenia*, *Syneilesis*, *Miricacalia*, *Koyamacalia* and *Sinacalia*. Phytologia 27:265–276.

WETTER, M.A. 1983. Micromorphological characters and generic delimitation of some New World Senecioneae (Asteraceae). Brittonia 35:1–22.

SEVEN NEW NOMENCLATURAL COMBINATIONS AND A NEW NAME IN *PACKERA* (ASTERACEAE: SENECIONEAE)

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ABSTRACT

The following new combinations and new name are proposed: *Packera bolanderi* var. *harfordii* (Greenm.) D.K. Trock & T.M. Barkley, comb. nov.; *Packera dimorphophylla* var. *intermedia* (T.M. Barkley) D.K. Trock & T.M. Barkley, comb. nov.; *Packera dimorphophylla* var. *paysoni* (T.M. Barkley) D.K. Trock & T.M. Barkley, comb. nov.; *Packera pseudaurea* var. *flavula* (Greene) D.K. Trock & T.M. Barkley, comb. nov.; Packera *pseudaurea* var. *semicordata* (Mack. & Bush) D.K. Trock & T.M. Barkley, comb. nov.; *Packera neomexicana* var. *toumeyi* (Greene) D.K. Trock & T.M. Barkley, comb. nov.; *Packera neomexicana* var. metcalfei (Greene) D.K. Trock & T.M. Barkley, comb. nov.; and *Packera buekii* D.K. Trock & T.M. Barkley, nom. nov.

RESUMEN

Se proponen las siguientes nuevas combinaciones y nuevo nombre: *Packera bolanderi* var. *harfordii* (Greenm.) D.K. Trock & T.M. Barkley, comb. nov.; *Packera dimorphophylla* var. *intermedia* (T.M. Barkley) D.K. Trock & T.M. Barkley, comb. nov.; *Packera dimorphophylla* var. *paysoni* (T.M. Barkley) D.K. Trock & T.M. Barkley, comb. nov.; *Packera pseudaurea* var. *flavula* (Greene) D.K. Trock & T.M. Barkley, comb. nov.; Packera *pseudaurea* var. *semicordata* (Mack. & Bush) D.K. Trock & T.M. Barkley, comb. nov.; *Packera neomexicana* var. *toumeyi* (Greene) D.K. Trock & T.M. Barkley, comb. nov.; *Packera neomexicana* var. metcalfei (Greene) D.K. Trock & T.M. Barkley, comb. nov.; y *Packera buekii* D.K. Trock & T.M. Barkley, nom. nov.

The genus *Packera* (Asteraceae: Senecioneae) has been known widely as the Aureoid group of *Senecio*, and the recognition of *Packera* necessitates many nomenclatural transfers. Preparation of the treatment of *Packera* for the Flora of North America project has drawn our attention to the transfers proposed here. Type specimens for the basionyms are provided by Barkley (1978). The combinations *P. pseudaurea* var. *semicordata* and *P. dimorphophylla* var. *intermedia* are proposed simply for consistency in the use of "varietas"

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as the infraspecific rank of choice in *Packera* The two epithets are otherwise available as subspecies.

Packera bolanderi var. **harfordii** (Greenm.) D.K. Trock & T.M. Barkley, comb.nov. BASIONYM: *Senecio harfordii* Greenm. in Piper, Contr. U.S. Natl. Herb. 11:567. 1906. *Senecio bolanderi* var. *harfordii* (Greenm.) T.M. Barkley

Packera dimorphophylla var. **intermedia** (T.M. Barkley) D.K. Trock & T.M. Barkley, comb. nov. BASIONYM: *Senecio dimorphophyllus* var. *intermedius* T.M. Barkley, Trans. Kansas Acad. Sci. 65:362. 1963. *Packera dimorphophylla* subsp. *intermedia* (T.M. Barkley) Weber & Löve.

Packera dimorphophylla var. **paysoni** (T.M. Barkley) D.K. Trock & T.M. Barkley, comb. nov. BASIONYM: *Senecio dimorphophyllus* var. *paysoni* T.M. Barkley, Trans. Kansas Acad. Sci. 65:362. 1963.

Packera pseudaurea var. **flavula** (Greene) D.K. Trock & T.M. Barkley, comb. nov. BASIONYM: *Senecio flavulus* Greene, Pittonia 4:108. 1900. *Senecio pseudaureus* var. *flavula* (Greene) Greenm. *Packera pseudaurea* subsp. *flavula* (Greene) Weber & Löve.

Packera pseudaurea var. **semicordata** (Mack & Bush) D.K. Trock & T.M. Barkley, comb. nov. BASIONYM: *Senecio semicordatus* Mack. & Bush, Rep. Missouri Bot. Gard. 16:107. 1905. *Senecio aureus* var. *semicordatus* (Mack. & Bush) Greenm. *Senecio pseudaureus* var. *semicordatus* (Mack. & Bush) T.M. Barkley.

Packera neomexicana var. **toumeyi** (Greene) D.K. Trock & T.M. Barkley, comb. nov. BASIONYM: *Senecio toumeyi* Greene, Pittonia 3:349. 1898. *Senecio neomexicanus* var. *toumeyi* (Greene) T.M. Barkley.

Packera neomexicana var. **metcalfei** (Greene) D.K. Trock & T.M. Barkley, comb.nov. BASIONYM: *Senecio metcalfei* Greene ex Wooton & Standl., Contr. U.S. Natl. Herb. 16:193. 1913. *Senecio neomexicanus* var. *metcalfei* (Greene) T.M. Barkley.

The situation with the epithet "*cymbalarioides*" is complicated. A single-headed plant of wet, open sites in western U.S. and adjacent Canada was long known as *Senecio subnudus* DC., a name that was introduced by A.P. de Candolle in 1837. Unfortunately, de Candolle used the epithet "subnudus" twice; the other time for an African plant. Heinrich W. Buek (1840) recognized the error in his index to the Prodromus and he chose the African plant to be the correct *Senecio subnudus*. He then called the American plant *Senecio cymbalarioides* H. Buek, and unfortunately, this name remained forgotten until the 1960s (Barkley 1962). In the meantime, a widespread plant of western North America was named *Senecio cymbalarioides* by Thomas Nuttall. It was necessary to change the name of the North American *S. subnudus* DC. to *S. cymbalarioides* H. Buek, and *S. cymbalarioides* Nutt. then became *S. streptanthifolius* Greene, which is the next oldest available name for that entity (Barkley 1962). Recognition of the genus *Packera* required the transfer of many epithets into that genus and, unfortunately, *Senecio cymbalarioides* Nutt. was transferred into *Packera* where it became *P. cymbalarioides* (Nutt.) W.A. Weber & A. Löve, (Weber & Löve 1981). Shortly thereafter, Weber and Löve recognized that it was *S. cymbalarioides* H. Buek that should have been transferred to *Packera*, so they made the combination: *P. cymbalaroides* (H. Buek) W.A. Weber & A. Löve (Weber 1984). The transfer of the Nuttall epithet into *Packera* preoccupies that name in *Packera* so *Packera cymbalioides* (H. Buek) W.A. Weber & A. Löve is illegitimate and must be rejected according the International Code of Botanical Nomenclature (Greuter et al. 1994). Thus, the American plant first known as *Senecio subnudus* DC. and then as *Senecio cymblalrioides* Buek must have a new name. The new epithet that we chose for this distinctive plant commemorates Heinrich Wilhelm Buek, the 19th Century German botanist whose carefully prepared index to de Candolle's Prodromus gave rise to the need for this new name.

Packera buekii D.K. Trock & T.M. Barkley, nom. nov. BASIONYM: *Senecio subnudus* DC., Prodr. 6:37. 1837 (non *S. subnudus* DC., Prodr. 6:405. 1837). *Senecio cymbalarioides* Buek, Gen. Sp. Synon. Cand. 2:6. 1840 (non *S. cymbalarioides* Nutt., Trans. Amer. Phil. Soc. II. 7:412.1841.).

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REFERENCES

BARKLEY, T.M. 1962. A revision of *Senecio aureus* Linn. and allied species. Trans. Kansas Acad. Sci. 65:318–408.

_____. 1978. *Senecio.* In: North American flora II. 10:50–137.

BUEK, H.W. 1840. Genera, species, et synonyma Candolleana. 2.

CANDOLLE, A.P. de, 1837. Prodromus systematis… 6:405.

GREUTER, W., F.R. BARRIE, H.M. BURDET, W.G. CHALONER, V. DEMOULIN, D.L. HAWKSWORTH, P.M. JOERGENSEN, D.H. NICOLSON, P.C. SILVA, P. TEHANE, & J.M. MCNEILL, eds. International code of botanical nomenclature (Tokyo Code). Regnum. Veg. 131:1–389.

WEBER, W.A. 1984. New names and combinations, principally in the Rocky Mountain flora–IV. Phytologia 55:1–11.

WEBER, W.A. and A. LÖVE. 1981. New combinations in the genus *Packera* (Asteraceae). Phytologia 49:44–50.

BOOK REVIEWS

A. ESPEJO and A.R. LÓPEZ-FERRARI. 1997. **Las Monocotiledóneas Mexicanas. Una Sinopsis Florística 1. Lista de Referencia PARTE VIII. Orchidaceae 1.** (ISBN 968-6144-10-2; 968-6144-20-X pbk). Consejo Nacional de la Flora de México, Apartado Postal 70-261, Delegación Coyoacán, 04510 México, D.F. and Universidad Autónoma Metropolitana-Iztapalapa, Av Michoacán y La Purisima, Col. Vicentina, Delegación Iztapalpa, 09340 México, D.F. No price given. 90 pp. Color cover.

A. ESPEJO and A.R. LÓPEZ-FERRARI. 1997. 1998. Las **Monocotiledóneas Mexicanas. Una Sinopsis Florística 1. Lista de Referencia PARTE VIII. Orchidaceae 2.** (ISBN 968-6144-10-2; 968-6144-21-8 pbk Consejo Nacional de la Flora de México, Apartado Postal 70-261, Delegación Coyoacán, 04510 México, D.F. and Universidad Autónoma Metropolitana-Iztapalapa, Av Michoacán y La Purisima, Col. Vicentina, Delegación Iztapalpa, 09340 México, D.F. No price given. 115 pp. Color cover.

These two volumes list the species of Orchidaceae known from Mexico, in alphabetical order by genus, then by species, from *Acineta* to *Laelia* (Orchidaceae 1) and from *Lemboglossum* to *Xylobium* (Orchidaceae 2). There are also errata and additions to the first six parts (Agavaceae through Nolinaceae). For each species, there is a complete literature citation, followed by the basionym, along with all taxonomic and nomenclatural synonyms and respective type citations. It is clear that the authors have seen the vast majority of the type specimens involved. There are no lectotypes chosen in the work, but lectotypes chosen by other authors are cited clearly. Type specimens seen have the traditional"!" marking; otherwise, location of the holotype is cited as it appears in the protologue. Each species' distribution within Mexico is also given.

The list is a very handy reference for anyone interested in the Orchid flora of Mexico, or for that matter, Mesoamerica. It is printed on high quality paper and is clear and easy to read. The author abbreviations correspond to *Authors of Plant Names*, published by the Royal Botanic Gardens, Kew, and the literature citations correspond to the B-P-H and TL-2. I have seen no notable typographical errors.

Annotated checklists such as these are extremely useful, especially given the complete index to accepted names and synomyms in the back. This series is absolutely necessary for any curator dealing with Mexican monocotyledonous plants. We anxiously await the arrival of the other volumes, and unhesitatingly recommend them for everyone!–*John J. Pipoly III*

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ARDISIA NIAMBIENSIS (MYRSINACEAE), A NEW SPECIES OF *ARDISIA* SUBGENUS *ARDISIA* FROM THE CHOCÓ FLORISTIC PROVINCE OF COLOMBIA

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ABSTRACT

Documentation of the flora of the Natural Reserve Río Ñambí has resulted in the discovery of a heretofore undescribed species, *Ardisia niambiensis.* The species is described, illustrated and its salient morphological features are elucidated. *Ardisia niambiensis* is best placed in subgenus *Ardisia* because of its terminal, glandular-papillate, paniculate inflorescences with tripinnate branches, and the evenly divided, 5-lobed calyx, whose symmetric lobes have glandular-ciliolate margins. It is most closely related to *Ardisia premontana,* a taxon endemic to the eastern slopes of the Eastern Andean Cordillera of southern Ecuador and Peru.

RESUMEN

Al documentar la flora de la Reserva Natural Río Ñambí, se encontró una nueva especie, *Ardisia niambiensis.* Se describe, se ilustra y se discuten sus caracteres principales y sobresalientes. *Ardisia niambiensis* se ubica mejor dentro del subgénero *Ardisia* debido a sus panículas terminales y glandular-papillosas con ramificación tripinnada, su cáliz simétricamente dividido con lóbulos simétricos y glandular-ciliolados a lo largo de los margenes. La nueva especie es muy afín a *Ardisia premontana,* una especie endémica a la falda oriental de la Cordillera Oriental del Ecuador y Perú.

INTRODUCTION

The pantropical genus *Ardisia* Swartz contains approximately 400–500 species (Chen Cheih & Pipoly 1996) with centers of high species diversity in Malesia and the Chocó Floristic Province from Panama through Colombia to Ecuador (Pipoly 1991, 1992, 1994, 1995, 1996). Within the Neotropics, approximately 300 species have been described, the majority from Mesoamerica. There are relatively few South American taxa, perhaps not passing 40 total. During the course of an analysis of the vegetation of the Río Ñambí Natural Reserve, located in western portion of Nariño corresponding to the Chocó Floristic Province, a new species of Ardisia was discovered, which is described herewith.

Ardisia niambiensis Pipoly & Cogollo, sp. nov. (**Fig. 1**). Type: COLOMBIA. Nariño: Mpio. Barbacoas; Corregimientos Ortíz y Zamora; Vereda El Barro; Reserva Natural Río Ñambí, ca. 5 dm al W de Altaquer, Faldas Occidentales de la Cordillera Occidental, 01° 15′N, 78° 08′W, 1,250–1,350 m, 9 Sep 1997 (stam. Fl), *J. Pipoly, A. Cogollo, M. López & M. Rodríguez 21572* (holotype: PSO; isotypes: BRIT, COL, FMB, GH, HUA, JAUM, K, MO, NY, TULV).

Ob inflorescentiam terminalem tripinnatipaniculatam, calycem aequaliter divisum, necnon lobos calycinos simetricos glandulari-ciliolaribusque subgeneri *Ardisiae* pertinet. Propter laminas ad apice breviacuminatas, rhachides inflorescentiares angulatos, margines sepalinos hyalinos carinatos subintegros erososque *A. premontano* valde arcte affinis, sed ab ea ramulis glabris (non fufuraceo-lepidotis), laminis coriaceis (non chartaceis), subter glabris dense punctatis punctato-lineatisque (nec furfuraceo-lepidotis), petiolis 7–10 (non 15–25) mm longis, floribus pedicellatis (non sessilis), denique lobis calycinis deltatis vel late triangularibus (non ovatis) 2–2.2 (nec 1–1.2) mm longis statim distinguitur.

Tree to 10 m × 15 cm DBH. *Branchlets* terete, 4–8 mm glabrous. *Leaves* alternate; blades coriaceous, oblanceolate to obovate, (14.1–)19–25.4 cm long, (6.8–)7.5–9.4 cm wide, apically abruptly acuminate, the acumen 5–8 mm long, basally acute, decurrent to petiole base, midrib canaliculate and prominently raised above, prominently raised and densely black punctate-lineate below, the secondary veins numerous, 39–47 pairs, prominulous above and below, drying dark above, pallid and densely perpuncticulose below, the punctations in the form of short lines, the margin slightly inrolled except revolute basally; petioles marginate to base, 7–10 mm long, glabrous. *Inflorescence* terminal, pyramidal, tripinnately paniculate, 12.8–22.5 cm long, 11.5–33 cm wide, peduncle 1–2.5 cm long, the rachis prominently angulate, the secondary branches with smaller panicular units 12–16 cm long, 6–10 cm wide, the ultimate branches racemose, moderately rufous glandular-granulose and prominently and densely black punctate-lineate; floral bracts caducous, unknown; pedicels cylindrical, (1.0–)1.5–2.5(–3.0) mm long. *Flowers* unknown, but fruiting calyx 3–3.5 mm long, rufous glandular papillate and darkened at junction of lobe and tube, the lobes deltate to widely triangular, 2–2.2 mm long, 2.2–2.5 mm wide, apex acute to a minutely acuminate apex, minutely rufous-lepidote and carinate medially without, prominently punctate and punctate-lineate, the margin hyaline, somewhat erose and sparsely glandular-ciliolate apically. *Fruit* globose, 5–8(–10) mm long and wide when dried; when fresh, exocarp fleshy, bitter tasting.

Distribution.—Known only from Reserva Natural Río Ñambí, Nariño, Colombia, at 1,250–1,350 m elevation.

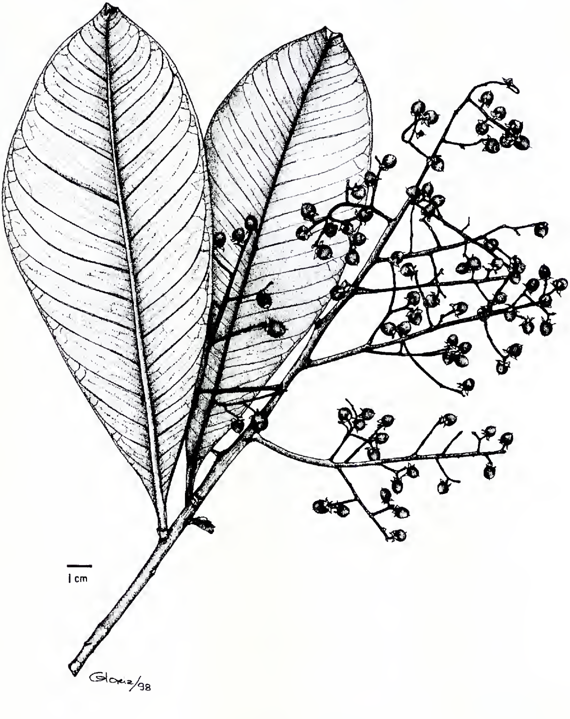

FIG. 1. *Ardisia niambiensis* Pipoly, showing the pyramidal tripinnate inflorescence, densely and prominently black punctate leaf surfaces, short petioles marginate to base, and pedicellate flowers. Drawn from the holotype.

Ecology.—*Ardisia niambiensis* occurs in premontane pluvial forest, receiving approximately 7,800 to 8,200 mm rain per year. The species occurs in relatively low densities, in at the forest margin on ridgetops.

Etymology.—Ardisia niambiensis is named phoenetically for the Reserva Natural Río Ñambí, a private, nonprofit, integrated conservation and development area in the state of Nariño, Colombia, operated by FELCA, the Ecological Foundation of the Hummingbirds of Altaquer (Fundación Ecológica de los Colibrís de Altaquer).

PARATYPE. **COLOMBIA. Nariño:** Mpio. Barbacoas; Corregimientos Ortíz Zamora; Vereda El Barro, Reserva Natural Río Ñambí, ca. 5 km al W de Altaquer, Faldas Occidentales de la Cordillera Occidental, 01° 15′ N, 78° 08′ W; 1,350–1,450 m, 3 Sep 1997 (ster.), *J. Pipoly, A Cogollo, M. López & M. Rodríguez 21227* (BRIT, FMB, JAUM, PSO).

On account of the shortly acuminate leaf apices, angulate inflorescence rachises, carinate sepals with hyaline and subentire to erose margins, *Ardisia niambiensis* is most closely related to *Ardisia premontana* Pipoly. It is separated from *A. premontana* by its glabrous (not furfuraceous-lepidote) branchlets, the coriaceous (not chartaceous) leaf blades that are densely black punctate and punctate lineate (and not furfuraceous-lepidote) below, petioles 7–10 (not 15–25) mm long, pedicellate (not sessile) flowers and deltate or widely triangular (not ovate) sepals that are 2.0–2.2 (and not 1.0–1.2) mm long.

Ardisia subgenus *Ardisia*, to which *A. niambiensis* belongs, is defined by the well-developed but early caducous floral and inflorescence bracts, racemose or rarely spicate branchlets of the inflorescence, the anthers dehiscing by subapical pores opening into wide longitudinal slits, and symmetric sepals. Within that subgenus, the other species known from the Chocó include *A. colombiana* Lundell, *A. granatensis* Mez, *A. opaca* Lundell, *A. valida* Mez (= *A. perinsignis* Lundell syn. nov.), *A. monsalveae* Pipoly, and *A. cabrerae* Pipoly (Forero & Gentry 1990; Pipoly 1991, 1995) Among these species, the only ones with inflorescence shape, pedicellate flowers and sepals similar to those of *Ardisia niambiensis* are *A. cabrerae* and *A. monsalveae*. However, the three species may be easily separated by the following key:

1. Calyx 2.4–2.9 mm long, apically obtuse, the margins glabrous, entire to subentire.
   2. Leaf blades coriaceous, elliptic; sepals 3.4–3.5 mm wide, glabrous .... **A. cabrerae**
   2. Leaf blades chartaceous, widely oblanceolate to obovate; sepals 0.5–0.6 mm wide, densely and minutely rufo-puberulent .... **A. monsalveae**
1. Calyx 3–3.5 mm long, apically acute to a minutely acuminate apex, minutely rufous-lepidote and carinate, the margin sparsely ciliolate .... **A. niambiensis**

ACKNOWLEDGMENTS

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REFERENCES

Chen, Chieh and J. Pipoly. 1996. Myrsinaceae. Pp. 1–38. In: Wu Zheng Yi and P.H. Raven, eds. Flora of China. Vol 15. Science Press, Beijing and Missouri Botanical Garden, St. Louis, Missouri.

Forero G., E. and A.H. Gentry. 1989. Lista Anotada de las Plantas del Departamento del Chocó, Colombia. Biblioteca José Jerónimo Triana, No. 10. Instituto de Ciencias Naturales, Museo de Historia Natural, Bogotá, D.E.

Pipoly, J. 1991. Notas sobre el género *Ardisia* Swartz (Myrsinaceae) en Colombia. Caldasia 16(78):277–284.

______. 1992. *Ardisia callejasii* (Myrsinaceae): a new species from the Antioquian Chocó of Colombia. Novon 2:389–391.

______. 1994. New species of *Ardisia* (Myrsinaceae) from the Cordillera Occidental of Colombia and Ecuador. Novon 4:38–44.

______. 1995. Dos nuevas especies del género *Ardisia* (Myrsinaceae) de la provincia florística chocoana de Colombia. Caldasia 17(82–85):419–424.

______. 1996. New species of *Ardisia* (Myrsinaceae) from Ecuador and Peru. Sida 17:445–458.

BOOK REVIEW

THOMAS LUMPKIN and DEAN MCCLARY. 1994. **Azuki Bean: Botany, Production and Uses.** (ISBN 0 85918 765 6, hbk). CAB International, Oxford University Press, 198 Madison Ave., New York, NY 10016. 800-451-7556. $70.00. 268 Pp.

This book purports to be a monograph, including both the basic botanical and applied agronomic aspects among the "Azuki" members of *Vigna* subgenus *Ceratotropis.* The book is divided into nine chapters, including an introduction, botany, physiological characteristics, production, insects and nematodes, diseases, breeding characteristics, food chemistry and processing, and uses and marketing. The agronomic chapters contain a thorough review of the literature, but much of it refers only to the Azuki beans in general, and not to a specific taxon. As a plant systematist, I am most disappointed with Chapter 2, the Botany of Azuki. I find it superficial, and not useful for understanding the differences among the species, or the infraspecific taxa (subspecies, varieties and cultivars). A synopsis or taxonomic revision for this relatively small group could have been contributed by any one of a number of qualified taxonomists, but the authors chose to avoid a formal treatment. They state that in their Table 2.1, "No attempt has been made to correct the confusion of different classifications in the literature." That statement amounts to a fatal flaw for the work, because many of the subsequent chapters make frequent reference to various cultivar names, without link to a taxon described in the Botany chapter. For example, in the discussion of starch granules and processing (Chapter 8), reference is made to "azuki cv *Takara,*" yet there is no mention of that or any other cultivar in the taxonomy chapter. Because the reader is most often unsure of the exact entity referred to, the rest of the book loses much of its usefulness, except in broad terms. I find the book hardly more than a literature review, and not a definitive monograph. Its extensive bibliography may be useful for agronomic investigators, but hardly justifies its hefty price. I would have preferred to have seen a comprehensive, well-executed systematic, agronomic and agricultural treatment, like the classic work of L. van der Maesen for *Cicer arietinum*, published in Meded. Landbouwhogeschool 72-10:1–342. 1972. I highly recommend that Maesen's monograph be used as a model (with phylogenetic systematics added) for economically critical and highly domesticated plant taxa. By following Maesen's model, we may better take advantage of wild relatives of currently cultivated plants, to bring useful characteristics into the cultivated from the wild. The book should be part of any major agricultural library, as a literature review source.–*John Pipoly, III*

CLUSIA NIAMBIENSIS (CLUSIACEAE), A NEW SPECIES FROM THE CHOCÓ FLORISTIC PROVINCE OF COLOMBIA AND ECUADOR

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ABSTRACT

Documentation of the flora of the Natural Reserve Río Ñambí has resulted in the discovery of a heretofore undescribed species, *Clusia niambiensis*. The species is described, illustrated and its salient morphological features are elucidated. While its vegetative morphology is reminiscent of both *Clusia laurifolia* and *C. venusta*, the free, numerous, and subulate stamens with a central mass of staminodia producing a waxy resin indicate it is a member of section *Chlamydoclusia* rather than section *Retinostemon*, where the aforementioned congeners belong. At present, the relationships of *Clusia niambiensis* within section *Chlamydoclusia*, are unknown. It is anticipated that continuing studies of the genus, leading to a treatment of the family for *Flora de Colombia*, will resolve this problem.

RESUMEN

Al documentar la flora de la Reserva Natural Río Ñambí, se encontró una nueva especie, Clusia niambiensis. Se describe, se ilustra y se discuten sus caracteres principales y sobresalientes. Mientras que sus caracteres vegetativos son muy semejantes a los de *Clusia laurifolia* y *C. venusta*, sus estambres libres, numerosos y subulados indican claramente que *C. niambiensis* pertenece a la sección *Chlamydoclusia* y no a la sección *Retinostemon*, donde se ubican las otras especies congenéricas susodichas. En este momento, no se sabe exactamente la ubicación taxonómica de *Clusia niambiensis* dentro de la sección *Chlamydoclusia*. Esperamos que a través de los estudios en proceso para el tratamiento taxonómico de la familia para Flora de Colombia, se pueda resolver este problema.

Recent exploration of the Reserva Natural Río Ñambí, located on the

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western slopes of the Western Cordillera of the Colombian Andes, has resulted in the discovery of this spectacular new species, described herewith.

Clusia (§ Chlamydoclusia) niambiensis, Pipoly, Cogollo et González, sp. nov. (**Fig. 1**). TYPE: COLOMBIA. NARIÑO: Mpio. Barbacoas; Corregimientos Ortíz y Zamora; Vereda El Barro; Reserva Natural Río Ñambí, ca. 5 km al W de Altaquer, Faldas Occidentales de la Cordillera Occidental, 01° 15' N, 78° 08' W; 1,450–1,500 m, 8 Sep 1997 (stam. Fl), *J. Pipoly, A. Cogollo, M. López & M. Rodríguez 21489* (HOLOTYPE: PSO; ISOTYPES: BRIT, COL, FMB, JAUM, K. MO).

Quoad lamina bullata nervatiosque brochidodromos, resinam albam, *C. laurifoliam* arcte similans sed ab ea petiolis profunde canaliculatisque marginatis (non aliquantam canaliculatis), ad bases laminas acutas decurrentesque (non obtusis haud decurrentes), denique fructibus ovoideis vel ellipsoideis (non subglobosis) praeclare distat. Propter stamina inter se libera subulataque centraliter resinifera, stigmata conniventaque sectio *Chlamydoclusia* pertinet, inter species aliis petiolis profunde canaliculatis marginatisque, laminis bullatis nervatiosque brochidodromis, fructibus longitudinaliter costatis statim distinguitur.

Glabrous, dioecious, *shrubs* or *treelets* to 2–3(–5) m tall, growth dynamics corresponding to Scarrone's Model; latex white. *Branchlets* terete, appearing tetragonal when dried, 8–10(–15) mm diam., the bark reddish-brown, exfoliating transversely in the upper nodes, appearing furfuraceous at times. *Leaves* decussate; blades chartaceous, obovate, (19–)27–38.5 cm long, (14.5–)15.2–23 cm wide, apically rounded to obtuse, basally acute, decurrent to the petiole base, bullate, the midrib prominently raised or raised within a depression above, prominently raised below, the secondary veins brochidodromous, 28–46 pairs, ca. 7–10 mm apart, alternating so every other vein has twice the diameter of the others, deeply impressed above, prominently raised below, the submarginal connecting vein ca. 2–4 mm from margin, glabrous above and below, at times when dried with small linear latex canals oxidizing red, the margin scarious, entire; petioles deeply canaliculate and marginate, (1.0–)2.5–3.5 cm long, without adaxial margined pit. *Staminate inflorescence* erect in bud, pendulous at maturity, a compound cyme, 20–25 cm long, 10–20 cm wide; peduncle appearing tetragonal when dried, 10.5–17 cm long, the bark transversely checked and exfoliating; primary inflorescence bract coriaceous, lanceolate, 18–21 mm long, 4-6 mm wide, apically acute, the midrib prominently raised above and below, the margin scarious, entire, glabrous; secondary inflorescence bracts cartilaginous, suborbicular, 3.5–4.0 mm long, 3.8–4.2 mm wide, apically broadly rounded, medially carinate, the margin scarious, entire; tertiary and floral bracts as in secondary but smaller acropetally, to the smallest that are rhomboid, 3 mm long and wide, apically acute; bracteoles 2, cartilaginous, ovate, .3.8–4.0 mm long, 2.5–3.0 mm wide, apically rounded, cucullate, the margin hyaline, not scarious, entire; pedicels 1–2.5(–5) mm long. *Staminate flowers* sepals 8, the lower 4 opposite, the upper 4 contorted, coriaceous, acro-

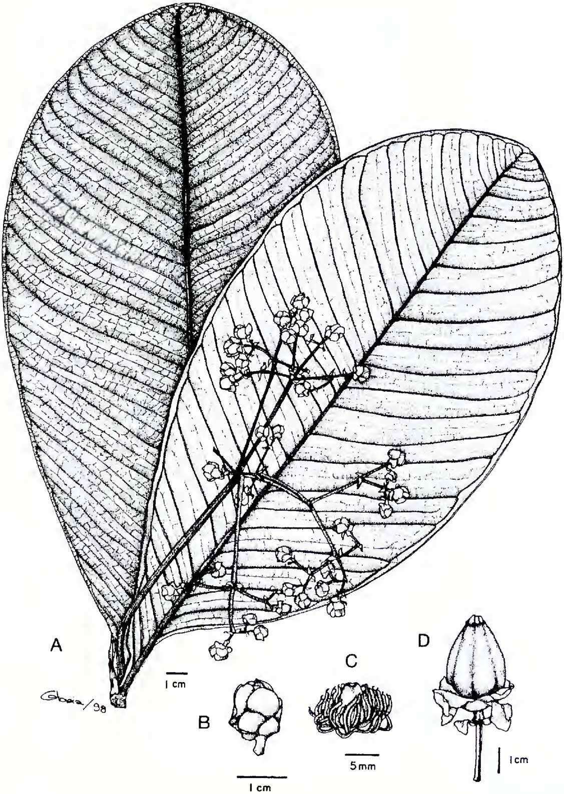

Fig. 1. *Clusia niambiensis* Pipoly, Cogollo & González. A. Habit. B. Opened pistillate flower, showing staminodes and stigmatic area. C. Opened staminate flower, showing stamens and central staminodial mass. D. Fruit, showing costae and mature stigmas. Figs. A–D, drawn from holotype.

petally larger, the lowermost oblate, 4.4–5.5 mm long, 5.5–6.5 mm wide, apically broadly rounded, translucent toward the margins, the linear latex canals black, conspicuous, the margins flat, scarious, irregularly notched, at times also appearing erose; uppermost sepals as in lowermost but oblong, 10–12 mm long, 7.5–8 mm wide, petals 12–16, contorted, membranaceous, oblong to oblanceolate, acropetally larger, the largest 16–19 mm long, 10–12 mm wide, somewhat clawed, some appearing oblanceolate-spathulate, apically broadly rounded to truncate, linear resin canals conspicuous, black, numerous, the margin undulate, somewhat irregular, minutely erose at tip; stamens numerous, linear 4–5 mm long, the filaments free, 2.0–2.2 mm long, the anther sacs linear, 2.0-3.0 mm long, the connective extending above the anthers ca. 0.5 mm long, subulate; central staminodes forming a mass agglutinated by orange waxy resin, the pistillode vestigial or absent. *Pistillate inflorescence* as in staminate but peduncle 7–20 cm long; secondary inflorescence bracts 11–13 mm long, 5.5–6.6 mm wide in lower portion of inflorescence, acropetally smaller to 3 mm long, 3 mm wide; pedicels accrescent to 2.8 cm in fruit. *Pistillate flowers* as in staminate but staminodes 4–5 mm long, devoid of pollen, the connectives 0.6-1 mm long, pistil ovoid, 7–8 mm long, 8–9 mm wide, carpels and stigmas 8, cuneiform at maturity, convex, 4.5–5.2 mm long, 2.0–2.5 mm wide. *Fruit* ovoid to oblong, 3.0–6.5 cm long, (1.8–)2.7–2.9 cm diam., 7-ribbed, the fruit grenadine, the ribs white when fresh.

Distribution.—Endemic to the Chocó Floristic Province of Colombia and adjacent Ecuador, (17–)650–1,650 m elevation.

Ecology and conservation status.—Clusia niambiensis occurs in premontane and montane pluvial forest, where it is an understory treelet. The populations of this species are composed of approximately 20 individuals per hectare.

Etymology.—Clusia niambiensis is named for the Reserva Natural Río Ñambí, a private Wildlife Reserve in the state of Nariño, Colombia, operated by FELCA, the Ecological Foundation of the Hummingbirds of Altaquer, where the largest populations of this species have been found.

Local names and uses.—"Guandera" (Colombia & Ecuador, Spanish).

PARATYPES: **COLOMBIA.** NARIÑO: Mpio. Barbacoas; Corregimientos Ortíz y Zamora; Vereda El Barro; Reserva Natural Río Ñambí, ca. 5 km al W de Altaquer, Faldas Occidentales de la Cordillera Occidental, 01° 15' N, 78° 08' W; 1,450–1,500 m, 1 Sep 1997 (pist. fl), *J. Pipoly, A. Cogollo et al. 21044* (BRIT, JAUM, PSO), 8 Sep 1997 (stam. fl), *J. Pipoly, A. Cogollo, M. López & M. Rodríguez 21490* (BRIT, COL, JAUM, PSO), 1,250–1,350 m, 10 Sep 1997 (stam. fl), *J. Pipoly, A. Cogollo et al. 21655* (BRIT, JAUM, PSO); Resguardo de El Sábalo, Río Cangapí, 01° 17' N, 78° 14' W, 580 m, 17 Aug 1995 (fr), *B. Ramírez et al. 8049* (BRIT, PSO); Corregimiento El Diviso, near El Diviso, 25 Nov 1979 (pist. fl), *O. de Benavides 2149* (PSO); Corregimiento de Junín, 1,200 m, 7 Oct 1988 (pist. fl bud), *O. de Benavides 10246* (PSO); Locality between Junín and Divisio, 1,700 m, 15 Sep 1978 (pist. fl), *O. de Benavides 1565* (PSO); Espino to Tumaco Road, 84 km W of Espino, on pass between Altaquer and Junín, 01° 15' N, 78° 09' W, 1,300 m, 18 Nov 1986 (fr), *B. Hammel & R. Bernal. 15751* (COL, HUA, MO, PSO); El Espino to Tumaco Road, 30 km W of Ricaurte, 10 km W of Altaquer, El Mirador, Finca Sta. Lucía, in forest N of Río Ñambí, 01° 17' N, 78° 07' W, 950 m, *B. Hammel & A. Narváez 17178* (MO, PSO); Mpio. Ricaurte, Hacienda La Planada, 1,850 m, 26 Nov 1981 (fr), *O. de Benavides 3338* (PSO); Resguardo Indígena Nulpe Medio, Andalucía- Nulpe Medio, 01° 05' N, 78° 14' W 01° 18' N, 77° 54' W, 800–1,100 m, 5 Jan 1996 (pist. fl), *B. Ramírez et al. 9364* (BRIT, PSO); El Diviso, highway to Tumaco, 790 m, 20 Feb 1968 (fr), *G. López 261* (PSO); Mpio. de Tumaco, 2 km from Tangareal, banks of Río Mira, 17 m, 8 Apr 1978 (pist. fl), *O. de Benavides 1383* (PSO). **ECUADOR. Carchi:** Cantón Tulcán, Reserva Indígena Awá, Gualpi Alto Community, Parroquia Chicál, 01° 02' N, 78° 14' W, 1,800 m, 15–28 Jul 1991 (stam. fl bud), *D. Rubio et al. 1589* (BRIT, MO, QCNE), (fr), *D. Rubio et al. 1590* (BRIT, MO, QCNE). **Los Ríos:** Cantón Quevedo, Parroquia Centinela-La Pirámide, vía Sto. Dominto de los Colorados-Quevedo, entrando por Patricia Pilar, km 41, 01° 40' S, 79° 20' W, 650 m, 25 Feb 1992 (fr), *C. Quelal & G. Tipaz 160* (BRIT, MO, QCNE). **Pichincha:** Quito-Puerto Quito Road, 10 km N of main road, Km 113, 00° 05' N, 79° 02' W, Reserva Forestal ENDESA, Río Silancha, Cooporación Forestal Juan Manuel Duriní, voucher for NCI, 650–700 m, 17 May 1987 (pist. fl), *P. Acevedo R., D. Daly & M. Ríos 1695* (BRIT, NY, QCA, US).

Clusia niambiensis is infrequent in the western slopes of the Cordillera Occidental of Colombia and adjacent Ecuador, where it has been frequently confused with its congeners, *Clusia laurifolia* Pl. & Tr., and *Clusia venusta* Little, all of them having bullate leaves with obviously brochidodromous venation. However, the free stamens with subulate apices, and resiniferous zone in the center of the androecium indicate it is a member of section *Chlamydoclusia*, and not section *Retinostemon*, where the other two taxa belong. At this time, it is not known which member of subgenus *Clusia* is its closest relative.

ACKNOWLEDGMENTS

This work is a result of a generous grant from the National Geographic Society, 5575-95, for exploration of the Reserva Natural Río Ñambí. We thank Bernardo Ramírez (PSO) for his technical assistance, as well as the administration of FELCA (Fundación Ecológica de los Colibrís de Altaquer), Marcial Bisbicuz, and Maruricio Flores. Ramiro Fonnegra, Director of HUA, graciously made the services of Gloria Mora available to us to prepare the line illustration, for which give thanks.

BOOK REVIEW

CHRISTINE PADOCH and NANCY LEE PELUSO, eds. 1996. **Borneo in Transition: People, Forests, Conservation and Development.** (ISBN 967-65-3110-3 (hbk). Oxford University Press, 198 Madison Ave., New York, NY 10016. 800-451-7556. $55.00. 291 pp, tables, figures, maps.

This book is a collection of papers resulting from a symposium "Interactions of People and Forests in Kalimantan" held at the New York Botanical Garden in 1991. Despite being published some five years after the event, the 17 papers contained therein have not lost their timeliness, and are synthesized by an excellent introductory chapter by Padoch and Peluso. The book is composed of three sections: I) Introduction to Conservation and Development Issues and the Role of Research, II) Local Transformations in Forest Use and Forest Rights, and III) Case-Studies in Resource Management.

The first section contains five papers that explain the current development of Borneo within the context of Indonesia, Malesia as a whole, and SE Asia. Of these, the chapter by Potter on forest degradation is particularly illuminating and logically outlines what the conservation situation was on the island (prior to El Niño-1998), although the debt for nature swap, sensu Potter, is an extremely controversial concept.

The second section is focused to development on a local level and its effects on the forest, its people, and their sociology. It was interesting to note that Map 9.2 (p. 140) in Ngo's article, showing the migratory direction of the Kayan in Kalimantan, lies along the continental divide (and the Sarawak Border) and is immediately adjacent to (east of) and slightly overlapping with, the area surveyed by Burley in Chapter 5. Chapter 8, by Peluso and Padoch, is a cogent analysis of how two Dyak villages have changed with development, and contains a new hypothesis regarding changes in "distribution and economic importance of particular crops and technologies" as the impetus behind changes in resource management and rights. It includes extensive footnotes and a bibliography, with a conclusion's section that pinpoints the areas where further research is needed.

In the third part, Peters (Chapter 14), in his article on Illipe Nuts, has provided a model case (and I hope a rapidly adopted standard protocol) for the study of underexploited tropical crops. If data similar to that presented by Peters are combined with market data using the methodology in the following Chapter 14, by Leaman et al., a realistic estimation of a crop's potential can be calculated. Understanding the biology, and therefore, the likelihood of cultivation success for a given crop, combined with its relative "competitive fitness" against other crops simultaneously available in the market, would be a desirable formula to guide local communities in preferential resource allocations.

In summary, this book provides not only information pertinent to Borneo, but also contains papers with protocols worthy of becoming standards for their respective fields, concomitant with rich bibliographies. I think every conservationist, economic botanist, sustainable development specialist, and resource manager should have a copy.–*John J. Pipoly III*

NEW SPECIES AND NOMENCLATURAL NOTES IN *CLUSIA* (CLUSIACEAE) FROM ANDEAN COLOMBIA AND VENEZUELA

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ABSTRACT

Continuing studies on the Clusiaceae for *Flora de Colombia*, and fieldwork to document the phytodiversity of Río Ñambí Natural Reserve have revealed two new species, *Clusia bernardoi* Pipoly & Cogollo, and *C. tetragona* Pipoly & Cogollo. The new species are described, illustrated, and hypotheses of their phylogenetic positions are proposed. Corrections to bibliographic errors in citations for *Clusia* sect. *Oedematopus* and *Clusia* sect. *Havetiopsis* are provided. The new combination *Clusia comans* (Mart.) Pipoly is validated. Colombian and related Andean Venezuelan species formerly included in the genus *Oedematopus* are transferred to *Clusia*, necessitating the new combinations: *C. aristeguietae* (Maguire) Pipoly, *C. divaricata* (Cuatrec.) Pipoly, *C. epiphytica* (Cuatrec.) Pipoly, *C. mirandensis* (Cuatrec.) Pipoly.

RESUMEN

Estudios hacia un tratamiento taxonómico de la familia Clusiaceae para *Flora de Colombia* y para documentar la fitodivdersidad de la Reserva Natural Río Ñambí, revelaron dos especies nuevas para la ciencia, *Clusia bernardoi* Pipoly & Cogollo, y *C. tetragona* Pipoly & Cogollo. Se describen, se ilustran y se proponen hipóteses de parentezco para las nuevas especies. Errores bibliográficos previamente publicados para *Clusia* secciones *Oedematopus* y *Havetiopsis* se corrigen. La nueva combinación *Clusia comans* (Mart.) Pipoly se valida. Especies colombianas y venezolanas de la región Andina anteriormente consideradas como miembros del género *Oedematopus* se transfieren a *Clusia*, resultando en las nuevas combinaciones: *C. aristeguietae* (Maguire) Pipoly, *C. divaricata* (Cuatrec.) Pipoly, *C. epiphytica* (Cuatrec.) Pipoly, *C. mirandensis* (Cuatrec.) Pipoly.

INTRODUCTION

The genus *Clusia* contains approximately 300 species, of which nearly 17% remain undescribed. Fundamental taxonomic work by Panchon and

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Triana (1860a, 1860b), Engler (1888, 1895), and Vesque (1892, 1893) form the basic framework which all modern studies have been based to date. Cuatrecasas (1949, 1950) was the first author of this century to critically reevaluate the Colombian members of the family, and in the two aforementioned papers, he described a total of 75 taxa. Most of the taxa described by Cuatrecasas belonged to the genus *Clusia* sensu stricto, but his work also included critical additions to the genera *Oedematopus* and *Clusiella* that left the circumscription of each significantly emended. Subsequently, Ewan (1951), Maguire (1951, 1977), Pipoly and Graff (1995a, 1995b), Pipoly (1997) and Pipoly and Graff (1995a, 1995b), described a number of new species. Pipoly et al. (1998), in their treatment of the family for *Flora of the Venezuelan Guayana,* relegated *Quapoya, Havetiopsis,* and *Oedematopus* (among other genera) to synonymy under *Clusia.* This paper is intended to describe novelties in *Clusia,* correct bibliographic errors in citation for sections *Havetiopsis* and *Oedematopus,* validate the new combination *Clusia comans,* and to complete the transferal of *Oedematopus* species to *Clusia.*

NOVELTIES IN *CLUSIA*

In the course of identification of herbarium materials for an analysis of the family for *Flora de Colombia,* the following new species were encountered.

Clusia (§ Anandrogyne) bernardoi Pipoly & Cogollo, sp. nov. (**Fig. 1**). COLOMBIA. CAUCA: Mpio.de Tambo, Parque Nacional Munchique, km 60–80 vía a la Galera, 1,850–2,150 m, 13 Apr 1995 (stam. fl), *B. Ramírez, N. Rojas, L. Zambrano, N. Diago 7198* (HOLOTYPE: PSO; ISOTYPES: CAUP, JAUM).

Quoad filamenta numerosa omnino libera, ad apices emarginata, adque bases cordata, androphoros paucipraedita *C.* sectio *Anandrogyno* pertinet, sed ab species illiis laminis oblongis vel peranguste oblanceolatis, nerviis secundariis numerosis ad apices truncatis vel late rotundatis hydropoditsque indutis, secus margines revolutis necnon sepalis petalisque 4 perfacile cognoscitur.

Glabrous *treelet* to 5 m tall; latex unknown. *Branchlets* terete, 5–8 mm diam., swollen at the nodes 7–10 mm diam., the nodes short, 1.3–2 cm long, glabrous. *Leaves* sessile; blades coriaceous, oblong to narrowly oblanceolate, 17–23 cm long, 4.6–6.0 cm wide, apically truncate to broadly rounded, basally cuneate, midrib prominently raised above and below, the secondary veins brochidodromous, numerous, 70–80 pairs, prominulous above, scarcely visible below, the submarginal collecting vein like the secondaries, 1–2 mm from margin, drying smooth and dark green above, pallid below, the linear resin canals visible in the lower 1/3, and with scattered, minute rubiginous hydropotes, the margin slightly revolute except prominently revolute in the basal 1/4 of leaf. *Staminate inflorescence* a terminal panicle of cymes, thrice-branched, and each subsequent branch divided 3 times; peduncle 3.7–4.7 cm long; inflorescence bracts cartilaginous, ovate, 7–10 mm long,

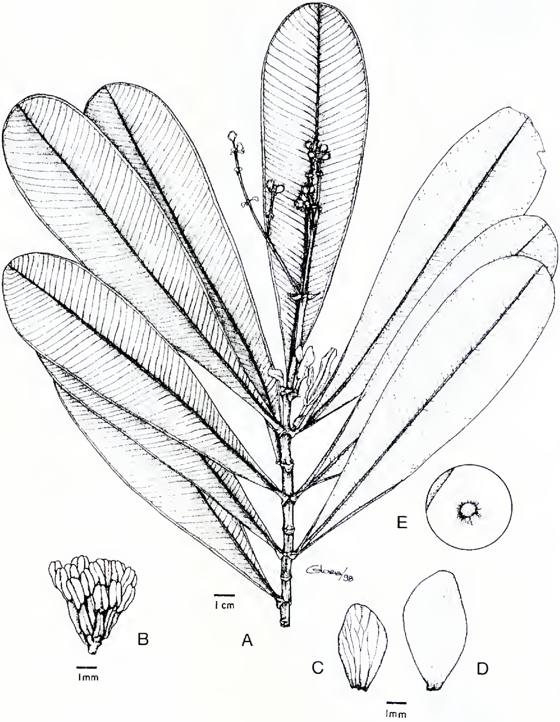

FIG. 1. *Clusia bernardoi* Pipoly & Cogollo. A. Branchlet, showing oblong to narrowly oblanceolate leaf blades. B. Androecium, showing poorly developed androphore and oblongoid anthers with emarginate apices. C. Sepal, showing asymmetry, and conspicuous venation. D. Petal, showing asymmetry and conspicuous venation. E. Abaxial leaf surface, showing hydropote. A–D, drawn from holotype.

4.5–6.5 mm wide, apically obtuse, medially thickened but not carinate, the linear resin canals drying black, conspicuous, the margin scarious, entire; floral bracts 2, as in secondary inflorescence branch bracts except oblate, 1.8–2.2 mm long, 2.1–4.1 mm wide, apex widely rounded; bracteoles 2, chartaceous, oblate to deltate, 2.0–2.2 mm long, 3.8-4.2 mm wide, apex obtuse to acutish, medially keeled, the margin entire; pedicels obsolete. *Staminate flowers* 3 per cymule, whitish-green; sepals 4, decussate, membranaceous, oblong, 5.5–6.5 mm long, 3.1–3.5 mm wide, asymmetric, apically obtuse, cucullate, hyaline, the venation conspicuous, the margin entire; petals 4, decussate, oblong, 5.5–7.0 mm long, apically broadly rounded and asymmetrically notched, hyaline, the venation conspicuous, the margin irregular, entire; androphore poorly developed or obsolete, stamens 22-28, 2.0–3.5 mm long, free to the base, the filaments 1–1.5 mm long, the anthers oblongoid, 0.5–0.9 mm long, 0.5–0.7 mm wide, apically emarginate, basally subcordate, as wide as the filaments, deshiscent by wide longitudinal slits throughout their length; pistillode absent. *Pistillate inflorescence, flowers,* and *fruit* unknown.

Distribution.—Known only from the type.

Ecology and conservation status.—The type locality lies in a transitional zone between premontane pluvial forest and cloud forest, but no further details are known. While the species is known from Munchique National Park, encroachment is common and poses a threat to this species.

Etymology.—It gives me great pleasure to dedicate this striking new species to Biól. Bernardo Ramiro Ramírez Padilla, Herbarium Technician of the University of Nariño in Pasto, Colombia. Bernardo has worked indefatigably for over twenty years, documenting the complex, species-rich and biogeographically important flora of the Department of Nariño and adjacent areas, such as Cauca and Putumayo.

Clusia bernardoi is unique among members of *C.* section *Anandrogyne* because of its oblong to narrowly oblanceolate leaf blades bearing rubiginous hydropotes, and 4-merous perianth. Four-merous flowers are otherwise frequent among members of *C.* section *Criuva* (Pipoly, 1996), but the oblongoid anthers with emarginate apices and cordate bases, dehiscent by wide longitudinal slits leave no doubt that *Clusia bernardoi* is a member of *C.* section *Anandrogyne*, the largest and most complicated section of the genus.

Clusia (§ Criuva) tetragona Pipoly & Cogollo, sp. nov. (**Fig. 2**). COLOMBIA. NARIÑO: Mpio. Barbacoas; Corregimiento Ortíz y Zamora; Vereda El Barro; Reserva Natural Río Ñambí; ca. 5 km W de Altaquer, faldas occidentales de la Cordillera Occidental; 01° 18' N, 78° 08' W, 1,350–1,400 m, 3 Sep 1997 (bud, fr), *J. Pipoly, A. Cogollo, M. López, & M. Rodríguez 21198* (HOLOTYPE: PSO; ISOTYPES: BRIT, COL, FMB, JAUM, K, MO, NY, TULV).

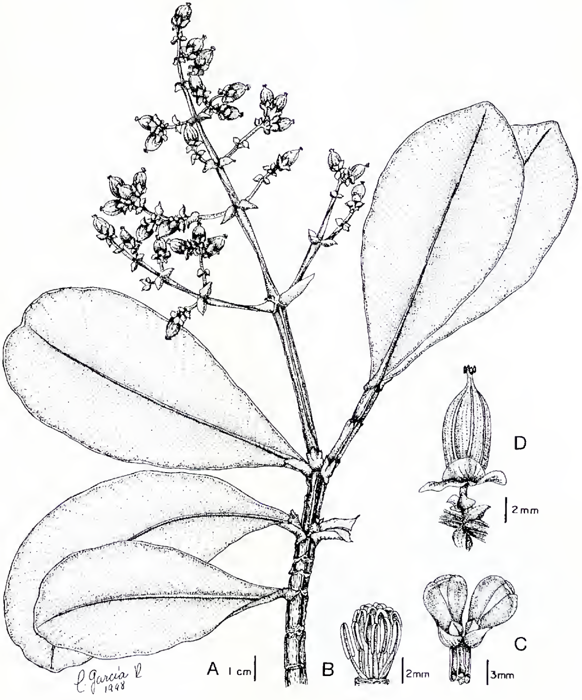

FIG. 2. *Clusia tetragona* Pipoly & Cogollo. A. Branchlet, showing tetragonal shape appearing alate, and subsessile leaves. B. Androecium, showing poorly developed androphore, free filaments, and muticous anthers. C. Flower buds, showing secondary inflorescence bracts and two of the four bracteoles. D. Fruit, showing rostrate apex. A–C, drawn from holotype. D, drawn from *J. Pipoly et al. 21157.*

Propter lamina obovata vel elliptica coriaceaque nervio submarginale prominente, inflorescentiam terminalem pyramido-paniculatam, petiolos marginatos necnon fructu rostrato, *C. garciabarrigae* valde arcte affinis, sed ab ea ramulis tetragonis (non teretibus), petiolis obsoletis vel usque ad 1.5 (non 2.5–4) cm longis, bracteis florinis 4(non 2), sepalis suborbicularibus (non oblongis), denique fructibus 8–10(–13) (non 5–7) mm longis statim distinguitur.

Terrestrial *tree* to 25 m tall, and to 45 cm DBH; latex white. *Branchlets* tetragonal, subalate, (4–)5–7 mm diam., glabrous. *Leaves* decussate; blades coriaceous, obovate to elliptic, (9.5–)14.2–19 cm long, 4.5–6(–9.5) cm wide, apically broadly rounded to truncate, basally acute, midrib prominently raised above and below, the secondary veins numerous, 50–52 pairs, connected by a submarginal collecting vein ca. 2 mm from margin; linear latex canals not visible from above, rubiginous and conspicuous below, the margin entire, flat; petioles obsolete to broadly marginate, to 1(–1.5) cm long. *Staminate inflorescence* a bipinnate panicle, ca. 12 cm long, 10 cm wide; peduncle 4–4.5 cm long, tetragonal except drying flat in the upper portion; primary inflorescence bracts 2, cartilaginous, 11–13 mm long, 5.5–6.5 mm wide, apically obtuse, medially keeled, the margin scarious, entire; secondary inflorescence bracts acropetally smaller and similar, except the uppermost suborbicular, ca. 3 mm long and wide; pedicels obsolete to 0.5 mm long. *Staminate flowers* greenish white; bracteoles 4, cartilaginous, oblate, 2.5–3 mm long, 3–3.5 mm wide, apically acute to rarely subobtuse, prominently carinate medially, the margin entire, opaque, glabrous; sepals 4, membranous, hyaline, decussate, the outer suborbicular, 4.5–5.5 mm long, 3.5–4 mm wide, the inner oblong, 7–8 mm long, 3.5–4 mm wide, apically cucullate and broadly rounded, the linear latex canals conspicuous, the margin entire; petals 4, decussate, membranaceous, obovate-spathulate, 8–9 mm long, 4–5 mm wide, linear latex canals conspicuous, the margin entire; androphore poorly developed, to 1 mm high; stamens 32–36, 3–4.5 mm long, the filaments free, angulate 1–2 mm long, the anthers linear, each theca half the diameter of the connective, apically muticous, tapering basally into filament, dehiscent by narrow longitudinal slits 2–2.5 mm long; pistillode absent. *Pistillate flowers* similar to staminate except somewhat smaller (in bud); staminodes obsolete; pistil oblongoid, 3.5–4 mm long, ca. 2 mm wide, the stigmas 4, sessile, cuneiform, concave, 0.9–1.3 mm long, 0.9–1.1 mm wide, appearing to be borne on connivent styles at maturity, the apparent styles 1–1.2 mm long. *Fruit* ellipsoid, 8–10(–13) mm long, 4.5–6 mm wide, abruptly constricted to a small "beak" apically (rostrate).

Distribution.—Apparently endemic to the Barbacoas area, on the western slopes of the Cordillera Occidental, in the Department of Nariño, Colombia, at 1,325–1,900 m elevation.

Ecology and conservation status.—*Clusia tetragona* is restricted to premontane pluvial and cloud forests, where it is found along forest margins.

Etymology.—The specific epithet, 'tetragona' refers to the tetragonal nature of the branchlets when seen in transverse section.

Common names.—"Guandera" (Spanish).

Paratypes. COLOMBIA. nariño: Mpio. Barbacoas, Corregimiento Altaquer, Vereda El Barro, Reserva Natural Río Ñambí, left bank of Río Ñambí, 01° 18' N, 78° 04' W, 1,325 m, 11 Dec 1993 (fr), *P. Franco et al. 5145* (COL, PSO); Corregimiento Ortíz y Zamora; Vereda El Barro; Reserva Natural Río Ñambí; ca. 5 km W de Altaquer, faldas occidentales de la Cordillera Occidental; 01° 18' N, 78° 08' W, 1,350–1,400 m, 2 Sep 1997 (bud, fr), *J. Pipoly, A. Cogollo, M. López & M. Rodríguez 21157* (BRIT, COL, FMB, JAUM, K, MO, PSO, TULV); Mpio. Ricaurte, La Planada, 1,900 m, 28 Nov 76 (stam. fl), *O. de Benavides 730* (PSO), La Planada, 5 km S of Altaquer, 01° 10' N, 78° 00' W, 1,750 m, 22 Nov 1986 (fr), *B. Hammel & R. Bernal 15802* (COL, MO, PSO); La Planada, 7 km de Chucunés, 01° 10' N, 77° 58' W, 1,800 m, 25 Sep 1989 (fr), *O. de Benavides 10803* (MO, PSO), 18 Jan 1990 (fr), *O. de Benavides 11337* (MO, PSO), 01° 05' N, 78° 01' W, 1,800 m, 22 Dec 1987 (fr), *A. Gentry & P. Keating 59721* (MO, PSO); Trail to El Hondón, 5–12 km SW of La Planada, 01° 04' N, 78° 02' W, 1,750–1,800 m, 6 Jan 1988 (fr), *A. Gentry & P. Keating 60474* (MO, PSO); Camino Las Cruces-Curucel, 01° 08' N, 77° 51' W, 1,700–1,800 m, 5 Nov 1995 (fr), *B. Ramirez, M. González & A. Muñoz 8692* (BRIT, PSO).

Because of its obovate to elliptic, coriaceous leaves, with a prominent submarginal collecting vein, terminal pyramidal-paniculate inflorescence, and rostrate fruit, *Clusia tetragona* is most closely related to *C. garciabarrigae* Cuatrecasas. However, *Clusia tetragona* is immediately separated from that species by the tetragonal branches, appearing alate when dried, sessile to short-petiolate leaves, more numerous floral bracteoles, suborbiculate sepals and much longer fruits. While *Clusia tetragona* is apparently sympatric with *C. garciabarrigae*, it is notable that *C. tetragona* is restricted to more open habitats than *C. garciabarrigae.* Clearly, more fieldwork is needed to understand the population biology of these species.

NOTES ON *CLUSIA* SECTIONS *OEDEMATOPUS* AND *HAVETIOPSIS*

In our recent treatment of this section for the Venezuelan Guayana (Pipoly et al. 1998), we inadvertently missed the first publication of the basionyms, *Oedematopus* Planch. & Triana, and *Havetiopsis* Planch. & Triana, and cited them as "Ann. Sci. Nat., Bot. ser. 4, 14:249. 1860," for *Oedematopus* and "Ann. Sci. Nat., Bot. ser. 4, 14:246. 1860" for *Havetiopsis*, where complete descriptions of the genera were presented, followed by descriptions of all infrageneric taxa. However, Planchon and Triana had first published the two generic names, with diagnoses inside a synoptic key, for the first time in the previous volume, published in the same year. For my relegation of *Pilosperma* Planch. & Triana to synonymy under *Clusia*, I (Pipoly 1997) cited "Ann. Sci. Nat., Bot ser. 4, 13:315. 1860," which was correct. Because the citations for *Oedematopus* and *Havetiopsis* only involve bibliographic errors (ICBN, Art. 33.3), the combinations are valid, but should be cited as follows:

Clusia L. sect. **Oedematopus** (Planch. & Triana) Pipoly in Steyermark, Berry & Holst, Fl. Venez. Guayana 4:269. 1998. *Oedematopus* Planch. & Triana, Ann. Sci. Nat., Bot. ser. 4, 13:315. 1860. TYPE: *Havetia octandra* Poepp. & Endl., Nov. Gen. Sp. 3:11. t. 209A. 1840 (LECTOTYPE, by Pipoly 1998). = *Clusia octandra* (Poepp.) Pipoly, Fl. Venez. Guayana 4:276. 1998.

Clusia L. sect. **Havetiopsis** (Planch. & Triana) Pipoly in Steyermark, Berry & Holst, Fl. Venez. Guayana 4:269. 1998. *Havetiopsis* Planch. & Triana, Ann. Sci. Nat., Bot. ser. 4, 13:315. 1860. LECTOTYPE SPECIES, here designated: *Clusia flavida* (Benth.) Pipoly, based on *Havetia flavida* Benth., London J. Bot. 2:369. 1843.

When relegating *Renggeria* to synonymy under *Clusia*, we (Pipoly et al. 1998), cited the basionym "*Renggeria comans* Meisn., Pl. Vasc. Gen., Commentarius 42. 1837." However, Meisner did not make a new combination on that page; he merely published the name of a new genus there, without listing any species. Therefore, the correct basionym was not cited and according to ICBN Art. 33.2, the combination is invalid. The new combination, citing the correct basionym is made herewith:

Clusia comans (Mart.) Pipoly, comb. nov. *Schweiggeria comans* Mart., Nov. Gen. Sp. Pl. 3:166. 1832. *Quapoya comans* (Mart.) Planch. & Triana, Ann. Sci. Nat. Bot. ser. 4, 14:239. 1860. *Renngeria comans* (Mart.) Meisn. ex Engl. in Mart., Fl. Bras. 12 (1):441. 1888.

Even though the generic name *Schweiggeria* Mart. (non Spreng.) is a later homonym, the binomial is legitimate, as per ICBN Art. 55.1.

In the treatment of the genus Clusia for *Flora of the Venezuelan Guayana,* (Pipoly et al. 1998), and subsequently (Pipoly 1997), we transferred a number of Andean species from *Oedematopus* to *Clusia*, but did not transfer the Andean species from Colombia and Venezuela, pending review of available material. Now that I have seen types and other material of these species, here I transfer the remainder of the species formerly in *Oedematopus,* to *Clusia* sect. *Oedematopus,* herewith.

Clusia aristeguietae (Maguire) Pipoly, comb. nov. *Oedematopus aristeguietae* Maguire, Bol. Soc. Venez. Ci. Nat. 25:228. 1964.

Clusia divaricata (Cuatrec.) Pipoly, comb. nov. *Oedematopus divaricatus* Cuatrec., Anales Inst. Biol. Univ. Nac. Mexico 20:108. 1949.

Clusia epiphytica (Cuatrec.) Pipoly, comb. nov. *Oedematopus epiphyticus* Cuatrec., Revista Acad. Colomb. Ci. Exact 8 (29):61. 1950.

Clusia mirandensis (Cuatrec.) Pipoly, comb. nov. *Oedematopus mirandensis* Maguire, Bol. Soc. Venez. Ci. Nat. 25:230. 1964.

ACKNOWLEDGMENTS

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We are also very grateful to K. Gandhi (GH) for bringing the bibliographic errors in the *Flora of the Venezuelan Guayana* treatment to the attention of Pipoly. Gandhi's thorough and meticulous work is most appreciated. The additional comments by D. Nicolson (US) did much to improve the quality of the paper, for which we are most thankful.

REFERENCES

Choisy, J. D. 1823. Mémoire su un noveau genre de Guttifères et sur l'arrangement méthodique de cette famille. Mém. Soc. Hist. Nat. Paris 1:210–232.

Cuatrecasas, J. 1949. Gutíferas nuevas o poco conocidas de Colombia. Anal. Inst. Biol. Méx. 22:91–112.

_____. 1950. Notas a la Flora de Colombia. X. Revista Acad. Colomb. Ci. Exact. 8(29):33–64.

Engler, A. 1888. Guttiferae. In: C. Martius, ed. Flora Brasiliensis 12(1):382–474.

_____. 1895. Guttiferae.. In: A. Engler and K. Prantl, eds. Die natürlichen Pflanzenfamilien. 3(6):191–242. Verlag von Wilhelm Engelmann. Leipzig.

Ewan, J. 1951. Taxonomic notes on various species of Musaceae, Marcgraviaceae, Guttiferae and Solanaceae of Colombia. Nat. Hist. Misc. 88:1–9.

Maguire, B. 1951. Guttiferae. In: R. Schultes, Plantae austroamericanae, VII. Bot. Mus. Leafl. 15:55–69.

_____. 1977. A revision of *Clusia* section *Cochlanthera* (Choisy) Engler. Caldasia 11(55):129–146.

Pipoly, J. 1997. Nomenclatural notes on neotropical Clusieae (Clusiaceae). Sida 17:763–765.

Pipoly, J. and A. Graff. 1995a. A synopsis of the genus *Clusia* sections *Criuvopsis* and *Brachystemon* (Clusiaceae) in northern South America. Sida 16:505–528.

_____ and _____. 1995b. The genus *Clusia* section *Criuva* (Clusiaceae) in Guayana. Sida 16:649–678.

_____, D. Kearns, and P. Berry. 1998. *Clusia*. Pp. 260–294. In: P. Berry, B. Holst, and K.Yatskevych, eds. Flora of the Venezuelan Guayana. Vol. 4. Caesalpiniaceae-Ericaceae. Missouri Botanical Garden. St. Louis.

Planchon, J. and J. Triana. 1860a. Mémoire sur la famille des Guttifères. Ann. Sci. Nat., Bot ser. 4, 13:307–367.

_____ and _____. 1860b. Mémoire sur la famille des Guttifères. Ann. Sci. Nat., Bot ser. 4, 14:226–367.

Vesque, J. 1892. Epharmosis sive materiae ad instrumendam anatomiam systematis naturalis. Vincennes. Paris.

_____. 1893. Guttiferae. In: Alphonse and Casmir de Candolle, eds. Monographie Phanerogamarum 8:1–669. Paris.

BOOK REVIEW

JONH LAIRD FARRAR. 1995. **Trees of the Northern United States and Canada.** 1995. (ISBN 0-8138-2740-X, hbk.) Iowa State University Press, 2121 South State Ave., Ames, Iowa 50014. $39.95. 502 pp, maps, line drawings, color.

This book's format is extremely similar to the classic *Textbook of Dendrology*, by W. Harlow & E. Harrar, published in 1958. Although I found no direct reference to that work mentioned in the text, the 7th edition of Harlow and Harrar, published in 1991, is cited in the Bibliography section. The author states that this book evolved from the *Native Trees of Canada*, first published in 1917. Clearly, there are only so many ways to present multiple dendrological characteristics graphically, clearly, yet with high technical accuracy, and this, like the other aforementioned books, does just that. For each "native" species, the "preferred" English common name, latin name, French common name, its distribution, and brief descriptions of the: leaves, buds, twigs, "seed cones" (in the case of gymnosperms), or flowers and fruit (for angiosperms), seeds, vegetative reproduction, bark, wood, size and form of bole and canopy, habitat and notes. The distrubution map, habit profile, twig profile, leaf profile, and fruit drawing are on a page facing color photos of the cones or flowers, fruits, seeds, young bark, and old bark, for most species. The entire work is divided into 12 groups, the first six of which are gymnosperms (needle and scale characters) and the second of which are angiosperms, separated by leaf morphology. While I believe the section entitled, "Tree names" contains several important conceptual errors, they do not comprise any meaningful pitfall. I would have also liked an explanation for determination of "native" species. In summary, it is one of those guides that every professional conservationist, forester and botanist should have, along with anyone who enjoys hiking, camping, nature walks, and other outdoor activities in the geographic area covered. The price is more than reasonable for such an absolutely practical work, that is easy to use, richly illustrated on acid-free paper, and with an extra-heavy-duty binding. I am not sure how the book would withstand a rainstorm or two, but I am anxious to find out, as should everyone.–*John Pipoly III*

SIDA 18(2): 410. 1998

DOS NUEVAS ADICIONES A LA ORQUIDEOFLORA MEXICANA

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RESUMEN

Se describen e ilustran dos nuevas especies del género *Malaxis* (Malaxideae, Orchidaceae) para México, *Malaxis palustris* y *Malaxis alvaroi*. La primera crece en el estado de Morelos y la segunda se conoce de los estados de Morelos y Guanajuato.

ABSTRACT

Malaxis palustris and *Malaxis alvaroi* (Malaxideae, Orchidaceae), two new species from Mexico, are described and illustrated. The former grows in Morelos and the latter is known from Morelos and Guanajuato.

INTRODUCCIÓN

El género *Malaxis* fue propuesto por Swartz en 1800 y comprende un grupo de orquídeas terrestres, bulbosas, ocasionalmente epífitas, que se caracterizan por presentar una o dos hojas (ocasionalmente tres) envainadoras y flores pequeñas, verdes a verde-amarillentas, raramente purpúreas dispuestas en inflorescencias racemosas a corimbosas. El género cuenta con cerca de 300 especies de distribución cosmopolita. Williams (1951) cita 24 especies para México, Soto Arenas (1988) reporta 32 taxa, en tanto que Espejo & López-Ferrari (1998) registran 47. Aunque los listados mencionados nos dan una idea del número de representantes mexicanos del género, aun está lejos de completarse la revisión del mismo para el país. En los últimos 15 años han sido descritos más de 10 taxa (McVaugh 1985; Catling 1990; Salazar

1990, 1993; Salazar y Soto Arenas 1990; Todzia 1993, 1995; González Tamayo 1991, 1992a, 1992b, 1994, 1995; Greenwood 1992) y la gran riqueza específica del género sugiere que aun restan por descubrirse varios más.

Por otra parte, la distribución de las especies de *Malaxis* en México es poco conocida o en algunos casos mal entendida, debido a que la delimitación específica se basa en buena medida en los caracteres florales, los cuales son difíciles de observar o interpretar en el material herborizado. Además, la falta de claves recientes para la identificación de las especies conduce a que los ejemplares, o bien no se identifiquen, o bien se determinen erróneamente.

En recientes salidas al campo a los estados de Morelos y Guanajuato, se recolectó material de dos especies del género *Malaxis*, que no pudieron asignarse a ninguno de los taxa conocidos. La revisión bibliográfica pertinente, así como el estudio de las colecciones del género, incluyendo material tipo, depositadas en los herbarios AMES, AMO, ENCB, GH, MEXU, MICH, NY, UAMIZ, VT y W nos llevaron a la conclusión de que se trata de dos novedades para la ciencia, que aquí proponemos.

Malaxis palustris Espejo & López-Ferrari, sp. nov. (**Fig. 1**). TIPO: MÉXICO. Morelos, municipio de Huitzilac, 1–2 km al W de la Laguna Zempoala, sobre el arroyo Las Trancas, Parque Nacional Lagunas de Zempoala, 19° 02' 37" N, 99° 19' 20" W, 2800 m, 12 jul 1997, *Espejo, 5714, López-Ferrari, García-Cruz y Jiménez M.* (HOLOTIPO: UAMIZ; ISOTIPOS: AMO, AMES).

Herba paludicola. Rizoma conspicuus. Pseudobulbus hipogeus, ovideus, inconspicuus. Folia unica, anguste elliptica vel elliptica. Inflorescentia racemosa, pedunculo penta-alato, racimo denso. Flores 10–30 non resupinatae. Labelum depresso-ovatum, concavum, acuminatum, basi truncatum.

Hierba paludícola de 12–33 cm de alto. *Raíces* pocas, originadas en la base del seudobulbo, de 0.2–0.5 mm de diámetro, pilosas, blanquecinas. *Rizoma* conspicuo, de 0.5–2.5 cm de largo por 2–3 mm de diámetro, cubierto por las vainas. *Seudobulbo* hipógeo, ovoide a oblongo, inconspicuo, blanco, de 5–10 mm de largo por 5–7 mm de ancho. *Vainas* dos, tubulares, estrechas, verdosas hacia el ápice, obtusas a agudas, de 3–4.5 cm de largo. *Hoja* única con una vaina tubular de 3–9.5 cm de largo que envuelve la porción inferior del escapo; lámina de 3.5–5.5 cm de largo por 1.3–2 cm de ancho, angostamente elíptica a elíptica, obtusa a redondeada, la base decurrente, el margen entero, con una quilla prominente en el envés. *Inflorescencia* erecta, originada de la parte apical del seudobulbo en desarrollo, racemosa, más larga que la hoja, con 10–30 flores sucesivas; pedúnculo de 8–16 cm de largo por 1–1.5 mm de diámetro, alado, pentagonal en corte transversal, racimo denso, de 2–4.5 cm de largo por ca. 1 cm de diámetro. *Brácteas florales* ascendentes, verdes, triangulares, agudas, de 1–1.5 mm de largo por ca. 1 mm de ancho. *Flores* ascendentes, de 5–6 mm de largo, amarillo-verdosas, no resupinadas. *Ovario* subcilíndrico, de 2–2.5 mm de largo por ca. 1 mm

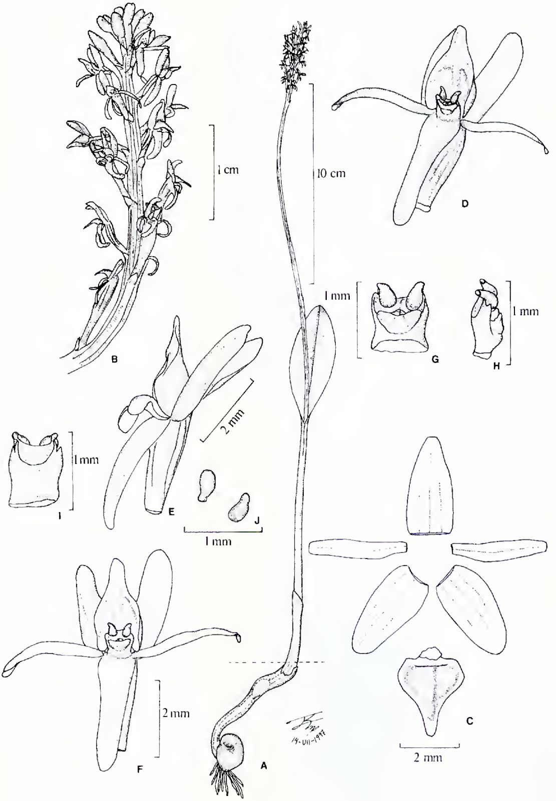


FIG. 1. *Malaxis palustris* Espejo & López-Ferrari. A. Hábito de la planta; B. Detalle de la inflorescencia; C. Flor disecada; D. Flor tres cuartos; E. Flor vista lateral; F. Flor vista frontal; G. Columna vista dorsal; H. Columna vista lateral; I. Columna vista ventral; J. polinios.

de diámetro. *Sépalo dorsal* extendido, con los márgenes deflexos a revolutos, angostamente triangular, obtuso, trinervado, de 2.5–3 mm de largo por 1.8 mm de ancho. *Sépalos laterales* extendidos, con los márgenes deflexos a revolutos, angostamente triangulares, ligeramente oblicuos, obtusos, trinervados, de 2.5–3 mm de largo por 1.8 mm de ancho. *Pétalos* extendidos a recurvados, oblongo-lineares, uninervados, de 2.5–3 mm de largo por ca. 0.3 mm de ancho, el ápice redondeado. *Labelo* depreso-ovado, abruptamente acuminado, cóncavo, abrazando la columna en posición natural, con una quilla media longitudinal evidente de color verde oscuro, de 2.5 mm de largo por 2.2 mm de ancho, la base truncada. *Columna* corta, cuadrada, comprimida dorsiventralmente, truncada, de 0.7 mm de largo por 0.7 mm de ancho. *Antera* transversalmente oblonga, bilocular, de 0.2 mm de largo por 0.6 mm de ancho. *Polinarios* dos, separados, divergentes, cada polinario formado por dos polinios fusionados entre sí; cada par de polinios obpiriforme, oblicuo, comprimido dorsiventralmente, amarillo, de 0.3 mm de largo con un *viscidio* apical, formado por una gota viscosa, de color ámbar. *Estigma* ventral, semicircular, cóncavo. *Cápsula* elipsoide, de 4–5 mm de largo por 2 mm de diámetro.

Material examinado: **México. Morelos:** municipio de Huitzilac, 1–2 km al W de la Laguna Zempoala, sobre el arroyo Las Trancas, Parque Nacional Lagunas de Zempoala, 19° 02' 37" N, 99° 19' 20" W, 2800 m, 12 jul 1997, *García-Cruz 751, Jiménez M., Sánchez S. y Jordan O.* (AMO, UAMIZ).

Etimología.—el nombre de la especie hace alusión a su hábito paludícola ya que crece en llanos permanentemente inundados rodeados por bosques de Abies.

Malaxis palustris se conoce hasta el momento sólo de la localidad tipo, en el estado de Morelos, sin embargo, es de esperarse su presencia en el vecino municipio de Ocuilan, en el Estado de México. La preferencia de las plantas de esta especie por los lugares abiertos y anegados, hábito poco común en el género, la distinguen del resto de las especies mexicanas. Otros caracteres peculiares de *M. palustris* son el rizoma evidente, las flores no resupinadas y el labelo depreso-ovado, abruptamente acuminado en el ápice y truncado en la base. El conjunto de todas estas características distinguen inconfundiblemente a *M. palustris* de cualquier otra especie mexicana conocida. Cabe señalar que en los alrededores de la localidad tipo de *M. palustris*, crecen también *M. ehrenbergii* (Rchb. f.) Kuntze, *M. myurus* (Lindl.) Kuntze, *M. salazarii* Catling, *M. soulei* L. O. Williams, *M. streptopetala* (B.L. Rob. & Greenm.) Ames y *M. tenuis* (S. Watson) Ames, sin embargo ninguna de ellas se encuentra en lugares pantanosos, sino que prefieren sitios elevados y secos dentro de los bosques de pino y/o *Abies*.

Malaxis alvaroi García-Cruz, R. Jiménez & L. Sánchez, sp. nov. (**Fig. 2**).
TIPO: MÉXICO. MORELOS: municipio de Tepoztlán, sobre la vía del ferrocarril México

Cuernavaca, al S de San Juan Tlacotenco, 19° 01' 00" N, 99° 06' 48" W, 2250 m, 27 jul 1996, *Jiménez M. 1962, García-Cruz, López-Ferrari y Espejo* (HOLOTIPO: AMO; ISOTIPOS: ENCB, IEB, UAMIZ).

Herba terrestre. Rizoma ausente. Pseudobulbus hipogeus, ovideus. Folia unica, ovata, apice obtusa vel rotundata, basi leviter cordata. Inflorescentia racemosa vel corimbosa, pedunculo deca-alato, racimo denso. Alas minutae erosae vel serratae. Flores 20–45, resupinatae. Labelum deltato-sagitatum, leviter concavum, acutum, basi bilobulatum. Lobuli triangularis nonunquam apice falcati.

Hierba terrestre de 12–23 cm de alto. *Raíces* pocas, originadas de la base del seudobulbo, de 0.3–0.6 mm de diámetro, pilosas, blanquecinas. *Rizoma* ausente. *Seudobulbo* hipógeo, ovoide, suculento, blanco, de 7 mm de largo por 4.3–8 mm de ancho. *Vaina* una, tubular, estrecha, verdosa, obtusa a redondeada, de 2–4 cm de largo. *Hoja* única con una vaina tubular, de 2.5–3.5 cm de largo, ligeramente comprimida, con cuatro quillas evidentes que envuelve la porción inferior del escapo; lámina de 3–4.5 cm de largo por 1.8–2.5 cm de ancho, ovada, obtusa a redondeada, la base ligeramente cordada, el margen levemente ondulado, sobre todo hacia la base, con cinco venas ligeramente hundidas en el haz y prominentes en el envés, la vena media marcadamente quillada, de color verde oscuro. *Inflorescencia* erecta, originada de la parte apical del seudobulbo, racemosa a corimbosa, más larga que la hoja, con 20–45 flores sucesivas; pedúnculo de 4–10 cm de largo por 0.8–1.5 mm de diámetro, con diez alas diminutamente aserradas a erosas, racimo denso, de 1.5–2.5 cm de largo por 0.8–1.5 cm de diámetro; raquis alado, las alas diminutamente aserradas a erosas. *Brácteas florales* extendidas, verdes, triangulares, agudas, de 0.5 mm de largo por 0.5 mm de ancho. *Flores* ascendentes, de 3–4.2 mm de largo, verde oscuras, resupinadas. *Ovario* torcido, quillado, subcilíndrico, de 1.7–4 mm de largo por 0.3–0.5 mm de diámetro. *Sépalo dorsal* extendido, aplanado, ovado a lanceolado, obtuso, trinervado, de 1.5–2.2 mm de largo por 1–1.3 mm de ancho. *Sépalos laterales* extendidos, brevemente connatos en la base, aplanados, ligeramente oblicuos, ovados a lanceolados, obtusos, trinervados, de 1.6–2.2 mm de largo por 1–1.3 mm de ancho. *Pétalos* recurvados, lineares, uninervados, de 1.5–2 mm de largo por ca. 0.2 mm de ancho, el ápice redondeado. *Labelo* deltado sagitado, ligeramente cóncavo, pentanervado, de 1.7–2.5 mm de largo por 2.1–2.3 mm de ancho, agudo, la base con dos lóbulos laterales triangulares con el ápice en ocasiones falcado. *Columna* corta, subcuadrada, comprimida dorsiventralmente, truncada, de ca. 0.5 mm de largo por ca. 0.5 mm de ancho. *Antera* dorsal, bilocular, reniforme, de 0.2 mm de largo por 0.4 mm de ancho. *Polinarios* dos, separados, divergentes, cada polinario formado por dos polinios fusionados entre sí, cada par de polinios obovoide, oblicuo, comprimido dorsiventralmente, amarillo, de 0.3 mm de largo con un *viscidio* apical, formado por una gota viscosa de color ámbar. *Estigma* ventral, subcuadrado, cóncavo. *Cápsula* obovoide, ascendente, de 5 mm de largo por 2 mm de diámetro.

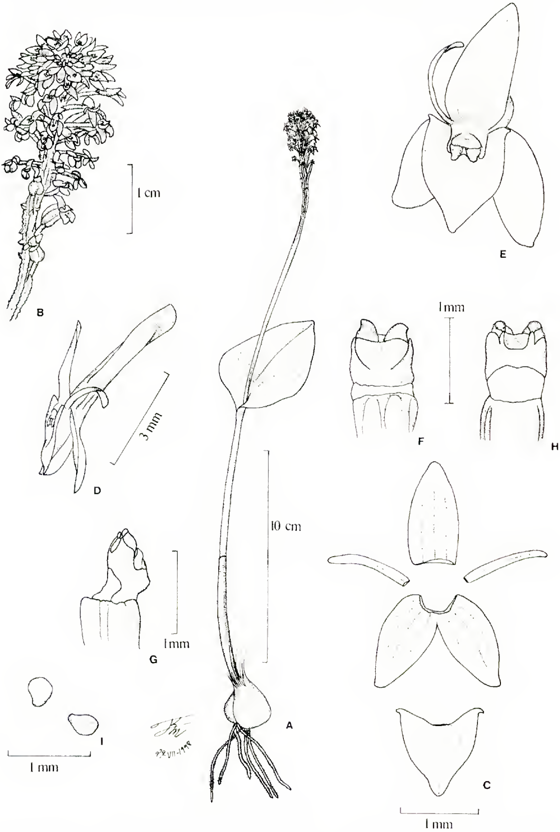


FIG. 2. *Malaxis alvaroi* García-Cruz, R. Jiménez & L. Sánchez. A. Hábito de la planta; B. Detalle de la inflorescencia; C. Flor disecada; D. Flor vista lateral; E. Flor vista frontal; F. Columna vista dorsal; G. Columna vista lateral; H. Columna vista ventral; I. Polinios.

Material examinado: **MÉXICO. Guanajuato:** municipio de San Luis de la Paz, camino de Las Mesas de Jesús al Vergel, 21° 31' 59" N, 100° 25' 56" W, 2240 m, 9 ago 1996, *Sánchez S. 375, Jiménez M. y García-Cruz* (AMO, UAMIZ). **Morelos:** municipio de Tepoztlán, km 93-94 sobre la vía del ferrocarril México-Cuernavaca, al S de San Juan Tlacotenco, 19° 01' 00" N, 99° 06' 48" W, 2250 m, 27 jul 1996, *Espejo 5430 y López-Ferrari* (AMO, UAMIZ).

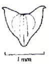
Etimología.—el epíteto asignado a este taxon se dedica al biólogo Alvaro Flores Castorena, amigo y colega con quien hemos recorrido gran parte del estado de Morelos recolectando orquídeas y otras plantas.

Esta especie crece en los bosques de encino secos y generalmente forma colonias pequeñas difíciles de encontrar.

Malaxis alvaroi se reconoce por sus flores pequeñas de menos de 4.3 mm de largo y de color verde obscuro, dispuestas apretadamente en una inflorescencia racemosa a corimbosa, que se va alargando por la permanencia de las flores marchitas en la parte inferior de la misma. Otros caracteres distintivos son el labelo deltado sagitado, con los lóbulos basales agudos y las alas aserradas a erosas del pedúnculo y el raquis.

Por sus caracteres vegetativos y florales, como son la hoja única y cordada, la inflorescencia racemoso-corimbosa y el labelo triangular y sin ornamentaciones, *Malaxis alvaroi* puede ubicarse dentro del grupo de especies formado por *M. brachystachys* y *M. corymbosa*. En el cuadro 1 pueden apreciarse las características comparativas entre éstas (Tabla 1).

Tabla 1. Comparación de algunas características entre *M. alvaroi*, *M. brachsytachys*, y *M. corymbosa*

Características	*M. alvaroi*	*M. brachsytachys*	*M. corymbosa*
longitud de pedúnculo (cm)	4–10	3–7	6.5–9.5
ornamentaciónalas pedúnculo	aserradas a erosas	alas lisas	alas lisas
inflorescencia	corimbo alargado	corimbo corto y aplanado	corimbo corto y aplanado
longitud de las flores (mm)	3–4.2	9.5–12	6–8.5
flor			
labelo			
color de las flores	verde obscuro, opacas	amarillo verdoso, hialinas	amarillo verdoso, hialinas
longitud del ovario (mm)	1.7–4	10–12	6–7

AGRADECIMIENTOS

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REFERENCIAS

CATLING, P.M. 1990. *Malaxis salazarii*, a new species from Mexico and Northern Mesoamerica. Orquídea (Mexico City) 12:93–104

ESPEJO, A. and A.R. LÓPEZ-FERRARI. (1998). Las Monocotiledóneas Mexicanas una Sinopsis Florística 1. Lista de Referencia PARTE VIII. Orchidaceae 2. Consejo Nacional de la Flora de México, A.C., Universidad Autónoma Metropolitana-Iztapalapa, México, D.F.

GONZÁLEZ TAMAYO, R. 1991. *Malaxis martinezii* (Orchidaceae), una especie nueva muy cercana a *M. reichei*. Bol. Inst. Bot. Univ. Gauadalajara 1:33–37.

GONZÁLEZ TAMAYO, R. 1992. *Malaxis luceroana* (Orchidaceae), una especie nueva en honor de una estudiosa de la Botánica. Bol. Inst. Bot. Univ. Gauadalajara 1:88–93.

GONZÁLEZ TAMAYO, R. 1992. *Malaxis ruizii*, una nueva especie del occidente de México (Orchidaceae). Bol. Inst. Bot. Univ. Gauadalajara 1:211–216.

GONZÁLEZ TAMAYO, R. 1994. Una curiosa *Malaxis* del occidente de México. Acta Bot. Mex. 29:93–99.

GONZÁLEZ TAMAYO, R. 1995. *Malaxis casillasii* (Orchidaceae), interesante especie del occidente de México. Bol. Inst. Bot. Univ. Guadalajara 3:123–128.

GREENWOOD, E.W. 1992. *Malaxis urbana*, a new species from Oaxaca. Orquídea (Mexico City) 12:199–203.

MCVAUGH, R. 1985. Flora Novo-Galiciana. Vol. 16. Orchidaceae. University of Michigan Press. Ann Arbor.

SALAZAR, G.A. 1990. *Malaxis hagsateri*, una nueva especie de Guerrero, México. Orquídea (Mexico City) 12:81–86.

SALAZAR, G.A. 1993. *Malaxis wendtii*, a new orchid species from Coahuila and Nuevo León, Mexico. Orquídea (Mexico City) 13:281–284.

SALAZAR, G.A. and M.A. SOTO ARENAS. 1990. Una nueva especie de *Malaxis* (Orchidaceae) de flores grandes del norte de Chiapas. Acta Bot. Mex. 10:45–49.

SOTO ARENAS, M.A. 1988. Listado actualizado de las orquídeas de México. Orquidea (Mexico City) 11:233–272.

TODZIA, C. 1993. *Malaxis hintonii*, a new species from Northern Mexico. Orquidea (Mexico City) 13:121–124.

TODZIA, C. 1995. *Malaxis chica* a new species of Orchidaceae from Nuevo León, México. Brittonia 47:24–26.

WILLIAMS, L.O. 1951. The Orchidaceae of Mexico. Ceiba 2:1—321

SEEDLING DEVELOPMENT IN SPECIES OF *CHAMAESYCE* (EUPHORBIACEAE) WITH ERECT GROWTH HABITS

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ABSTRACT

Seedling development is described for *Chamaesyce hirta*, *C. hypericifolia*, and *C. mesembrianthemifolia* as discerned by light microscopy and scanning electron microscopy. Although these species ultimately develop erect to ascending growth habits, epicotyl development is limited to the production of a single pair of leaves located immediately superjacent to and decussate with the cotyledons. The shoot system develops from one or more buds located in the axils of the cotyledons. In all respects, seedling ontogeny is very similar to that of previously studied prostrate species of *Chamaesyce*. Evidence from seedling ontogeny thus contradicts a hypothesis concerning homologies of plant form pertinent to the origin of *Chamaesyce* from *Euphorbia* that was first articulated by Roeper in 1824. These results support an alternative hypothesis based on proliferation of branches from the cotyledonary node in hypothetical ancestral elements within *Euphorbia* where this morphology can be found in perennial hemicryptophytes as well as certain annual species.

RESUMEN

Se describe el desarrollo de la semilla de *Chamaesyce hirta*, *C. hypericifolia*, y *C. mesembrianthemifolia* al microscopio óptico y microscopio electrónico de barrido. Aunque estas especies desarrollan finalmente hábitos de crecimiento de erectos a ascendentes, el desarrollo del epicótilo se limita únicamente a la producción de un par de hojas localizadas inmediatamente encima y decusadas con los cotiledones. El sistema de ramas se desarrolla a partir de una o más yemas localizadas en las axilas de los cotiledones. La ontogenia de la semilla es en todos los aspectos muy semejante a la de las especies de *Chamaesyce* postradas estudiadas previamente. Esta evidencia de la ontogenia de la semilla contradice la hipótesis relativa a las homologías, de la forma de la planta, relativas al origen de *Chamaesyce* a partir de *Euphorbia* emitida por Roeper en 1824. Estos resultados apoyan la hipótesis alternativa basada en la proliferación de ramas a partir del nudo de los cotiledones en los hipotéticos elementos ancestrales de *Euphorbia* donde puede encontrarse esta morfología en hemicriptófitos perennes así como en algunas especies anuales.

The genus *Chamaesyce* Gray can be distinguished from its close relatives in *Euphorbia* L. by a series of morphological, physiological, and developmental characters (Webster 1967, 1994; Koutnik 1984). The peculiar features of seedling ontogeny in *Chamaesyce* are often asserted to be characteristic for the genus (Degener & Croizat 1938; Koutnik 1987). However,

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seedlings of only a few species have been studied anatomically (Veh 1928; Mangaly et al. 1979; Rosengarten & Hayden 1983; Hayden 1988). Moreover, these few anatomical studies have generally focused on species of section *Chamaesyce*, a group characterized by radiating, prostrate branches. This paper describes seedling development in species with erect to ascending growth habits for comparison with the known structures and developmental events of prostrate species. Further, this paper critically assesses the interpretation of Mangaly et al. (1979) who described extra-axillary origin of lateral branching in seedlings of *Chamaesyce* and it is the first study to examine *Chamaesyce* seedlings with the scanning electron microscope (SEM).

We document and describe seedling development for three species representing two sections of the genus characterized by erect to ascending stems. *Chamaesyce hypericifolia* (L.) Millsp., the type species of section *Hypericifoliae* (Boiss.) Hurus., is a widely distributed weed (Holm et al. 1979) thought originally to be native to warm regions of the Americas (Webster 1967; Koutnik & Huft 1990). *Chamaesyce hirta* (L.) Millsp. is also classified in section *Hypericifoliae* and has similar present day status as a pantropical weed (Cardenas et al. 1972; Holm et al. 1979); however, it may be native to both the New and the Old World tropics (Koutnik & Huft 1990). *Chamaesyce mesembrianthemifolia* (Jacq.) Dugand is a shrubby plant classified in section *Sclerophyllae* (Boiss.) Hurusawa and found near seashores of the Caribbean and northern South America (Long & Lakela 1976; Acevedo-Rodríguez 1996). Although *C. hypericifolia* is often characterized as an herb, under favorable conditions it can produce weakly woody stems approaching a meter in height and 1 cm in basal diameter; thus, it can attain a stature comparable to that of *C. mesembrianthemifolia*. In contrast, *C. hirta* is smaller, and somewhat intermediate between the prostrate growth habit typical of section *Chamaesyce* and the erect growth habits of sections *Hypericifoliae* and *Sclerophyllae*. In *C. hirta*, each plant produces multiple stems, but seldom as many as found in species of section *Chamaesyce*, and while these stems are sometimes more or less prostrate, they more frequently ascend, but seldom to heights exceeding 15 or 20 cm.

MATERIALS AND METHODS

Specimens of *C. hirta* were collected in 1982 from weeds among nursery stock in a Richmond, VA, garden center. Plants of *C. mesembrianthemifolia* were collected at West Summerland Key, Florida, in 1983 and plants and seeds of *C. hypericifolia* were collected from Big Pine Key, Florida, in 1986. All three species have been maintained subsequently in greenhouse cultivation at the University of Richmond. Adult plants were prolific in cultivation; over several years *C. hypericifolia* produced many thousands of seedlings whereas *C. hirta* and *C. mesembrianthemifolia* each produced several hundred. Preparations of *C. hirta* and *C. hypericifolia* were derived from seedlings obtained spontaneously from containers of sterile soil placed in the vicinity of mature greenhouse-grown plants. Preparations of *C. mesembrianthemifolia* were derived largely from a dense mass of seedlings collected in the wild from the surface of a small anthill and supplemented with greenhouse materials. Herbarium vouchers at URV for materials studied include: *C. hirta—Hayden 614*; *C. mesembrianthemifolia—Hayden 709*; and *C. hypericifolia—Hayden 1433*, *3252* and *3281*. All specimens were preserved in FAA (formalin—acetic acid—70% alcohol). Numbers of seedlings studied for each species are as follows: *C. hirta*—30 for light microscopy (LM); *C. hypericifolia*—30 for LM and 42 for SEM; *C. mesembrianthemifolia*—17 for LM and 14 for SEM.

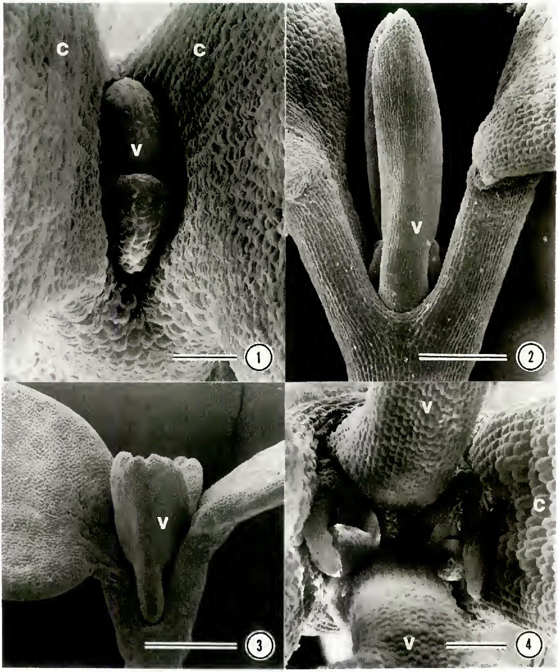
For light microscopy, fixed seedlings were trimmed to remove structures more than 5 mm below or above the cotyledonary node (if present), dehydrated in a tert-butanol series, embedded in paraffin, sectioned at 10 µm, affixed to slides with Bissing's adhesive (Bissing 1974), and stained in a combination of safranin and hematoxylin (Johansen 1940). Photomicrographs were prepared from Kodak Technical Pan film developed in Kodak HC110 developer at dilution F. For SEM, fixed seedlings were trimmed, dehydrated in ethanol, subjected to critical point-drying with CO_2 as the intermediate solvent, affixed to stubs with aluminum tape, sputter-coated with a gold-palladium mixture to a thickness of 40 nm, and observed with a Hitachi S-2300 SEM. Scanning electron micrographs were prepared from Kodak Tri-X film developed in Kodak HC110 developer at dilution B.

RESULTS

External morphology

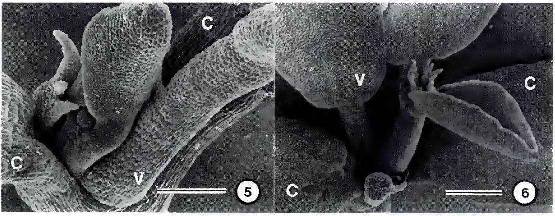
In the seed and during initial stages of germination, the cotyledons are tightly appressed. Upon germination, blades of the cotyledons diverge first, leaving their petioles in close contact. Soon, however, petioles also diverge, revealing primordia for the first pair of true leaves (Figs. 1–3). Following Hayden (1988), these first leaves are referred to as v-leaves to indicate their supposed homology with leaves on the vegetative axis of *Euphorbia* species classified in subgenus *Agaloma* (Raf.) House and subgenus *Esula* Pers. Upon their full expansion, v-leaves are inserted directly superjacent to and decussate with the cotyledons (Fig. 3). There is no residue of meristematically active cells at the epicotyl apex following v-leaf formation (Figs. 4, 9, 10, 15–17). Seedling growth continues via lateral branches that arise from buds axillary to the cotyledons (Figs. 4–8, 10–12, 15, 17, 20).

Although multiple buds routinely develop in the axils of each cotyledon (Figs. 11, 20), just a single lateral branch dominates early growth in *C. hypericifolia* and *C. mesembrianthemifolia* (Figs. 5, 6). This first, dominant branch is



FIGS. 1–4. Seedlings of *Chamaesyce*, SEM. 1. *C. hypericifolia*, *Hayden 3281*, v-leaf primordia, top view of seedling soon after divergence of cotyledonary petioles; bar = 100 µm. 2. *C. hypericifolia*, *Hayden 3690*, cotyledons and v-leaf primordia, lateral view; bar = 250 µm. 3, 4. *C. mesembrianthemifolia*, *Hayden 709*. 3. Cotyledons and v-leaf primordia, lateral view; bar = 500 µm. 4. Epicotyl apex, petioles of cotyledons and v-leaves, and cotyledonary axillary buds; bar = 100 µm. c = cotyledon; v = v-leaf.

erect or slightly inclined from vertical. Growth of additional lateral branches at the cotyledonary node as plants grow older is highly variable in these two species. Vigorous specimens with sparse or no competing nearby vegetation tend to produce one or two additional basal branches, but these remain smaller than the first branch unless the latter is removed or dam-



FIGS. 5,6. Cotyledonary node of seedlings of *Chamaesyce mesembrianthemifolia*, *Hayden 709*, each with one v-leaf removed, SEM. 5. Bud in axil of cotyledon; bar = 250 µm. 6. Young lateral branch, arising from axil of cotyledon; bar = 500 µm. c = cotyledon; v = v-leaf.

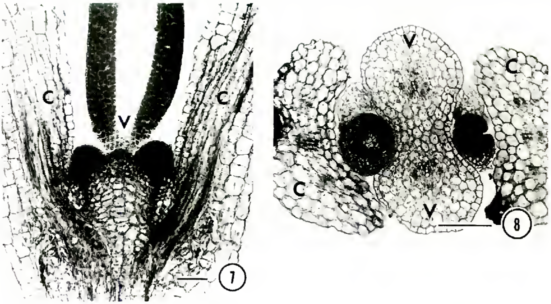
aged. It is not unusual for nearly the entire aerial system in these species to develop from the first dominant branch that arises at the cotyledonary node.

Initially, seedlings of *C. hirta* are similar to those of *C. hypericifolia* and *C. mesembrianthemifolia*. However, in *C. hirta*, multiple lateral branches develop from the cotyledonary node. The first two branches arise one each from the axils of the cotyledons and, frequently, two additional branches develop from buds located at the bases of the first two branches.

Anatomical structure

Cotyledon stage.—The hypocotyl is traversed by four vascular bundles that ascend from the radicle to the cotyledonary node. Two of these bundles, each located on opposite sides of the axis, constitute the median traces to the cotyledons; each passes directly from the hypocotyl into the petiole of its respective cotyledon. The other two bundles form four lateral traces to the cotyledons; each splits into two bundles at the cotyledonary node and the resultant pair of traces diverge towards cotyledons on opposite sides of the stem. Cotyledonary node vasculature is thus trilacunar with split laterals (Fig. 19). The system of non-articulated branched laticifers that ultimately permeates the plant body arises from initials located external to the vascular tissue at the cotyledonary node.

V-leaves.—V-leaves arise on the flanks of the epicotyl apex (Figs. 1, 9). As soon as v-leaf primordia can be detected, cells of the epicotyl apex are larger and more vacuolate than those of the v-leaf primordia (Fig. 9). Thus, the only meristematically active cells of the epicotyl apex are fully consumed in formation of the v-leaves. Each v-leaf is vascularized by three traces that differentiate from procambium near the split lateral traces to the cotyledons; of the three traces for a given v-leaf, two traces insert on one side of the cotyledonary split lateral and one trace inserts on the opposite side. General



FIGS. 7, 8. Seedlings of *Chamaesyce hirta*, *Hayden 614*, LM. 7. Cotyledons, their lateral buds, and portions of one v-leaf, longitudinal section in the cotyledonary plane; bar = 50 µm. 8. Cotyledon petioles, their lateral buds, and v-leaf petioles; bar = 100 µm. c = cotyledon; v = v-leaf.

vascular development of the seedling continues as the v-leaves develop. Once the v-leaves are fully expanded, the hypocotyl contains four well-defined vascular strands that supply the first four leaves of the seedling.

Branch development.—SEM micrographs of intact seedling apices and LM sections reveal branch primordia in the axils of the cotyledons (Figs. 4, 7, 8, 12, 15, 17, 20). Lateral branches arise from ordinary lateral buds located at the cotyledonary node. The densely-stained and meristematically active lateral buds (or the subsequent active branch apex, e.g., Fig. 13) contrast sharply with the inert epicotyl apex (Figs. 7, 8, 10, 12, 17). Each axillary bud is also associated with a non-vascularized, persistent stipule-like flap of tissue (Figs. 10, 11, 18). Whereas stipules located on subsequent nodes (i.e., nodes of the lateral branch) generally consist of a planar interpetiolar sheath, stipules at the cotyledonary node are elongate and bear a distinct curve that conforms with the curved surface of its associated bud primordium.

At their initiation, the buds that produce lateral branches are clearly not aligned with the axis defined by the hypocotyl and truncated epicotyl. In time however, the first, dominant, branch of fully erect species assumes an apparent axial position (Fig. 14), a consequence of its growth and expansion concomitant with that of the hypocotyl.

DISCUSSION

Based on previous literature (Veh 1928; Mangaly et al. 1979; Rosengarten & Hayden 1983; Hayden 1988) and the species described above, early stages of seedling development in *Chamaesyce* appear to be similar in sections *Chamaesyce, Hypericifoliae*, and *Sclerophyllae*. Common features include the vascular architecture of the cotyledonary node, the development of v-leaves and their vascular supply, and the origin of lateral branches from the axils of the cotyledons. The potential for multiple branches from the cotyledonary node is also uniform throughout the species for which seedling ontogeny is known. The chief differences between previously studied prostrate species and the erect or semi-erect species documented here involves the number of lateral branches that develop from the axils of the cotyledons and their orientation with respect to gravity. Thus, species of section *Chamaesyce* routinely produce multiple branches that radiate at ground level, whereas most species of sections *Hypericifoliae* and *Sclerophyllae* produce one dominant, erect branch and, sometimes, another small, subsidiary branch. *Chamaesyce hirta* appears somewhat intermediate in that it produces a limited number of semi-erect branches.

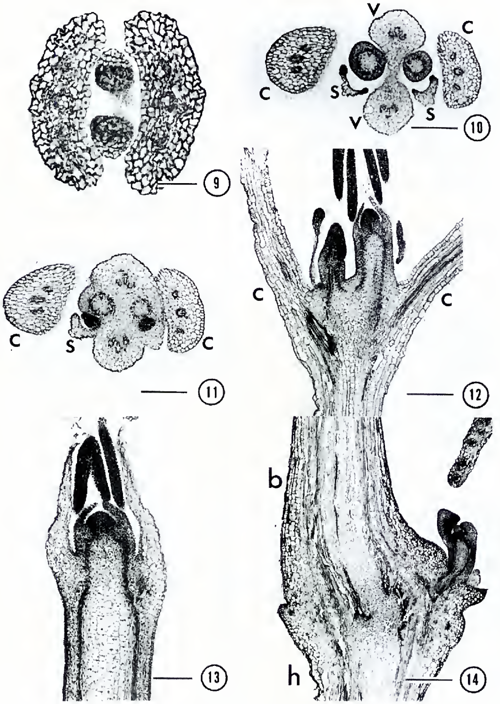
Mangaly et al. (1979) reported on seedling development in *Chamaesyce hirta* and *C. thymifolia* (L.) Millsp. We find their illustrations consistent with the anatomy and morphology of the species reported here and in Hayden (1988). We differ, however, in the interpretation of certain aspects of seedling structure and developmental processes. For example, Mangaly et al. (1979) failed to notice the absence of an epicotylar apical meristem upon development of the v-leaves. Thus, they interpreted the first lateral branch, which actually develops from the axil of a cotyledon, to be the "main axis" and they also described the second lateral branch, which develops from the axil of the other cotyledon, as "extra-axillary." On the basis of gross external morphology, numerous authors have expounded on the significance of the absence of true epicotyl development (main axis) in *Chamaesyce* (e.g., Wheeler 1941; Degener & Croizat 1938; Webster 1967). Both the absence of epicotyl and the axillary origin of the first two branches are clearly indicated by the LM and SEM evidence presented here. Hayden (1988) earlier refuted other evidently erroneous ontogenetic interpretations of seedling structure in *Chamaesyce* found in Veh (1928) and Degener and Croizat (1938).

We hypothesize that seedling form in *Chamaesyce* is derived from plants with growth habits that are widespread in *Euphorbia* subgenus *Agaloma* and subgenus *Esula*. Such plants produce ordinary, vegetative stems from the seedling epicotyl that eventually terminate in a single cyathium followed by a pleiochasial and dichasial pattern of cyathium production; they also produce additional vegetative axes from the cotyledonary node which also become pleiochasial or dichasial (Fig. 21-A). *Euphorbia helioscopia* L., as illustrated in Korsmo (1954; fig. 111) or Holm et al. (1997; fig. 41-2), provides a good example of this growth habit in an annual species. Reduction of the epicotyl to the first pair of leaves and accelerated proliferation of branches from the cotyledonary node (Fig. 21-C) would result in the growth habit found in *Chamaesyce*. By this interpretation, the majority of the shoot system in *Chamaesyce* would be homologous with proliferative cotyledonary branches in species of *Euphorbia*.

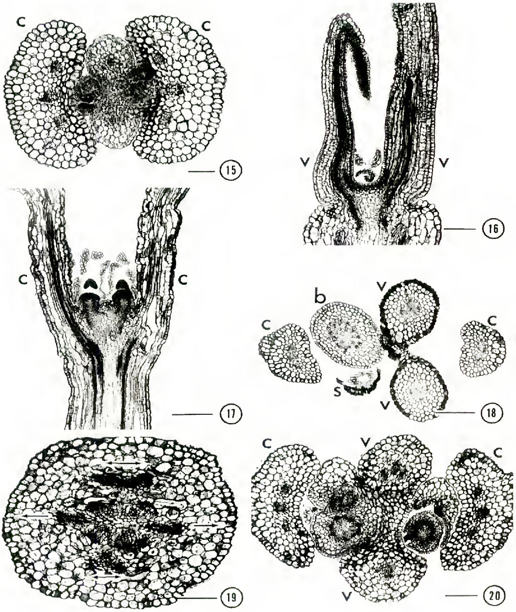
The hypothesis of homology at the cotyledonary node described above stands in partial contradiction to the oft-cited hypothesis of Roeper (1824) (Fig. 21-A,-B,-D) who said that foreshortening of the epicotyl results in development of pleiochasial branches (inflorescence axes) at ground level (see, for example, Wheeler 1941; Webster 1967). Pleiochasial branches in *Euphorbia* arise individually from the axils of a whorl of leaves at the apex of the epicotyl-derived main axis of the plant (Hayden 1988). If lateral branches in seedlings of *Chamaesyce* developed also from the axils of the v-leaves, then Roeper's hypothesis could be supported. However, this paper provides additional confirmation of the fact that lateral branches in *Chamaesyce* are strictly axillary to the cotyledons and never arise from axils of the v-leaves (Hayden 1988).

Plants with well-developed epicotyls and proliferative branches from the cotyledonary node, the hypothesized condition in ancestors of *Chamaesyce*, are common in *Euphorbia*. This growth habit occurs in both hemicryptophytic perennials and annuals. Among the hemicryptophytic forms, some familiar garden examples from subgenus *Esula* include *Euphorbia myrsinites* L. and *E. epithymoides* L. (*E. polychroma* A. Kern.); *Euphorbia corollata* L., widespread in eastern North America, and its close relatives in subgenus *Agaloma* section *Tithymalopsis* (Klotzsch & Garcke) Boiss., also proliferate from the cotyledonary node. Examples of annual species with proliferative branches from the cotyledonary node include *E. helioscopia* from subgenus *Esula*, *E. exstipulata* Engelm. from subgenus *Agaloma*, and *E. dentata* Michx. from subgenus *Poinsettia* (Graham) House. In *Chamaesyce*, species with proliferative cotyledonary nodes include hemicryptophytic perennials (Simmons & Hayden 1997), prostrate annuals (Hayden 1988), erect to ascending annuals (present study), sub-shrubs (present study), and small trees (Koutnik 1987). In contrast to the situation in *Chamaesyce*, *Euphorbia* species possess well-developed epicotyls.

Despite the uniformity of form and development that seems to be emerging from studies of *Chamaesyce* seedlings, examination of a few additional critical taxa appears warranted. Based on our unpublished observations of very limited material, seedlings of *C. acuta* (Engelm.) Millsp. appear to possess a relatively normal pattern of seedling development, with well-developed epicotyls. *Chamaesyce acuta* also lacks C4 photosynthesis (Webster et al. 1975) and its inclusion within *Chamaesyce* might thus be doubted. Confirmation



FIGS. 9–14. Seedlings of *Chamaesyce hypericifolia*, LM; 9, 13, *Hayden 3252*; 10–12, 14, *Hayden 3281*. 9. Petioles of cotyledons and v-leaf primordia, cross section at the epicotyl apex; bar = 50 µm. 10. Petioles of cotyledons, their lateral buds, and petioles of fully expanded v-leaves, cross section at the epicotyl apex; bar = 200 µm. 11. Same seedling as Fig. 10, cross section just above insertion of cotyledons; bar = 200 µm. 12. Petioles of cotyledons and their axillary buds, longitudinal section in the cotyledonary plane; bar = 200 µm. 13. Apex of lateral branch, longitudinal section; bar = 100 µm. 14. Cotyledonary node of seedling dominated by one lateral branch, longitudinal section in the intercotyledonary plane; bar = 200 µm. b = branch from axil of cotyledon, c = cotyledon, h = hypocotyl, s = stipule-like flap, v = v-leaf.



FIGS. 15–20. Seedlings of *Chamaesyce mesembrianthemifolia*, *Hayden 709*, LM. 15. Petioles of cotyledons, their lateral buds, and petioles of v-leaves, cross section below the epicotyl apex; bar = 50 µm. 16. v-leaf primordia, longitudinal section in the intercotyledonary plane; bar = 100 µm. 17. Petioles of cotyledons and their lateral buds, longitudinal section in the cotyledonary plane; bar = 200 µm. 18. Base of lateral branch arising from cotyledon axil and adjacent petiole bases of cotyledons and v-leaves, cross section at the epicotyl apex; bar = 200 µm. 19. Cotyledonary node from seedling with expanded v-leaves, note median traces (single arrows) and split lateral traces (double-headed arrows) to the cotyledons; bar = 100 µm. 20. Petioles of cotyledons, their lateral buds, and petioles of v-leaves; bar = 100 µm. b = branch from axil of cotyledon, c = cotyledon, s = stipule-like flap, v = v-leaf.

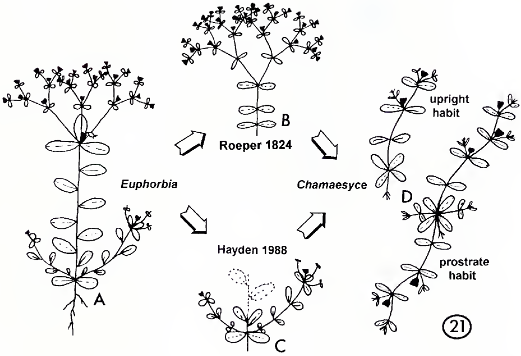


FIG. 21. Comparison of Roeper's (1824) and Hayden's (1988) hypotheses concerning the origin of the plant body in *Chamaesyce*. A. Hypothetical ancestor with habit common in *Euphorbia* subgenus *Agaloma* or subgenus *Esula*, i.e., epicotyl well-developed, with terminal cyathium/pleiochasium system and reiterative lateral branches from the cotyledonary node. B. Hypothetical intermediate (Roeper's Hypothesis) with reduced epicotyl development and no reiterative lateral branches. C. Hypothetical intermediate (Hayden's Hypothesis) with epicotyl aborted above the first node. D. Erect and prostrate growth habits in *Chamaesyce*.

of seedling development in this and supposedly related species of section Acutae (Boiss.) Webster (see discussion in Mayfield 1991) would thus prove useful. Also, seedling development in *C. potentilloides* (Boiss.) Croizat [=*C. caecorum* (Mart. ex Boiss.) Croizat] of southern Brazil and adjacent regions is completely unknown; because this is a hemicryptophyte species that routinely produces pleiochasial inflorescences reminiscent of the reproductive branches in subgenus *Agaloma* and Esula of *Euphorbia* (Simmons & Hayden 1997), a developmental study of its seedlings may provide useful phylogenetic insight for the genus as a whole. Finally, certain Hawaiian *Chamaesyce* species endemic to the island of Kauai appear to have ordinary seedling development with well-developed epicotyls (Koutnik 1987); anatomical comparisons between these epicotyl-present and epicotyl-absent species of *Chamaesyce* should prove critical in assessing relationships among the Hawaiian species of *Chamaesyce*.

A developmental mutant known in *Arabidopsis* Heynh. (Brassicaceae) results in a pattern of epicotyl deletion reminiscent of this hallmark feature of seedling ontogeny in *Chamaesyce*. In *Arabidopsis*, plants homozygous for the *WUSCHEL (WUS)* allele form a pair of leaves above the cotyledons but fail to develop any other ordinary epicotylar structure (Clark 1997). In *WUS* mutants, the epicotyl apex remains somewhat flattened and essentially non-meristematic, although it can initiate adventitious meristems that reiterate the abruptly terminated structure of these mutant seedlings (Clark 1997). Evidently, ordinary branches do not form at the cotyledonary node in these *WUS* mutants of *Arabidopsis*, so the analogy with developmental events in *Chamaesyce* is only approximate.

ACKNOWLEDGMENTS

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REFERENCES

ACEVEDO-RODRÍGUEZ, P. (and collaborators). 1996. Flora of St. John U.S. Virgin Islands. Mem. New York Bot. Gard. Vol. 78.

BISSING, D.R. 1974. Haupt's gelatin adhesive mixed with formalin for affixing paraffin sections to slides. Stain Technol. 49:116–117.

CARDENAS, J., C.E. REYES, and J.D. DOLL. 1972. Tropical weeds, malezas tropicales. Vol. 1. Instituto Colombiano Agropécurio, Bogotá.

CLARK, S.E. 1997. Organ formation at the vegetative shoot meristem. Pl. Cell 9:1067–1076.

DEGENER, O. and L. CROIZAT. 1938. *Chamaesyce*. In: O. Degener, Flora Hawaiiensis. [Offset printed in 1946 with some revisions, not paginated.]

HAYDEN, W.J. 1988. Ontogeny of the cotyledonary region of *Chamaesyce maculata* (Euphorbiaceae). Amer. J. Bot. 75:1701–1713.

HOLM, L., J. DOLL, E. HOLM, J. PANCHO, and J. HERBERGER. 1997. World weeds, natural histories and distribution. John Wiley & Sons, New York.

HOLM, L., J.V. PANCHO, J.P. HERBERGER, and D.L. PLUCKNETT. 1979. A geographical atlas of world weeds. John Wiley & Sons, New York.

JOHANSEN, D.A. 1940. Plant microtechnique. McGraw-Hill Book Co., New York.

KORSMO, E. 1954. Anatomy of weeds. Grøndahl & Søns, Oslo.

KOUTNIK, D.L. 1984. *Chamaesyce* (Euphorbiaceae)–a newly recognized genus in southern Africa. S. African J. Bot. 3:262–264.

KOUTNIK, D.L. 1987. A taxonomic revision of the Hawaiian species of the genus *Chamaesyce* (Euphorbiaceae). Allertonia 4:331–388.

KOUTNIK, D.L. and M.J. HUFT. 1990. *Chamaesyce* (Euphorbiaceae). In: W.L. Wagner, D.R. Herbst, and S.H. Sohmer, Manual of the flowering plants of Hawai'i. Special Publ. Bernice Pauahi Bishop Mus. 83, Honolulu. Pp. 602–617.

LONG, R.W. and O. LAKELA. 1976. A flora of tropical Florida. Banyan Books, Miami.

MANGALY, J.K., K. SWARUPANANDAN, and P.V. MADHUSOODAN. 1979. Seed and seedling morphology of two species of *Euphorbia* (Euphorbiaceae). Proc. Indian Acad. Sci. 88:87–94.

Mayfield, M. 1991. *Euphorbia johnstonii* (Euphorbiaceae), a new species from Tamaulipas, Mexico, with notes on *Euphorbia* section *Acutae*. Sida 14:573–579.

Roeper, J. 1824. Enumeratio Euphorbiarum quae in Germania et Pannonia gignuntur. Göttingen.

Rosengarten, M., and W.J. Hayden. 1983. Stem ontogeny in *Chamaesyce hirta* (Euphorbiaceae). Virginia Academy of Science Annual Meeting, Fairfax, Virginia. ABSTRACT: Virginia J. Sci. 34:142.

Simmons, M.P., and W.J. Hayden. 1997. Revision of the cerrado hemicryptophyte *Chamaesyce* of Boissier's "Pleiadeniae" (Euphorbiaceae). Brittonia 49:155–180.

Veh, R.Von. 1928. Beitrag zur Kenntnis der Anisophyllum-Euphorbiaceen und einige Vergleichende und Entwicklungsgeschichtliche Untersuchungen über die Drüse des Cyathiums. Ann. Jard. Bot. Buitenzorg 38:131–162.

Webster, G.L. 1967. The genera of Euphorbiaceae in the southeastern United States. J. Arnold Arbor. 48:303–430.

Webster, G.L. 1994. Classification of the Euphorbiaceae. Ann. Missouri Bot. Garden. 81:3–32.

Webster, G.L., W.V. Brown, and B.N. Smith. 1975. Systematics of photosynthetic carbon fixation pathways in *Euphorbia*. Taxon 24:27–33.

Wheeler, L.C. 1941. *Euphorbia* subgenus *Chamaesyce* in Canada and the United States exclusive of southern Florida. Rhodora 43:97–286.

W. CHAPMAN, V. CHAPMAN, A. BESSETTE, A. BESSETTE, and D. PENS. 1998. **Wildflowers of New York in Color.** (ISBN 0-8156-2746-7, hbk.; ISBN 0-8156-0470-X, pbk.). Syracuse University Press, 1600 Jamesville Avenue, Syracuse, NY 13244-5160. 315-443-5547; fax 315-443-5545; <talitz@summon3.syr.edu>. $24.95 (pbk), $59.95 (hbk). 163 pp, 350 color photos.

This book is a popular field picture guide to the wildflowers of New York State, based principally on Dick Mitchell and Gordon Tucker's *The Revised Checklist of New York State Plants.* It is arranged so that one first must identify the color and structure (symmetry) of the flowers, then look to habitat (terrestrial vs. aquatic), then to determine if there are leaves, and if they are present, whether they are basal, alternate, opposite or whorled. The common name, Latin name and authority, family, flowering season, floral description, plant description, habitat, and comments are given for each of 350 of the most common wildflowers found in the state, as well as some of the rare and endangered taxa. The table of contents, visual glossary, glossary of terms, index to common names, and index to genera and species, makes finding one's way around the book extremely easy. The chapter "how to use this guide" will allow anyone to use the book right away, with virtually no instruction needed. The photographs are superb, with excellent depth-of-field and vibrant colors. The high quality, alkaline paper is also a plus, as is the sturdy, yet flexible cover on the paperback. I have seen few other wildflower books of this caliber made for the general public. The authors are to be congratulated for their fine work and no botanist traveling through New York State, or from the Northeast, should be without it.—*John J. Pipoly III*

A REVISION OF THE GENUS *ARDISIA* SUBGENUS *GRAPHARDISIA* (MYRSINACEAE)

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ABSTRACT

A taxonomic revision of *Ardisia* subgenus *Graphardisia* is presented, including an emended description of the subgenus, a key to the species and subspecies, along with updated descriptions and new illustrations for each taxon. Six taxa are recognized, including three new combinations: *Ardisia opegrapha* subsp. *paquitensis* (Lundell) Pipoly & Ricketson, *A. opegrapha* subsp. *wagneri* (Mez) Pipoly & Ricketson, and *A. bartlettii* subsp. *lilacina* (Lundell) Pipoly & Ricketson. Four binomials, *Ardisia weberbaueri, A. opegrapha, A. wagneri* and *A. albovirens,* are lectotypified and twenty-one are newly relegated to synonymy. *Ardisia nigrovirens* J. F. Macbr. is relegated to synonymy under *A. albovirens* Mez, and both are excluded from subgenus *Graphardisia.*

RESUMEN

Se presenta una revisión taxonómica del género *Ardisia* subgénero *Graphardisia*. Se provée una descripción actualizada del subgénero junto con una clave para identificar las especies y subespecies, descripciones acutalizadas y nuevas ilustraciones para cada taxon. Se reconoce seis taxa, incluyendo tres combinaciones nuevas: *Ardisia opegrapha* subsp. *paquitensis* (Lundell) Pipoly & Ricketson, *A. opegrapha* subsp. *wagneri* (Mez) Pipoly & Ricketson, y *A. bartlettii* subsp. *lilacina* (Lundell) Pipoly & Ricketson. Se lectotipifican cuatro binomiales: *Ardisia weberbaueri, A. opegrapha, A. wagneri y A. albovirens* y se relega veintiuno a la sinonímia. También, *Ardisia nigrovirens* se relega bajo sinonímia de *A. albovirens,* y ambas se excluyen del subgénero *Graphardisia.*

INTRODUCTION

The pantropical genus *Ardisia* Sw. is the largest within the Myrsinaceae, containing perhaps as many as 500 species (Chen & Pipoly 1996). The genus has been separated from all others in the Myrsinaceae by the free filaments and pluriseriate ovules (Mez 1902). While only a few groups within *Ardisia sensu latissimo* have been segregated as separate genera in the Paleotropics

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(*Sadiria* Mez (1902), *Afrardisia* Mez (1902), *Tetrardisia* Mez (1902), *Hymenandra* A. DC. (1834), *Parardisia* Nayar & Giri (1986)), there has been an enormous increase in separation of species groups from *Ardisia* to new genera in the Neotropics, starting with those who recognize Aublet's (1775), *Icacorea* (against which *Ardisia* is conserved), followed by Alphonse de Candolle (1841), Ducke (1930), and finally Cyrus Lundell (1963, 1964, 1981a, 1981b, 1981c, 1981d, 1982). Lundell's contribution was clearly the most extensive, consisting of the segregation of *Amatlania* Lundell, *Auriculardisia* Lundell, *Chontalesia* Lundell, *Yunckeria* Lundell (=*Ctenardisia* Ducke), *Gentlea* Lundell, *Graphardisia* (Mez) Lundell, *Ibarrea* Lundell, *Oerstedianthus* Lundell, *Synardisia* (Mez) Lundell, *Valerioanthus* (Mez) Lundell, and *Zunilia* Lundell. Because the group is comprised of over 800 names, it will be some time before each species has been reviewed and the entire group is revised. In the meantime, we suggest using the key to the Mesoamerican genera we published (Ricketson & Pipoly 1997) to identify specimens to generic level (*Ardisia* versus *Synardisia*, *Ctenardisia* or *Gentlea*). For groups within *Ardisia*, the use of *Flora of Guatemala* (Lundell 1966a) and *Flora of Panama* (Lundell 1971) will permit rough identification, at least to species groups, until our review of the entire complex is complete. While most of the taxa described in the remaining segregated groups are best placed in *Ardisia*, it appears that some currently placed in *Icacorea* and *Chontalesia* may prove to be problematic. Treatment of those taxa is now underway (Pipoly & Ricketson, in prep.).

Ardisia subgenus *Graphardisia* Mez (1902) was described in the *Das Pflanzenreich* treatment of the Myrsinaceae and was comprised of only two species. *Ardisia opegrapha* Oerst. and *A. wagneri* Mez. Mez considered subgenus *Graphardisia* allied to *Ardisia* subg. *Synardisia* Mez [=*Synardisia* (Mez) Lundell] by its imbricate or contorted (but not valvate) corolla lobes and the included (rather than exserted) stamens. Subgenus *Graphardisia* was separated from subg. *Synardisia* by the rotate (not infundibuliform) corolla, with lobes connate to only 1/3 (not 3/4) their length. He also considered *Ardisia* subg. *Graphardisia* closely related to *A.* subg. *Ardisia*, because of the often persistent inflorescence bracts and floral bud shape, and contrasted these two subgenera with *A.* subg. *Icacorea* (Aubl.) Mez, known for its very inconspicuous inflorescence bracts.

Lundell (1966b) treated subgenus *Graphardisia*, but later raised *Graphardisia* to generic rank (Lundell 1981c). He (Lundell 1981c) stated that it was most closely related to *Oerstedianthus* Lundell, because both groups of species have linear-lanceolate anthers deshiscent by apical pores. *Oerstedianthus* (Lundell 1981c) is comprised of a group including *Ardisia nigrescens* Oerst., *A. tuerckheimii* Donn. Sm., and eight other taxa, formerly placed by Mez (1902) in subgenus *Icacorea*, but segregated from *Icacorea* by Lundell because of its glandular trichomes of the branchlets, inflorescence and perianth parts. Lundell

(1981c) separated *Graphardisia* from *Oerstedianthus* by the following key:

"1. Filaments strictly glabrous; stems and inflorescence glabrous; punctation of all parts dense and blackish; bracts and bracrlets usually foliaceous and often persisitent; sepals and petals large, accrescent, usually blackened, usually ribbed or with dense elevated black glands. .... **Graphardisia**
1. Filaments pubescent with gland-tipped hairs; stems and inflorescence rarely glabrous, usually puberulent, hirtellous or densely hirsute-tomentose; bractlets and sepals small, not accrescent; sepals not ribbed with glands. .... **Oerstedianthus**"

Upon examination of the six taxa we recognize in *Ardisia* subgenus *Graphardisia*, 4 taxa (comprising two species in our classification) have either stalked glandular papillae or sessile glandular granules on the filaments near the base, thus invalidating the first part of Lundell's lead couplet. While members of the *Oerstedianthus* species group have anthers very similar to that of *A.* subg. *Graphardisia*, the unique glandular tomentum, and small, corymbose inflorescences are much different than the panicles of corymbs, and essentially glabrous plants of subgenus *Graphardisia*. Our studies indicate that *Ardisia* subg. *Graphardisia* is most closely related to *A.* subg. *Icacorea* based on its well-developed panicles with flowers in terminal corymbs; apiculate, subapically poricidal, concolorous anthers, and style two to three times longer than the ovary. The two subgenera may be separated by the following key:

1. Branchlets and inflorescence rachises glabrous or rarely, sparsely glandular-granulose; leaf blades, inflorescence and floral bracts, and perianth densely and prominently black or red punctate and/or punctate-lineate; sepals accrescent, usually clasping the developing fruit....... **Ardisia** subg. **Graphardisia**
1. Branchlets and inflorescence rachis furfuraceous-lepidote; leaf blades rarely conspicuously but never prominently punctate-lineate, the inflorescence and floral bracts mostly orange, rarely black, punctate, the perianth mostly orange, rarely black punctate; sepals nor accrescent, never clasping the developing fruit. .... **Ardisia** subg. **Icacorea**

While preparing a treatment of *Ardisia* subg. *Graphardisia* as part of the Myrsinaceae for *Flora Mesoamericana*, we treated the entire subgenus so that it might serve as a precursor to our treatment of the tribe Ardisieae for *Flora Neotropica,* that is now in preparation. The revision here presented provides a nomenclator for *Ardisia* subg. *Graphardisia*, that is beyond the format limitations of the *Flora Mesoamericana.*

NOTES ON KEYS, TAXONOMIC CONCEPTS, TERMINOLOGY

The keys are artificial and designed to expedite identification of herbarium specimens. An attempt has been made to emphasize vegetative characters to increase the keys' usefulness with sterile material. The numbers appearing before the taxa refer to their respective position in the key; any correlations with phylogenetic relationships are coincidental. Quantitative and qualitative data presented in keys and descriptions for floral parts and bracts were taken from organs rehydrated from herbarium specimens by boiling in water. Measurements from these range from 10% to 15% greater than those measurements taken directly from dried material. Data regarding stem diameters, inflorescence rachises, pedicels, leaf and fruit shape and size were taken from dried herbarium specimens.

Our concept of subspecies follows that of Pipoly (1987) who defined subspecies as: "groups of populations within a single lineage of ancestor-descendant populations that show variation by unique combinations of plesiomorphies, or homoplasic apomorphies, correlated with biogeography and/or ecology. This rank is primarily used to convey information regarding variation in the life histories of these populations and character state differences hypothesized to be the result of this variation. The subspecific rank in no way attempts to predict speciation events."

Morphological terms in this treatment follow Lindley (1848) and Pipoly (1987, 1992) for the inflorescence, rachis pedicels and floral parts. Description of leaf morphology follows Hickey (1984), trichome description follows Theobald et al. (1984) and basic cell and tissue terminology follow Metcalfe (1984).

TAXONOMIC TREATMENT

Ardisia subgenus **Graphardisia** Mez in Engl., Pflanzenr. IV. 236 (Heft 9):78. 1902; Lundell, Wrightia 3:192–198. 1966. *Graphardisia* (Mez) Lundell, Phytologia 48:139. 1981; Lundell, Phytologia 59:429–433. 1986. TYPE: *Ardisia opegrapha* Oerst. (LECTOTYPE, here designated).

Mez (1902) included both *Ardisia opegrapha* as well as *A. wagneri* in his new subgenus. Subsequently, Lundell (1966b) did not designate a lectotype. Therefore, we have chosen *A. opegrapha* because it most closely fits the original circumscription of the subgenus.

Subshrubs to *trees*. *Branchlets* mostly terete, glabrous or rarely, glandular-granulose. *Leaves* petiolate; blades membranaceous to subcoriaceous, densely and prominently black (rarely pellucid-) punctate and punctate-lineate, the margins entire to crenulate, rarely sharply and irregularly dentate. *Inflorescence* terminal, uni- to tripinnately paniculate, pyramidal to obpyramidal rarely globose, the ultimate branches corymbose, at times in high anthotactic spirals and thus appearing umbellate, the rachis often densely and prominently black punctate and punctate-lineate; inflorescence and floral bracts foliaceous, mostly persistent, resembling the vegetative leaves but acropetally reduced in size. *Flowers* white, pink, lavender or purple, densely and prominently black punctate and punctate-lineate; calyx with sepals free or nearly free, large, accrescent and clasping fruits at maturity; corolla rotate, the lobes imbricate in bud, basally short-connate and sparsely to densely yellow glandular-granulose within, densely and prominently black punctate-lineate, stamens inserted at corolla tube base, the filaments basally connate to form an inconspicuous tube, the tube free from the corolla tube, the apically free portions of the filaments glandular-granulose or glandular-papillate, less than half the length of the anthers, the anthers ovoid-lanceoloid, linear or lanceoloid, prominently apiculate, dehiscent by subapical pores; ovary globose, the style slender, equalling the sepals, 2–3 times longer than the ovary, the placenta apiculate, the ovules pluriseriate, biseriate, or apparently uniseriate (few in number and in a very high anthotactic spiral). *Fruit* globose or oblongoid, densely punctate and punctate-lineate,basally surrounded by persistent, clasping sepals.

Distribution.—A small distinctive subgenus of three species with five subspecies found from Nicaragua to Bolivia and adjacent Brazil.

Ecology.—Members of the subgenus occur in diverse vegetation types, including wet and pluvial lowland, premontane, montane, and cloud forests.

The subgenus is defined by: 1) glabrous branchlets and inflorescence rachises; 2) dense and prominently raised black, or rarely, reddish-black, punctations or punctate-lineations on all leaf and floral parts; 3) sepals often accrescent and usually clasping the developing fruit; 5) linear-lanceolate, concolorous, apiculate anthers with subapically poricidal dehiscence; and 6) style 2–3 times longer than the ovary. Species of the subgenus are often used for home decoration and for use in Christian churches for religious holidays (Pipoly, pers. obs.).

KEY TO TAXA OF *ARDISIA* SUBGENUS *GRAPHARDISIA*

1. Stoloniferous subshrubs mostly less than 1(–2) m tall; leaf blade margins sharply and irregularly dentate; corolla tube and filaments yellow glandular-granulose; Ecuador to Bolivia and adjacent Brazil...........**1. A. weberbaueri**

1. Shrubs to small trees (0.5–)2–6(–10) m tall without stolons; leaf blade margins entire, undulate or crenulate; corolla tube yellow glandular-granulose; filaments glabrous or sessile to stalked glandular-papillate; Nicaragua to Colombia.

    2. Sepals membranaceous, oblong, 4.2–8 mm long, apically broadly rounded to obtuse, hyaline throughout, the margins entire; filaments sessile-to stalked- glandular-papillate. ....**2. A. opegrapha**

        3. Inflorescence obpyramidal; leaf blades oblanceolate or rarely obovate, 3.5–7.5(–8) cm wide, 3 or more times longer than wide.

            4. Floral bracts caducous; stamens 5.2–6.5 mm long; filaments 2.5–3 mm long; sepals 5–8 mm long. ...**2a. A. opegrapha** subsp. **opegrapha**

            4. Floral bracts persistent; stamens 3.8–5 mm long; filaments 1.5–2 mm long; sepals 4.2–5.2 mm long. ....**2b. A. opegrapha** subsp. **wagneri**

        3. Inflorescence globose; leaf blades elliptic to broadly elliptic (7.5–) 8–14.5 cm wide, 2–2.5 times longer than wide. ....**2c. A. opegrapha** subsp. **paquitensis**

2. Sepals chartaceous, ovate, 1.5–2.5 mm long, apically acute, opaque except at margin, the margins subentire to erose; filaments glabrous. .... **3. A. bartlettii**
    5. Sepals 1.5–1.8 mm long; petal lobes 6–6.5 mm long; stamens 3.5–4.8 mm long; style base tapering; tall wet forests. .... **3a. A. bartlettii subsp. bartlettii**
    5. Sepals 2–2.5 mm long; petal lobes 7–8 mm long; stamens 4.5–5.7 mm long; style base stylopodic; strand vegetation and beach forests. .... **3b. A. bartlettii** subsp. **lilacina**

1. Ardisia weberbaueri Mez, **(Figs. 1D, 2),** Repert. Spec. Nov. Regni Veg. 3:97. 1906. *Graphardisia weberbaueri* (Mez) Lundell, Wrightia 7:46. 1982. TYPE: PERU. JUNÍN: Prov. Tarma, near La Merced in Chanchamoyo Valley, without elev., Dec 1902 (fl), *A. Weberbauer 1809* (HOLOTYPE: B-destr.; LECTOTYPE, here designated: F).

The holotype of *Ardisia weberbaueri* was destroyed in Berlin (B) in 1943 during WWII. According to *Index Herbariorum* (Holmgren et al. 1990), other institutions housing duplicate A. Weberbauer collections are: F, MOL, USM and WRSL. Through the kindness of Carlos Reynel (MOL), Asunción Cano (USM), and Krzysztof Swierkosz (WRSL), thorough searches were conducted at their respective institutions, all failing to locate isotypes of *A. Weberbauer 1809*. A fragment of the holotype, including a mature flower and leaf fragment, was taken from B in 1926, and is available at F (a "clastotype"–see Pipoly 1983), and is here selected as the lectotype.

Ardisia vigoi Lundell, Wrightia 6:94. 1979. SYN. NOV. *Graphardisia vigoi* (Lundell) Lundell, Phytologia 48:140. 1981. TYPE: PERU. SAN MARTÍN: Prov. Mariscal Cáceres, Dtto. Tocache Nuevo, Río de la Plata, NE of Tocache, 500–600 m, 5 May 1975 (fl, fr), *J. Schunke Vigo 8384* (HOLOTYPE: LL-TEX; ISOTYPE: MO).

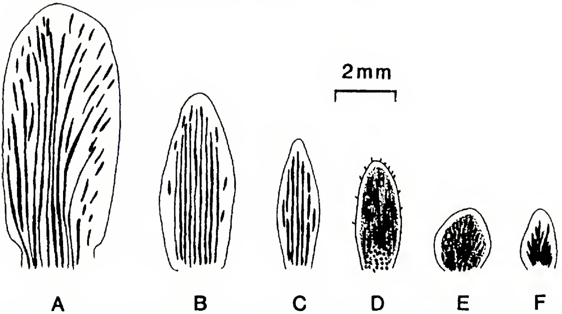

FIG. 1. Comparison of sepal size, shape and punctations amoung the taxa of *Ardisia* subgen. *Graphardisia*. See individual taxon descriptions for details. A. *Ardisia opegrapha* subsp. *opegrapha*, drawn from *G. Webster 16867*. B. *Ardisia opegrapha* subsp. *wagneri*, drawn from *L.D. Gomez 24093*. C. *Ardisia opegrapha* subsp. *paquitensis*, drawn from *Araquistain 3007*. D. *Ardisia weberbaueri*, drawn from *R. Vasquez 5924*. E. *Ardisia bartlettii* subsp. *bartlettii*, drawn from *H. Bartlett & T. Lasser 16720*. F. *Ardisia bartlettii* subsp. *lilacina*, drawn from *J. Dwyer 4354*.

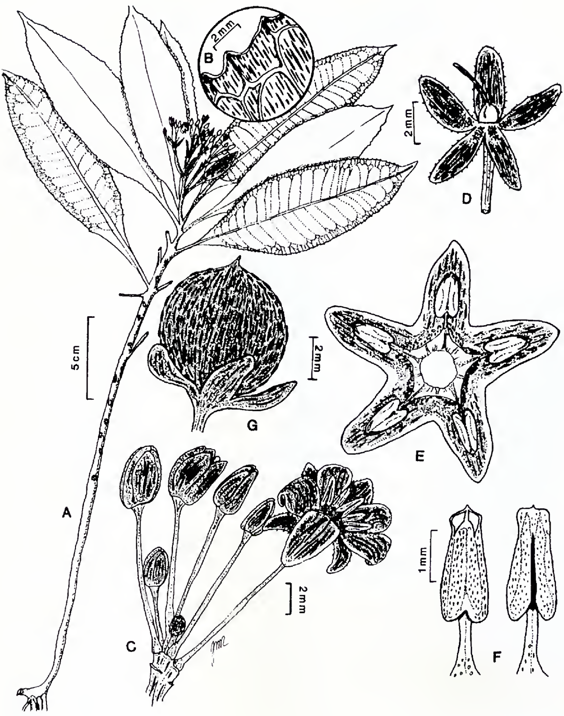

FIG. 2. *Ardisia weberbaueri* Mez. A. Habit, flowering branch. B. Detail of abaxial leaf surface. C. Detail of inflorescence. D. Detail of flower, showing calyx and pistil. E. Detail of flower, showing corolla and stamens. F. Detail of stamen, showing adaxial and abaxial surfaces. G. Fruit. A G drawn from *R. Vasquez 5924.*

Stoloniferous *subshrubs* to *shrubs*, 0.75–1.0(–2.0) m tall. *Branchlets* slender, terete, 2–4 mm in diam., glabrous to scattered glandular-granulose. *Leaves* alternate; blades membranaceous to chartaceous, oblong to elliptic, 8.2–19.4 cm long, 1.9–6.6 cm wide apically acuminate, the acumen 5–9 mm long, basally acute to acuminate, decurrent on the petiole, the midrib impressed above, prominently raised below, the secondary veins 22–26 pairs, obscure above, prominent below, conspicuously punctate and punctate-lineate, glabrous, the margins irregularly dentate, the teeth 0.4–0.8 mm long, mostly flat; petioles slender, canaliculate. 0.7–2.1 cm long, glabrous. *Inflorescence* terminal, 2.5–7 cm long, 2.5–8 cm wide, usually shorter than the leaves, the rachis conspicuously punctate and punctate-lineate, glabrous to sparsely scattered glandular-grandulose; peduncle 2–5 mm long; inflorescence branch bracts foliaceous, membranaceous, oblong or elliptic, 1.4–2.5 cm long, 0.5–0.8 cm wide, apically acute to rounded, the midrib impressed above, prominently raised below, the secondary veins obscure above and below, conspicuously punctate and punctate-lineate, glabrous, the margins entire to undulate; petioles 0.8–1.2 mm long, glabrous; inflorescence branches 2–9 mm long, conspicuously punctate and punctate-lineate, glabrous to scattered glandular-grandulose, bearing terminal corymbs; floral bracts resembling secondary inflorescence branch bracts, but 7.2–8.1 mm long, 1.7–2.2 mm wide, sessile or nearly so; pedicels 11.6–13.5 mm long, slender, mostly accescent in fruit, glabrous to scattered glandular-grandulose. *Flowers* 5-merous (occasionally with sepals 6–7), membranaceous, 4.5–5.5 mm long; calyx with sepals free, oblong, 3.2–4.2 mm long, 1.4–1.6 mm wide, apically broadly obtuse to rounded, densely and prominently punctate and punctate-lineate, glabrous, except densely glandular-grandulose within basally, the margins hyaline, subentire, glandular-ciliolate; corolla rotate, 4.3–5.3 mm long, the tube 0.4–0.5 mm long, densely yellow glandular-grandulose within apically above staminal tube and below corolla tube and lobe junction, the lobes ovate, 4.1–4.8 mm long, 2.3–2.5 mm wide, apically rounded to obtuse, prominently punctate and punctate-lineate, glabrous, the margins entire; stamens 3.2–3.8 mm long, connate by their bases and adnate to corolla to form a tube 0.4–0.5 mm long, the free portion 2.8–3.3 mm long, the filaments 1.2–1.4 mm long, 0.5–0.7 mm wide at base, conspicuously punctate, glabrous except scattered sessile glandular-papilllate basally, the anthers linear-lanceoloid, 2.0–2.2 mm long, 0.9–1.0 mm wide at base, apically apiculate, basally sagittate, dehiscent by subapical pores, the connective prominently black punctate dorsally; pistil obturbinate, the ovary glabrous, the style 1.9–2.7 mm long, slender, tapering, punctate, glabrous, the ovules 13–14, pluriseriate. *Fruit* globose, 6.1–6.8 mm in diam., densely and prominently punctate and punctate-lineate, the style base persistent, glabrous.

Distribution.—*Ardisia weberbaueri* is endemic to the junction of the Andes and Western Amazonia, from Napo and Pastaza Provinces, Ecuador, southward through the Departments of Loreto, San Martín, Junín and Madre de Dios, Peru, to the Departments of Beni, La Paz and Santa Cruz, Bolivia and the adjacent state of Acre, Brazil. It grows from 180–1,100 m in elevation. This is the first report of the species for Ecuador.

Ecology and conservation status.—Ardisia weberbaueri is restricted to tall, lowland and premontane tropical moist and wet forests, where it is an understory subshrub, growing in loose detritus in sheltered areas near rocks and tree buttresses. While it is certainly not common, at this time, there are no data to suggest the species is threatened.

Etymology.—Ardisia weberbaueri is named in honor of August Weberbauer (1871–1948), a German botanist and phytogeographer who collected in Peru from 1901–1905 and again from 1908–1948 (Stafleu & Cowan 1988). During the 1920s, he was sponsored by the Field Museum of Natural History (F), under J. Francis MacBride's *Flora of Peru* project. Many of Weberbauer's collections are type specimens today. *Ardisia weberbaueri*'s taxonomic synonym, *Ardisia vigoi* Lundell, was named in honor of José Schunke Vigo, who had a long collaborative history with the Missouri Botanical Garden (MO), Field Museum of Natural History (F) and Peruvian Herbaria's revived *Flora of Peru* project. José is the son of Carlos Schunke, who was guide and field assistant to J. Francis MacBride of the Field Museum and G.S. Bryan of the University of Wisconsin, during their 1923 botanical expedition to Peru (Dahlgren 1936). Unfortunately, Lundell (1979), confused José's second surname (maternal) with his legal (paternal) one, hence the epithet "vigoi" instead of "schunkei."

Additional specimens examined. **ECUADOR. Napo:** Laguna de Yuturí, along both sides of Río Yuturí, 00° 36' S, 76° 01' W, 220 m, 26 Feb 1990 (fr), *J. Jaramillo & A. Grijalva 11402* (K); Cantón Orellana, Yasuní National Park, Maxus road and pipeline under construction, km 3 of NPF-Puerto Maxus branch, 04° 01' 00" S, 76° 25' 00" W, 250 m, 10 Jun 1994 (fr), *N. Pitman & M. Aulestia 232* (BRIT, F, MO). **Pastaza:** Cantón Pastaza, "Masaramu" Oil well, of UNOCAL, 40 km NNE of Montalvo, 00° 44' S, 76° 52' W, 400 m, 1–16 May 1990 (fr), *E. Gudiño 355* (BRIT, MO, QCNE). **PERU. Huánuco:** Prov. Pachitea, Region Pucallpa, W part, "Sirá Mountains," and adjacent lowland; 20–24 km SE of Puerto Inca, Crest of mountain range going W to E from "Campamento Oro," to "Campamento Sirá" 09° 28' S, 74° 47' W, 600 m, 20 Dec 1987 (fr), *B. Wallnöfer 16-201287* (BRIT, MO, USM, W), 700 m, 8 Apr 1988 (fr), *B. Wallnöfer 18-8488* (BRIT, MO, W). **Junín:** Prov. Chanchamayo, Chanchamayo, without elev., 22 Oct 1863 (fl), *J. Isern 2234* (F, MA). **Loreto:** Prov. Maynas, Allpahuayo, Estación IIAP, without elev., 13 Nov 1984 (fl), *R. Vásquez et al. 5924* (MO); Prov. Maynas, Iquitos, Estación Experimental IIAP, Allpahuayo, 21 km al S de Iquitos, 4° 10' S, 73° 30' W, 180 m, 19 Sep 1990 (ster.), *J. Pipoly et al. 12168* (MO). **Madre de Dios:** Prov. Manu, Manu, Parque Nacional Manu, Cocha Juárez, Río Manu, 400 m, 3–5 May 1987 (fr), *P. Núñez et al. 8053* (MO). **San Martín:** Prov. Huallaga, Chazute, Río Huallaga, 260 m, Mar 1935 (fl), *G. Klug 3978* (F, GH, MO); Prov. Mariscal Cáceres, Quebrada Huicte, Río Huallaga, 590 m, 26 May 1964 (fr), *J. Schunke V. 6449* (MO); Dtto. Tocache Nuevo, Quebrada de Huaquisha, right bank of Río Huallaga, without elev., 17 May 1970 (fr), *J. Schunke V. 3983* (F), 8 Jun 1970 (fr), *J. Schunke V. 4039* (F); Puerto Pizana, right bank of Río Huallaga, without elev., 3 Sep 1971 (fr), *J. Schunke V. 4983* (F, MO); Quebrada de Cachiyacu de Lopuna, Progreso Hwy., 500–850 m, 21 Jul 1974 (fl, fr), *J. Schunke V. 7647* (MO); Quebrada Paraíso, 5 km below Tocache, 400 m, 27 Nov 1974 (fl, fr), *J. Schunke V. 8133* (MO). **BOLIVIA. Beni:** Prov. Ballivián, lower slopes of Serranía Pilón Lajas, 14.3 km N of the bridge over the Río Quiquibey, 15° 19' S, 67° 03' W, 700 m, 10 Jun 1985 (fr), *J. Solomon 13940* (MO); Misión Fátima, S of San Borja, near Río Maniquí, on afluent of Río Chimané, behind the Misión, 240 m, 20 May 1988 (fr), *S. Beck 16323* (MO); E slopes, 21 km from Yucumo, 15° 17' S, 67° 04' O, 1,035 m, 17 May 1989 (fr), *D. Smith et al. 13188* (MO). **La Paz:** Prov. Nor Yungas, Alto Madidi, ridge top ca. 7 km NE of camp, 13° 35' S, 68° 46' W, 300 m, 27 May 1990 (fr), *A. Gentry & S. Estensoro 70712* (MO); Alto Beni, trail from bridge toward San Antonio, 570 m, 3 Jan 1988 (fr), *R. Seidel & M. Schulte 2316* (MO); Prov. Sud Yungas, Alto Beni, Sapecho Concession, Yungas, 15° 30' S, 67° 20' W, 550 m, 3 Apr 1989 (fr), *R. Seidel et al. 2671* (MO), 3 Feb 1990, *R. Seidel & V. Baptista 2824* (MO). **Santa Cruz:** Prov. Ichilo, Parque Nacional Amboró, 3 km SW of Estancia San Rafael de Amboró, 17 km by air, SSE of Buena Vista, forest near Río Surutu, 17° 36' S, 63° 37' W, 350 m, 29 Jul 1987 (fr), *M. Nee et al. 35424* (MO, TEX); ca. 15 km (SE) up the Río Pitasama from the Río Surutú, 17° 44' S, 63° 40' W, 700 m, 28 Aug 1985 (fr), *J. Solomon 14104* (MO). **BRAZIL. Acre:** Rio Acre, Seringal, São Francisco, without elev., Oct 1911 (fl), *E. Ule 9641* (K).

Ardisia weberbaueri appears to be most closely related to *A. bartlettii*, based on its sepals that are opaque except along the margin, relatively small inflorescences with early caducous floral bracts, and non-entire margined leaf blades. However, *Ardisia weberbaueri* may be easily separated from *A. bartlettii* by its diminutive, stoloniferous habit, sharp and irregular teeth of the leaf blades, and the glandular-granulose filaments.

Detailed study of the lectotype of *A. weberbaueri* and the type of *A. vigoi* revealed no quantitative or qualitative difference between the two respective type specimens.

2. **Ardisia opegrapha** Oerst.

Shrubs or small trees (0.6–)2–10 m tall. *Branchlets* (2–)3–5(–7) mm in diam., glabrous throughout. *Leaves* alternate or pseudoverticillate; blades membranaceous, elliptic, broadly elliptic, oblanceolate, or obovate, 10–30 cm long, 3.5–14.5 cm wide, apically acuminate, base acute or attenuate, decurrent on the petiole; midvein impressed above, prominently raised below, the secondary veins prominulous above, inconspicuous below, densely and conspicuously punctate and punctate-lineate, glabrous, the margins entire or irregular; petioles canaliculate and usually marginate, 0.2–3.5 cm long, glabrous. *Inflorescence* terminal, a bipinnate, radially symmetrical (globose) or obpyramidal panicle of corymbs, 2–12 cm long, 2–15 cm wide, usually shorter than the leaves; peduncle obsolete to 3.5 cm long, conspicuously punctate and punctate- lineate, glabrous, inflorescence branch bracts membranaceous, widely ovate, 7.2–26 mm long, 1.4–8 mm wide, apically broadly rounded, densely and prominently punctate and punctate-lineate, glabrous, caducous or persistent in fruit, the margins entire; floral bracts as in secondary branch bracts except oblong, 3.7–12 mm long, 0.8–5.5 mm wide; pedicels 6–23 mm long, slender, conspicuously punctate and punctate lineate, sparsely glandular-glandulose. *Flowers* 5-merous, membranaceous, 7.5–10 mm long; calyx with sepals free, linear, oblong or broadly elliptic, 4.2–8 mm long, 2.2–3.1 mm wide; apically rounded, emarginate, densely and prominently punctate and punctate-lineate, very sparsely glandular-granulose without, densely glandular-granulose at base within, the margins entire, sparsely glandular-ciliolate or not; corolla rotate, 6.5–9.5 mm long, the tube 0.3–0.7 mm densely yellow glandular-granulose within apically above staminal tube as well as below corolla tube and lobe junction, the lobes ovate to elliptic, 6.5–9 mm long, 3.8–5.7 mm wide, apically rounded, densely and prominently punctate and punctate-lineate, glabrous, the margins entire; stamens 3.8–6.5 mm long, the staminal tube 0.3–0.8 mm long, the filaments 1–3 mm long, 0.5–0.8 mm wide, epunctate, scattered glandular-papillate, the anthers linear-lanceoloid, 2.3–3.6 mm long, 0.9–1.1 mm wide at base, apiculate, basally sagittate, concolorous, dehiscent by subapical pores, the connective inconspicously punctate dorsally; pistil obturbinate, the ovary glabrous, the style 3.5–5 mm long, slender, punctate and punctate-lineate, glabrous, the ovules 11–13, pluriseriate. *Fruit* globose, 4.2–8 mm in diam., densely and prominently punctate, glabrous.

Ardisia opegrapha, as here circumscribed, includes three newly recognized subspecies for which combinations are made herewith.

2a. Ardisia opegrapha Oersted subsp. **opegrapha (Figs. 1A, 3).** *Ardisia opegrapha* Oerst., Vidensk. Meddel. Dansk Naturhist. Føren Kjøbenhavn 1861:126. 1861. *Graphardisia opegrapha* (Oerst.) Lundell, Phytologia 48:140. 1981. TYPE: COSTA RICA. ALAJUELA: Aguacate, without elev., Nov 1847 (fl), *A. Oersted 29A* (LECTOTYPE, here designated: C, (F Neg. # 22954); ISOLECTOTYPE: F).

In the Botanical Museum, University of Copenhagen Herbarium (C), there are two different collections that were cited in the protologue by Oersted, two duplicates of *A.S. Oersted 29* from Jaris, and one of *A. Oersted 29A* from Aguacate, of which only *A. Oersted 29A* is duplicated in the Field Museum of Natural History (F). The collection from Jaris was made in November 1846, and that from Aguacate in November 1847. In Oersted's original description he states "Crescit in montibus costaricencibus Aguacate et Jaris (1500–2000'), ubi florentem et fructificantem Novembri legi," without further specifying the location. Mez (1902) and subsequent authors have not designated a lectotype. We here select the collection from Aguacate at C as the lectotype because it contains the greatest number of dissections in the original fragment packet, indicating it was a more critical element in the description of the species.

Ardisia oliveri Mast., Gard. Chron., n.s., 8:680, *fig.* 132. 1877. SYN. NOV. non Bot. Mag., 104[ser. 3, vol. 34]:*t.* 6357. 1878,. *Graphardisia oliveri* (Mast.) Lundell, Phytologia 54:285. 1983. TYPE: COSTA RICA. PROV. UNKNOWN: From Messrs. Veitch & Sons Nursery, Jul 1876 (fl), *A. Endres s.n.* (HOLOTYPE: K, (LL-TEX Neg. # 71-146); ISOTYPES:

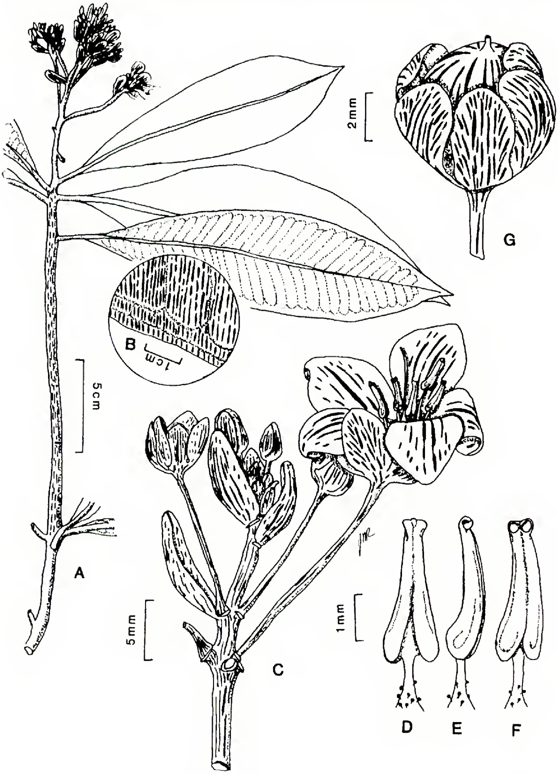

FIG. 3. *Ardisia opegrapha* Oersted subsp. *opegrapha*. A. Habit, flowering branch. B. Detail of abaxial leaf surface. C. Detail of inflorescence. D. Detail of stamen, showing adaxial surface. E. Detail of stamen, showing laterial surface. F. Detail of stamen, showing abaxial surface. G. Fruit. A, B drawn from lectotype. C–F drawn from *G. Webster 16516*. G drawn from *R. Mendoza 26*.

W 3-sheets).

Ardisia seibertii Standl., Ann. Missouri Bot. Gard. 24:198. 1937. Syn. nov. *Graphardisia seibertii* (Standl.) Lundell, Phytologia 48:140. 1981. Type: PANAMA. Coclé: El Valle de Antón and vicinity, 500–700 m, 23–27 Jul 1935 (fl, fr), *R.J. Seibert 456* (holotype: F, (F Neg. # 68250); isotypes: A, K, MO (LL-TEX Neg. # 71-102)).

Ardisia skutchii C. V. Morton, J. Wash. Acad. Sci. 27:309. 1937. Syn. nov. *Graphardisia skutchii* (Morton) Lundell, Phytologia 59:432. 1986. Type: COSTA RICA. San José: Vicinity of El General, 1,070 m, Jun 1936 (fl), *A.F. Skutch 2660* (holotype: US (CM Neg. # 49641, LL-TEX Neg. # 71-104, US Neg. # 2386); isotype: MO (LL-TEX Neg. # 71-104)).

Ardisia subcoriacea Lundell, Wrightia 3:193. 1966. Syn. nov. *Graphardisia subcoriacea* (Lundell) Lundell, Phytologia 48:140. 1981. Type: PANAMA. Coclé: El Valle de Anton, vicinity of La Mesa, ca. 1,000 m, 22 Jun 1941 (fl), *P.H. Allen 2571* (holotype: US, (LL-TEX Neg. # 71-111); isotypes: A, F (F Neg. # 68253)).

Ardisia picturata Lundell, Wrightia 4:164. 1971. Syn. nov. *Graphardisia picturata* (Lundell) Lundell, Phytologia 48:140. 1981. Type: PANAMA. Panamá: Cerro Campana area, above Su Lin Motel, ca. 3,000 ft [904 m], 11 Aug 1967 (fr), *J. D. Dwyer & J.H. Kirkbride Jr. 7818* (holotype: LL-TEX n.v.; isotypes: K n.v., LL-TEX, MO, NY, UC n.v., US).

Graphardisia coibana Lundell, Phytologia 59:429. 1986. Syn. nov. *Ardisia coibana* (Lundell) Lundell, Phytologia 61:63. 1986, nomen invalidum. Type: PANAMA. Veraguas: Playa Rosario, N tip of Coiba Island, without elev., 26 Aug 1970 (fr), *R. Foster 1600* (holotype: LL-TEX; isotypes: DUKE n.v., F (F Neg. # 68357), MO).

Graphardisia nicaraguensis Lundell, Phytologia, 59:429. 1986. Syn. nov. *Ardisia esquipulasana* Lundell, Phytologia 61:63. 1986, nomen novum invalidum, non *Ardisia nicaraguensis* Oerst., Vidensk. Meddel. Dansk Naturhist. Føren Kjøbenhavn 1861:123. 1861. Type: NICARAGUA. Zelaya: Montaña Esquipulas, 130 m, 22 Nov 1951 (fr), *P.J. Shank & A. Molina R. 4719* (holotype: F (F Neg. # 68356); isotype: US).

Graphardisia obtusata Lundell, Phytologia 59:430. 1986. Syn. nov. *Ardisia obtusata* (Lundell) Lundell, Phytologia 61:66. 1986, nomen invalidum. Type: PANAMA. Darién: Río Tuquesa, at middle Tuquesa Mining Company camp called Charco Peje, ca. 250 m, 8 Jul 1975 (fr), *S. Mori 7034* (holotype: LL-TEX; isotype: MO).

Graphardisia oxyphylla Lundell, Phytologia 59:430. 1986. Syn. nov. *Ardisia riomonteana* Lundell, Phytologia 61:66. 1986, nomen novum invalidum, non *Ardisia oxyphylla* Wall., Numer. List 2291. 1830. Type: PANAMA. Chiriquí: 2.5 km from Questa Piedra along Río Monte Road, at stream, without elev., 27 Jun 1977 (fl), *J.P. Folsom 3975* (holotype: LL-TEX; isotypes: CR n.v., MEXU n.v., MO, NY, PMA n.v.).

Graphardisia ustupoana Lundell, Phytologia 59:432. 1986. Syn. nov. *Ardisia ustupoana* (Lundell) Lundell, Phytologia 61:68. 1986, nomen novum invalidum. Type: PANAMA. San Blas: through cultivation on mainland in front of Ustupo, overhanging river, without elev., 9 Nov 1975 (fr), *W.G. D'Arcy 9535* (holotype: LL-TEX; isotypes: BRIT, MO).

Graphardisia murphyae Lundell, Phytologia 63:77. 1987. Syn. nov. *Ardisia murphyae* (Lundell) Lundell, Phytologia 63:463. 1987. Type: COSTA RICA. Puntarenas: N of La Lucha road to Progresso, 1,200 m, 23 May 1984 (fl), *H. Murphy 1248* (holotype: DUKE, n.v., LL-TEX fragment of holotype).

Graphardisia serenoana [seranoana] Lundell, Phytologia 59:431. 1986. Syn. nov. *Ardisia seranoana* (Lundell) Lundell, Phytologia 61:66. 1986, nomen invalidum. Type: PANAMA. Chiriquí: road from Volcán to Río Sereno [Serano], road that turns E 7.2 km from Río Serano, 3.2 km along side road, without elev., 29 Jun 1977 (fl), *J.P. Folsom 4029* (holotype: LL-TEX; isotypes: MEXU n.v., MO, PMA n.v.).

Shrubs or small trees (1–)2–10 m tall, 2–5 cm in diam. *Branchlets* 3–5 mm in diam. *Leaves* with blades elliptic to lanceolate, broadly elliptic or oblanceolate, 12–25 cm long, 3.5–7.5 cm wide; petioles canaliculate, usually marginate, 0.2–1.5 cm long. *Inflorescence* obpyramidal, bipinnately paniculate, 2–12 cm long, 4–15 cm wide; peduncle 0.5–1.5 cm long; inflorescence branch bracts widely ovate, 16–18 mm long, 14–16 mm wide, caducous; floral bracts 7–12 mm long, 3–5.5 mm wide, oblong, caducous; pedicels 10–23 mm long. *Flowers* 9–10 mm long; sepals linear, oblong to broadly elliptic, 5–8 mm long, 2.2–2.5 mm wide; corolla 8–9.5 mm long, the tube 0.4–0.6 mm long, the lobes oblong to broadly elliptic 7.6–8.9 mm long, 4.5–5.5 mm wide; stamens 5.2–6.5 mm long, the staminal tube 0.4–0.7 mm long, the filaments 2.5–3 mm long, 0.6–0.8 mm wide, the anthers 2.7–3 mm long, 0.9–1 mm wide at base; ovary with style 4–5 mm long, the ovules 12-many. *Fruit* 5–8 mm in diam.

Distribution.—Nicaragua (Jinotega, Matagalpa, Zelaya, Río San Juan), Costa Rica (Alajuela, Puntarenas, San José), Panama (Chiriquí, Veraguas, Herrera, Los Santos, Coclé, Panamá, San Blas, Darién) and Colombia (Chocó); sea level–2,500 m elevation. It is notable that the subspecies principally inhabits areas facing the Pacific coast of Central and adjacent South America.

Ecology and conservation status.—Ardisia opegrapha subsp. *opegrapha* inhabits a wide range of habitats, including beach thickets; gallery forests in deciduous woodlands and dry oak forests; moist, wet, lower montane, montane, cloud and elfin forests. Because it is mostly found at forest margins, and along watercourses, subsp. *opegrapha* may be found in primary and disturbed or remnant sites.

Etymology.—The epithet 'opegrapha' comes from the Greek, '*opsis*', resembling, and *graphe*, meaning drawing, picture or writing. This refers to the densely and prominently punctate and punctate-lineate vegetative and floral parts.

Additional specimens examined. **NICARAGUA. Jinotega:** Cerro San Pedro, Comarca Kilambé, 13° 36' N, 85° 38–39' W, 820 m, 21 Jul 1980 (fl), *J. Sandino 192* (MO). **Matagalpa:** Las Brisas, 15 km W of Waslala, road to El Tuma, 13° 15' N, 85° 28' W, 250–300 m, 23 Dec 1982 (fr), *P. Moreno 19225* (MO). **Río San Juan:** Buenos Aires, 1 km al N of Caserío Sábalo, along Río Sábalo, 11° 02' N, 84° 28' W, 70 m, 10 Sep 1985 (fr), *P. Moreno 26297* (MO); between Río Santa Cruz and Caño Santa Crucita, La Palma, 11° 02–04' N, 84° 24–26' W, 40–60 m, 30 Nov–2 Dec 1984 (fr), *W. Stevens et al. 23470* (MO). **Zelaya:** El Achiote, 11° 47' N, 84° 26' W, 200 m, 25 Aug 1982 (fr), *M. Araquistain 3130* (MO); San Antonio, 200 m, 29 Aug 1982 (fr), *A. Laguna 27* (MO); along Río El Zapote, W of Nueva Guinea, 11° 42' N, 84° 26' W, 130 m, 21 Aug 1983 (fr), *J. Miller & J. Sandino 1257* (MO); 4.4 km N of base camp, base camp 3.6 km SE of Cerro San Isidro, Río Kama, Río Escondido, 12° 05–15' N, 83° 45'–84° 20' W, sea level–65 m, 16 Mar 1966 (fr), *G. Proctor et al. 27151* (NY, LL-TEX); 5 km SE de La Providencia, along Caño Chiquito, without elev., 21 Aug 1983 (fr), *J. Sandino 4534* (MO); Comarca de El Cabo, 40–45 km SW of Waspám, 10–100 m, 21 Jan 1970 (fr), *F. Seymour 3783* (MO); Esquipulas and Alemán, Río Alemán drainage, 150 m, 27–29 Nov 1951 (fr), *P. Shank & A. Molina R. 4783* (F, LL-TEX, MO). **COSTA RICA. Alajuela:** toward center of Cerro de San Isidro, San Ramón, 1,150 m, 10 Jul 1925 (fl), *A. Brenes 4313* (F, LL-TEX); between Santiago and San José de San Ramón, without elev., 17 Oct 1928 (fr), *A. Brenes 6349* (F); San Miguel de San Ramón, without elev., 21 Jul 1934 (fl), *A. Brenes 19242* (F); Río Grande, San Isidro, San Ramón-Alajuela, 1,000 m, 10 Jun 1982 (fr), *A. Carvajal 269* (LL-TEX, MO); 3 km E of San Ramón, 1,025 m, 22 Jun 1969 (fl), *R. Lent 1765* (F); Los Angeles de Las Gania, 1,100 m, 21 Dic 1936 (fl), *F. Solís R. 495* (LL-TEX, MO). **Puntarenas:** Cantón Coto Brus, Las Cruces Botanical Garden, Cordillera de Talamanca, 08° 47' 10" N, 82° 58' 30" W, 1,200–1,300 m, 30 Jun 1995 (fr), *L. Angulo 388* (BRIT, MO); "Hort. Eisgmb, Clt. Lauche," without elev., 1895 (fl), *C. Beck s.n.* (W); Cerro Pando, ridges above the Río Cotón and the Río Negro, near La Lucha, Río Cotón, 08° 55' N, 82° 45' W, 1,000–1,800 m, 19–21 Feb 1982 (fr), *K. Barringer & L. Diego G. 1652* (F); Puerto Quepos, along stream in shady woods on W side of National Park, 16 mi E of town, without elev., 28 Feb 1982 (fr), *J. Churchill 82022* (F); foothills of the Cordillera de Talamanca, directly N of Las Alturas, 08° 57' N, 82° 50' W, 1,400–1,500 m, 28 Aug 1983 (fr), *G. Davidse 24159* (MO); Fila El Tigre, SE of Las Alturas, 08° 56' N, 82° 51' W, 1,350–1,450 m, 29 Aug 1983 (fr), *G. Davidse 24176* (MO); Foothills of Cordillera de Talamanca, forested valley of the Río Cotón between Sitio Cotón (Cotoncito), and Sitio Tablas, 08° 57' N, 82° 46' W, 1,500–1,600 m, 2 Sep 1983 (fl), *G. Davidse 24428* (MO); Parque Bolívar, without elev., 10 Jul 1945 (fl), *J. Echeverría 4147* (F); La Tigra-Las Mellizas, 1,280 m, Aug 1983 (fl, fr), *L. Gómez et al. 21982* (LL-TEX, MO); Cantón Coto Brus, NE slopes of Fila de Cal, between San Vito de Coto Brus and Ciudad Neily, 08° 41' N, 82° 56' 50" W, 500–620 m, 12 Jul 1985 (fr), *M. Grayum & B. Hammel 5638* (MO); Alturas de Coto Brus, ca. 20 km NE of San Vito, 1–3 km S of Las Alturas, 08° 56' N, 82° 50' W, 1,300–1,400 m, 13 Jul 1985 (fl), *B. Hammel & M. Grayum 14201* (MO); Las Cruces Botanical Garden, San Vito, jungle trail, 08° 47' 08" N, 82° 57' 29" W, 1,250 m, 4 Jul 1994 (fl), *W. Kress & T. Prinzie 4572* (MO, US); Amistad Biosphere Reserve, near Las Alturas de Cotón Biological Station, 08° 57' 00.3" N, 82° 49' 56.8" W, 1,455–2,100 m, 8 Jul 1994 (fl), *W. Kress & T. Flores 4266* (MO, US); 1,475–1,750 m, 8 Jul 1994 (fl), *W. Kress & T. Prinzie 4582* (BRIT, MO, US); above La Tigra, Talamanca Range, near Panamanian border, 1,600–1,800 m, 20 Mar 1982 (fr), *D. Hazlett 5064* (F); between Sitio Tigra and Sitio Las Tablas picnic area, near Cerro Chivo, S of Cotón river, 1,600–1,800 m, 17 Jul 1983 (fl), *D. Hazlett 5229* (F); beside Río Bella Vista near Las Alturas, 08° 56' N, 82° 51' W, 1,300 m, 8 Jul 1972 (fl), *R. Lent 2693* (F, MO); Cañas Gordas, 1,100 m, Feb 1897 (fr), *H. Pittier 11190* (LL-TEX); 1 mi S of San Vito de Java, 3,500 ft [1,067 m], 18 Aug 1967 (fr), *P. Raven 21889* (F, MO); Piedra Blanca de Villa Colón, 1,200 m, 17 Abr 1935 (fl), *M. Valerio 1268* (F); 7.5 km NE of Sabalito, 08° 51' N, 82° 53' W, 1,021 m, 7 Jul 1977 (fl), *G. Webster 21876* (F); Finca Loma Linda, SW of Cañas Gordas, 08° 44' N, 82° 56' W, 3,600 ft [1,097 m], 17 Jul 1977 (fl), *G. Webster 21937* (F); 4 km S of Las Alturas, 1,400 m, 15 Jul 1977 (fl), *R. Wilbur et al. 22713* (MO). **San José:** forest along Quebrada de los Micos, ca. 8.5 km by road, W of Ciudad Colón, 09° 55' 50" N, 83° 17' 50" W, 600 m, 16 Jan 1986 (fr), *M. Grayum & P. Sleeper 6103* (MO); Zona Protectora La Cangreja, along Río Negro, ca. 1.5 km E of Santa Rosa de Puriscal, 09° 42' N, 84° 23' 05" W, 320 m, 14 May 1987 (fl), *M. Grayum et al. 8325* (MO); between Pedernal and Candelaria, 900 m, 29 May 1966 (fl), *A. Jiménez 3966* (F, MO); road from Santiago to Parrita, 600 m, 24 Sep 1967 (fr), *R. Lent 1321* (F, NY); Zona Protectora La Cangreja, Santa Rosa de Puriscal, en las márgenes del Río Negro, 09° 42' 24" N, 84° 23' 35" W, 400 m, 10 Aug 1992 (fr), *J. Morales 318* (BRIT, MO); "Cultivé, Jardin Monte Alegre á San José", wirhout elev., without date (fl), *H. Pittier 2298* (BR); vicinity of El General, 1,190 m, Nov 1936 (fl, fr), *A. Skutch 2890* (GH, MO), 670 m, Jun 1939 (fl), *A. Skutch 4371* (A, F, K, LL-TEX, MO); Cantón Turrubares, flank of Cerro

Pelón, Zona Protectora Cerros de Turrubares, 09° 48' 50" N, 84° 28' 00" W, 1,500 m, 7 Nov 1990 (fr), *R. Zúñiga et al. 392* (BRIT, MO). **PANAMA. Chiriquí:** Cerro Colorado, mining road 15.6 mi above bridge over Río San Félix, 1,330 m, 21 Nov 1979 (fr), *T. Antonio 2573* (LL-TEX, MO); Cerro Colorado, 8.5 km from Escopeta, along stream, 800–1,000 m, 17 Aug 1977 (fr), *J. Folsom 4925* (LL-TEX, MO). **Coclé:** vicinity of El Valle, 800–1,000 m, 22 Dec 1936 (fl), *P. Allen 72* (LL-TEX, MO); vicinity of El Valle, 800–1,000 m, 5 Sep 1938 (fl, fr), *P. Allen 786* (LL-TEX, MO); N rim of El Valle, without elev., 4 Jun 1939 (fl), *P. Allen & A. Alston 1846* (MO); El Valle de Antón, 750 m, 2 Jul 1941 (fl), *P. Allen 2577* (A, LL-TEX, MO), 1,000 m, 16 Jun 1946 (fl), *P. Allen 3535* (BM, MO); El Valle de Antón, N hills, without elev., 29 Jun 1946 (fl), *P. Allen 3561* (F-3-sheets, G, LL-TEX -2 sheets, MO, MU); El Valle, without elev., 20 Jun 1966 (fl) *K. Blum et al. 2382* (MO); 5 km W of El Valle on dirt road to top of grassy ridge, 3,000 ft [914 m], 26 Feb 1978 (fl), *B. Hammel 1764* (LL-TEX, MO); hills NE of El Valle de Antón, 2,000 ft [610 m], 27–29 May 1967 (fl), *W. Lewis et al. 1803* (LL-TEX, MO); El Valle, on mountain slope near hotel, without elev., 30 Nov 1975 (fl), *R. Mendoza 26* (MO); ca.15–20 km NE of La Pintada towards Toábre, largest peak in vicinty, 600–1,000 ft [183–305 m], 15 Feb 1981 (fl), *K. Sytsma & W. D'Arcy 3610* (MO); border Coclé-Panamá Prov., N slopes of Cerro Guacamayo, SE of El Valle, 08° 36' N, 80° 07' W, 1,800 ft [549 m], 3 Jul 1971 (fl), *G. Webster 16867* (MO); between Las Margaritas and El Valle, without elev., 15 Jul–8 Aug 1938 (fl), *R. Woodson et al. 1239* (A, LL-TEX, MO), *1746* (MO). **Herrera:** hill above Chepo de Las Minas, 700 m, 19 Dec 1977 (fr), *J. Folsom et al. 6991* (LL-TEX, MO); W of Las Minas, on Montosa de Chepo, vicinity of Chepo, 07° 42' N, 80° 51' W, 900 m, 20 May 1987 (fl), *G. McPherson 10933* (MO, PMA). **Los Santos:** Río Guanico Valley, 07° 18' N, 80° 30' W, 600 m, 25 May 1986 (fl), *G. McPherson 9248* (BRIT, LL-TEX, MO, PMA); above Guanico River, on hills W of river, 07° 20' N, 80° 30' W, 550–650 m, 5 Jan 1989 (fr), *G. McPherson 13513* (BRIT, MO, PMA). **Panamá:** Camino de Plantación, 09° 04' N, 79° 39' W, 80 m, 1 Jun 1995 (ster.), *S. Aguilar & A. Castillo 2116* (F); Summit of Cerro Campana, 800–1,000 m, 1 Sep 1940 (fl), *P. Allen 2226* (F, LL-TEX); Cerro Campana, trail Campana to Chica, 600–800 m, 10 Aug 1941 (fl), *P. Allen 2661* (LL-TEX); Interpretation Trail, 1 km E of INRENARE Forest Ranger Camp, 8° 40' N, 79° 55' W, 800–900 m, 2 Aug 1989 (fl), *M. Correa et al. 5139* (BRIT, MO, PMA); Cerro Campana above Su Lin Motel, without elev., 25 May 1971 (fl), *T. Croat 14746* (MO); Cerro Campana at turnoff to FSU cabin, without elev., 20 Jul 1974 (fl), *T. Croat 25189* (MO);Cerro Campana, 2,500 ft [762 m], 17 Aug 1982 (fr), *W. D'Arcy & C. Hamilton 14976* (LL-TEX, MO); Cerro Campana, upper slopes in National Park, 207 m, 13 May 1980 (fl), *D. LeDoux 2630* (MO); Cerro Campana, beyond Su-Lin, 2,700–3,000 ft [823–914 m], 8 Sep 1966 (ster.), *J. Duke 8650A* (MO); Cerro Azul, 1 mi below Goofy Lake, 2,000 ft [610 m], 21 Jul 1972 (fl), *A. Gentry & J. Dwyer 5512* (F, MO);Cerro Campana, slopes S of radio tower, 2,500 ft [762 m], 1 Jul 1978 (fl), *B. Hammel 3761* (LL-TEX, MO); between peaks of Cerro Trinidad, saddle on SE slope, without elev., 5 May 1968 (fl), *J. Kirkbride & J. Duke 1642* (MO); Cerro Campana, without elev., 10 Dec 1967 (fl), *W. Lewis et al. 3038* (LL-TEX, MO); Altos de Campana, 285 m fromMotel Su Lin, 951 m, 25 Jun 1977 (fl), *R. Méndez 45* (MO), without elev., 25 Jun 1977 (fl), *R. Méndez 47* (MO), 3,045 ft [928 m], 3 Dic 1977 (fr), *R. Méndez 80* (F, MO); Cerro Campana, 2,800 ft [853 m], 29 Aug 1965 (fl), *S. McDaniel 6912* (MO); W of Inter-American Hwy. near Capira, Cerro Campana, 08° 40' N, 79° 50' W, 900 m, 11 Nov 1985 (fl, fr), *G. McPherson 7458* (BRIT, F, LL-TEX, MEXU, MO, PMA, US); Parque Nacional Altos de Campana, Inrerpretarion Trail, 1 km E of forest INRENARE forest ranger cabin, Tree No. S2158, 08° 40 N, 79° 55' W, 800-900 m, 8 Jul 1988 (fl), *M. Ruíz et al. 165* (BRIT, PMA), 30 Sep 1988 (fr), *M. Ruíz et al. 210* (BRIT, PMA), 2 Aug 1989 (fl), *M. Ruíz et al. 5139* (BRIT, PMA), 23 Aug 1990 (fl), *M. Ruíz et al. 7320* (BRIT, PMA), 23 May 1991 (fl), *M. Ruíz et al. 7800* (BRIT, PMA), 13 Jun 1991 *M. Ruíz et al. 7865* (BRIT, PMA); Goofy Lake, SW facing slope, 500 m, 5 Jul 1976 (fl), *G. Sullivan 58* (MO); Cerro Campana, 08° 40' N, 79° 55' W, 2,700–2,800 ft [823–853 m], 11–12 Jun 1971 (fl), *G. Webster & G. Breckon 16516* (MO, TEX). **Veraguas:** Vicinity Santa Fé, forested slopes of Cerro Tute, 2,500 ft [762 m], 25 Mar 1947 (fl), *P. Allen 4404* (F, G, MO); vicinity of Escuela Agricultura Alto Piedra, near Santa Fé, along trail to top of Cerro Tute, 3,600–4,000 ft [1,097–1,219 m], 29 Jun 1980 (fl), *T. Antonio 4961* (LL-TEX, MO); Islas Contreras, Isla Uva, 08° 48' N, 81° 45' W, 50 m, 18 Jul 1984 (fr), *H. Churchill 5687* (LL-TEX, MO); along road on Pacific slope 1–3 km above Escuela Agricola Alto Piedra, 700–800 m, 26 Jul 1974 (fl), *T. Croat 25995* (LL-TEX, MO); between Santa Fé and Escuela Agrícola Alto de Piedras, without elev., 29 Aug 1974 (fr), *T. Croat 27350* (LL-TEX, MO); 0.2 mi beyond fork in road at Escuela Agricola Alto de Piedra on road to Río Calovebora, 750 m, 3 Apr 1976 (fl, fr), *T. Croat & J. Folsom 33865* (LL-TEX, MO); above Santa Fé beyond Escuela Agrícola Inter-Americana, 1.8 mi beyond fork in road on Pacific slope, on side of Cerro Tute, without elev., 5 Apr 1976 (fr), *T. Croat 34205* (LL-TEX, MO); along road between Santa Fé and Río Calovebora, 1.8 mi beyond Escuela Agrícola Alto de Piedra, 735 m, 5 Apr 1976 (fr), *T. Croat & J. Folsom 34267* (MO);vicinity of Santa Fé, along dirt road past Escuela Circlo Alto de Piedra, formerly Escuela Agrícola Alto de Piedra, to Río Luis, along Río Primero Brazo, first stream below school, on Atlantic Coast, 08° 33' N, 81° 08' W, 490 m, 28 Jun 1987 (fl), *T. Croat 66873* (BRIT, LL-TEX, MO, PMA); Parque Nacional, Cerro Tute, vicinity of Santa Fé, along road between Alto Piedra, on slopes of Cerro Tute, 800–1,030 m, 15 Jul 1994 (fl), *T. Croat & G. Zhu 76926* (MO); 7 km NW on road to Santa Fé, without elev., 5 Dec 1975 (fr), *W. D'Arcy 10274* (MO); SW side of Cerro Tute, La Cuchilla, 2,500 m, 10 Sep 1982 (fl), *W. D'Arcy 15019* (MO); Isla de Coiba, without elev., 18 Aug 1961 (fl, fr), *J. Dwyer 1612* (F); along beach of Isla de Coiba, without elev., 28 Jul 1962 (fr), *J. Dwyer 2363* (MEXU, NY); rraditional campsite, 1 km past Ag School, forest slope to the rear, road from Santa Fé, 1,000–1,200 m, 5 Feb 1977 (fr), *J. Folsom & L. Collins 1613* (MO); shoulder of Cerro Turi, without elev., 25 May 1977 (fl), *J. Folsom et al. 3375* (MO); Cerro Tute ridge up from former Escuela Agrícola, Santa Fé, 08° 35' N, 81° 05' W, 800–1,100 m, 15 Jul 1983 (fl), *C. Hamilton & K. Krager 3973* (LL-TEX, MO); trail on ridge to summit of Cerro Tute, Cordillera de Tute, 1 km past Escuela Agricola Altos de Piedras, W of Santa Fé, 08° 36' N, 81° 06' W, 750–950 m, 15 Dec 1981 (fl), *S. Knapp & K. Sytsma 2498* (LL-TEX, MO); (fr), *S. Knapp & K. Sytsma 2518* (LL-TEX, MO); above Escuela Agrícola Alto de Piedra, just W of Santa Fé, 3,200 ft [975 m], 7 Jun 1973 (fl), *J. Luteyn 4012* (LL-TEX); N of Santa Fé, on property of Escuela Agricola Alto de Piedra, woods near cattle shelter at Girasol, 16 Oct 1974 (fl), *S. Mori & J. Kallunki 2520* (LL-TEX, MO); Cerro Tute, ca. 10 km NW of Santa Fé, on lower slopes, 750–1,000 m, 19 Jun 1975 (fl), *S. Mori 6738* (LL-TEX, MO), 2 Aug 1975 (fl), *S. Mori et al. 7545* (LL-TEX, MO); Cerro Tute, along ridge-trial towards summit, 08° 30' N, 81° 07' W, 1,000–1,250 m, 21 Mar 1987 (fr), *G. McPherson 10744* (MO); vicinity of Cerro Tute-Arizona, along trail to summit beyond Altos de Piedra, above Santa Fé, 08° 30' N, 81° 10' W, 850–1,100 m, 27 Jul 1988 (fl), *G. McPherson 12797* (BRIT, F, LL-TEX, MO, PMA); along trail to summit of Cerro Tute, ca. 3 km above Escuela Agricultura Alto Piedra near Santa Fé, 2600–2800 ft [792–853 m], 4 Jan 1981 (fr), *K. Sytsma & T. Antonio 2997* (BRIT, MO). **COLOMBIA. Chocó:** Quebrada Changamé to the mouth of the Río Jurubidá, 06° 05' N, 77° 10' W, sea level–100 m, 5 May 1990 (fl), *C. Barbosa 6412* (BRIT, MO); trail between Curiche and Alto de Curiche, 10–1,000 m, 22 Jun 1968 (fl, fr), *J. Duke 15799* (MO, OS).

It is notable that *Ardisia coibana* (Lundell) Lundell, *A. esquipulasana* Lundell, *A. obtusata* (Lundell) Lundell, *A. riomonteana* Lundell, and *A. ustupoana* (Lundell) Lundell, are all invalid names because Lundell (1986) made the transfers "to obviate the incentive of workers to undertake such unnecessary reductions [of *Icacorea* (Aubl.) Mez, *Auriculardisia* Lundell, *Gentlea* Lundell, *Graphardisia* (Mez) Lundell, *Oerstedianthus* Lundell, *Ibarrea* Lundell, *Amatlania* Lundell, and *Zunilia* Lundell*]* to subgenera." Therefore, according to ICBN 34.1, we feel that the names are invalidly published because both clauses, "(a) when it is not accepted by the author in the original publication, and (b) when it is merely proposed in anticipation of the future acceptance of the group concerned, or of a particular circumscription, position or rank of the group," are clearly fulfilled. However, this is not the case for *Ardisia murphyae* (Lundell) Lundell because the transfer (Lundell 1987) was effected with no commentary on the part of the author. We have not validated Lundell's combinations in *Ardisia* here because we consider these names taxonomic synonyms and to do so would require that we recognize them as distinct taxa.

Ardisia opegrapha subsp. *opegrapha* exhibits great quantitative variation among relative size of its organs within individuals and among populations within its somewhat restricted geographic range. Repeated sampling from one individual at Parque Nacional Altos de Campana, Panama (*M. Ruíz et al. 165, 210, 5139, 7320, 7800, 7865*) over a three year period revealed that relative size of leaves to inflorescence is highly variable even within the same individual. Given that the inflorescences are terminal, the branches are pseudoverticillate and growth is rythmic, *Ardisia opegrapha* exhibits Scarrone's Model (Hallé et al. 1978). Repeated collections would amount to a pruning experiment and while the tree grew from 1.5 m tall when first collected in July of 1988 (*M. Ruíz et al. 165*) and reached a height of three meters in June of 1991 (*M. Ruíz et al. 7865*), some of the radical size difference among the leaves on the specimens may be consequent to reiteration phenomena previously discussed by Pipoly (1992, 1998). Unfortunately, no data is available to determine whether successive specimens were taken from normal sympodial (by substitution) branches of the tree, or from reiterative (bayonet type) shoots as a direct result of pruning effected during specimen collection. Morphological variation among populations is much greater than that observed within individuals, and this plasticity has led to overdescription, because species circumscription has been reliant on relative size of inflorescences to leaves, bracts to pedicels, relative crowding of the flowers in the corymbs, length of floral parts, and plant height. The rationale for relegating 12 species to synonymy is explained below; relative terms (larger, smaller, thinner, and thicker) refer to comparisons with populations with features of the type of *Ardisia opegrapha*.

Ardisia oliveri was collected from populations whose inflorescences are larger than average, large relative to the leaves, and whose flowers were in full anthesis. *Ardisia seibertii* also has inflorescences that are large relative to the size of the leaves; the inflorescence branches bear pedicels in high anthotactic spirals, giving the impression that the flowers are in umbels rather than true corymbs. The type of *Ardisia skutchii* is notable only for its sepals that are slightly shorter and wider than the average, short petioles and flowers white with only a slight pink tinge. *Ardisia subcoriacea* was described because it has relatively smaller, subcoriaceous leaves, petioles not marginate to the base, smaller flowers, elliptic sepals with hyaline margins and short stamens. *Graphardisia coibana*, whose type is a fruiting collection, was separated by its thick leaves with abruptly caudate-acuminate apices and long-attenuate bases. However, both of these features lie well within the range of quantitative variation for the subspecies.

Ardisia picturata's type represents populations with extremely thin leaves, but otherwise identical to "typical" subspecies *opegrapha*. It is interesting to note that the type (*Dwyer & Kirkbride 7818*) is a specimen that amply demonstrates the range of variation in size and shape of the leaves within the taxon; the LL-TEX isotype has small nearly elliptic leaves, while the isotypes at MO and NY have leaves nearly twice as large as the LL-TEX sheet, and are elliptic to widely oblanceolate (essentially obovate). Clearly, there is no practical way to separate the *A. picturata* morphotype. Other taxa segregated principally because of thin leaves include *Graphardisia nicaraguensis* and *G. obtusata*, both of which are otherwise notable for their oblanceolate and oblong leaves, the former with obovate or elliptic sepals and the latter with narrowly obtuse sepal apices. Recognition of these various taxa amounts to describing plants different in overall aspect rather than unique characters.

Other examples of minor variations used to separate species include the sparsely ciliolate sepals found on the type of *Graphardisia ustupoana*, and the pellucid rather than black punctate leaves found on the type of *Graphardisia murphyae*. In addition, *Graphardisia oxyphylla* has reddish instead of black punctate-lineate sepals, relatively thick petioles and flower size at the smaller end of the continuum for the subspecies. The description of *Graphardisia seranoana* was based primarily on its subsessile anthers, but reexamination of the type reveals that the measurements were taken from very young floral buds. The duplicate collection at MO contained more mature buds, and open floral remnants with stamens well within the size range of variation found in subsp. *opegrapha*. Therefore the mistake was owing to the holotype specimen's condition rather than to a biological characteristic.

Ardisia opegrapha is most closely related to *A. bartlettii* based on its yellow glandular-granulose corolla tube, but can easily be separated from it by the membranaceous, oblong apically broadly rounded to obtuse sepals with entire margins, and sessile- to stalked glandular-papillate filaments. Among the subspecies of *Ardisia opegrapha*, subspecies *opegrapha* is most easily recognized by a combination of the obpyramidal inflorescence, caducous floral bracts and floral parts larger than the other two subspecies. It appears to be more closely related to subsp. *wagneri* than it is to subsp. *paquitensis* because of the obpyramidal inflorescence shape and leaves 3 or more times longer than wide.

2b. Ardisia opegrapha Oerst. subsp. **wagneri** (Mez) Pipoly & Ricketson, comb. et stat. nov. (**Figs. 1B, 4**). *Ardisia wagneri* Mez, Pflanzenr. IV. 236 (Heft 9):79. 1902. *Graphardisia wagneri* (Mez) Lundell, Phytologia 48:141. 1981. TYPE: PANAMA. CHIRIQUÍ: Volcán de Chiriquí [Volcán de Barú], without elev., without date (fr), *M. Wagner 623* (LECTOTYPE, here designated: GOET).

Mez (1902) listed collections from Volcán Barú, including *M. Wagner 623* and *F. Lehmann s.n.*, and cited herbaria at GOET, M, and W, without reference as to which specimen was deposited where. Searches of the collections at M and W failed to discover any material of either *M. Wagner 623* or *F. Lehmann s.n.* A misidentified collection of *Lehmann s.n.* was located at W, bearing a determination by Mez in 1901 as *Ardisia opegrapha*. Therefore, we assume it does not fit Mez's original concept of *A. wagneri*. The Wagner collection at GOET most closely fits the description of *A. wagneri* and we therefore designate it as the lectotype.

Ardisia bracteolata Lundell, Wrightia 6:65. 1979. SYN. NOV. *Graphardisia bracteolata* (Lundell) Lundell, Phytologia 48:140. 1981. TYPE: NICARAGUA. ZELAYA: 6.3 km S of bridge at Colonia Yolaina on road to Colonia Manantiales of Nueva Guinea, primary tall, evergreen forest on steep areas above stream, 200–300 m, 13–14 Feb 1978 (fr), *P.C. Vincelli 252* (HOLOTYPE: MO; ISOTYPE: NY).

Ardisia zelayensis Lundell, Wrightia 6:95. 1979. SYN. NOV. *Graphardisia zelayensis* (Lundell) Lundell, Phytologia 48:141. 1981. TYPE: NICARAGUA. ZELAYA: near Río Okwamwás, 12 km E of Rosita, without elev., 15 Jun 1978 (fl), *D. Neill 4478* (HOLOTYPE: MO (F Neg. # 55686)).

Graphardisia hyalina Lundell, Wrightia 7:273. 1984. SYN. NOV. *Ardisia neohyalina* Lundell, Phytologia 61:65. 1986, nomen novum invalidum, non *Ardisia hyalina* Lundell, Wrightia 3:99. 1964. TYPE: COSTA RICA. ALAJUELA: Finca Los Ensayos, ca. 11 mi NW of Zarcero, primary forest and perimeter, ca. 850 m, 15 Aug 1977 (fl), *T. Croat 43565* (HOLOTYPE: LL-TEX; ISOTYPE: MO).

Graphardisia purpurea Lundell, Phytologia 59:431. 1986. SYN. NOV. *Ardisia ebingeri* Lundell, Phytologia 61:63. 1986, nomen novum invalidum, non *Ardisia purpurea* Reinw. in Blume, Bijdr. 13:684. 1826. TYPE: PANAMA. CHIRIQUÍ: Boquete, 6 mi N of Concepción, second growth forest, without elev., 4 Aug 1960 (fr), *J.E. Ebinger 751* (HOLOTYPE: US; ISOTYPE: MO).

Shrubs to *small trees* (0.5–)2–6 m tall, 2–5 cm in diam. *Branchlets* 2–4 mm in diam. *Leaves* with blades elliptic or oblanceolate 10–23 cm long, 4–7.5(–8) cm wide; petioles canaliculate, 0.7–2 cm long. *Inflorescence* obpyramidal, a pinnate panicle of corymbs, 2–8.5 cm long, 4–15 cm wide; peduncle obsolete to 3.5 cm long; inflorescence branch bracts numerous, oblong, 10–26 mm long, 3.5–8 mm wide, persistent; floral bracts linear to oblong, 6–9.2 mm long, 1–3.1 mm wide, persistent; pedicels 6–23 mm long. *Flowers* 8–9.2 mm long; sepals oblong or widely oblong, 4.2–5.2 mm

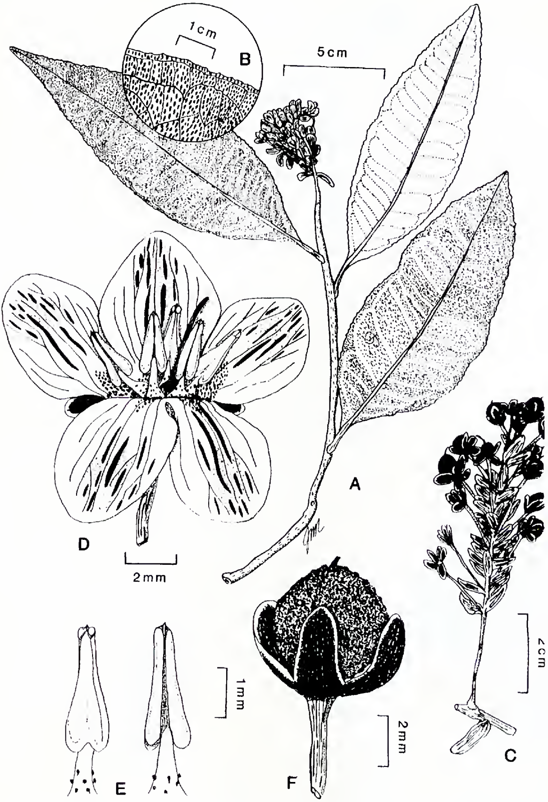

Fig. 4. *Ardisia opegrapha* Oersted subsp. *wagneri* (Mez) Pipoly & Ricketson. A. Habit, flowering branch. B. Detail of abaxial leaf surface. C. Detail of inflorescence. D. Detail of flower, showing corolla and stamens. E. Detail of stamen, showing adaxial and abaxial surfaces. F. Fruit. A, B, drawn from lectotype. C, F drawn from *P. Moreno & W. Robleto 20745*. D–E, drawn from *F. Araya et al. 306.*

long, 2.2–3.1 mm wide; corolla 7.1–9 mm long, the tube 0.3–0.5 mm, the lobes ovate, 7.0–8.5 mm long, 3.8–4.5 mm wide; stamens 3.8–5 mm long, the staminal tube 0.3–0.6 mm long, the filaments (0.5–)1.5–2 mm long, 0.5–0.7 mm wide, the anthers 2.3–3.2 mm long, 0.9–1.1 mm wide at base; ovary with style 3.5–5 mm long; ovules 12–13, pluriseriate. *Fruit* 4.2–5.5 mm in diam.

Distribution.—Central America, primarily in areas with drainage toward the Caribbean, subsp. *paquitensis* is found from Nicaragua (Jinotega, Matagalpa, Chontales, Zelaya and Rio San Juan) southward through Costa Rica (Guanacaste, Alajuela, Heredia, Puntarenas and Limón) to Panama (Chiriquí and Bocas del Toro) from sea level–1450 m elevation.

Ecology and conservation status.—Primary, remnant and secondary forests in lower montane, premontane, evergreen tropical wet forests and cloud forests.

Etymology.—The specific epithet commemorates Moritz Friedrich Wagner (1813–1887), Bavarian botanist and zoologist, who traveled to Panama and Ecuador between 1857–1860.

Additional specimens examined. **NICARAGUA. Chontales:** Santo Domingo, 500–1000 m, 13 Jan 1970 (fl, fr), *J. Atwood 3346* (MO); Cerro Oluma, near top of Cordillera Amerisque, 12° 18' N, 85° 24' W, 840 m, 3 Jan 1984 (fr), *A. Gentry et al. 43897* (MO); Cerro Oluma, ca. 3 km SW de Ciudad Cuapa, 12° 18' N, 85° 20' W, 700–740 m, 3 Jan 1984 (fl), *A. Grijalva et al. 3380B* (MO); Cerro Las Nubes, El Tamagás and Loma San Gregorio, ca. 2 km N of Santo Domingo, 600 m, 20 Jan1984 (fr), *A. Grijalva & D. Ríos 3493* (MO); 4 km NNW of Cuapa, ridgetops and summits of Cerro Oluma, 12° 18' N, 85° 23' 30" W, 700–775 m, 23 Sep 1983 (fl), *M. Nee 28425* (MO). **Jinotega:** Comarca Santa Cruz, el Calvario, al SW del Cerro Kilambé, 13° 34' N, 85° 40' W, 900–1,000 m, 27 Mar 1981 (fr), *P. Moreno 7730* (MO); Las Brisas, Comarca Kilambé, 13° 35–36' N, 85° 39' W, 930 m, 13 Jul 1980 (fl), *J. Sandino 160* (MO); Cerro San Pedro, Comarca Kilambé, 13° 30' N, 85° 38–39' W, 820 m, 21 Jul 1980 (fl), *J. Sandino 186* (MO). **Matagalpa:** 78 km from Matagalpa, along Matagalpa-Siuna Hwy, La Gloria, 13° 15' N, 85° 35' W, 600 m, 13 Sep 1982 (fr), *P. Moreno 17227* (MO); El Comején, 1 km W of Hwy. to Waslala, 13° 15' N, 85° 34' W, 600 m, 23 Feb 1983 (fr), *P. Moreno 20597* (MO). **Río San Juan:** Along Río Sábalo, 11° 03' N, 84° 28' W, 40 m, 07–08 Jul 1984 (fl), *P. Moreno & W. Robleto 25981* (MO); La Lupe near Río Santa Cruz, 11° 08' N, 84° 22' W, without elev., 7 Oct 1990 (fr), *J. Salick 7860* (MO). **Zelaya:** Nueva Guinea, 11° 46' N, 84° 26' 30" W, 200 m, 11 Ago 1982 (fl), *M. Araquistain 3007* (MO); Nueva Guinea, Colonia Yolaina, 11° 40' N, 84° 22' 30" W, without elev., 13 Ago 1982 (fl), *M. Araquistain 3087* (MO); El Achiote, 11° 47' N, 84° 26' W, 200 m, 25 Ago 1982 (fl), *M. Araquistain 3132* (MO); Cerro El Naranjo, ca. 15 km SW of Waní, without elev., 14 Sep 1982 (fl), *A. Grijalva & P. Moreno 1134* (MO), (fr), *A. Grijalva & P. Moreno 1153* (MO); Río Punta Gorda, Atlanta, La Richard, Loma San Jorge, 11° 31' N, 84° 04' W, 150–160 m, 13 Nov 1981 (fr), *P. Moreno & J. Sandino 13039* (MO); Río Punta Gorda, Atlanta, al SE de La Richard, 11° 32' N, 84° 05' W, 30 m, 14 Nov 1981 (fr), *P. Moreno & J. Sandino 13100* (MO); Comarca Waslala, 6.5 km al SE de Waslala, 13° 16' N, 85° 24' W, 520–560 m, 14 Sep 1982 (fr), *P. Moreno 17273* (MO); El Naranjo, a 50 km de Siuna, along Matagalpa-Siuna Hwy., 10 km al W de la cuesta El Guayabo, 13° 34' N, 85° 10' W, 300 m, 14 Sep 1982 (fr), *P. Moreno 17312* (MO); La Posolera, 5 km al W de Waslala, carretera El Tuma a Waslala, 13° 17' N, 85° 24'

W, 700 m, 22 Dic 1982 (fr), *P. Moreno 19119* (MO); El Guásimo, camino a El Dos, NE de Siuna, 13° 48' N, 84° 39' W, 360–380 m, 25 Feb 1983 (fr), *P. Moreno & W. Robleto 20745* (MO); Mpio. de Siuna, Waní, without elev., 27 Ago 1982 (fr), *F. Ortíz 49* (MO); Mpio. de Siuna, Comarca Santa Rosa, without elev., 6 Sep 1982 (fr), *F. Ortíz 112* (MO); Mpio. de Siuna, Comarca Danlí, 100–130 m, 31 Sep 1982 (fl), *F. Ortíz 201* (MO); Mpio. de Siuna, Waspado, 100–120 m, 6 Oct 1982 (fr), *F. Ortíz 281* (MO); Mpio. de Siuna, El Torno, 120 m, 10 Oct 1982 (fr), *F. Ortíz 324* (MO); Sector Mina Nueva América, 13° 45' N, 84° 30' W, 500 m, 22 Sep 1984 (fr), *F. Ortíz 2130* (MO); Bonanza, on ground of Neptune Mining Co, 14° 02' N, 84° 35' W, 350–450 m, 26 Feb 1979 (fr), *J. Pipoly 3516* (MO); Laguna Santa Rosita on road from Bonanza to El Salto Grande, 14° 03' N, 84° 37' W, 140–160 m, 27 Feb 1979 (fl), *J. Pipoly 3670* (MO); Finca Waylawás, 13° 39' N, 84° 48' W, 80 m, 12 Mar 1979 (fl), *J. Pipoly 4420* (MO); Risco de Oro, 40 m, 22 Mar 1979 (fl), *J. Pipoly 5010* (MO); Estación Experimental El Recreo, 12° 09' N, 84° 17' W, 15 m, 10 Jan 1985 (fr), *D. Ríos 232* (MO); 1 km S de Colonia Verdún, en Nueva Guinea, 11° 38' N, 84° 26' W, 200–250 m, 17 Jul 1982 (fl), *J. Sandino 3260* (MO); Cerro El Escobín, 4 km de Colonia Serrano, 11° 33–34' N, 84° 21–22' W, 120–130 m, 30 Jul 1982 (fl), *J. Sandino 3369* (MO); 1 km de Colonia Serrano, Río Serrano, 11° 34' N, 84° 21–22' W, 70–80 m, 31 Jul 1982 (fl), *J. Sandino 3427* (MO); Toro Bayo and Esquipulas, drainage of Ríos Jícaro and Esquipulas, 130 m, 20 Nov 1951 (fr), *P. Shank & A. Molina R. 4610* (F); Esquipulas Mountains, 130 m, 22 Nov 1951 (fr), *P. Shank & A. Molina R. 4696* (F); Esquipulas Mountains and Alemán, Río Alemán Drainage Basin, 150 m, 27–29 Nov 1951 (fr), *P. Shank & A. Molina R. 4766* (F), (ster.), *P. Shank & A. Molina R. 4850* (F); Ríos Punta Gorda, Alemán, and Zapote Drainage Basins, 30 m, 5 Dic 1951 (fl), *P. Shank & A. Molina R. 4966* (F); Estación Experimental El Recreo, ca. 1.5 km SE of the station, 100 m, 10 Ene 1985 (fr), *D. Soza et al. 378* (MO). along new road from Río Blanco to Río Copalar, ca. 31 km E of Río Blanco, 12° 50–55' N, 85° 00–05' W, 200–400 m, 13 Feb 1979 (fl), *W. Stevens 12153* (MO, NY); along road from Bonanza to Constancia, 13° 58'–14° 01' N, 84° 37–40' W, 160–360 m, 21 Feb 1979 (fl), *W. Stevens 12493* (MO); along road between El Empalme and Limbaika, ca. 1.5 km SE of Palmera, 13° 35' N, 84° 20' W, 60 m, 24 Feb 1979 (fr), *W. Stevens 12836* (MO); along Río Waspúk ca. 1 km upstream from confluence of Río Pis-Pís, 14° 15' N, 84° 36 W, 75–100 m, 1 Mar 1979 (fr), *W. Stevens 13083* (MO). **Without Department:** 1867 (fl), *B. Seeman s.n.* (BM). **COSTA RICA. Alajuela:** Cantón San Ramón, R.F. San Ramón, Cordillera de Tilarán, trail to Volcán Muerto, 10° 12' 55" N, 84° 36' 25" W, 1,100–1,200 m, 11 May 1993 (fl), *F. Araya et al. 306* (BRIT, MO, NY); Reserva Biológica Monteverde Río Peñas Blancas, Parcela de Manuel Rojas, 850 m, 8 Aug 1988 (fl), *E. Bello 291* (MO); Cantón Upala, ca. 3 km NNE of Bijagua along new road to Upala, 10° 45' N, 85° 03' W, 450 m, 7–8 Nov 1975 (fr), *W. Burger & R. Baker 9847* (F); E slopes of Volcan Miravalles, W of Bijagua, near the Río Zapote, 10° 44' N, 85° 05' W, 600 m, 11–12 Feb 1982 (fr), *W. Burger et al. 11684* (BM, F, LL-TEX); along road between Canas (Guancaste) and Upala, near Río Zapote, 1.8–2.7 km S of Río Canalete, 100 m, 25 Jun 1976 (fl), *T. Croat 36349* (BRIT, MO); along Hwy. 15, between Naranjo and Aguas Zarcas, 8 km NE of Quesada, 600 m, 3 Feb 1979 (fr), *T. Croat 46928* (MO); without further locality, without elev., without date (fl), *E. Friedrichsthal 1296* (W); Cantón Upala, P.N. Guanacaste, Cordillera de Guanacaste, Estación San Ramón, La Campana, Dos Ríos, 10° 52' 50" N, 85° 24' 05" W, 550 m, 23 Mar 1994 (fl), *T. García 203* (BRIT, MO); Laguna de Río Cuarto, Sarapiquí, 400 m, 5 Nov 1984 (fr), *J. Gómez-Laurito 10215* (F); along creek in Florencia San Carlos, 250 m, 30 Jun 1985 (fl), *W. Haber et al. 1770* (MO); Cantón San Ramón, Valley of Río La Esperanza, 4 km SW of La Tigra, Finca Araya Ledezma, Bosque Eterno de Los Niños, 10° 18' N, 84° 37' W, 500–600 m, 3 Jul 1992 (fl), *W. Haber et al. 11260* (MO); Cantón Upala, Dos Ríos, 5 km S of Brasilia, right bank of Río Pizote to Minga House, 10° 55' N, 85° 20' W, 500 m, 31 Oct 1987 (fr), *G. Herrera*

1060 (MO); Cantón San Carlos, along Río Rafael, near La Marina, Llanura de San Carlos, 550 m, 21 Feb 1966 (fr), *A. Molina et al. 17708* (F); Parque Nacional Rincón de la Vieja Colonia Blanca, farm in Quebrada Rancho Grande, 10° 46' 55" N, 85° 15' 10" W, 500 m, 14 Jul 1991 (fl), *G. Rivera 1452* (MO); S slope of Volcan Arenal, above Río Agua Caliente, without elev., 21 Feb 1989 (fr), *G. Russell et al. 870* (MO, US); 9.8 km N of Río Naranjo on road to Upala, local name for area is El Macho, 440 m, 8 Nov 1975 (fr), *J. Utley & K. Utley 3273* (F); ca. 2 km S of the town of Canalete along road to Upala, 100 m, 12 Nov 1975 (fr), *J. Utley & K. Utley 3305* (F); Cantón Aguas Zarcas, Atlantic rain forest area on Hacienda la Marina, Río San Rafael, 450–500 m, 8 Feb 1965 (fr), *L. Williams et al. 29120* (F). **Guanacaste:** Cantón Tilarán, bosque entre La Laguna del Arenal y el Alto de La Carpintera, 700 m, 26 Jun 1930 (fl), *A. Brenes 12653* (F); Z.P. Tenorio, Cordillera de Guanacaste, Estación Tenorio, 10° 36' 40" N, 84° 59' 45" W, 1,050 m, 10 Aug 1992 (fl), *G. Carballo 436* (MO); Rancho Harold, región del Volcán Cacao, 700–1,200 m, 30 Jul 1986 (fl), *J. Chacón & A. Chacón 2153* (MO); La Cruz de Abangares, 1,400 m, 15 Jul 1985 (fl), *W. Haber & E. Bello C. 1995* (MO), *W. Haber 2000* (MO), *2079* (MO); 2 km SW of La Cruz, on J. Wolfe Farm, 1,400 m, 28 Aug 1985 (fl), *W. Haber 2439* (MO), *2440* (LL-TEX), *2441* (MO), *2442* (MO); La Cruz de Abangares, 1,360 m, 4 Sep 1985 (fl), *W. Haber & J. Wolfe 2513* (BRIT, LL-TEX, MO), 1,400 m, 10 Sep 1985 (fl), *W. Haber & E. Bello C. 2667* (BRIT, LL-TEX, MO), *2691* (LL-TEX), *2693* (MO), 24 Sep 1985 (fl), *W. Haber & E. Bello C. 2888* (LL-TEX, MO); Cantón Tilarán, Río Chiquito Zona Monteverde, Finca de Campos, Vertiente Atlántica, 10° 25' N, 84° 53' W, 1,100 m, 7 Jun 1987 (fl), *W. Haber & E. Bello C. 7439* (MO), *7454* (MO, US); Cantón Liberia, Parque Rincón de La Vieja, del Mirador siguiendo la Fila al Volcán Santa María, 10° 46' N, 85° 49' W, 1,100–1,300 m, 27 Nov 1987 (fl, fr), *G. Herrera 1435* (MO); Parque Nacional Guanacaste Estación Pitilla, Finca La Pasmompa, 11° 02' N, 85° 24' W, 300 m, 17 Jun 1989 (fl), *II INBIO 53* (BRIT, MO); Silencio-Tilarán, without elev., 31 May 1932 (fl), *W. Kupper 1529* (M); Cantón Liberia, Parque Nacional Guanacaste, Cordillera de Guanacaste, Estación Cacao, trail to Fran's House, 10° 55' 43" N, 85° 28' 10" W, 1,100 m, 8 Feb 1995 (fr), *M. Lobo 25* (BRIT, MO); Sendero Nacho y La Esperanza, 10° 59' 26" N, 85° 25' 40" W, 700 m, 22 Jul 1991 (fl), *P. Ríos 385* (MO); Hacienda Tenorio, without elev., 17 Feb 1956 (fl, fr), *B. Schubert 1086* (A); ca. 3 km N of Río Naranjo, near the continental divide and ca. 100 m S of the Guanacaste–Alajuela border, 10° 42' N, 85° 04' W, 500 m, 5 Jan 1975 (fl), *J. Taylor 18094* (F). **Heredia:** Carrillo Estación Magsasay, Sarapiquí, 10° 24' 18" N, 84° 03' 30" W, 200 m, 5 Jul 1990 (fl), *D. Acevedo et al. 128* (MO); 5 Jul 1990 (fl), *G. Carballo 151* (BRIT, MO); N of Puerto Viejo, 12 km to ferry, over ferry, 6 km along road, 100 m, 3 Feb 1983 (fr), *N. Garwood et al. 961* (BM); Cantón Sarapiquí, Parque Nacional Braulio Carrillo, Estación Carrillo, Quebrada Sandijuela, 500 m, 25 Jul 1984 (fl), *L. Gómez et al. 22966* (F, LL-TEX, MO); Finca La Selva, the OTS field station on the Río Puerto Viejo just E of its junction with the Río Sarapiquí, along West River Road, near point, without elev., 16 Aug 1979 (fl), *M. Grayum 2403* (MO); edge of trail on point, 100 m, 8 Apr 1982 (fl), *B. Hammel 11619* (F), 100 m, 23 Apr 1982 (fl), *B. Hammel 11825* (F, LL-TEX); Cantón Sarapiquí, Finca La Selva, Puerto Viejo, forest along Quebrada Leonél, 10° 26' N, 84° 01' W, without elev., 11 Jul 1973 (fl), *G. Hartshorn 1254* (BRIT, F, MO); La Selva, ca. 1,650 m along Holdridge Trail, at creek crossing, tributary of Quebrada El Pantana, 100 m, 15 Jul 1984 (fl), *B. Jacobs 2871* (MO); La Selva, 775 m line, West River Road, 100 m, 22 Oct 1982 (fr), *T. McDowell 562* (MO); E of 1120 West River Road, between Río Puerto Viejo and Hunters Cocoa grove, 100 m, 1 Dec 1982 (fr), *T. McDowell 1007* (MO); Finca La Selva, ca. 4 km SE of Puerto Viejo, 10° 28' N, 84° 00' W, 50 m, 21 Jul 1976 (fl, fr), *J. Solomon 5328* (F, MO). **Limón:** Cantón Pococi, R.N.F.S. Barra del Colorado, Llanura de Tortuguero, Sardinas, 15–20 m, 12 Dec 1992 (fl, fr), *F. Araya 147* (MO); La Concepción, Llanuras de Santa Clara, 250 m, Apr 1896 (fl), *J. Donnell Smith 6677* (LL-TEX); Vicinity of U.S. Department of Agriculture Rubber Experiment Station, Los Diamantes, on Río St. Clara, 1.6 km E of Guapiles, 200 m, 9 Jul 1949 (fl), *R. Holm & H. Iltis 315* (G, GH); Cantón Poweí, La Granja, Finca Vieja, 260 m, 26 Jul 1936 (fl), *F. Solís R. 416* (F, MO). **Puntarenas:** Monteverde, Altos del Río San Luis, División al Río Lagarto, Santa Elena, 10° 16' N, 84° 50' W, 1,000 m, 18 Jul 1989 (fl), *E. Bello C. 1032* (MO); Reserva Biológica Monteverde, Altos de Santa Elena, 10° 19' N, 84° 49' W, 1, 400 m, 6 Aug 1991 (fl), *E. Bello C. 2929* (INB, MO); Monteverde, lower community, 1,350–1,400 m, 1 Mar 1985 (fr), *W. Haber 1427* (MO), *1428* (LL-TEX); Monteverde, Pacific slope forest, 1,450 m, 8 Aug 1985 (fl), *W. Haber 2187* (MO), *2188* (LL-TEX), *2189* (MO), *2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199* (MO); Monteverde community, 1,450 m,18 Aug 1985 (fl), *W. Haber 2276* (MO), *2315, 2316* (LL-TEX); *2317* (MO), *2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2329, 2331* (MO); Monteverde community, Pacific slope, 10° 20' N, 84° 50' W, 1,400 m, 9 Jun 1986 (fl), *W. Haber & E. Bello C. 5031, 5039, 5055, 5063* (MO), 16 Sep 1986 (fl), *W. Haber & E. Bello C. 5641* (MO). **Province unknown:** without date, (fl), *E. Friedrichsthal s.n.* (W), (fl), *F. Lehmann s.n.* (W). **PANAMA. Bocas del Toro:** Water Valley, Vicinity of Chiriquí Lagoon, without elev., 9 Sep 1940 (fl), *H. von Wedel 661* (LL-TEX, MO), 23 Sep 1940 (fl), *H. von Wedel 932* (MO), 9 Oct 1940 (fl), *H. von Wedel 1109* (MO), 5 Nov 1940 (fr), *H. von Wedel 1536* (LL-TEX, MO), 26 Nov 1940 (fr), *H. von Wedel 1769* (MO). **Chiriquí:** Without further locality, without elev., 1858 (fl), *M. Wagner 246* (M (F Neg. # 20056)); Vicinity of San Bartolomé, Península de Burica, sea level–50 m, 28 Jul–01 Aug 1940 (fl), *R. Woodson & R. Schery 906* (LL-TEX, MO).

As with the other two subspecies of *Ardisia opegrapha*, marked but continuous quantitative variation in relative sizes of parts and persistence of floral bracts has caused much overdescription. The type of *Ardisia bracteolata*, a fruiting collection, is notable only for its thin, narrowly oblong sepals that are at times emarginate apically, often varying within the same specimen. *Ardisia zelayensis* was described owing to its relatively large sepals with obtuse apices, and the leaves with acute apices and cuneate bases. Populations represented by the type of *Graphardisia hyalina* vary from all others of the subspecies because their anthers have more rounded bases and more narrow apices. The diminutive size of the inflorescence, its rachis and pedicels, together with the extremely slender pedicels of populations from which the type of *Graphardisia purpurea* was collected probably led to its description.

The numerous, persistent floral bracts distinguish subsp. *wagneri* from subsp. *opegrapha* and subsp. *paquitensis*. In late fruit, the bracts sometimes fall, but even then, this subspecies can easily be recognized by the crowded pedicel scars.

2c. **Ardisia opegrapha** Oerst. subsp. **paquitensis** (Lundell) Pipoly & Ricketson, comb et stat. nov. (**Figs. 1C, 5**). *Ardisia paquitensis* Lundell, Phytologia 2:4. 1941. *Graphardisia paquitensis* (Lundell) Lundell, Phytologia 48:140. 1981. TYPE: COSTA RICA. SAN JOSÉ: San José, low hills above Río Paquita, 5–50 m, 15 Aug. 1936 (fl, fr), *C.W. Dodge & V.F. Goerger 9885* (HOLOTYPE: F, (F Neg. # 68245, LL-TEX Neg. # 1971-81); ISOTYPE: MO, (LL-TEX Neg. # 1971-81)).

Shrubs or *small trees* (0.6–)1–6 m tall. *Branchlets* 4–6(–7) mm in diam. *Leaves* with blades elliptic to broadly elliptic 20.5–30 cm long, (7.5–)8–

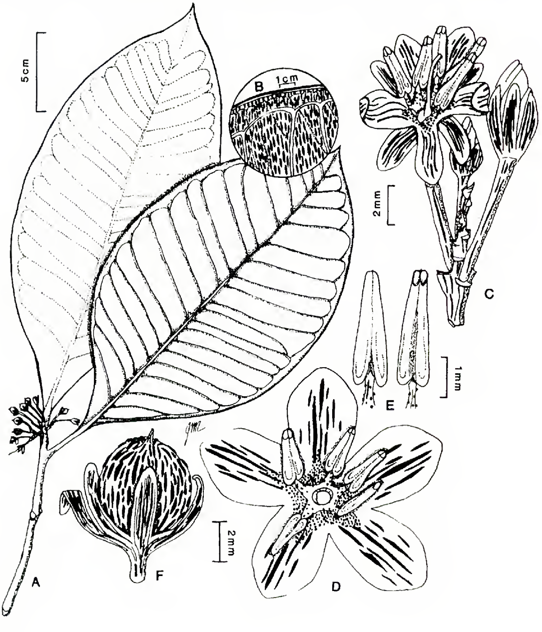

FIG. 5. *Ardisia opegrapha* Oersted subsp. *paquitensis* (Lundell) Pipoly & Ricketson. A. Habit, flowering branch. B. Detail of abaxial leaf surface. C. Detail of inflorescence. D. Detail of flower, showing corolla and stamens. E. Detail of stamen, showing adaxial and abaxial surfaces. F. Fruit. A, C–E drawn from holotype. B, F drawn from isotype.

14.5 cm wide; petioles marginate, (1.5–)2–3(–3.5) cm long. *Inflorescence* globose, a panicle of compound corymbs, (2.5–)3–5 (–7) cm long; peduncle obsolete to 0.5(–1) cm long; inflorescence branch bracts 7.2–15.5 mm long, 2.6–6.5 mm wide, caducous; floral bracts 3.7–4.8 mm long, 0.8–1.3 mm wide, caducous; pedicels 8.5–13 mm long. *Flowers* 7.5–10 mm long; sepals oblong, 4.5–7 mm long, 2.5–3 mm wide; corolla 7–9.5 mm long, the tube 0.6–0.7 mm long, the lobes widely ovate to oblong, 6.5–9 mm long, 4.6–5.7 mm wide; stamens 4–5.2 mm long, the staminal tube 0.6–0.8 mm long, the filaments 1–2.5 mm long, 0.5–0.7 mm wide, the anthers 3.3–3.6 mm long, 0.9–1.1 mm wide at base; ovary with style 4–4.2 mm long, the ovules 11–12, pluriseriate. *Fruit* 4.5–5(–7) mm in diam.

Distribution.—Endemic to Costa Rica, in the Provinces of Limón, Cartago, San José and Puntarenas (especially common in the Cantons of Osa and Golfito); sea level–1,400 m elevation.

Ecology and conservation status.—Subspecies *paquitensis* occurs in primary and secondary tropical wet forests as a locally infrequent component of the understory. Because of its restricted distribution, it should be considered threatened.

Etymology.—The specific epithet 'paquitensis' refers to the type locality, along the Río Paquita, Province of San José, Costa Rica.

Additional specimens examined. COSTA RICA. **Cartago:** above Tuíz, road to Morravia Chirripó, without elev., 1 Oct 1982 (fr), *D. Hazlett 5101* (F, LL-TEX). **Limón:** Reserva Indígena Talamanca Sukut, mouth of Río Sukut at Río Urén path to SE, toward Purisquí, 09° 24' 15" N, 82° 58' 10" W, 350–550 m, 6 Jul 1989 (fl), *B. Hammel et al. 17551* (BRIT, MO). **Puntarenas:** Cantón Osa, Reserva Forestal Golfo Dulce Aguabuena, 08° 41' 50" N, 83° 30' 43" W, 40–50 m, 2 Aug 1991 (fl), *R. Aguilar 178* (MO); Cantón Golfito, Parque Nacional Corcovado, Peninsula de Osa, Estación Sirena, Sendero Ollas, 08° 28' 50" N, 83° 35' 30" W, 10 m, 13 Jun 1994 (fl), *R. Aguilar 3411* (BRIT, MO); Cantón Osa, vicinity of Palmar Norte, along Río Grande de Terraba, sea level, 2 Jul 1949 (fl), *P. Allen 5317* (A, F 3-sheets, GH, MO); vicinity Palmar Norte de Osa, 30 m, 6 Sep 1950 (fl), *P. Allen 5657* (F); Parque Nacional Corcovado, Peninsula de Osa, Sendero Mirador, 08° 33' 10" N, 83° 30' 40" W, 200 m, 30 Aug 1995 (fr), *L. Angulo 487* (MO); Reserva Biológia Carara Estación Quebrada Bonita, 09° 46' N, 84° 36' W, 30 m, 26 Jun 1990 (fl), *E. Bello C. & E. Rojas 2283* (BRIT, MO); near airport, 4 mi W of Rincón de Osa, 08° 42' N, 83° 31' W, 30 m, 4–7 Jun 1968 (fl), *W. Burger & R. Stolze 5463* (F); Cantón Golfito, along hwy from Río Claro (on Panamerican Hwy.) to Golfito, 2.5 m SE of Golfito, 27.5 mi S of Río Claro, 08° 36' N, 83° 04' W, 60 m, 15 Sep 1987 (fr), *T. Croat 67621* (BRIT, LL-TEX, MO); Sirena, 08° 28' 00" N, 83° 35' 00" W, 1–200 m, 26 Jun 1991 (fl), *P. Delprete 5117* (TEX); Quebrada Benjamín, Palmar Norte, 08° 59' N, 83° 28' W, 50 m, 14 Jan 1993 (fr), *A. Gentry et al. 78808* (BRIT, MO); Quebrada Cunabrí, Hitoy-Cerera, Baja Talamanca, 500–800 m, Jul 1984 (fl), *L. Gómez 24093* (MO); divide between Quebrada Benjamín and Quebrada Batambal, SW slope of Fila Retinto, NW of Palmar Norte, 08° 59' 00" N, 83° 28' 30" W, 300–400 m, 9 Jul 1990 (fl), *M. Grayum & R. Evans 9867* (MO); La Palma, Río Rincón headwaters, trail to Cerro de Oro, 08° 35' N, 83° 30' 40" W, 100 m, 30 Jul 1990 (fl), *G. Herrera 4070* (BRIT, MO); Playa Cacao, lower basin of Quebrada Nazareno, 08° 37' 50" N, 83° 11' 00" W, 70 m, 27 May 1994 (fl), *G. Herrera & G. Rivera 7081* (F);

between Palmar Norte and Puerto Cortéz, Osa Peninsula, 50 m, 6 Aug 1964 (fl), *A. Jiménez 2239* (F); In Webb's forest, between Palmar Sur and Puerto Cortéz, 400 m, 23 Aug 1965 (fl), *A. Jiménez 3462* (F); Estación Sirena, Naranjo Trail, 08° 27–30' N, 83° 33–38' W, sea level–150 m, 27 May 1988 (fl), *C. Kernan 537* (MO); Monkey Woods, 08° 27–30' N, 83° 33–38' W, sea level, 16 Aug 1988 (fr), *C. Kernan & P. Phillips 828* (MO); Estación Sirena, S of Río Sirena along Río Camaronal, 08° 28' N, 83° 35' W, sea level, 22 Nov 1981 (fr), *S. Knapp 2177* (MO); Corcovado National Park, on hills 0–1 km W of the park headquarters at Sirena, 08° 29' N, 83° 36' W, sea level–200 m, 4 Jul 1977 (fl), *R. Liesner 2832* (MO); Along trail and in forest between park headquarters to Sirena and Pavo, 08° 30' N, 83° 36' W, sea level–10 m, 5 Jul 1977 (fl), *R. Liesner & G. Vega 2900* (MO); Puntarenas-San José border, Barú, 100 m, 16 Aug 1974 (fl), *P. Maas & J. Cramer 1359* (F); Osa Peninsula, Coronado de Osa, 08° 32' 30" N, 83° 18' 30" W, 1–10 m, 24 Jun 1995 (fl), *M. Madrigal 76* (MO); Cantón Osa, Fila Estero Guerra, Sierpe, 08° 34' 30" N, 83° 34' 30" W, 300 m, 27 Sep 1991 (fr), *J. Marín 204* (MO); near the airport area, 4 mi W of Rincón de Osa, 100 ft [30 m], 8 Aug 1967 (fr), *P. Raven 21627* (F, MO); along road to Pacific Ocean, W of Rincón de Osa, Osa Peninsula, near Mile 15, 100 ft [30 m], 8 Aug 1967 (fl), *P. Raven 21681* (F, MO); Rincón de Osa, region N of airfield and ridges running NE, 100–300 m, 23 Jul 1974 (fl, fr), *J. Utley & K. Utley 1194* (F); San Luís de Turrubales, 450 m, 20 Jul 1933 (fl), *M. Valerio 651* (F). San José: Cantón Pérez Zeledón, along road between San Isidro General and Domincal, Fila Tinamastes, 09° 18' 24" N, 83° 46' 11" W, 990–1,100 m, 9 Sep 1996 (fl), *T. Croat & D. Hannon 79101* (MO); Cantón Tarrazú, San Lorenzo, 09° 34' 20" N, 84° 03' 52" W, 1,400 m, 9 Jul 1997 (fr), *L. Gutiérrez et al. 64* (MO); between La Lengua y La Víbora de Puriscal, 1,030 m, 23 Apr 1963 (fl), *A. Jiménez 692* (F); El General Basin, 675–900 m, Jul 1945 (fl), *A. Skutch 5201* (F, MO, NY).

Ardisia opegrapha subsp. *paquitensis* is distinctive because of its globose inflorescence, dwarfed by relatively large elliptic to broadly elliptic leaves.

3. **Ardisia bartlettii** Lundell

Shrubs or small *trees* (0.5–)2–10 m tall, 1–5 cm in diam. *Branchlets* slender, (1.5–)2–3(–3.5) mm in diam., glabrous throughout. *Leaves* with blades membranaceous to chartaceous, lanceolate elliptic or oblong 5.5–16 cm long, 1.8–7 cm wide, apically acute to acuminate, basally acute to acuminate, decurrent on the petiole, midrib impressed above, prominently raised below, the secondary veins prominulous above, inconspicuous below, densely and prominently punctate and punctate-lineate, glabrous, the margins entire, undulate to irregularly crenulate; petioles marginate to canaliculate, slender to stout, 0.2–1.1 cm long, glabrous. *Inflorescence* terminal, bipinnately paniculate, 2–6 cm long, 3.5–7 cm wide, the rachis glabrous, the branches terminating in corymbs; peduncle obsolete to 0.5 cm; secondary inflorescence bracts early caducous, membranaceous, oblong, (2.8–)5.5–11.2(–14.2) mm long, (1.3–)2.5–3.9(–5.4) mm wide, apically acute to obtuse, the midrib prominulous above and below, the secondary veins inconspicuous, densely and prominently black punctate, glabrous, the margins entire, sparsely glandular-ciliolate; floral bracts very early caducous, unknown, at times not leaving detectable scars axillant to pedicel (aborted at primordial stage ?); pedicels 6–15 mm long, slender, mostly accrescent, glandular-grandulose. *Flowers*

5-merous, chartaceous, 6.8–9.2 mm long; calyx with sepals free, broadly ovate, 1.5–2.5 mm long, 0.9–2 mm wide, apically acute, prominately punctate and punctate lineate, glandular-grandulose within, opaque except at margin, the margins erose to subentire, ciliolate; corolla rotate, 6.5–9.2 mm long, the tube 0.5–1.4 mm long, the lobes ovate, elliptic or lanceolate, 6–8 mm long, 1.6–5 mm wide, apically rounded, prominently punctate and punctate-lineate, yellow glandular-grandulose at base between corolla lobe and tube junction and above staminal tube within, glabrous otherwise; margins entire, ciliolate; stamens 3.5–5.7 mm long, the staminal tube 0.5–1.5 mm long, the filaments 0.5–1.5 mm long, 0.2–0.5 mm wide at base, punctate, glabrous, the anthers linear-lanceoloid, 2.5–3.5 mm long, 0.6–0.9 mm wide at base, apiculate, basally sagittate, dehiscent by subapical pores, the connective darkened; ovary glabrous, the style 4.5–5 mm long, slender, stylopodic at base or not stylopodic (tapered), punctate, glabrous, the ovules 13–16, pluriseriate. *Fruit* globose to oblong, 4–5.2 mm long, 4.2–5 mm wide, densely and prominently punctate, glabrous.

Because of its yellow glandular-granules within the corolla tube, *Ardisia bartlettii* is most closely related to *A. opegrapha*, but is easily separated from it by the chartaceous ovate, sepals 1.5–2.5 mm long, with acute apices, opaque except at margin, and the margins subentire to erose. The glabrous filaments are also distinctive. *Ardisia bartlettii* is comprised of two subspecies, separated by size of floral parts, tapering vs. stylopodic style base, and habitat.

3a. Ardisia bartlettii Lundell subsp. **bartlettii (Figs. 1E, 6).** *Ardisia bartletii* Lundell, Contr. Univ. Michigan Herb. 7:37. 1942. *Graphardisia bartlettii* (Lundell) Lundell, Phytologia 48:140. 1981. Type: PANAMA. CANAL ZONE: Barro Colorado Island, Gatún Lake, along William Morton Wheeler Trail, without elev., 8–10 Aug 1940 (fl, fr), *H.H. Bartlett & T. Lasser 16720* (HOLOTYPE: MICH; ISOTYPES: LL-. TEX, MO (LL-TEX Neg. # 1971-20)).

Ardisia romeroi Cuatrec., Revista. Acad. Colomb. Ci. Exact. 8:319. 1951. Syn. nov. *Graphardisia romeroi* (Cuatrec.) Lundell, Wrightia 7:46. 1982. Type: COLOMBIA. Bolívar: Camino de Monte Líbano a San Pedro, without elev., 28 May 1949 (fl), *R. Romero Castañeda 1756* (holotype: F (LL-TEX Neg. 1971-92)).

Ardisia lewisii Lundell, Wrightia 4:146. 1970. Syn. nov. *Graphardisia lewisii* (Lundell) Lundell, Phytologia 48:140. 1981. Type: PANAMA. Colón: Santa Rita Ridge, ca. 5.5–6 mi E of Transisthmian Highway, without elev., 9 Apr 1969 (fl), *W.H. Lewis, D.M. Porter, L.H. Durkee & R.K. Baker 5377* (holotype: LL-TEX; isotypes: LL-TEX, MO, MOCZ n.v., UC).

Ardisia tuirana Lundell, Wrightia 6:91. 1979. Syn. nov. *Graphardisia tuirana* (Lundell) Lundell, Wrightia 7:46. 1982. Type: PANAMA. Darién: Río Tuira and Río Paca, without elev., 21 Jun 1962 (fr), *J.A. Duke 5025* (holotype: LL-TEX; isotypes: BRIT, GH, MO).

Ardisia sapoana Lundell, Phytologia 48:135. 1981. Syn. nov. *Graphardisia sapoana* (Lundell) Lundell, Wrightia 7:46. 1982. Type: PANAMA. Darién: Cerro Sapo, NE slope of summit, approach from Garachiné, knife edge ridge before ascent to top, 2,800 ft [853 m], 9 May 1979 (fl), *B. Hammel 7297* (holotype: LL-TEX; isotype: MO).

FIG. 6. *Ardisia bartlettii* Lundell subsp. *bartlettii*. A. Habit, flowering branch. B. Detail of abaxial leaf surface. C. Detail of inflorescence. D. Detail of flower, showing corolla and stamens. E. Detail of stamen, showing abaxial surface. F. Detail of stamen, showing laterial surface. G. Detail of stamen, showing adaxial surface. H. Fruit. A C, E–H drawn from holotype. D drawn from *T. Croat 15005*.

Shrubs (0.5–)2–10 m tall, 1–5 cm in diam. *Branchlets* slender, 1.5–3 mm in diam., glabrous throughout. *Leaves* with blades 5.5–12.5 cm long, 1.8–4.5 cm wide; petioles slender, canaliculate and slightly marginate, 0.2–1.1 cm long. *Inflorescence* 2–6 cm long, 4–6.5 cm wide; peduncle obsolete to 0.5 cm; secondary inflorescence bracts 5.5–14.2 mm long, 2.5–5.4 mm wide; pedicels 6–15 mm long, slender, accrescent, glandular-grandulose. *Flowers* 6.8–7.2 mm long; sepals 1.5–1.8 mm long, 0.9–1.1 mm wide; corolla 6.5–7.7 mm long, the tube 0.5–1.2 mm long, the lobes ovate or elliptic to lanceolate, 6–6.5 mm long, 1.6–4.1 mm wide; stamens 3.5–4.8 mm long; the staminal tube 0.5–1.3 mm long, the filaments 1–1.5 mm long, 0.4–0.5 mm wide at base, punctate, glabrous, the anthers 2.5–2.8 mm long, 0.6–0.8 mm wide at base; ovary glabrous, the style 4.5–4.8 mm long, slender, not stylopodic at base, punctate, glabrous, the ovules 15, pluriseriate. *Fruit* globose to oblong, 4.5–5.2 mm long, 4.2–4.5 mm wide, conspicuously punctate, glabrous.

Distribution.—Known only from eastern Panama (Coclé, Colón, Panamá, Darién, San Blas), and on the Caribbean coast of Colombia (Bolívar), growing at sea level–900 m elevation.

Ecology and conservation status.—Ardisia bartlettii subsp. *bartlettii* occurs along streams and rivers in wet and pluvial lowland, premontane and cloud forests. It appears to be relatively tolerant of disturbance, so we believe it is not threatened at this time.

Etymology.—The specific and subspecific epithet honors Harley Harris Bartlett (1886–1960), American botanist at the University of Michigan at Ann Arbor, who collected the type specimen.

Additonal specimens examined. **PANAMA. Coclé:** Santa Rita Ridge, 5–10 mi from Transisthmian Hwy., sea level–100 m, 28 Jun 1984 (fl), *W. D'Arcy et al. 15548* (BRIT, LL-TEX, MO, PMA); from Torti to Pilota del Toro, mountain overlooking Torti Arriba, without elev., 27 Aug 1977 (fr), *J. Folsom & G. Alonzo de Monte 4973* (LL-TEX, MO), *5012* (MO); mountains above Torti Arriba, without elev., 2 Dec 1977 (fr), *J. Folsom et al. 6576* (MO); 4–5 hours walk upriver from Torti Arriba, 200–300 m, 6 Dec 1977 (fr), *J. Folsom et al. 6844* (MO); lowland area along the stream that passes through Torti, on the S side of the Pan-American Hwy., on Quipo slopes over river, without elev., 25 May 1980 (fl), *J. Folsom et al. 7825* (F, TEX); Hill S of Guacuco, 8 km E of Ipetí, 08° 55' N, 78° 20' W, 600 m, 18 Sep 1982 (fr), *C. Hamilton & W. D'Arcy 1387* (LL-TEX, MO); Pipeline road, N of Gamboa, upstream of the tenth bridge (Río Guacharo), beyond the big waterfall, 09° 10' N, 79° 45' W, 100 m, 4 Aug 1984 (fl), *G. de Nevers & D. Hews 3627* (LL-TEX, MO); Pipeline Road near Gamboa, Río Mendoza, upstream of road, without elev., 09° 09' N, 79° 42' W, 7 Jul 1985 (fl), *G. de Nevers 5963* (LL-TEX, MO, US). **Colón:** Trail from end of Santa Rita Ridge Road to Río Piedras, 1,400–1,600 ft [427–488 m], 23 Mar 1980 (fr), *T. Antonio 3889* (LL-TEX, MO); Santa Rita Ridge, along road, ca. 1 mi from Boyd Roosevelt Hwy., without elev., 9 Jul 1971 (fl), *T. Croat 15340* (MO); Santa Rita Lumber Road, ca. 15 km E of Colón, without elev., 20 Apr 1971 (fl), *R. Dressler & N. Williams 3967* (MO); Santa Rita Ridge, 20.7 km from Transisthmian Hwy., 09° 23' N, 79° 40' W, 530 m, 22 Mar 1992 (ster.), *R. Foster et al. 14038* (MO); ridge top 1–3 mi W of Portobello, without elev., 7 Sep 1971 (fr), *A. Gentry 1758* (F, MO); Santa Rita Ridge, ca. 12 km from Transisthmian Hwy., without elev., 28 Jun 1978 (fr), *B. Hammel 3646* (MO); end of Santa Rita Ridge Road, 21 km from Transisthmian Hwy., 09° 25' N, 79° 37' W, 400–500 m, 22 May 1982 (fl), *S. Knapp & R. Schmalzel 5247* (LL-TEX, MO); 26–28 km from Transisthmian Hwy. on the Santa Rita Ridge Road, 09° 25' N, 79° 37' W, 250–400 m, 23 May 1982 (fl), *S. Knapp & R. Schmalzel 5268* (LL-TEX 2-sheets, MO); Santa Rita Ridge Road, 21–26 km from Transisthmian Hwy., 09° 25' N, 79° 37' W, 500–550 m, 4 Jul 1982 (fl, fr), *S. Knapp 5892* (LL-TEX, MO); Santa Rita Ridge, SE of Colón, along rodge road, 10–12 mi from Transisthmian Hwy., 09° 20' N, 79° 45' W, 550 m, 21 May 1986 (fl), *G. McPherson 9206* (MO); Santa Rita Ridge Road, ca. 6 km from Boyd Roosevelt Hwy., without elev., 26 Sep 1974 (fr), *S. Mori & J. Kallunki 2140* (LL-TEX, MO); Santa Rita Ridge road, 20–25 mi from Transisthmian Hwy., 09° 24' N, 79° 39' W, 100–1,200 m, 10 Oct 1980 (fr), *K. Sytsma 1523* (LL-TEX, MO); Upper Río Piedras headwaters, along trail from end of Santa Rita Ridge Road, ca. 11 km SW of Cerro Braja, 09° 25' N, 79° 35' W, 600–700 m, 30 Apr 1981 (fl), *K. Sytsma et al. 4192* (LL-TEX, MO); along Santa Rita Ridge, road to Estación Calibar Lluvia el Agua Clara, 09° 22' N, 79° 42–45' W, 1,300 ft [396 m], 26 Jun 1971 (fl), *G. Webster & R. Dressler 16745* (MO). **Darién:** vicinity of Tortí, 38.6 mi E of Bayano Dam Bridge, trail from village to mountains near Río Tortí, 50–250 ft [15–76 m], 17 May 1980 (fl), *T. Antonio 4674* (LL-TEX, MO); Río Tuira 2 mi upstream from Boca del Cupa, 4 Aug 1962 (fr), *J. Duke 5381* (MO); vicinity of Las Piñas, without elev., 2 Mar 1967 (fr), *J. Duke 10612* (LL-TEX); S of Garachiné near Pacific coast above Casa Vieja, along boundary trail of Parque Nacional Darién, W flank, Serranía del Sapo, 07° 58' N, 78° 23' W, 50–150 m, 21 May 1991 (fl), *N. Hensold 1078* (F, MO); Casa Vieja hacia Cerro Sapo, 07° 58' N, 78° 23' W, 180–500 m, 23 May 1991 (fl), *H. Herrera, et al. 984* (BRIT, F, MO, PMA); S of Garachiné on W flank of Serranía del Sapo, above place called Casa Vieja, along boundary trail of Darién National Park, 07° 58' N, 78° 23' W, 300–500 m, 24 May 1991 (fl, fr), *G. McPherson 15369* (BRIT, MO). **Panamá:** Barro Colorado, Mojinga swamp near mouth of Río Chagres, 1 m, 11 Mar 1935 (fl), *P. Allen 865* (MO); road to Cerro Jefe, 900 m, 9 Jul 1976 (fl), *T. Antonio 1296* (BRIT, LL-TEX, MO); Barro Colorado Island, without elev., 1931 (fl), *S. Aviles 10* (MO); Barro Colorado, Snyder-Molina Trail, without elev., 29 Jun 1940 (fl), *M. Chrysler 4796* (F); near Gamboa, without elev., 26 Jun 1972 (fl); *A. Clewell & E. Tyson 3222* (MO); Barro Colorado, Drayton Trail, without elev., 22 May 1968 (fl), *T. Croat 5756* (BRIT, MO); Barro Colorado, Wheeler Trail, without elev., 19 Sep 1968 (fr), *T. Croat 6215* (BRIT 2-sheets, MO); Barro Colorado, Wheeler Trail, without elev., 11 Jun 1970 (fl, fr), *T. Croat 10845* (F, MO); Barro Colorado, Shannon Trail, without elev., 15 Jul 1970 (fl, fr), *T. Croat 11271* (MO); Barro Colorado, Wheeler Trail, without elev., 17 Sep 1970 (fl, fr), *T. Croat 12219* (MO); Barro Colorado, without elev., 20 May 1971 (fl), *T. Croat 14650* (MO); Barro Colorado, Lake Trail, without elev., 16 Jun 1971 (fl), *T. Croat 15005* (MO); Barro Colorado, Barbour Trail, without elev., 25 Jun 1971 (fl), *T. Croat 15105* (F, MO), between Fort Sherman and Fort San Lorenzo, without elev., 10 Jul 1971 (fl), *T. Croat 15414* (LL-TEX, MO); Cerro Jefe, 2,900 ft [884 m], 21 Jul 1972 (fl), *J. Dwyer & A. Gentry 10249* (F, MO); Barro Colorado, Snyder Molino Trail, along edge of trail, 300–600 m, 25 Jun 1960 (fl), *J. Ebinger 182* (BRIT, MO); along the border of Canal Zona-Colón Prov., from parallel in NW shore of Canal along road to Achiote, within 2 mi of Achiote, without elev., 23 Jun 1977 (fl), *J. Folsom 3880* (LL-TEX, MO); road leading around the shoulder of Cerro Jefe, turns to the right at 21.5 km from the Pan-American Hwy., around the first stream encountered, 800 m, 29 Sep 1977 (fl, fr), *J. Folsom et al. 5663* (MO); ca. 1 mi upstream from Frizzel's Finca Indio, on slope of Cerro Jefe, without elev., 9 Sep 1970 (fl), *R. Foster & H. Kennedy 1849* (LL-TEX); Barro Colorado Island, without elev., 9 Oct 1985 (fr), *N. Garwood & S. Arne 1595* (F), 1 Dec 1985 (fr), *N. Garwood 1687* (F), 28 Sep 1986 (fl, fr), *N. Garwood 1943*

(F), 18 Nov 1988 (fr), *N. Garwood 2658* (F); Pipeline Road, without elev., 30 Sep 1971 (fl), *A. Gentry & R. Dressler 1979* (MO), 6 mi N of Gamboa, without elev., 28 Dec 1971 (ster.), *A. Gentry 3319* (MO); Cerro Jefe, region roadside along road to Altode Pacora, 2 km N of turnoff to Cerro Jefe radio tower, along small stream, 2,500–2,700 ft [762–823 m], 30 Sep 1978 (fl), *B. Hammel 4854* (MO); Fort Sherman, Atlantic coastal forest, without elev., Jul 1965 (fl), *M. Hayden 95* (MO); trail along Río Petitpie from road to Fort Sherman from Gatum Locks, without elev., 22 Oct 1974 (fr), *S. Mori & J. Kallunki 2665* (MO), 12 Dec 1974 (fr), *S. Mori & J. Kallunki 3661* (MO); ca. 12 km NW of Gamboa, without elev., 26 Aug 1975 (fr), *S. Mori 7943* (LL-TEX, MO), 9 km NW of Gamboa, 150 m, 29 Oct 1973 (fr), *M. Nee 7657* (LL-TEX, MO), 125 m, 28 Nov 1973 (fl), *M. Nee 8435* (LL-TEX 2-sheets, MO); Along road S1, 4 km W of Gatun Dam, 190–200 m, 20 Dec 1973 (fl), *M. Nee 8913* (MO 2-sheets); Barro Colorado, near A.V. Armour Trail, 5, on Hubbell Permanent Plot, without elev., 13 Nov 1981 (fl), *R. Schmalzel & M. Aide 56* (MO), Sugar Mill, without elev., 20 Dec 1931 (fr), *O. Shattuck 611* (F, MO), Standley No. 20, without elev., 31 Jul 1934 (fr), *O. Shattuck 1098* (BRIT, F, MO); Gatun Lake, 120 m, 18–24 Nov 1925 (fr), *P. Standley 41029* (LL-TEX), Barro Colorado, Zetele Trail, without elev., 6 Jul 1931 (fl), *D. Starry 28* (F, MO); Peña Blanca Trail, without elev., Jul 1931 (fl), *D. Starry 178* (F); Cerro Jefe, 850–900 m, 29 Oct 1980 (fr), *K. Sytsma 1975* (BRIT, MO); Cerro Jefe, 1.5 mi down right turnoff, 6.7 mi past Goofy Lake, 700 m, 27 Dec 1980 (fl, fr), *K. Sytsma et al. 2900* (MO); Cerro Jefe, 6 mi past Cerro Azul on road to Altos Pacora, 2,600 ft [792 m], 19 Feb 1981 (fr), *K. Sytsma & W. D'Arcy 3690* (LL-TEX, MO); vicinity of Salamanca Hydrographic Station, Río Pequení, 80 m, 28–29 Jul 1938 (fl), *R. Woodson et al. 1569* (F, MO). **San Blas:** Nusagandi, Campo de PEMASKY, ca. 20 km on El Llano-Carti Road, trails near station, 09° 18' N, 78° 59' W, 350 m, 1 May 1992 (fl, fr), *R. Foster et al. 917* (MO); 3–4 hours up Río Mulatupo by foot, without elev., 17 Aug 1967 (fr), *J. Kirkbride 216* (MO); Udirbí Reserve, waterfall trail along park boundary, 09° 18' N, 78° 58' W, 350–400 m, 21 Jul 1986 (fl), *J. McDonagh et al. 244* (MO); El Llano-Carti Road, 24.5–25 km from Inter-American Hwy., near continental divide, 13 Apr 1975 (fl), *S. Mori & J. Kallunki 5556* (MO), 17.4 km from Inter-American Hwy, 09° 19' N, 78° 55' W, 350 m, 27 Sep 1984 (fl, fr), *G. de Nevers 3943* (BRIT, MO), km 16.7, trail W to waterfall 5 km from road, 09° 19' N, 78° 55' W, 350 m, 16 Jun 1985 (fl), *G. de Nevers & S. Charnley 5899* (LL-TEX, MO, US); Cerro Habú, trail from Río Sidro, 09° 23' N, 78° 49' W, 800–1,400 ft [244–427 m], 18 Dec 1980 (fr), *K. Sytsma 2650* (MO).

Cuatrecasas misinterpreted *Ardisia romeroi* as a member of subgenus *Icacorea*, largely because of the early caducous floral bracts and concolorous, poricidally dehiscent anthers. However, it closely matches the type of *Ardisia bartlettii* subsp. *bartlettii*. *Ardisia lewisii* is notable only for its inflorescence with pedicels in loose (low) anthotactic spirals. *Ardisia tuirana* was separated because of its somewhat less punctate, ovate sepals and sparse, finely stellate tomentum on the lower branches of the inflorescence. It is otherwise not significantly different from the type of the subspecies. Populations corresponding to the type of *Ardisia sapoana* vary from the subspecies type only by having sessile inflorescences with longer secondary inflorescence branch bracts, and longer corolla tubes.

Ardisia bartlettii subsp. *bartlettii* may be separated from subspecies *lilacina* by the shorter calyx and corolla, the generally shorter stamens and tapering style base.

3b. Ardisia bartletii Lundell subsp. **lilacina** (Lundell) Pipoly & Ricketson, comb. et stat. nov. (**Figs. 1F, 7**). *Ardisia lilacina* Lundell, Wrightia 3:198. 1966. *Graphardisia lilacina* (Lundell) Lundell, Phytologia 48:140. 1981. TYPE: PANAMA. COLÓN: Porto Belo [Bello], beach, without elevation [ca. sea level], 13 Jul 1964 (fl), *J. Dwyer 4354* (HOLOTYPE: MO).

Shrubs or small trees (0.5–)2–7 m tall, 1-4 cm in diam. *Branchlets* slender, 2–3.5 mm in diam., glabrous throughout. *Leaves* with blades 6–16 cm long, 3.5–7 cm wide; petioles stout, marginate, 0.4–1 cm. *Inflorescence* 2.5–4 cm long, 3.5–7 cm wide, sessile or nearly so; peduncle obsolete to 0.2 cm; secondary inflorescence bracts 2.8–11.2 mm long, 1.3–3.9 mm wide; pedicles 10–15 mm long, slender, glandular-glandulose. *Flowers* 8–9.2 mm long; sepals 2–2.5 mm long, 1.5–2 mm wide; corolla 7.5–9.2 mm long, the tube 0.5–1.4 mm long, the lobes ovate to elliptic, 7–8 mm long, 4.5–5 mm wide; stamens 4.5–5.7 mm, the staminal tube 0.5–1.5 mm long, the filaments 0.5–1 mm long, 0.2–0.3 mm wide at base, punctate, glabrous; the anthers 3–3.5 mm long, 0.7–0.9 mm wide at base; ovary glabrous, the style 4.5–5 mm long, slender, stylopodic at base, punctate, glabrous, the ovules 14–16, pluriseriate. *Fruit* globose, 4–5 mm in diameter, conspicuously punctate, glabrous.

Distribution.—Subspecies *lilacina* is restricted to the Caribbean coast of Panama (Colón, Panamá, San Blas), with one disjunct population in the Chocó, Colombia. We may also expect subsp. *lilacina* in lowland Antioquia and Valle Departments of Colombia, areas sorely lacking in collections. It grows from sea level–180 m elevation.

Ecology and conservation status.—This subspecies occurs in strand vegetation and beach forests. It is said to be locally uncommon, so it should be considered threatened.

Etymology.—The epithet 'lilacina' refers to the striking lilac color of the flowers.

Additional specimens examined. **PANAMA. Colón:** vicinity of Viento Frio, along the beach, sea level, 07–08 Aug 1911 (fl), *H. Pittier 4114* (F); Río Indio de Fató, sea level, 24 Aug 1911 (fl), *H. Pittier 4273* (F, LL-TEX, NY); 3 km SW of Río Guanche along road from Puerto Pilón to Portobelo, sea level, 20 May 1981 (fl), *K. Sytsma & L. Andersson 4791* (LL-TEX, MO). **Panamá:** Río Providencia and ridge S of river, 5–170 m, 5 Dec 1973 (fl, fr), *A. Gentry & M. Nee 8706* (LL-TEX, MO). **San Blas:** Río Cangandí, pueblo Cangandí, path to Quebrada Inadí, 09° 27' N, 79° 07' W, 50 m, 20 May 1987 (fl), *H. Herrera & P. Pérez 127* (MO); Vertiente Pacífica de la Cordillera de San Blas, Cabecera del Río Piriadí, 09° 11' 05" N, 78° 16' W, 100–150 m, 14 Jun 1994 (fl), *H. Herrera 1633* (BRIT, F, MO, PMA); Comarca de San Blas, tierra firme de Playón Chico, vicinity of the aqueduct trail, 09° 17' N, 78° 15' W, 30 m, 12 Sep 1994 (fr), *H. Herrera 1839* (BRIT, MO, PMA); Playón Chico and vicinity San Blas, Yantuppu, coral island, without elev., 8 Jul 1975 (fl), *F. Stier 193* (MO). **COLOMBIA. Chocó:** Mpio. Acandí, Vereda El Páramo, Quebrada Sardí, 08° 20' N, 77° 06' W, 180 m, 22 May 1989 (fl), *R. Fonnegra et al. 2792* (HUA, MO), *F. Roldán et al. 1190* (HUA, MO).

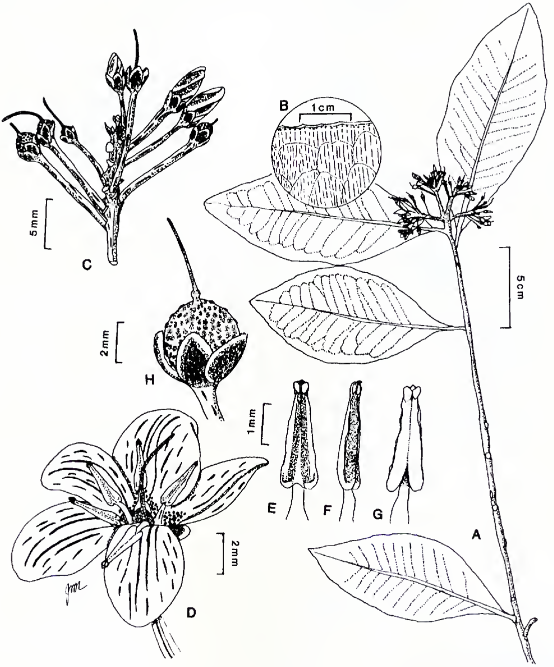

Fig. 7. *Ardisia bartlettii* Lundell subsp. *lilacina* (Lundell) Pipoly & Ricketson. A. Habit, flowering branch. B. Detail of abaxial leaf surface. C. Detail of inflorescence. D. Detail of flower. E. Detail of stamen, showing abaxial surface. F. Detail of stamen, showing laterial surface. G. Detail of stamen, showing adaxial surface. H. Fruit. A–G drawn from holotype. H drawn from *F. Stier 193*.

Ardisia bartlettii subsp. *lilacina* may easily be separated from subsp. *bartletii* by its longer perianth parts, usually longer stamens and unique stylopodic (swollen) style base. While the stylopodic style base is unique within the subgenus, there is no corresponding unique feature for subspecies *bartlettii* to define it. Therefore, the two taxa are recognized at the subspecific level. In addition, it is restricted to strand and beach forests, while subsp. *bartlettii* is from tall wet forests.

EXCLUDED NAMES

Ardisia albovirens Mez, Repert. Spec. Nov. Regni Veg. 16:311. 1920. *Graphardisia albovirens* (Mez) Lundell, Wrightia 7:46. 1982. TYPE: BRAZIL. ACRE: Río Acre bei Xapury [Xapuri], without elev., Jan. 1911 (fl), *E. Ule 9682* (HOLOTYPE: B-destroyed in 1943 (F Neg. # 4876); LECTOTYPE, here designated; K; photo of lectotype: LL-TEX Neg. # 71-157).

Ardisia nigrovirens J. F. Macbr., Candollea 5:397. 1934. SYN. NOV. *Graphardisia nigrovirens* (J. F. Macbr.) Lundell, Wrightia 7:46. 1982. TYPE: PERU. LORETO: Puerto Arturo, Yurimaguas, lower Río Huallage, 155–210 m, 15 Nov 1929 (fr), *L. Williams 5081* (HOLOTYPE: F (LL-TEX Neg. # 1971-74)).

Now that recent collections have provided us with material both in flower and fruit, it is clear that this species is not a member of subgenus *Graphardisia*, but rather, subgenus *Ardisia*. This species has ovate anthers with subapical pores opening into slits, has panicles with racemose branchlets, inflorescence and secondary inflorescence branch bracts that are subcoriaceous to coriaceous and cucullate, and coriaceous sepals that are quincuncial. We postulate that the rather large floral and secondary inflorescence branch bracts of the species may have led to its misplacement.

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REFERENCES

Aublet, F. 1775. Histoire des plantes de la Guiane francaise. Vols. 1 and 2.

Candolle, A. de. 1834. Review of the natural order Myrsineae. Trans. Linn. Soc. London 17:100–112.

_____. 1841. Second mémoire sur la famille Myrsinéacées. Ann. Sci. Nat. Bot. 16:65–97.

Chen, C. and J. Pipoly. 1996. Myrsinaceae. In: Wu Zheng-Yi and P.H. Raven, eds. Flora of China. Vol. 15. Science Press, Beijing, People's Republic of China, and Missouri Botanical Garden, St. Louis, MO, U.S.A. Pp. 1–38.

Dahlgren, B. 1936. Preface. In: F. J. Macbride, Flora of Peru. Field Mus. Nat. Hist., Bot. Ser. 13(I, no.1):5–8.

Ducke, A. 1930. Plantes nouvelles o peu connues de la région amazonienne. Archiv. Jard. Bot. Rio 5:99–188.

Hallé, F., R. A. Oldeman, and P. B. Tomlinson. 1978. Tropical trees and forests. An architectural analysis. Springer-Verlag, New York.

Hickey, L. 1984. A revised classification of the architecture of dicotyledonous leaves. In: C. R. Metcalfe and L. Chalk, eds. Anatomy of the dictyledons. Vol. 1. Systematic anatomy of leaf and stem, with a brief history of the subject. Clarendon Press, Oxford, U.K. Pp. 25–39.

Holmgren, P.K., N.H. Holmgren, and L.C. Barnett. 1990. Index herbariorum. Part I: The herbaria of the world. 8th. Ed. Regnum Veg. 120:1–693.

Lindley, J. 1848. Illustrated dictionary of botanical terms. Excerpt from illustrated dictionary of botanical terms by John Lindley. [Reprint, with an introduction by Alice Eastwood, Stanford University, School of Earth Sciences, 1964]. Pp. 346–383.

Lundell, C.L. 1963. Studies of the American Myrsinaceae– I. Wrightia 3:77–90.

_____. 1964. Studies of the American Myrsinaceae- II. Wrightia 3:97–114.

_____. 1966a. Myrsinaceae. In: P.C. Standley and L.O. Williams, eds. Flora of Guatemala Part VIII Number 1. Fieldiana, Bot. 24(8/2):135–200.

_____. 1966b. Studies of the American Myrsinaceae–III. Wrightia 3:192–199.

_____. 1971. Flora of Panama, Part VIII. Family 150. Myrsinaceae. Ann. Missouri Bot. Gard. 58:285–353.

_____. 1979. Neotropical Myrsinaceae—II. Wrightia 6:60–100.

_____. 1981a. Neotropical Myrsinaceae—IV. Phytologia 48:139–142.

_____. 1981b. Neotropical Myrsinaceae—V. Wrightia 7:23–25.

_____. 1981c. Studies of American plants—XX. Phytologia 48:131–136.

_____. 1981d. Neotropical Myrsinaceae—VI. Phytologia 49:341–354.

_____. 1982. Neotropical Myrsinaceae—VII. Wrightia 7:38–50.

_____. 1986. Neotropical Myrsinaceae—XX. Phytologia 61:62–68.

_____. 1987. Neotropical Myrsinaceae—XXI. Phytologia 63:463–465.

Metcalfe, C.R. 1984. Some basic types of cells and tissues. In: C.R. Metcalfe and L. Chalk, eds. Anatomy of the Dictyledons. Vol. 1. Systematic anatomy of leaf and stem, with a brief history of the subject. Clarendon Press, Oxford, U.K. Pp. 54–62.

MEZ, C. 1902. Myrsinaceae. In: A. Engler, ed. Das Pflanzenreich IV. 236 (Heft 9):1–437.

NAYAR, M. P. & G. S. GIRI.1986. *Parardisia*- a new genus in the family Myrsinaceae with two species. Bull. Bot. Surv. India 28:247–252.

PIPOLY, J. 1983. Contributions toward a monograph of *Cybianthus* (Myrsinaceae): III. A revision of subgenus *Laxiflorus*. Brittonia 35:61–80.

______. 1987. A systematic revision of the genus *Cybianthus* subgenus *Grammadenia* (Myrsinaceae). Mem. New York Bot. Gard. 43:1–76.

______. 1992. The genus *Cybianthus* subgenus *Conomorpha* (Myrsinaceae) in Guayana. Ann. Missouri Bot. Gard. 79:908–957.

______. 1998. The genus *Cybianthus* (Myrsinaceae) in Ecuador and Peru. Sida 18:1–160.

RICKETSON, J. & J. PIPOLY. 1997. A synopsis of the genus *Gentlea* (Myrsinaceae) and a key to the genera of Myrsinaceae in Mesoamerica. Sida 17:697–707.

STAFLEU, F.A. & R.S. COWAN. 1988. Taxonomic literature. A selective guide to botanical publications and collections with dates, commentaries and types. Vol. VII: W–Z. 2nd. Ed. Regnum Veg. 116:1–653.

THEOBALD, W.L., J. KRAHULIK, and R.C. ROLLINS. 1984. Trichome description and classification. In: C.R. Metcalfe and L. Chalk, eds. Anatomy of the Dictyledons. Vol. 1. Systematic Anatomy of Leaf and Stem, With a Brief History of the Subject. Clarendon Press, Oxford, U.K. Pp. 40–53.

NUMERICAL LIST OF TAXA

1. *A. weberbaueri* Mez
2. *A. opegrapha* Oerst.
2a. subsp. *opegrapha*
2b. subsp. *wagneri* (Mez) Pipoly & Ricketson
2c. subsp. *paquitensis* (Lundell) Pipoly & Ricketson
3. *A. bartlettii* Lundell
3a. subsp. *bartlettii*
3b. subsp. *lilacina* (Lundell) Pipoly & Ricketson

LIST OF EXSICCATAE

The figures in parentheses refer to the numbers from the numerical list of taxa. Collection numbers in **boldface** type indicate type specimens.

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UNA NUEVA ESPECIE DE *POLIANTHES* (AGAVACEAE) DEL ESTADO DE OAXACA, MÉXICO

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RESUMEN

Se describe e ilustra *Polianthes bicolor*, una nueva especie del estado de Oaxaca, México. Esta especie muestra similitudes con *Polianthes geminiflora* (La Llave et Lex.) Rose var. *geminiflora*, *Polianthes geminiflora* (La Llave et Lex.) Rose var. *clivicola* McVaugh y *Polianthes graminifolia* Rose.

ABSTRACT

Polianthes bicolor from the state of Oaxaca, México, is described as new and illustrated. This species is similar to *Polianthes geminiflora* (La Llave et Lex.) Rose var. *geminiflora*, *Polianthes geminiflora* (La Llave et Lex.) Rose var. *clivicola* McVaugh and *Polianthes graminifolia* Rose.

El género *Polianthes* es endémico de México y las especies que lo conforman han sido poco estudiadas desde el punto de vista taxonómico. La última revisión fue hecha en 1903 por Rose, quien reconoció 12 especies. Durante mucho tiempo, la delimitación de sus especies y de los géneros cercanamente relacionados ha sido confusa. Actualmente se está realizando la revisión sistemática del género y las observaciones generadas durante el estudio, incluidas las investigaciones anatómicas y la exploración botánica en toda su área de distribución geográfica, revelaron la existencia de una nueva especie que se describe a continuación.

Polianthes bicolor Solano & García-Mend., sp. nov. (**Fig. 1**). TIPO: MÉXICO. OAXACA: Municipio de Coixtlahuaca, en la base del Cerro Verde, 4 km al N de Marcos Pérez y 5 km al S de Coixtlahuaca, pastizal, 2500 m, 7 Jul 1986, *A. García-Mendoza et al. 2403* (HOLOTIPO: MEXU; ISOTIPOS: BRIT, FEZA, MEXU).

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Herba perennis; lamina semisucculenta, plerumque undulata; bracteolae florum basalium saepe in pedicello insertae; tubus floralis supra basim abrupte dilatatus; flores aurantiaco-virides, lobis viridibus; filamenta in perianthii tubo 1.1–1.8 cm supra apicem ovarii inserta.

Hierba perenne con un bulbo de (2–)3–4(–5) cm de largo, (1–)1.5–2.5 cm de diámetro; (3–)4–6(–12) hojas basales de (5–)8–15 cm de largo, 0.6–1(–1.4) cm de ancho, lanceoladas, lámina semi-suculenta, generalmente ondulada; margen usualmente ondulado, papiloso, hialino; superficie lisa a papilosa. Brácteas de la base de la inflorescencia 3–5(–7.5) cm de largo y 0.2–0.5 cm de ancho, lanceoladas; inflorescencia de 24–40(–54) cm de longitud, con 3–5(–9) nudos fértiles; flores geminadas, las inferiores a veces fusionadas. Brácteas y bractéolas lanceoladas que disminuyen en tamaño desde la base de la inflorescencia hacia el ápice, bractéolas de las flores basales frecuentemente insertas sobre el pedicelo; pedicelos de 0.6–1.3 cm de largo, rojizos. Flores de (2–)2.3–2.9 cm de largo, (1.6–)2.4–3(–5.5) mm de ancho en la base de los lóbulos de la corola, tubo del perianto abruptamente ensanchado por arriba de la base; lóbulos externos de 2–3(–4) mm de largo, (1.7–)2–3(–4) mm y en ocasiones de hasta 5 mm de ancho, de orbiculares a transversalmente elípticos, apiculados, los internos con los ápices redondeados y pilosos; color de las flores anaranjado-verdoso, con los lóbulos verdes; estambres inclusos, filamentos de 1.8–2.5(–2.8) cm de largo, insertos en el tubo del perianto, 1.1–1.8(–1.9) cm por arriba del ápice del ovario, filiformes, de color verde; anteras de 4–5(–9) mm de largo, 1–1.5(–2.5) mm de ancho, oblongas, amarillo-verdosas; estilo de (1–)1.9–2.6(–3.2) cm de largo; estigma trilobado. Fruto semiesférico de 1.1 cm de largo por 1.1 cm de diámetro. Semillas de 4.5 mm de largo por 2.4 mm de ancho, de color negro, semicirculares vistas en perfil, con uno de los lados recto.

PARATIPOS: **MÉXICO. Oaxaca:** Municipio Teposcolula, 3 km al N de Yucunama, 24 Jul 1982, *A. García-Mendoza. 1052* (ENCB); Municipio Coixtlahuaca, Cerro Verde, S of Coixtlahuaca, 7 Jul 1986, *D. Frame et al. 317* (NY); Municipio de San Juan Mixtepec, Cañada Cerro de Metates, 20 km al NW de San Juan Mixtepec, 8 Jul 1988, *J. Reyes 300* (MEXU); Municipio de San Juan Mixtepec, Yucu Shuun (Monte del Tesoro), 16 km al S de San Juan Mixtepec, 6 Oct 1988, *J. Reyes 881* (MEXU); Municipio de Teposcolula, aproximadamente 5 km al NE de Marcos Pérez, 5 km al NE de Tierra Blanca, 3 km al NE de Yodobada, a un costado del camino de terracería que va de Tierra Blanca a Marcos Pérez, 26 Jul 1996, *E. Solano & Ma. del C. López 857* (FEZA, MEXU); Municipio de Coixtlahuaca, Cerro Verde al NE de Marcos Pérez, 7 Jul 1986, *P. Tenorio et al. 11656* (MEXU).

Polianthes bicolor se caracteriza por sus hojas semisuculentas, generalmente con la lámina y el margen ondulados, flores con el tubo del perianto abruptamente ensanchado por arriba de la base, con lóbulos verdes y estambres insertos sobre el tubo del perianto. Además, los estudios anatómicos, muestran la ausencia de taninos en las células del mesofilo y de fibras en la vaina de los haces vasculares de las hojas. Florece en los meses de julio a agosto; sus flores no son fragantes, igual que en los otros taxa con los que aquí se compara.

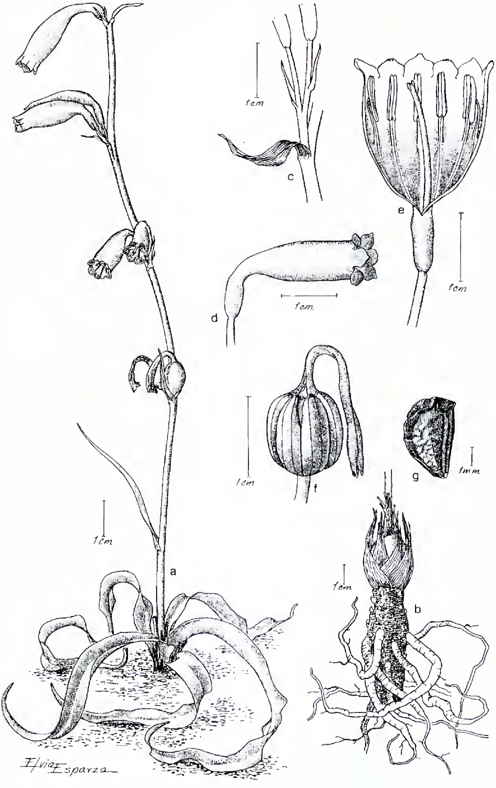

Fig. 1. *Polianthes bicolor.* a) Planta con inflorescencia, b) Bulbo y cormo con raíces contráctiles, c) Bractéolas insertas en los pedicelos, d) Flor completa, e) Flor disecada, f) Fruto, g) Semilla. Ilustración: a, c, d, e, de A. *García-M. 2403*; b, f, g, de *E. Solano C. & Ma. del C. López B. 857*.

Morfológicamente se relaciona con *P. geminiflora* (La Llave et Lex.) Rose var. *geminiflora*, *P. geminiflora* (La Llave et Lex.) Rose var. *clivicola* McVaugh y *P. graminifolia* Rose, de las que se distingue claramente por las características mostradas en la tabla 1.

Polianthes bicolor se desarrolla entre los 2300–2500 m, en pastizales, bosques de *Quercus* y *Pinus-Quercus* con *Agave*, *Anthericum*, *Opuntia*, *Salvia* y *Sedum*, en suelos erosionados de color pardo a negro con textura arenosa y material parental calizo.

La especie aquí descrita se localiza en la Mixteca Alta del estado de Oaxaca, en la provincia fisiográfica conocida como sistema montañoso del norte de Oaxaca, en los distritos de Coixtlahuaca, Teposcolula y Juxtlahuaca. Probablemente las plantas señaladas por Howard (1986) para Huajuapan de León, correspondan a esta nueva especie; el mismo autor se refiere a las poblaciones en cuestión como raras y poco similares a *Polianthes geminiflora*, ya que tienen flores de color escarlata, con lóbulos de la corola e interior del tubo verdes.

TABLA 1. Características morfológicas comparativas entre *Polianthes bicolor, P. geminiflora* var. *geminiflora, P. geminiflora* var. *clivicola y P. graminifolia.*

Carácter	Polianthes bicolor var. geminiflora	P. geminiflora var. clivicola	P. geminiflora	P. graminifolia
Lámina foliar	Ondulada, rara vez plana, semisuculenta	Plana, rara vez ondulada, no suculenta	Plana, suculenta	Involuta, no suculenta
Tubo del perianto	Abruptamente ensanchado por arriba de la base	Tubular	Tubular	Tubular
Color del tubo	Anaranjado-verdoso	Anaranjado, coral o rojol	Anaranjado, rojo o coral	Coral, casi rosa o rojo
Color de los lóbulos	Verde	Anaranjado, a veces verde	Anaranjado	Casi rosa
Inserción de los filamentos	11–18 mm por arriba del ovario	1.7–5 mm por arriba del ovario	2–3 mm por arriba del ovario	3.5–8 mm por arriba del ovario
Taninos en las células del mesofilo	Ausentes	Presentes	Presentes	Presentes
Fibras en la vaina del haz vascular	Ausentes	Presentes	Presentes	Presentes

Polianthes bicolor es la especie con distribución más sureña del género, sólo conocida del estado de Oaxaca. En cuanto a los otros taxa, *P. geminiflora* (La Llave et Lex.) Rose var. *geminiflora* se distribuye del estado de Nayarit a Tlaxcala y probablemente hasta el estado de Puebla, *Polianthes geminiflora* (La Llave et Lex.) Rose var. *clivicola* McVaugh es endémica de Jalisco y Michoacán, mientras que *Polianthes graminifolia* Rose solamente se ha registrado de Aguascalientes y Jalisco.

El epíteto específico hace referencia a la coloración que presentan las flores.

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REFERENCIAS

Howard, T.M. 1985. Stalking the *Polianthes* of Mexico-Part two, 1985. Herbertia 42:84–87.

Rose, J.N. 1903. Studies of Mexican and Central American plants. Contr. U.S. Natl. Herb. 8:8–23.

BOOK REVIEW

EDWARD G. VOSS. **Michigan Flora. Part III. Dicots (Pyrolaceae-Compositae).** 1996. (ISBN 87737-040-0, hbk). Cranbrook Institute of Science Bulletin 61 and University of Michigan Herbarium, Ann Arbor, Michigan. Orders: Cranbrook Institute of Science, 1221 N Woodward Ave., P.O. Box 801, Bloomfield Hills, MI 48303-0801. 810-645-3239 or 810-645-3203. $15.00 + shipping and handling. 622 pp, 771 maps, 267 illustrations.

This volume, is the third and last of a series of volumes providing practical, user-friendly keys, diagnostic characters, literature references and detailed ecological notes, supplemented by 771 disrribution maps, 267 line drawings, 53 color photographs and keys to all the vascular plant families occurring within the 86 counties comprising Michigan. My personal experience with Part I. Gymnosperms and Monocots, as an undergraduate student at Michigan State, combined with my knowledge of Ed's passion for detail and accuracy, tell me that this volume is an excellent reference as were the previous two. The only item I consider missing from this fine book is that of a summary table, where total number of habitats, number of families, genera, species, and perhaps endangered, threatened or rare species, was included. While one can caution against such lists that often become restrictive and authoritarian, they are nonetheless, extremely useful to conservationists, land use planners and resource managers, particularly those operating at the Great Lakes Regional level. However, that is an insignificant blemish on an otherwise perfect publication. At the incredibly low price of $15.00, this hard bound book on high quality paper is a must for every botanist's bookshelf.–*John J. Pipoly III*

POLLEN MORPHOLOGY OF THE GENUS *ECHINOPEPON* (CUCURBITACEAE)

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ABSTRACT

Pollen descriptions of *Echinopepon* species and a palynological key are presented. Data on apertures, exine, polarity, shape, and size of pollen grains are included. Pollen morphology is distinctive for the species of *Echinopepon* and *Echinocystis* and in some *Marah* species. The main features of each taxon are illustrated by photographs.

RESUMEN

Se presenta la descripción del polen de las especies de *Echinopepon*. Se incluyen datos de la apertura, exina, polaridad, forma y tamaño de los granos, asi como una clave palinológica para su identificación. La morfología polínica es característica en *Echinopepon* y distintiva de *Echinocystis* y de algunas especies de *Marah*. Se ilustra con fotografias las características principales de cada taxon.

Echinopepon is an American genus, whose distribution extends from southeastern United States to Argentina. It has seven species (Rodríguez, in press): *E. cirrhopedunculatus* Rose, *E. coulteri* (A. Gray) Rose, *E. gemellus* (Ser.) Rodríguez, *E. minimus* (Kellogg) S. Watson, *E. pubescens* (Benth.) Rose, *E. racemosus* (Steud.) C. Jeffrey, and *E. wrightii* (A. Gray) S. Watson (Table 1); the first four are endemic to Mexico. All species are herbaceous, generally with an annual life cycle; have characteristic capsular, echinate, rostrate, and operculate fruit; and white or white-green pentamerous flowers, five stamens with filaments joined and anthers forming heads.

Jeffrey (1978) placed *Echinopepon* in the tribe Cyclanthereae. He later (Jeffrey 1990) placed it in tribe Sicyeae subtribe Cyclantherinae, showing its close relationship to the genera *Marah* and *Echinocystis* as demonstrated by the large number of morphologic characteristics which it shares with these genera. They are distinguished from *Echinopepon* by two or three stamens and globose fruits with apical and irregular dehiscence. *Marah* is distinguished also by its perennial habit and swollen seeds.

Palynologically the tribe Cyclanthereae (Jeffrey 1964) is characterized by 4–8-colporate and punctitegillate pollen grains (Jeffrey 1964), the same as the subtribe Cyclantherinae (Jeffrey 1990). This tribe was also described by Marticorena (1963) as having 4 to polycolporate pollen grains except, *Echinopepon wrightii* (A. Gray) S. Watson (as *Echinocystis wrightii* A. Gray) which has only polycolporate pollen grains. In a palynologicalal classification of Cucurbitaceae from India (Shridar & Sing 1990), subtribe Cyclantherinae was described as having multizonocolporate pollen grains.

The pollen morphology of *Echinopepon* species has been little studied. Dieterele (1974) found similarities between *Apatzingania arachoidea* Dieter. pollen grains (asymetrical polycolpate, spinulose and exquisitely foveolate-reticulate) and those of *Echinopepon cirrhopedunculatus* and *E. ge*

TABLE 1. The species of *Echinopepon*.

Accepted name	Synonyms
E. cirrhopedunculatus Rose	
E. coulteri (A. Gray) Rose	*Echinocystis coulteri* (A. Gray) Cogn., 1877; *Echinopepon confusus* Rose, 1897; *Echinopepon parvifolius* Rose, 1897.
E. gemellus (Ser.) C. Rodríguez	*Echinopepon milleflorus* Naudin, 1866; *Echinopepon quinquelobatus* Naudin, 1866; *Echinocystis gemella* (Ser.) Cogn., 1877; *Echinocystis milleflora* (Naudin) Cogn., 1877; *Echinocystis torquata* (Ser.) Cogn., 1877; *Echinocystis torquata* var. *brevispina* Cogn., 1881; *Echinopepon torquatus* (Ser.) Rose, 1897.
E. minimus (Kellogg) S. Watson	*Echinocystis minima* (S. Watson) Cogn., 1881; *Echinopepon peninsularis* H.S. Gentry, 1949; *Echinopepon minimus* (Kell.) S. Watson var. *peninsularis* (H.S. Gentry) K.M. Stocking, 1955.
E. pubescens (Benth.) Rose	*Echinocystis floribunda* Cogn., 1877; *Echinocystis pubescens* (Benth.) Cogn., 1877; *Echinopepon floribundus* (Cogn.) Rose, 1897.
E. racemosus (Steud.) C. Jeffrey	*Echinopepon horridus* Naudin, 1866; *Echinocystis lanata* Cogn., 1877; *Echinocystis polycarpa* Cogn., 1877; *Echinocystis muricata* Cogn., 1878; *Echinocystis araneosa* Griseb., 1879; *Echinocystis macrocarpa* Britton, 1890; *Echinopepon jaliscanus* Rose, 1897; *Echinopepon lanatus* (Cogn.) Rose, 1897; *Echinopepon pringlei* Rose, 1897; *Echinopepon racemosus* (Steud.) Martínez, Crov., 1955.
E. wrightii (A. Gray) S. Watson	*Echinocystis glutinosa* Cogn., 1877; *Echinocystis longispina* Cogn., 1877; *Echinocystis paniculata* Cogn., 1877; *Echinocystis wrightii* (A. Gray) Cogn., 1877; *Echinopepon longispina* (Cogn.) Rose, *1897;* *Echinopepon nelsoni* Rose, 1897; *Echinopepon paniculatus* (Cogn.) J.V. Dieterle, 1976.

mellus (as *Echinocystis gemella*). Dieterle (1976) also found that different types of apertures in pollen grains seemed to be associated with thecae form, replicate thecae occurring with non-colpate grains and U-shaped thecae occurring with multicolpate grains. Stafford and Sutton (1992, 1994) indicated that certain species of *Echinopepon* had pantozonocolporate pollen grains, corroborating Dieterle's idea about palynological similarities between the genera *Apatzingania* and *Echinopepon*, however, there are enough macromorphological differences to distinguish *Apatzingania* from *Echinopepon*. Palacios-Chavez et al. (1995) described *Echinopepon coulteri* pollen the valley of Mexico as 7-colpate, perreticulate and suboblate grains and *E. gemellus* pollen (as *Echinopepon milleflorus*) as 14-colpate, punctitegillate and suboblate.

MATERIALS AND METHODS

Pollen samples of the seven taxa of *Echinopepon* and the relatives *Echinocystis* and *Marah* were taken from herbarium specimens at: Escuela Nacional de Ciencias Biológicas, IPN, México (ENCB); Herbario Nacional of México, UNAM, México (MEXU); Instituto de Ecología, Bajío, México (IEB) and Field Museum (F). The samples were prepared using the standard acetolysis method of Erdtman (1943) and mounted in glycerine jelly. The samples were examined by the light microscope. The slides are deposited in the pollen collections of the Palynology Laboratory, Department of Botany, ENCB, Mexico.

RESULTS

Palynological key to the species *Echinopepon*

1. Grains stephanocolpate, 7–16-colpate or 7–17-colporoidate, reticulate or punctitegillate.
    2. Grains 7-colpate or colporoidate.
        3. Grains 7-colpate, reticulate .... **E. coulteri** (Figs. 6–11)
        3. Grains 7-colporoidate, punctitegillate .... **E. pubescens** (Figs. 22–27)
    2. Grains 14–16-colpate or 9–10-colporoidate.
        4. Grains 9–10-colporoidate .... **E. minimus** (Figs. 16–21)
        4. Grains 14–16-colpate.
            5. Grains 14-colpate, punctitegillate .... **E. gemellus** (Figs 12–15)
            5. Grains 16-colpate, reticulate .... **E. cirrhopedunculatus** (Figs. 1–5)
1. Grains 10–12-perirrugate or 7–8-pericolpate, punctitegillate-echinulate or perreticulate.
    6. Grains perirrugate, 10–12 rugas, echinulate.................. **E. racemosus** (Figs. 28–34)
    6. Grains pericolpate, perreticulate...................................... **E. wrightii** (Figs. 35–41)

Descriptions of pollen grains

Echinopepon cirrhopedunculatus Rose (Figs. 1–5). MEXICO. MORELOS: Zacatepec, *C. Rodríguez et al. 1856* (ENCB).

Grains usually stephanocolpate, 16-colpate (sometimes with 15 or 17 colpi), semitectate, spheroidal, (88–)72–104 × 77–104(–82) µm P/E 1.07. Polar view circular, (103–)92–114 µm in diameter. Exine 5.6 µm, thick, sexine 4 µm and nexine 1.6 µm, thick reticulate, with colpus thin; membrane smooth.

Echinopepon coulteri (A. Gray) Rose (**Figs. 6–11**). MEXICO. HIDALGO: Cerro Gordo, 5 km W of Pachuca, *J. Rzedowski 33524* (ENCB).

Grains usually stephanocolpate, 7-colpate, sometimes 8-colpate, semitectate, suboblate, (104–)83–117 × 87–142(–126) µm. P/E 0.82. Polar view circular (118–)77–154 µm in diameter. Exine 4 µm, thick sexine 3.2 µm and nexine 0.8 µm, thick, reticulate superficially, colpus shallow, membrane smooth.

Echinopepon gemellus (Ser.) C. Rodríguez (**Figs. 12–15**). MEXICO. VERACRUZ: Camino a Tatatila, Las Vigas, *F. Ventura 17716* (ENCB).

Grains stephanocolpate, 14-colpate,tectate, suboblate, (76–)66–97 × 66–106(–90) µm. P/E 0.84. Polar view circular (88–)70–112 µm in diameter. Exine 4 µm, thick, sexine 3.2 µm and nexine 0.8 µm, thick, punctitegillate superficially, colpus thin; membrane smooth.

Echinopepon minimus (Kellogg) S. Watson (**Figs. 16–21**). MEXICO. BAJA CALIFORNIA: Sierra de Plateros, Mulege, *D. Breedlove 60907* (ENCB).

Grains usually stephanocolporoidate, 10-colporoidate, sometimes 9-colporoidate, semitectate, spheroidal, (71–)60–85.6 × 74–84(–80) µm. P/E 0.95. Polar view circular, (85–)80–96 µm in diameter. Exine 5 µm, thick, sexine 3.2 µm and nexine 1.8 µm, thick, reticulate superficially, colpus with smooth membrane. Pores diffuse.

Echinopepon pubescens (Benth.) Rose (**Figs. 22–27**). MEXICO. OAXACA: Chilapa, Tamazulapa, *J. Rzedowski 34498* (ENCB).

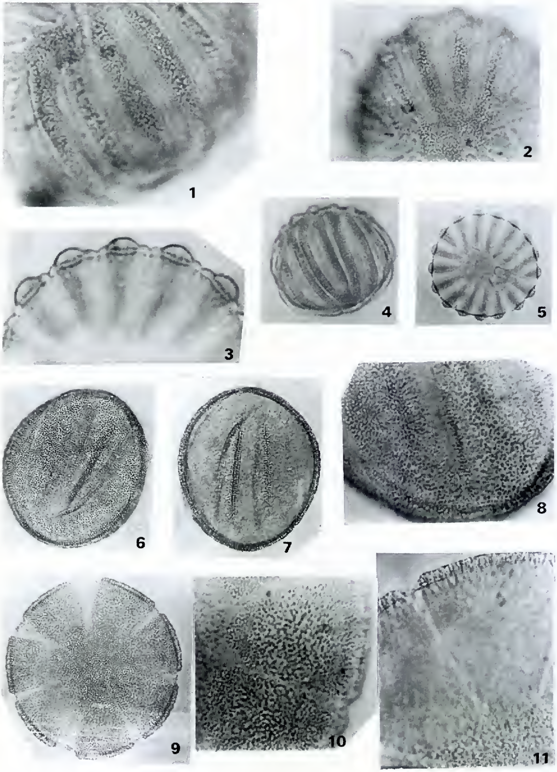
Grains stephanocolporoidate,7-colporoidate some times 6-colporoidate, tectate, spheroidal, (94–)81–110 × 81–103(–94) µm. P/E 1.0. Polar view circular (102–)91–112 µm in diameter. Exine 4 µm, thick, sexine as thick as sexine, punctitegillate superficially, thin colpus, smooth membrane, bordered with margin 2–3 µm wide.

Echinopepon racemosus (Steud.) C. Jeffrey (**Figs. 28–34**). MEXICO. OAXACA: Ojitlán, Buena Vista, *F. Ventura 15539* (ENCB).

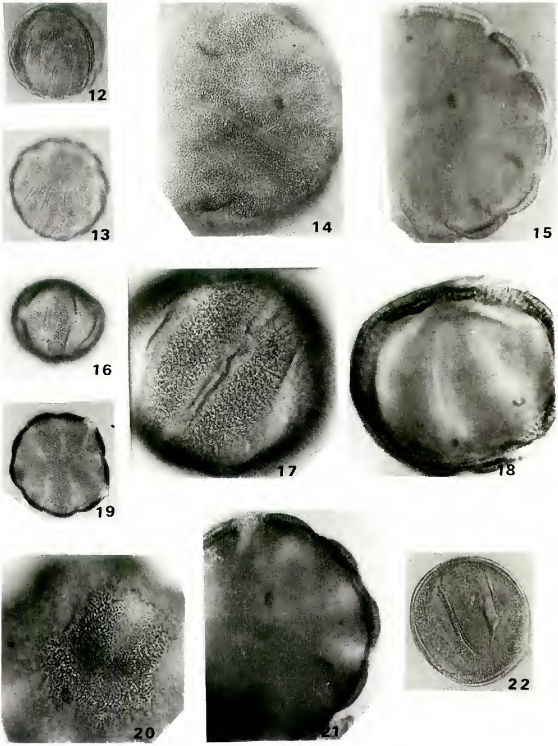
Grains perirrugate, tectate, apolar, spheroidal, (94–)81–110 × 91–112(–102) µm in diameter. Exine 5.6 µm, thick, sexine as thick as nexine, echinulate superficially. Rugas 10 or 12 of 16 µm long, situated superficially, with verrucate membranes. Some grains have a triradiate colpus.

Echinopepon wrightii (A. Gray) S. Watson (**Figs. 35–41**). MEXICO. MICHOACÁN: 3 km NW of Eréndira Carácuaro, *J. Rzedowski 35510* (ENCB).

Grains stephanocolpate, usually 7-colpate,sometimes 8-colpate, semitectate,



Figs. 1–11.—*Echinopepon cirrhopedunculatus*. Fig. 1. Equatorial view; Fig. 2. Polar view; Fig. 3. Optical section exine (× 1000); Fig. 4. Equatorial view (× 800); Fig. 5. Polar view (× 800). *Echinopepon coulteri*. Fig. 6. Transversal section exine; Fig. 7. Polar view surface × 800); Fig. 8. Polar view optical section (× 800); Fig. 9. Equatorial view surface (× 800); Fig. 10. Reticulate surface; Fig. 11. Optical section (× 1000).



FIGS. 12–22.—*Echinopepon gemellus*. Fig. 12. Equatorial view (× 800); Fig. 13. Polar view (× 800); Fig. 14. Polar view, punctitegillate surface; Fig. 15. Optical section.(× 1000). *Echinopepon minimus*. Fig. 16. Equatorial view (x 800); Fig. 17. Equatorial view, reticulate surface; Fig. 18. Optical section (× 1000); Fig. 19. Polar view (× 800); Fig. 20. Echinulate apocalpium; Fig. 21. Optical section (× 1000). Fig. 22. *E. pubescens*. Equatorial view (× 800)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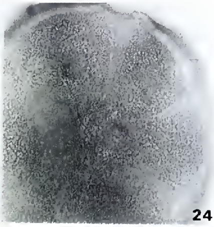
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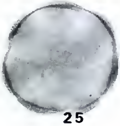
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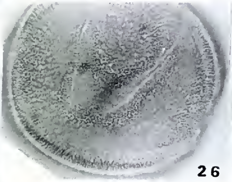
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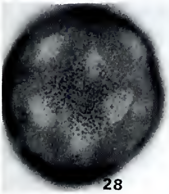
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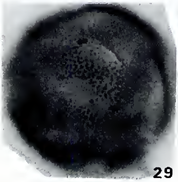
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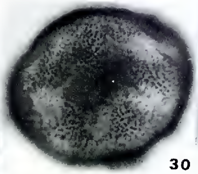
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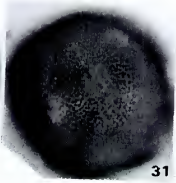
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FIGS. 23–31.—*Echinopepon pubescens.* Fig. 23. Punctitegillate surface; Fig. 24. Polar view (× 1000); Fig. 25. Polar view, optical section (× 800); Fig. 26. Colpi and punctitegillate surface; Fig. 27. Exine thick. Figs. 28–31. *Echinopepon racemosus.* (× 800). Fig. 28. Perirrugate; Fig. 29. Ruga aequatorialis; Fig. 30.Ruga and echinulate surface; Fig. 31. Echinulate surface.

spheroidal, (81–)71–90 × 86–94(–89) µm. P/E 0.94. Polar view circular, (94–)80–108 µm in diameter. Exine 5 µm, thick, sexine and nexine with the same thickness, perreticulate superficially, 7 colpi in equatorial position but 8-colpate where one colpus is over a pole.

Echinocystis lobata (Michx.) Torr. & A. Gray (**Figs. 42–49**). U.S.A. OHIO. DARKE CO.: *M.A. Vincent 1372* (MEXU).

Grains stephanocolporate, usually 5-colporate, often 6-colporate, tectate, suboblate, (60–)53–68 × 64–77(–70) µm. P/E 0.85. Polar view pentagonal or circular of (69–)64–72 µm in diameter. Exine 4.8 µm, thick, sexine and nexine the same thickness, punctitegillate. Colpi with scabrate membranes, margocolpate. Pores lalongate, (17–)12–20 µm × (7.6–)4–9 µm, with granulate opercula.

Marah gilensis (Greene) Greene (**Figs. 50–53**). U.S.A. ARIZONA: 1968, *P. Stewart s.n.* (MEXU).

Grains stephanocolporate, usually 4-colporate, often 5-colporate, semitectate, spheroidal, (60–)56–63 × 47–60(–56) µm. P/E 1.07. Polar view quadrangular, (56–)53–63 µm in diameter. Exine 4 µm, thick, sexine thicker than nexine, reticulate (clava forming a reticulum). Colpi with smooth membranes, acute ends, with broad margin 3 µm wide. Transversal colpi (18–)14–21 × 3–5(–4) µm, with scabrate opercula.

Marah macrocarpa (Greene) Greene (**Figs. 54–57**). MÉXICO. BAJA CALIFORNIA: *R. Moran 29109* (ENCB).

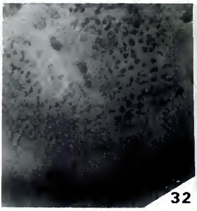
Grains stephanocolporate, 4-colporate, semitectate, subprolate, (69–)65–76 × 50–62(–57) µm. P/E 1.2. Polar view circular (64–)50–73 µm in diameter. Exine 3 µm, thick, sexine and nexine the same thickness retipilate. Colpi with acute ends, with broad margin 3 µm wide, syncolpate at a pole, membranes smooth. Circular pores (7–)5–10 µm in diameter.

DISCUSSION

Pollen morphology is characteristic for *Echinopepon* and *Echinocystis* and for some species of *Marah*.

Pollen from *Echinopepon* species was found to be variable between species, especially in the number of openings and in their ornamentation. The highest number of colpi was sixteen (Table 2) and contrasts with Jeffrey's data (4–8-colporate) for tribe Cyclanthereae (1964) and subtribe Cyclantherinae (Jeffrey 1990).

The pollen ornamentation was found to be reticulate (R), echinate (E), perreticulate (PR) and punctitegillate (PT) in different species (Table 2). The punctitegillate type was reported by Jeffrey (1964,1990) and Stafford and Sutton (1994) for *Echinopepon coulteri*, *E. racemosus* and *Echinocystis lobata*.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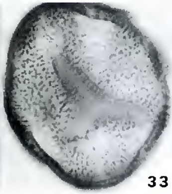
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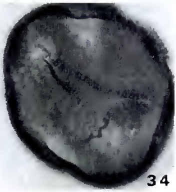
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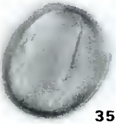
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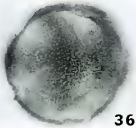
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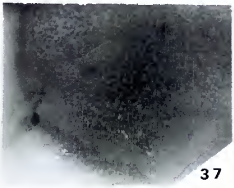
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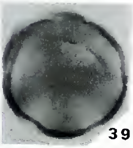
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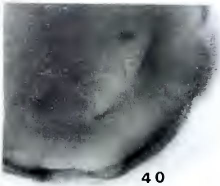
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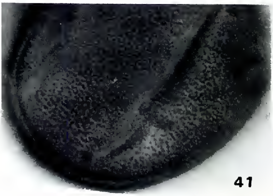
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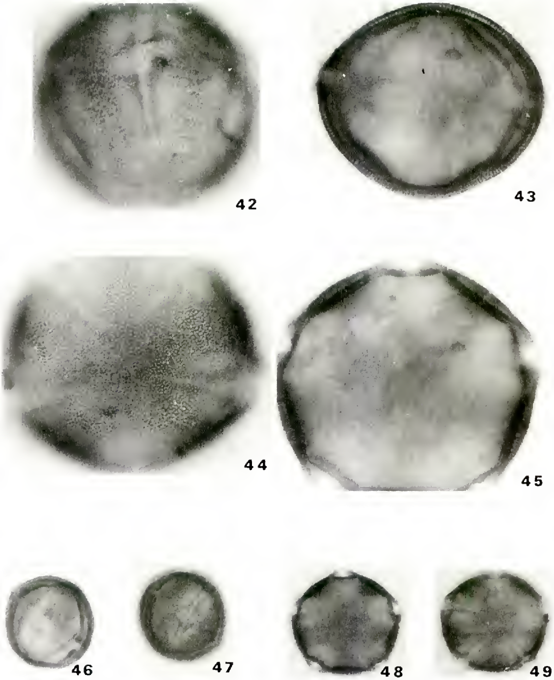
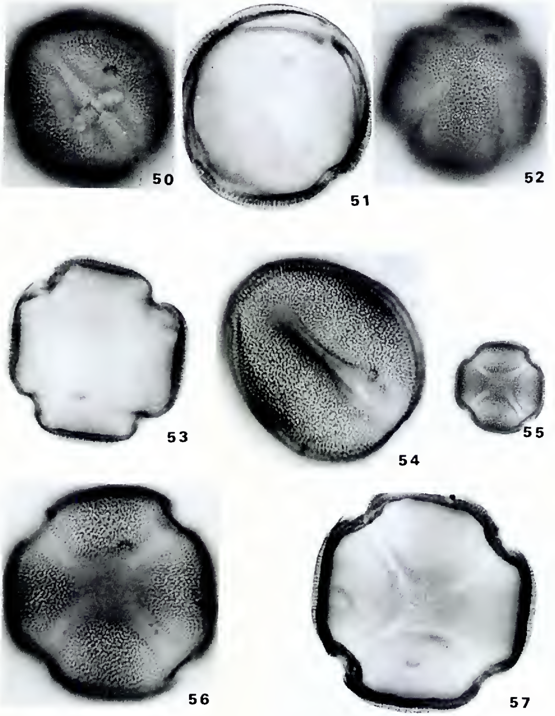
FIGS. 32–41.—*Echinopepon racemosus*. Fig. 32. Echinulate surface; Figs. 33, 34. Triradiate colpi (× 1000). *Echinopepon wrightii*. Fig. 35. Equatorial view (× 800); Fig. 36. Polar view (× 800). 37. Perreticulate surface; Fig. 38. Equatorial view; Fig. 39. Polar view, optical section (× 800); Fig. 40. Colpus over a pole; Fig. 41. Perreticulate surface (× 1000).



Figs. 42–49.—*Echinocystis lobata*. Fig. 42. Equatorial view, punctitegillate surface; Fig. 43. Optical section; Fig. 44. Polar view (× 1000); Figs. 45–49. Optical section (× 800).



FIGS. 50–57.—*Marah gilensis.* Fig. 50. Equatorial view; Fig. 51. Optical section; Fig. 52. Polar view surface; Fig. 53. Optical section (× 1000); *M. macrocarpa.* Fig. 54. Equatorial view surface (× 1000); Fig. 55. Syncolpate grain; Fig. 56. Polar view syncolpate (× 800); Fig. 57. Optical section (× 1000).

TABLE 2. Palynological characteristics *Echinopepon* species.

	P (µm) X	E (µm) X	P/E	Ornam.	N° Colpi	Exine	Thecae Type
E. cirrhopedunculatus	88	82	1.07	R	16	5.6	U
E. coulteri	104	126	0.82	R	7	4.0	U
E. gemellus	76	90	0.84	PT	14	4.0	U
E. minimus	71	80	0.95	R	10 por.	5.0	U
E. pubescens	94	94	1.00	PT	7 por.	4.0	Replicate
E. racemosus	94	102		E		5.6	Replicate
E. wrightii	81	89	0.94	PR	7	5.0	Straight or Arched

P. Polar Axis E. Equatorial Axis P/E. Relation between polar axis and equatorial axis.

Echinopepon cirrhopedunculatus, *E. coulteri*, *E. gemellus* and *E. minimus* have U-shaped thecae and colpate or colporoidate pollen grains, while *E. racemosus* has replicate thecae and its pollen grains lack longitudinal colpi. *E. pubescens* has replicate thecae and colporoidate pollen grains, while the thecae of *E. wrightii* are straight or arched with a 7–8 colpate pollen. The results presented in Table 2 agree with those reported by Dieterle (1976) for *E. gemellus* (as *E. torquatus*), *E. racemosus* (as *E. horridus*) and *E. wrightii* (as *E.paniculatum*).

The tectate pollen grains and the absence of longitudinal colpi observed in *E. racemosus* may suggest that it is the most advanced species of the genus. This taxon is quite variable regarding the shape of its leaves, number of tendrils and branches, degree of pubescence and wide geographical distribution from Mexico to Argentina. On the other hand, *E. cirrhopedunculatus*, *E. gemellus* and *E. minimus* may be considered less advanced because their pollen grains are semitectate and 10–17 colpate-colporoidate; they are reported as endemic to Mexico (Rodríguez 1995). Although *E. pubescens* is also considered endemic to México, it has 6–7-colporoidate pollen grains.

In conclusion, the pollen of *Echinopepon*, *Echinocystis* and *Marah* is often distinctive, which in some cases helps in taxonomic determination. *Echinopepon* pollen characters have diagnostic value in identification of the seven accepted species.

REFERENCES

DIETERLE, J.V.A. 1974. A new geocarpic genus from Mexico: *Apatzingania* (Cucurbitaceae). Brittonia 26:129–132.

______. 1976. Flora of Guatemala. Cucurbitaceae. Fieldiana Bot. 24, XI(4):306–395.

ERDTMAN, G. 1943. An introduction to pollen analysis. The Ronald Press Co., New York.

JEFFREY, C. 1964. A note on pollen morphology in Cucurbitaceae. Kew Bull. 17:473–477.

_____. 1978. Further notes on Cucurbitaceae IV. Some new world taxa. Kew Bull. 33:347–380

_____. 1990. Appendix: An outline classification of the Cucurbitaceae. In: D.M. Bates, R.W. Robinson, and C. Jeffrey, eds. Biology and utilization of Cucurbitaceae. Cornell Univ. Press. Ithaca, New York. Pp. 449–463.

Marticorena, C. 1963. Material para una monografía de la morfología de polen de Cucurbitaceae. Grana Palynologica 4:78–91.

Palacios-Ch.R., Ma.L. Arreguín S., y D.L. Quiroz G. 1995. Morfología de los granos de polen de la familia Cucurbitaceae del Valle de México. Anales Esc. Nac. Ci. Biol. 40:133–152.

Rodríguez, J.C. 1995. Distribución geográfica del género *Echinopepon* (Cucurbitaceae). Anales Inst. Biol. Univ. Nac. México. Ser. Bot. 66:171–181.

_____. Taxonomía del género *Echinopepon* (In press).

Shridhar and D. Sing. 1990. Palynology of the Indian Cucurbitaceae. In: D.M. Bates, R.W. Robinson and C. Jeffrey, eds. Biology and utilization of Cucurbitaceae. Cornell Univ.Press. Ithaca, New York. Pp. 200–208.

Stafford, P.J. and D.A. Sutton.1992. Pollen morphology of the Cyclantherinae. C. Jeffr. (Tribe Syceae Schrad. Cucurbitaceae) and its taxonomic significance. 8th Internat. Palynol. Congress, Aix en Provence. Abstracts. P. 140.

_____. 1994. Pollen morphology of the Cyclantherinae C. Jeffrey (Tribe Syceae Schrad., (Cucurbitaceae) and its taxonomic significance. Acta Bot. Gallica 141:171–182.

BOOK REVIEW

RICHARD UVA, JOSEPH NEAL and JOSEPH DITOMASO. 1997. **Weeds of the Northeast.** (ISBN 0-8014-3391-6 (hbk); ISBN 0-8014-8334-4 (pbk). Cornell University Press, Sage House, 512 E State Street, Ithaca, NY 14850. $29.95, 397 pp, color photographs.

This book contains practical keys, shortcut identification tables, and descriptions for 299 common agricultural weeds in the area bounded by southeastern Canada, Virginia, and Wisconsin. For each species, the description consists of common name, scientific name, important common name synonyms or taxonomic synonyms, a general description, propagation/phenology, seedling description, mature plant description (very brief), roots and underground structures, flowers and fruit (when applicable), post senescence characteristics, habitat, distribution and similar species. On the facing page for each of these descriptions are lovely color photographs of the habit, a line drawing of a drawing and/or photo of the inflorescence or flower (or other reproductive structure for non-angiospermous plants), stem or trunk, and seeds. There are also several comparison tables in the back of the book with salient features of closely related or similar-looking species, and a fold-out grass identification table. A vegetative key runs from page 9 to page 17, and while not dichotomous, seems fairly easy to use.

While not exhaustive, and missing one of my favorite roadside weeds, *Antennaria* (Asteraceae), it is a wonderful pocket guide for the amateur nature enthusiast, gardeners, farmers, and others interested in weeds. I also thought it strange Andrew F. Senesac is an author on the inside back cover, but not on the front cover, nor on the title page. The high quality of the photos and illustrations, up-to-date nomenclature, glossary, index and other features make this book attractive, user-friendly and worth buying. I certainly recommend it to anyone as a supplemental book, especially for use in poison control centers and other places where people bring in weeds that either their children or pets have eaten.–*John J. Pipoly III*

VARIATION IN THE *BERLANDIERA PUMILA* (ASTERACEAE) COMPLEX

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ABSTRACT

Plants from southeast Texas and adjacent Louisiana previously identified in part as *Berlandiera ×betonicifolia* are regarded here as geographical variants of *B. pumila* and are treated as *B. pumila* var. *scabrella* Nesom & Turner, var. nov. Variety *pumila* and var. *scabrella* differ in features of cauline and foliar vestiture, that of the upper leaf surfaces allowing the most consistent separation. The type collection of *B. betonicifolia* (Hook.) Small (*Silphium betonicifolium* Hook., 1835) represents a species distinct from *B. pumila* and comprises plants previously identified by the name *B. texana* DC. (1836), which is displaced by the former. While the morphology of *B. pumila* var. *scabrella* has suggested that it originated as a hybrid between typical *B. pumila* and *B. betonicifolia*, there is no evidence of current hybridization between these two species.

KEY WORDS: *Berlandiera*, *B. pumila*, *B. betonicifolia*, Asteraceae

RESUMEN

Plantas del sudeste de Texas y la parte adyacente de Louisiana identificadas previamente en parte como *Berlandiera ×betonicifolia* son consideradas aquí como variantes geográficas de *B. pumila* y son tratadas como *B. pumila* var. *scabrella* Nesom & Turner, var. nov. La variedad *pumila* y var. *scabrella* difieren en características del indumento caulinar y foliar, siendo la del haz la que permite una mejor separación. El tipo de *B. betonicifolia* (Hook.) Small (*Silphium betonicifolium* Hook., 1835) representa una especie distinta de *B. pumila* y comprende plantas previamente identificadas como *B. texana* DC. (1836), que es desplazada por la anterior. Mientras que la morfología de *B. pumila* var. *scabrella* ha sugerido que se formó como un híbrido *B. pumila* típica y *B. betonicifolia*, no hay evidencia de hibridación actual entre estas dos especies.

Shinners (1951) followed Small (1903, 1933) in treating *Berlandiera pumila* (Michx.) Nutt. as a species restricted to the southeastern United States east

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of the state of Mississippi; its vicariad west of the Mississippi River was identified as *B. dealbata* (Torr. & A. Gray) Small. Turner and Johnston (1956) returned to the concept of Torrey and Gray by including the western plants within a more broadly defined *B. pumila*, acknowledging the existence of a distributional hiatus between the two geographic segments of the species. The western segment of *B. pumila* occurs primarily in east Texas and adjacent Louisiana (Fig. 1), barely reaching into the adjacent corners of southeastern Oklahoma and southwestern Arkansas.

Shinners (1951) accepted the existence of *Berlandiera betonicifolia* (Hook.) Small as a distinct species similar to western *B. pumila* (*B. dealbata* in his sense) in morphology and geography. Turner and Johnston (1956) viewed *B. betonicifolia* as intergrading with both *B. pumila* and *B. texana* DC. and adopted the earlier combination *B. texana* var. *betonicifolia* (Hook.) Torr. & A. Gray. This group of entities/taxa is referred to in the present study as

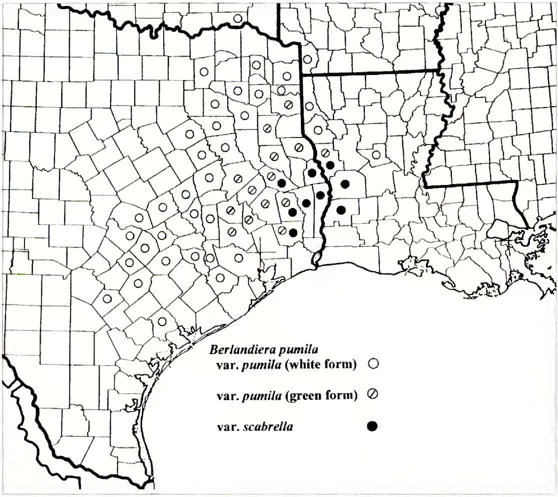

FIG. 1. Distribution by county of *Berlandiera pumila* in Texas, Louisiana, Arkansas, and Oklahoma.

the "*B. pumila* complex."

In a biosystematic study of the whole genus, Pinkava (1967) found that crosses between all combinations of species of *Berlandiera* were easily made under greenhouse conditions and he provided evidence of natural hybridization between many of the taxa. All entities of the genus are reported to have an apparently invariant chromosome number of n=15 (see Pinkava 1970 for original counts and summary of previous literature). Based on the morphology of artificially constructed hybrids, Pinkava observed that "although the [GH] type of *B. betonicifolia* lies between the F_1 [of *B. pumila* and *B. texana*] and *B. texana*, it is definitely an intermediate of the two species and its name has been retained for the hybrid group" (p. 292). Pinkava used the designation "*B.* ×*betonicifolia*" and has been followed in this by recent treatments that have adopted his view.

Pinkava interpreted the *Berlandiera pumila* complex in east Texas (his Fig. 4, p. 294) essentially as an intergrading nexus between *B. pumila*, *B. betonicifolia*, and *B. texana*. In *B. betonicifolia*, "most characters are intermediate to those of the putative parents in varying degrees and combinations over its range of east-central Texas and western Louisiana" (Pinkava 1970, p. 1625). He found apparent intermediates between *B. texana* and *B. betonicifolia*, however, to be rare. Although his histogram of hybrid index values in the "Western *B. pumila*/*texana* complex" (Fig. 2b, p. 290) indicates that he observed several populations of such intermediates, only one such collection is mapped on his Fig. 4 (1967); it is in central Louisiana (Rapides Parish), where *B. pumila* apparently is absent but where *B. texana* (sensu Pinkava) is known by a number of collections (Fig. 2).

In the Louisiana flora, Gandhi and Thomas (1989) and MacRoberts (1989) recognized both *Berlandiera pumila* and *B.* ×*betonicifolia*, showing these two taxa with nearly identical geographic ranges. MacRoberts (1989, p. 313) noted that the latter "seems to be inordinately common compared with its putative parents." *Berlandiera pumila* and *B.* ×*betonicifolia* both have been recognized from the southeastern corner of Oklahoma (Taylor and Taylor 1994).

Berlandiera ×*betonicifolia* (sensu Pinkava) was reported from the southwestern corner of Arkansas (Miller Co.) by Orzell and Bridges (1987, p. 88), who adopted Pinkava's interpretation of variability among the plants they observed. They noted that "Our specimens mostly fit the putative backcross hybrid of *Berlandiera* ×*betonicifolia* with *B. pumila*, . . . although some of our specimens have dense, matted white-tomentose pubescence, and could be referred to *B. pumila*." Smith (1994) identified these Arkansas plants simply as *B. pumila*.

Cronquist (1980) did not include *Berlandiera betonicifolia* among the three species formally recognized in his treatment of the genus for the southeastern

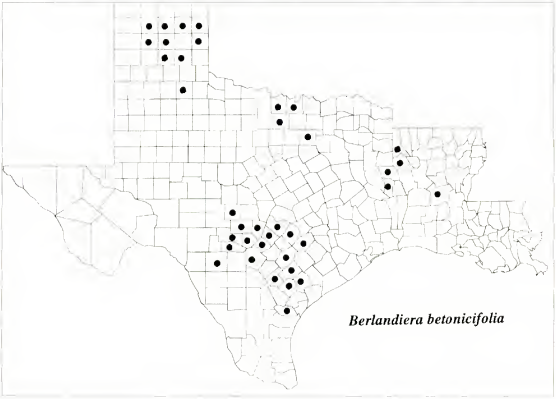

FIG. 2. Distribution by county of *Berlandiera betonicifolia* (see text for definition) in Texas and Louisiana. The species also occurs northward through Oklahoma into northern Arkansas, Missouri, and southern Kansas.

United States. He referred to it in introductory comments simply as the name covering hybrids between *B. pumila* and *B. texana*.

Despite the considerable previous attention given to patterns of variation and accompanying taxonomy of plants of the *Berlandiera pumila* complex in Texas and Louisiana, field experience in east Texas and adjacent Louisiana suggested that the pattern of variation in this group might be viewed from another perspective. This problem was approached in more detail through study of numerous collections available in regional herbaria and field observations in 1996 and 1997 covering Anderson, Angelina, Cherokee, Hardin, Houston, Jasper, Montgomery, Nacogdoches, Newton, Polk, Rusk, Sabine, San Augustine, San Jacinto, Shelby, Trinity, Tyler, Upshur, Van Zandt, Walker, and Wood counties, Texas, and Vernon Parish, Louisiana.

THE IDENTITY OF *BERLANDIERA BETONICIFOLIA*

Pinkava did not examine the original type material of *Silphium betonicifolium*, but based on a photo, he noted (1967, p. 297) that "Drummond's holotype [of *S. betonicifolium*] more closely resembles *B. texana* [than *B. pumila*] and was assigned to it [*B. texana*] as a variety by Torrey & Gray (1842), who commented that other specimens fitted neither varietal description completely." Gray annotated at least two of the Drummond sheets now at K (see below) as "*Berlandiera texana* DC. ß *betonicifolia* Torr. & Gray." The present examination of the original material at K shows it to be the species that has long been identified as *Berlandiera texana* DC., which de Candolle named a year later than Hooker's *S. betonicifolium*.

The material at K consists of four sheets, which are similar among themselves in habit and other morphological features, and it seems likely that Drummond collected all of this material at the same site. The lectotype (designated below) bears detailed sketches of the ray and disc achenes, which were probably used by Bentham in his preparation of the Compositae treatment for *Genera Plantarum*.

The correspondingly modified nomenclature for this species is summarized below.

Berlandiera betonicifolia (Hook.) Small, Fl. SE U.S. 1246, 1340. 1903. *Silphium betonicifolium* Hook., Comp. Bot. Mag. 1:99. 1835. *Berlandiera texana* var. *betonicifolia* (Hook.) Torr. & A. Gray, Fl. N. Amer. 2:281. 1842. *Berlandiera* x*betonicifolia* (Hook.) Small sensu Pinkava, Brittonia 19:297. 1967. Type: (as cited in the protologue and on the label, see comments in text): [United States, Louisiana], New Orleans, 1833, *T. Drummond s.n.* (LECTOTYPE, designated here: K!; ISOLECTOTYPES: K-3 sheets!; probable ISOLECTOTYPE: GH!). Color photos of two of the K isolectotypes are on file at TEX.

Berlandiera texana DC., Prodr. 5:317. 1836. Type: TEXAS: between the Trinity River and Bejar [San Antonio], Jun 1828, *J.L. Berlandier 2044* (HOLOTYPE: G fiche!; ISOTYPES: F, MO, NY, P).

On the lectotype of *Silphium betonicifolium* (and one of the isolectotypes), presumably written by Hooker himself, the collection locality and date are given as "N. Orl. 1833." The possible GH type material of *S. betonicifolium* was annotated by B.L. Turner and M.C. Johnston in 1955: "Possible isotype, as questioned by Gray (Fl. N. Amer. 2:281. First edition). Drummond's plant possibly came from Texas—'New Orleans' being a citation error." Gray himself (1842) cited the locality of the type collection as "New Orleans?," apparently questioning its provenance. There are no other historical or recent collections of any species of *Berlandiera* from southeastern Louisiana and none from Mississippi, and it seems unlikely on this basis that Drummond made the "betonicifolia" type collection in the area of New Orleans.

One of the isolectotypes bears a glued annotation label (pasted over the lower stem), presumably in Asa Gray's script: *Berlandiera texana* DC. Torr. Gr. Fl. N. Am. 2.286." At the bottom of the label, in print, there is a line "Jacksonville (Amer. Bor.) *Drummond* 1833." Gray (presumably) crossed out the word Jacksonville and wrote above it "Louisiana." An early Texas site for "Jacksonville" is not known to the present authors.

Drummond sailed from New Orleans to reach Texas (Brazoria County) in March 1833, and during his 21-month stay in Texas (Geiser 1948), he stayed or traveled in areas where *Berlandiera pumila* var. *pumila* occurs (e.g., Fayette, Austin, Lee, Colorado, Fort Bend counties), but he did not travel in the area where plants previously identified as *B.* ×*betonicifolia* (see below) occur (Fig. 1). Geiser's account shows that Drummond passed through at least one county (Gonzales Co.) where *B. betonicifolia* (of the present interpretation) is known to occur (Fig. 2). From among the 100 or more collections of the *Berlandiera pumila* complex at LL,TEX, the plant most similar to the Kew types is a collection (*Gentry & Smith 2024*, LL) from Victoria Co., which is only a short distance from Gonzales County.

Considering the information presented in the present study, Drummond probably collected the plants of the type material in south-central Texas at some locality near the Guadalupe River, which traverses both Gonzales and Victoria counties. Drummond collected along this river (fide Gaiser) between 24 April and 26 September, 1834, at which time he was assembling his "set II." One of the isolectotypes bears the handwritten notation "Texas II, no No. [s.n.], *Drummond*."

With his last set of collections, Drummond sailed from New Orleans in December 1834 on his return to Europe. He disappeared enroute (apparently in Cuba) but his specimens arrived safely.

THE NATURE OF *BERLANDIERA BETONICIFOLIA*

Berlandiera betonicifolia (*B. texana* of previous interpretations) occurs from panhandle and south-central Texas and adjacent Louisiana (Fig. 2) northward through Oklahoma into northern Arkansas, Missouri, and southern Kansas (Pinkava 1967; Turner and Johnston 1956; Great Plains Flora Assoc. 1986). This species can be separated from the *B. pumila* complex without intergrades by making comparisons in the key below. Collections of both *B. betonicifolia* and *B. pumila* have been made in the same counties in central and east Texas (Victoria, Bastrop, Burleson, Gonzales, Travis, Fayette, and Shelby) and parishes of adjacent Louisiana (Caddo and DeSoto) (Figs. 1 and 2), but in this region of geographic overlap, there are no plants suggestive of hybridization and/or introgression between them. For the most part, plants that previously have been interpreted as such hybrids (*B. pumila* var. *scabrella*, as identified here) occur outside of the present geographic range of *B. betonicifolia*.

As noted by Pinkava (1967), the lower stems of plants of *Berlandiera betonicifolia* from parts of Texas tend to be silky-pilose with soft, white hairs while those from further north have shorter, thicker, and slightly vitreous hairs. Infraspecific variation in leaf shape and margin also exists within the species, but this variability apparently does not bear on its relationship to *B. pumila*.

Based primarily on perceived similarities in stem leafiness and leaf insertion, Turner and Johnston (1956) regarded *Berlandiera betonicifolia* (as *B. texana*) and *B. pumila* var. *scabrella* (as *B. betonicifolia*) as conspecific and intergrading. The current study, in contrast, concludes that *B. betonicifolia* is distinct from other closely related entities.

VARIATION WITHIN *BERLANDIERA PUMILA*

Plants from east Texas and western Louisiana previously identified as *Berlandiera pumila* and *B. ×betonicifolia* are best represented as two entities within a single species (*B. pumila*), differing in features of vestiture. The nomenclatural summary for typical *B. pumila* and the newly recognized variant are given here.

Berlandiera pumila (Michx.) Nutt., Trans. Amer. Philos. Soc. ser. 2, 7:342. 1841. *Silphium pumilum* Michx., Fl. Bor.-Amer. 2:146. 1803. TYPE: UNITED STATES. FLORIDA: [no date], *A. Michaux 10* (HOLOTYPE: P fiche!).

Berlandiera tomentosa var. *dealbata* Torr. & A. Gray, Fl. N. Amer. 2:282. 1842. *Berlandiera pumila* var. *dealbata* (Torr. & A. Gray) Trel., Rep. Ark. Geol. Survey 1888, 4:193. 1891.

Berlandiera dealbata (Torr. & A. Gray) Small, Fl. S.E. U.S. 1246, 1340. 1903. TYPE: UNITED STATES. "ARKANSAS" [present day Oklahoma], [date], *T. Nuttall* (HOLOTYPE: NY fiche!).

Berlandiera pumila (Michx.) Nutt. var. **scabrella** Nesom & Turner, var. **nov.** TYPE: U.S.A. TEXAS. Jasper Co.: roadside of Hwy 63, 0.8 mi E of jct with FM 1738, 1.0 mi E of crossing of Melholms Creek, 7.0 mi E of jct Hwys 290 and 96 in Jasper; narrow strip of native vegetation along side of hwy, buffer to loblolly pine plantation behind; dominant scrubby post oak, blackjack oak, black hickory, and bluejack oak, with less common sweetgum, dogwood, sassafras, yaupon, buckeye, and winged sumac; *Berlandiera* scattered but abundant along edge of woods for ca 50 yards on N side of hwy, in deep, loose sand; 16 May 1998, *G.L. Nesom 98J1* (HOLOTYPE: TEX; ISOTYPES: ASTC, BRIT, FSU, GH, IBE, LSU, MISSA, MO, NCU, NLU, OKL, SHST, TAES, TAMU, UARK, US, USCH).

A *B. pumilo* var. *pumilo* similis sed differt vestimento hispidulo paginis superis foliaribus, trichomatibus basaliter erectis basibus incrassitis.

Most of the variation that occurs among plants of *Berlandiera pumila* is attributable to three patterns: 1) vestiture of the upper leaf surfaces—a relatively abrupt transition in easternmost Texas from fine, thin-based, reclining or appressed hairs to thick, basally erect hairs; 2) vestiture density of the stems and lower leaf surfaces—interpopulational variation in central and east-central Texas and the gradual reduction in density, with loosening of the matted tomentum and shortening and thickening of the hairs, in populations from west to east toward Louisiana; and 3) stem vestiture coloration—production of reddish cross-wall pigments mostly in southeastern Texas and adjacent west-central Louisiana. Each of these patterns is discussed below in more detail.

1) The morphological feature that shows the sharpest geographic transition within *Berlandiera pumila* is the nature of the vestiture on the upper leaf surfaces: fine, silky, thin-based, basally reclining or appressed hairs (var. *pumila*) vs. thicker-based and basally erect hairs (var. *scabrella*). It is primarily on this basis that the taxonomic separation between the varieties of *B. pumila* in the present interpretation can be made most consistently. Intermediacy in hair morphology occurs in Cass, Harrison, Shelby, Polk, and Tyler counties and Caddo and DeSoto parishes (and perhaps others). This feature also was emphasized by Pinkava (1970) in his key to Texas *Berlandiera* and was described by Torrey and Gray (1842, their "*B. tomentosa* y").

2) Plants of *Berlandiera pumila* var. *pumila* with a dense vestiture of long, thin, matted hairs show white stems and distinctly bicolored leaves (white beneath, green above), the stem and lower leaf surfaces obscured by the tomentum (the "white form" of var. *pumila*). Plants with trichomes shortened in length show a corresponding reduction in density of vestiture and the green surfaces of the stems and leaves are visible through the hairs (the "gray-green form" of var. *pumila*, not mapped on Fig. 1, intermediate between the "white form" and "green form"). Shorter trichomes of the lower leaf surfaces tend to be somewhat erect and separate rather than parallel to the surface and closely intertwined. Only the white form of *B. pumila* occurs in populations from the westernmost area of the range (Fig. 1). The white form and gray-green form occur broadly over east Texas. In this area are plants with dense white tomentum as well as plants with vestiture reduced by degrees in density, this feature tending to be relatively uniform within a local population. A corresponding reduction in stem vestiture appears to be the only morphological difference correlated with the variation in leaf vestiture. The "green form" of *B. pumila* occurs in easternmost Texas counties and in Louisiana; in these plants the vestiture is further reduced, with the lower leaf surfaces showing greenish or yellowish-green and hardly different in color from the upper surface. In this area, the gray-green form occurs infrequently and the white form is rare or absent. The reduction in stem and abaxial leaf vestiture is characteristic of some populations of var. *pumila* and all of var. *scabrella*. In the present attempt to characterize finer patterns of infraspecific variation, we note the that the informally designated white, gray-green, and green forms are found within var. *pumila* but var. *scabrella* includes only the green form.

3) The stem vestiture of plants from a cluster of southeasternmost Texas counties (Hardin, Polk, Jasper, Newton, Angelina, and Sabine cos.) and adjacent Louisiana (Fig. 1) is reduced and the hairs distinctly colored. The hairs are basally erect, though not thick and long like those of *B. betonicifolia*, and the strongly colored cross-walls of all the hairs give a purplish or reddish-brown color to at least the upper stems. Such purplish stems are char-

acteristic primarily of plants recognized here as var. *scabrella*, but intergradation in this feature occurs with plants of var. *pumila* (the gray-green form) from slightly further west. In these intergrades, hairs with colored cross-walls are formed among the more abundant white hairs but are less noticeable within the predominately grayish cauline vestiture.

The evolutionary origin of *Berlandiera pumila* var. *scabrella*, as suggested by Pinkava (1977), may have been through hybridization between *B. betonicifolia* and typical *B. pumila*. Both *B. betonicifolia* and *B. pumila* var. *scabrella* have reduced vestiture of stems and leaves and neither produces white tomentum; the upper leaf surfaces in both are somewhat hispid with thickened, basally erect hairs. Stem hairs in both entities usually produce purplish cross-walls. As noted above, however, such hybridization is not currently evident and parallel evolution is an equally reasonable explanation of these morphological similarities between *B. betonicifolia* and var. *scabrella*.

THE NATURE OF TYPICAL *BERLANDIERA PUMILA*

Berlandiera pumila in its typical form occurs in western Florida (where the type collection was made by Michaux), Alabama, Georgia, South Carolina, and North Carolina. The general distribution of the species was shown by Pinkava (1967); its absence from Mississippi remains a reality (S. McDaniel, pers. comm.). Various populations of *B. pumila* in this eastern segment of its geographic range correspond to both the "white form" and "green form" of the western segment of the species, as outlined in the comments above. There is no variation within *B. pumila* of the eastern U.S. toward the morphological features characteristic of var. *scabrella*.

KEY TO THE TAXA OF THE *BERLANDIERA PUMILA* COMPLEX

1. Stem hairs thick-based, erect, mostly 1.0–1.5(–2.0) mm long, commonly distinctly flattened and vitreous; lower leaf surfaces greenish; leaves lanceolate to deltate, the mid-cauline and upper usually sessile ....**B. betonicifolia**

1. Stem hairs soft and thin, densely matted and closely appressed or sometimes oriented in parallel, the length of the individual hairs difficult to observe, sometimes more loosely arranged and less than 1 mm long, white; lower leaf surfaces white to gray-green or greenish; leaves ovate to triangular or lanceolate, the mid-cauline and upper usually on short (1–2 mm) petioles ....**B. pumila (2)**

    2. Upper leaf surfaces softly pubescent with very thin, appressed or basally reclining hairs (sometimes basally erect in Cass, Harrison, and Shelby cos., Caddo Parish), the leaves strongly to weakly or not at all bicolored; stem vestiture relatively dense and matted or reduced in density with the stem surface visible, the hairs evenly whitish or some with purplish cross-walls near the base ....**B. pumila var. pumila**

    2. Upper leaf surfaces minutely hispidulous with relatively thicker-based and basally erect hairs, the leaves not bicolored; stem surface visible, the vestiture reduced in density, the hairs often reddish-brown to purple because of colored cross-walls ....**B. pumila var. scabrella**

ACKNOWLEDGMENTS

Specimens have been examined from ASTC, BRIT, NLU, SBSC, SHST, TAES, TAMU, and LL,TEX. The K holotype was loaned to Turner at LL,TEX. Walter Holmes provided information on collections housed at BAYLU and Sidney McDaniel verified the absence of *Berlandiera pumila* from Mississippi. Thanks to Mark Bierner and Reviewer #2 for their helpful criticisms.

REFERENCES

CRONQUIST, A. 1980. Asteraceae. Vascular flora of the southeastern United States, Volume I. Univ. of North Carolina Press, Chapel Hill.

GANDHI, K.N. and R.D. THOMAS. 1989. Asteraceae of Louisiana. Sida, Bot. Misc. 4:1–202.

GEISER, S.W. 1948. Naturalists of the Frontier (ed. 2). Southern Methodist University Press, Dallas, Texas.

GRAY, A. 1842. *Berlandiera*. In: Torrey, J. and A. Gray. Fl. N. Amer. 2:280–283.

GREAT PLAINS FLORA ASSOCIATION. 1986. Flora of the Great Plains. Univ. of Kansas Press, Lawrence.

MACROBERTS, D.T. 1989. A documented checklist and atlas of the vascular flora of Louisiana. Bull. Mus. Life Sci., No. 8:1–534; Appendix, bibliography, and addendum.

ORZELL, S.L. and E.L. BRIDGES. 1987. Further additions and noteworthy collections in the flora of Arkansas, with historical, ecological, and phytogeographical notes. Phytologia 64:81–144.

PINKAVA, D.J. 1967. Biosystematic study of *Berlandiera* (Compositae). Brittonia 19:285–298.

_____. 1970. *Berlandiera*. Pp. 1623–1625. In: Correll, D.S. and M.C. Johnston. Manual of the vascular flora of Texas. Texas Research Foundation, Renner, Texas.

SHINNERS, L.H. 1951. Notes on Texas Compositae—VIII. Field & Lab. 19:133–136.

SMALL, J.K. 1903. Flora of the southeastern United States. Published by the author, New York.

SMALL, J.K. 1933. Manual of the southeastern flora. Univ. of North Carolina Press, Chapel Hill.

SMITH, E.B. 1994. Keys to the flora of Arkansas. Univ. of Arkansas Press, Fayetteville.

TAYLOR, R.J. and C.E.S. TAYLOR. 1994. An annotated list of the ferns, fern allies, and flowering plants of Oklahoma (ed. 3). Biology Dept. Herbarium, Southeastern Oklahoma State University, Durant.

TORREY, J.R. and A. GRAY. 1842. A flora of North America, Vol. 2. part 2. Wiley and Putnam, New York.

TURNER, B.L. and M.C. JOHNSTON. 1956. Chromosome numbers and geographic distribution of *Lindheimera*, *Engelmannia*, and *Berlandiera* (Compositae—Heliantheae–Melampodinae). Southw. Nat. 1:125–132.

NEW NAMES AND COMBINATIONS IN NEOTROPICAL MYRSINACEAE

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ABSTRACT

Lundell (1981a, 1986) published 68 new names and combinations for binomials in *Ardisia* and *Myrsine*. In both papers, he indicated that he was opposed to placement of the taxa involved in those genera and that the combinations and new names were provided in anticipation of future circumscriptions of the genera. We agree with Morales (1997) that in doing so, Lundell inadvertently invalidated his new names and combinations, according to the *International Code of Botanical Nomenclature* Article 34.1. To remedy the situation, the following new combinations are proposed in *Myrsine*: *M.. calcarata* (Lundell) Ricketson & Pipoly and *M. juergensenii* (Mez) Ricketson & Pipoly; the other seven Lundell combinations are taxonomic synonyms and thus, not in need of validation. In addition to those combinations validated by Morales (1997) in *Ardisia*, 27 new combinations are made, nine new names are proposed, and for those taxa described by Lundell in the segregate genus *Icacorea* Aublet but never transferred, five new combinations are proposed. The remaining 17 binomials are taxonomic synonyms and therefore, are not validated.

RESUMEN

Lundell (1981a, 1986) publicó 68 nombres y combinaciones nuevos para binomiales en los géneros *Ardisia* y *Myrsine*. En ambos trabajos, el indicó que no estaba de acuerdo con la ubicación taxnómica de los taxa dentro de los géneros susodichos y que se estaba llevando a cabo las combinaciones y nombres nuevos para anticipar circumscripciones futuras que podrían ser descritas para los géneros. Estamos de acuerdo con Morales (1997) quien consideraba que Lundell, por haber dicho eso claramente, invalidó sus nombres y combinaciones nuevos según el *Codigo Internacional de Nomenclatura Botánica* (ICBN) Artículo 34.1. Para corregir esta situación, las combinaciones nuevas se proponen dentro del género *Myrsine*: *M. calcarata* (Lundell) Ricketson & Pipoly, y *M. juergensenii* (Lundell) Ricketson & Pipoly; las otras siete combinaciones que hizo Lundell se consideran como sinónimos taxonómicos y por lo tanto, no necesitan ser transferidos. Además de las combinaciones validadas por Morales (1977) dentro de *Ardisia*, se proponen 27 combinaciones nuevas y nueve nombres

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nuevos. Para los taxa descrito por Lundell dentro del género segregado como *Icacorea* Aublet, pero nunca transferidos al género *Ardisia*, se transfierren cinco combinaciones nuevas. Los 17 binomiales restantes son sinónimos taxonómicos y por lo tanto, no necesitan ser transferidos.

INTRODUCTION

Cyrus L. Lundell studied the neotropical members of the Myrsinaceae for over 60 years, and was the principal monographer of the family since the monograph of Mez (1902) in Engler's *Das Pflanzenreich*. In addition to treatments of the family for *Flora of Guatemala* (Lundell 1966) and *Flora of Panama* (Lundell 1971), Lundell published a series of 26 papers in the journals *Wrightia* and *Phytologia* dealing with the taxonomy of the family. The senior author began collaboration with Lundell in 1981 while a graduate student, and corresponded with him regarding generic delimitation for almost six years.

Ardisia was described by Swartz (1788) in his *Nova Genera et Species Plantarum*, and eventually conserved over the earlier *Icacorea* Aublet (1775). However, Lundell perceived that *Ardisia,* as defined in the broad sense by Mez (1902), was an artificial assemblage (paraphyletic in more modern terminology), and therefore, segregated the following genera from it: *Amatlania* Lundell (1982), *Auriculardisia* Lundell (1981c), *Chontalesia* Lundell (1982), *Gentlea* Lundell (1964), *Graphardisia* (Mez) Lundell (1981a), *Ibarrea* Lundell (1981a), *Oerstedianthus* Lundell (1981b), *Synardisia* (Mez) Lundell (1963), *Valerioanthus* Lundell (1982), *Yunckeria* Lundell (1964), and *Zunilia* Lundell (1981c). While some of these segregate genera undoubtedly represent monophyletic lineages, the question of their respective circumscriptions and the consequent limits of the pantropical genus *Ardisia,* as well as the limits of all the genera in the tribe Ardisieae, was often a source of confusion.

Simultaneously, circumscription of the genus *Myrsine* L. and its relationship to the pantropical genus *Rapanea* Aublet, formed another source of taxonomic debate. While Mez (1902) recognized *Myrsine* as a small genus of paleotropical species, Hosaka (1940) demonstrated that the characters used to separate the two were not constant, resulting in Walker's (1959) change in taxonomic opinion. Lundell (1966, 1971) recognized *Rapanea* as distinct from *Myrsine*, but noted that Stearn (1969) elected to accept the more inclusive concept of *Myrsine* to include *Rapanea* in his treatment of the Jamaican species, a view increasingly adopted by modern workers (see Pipoly 1996 for a complete discussion).

During the early 1980s, the senior author was in close communication with Lundell and frequently discussed the problem of generic delimitation in the Myrsinaceae, particularly when viewed on a worldwide basis. The problem was compounded when preliminary cladograms were tested, and it appeared that several groups recognized by Mez were found to be paraphyletic (Pipoly 1987). As Lundell carried out the mammoth job of describing the many neotropical novelties discovered in the late 1970's and early 1980's, it became necessary for him to determine limits of the genera, and he apparently decided to provide names for the Ardisioid taxa both in the narrowest and broadest concepts that had been circumscribed to that date. Unfortunately, this philosophy led to the publication of two papers in which he essentially proposed new names and combinations in anticipation of future circumscription, even though he was not convinced of the placement of the taxa, thus invalidating all of them according to ICBN Article 34.1.

In preparation for our treatment of the Myrsinaceae for the *Flora Mesoamericana* Project of the National Herbarium of Mexico (MEXU), Missouri Botanical Garden (MO), the British Museum (BM) and other collaborators, we have published synopses for the genera *Myrsine* (Ricketson & Pipoly 1997a), *Stylogyne* (Ricketson & Pipoly 1997b), *Gentlea* (Ricketson & Pipoly 1997c), along with a revision of the genus *Ardisia* subgenus *Graphardisia* Mez (Pipoly & Ricketson, 1998). The problems posed by Lundell's (1981b) transfer of Mesoamerican *Rapanea* species to *Myrsine* were overlooked, but are rectified below. As work continues on *Ardisia* in its broadest sense, it becomes increasingly necessary to validate the invalid names and combinations made by Lundell (1986) in transferring species described in the various segregate genera of *Ardisia* to that genus, just as Morales (1997) did for only a few from Costa Rica and Panama. The consequent combinations, new names and updated synonymies for the taxa we recognize in these two problematic taxonomic groups are also effected below.

NOTES ON *MYRSINE*

Lundell (1981b) described the genera *Ibarrea* and *Oerstedianthus* as new, raised *Ardisia* subgenus *Graphardisia* to generic status, and transferred the Mesoamerican (and one Peruvian) species of *Rapanea* to *Myrsine*. However, in the introduction, Lundell stated "Nine species described in *Rapanea* Aubl., all except one from Mexico and Central America, are transferred to *Myrsine* L. to follow current practice, not out of any conviction as to the justification for this disposition of the taxa!" By including that statement in the introduction, he inadvertently invalidated the subject new combinations because Article 34.1 of the ICBN unequivocally states, "A name is not validly published (a) when it is not accepted by the author in the original publication; (b) when it is merely proposed in anticipation of the future acceptance of the group concerned, or of a particular circumscription, position or rank of the group (so-called provisional names), except as provided for in Art. 59..." While there is no doubt that Lundell recognized the entities involved as distinct taxa, we feel that he purposely effected the transfers as a result of discussions with the senior author and in anticipation of his (and others') future work on the group as the more broadly circumscribed *Myrsine* rather than setting it apart as *Rapanea*. Therefore, among the nine taxa he transferred, all are invalid. However, Ricketson and Pipoly (1997a) recognized only two of these species, *Myrsine calcarata* and *M. juergensenii*. The other six species, *Rapanea pittieri, R. peruviana, R. rufa, R. panamensis, R. allenii, R. mexicana* and *R. reflexiflora*, were synonymized, and thus the combinations made by Lundell are nomenclatural synonyms of them, with no need for validation. The new combinations and corrected synonymies for those species are presented below. For complete synonymies and citation of basionyms of recognized taxa, see Pipoly and Ricketson (1997a).

Myrsine calcarata (Lundell) Ricketson & Pipoly, comb. nov. *Rapanea calcarata* Lundell, Wrightia 5:295. 1976. *Myrsine calcarata* (Lundell) Lundell, Phytologia 48:142. 1981, nomen invalidum. TYPE: COSTA RICA. ALAJUELA: S side of Volcán Poás, upper slopes, on road leading past weather station, without elev., 24 Mar 1972, *D. Stone 3141* (HOLOTYPE: LL-TEX).

Myrsine coriacea (Sw.) R. Br. ex Roem. & Schult. subsp. **coriacea**, Syst. Veg. 4:511. 1819.

Rapanea rufa Lundell, Wrightia 5:298. 1976. *Myrsine rufa* (Lundell) Lundell, Phytologia 48:142. 1981, nomen invalidum. TYPE: COSTA RICA. SAN JOSÉ: Cordillera de Talamanca, Pacific Slope of the Chirripó Massif, 2,700–3,000 m, 6 Apr 1969, *G. Davidse & R. Pohl 1635* (HOLOTYPE: LL-TEX; ISOTYPE: MO).

Myrsine dependens (Ruíz & Pav.) Spreng., Syst. Veg. 1:664. 1825.

Rapanea pittieri Mez in Engl., Pflanzenr. IV. 236(Heft 9):378. 1902. *Myrsine pittieri* (Mez) Lundell, Phytologia 48:142. 1981, nomen invalidum. TYPE: COSTA RICA. CARTAGO: Volcán Irazú, 3,000 m, *H. Pittier 14111* (HOLOTYPE: B-destr. 1943; LECTOTYPE: by Pipoly 1992, BR; ISOLECTOTYPE: US).

Rapanea peruviana Lundell, Wrightia 6:117. 1980. *Myrsine peruviana* (Lundell) Lundell, Phytologia 48:142. 1981, nomen invalidum. TYPE: PERU. CUZCO: Tres Cruces, upper edge of Parque Nacional de Manu, 1–13 km NW of Paucartambo-Pilcopara Road, 3,300–3,500 m, 29 Jun 1978, *A. Gentry et al. 23478* (HOLOTYPE: LL-TEX; ISOTYPES: MO, USM).

Myrsine juergensenii (Mez) Ricketson & Pipoly, comb. nov. *Rapanea juergensenii* Mez in Engl., Pflanzenr. IV. 236(Heft 9):388. 1902. *Myrsine juergensenii* (Mez) Lundell, Phytologia 48:142. 1981, nomen invalidum. TYPE: MEXICO. OAXACA: without locality, without elev., without date, *H. Galeotti 530* (LECTOTYPE: US, by Ricketson & Pipoly, 1997a; ISOLECTOTYPES: G, NY).

Rapanea allenii Lundell, Wrightia 4:168. 1971. *Myrsine allenii* (Lundell) Lundell, Phytologia 48:142. 1981, nomen invalidum. TYPE: PANAMA. CHIRIQUÍ: N forested face of Cerro Copete, an E spur of Chiriquí Volcano, 2,438–2,591 m, 29 Jul 1947, *P. Allen 4869* (HOLOTYPE: US; ISOTYPES: G, MO).

Rapanea mexicana Lundell, Wrightia 5:296. 1976. *Myrsine mexicana* (Lundell) Lundell, Phytologia 48:142. 1981, nomen invalidum. TYPE: MEXICO. CHIAPAS: Pico de Loro, near Escuintla, without elev., 25 Jun 1941, *E. Matuda 4228* (HOLOTYPE: LL-TEX; ISOTYPES: A, F, MO, NY, US).

Rapanea reflexiflora Lundell, Wrightia 5:297. 1976. *Myrsine reflexiflora* (Lundell) Lundell, Phytologia 48:142. 1981, nomen invalidum. TYPE: PANAMA. COCLÉ: Woods adjacent to chicken farm, La Mesa, above El Valle, without elev., 3 Jan 1974, *J. Dwyer 11885* (HOLOTYPE: LL-TEX; ISOTYPES: BRIT, F, MO, PMA).

Myrsine pellucidopunctata Oerst., Vidensk. Meddel. Dansk Naturhist. Føren. Kjøbenhavn 1861: 133. 1861.

Rapanea panamensis Lundell, Wrightia 4:169. 1971. *Myrsine panamensis* (Lundell) Lundell, Phytologia 48:142. 1981, nomen invalidum. TYPE: PANAMA. PANAMÁ: San José Island, Perlas Archipelago, Gulf of Panama, ca. 55 mi SSE of Balboa, main road W of Matta Puerco, 9 Nov 1944, *I. Johnston 441* (HOLOTYPE: LL-TEX; ISOTYPES: GH, MO, US).

NOTES ON *ARDISIA*

The situation regarding generic delimitation among the taxa comprising *Ardisia* in its broadest sense, and that of the segregate taxa proposed or recognized by Lundell, was very similar to that described above for *Myrsine.* Work underway among these taxa for our studies in Mesoamerica has caused us to reexamine the nomenclatural legalities regarding the new combinations and names proposed by Lundell (1986), particularly in light of the recent new names and combinations made by Morales (1997), in his paper anticipating a treatment of the Myrsinaceae for the *A Manual to the Plants of Costa Rica.*

Lundell (1986) effected 59 nomenclatural changes, comprising 23 new names and 36 new combinations for taxa previously described in genera segregated from *Ardisia*. However, in the introduction, he stated, "Just as the very distinct genus *Icacorea* Aubl. has been ridicuously submerged as a subgenus of *Ardisia* Sw. for generations, we can also assume that the vagaries of taxonomists will result in the reduction of such recently described genera as *Auriculardisia* Lundell, *Gentlea* Lundell, *Graphardisia* Lundell, *Oerstedianthus* Lundell, *Ibarrea* Lundell, *Amatlantia* Lundell, and *Zunilia* Lundell to subgenera of *Ardisia*. The transfer of the following species is made to that genus to obviate the incentive of workers to undertake such unnecessary reductions to subgenera." While the wording of this introduction is not as clear a violation of the rules of Article 34.1 of the ICBN as that of the *Myrsine* paper, we feel that the intention was to specifically provide names "proposed in anticipation of the future acceptance of the group concerned, or of a particular circumscription, position or rank" and are therefore, invalid. This agrees with the conclusion reached by Morales (1997) in his validation for six of the subject taxa. In addition, while implied and not specifically stated, we feel that Lundell accepted the taxa, but not the names (i.e., the placement) he published in the work.

Our work thus far has shown that among the segregate genera recognized by Lundell, *Gentlea*, *Ctenardisia* Ducke (=*Yunckeria* Lundell), and *Synardisia* will all be recognized with certainty, while the remaining groups will not. Because we recognize *Gentlea* as a genus distinct from *Ardisia*, no validation of the invalidly published Lundell new names and combinations for *Gentlea* species as members of *Ardisia* is necessary, but we provide the following corrections to synonymies listed in our previous work, to include the invalid names (Ricketson & Pipoly 1997c). For complete synonymies, see Ricketson and Pipoly (1997c).

Gentlea austinsmithii (Lundell) Lundell, Wrightia 4:68. 1968. *Gentlea molinae* Lundell, Wrightia 4:150. 1970. *Ardisia molinae* (Lundell) Lundell, Phytologia 61:65. 1986, nomen invalidum. TYPE: HONDURAS. LA PAZ: Montaña Verde on Cordillera Guajiquiro, 1,900 m, 23 Mar 1969 (fr), *A. Molina R. & A. Molina 24389* (HOLOTYPE: LL-TEX; ISOTYPES: F, LL-TEX, NY).

Gentlea parviflora Lundell, Wrightia 5:89. 1975, non *Ardisia parviflora* Talbot, Syst. List Trees, Bombay ed. 2, 204. 1902. *Ardisia parvissima* Lundell, Phytologia 61:66. 1986, nomen novum invalidum TYPE: GUATEMALA. BAJA VERAPAZ: Union Barrios, in high forest, on top of hill, E of km 154, 11 Apr 1975 (fl), *C. Lundell & E. Contreras 19212* (HOLOTYPE: LL-TEX; ISOTYPES: CAS, LL-TEX).

Gentlea crenulata Lundell, Wrightia 6:96. 1979. Non *Ardisia crenulata* Vent., Choix Pl., 5, t. 5. 1803, non *Ardisia crenulata* C. Lodd., Bot. Cab. 1: t. 2., 1817, nom. illegit. *Ardisia contrerasii* Lundell, Phytologia 61:63.1986, nomen novum invalidum. TYPE: GUATEMALA. BAJA VERAPAZ: Niño Perdido, bordering Río San José, 8 km N, in high forest, on top of hill, 27 May 1977 (fl, fr), *C. Lundell & E. Contreras 21004* (HOLOTYPE: LL-TEX; ISOTYPES CAS, LL-TEX 2-SHEETS)

Gentlea lancifolia Lundell, Phytologia 58:273. 1985. Non *Ardisia lancifolia* Merr., Philipp. J. Sci. 13:113. 1918. *Ardisia intibucana* Lundell, Phytologia 61:65. 1986, nomen novum invalidum. TYPE: HONDURAS. INTIBUCA: Between Calaveras and El Duraznillo, Cordillera Opalaca, 1,800 m, 12 Mar 1970 (fr), *A. Molina R. & A. Molina 25547* (HOLOTYPE: F; ISOTYPE US).

Gentlea micranthera (Donn. Sm.) Lundell, Wrightia 4:69. 1968.

Gentlea cuneifolia Lundell, Wrightia 7:245. 1983. *Ardisia cuneifolia* (Lundell) Lundell, Phytologia 61:63. 1986, nomen invalidum. TYPE: MEXICO. VERACRUZ: Municipio de San Andrés Tuxtla, ca. del aguaje en el lado S del Volcán San Martín Tuxtla, 1,250 m, 15 Feb 1972 (fr), *J. Beaman & C. Alvarez del Castillo 5751* (HOLOTYPE: LL-TEX; ISOTYPES: F, MEXU).

Gentlea auriculata Lundell, Phytologia 58:273. 1985, non *Ardisia auriculata* Donn. Sm., Bot. Gaz. 24:395. 1897. *Ardisia parviauriculata* Lundell, Phytologia 61:66. 1986, nomen novum invalidum. TYPE: GUATEMALA. ZACAPA: Sierra de Las Minas, middle and upper S-facing slopes of Volcán Gemelos, 2,100–3,200 m, 26 Jan 1942 (fl, fr), *J. Steyermark 43277* (HOLOTYPE F; ISOTYPES: LL-TEX, US).

Gentlea maculata Lundell, Phytologia 58:274. 1985. Non *Ardisia maculata* . Poit. ex A. DC., Trans. Linn. Soc., London 17:116. 1834. *Ardisia morazanensis* Lundell, Phytologia 61:65. 1986, nomen novum invalidum. TYPE: HONDURAS. FRANCISCO MORAZAN: On mountain La Tigra, SW of San Juancito, 1,800–2,100 m, 2 Feb 1966 (fl), *A. Molina R., L. Williams, W. Burger & B. Wallenta 16972* (HOLOTYPE: F; ISOTYPES: NY, US).

Gentlea standleyi Lundell, Wrightia 4:69. 1968. *Ardisia standleyi* (Lundell) Lundell, Phytologia 61:67. 1986, nomen invalidum. TYPE: COSTA RICA. HEREDIA: Cerros de Zurquí, NE of San Isidro, 2,000–2,400 m (fr), 3 Mar 1926, *P. Standley & J. Valerio 50613* (HOLOTYPE: US; ISOTYPE: LL-TEX).

Gentlea venosissima (Rúiz & Pavón) Lundell, Wrightia 3:103. 1964.

Gentlea tenuis Lundell, Wrightia 7:24. 1981, non *Ardisia tenuis* Lundell, Wrightia 4:149. 1970. *Ardisia jitotolana* Lundell, Phytologia 61:65. 1986, nomen novum invalidum TYPE: MEXICO. CHIAPAS: Municipio de Rayón, in the Selva Negra 10 km above Rayón Meycalapa along road to Jitotol, 1,700 m, 12 Dec 1971 (fl), *D. Breedlove 23144* (HOLOTYPE: F; ISOTYPES: DS, LL-TEX, MO, NY).

While we agree with Morales (1997) in his view that the new names and combinations published by Lundell (1986) are invalid, Morales did not make direct reference to the invalid names in the synonymy listed with new combinations. Therefore we provide them below in the interest of providing complete synonymy for those species.

Ardisia apodophylla J.F. Morales, Phytologia 83:111. 1997 [1998]. *Auriculardisia sessilifolia* Lundell, Wrightia 7:272. 1984, non *Ardisia sessilifolia* Mez in Engler, Pfanzenr. IV. 236(Heft 9):125. 1902. *Ardisia zarceroana* Lundell, Phytologia 61:68. 1986, nomen novum invalidum. TYPE: COSTA RICA. ALAJUELA: Cordillera Central near San Juan de Laja about 15 km N of Zarcero, 1,350 m, 7 Feb 1965 (fl, fr), *L. Williams, A. Molina R., T. Williams & D. Gibson 28998* (HOLOTYPE: F).

Ardisia bekomiensis (Lundell) J.F. Morales, Phytologia 83:111. 1997 [1998]. *Icacorea bekomiensis* Lundell, Phytologia 56:414. 1984. *Ardisia bekomiensis* (Lundell) Lundell, Phytologia 61:62. 1986, nomen invalidum. TYPE: COSTA RICA. PUNTARENAS–LIMÓN: border, Cordillera de Talamanca, Cerro Bekom, 11 airline km SSW of the peak of Cerro Kamuk, 9° 10' 30" N, 83° 03' 45" W, 2,6002,750 m, 21 Mar 1984 (fl), *G. Davidse, G. Herrera Ch. & R. Warner 25710* (HOLOTYPE: LL-TEX; ISOTYPES: INB, MO).

Ardisia eurubiginosa (Lundell) J.F. Morales, Phytologia 83:111. 1997 [1998]. *Auriculardisia eurubiginosa* Lundell, Phytologia 56:413. 1984. *Ardisia eurubiginosa* (Lundell) Lundell, Phytologia 61:63. 1986, nomen invalidum. TYPE: PANAMA. BOCAS DE TORO: Cordillera de Talamanca, 2–5 airline km NW of the Peak of Cerro Echandi on the Costa Rican-Panamanian international border, 2,600–2,850 m, 1–9 Mar 1984 (fl, fr), *G. Davidse, L. Gómez, G. Herrera, C. Chacón, I. Chacón & A. Chacón 25486* (HOLOTYPE: LL-TEX; ISOTYPES: INB, MO, NY).

Ardisia quadrata (Lundell) J.F. Morales, Phytologia 83:111. 1997 [1998]. *Auriculardisia quadrata* Lundell, Phytologia 56:413. 1984. *Ardisia quadrata* (Lundell) Lundell, Phytologia 61:66. 1986, nomen invalidum. TYPE: COSTA RICA. PUNTARENAS: Foothills of the Cordillera de Talamanca, around Tres Colinas, 9° 07' N, 83° 04' W, 1,800–1,850 m, 20 Mar 1984 (fl) *G. Davidse, G. Herrera Ch. & R. Warner 25645* (HOLOTYPE: LL-TEX; ISOTYPES: INB, MO).

Ardisia sordida (Lundell) J.F. Morales, Phytologia 83:111. 1997 [1998]. *Auriculardisia sordida* Lundell, Wrightia 7:272. 1984. *Ardisia sordida* (Lundell) Lundell, Phytologia 61:66. 1986, nomen invalidum. TYPE: COSTA RICA. ALAJUELA: Finca Los Ensayos, ca. 11 mi. NW of Zarcero, ca. 850 m, 15 Aug 1977 (fl), *T. Croat 43538* (HOLOTYPE: LL-TEX; ISOTYPES: CR, MO).

Ardisia squamata (Lundell) J.F. Morales, Phytologia 83:111. 1997 [1998]. *Auriculardisia squamata* Lundell, Phytologia 56:19. 1984. *Ardisia squamata* (Lundell)

Lundell, Phytologia 61:67. 1986, nomen invalidum. TYPE: COSTA RICA. HEREDIA: Original forest near the Río Puerto Viejo, ca. 2 km upstream from the confluence with Río Sarapiquí, formerly "Finca La Selva" of L.R. Holdridge, 10° 26' N, 84° 0' W, 100 m, 1417 Jun 1968 (fl), *W. Burger & R. Stolze 5853* (HOLOTYPE: F; ISOTYPES: CR, F, TEX, MO).

Regarding those taxa originally placed by Lundell (1981a) in his concept of the segregate genus *Graphardisia*, the following binomials invalidly published by Lundell (1986) as new combinations and names: *Ardisia coibana* (Lundell) Lundell, *Ardisia ebingeri* Lundell, *Ardisia esquipulasana* Lundell, *Ardisia neohyalina* Lundell, *Ardisia obtusata* (Lundell) Lundell, *Ardisia riomonteana* Lundell, *Ardisia seranoana* (Lundell) Lundell and *Ardisia ustupoana* (Lundell) Lundell, are considered taxonomic synonyms (Pipoly & Ricketson 1998) and thus, need no validation.

Lundell (1986) also described two new species of *Ardisia*, *A. hirsutissima* Lundell, and *A. tarariae* Lundell. He aligned *Ardisia hirsutissima* with *A. nevermannii* and *A. ursina*, two species he had previously transferred (Lundell 1982) to his segregate genus *Valerioanthus*, and subsequently transferred them once more, to his segregate genus *Auriculardisia* (Lundell 1985). Curiously, Lundell (1987) transferred *Ardisia hirsutissima* to *Valerioanthus* rather than to *Auriculardisia*, as he had previously done with the other members of *Valerioanthus* and which, at that point, had its type already transferred. It is unclear whether these nomenclatural transactions represent a mere *lapsus calimae*, or a purposeful taxonomic decision. Lundell (1987) validly transferred *Ardisia tarariae* Lundell to *Auriculardisia*. However, our studies have shown that this taxon is also best retained in *Ardisia*. In order to provide complete synonymies for these apparent taxonomic nomads, we provide the following nomenclator.

Ardisia hirsutissima Lundell, Phytologia 61:64. 1986. *Valerioanthus hirsutissima* (Lundell) Lundell, Phytologia 63:78. 1987. TYPE: PANAMA. COCLÉ: Continental Divide above El Copé, 8° 38' N, 80° 39' W, 650750 m, 27 Nov 1985 (fr), *G. de Nevers, A. Henderson, H. Herrera, G. McPherson & L. Brako 6408* (HOLOTYPE: LL-TEX; ISOTYPES: BM, CAS, CR, MEXU, MO, NY, PMA).

Ardisia nevermannii Standl., J. Wash. Acad. Sci. 17:524. 1927. *Valerioanthus nevermannii* (Standl.) Lundell, Wrightia 7:50. 1982. *Auriculardisia nevermannii* (Standl.) Lundell, Phytologia 57:450. 1985. TYPE: COSTA RICA. LIMÓN: Finca Montecristo, on the Río Reventazón, below El Cairo, ca. 25 m, 18–19 Feb 1926 (fl), *P. Standley & J. Valerio 48603* (HOLOTYPE: US).

Ardisia ursina Lundell, Wrightia 6:97. 1979. *Valerioanthus ursinus* (Lundell) Lundell, Wrightia 7:50. 1982. *Auriculardisia ursinus* (Lundell) Lundell, Phytologia 57:450. 1985. TYPE: PANAMA. PANAMÁ: El Llano-Carti Road, 10 km from Inter-American Hwy., without elev., 5 Oct 1974 (fl), *S. Mori & J. Kallunki 2314* (HOLOTYPE: MO).

Ardisia tartariae Lundell, Phytologia 61:67. 1986. *Auriculardisia tartariae* (Lundell) Lundell, Phytologia 63:75. 1987. TYPE: COSTA RICA. LIMON: Cordillera de Talamanca, Atlantic slope, Cerros Tararia (locally known as Tres Picos), 2,400–2,600 m, 10 Sep 1984 (fl), *G. Davidse, G. Herrera Ch. & M. Grayum 28882* (holotype: LL-TEX; isotype: MO).

For the remaining 27 binomials invalidly published by Lundell (1986), we provide the following new names and combinations.

Ardisia alajuelae (Lundell) Pipoly & Ricketson, comb. nov. *Icacorea alajuelae* Lundell, Phytologia 56:141. 1984. *Ardisia alajuelae* (Lundell) Lundell, Phytologia 61:62. 1986, nomen invalidum. Type: COSTA RICA. Alajuela: San Pedro de San Ramón, without elev., 12 Mar 1932 (fl), *A. Brenes 15091* (holotype: NY).

Ardisia albipedicellata Pipoly & Ricketson, nom. nov. *Icacorea parvifolia* Lundell, Phytologia 57:452. 1985, non *Ardisia parvifolia* Humb. ex Willd. in Roem. & Schult, Syst. Veg. 4:804. 1819. *Ardisia albipedicellata* Lundell, Phytologia 61:62. 1986, nomen novum invalidum. Type: COSTA RICA. Puntarenas: Just E of Monteverde on the Pacific watershed, 10° 18' N, 84° 48' W, 1,3001,450 m, 29 Oct2 Nov 1975 (fl), *W. Burger & R. Baker 9628* (holotype: F).

Ardisia albisepala (Lundell) Pipoly & Ricketson, comb. nov. *Auriculardisia albisepala* Lundell, Wrightia 7:266. 1984. *Ardisia albisepala* (Lundell) Lundell, Phytologia 61:62. 1986, nomen invalidum Type: PANAMA. Veraguas: Trail on ridge to summit of Cerro Tute, Cordillera de Tute, 1 km past Escuela Agricola Altos de Piedras, W of Santa Fe, 8° 36' N, 81° 06' W, 9501,250 m, 15 Dec 1981 (fl), *S. Knapp y K. Sytsma 2548* (holotype: LL-TEX; isotypes: MO, NY).

Ardisia azaharensis Pipoly & Ricketson, nom. nov. *Auriculardisia microcalyx* Lundell, Wrightia 7:270. 1984, non *Ardisia microcalyx* Lundell, Wrightia 4:46. 1968. *Ardisia azaharensis* Lundell, Phytologia 61:62. 1986, nomen invalidum. Type: COSTA RICA. Alajuela: 15 km NW of San Ramón by air, Cerro Azahar, headwaters of Río San Pedro, by road, 9 km NW of San Ramón to Piedades Norte, then 3 more km NW to La Paz, 1.7 km to cluster of houses, then left again on jeep road 45 km to top of ridge, 10° 09' 30" N, 84° 3435' W, 1,4001,500 m, 14 May 1983 (fr), *R. Liesner, E. Judziewicz, J. Gómez-Laurito, B. Pérez G. & A. Carvajal 15575* (holotype: LL-TEX; isotypes: F, MO).

Ardisia bristanii Pipoly & Ricketson, nom. nov. *Auriculardisia parviflora* Lundell, Wrightia 7:271. 1984, non *Ardisia parviflora* Talbot, Syst. list Trees, Bombay ed. 2, 204. 1902. *Ardisia bristanii* Lundell, Phytologia 61:62. 1986, nomen novum invalidum. Type: PANAMA. Darién: Cerro Pirre, without elev., 4 Aug 1967 (fl), *N. Bristan 1236* (holotype: US; isotype: MO).

Ardisia chiriquiana (Lundell) Pipoly & Ricketson, comb. nov. *Auriculardisia chiriquiana* Lundell, Wrightia 7:267. 1984. *Ardisia chiriquiana* (Lundell) Lundell, Phytologia 61:62. 1986, nomen invalidum. Type: PANAMA. Chiriquí: Trail up Cerro Pate Macho, 8° 50' N, 82° 25' W, 1,5001,900 m, 7 Jan 1938 (fl), *B. Stein, B. Schmalzel & D. Roubik 1223* (holotype: LL-TEX; isotype: MO).

Ardisia dressleri Pipoly & Ricketson, nom. nov. *Auriculardisia roseiflora* Lundell, Wrightia 7:271. 1984, non *Ardisia roseiflora* Pitard, Fl. Indo-Chine, 3:866. 1930. *Ardisia dressleri* Lundell, Phytologia 61:63. 1986, nomen novum invalidum. Type: PANAMA. Coclé: Trail from Continental Divide near the sawmill above El Copé to Río Blanco del Norte, 8° 40' N, 80° 36' W, 350700 m, 20 Feb 1982 (fl), *S. Knapp, J. Mallet & R. Dressler 3646* (holotype: MO).

Ardisia dryeri Pipoly & Ricketson, nom. nov. *Auriculardisia micrantha* Lundell, Wrightia 7:269. 1984, non *Ardisia micrantha* Kunth, Nov. Gen. Sp. 3:246. 1818 [1819], non *Ardisia micrantha* Donn. Sm., Bot. Gaz. 14:26. 1889, nom. illeg. *Ardisia dryeri* Lundell, Phytologia 61:63. 1986, nomen invalidum. TYPE: COSTA RICA. ALAJUELA or PUNTARENAS: Reserva de Monteverde, Cordillera de Tilaran, al lado del camino por la ventana, Div. Continental, 1,560–1,580 m, 15 Aug 1976 (fl), *V. Dryer 577* (HOLOTYPE: MO; ISOTYPE: F).

Ardisia eciliata (Lundell) Pipoly & Ricketson, comb. nov. *Zunilia eciliata* Lundell, Phytologia 58:490. 1985. *Ardisia eciliata* (Lundell) Lundell, Phytologia 61:63. 1986, nomen invalidum. TYPE: MEXICO. CHIAPAS: Municipio de Ocozocoautla de Espinosa, Cerro del Ocote, 30 km NW of Ocozocoautla, 1,500 m, 14 Oct 1972 (fl), *D. Breedlove 28973* (HOLOTYPE: LL-TEX; ISOTYPES: CAS-DS, MEXU, MO).

Ardisia ellipticifolia Pipoly & Ricketson, nom. nov. *Amatlania elliptica* Lundell, Phytologia 56:19. 1984, non *Ardisia elliptica* Thunb., Nov. Gen. Pl. 8:119. 1798. *Ardisia elliptifolia* Lundell, Phytologia 61:63. 1986, nomen novum invalidum. TYPE: MEXICO. OAXACA: Municipio de Comaltepec, km 149 carr. Tuxtepec, Sierra Juárez, Puerto Eligio, 800 m, 17 Jun 1966 (fr), *G. Martínez C. 884* (HOLOTYPE: XAL; ISOTYPES: MEXU, MO).

In choosing the epithet 'ellipticifolia' over 'elliptifolia' used by Lundell, we believe we are correcting a spelling error rather than changing the stem.

Ardisia eucuneata (Lundell) Pipoly & Ricketson, comb. nov. *Auriculardisia eucuneata* Lundell, Phytologia 57:449. 1985. *Ardisia eucuneata* (Lundell) Lundell, Phytologia 61:63. 1987, nomen invalidum. TYPE: PANAMA. SAN BLAS: Nusagandi, trail from camp NW to a Quebrada, 9° 19' N, 78° 15' W, 300 m, 31 Jul 1984 (fl), *G. de Nevers & C. de Leon 3598* (HOLOTYPE: LL-TEX; ISOTYPE: MO).

Ardisia feniana Pipoly & Ricketson, nom. nov. *Zunilia purpusii* Lundell, Phytologia 58:491. 1985, non *Ardisia purpusii* Brandeg., Univ. Calif. Publ. Bot. 6:189. 1915. *Ardisia feniana* Lundell, Phytologia 61:64. 1986, nomen novum invalidum. TYPE: MEXICO. CHIAPAS: Mountains near Fenia, without elev., May 1925 (fr), *C. Purpus 100* (HOLOTYPE: US).

Ardisia guanacastensis (Lundell) Pipoly & Ricketson, comb. nov. *Icacorea guanacastensis* Lundell, Phytologia 56:415. 1984. *Ardisia guanacastensis* (Lundell) Lundell, Phytologia 61:64. 1986, nomen invalidum. TYPE: COSTA RICA. GUANACASTE: Parque Nacional Rincon de la Vieja, the SE slopes of Volcán Santa Maria, above Estacion Hacienda Santa Maria, 10° 47' N, 85° 18' W, 9001,200 m, 2728 Jan 1983 (fl), *G. Davidse, L. Gómez, M. Sousa, C. Humphries, N. Garwood, R. Hampshire & M. Gibby 23307* (HOLOTYPE: LL-TEX; ISOTYPES: MO, NY).

Ardisia guinealensis (Lundell) Pipoly & Ricketson, comb. nov. *Icacorea guinealensis* Lundell, Phytologia 56:416. 1984. *Ardisia guinealensis* (Lundell) Lundell, Phytologia 61:64. 1986, nomen invalidum. TYPE: COSTA RICA. PUNTARENAS: Foothills of the Cordillera de Talamanca, vicinity of Helechales, along the Río Guineal, 9° 04' 30" N, 83° 05' W, 1,1001,200 m, 29 Mar 1984 (fr), *G. Davidse & G. Herrera Ch. 26215* (HOLOTYPE: LL-TEX; ISOTYPE: MO).

Ardisia heterotricha (Lundell) Pipoly & Ricketson, comb. nov. *Auriculardisia heterotricha* Lundell, Wrightia 7:268. 1984. *Ardisia heterotricha* (Lundell) Lundell, Phytologia 61:64. 1986, nomen invalidum. TYPE: PANAMA. PANAMÁ: On road near slopes of Cerro Jefe, 2,400 ft [732 m], 20 Jan 1980 (fr), *T. Antonio, H. Moore & F. Putz 3417* (holotype: MO).

Ardisia hornitoana Pipoly & Ricketson, nom. nov. *Icacorea reflexa* Lundell, Phytologia 56:20. 1984, non *Ardisia reflexa* Wall., Cat. No. 2282. 1830. *Ardisia hornitoana* Lundell, Phytologia 61:64. 1986, nomen novum invalidum. Type: PANAMA. Chiriquí: Path from Linares farm ca. 1,400 m to top of Cerro Hornito, 1,750 m, 27 Dec 1977 (fl), *J. Folsom, R. Dressler & R. Channell 7257* (holotype: LL-TEX; isotype: MO).

Ardisia hugonensis (Lundell) Pipoly & Ricketson, comb. nov. *Auriculardisia hugonensis* Lundell, Wrightia 7:268. 1984. *Ardisia hugonensis* (Lundell) Lundell, Phytologia 61:64. 1986, nomen invalidum. Type: COLOMBIA. Choco: Municipio de Quibdó, Corregimiento de Guayabal, Río Hugón, without elev., 12 Sep 1976 (fr), *E. Forero & R. Jaramillo 2812* (holotype: NY; isotype: MO).

Ardisia ixcanensis (Lundell) Pipoly & Ricketson, comb. nov. *Icacorea ixcanensis* Lundell, Phytologia 58:489. 1985. *Ardisia ixcanensis* (Lundell) Lundell, Phytologia 61:65. 1986, nomen invalidum. Type: MEXICO. Chiapas: Municipio La Independencía, 12 km from Laguna Tsiskaw on road to Ixcan, 1,250 m, 19 Oct 1974 (fl), *D.E. Breedlove 38965* (holotype: CAS-DS).

Ardisia jaliscensis (Lundell) Pipoly & Ricketson, comb. nov. *Icacorea jaliscensis* Lundell, Phytologia 53:412. 1983. *Ardisia jaliscensis* (Lundell) Lundell, Phytologia 61:65. 1986, nomen invalidum. Type: MEXICO. Jalisco: Along road to Jirosto, ca. 10 km WNW of Purificación, 19° 44' N, 104° 42' W, 400 m, 11 Jan 1979 (fr), *H. Iltis & M. Nee 1437* (holotype: LL-TEX; isotype: US).

Ardisia knappii (Lundell) Pipoly & Ricketson, comb. nov. *Auriculardisia knappii* Lundell, Phytologia 55:235. 1984. *Ardisia knappii* (Lundell) Lundell, Phytologia 61:65. 1986, nomen invalidum. Type: PANAMA. San Blas: 23–29 km from Pan-American Highway on El Llano-Cartí Road, 9° 22' N, 78° 69' W, 300400 m, 28 Oct 1981 (fl), *S. Knapp 1843* (holotype: LL-TEX; isotype: MO).

Ardisia latisepala (Lundell) Pipoly & Ricketson, comb. nov. *Auriculardisia latisepala* Lundell, Wrightia 7:269. 1984, non *Icacorea latisepala* Lundell, Phytologia 56:417. 1984. *Ardisia latisepala* (Lundell) Lundell, Phytologia 61:65. 1986, nomen invalidum. Type: COSTA RICA. Puntarenas: 6 km S of San Vito de Java, around Wilson's finca, ca. 4,000 ft [1,219 m], 19 Aug 1967 (fl), *P. Raven 21653A* (holotype: F; isotype: MO).

Ardisia leptopoda (Lundell) Pipoly & Ricketson, comb. nov. *Auriculardisia leptopoda* Lundell, Phytologia 57:450. 1985. *Ardisia leptopoda* (Lundell) Lundell, Phytologia 61:65. 1986, nomen invalidum. Type: PANAMA. Chiriquí: E of Guadeloupe along the Río Chiriquí Viejo, ca. 2 mi NE of Cerro Punta, ridge of Cerro Respinga, ca. 7,000 ft [2,134 m], 13 Jan 1971 (fr), *R. Wilbur, J. Teeri & R. Foster 13111* (holotype: F).

Ardisia monteverdeana (Lundell) Pipoly & Ricketson, comb. nov. *Icacorea monteverdeana* Lundell, Phytologia 57:451. 1985. *Ardisia monteverdeana* (Lundell) Lundell, Phytologia 61:65. 1986, nomen invalidum. Type: COSTA RICA. Puntarenas: Monteverde, Laguna-Hollander's & Hoge's, 1,320 m, 10 Dec 1979 (fl), *S. Koptur SK-251* (holotype: LL-TEX; isotype: MO).

Ardisia nebulosa (Lundell) Pipoly & Ricketson, comb. nov. *Auriculardisia nebulosa* Lundell, Wrightia 7:270. 1984. *Ardisia nebulosa* (Lundell) Lundell, Phytologia 61:65. 1986, nomen invalidum. Type: PANAMA. Panamá: Cerro Jefe, 850–900 m, 29 Oct 1980 (fr), *K. Sytsma 1980* (holotype: LL-TEX; isotypes: BM, MO).

Ardisia neomirandae Pipoly & Ricketson, nom. nov. *Zunilia mirandae* Lundell, Phytologia 58:491. 1985, non *Ardisia mirandae* Merr., Philipp. J. Sci. 12:154. 1917. *Ardisia neomirandae* Lundell, Phytologia 61:66. 1986, nomen novum invalidum. TYPE: MEXICO. CHIAPAS: Finca Prusia, por camino a Mapastepec hasta–ca. Triunfo (S. Jaltenango), without elev., 24 Feb 1951 (fl), *F. Miranda 7004* (HOLOTYPE: MEXU).

Ardisia oaxacana (Lundell) Pipoly & Ricketson, comb. nov. *Icacorea oaxacana* Lundell, Wrightia 7:48. 1982. *Ardisia oaxacana* (Lundell) Lundell, Phytologia 61:66. 1986, nomen invalidum. TYPE: MEXICO. OAXACA: Municipio Pluma Hídalgo, carretera Pochutla, Oaxaca, 1 km al N de Chacalapa, 13 km al N de Pochutla, 225 m, 13 Nov 1979 (fl), *S. Koch, P. Fryxell y T. Wendt 79512* (HOLOTYPE: LL-TEX; ISOTYPES: F, MO, NY).

Ardisia parvidenticulata Pipoly & Ricketson, nom. nov. *Icacorea denticulata* Lundell, Phytologia 56:415. 1984, non *Ardisia denticulata* Blume, Bijdr. 13: 691. 1826. *Ardisia parvidenticulata* Lundell, Phytologia 61:66. 1986, nomen novum invalidum. TYPE: COSTA RICA. ALAJUELA or PUNTARENAS: Cordillera de Tilarán, Flora of Monteverde, comunidad, 1,400–1,500 m, 28 Nov 1976 (fl), *V. Dryer 1010* (HOLOTYPE: F).

Ardisia parvipunctata (Lundell) Pipoly & Ricketson, comb. nov. *Icacorea parvipunctata* Lundell, Wrightia 7:274. 1984. *Ardisia parvipunctata* (Lundell) Lundell, Phytologia 61:66. 1986, nomen invalidum. TYPE: MEXICO. OAXACA: Along highway 175, in the vicinity of La Galera, ca. 500 m S, 2.1 mi N of turn-off to Pluma Hidalgo, 9.6 mi S of Puente Jalatengo near village of Jalatengo, loose slope along ravine above spring on highway, 1,340 m, 20 Jan 1979 (fr), *T. Croat 46150* (HOLOTYPE: MO).

Ardisia samalana (Lundell) Pipoly & Ricketson, comb. nov. *Icacorea samalana* Lundell, Phytologia 57:451. 1985. *Ardisia samalana* (Lundell) Lundell, Phytologia 61:66. 1986, nomen invalidum. TYPE: GUATEMALA. QUETZALTENANGO: Hot springs along Río Samalá, below Zunil, 2,500 m, 24 Jan 1940 (fl), *J. Steyermark 34962* (HOLOTYPE: F).

Ardisia steinii Pipoly & Ricketson, nom. nov. *Auriculardisia baruana* Lundell, Wrightia 7:267. 1984, non *Ardisia baruana* Lundell, Wrightia 6:61. 1979. *Ardisia steinii* Lundell, Phytologia 61:67. 1986, nomen novum invalidum. TYPE: PANAMA. CHIRIQUÍ: Volcán Baru, E slope on road from Boquete, 8 km W of Boquete (air distance), 8° 50' N, 82° 30' W, 1,900 m, 8 Jan 1983 (fr), *B. Stein 1267* (HOLOTYPE: LL-TEX; ISOTYPE: MO).

Ardisia stevensii (Lundell) Pipoly & Ricketson, comb. nov. *Gentlea stevensii* Lundell, Wrightia 6:97. 1979. *Ardisia stevensii* (Lundell) Lundell, Phytologia 61:67. 1986, nomen invalidum. TYPE: NICARAGUA. CHONTALES: ca. 2.8 km above (N of) Cuapa, 12° 17' N, 85° 23' W, 400500 m, 21 Jan 1978 (fr), *W. Stevens 6053* (HOLOTYPE: LL-TEX; ISOTYPE: MO).

Ardisia toroana (Lundell) Pipoly & Ricketson, comb. nov. *Auriculardisia toroana* Lundell, Wrightia 7:273. 1984. *Ardisia toroana* (Lundell) Lundell, Phytologia 61:67. 1986, nomen invalidum. TYPE: PANAMA. BOCAS DEL TORO: 15 km up the Changuinola river to I.R.H.E. dam site No. 1, near campsite on trail to ridge NE of campsite, 800–900 ft [244–274 m], 12 Dec 1979 (fl), *T. Antonio 3079* (HOLOTYPE: LL-TEX; ISOTYPE: MO).

Ardisia triangula (Lundell) Pipoly & Ricketson, comb. nov. *Icacorea triangula* Lundell, Phytologia 56:417. 1984. *Ardisia triangula* (Lundell) Lundell, Phytologia

61:67. 1984, nomen invalidum. Type: COSTA RICA. San José: Patarrá, Cerro El Espino, Alto Mata de Caña-Azahar, 1,600–1,800 m, 13 Nov 1983 (fl, fr), *G. Herrera & I. Chacón 1579* (holotype: LL-TEX; isotypes: MO, NY).

Ardisia utleyi (Lundell) Pipoly & Ricketson, comb. nov. *Icacorea utleyi* Lundell, Phytologia 57:452. 1985. *Ardisia utleyi* (Lundell) Lundell, Phytologia 61:68. 1986, nomen invalidum. COSTA RICA. San José: 2–5 km SE of Higuito on Calle Tablazo or 8–12 km SE of Desemparados, 1,800–1,900 m, 5 Sep 1975 (fl), *J. Utley & K. Utley 3023* (holotype: F).

Ardisia warneri Pipoly & Ricketson, nom. nov. *Icacorea brevipes* Lundell, Phytologia 56:414. 1984, non *Ardisia brevipes* Lundell, Wrightia 3:97. 1964. *Ardisia warneri* Lundell, Phytologia 61:68. 1986, nomen novum invalidum. Type: COSTA RICA. Puntarenas: Foothills of the Cordillera de Talamanca, around Tres Colinas, 1,800–1,850 m, 20 Mar 1984 (fr), *G. Davidse, G. Herrera Ch. & R. Warner 25680* (holotype: LL-TEX; isotypes: BM, MO, NY).

Ardisia wendtii (Lundell) Pipoly & Ricketson, comb. nov. *Ibarraea wendtii* Lundell, Wrightia 7:46. 1982. *Ardisia wendtii* (Lundell) Lundell, Phytologia 61:68. 1986, nomen invalidum. Type: MEXICO. Veracruz: Municipio Minatitlán, 8.2 km al N de la terracería La Laguna-Río Grande, sobre camino nuevo, a Ejido Belisario Dominguez, el cual sale de la terracería 14.7 km al E de La Laguna, 17° 22' N, 94° 22' O, 130 m, 16 Jul 1980 (fl, fr), *T. Wendt, A. Villalobos, R. Lara, M. Navarrete & I. Navarrete 2584* (holotype: LL-TEX; isotypes: F, MO).

Finally, the following five taxa were originally described by Lundell (1984, 1987) as species of *Icacorea*, but our studies indicate they are members of *Ardisia* subgenus *Icacorea*, to which we effect the transfers using the following new names and combinations.

Ardisia albipetala (Lundell) Pipoly & Ricketson, comb. nov. *Icacorea albipetala* Lundell, Phytologia 63:465. 1987. Type: PANAMA. Bocas del Toro: Region of Cerro Colorado, on trails from continental divide 7 mi. from Champi Camp, ca. 8° 35' N, 81° 45' W, 1,500 m, 12 Apr 1986 (fl), *G. McPherson 8832* (holotype: LL-TEX; isotypes: MEXU, MO, PMA).

Ardisia duripetala (Lundell) Pipoly & Ricketson, comb. nov. *Icacorea duripetala* Lundell, Phytologia 63:464. 1987. Type: PANAMA. Chiriquí: S slopes of Cerro Horqueta, N of Boquete, 6,500 ft [1,981 m], 21 Jan 1971 (fl), *R. Wilbur, J. Teeri & R. Foster 13471* (holotype: LL-TEX).

Ardisia hatoana (Lundell) Pipoly & Ricketson, comb. nov. *Icacorea hatoana* Lundell, Phytologia 63:464. 1987. Type: PANAMA. Chiriquí: Near Las Lagunas, W of El Hato del Volcán, ca. 1,400 m, 15 Jan 1970 (fl), *R. Wilbur, R. Weaver, R. Foster & M. Correa 11002* (holotype: LL-TEX; isotype: DUKE).

Ardisia lajana (Lundell) Pipoly & Ricketson, comb. nov. *Icacorea lajana* Lundell, Phytologia 63:465. 1987. Type: MEXICO. Veracruz: Municipio Zapata, La Laja, entre Corral Falso y Pinaltepec, a 900 m de carretera Xalapa-Veracruz por camino Corral Falso-Pinaltepec, 900 m, 8 Ene 1985 (fr), *H. Hernández y R. Torres 769* (holotype: LL-TEX; isotypes: CHAPA, ENCB, MEXU, MO).

Ardisia mesoamericana Pipoly & Ricketson, nom. nov. *Icacorea latisepala* Lundell, Phytologia 56:417. 1984, *non Ardisia latisepala* (Lundell) Pipoly & Ricketson, Sida 18: 513. 1998. (based on *Auriculardisia latisepala* Lundell, Wrightia 7: 269. 1984).

TYPE: PANAMA. BOCAS DEL TORO: Cordillera de Talamanca, 8 airline km NW of the peak of Cerro Echandi on the Costa Rican-Panamanian international border, 9° 05' 30" N, 82° 51' 30" W, 2,8002,900 m, 49 Mar 1984 (fl), *G. Davidse, L. Gómez, G. Herrera, C. Chacón & A. Chacón 25279* (HOLOTYPE: LL-TEX; ISOTYPES: BM, MO, NY).

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REFERENCES

AUBLET, F. 1775. Histoire des plantes de la Guiane francoise. P.-F. Didot. 2 vols.

HOSAKA, E. 1940. A revision of the Hawaiian species of *Myrsine (Suttonia, Rapanea)* (Myrsinaceae). Occ. Pap. Bishop Mus. 16:25–76.

LUNDELL, C.L. 1963. Studies of the American Myrsinaceae- I. Wrightia 3:77–90.

_____. 1964. Studies of the American Myrsinaceae- II. Wrightia 3: 97–114.

_____. 1966. Myrsinaceae. In: P.C. Standley and L.O. Williams, eds. Flora of Guatemala, Part VIII Number 1. Fieldiana, Bot. 24 (8/2): 135–200.

_____. 1971. Flora of Panama, Part VIII. Family 150. Myrsinaceae. Ann. Missouri Bot. Gard. 58:285–353.

_____. 1981a. Neotropical Myrsinaceae—IV. Phytologia 48:137–142.

_____. 1981b. Studies of American plants—XX. Phytologia 48:131–136.

_____. 1981c. Neotropical Myrsinaceae—VI. Phytologia 49:341–354.

_____. 1982. Neotropical Myrsinaceae—VII. Wrightia 7:38–50.

_____. 1984. Neotropical Myrsinaceae—XV. Phytologia 56:413–419.

_____. 1985. Neotropical Myrsinaceae—XVI. Phytologia 57:449–452.

_____. 1986. Neotropical Myrsinaceae—XX. Phytologia 61:62–68.

_____. 1987. Neotropical Myrsinaceae—XXI. Phytologia 63:463–465.

Mez, C. 1902. Myrsinaceae. In: A. Engler, ed. Das Pflanzenreich IV. 236 (Heft 9):1–437.

Morales, J.F. 1997 [1998]. Una nueva especie y seis nuevas combinaciones en las Myrsinaceae de Costa Rica y Panama. Phytologia 83:109–112.

Pipoly, J. 1987. A systematic revision of the genus *Cybianthus* subgenus *Grammadenia* (Myrsinaceae). Mem. New York Bot. Gard. 43:1–76.

_____. 1992. Notes on the genus *Myrsine* (Myrsinaceae) in Peru. Novon 2:392–407.

_____. 1996. Contributions toward a new flora of the Philippines: I. A synopsis of the genus *Myrsine* (Myrsinaceae). Sida 17:115–162.

_____. and J. Ricketson. 1998. A revision of the genus *Ardisia* subg. *Graphardisia* (Myrsinaceae). Sida 18:xxx–xxx.

Ricketson, J. and J. Pipoly. 1997a. Nomenclatural notes and a synopsis of the genus *Myrsine* (Myrsinaceae) in Mesoamerica. Sida 17:579–5.

_____. 1997b. Nomenclatural notes and a synopsis of Mesoamerican *Stylogyne* (Myrsinaceae). Sida 17:591–598.

_____. 1997c. A. synopsis of the genus *Gentlea* (Myrsinaceae) and a key to the genera of Myrsinaceae in Mesoamericana. Sida 17:697–707.

Stearn, W.T. 1969. A synopsis of Jamaican Myrsinaceae. Bull. Brit. Mus. Nat Hist. Bot. Ser. 18:884–900.

Swartz, O. 1788. Nova genera & species plantarum seu Prodromus. Holmiae [Stockholm], Uppsalae [Uppsala], & Aboae [Abo]. 1–158.

Walker, E.H. 1959. A revision of the Myrsinaceae of Taiwan. Quart. J. Taiwan Mus. 12:161–194.

BOOK NOTICE

WILLIAM A. WEBER. 1997. **King of Colorado Botany. Charles Christopher Parry, 1823-1890.** (ISBN 0 87081 431-1, hbk). University of Colorado Press, P.O. Box 849, Niwot, CO 80544. 303-530-5337. $39.95. 183 Pp.

This book is about Charles Christopher Parry's exploration of the southern Rocky Mountains of Colorado. Weber introduces the life of Parry and his botanical collections that introduced the Colorado flora to the world. "Over eighty new species of flowering plants were named from Parry's Colorado collections, and many more from his collections in Mexico and the U.S. Southwest. Two genera, *Neoparrya* and *Parryella,* were dedicated to him. Some of the Colorado novelties, such as *Astragalus parryi, Campanula parryi, Chrysothamnus parryi, Helianthella parryi, Oxytropis parryi, Pedicularis parryi, Primula parryi,* and *Trifolium parryi* are Colorado's most well-known wildflowers."

The 183 page book on the "King of Colorado Botany" is broken up into the following: Preface; Acknowledgments; an Introduction to The Collections and The Life of C.C. Parry; 1) Setting the State: The Parry Narratives; 2) Parry's Colorado Expedition of 1861; 3) The Parry, Hall, and Harbour Expedition of 1862; 4) Expedition of 1864; 5) Observations on Snow Line and Timberline; 6) Expedition of 1867; 7) Dedication of Gray's and Torrey's Peaks, 1872; 8) Collections of 1873-1889; and 9) Cryptogamic Collections. These chapters are followed by four appendixes: New Taxa Described from Parry's Colorado Collections, The Parry Herbarium, Parry's Dismissal as Botanist for the Department of Agriculture, and Publications of C.C. Parry. References and Index follow the appendixes.

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A NEW SPECIES OF FILMY FERN (HYMENOPHYLLACEAE: PTERIDOPHYTA) FROM SOUTH INDIA

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ABSTRACT

Crepidomanes indicum, a new species of filmy fern is described and illustrated from southern Western Ghats of India.

RESUMEN

Se describe e ilustra *Crepidomanes indicum*, una nueva especie de helecho membranoso de los Ghats del suroeste de la India.

Crepidomanes is an Old World genus of more than a dozen species ranging from East African islands to Japan and Polynesia (Tagawa & Iwatsuki 1979). The name derived from two Greek words *viz.*, *Krepis* = slipper + *manes* = cup, alluding to the shape of the indusium (Stewart et al. 1983). The presence of striae and a submarginal pseudovein are the conspicuous diagnostic characters of this genus. Beddome (1883) has reported three species now known as *C. kurzii* (Bedd.) Tagawa & K. Iwats., *C. intramarginale* (Hook. & Grev.) Copel. and *C. bipunctatum* (Poir.) Copel. from South India. Later, Nair et al. (1992) and Manickam & Irudayaraj (1992) reported the occurrence of *C. latealatum* (Bosch) Copel. and *C. plicatum* (Bosch) Ching. respectively from the South India. Recently Madhusoodanan and Hameed (1997, 1998) reported *C. christii* (Copel.) Copel. and *C. agasthianum* Madhusoodanan & Hameed from the dense evergreen forests of western Ghats, South India.

While revising the genus *Crepidomanes* of India, the authors collected a very small filmy fern from the mature, dense, tropical evergreen forest of Thommankuthu in the foothills of the Western Ghats mountains in the

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Idukki district of Kerala state, S. India (alt. 700 m; annual rainfall 3000 mm; temp 20–35°C). The plant shows a high degree of differentiation from the species previously described under the genus *Crepidomanes* (Beddome 1863, 1866, 1883; Copeland 1938; Devol 1975; Holttum 1954; Iwatsuki 1984, 1985; Jinn-Lai & Wang-Chueng 1994; Sledge 1968). It differs from other species in its smaller size, dark green, evenly pinnatifid fronds having the rachis-wing and segements with an entire margin; thin submarginal veins and cupular indusia with highly dilated mouths. The plant is described here as *Crepidomanes indicum.*

Crepidomanes indicum Hameed & Madhusoodanan, sp. nov. (**Fig. 1**) TYPE: INDIA. Kerala: Idukki Dt.: Thommankuthu water fall, 600 m, 1 Sep 1996, *C.A. Hameed CU 34880* (HOLOTYPE: CALI; ISOTYPES: K, MH).

Crepidomani agasthiano affinis, sed frondibus atro-viridibus profunde, regulariter pinnatifidis segmentis aequalibus, margine recto, apice vadose emarginato, venula falsa intra-marginali tenui, cellulis marginalibus latis unistratis contentis repletis differt. Sori 2–8 terminales, involucre cupuliformes, latiore quam longiore, partibus dimidiis involucralibus plenissimis, ore maxime dilatato.

Rhizome filiform, long, creeping, profusely branched, less than 0.25 mm thick, bearing thick walled, dark brown, unicellular rhizoids, 0.5–1.5 mm long. Fronds scattered on rhizome at intervals of 2–4 mm; stipes 3–5 mm long, covered with profuse hairs like those of rhizomes (but smaller in size). Laminae regularly pinnatifid (pinnate-pinnatifid or rarely bipinnatifid) 2–7 mm long, thin, membranous. Pinnae 2 or 3-lobed, segments ca. 0.6–0.7 mm wide, margins entire, single-celled in thickness with shallowly emarginate apex. Laminal segments each with a single vein ending at the apex, arising alternately from the midrib, clothed with sparse, clavate trichomes; intramarginal pseudoveins thin and continuous, separated from the margin by a single row of comparatively broad, marginal cells; other false veins absent. Sori 2–8, embedded at the apices of distal segments, involucres cup-shaped, broader than long, ca. 1 × 1.2 mm, involucral halves over-full, mouths highly, dilated but without lips. Receptacle filiform, included. Sporangia subsessile, spherical with an oblique annulus composed of 16–21 indurated cells without any thin walled cells; spores tetrahedral, trilete, greenish, perineless, 30–43 mm in diameter, with a sparsely tuberculate exine.

Distribution.— *Crepidomanes indicum* is not very common and so far known only from Athirapally forest of Trichur district (ca. 200 km south), in addition to the type locality.

Ecology.—*Crepidomanes indicum* was found growing epiphytically on the trunks of the large trees (about 15–20 m height) in the dense evergreen riparian forests. The black wiry rhizome forms a prominent network on the bark of trees about 1.5 m above the ground. The species is confined to the trees growing very near to the streams.

Notes.—*Crepidomanes indicum* resembles *C. agasthianum* Madhusoodanan

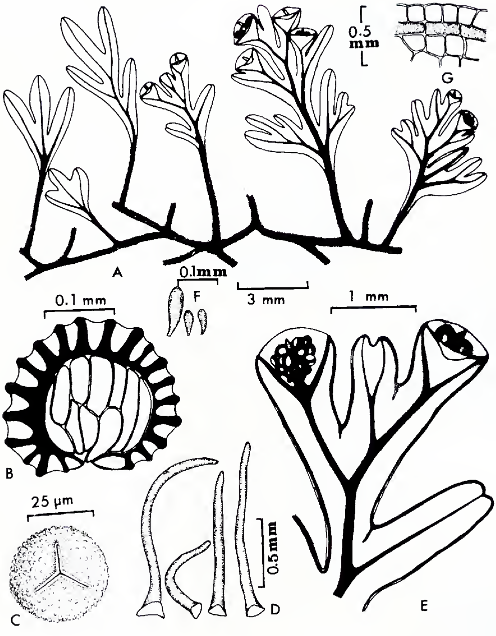

FIG. 1. *Crepidomanes indicum*. A. Habit; B. Sporangium; C. Spores; D. Hairs on rhizome; E. Tip of fertile frond with sori with sporangia; left sorus showing view with one half of the indusium removed; F. Trichomes on veins; G. Details of frond margin with intramarginal pseudovein.

& Hameed in appearence. It shows an affinity to *Microtrichomanes nitidulum* (Bosch) Copel. in indusium shape and to *Microgonium henzaianum* (Parish ex Hook.) Copel. in the shape of its involucral halves. It differs from *C. agasthianum* in having pinnatifid, dark green fronds with entire margined laminae and cup-shaped, broader than long indusia with dilated but not spreading mouths. *Crepidomanes agasthianum* has pale green, digitate, narrowly segmented fronds with undulate margins and cupular sori with narrow mouths subtended by branches of costa running into two long overtopping segments. Sori are characteristic in their dilation of the involucral mouths as well as in the overfullness of the involucral halves, which brings about the entire length of receptacle with sporangia visible from the upper view. These characters, along with the extreme dwarfness of the plant, differentiate this new taxon from *C. kurzii*, which is luxuriantly growing in the type locality.

PARATYPES: INDIA. **Kerala. Idukki Dt.**: Thommankuthu stream, near Thodupuzha, 750 m, 27 Dec 1996, *C.A. Hameed CU 34810* (CALI); Thommankuthu forest, 750 m, 13 Dec 1997, *C.A. Hameed CU 34853* (CALI). **Trichur Dt.**: Athirapally forest, 1 km above Athirapally waterfall, 800m, 21 Dec 1997, *C.A. Hameed, CU 34859* (CALI); Athirapally waterfall, 21 Dec 1997, *C.A. Hameed CU 34864* (CALI).

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REFERENCES

BEDDOME, R.H. 1863. The ferns of southern India and Ceylon. Gantz. Bros., Madras.

BEDDOME, R.H. 1866. The ferns of British India. Gantz Bros., Madras.

BEDDOME, R.H. 1883. A handbook to the ferns of British India, Ceylon and Malay Peninsula. Thaiker Spink & Co., Calcutta.

DEVOL, C.E. 1975. Hymenophyllaceae. In: H. Li, T. Liu, T. Huang, T. Koyama and C.E. Devol, eds. Flora of Taiwan. Pp. 97–128.

HOLTTUM, R.E. 1954. A revised flora of Malaya-II. Ferns of Malaya. Govt. Press, Singapore. Pp. 72–109.

IWATSUKI, K. 1984. Studies in the systematics of filmy ferns VII. A scheme of classification based chiefly on the Asiatic species. Acta Phytotax. Geobot. 3:165–179.

IWATSUKI, K. 1985. The Hymenophyllaceae of Asia, excluding Malesia. J. Fac. Sci. Univ. Tokyo, Sect. 3, Bot. 13:501–551.

JINN-LAI, T. and S. WANG-CHEUNG. 1994. Hymenophyllaceae. In Huang, Tseng-Ching, ed. Flora of Taiwan, Taipei. Second Edition. 1:99–133.

MADHUSOODANAN, P.V. and C.A. HAMEED. 1997. *Crepidomanes christii* (Copel.) Copel. Hymenophyllaceae—A new filmy fern species from India. Indian J. Forest. 20:190–192.

MADHUSOODANAN, P.V. and C.A. HAMEED. 1998. *Crepidomanes agasthianum*, a new filmy fern species (Hymenophyllaceae - Pteridophyta) from India. Nordic. J. Bot. 18:169–170.

MANICKAM, V.S. and V. IRUDAYARAJ. 1992. Pteridophyte flora of the Western ghats—South India. New Delhi.

NAIR, N.C., S.R. GHOSH, and P. BHARGAVAN. 1992. Fern-allies and ferns of Kerala—Part IV. J. Econ. Taxon. Bot. 16:449–53.

SLEDGE, W.A. 1968. Hymenophyllaceae of Ceylon. J. Linn. Soc., Bot. 60:289–308.

STEWART, R.R., D.M. JOHNSON and J.T. MICKEL. 1983. Pteridophyte genera. The meaning of their names. Fiddlehead Forum. 10:21–36.

TAGAWA, M. and K. IWATSUKI. 1979. Flora of Thailand. Thailand Institute of Scientific and Technological Research. Bangkok, Pp. 68–99.

A SECOND SPECIES OF *ORITROPHIUM* (ASTERACEAE: ASTEREAE) FROM MEXICO

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ABSTRACT

Oritrophium durangense Nesom, sp. nov., is described from the Sierra Madre of southern Durango, Mexico. It is the second species of the genus known from Mexico, following another recently described from the northeastern slopes of Pico de Orizaba in Veracruz, about 1000 kilometers northwest of the Durango locality. The remainder of the species of *Oritrophium* occur in montane habitats of northern South America.

RESUMEN

Se describe *Oritrophium durangense* Nesom, sp. nov., de la Sierra Madre del sur de Durango, México. Es la segunda especie del género que se conoce en México, después de otra recientemente descrita de las laderas noreste del Pico de Orizaba en Veracruz, unos 1000 kilómetros al noroeste de la localidad de Durango. Las otras especies de *Oritrophium* se dan en hábitats del norte de América del Sur.

Identification and review of specimens of Asteraceae tribe Astereae in LL,TEX have brought to light a collection of the genus *Oritrophium* (Kunth) Cuatrec. from near the crest of the Sierra Madre in southern Durango, Mexico. These plants do not correspond to the single previously described species of *Oritrophium* in Mexico (Nesom 1992) or any other species of the genus from its center of diversity in South America (Aristeguieta 1964; Cuatrecasas 1961, 1969, 1997). The plants from Durango are described here as a new species.

Oritrophium durangense Nesom, sp. nov. (**Fig. 1**). Type: MEXICO. Durango: Mpio. El Salto, 4 km de la desv. hacia San Miguel de Cruces, bosque de pino-encino principalmente, suelo profundo, con piedra suelto, 2200 m; herbacea de 15–25 cm de alto, flores amarillas, en cabezuela, abundante; 6 Jul 1982, *R. Hernandez 7676 con P. Tenorio* (holotype: TEX!). The specimen was identified (on the distributed label) as "*Pionocarpus* [= *Iostephane*] af. *madrensis* (Wats.) Blake."

A *Oritrophio orizabense* Nesom differt caudice tenui foliis basalibus paucis, foliis inregris, foliis basalibus caulinis longioribus, et floribus radii paucioribus limbis multo brevioribus.

Perennial herbs from a short, thick (ca. 8 mm) fibrous-rooted rhizome, producing an erect, unbranched stem and a cluster of erect-ascending basal

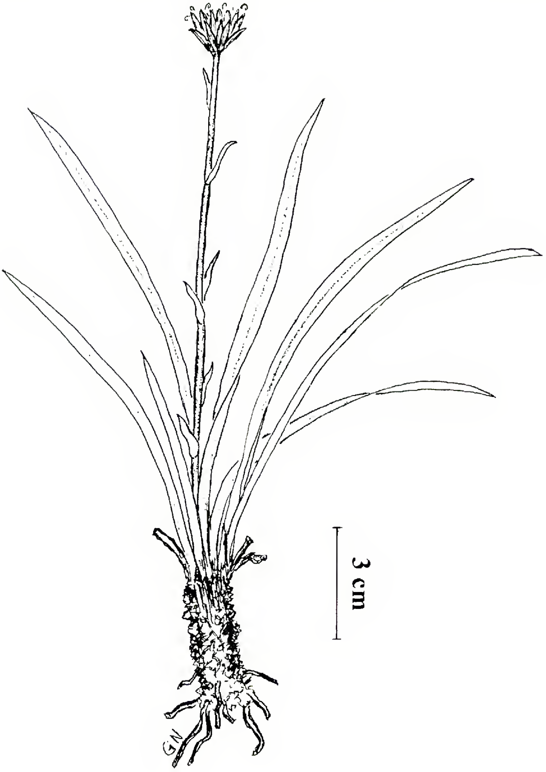

FIG. 1. Habit illustration of *Oritrophium durangense*, from the type collection.

leaves. Stems 12–16(–25) cm tall, purplish, minutely pubescent with a mixture of Type B and Type C trichomes (see Nesom 1976 for illustrations), most densely so near the heads. Leaves basal (largest) and cauline (reduced in size); basal leaves linear, 1-nerved, entire, flat, somewhat succulent, 7–14 cm long, 3–6 mm wide, gradually tapered to a long, sharp point, glabrous except near the base, where long, thin, cobwebby hairs (Type B) become copious and conspicuous near the leaf insertion; cauline leaves reduced in size from the basal, linear-lanceolate, 10–14 mm long, 2–2.5 mm wide at the base, subclasping but not at all auriculate, 7–11 per stem, relatively even-sized up the stem, with internodes 1–3 cm long, most closely spaced toward the base. Heads radiate, turbinate, the involucres 10–14 mm wide; phyllaries thin-herbaceous, without conspicuous venation, purple on the margins and apex, nearly flat, oblong-lanceolate, mostly with acute apices, slightly lacerate-fringed on the distal margins, in 3(–4) graduated series, the innermost 8–10 mm long, ca. 2 mm wide, the outermost 1/2–2/3 as long as the inner; receptacles flat, epaleate. Ray flowers pistillate, ca. 10–15 in a single series, the corollas 6–7 mm long, the limbs 3–5 mm long, barely exserted from the head, white or creamy, 1.8 mm wide, apically coiling, densely invested with viscid, unicellular hairs around the tube-limb junction, the tube ca 2 mm long; disc flowers functionally staminate, with regular corollas, 5 mm long, yellow, narrowly tubular-funnelform, the lobes triangular, 1 mm long, the style branches linear-lanceolate, 1.8 mm long, densely long-papillate, without stigmatic lines. Ray achenes fertile, densely sericeous, eglandular, 5-nerved, ca. 5 mm long (not completely mature), narrowly oblong, with pappus of numerous barbellate bristles 4–5 mm long in 1–2 series; disc ovaries sterile, with pappus bristles nearly smooth, equalling the disc corolla length.

The new species is known only from the type collection. The type sheet apparently bears two plants (one without the root/caudex system) and four basal leaves disconnected from a plant. The illustration "attaches" several of these leaves to the more complete plant. It is likely that a single plant may produce several flowering stems, as is characteristic of other species of the genus.

The plants of *Oritrophium durangense* are simple in habit but distinct in appearance, producing a few, linear, basal leaves, a single, monocephalous stem with a few, small, nearly bracteate cauline leaves, and a relatively small head. The ray corollas are white and apparently barely exserted from the involucre, perhaps accounting for why the collectors described the flowers as yellow (the color of the disc corollas). Still, it seems unusual that the species is currently known only from a single collection, since numerous botanists have passed through the area and made collections. The collectors of *O. durangense* noted that it was "abundante."

These plants are unequivocally identified as the genus *Oritrophium* by a distinctive set of features: monocephalous herbs producing a basal rosette of elongate leaves, white rays, functionally staminate disc flowers (with sterile ovaries and associated features of the style branches), phyllaries with inconspicuous venation, copiously elaborated, thin, nearly floccose white hairs (Type B trichomes) in the axils of the basal leaves, and a lack of long, uniseriate, thick-walled trichomes (Type A trichomes). The new species is perhaps related to *O. orizabense* and a small group of Venezuelan species (Nesom 1992), but this is speculative. The two Mexican species are different enough from each other that even a hypothesis of sister relationship between them is obscure.

The new species differs from *Oritrophium orizabense* in its relatively thin caudex/rhizome (8 mm vs. 7–15 mm) with few basal leaves (vs. dense cluster of basal leaves), entire (vs. serrate) leaves, longer leaves (basal 7–14 cm vs 1.5–4.0 cm, cauline 10–14 mm vs. 4–6 mm), and fewer ray flowers (10–15 vs. 21–37) with much shorter limbs (3–5 mm vs. 7–10 mm). While the habitat of *O. orizabense* is a cliff face, that of *O. durangense* is in soil ("suelo profundo"), probably in a relatively flat area, with loose rocks ("con piedra suelto"). The habitat of *O. orizabense* apparently is more like that of most of the South American species, which generally grow "in wet places, the marshy and swampy ground of the *paramos*, locations that are visited by birds looking for water and seeds" (Cuatrecasas 1997, p. 289).

Oritrophium orizabense is disjunct from the main part of the genus (from the closest point of distribution in Venezuela) by about 1500 kilometers. The separation between *O. durangense* and *O. orizabense* is about 1000 kilometers, with the latter the midpoint in more or less a straight line, making the distance between the Durango locality and those in South America about 2500 kilometers.

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REFERENCES

ARISTEGUIETA, L. 1964. Compositae. Flora de Venezuela 10:1–483.

CUATRECASAS, J. 1961. Notas sobre Astereas Andinas. Ciencia [Mexico] 21:21–32.

CUATRECASAS, J. 1969. Prima flora Colombiana. 3. Compositae–Astereae. Webbia 24:1–335.

CUATRECASAS, J. 1997. Synopsis of the neotropical genus *Oritrophium* (Asteraceae: Astereae). BioLlania, Edicion Especial 6:287–303.

NESOM, G.L. 1976. A new species of *Erigeron* (Asteraceae) and its relatives in southwestern Utah. Brittonia 28:263–272.

NESOM, G.L. 1992. *Oritrophium orizabense* (Asteraceae: Astereae), a new species and the first report of the genus from North America. Phytologia 73:338–344.

UNIQUENESS OF THE ENDANGERED FLORIDA SEMAPHORE CACTUS (*OPUNTIA CORALLICOLA*)

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ABSTRACT

Morphological analysis led to the conclusion that Florida Semaphore Cactus is a distinct species. That conclusion is congruent with genetic studies reported elsewhere. Our plants are properly called *Opuntia corallicola* (Small) Werdermann (*O.* subgenus *Consolea*). The Florida plants are not *O. spinosissima*, as recorded in recent literature. Indeed, the Florida plants are probably more closely related to *O. rubescens* and *O. millspaughii* than to *O. spinosissima*. Details of the Florida species, and a key to similar and confusing Caribbean relatives are provided. Because of the limited number of individuals remaining in the wild, the threat from the alien pest moth *Cactoblastis cactorum*, the low genetic diversity within Florida, and recent damage by Hurricane Georges, the Semaphore Cactus may be the most endangered plant in the United States.

RESUMEN

El estudio morfológico nos lleva a la conclusión de que el cactus semáforo de Florida es una especie distinta. Esta conclusión está de acuerdo con los estudios genéticos publicados en otros lugares. Las plantas son propiamente llamadas *Opuntia corallicola* (Small) Werdermann (*O.* subgénero *Consolea*). Las plantas de Florida no son *O. spinosissima*, tal como fue publicado en la literatura reciente. Es mas, las plantas de Florida probablemente son más cercanas a *O. rubescens* y *O. millspaughii* que a *O. spinosissima*. Se ofrecen detalles de la especie de Florida y una clave taxonómica de las especies emparentadas y confusas del área del Caribe. Dado el número limitado de individuos que quedan en estado salvaje, la amenaza de la polilla alóctona *Cactoblastis cactorum*, la poca diversidad genética dentro de Florida, y el reciente impacto del huracán Georges, el cactus semáforo puede que sea la planta más amenazada de los Estados Unidos de Norte América (EEUU).

In 1930, John K. Small described a cactus from the Florida Keys as a new species that he called *Consolea corallicola*. Very little was known about the species in the 1930s and in the subsequent decades until it became a candidate for endangerment in the 1970s under the name *O. spinosissima*.

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Cactus hobbyists were thought to have eliminated the species from the state in the late 1970s. Even George Avery, a student of the Keys flora for 25 years at the time, could not locate the plants because they no longer grew where he had known them (Austin et al. 1980; Avery 1981). Somewhat later Ann Williams (in litt. 1986) found plants in the lower Keys and brought them to everyone's attention. Eventually the land on which the Semaphore Cactus grew was purchased by The Nature Conservancy and it is now managed as a preserve (Gordon & Kubisiak 1998; Negrón-Ortiz 1998).

Although the Florida Semaphore Cactus rarely appears in the literature, there has been a raging controversy behind the scenes about what species it really is. Long and Lakela (1971) seem to be responsible for first calling the plants *Opuntia spinosissima* Miller, and they recorded it as endemic to Florida even though that name was given originally to Jamaican plants (Britton & Rose 1937). *Opuntia spinosissima* was picked up by those compiling the "Smithsonian List" of endangered species from the 1970s and that name continued to be used in subsequent publications (e.g., Benson 1982; Palmer 1984; Wunderlin 1998; Negrón-Ortiz 1998).

In the early 1980s, unpublished letters were being exchanged by Richard Howard of Harvard University and George Avery of Miami. Swayed by Howard and Touw's (1982) comments on the Lesser Antilles plants, Avery decided that the Florida Keys plants must be *Opuntia rubescens* Salm-Dyck. ex DC. (G. N. Avery, in litt.).

This was the state of affairs in 1990 when Doria Gordon (The Nature Conservancy, Gainesville), who was concerned about their plants on the preserve, brought the problem to our attention. We present here the first results of our studies. Other studies examine the genetic relationships of these endangered plants and their relatives (Dougherty 1996; Gordon & Kubisiak 1998).

To discover the evolutionary and nomenclatural status of the Florida plants, it was first necessary to determine what taxa have been considered related to those plants. Various authors have considered this alliance at different ranks. Some consider *Consolea* Lemaire a distinct genus (Areces 1996). We consider it a subgenus, e.g., *Opuntia* subg. *Consolea* (Lemaire) A. Burger.

Methods. Survey of the literature revealed nine nominate species. Areces (1996) has excluded *O. bahamana* from them and we concur (Fig. 1). We were able to obtain live specimens of six of the taxa. Live material of these six remains in the collections at Fairchild Tropical Garden. Duplicates have been sent to the University of Arizona and Desert Botanical Garden, Tempe. From the living material available, and the literature records of the other species, we created a data matrix of morphological traits that may be used for recognizing these various plants. We present here only those six species most likely to be confused with the Florida plants (Table 1).

FIG. 1. Distribution of the species in *Opuntia* subgenus *Consolea*. This subgenus is confined to the Caribbean.

Results and Conclusions. Confusion of *O. corallicola* with *O. spinosissima* apparently resulted from previous studies not having examined living plants (Austin and Pinkava 1991). Although names are not fixed by typification in *O. spinosissima* and *O. rubescens*, we are applying them consistently with historical usage. Moreover, the morphotypes have distinct ranges (Table 1) consistent with historical name application, and with the usage by Areces (1996).

As stated by Britton and Rose (1937), *O. spinosissima* is endemic to Jamaica. Although *O. rubescens* is widespread in the upper Antilles (Fig. 1), it too is distinct from the Florida plants. In addition to morphological traits, *O. rubescens* has $2n=132$ chromosomes in the living material we examined. Previous reports have given *Opuntia rubescens* as $2n=22$ and 132 (Spencer 1955; Katagiri 1952; Yuasa et al. 1973). We do not know if these reports represent different chromosome races or misidentifications. At least the numbers are consistent with polyploid series known within the genus (Pinkava et al. 1985).

Analysis of morphology indicates that the Florida population of Semaphore Cactus, *O. corallicola*, is related to *O. millspaughii*, *O. rubescens*, and

TABLE 1. Comparative morphology of Caribbean species confused with *O. corallicola.*

Traits	*corallicola*	*spinosissima*	*rubescens*	*millspaughii*	*nashii*	*moniliformis*
Distribution	Florida Keys	Jamaica	Hispaniola & Puerto Rico to Guadelupe	Cuba and the Bahamas to Caymans	Bahamas	Cuba
Habitat	mesic	xeric	xeric	xeric	xeric	xeric
Height	1–3.5 m	1–3.5 m	5–10 m	±4 m	1–3.5 m	≤5 m
Areoles	not reticulate	reticulate	not reticulate	reticulate	not reticulate	reticulate
Areole distance	1–1.5 cm	1–1.5 cm	1–1.5 cm	1–1.5 cm	1.5–3 cm	1–1.5 cm
Areole level	sunken	raised	raised	raised & pitted	raised & pitted	raised
Pad shape	elliptic	oblong-linear to oblong	oblong-linear to oblong	lanceolate to lanceolate-oblong	oblong-linear to oblong	oblong-linear to oblong
Joint length	1–3 dm	3–5 dm	1–3 dm	3–5 dm	≤10 dm	1–3 dm
Spine color	gray or white	straw	straw	gray or white	gray or white	gray or white
Spine location	entire surface	entire surface	entire surface	marginal	entire surface	marginal
Maximum spine number	1–5	1–5	5–9	1–5	1–5	1–5
Spine shape	acicular	acicular	subulate	acicular	acicular	subulate
Spine length	7–12 cm	7–12 cm	7–12 cm	>12 cm	3–5 cm	7–12 cm
Spine direction	deflexed	deflexed	spreading	deflexed	deflexed	spreading
Petal apex	acute	rounded	acute	acute	acute	rounded
Petal length	10–15 mm	10–15 mm	10–15 mm	≤5 mm	10–15 mm	10–15 mm
Maximum pericarpel length	5–6 cm	7–8 cm	5–6 cm	3–4 cm	3–4 cm	5–6 cm
Fruits	proliferous	non-proliferous	proliferous	non-proliferous	proliferous	non-proliferous
Chromosomes	2n=66	2n=?	2n=22, 132	2n=66	2n=?	2n = 22

the Jamaican endemic *O. spinosissima* (Austin and Pinkava 1991). Chloroplast DNA study (Dougherty 1996) supports that conclusion. The morphological data (Table 1) indicates more similarities between *O. millspaughii* and *O. corallicola* than between the others. RAPD data (Gordon & Kubisiak 1998) also indicate that *O. corallicola* is more closely related to *O. millspaughii* (Cayman Brac plants of Gordon & Kubisiak 1998) than to *O. spinosissima*.

As the Cayman Brac plants are a species (*O. millspaughii*) that ranges geographically closer to Florida than Jamaica, the morphological and genetic results are consistent with biogeographic predictions (Brown 1998). More exact relationships among the various species within *Opuntia* subg. *Consolea*, and between those species and the remainder of the genus will be reported by Areces (New York Botanical Garden).

We conclude that Small (1930) was correct when he proposed the Florida Semaphore cacti as distinct. While this uniqueness was confused by use of the name *O. spinosissima* in recent literature, available data indicate that the Florida and Jamaica plants are markedly different species. The Jamaica plants are morphologically unique (Table 1) and endemic to that island, as originally recorded by Britton and Rose (1937).

TAXONOMY

The complete taxonomy of the group *Consolea* is being revised by Areces (1996). Here, only the Florida taxon will be addressed.

Opuntia corallicola (Small) Bakeberg, Neue Kakteen, Jagden, Arten, Kultur. Gartenbau-Verlag Trowitzsch and Shon, Frankfurt (Oder)-Berlin. 1931. *Consolea corallicola* Small, Addisonia 15:25–26, pl. 493. 1930. TYPE: FLORIDA. Monroe Co.: Big Pine Key, 1919, *Small* (SYNTYPE: NY!); Key Largo, *Small* (SYNTYPE: NY!). No lectotype is chosen in deference to Areces (in prep.).

Opuntia spinosissima sensu authors, non Miller (1768).

Description: Shrub or small tree 1–3.5 m tall. Trunk nearly cylindrical, 0.5–2.5 m long, reaching 3–4 cm in diameter. Larger terminal joints light green, standing mostly ascending, all flattened, ca. 1 cm thick, mostly elliptic, but ranging to elongate or asymmetrical, 1–3 dm long. Areoles elliptic, typically 1–1.5 cm apart. Spines numerous, in all areoles or some joints nearly spineless, gray or white, turning brown with age, 2–3(–4) per areole, spreading and deflexed, the longer 7–12 cm, basally 0.25–0.5 mm in diameter, acicular, nearly circular in cross section, twisted, somewhat barbed. Glochids yellow, abundant, 1–1.5 mm long. Leaves rudimentary, small, deciduous, scale-like. Flowers 1.2–2.5 cm in diameter. Sepals green, ovate-deltoid, 3–6 mm long, mostly acute. Petals orange-yellow, turning red shortly after opening, broadly ovate-acute, mucronate, entire. Filaments yellow, 6 mm long; anthers yellow, 0.5 mm long. Styles 6–7.5 mm long, ca 0.5 mm in diameter; stigmas 5, thick, mostly 1.5 mm long. Ovary in anthesis spiny, flattened. Fruits when produced turning yellow, 5–6 cm long, proliferous; seeds few, circular and flattened, irregular, the edges cristate, the sides puberulent, 6–8 mm in diameter.

Range.—Known from 12 plants with vegetative seedlings on The Nature Conservancy preserve in the Florida Keys; also a few individuals that have been brought into cultivation from sites in the keys, both known and unknown. Formerly known from Key Largo and Big Pine Key.

Illustrations.—A color plate 493 was published by Small (1930).

Comments.—Britton and Rose (1937) provided a black and white plate of *O. spinosissima* with a longitudinal section of the flower and ovary showing the nectar chamber typical of subgenus *Consolea*. That chamber is also found in *Nopalea*. Areces (1996:230) has given superlative diagnostic sketches of the flowers of four other species in subgenus *Consolea*: *O. macracantha, O. moniliformis, O. nashii*, and *O. millspaughii*. The flowers of *O. corallicola* are most similar to those of *O. millspaughii*, but these two differ in several other traits (Table 1).

The nectary chamber, the unjointed central woody axis, and distinctive pollen (Leuenberger 1976), are among traits that make *Consolea* distinctive, regardless of the rank it is given (Areces 1996).

KEY TO SOME CONFUSING CARIBBEAN *OPUNTIA*

1. Spines straw-colored.
    2. Plants 1–3.5 m tall. Areoles reticulate. Joints 3–5 dm long. Spines 1–5, acicular, deflexed. Petal apex rounded. Pericarpel 7–8 cm long. Fruits not proliferous .... **O. spinosissima**
    2. Plants 5–10 m tall. Areoles not reticulate. Joints 1–3 dm long. Spines 5–9, subulate, spreading. Petal apex acute. Pericarpel 5–6 cm long. Fruits proliferous .... **O. rubescens**
1. Spines gray or white (brownish with age).
    3. Areoles reticulate. Spines >12 cm long, mostly marginal. Fruits non-proliferous. .... **O. millspaughii**
    3. Areoles not reticulate. Spines 3–12 cm long, over entire surface. Fruits proliferous.
        4. Areoles sunken, 1–1.5 cm apart. Joinrs 1–3 dm long. Pericarpels 5–6 cm long .... **O. corallicola**
        4. Areoles raised and pitted, 1.5–3 cm apart. Joints ≥ 10 dm long. Pericarpels 3–4 cm long. .... **O. nashii**

The future. Current findings indicate that the Florida plants are an exceptionally rare and endangered endemic species. Presently *O. corallicola* is known from 12 plants on one small land parcel that is owned and protected by The Nature Conservancy. That organization has formulated and implemented an informal recovery plan for this endangered species, but that procedure is complicated by recent events.

The presence of the exotic moth *Cactoblastis cactorum* has initiated a series of problems with those plants (Pemberton 1995). This moth has substantially reduced the abundance of *Opuntia* in the Keys and attacked the Semaphore cacti in the past. Those attacks resulted in most of the remaining plants being placed within screened "cages" in 1990. Although the cacti grow in partial shade conditions, the exclosures may have altered the light quality reaching the plants and caused growth anomalies such as etiolation. No data are available on these characters. Moreover, the cages exclude any potential pollinators of the cacti, precluding potential allogamous sexual reproduction. Future survival with this insect pest is problematical for the Florida plants in spite of the dubious declining infestation trends predicted by Johnson and Stiling (1998). That short-term study, terminated in 1993, did not include the Florida Atlantic University (FAU) campus (Pierce 1995), nor did it address the more recent (1996–1998) upswing in infestation in southern Florida. Cultivated plants on the FAU campus were destroyed during 1997 by *Cactoblastis*, after the native population of *O. stricta* was decimated.

A second more recent event has led to another problem for the plants. Hurricane Georges swept through the Florida Keys in September of 1998. The exclosures were removed when the Hurricane was approaching and have not been replaced. With that event, storm surge swept over the low limestone keys and deposited ocean water. That salty deposit was not immediately diluted by subsequent rainfall, and its long-term impact on the plants is unknown. Also, the main stems on two of the individuals were broken. On others the stems remained erect, but the pads were removed (D. Gordon, pers. comm., 13 Oct 1998). Smaller propagules at the bases of the cacti remain. The full impact of the hurricane on these plants is still being evaluated.

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REFERENCES

Areces-M., A. 1996. New taxa of *Consolea* Lemaire (Cactaceae: Opuntioideae) from Cuba. Brittonia 48:224–236.

Austin, D.F., P. Krauss, J.L. Jones, C.E. Nauman, and B.E. Tatje. 1980. Endangered species of southern Florida. Report to U.S. Fish and Wildlife Service, Office of Endangered Species, Atlanta, GA. Contract No. 14-1600004-79-106.

—- and D.J. PINKAVA. 1991. Preliminary summary of the taxonomic status of the Florida Semaphore Cactus. report to U.S. Fish and Wildlife Service, Office of Endangered Species, Jacksonville, FL.

AVERY, G. 1981. A history of the Cactaceae in the southeastern United States. Cac. Succ. J. (Los Angeles) 53:177–182.

BAKEBERG, C. 1931. Neue Kakteen, Jagden, Arten, Kultur. Gartenbau-Verlag Trowitzsch and Shon, Frankfurt (Oder)-Berlin.

BENSON, L. 1982. The cacti of the United States and Canada. Stanford University Press, Stanford, CA.

BRITTON, N.L. and J.N. ROSE. 1937. The Cactaceae. Descriptions and illustrations of plants of the Cactus Family. Dover Publ. Inc., New York.

BROWN, J. H. AND M. V. LOMOLINO. 1998. Biogeography. Second ed. Sinauer Associates, Inc., Sunderland, MA.

DOUGHERTY, C. J. 1996. Novel DNA sequences of the endangered Florida Semaphore Cactus. M.S. Thesis, Florida Atlantic University.

GORDON, D.R. and T.L. KUBISIAK. 1998. RAPD analysis of the last populations of a likely Florida Keys endemic cactus. Florida Sci. 61:203–210.

HOWARD, R.A. and M. TOUW. 1982, *Opuntia* species in the Lesser Antilles. Cac. Succ. J. (Los Angeles) 54:170–179.

KATIGIRI, S. 1952. Studies on the chromosome number in some Cactaceae species. Ed. by E.B. Kurtz, Jr. Jap. J. Breed. 1:233–236.

LEUENBERGER, B.E. 1976. Die Pollenmorphologie der Cactaceae. Diss. Bot. 31.

LONG, R.W. and O. LAKELA. 1971. A flora of Tropical Florida. Univ. Miami Press, Miami.

NEGRÓN-ORTIZ, V. 1998. Reproductive biology of a rare cactus, *Opuntia spinosissima* (Cactaceae), in the Florida Keys: why is seed set very low? Sexual Pl. Reprod. 11:208–212.

PALMER, D.T. 1984. Endangered and threatened wildlife and plants; Final rule to determine *Cereus robinii* (Key Tree-Cactus) to be an endangered species. Fed. Reg. 49(140):29234–29237.

PEMBERTON, R.W. 1995. *Cactoblastis cactorum* (Lepidoptera: Pyralidae) in the United States: An immigrant biological control agent or an introduction of the nursery industry? Amer. Entomol. 41:230–232.

PIERCE, R.L. 1995. Infestation of *Opuntia* by the phycitid moths *Melitara prodenialis* and *Cactoblastis cactorum*. M.S. Thesis, Florida Atlantic University.

PINKAVA, D.J., M.A, BAKER, B.D. PARFITT, M.W. MOHLENBROCK, and R.D. WORTHINGTON. 1985. Chromosome numbers in some Cacti of western North America—V. Syst. Bot. 10:471-483.

SMALL, J.K. 1930. *Consolea corallicola*, Florida Semaphore Cactus. Addisonia 15:25–26, pl. 493.

SPENCER, J.L. 1955. A cytological study of the Cactaceae of Puerto Rico. Bot. Gaz. 117:33–37.

WUNDERLIN, R.P. 1998. Guide to the vascular plants of Florida. University Presses of Florida, Gainesville.

YUASA, H., H. SHIMIZU, S. KASHIWAI, and N. KONDO. 1973. Chromosome numbers and their bearing on the geographic distribution of the subfamily Opuntioideae (Cactaceae). Rep. Inst. Breed. Res., Tokyo Univ. Agric. 4:1–10.

ARKANSAS *CAREX* (CYPERACEAE): A BRIEFLY ANNOTATED LIST

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ABSTRACT

Recent collections and herbarium specimen study resulted in this review of the status of the 121 taxa in the genus *Carex* occurring the state of Arkansas, USA. A list of these taxa provides frequency and habitat data, while county dot maps show known distribution. The list gives additional information on selected taxa, especially on rare species, on taxa previously considered rare in Arkansas, or on nine taxa reported new to Arkansas. This paper considers several taxa as distinct which were previously treated as synonyms by other authors. It reports four hybrids, and treats taxa excluded from the Arkansas flora, as well as taxa considered to be possible additions to the state flora.

RESUMEN

Recientes recolecciones estudios de especímenes de herbario dieron como resultado esta revisión del estatus de los 121 taxa del género *Carex* del estado de Arkansas, USA. Una lista de estos taxa ofrece datos de frecuencia y hábitat, mientras que los mapas de condados muestran la distribución conocida. La lista da información adicional de taxa selectos, especialmente de especies raras, de taxa considerados raros previamente en Arkansas, o de los nueve taxa citados como nuevos para Arkansas. Este trabajo considera como distintos varios taxa que habían sido tratados como sinónimos por otros autores. Se citan cuatro híbridos, y se tratan taxa excluidos de la flora de Arkansas, así como taxa considerados como posibles adiciones a la flora del estado.

INTRODUCTION

Smith published county record dot maps for 2,469 taxa of vascular plants (1988), and keys to Arkansas' vascular flora (1994). In May 1991, the author set a goal of publishing a book on Arkansas *Carex* in 2011 and began field work toward that end. This paper presents initial results of that study through the 1996 field season. The author's collections, a review of literature, and a review of collections at several herbaria provide the bases for this study.

METHODS

Field work in the last seven years resulted in 1523 Arkansas *Carex* collections, excluding duplicates. 1794 herbarium collections were reviewed [ACPR had 178 collections, CLEM 18, LSU 24, LSUS 3, LTU 46, MO

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149*, MOR 8, NA 88, NLU 652, NO 28, SFRP 21, STAR 147, UAM 113, UARK 237*, UNCC 0, USCH 14, WCUH 1, Buffalo National River herbarium 58, Sylamore Ranger District/Experimental Forest herbarium (Ozark National Forest) 9]. An asterisk (*) indicates incomplete reviews. Anthony A. Reznicek reviewed and provided reports of 483 additional Arkansas *Carex* collections at MICH, excluding Hyatt collections. Several factors make the declaration of state records difficult. Consultation with Reznicek resulted in the recognition of many taxa not formerly recognized as distinct by some authors. Some species pairs previously lumped and now split are not treated herein as state records. Declaring state records draws attention to both species new to Arkansas and to species with vouchers which may have been lying unreported in herbaria.

ECOLOGICAL UNITS OF ARKANSAS

Keys, et al. (1995) provides the basis for a map of the ecological regions of Arkansas (Fig. 1). Keys' map and accompanying booklet describe ecological units for the eastern United States, defined as part of the Humid Temperate Domain. Within Arkansas, the Subtropical and Hot Continental Divisions of the Domain occur, with the Ozark Highlands and Boston Mountain Sections represented in the latter, and several sections represented in the former Division. A brief description of the ecologically defined Sections represented in Arkansas, and mapped in Figure 1, based, in part, on Keys' text follows. The figure also shows Crowley's Ridge, a significant subsection. Two letter abbreviations used in Figure 1 precede each section's description.

AV—The Arkansas Valley Section contains the Arkansas River in western Arkansas, and unique Mount Magazine, the highest peak in the state. The sandy and alluvial soils of the valley contrast with the sandstone and shale of the Mountain. White Oak, Northern Red Oak, and hickories dominate the hills which hide a few small wetlands and many perennial streams.

BM—The Boston Mountains, made of high hills and low mountains, lay over sandstones. Southern Red, White, Northern Red, and Post Oaks share the hillsides with various hickories, the hills cut by perennial streams.

CP—Often referred to as the West Gulf Coastal Plain, the Middle Coastal Plains, Western Section (as labeled by Keys et. al. 1995), forms smooth to irregular plains and riverine valleys on various mixtures of sands, silts, clays, and gravels. Shortleaf and Loblolly pines mix with a variety of oaks and hickories, with other wetland species along the frequent streams and rivers.

CR—The subsection known as Crowley's Ridge, an isolated low ridge of Pleistocene loess, nearly bisects the Mississippi Alluvial Basin. Various oaks as well as Beech-Maple forest thrive on this narrow strip of rolling hills surrounded by flatlands. Short stream channels drain the ridge.

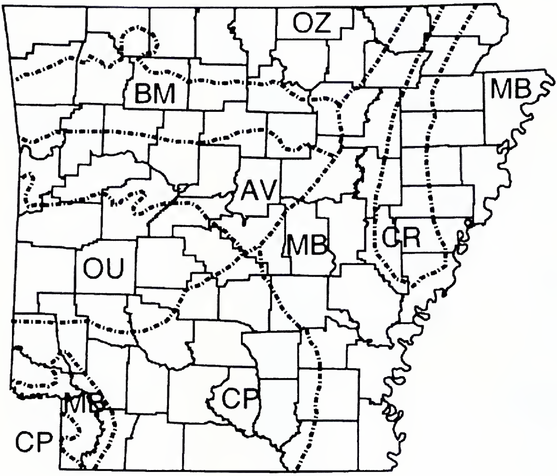


FIG. 1. Ecological units of Arkansas (modified from U.S.D.A. Forest Service, 1995).

MB—The fertile farms of the Mississippi Alluvial Basin Section lie in an area which once held much of Arkansas' wetlands. Earthquakes infrequently rock northeastern sections near the New Madrid fault, causing liquefaction of the alluvial sands, silts, and clays which cover this section. Forests vary from more upland species such as oaks and hickories, to those associated with wetter sites to riverine wetlands, including Loblolly Pine, Sweetgum, hickories, Willow and other oaks, Sycamore, and Birch. Drainage ditches reduced wetlands, although many wetlands remain.

OU—The Ouachita Mountains, unlike the eroded plain of the Ozarks, fold into open high hills and low mountains, on sandstone, shales, and cherts, often with bouldery characteristics. Shortleaf Pine and a mixture of the above oak species cover the hills, with streams often following the east-west lie of the mountains.

OZ—The low hills, irregular plains, karst, and entrenched valleys of the Ozark Highlands contain cherty clay residuum on dolomites, limestones, and sandstones. Vegetation includes various Oak forests, including White, Post, Blackjack, and Black Oak, with prairie potential in Bluestem and other grasses. Entrenched streams and cool springs provide a haven for northern carices reaching the southern edge of their range.

ARKANSAS *CAREX* (CYPERACEAE): A BRIEFLY ANNOTATED LIST

The following alphabetical list provides a snapshot of current knowledge on the 121 *Carex* taxa recognized in Arkansas. Taxonomy follows the draft of the Flora of North America *Carex* treatment, provided by A.A. Reznicek of MICH (ined.). The general format for entries follows:

Accepted **genus species** (in bold); author(s); figure number (distribution mapped); *synonyms* (in italics); frequency, habitat, comments. An asterisk indicates new state records; voucher specimens cited in some cases.

Frequency statements, unless qualified, represent observed frequency in Arkansas. Arkansas habitats listed include data drawn from personal observations, herbarium labels, consultation with others, or in rare cases, the literature.

The author's collections skew the distributions of some species; Baxter County, the author's home for several years, is both the most heavily collected and has the most known species. North Central Arkansas is better represented than most other regions. Recent collections in south Arkansas, nearest the author's current home, make it better represented than eastern Arkansas, a neglected area. For example, *Carex umbellata* turned up in 28 new western Arkansas counties on a single trip in 1996, while eastern Arkansas has known records primarily from the author's recent collections.

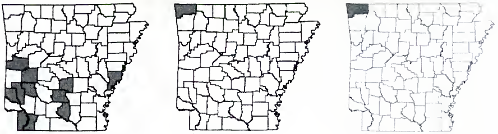
Arkansas distribution maps have two shades, solid for counties where the author confirmed the identification of a specimen, cross-hatched when reported elsewhere without the author's confirmation of the identification. Most of the identifications of the author's collections were confirmed or corrected by A.A. Reznicek, while most herbarium specimens (with the exception of those at MICH) were not.

C. abscondita Mack.—(Fig. 2). Locally numerous, in dense colonies; restricted to floodplains in moist deciduous woods (prefers natural levees). See Naczi and Bryson (1990).

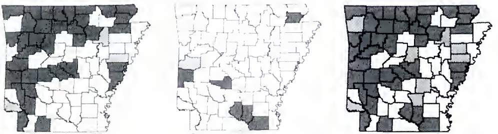
***C. aggregata** Mack.—(Fig. 2). Rare, moist opening in a disturbed creek bottom forest, and also an adjacent pasture (formerly forest) and hedgerow by road next to the pasture (*S. & G. Jones, A. & S. Reznicek 11140* BRCH, MICH, TRTE, VDB); Benton Co. *Bailey & Gibbons s.n.* (UARK) from May 28, 1975 was determined as *C. aggregata* by Stanley D. Jones (E.B. Smith, pers. comm.).

***C. alata** Torr. & A. Gray.—(Fig. 2). A record of this plant (*D. Castaner 9119* at WIS) from Crowley's Ridge State Park area, collected May 10, 1986 was pointed out by Anthony A. Reznicek. This plant, probably scattered in northern Arkansas, also occurs in Missouri within four miles of Fulton County, Arkansas.

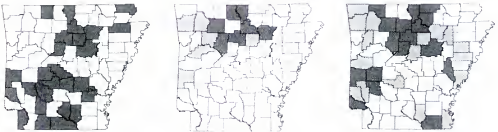
C. albicans Willd. var. **albicans.**—(Fig. 2). *Carex artitecta* Mack., *C. emmonsii* Dew. ex Torr. var. *muhlenbergii* (A. Gray) Rettig, *C. physorhyncha* Liebm. Occasional, widespread; bluffs, hillsides.



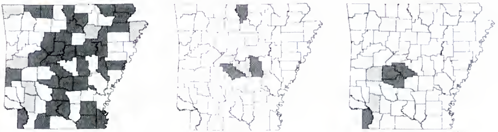
C. abscondita C. aggregata C. alata



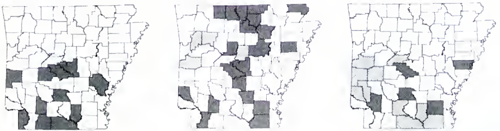
C. albicans var. albicans C. albicans var. australis C. albicans (all records)



C. albolutescens C. albursina C amphibola



C. annectens var. annectens C. arkansana C. atlantica spp. atlantica



C. atlantica spp. capillacea C. austrina C. basiantha

FIG. 2. Documented county records in Arkansas for *Carex* species (**solid** = counties where the author confirmed the identification, and **cross-hatched** = when reported elsewhere without the author's confirmation).

C. **albicans** Willd. var. **australis** (L.H. Bailey) Rettig.—(Fig. 2). *Carex emmonsii* Dew. ex Torrey var. *australis* (L.H. Bailey) Rettig, *C. physorhyncha* Liebm. Infrequent, poorly known in state. See Orzell and Bridges (1987).

C. **albolutescens** Schwein.—(Fig. 2). Occasional to common south, infrequent northwest; floodplains, wet woods.

C. **albursina** Sheldon.—(Fig. 2). Taxonomy of Arkansas material needs study; locally abundant, deep valleys, mesic north-facing slopes.

C. **amphibola** Steud. sensu lato—(Fig. 2). Common northwest, occasional elsewhere; valleys, floodplains.

C. **annectens** Bickn. var. **annectens.**—(Fig. 2). Common (several more counties represented at UARK per E.B. Smith, pers. comm. 1994), ruderal.

C. **arkansana** L.H. Bailey.—(Fig. 2). Infrequent to rare; prairies, surrounding ruderal areas (*Hyatt 4623.03, 4829.03* MICH, UARK).

C. **atlantica** L.H. Bailey subsp. **atlantica.**—(Fig. 2). Infrequent; streamsides in bog-like areas, sometimes with *Sphagnum* mosses. Poorly studied in Arkansas *(Orzell 1783* MICH).

C. **atlantica** L.H. Bailey subsp. **capillacea** (L.H. Bailey) Reznicek.—(Fig. 2). Locally abundant; bog-like streamside floodplain (*Orzell 1321* MICH).

C. **austrina** (Small) Mack.—(Fig. 2). Occasional to common north, infrequent south; roadsides, prairies.

*C. **basiantha** Schk.—(Fig. 2). Occasional, locally abundant; floodplains, forms large colonies along larger streams. Infrequent in the Ozarks, where *C. jamesii* largely replaces it (*Orzell 1733* MICH). Considered distinct from *C. willdenowii.* Naczi et al. (1998) discussed the recognition of this species.

C. **bicknellii** Britt. var. **opaca** F.J. Herm.—(Fig. 3). Infrequent; prairie regions and remnants. See Jones and Reznicek (1991) for a key to Texas *Ovales*, and Herman (1972).

C. **blanda** Dew.—(Fig. 3). *Carex laxiflora* Lam. var. *blanda* (Dew.) Boott. Common to abundant, widespread; mesic woodlands, ruderal.

C. **brevior** (Dew.) Mack. ex Lunell.—(Fig. 3). Occasional; ruderal, natural habitats poorly known in Arkansas.

C. **bromoides** Schk. var. **bromoides.**—(Fig. 3). Rare, cherty soil, full shade (Rettig 1982); probably from swampy areas.

C. **bulbostylis** Mack.—(Fig. 3). Infrequent to occasional, poorly known; "mesic sandy ravine forest with some calcareous influence" (Orzell & Bridges 1987), floodplain forests.

C. **bullata** Schk.—(Fig. 3). Rare; wet areas on sandy soil, roadside, open or wooded. Known in Arkansas from two collections (*Moore 400396*, and *Bryson 5775;* UARK). These represent the only known sites west of the Mississippi River (A.A. Reznicek, pers. comm.). Lipscomb (1980) cites *Moore 480070* WIS, from Logan County.

C. **bushii** Mack.—(Fig. 3). Occasional, locally common; prairies, glades.

C. **careyana** Torr.—(Fig. 3). Infrequent, very locally abundant; deep mesic valleys on talus slopes often below bluffs (*Hyatt 5891* MICH).

C. **caroliniana** Schwein.—(Fig. 3). Occasional north, common south; ditches, sunny valleys.

C. **cephalophora** Muhl. ex Willd.—(Fig. 3). Common, widespread; woodlands.

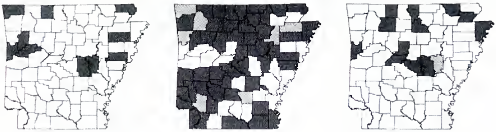
C. **cherokeensis** Schwein.—(Fig. 3). Common, widespread; floodplains, often of smaller streams, ditches, old fields, wet woods, swamps.

C. **communis** L.H. Bailey.—(Fig. 3). Occasional, locally abundant; blufflines, especially below bluffs on upper talus slopes.

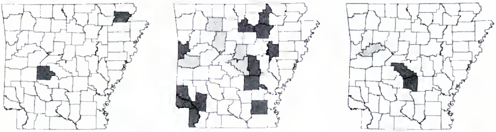
C. **comosa** Boott.—(Fig. 3). Infrequent; borders of larger streams, small lakes.

C. **complanata** Torr. & Hook.—(Fig. 3). *Carex complanata* Torr. and Hook. var. *complanata* Infrequent north, common to abundant elsewhere; ditches, pine woods, often ruderal.

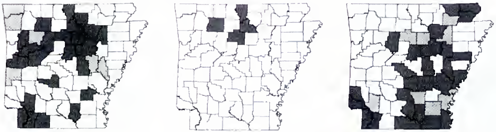
C. **conjuncta** Boott.—(Fig. 3). Rare; open wooded pasture, wet area (*Reznicek 9792* MICH,



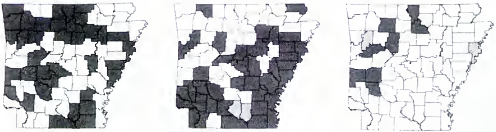
C. bicknellii var. opaca C. blanda C. brevior



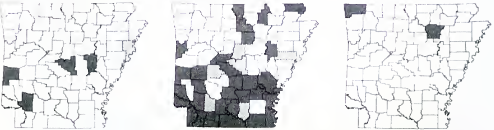
C. bromoides C. bulbostylis C bullata



C. bushii C. careyana C. caroliniana



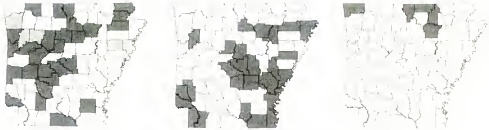
C. cephalophora C. cherokeensis C. communis



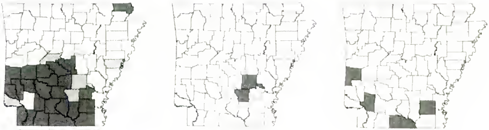
C. comosa C. complanata C. conjuncta

FIG. 3. Documented county records in Arkansas for *Carex* species (**solid** = counties where the author confirmed the identification, and **cross-hatched** = when reported elsewhere without the author's confirmation).

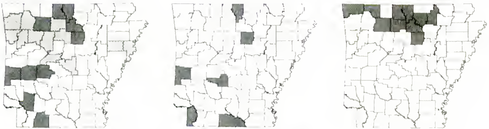
C. corrugata C. crawei C crebriflora



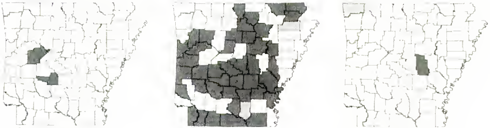
C. crinita C. crus-corvi C davisii



C. debilis var. debilis C. debilis var. pubera C. decomposita



C. digitalis var. digitalis C. digitalis var. macropoda C. eburnea



C. emoryi C. festucacea C. fissa var. fissa

FIG. 4. Documented county records in Arkansas for *Carex* species (**solid** = counties where the author confirmed the identification, and **cross-hatched** = when reported elsewhere without the author's confirmation).

UARK). The author has not seen the voucher (Jones & Reznicek 1995).

C. **corrugata** Fern.—(Fig. 4). Locally common; restricted to floodplains of major rivers, streams, low woods.

C. **crawei** Dew.—(Fig. 4). Occasional, very locally abundant; calcareous sunny seeps, springs, glades, most frequent in rights-of-way which cross glades.

C. **crebriflora** Wieg.—(Fig. 4). Occasional to common; local to small drainages, stream floodplains (*Demaree 14415* MICH).

C. **crinata** Lam.—(Fig. 4). Locally common; perennial streambanks, wetlands.

C. **crus-corvi** Shuttlew. ex Kuntze.—(Fig. 4). Occasional, often scattered; wetlands, ruderal wetlands, often roadsides.

C. **davisii** Schwein. & Torr.—(Fig. 4). Locally common, occasional in north Arkansas, especially on the Salem Plateau; calcareous stream floodplains, pastures, woodlands (Hyatt 1994).

C. **debilis** Michx. var. **debilis.**—(Fig. 4). Common to abundant south; sweet bay and magnolia swamps, stream terraces, creekbanks.

C. **debilis** Michx. var. **pubera** A. Gray.—(Fig. 4). Rare; Morrow's Bottoms Natural Area (*Sundell* and *Barnes 9753*, UAM).

C. **decomposita** Muhl.—(Fig. 4). Infrequent, swamp and lake margins (*Moore 490043* UARK).

C. **digitalis** Willd. var. **digitalis.**—(Fig. 4). Common; upland and north-facing deciduous woods.

C. **digitalis** Willd. var. **macropoda** Fern.—(Fig. 4). Infrequent; rich woods and floodplains (*Hyatt, et. al. 5290*, MICH, UARK). Anthony A. Reznicek reports (pers. comm.) a specimen collected by Hasse in Little Rock, May 1886, has vouchers at BH, MICH, and NY.

C. **eburnea** Boott.—(Fig. 4). Occasional; very local herbaceous dominant, calcareous glade outcrops, bluffs at wet microsites.

C. **emoryi** Dew.—(Fig. 4). Rare; streambanks (*Walker, s.n.* UARK).

C. **festucacea** Schk.—(Fig. 4). Common; prairie wetlands, ruderal. Underrepresented in collections.

*C. **fissa** Mack. var. **fissa.**—(Fig. 4). Rare, "Moist, open grassy and sedgey meadow, heavy clay soil (*Reznicek 9271*, MICH). See Jones, et. al. (1990).

C. **flaccosperma** Dew.—(Fig. 5). Common; floodplains, widespread in flatlands.

C. **frankii** Kunth.—(Fig. 5). Abundant; creekbanks, lakeshores, ditches. Arkansas' most widely reported *Carex* sedge.

C. **gigantea** Rudge.—(Fig. 5). Infrequent; riverside (*Demaree 3379*, UARK), lowlands near Crowley's Ridge and common in a backwater swamp (*Orzell 3483* MICH).

C. **glaucescens** Ell.—(Fig. 5). Infrequent; floodplains of smaller streams, swamps (*A.A. Martin s.n.* SFRP).

C. **glaucodea** Tuckerm.—(Fig. 5). Occasional; ruderal, woodlands, frequent in seldom used woods roads.

C. **gracilescens** Steud.—(Fig. 5). Rare; steep rocky slopes above the Cossatot River (*Naczi 1917, 1926*, MICH). Record courtesy of A.A. Reznicek.

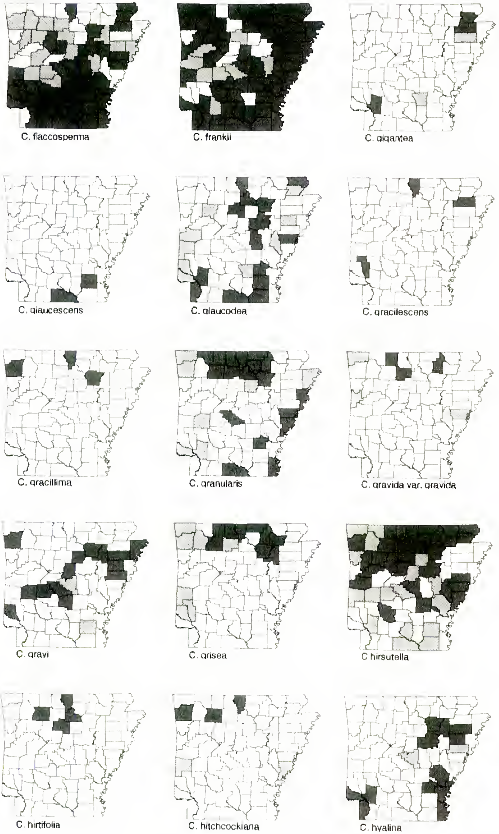
C. **gracillima** Schwein.—(Fig. 5). Rare, two very small, local, Ozark populations on moist north facing rock outcrop (Hyatt 1993), mesic deep valley below sandstone bluff at dripping waterfall (*Hyatt 5723*, MICH, UARK).

C. **granularis** Muhl.—(Fig. 5). Locally common to occasional; springs, seeps, ditches.

C. **gravida** L.H. Bailey var. **gravida.**—(Fig. 5). Infrequent; prairies.

C. **grayi** Carey.—(Fig. 5). *Carex grayii* Carey, an orthographic variant. Occasional; wooded wetlands, ditches.

C. **grisea** Wahl.—(Fig. 5). Occasional; calcareous floodplain woods, less frequent in sur-



C. flaccosperma

C. frankii

C. gigantea

C. glaucescens

C. glaucodea

C. gracilescens

C. gracillima

C. granularis

C. gravida var. gravida

C. grayi

C. grisea

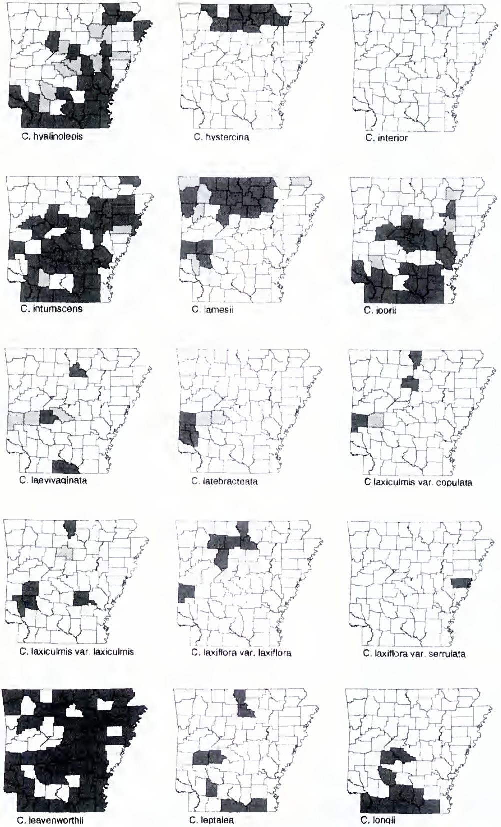
C hirsutella

C. hirtifolia

C. hitchcockiana

C. hyalina

FIG. 5. Documented county records in Arkansas for *Carex* species (**solid** = counties where the author confirmed the identification, and **cross-hatched** = when reported elsewhere without the author's confirmation).



C. hyalinolepis

C. hystercina

C. interior

C. intumscens

C. jamesii

C. joorii

C. laevivaginata

C. latebracteata

C laxiculmis var. copulata

C. laxiculmis var. laxiculmis

C. laxiflora var. laxiflora

C. laxiflora var. serrulata

C. leavenworthii

C. leptalea

C. longii

FIG. 6. Documented county records in Arkansas for *Carex* species (**solid** = counties where the author confirmed the identification, and **cross-hatched** = when reported elsewhere without the author's confirmation).

rounding uplands.

C. hirsutella Mack.—(Fig. 5). *Carex complanata* Torr. and Hook. var. *hirsutella* (L.H. Bailey) Gleason. Abundant to common north, occasional to infrequent south; ruderal, very widespread.

C. hirtifolia Mack.—(Fig. 5). Infrequent; mesic valleys and floodplains of small to medium sized streams at many, but localized sites (Thomas et. al. 1991).

C. hitchcockiana Dew.—(Fig. 5). Infrequent; mesic, topographically shaded and protected, cool north facing slopes in deep valleys near larger intermittent streams. Such Ozark streams often have long superficially dry sections with flow under gravel.

C. hyalina Boott.—(Fig. 5). Locally abundant to common, absent outside specialized habitat; prefers shaded deciduous woods often on clay soils, periodically flooded, usually along major rivers and tributaries. Often easily found by looking near bridges on rights-of-way crossing floodplains. See Bryson, et. al. (1992), Reznicek and Naczi (1993), Reznicek and Hyatt (1996).

C. hyalinolepis Steud.—(Fig. 6). Occasional; forming huge colonies with long, stout rhizomes in swamps, ditches, wet prairies.

C. hystericina Muhl. ex Willd.—(Fig. 6). *Carex hystricina* Muhl. ex Willd. an orthographic variant. Occasional, very locally abundant; limestone dominated seeps, springs, and streams. Prefers sunny sites with perennial streams; absent nearly everywhere else; rare at heavily shaded sites.

C. interior L.H. Bailey.—(Fig. 6). Rare; calcareous seeps (Orzell and Bridges 1987; Reznicek and Ball 1980).

C. intumescens Rudge.—(Fig. 6). Common; widespread in wetland woods, wetland edges.

C. jamesii Schwein.—(Fig. 6). Locally abundant; floodplains, especially in deep, narrow valleys.

C. joorii L.H. Bailey.—(Fig. 6). Common to infrequent; wetland woods, swamps, wooded roadsides.

C. laevivaginata (Kukenth.) Mack.—(Fig. 6). Infrequent; swampy meadows, calcareous seeps.

C. latebracteata Waterfall.—(Fig. 6). Infrequent, locally numerous; "well drained dry to dry-mesic slopes" (Orzell & Bridges, 1987).

C. laxiculmis Schwein. var. **copulata** (L.H. Bailey) Mack.—(Fig. 6). Infrequent; mesic north-facing slopes in deep valleys.

C. laxiculmis Schwein. var. **laxiculmis.**—(Fig. 6). Taxonomy of Arkansas varieties needs study, poorly known, but 1997 collections revealed several new sites; infrequent; mesic valleys in deciduous woods.

C. laxiflora Lam. var. **laxiflora.**—(Fig. 6). Arkansas distribution poorly understood, Arkansas material needs taxonomic study; occasional (but varieties in question); mesic woodlands.

C. laxiflora Lam. var. **serrulata** Underwood.—(Fig. 6). Arkansas distribution poorly understood, Arkansas material needs taxonomic study; rare; rich woods.

C. leavenworthii Dew.—(Fig. 6). Common; ruderal.

C. leptalea Wahl.—(Fig. 6). *Carex leptalea* Wahl. var. *leptalea*. Occasional; calcareous seeps in northern Arkansas, wooded seeps at base of slopes in southern Arkansas.

C. longii Mack.—(Fig. 6). Occasional and probably very undercollected, especially in south Arkansas; wet woods. See Rothrock (1991).

C. louisianica L.H. Bailey.—(Fig. 7). Occasional; swamps and low wetland woods. See Reznicek and Ball (1974); Jones and Hatch (1990).

C. lupuliformis Sartwell.—(Fig. 7). Occasional; wetter habitats than and similar habitats to *C. lupulina* (A.A. Reznicek, pers. comm. 1993).

C. lupulina Muhl.—(Fig. 7). Common; wetland woods, prairie edges, swamps, ditches.

C. lurida Wahl.—(Fig. 7). Common; widespread along streams, lakeshores, ditches, swamps.

C. meadii Dew.—(Fig. 7). Occasional; limestone glades, sinks, prairies.

***C. mesochorea** Muhl. ex Willd.—(Fig. 7). Reported here as a state record for Arkansas; rare, ruderal; (*Hyatt 5485, 5494, 5636*, MICH, UARK).

C. microdonta Torr. & Hook.—(Fig. 7). Infrequent; chalk glades (*Moore 400161* UARK), prairie openings, glades. See Lipscomb (1980).

C. molesta Mack.—(Fig. 7). Occasional; floodplains, usually of larger streams "commonly ruderal . . . near or along streams and in open woodland. However it often prefers heavy, clayey soils and is definitely more of a calciphile [than *C. molestiformis*]" (Reznicek & Rothrock 1997).

C. molestiformis Reznicek & Rothrock.—(Fig. 7). Occasional; riverine floodplains, ruderal. Reznicek and Rothrock (1997), in recently describing this species, note it "thrives in a wide vatiety of open to somewhat shaded, mostly ruderal, habitats with a wide range of associates, including ditches, dryish roadsides, river and streambanks, moist meadows, and open forests . . . . Typically, colonies of *C. molestiformis* rarely occur far from streams . . ." collaborating the author's initial observations. *C. molesta*, while also exhibiting strong ruderal tendencies, occurs more typically in sunny upland spring and stream sites and ruderal settings which imitate these habitats, while *C. molestiformis* is more riverine.

C. muhlenbergii Willd. var. **enervis** Boott.—(Fig. 7). Varieties poorly studied in Arkansas; common species; dry, acid soil woodland/glade complex (Orzell & Bridges 1987).

C. muhlenbergii Willd. var. **muhlenbergii.**—(Fig. 7). Varieties poorly studied in Arkansas; common species; widespread in woodlands, roadsides. The varieties may have once been separate species with separate habitats and little intergrading until recent disturbance confused the issue (S. D. Jones, pers. comm.).

C. muskingumensis Schw.—(Fig. 7). Infrequent; floodplains. Orzell and Bridges (1987) report it in "open areas of a wet-mesic interstream flatwoods."

C. nigromarginata Schw.—(Fig. 7). including the poorly differentiated *C. floridana* Schw. Occasional; widespread in woodlands. This species presents a variety of overlapping growth and color forms, with occasional long rhizomes and pale to heavily purple splotched and dark green leaves. Morphology intergrades, making distinctions difficult.

***C. normalis** Mack.—(Fig. 7). Reported here new to Arkansas. Rare; seepy roadside ditch on acid sandstone, deep valley, deciduous woods, floodplain of the Little Red River of the Ozark region (*Hyatt, et. al. 5275*, MICH, UARK), streamside in Sharp County.

C. oklahomensis Mack.—(Fig. 7). Common; ditches, wetlands.

C. oligocarpa Schk.—(Fig. 8). Common; streambanks, north-facing slopes, deciduous woods.

C. ouachitana Kral, Manhart, & Bryson.—(Fig. 8). Occasional, locally widespread and abundant; "arenaceous oak-hickory-pine uplands" (Kral et al. 1987) and "rocky ridgetop and slope forest throughout much of the Ouachita Mountains" (Orzell and Bridges 1987). See also McNeilus (1992) and Naczi and Bryson (1990).

C. oxylepis Torr. & Hook. var. **oxylepis.**—(Fig. 8). Occasional; rich hardwoods in mountains, swamps and ditches elsewhere.

C. oxylepis Torr. & Hook. var. **pubescens** Underwood.—(Fig. 8). Occasional, locally common; seeps, moist bluffs, floodplains. Rarely reported outside Arkansas.

C. ozarkana Rothrock & Reznicek.—(Fig. 8). Occasional, locally frequent; Rothrock and Reznicek (1996) described this species from the Arkansas hills, Oklahoma Ouachitas, and one Texas location. The author found it at two locations within 30 miles of, and expects it in, extreme north Louisiana. Rothrock and Reznicek (ibid) call it "a species of early succession wetlands on mineral soil . . . . [from] banks of streams and . . . ditches, pond shores, and wet depressions in meadows and pastures."

C. pellita Willd.—(Fig. 8). *Carex lanuginosa* Michx. Rare (*McNalty 321* STAR).

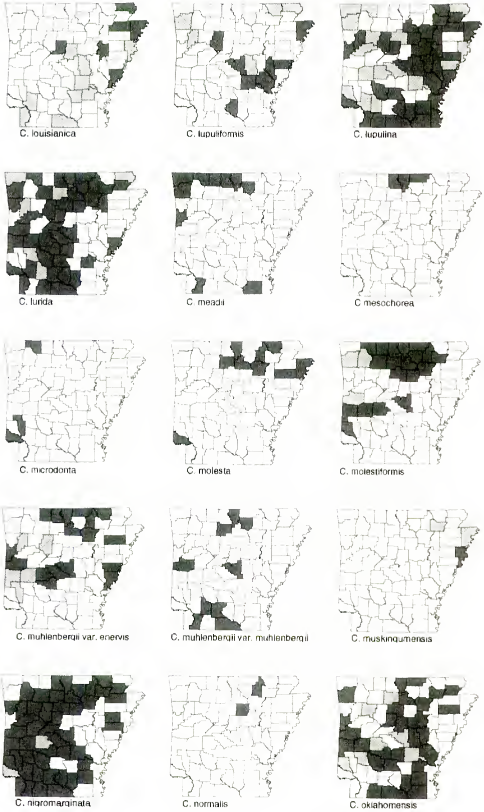
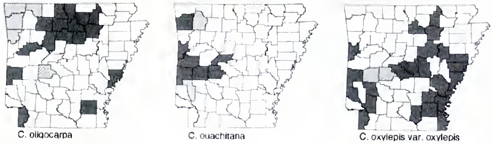
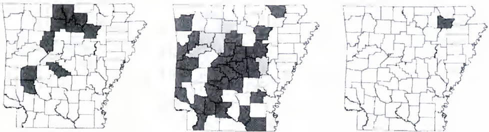


FIG. 7. Documented county records in Arkansas for *Carex* species (**solid** = counties where the author confirmed the identification, and **cross-hatched** = when reported elsewhere without the author's confirmation).

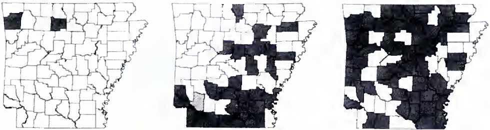


C. oligocarpa C. ouachitana C. oxylepis var. oxylepis



C. oxylepis var. pubescens C. ozarkana C. pellita

C. pensylvanica C. planostachys C. prasina



C. radiata C. reniformis C. retroflexa

C. rosea C. scoparia C. seorsa

FIG. 8. Documented county records in Arkansas for *Carex* species (**solid** = counties where the author confirmed the identification, and **cross-hatched** = when reported elsewhere without the author's confirmation).

C. pensylvanica Lam.—(Fig. 8). Occasional; benches on north facing slopes in White Oak woods, habitat poorly reviewed.

C. planostachys Kunze.—(Fig. 8). Rare, locally abundant; chalk glade outcrop complex. Northeastern extent of range barely extending into southwest Arkansas in a unique habitat with *Juniperus virginiana* on exposed white chalk outcrop (*Davis* and *Rettig 2840* APCR earliest collection found, April 1, 1981).

C. prasina Wahl.—(Fig. 8). Rare; a single collection (*Demaree 5050* UARK) from May 12, 1928 along War Eagle Creek in northwest Arkansas. "Rare in Mississippi and Missouri" states A.A. Reznicek (pers. comm.) suggesting "Crowley's Ridge is a likely bet, along a woodland seep with *Liriodendron*."

***C. radiata** (Wahl.) Small—(Fig. 8). *Carex rosea* sensu Mack. Reported here as new to Arkansas, rare. *Hyatt 5678* MICH, UARK, peh from the Buffalo National River at T16N,R15W,S4, in moist calcareous woods near Arkansas Highway 14.

C. reniformis (L.H. Bailey) Small.—(Fig. 8). Occasional; floodplains of larger streams, lakeshores.

C. retroflexa Willd.—(Fig. 8). Common; widespread.

C. rosea Schkuhr.—(Fig. 8). *Carex convulata* sensu Mack. See Webber and Ball (1984) for taxonomy and synonymy of *C. radiata*, *C. rosea*, and *C. socialis*; common mountains, infrequent elsewhere; valleys and riparian areas.

***C. scoparia** Schk. ex Willd.—(Fig. 8). Rare; wet, disturbed meadow dominated by *Juncus*, *Carex*, and diverse weedy grasses where it forms frequent large clumps (*Reznicek 9789* MICH). Numerous authors included it Arkansas' flora (Smith 1988).

***C. seorsa** Howe.—(Fig. 8). Rare; "low woods". Historic record only, no reports in this century. A.A. Reznicek (pers. comm. 1995) located a specimen collected by Hasse in 1885 at MICH.

C. shortiana Dew.—(Fig. 9). Infrequent; calcareous sunny wetlands and springs.

C. socialis Mohlenbrock and Schwegmann.—(Fig. 9). Occasional; floodplains of larger rivers in several areas, associated with *C. hyalina* and *C. corrugata*. Some authors have treated this as a synonym of *C. rosea*; habitat and morphology make it distinct (Webber & Ball 1984).

C. sparganioides Muhl..—(Fig. 9). Infrequent, typically local in small colonies of fewer than 20 plants, sometimes 3-4, rarely near 100, with colonies widespread but well scattered; calcareous valleys and floodplains.

C. squarrosa L.—(Fig. 9). Occasional, usually scattered individuals; ditches, floodplain woods.

C. striatula Michx.—(Fig. 9). Locally common; rich wooded slopes on sandy soils. See Naczi and Bryson (1990).

C. stricta Lam.—(Fig. 9). Infrequent; creek gravelbeds.

C. suberecta (Olney) Britt.—(Fig. 9). Infrequent; calciphile at springs, mossy fens, seeps.

C. swanii (Fern.) Mack.—(Fig. 9). Infrequent; sinks, deep valleys, floodplains.

C. texensis L.H. Bailey.—(Fig. 9). Occasional; mountain valleys.

C. torta Boott.—(Fig. 9). Occasional; mountain gravel streams, forming clumps between rocks.

C. triangularis Boeck.—(Fig. 9). Common; ditches.

C. tribuloides Wahl.—(Fig. 9). Common; widespread. See also Reznicek (1993).

C. typhina Michx.—(Fig. 9). Occasional; oak savannah wetlands, ditches, creek terraces, and other wetlands.

C. umbellata Schkuhr.—(Fig. 9). including Arkansas reports of *C. abdita*. Considered Arkansas' most frequent and widespread sedge (third most widely reported), easily overlooked, upland forests, roadsides. In 1992, ranked S1 (6 or fewer known locations in state) by the

Arkansas Natural Heritage Commission; 1996 collections added 28 counties. Now rivaling the frequently collected *C. frankii* and *C. vulpinoidea*. Recommended as the state *Carex* sedge of Arkansas. Fruits often infested by smut. Early blooming species with fruits often harvested by ants; may be an important spring food for ants.

C. virescens Muhl. ex Willd.—(Fig. 9). Two records: historic *Harvey s.n.* UARK, "low woods", July 1884, county unknown; *Rettig 554* UARK, 20MAY1982, Mont. Co., "Red Oak, Sweet Gum overstory."

C. vulpinoidea Michx.—(Fig. 10). Abundant; ruderal and widespread, a wetland species. The second most widely reported Arkansas *Carex* sedge.

C. willdenowii Willd. var. **willdenowii**.—(Fig. 10). Rare; known only from a single location (Iron Springs Recreation Area, Ouachita National Forest) west of the Mississippi River (A.A. Reznicek, pers. comm.). See Orzell and Bridges (1987) and Naczi and Bryson (1990). All other Arkansas "*C. willdenowii*" specimens reviewed should be considered *C. basiantha*.

HYBRIDS

C. albicans var. **albicans** × **C. nigromarginata** punitive hybrid—Determined by A.A. Reznicek (*Hyatt 6907*, MICH); from Woodruff County.

C. flaccosperma × **C. glaucodea** punitive hybrid—Determined by A.A. Reznicek (*Hyatt 6488*, MICH); from Saline County.

C. flaccosperma × **C. granularis** punitive hybrid—Determined by A.A. Reznicek (*Reznicek 9291*, MICH); from Saline County.

C. lurida × **C. lupulina** punitive hybrid—Determined by A.A. Reznicek (*Hyatt 5720*, MICH, UARK); from Lonoke County.

POSSIBLE ADDITIONS

The following taxa, listed as "possible additions" by Smith (1988) have since been confirmed in Arkansas by collections: *C. davisii*, *C. gracilescens*, *C. hyalina* (pre-1988 collections of *C. hyalina* were not represented at UARK), and *C. suberecta*. Possible additions to the flora of Arkansas follow.

C. annectens Bickn. var. **xanthocarpa** (Bicknell) Wiegand.—*Hyatt 4343* (MICH, UARK) was misidentified as this taxon initially. This variety could occur in north Arkansas.

C. buxbaumi Wahl.—Reported for Arkansas by Demaree (1943). Tucker (1987) notes it "reaches its southern limit in . . . Arkansas". Smith (1988) only refers to Tucker (1987) and lists it as a possible addition to the flora of Arkansas (1994). No vouchers found.

C. incomptera Bickn.—Reported for Arkansas by Demaree (1943). No vouchers found.

C. picta Steud.—Possibly rare in southern Arkansas.

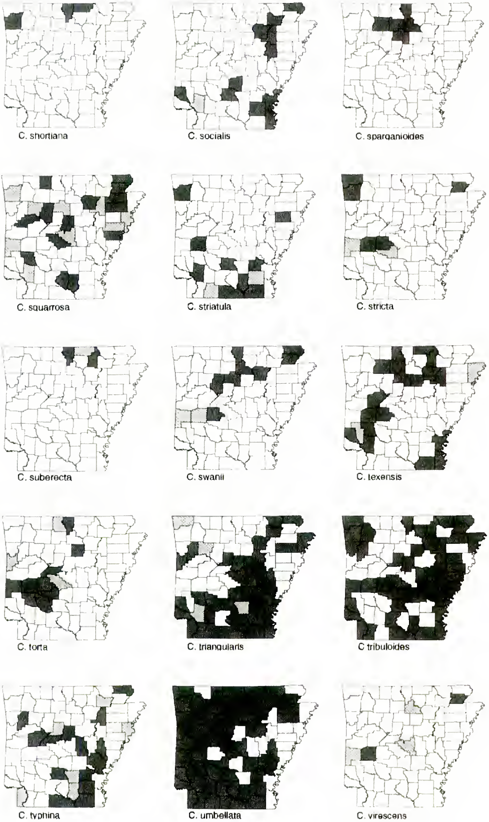
C. styloflexa Buckl.—Possibly in "southeast Arkansas in boggy or wet places in hardwoods at the bases of slopes of bluffs" (Reznicek, pers. comm.).

C. tenera Dew.—Possibly rare in northern Arkansas. Unpublished reports by the author based on an immature specimen of *C. normalis*.

C. verrucosa Muhl.—"Listed for Arkansas by Demaree (1943); perhaps rare in south Arkansas" (Smith 1988).

EXCLUDED TAXA

Smith (1988) excluded the following taxa from the flora of Arkansas; I concur; *C. baileyi*, *C. douglasii*, *C. exilis*, *C. flava*, *C. gynandra*, *C. haydenii*,



C. shortiana

C. socialis

C. sparganioides

C. squarrosa

C. striatula

C. stricta

C. suberecta

C. swanii

C. texensis

C. torta

C. triangularis

C tribuloides

C. typhina

C. umbellata

C. virescens

FIG. 9. Documented county records in Arkansas for *Carex* species (**solid** = counties where the author confirmed the identification, and **cross-hatched** = when reported elsewhere without the author's confirmation).

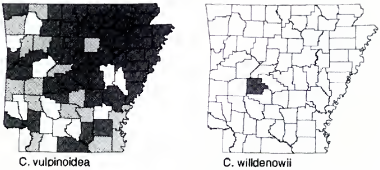


Fig. 10. Documented county records in Arkansas for *Carex* species (**solid** = counties where the author confirmed the identification, and cross-**hatched** = when reported elsewhere without the author's confirmation).

C. lacustris, C. muricata, C. plantaginea, C. platyphylla, C. sartwellii, C. sprengelii, C. tetanica. Two additional taxa, excluded by Smith (ibid), are now known to occur in Arkansas. Additional excluded taxa follow.

C. **backii** Boott.—Reported for Arkansas by Lipscomb (1980) based on immature specimens of *C. latebracteata.* A.A. Reznicek (pers. comm.) has seen the voucher.

C. **straminea** Willd.—Anthony A. Reznicek (pers. comm. 1996) noted the one Missouri location for this is a considerable disjunct, and Oklahoma reports of *C. straminea* are based on the recently named *C. ozarkana.*

C. **tetanica** Schk.—Anthony A. Reznicek (pers. comm. 1993) notes "not in Arkansas, possibly not in Missouri even."

ACKNOWLEDGMENTS

Many thanks to A.A. Reznicek (MICH) for his abundant help in nearly all facets of the work required to produce this article, E.B. Smith (UARK) for his continuous encouragement and assistance, and to the various state and federal agencies who provided permission to collect on their lands, including especially the U.S.D.A. Forest Service, Buffalo National River, and the Arkansas State Parks.

REFERENCES

Bryson, C. T., R. F. C. Naczi, and S. McDaniel. 1992. Notes on noteworthy records of *Carex* (Cyperaceae) from the southeastern United States. Sida 15:125–135.

Demaree, D. 1943. A catalogue of the vascular plants of Arkansas. Taxodium 1:1–88.

Hermann, F.J. 1972. A new variety of *Carex bicknellii* from Arkansas. Sida 5:49.

Hyatt, P.E. 1993. A survey of the vascular flora of Baxter County, Arkansas. Castanea 58:115–140.

Hyatt, P.E. 1994. Significant collections: Arkansas. Castanea 59:78–79.

Jones, S.D. and S.L. Hatch. 1990. Synopsis of *Carex* Section *Lupulinae* (Cyperaceae) in Texas. Sida 14:87–99.

Jones, S.D., G.D. Jones, and J.K. Wipff. 1990. *Carex fissa* section *Multiflorae* (Cyperaceae): new to Texas. Phytologia 68:47–50.

Jones, S.D. and A.A. Reznicek. 1991. *Carex bicknellii,* "Bicknell's Sedge" (Cyperaceae): new to Texas, with a key to Texas species of section *Ovales.* Phytologia 70:115–118.

JONES, S.D. and A.A. REZNICEK. 1995. *Carex conjuncta* (Cyperaceae) verified for Arkansas, and notes on the range of *Carex oklahomensis*. Sida 16:772–774.

KEYS, JR., J., C. CARPENTER, S. HOOKS, S. KOENIG, F. MCNAB, W.H. RUSSELL, W.E. SMITH, M-L. 1995. Ecological units of the eastern United States – first approximation (map and booklet of map unit tables). Atlanta, GA: U.S.D.A. Dept. Agric. Forest Ser. Tech. Publ. R8-TP 21.

KRAL, R., J. MANHART, and C.T. BRYSON. 1987. A new *Carex* sect. *Oligocarpae* (Cyperaceae) from western Arkansas and eastern Oklahoma. Ann. Missouri Bot. Gard. 74:440–442.

LIPSCOMB, B.L. 1980. Additions to the Cyperaceae of Arkansas. Castanea 45:70.

MCNEILUS, V.B. 1992. *Carex ouachitana* (Cyperaceae) new to Tennessee. Sida 15:154.

NACZI, R.F.C. and C.T. BRYSON. 1990. Noteworthy records of *Carex* (Cyperaceae) from the southeastern United States. Bartonia 56:49–58.

NACZI, R.F.S., A.A. REZNICEK, and B.A. FORD. 1998 Morphological, geographical, and ecologcal differentiation in *Carex willdenowii* complex (Cyperaceae). Amer. J. Bot. 85:34–447

ORZELL, S.L. and E.L. BRIDGES. 1987. Further additions and noteworthy collections in the flora of Arkansas, with historical, ecological, and phytogeographical notes. Phytologia 64: 81–144.

RETTIG, J.H. 1982. Seven significant vascular plant records from Arkansas. Proc. Ark. Acad. Sci. 36:98.

REZNICEK, A.A. 1990. Evolution in sedges (*Carex*, Cyperaceae). Canad. J. Bot. 68:1409–1432.

REZNICEK, A.A. 1993. Revision of *Carex* section *Ovales* (Cyperaceae) in Mexico. Contr. Univ. Michigan Herb. 19:97–136.

REZNICEK, A.A. and P.W. Ball. 1974. The taxonomy of *Carex* series *Lupulinae* in Canada. Canad. J. Bot. 52:2387–2399.

REZNICEK, A.A. and P.W. BALL. 1980. The taxonomy of *Carex* section *Stellulatae* in North America north of Mexico. Contr. Univ. Michigan Herb. 14:153–203.

REZNICEK, A.A. and P.E. HYATT. 1996. Conservation assessment for *Carex hyalina*. Document produced for the U. S. D. A. Forest Service, Kisatchie National Forest, Pineville, Louisiana.

REZNICEK, A.A. and R.F.C. NACZI. 1993. Taxonomic status, ecology, and distribution of *Carex hyalina* (Cyperaceae). Contr. Univ. Michigan Herb. 19:141–147.

REZNICEK, A.A. and P.E. ROTHROCK. 1997. *Carex molestiformis* (Cyperaceae), a new species of section *Ovales* from the Ozark Mountain Region. Contr. Univ. Michigan Herb. 21:299–308.

ROTHROCK, P.E. 1991. The identity of *Carex albolutescens*, *C. festucacea*, and *C. longii* (Cyperaceae). Rhodora 93:51–66.

ROTHROCK, P.E. and A.A. REZNICEK. 1996. A new species of *Carex* section *Ovales* (Cyperaceae) occurring in the Ozark Mountain region. Brittonia 48:104–110

SMITH, E.B. 1988. An atlas and annotated list of the vascular flora of Arkansas. Published by the author. Fayetteville, Arkansas (out of print).

SMITH, E.B. 1994. Keys to the flora of Arkansas. University of Arkansas Press. Fayetteville, Arkansas.

THOMAS, R.D., E.B. SMITH, E. SUNDELL, P.E. Hyatt, and C. AMASON. 1991. Additions to the flora of Arkansas. Sida 14:483–491.

TUCKER, G.C. 1987. The genera of Cyperaceae of the southeastern United States. J. Arnold. Arbor. 68:361–445.

WEBBER, J.M. and P.W. BALL. 1984. The taxonomy of the *Carex rosea* group (Section *Phaestoglochin*) in Canada. Canad. J. Bot. 62:2058–2073.

AGALINIS (SCROPHULARIACEAE) IN THE OZARK HIGHLANDS

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ABSTRACT

The ten species of *Agalinis* known to occur in the Ozark Highlands are treated floristically. A key to the species is presented along with descriptions, flowering time, ecological data, and distribution maps. In addition, taxa considered rare are noted and their current statuses indicated.

RESUMEN

Se trataron las diez especies de *Agalinis* conocidas de los "Ozark Highlands." Se presenta una clave de las especies, con descripciones, datos fenológicos y ecológicos, y mapas de distribución. Además, se anota el estado actual de las especies raras.

INTRODUCTION

Agalinis is a New World genus of about 60 species (Canne-Hilliker 1988). Thirty-three species of *Agalinis* occur in North America (Canne-Hilliker & Dubrule 1993; Canne-Hilliker & Kampny 1991). The genus is most diversified from southeastern Texas eastward to the Florida panhandle (Canne-Hilliker & Dubrule 1993; Clewell 1985; Correll & Johnston 1970; McRoberts 1989; Vincent 1982; Wilhelm 1984). Eleven species of *Agalinis* (sensu Canne-Hilliker & Kampny 1991) occur in the Midwest (Deam 1940; Holmgren 1986; Mohlenbrock 1986; Smith 1988; Steyermark 1963; Swink & Wilhelm 1994; Voss 1996; Williams 1973), ten of which occur in the Ozark Highlands. Taxonomically, North American species of *Agalinis* are relatively well known, although the need still exists for a modern, monographic treatment of the genus. Pennell's work on the group (1929, 1935), while comprehensive and still useful, is also outdated, as recent scholarship has suggested. Studies by Canne-Hilliker and associates on the cytology, micromorphology, comparative anatomy, and seedling morphology of most species of North American *Agalinis* (Canne 1979, 1981, 1983, 1984; Canne-Hilliker 1987; Canne-Hilliker & Kampny 1991; Stewart & Canne-Hilliker 1998) have resulted in a revision of Pennell's ideas concerning the delimitations of species and the classification of and within the genus.

These revisions, along with nearly 90 years of collecting since Pennell first undertook his study of the genus, necessitate the presentation of new

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data concerning the taxonomic status and distribution of *Agalinis* throughout North America. The purpose of my paper is to present an up-to-date account of the distribution, taxonomy, nomenclature, and rarity of *Agalinis* in the Ozark Highlands as well as to provide an unambiguous key for the identification of these species. Approximately 3,000 herbarium specimens from 24 herbaria were examined (listed in acknowledgments), and I made over 200 collections of *Agalinis* during the course of this study. Each dot on a distribution map represents one or more verified voucher specimens. Vouchers I collected were deposited at MO or remain in my possession.

STUDY AREA

The Ozark Highlands, often referred to as the Ozark Plateau(s), Ozark Province, the Ozark Highland (Cozzens 1940; Fenneman 1938; Sauer 1920; Thom and Wilson 1980), or locally as simply the "Ozarks," is a distinct geological area classified as the Ozark Plateaus geomorphic province (Thornbury 1965), an area of over 134,000 square kilometers. Within this geomorphic province fall two distinct ecological sections, the Ozark Highlands Section, and the Boston Mountains Section (McNab and Evers 1994). The Ozark Highlands Section comprises over 85 percent of the area, and dolomites and limestones predominate, forming one of the most extensive karst regions in the country (Nigh et al. 1992). Such extensive karst features as caves, springs, seeps, and sinkholes are common. In the Boston Mountains Section to the southwest, on the other hand, sandstones and shales predominate, and the sandstone exposures that dominate the landscape in this section stand in contrast to the more carbonate landscape of the Ozark Highlands Section.

The Ozark Highlands Section is characterized by gently rolling to heavily dissected hills, whereas the Boston Mountains Section is characterized by low mountains, open hills, and hilly plains. The varied topography, as well as the distinct bedrock and soil types displayed throughout the Ozark Highlands, has produced a unique assemblage of terrestrial and aquatic communities, and the Ozark Highlands is considered a center of endemism (Nigh et al. 1992). Broadleaf deciduous forest (mostly oak-hickory) comprises the dominant vegetation type in the Ozark Highlands, but pine forests, prairies, glades, fens, marshes, and large rivers are also present in the area and add to its biological diversity.

The climate of the Ozark Highlands is continental, with precipitation averaging 122 to 132 centimeters annually, and the annual temperature averaging 13 to 18 degrees Celsius (McNab and Evers 1994). Elevation ranges from a low of 91 meters in Missouri to 914 meters in the Boston Mountains of Arkansas (Keys et al. 1995). Portions of Arkansas, Illinois, Kansas, Missouri, and Oklahoma fall within the boundaries of the Ozark Highlands, but the overwhelming majority of this geomorphic province is found in Missouri and Arkansas.

TAXONOMIC TREATMENT

Agalinis Raf. (nom. conserv.), New Fl. N. Amer. 2:61. 1837. *Gerardia* L., Sp. Pl. 610. 1753.

Ours annual, hemi-parasitic herbs with erect stems; leaves opposite or subopposite, linear to lanceolate or lance-ovate, sessile, entire, or (in two species) the leaves sometimes 3-cleft, laciniate, or with lateral lobes; inflorescences terminating most branches, a raceme or spike, sometimes racemiform; calyx gamosepalous, campanulate to hemispherical, 5-lobed, the lobes sometimes reduced to minute teeth; corolla gamopetalous, zygomorphic, 5-lobed, the two upper lobes reflexed-spreading or projecting forward, the three lower lobes spreading, usually pale pink to light purple, rarely white, the throat often dotted purple and with two yellow, longitudinal lines; stamens 4, didynamous; fruit a loculicidal capsule, globose, subglobose, ovoid, obovoid, or ellipsoid; seeds small, angular, the testa conspicuously reticulate, yellowish to black.

North American species are taxonomically difficult at the macromorphological level, and there is a relatively high percentage of misidentifications, especially in herbaria where specimens have not been examined critically. This frequent misidentification is a source of concern, considering the fact that 25 of the 33 North American species of *Agalinis* are tracked by state natural heritage programs as sensitive or rare species (Unpublished data, State Natural Heritage Programs, 1996 and 1997). The status of each species of *Agalinis* considered rare is indicated following its description. Status is based on the system of ranking rare taxa developed by the Nature Conservancy (LaRoe 1995). The Nature Conservancy's current method of ranking is summarized as follows (G=global and S=state): G1 and S1 (1–5 occurrences - critically imperiled), G2 and S2 (6–20 occurrences - imperiled), G3 and S3 (21–100 occurrences - rare), G4 and S4 (more than 101 occurrences - apparently secure), G5 and S5 (demonstratively secure), GH and SH (of historical occurrence only), GU and SU (possibly rare, but not enough documentation exists to propose a ranking), and GX and SX (apparently extinct or extirpated).

The synonymy listed under each species correlates with the nomenclature of other manuals a worker may use to identify *Agalinis* in the Ozark Highlands: Britton & Brown (1913), Fernald (1950), Gleason (1952), Gleason & Cronquist (1991), Holmgren (1986), Mohlenbrock (1986), and Steyermark (1963). Nomenclature follows Canne-Hilliker and Kampny (1991).

KEY TO SPECIES

Living plants of *Agalinis* appear quite different from their pressed and dried counterparts. It is helpful, therefore, to familiarize oneself with both fresh and dried material when working with this group. When identifying fresh or dried specimens, it is often necessary to examine specimens at 10X or greater magnification, and preferably with a dissecting microscope; sketching the corolla in the field while fresh to show the orientation of the lobes and the shape of the tube can also be helpful due to the membranous nature of the corollas, which can be easily distorted once pressed. The measurements used in the key and descriptions that follow are based on well-developed flowering and fruiting specimens, both fresh and dried. One must keep in mind that species in this genus demonstrate considerable plasticity, and that immature, depauperate, or diseased plants can make this inherent variation even more difficult to interpret; to the collector of such specimens: beware. There is also a genuine need for a thorough and detailed illustration of each species of *Agalinis*, which would greatly facilitate proper identification.

KEY TO THE SPECIES OF *AGALINIS* IN THE OZARK HIGHLANDS

1. Leaves lanceolate to lance-ovate, 5–25 mm wide, the upper leaves with two basal, lateral lobes; stem and calyx tube with retrorse-spreading hairs; calyx 10–16 mm long .... **2. A. auriculata**

1. Leaves linear to lanceolate, 0.5–6(–7) mm broad, the upper leaves without basal, lateral lobes; stem and calyx tube glabrous or occasionally somewhat scabrous; calyx 3.5–8(–9) mm long.
   2. Longest pedicels 6 mm or less long, shorter to slightly longer than the calyx.
      3. Pedicels 1–3 mm long; calyx lobes 3–6 mm long, clearly longer than the calyx tube, the midveins of the lobes prominently ribbed; leaves lanceolate to linear-lanceolate, lower leaves sometimes 3-cleft or laciniate .... **5. A. heterophylla**
      3. Pedicels 2–6 mm long; calyx lobes 0.5–2(–2.5) mm long, shorter than the calyx tube, the midveins of the lobes without prominent keels; leaves linear to narrowly lanceolate, the lower leaves never 3-cleft or laciniate.
         4. Calyx 5–9 mm long, long-campanulate; anthers 1.9–2.5 mm long; capsule 7–12 mm long, ellipsoid to oblong, longer than broad; leaves narrowly linear, 0.5–1.5 mm wide, erect and ascending, harshly scabrous above, the hairs heavily silicified, appearing marbled; fascicled leaves also ascending .... **1. A. aspera**
         4. Calyx 3–5 mm long, hemispheric to short-campanulate; anthers 2.3–3.5 mm long; capsule 4–6 mm long, globose to subglobose, as broad or nearly as broad as long; leaves linear to linear-lanceolate, 1–4(–5) mm wide, spreading, arching, or curling, scabrous above, but not harshly so, or the hairs neither heavily silicified nor appearing marbled; fascicled leaves spreading, arching, or curling.

5. Middle 2/3 of main stem and largest branches noticeably to harshly scabrous; branches mostly ascending; axillary fascicles usually well-developed; 5 principal veins of the calyx (those leading to the lobes) as well as the lobes, scabrous ....3. **A. fasciculata**

5. Middle 2/3 of main stem and largest branches glabrous to sparingly scabrous, but not harshly scabrous; branches spreading to ascending, axillary fascicles weakly to well-developed; 5 principal veins of the calyx as well as the lobes usually glabrous, or occasionally the veins of a few capsules scabrous.

6. Middle 2/3 of main stem and largest branches scabrous, the pubescence obvious, but scattered on both the stem faces and angles (avoid areas immediately around the nodes); branches mostly ascending; axillary fascicles usually well-developed, but sometimes only weakly so, the fascicled leaves often approaching or equaling the subtending leaves in length ....3. **A. fasciculata**

6. Middle 2/3 of main stem and largest branches glabrous to subglabrous, the pubescence, when present, conspicuous on the angles (avoid areas immediately around the nodes); branches mostly spreading, but sometimes ascending, axillary fascicles absent or only weakly developed, the fascicled leaves, when present, noticeably shorter than the subtending leaves. ....7. **A. purpurea**

2. Longest pedicels 6–30 mm long, slightly to much longer than the calyx.

7. Calyx 5–9 mm long, long-campanulate; capsule 7–12 mm long, ellipsoid to oblong, longer than broad; pedicels erect-ascending to arched-ascending; leaves stiffly ascending, harshly scabrous above, the hairs heavily silicified, appearing marbled ....1. **A. aspera**

7. Calyx 3–5.5 mm long, hemispheric to campanulate; capsule 3.5–6 (–7) mm long, globose or obovoid, as broad as long; pedicels spreading to ascending; leaves spreading to ascending, subglabrous to scabrous, but if scabrous, the hairs neither heavily silicified nor appearing marbled.

8. Upper two lobes of the corolla arching or projecting forward over the stamens; corolla glabrous within across the base of the two upper lobes; many pedicels abruptly upcurved distally; axillary fascicles often present.

9. Stem scabrous; leaves narrowly linear, 0.8–1.5 mm wide; the two upper lobes of the corolla projecting forward over the stamens, half the length of the three lower lobes, 2–3 mm long; pedicels scabrous at least basally; anthers 3–4 mm long, the two upper filaments densely villous basally and distally; seeds 0.8–1.6 mm long, the testa cells large in proportion to the total size of the seed ....6. **A. homalantha**

9. Stem glabrous or with a few scattered hairs on the angles; leaves linear to narrowly lanceolate, 1–5(–6) mm wide; the two upper lobes of the corolla arched over the stamens, subequal to the three lower lobes, 4–5 mm long; pedicels glabrous; anthers 1–2.3 mm long, the upper filaments sparingly hairy throughout, but not densely villous basally and distally; seeds 0.7–1 mm long, the testa cells small in proportion to the total size of the seed .... 9. **A. tenuifolia**

8. Upper two lobes of the corolla reflexed-spreading; corolla pubescent within across the base of the two upper lobes; pedicels not abruptly upcurved distally (occasionally a few pedicels of A. gattingeri are upcurved distally); fascicles absent.
  10. Outside of the three lower corolla lobes pubescent; leaves spreading, arching, or curling; numerous floriferous, lateral branches present, the flowers appearing solitary at the nodes, a terminal raceme rarely developed, the inflorescence more racemiform; stem subterete to 4-angled .... **4. A. gattingeri**
  10. Outside of the three lower corolla lobes glabrous; leaves mostly erect and ascending; few to many branches bearing obvious terminal racemes present; stem noticeably 4-angled and appearing winged.
    11. Stem scabrous on the angles; few to many strongly ascending branches present; calyx hemispherical, the longest lobes 0.7–1.2 mm long; fruit globose .... **8. A. skinneriana**
    11. Stem glabrous on the angles; a few to many widely spreading branches present; calyx campanulate, the longest lobes 1.5–2.2 mm long; fruit obovoid .... **10. A. viridis**

1. Agalinis aspera (Douglas ex Benth.) Britton. *Gerardia aspera* Douglas ex Benth.

Stem 2–7 dm, subglabrous to sparingly scabrous, the branches ascending. *Leaves* narrowly linear, stiffly ascending, 0.5–1.5 mm wide, 1.5–4 cm long, harshly scabrous above, presenting a marbled appearance, and frequently scabrous on the midveins below. *Fascicles* well-developed and also ascending. *Inflorescences* short to elongate racemes. *Pedicels* erect to arched-ascending, stout, 5–11 mm long, to 16 mm in fruit. *Calyx* campanulate, 5–9 mm long, the lobes 1.0–2.5 mm long. *Corolla* deep pink, 16–25(–28) mm long, the throat glabrous within or with a few scattered hairs across the base of the two reflexed-spreading, upper lobes. *Anthers* 1.9–2.5 mm long. *Capsule* ellipsoid to oblong, clearly longer than broad, 7–12 mm long. *Seeds* black, 0.9–1.1 mm long. $n=14$ (Löve & Löve 1982). Note: voucher not seen. *Flowering* late August–early October.

Distribution.—Dry prairies, open woodlands, glades, and bluffs. Very rare in the Ozark Highlands (Fig. 1).

Ecology and conservation status.—G5; S2 in Arkansas. Although this species has been reported from Arkansas (Smith 1988), I have not found any vouchers specimens; all specimens labeled *A. aspera* from Arkansas have proved to be another species. *Agalinis aspera* is largely a species of the eastern Great Plains, and populations found eastward of this area are mostly peripheral and of scattered occurrence, usually being restricted to xeric habitats, such as bluffs, glades, and loess hills.

2. Agalinis auriculata (Michx.) S.F. Blake. *Gerardia auriculata* Michx., *Otophylla auriculata* (Michx.) Small, *Tomanthera auriculata* (Michx.) Raf.

Stem 2–7(–8) dm, retrorsely scabrous, simple to sparingly branched above. *Leaves* lanceolate to lance-ovate, the upper with two basal, lateral lobes, 2.3–6 cm long, 0.5–2(–2.5) cm wide, scabrous above and below, lateral veins visible on both surfaces. *Inflorescences* spikes. *Flowers* essentially sessile, occurring in pairs in the upper leaf axils. *Calyx* campanulate, 10–16 mm long, the tube spreading-pubescent, the lobes 6–12 mm long, scabrous, longer than the tube. *Corolla* pink, 20–27(–29) mm long, the throat pubescent within across the base of the two reflexed-spreading, upper lobes. *Anthers* 1.9–2.4 mm long. *Capsule* ovoid, 9–14 mm long. *Seeds* yellowish, 1.2–1.6 mm long. *n*=13 (Kondo 1973). *Flowering* late August–September.

Distribution.—Dry or mesic prairies, fallow fields, borders of dry woods, and roadsides. Very rare in the Ozark Highlands (Fig. 2).

Ecology and conservation status.—G3; S1 in Arkansas, S2 in Illinois, S2 in Kansas, S2 in Missouri, and S1 in Oklahoma. Although a rare species throughout its range, *Agalinis auriculata* apparently can tolerate considerable disturbance, as evidenced by its ability to persist in degraded prairies, fallow fields, grazed meadows, and roadsides. Despite this apparent ablility to tolerate continued human disturbance, the Jasper, Newton, Ozark, and St. Louis County, Missouri, sites, as well as the St. Clair County, Illinois, site, are based on historic collections or the populations are thought to be extirpated. Fortunately, however, there are a number of recent collections from the northern half of Missouri.

3. **Agalinis fasciculata** (Elliott) Raf. *Gerardia fasciculata* Elliott. *Gerardia fasciculata* Elliott f. *fasciculata*.

Gerardia fasciculata Elliott f. *albiflora* Palmer.

Stem 2.5–12 dm, scabridulous to harshly scabrous, much branched on larger plants, the branches ascending or spreading. *Leaves* linear to narrowly lanceolate, 1–4 cm long, 1–2(–4) mm wide, spreading, arching, or curling, scabrous above and often on the midveins below. *Fascicles* present and well-developed or sometimes only weakly so, the fascicled leaves shorter than to nearly approaching the main leaves, also spreading, arching, or curling. *Inflorescences* short to elongate racemes. *Pedicels* 2–6 mm long. *Calyx* campanulate to hemispherical, 3–5(–6) mm long, the lobes 0.5–1.5(–2) mm long, the five principal veins of the calyx (leading to the calyx lobes) scabrous; corolla pink to light purple, rarely white, 15–30 mm long, the throat noticeably pubescent within across the base of the two reflexed-spreading, upper lobes. *Anthers* 2.3–3.5 mm long. *Capsule* subglobose, 4.5–6(–7) mm long. *Seeds* 0.6–1 mm long, dark brown to black. *n*=14 (Canne 1981). *Flowering* from late August–late September.

Distribution.—Dry to moist prairies, borders of woods and ponds, open ground, fallow fields, and roadsides. Scattered in the Ozark Highlands (Fig.

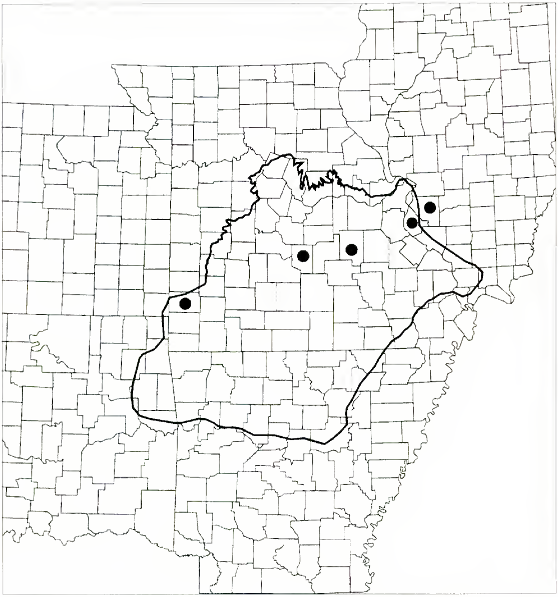

FIG. 1. Presently confirmed county records in the Ozark Highlands for *Agalinis aspera*.

3), occurring most frequently in the west and southwest portions of our area, where it nears the northern and northwesternmost limit of its range.

Ecology and conservation status.—G5; S2 in Kansas. In our area, *A. fasciculata* is most easily confused with the closely related and widespread *A. purpurea* (L.) Pennell. Less scabrous specimens of *A. fasciculata* with weakly developed fascicles are especially troublesome and difficult to separate from the more fascicled and scabrous specimens of *A. purpurea* (fortunately few specimens pose such problems). It is not the amount of stem pubescence on the less scabrous specimens of *A. fasciculata* that best distinguishes it from the more scabrous specimens of *A. purpurea*, but rather the size of the hairs, which tend to be larger and broader-based, and in the distribution of the pubescence, which is usually scattered, but present throughout the stem faces as well as on the angles of the main stem in *A. fasciculata*.

Agalinis purpurea, on the other hand, has smooth stem faces and quite often smooth stem angles. On a noticeably pubescent plant of *A. purpurea*, the broad-based hairs occur mostly along the stem angles at regular intervals. It is important to rely on the middle two-thirds of the main stem and largest branches when making observations concerning stem pubescence, as the smaller branches on both species can be quite scabrous, especially distally. In addition, the nodes should be avoided when relying on pubescence in identification, because both species are usually quite scabrous around these areas.

4. **Agalinis gattingeri** (Small) Small ex Britton. *Gerardia gattingeri* Small. *Agalinis skinneriana* (sensu Holmgren 1986).

Stem 1–5 dm, subglabrous to slightly scabrous, with spreading to somewhat ascending branches. *Leaves* narrowly linear, 0.4–1.4 mm wide, 1.5–3(–4) cm long, spreading, arching, or curling, slightly scabrous above, and often on the midveins below. *Fascicles* absent. *Inflorescence* racemiform, a true raceme rarely developed, most flowers appearing solitary at the nodes on numerous short, floriferous, lateral branches. *Pedicels* slender, spreading-ascending, 4–25(–30) mm long. *Calyx* hemispherical, 3–5 mm long, the lobes 0.5–1.4 mm long. *Corolla* pink to light purple, 8–15 mm long, the throat noticeably pubescent across the base of the two reflexed-spreading, upper lobes, the outside of the three lower lobes pubescent. *Anthers* 1.3–2.0 mm long. *Capsule* subglobose, 4–5 mm long. *Seeds* 0.5–0.9 mm long, yellowish. n=13 (Canne 1984). *Flowering* late August–early October.

Distribution.—Dry, open woodlands, often in rocky soils of chert or sandstone, borders of dry forests, dry roadsides, glades, bluffs, and exposed ridges. Common throughout the Ozark Highlands (Fig. 4).

Ecology and conservation status.—None. Holmgren (1986) combined *A. gattingeri* with *A. skinneriana*, but the two species have been shown to be distinct based on macromorphological and anatomical evidence (Canne-Hilliker 1987; Canne-Hilliker and Kampny 1991). *Agalinis gattingeri* and *A. tenuifolia* are the two most common species in the Ozark Highlands and are the only two species that have established themselves throughout the region with any frequency. Our other species occur mostly on the periphery of the Highlands or are localized within the area in particular habitat types.

5. **Agalinis heterophylla** (Nutt.) Small ex Britton. *Gerardia heterophylla* Nutt.

Stem 3–8 dm, glabrous to very sparingly scabrous, usually much branched

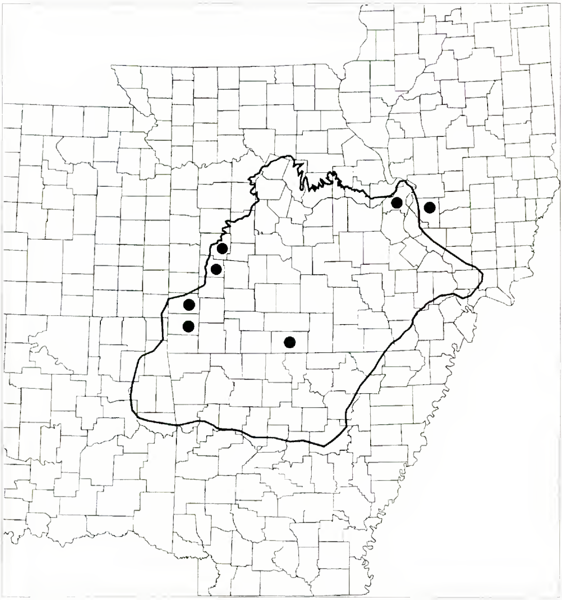

FIG. 2. Presently confirmed county records in the Ozark Highlands for *Agalinis auriculata*.

above. *Leaves* linear-lanceolate to lanceolate, 1.5–3.5 cm long, 1.8–6 mm broad, the lowermost sometimes 3-cleft or laciniate, but these usually not present at flowering time, scabrous above and occasionally on the midveins below, the undersurfaces of larger stem leaves with a few faint, but noticeable, lateral veins, (these veins usually not noticeable on dried specimens). *Fascicles* absent. *Inflorescences* short to elongate racemes. *Pedicels* stout, 1–3 mm long. *Calyx* campanulate, 5.5–10(–11) mm long, the lobes 3–6 mm long, clearly longer than the calyx tube, usually with a prominent midnerve and appearing ribbed. *Corolla* pink to light purple, 20–33 mm long, the throat glabrous across the base of the two reflexed-spreading, upper lobes.

Anthers 2.7–3.5 mm long. *Capsule* subglobose, 5–8(–9) mm long. *Seeds* dark brown to black, 0.7–1.1 mm long. *n*=14 (Canne 1981). *Flowering* late August–September.

Distribution.—Moist prairies, fallow fields, moist, open ground, and roadsides, usually in moist soils, but occasionally found in drier sites. Rare and localized in the Ozark Highlands (Fig. 5).

Ecology and conservation status.—G5; S2 in Kansas, S1 in Missouri. This is another species of *Agalinis* that nears the northwesternmost occurrence of its range in the Ozark Highlands; it is much more common in southern Arkansas, eastern Texas, Louisiana, and Oklahoma outside of the Ozarkian region of the state.

6. **Agalinis homalantha** Pennell. *Gerardia homalantha* (Pennell) Pennell.

Stem 3–10 dm, scabrous. *Leaves* narrowly linear, scabrous above and on the midveins below, 1.5–4.5 cm long, 0.8–1.5 mm wide. *Fascicles* well-developed. *Inflorescences* short racemes, with only 3–8(–10) flowers per raceme. *Pedicels* slender, spreading-ascending, often upcurved distally, 6–30 mm long, usually scabrous throughout, but at least basally. *Calyx* campanulate, 3–5(–6) mm long, the lobes 0.6–1.5 mm long. *Corolla* deep pink, 15–26 mm long, the throat glabrous across the base of the two flattened to slightly arched, forward projecting upper lobes, the upper two lobes 2–3 mm long and half the length of the three spreading lower lobes. *Anthers* 3–4 mm long, the upper filaments densely pubescent basally and distally. *Capsule* globose, 5–7 mm long. *Seeds* dark brown to nearly black, 0.8–1.6 mm long. *n*=13 (Vincent 1982). *Flowering* August–September.

Distribution.—Dry, sandy soils along roadsides, along the dry, sandy banks of the Arkansas River and the dry to xeric, sandy terrace communities just beyond the banks of the river. Very rare in the Ozark Highlands (Fig. 6), restricted to a few counties where the Ozark Highlands approach the Arkansas River Valley in Conway, Crawford, Franklin, and Pope counties in Arkansas, and Sequoyah County in Oklahoma. This is yet another species of *Agalinis* that reaches the limits of its range in the Ozark Highlands; in this case the species northernmost occurrence.

Ecology and conservation status.—G5; S1 in Arkansas, S1 in Oklahoma. This species was only recently found to occur in Arkansas, and most of the sites in the state are found outside of the Ozark Highlands along the Arkansas River. I believe based on my field work along the Arkansas River alone that enough sites will eventually be found to judge this species demonstratively secure in Arkansas. *Agalinis homalantha* has also been collected recently in Mississippi. While reviewing the holdings of *Agalinis* at the Missouri Botanical Garden in January 1997, I found a specimen originally determined as *A. tenuifolia* that is actually *A. homalanta*; this collec-

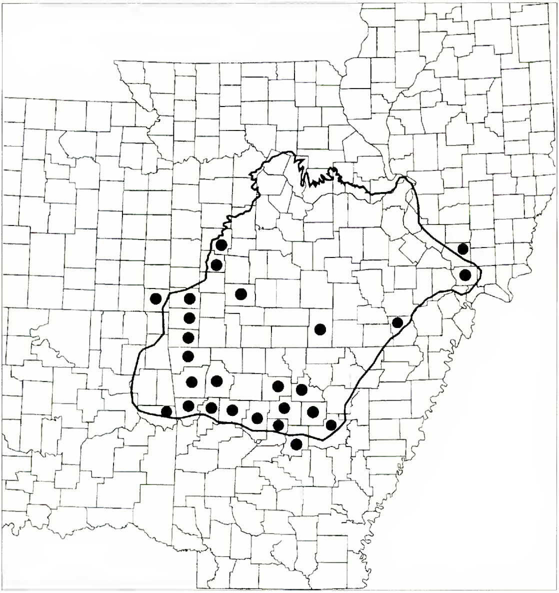

FIG. 3. Presently confirmed county records in the Ozark Highlands for *Agalinis fasciculata*.

tion represents the first known occurrence for this species in Mississippi. MISSISSIPPI: Bolivar Co.: 2 mi S of Rosedale, W of MS HW 1, T23N, R8W, S. 27, S2; coarse, sandy soil along wood's edge between levee and Mississippi River, 16 Aug 1990, *Bryson 10170* (MO).

In our area this species is most easily confused with *A. tenuifolia*, from which it can be readily distinguished by its scabrous stems and pedicels, the two very short, flattened or slightly arched upper corolla lobes, the size of the anthers, which average twice as long as those of *A. tenuifolia*, and the much larger seeds.

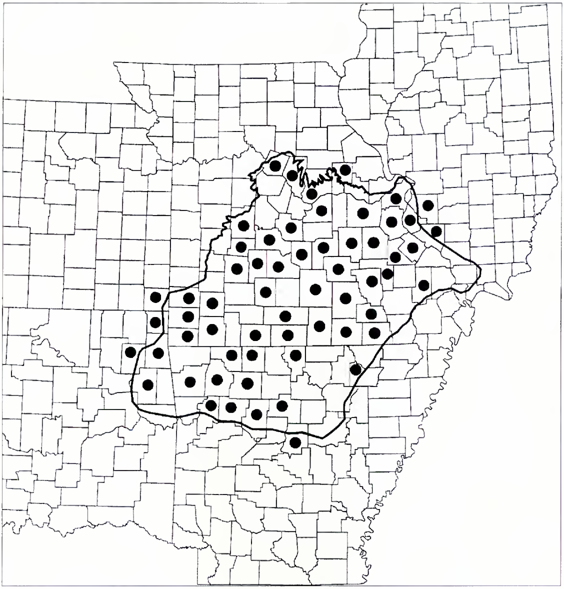

Fig. 4. Presently confirmed county records in the Ozark Highlands for *Agalinis gattingeri*.

7. Agalinis purpurea (L.) Pennell. *Agalinis purpurea* (L.) Pennell var. *purpurea*. *Gerardia purpurea* L. var. *purpurea*. *Gerardia purpurea* L. f. *purpurea*.

Gerardia purpurea L. f. *albiflora* Britton.

Stem 1–10 dm, glabrous to subglabrous, much branched on larger plants. *Leaves* linear to narrowly linear-lanceolate, 1–4(–5) mm wide, 1–5 cm long, spreading, arching, or curling, scabrous above and often on the midveins below. *Fascicles* usually absent or only weakly developed, but when present clearly shorter than the main leaves. *Inflorescences* short to elongate racemes. *Pedicels* 2–5(–6) mm long. *Calyx* campanulate to hemispherical, 4–6 mm

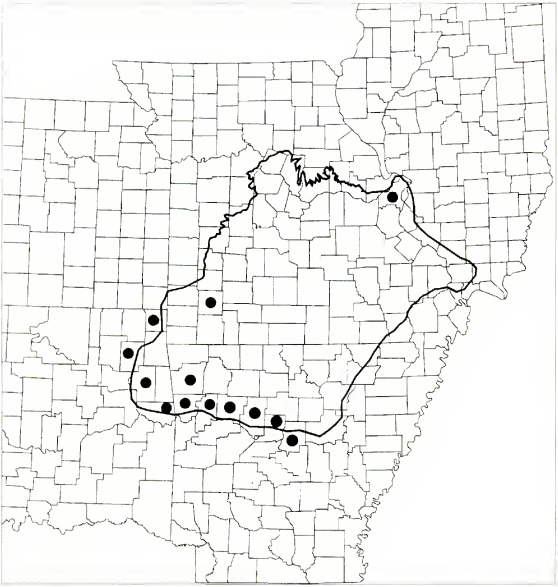

FIG. 5. Presently confirmed county records in the Ozark Highlands for *Agalinis heterophylla*.

long, the lobes 0.8–2(–2.3) mm long, the five principal veins of the calyx (leading to the calyx lobes) glabrous or rarely a few veins slightly scabrous. *Corolla* rose-purple, rarely white, 18–33 mm long, the throat noticeably pubescent within across the base of the two reflexed-spreading, upper lobes. *Anthers* 2–3.5 mm long. *Capsule* subglobose, 4–6 mm long. *Seeds* dark brown to black, 0.7–1.2 mm long. *n*=14 (Canne 1981). *Flowering* late August–early October.

Distribution.—Moist prairies and roadsides, moist open ground, ditches, and pond margins. Rare and scattered in the Ozark Highlands (Fig. 7), but probably more common than its distribution suggests.

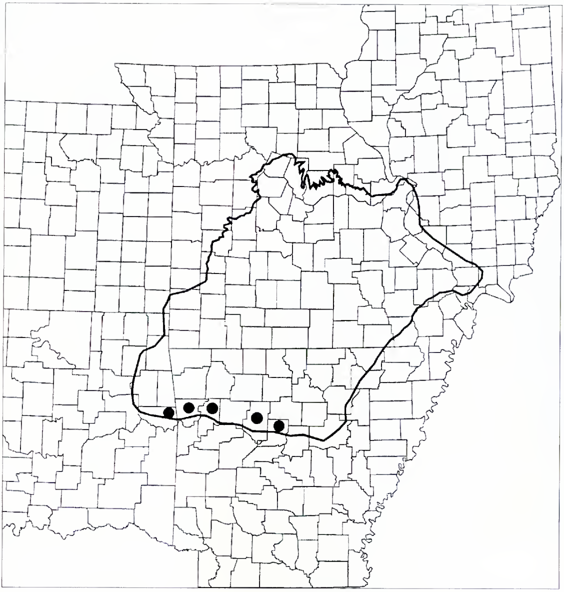

FIG. 6. Presently confirmed county records in the Ozark Highlands for *Agalinis homalantha*.

Ecology and conservation status.—G5; S2 in Kansas, S2 in Missouri. *Agalinis purpurea* and *A. fasciculata* are the most difficult species to distinguish from one another in the Ozark Highlands due to the variable nature of each taxon (see the discussion under *A. fasciculata*). Although *A. fasciculata* can be found under wet to mesic conditions, *A. purpurea* cannot tolerate the more xeric conditions favored by *A. fasciculata* in our area, and thus a difficult specimen collected on an upland prairie or another dry to xeric site can be defaulted to *A. fasciculata.* Occasionally, *A. purpurea* is found in dry soil, but close attention to its associate species will indicate that the habitat is actually a seasonally dry, moist to wet community.

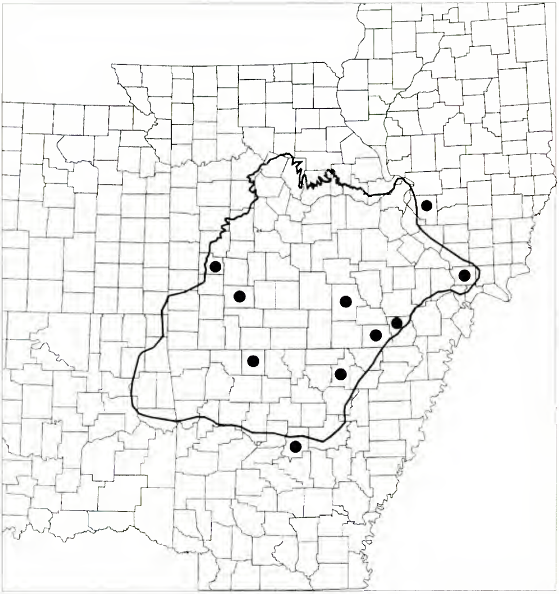

FIG. 7. Presently confirmed county records in the Ozark Highlands for *Agalinis purpurea*.

8. Agalinis skinneriana (A.W. Wood) Britton. *Gerardia skinneriana* A.W. Wood.

Stem 1–5(–6) dm, sharply 4-angled, appearing winged, the angles scabrous but the stem faces glabrous, simple to sparingly branched, the branches ascending. *Leaves* linear, ascending-appressed, the lowermost slightly spreading, 0.5–1.5 mm wide, 1–2(–2.5) cm long, scabrous above and on the midveins below. *Fascicles* absent. *Inflorescences* short racemes. *Pedicels* 0.4–1.6(–2) cm long. *Calyx* hemispherical, 2–4(–4.5) mm long, the lobes 0.4–1.2 mm long. *Corolla* pink to rarely white, 8–16 mm long, the throat noticeably pubescent within across the base of the two reflexed-spreading, upper lobes, the outside of the three lower lobes glabrous. *Anthers* 0.6–1.2 mm long. *Cap-*

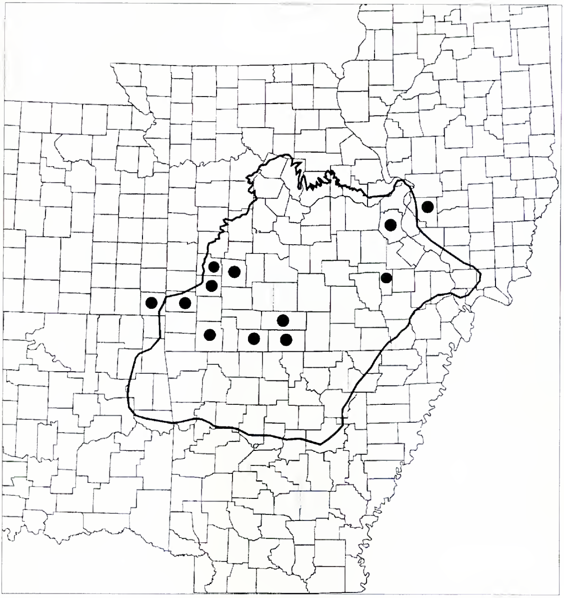

FIG. 8. Presently confirmed county records in the Ozark Highlands for *Agalinis skinneriana.*

sule globose, 3.5–5 mm long. *Seeds* 0.6–1.0 mm long, yellowish. n=13 (Canne 1984). *Flowering* late August–early October.

Distribution.—Dry prairies and large dolomite glades. Rare and localized in the Ozark Highlands (Fig. 8).

Ecology and conservation status.—G3; S2 in Illinois, S3 in Missouri. Although not state-listed in Kansas, there are only a handful of known sites there, and the species clearly warrants protection in that state. Smith (1988) reported *A. skinneriana* from numerous counties in Arkansas, but I have been able to locate only one historic (19th century) specimen of this species for the state in all of my herbarium searches, and the specimen has very imprecise label data. ARKANSAS: Prairies and woods, N.W. Arkansas, *Floyd s.n.* (UARK); all other specimens seen by me labeled *A. skinneriana* have proved to be another species. The sites in Barry and Iron counties, Missouri, are based on historic collections, but I believe that *A. skinneriana* will eventually be relocated in Iron County or found in adjacent Reynolds County, due to the abundance of suitable habitat (in this case igneous glades) that still remains in both counties. Steyermark (1963) also recorded *A. skinneriana* from McDonald County, Missouri. He was undoubtedly referring to a specimen collected by B.F. Bush, cited by Pennell (1929), that resides in the herbarium of the Botanical Museum at the University of Copenhagen, Denmark (C). But because I did not review this specimen I have not included *A. skinneriana* from McDonald County, although Pennell's annotation was in all likelihood correct.

On dry prairies *A. skinneriana* occurs mostly where the vegetation is sparse, such as the summit of hills or on gentle slopes where the substrate is near the surface, or along the upper parts of the narrow draws that frequently occur on prairies, where some slight erosion is usually evident. On dolomite glades it is found in either the more vegetated parts of the glade or in nearly bare soil.

In the Ozark Highlands *Agalinis skinneriana* is often confused with *A. gattingeri,* or smaller plants of *A. tenuifolia.* It is readily distinguished from *A. tenuifolia* by the corolla, which in *A. skinneriana* is pubescent within across the base of the two reflexed-spreading, upper corolla lobes, and by the sharply winged stem with its noticeably scabrous margins. It can be distinguished from *A. gattingeri* by the presence of a true raceme, the glabrous outersurface of the three lower corolla lobes, and erect-ascending leaves.

9. **Agalinis tenuifolia** (Vahl) Raf. *Gerardia tenuifolia* Vahl. *Gerardia tenuifolia* Vahl var. *tenuifolia, Gerardia tenuifolia* Vahl subsp. *tenuifolia.*

Agalinis besseyana (Britton) Britton.
Agalinis tenuifolia (Vahl) Raf. var. *macrophylla* (Benth.) S.F. Blake. *Gerardia tenuifolia* Vahl var. *macrophylla* Benth. *Gerardia tenuifolia* Vahl subsp. *macrophylla* (Benth.) Pennell.
Agalinis tenuifolia (Vahl) Raf. var. *parviflora* (Nutt.) Pennell. *Gerardia tenuifolia* Vahl var. *parviflora* Nutt. *Gerardia tenuifolia* Vahl subsp. *parviflora* (Nutt.) Pennell.

Stem 2–7 dm, subglabrous to glabrous, much branched on larger plants. *Leaves* linear to lanceolate, spreading, ascending, or arched, 1–5(–6) mm wide, 3–7 cm long, scabridulous above and often on the midveins below. *Fascicles* absent or present. *Inflorescences* elongate racemes. *Pedicels* slender, spreading, often abruptly upcurved distally, 6–25 mm long. *Calyx* hemispherical, 3–5.5 mm long, the lobes 0.5–2 mm long. *Corolla* light to dark pink, 10–16 mm long, the lobes 4–6 mm long, the throat glabrous within across the base of the two forward arching, upper lobes, the two upper lobes subequal to the three lower lobes. *Anthers* 1–2(–2.3) mm long. *Capsule* globose,

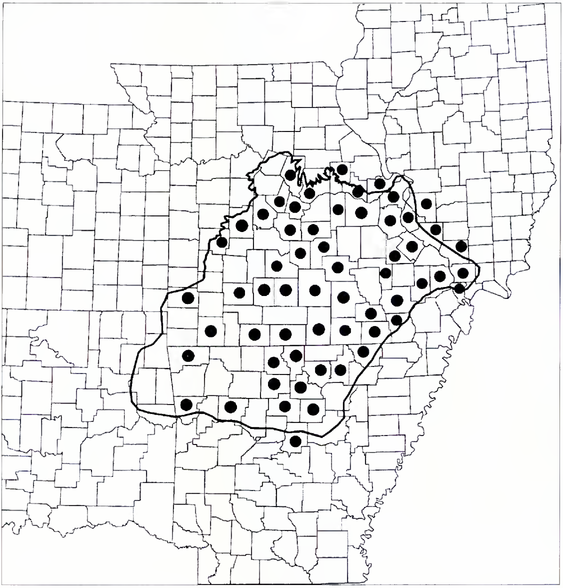

FIG. 9. Presently confirmed county records in the Ozark Highlands for *Agalinis tenuifolia*.

4–6 mm long. *Seeds* tan to dark brown, 0.7–1 mm long. n=14 (Canne 1984). *Flowering* principally from late August–early October, occasionally flowering as early as late June.

Distribution.—Dry or moist prairies, borders of woodlands, ponds, marshes, and rocky streams, also in ditches, fallow fields, and along railroads and roadsides Common in the Ozark Highlands (Fig. 9), but less frequent in the west and southwest portions of the region.

Ecology and conservation status.—G5; S3 in Oklahoma. Along with *Agalinis gattingeri, A. tenuifolia* is the most common species in the Ozark Highlands, and is the most common and widespread species of *Agalinis* in North

America. *Agalinis tenuifolia* and *A. gattingeri* are the only two species that occur with any frequency in the Ozark Highlands, the other species being restricted to the periphery of our area or to particular habitats within the Highlands. *Agalinis tenuifolia* is easily recognized in the field during flowering by the two long, forward arching, upper lobes of the corolla, which project over the anthers and most of the style. The only species that it can be confused with in the field during flowering in our area is *A. homalantha*. In *A. homalantha*, however, the style extends well beyond the two very short, forward to slightly arching upper corolla lobes, the pedicels are scabrous, and the species has a specific habitat and restricted range in our area.

Agalinis tenuifolia is a complex and variable species for which a number of intergrading varieties have been described. As Steyermark (1963) aptly stated of the varieties in our area: "The varieties presented here are not very distinct, except in their extremes, often showing overlapping characters, thus making their determination doubtful or unsatisfactory." Although it is possible at times to identify plants confidently as a particular variety, I believe it best at present to treat these weak varieties as one highly variable species pending future research.

10. Agalinis viridis (Small) Pennell *Gerardia viridis* Small.

Stem 1–6 dm, sharply 4-angled, appearing winged, the angles and stem faces glabrous, with a few to many widely spreading branches. *Leaves* linear 0.5–2 mm wide, sometimes the lowermost stem leaves approaching 3 mm in width, 1–2.5(–3) cm long, scabrous above and on the midveins below. *Fascicles* absent. *Inflorescences* racemes. *Calyx* campanulate, 3–4.5 mm long, the longest lobes 1.5–2.2 mm long. *Corolla* translucent to pink, 8–12 mm long, the throat noticeably pubescent within across the base of the two reflexed-spreading, upper lobes, the outside of the three lower lobes glabrous. *Anthers* 0.8–1.3 mm long. *Capsule* obovoid, 5–6(–7) mm long. *Seeds* yellowish, 0.7–1 mm long. *n*=?. *Flowering* late August–September.

Distribution.—Moist prairies, along the non-forested portions of prairie draws, along the borders of seasonally wet depressions in prairies where the vegetation is sparse, and rarely on the drier portions of prairies. Very rare in the Ozark Highlands (Fig. 10), where it is currently known from only four counties.

Ecology and conservation status.—G4; S1 in Missouri, S1 in Oklahoma. *Agalinis viridis* is yet another species that reaches its northern and northwesternmost occurrence in the Ozark Highlands; it is much more common south of the Arkansas River, and occupies a wider range of habitats there. The Jasper County, Missouri, location represents an isolated occurrence of this species; it was once collected throughout this county, but is now re-

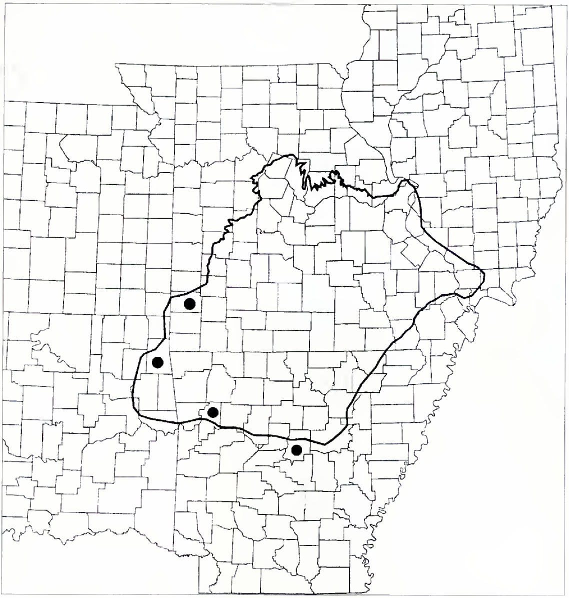

FIG. 10. Presently confirmed county records in the Ozark Highlands for *Agalinis viridis.*

stricted to Wah-Sha-She Prairie Natural Area, over 300 kilometers from the nearest known extant site for this species.

ACKNOWLEDGMENTS

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REFERENCES

BRITTON, N.L., and A. BROWN. [1913] 1970. An illustrated flora of northern United States and Canada, vol 3, 2d ed. Dover Publications, New York.

CANNE, J.M. 1979. A light and scanning electron microscope study of seed morphology in *Agalinis* (Scrophulariaceae) and its taxonomic significance. Syst. Bot. 4:281–296.

—-. 1981. Chromosome counts in *Agalinis* and related taxa (Scrophulariaceae). Canad. J. Bot. 59:1111–1116.

—-. 1983. The taxonomic significance of seedling morphology in *Agalinis* (Scrophulariaceae). Canad. J. Bot. 61:1868–1874.

—-. 1984. Chromosome numbers and the taxonomy of North American *Agalinis* (Scrophulariaceae). Canad. J. Bot. 62:454–456.

CANNE-HILLIKER, J.M. 1987. Status report on Skinner's purple false foxglove, *Agalinis skinneriana* (Wood) Britton, an endangered species in Canada. Department of Botany, University of Guelph, Guelph, Ontario.

CANNE-HILLIKER, J.M. and M.L. DUBRULE. 1993. A new species of *Agalinis* (Scrophulariaceae) from Grimes County, Texas. Sida 15:425–440.

—-. 1988. *Agalinis* (Scrophulariaceae) in Peru and Bolivia. Brittonia 40:433–440.

CANNE-HILLIKER, J.M. and C.M. KAMPNY. 1991. Taxonomic significance of leaf and stem anatomy of *Agalinis* (Scrophulariaceae) from the U.S.A. and Canada. Canad. J. Bot. 69:1935–1950.

CLEWELL, A.F. 1985. Guide to the vascular plants of the Florida panhandle. Florida State University Press, Tallahassee.

CORRELL, D.S. and M.C. JOHNSTON. 1970. Manual of the vascular plants of Texas. Texas Research Foundation, Renner.

COZZENS, A.B. 1940. Physical profiles of the Ozark Province. Amer. Midl. Naturalist 24:477–489.

DEAM, C.C. 1940. Flora of Indiana. Indiana Department of Conservation, Indianapolis.

FENNEMAN, N.M. 1938. Physiography of eastern United States. McGraw-Hill Book Company, New York.

FERNALD, M.L. 1950. Gray's manual of botany. 8th ed. American Book Company, New York.

GLEASON, H.A. 1952. The new Britton and Brown illustrated flora of the northeastern United States and adjacent Canada. New York Botanical Garden, New York.

GLEASON, H.A. and A. CRONQUIST. 1991. Manual of vascular plants of northeastern United States and adjacent Canada. 2d ed. New York Botanical Garden, New York.

HOLMGREN, N.H. 1986. Scrophulariaceae. In: R.L. McGregor, T.M. Barkley, R.E. Brooks, and E.K. Schofield, eds. Flora of the Great Plains. University Press of Kansas, Lawrence.

KEYS, J. Jr., C. CARPENTER, S. HOOKS, F. KOENIG, W.H. MCNAB, W. RUSSELL, and M.L.

Smith. 1995. Ecological units of the eastern United States, first approximation (map and booklet of map unit tables). U.S. Department of Agriculture, Forest Service, Atlanta.

Kondo, K. 1973. The chromosome numbers of four species in the Scrophulariaceae from the United States. CIS, Chromosome Inf. Serv. 14:25–26.

LaRoe, E.T., ed. 1995. Our living resources: a report to the nation on the distribution, abundance, and health of U.S. plants, animals, and ecosystems. U.S. Department of the Interior, National Biological Service, Washington, D.C.

Löve, A., and D. Löve. 1982. IOPB Chromosome Number Reports LXXV. Taxon 31:344–360.

McNab, W. and P.E. Evers. 1994. Ecological subregions of the United States: Section descriptions. Administrative Publication WO-WSA-5. U.S. Department of Agriculture, Forest Service, Washington, D.C.

McRoberts, D.T. 1989. A documented checklist and atlas of the vascular flora of Louisiana, part III, Dicotyledoneae: Fagaceae to Zygophyllaceae. Bull. Mus. Life Sci. No. 9.

Mohlenbrock, R.H. 1986. Guide to the vascular flora of Illinois. 2nd ed. Southern Illinois University Press, Carbondale.

Nigh, T.A., W.L. Pflieger, P.L. Redfearn Jr., W.A. Schroeder, A.R. Templeton, and F.R. Thompson III. 1992. The biodiversity of Missouri: definition, status, and recommendations for its conservation. Report of the Biodiversity Task Force. Missouri Department of Conservation, Jefferson City.

Pennell, F.W. 1929. *Agalinis* and allies in North America-II. Proc. Acad. Natl. Sci. Philadelphia 81:11–249.

—-. 1935. The Scrophulariaceae of eastern temperate North America (41 *Gerardia*). Acad. Natl. Sci. Philadelphia Monogr. 1:419–476.

Sauer, C.O. 1920. The geography of the Ozark Highland of Missouri. The Geographic Society of Chicago Bulletin No. 7, University of Chicago Press, Chicago.

Smith, E.B. 1988. An atlas and annotated list of the vascular plants of Arkansas. 2nd ed. Published by the author, Fayetteville, Arkansas.

Stewart, H.M. and J.M. Canne-Hilliker. 1998. Floral development of *Agalinis neoscotica, Agalinis paupercula* var. *borealis*, and *Agalinis purpurea* (Scrophulariaceae): implications for taxonomy and mating system. Int. J. Plant Sci. 159:418–439.

Steyermark, J.A. 1963. Flora of Missouri. Iowa State University Press, Ames.

Swink, F. and G. Wilhelm. 1994. Plants of the Chicago region. 4th ed. Indiana Academy of Science, Indianapolis.

Thom, R.H. and J.H. Wilson. 1980. The natural divisions of Missouri. Trans. Missouri Acad. Sci. 14:9–23.

Thornbury, W.D. 1965. Regional geomorphology of the United States. John Wiley & Sons, New York.

Vincent, K.A. 1982. Scrophulariaceae of Louisiana. M.S. Thesis, University of Southwestern Louisiana, Lafayette.

Voss, E.G. Michigan flora. 1996. Part III. Dicots (Pyrolaceae- Compositae). Cranbrook Inst. of Sci. Bull. 61 and University of Michigan Herbarium, Bloomfield Hills.

Wilhelm, G. 1984. Vascular flora of the Pensacola region. Ph.D. Dissertation, Southern Illinois University, Carbondale.

Williams, J.E. 1973. *Agalinis* and related genera in Oklahoma. M.S. Thesis, University of Oklahoma, Norman.

BOOK NOTICE

JOHN SHELHAS and RUSSELL GREENBERG, eds. 1996. **Forest Patches in Tropical Landscapes.** (ISBN 1-55963-426, pbk; ISBN 1-55963-425-1, hbk). Island Press, Box 7, Covelo, CA, 95428, U.S.A. 800-828-1301. $30.00 (pbk), $50.00 (hbk). 426 pp, tables, figures, maps, photos, satellite images, index.

This book contains results of a symposium hosted by the Smithsonian Migratory Bird Center. It includes an extensive introduction and 19 chapters contributed by some of the most active field researchers studying forest patches in the Tropics. Original concepts and thought-provoking guidelines for further investigation are preposed in Chapters 1, 3, 4, 7, 8, 9, 12, 14, and 17. The remaining chapters largely contain case studies that are extremely useful, especially to indicate where much more data is needed for us to efficiently promote forest patches as a mechanism to conserve significant elements of tropical biological diversity. The summary chapter (19) by Fisher and Bunch is useful because it skillfully presents the problems encountered in fostering forest patches in the tropics, and because of its frequent citation of symposia results, independently published works, and other publications out of the mainstream of scientific literature indices.

In summary, this book absolutely essential for the library of any conservation biologist, landscape ecologist, or land use planner. The wealth of information, practicality of presentation, extensive literature citations and thrifty price, make it ideal for use in courses as well. I highly recommend this book without any hesitation.–*John Pipoly, III*

FLORA ORNAMENTAL EN PLAZAS Y JARDINES PUBLICOS DEL AREA METROPOLITANA DE MONTERREY, MEXICO

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RESUMEN

Se realizó un inventario de las especies vegetales que son utilizadas con fines ornamentales en el área metropolitana de Monterrey, encontrándose que se cuenta con 137 especies pertenecientes a 68 familias, de las cuales *Fraxinus* sp., *Ligustrum lucidum* Ait., *Rosa centifolia* L. y *Melia azedarach* L. son las especies más frecuentes.

ABSTRACT

An inventory was taken of the ornamental plants in the metropolitan area of Monterrey. We found 137 species in 68 families. The most frequent species are *Fraxinus* sp., *Ligustrum lucidum* Ait., *Rosa centifolia* L. and *Melia azedarach* L.

INTRODUCCION

Es indudable la importancia ecológica y estética de las plantas ornamentales en las ciudades modernas, donde se conjuntan infinidad de problemas que son el resultado de la urbanización exhaustiva, y en las cuales las plantas ornamentales pasan en el mejor de los casos a segundo término, sin considerar los múltiples beneficios que estas aportan, como son: purificación de la atmósfera, la cual es contaminada por el mismo hombre; liberación de oxígeno; evitan la erosión del suelo, pueden funcionar como cortina rompeviento, etc. Desde el punto de vista estético, las plantas aumentan la belleza de la ciudad con su follaje multicolor, hermosas y abundantes flores, además del equilibrio que proporcionan al paisaje.

Por ser las plantas ornamentales poco estudiadas en el estado de Nuevo León y en particular para el área metropolitana de Monterrey, se consideró pertinente realizar un inventario de éstas plantas con el fin de ampliar el conocimiento de las mismas y aportar datos que contribuyan a estudios posteriores.

Algunos autores han trabajado diversos aspectos acerca de la Flora en el

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estado de Nuevo León, sin embargo ninguno de ellos, tiene un enfoque particular hacia las plantas ornamentales, aunque algunos por su amplitud hacen mención de algunas de ellas. Entre estos trabajos destacan el de González (1888), pionero de los estudios botánicos en el estado, él realizó un inventario florístico acerca de las plantas cultivadas y silvestres para Nuevo León, encontrando cerca de 264 especies incluidas en 70 familias. Por su parte Rojas-Mendoza (1965), describió la vegetación y la flora para el Estado, él reporta 148 familias, 657 géneros y un total de 1484 plantas con categoría de especie, subespecie, variedad o forma.

Es conveniente mencionar que si existen trabajos florísticos o inventarios de plantas ornamentales para otras ciudades en el país, como es el caso de Teresa de Tovar (1982), quién llevó a cabo un estudio descriptivo de los árboles y arbustos más comunes en el Bosque de Chapultepec, describiendo un total de 57 familias, 113 géneros y 168 especies. Capitanachi-Moreno y Amante-Haddad (1995), realizaron un estudio de vegetación urbana en Xalapa, Veracruz, encontrando 443 especies correspondientes a 317 géneros incluidos en 117 familias.

AREA DE ESTUDIO

El área metropolitana de Monterrey comprende los municipios de San Nicolás de los Garza, Guadalupe, San Pedro Garza García, Santa Catarina y Monterrey. Ocupa una superficie de 1976.480 Km^2, localizándose entre las coordenadas 25° 02' y 25° 47' de latitud Norte y entre los 100° 06' y 100° 43' de longitud Oeste, con una altitud de 554 msnm. La precipitación pluvial es escasa, oscilando la media general anual entre 300 y 600 mm, pero hay zonas que registran lluvias anuales mayores de 800 mm.

MATERIAL Y METODO

La colecta de las plantas se llevó a cabo en plazas y jardines públicos del área metropolitana de Monterrey, las cuales suman un total de 393, debido a su considerable número, se hizo necesario calcular un tamaño de muestra estadísticamente significativo, para lo cual se realizó un muestreo piloto, en tres plazas o jardines públicos (seleccionados aleatoriamente) de cada municipio y con los resultados obtenidos se realizó el cálculo para el tamaño de muestra total (número de plazas y jardines a muestrear) mediante la fórmula de muestreo estratificado (Abad de Servin y Servin-Andrade 1978), lo cual nos permitió conocer el número de plazas y jardines a muestrear en cada municipio, así como el número total para el área metropolitana de Monterrey.

El tamaño de muestra total fue de 52 plazas y jardines, de las cuales cinco corresponden al municipio de Santa Catarina, tres al municipio de Guadalupe, ocho al municipio de San Pedro, dieciséis al municipio de San Nicolás y veinte al municipio de Monterrey.

El material biológico obtenido durante las colectas fue debidamente herborizado y etiquetado para su posterior identificación, siguiendo el criterio de Bailey (1949), Correll y Johnston (1970) y Elias (1980), considerando además los trabajos de Martínez (1979), Sánchez-Monje (1980), Capitanachi-Moreno y Amante-Hadadd (1995). Los ejemplares se encuentran depositados en el Herbario de la Facultad de Ciencias Biológicas, U.A.N.L. (UNL).

RESULTADOS

Se colectaron un total de 137 especies, las cuales están incluidas en 68 familias representativas de las plantas ornamentales. La familia con el número mayor de especies corresponde a Leguminosae con 10 especies, seguida por las familias Liliaceae y Malvaceae con 8 y 6, las familias Apocynaceae, Compositae y Euphorbiaceae con 5 especies y el resto de las familias con menor número de miembros (Fig. 1 y listado).

Las especies que con mayor frecuencia se encontraron en los sitios de colecta fueron: *Fraxinus* sp. (80.76%), *Ligustrum lucidum* Ait. (59.61%), *Rosa centifolia* L. (42.30%) y *Melia azedarach* L. (36.52%) (Fig. 2).

Se apreció que las plantas encontradas en las plazas y jardines públicos del área metropolitana de Monterrey son básicamente hierbas (37.95%), árboles (30.65%), arbustos (26.27%), palmas (2.91%) y trepadoras (2.18%) (Cuadro 1).

En relación al origen de la flora ornamental del área en estudio, se encontró que del total de especies aproximadamente un 38% son especies nativas y el resto (62%) son especies introducidas provenientes básicamente de Europa, Asia y Africa.

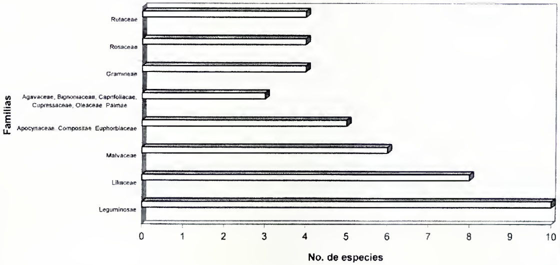

FIG. 1. Familias con mayor número de especies ornamentales en los parques y jardines públicos del área metropolitana de Monterrey, N.L., México.

Por otra parte en el Cuadro 2 puede apreciarse que existen diferencias entre la diversidad florística presente en los municipios del área metropolitana de Monterrey, donde sobresale Monterrey con un promedio de 19 especies por área verde, en tanto que el municipio de Guadalupe solo existen 6 especies en promedio.

DISCUSIONES Y CONCLUSIONES

De las especies colectadas por González (1888) para el Estado de Nuevo León, 25 coinciden con las aquí encontradas; así como 73 con el inventario realizado por Rojas-Mendoza (1965) para el estado y 24 con Teresa de Tovar (1982) quien estudió el bosque recreativo de Chapultepec; con el estudio realizado por Capitanachi-Moreno y Amante-Haddad (1995) coincide con 45 especies reportadas en este trabajo.

La forma biológica más frecuente fue la herbácea, esto contrasta con el estudio realizado por Tovar de Teresa (1982) en el Bosque de Chapultepec, ya que ella menciona que las especies arboreas son las que tienen mayor diversidad y frecuencia. Por su parte Capitanachi-Moreno y Amante-Haddad (1995) concuerda con la forma herbácea.

En relación al origen de las especies se encontró que solo un 38% son especies nativas y el resto son introducidas (62%), lo cual es congruente con lo mencionado por Rzedowski y Calderon de Rzedowski (1990), quienes mencionan que dentro del conjunto de plantas introducidas en México la mayoría tiene un origen europeo, siendo particularmente frecuente la procedencia mediterránea.

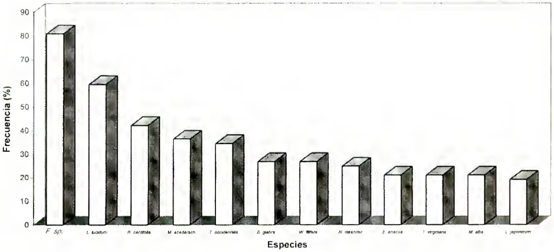

FIG. 2. Especies ornamentales más frecuentes en los parques y jardines públicos del área metropolitana de Monterrey, N.L., México.

Cuadro 1. Formas biológicas de las plantas ornamentales del área metropolitana de Monterrey, N.L., México.

Forma biológica	No. especies	Porcentaje
Hieba	52	37.95
Arbol	42	30.65
Arbusto	36	26.67
Palma	4	2.91
Trepadora	3	2.16

Cuadro 2. Número de especies promedio presentes en los municipios del área metropolitana de Monterrey, N.L., México.

Municipio	No. especies promedio	No. mínimo	No. máximo
Monterrey	19	1	70
San Nicolás	14	1	43
Guadalupe	6	1	13
San Pedro	115	20	
Santa Catarina	15	7	29

APPENDICE

Listado de especies ornamentales en parques, plazas Y jardines públicos del área Metropolitana de Monterrey, N.L., México.

ACANTHACEAE
Ruellia brittoniana Leonard, NH

ADIANTACEAE
Pteris longifolia L., IH

AIZOACEAE
Sesuvium portulacastrum L., IH

AGAVACEAE
Agave asperrima Jacobi, NH
Sansevieria zeylanica Willd., IH
Yucca carnerosana (Trel.) McKelvey, NP

AMARANTHACEAE
Alternanthera repens (L.) Kuntze, IH
Amaranthus caudatus L., IH

AMARYLLIDACEAE
Crinum zeylanicum L., IH
Hippeastrum equestre Herb., IH
Nothoscordum bivalve (L.) Britton, IH

ANACARDIACEAE
Rhus laurina Nutt., IA

APOCYNACEAE
Carissa grandiflora A. DC., IAr
Nerium oleander L., IAr
Ochrosia elliptica Labill., IA
Thevetia peruviana (Pers.) K. Schum., IA
Vinca rosea L., IH

ARACEAE
Monstera deliciosa Liebm., NH
Philodendron cordatum Kunth, IH

ARALIACEAE
Hedera helix L., IT

BEGONIACEAE
Begonia semperflorens Link & Otto, IH

BIGNONIACEAE
Chilopsis linearis Sweet, NA
Jacaranda mimosifolia D. Don, IA
Tecoma stans (L.) Juss ex HBK, NAr

BORAGINACEAE
Cordia boissieri A. DC., NAr
Ehretia anacua (Teran & Berl.) I.M. Johnst, NA

CANNACEAE
- *Canna indica* L., IH

CARICACEAE
- *Carica papaya* L., NA

CAPRIFOLIACEAE
- *Abelia chinensis* R. Br., IAr
- *Lonicera japonica* Thunb., IT
- *Sambucus mexicana* Presl, NA

CARYOPHYLLACEAE
- *Dianthus caryophyllus* L. ex J. R. & G. Forst., IH

CASUARINACEAE
- *Casuarina equisetifolia* L., IA

COMMELINACEAE
- *Commelina tuberosa* L., NH
- *Tradescantia virginiana* L., NH

COMPOSITAE
- *Artemisia albula* Nutt., NH
- *Cosmos bipinnatus* Cav., NH
- *Tagetes erecta* L., NH
- *Tagetes patula* L., NH
- *Zinnia elegans* Jacq., NH

CONVOLVULACEAE
- *Ipomoea fistulosa* Mart., NT

CRASSULACEAE
- *Kalanchoe blossfeldiana* Poellnitz, IH

CUPRESSACEAE
- *Cupressus sempervirens* L., IA
- *Juniperus monosperma* (Engelm.) Sarg., NA
- *Thuja occidentalis* L., NA

CYPERACEAE
- *Cyperus alternifolius* L., IH

ERICACEAE
- *Arctostaphylos glauca* Lindl., NAr
- *Rhododendron mucronatum* Don, IAr

EUPHORBIACEAE
- *Cnidoscolus chayamansa* Mc. Vaugh., NAr
- *Croton ciliato-glandulosum* Ort., NAr
- *Euphorbia pulcherrima* Willd. ex Klotzsch, NAr
- *Jatropha dioica* Cerv., NAr
- *Sapium sebiferum* (L.) Roxb., IA

FAGACEAE
- *Quercus virginiana* Mill., NA

FOUQUIERIACEAE
- *Fouquieria splendens* Engelm., NAr

GERANIACEAE
- *Pelargonium zonale* Ait., IH

GRAMINEAE
- *Bambusa vulgaris* Schrad. ex Wendl., -H
- *Cortaderia selloana* Aschers & Graebn., IH
- *Saccharum officinarum* L., IH
- *Stenotaphrum secundatum* (Walt.) O. Kuntze, IH

HAMAMELIDACEAE
- *Liquidambar styraciflua* L., NA

JUGLANDACEAE
- *Carya cordiformis* (Wangenh.) K. Koch, NA

LABIATAE
- *Ocimum basilicum* L., IH
- *Teucrium cubense* L., IH

LAURACEAE
- *Persea americana* Mill., NA

LEGUMINOSAE
- *Acacia farnesiana* (L.) Willd., NA
- *Bauhinia variegata* L., IA
- *Caesalpinia mexicana* Gray., NAr
- *Caesalpinia pulcherrima* (L.) Swartz, -Ar
- *Erythrina coralloides* D.C., NA
- *Leucaena glauca* L., NAr
- *Mimosa malacophylla* Gray, NH
- *Parkinsonia aculeata* L., IAr
- *Prosopis glandulosa* Torr., NA
- *Trifolium repens* L., IH

LILIACEAE
- *Aloe vera* L., IH
- *Allium scaposum* Benth., NH
- *Asparagus sprengeri* Regel., IH
- *Asparagus virgatus* Baker, IH
- *Chlorophytum capense* Thunb., IH
- *Dasylirion longissimum* Lem., IH
- *Hemerocallis middendorffii* Traufv., IH
- *Ophiopogon jaburan* Lodd., IH

LYTHRACEAE
- *Lagerstroemia indica* L., IA

MAGNOLIACEAE
- *Magnolia grandiflora* L., IA

MALVACEAE
- *Hibiscus rosa-sinensis* L., IAr

Hibiscus syriacus L., IAr
Lavatera trimestris L., IAr
Malvaviscus arboreus Cav., NAr
Sida abutifolia Miller, NH
Thespesia populnea (L.) Soland ex Correa, IAr

MELIACEAE
Melia azedarach L., IA

MORACEAE
Morus alba L., IA
Ficus elastica Roxbg., IA

MUSACEAE
Musa paradisiaca L., IAr

MYRTACEAE
Callistemon specious DC., NAr
Eucalyptus globulus Labill., IA

NYCTAGINACEAE
Bougainvillea glabra Choisy, IAr
Mirabilis jalapa L., NH

OLEACEAE
Fraxinus velutina Torr., NA
Ligustrum japonicum Thunb., IAr
Ligustrum lucidum Ait., IA

PALMAE
Arecastrum romanzoffiana Becc., IP
Phoenix dactylifera L., IP
Washingtonia filifera (Linden) H. Wendl., NP

PINACEAE
Pinus halepensis Mill., NA

PITTOSPORACEAE
Pittosporum tobira Ait., IAr

PLATANACEAE
Platanus occidentalis L., NA

PLUMBAGINACEAE
Plumbago capensis Thunb., IAr

POLYPODIACEAE
Nephrolepis exaltata (L.) Scott, NH

PUNICACEAE
Punica granatum L., IAr

RANUNCULACEAE
Delphinium ajacis L., IH

RHAMNACEAE
Colubrina greggii Wats., NAr

ROSACEAE
Eriobotrya japonica Lindl., IA
Prunus persica (L.) Osbeck., IA
Pyracantha coccinea L., IAr
Rosa centifolia L., IAr

RUBIACEAE
Gardenia jasminoides Ellis, IAr

RUTACEAE
Citrus aurantifolia (Christm.) Swingle, IA
Citrus sinensis Osbeck., IA
Sargentia greggii Wats., NAr
Zanthoxylum fagara (L.) Sarg., NAr

SALICACEAE
Populus tremuloides Michx., IA
Salix nigra Marsh., IA

SAPINDACEAE
Koelreuteria paniculata Laxmn., IA

SCROPHULARIACEAE
Leucophyllum frutescens (Berl.) I.M. Johnst., IAr
Mimulus puniceus Steud., IAr

SOLANACEAE
Petunia axillaris BSP., IH
Petunia hybrida Hort. ex Vilm, IH

STRELITZIACEAE
Strelitzia reginae Banks, IH

TAMARICACEAE
Tamarix gallica L., IA

TAXODIACEAE
Taxodium mucronatum Ten., NA

TROPAEOLACEAE
Tropaeolum majus L., IH

ULMACEAE
Celtis laevigata Willd., NA
Celtis pallida Torr., NA

UMBELLIFEREAE
Coriandrum sativum L., IH

VERBENACEAE
Lantana camara L., IAr
Verbena bipinnatifida Nutt., IH

Nota: las siglas que aparecen a la derecha corresponden al origen: - desconocido, N nativa, I introducida y a la forma biológica: H herbácea, A árbol, Ar arbusto, P palma, T trepadora.

REFERENCIAS

Abad De Servin, A. y L. A. Servin-Andrade. 1978. Introducción al muestreo. Primera edición. Editorial Limusa, México, D.F. Pp. 105–141.

Bailey, L.H. 1949. Manual of cultivated plants. MacMillan Publishing CO, Inc, New York.

Capitanachi-Moreno, C.Y.S. Amante-Haddad. 1995. Las areas verdes urbanas en Xalapa, Veracruz. Catálogo de Flora Urbano. Universidad Veracruzana/Instituto de Ecología A.C.

Correll, D.S. and Johnston, M.C. 1970. Manual of the vascular plants of Texas. Published by Texas Research Foundation, Renner Texas.

Elias, S.T. 1980. Trees of North America. Van Nostrand Reinhold Company, New York.

González, J.E. 1888. Un discurso y un catálogo de plantas Clasificadas. Imprenta Católica.

Martinez, M. 1979. Catálogo de nombres vulgares y científicos de plantas Mexicanas. Primera edición. Fondo de Cultura Económica. México, D.F.

Rzedoswki, J. y G. Calderon de Rzedowski. 1990. Nota sobre el elemento africano en la flora adventicia de México. Acta Bot. Mexicana. 12:21–24 pp

Rojas-Mendoza, P. 1965. Generalidades sobre la vegetación del estado de Nuevo León y datos acerca de su flora. Tésis doctoral inédita Universidad Nacional Autónoma de México, México, D.F.

Sanchez-Monje, E. 1980. Diccionario de plantas agrícolas. Ministerio de Agricultura. Madrid, España.

Teresa De Tovar, L. 1982. Estudio descriptivo de los árboles y arbustos más comunes del Bosque de Chapultepec. Tesis profesional. Facultad de Ciencias. Universidad Nacional Autónoma de México.

DOCUMENTED CHROMOSOME NUMBERS 1998:1. CHROMOSOME NUMBERS IN *CAREX* SECTION *OVALES* (CYPERACEAE): ADDITIONS, VARIATIONS, AND CORRECTIONS

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ABSTRACT

Chromosome counts for 14 species of *Carex* section *Ovales* are documented completing at least a single report for each of the over 40 species known for eastern North America. The haploid numbers in this report ranged from $n = 24$ to $n = 42$. Counts for *Carex feta*, *C. muskingumensis*, *C. oronensis*, and *C. tetrastachya* were determined for the first time and six aneuploid (sensu lato) series are indicated. The only previously published counts for *C. adusta*, *C. argyrantha*, and *C. foenea* (*C. aenea*) were found to be incorrect.

RESUMEN

Se documentan los recuentos de 14 especies de *Carex* sección *Ovales* completando al menos una cita de las más de 40 especies conocidas del este de América del Norte. Los números haploides varían de $n = 24$ hasta $n = 42$. Se hacen por primera vez recuentos de *Carex feta*, *C. muskingumensis*, *C. oronensis*, y *C. tetrastachya* y se indican seis series aneuploides (sensu lato). Los únicos recuentos previos de *C. adusta*, *C. argyrantha*, y *C. foenea* (*C. aenea*) se ha encontrado que son incorrectos.

INTRODUCTION

Carex section *Ovales* is a large, coherent group of sedges with a center of diversity in North America. At least 40 species occur east of the Rocky Mountains and about as many species occur from the Rocky Mountains westward (Mastrogiuseppe et al. in review). Numerous karyological studies over the past 50 years (Whitkus 1991) have shown much chromosomal variation at the sectional, species, and population level. Even individual plants may have some cell to cell changes in karyotype. Much of this variation is thought to be the consequence of polycentric chromosomes with diffuse centromeres (Grant 1981). Polycentric chromosomes have the ability to fragment or fuse with other chromosome pieces and still retain the potential of completing

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normal movements during mitosis and meiosis. In spite or because of this variation, chromosome data have been informative in understanding the taxonomy and probable phylogenetic relationships among these species (Rothrock & Reznicek 1996a). And previously unrecognized species, such as *Carex ozarkana* and *C. molestiformis*, have been revealed to have distinctive chromosome numbers (Rothrock & Reznicek 1996b; Reznicek & Rothrock 1997).

As part of ongoing taxonomic studies of eastern North American species of *Carex* section *Ovales* and especially as part of the Flora of North America project, an effort was made to complete a karyological survey of all species which occur in eastern North America and, where possible, to capture additional intraspecific variability. This update documents the karyotypes of 40 plants from 14 species.

MATERIALS AND METHODS

As described previously (Rothrock & Reznicek 1996a), living plants were collected in the field during their fruiting stage and cultivated in a sand-peat-perlite medium under greenhouse conditions. In this study, two species, *C. praticola* and *C. xerantica*, were grown from seed taken from herbarium specimens. Cold treatment was used to stimulate the production of new inflorescences by the following spring. Immature spikes were preserved in methanol, chloroform, propionic acid (6:3:2). Within the subsequent 72 hours, anthers were dissected from the spikes and squashed in 2% lactic-acetic-orcein (Cooperrider & Morrison 1967). Meiosis I chromosome figures were examined from five or more pollen mother cells. Photographs and drawings were made with a Nikon Labophot-2 microscope using phase contrast at 1000x magnification.

Voucher specimens were typically prepared at the time of field collection or occasionally from fruiting greenhouse material. Vouchers, on deposit at the University of Michigan Herbarium (MICH), include photomicrographs and drawings of countable figures.

RESULTS AND DISCUSSION

The chromosome counts for the 14 species reported in this study ranged from $n = 24$, the lowest now known for section *Ovales* (Whitkus 1991), to $n = 42$ (Table 1). For six of the species intraspecific variation in chromosome number is reported. Five counts published by Löve and Löve (1981) are clearly at odds with our results and, given the often subtle differences between species, likely indicate faulty identification of the plant being examined.

Carex adusta F. Boott.—Our material from Washington Co., Maine, comes from near the eastern extreme of the distribution of *C. adusta*. Its $n = 39$

Table 1. New and published chromosome numbers for select species of *Carex* section *Ovales*.

Species	*n*	Location:Voucher or Reference
Carex adusta F. Boott	39	Washington Co., ME: A.A.R 10560
	32*	Löve & Löve 1981
Carex argyrantha Tuckerman	40	Hancock Co., ME: P.E.R. 3479
	40	Washington Co., ME: A.A.R. 10087
	40	Centre Co., PA: P.E.R. 3494
	40	Wahl 1940
	32*	Löve & Löve 1981
Carex brevior (Dewey) Mackenzie	24	Kaufman Co., TX: A.A.R.10345b
	24+IV	Kaufman Co., TX: A.A.R. 10345c
	26	Kaufman Co., TX: A.A.R. 10345a
	28	Christian Co., IL: P.E.R. 3545
	30	Lonoke Co., AR: P.E.R. 2885
	30+IV	Coahoma Co., MS: Bryson 14829
	32	Fayette Co., IL: P.E.R. 3540
	32	Pulaski Co., AR: P.E.R. 2902
	34	Löve & Löve 1981
Carex feta L.H. Bailey	33	Lane Co., OR: Wilson 7869
Carex foenea Willd.	41	Hancock Co., ME: P.E.R. 3480
	41	Strafford Co., NH: P.E.R. 3478
	42	Hancock Co., ME: P.E.R. 3480
	32*	Löve & Löve 1981
Carex hyalina F. Boott	37	Morris Co., TX: A.A.R. 8489
	37	Rothrock & Reznicek 1996a
Carex longii Mackenzie	29	Cumberland Co., TN: P.E.R. 3638
	28+IV	Rothrock & Reznicek 1996a
	31	Rothrock & Reznicek 1996a
Carex merritt-fernaldii Mackenzie	37	Strafford Co., NH: P.E.R. 3475
	34*	Löve & Löve 1981
	35	Tanaka 1942
Carex molesta Bright	34	Bolivar Co., MS: Bryson 12209
	34	White Co., IN: P.E.R. 3356
	35	Grant Co., IN: P.E.R. 2482
	35	Macon Co., MO: P.E.R. 3567.5
	34	Wahl 1940
	34*	Löve & Löve 1981
Carex muskingumensis Schwein.	40	Huntington Co., IN: P.E.R. 2132
Carex oronensis Fernald	37	Hancock Co., ME: P.E.R. 3481
	37	Penobscot Co., ME: P.E.R. 3483
Carex praticola Rydb.	39	Thunder Bay District, Ontario: Oldham 17731a
	38, 39	Packer & Whitkus 1982
	38, 39	Whitkus 1991
	32*	Löve & Löve 1981
Carex tetrastachya Scheele	30+III	Kaufman Co., TX: A.A.R. 10344
	32	Zavala Co., TX: Wipff 2915
	32	Brazos Co., TX: Jones 12345a
	33	Brazos Co., TX: Jones 12345b
	33	Burleson Co., TX: A.A.R. 10421
	33	Jefferson Co., TX: A.A.R. 10411
Carex xerantica L.H. Bailey	34	Thunder Bay District, Ontario: Oldham 17732
	34	Löve & Löve 1981

* problematic, unvouchered reports; see text

disagrees with the n = 32 listed by Löve and Löve (1981). Unfortunately many Löve and Löve chromosome counts for *Carex* section *Ovales*, including this one, have no known, extant voucher specimens. We suspect, however, that their n = 32 count may be based upon an individual belonging to some other species, perhaps *C. brevior* (Dewey) Mackenzie.

Carex argyrantha Tuckerman.—Based upon single plants from 3 localities, this species had a consistent n = 40. Wahl (1940) published a count of n = 40 for this species under the misapplied name *C. foenea*. Löve and Löve (1981) incorrectly attribute an n = 32 to this species. Their material came from a Manitoba source which lies outside the range of *C. argyrantha*. Unfortunately no voucher is known for their count.

Carex brevior (Dewey) Mackenzie.—Our material (10 plants) gave a surprisingly broad range of chromosome counts, from n = 24 to 32. Morphologically the species is variable but we were unable to correlate any particular phenotype with chromosome count. We thus have no reason as yet to suspect that 2 or more sibling species are hidden within this taxon. The lowest counts, n = 24, 24 + IV, and 26 are from unusually robust individuals collected in Kaufman Co., Texas. The n = 30 individual was noteworthy in having clear nervation on the dorsal face of the perigynia. A previous report for *Carex brevior* (with voucher specimen documentation available) is n = 34 (Löve & Löve 1981). This report is plausible, though the number remains unconfirmed.

Carex feta L.H. Bailey.—This species, from western North America, had an n = 33. Given the size and shape of the perigynia and achenes as well as the clear collar at the orifice of the leaf sheath, we suspect that *C. feta* is most closely related to *C. festucacea* Schk. ex Willd. found in eastern North America. The later species has a chromosome range of n = 33 + III, 34, and 35 (Wahl 1940; Rothrock & Reznicek 1996a).

Carex foenea Willd.—Our material (4 plants) had n = 41 and 42. In fact, the short aneuploid series was observed within the population from Hancock Co., Maine. Many taxonomic treatments (e.g. Fernald 1950) have incorrectly called this taxon *C. aenea* Fern. Löve and Löve (1981) published an n = 32 for *C. aenea* for material collected from near Brandon, Manitoba. No voucher specimen from this locality could be found. On the other hand, their voucher from Maskwa rapids, Manitoba (Löve & Löve 5512, WIN!) is a specimen of *C. foenea* and the annotation label indicates that the chromosome count was "$2n$ = 64." Unfortunately this voucher was intended for their report of *C. tenera*, a species with n = 26 to 28 (Wahl 1940; Rothrock & Reznicek, unpublished data).

The relatively high chromosome number for *C. foenea* compares favorably to that of several other species possessing long pistillate scales. These include *C. adusta* ($n = 39$), *C. argyrantha* ($n = 40$), and perhaps *C. silicea* Olney ($n = 37, 38$).

Carex hyalina F. Boott.—This specimen from the southwestern extreme of the species' range had an $n = 37$. Our previous report (Rothrock & Reznicek 1996a) for the rare *C. hyalina,* from the northern portion of its range in Mississippi, also provided an $n = 37$.

Carex longii Mackenzie.—Previous work (Rothrock & Reznicek 1996a) found $n = 28 + \mathrm{IV}$ and 31 for plants from the coastal plain of the southeastern US and from southern Michigan. This plant with $n = 29$ comes from the Cumberland Mountain region of Tennessee.

Carex merritt-fernaldii Mackenzie.—Given a count by Tanaka (1942) of $n = 35$, our result of $n = 37$ suggests possible aneuploidy for this species. Löve and Löve (1981) offer an undocumented count of $2n = 68$. However their count must be in error since the plant material came from Melita in extreme southwestern Manitoba, well outside the known range for *C. merritt-fernaldii* in that province.

Carex merritt-fernaldii often is morphologically confused with *C. brevior*. The differences in chromosome condition, however, reinforce its recognition at the species level.

Carex molesta Bright.—Previous work found $n = 34$ for this taxon (Wahl 1940). Löve and Löve (1981) also found $n = 34$ for undocumented material from Manitoba where, as far as we know, *C. molesta* does not occur. We confirm $n = 34$ but also found an aneuploid variation of $n = 35$.

Carex muskingumensis Schwein.—The count of $n = 40$ (based upon 2 plants) is the first for this species. For a member of *Carex* section *Ovales, C. muskingumensis* is quite distinctive. The stiff inflorescence, spikes, and lanceolate perigynia are unusually large. The vegetative culms have numerous evenly spaced leaves reminiscent of the *C. tribuloides* group (with $n = 32$ & 35), the mostly likely near relative of *C. muskingumensis.*

Carex oronensis Fernald.—The counts of $n = 37$ are the first for this rare endemic of the Penobscot River valley in central Maine. Dibble (1991) hypothesizes that the European *C. ovales* is a near relative. However, this is not supported by the numerous chromosome counts for *C. ovalis* which range from $n = 32$ to 34 (Whitkus 1991). We are unable to suggest possible close affinities between *C. oronensis* and other species in eastern North America.

Carex praticola Rydb.—Primarily a species of western North America, this plant comes from a disjunct southern outlier of the species' natural distribution. Its $n = 39$ is identical to that of Packer and Whitkus (1982) and Whitkus (1991), who additionally reported $n = 38$. The unvouchered report of $n = 32$ by Löve and Löve (1981) is highly suspect.

Carex tetrastachya Scheele.—Formerly known as *C. brittoniana*, *C. tetrastachya* displays an aneuploid series. Among the material available, we observed $n = 30 + \text{III}$ (1 plant), 32 (3 plants), 33 (4 plants). Correll and Johnson (1970) suggest that this taxon and *C. hyalina* are most closely related. Vegetatively we especially find the two to be quite distinctive and the *C. hyalina* counts of $n = 37$ do not immediately suggest a close affinity.

Carex xerantica L.H. Bailey.—Our plant from a disjunct and eastern outlier of the species in Ontario yielded an $n = 34$. This confirms an unvouchered (but geographically plausible) report by Löve and Löve (1981) for this northern species.

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REFERENCES

COOPERRIDER, T.S. and J.H. MORRISON. 1967. Lactic-acetic-orcein as a chromosome stain. Michigan Bot. 6:176–178.

CORRELL, D.S. and M.C. JOHNSON. 1970. Manual of the vascular plants of Texas. Texas Research Foundation, Renner.

DIBBLE, A.C. 1991. *Carex oronensis* (Cyperaceae), a possible neoendemic of Maine. M.S. thesis, University of Maine, Orono.

FERNALD, M.L. 1950. Gray's manual of botany. Reprinted edition. D. Van Nostrand Co., New York, NY.

GRANT, V. 1981. Plant speciation (second edirion). Columbia University Press, New York, NY.

LÖVE, A. and D. LÖVE. 1981. Chromosome number reports LXXIII. Taxon 30:829–861.

MAESTROGIUSEPPE, J. P.E. ROTHROCK, P. BALL, A.C. DIBBLE, and A.A. REZNICEK. *Carex* section *Ovales* (Knuth) Christ, Flora of North America (In review).

PACKER, J.G. and R. WHITKUS. 1982. Chromosome number reports LXXV. Taxon 31:342–368.

REZNICEK, A.A. and P.E. ROTHROCK. 1997. *Carex molestiformis* (Cyperaceae), a new species of section *Ovales* from the Ozark Mountain region. Contr. Univ. Michigan Herb. 21:299–308.

ROTHROCK, P.E. and A.A. REZNICEK. 1996a. Chromosome numbers in *Carex* section *Ovales* (Cyperaceae) from eastern North America. Sida 17:251–258.

ROTHROCK, P.E. and A.A. REZNICEK. 1996b. A new species of *Carex* section *Ovales* (Cyperaceae) occurring in the Ozark Mountain region. Brittonia 48:104–110.

TANAKA, H. 1942. Chromosome studies in Cyperaceae. XX. Chromosome numbers of *Carex* (*Vignea*–II). Med. and Biol. 2:220–224.

WAHL, H.A. 1940. Chromosome numbers and meiosis in the genus *Carex*. Amer. J. Bot. 27:458–470.

WHITKUS, R. 1991. Chromosome counts of *Carex* section *Ovales*. Bot. Gaz. (Crawfordsville) 152:224–230.

VASCULAR PLANTS NEW TO KANSAS

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Recent field and herbarium studies have yielded 37 vascular plant taxa previously undocumented in Kansas. Seventeen of these are introduced and naturalized; the others are considered native to Kansas. Notes about these taxa are provided to update distribution data contained in the *Atlas of the Flora of the Great Plains* (1977) and the *Flora of the Great Plains* (1991) and to make these data more widely available to botanists working on the *Flora of North America* project. All voucher specimens are deposited in the R.L. McGregor Herbarium (KANU), University of Kansas, unless otherwise indicated.

Acalypha deamii (Weath.) H.E. Ahles (Euphorbiaceae).—*Acalypha deamii* occurs at scattered localities from the Ohio River valley west to Kansas. It typically grows in floodplain forests along rivers and streams. Geoffrey A. Levin, Illinois Natural History Survey, discovered a single sheet among KANU specimens of *Acalypha* while annotating material for the *Flora of North America* project in 1995. The collection site, in Chase County, was visited in 1995 but no *A. deamii* was found. A population of several dozen plants was discovered the following year in east-central Shawnee Co.

Voucher specimens: **KANSAS. Chase Co.:** Cottonwood Falls, 6.5 mi S, wooded area along Rock Creek, moist, rich soil, 12 Sep 1975, *Stephens 88044*. **Shawnee Co.:** T12S, R16E, sec 1, W 1/2, Tecumseh, 0.5 mi S, 0.5 mi W, elev 880–920 ft, floodplain forest with scattered limestone outcrops along Stinson Creek between US 40 & I-70, 27 Aug 1996, *Freeman 8172*.

Alyssum desertorum Stapf var. **desertorum** (Brassicaceae).—This small, introduced annual is an innocuous range weed throughout much of the western U.S. (Rollins 1993). In the northern Great Plains it is encountered on disturbed prairies, along roadsides, and in waste places, especially in the High Plains (Great Plains Flora Association 1991). A single population was discovered in northwest Kansas, where plants occupy a cemetery and shoulder of an adjacent gravel road.

SIDA 18(2): 593–604. 1998

Voucher specimen: **KANSAS. Thomas Co.:** T7S, R32W, sec 28, NW 1/4, NW 1/4, Gem, 0.25 mi SW, Gem Cemetery, elev 3090 ft, mowed, upland cemetery with some remnant shortgrass prairie, 24 Apr 1996, *Freeman 7939.*

Amaranthus californicus (Moq.) S. Watson (Amaranthaceae).—A number of sheets of this species recently were discovered among KANU specimens identified as *A. blitoides* S. Watson. *Amaranthus californicus* can be distinguished from *A. blitoides* by its smaller seeds (0.8–1.1 mm diameter vs 1.2–1.7 mm diameter) and fewer (1–3 vs. 4–5), scabrous, pistillate sepals (Henrickson 1993). California pigweed is a widespread native in the western U.S. and first was reported in the Great Plains based on a 1995 collection from Dawes Co., Nebraska, by Steve Rolfsmeier. We also have vouchers from South Dakota (Shannon Co.) and Texas (Deaf Smith, Gray, and Parmer cos.)

Voucher specimens: **KANSAS. Barton Co.:** Great Bend, 7 mi NE, area of Cheyenne Bottoms, along dry pond shore, 15 Aug 1977, *McGregor 30538.* **Morton Co.:** Elkhart, 6 mi N, 3 mi W, edge of dried pool, 13 Aug 1982, *McGregor 33603.* **Rush Co.:** Bison, 1 mi S, bank of Sand Creek, 15 Aug 1977, *McGregor 30541.* **Sherman Co.:** Goodland, 9 mi S, 3 mi W, Sherman County Lake, along lake shore, 15 Aug 1983, *McGregor 34742.*

Antennaria parvifolia Nutt. (Asteraceae).—Small-leaf pussy's-toes is a common, widespread, spring ephemeral in the northern and central Great Plains (Great Plains Flora Association 1991). Earlier collections document its range in the central Great Plains south to the near the north border of Kansas. The species is added to the Kansas flora based on two collections from the northwest part of the state.

Voucher specimens: **KANSAS. Norton Co.:** T5S, R24W, sec 23, SE 1/4, SE 1/4, NW 1/4, Lenora, SE edge of town in Lenora Cemetery, elev 2310–2320 ft, hill above Lost Creek, overlooking the floodplain of the North Fork Solomon River, site with remnant mixed grass prairie vegetation, 8 May 1997, *Freeman 8786*; T5S, R22W, sec 8, W 1/2, NW 1/4, NE 1/4, Edmond, 1 mi N, Edmond Cemetery, elev 2220 ft, level, upland, mowed cemetery E of draw dominated by mixed grass prairie, 8 May 1997, *Freeman 8795.*

Arabis hirsuta (L.) Scop. var. **adpressipilis** (M. Hopkins) Rollins (Brassicaceae).—Two varieties of hairy rockcress occur in the Great Plains. *Arabis hirsuta* var. *pycnocarpa* (M. Hopkins) Rollins has trichomes on the stem spreading and unbranched and occurs throughout the northern Great Plains southward into central Kansas. Variety *adpressipilis,* with appressed and forked stem trichomes, barely enters the southeastern Great Plains. It is the common variety throughout Missouri (Steyermark 1977) and occurs in extreme southeast Kansas at a single locality.

Voucher specimen: **KANSAS. Cherokee Co.:** T34S, R25E, sec 35, NW 1/4, NE 1/4 & NE 1/4, NW 1/4, jct US 166 & KS 26, 1.5 mi N, Schermerhorn Park, elev 830–900 ft, rocky, oak-hickory forest on bluffs and uplands N of Shoal Creek, scattered along creek in NW part of park, 23 Apr 1992, *Freeman 4323.*

Armoracia lacustris (A. Gray) Al-Shehbaz & V.M. Bates (Brassicaceae).—Al-Shehbaz and Bates (1987) mapped the distribution of this aquatic perennial throughout the Great Lakes region, Midwest, lower Mississippi River valley, and at other widely scattered sites in the eastern U.S. A population discovered in southeast Kansas extends the western range of the species roughly 30 kilometers. Unfortunately, it was destroyed by construction activity shortly after it was discovered.

Voucher specimen: **KANSAS. Neosho Co.:** just S of South Mound in shallow body of water by road near railroad, 25 Jun 1995, *Holland 8358.*

Aster lateriflorus (L.) Britton var. **lateriflorus** (Asteraceae).—This aster erroneously has been attributed to Kansas (Gates 1940; Great Plains Flora Association 1991; Gleason & Cronquist 1991) based on misidentified specimens of *A. ontarionis* Wiegand. It is fairly common in mesic forest and woodlands in Missouri (Steyermark 1977), and a population discovered during recent field studies in northeast Kansas confirms the species occurs in Kansas.

Voucher specimen: **KANSAS. Leavenworth Co.:** T8S, R22E, sec 15, SE 1/4, Ft. Leavenworth Military Reservation, W-central part, slopes ESE of Wagner Point, elev 900–1050 ft, mesic, oak-hickory-maple-basswood forest and small, xeric, tallgrass prairie remnants on ridge E of Sheridan Drive, 3 Oct 1995, *Freeman 7808.*

Atriplex prostrata Bouchér ex DC. (Chenopodiaceae).—An examination of KANU *Artriplex* specimens by Steve Rolfsmeier, University of Nebraska, revealed *A. prostrata*, an introduced, European annual previously undocumented in Kansas. Kansas specimens all had been mistaken for *A. patula* L., which appears to be rare in the Great Plains.

Voucher specimens: **KANSAS. Barton Co.:** T18S, R12W, sec 9, NW 1/4, SW 1/4, Cheyenne Bottoms, pool 3, dry, flat, exposed, vegetation sparse, 18 Jul 1985, *Brooks 17543 & Laushman.* **Edwards Co.:** Kinsley, 2 mi E, floodplain of Arkansas River, wet, sandy soil, 5 Oct 1972, *Stephens 63220.* **Ford Co.:** Dodge City, 5 mi E, low bank of Arkansas River, moist, sandy soil, 18 Sep 1973, *Stephens 73993.* **Gray Co.:** Cimarron, 0.5 mi S, bank of Arkansas River, brushy, weedy, moist, sandy soil, 4 Aug 1971, *Stephens 50414.* **Kearny Co.:** Lakin, 4 mi NE, dry bottom of Lake McKinney, sandy, silty soil, 10 Aug 1975, *Stephens 87379.*

Berberis thunbergii DC. (Berberidaceae).—Japanese barberry is cultivated widely as a hedge plant and ornamental. During recent field surveys of the Ft. Leavenworth Military Reservation in northeast Kansas, widely scattered plants were encountered in open woods and mesic forests.

Voucher specimens: **KANSAS. Leavenworth Co.:** T8S, R22E, sec 15, SE 1/4, Ft. Leavenworth Military Reservation, W-central part, elev 900–1050 ft, mesic, upland, oak-hickory-maple-basswood forest on slopes SE of Wagner Point, steep draws with few limestone outcrops, 18 May 1995, *Freeman 7132*; T8S, R22E, sec 23, SE 1/4, Ft. Leavenworth Military Reservation, SE corner along Corral Creek, E and W along Grant Ave., elev 770–800 ft, open banks of creek and wooded riparian area immediately W of Grant Ave., 12 Oct 1995, *Freeman 7867.*

Bromus nottowayanus Fernald (Poaceae).—Nottoway brome grows in mesic forests from southern Quebec south to northern Georgia and east to eastern Texas (Pavlick 1995). It may be confused with *B. pubescens* Muhl. ex Willd., from which it is distinguished by its sericeous lower leaf sheaths and densely pilose collars. A population of *B. nottowayanus* discovered in northeast Kansas extends its range westward from Missouri. At the site, it grows in close proximity with *B. pubescens*. However, *B. nottowayanus* is strictly confined to the narrow floodplain of a small, upland, intermittent stream in mesic, oak-hickory forest, whereas *B. pubescens* is much more widespread, occupying gentle slopes and ridges throughout the forest.

Voucher specimen: **KANSAS. Leavenworth Co.:** T8S, R22E, sec 11, NW 1/4, Ft. Leavenworth Military Reservation, central part ENE of Hancock Hill at Fort de Cavaginal Picnic Area, elev 860–1000 ft, mesic to dry-mesic, oak-hickory forest on hills and bluffs above Missouri River, 21 Jul 1995, *Freeman 7448.*

Calibrachoa parviflora (Juss.) D'Arcy (Solanaceae).—Streamside petunia is a prostrate annual known to occur throughout the southern U.S. and tropical America (Correll & Johnston 1970; Nee 1993), with historical collections north to Oregon (Halse 1996). A large population was discovered in central Kansas where it occurs in seasonally wet basins. This is the northernmost locality for the species in the Great Plains. It is possible that this species has been overlooked in the Great Plains due to the ephemeral nature of its habitat.

Voucher specimen: **KANSAS. Barton Co.:** T18S, R12W, sec 7, SW 1/4 & sec 8, E 1/2, Hoisington, 2 mi S, 5 mi W, Cheyenne Bottoms Nature Conservancy Reserve, near Rush Lake, elev 1960 ft, barren, dry basins in grazed, seasonally wet, *Pascopyrum-Distichlis* grassland, soil clayey, 17 Jun 1997, *Morse 1586 & Loring.*

Chenopodium pumilio R. Br. (Chenopodiaceae).—Ridged goosefoot is an annual plant native to Australia and reported over much of the eastern U.S., southeastern Oklahoma, much of Texas, and on the West Coast (Gleason & Cronquist 1991; Hatch et al. 1990; Wilken 1993). A central Kansas collection extends its range some 270 kilometers westward from Missouri.

Voucher specimen: **KANSAS. Reno Co.:** T22S, R7W, sec 10, NE 1/4, Nickerson, 9011 N Riverton Rd., common in farm yard, 1 Sep 1992, *Foster s.n.*

Digitalis lanata Ehrh. (Scrophulariaceae).—Grecian foxglove is a biennial or perennial sometimes grown as an ornamental or cultivated for the production of digitalis, a drug used as a cardiac stimulant (Moe & Farah 1975). It is a native of the Balkan Peninsula, Hungary, and Romania. In 1994 it was reported in southeast Kansas by a landowner in whose scrub-oak woodland pasture plants were very common and spreading rapidly. This is the only report of this species naturalizing and becoming noxious in North America. Since 1995, the Plant Health Division, Kansas Department of Agriculture, has been attempting to eradicate the plant, a task made difficult by the large seed bank apparently present at the site.

Voucher specimens: **KANSAS. Wilson Co.:** T28S, R14E, sec 7, SE 1/4, SE 1/4, Fredonia, 6 mi N, 4 mi W, sandy scrub oak pasture, common over ca 20 acres, May 1994, *Vaughn s.n.*, 27 Jun 1994, *McGregor 41110 & Russell*, 8 Jun 1995, *McGregor 41121.*

Dirca palustris L. (Thymelaeaceae).—Leatherwood grows on rocky slopes and along floodplains in mesic, deciduous forests in the eastern U.S. and southeastern Canada. A thriving population discovered in extreme eastern Kansas extends the range of this shrub nearly 120 kilometers westward from central Missouri (Steyermark 1977). The plants first were discovered around 1990 when a site analysis was conducted and land use plans were being developed for the Overland Park Arboretum and Botanical Gardens, which now occupies the site.

Voucher specimen: **KANSAS. Johnson Co.:** T14S, R24E, sec 25, S 1/2, SE 1/4 & sec 26, N 1/2, NE 1/4, jct US 69 & US 169, 6 mi S, 1 mi W, Overland Park Arboretum and Botanical Gardens, elev 900–1000 ft, mesic, oak-hickory forest on NE-facing slope S of Wolf Creek and small limestone glades above steep limestone outcrops, 8 May 1998, *Freeman 10700.*

Elaeagnus umbellata Thunb. (Elaeagnaceae).—Autumn olive is an Asian species planted in the U.S. as an ornamental and for wildlife habitat. Scattered, mature plants occupy clearings and disturbed sites on the Ft. Leavenworth Military Reservation in northeast Kansas. The first collections from noncultivated plants in Missouri were made in the late 1980s, but the species is believed to be naturalized in most Missouri counties and is a serious pest (Smith 1997).

Voucher specimen: **KANSAS. Leavenworth Co.:** T8S, R22E, sec 11, NW 1/4, Ft. Leavenworth Military Reservation, central part ENE of Hancock Hill at Fort de Cavaginal Picnic Area, elev 860–1000 ft, mesic to dry-mesic, oak-hickory forest on hills and bluffs above Missouri River, open, disturbed areas along roads and trails, several dozen scattered shrubs, 21 Jul 1995, *Freeman 7441.*

Elodea bifoliata H. St. John (Hydrocharitaceae).—This aquatic macrophyte, which is native to parts of the Great Plains, Rocky Mountains, and Pacific Northwest, is added to the Kansas flora based on specimens annotated in 1995 by Robert R. Haynes, University of Alabama. The three specimens originally were identified as *E. nuttallii* (Planch.) H. St. John, another member of the genus that occurs in a few, scattered localities in the state.

Voucher specimens: **KANSAS. Cheyenne Co.:** St. Francis, 9 mi SW, small seepage feed pool along Republican River beneath county road bridge, 5 Aug 1980, *Brooks 14822*; St. Francis, 4 mi SW, pool in South Fork Republican River, 15 Oct 1980, *McGregor 32079*; St. Francis, 3.5 mi SW, pool along South Fork Republican River, 16 Aug 1983, *McGregor 34761.*

Eragrostis pectinacea (Michx.) Nees var. **miserrima** (E. Fourn.) Reeder (Poaceae).—This variety (as *E. tephrosanthos* Schult.) was included in synonymy in the *Flora of the Great Plains* (Great Plains Flora Association 1991). However, following Reeder's (1986) treatment of the species, we have vouchers for var. *miserrima* from the following eastern Kansas counties: Allen, Anderson, Bourbon, Coffey, Douglas, Franklin, Jefferson, Labette, Leavenworth, Linn, Lyon, Marion, Miami, Morris, Osage, Shawnee, Wilson, and Woodson. The rangewide distribution of this variety is from Florida and the southern Gulf Coast west to southeastern Arizona and south through Mexico, Central America, and the West Indies (Koch 1974). Variety *pectinacea*, which is widespread in the U.S., Mexico, and Central America (Koch 1974), is common statewide.

Euonymus fortunei (Turcz.) Hand.-Mazz. (Celastraceae).—This climbing shrub is a frequently planted ornamental in eastern Kansas. Large, well-established, naturalized populations along the Missouri and Wakarusa Rivers in eastern Kansas recently have come to our attention. At these sites, *E. fortunei* forms dense, spreading carpets in the understory of disturbed floodplain forests. This species has been seen at numerous other sites in eastern Kansas, most of which have not been documented by vouchers. The varietal status of these plants has not been determined.

Voucher specimens: **Cherokee Co.:** T35S, R35E, sec 1, SE 1/4, NE 1/4, Baxter Springs, E side, Kiwanis Park, elev 200 m, weedy bottomland forest along Spring River, 30 Aug 1998, *Morse 2723*. **Douglas Co.:** University of Kansas West Campus, woodland west of Bridwell Lab, undisturbed for over 50 years, 16 Oct 1995, *McGregor 41197A, 41197B*. **Leavenworth Co.:** T8S, R22E, sec 23, SE 1/4, Ft. Leavenworth Military Reservation, SE corner along Corral Creek, E and W of Grant Ave, open banks of creek and wooded riparian area immediately W of Grant Ave, 12 Oct 1995, *Freeman 7868*. **Reno Co.:** T25S, R8W, sec 3, NW 1/4, SE 1/4, Arlington, 0.5 mi N, 0.75 mi W, elev 1590 ft, sandy, spring-run below a spring-fed pond on the S side of the North Fork Ninnescah River, trunks of largest vines 30–40 cm in diameter, other smaller vines scattered E of pond, 13 Jul 1997, *Freeman 8889*.

Eupatorium purpureum L. var. **holzingeri** (Rydb.) E. Lamont (Asteraceae).—Lamont (1990; 1995) distinguished two varieties of widespread *Eupatorium purpureum* based on leaf pubescence. Variety *purpureum* has glabrous or nearly glabrous abaxial leaf surfaces and occurs throughout most of the range of the species. In var. *holzingeri*, the abaxial leaf surface is densely and persistently puberulent to villose. This variety occurs largely in the Midwest and eastern Great Plains. An examination of specimens at KANU reveals both varieties are present in Kansas, with var. *purpureum* documented only from Cherokee Co. We have vouchers for var. *holzingeri* (Rydb.) E. Lamont from the following 21 counties; Allen, Anderson, Atchison, Bourbon, Cherokee, Coffey, Crawford, Doniphan, Douglas, Franklin, Jefferson, Johnson, Labette, Linn, Leavenworth, Miami, Neosho, Osage, Shawnee, Woodson, and Wyandotte.

Leptochloa uninervia (J. Presl) Hitchc. & Chase (Poaceae).—Mexican sprangletop is added to the Kansas flora based on a single specimen annotated in 1990 by Neil Snow, Washington University. This is the only Great Plains record of this grass, which generally ranges from southern Texas south into Central and South America (Gould 1975).

Voucher specimen: **KANSAS. Rice Co.:** T21S, R9W, sec 21, NE 1/4, SW 1/4, Alden, 2.75 mi S, S side of Arkansas River, sandy river floodplain, open, 14 Sep 1983, *Brooks 17036*.

Lespedeza bicolor Turcz. (Fabaceae).—This perennial legume was introduced from Asia and now is naturalized throughout much of the southeastern U.S. (Isely 1990). A small, persistent population found in eastern Kansas extends the range of the species more than 300 kilometers from localities in eastern Missouri (Mühlenbach 1979) and northern Arkansas (Smith 1988).

Voucher specimen: **KANSAS. Douglas Co.:** T13S, R18E, sec 8, N 1/2, SE 1/4, W side of Clinton Reservoir, Woodridge Public Use Area, elev 1000–1010 ft, weedy, annually mowed, reseeded tallgrass prairie, scattered wet depressions, 16 Sep 1996, *Morse 1077*, 9 Oct 1996, *Morse 1109*.

Loeflingia squarrosa Nutt. subsp. **texana** (Hook.) Barneby & Twisselm. (Caryophyllaceae).—This diminutive, native annual grows in sandy soil from east-central Texas north to north-central Oklahoma, with widely disjunct populations in Dawes Co., Nebraska (Barneby & Twisselmann 1970) and Weston Co., Wyoming (Hartman et al. 1985). Smyth (1898) reported it from Wichita Co., Kansas, but no voucher has been located. The discovery of a population in southwest Kansas supports its inclusion in the state's flora.

Voucher specimen: **KANSAS. Clark Co.:** T34S, R23W, sec 35, S 1/2, Ashland, 11 mi S, 0.5 mi W, Dunne Ranch, SE part, elev 1850–1870 ft, sandy, mixed grass prairie on S side of the Cimarron River, 28 Apr 1998, *Freeman 10588*.

Lupinus argenteus Pursh var. **argenteus** (Fabaceae).—Silvery lupine is a common species on rocky, mixed grass and shortgrass prairies throughout the High Plains (Great Plains Flora Association 1977, 1991). A population found in northwest Kansas is nearly 200 kilometers from the nearest locations in western Nebraska and eastern Colorado.

Voucher specimens: **KANSAS. Rawlins Co.:** T5S, R35W, sec 7, E 1/2 & sec 8, W 1/2, McDonald, ca 11 mi S, 6 mi E, N-S trending draw on the S side of Beaver Creek, E of the Dewey Ranch, elev 3200–3300 ft, grazed, upland, shortgrass prairie and rocky slopes below outcrops of the Ogallala Formation, 20 Jun 1990, *Freeman 3135*, 30 May 1991, *Freeman 3522 & Brooks*.

Malus coronaria (L.) Mill. var. **coronaria** (Rosaceae).—Wild crab apple is a low shrub or small tree of thickets and woods in the northeastern U.S. (Gleason & Cronquist 1991). A small, presumably native population was discovered in extreme eastern Kansas. This species has been documented in scattered counties in Missouri (Steyermark 1977), including Jackson and Clay, which are just east of the Kansas locality.

Voucher specimen: **KANSAS. Wyandotte Co.:** T11S, R25E, sec 34, NW 1/4, Roeland Park, N side of town, Rosedale Park, elev 850–950 ft, open, oak-hickory forest on predominantly N-facing slopes S of Turkey Creek, forest slightly to moderately disturbed, 4 May 1998, *Freeman 10698*.

Malus floribunda Siebold ex Van Houtte (Rosaceae).—This handsome, nonnative, ornamental tree is cultivated widely in eastern Kansas. It is added to the flora based on a collection from the east-central part of the state.

Voucher specimen: **KANSAS. Douglas Co.:** University of Kansas West Campus, brushy woodland SW of greenhouse, area originally an open wooded pasture, undisturbed for 45 years, 7 Apr 1995, *McGregor 41140.*

Paspalum dissectum (L.) L. (Poaceae).—This mat-forming grass grows along muddy streambanks, ditches, and the margins of ponds in the southeast U.S. and in Cuba (Gould 1975; Steyermark 1977). Populations in southeast Kansas extend the range of the species westward 120 kilometers from the nearest Missouri sites (Steyermark 1977).

Voucher specimens: **KANSAS. Woodson Co.:** T26S, R14E, sec 11, Woodson County State Lake, on dry lake shore flats, common, 13 Oct 1988, *McGregor 39793;* T25S, R15E, sec 15, SW 1/4, Yates Center, ca 0.25 mi SW, moist area in drained lake bed, 2 Sep 1993, *McGregor 41064.*

Polygonum cespitosum Blume var. **longisetum** (Bruijn) Steward (Polygonaceae).—This introduced, Asian annual has been reported from several localities along the Missouri River in Iowa and Nebraska (Great Plains Flora Association 1991). Mitchell and Dean (1978) report the species has spread rapidly in the U.S. since the 1940s. In recent years, populations in two northeast Kansas counties have come to our attention. In 1998, it was observed to be an abundant weed in pots and on the grounds of a plant nursery in Douglas County, Kansas.

Voucher specimens: **KANSAS. Douglas Co.:** Lawrence, E of Heatherwood Drive, 100 m NW of Heatherwood and 22nd Street, disturbed area behind Shannon Plaza Apartments, 23 Oct 1996, *Kaderly 15.* **Leavenworth Co.:** T8S, R23E, sec 18, NW 1/4, Ft. Leavenworth Military Reservation, E-central part, Missouri River floodplain, 1 mi ENE of S end of Sherman Army Airfield, elev 765 ft, open, silty river bank and mesic, floodplain forest, 3 Oct 1995, *Freeman 7779;* T8S, R22E, sec 23, SE 1/4, Ft. Leavenworth Military Reservation, SE corner along Corral Creek, E and W of Grant Avenue, open banks of creek and wooded riparian area immediately W of Grant Avenue, 12 Oct 1995, *Freeman 7864.*

Rhamnus cathartica L. (Rhamnaceae).—Common buckthorn is a European shrub or small tree cultivated in the U.S. as a hedge plant. It has become naturalized and occasionally weedy in parts of the eastern U.S. and southern Canada (Elias 1980; Smith 1997). Scattered, small trees were discovered in a disturbed forest in extreme eastern Kansas.

Voucher specimen: **KANSAS. Wyandotte Co.:** T11S, R25E, sec 34, NW 1/4, Roeland Park, N side of town, Rosedale Park, elev 850–950 ft, open, oak-hickory forest on predominantly N-facing slopes S of Turkey Creek, 4 May 1998, *Freeman 10677.*

Schoenoplectus californicus (C.A. Mey.) Soják (Cyperaceae).—A single specimen of California bulrush was discovered among KANU specimens of *Schoenoplectus* in 1993 by S. Galen Smith, University of Wisconsin-Whitewater, while he was annotating specimens for the *Flora of North America* project. As far as we are aware, this is the only record of this taxon in the Great Plains. It differs from other members of the *Schoenoplectus lacustris* complex (*S. tabernaemontani* (C.C. Gmel.) Palla, *S. acutus* (Muhl. ex Bigelow)

Á. Löve & D. Löve, and *S. heterochaetus* (Chase) Soják) in having bluntly trigonous culms near the inflorescence, leaf blades lacking or up to 2 mm long, strap-like floral bristles, and smooth floral scales. In the U.S., *Schoenoplectus californicus* is distributed discontinuously from the southern Atlantic Coastal Plain west to California.

Voucher specimen: **KANSAS. Barber Co.:** 2 mi SE of Sun City, edge of creek bank, 4 Aug 1959, *McGregor 14712.*

Shepherdia argentea (Pursh) Nutt. (Elaeagnaceae).—Smyth (1892), Hitchcock (1899), and Gates (1940) listed buffaloberry in Kansas, but we are unable to locate a voucher substantiating the historical occurrence of this species in the state. This is a common, widespread shrub in the northern half of the Great Plains. A small population in northwest Kansas confirms its presence in Kansas and extends the species' range south from Nebraska roughly 40 kilometers.

Voucher specimen: **KANSAS. Rawlins Co.:** T4S, R36W, sec 32, ca 8.5 mi S, 5.5 mi E of McDonald, SE-trending canyon that joins Beaver Creek to the S, elev 3100–3160 ft, grazed, upland, shortgrass prairie and canyons with extensive outcrops of the Ogallala Formation, restricted to a ca 50 yd stretch of the N bank of Beaver Creek, 19 Sep 1990, *Freeman 3248 & Brooks.*

Sida rhombifolia L. (Malvaceae).—No other reports of this pantropical annual, which occurs sporadically in ruderal sites in the eastern U.S. (Fryxell 1985; Gleason & Cronquist 1991), are known for the Great Plains. When it was collected, the land owner reported the population had been present at least 10 years. It is not known if this population persists.

Voucher specimen: **KANSAS. Shawnee Co.:** Topeka, backyard of home at 1916 SW Atwood, lawn weed at edge of garden, known from the site for at least 10 years, 5 Oct 1992, *Coleman s.n.*

Stellaria pallida (Dumort.) Crép. (Caryophyllaceae).—Lesser chickweed first was reported for North America by Morton (1972), who collected it in North Carolina. Rabeler (1997) reported it for Texas and noted that it had been found in nearby southeastern states, including Arkansas and Tennessee. Our field and herbarium studies reveal this annual weed of lawns and disturbed areas occurs in 84 Kansas counties. In the past it has been misidentified as the ubiquitous *Stellaria media* (L.) Vill., common chickweed. Rabeler (1997) considered *S. pallida* to be a probable recent introduction, but specimens indicate it has been in Kansas at least 67 years. The oldest collections we have seen are deposited at the Kansas State University Herbarium (KSC): a 1931 collection from Lyon Co. and a 1946 collection from Cherokee Co.

Tridens ×oklahomensis (Feath.) Feath. (Poaceae).—Oklahoma tridens is a naturally occurring, sterile hybrid between *Tridens flavus* (L.) Hitchc. and *T. strictus* (Nutt.) Nash (Crooks & Kucera 1973). It currently is known from two sites in southeast Kansas, and additional field studies likely will reveal other populations where the parent species are sympatric.

Voucher specimens: **KANSAS. Labette Co.:** Parsons, near the arboretum, native-like area, 2 Oct 1995, *Holland 8560.* **Neosho Co.:** St. Paul, 1 mi N, open pasture, growing with *Tridens strictus,* 19 Oct 1995, *Holland 8583.*

Trifolium incarnatum L. (Fabaceae).—Records of crimson clover in the Great Plains are based on infrequent escapes from plantings (Great Plains Flora Association 1991). This showy, European legume was found at a single locality in east-central Kansas where the land owner reports it has persisted for at least four years.

Voucher specimen: **KANSAS. Douglas Co.:** T12S, R19E, sec 21, E 1/2, SW 1/4, jct KS 10 & US 40 (W of Lawrence), 1.5 mi N, 1.5 mi E, elev 890–960 ft, disturbed, oak-hickory woodland on N-S ridge between two unnamed tributaries to Baldwin Creek, mowed path on E side of ridge, 5 May 1998, *Freeman 10699.*

Veronica biloba L. (Scrophulariaceae).—Two-lobe speedwell, an annual introduced from western Asia, has been reported in the Great Plains from ruderal sites along the Front Range of the Rocky Mountains (Great Plains Flora Association 1991) and from two recent collections in Nebraska. It is added to the Kansas list based on a collection in north-central Kansas.

Voucher specimen: **KANSAS. Ottawa Co:** T11S, R4W, sec 1, SE 1/4, Minneapolis, S edge of town in Markley Grove Park, elev 1240 ft, wooded floodplain on S side of Solomon River, woods dominated by *Quercus macrocarpa,* understory mostly mowed, 6 May 1997, *Freeman 8675.*

Veronica hederifolia L. (Scrophulariaceae).—Ivy-leaf speedwell is a widely introduced, European species known from three previous collections in the Great Plains: two in Nebraska and one in South Dakota (Great Plains Flora Association 1977, 1991). Populations discovered in Lawrence, Kansas, in 1993 and 1995 are persisting.

Voucher specimens: **KANSAS. Douglas Co.:** T12S, R19E, sec 31, Lawrence, NW of the University of Kansas campus, W side of Emery Rd, ca 30 ft S of jct with Sigma Nu Place, disturbed, open, wooded, weedy, E-facing slope, 17 Apr 1993, *Freeman 4761*; 4 May 1993, *Freeman 4778*; T13S, R20E, sec 6, NW 1/4, NW 1/4, Lawrence, alley on W side of Tennessee just S of corner of 16th and Tennessee, dominant ground cover along alley and behind house at 1627 Tennessee, 24 Apr 1995, *Morse 203*; Clinton Lake, lawn of headquarters office, 20 Apr 1997, *McGregor 41252.* **Franklin Co.:** In Ottawa, lawn of city park, 19 Apr 1997, *McGregor 41250.*

Veronica persica Poir. (Scrophulariaceae).—Bird-eye speedwell is another widely introduced, European annual known from a few sites in the Great Plains. It was inadvertently omitted from the *Flora of the Great Plains* (Great Plains Flora Association 1991), although it has been documented in Iowa, Nebraska, South Dakota, and Wyoming. A 1975 collection from western Kansas went unnoticed until recently, and it is not known if the species still occurs at the site.

Voucher specimen: **KANSAS. Scott Co.:** Scott City, park at south edge of city, scattered in lawn, 26 Jul 1975, *McGregor 27516.*

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REFERENCES

AL-SHEHBAZ, I.A. and V. BATES. 1987. *Armoracia lacustris* (Brassicaceae), the correct name for the North American lake cress. J. Arnold Arbor. 68:357–359.

BARNEBY, R.C. and E.C. TWISSELMANN. 1970. Notes on *Loeflingia* (Caryophyllaceae). Madroño 20:398–407.

CORRELL, D.S. and M.C. JOHNSTON. 1970. *Manual of the vascular plants of Texas*. Texas Research Foundation, Renner.

CROOKS, P. and C.L. KUCERA. 1973. *Tridens* x *oklahomensis* (*T. flavus* x *T. strictus*), an interspecific sterile hybrid in the Eragrosteae (Gramineae). Amer. J. Bot. 60:262–267.

ELIAS, T.S. 1980. The complete trees of North America: field guide and natural history. Van Nostrand Reinhold Co., New York, NY.

FRYXELL, P.A. 1985. *Sida* sidarum - V. The North and Central American species of *Sida*. Sida 11:62–91.

GATES, F.C. 1940. Flora of Kansas. Agric. Exper. Sta., Kansas State Coll. Agric., Manhattan.

GLEASON, H.A. and A. CRONQUIST. 1991. Manual of vascular plants of northeastern United States and adjacent Canada. New York Botanical Garden, Bronx.

GOULD, F.W. 1975. The grasses of Texas. Texas A&M University Press, College Station.

GREAT PLAINS FLORA ASSOCIATION. 1977. Atlas of the flora of the Great Plains. Iowa State University Press, Ames.

GREAT PLAINS FLORA ASSOCIATION. 1991 (second printing). Flora of the Great Plains. University Press of Kansas, Lawrence.

HALSE, R. 1996. Noteworthy collections: Oregon. Madroño 43:98.

HARTMAN, R.L., B.E. NELSON, and K.H. DUEHOLM. 1985. Noteworthy collections: Wyoming. Madroño 32:125–128.

HATCH, S.L., K.N. GANDHI and L.E. BROWN. 1990. Checklist of the vascular plants of Texas. Texas Agric. Exp. Sta. MP-1655. Texas A & M Univ., College Station.

HENRICKSON, J. 1993. Solanaceae. In: J.C. Hickman, ed. The Jepson manual: Higher plants of California. University of California Press, Berkeley.

Hitchcock, A.S. 1899. Flora of Kansas; a series of maps illustrating the distribution of flowering plants by counties. Kansas State Agric. Coll., Manhattan.

ISELY, D. 1990. Vascular flora of the southeastern United States. vol. 3, pt. 2: Leguminosae (Fabaceae). University of North Carolina Press, Chapel Hill.

KOCH, S.D. 1974. The *Eragrostis pectinacea-pilosa* complex in North and Central America (Gramineae: Eragrostoideae). Illinois Biol. Monogr. 48:1–74.

LAMONT, E.E. 1990. A new combination in *Eupatorium* section *Verticillata* (Asteraceae). Phytologia 69:467–468.

LAMONT, E.E. 1995. Taxonomy of *Eupatorium* section *Verticillata* (Asteraceae). Mem. New York Bot. Gard. 72:1–66.

MITCHELL, R.S. and J.K. DEAN. 1978. Polygonaceae (buckwheat family) of New York state. New York State Mus. Bull. 431:1–79.

MOE, G.K. and A.E. FARAH. 1975. Digitalis and allied cardiac glycosides. In: L.S. Goodman and A. Gilman, eds. The pharmacological basis of therapeutics. MacMillan Publishing

Co., Inc. New York, NY.

MORTON, J.K. 1972. On the occurrence of *Stellaria pallida* in North America. Bull. Torrey Bot. Club 99:95–103.

MÜHLENBACH, V. 1979. Contributions to the synanthropic (adventive) flora of the railroads in St. Louis, Missouri, USA. Ann. Missouri Bot. Gard. 66:1–108.

NEE, M. 1993. Solanaceae. In: J.C. Hickman, ed. The Jepson manual: Higher plants of California. University of California Press, Berkeley.

PAVLICK, L. 1995. *Bromus* L. of North America. Royal British Columbia Mus., Victoria, BC.

RABELER, R.K. 1997. *Cerastium pumilum* and *Stellaria pallida* new for Texas. Sida 17:843–845.

REEDER, J.R. 1986. Another look at *Eragrostis tephrosanthos* (Gramineae). Phytologia 60:153–154.

ROLLINS, R.C. 1993. The Cruciferae of continental North America: Systematics of the mustard family from the arctic to Panama. Stanford University Press, Stanford, CA.

SMITH, E.B. 1988. An atlas and annotated list of the vascular plants of Arkansas. Published by the author, Fayetteville, AR.

SMITH, T.E., ed. 1997. Missouri vegetation management manual. Missouri Dept. of Conservation, Jefferson City, MO.

SMYTH, B.B. 1892. Checklist of the plants of Kansas, 2nd ed. Crane & Co., Topeka, KS.

SMYTH, B.B. 1898. Additions to the flora of Kansas. Trans. Kansas Acad. Sci. 15:60–73.

STEYERMARK, J.A. 1977. Flora of Missouri. Iowa State University Press, Ames.

WILKEN, D.H. 1993. *Chenopodium*. In: J.C. Hickman, ed. The Jepson manual: Higher plants of California. University of California Press, Berkeley.

NEW AND NOTEWORTHY ANGIOSPERM RECORDS FOR IOWA

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Recent field work in Iowa has resulted in the discovery of three angiosperms previously unknown in the state and populations of nine other angiosperms that are rare. Eight of the 12 species are considered native in Iowa. Most populations were discovered during field surveys that are part of an effort to complete a comprehensive flora of Bremer County, located in northeast Iowa. One species excluded from the Iowa flora by recent workers should be reinstated based on a 1998 collection in the state and an older herbarium specimen at the R.L. McGregor Herbarium (KANU), University of Kansas.

NEW STATE RECORDS

Eleocharis intermedia (Muhl.) Schult. (Cyperaceae).—A number of authors have included Iowa within the range of this cespitose spike-rush (Rydberg 1932; Svenson 1957; Mohlenbrock 1976; Gleason & Cronquist 1991); however, it was not listed for the state by Eilers and Roosa (1994). A small population discovered along the Cedar River in 1997 supports its inclusion in the state's flora.

Voucher specimen: **IOWA. Bremer Co.:** T92N, R14W, sec 22, SW 1/4, SW 1/4 & sec 21, SE 1/4, SE 1/4, Waverly, 0.5 mi W, 1.5 mi N, Cedar Bend Conservation Park, E end, drying mud flats along the Cedar River, 7 Oct 1997, *Freeman 10198* (ISC, KANU).

Rumex stenophyllus Ledeb. (Polygonaceae).—Eilers and Roosa (1994) excluded this introduced species from their checklist, stating that reports of the taxon in Iowa were unsubstantiated. It was mapped in Harrison County, Iowa, in the *Atlas of the Flora of the Great Plains* (Great Plains Flora Association 1977) based on a voucher at KANU, and it recently was collected at a second locality in the state.

Voucher specimens: **IOWA. Bremer Co.:** T91N, R14W, sec 2, SE 1/4 NW 1/4, Waverly, E side of town, open, disturbed railroad right-of-way just S of Bremer Avenue, 18 Jul 1998, *Freeman 11090* (ISC, KANU). **Harrison Co.:** 3 mi SE of Modale, margin of farm pond, exposed, weedy, wet, 17 Aug 1974, *Brooks 8173, McGregor & Stephens* (KANU).

Sida 18(2): 605–609. 1998

Spergularia marina (L.) Griseb. (Caryophyllaceae).—This diminutive, introduced, annual weed occurs sporadically in central North America and more commonly along the coasts (Rossbach 1940). A small population was discovered in 1991 in a disturbed, grassy site at the edge of a sidewalk in a rest area along Interstate 35. More plants were discovered in a grassy median in the parking lot of the same rest area in 1995. Annual visits reveal this population is persisting.

Voucher specimens: **IOWA. Clarke Co.:** roadside rest area along I-35, ca 2 mi W & 2 mi S of Osceola, W side of interstate, 2 Sep 1991, *Freeman & Freeman 4124* (KANU); 5 Sep 1995, *Freeman & Freeman 7766* (ISC, KANU).

NOTEWORTHY RECORDS

Astragalus distortus Torr. & A. Gray var. **distortus** (Fabaceae).—Bent milk-vetch is documented in 11 southeastern and eastern Iowa counties; however, extant populations occur in only six of these (Roosa et al. 1989). The species typically is associated with sand prairies (Eilers & Roosa 1994) and is a special concern plant (Iowa Administrative Code 571 1994). A small, degraded, sandy prairie remnant in a cemetery north of Janesville supports roughly two-dozen plants of this species. Despite the small size of this population, many individuals produced fruits in the spring of 1998. This is the first report of the species from the county.

Voucher specimen: **IOWA. Bremer Co.:** T91N, R14W, sec 35, NE 1/4, NE 1/4, NE 1/4, Janesville, 0.5 mi N, Oakville Cemetery, mowed, sandy, upland cemetery E of the Cedar River, 24 May 1998, *Freeman 10757* (ISC, KANU).

Besseya bullii (Eaton) Rydb. (Scrophulariaceae).—Eastern kittentail is a Midwest endemic found on dry prairie ridges, in woodlands, and along sandy river terraces (Roosa et al. 1989). It has been documented in more than a dozen eastern and north-central Iowa counties, including Bremer County. It is a threatened species in the state (Iowa Administrative Code 571 1994). A new population of fewer than 20 individuals was discovered in Bremer County in 1997, and because the population is small, a voucher specimen was not collected. Instead, a photograph was taken and serves as the voucher for this population.

Voucher specimen: **IOWA. Bremer Co.:** T91N, R14W, sec 21, W 1/2, Janesville, 2 mi N, 2.5 mi W, Shell Rock Greenway, Shell Rock Access, mesic floodplain forest along a tributary to the Shell Rock River and small area of remnant tallgrass prairie along an old road right-of-way, 3 Jun 1997, *Freeman s.n.* [photographic vouchers] (KANU).

Carex conoidea Schkuhr ex Willd. (Cyperaceae).—Field sedge is a special concern plant in Iowa (Iowa Administrative Code 571 1994). It is documented from Black Hawk, Bremer, Fayette, Linn, and Scott counties in eastern Iowa (Mark Leoschke, pers. comm.; Roosa et al. 1989). A second Bremer County population recently was discovered in a mesic prairie growing with *C. bicknellii* Britton, *C. cristatella* Britton, *C. sartwellii* Dewey, and *C. stricta* Lam.

Voucher specimen: **IOWA. Bremer Co.:** T92N, R13W, sec 29, NE 1/4, NE 1/4, NE 1/4, Bremer, 1.1 mi S, elev 1000 ft, small, mesic, upland, tallgrass prairie remnant along intermittent stream on W side of blacktop, soil rich and loamy, infrequent, 19 Jun 1998, *Freeman 11055* (ISC, KANU).

Carex siccata Willd. (Cyperaceae).—The only previous record of this sedge in Iowa is a 1936 collection from Clay County (Gilly 1946; Roosa et al. 1989), where it was reported as *C. foenea* Willd. However, the name *Carex foenea* has been misapplied in much of the literature (Cronquist et al. 1977; Gleason & Cronquist 1991). While I have not seen the voucher cited by Gilly (1946), his key and description match *C. siccata* rather than *C. foenea*. True *C. foenea* is a member of section *Ovales* and occurs north of Iowa. *Carex siccata*, a member of section Arenariae, is widely distributed in the northern U.S. and southern Canada (Cronquist et al. 1977). It is listed (as *C. foenea*) as presumed extirpated by Roosa et al. (1989) and is a special concern plant (Iowa Administrative Code 571 1994). A small population was discovered in a sand prairie remnant along the Wapsipinicon River, where *Stipa spartea* Trin. is the dominant species. Common species at the site are *Dichanthelium depauperatum* (Muhl.) Gould, *Euphorbia corollata* L., *Plantago patagonica* Jacq. var. *patagonica*, *Poa pratensis* L., *Lespedeza capitata* Michx., *Rumex acetosella* L., and *Vulpia octoflora* (Walter) Rydb.

Voucher specimens: **IOWA. Bremer Co.:** T92N, R12W, sec 2, E 1/2, Tripoli, 1.5 mi E, Sweet Marsh Wildlife Management Area, S end, small, sandy prairie remnant on the E side of the Wapsipinicon River, 4 Jun 1997, *Freeman 9018* (KANU); 16 Jun 1997, *Freeman 9234* (KANU, ISC).

Floerkea proserpinacoides Willd. (Limnanthaceae).—This weak, forest annual is reported only from Dubuque County (Eilers & Roosa 1994). It is a species of special concern (Iowa Administrative Code 571 1994). A large colony was discovered in a narrow, forested, creek floodplain southeast of Waverly.

Voucher specimen: **IOWA. Bremer Co.:** T91N, R13W, sec 16, NW 1/4, SW 1/4, Waverly, 3 mi E, 1.5 mi S, rich, mesic, upland, maple-basswood forest and oak-hickory forest on slopes along Baskins Creek and its tributaries, large colony along floodplain of creek, 24 May 1997, *Freeman 8947* (ISC, KANU).

Geum vernum (Raf.) Torr. & A. Gray (Rosaceae).—Spring avens is reported from five Iowa counties, mostly in the southern third of the state (Eilers & Roosa 1994). It is a species of special concern (Iowa Administrative Code 571 1994). Scattered plants were discovered in northeast Bremer County in 1997, the first record for the county.

Voucher specimen: **IOWA. Bremer Co.:** T93N, R11W, sec 13, N 1/2, NE 1/4, Sumner, 1 mi N. 0.5 mi E, North Woods County Park, mesic, maple-basswood-hickory forest E of the Little Wapsipinicon River and clearings in the forest, infrequent, 4 Jun 1997, *Freeman 9049* (ISC, KANU).

Platanthera flava (L.) Lindl. var. **herbiola** (R. Br.) Luer (Orchidaceae).—This orchid has been reported in low, mesic prairies and sedge meadows in eight counties scattered in the eastern third of the state (Roosa et al. 1989), including Bremer County. It is endangered in Iowa (Iowa Administrative Code 571 1994). Two populations were discovered in the Wapsipinicon River drainage in Bremer County. One population of less than a dozen individuals (*Freeman 9685*) was found in a formerly pastured, sedge meadow. This appears to be the first record of the species at this site. The second population (*Freeman 11020*) is much larger, comprising more than 100 individuals scattered in a 2-acre area of mesic tallgrass prairie on the north end of the Sweet Marsh Wildlife Management Area. This population first was discovered in 1993 by Mark Leoschke of the Iowa Department of Natural Resources (John Pearson, pers. comm.).

Voucher specimens: **IOWA. Bremer Co.:** T92N, R11W, sec 20, NW 1/4 & sec 19, NE 1/4, Tripoli, 2.5 mi S, 4 mi E, Wapsi Greenbelt, Buhr Access, open sedge meadow S of Bremer Co. C33 and E of the Wapsipinicon River, 7 Aug 1997, *Freeman 9685* (KANU); T92N, R12W, sec 27, SE 1/4, SE 1/4, SE 1/4, Tripoli, 1 mi N, 1 mi E, Sweet Marsh Wildlife Management Area, N side, mesic to wet-mesic prairie W of the East Fork Wapsipinicon River, 18 Jun 1998, *Freeman 11020* (ISC, KANU).

Platanthera psycodes (L.) Lindl. (Orchidaceae).—Purple fringed orchid has been documented in 10 counties in northeast and east-central Iowa where it typically grow in mesic prairies, sedge meadows, and fens (Roosa et al. 1989). Nekola (1990) reported populations from two sites in Bremer County. Recently, one additional site for this threatened species (Iowa Administrative Code 571 1994) was discovered in the same county. A photographic voucher was taken due to the small size of this population.

Voucher specimen: **IOWA. Bremer Co.:** T92N, R11W, sec 20, NW 1/4 & sec 19, NE 1/4, Tripoli, 2.5 mi S, 4 mi E, Wapsi Greenbelt, Buhr Access, open sedge meadow S of Bremer Co. C33 and E of the Wapsipinicon River, 7 Aug 1997, *Freeman 8033-8036* [photographic vouchers] (KANU).

Potentilla intermedia L. (Rosaceae).—This European native previously was reported only from Black Hawk County, Iowa (Eilers & Roosa 1994). A small population was discovered in 1997 in adjacent Bremer County.

Voucher specimen: **IOWA. Bremer Co.:** T91N, R14W, sec 2, N 1/2, SE 1/4, Waverly, SE side of town along the Cedar River in Brookwood Park, mesic floodplain forest and clearing along the river, infrequent along gravelly trail, 16 Jun 1997, *Freeman 9205* (ISC, KANU).

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REFERENCES

CRONQUIST, A., A.H. HOLMGREN, N.H. HOLMGREN, J.L. REVEAL and P.K. HOLMGREN. 1977.

Intermountain flora: vascular plants of the Intermountain west, U.S.A. Vol. 6; the monocotyledons. Columbia Univ. Press. New York, NY.

EILERS, L.J. and D.M. ROOSA. 1994. The vascular plants of Iowa. Univ. Iowa Press. Iowa City.

GILLY, C.L. 1946. The Cyperaceae of Iowa. Iowa State Coll. J. Sci. 21:55–151.

GLEASON, H.A. and A. CRONQUIST. 1991. Manual of the vascular plants of the north-eastern United States and adjacent Canada. New York Bot. Gard. Bronx.

GREAT PLAINS FLORA ASSOCIATION. 1977. Atlas of the flora of the Great Plains. Iowa State Univ. Press. Ames, IA.

IOWA ADMINISTRATIVE CODE 571. 1994. Chapter 77: endangered and threatened plant and animal species. Iowa Dept. Nat. Resources. Des Moines.

MOHLENBROCK, R.H. 1976. The illustrated flora of Illinois. Sedges: *Cyperus* to *Scleria*.Southern Illinois Univ. Press. Carbondale.

NEKOLA, J.C. 1990. Rare Iowa plant notes from the R.V. Drexler Herbarium. J. Iowa Acad. Sci. 97: 55-73.

ROOSA, D.M., M.J. LEOSCHKE, and L.J. EILERS. 1989. Distribution of Iowa's endangered and threatened vascular plants. Iowa Dept. Nat. Resources. Des Moines.

ROSSBACH, R.P. 1940. *Spergularia* in North and South America. Rhodora 42:57–83, 105–143, 158–193, 203–213.

RYDBERG, P.A. 1932. Flora of the prairies and plains of central North America. New York Bot. Gard. Bronx.

SVENSON, H.K. 1957. *Eleocharis*. N. Amer. Fl. 18:509–540.

BOOK NOTICE

JOSEF J. HALDA. 1996. **The genus Gentiana by Josef J. Halda, Illustrated by Jarmila Haldová.** (ISBN 80-901846-6-9, hbk). Sen, Dobre. Available through: Harvy Wrightman, Rr#3, Kerwood Ontario, N0M 2B0, CANADA; Josef J. Halda, PO Box 110, Hradec Králové 2, 501 01, CZECH REPUBLIC. US$60.00 (hbk), $US50.00 (pbk) + US$10 p&h. 241 pp, 300 colored paintings on 32 plates.

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The contents of the book include: Introduction; Morphology; Cultivation; Propagation; Key to the subgenera; Synopsis of the Genus *Gentiana*; Sugenus *Gentiana*; Subgenus *Stylophora*; Subgenus *Otophora*; Subgenus *Pneumonanthe*; Subgenus *Newberryi*; Subgenus *Ciminalis*; Subgenus *Cruciata*; Subgenus *Phyllocalyx*; Subgenus *Frigida*; Subgenus *Monopodiae*; Subgenus *Isomeria*; Subgenus *Microsperma*; Subgenus *Stenogyne*; Subgenus *Calathianae*; Subgenus *Chondrophyllae*; Gentians hybrids and cultivars; Related genera; Species originally described as Gentians later transferred to the related genera; References; and Index.

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LUZIOLA PERUVIANA (POACEAE: ORYZEAE) PREVIOUSLY UNREPORTED FROM TEXAS AND A KEY TO TEXAS SPECIES

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Luziola peruviana Gmel. was collected June 28, 1997, while collecting wetland plant specimens at the J.D. Murphree Wildlife Management Area southwest of Port Arthur, Texas. *Luziola peruviana* was identified using Chase (1951), Allen (1975), and Terrell and Robinson (1974) and verified from specimens in the S.M. Tracy Herbarium (TAES).

Luziola peruviana has previously been reported to occur in western Florida (Chase 1951) but specimens were not examined by Hall (1978). Allen (1975) reported the species from Orleans and Plaquemine Parishes in Louisiana. A search of Texas floras and checklists does not render a report for this species (Correll & Johnston 1970; Gould 1975; Hatch et al. 1990. Jones et al. 1997).

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A KEY TO *LUZIOLA* IN TEXAS

1. Pistillate inflorescences a raceme or solitary spikelet, axillary; staminate inflorescences a raceme or panicle, terminal; culms 30–100 cm long, slender, floating-trailing; leaf blades 2–4 cm long, 2–4(–5) mm wide, flat, linear to lanceolate .... **L. fluitans**
1. Pistillate inflorescences a panicle, axillary, diffuse; staminate inflorescences a panicle, terminal; culms 21–35 cm long, slender, ascending; leaf blades 10–12 cm long, 2.5–3 mm wide, flat, linear .... **L. peruviana**

Luziola fluitans (Michx.) Terrell & H. Robinson, Bull. Torrey Bot. Club 101:235–245. 1974.

For a description see Gould (1975) under the synonym *Hydrochloa caroliniensis* Beauv.

Luziola peruviana Gmel. Syst. Nat. 2:637. 1791. (**Fig. 1**).

Plants monoecious, stoloniferous, aquatic. Culms 21–32(–35) cm long, slender, ascending; nodes often with a dark purple ring below. Leaves cauline; sheaths open, tessellate; ligules 5–11(–12) mm long, membranous, lacerate with 3-several hyaline, acuminate divisions; blades (those subtending pistillate inflorescences) 10–12 cm long, 2.5–3 mm wide, linear, flat, glabrous, margins serrulate. Spikelets unisexual, florets disarticulating at the base; glumes absent. Staminate inflorescences a panicle, terminal, narrow, exserted above leaves; staminate spikelets 5.3–6.5(–7) mm long, hyaline; lemmas 7-veined, erose; paleas 5-veined, sub-equal to lemmas; stamens 6; anthers 3–3.2 mm long, basifixed, yellow, visible through floret. Pistillate inflorescences a panicle, axillary, not exserted above the leaves, diffuse. Pistillate spikelets (1.8–)2.1–2.5 mm long, glabrous, ovoid, acuminate; lemmas 7-veined; paleas 5-veined, sub-equal to lemmas, loosely enclosing mature caryopses.

The species *L. peruviana* was flowering when collected in 0.6–0.75 m of water. The water temperature at the site was 28°C and the salinity 0.2 ppt (fresh water). The associated species included *Panicum repens* L., *Paspalum distichum* L., *Limnobium spongia* (Bosc.) Steud., *Hydrocotyle umbellata* L., *Alternanthera philoxeroides* (Mart.) Griseb., *Ludwigia peploides* H.B.K., and *Ludwigia uruguayensis* (Camb.) Hara.

Distribution.—In Texas, along coastal waterways of Jefferson County.

Specimens examined. **TEXAS. Jefferson Co.:** J.D. Murphree Wildlife Management Area, Big Hill Unit, 28 Jun 1997, *D. Rosen, S. Hatch, J. Thomas, J. Sutherlin 364* (TAES); *S. Hatch, D. Rosen, J. Thomas 6746* (BRIT, TAES); J.D. Murphree Wildlife Management Area, Big Hill Bayou, 3.5 mi S of the convergence with Taylor's Bayou, between compartments 4 & 5, 30 Jun 1997, *Thomas 73* (TAES), associated with *Panicum repens, Paspalum distichum,* and *Hydrocotyle umbellata.*

FIG. 1. *Luziola peruviana*. A. Plant. B. Pistillate spikelet. C. Staminate spikelet. D. Staminate inflorescence. E. Ligule. F. Pistillate inflorescence. (A-D and F, Chase 1951; E. J.E. Dawson III).

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REFERENCES

ALLEN, C.M. 1975. Grasses of Louisiana. Univ. of Southwestern Louisiana. Lafayette, LA.

CHASE, A. 1951. Hitchcock's manual of the grasses of the United States, 2nd. ed. U.S.D.A. Misc. Publ. No. 200. U.S. Government Printing Office, Washington, DC.

CORRELL, D.S. and M.C. JOHNSTON. 1970. Manual of the vascular plants of Texas. Texas Research Foundation, Renner, TX.

GOULD, F.W. 1975. The grasses of Texas. Texas A&M Univ. Press, College Station, TX.

HALL, D.W. 1978. The grasses of Florida. University of Florida, Ph.D. Dissertation, Gainsville.

HATCH, S.L., K.N. GANDHI, and L.E. BROWN. 1990. Checklist of the vascular plants of Texas. Texas Agric. Exp. Sta. Bull. MP-1655, College Station.

JONES, S.D., J.K. WIPFF, and P.M. MONTGOMERY. 1997. Vascular plants of Texas. University of Texas Press, Austin.

TERRELL, E.E., and H. ROBINSON. 1974. *Luziolinae*, a new subtribe of oryzoid grasses. Bull. Torrey Bot. Club 101:235–245.

LACTUCA SALIGNA (ASTERACEAE), A LETTUCE NEW FOR TEXAS

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Lactuca saligna L., willow-leaf lettuce, is a European native (Feráková 1976) naturalized in a variety of localities in the United States. It is usually described as a weed inhabiting roadsides, disturbed places, and waste areas. The species is widely known from the eastern U.S., with localities reported from near the east coast (North Carolina, South Carolina, Virginia) west to Arkansas, Michigan, Missouri, Ohio, Tennessee, and West Virginia (Robinson & Fernald 1908; Britton & Brown 1913; Fernald 1950; Gleason 1952; Gleason & Cronquist 1963, 1991; Steyermark 1963; Radford et al. 1968; Strausbaugh & Core 1978; Cronquist 1980; Smith 1988). Its spread has apparently occurred mainly during this century because it was reported by neither Watson and Coulter (1889), Britton and Brown (1898), nor Small (1903, 1913, 1933). Further, Strausbaugh and Core (1978) indicated that the species ". . . was not reported by Millspaugh [for West Virginia] in 1913, which may be an indication that it has spread widely since that time." It was, however, reported early in the century for Ohio by Robinson and Fernald (1908). A relatively late spread to the west is supported by Steyermark's (1963) statement that the species was first known from Missouri in 1932. In addition to the eastern United States, *Lactuca saligna* has been reported from the Great Plains (Iowa, Kansas, Nebraska, South Dakota—Great Plains Flora Association 1977; Barkley 1986) and California (Stebbins 1993). It

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FIG. 1. Habit of *Lactuca saligna* (Britton & Brown 1913).

is also known from Oklahoma (Taylor & Taylor 1994), with forma *ruppiana* (Wallr.) Beck [entire-leaved form] having been first reported from that state in 1972 (McGrath & Weedon 1974). In fact, *Lactuca saligna* is known from Bryan County, Oklahoma, just north of the Red River border with Texas (*J. Taylor 29740*, 28 Aug 1980, BRIT). However, despite this proximity, the species has not been previously reported from Texas (Correll & Johnston 1970; Stanford 1976; Hatch et al. 1990; Jones et al. 1997).

As part of the collecting efforr for the forthcoming *Shinners & Mahler's Illustrated Flora of North Central Texas* (Diggs et al.), a collection made in 1998 in Fort Worth (Tarrant County) is apparently the first documented occurrence of this species for Texas.

Voucher specimen: **TEXAS. Tarrant Co.:** weedy area in landscape, 301 Crestwood, Fort Worth, 21 Aug 1998, *O'Kennon 14252* (BRIT).

At the collection locality a single large individual was observed as a landscape weed. This plant was nearly two meters tall and more than a meter wide. Other populations have not been found in North Central Texas, and it is unclear whether the species will become more widely established. However, given that the species is known just north of the Red River and that in some areas of the Great Plains it is rather frequent (Great Plains Flora Association 1977; Ted Barkley, pers. comm.), it would not be surprising if

Lactuca saligna were already widespread but unnoticed in the state of Texas.

Lactuca saligna can be recognized by the following description (from original observations and from Radford et al. 1968; Feráková 1976; Barkley 1986; Stebbins 1993): Taprooted herbaceous annual (or rarely biennial?) 0.3–1(–2) m tall; latex white; stems erect, branched, usually glabrous or with remote bristles; cauline leaves linear to linear-lanceolate, entire to pinnatified with 1–2(–3) pairs of narrow, sometimes slightly toothed lobes, with sagittate-clasping base; midrib of leaf white, glabrous or with remote bristles abaxially; inflorescences spike-like panicles with numerous heads; involucres 10–18 mm high in fruit; corollas yellow (with bluish or purplish on the abaxial side), drying blue; ligules 4.5–5 mm long; body of achenes 3–3.6 mm long, ca. 1 mm wide, with 5–9 nerves on each face; beak of achenes filiform, usually 1.5–3 times as long as achene body; pappus white, the bristles ca. 4 mm long; $2n = 18$; flowering Jul–frost. The accompanying illustration (Fig. 1) is reprinted from Britton and Brown (1913).

While the Tarrant County individual has mostly pinnatifid lower and middle leaves and entire upper leaves, leaves in this species can vary greatly. According to Barkley (1986), "Three phases of *L. saligna* based on leaf morphology occur throughout its range. The phase with all leaves linear and entire, referred to by Fernald as f. [forma] *ruppiana* (Wallr.) G. Beck, will often occur in the same population with the phase that has all leaves pinnatifid. The phase with lower cauline leaves pinnatifid and upper cauline leaves linear and entire may be found with one or both of the other phases."

The six species of *Lactuca* occurring in the eastern two-thirds of Texas (excluding the two species limited to the Trans-Pecos) can be distinguished using the following key modified from those in Radford et al. (1968), Correll and Johnston (1970), Barkley (1986), and Stebbins (1993):

1. Beak of achenes (connecting achene body and pappus) stout, 0.5–1(–2) mm long OR absent; corollas blue or white; body of achenes 4–5 mm long .... **L. floridana (L.) Gaertn.**

1. Beak of achenes thread-like, 2–10 mm long; corollas usually yellow (rarely cream to pink or pale lavender); body of achenes of various lengths.
    2. Beak of achenes equal to or conspicuously longer than body of achenes; body of achenes ca. 1 mm wide, ca. 1/3 as thick as wide, 5- to 9-nerved on each face; plants annuals (or rarely biennials) with taproot; latex white.
        3. Leaves linear to linear-lanceolate, 0.3–5 cm wide, with narrow lobes OR lobes absent (except for basal lobes); margins of leaves or leaf lobes entire or remotely prickly-toothed; body of achenes without conspicuous bristles at base of beak; flowers 8–15 per head; abaxial midrib of leaves and lower stems glabrous or remotely bristly ... **L. saligna L.**
        3. Leaves lanceolate to ovate, oblong-elliptic, or obovate, 1–10(–15+) cm wide, with broad lobes; margins of leaves or leaf lobes usually conspicuously prickly-toothed; body of achenes with conspicuous bristles at base of beak; flowers 14–25 per head; abaxial midrib of leaves and lower stems usually with stiff bristles .... **L. serriola L.**

2. Beak of achenes equal to or shorter than body of achenes; body of achenes 1.6–3 mm wide, very flat, 1- to 3-nerved on each face; plants biennials with abundant, tufted, branching roots; latex brownish.
    4. Corollas very pale yellow to cream, pink, or pale lavender; lower leaves usually pinnately lobed; upper midstem leaves usually without a clasping base; body of achenes 2–2.5 times as long as wide; infrequent in sandy woods in eastern Texas .... **L. hirsuta Muhl. var. albiflora (Torr. & A. Gray) Shinners**
    4. Corollas usually yellow; lower leaves pinnately lobed OR not so; body of achenes 1.5–2 times as long as wide: widespread in various soils in Texas.
        5. Body of achenes 4.5–5 mm long, the achenes including beak 7–10 mm long; pappus bristles 7–10 mm long; involucres 13–22 mm long in fruit; upper leaf blades pinnately lobed, the margins conspicuously prickly-toothed .... **L. ludoviciana (Nutt.) Riddell**
        5. Body of achenes 3.5–4.5 mm long, the achenes including beak 4.5–6.5 mm long; pappus bristles 5–7 mm long; involucres 10–15 mm long in fruit; upper leaf blades usually not lobed, the margins entire to toothed but usually not prickly-toothed .... **L. canadensis L.**

REFFRENCES

BARKLEY, T.M. 1986. *Lactuca*. In: Great Plains Flora Association. Flora of the Great Plains. Pp. 838–1021. Univ. Press of Kansas, Lawrence. (Cites: Dille, D.P. 1976. A revision of the genus *Lactuca* in the Great Plains. M.S. thesis, Kansas State Univ., Manhattan)

BRITTON, N.L. and A. BROWN. 1898. An illustrated flora of the northern United States, Canada and the British possessions. Charles Scribner's Sons, New York.

______ and ______. 1913. An illustrated flora of the northern United States, Canada and the British possessions. The New York Botanical Garden, New York.

CORRELL, D.S. and M.C. JOHNSTON. 1970. Manual of the vascular plants of Texas. Texas Research Foundation, Renner.

CRONQUIST, A. 1980. Asteraceae. Vascular flora of the southeastern United States 1:1–261. The Univ. of North Carolina Press, Chapel Hill.

DIGGS, G.M. Jr., B.L. LIPSCOMB, and R.J. O'KENNON. Shinners & Mahler's illustrated flora of North Central Texas. To be published in early 1999 by the Botanical Research Institute of Texas, Fort Worth.

FERÁKOVÁ, V. 1976. *Lactuca*. In: T.G. Tutin, V.H. Heywood, N.A. Burges, D.M. Moore, D.H. Valentine, S.M. Walters, and D.A. Webb, eds. Flora Europaea, Vol. 4, Plantaginaceae to Compositae. Cambridge Univ. Press, Cambridge, England, U.K.

FERNALD, M.L. 1950. Gray's manual of botany, 8rh ed. Reprinted 1987. Dioscorides Press, Portland, OR.

GLEASON, H.A. 1952. The new Britton and Brown illustrated flora of the northeastern United States and adjacent Canada, 3 vols. New York Botanical Garden, Bronx.

______ and A. CRONQUIST. 1963. Manual of the vascular plants of northeastern United States and adjacent Canada. Van Nostrand Reinhold Company, New York.

______ and ______. 1991. Manual of the vascular plants of northeastern United States and adjacent Canada, 2nd ed. Van Nostrand Reinhold Company, New York.

GREAT PLAINS FLORA ASSOCIATION. 1977. Atlas of the flora of the Great Plains. Iowa State Univ. Press, Ames.

Hatch, S.L., K.N. Gandhi, and L.E. Brown. 1990. Checklist of the vascular plants of Texas. Texas Agric. Exp. Sta. Misc. Publ. No. 1655.

Jones, S.D., J.K. Wipff, and P.M. Montgomery. 1997. Vascular plants of Texas: A comprehensive checklist including synonymy, bibliography, and index. Univ. of Texas Press, Austin.

Magrath, L.K. and R.R. Weedon. 1974. New and interesting plants from the central plains states. Rhodora 76:489–491.

Radford, A.E., H.E. Ahles, and C.R. Bell. 1968. Manual of the vascular flora of the Carolinas. The Univ. of North Carolina Press, Chapel Hill.

Robinson, B.L. and M.L. Fernald. 1908. Gray's new manual of botany, 7th ed.: A handbook of the flowering plants and ferns of the central and northeastern United States and adjacent Canada. American Book Company, New York.

Small, J.K. 1903. Flora of the southeastern United States. Published by the author, New York.

______. 1913. Flora of the southeastern United States, 2nd ed. Published by the author, New York.

______. 1933. Manual of the southeastern flora. Univ. of North Carolina Press, Chapel Hill.

Smith, E.B. 1988. An atlas and annotated list of the vascular plants of Arkansas, 2nd ed. Published by the author, Fayetteville, AR.

Stanford, J.W. 1976. Keys to the vascular plants of the Texas Edwards Plateau and adjacent areas. Published by the author, Brownwood, TX.

Stebbins, G.L. 1993. *Lactuca*. In: J.C.Hickman, ed. The Jepson manual: Higher plants of California. Pp. 296, 301. Univ. of California Press, Berkeley.

Steyermark, J.A. 1963. Flora of Missouri. The Iowa State Univ. Press, Ames.

Strausbaugh, P.D. and E.L. Core. 1978. Flora of West Virginia, 2nd ed. Seneca Books, Inc., Grantsville, West Virginia.

Taylor, R.J. and C.E.S. Taylor. 1994. An annotated list of the ferns, fern allies, gymnosperms and flowering plants of Oklahoma, 3rd ed. Southeastern Oklahoma State Univ., Durant.

Watson, S. and J.M. Coulter. 1889. Gray's manual of the botany of the northern United States, including the district east of the Mississippi and north of North Carolina and Tennessee, 6th ed. American Book Co., NY.

BOOKS RECEIVED

SAMUEL SCHMIDT and GLORIA P. MACIAS, eds. 1997. **United States-Mexico Border Environmental Directory. Directorio Ambiental Fronterizo México-Estados Unidos.** 1996. (ISBN 968-6287-94-9, pbk). Universidad Autonoma de Ciudad Juarez, Lopez Mateos Norte Num. 20, 32310 Ciudad Juarez, Chihuahua, Mexico. Price not given. 389 Pp.

Contenido: Introduccion, Directorio, Índice de nombres en orden alfabético (Gobierno/Government; Organizaciones no gubernamentales/non; Governmental Organizations; Negocios/Business; Universidades/Universities; Estados/States; Instituciones/Institutions; and Miscelánea/Miscellaneous.

S.D. JONES, J.K. WIPFF, and P.M. MONTOGOMERY. 1997. **Vascular plants of Texas: A comprehensive checklist including synonymy, bibliography, and index.** (ISBN 0-292-74044-1, hbk). Univ. of Texas Press, P.O. Box 7819, Austin, TX 78713-7819. $55.00. 404 Pp.

Contents: Preface; Acknowledgment; Introduction; Format; Scientific Names: Species and Infraspecific Rank; Authors of Taxa; Common Names; Abbreviations and Special Designations; Conserved Names; Cultivated Plants; Endangered and Threatened Taxa; Federal Noxious Weeds; Hybrid Taxa; Misapplied Names; Orthography; State Symbols; Synonyms; Unpublished Names; Summary of Taxa; Summary Table; Checklist; Bibliography; and Index.

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PENSTEMON METCALFEI (SCROPHULARIACEAE), A VALID SPECIES

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In 1905, O.B. Metcalfe collected a Penstemon under spruce at the Lookout Mine in upper Trujillo Canyon in the Black Range of southern New Mexico (*Metcalfe 1605*, NMC!, NY!). Wooton and Standley (1909a) described it as *Penstemon puberulus* Woot. & Standl. Then, realizing that the specific epithet was previously used, they (1909b) proposed the new name, *Penstemon metcalfei* Woot. & Standl. Keck (1945) decided that *P. metcalfei* was synonymous with *Penstemon whippleanus* Gray, based on his examination of the NY specimen cited above. His only reservation was that the stem was puberulous, which differed from the typically glabrous stem of *P. whippleanus*.

In 1967, I collected a *Penstemon* under spruce beside the Black Range Crest Trail on Cross O Mtn (*Todsen s.n.*, NMC) and determined it to be *P. metcalfei* using Wooton and Standley's "Flora of New Mexico" (1915). This was the second time the taxon had been collected. Only later did I become aware that Keck had submerged it under *P. whippleanus*.

In the summer of 1995, I collected plants from the Cross O Mtn. Location (*Todsen 95-7-1*, NMC) and compared the live material with the type and isotype sheets at NMC. There was no significant morphological difference in plants from the two locations. At the same time, I collected *P. whippleanus* (*Todsen 95-7-7*, NMC) from the Sandia Mountains, the type

TABLE 1. Morphological differences between *P. metcalfei* and *P. whippleanus*.

Characteristics	P. metcalfei	P. whippleanus
Stem	Puberulous	Glabrous
Leaves	Entire	Toothed
Corolla	Pale blue-lavender	Deep red-purple
	Slightly gibbous	Abruptly gibbous
Lower Lip	Wider than long	Longer than wide
Staminode	Not or slightly exserted	Well-exserted
	Bearded 1/2 its length	Glabrous or with tuft
Stamens	Not explanate	Explanate

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locality, and compared that with the Cross O Mtn. Plants. Differences between the two are shown in Table 1. These characteristics put *P. metcalfei* in Keck's subsection *Graciles* rather than in subsection *Humiles* where he had placed *P. whippleanus*.

Later, when Crosswhite (1965a) was revising *Penstemon* section *Penstemon*, approximately equivalent to Keck's *Penstemon* section *Spermunculus*, he placed *P. whippleanus* in series *Whippleani* and retained series *Graciles*, equivalent to Keck's subsection *Graciles*. Crosswhite (1965b) also addressed a situation in series *Graciles*, where he divided the series into two "alliances," *Graciles* and *Oliganthi*, based on differences in distribution, habit, and habitat. *Penstemon metcalfei* falls within "alliance" *Oliganthi* as Crosswhite defined it.

I thank Richard Spellenberg for his many comments and suggestions.

REFERENCES

CROSSWHITE, F.S. 1965a. Subdivisions of *Penstemon* section *Penstemon*. Sida 2:160-162.

____. 1965b. Revision of *Penstemon* section *Penstemon* (Scrophulariaceae). II. A western alliance in series *Graciles*. Amer. Midl. Naturalist 74:429–442.

KECK, D.D. 1945. Studies in *Penstemon*. VIII. A cytotaxonomic account of the section *Spermunculus*. Amer. Midl. Naturalist 33:128–206

WOOTON, E.O. and P.C. STANDLEY. 1909a. Plants from New Mexico. Bull. Torrefy Club 36:112.

____ and ____. 1909b. A new name—*Penstemon metcalfei* Wooton & Standley. Torreya 9:145.

____ and ____. 1915. Flora of New Mexico. Contr. U.S. Natl. Herb. 19:579–586.

COMMENTS ON THE DISTRIBUTION OF *SEDUM PULCHELLUM* (CRASSULACEAE) IN TEXAS

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Sedum pulchellum Michx. is usually a succulent annual, but may occasionally be a perennial due to the production of secondary roots (Clausen 1975). Leaves of rosettes, when present, are spirally arranged, spatulate-linear, obtuse and slightly papillose at the apex. Leaves of floriferous stems are linear and subterete. Among the North American species, *S. pulchellum* is unique in that the leaves of floriferous stems have basal sagittate spurs (Clausen 1975). Flowers are pale pink, purplish-white, or white, 4-merous, sessile or subsessile, and occur primarily in 3-branched cymes. Peak flowering takes place in May and June, but sometimes as early as March.

According to Clausen (1975), *Sedum pulchellum* occurs on flat rock formations (typically limestone, sandstone, or chert) from NC Kentucky south to NW Georgia, west through N Alabama to Arkansas, Texas, Oklahoma, SE Kansas, Missouri, and S Illinois. Northern Mississippi is not included in Clausen's distribution, but the species is known from Oktibbeha County [*Brent 181* (IBE!); *Stauffer s.n.* (MISSA!)]. Recent collections of the species in the central part of the state and the lack of satisfactory documentation of its occurrence have prompted us to investigate the distribution in Texas. Correll and Johnston (1970) state that *S. pulchellum* occurs "In seepage on and about calcareous rocks in e. Tex...," while Hatch et al. (1990) list the species as a native plant of the Pineywoods and Blackland Prairies vegetational regions of the state. The species is not included in *Shinners' Manual of the Flora of North Central Texas* (Mahler 1988), although Clausen (1975) indicated its occurrence within the area treated by the work.

Clausen's (1975) distribution map gives the most thorough account of *Sedum pulchellum* in Texas. Unfortunately, his treatment presents certain

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problems. Foremost is the lack of an exsiccata list used in preparation of the map. He mentions that "A person desiring accurate information about species in any area not surveyed in detail in the present study should go to the area himself. The indication on maps that a species occurs in such an area should be sufficient notice." The scale of the map is such that it is difficult to determine the location of the sites. Additionally, points that could have been included, based upon dates of collections and presence in herbaria that were cited as being consulted, do not appear. This includes the Weches formation of San Augustine and Sabine counties in east Texas, an area from which the species is well known, and Grayson County in NC Texas. Nonetheless, after canvassing the herbaria cited by Clausen, it was possible to later verify all but two of the locations indicated on his map (see Fig. 1). A search of Clausen's documents in the Cornell University Archives yielded no additional information. These undocumented locations include one point in NE Texas, which, as best can be determined, is either in Red River or Bowie County. Considering the species documentation in nearby Lamar County and adjacent Oklahoma [McCurtain, Choctaw, and Bryan Counties (McGregor et al. 1977)], this particular occurrence is of minor significance. The other undocumented location given by Clausen, however, appears to be either in Burnet County or Llano County (or Blanco County?), an area visited by Clausen in 1970 (Clausen 1975). This unconfirmed record is far more notable because it appears to be on the Edwards Plateau, and therefore may be the most western point in the distribution of the species.

Additional field collections, a survey of herbarium specimens, and Clausen's (1975) distribution map in *The Sedum of North America* were used to document the expansion of the known distribution of *Sedum pulchellum* to include other counties of the Blackland Prairies and Pineywoods as well as the Post Oak Savannah, Cross Timbers and Prairies, and the Edwards Plateau.

Specimens examined: **TEXAS. Bell Co.:** Owl Creek Mts., ca. 0.8 air mi SSW of jct. of Preachers Creek and Owl Creek, Ft. Hood, 4 Jun 1992, *Carr 11984* (TEX); N side of Leon River ca. 0.7 mi ESE of center of Belton Dam, 1 May 1992, *Carr 11868*, *Enquist* & *McNeal* (TEX). **Bosque Co.:** at intersection of Brazos River & Cedar Creek, 97.32808 lat. 31.78761 long., 31 May 1998, *Branch 300* (BAYLU). **Coryell Co.:** Bluff over Leon River ca. 200 m W of Mother Neff State Park on property of Charlotte & Larry Weiss, 18 May 1996, *Holmes 8240* (BAYLU). **Grayson Co.:** E of Denison in field near creek running into Smith Creek, 18 May 1950, *Gentry 51-1430* (TEX). **Lamar Co.:** 2.25 mi N of Roxton, 21 May 1937, *Cory 23107* (GH). **Limestone Co.:** Hwy 14 and Pk. Rd. 35, Jun 1993, *Singhurst 1665*, *Jones*, & *Blair* (BAYLU). **Palo Pinto Co.:** 3.3 mi N of jct. Hwy 287 & FM 3027 on Hwy 287, 1.7 mi WSW of Grantham Cemetery, 11 Apr 1998, *Singhurst 6593* (BAYLU). **Sabine Co.:** Weches Formation ca. 4 mi W of Milam, 9 Apr 1964, *Correll* & *Correll 29088* (LL); ca. 1 mi W of jct. Hwy 21 and FR 226 on Hwy 21, 31 Mar 1980, *Nixon 10116* (ASTC); 1.4 mi E of jct. of Hwys 21 and 330, 12 May 1980, *Nixon 10534* (ASTC); on W side of TX 21 ca. 1.5 mi S of Geneva, 22 Apr 1987, *Orzell 5104* & *Bridges* (TEX). **San Augustine Co.:** Weches formation ca. 1 mi SE of San Augustine, 20 Apr 1962,

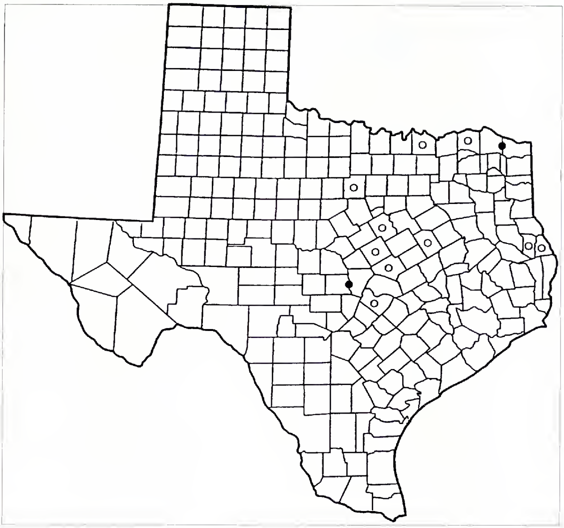

Fig. 1 Documented distribution of *Sedum pulchellum* by county in Texas. The closed circles represent locations cited by Clausen (1975) that could not be verified (see text for additional comments).

Correll 25003 (LL); old Hemphill Rd. just E of San Augustine, 10 May 1969, *Correll 37202* (LL); ca. 0.5 mi E of San Augustine on Hwy 21, S on a dirt road ca. 1.0 mi, 11 May 1979, *Nixon 9473, Marietta* & *Matos* (ASTC); ca. 1.0 mi S of Chapel Hill on Sanitary Landfill Rd., 15 Apr 1985, *Nixon 14423* (ASTC); 0.2 mi SW of road to Sunrise, 0.9 mi SE of jct. TX 21 at point 1.1 mi E of center of St. Augustine, 22 Apr 1987, *Orzell 5109* & *Bridges* (TEX). **Travis Co.:** near Jester Blvd., Jester Estates, Austin, 1 May 1995, *Miller s.n.* (TEX); Bull Creek, 11 Apr 1914, *Young s.n.* (TEX).

We wish to thank the curators of the following herbaria for supplying the specimens and other information that made this study possible: ASTC, BH, BM, CHRB, CLEMS, DUKE, F, GA, GH, IBE, K, MISSA, NLU, NY, NYS, PH, TEX, and US. Assistance provided by Thomas Clausen, the son of the late R.T. Clausen, and Nancy Dean of the Cornell University Archives was also greatly appreciated.

REFERENCES

CLAUSEN, R.T. 1975. *Sedum* of North America north of the Mexican Plateau. Cornell University Press: Ithaca, New York.

CORRELL, D.S. and M.C. JOHNSTON. 1970. Manual of the vascular plants of Texas. The University of Texas at Dallas: Richardson.

HATCH, S.L., K.N. GANDHI, and L.E. BROWN. 1990. Checklist of the vascular flora of Texas. Texas Agric. Exp. Sta. MP-1655, Texas A&M University, College Station.

MAHLER, W.F. 1988. Shinners' manual of the North Central Texas flora. Botanical Research Institute of Texas, Inc.: Fort Worth.

McGREGOR, R.L. 1977. Atlas of the flora of the Great Plains. Iowa University Press: Ames.

AGAVE PETROPHILA GARCÍA-MEND. & E. MARTÍNEZ, NOM. NOV. (AGAVACEAE)

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Agave petrophila García-Mend. & E. Martínez, nom. nov. BASÓNIMO: *Agave gracilis* García-Mend. & E. Martínez, Sida 18:227. 1998. Non *Agave gracilis* Jacobi, Abh. Schles. Ges. Vaterl. Cult. Abth. Naturwiss. 2:66. 1871. Nombre basado en una cultivada por van Houtte en Gante. Non *Agave gracillima* A. Berger, Die Agaven, 33, 288. 1915. BASÓNIMO: Agave gracilis A. Berger, Die Agaven, 33. 1915. = *Manfreda elongata* Rose.

Agave gracilis García-Mend. & E. Martínez es un homónimo posterior a las propuestas del mismo nombre por Jacobi, 1871 y Berger, 1915, por lo que con base en el artículo 58.1 del International Code of Botanical Nomenclature (1994), se reemplaza este nombre con un nuevo epíteto.

REFERENCIA

GARCÍA-M., A. y E. MARTÍNEZ. 1998. Una nueva especie de *Agave*, subgénero *Littaea* (Agavaceae) de Guerrero y Oaxaca, México. Sida 18:227–230.

AMELIA ANDERSON LUNDELL (1908-1998) BOTANICAL ARTIST AND FRIEND

RUTH ANDERSSON MAY

4920 Mangold Circle
Dallas, TX 75229, U.S.A.

Amelia Anderson Lundell, born December 21, 1908 in Fort Worth, who passed away in Dallas in her 90th year on August 27, 1998, gave much to the world of art and science. The Botanical Research Institute of Texas (BRIT) has many of her renditions of shells and wildflowers that she donated after the death of her husband, Cyrus Longworth Lundell, the posthumous recipient of BRIT's International Award of Excellence in 1994. She drew all the insects pictured in the Dallas Planting Manual. Amelia's Sand-Verbena (*Abronia ameliae* Lundell, Verbenaceae) is named for her. She and Cyrus found the undescribed endemic *Abronia* near the Texas coast on a collecting trip years ago. Many of her paintings of wildflowers are in a suite of rooms near the Rare Book Library of UT Austin. Amelia made exquisite needlework embroideries and enjoyed sewing for her granddaughters when they were babies. Her home was adorned with her artwork and she loved to cook. The following is one of her favorite recipes, always included in her collection of home baked Christmas cookies that were shared with friends.

AMELIA'S BUTTER FINGERS

2 cups flour
1 cup butter
1/2 cup whipping cream (not whipped)

Blend flour and butter. Add cream. Roll out and fold over, dusting lightly with sugar, four or more times. Cut in sticks. Brush top with egg white and sprinkle with sugar. Bake at 300 degrees for at least 20 minutes or more.

She was an honorary member of Founder's Garden Club (GCA) of Dallas, the Dallas Woman's Club, and the Dallas Garden Club. Her generosity made possible the handsome gift of the *Wildflowers of the United States* (Rickett 1966–1973, vols. 1–6) series of books to the Woman's Club library. This is a lasting memorial to a beloved, knowledgeable, and talented friend of botany.

Obituary
LUNDELL, AMELIA ANDERSON. Dallas Morning News. Obituaries, 34 A. Saturday, 29 August 1998.

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Abronia ameliae / Amelia's Sand-Verbena. Photograph by Robert J. O'Kennon.

Amelia Anderson Lundell at BRIT's International Award of Excellence in 1994 where her late husband was honored.

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VILLASENORIA (ASTERACEAE: SENECIONEAE): A NEW GENUS AND COMBINATION FROM MEXICO

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ABSTRACT

A new genus, *Villasenoria* (Asteraceae: Senecioneae), is described and a new combination, *Villasenoria orcuttii* (Greenm.) B.L. Clark, comb. nov., is proposed.

RESUMEN

Se describe un nuevo género, *Villasenoria* (Asteraceae: Senecioneae), y se propone una nueva combinación, *Villasenoria orcuttii* (Greenm.) B.L. Clark, comb. nov.

During the course of revising the traditional section *Terminales* Greenm. of the genus *Senecio* (Clark 1996), I had the opportunity to see an under-collected entity originally described by Greenman (1912) as *Senecio orcuttii*. This entity was subsequently included in the segregate genus *Telanthophora* by Robinson & Brettell (1974). With the collection of more specimens and better habitat information, it became evident that the entity is sharply distinct from the rest of *Telanthophora* and other groups of *Senecio*, s.l., and that it should be placed in its own genus. *Villasenoria* is described herein as a new genus to accommodate *Senecio (Telanthophora) orcuttii.*

The plants of the traditional section *Terminales* are shrubs and small trees mostly of middle elevations and the highlands of Mexico and Central America. As conceived by Greenman (1901), this section is distinguished by plants with stems that are abruptly contracted or foreshortened just below the terminal capitulescences, which are pedunculate clusters of corymbiform cymes. Studies by Robinson and Brettell in the 1970s led them to suggest that the Mexican and Central American species of the super-genus *Senecio* should be split into several segregate genera, and *Senecio* sect. *Terminales* Greenm. was split into two genera, *Pittocaulon* and *Telanthophora* (Robinson & Brettell 1973, 1974). Though slow to receive support in the literature, recent synthetic publications, e.g., Jeffrey (1992), Bremer (1994), and Barkley et al. (1996), have adopted these segregate genera.

Senecio orcuttii is an anomaly in either *Telanthophora* or *Pittocaulon* in that it has large principal leaves (to 7 dm long) that are pinnately compound, and the stems merely taper to the capitulescence. Moreover, the capitulescence

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is a loose, elongate cluster of numerous heads, without the distinctive corymbiform or dome-shaped aspect of the capitulescences of *Telanthophora* and *Pittocaulon.* The species is known only from limestone karst outcrops in rainforests from 100 to nearly 2000 m elevation in Chiapas, Oaxaca, and Veracruz, Mexico. On the other hand, species of *Pittocaulon* occur in seasonally dry scrublands of central and southern Mexico at 300–3250 m, while species *of Telanthophora* occur in cloud forests or mixed hardwood forests from central Mexico southward to Honduras, at 600–5000 m.

Pittocaulon, Telanthophora, and the new genus *Villasenoria* are separated by the following key:

KEY TO GENERA

1\. Leaves pinnately compound, the largest to 7 dm long overall; capitulescences elongate and neither corymbiform nor dome-shaped; plants single-stemmed, the stems tapering to the capitulescences; plants tree-like, achene surfaces papillate. .... **Villasenoria**

1\. Leaves variously entire to lobed but not compound, rarely more than 4 dm long overall; capitulescences of terminal, dome-shaped corymbiform cymes; plants single stemmed or multi-branched, with stems abruptly foreshortened below the capitulescence; shrubs or small trees; achene surfaces smooth, glabrous.

  2\. Leaves palmately veined, seasonally deciduous, mostly absent at flowering time; stems rubbery and subsucculent, with subepidermal resin ducts; pith chambered. .... **Pittocaulon**

  2\. Leaves pinnately veined, persistent; stems woody, without evident sub epidermal resin ducts; pith continuous. .... **Telanthophora**

Villasenoria B.L. Clark, gen. nov. TYPE SPECIES: *Villasenoria orcuttii* (Greenm.) B.L. Clark.

Herbae lignescentes, caule e radicibus fasciculatis fibrosis emisso. Apicem versus in inflorescentiam terminalem, corymbiformem vel paniculatum abeunti. Foloia pinnatim decomposita, infra inflorescentiam conferta. Capitula numerosa radiata; phyllaria (plus/minus) 8, inter se aequilonga, biseriata; flosculi quoad structuram microscopicam cum iis subtribui Tussalagineorum tribui Senecionearum congrui, superficie stigmatica trans interiorem styli ramulorum faciem continua; antherarum collum parum incrassatum sed cellulae basi haud auctae.

Plants erect, to 3.5 m tall, stems single, arising from a cluster of fibrous roots; leaves present just below the capitulescence, lower leaves deciduous. Stems terete with solid pith, glabrous but with circular to horseshoe-shaped leaf scars; bases of recently dropped leaves persistent; stems tapering to the capitulescence and not conspicuously foreshortened. Leaves alternate, pinnately compound, petiolate; blades oblong to ovate in outline, leaflets ovate or obovate to broadly lanceolate; adaxial surface lightly stromose-papillate to lightly pubescent. Capitulescences terminal, open-paniculiform to loosely corymbiform clusters of capitula, peduncles multibranching, with scattered linear-subulate bracts. Capitula numerous, radiate. Involucre narrowly campanulate to cylindrical; receptacle flat, naked or but shallowly alveolate, fistulose;

phyllaries 8(–9), biseriate, in an inner and an outer series, linear-lanceolate, slightly swollen or thickened at the base, inner phyllaries with scarious margins; calyculate bracts few and inconspicuous, linear. Ray florets 2–5, ligulate, pistillate, corollas yellow, tube cylindrical, lamina apex with 3 minute teeth, veins unbranched. Disk florets 16–23, corollas yellow, gradually to sometimes abruptly expanded upward, lobes 5. Anther bases sagittate, anther collars slightly swollen but the cells not basally dilated; endothecial cell walls with radial thickenings. Styles with stigmatic areas entire or weakly transitional, with morphologically distinctive cells in triangles at the bases of the stigmatic areas; apices unappendaged, truncate to conical, with fringing papillae of uniform length; stylopodia free. Achenes cylindrical, glabrous but with papillate projections; epidermal cells of pericarp oblong in surface view; carpopodia of 5–17 rows of thickened quadrate cells, margins regular to irregular; ovary walls with heterohexagonal and occasionally with acerose crystals. Pappus of numerous white, uniform, capillary hairs. Chromosome number unknown.

Etymology.—The genus name honors Dr. José Luis Villaseñor, a dedicated botanist of the Instituto de Biología, Universidad Nacional Autónoma de México, in Mexico City.

Villasenoria orcuttii (Greenm.) B.L. Clark, comb. nov. *Senecio orcuttii* Greenm. Field Mus. Bot. 2:350. 1912. *Telanthophora orcuttii* (Greenm.) H. Rob. & Brettell, Phytologia 27:428. 1974. Type: MEXICO. Veracruz: Omealca, near Córdoba, on limestone cliffs, 6 Apr 1910, *C.R. Orcutt 3150* (holotype: F!; isotype: MO!).

Additional specimens examined: **MEXICO: Chiapas:** de Tuxtla G. a Montecristo (N Tuxtla G.), 17 Nov 1949, *F. Miranda 5695* (MEXU). **Oaxaca:** San Felipe Usila, en cerro Casa de San Felipe de Usila, tipo veg. Selva alta perennifolia, suelo negro rocoso, elev. 250 m, 17 Oct 1989, *J.I. Calzada* 14977 (KSC); 5 km N of Huatla de Jimínez on road to Santa María Chilchotla, on steep slopes of calcareous rock, in rainforest remains along edge of coffee plantations, 18°09'N, 96°52'W, elev. 1200 m, 25 Mar 1992, *B.L. Clark, A. Salinas & J. I. Calzada 53* (KSC, MEXU); 5 km N of Huatla de Jiménez on road to Santa María Chilchotla, on steep slopes of calcareous rock, in rainforest remains along edge of coffee plantations, 18°09'N, 96°52'w, elev. 1200 m, 16 Mar 1994, *B.L. Clark & A. Campos V. 148* (KSC, MEXU), *149* (KSC, MEXU), *151* (KSC, MEXU); along road from Teotitlán del Camino to Chilchotla, 4.4 mi beyond turn-off to Huatla de Jiménez, steep slopes with huge boulders, a few native trees persisting in a coffee plantation, elev. 1980 m, 23 Feb 1979, *T.B. Croat 48378* (KSC, MO); Chilchotla, Huatla de Jiménez, bosque de encinos, suelo pedregoso, pardo-obscuro, 1200 msnm, 6 Apr 1975, *R. Hernández 2105* (MEXU). **Veracruz:** Axocuapán, selva media subperennifolia, elev. 450 m, 30 Dec 1988, *M. Cházaro, L. Robles, & J.L. Tapia 5793* (WIS); Jesús Carranza, km 6 del Camino Cedillo-Río Alegre, selva alta perennifolia, primaria y secundaria, suelo café claro arcilloso rocoso, 17°10'N, 94°40'W, elev. 150 m, 18 Jan 1975, *B. Dorantes 3905* (MEXU); Hidalgotitlán, km 3 del Camino Cedillo-La Laguna, selva alta perennifolia, primaria, suelo café claro arcilloso rocoso, elev. 150 m, 19 Jan 1975, *B. Dorantes 3971* (MEXU); Atoyac, 13 May 1937, *E. Matuda 1394* (MEXU, MICH); Hidalgotitlán, 3 km SW of Campamento La Laguna, selva alta perennifolia, original forest on isolated small fills of extreme limestone karst, surrounded by flat pastures with scattered remnant trees, 17°16'N, 94°32'W, elev. 100 m, 6 Mar 1984, *M. Nee 30011* (KSC, MO, NY); Motzorongo, mountain side, 11 Feb 1892, *J.G. Smith 135* (MO); Hidalgotitlán, 300 m W Campamento Hermanos Cedillo, parte alta cantiles Río Solosúchil, selva alta perennifolia, primaria, suelo cárstico, sobre suelo rocoso por completo, 17°16'N, 94°36'W, elev. 150 m, 1 Nov 1975, *B. Vásquez 1632* (MEXU); Coetzala, por el camino a Ceotzapotitla, selva alta subperennifolia, secundaria, suelo rojo amarillento con rocas aflorantes, 25 Apr 1976, *V. Vásquez 400* (MEXU); Córdoba, San Rafael, bosque de encino en ladera de cerro, elev. 900 m, 28 Mar 1979, *F. Ventura 15949* (MEXU); Hidalgotitlán, 0.6 km al E del Poblado 7, sobre camino a La Raya, afloramiento kárstica con selva perturbada de *Spondias, Bursera, Dialum*, etc., rodeada por acahual, 17°19'N, 94°31'20" W, elev. 130 m, 31 Mar 1981, *T. Wendt, et al. 3122* (MEXU); Minantlán, 13.7 km al E de La Laguna, sobre la terraceria a Uxpanapa, luego 6.2 km al N sobre el camino nuevo (no completo) a Belisario Domínguez, selva mediana con *Dialium*, en area kárstica con afloramientos de piedra, 17°19'30"N, 94°23'W, elev. 130 m, 11 Feb 1981, *T. Wendt, A. Villalobos, & D. Olmstead 2838* (MEXU).

ACKNOWLEDGMENTS

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REFERENCES

Barkley, T.M., B.L. Clark, and A.M. Funston. 1996. The segregate genera of *Senecio*, s.l., and *Cacalia*, s.l., in Mexico and Central America (Asteraceae: Senecioneae). In: D.J.N. Hind and H.J. Beentje, eds. Compositae: Systematics. Proceedings of the International Compositae Conference, Kew, 1994. 1:613–620. Royal Botanic Gardens, Kew, U.K.

Bremer, K. 1994. Asteraceae: cladistics & classification. Timber Press, Portland, Oregon.

Clark, B.L. 1996. A study of variation in *Senecio* Sect. *Terminales* Greenm. (Compositae: Senecioneae). Ph.D. dissertation, Kansas State University, Manhattan, Kansas.

Greenman, J.M. 1901. Monographie der nord- und centralamerikanischen Arten der Gattung Senecio. I. Teil. Allgemeines und Morphologie. Leipzig. 37 pp. Reprinted in Syst. Bot. Jahrb. 32:1–33. 1902.

__________. 1912. Diagnoses of new species and notes on other spermatophytes, chiefly from Mexico and Central America. Field Mus. Nat. Hist., Bot. Ser. 2:329–350.

Jeffrey, C. 1992. The tribe Senecioneae (Compositae) in the Mascarene Islands with an annotated world checklist of the genera of the tribe. Notes on Compositae. VI. Kew Bull. 47:49–109.

Robinson, H. and R.D. Brettell. 1973. Studies on the Senecioneae (Asteraceae). I. A new genus, *Pittocaulon*. Phytologia 26:451–452.

__________. 1974. Studies in the Senecioneae (Asteraceae). V. The genera *Psacaliopsis, Barkleyanthus, Telanthophora*, and *Roldana*. Phytologia 27:402–439.

PACKERA SUBNUDA COMB. NOV., A CORRECTED NAME FOR *PACKERA BUEKII* (ASTERACEAE: SENECIONEAE)

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ABSTRACT

The new combination, *Packera subnuda* (DC.) D.K. Trock & T.M. Barkley is proposed, based upon *Senecio subnudus* DC.

RESUMEN

Se propone la nueva combinación *Packera subnuda* (DC.) D.K. Trock & T.M. Barkley, en base a *Senecio subnudus* DC.

The North American entity once known as *Senecio subnudus* DC. and later as *Senecio cymbalarioides* H. Buek has a tangled nomenclatural history, especially when transferred to the segregate genus *Packera*. We reviewed these complexities (Trock & Barkley 1998) and proposed the new name, *Packera buekii* D.K. Trock & T.M. Barkley for this plant. Drs. K.N. Gandhi and John Strother have both pointed out that the nomenclatural session of the recent International Botanical Congress (Saint Louis, 1999) passed a rule which pertains to our *nomen novum*. The new rule is an addition to the present art. 53.6, & ex. 17, to be included in the forthcoming International Code of Botanical Nomenclature (ICBN). According to the concept of the new rule, a renamed legitimate homonym has priority over its *nomen novum* during a transfer to another genus. In this case, the basionym *Senecio subnudus* is legitimate in the segregate genus *Packera* and, therefore, the replacement name, *Packera buekii* is superfluous. The following new combination is proposed:

Packera subnuda (DC.) D.K. Trock & T.M. Barkley, comb. nov. BASIONYM: *Senecio subnudus* DC., Prodr. 6:428. 1837 (non *Senecio subnudus* DC, Prodr. 6:405. 1837, an African plant.). *Senecio cymbalarioides* H. Buek, Gen. Sp. Synon. Cand. 2:6. 1840 (non *Senecio cymbalarioides* Nutt., Trans. Amer. Phil. Soc. II. 7:412. 1841.). *Packera buekii* D.K. Trock & T.M. Barkley, Sida 18:387. 1998 (nom. superfl.).

REFERENCE

TROCK, D.K. and T.M. BARKLEY. 1998. Seven new nomenclatural combinations and a new name in *Packera* (Asteraceae: Senecioneae). Sida 18:385–387.

BOOK NOTICE

DOUGLAS B. EVANS. 1998. **The Cactuses of Big Bend National Park.** (ISBN 0-292-72098-x, hbk, 0-292-72099-8, pbk.) University of Texas Press, Box 7819, Austin, TX 78713-7819. $12.95. 82 Pp.

This book provides color photographs for the common cacti of this important national park. After a brief introduction and glossary, the book is divided into 12 chapters, arranged by genus, including *Ariocarpus, Coryphantha, Echinocactus, Echinocereus, Echinomastus, Epithelantha, Ferocactus, Glandulicactus, Mammillaria, Neolloydia, Opuntia*, and *Thelocactus*. Finally, the book ends with a list of cacti historically reported but not recently seen, or cacti that one would expect but have not as yet been found in the park.

The photographs are excellent, and the high quality, glossy paper accentuates their aesthetic value. The descriptions are pointed at the hobbyist but are practical and useful to everyone. Both common and scientific names are given for each species, and no precise localities are given, presumably to inhibit poachers. For some species, details about the ecological life history and elevational range is also given.

This is a wonderful, thrifty "coffee table" and field guide, and I highly recommend it to plant enthusiasts planning to visit the park, or working with the flora of Texas.—*John J. Pipoly III.*

A NEW SPECIES OF *PHASEOLUS* (FABACEAE) FROM WEST-CENTRAL MEXICO

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ABSTRACT

We report the existence of a new species, *Phaseolus albescens*, from western Mexico, with close affinities to *P. vulgaris*, *P. coccineus*, *P. costaricensis*, and particularly to *P. polyanthus*, and describe plants commonly occurring in wild habitats, examine morphological and anatomical characters and give notes on observations made on its floral biology. An illustration of the plant, photographs of its pollen, and stem anatomy are provided. Also, a key to the species of the *Phaseolus vulgaris* group is presented.

RESUMEN

Se reporta la existencia de una nueva especie, *Phaseolus albescens*, del occidente de México, especie afín a *P. vulgaris*, *P. coccineus*, *P. costaricensis*, y en particular a *P. polyanthus* y se describen plantas de esta especie de hábitats silvestres, se examinan caracteres morfológica y anatómicamente y se presentan notas sobre observaciones efectuadas a su biología floral. La especie se ilustra y se provee de figuras de su polen y anatomía del tallo. También, una clave de las especies del grupo *Phaseolus vulgaris* es presentada.

INTRODUCTION

Populations of *Phaseolus albescens* have been recognized as morphologically distinct for a decade (Delgado-Salinas 1988; Ramírez-Delgadillo 1991). Some of the differences were clearly detailed by McVaugh (1987), who treated this species as *Phaseolus*, aff. *P. coccineus* for the Flora Novo-Galiciana. Indeed, McVaugh (1987) recognized *Phaseolus albescens* as different, but nor convincingly so from *P. coccineus*. According to him, this plant is easily distinguished from sympatric wild plants of *P. coccineus* by the color of its flowers ["pale-lavender," "old-rose," or "pale rose-pink, fading yellowish"], and by "… less tendency for the flowering axes to be crowded towards the tip." He also compared it with *P. polyanthus* Greenman (also recognized as *P. coccineus*

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subsp. *darwinianus* or also as *P. coccineus* subsp. *polyanthus*), stating that this Nueva Galicia plant has shorter, ovate to lanceolate bracteoles and glabrate foliage.

During the course of a phylogenetic study of the genus *Phaseolus*, inferred from molecular data and non-molecular data (Delgado-Salinas et al. unpublished), three collections of *P. albescens* from west-central Mexico were shown to be clearly different from three samples of *P. polyanthus*, one wild collection from Guatemala, one cultivated from Puebla, and one escaped from Perú. *Phaseolus albescens* collections differ from those of *P. polyanthus*, by at least 51 pair-base mutations, 7 of which are transversions, and one deletion of 3 base pairs. In addition to these molecular characters, morphological differences observed during previous studies were shown to be distinguishing. Such characters included the floral bracteoles, flower color, and glabrate foliage. Also the *P. albescens* clade was restricted to a region north of the range of *P. polyanthus*.

In this paper information on the anatomy of the stem and on the floral biology of this species is brought into consideration and thus, the species is described and finally formalized below:

Phaseolus albescens McVaugh ex R. Ramírez & A. Delgado, sp. nov. (**Fig. 1**). *Phaseolus*, aff. *P. coccineus* sensu McVaugh, in McVaugh, Flora Novo-Galiciana 5:654–655. 1987. TYPE: MEXICO. JALISCO: Municipio de Ciudad Guzmán, Natanja Verde-La Retama, a 2 km sobre la deviación que va al Fresnito de la carretera Cd. Guzmán-El Grullo, N 19° 36' 59", O 103° 30' 54.7", 1640 m, 19 Nov 1996, *Delgado et al. 1705* (HOLOTYPE: MEXU; ISOTYPE: IBUG).

Phaseolus polyantho Greenman sylvestri affinis, sed differt bracteolis calycinis brevioribus, floribus lilacinis, postea albescentibus, demum lutescentibus, ovulis 4–5, et distributione geographica in Mexico occidentali.

Perennial herbaceous and woody vine, with secondary growth developed in basal stems, 2–3 cm in diameter, with corky appearance and displaying conspicuous rows of lenticels; root long and lignescent, non-tuberous; stems up to 10 m long, terete, leaning or twining, sparingly branched, covered with sparsely appressed and uncinate hairs. *Leaves* membranous and large, up to 30 cm; *stipules* triangular, ca. 5 mm long, ca. 3 mm wide at base, striate, lately caducous, horizontal to reflexed; *petioles* striate, sparsely strigose, up to 10 cm long, sometimes longer than leaflets, rachis up to 3.5 cm long; stipels ovate to lanceolate, ca. 5 mm long; leaflets entire, terminal ones, ovate to widely ovate, slightly oblique (lateral leaflets) at base, acute or acuminate at apex, apiculate, 8–15 cm long, ca. 10 cm wide, the lateral leaflets sometimes with domatia within its basal veins, sparsely strigose on both surface. *Inflorescences* in axillary pseudoracemes, glabrate or covered with uncinulated or appressed, antrorse hairs, 10–50 cm long, with 10-40 flowering nodes; buds 1–3 in each fascicle, 2 buds commonly flowering; primary bracts nar-

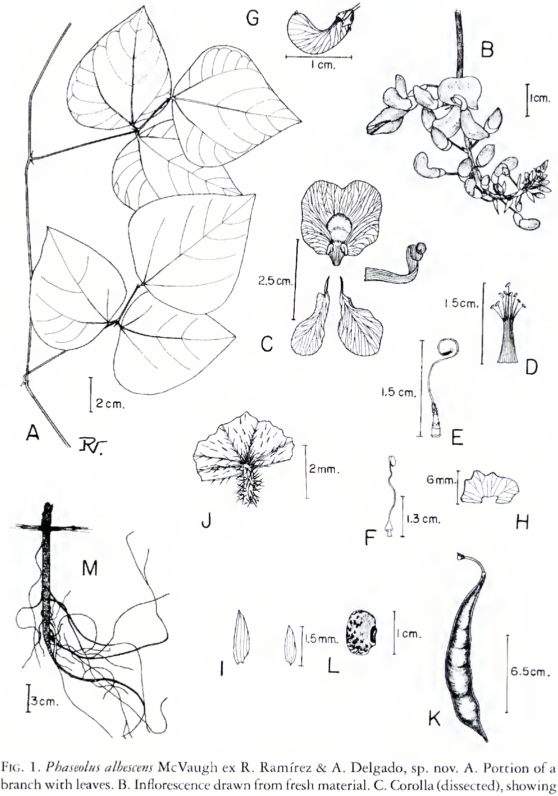


Fig. 1. *Phaseolus albescens* McVaugh ex R. Ramírez & A. Delgado, sp. nov. A. Portion of a branch with leaves. B. Inflorescence drawn from fresh material. C. Corolla (dissected), showing a standard, two wings, and the keel with two tight coils at the apex. D. Androecium. E. Gynoecium. F. Vexillary stamen. G. Flower bud. H, Calyx, dissected. I, Bracts and bracteoles. J. View of the base (amplified) of the terminal leaflet lower surface. K. Pod. L. Seed. M. Root. A–J, *Machuca N. 4708*; K–M, *Ramírez-Delgadillo 2537*.

rowly triangular to lanceolate, striate, persistent, 3–5 mm long, ca. 1 mm wide at base; secondary bracts narrowly triangular, horizontal or reflexed, ca. 2 mm long, 1 mm wide, subpersistent; pedicels thin, thicker at fruiting, 1.5–2 cm long; bracteoles shorter than the calyx, lanceolate, never falcate, slightly auricled at the base, 1–5-nerved, subpersistent, 3–4.5 mm long, ca. 1 mm wide; *flowers* ca. 2 cm long, with *calyx* obliquely campanulate, sometimes with a bulged upper base, tube sparsely strigillose on the outer and the inner surfaces, 5–6 mm long, upper lip emarginate, lower lip with 3 subequal, triangular lobes, ca. 1 mm long; *corolla* lilac fading to white, and later to yellow; standard oblong to orbicular, often little wider than long, 1–1.4 cm long, 0.9–1.2 cm wide, distal portion of outer surface setose, covered with appressed, minute hairs, on the inner surface the lamina shows a thickening at the point of reflexion, the surface between the bending point and the claw covered with micro-papillae, with two swollen appendages at each side of this basal portion, claw ca. 2 mm long; wings obovate, ca. 2 cm long, ca. 1 cm wide, constricted toward the base, upper basal margin round-auriculed with a lamellate surface, claw of wing ca. 5 mm long; keel ca. 1.5 cm long, claws 3 mm long, on distally 1.5 coiled, diameter ca. 3 mm; staminal tube biauriculed towards the base, with sub-basifixed anthers, vexillary or free stamen ca. 1.5 cm long, with a trapezoid-shaped appendage toward the base, its edge undulated; pollen tricolporate, brevicolpate, edge of the colpi reinforced by a margo, ectoaperture membrane granulated, endoaperture (on non-acetolyzed pollen) covered with a smooth operculum; exine with a distinctive sculpturing between the mesocolpium (foveolated-pisilated) and the apocolpium (rugulated)(Figs. 4–5, 8–9); ovaries with 4–5 ovules, strigose, pollen brush short and laterally-placed on the last coil of the style; *stigma* apical, sometimes slightly introrse. *Pods* linear, slightly curved, 7–9 cm long, ca. 1.2 cm wide, short tapered to tapered at base, and with a ca. 1 cm straight beak at the apex; valves chartaceous with narrowly thickened sutures, dehiscent, with a slightly glossy epicarp, light brown-yellowish coloured at maturity, sometimes purple-pigmented, striated, glabrate, (3) 4–5 seeded. *Seeds* 1–1.3 cm long, 7–8 mm wide, ca. 3 mm thick (weight of 100 seed, ca. 20 grams), reniform to sometimes quadrangular, compressed; testa glossy and tan to dark brown mottled and streaked; hilum ovate with a persistent ephilum, ca. 3 mm long, ca. 1.5 mm wide, rim aril prominent, micropylar area lighter than testa color; lens prominent, slightly divided in two. *Seedling* with epigeal germination; epicotyl pubescent; stipules bifid, petiole with basal and apical pulvini (3-portioned); eophylls simple, ovate with a cordate-truncate base, next leaves trifoliolate. Chromosome number, $2n = 22$, in root-tip cells, voucher: *Ramírez-Delgadillo 2553* (IBUG) (P. Mercado-Ruaro, pers. comm.).

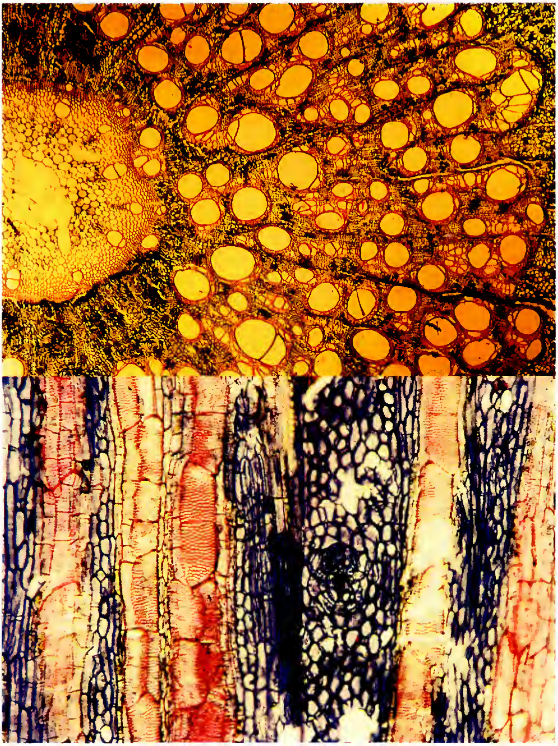
PARATYPES. **MEXICO. Colima:** Municipio de Colima. Rancho El Jabalí, aprox. a 20 km al N de la Cd. de Colima, cerca de la Hacienda San Antonio, 19° 26' N; 103° 40' W, 1,300 m, 7 Feb 1992, *Rico 921 y Martínez* (MEXU). **Guerrero:** Municipio de La Unión, 73 km al NE de Zihuatanejo, carretera Zihuatanejo-Ciudad Altamirano, 1,770 m, 2 Feb 1983, *Tenorio et al. 3237* (MEXU). **Jalisco:** Municipio de Cuautitlán, Sierra de Manantlán, (15–20 mi SE of Autlán) on the bajada south and west of the divide between Aserradero San Miguel and Durazno, 2,000–2,350 m, 6 Nov 1952, *McVaugh 13943* (MEXU; MICH); Arroyo San Miguel, 1.5 km al E de su desembocadura, ca. 1 km al S de Rincón de Manantlán, 19° 35' N; 104° 12' 30 W, Sierra de Manatlán Ocidental, 1,600–1,800 m, 5 Jan 1985, *Judziewicz et al. 5113* (MEXU; WIS); Sierra de Manantlán, en el Rancho El Lamial, carretera para el Rancho de la Jofa, 2,050 m, 10 Dic 1982, *Calzada 9466 y Nieves* (MEXU;XAL); Municipio de Jocotepec, Barranca del Agua, al N de Zapotitán, 18 Dic 1994, *Machuca N. 4708* (IBUG); *Ramírez-Delgadillo 2553, 3600* (IBUG); Municipio de Tecalitlán, Sierra del Halo, primitive road to San Isidro above the junction SSW of Tecalitlán, 2,000–2,200 m, 20 Nov 1959, *McVaugh & Koelz 1240* (MICH); 20 km SE of JCT with Route 110, on the way to Jalotlán via San Isidro, 2,130 m, 3 Dec 1995, *Kajita et al. 95 120310* (MEXU). **Michoacán:** Municipio de Coalcomán, W of Aguililla, 12 km SE of Aserradero Dos Aguas, 1,600–1,700 m, 27 Nov 1970, *McVaugh 24754* (MEXU; MICH).

Distribution, habitat, and phenology.—*Phaseolus albescens* is restricted to western Mexico, where the genus *Phaseolus* is well-represented (Delgado-Salinas 1985). Sparse populations of *P. albescens* occur mainly in montane forests of the Sierra Madre del Sur (i.e., Sierra de Manantlán and Sierra del Halo). Also on the isolated mountain range known as the Sierra del Madroño, located in the center of the state of Jalisco, with geological links with the Trans-Mexican Volcanic Belt. In Colima, Michoacán, and Guerrero it is distributed on mountains of the Sierra Madre del Sur. The species grows in pine, pine-oak, and deciduous forests, on brown and light-brown clay soils, always in humid and protected environments at 1,300–2,100 m.

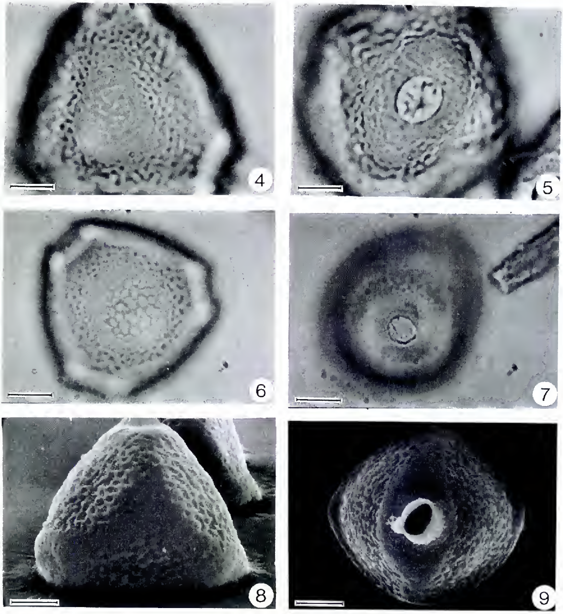
Phaseolus albescens its a late-fall and early winter bloomer (Oct. to Jan.), and sets pods from November to March. In cultivation on the Universidad de Guadalajara grounds, *P. albescens* grew to be a large and vigorous vine, climbing up to ca. 10 meters high. It produced leaves every year and all year around, flowering profusely from October to December, when *Xylocopa* bees were observed visiting its flowers. However, few fruits were set by this plant each year. The plant lived for six years, until a severe drought killed it.

Common name and uses.—While people in Colima are aware of these plants, which they called 'frijolillo', they do not eat them.

Wood anatomy of Phaseolus albescens (Figs. 2–3).—Wood is diffuse porous, with shape of pores oval to angular, in distribution of radial multiples of 2–10 vessels, aggregated in multiples chains or clusters; solitary vessels are of uncommon occurrence. Numerous narrow vessels with 61 pores per mm^2 mixed with the fewer wider vessels with 10 pores per mm^2. Vessel elements are short, with length that ranges from 174 to 192 µm. There is a considerable range of variation, however, in vessel diameter, ranging from a mean



FIGS. 2–3. Anatomical features of the stem of *Phaseolus albescens*. Fig. 2. Cross-section (× 2.5) showing the secondary xylem with a diffuse arrangement of its vessels; also the presence of a sclerenchymatous ring of fibers adjacent to the primary xylem. Fig. 3. Tangential section (× 10) showing radial wood parenchyma composed of homocellular rays, with the presence of nodules (typical of this species), indicated by an arrow. Fibers are located around vessels, excluding the parenchyma cells, which contain abundant polyhedron crystals. Figs. 2–3. *Delgado et al. 1705*.



Figs. 4–9. Pollen grains of *Phaseolus albescens* and *P. polyanthus*. Figs. 4–5. Light microscopic photographs of *P. albescens*: Fig. 4 showing rugulate ornamentation on the apocolpium. Fig. 5 showing the brevicolpus with a margo surrounding the furrow. Figs. 6–7. Light microscopic photographs of *P. polyanthus*: Fig. 6 showing the finely-reticulated ornamentation on the apocolpium. Fig. 7 showing the short colpus. Figs. 8–9. Scanning electron micrographs of acetolyzed pollen grains of *P. albescens*. Fig. 8 showing at equatorial view one of the three short colpus. Fig. 9. Colpus covered with a finely granulated membrane, and with a slightly lalongate pore, without operculum present due to acetolysis process. Scale bars = 10 µm. Figs. 4–5. *Machuca N. 4708*. Figs. 6–7. *Debouck & Soto 1608*. Figs. 8–9, *Delgado et al. 1705*.

tangential diameter of 42 μm in the narrow vessels to a tangential diameter of 198 μm in the wider vessels. Perforation plates are all simple, the ones from wider vessels elements are predominately transversal, while those of narrower vessels are oblique. Intervessel and vessel-ray pitting is alternate, with minute pits from 5 to 8 μm.

Axial wood parenchyma is abundant and apotracheal, with 2 to 3 cells per segment. Polyhedron crystals frequently forming long chains are abundant in parenchyma cells that surround strands of fibers.

Radial wood parenchyma are composed of scanty homocellular rays, with 3 to 4 rays per mm^2. Ray cells are usually square to upright, where nodules can be observed in tangential section.

The average length of the libriform fibers ranges from 741–1,667 μm (with a mean of 1,310 μm), with a tangential diameter of 25 μm. Fibers are located around vessels, their secondary walls reinforce the wall of the vessels, but also excluding the parenchyma cells.

Pollen description (Figs. 4–9).—Tricolporate, semitectate, spheroidal, P= (40–)51.3(–55) μm length; E= (40–)55(–60) μm width. P:E=1.05. Polar view subcircular, (47.2–)53.3(–60) μm. Exine thickness of 2.4–3 μm. Colpi, brevicolpate, covered with a finely granulated membrane, (19.2–)29.8(–30.4) × (16.8–)21.7(–28.0) μm. Pori slightly lalongate, 5 μm in diameter, the pore is coveted with a conspicuous operculum (non-acetolyzed pollen grains).

Observations on the floral biology of Phaseolus albescens.—Flowers of this species were observed in Jalisco (N 19 36' 59"; W 103 30' 54.7"; 1,640 m) in mid November where high visitation rates were registered, with numerous intrafloral movements made by bees (*Xylocopa guatemalensis*, *Bombus pullatus*, *Bombus* sp., and *Apis mellifera*). Observations occurred between 9:00 am and noon. The color of flowers in this population was lilac fading to white and later to yellow. White flowers were ignored and visits were confined to the lilac-colored flowers, whose standard petal was normally raised and not almost fully reflexed as happens in the white-yellowish ones. The color change (lilac to white) is accompanied by a change in the position of the standard, which the bees probably perceived, so they are able to distinguish between the young and older flowers, apparently there is both an optical and position change to aid the insect in its visit.

Although flowers of a wild plant of *Phaseolus vulgaris* were close-by, no visitation of bees between both species were detected. Also, plants of wild *P. coccineus* were seen growing within two hundred meters, no hybrids between them or with *P. vulgaris* were found.

Relationships with the wild P. polyanthus.—As noted in the introduction, McVaugh (1987) recognized differences between plants corresponding to *Phaseolus albescens* and plants of wild *P. coccineus* and cultivated plants of *P.*

polyanthus. Recently, the wild progenitor of the cultivated *P. polyanthus* has been identified in Gutemala by Schmidt and Debouck (1991), although still not completely described, observations made on its general morphology (*Debouck & Soto 1608*; WIS) and on its seeds (CIAT # 35877) show consistent differences between the two.

Indeed, *P. albescens* is superficially very similar to the wild *P. polyanthus* in fruit, but the number of seeds in the fruit of each taxon differ, mainly having 4–5 seeds in *P. albescens*, while pods with 3–4 seeds are present in the Guatemalan plants. Also the flowers of the two species differ in a number of ways, most noticeably in the form and size of the bracteoles, which in *P. polyanthus* are longer and broadly lanceolate, in addition to the contrasting floral coloration, and change in position of the *P. albescens* standard petal. The pollen of *P. albescens* can be distinguished from *P. polyanthus* by larger dimensions (P:E ratio > 0.13) and foveolate-rugulate exine ornamentation instead of a finely-reticulated one. Furthermore, their actual disjunct distribution (*P. albescens* restricted to west-central Mexico and wild *P. polyanthus* mainly to Guatemala), apparently endures from a fairly old separation from each other in the past. This can be assumed comparatively by the number of molecular changes presented by *P. albescens* different from the cultivated and wild *P. polyanthus*.

The specific epithet '*albescens*' refers to the flower color of this species being lilac at anthesis, then turn in, white and later yellow when older.

KEY TO *PHASEOLUS ALBESCENS* AND WILD RELATIVES

1. Inflorescences few-flowered, commonly with 8 or less flowering nodes; flowers small to medium size, standard-petal 1 cm or less long; pods narrow, ca. 1 cm wide; seedlings with epigeal germination.
  2. Pedicels in flower 3-7 mm long; bracteoles linear-ovate to lanceolate, shorter than calyx, less than 1 mm wide, 1–3 veined; petioles of first seedling leaves (eophylls) subsessile .... **P. acutifolius** A. Gray
  2. Pedicels in flower 0.5–1.2 cm long; bracteoles broadly ovate, prominent, equaling the calyx, 2.5–4 mm wide, 5–10 veined; petioles of first seedling leaves (eophylls) elongated, not sessile .... **P. vulgaris** L.
1. Inflorescences many-flowered, commonly with 10–30 flowering nodes; flowers medium to large size, standard-petal more than 1 cm long; pods broader, more than 1 cm wide; seedlings with epigeal or hypogeal germination.
  3. Plants developing of a thick, often branched, tuberous root; corolla commonly red, rarely purple or white; stigma apical-extrorse; seedlings with hypogeal germination .... **P. coccineus** L.
  3. Plants not developing of a tuberous root, main root lignified or fibrous; corolla dark pink, purplish, lilac or white; stigma terminal or introrse; seedlings with epigeal germination.
    4. Corollas dark pink or lilac to purple, wing-blades at anthesis not fully expanded, clasping; bracteoles broad, 2.5–8 mm wide; plants from Costa Rica and Panamá .... **P costaricensis** Freytag & Debouck

4. Corollas lilac-white or white, wing-blades at anthesis fully expanded; bracteoles narrower, 1–1.5 mm wide; plants from western México and Guatemala.
    5. Bracteoles broadly lanceolate, sometimes falcate, commonly exceeding the calyx, 6–8 mm long; pods with 3–4 seeds .... **P. polyanthus** Greenman
    5. Bracteoles lanceolate, never falcate, shorter than calyx, 3–4.5 mm long; pods with 4–5 seeds. .... **Phaseolus albescens** McVaugh ex R. Ramirez & A. Delgado

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REFERENCES

DELGADO-SALINAS, A. 1985. Systematics of the genus *Phaseolus* (Leguminosae) in North and Central America. Ph.D. dissertation. University of Texas-Austin. P. 345.

DELGADO-SALINAS, A. 1988. Variation, taxonomy, domestication, and germplasm potentialities of *Phaseolus coccineus* L. In: P. Gepts, ed. Genetic resources, domestication and evolution of *Phaseolus* beans. Kluwer Academic Publishers, Dordrecht, Holland. Pp. 441–466.

DELGADO-SALINAS, A., T. TURLEY, A. RICHMAN, and M. LAVIN. 1999. Phylogenetic analysis of the cultivated and wild species of *Phaseolus* (Fabaceae). Syst. Bot. 24(3). In Press.

MCVAUGH, R. 1987. *Phaseolus*. In: W.R. Anderson, ed. Flora Novo-Galiciana. Vol. 5, Leguminosae. The University of Michigan Press, Ann Arbor, U.S.A. Pp. 654–655.

RAMÍREZ-DELGADILLO, R. 1991. Taxonomía, Ecología y Distribución del género *Phaseolus* (Leguminosae) en los municipios de Tlajomulco de Zúñiga y Jocotepec, Jalisco. Tesis de Ingeniero Agrónomo, Universidad de Guadalajara, México.

SCHMIT, V. and D.G. DEBOUCK. 1991. Observations on the origin of *Phaseolus polyanthus* Greenman. Econ. Bot. 45:345–364.

THE RELATIONSHIPS OF THE AMERICAN BLACK-FRUITED HAWTHORNS *CRATAEGUS ERYTHROPODA*, *C. RIVULARIS*, *C. SALIGNA* AND *C. BRACHYACANTHA* TO *C.* SER. *DOUGLASIANAE* (ROSACEAE)

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ABSTRACT

A group of black-fruited *Crataegus* (Rosaceae) from the western United States is analysed. *Crataegus erythopoda*, a species with previously poorly understood affinities, is shown to be closely related to *C. rivularis*. The affinity of *C. rivularis* and *C. saligna* is reconfirmed. The three species form a clade subtended by *C. brachyacantha* and different from the clade containing *C. douglasii* and *C. okennonii* when analyzed by PAUP using 38 morphological characteristics. *Crataegus rivularis* and *C. saligna* are lectotypified.

RESUMEN

Se estudia un grupo de *Crataegus* (Rosaceae) con frutos negros del oeste de los Estados Unidos. *Crataegus erythopoda*, una especie con afinidades pobremente conocidas, se muestra que está muy relacionado con *C. rivularis*. Se reconfirma que *C. rivularis* es también muy afín a *C. saligna*. Las tres especies forman un clado en cuya base se encuentra *C. brachyacantha* y que es diferente del clado que contiene a *C. douglasii* y *C. okennonii* cuando se analiza mediante el PAUP usando 38 características morfológicas. Se lectotipifican *Crataegus rivularis* y *C. saligna*.

Black-fruited *Crataegus* are in a substantial minority worldwide, as also in North America where perhaps seven species are black-fruited. Numerous authors have pointed out the significance of fruit color in relation to frugivor dispersal and this topic has even received a little attention for North American hawthorns (e.g. Sallabanks 1993). It is not known whether North American black-fruited hawthorns form a natural clade and without undertaking an exhaustive examination that potentially includes many red-fruited species, this fact cannot be determined. However, it had appeared to me that they fell into at least two groups, the first being all members of series *Douglasianae* (Rehd. ex Sarg.) Rehd. (this includes *C. douglasii* Lindl., *C. suksdorfii* (Sarg.) Kruschke and *C. okennonii* J.B. Phipps) together with a second group (*C. brachyacantha* Sarg. & Engelm., *C. erythropoda* Greene, *C. rivularis* Nutt. ex Torr. & A. Gray and *C. saligna* Greene) which might have

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some loose interrelationship. I test this hypothesis of two clades with a cladistic analysis using 38 morphological characteristics.

Series *Douglasianae* has been the subject of a substantial amount of recent research and is more northerly than the group of species on which I focus in this paper, with a southern limit of about 43° N except in California where it is farther south. Love and Feigen (1978) showed that *C. douglasii* could hybridize with the distantly related and introduced *C. monogyna* Jacq., Brunsfeld and Johnston (1990) provided solid grounds for raising *C. suksdorfii* (Sarg.) Kruschke from a variety of *C. douglasii* to specific rank while Dickinson *et al.* (1996) contrasted the breeding systems in the 20-stamen *C. suksdorfii* and the 10-stamen *C. douglasii* to good effect. Dickinson and students are continuing their biosystematic and morphometric analyses of ser. *Douglasianae*. Recently, I described a new species, *C. okennonii*, from this group (Phipps & O'Kennon 1998). Due to this recent activity and the continuing researches of the Dickinson group on ser. *Douglasianae*, I restrict coverage of the series in this paper to the cladistic analysis merely to discover if ser. *Douglasianae* is a separate clade from the other species considered.

Here, therefore, I direct attention to the more southerly, and allopatric, component of the 'black-fruited' *Crataegi*, the group of *C. rivularis*, *C. erythropoda*, *C. saligna* and *C. brachyacantha*. The relationships of these species has always been much more controversial. *Crataegus saligna* was placed with *C. brachyacantha* by Palmer (1925), a supposition that I followed without study in the Maloid checklist (Phipps, et al. 1990). Then, particularly influenced by field observations, I recognized its probable affinity to *C. rivularis*, a relationship in fact explicitly noted by Greene (1896) when he described *C. saligna*. With regard to C. *erythropoda*, as recently as this year (Phipps 1999), I included this species among the western red-fruited species. Nevertheless, the existence of a few intermediate specimens noted since that paper was prepared, together with the detailed examination for this paper, and preparation of the draft description for the *Flora of North America*, showed conclusively that it was actually close to *C. rivularis*. Also recently, Welsh (1982) placed both *C. rivularis* and *C. saligna* under *C. douglasii*, a solution that I do not believe that any current student of *Crataegus* would consider tenable.

I therefore resolved to investigate the cladistic interrelationships of the North American black-fruited species and, in the cases of *C. saligna*, *C. rivularis* and *C. erythropoda*, which have never received any independent taxonomic study since their original descriptions, in contrast to ser. *Douglasianae*, to carefully characterize and typify them. In addition, *C. rivularis* and *C. saligna* are provided with detailed distribution maps for the first time. Finally, I need to comment on my cautious 'black fruited'. Species in this group either have black, purple, or burgundy fruit when fully ripe, the particular color, and its changes during ripening, having taxonomic significance. The term 'black-fruited' in the title therefore refers to a group of related hawthorns that are predominantly, but not entirely, black-fruited at full maturity.

METHODS

An extensive sample of herbarium specimens of the taxa to be studied has been assembled by my own fieldwork in recent years, assisted by R.J. O'Kennon, together with many examples of loan specimens. As this paper is not aimed at assessing specific limits, no morphometric phenetic analysis of large samples was conducted. However, the samples were used to determine the characteristics of synthetic OTU's, one for each species, that would be analyzed by PAUP 2.4.1. The 38 characteristics used for this purpose are listed in Table 1. Distribution maps for previously unmapped or inadequately mapped species were created by Range-Mapper, a program created by the firm Tundra Vole of Fairbanks, Alaska. For this purpose, where sufficiently precise location data existed on the herbarium label this was converted into latitude/longitude coordinates accurate to the nearest minute. Files for each species were then mapped. Typification followed standard procedures. Syntypes or potential lectotypes were located, occasionally with great difficulty, and hololectotypes or neotypes selected on the basis of goodness of fit to the protologue, citation in the protologue (if pertinent), and specimen quality, when a choice was available. No specimens are illustrated due to the existence of excellent illustrations elsewhere. The characterizations presented here of the species outside ser. *Douglasianae* are in fact somewhat detailed diagnoses because this work does not purport to be a taxonomic revision, because excellent descriptions exist elsewhere and because, in my view, they represent four well-marked species even by conservative criteria.

INTERRELATIONSHIPS

The possible and intriguing relationship between *C. saligna* and *C. rivularis* has already been suggested. If these two proved to be sister species then a new series '*Rivulares*' could be created to accomodate them. However, on reflection, it seemed that *C. rivularis* might be even closer to *C. erythropoda* on the basis of identical floral and inflorescence characteristics and fruit differing only in fully ripe color. A series that included both *C. saligna* and *C. erythropoda* is perhaps a little broader than most series in North American *Crataegus*. We need also to pay attention to Palmer's (1925) view that *C. saligna* was closely related to *C. brachyacantha* and therefore should be placed in ser. *Brevispinae* (Palmer used the *nomen nudum Brachyacanthae*), where I had provisionally placed it (Phipps et al. 1990) following convention and without study. *Crataegus brachyacantha* is very similar to *C. saligna* in flower and leaf characteristics

TABLE 1. Thirty-eight morphological characteristics scored for cladistic analysis.

Plant, general

1. Plant habit
2. Bark type
3. Branch arrangement

Thorns and Twigs

4. Thorns: indeterminate present?
5. Thorns: length
6. Thorns: curvature
7. Thorns, color: browns
8. Thorns, color: gray
9. Twigs, 1 yr old, color; browns
10. Twigs, 1 yr old, color; gray

Leaf

11. Lamina: length
12. Lamina: length/breadth
13. Lamina: position of widest part
14. Lamina: venation, number
15. Lamina: veins to sinuses
16. Lamina: lobe number
17. Lamina: lobe shape
18. Lamina: max. sinus depth (L/l)
19. Lamina: abaxial pubescence, young
20. Petiole: glands
21. Leaf teeth: glands

Inflorescence

22. Flower: number
23. Pedicel: pubescence
24. Anthesis time

Flower

25. Diameter
26. Calyx lobes: margins
27. Stamen: no.
28. Anther: color
29. Style: number

Fruit

30. Fruit: color, month before full ripeness
31. Fruit: color at full ripeness
32. Fruit: shape, 1
33. Fruit: shape, 2
34. Fruit: pubescence
35. Fruit: calyx orientation
36. Fruit: length (height)
37. Pyrenes: lateral faces

Autumnal foliage

38. Color

but differs greatly in the thorns (curved, ≤ 1.5 cm long), color of overmature inflorescence (yellowish orange), fruit size (generally larger), smooth lateral faces of the pyrenes, and lack of copper-colored bark. Also Welsh had made both *C. saligna* and *C. rivularis* varieties of *C. douglasii*, in what seemed to me to be an untenable association. It therefore seemed pointful to conduct a numerical taxonomic study to throw light on these contrasting possibilities and to establish whether any of these taxa were especially close to members of ser. *Douglasianae*.

For this, I scored 38 characters (Table 1) for 9 synthetic OTUs, one for each species, which included all the black-fruited *Crataegus* species that are the particular subjects of this paper (*C. saligna*, *C. rivularis*, *C. erythropoda* and *C. brachyacantha*) plus *C. douglasii s.s.* , *C. suksdorfii* and *C. okennonii* of ser. *Douglasianae* as well as the red-fruited outgroups *C. mollis* (Torr. & A.Gr.) Scheele and *C. monogyna* Jacq.

Using PAUP 2.4.1, *C. erythropoda* and *C. rivularis* are shown to be sister species in the three shortest trees (Fig. 1). The *douglasii* group, consisting of *Cc. douglasii* and *okennonii*, always formed one sub-clade while *C. brachyacantha*, *C. saligna*, *C. rivularis* and *C. erythropoda* always formed another in all shortest cladograms. However, *C. saligna* and *C. brachyacantha* were by no means very close in these cladograms although *C. rivularis* and *C. erythropoda* were

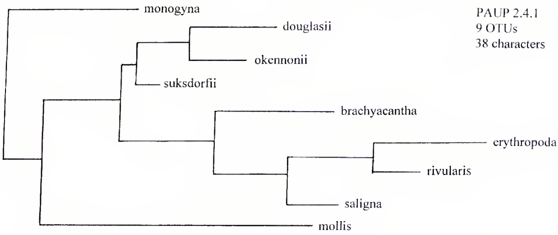

FIG. 1. Cladogram of North-American black-fruited *Crataegi* created by PAUP using 38 morphological characters.

shown in all analyses to be sister species. The two unpublished trees only differ in the location of *C. suksdorfii* which is either basal to *C. douglasii / okennonii* (published tree), basal to (B(Sa(R,E))), using their epithet abbreviations, in one unpublished tree or basal to both (D,O) and (B(Sa(R,E)) in the other.

The union of all seven black-fruited species inside the red-fruited outgroups *C. mollis* and *C. monogyna* does not, however, indicate that the black-fruited group is monophyletic. An analysis using all the red-fruited species would be required to generate such a finding and that is not the function of this exercise. Rather, it is to locate the position of *C. erythropoda*, *C. rivularis*, *C. saligna* and *C. brachyacantha* relative to the immediate *C. douglasii* group. The cladogram endorses the view that neither *C. saligna* nor *C. rivularis* are part of the species *C. douglasii*. The following key summarizes the differences among the four species in *rivularis* clade.

KEY TO *RIVULARIS*-CLADE OF BLACK AND BURGUNDY-FRUITED *CRATAEGUS*

1. Stamens 20; anthers cream; flowers 10–12 mm diam.
   2. Thorns 1–1.5 cm long, decurved, grayish; twigs grayish; overmature flowers orange-yellow; nutlets with lateral faces plane .... **C. brachyacantha**
   2. Thorns 2–4 cm long, straight, black; twigs copper-colored; overmature flowers white to dirty white; nutlets with lateral faces pitted .... **C. saligna**
1. Stamens 10; anthers pink; flowers 15–17 mm diam.
   3. Leaves essentially unlobed, usually more than 2 times as long as broad, widest near the middle; fully ripe fruit black .... **C. rivularis**
   3. Leaves evidently about 3-lobed per side; usually ca. 1.5 times as long as broad, usually widest in the basal third; fully ripe fruit usually burgundy .... **C. erythropoda**

TAXONOMIC AND NOMENCLATURAL NOTES ON INDIVIDUAL SPECIES

CRATAEGUS ERYTHROPODA—Characterization

Crataegus erythropoda Ashe, North Carolina Agric. Exp. Sta. Bull. 175:113. 1900.

Crataegus bakeri Greene, nomen nudum

This species has been described, illustrated and mapped in my recent paper (Phipps 1999) where it was entered into a new monotypic series, *Cerrones* J.B. Phipps, on account of its distinctness from other red-fruited species. *Crataegus erythropoda* may be briefly characterized by its ovate-rhombic, ± glabrous, shallowly-lobed, smallish leaves; glabrous inflorescences with 10-stamen flowers having pink-purple anthers; suborbicular fruit which is burgundy at maturity (I have never once seen 'orange' as described in the protologue by Ashe (1900) and Holmgren (1997)); shiny coppery bark on 2–5 cm thick stems and thorns mainly 2–4 cm long. *Crataegus erythropoda* occurs in sites with groundwater available, or otherwise mesic, mainly in intermountain Colorado and adjacent New Mexico, where it is quite common. Holmgren (1997) also records it from eastern Utah and northeastern Arizona. The 'orange' fruit color cited may refer to immature fruit since the type was collected in August, but I have not myself seen this color even in mid-August. *Crataegus erythropoda* has presented no serious problems in delimitation or recognition though its relationships have been hitherto obscure. See the protologue (Ashe 1900) for another full description. Interestingly, Palmer (1925) assigned *C. erythopoda* to ser. *Douglasianae*, an idea taken up by no-one else, but nevertheless the closest approximation to date. Observations made for this paper indicate that at anthesis *C. erythropoda* is almost indistinguishable from *C. rivularis* in floral/inflorescence characteristics. Significant differences in leaf shape and ripe fruit color exist, however, as indicated in the key.

A specimen of Greene's from the Lower Cimarron River, Colorado (NDG), collected in 1896 and labelled '*C. bakeri*', a name never published, is actually a perfectly adequate specimen of *C. erythropoda* Ashe.

CRATAEGUS RIVULARIS—Synonymy, Characterization and Typification

Crataegus rivularis Nutt. ap. Torr. & A. Gray, Fl. N. Amer. 1:464. 1840.

Crataegus douglasii Lindl. var. *rivularis* (Nutt. ap. Torr. & A. Gray) Sarg., Gard. & Forest 4:81. 1902.

As with *C. erythropoda*, there have not been serious problems in taxon recognition or delimitation although some floristic authors have followed Sargent (1889) in relegating *C. rivularis* to varietal rank under *C. douglasii*.

Crataegus rivularis is a locally common, even locally abundant, species of intermountain USA, found in many locations in this generally dry area where there is a high water-table. I map this widespread species (Fig. 2) which occurs from southern Idaho to northern New Mexico and from south-central Utah east to the Rocky Mountains. It reaches 6–7 m in favorable sites where it may form extensive thickets. The bark of 2 cm diameter branches is copper-colored like *C. erythropoda* and the generally fine thorns are mainly 2.5–4 cm long. The normally elliptic leaves are tapered at each end, subglabrous, 4–6-veined and quite unlobed on short-shoots, being beset with many sharp, forward-pointing fine marginal teeth. The glabrous inflorescence bears large 10-stamened flowers with pink anthers and can hardly be differentiated from that of *C. erythropoda.* The numerous, often large, suborbicular fruit pass through a striking deep reddish-burgundy color to deep purple and finally black. See also Sargent (1890) for a detailed characterization and excellent plate by Faxon. Intermediates with *C. douglasii* are not known and *C. rivularis* is essentially allopatric with that more northern species which facts reinforce the findings of the cladistic analysis. However, because Welsh (1982), Holmgren (1997), and Sargent (1889, 1890) have included *C. rivularis* in *C. douglasii*, I would like to emphasize their distinction with the following key couplet.

1. Thorns fine, little recurved, usually 2.5–5 cm long; bark of 1–2 cm diam. branches shiny coppery brown; flowers 14–18 mm diameter, calyx lobes 5–8 mm long, long-attenuate from a broad base; leaves narrow elliptic, unlobed or rarely with 1–2 very small lobes per side, tapered at both ends, acute to acuminate at the apex, the venation semi-camptodromous; fruit subglobose, 11–14 mm diam., crimson-lake ripening to shiny black .... **C. rivularis**

1. Thorns stout, often recurved, usually 1.5–3 cm long; bark of 1–2 cm diam. branches tan to gray-brown; flowers 12–15 mm diam., calyx lobes 3–4 mm long, narrow-triangular from a broad base; leaves much broader, most commonly broad elliptic to narrow-obovate in general shape, usually lobed (unlobed in rare narrow-leaved specimens), the venation clearly craspedodromous except in rare narrow-leaved specimens, usually obtuse to subacute at the apex; fruit generally ellipsoid, usually $\leq$ 9 mm diameter, ripening dull purple to purple-black or black, generally with rather strong bloom .... **C. douglasii**, s.s.

The suite of differences is so large, together with the lack of intermediates and different distribution, that one cannot reasonably place *C. rivularis* in the same species as *C. douglasii.*

In making *C. rivularis* a variety of *C. douglasii* Sargent's overall understanding of this taxon was poor, illustrated by his providing (1890) an inaccurate range extension from northwestern California to Puget Sound and his statement, "usually a low intricately branched.....shrub." This perhaps helps to explain the cautious rank chosen by Sargent, a notorious splitter by modern criteria.

Crataegus rivularis has not been typified, therefore, I lectotypify it here. The type description for *C. rivularis* (Torrey & Gray 1843) is of characteristic brevity and imprecision for the period and might at first sight refer to

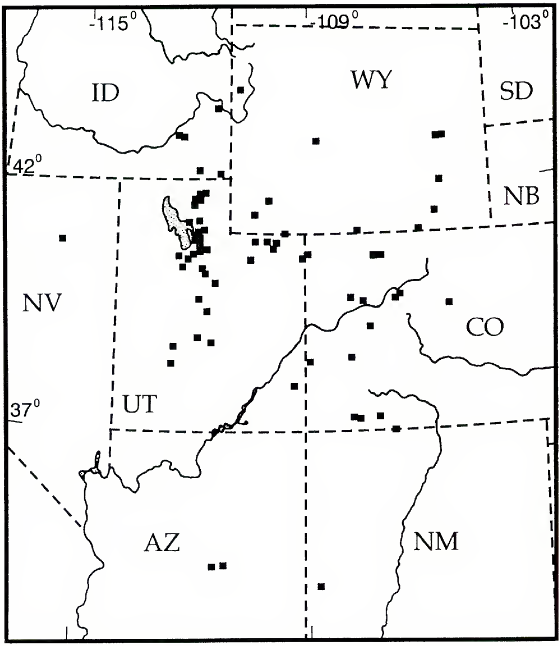

FIG. 2. Distribution of *C. rivularis* Nutt. ap. Torrey and A. Gray from collated herbarium records.

C. douglasii or even *C. saligna*, as well as to the taxon normally associated with the name.

The protologue for *C. rivularis* cites "Oregon, rivulets in the Rocky Mountains" as the type area with Nuttall as collector. It is hard to know exactly where this is, because of the extensive nature of the Oregon Territory in 1843. What we call *C. rivularis* today is a distinct, well-collected taxon with a well-established range (Fig. 2) which just reaches southern Idaho, part of which is an acceptable area for "Rocky Mountains." Putative syntype materials of *C. rivularis* from BM, GH and PH were borrowed in order to lectotypify this species.

Of the two PH specimens sent (both on the same sheet) one (on the right-hand side) can be rejected directly as it is a Canby-collected *C. douglasii* from 1873, while the left-hand specimen, labelled 'Rocky Mountains', is a leafy twig without reproductive material that requires comparison with the protologue. Both the BM and GH sheets have specimens collected by Nuttall that are a reasonable match for the somewhat poor description in the protologue and are clearly the same species as each other. In view of the indifferent quality of the protologue and the consequence that a species other than what is conventionally called *C. rivularis* might have been described, I provide in Table 2 critical comparisons between the protologue and putative types (cols. 1, 2), between the protologue and *C. douglasii* (col. 3) and between the protologue and standard interpretation of *C. rivularis* (col. 4).

Several points in the protologue cannot be assessed from the putative syntypes from BM and GH. These are the arborescent nature of the plant (not recorded on the collection label) and flowering characteristics (the putative syntypes are post-flowering). Also, Nuttall in describing the leaves as "ovate, obovate" poses something of a problem, as these are not terms that we would apply today to the putative syntype leaves, which are clearly nearer to narrowly elliptic. In fact, in examining many protologues for *C.* series *Coccineae* drawn up by C.S. Sargent in the first and second decades of this century, I have observed that "ovate" is almost a generic leaf-shape. In my opinion, having also examined many other *Crataegus* type descriptions from the nineteenth century and earlier, the term "ovate" was not used with its present precision and therefore, with regard to leaf-shape, the protologue may be said to describe the material of the putative syntypes in question with adequate accuracy for the period. The other characters match the protologue. As to the PH putative syntype (col. 2), the matches between it and the protologue are so few as to be almost meaningless. Moreover, the specimen possibly belongs to *C. crus-galli*, as previously stated by Eggleston in an annotation on the sheet, but this is a species never found in the Rocky Mountain area. However, the specimen also resembles *C. saligna*, but because it is sterile, conspecificity is uncertain. The final two columns in the table compare the protologue with typical *C. douglasii* and what is normally called *C. rivularis* (alternatively *C. douglasii* var. *rivularis*). Because *C. douglasii* has lobed leaf-blades and "short" thorns, whereas *C. rivularis* has longer thorns and unlobed leaves, the latter constitutes the better match for the protologue. Thus, the choice of lectotype lies between inadequate vegetative material of what is possibly *C. saligna* at PH and adequate specimens clearly representing what is normally called *C. rivularis* at BM and GH. Therefore, I lectotypify

TABLE 2. Comparison of protologue characteristics with putative syntypes of *C. rivularis* (see text) and with plants of *C. douglasii* and *C. rivularis*.

protologue characteristics	match for putative syntypes at BM,GH	match for putative syntype at PH	match for *C.* douglasii	match for *C.* rivularis
Arborescent	?	?	+	+
Nearly glabrous	+	+	+	+
Not glandular	+	+	+	+
Leaves - ovate or obovate	?, ?	?,?	+,+	?, ?
- obtuse or sometimes acute	+	+	+	+
- simply or somewhat incisely serrate	+	+	•	+
- attenuate into a short petiole	+	+	+	+
Thorns - "spines" long	+	?	•	+
Corymb - many flowered	?	?	±	±
- glabrous	?	?	us	+
- flowers small	?	?	+	+
- segments of calyx obtuse and very short	±	?	+	±
Fruit - *black*	?	?	+	+

? = cannot determine a match
\+ = perfect match
± = reasonable match
us = usually a match
• = not a match

C. rivularis with the Nuttall specimen "Rocky Mountains" (holotype BM; isotype GH) and retain the usual interpretation of this taxon.

CRATAEGUS SALIGNA—Synonymy, Characterization and Typification

Crataegus saligna Greene, Pittonia 3:99. 1896.

Crataegus wheeleri A. Nelson, Bot. Gaz. 34:369. 1902.
Crataegus douglasii Lindl. var. *duchesnensis* S.L. Welsh, Great Basin Naturalist 42:9. 1982.

Crataegus saligna is a medium-sized to large thicket-forming bush growing along streams and other locally moist areas in intermountain Colorado and northeastern Utah (Fig. 3). Its range is the most restricted of the four species dealt with in this paper. In many respects it is like *C. rivularis* but it has smaller leaves, thorns, flowers and fruit and 20 cream instead of 10 pink anthers. The fruit is more fully black (darker than *C. rivularis* when sub-ripe in late August) and the leaf-teeth are quite different from *C. rivularis*, being small, numerous and obtuse, rather than longer and sharp. Moreover

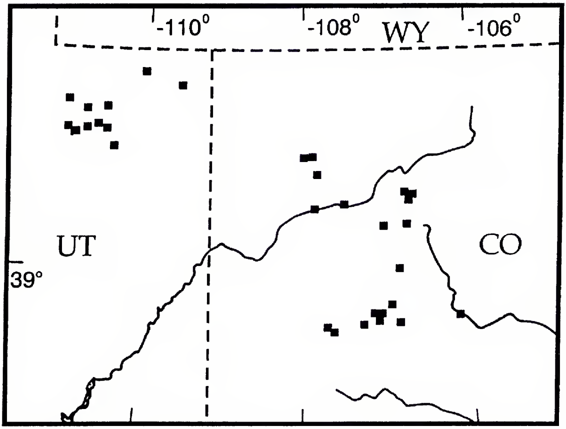

FIG. 3. Distribution of *C. saligna* Greene from collated herbarium records.

there are usually 6–9 lateral veins on one side of a leaf, compared to 4–5 in the much larger leaf of *C. rivularis*. Indeed, the leaves are remarkably similar to those of *C. brachyacantha*. *Crataegus saligna* has sometimes been confused with *C. douglasii* from which it has even more differences than *C. rivularis* and it was erroneously called *C. douglasii* var. *duchesnensis* by Welsh (1982). It is similar to *C. rivularis* in its coppery bark on 2–5 cm diameter branches, and slender, ± straight thorns usually 2–4 cm long [except recurved and 0.75–1.5 cm long in *W.W. Robbins 6972* from Newcastle, Colo. (COLO)], narrow leaves, intermountain distribution and similar habitat.

Crataegus saligna was described by Greene (1896) from the Lower Cimarron River, Colorado, without citation of type material, a situation that has not been remedied to date. My search for potential lectotype material involved the main Greene herbarium at Notre Dame University, Indiana (NDG), WIS and NA where remnants of the remainder of Greene's herbarium had been dispersed from LCU, and CAS, COLO, NY, UC, and US. Only one herbarium generated a putative lectotype, the specimen being *E.L. Greene s.n.*, Colo., Cimarron, 31 Aug 1896 (NY). I therefore lectotypify *C. saligna* by this specimen. Fortunately, the type description of *C. saligna* is entirely adequate for species recognition, such that this taxon has become a well-accepted element in the Colorado flora (Harrington 1964; Weber & Wittmann

1992). Sargent (1902) provided a more extensive description of *C. saligna*, together with the citation of specimens dating back to 1845 and a fine illustration by Faxon.

Crandall's 1896 collection of *C. saligna* (at RM) from the Lower Cimarron River also became a potential lectotype for this species because the Lower Cimarron River, Greene's type location for *C. saligna*, enters the Black Canyon of the Gunnison. However, there is no indication that Crandall's specimen was ever studied by Greene, and therefore it is rejected for this purpose.

Wheeler also collected several hawthorn specimens from the same area, but in 1898, too late to be lectotype material of *C. saligna* but which it is convenient to comment on here. From among these, Aven Nelson (1902) described *C. wheeleri* which I lectotypify by *H.N. Wheeler 523*, Black Canyon of the Gunnison (RM). As this is identical to *C. saligna*, *C. wheeleri* becomes a synonym of that species.

Complicating the taxonomic picture was S.L. Welsh's description (Welsh 1982) of a new variety of *C. douglasii*, var. *duchesnensis* S.L. Welsh, from northeastern Utah. From the type description, though very brief, this new taxon appeared to me to resemble *C. saligna* rather then *C. douglasii*. Loan of relevant material from BRY proved this suspicion to be correct, consequently *C. douglasii* Lindl. var. *duchesnensis* S.L. Welsh is here synonymized under *C. saligna*. Also, some of Welsh's specimens annotated as his new variety of *C. douglasii* proved to be *C. rivularis* and I therefore supply hereunder a list of Utah specimens cited by Welsh (1982) as *C. douglasii* var. *duchesnensis* that I identify as *C. saligna*:

UTAH: **Duchesne Co.:** 5 mi N of Fruitland, 21 Jun 1965, *J. Brotherson 508*; 5 mi NW of Hannah, 17 Aug 1965, *K.S. Erdman 2522*; T15 R6W Sec. 36, 9 Jun 1976, *Dennis J. Hansen s.n.*; 24 km NW of Duchesne, along Utah Hwy. 35, 10 Sep 1970, *S.L. Welsh, N.D. Atwood and G. Moore 10928* (HOLOTYPE). **Uintah Co.:** Merkley Park, 18 May 1963, *S.L. Welsh & G. Moore 1948*.

These records, and others of my own generated by this discovery, represent quite a significant range extension for *C. saligna*, a species hitherto known only from intermountain Colorado. I therefore offer what I believe to be the first published range map (Fig. 3) of *C. saligna*.

CRATAEGUS BRACHYACANTHA Sarg. & Engelm.—Characterization

Crataegus brachyacantha Sarg. & Engelm., Bot. Gaz. 7:128. 1882.

Crataegus brachyacantha lies among the select group of hawthorns without synonymy, this fact alone attesting to its distinctiveness. It is one of the largest North American hawthorns, occasionally reaching 14 m tall, though it is more usually a bush or small tree at maturity 4–8 m tall. It occurs naturally throughout Louisiana and the adjacent parts of all surrounding states reaching its best growth on moist bottomlands. The twigs are beset with few to numerous very short (ca. 1 cm long) recurved thorns, unique in *Crataegus* to my knowledge. The short-shoot leaves are elliptic, unlobed, very glossy, glabrous with numerous secondary veins and crenate margins. They resemble the leaves of *C. saligna* and color brilliantly in autumn. The multi-flowered inflorescence is glabrous and turns orange-yellow when overmature, also apparently unique in *Crataegus*. The small flowers have 20 stamens. The fruit, dead-black at full maturity, is covered by a dense bloom before the bloom is abraded, and together with a more purple-black submature skin, the fruit may look 'blue', hence the vernacular name 'blueberry haw'. The fruit is somewhat bitter and has five plane-sided nutlets. Full descriptions and illustrations may be found in Phipps (1998) and Sargent (1902). The species is also mapped in detail in Phipps (1998). A white-fruited variant, unique to *Crataegus* in this respect, was seen in 1922.

There is no problem in delimiting this species and it has never been thought to be especially closely related to, or a part of, *C. douglasii*.

ACKNOWLEDGMENTS

I thank the curators of BM, BRY, CAS, COLO, GH, NDG, NY, PH, RM, UC, US, and WIS for loans of specimens and/or cooperation in the search for lectotype material. I also thank the National Sciences and Engineering Research Council of Canada for funding that supported this work and an anonymous reviewer for the suggestion that NY might possess a potential lectotype of *C. saligna*, a circumstance that prevented neotypification.

REFERENCES

Ashe, W.W. 1900. *Crataegus erythropoda*. North Carolina Agric. Exp. Sta. Bull. 175:113.

Brunsfeld, S.J. and F.D. Johnson. 1990. Cytological, morphological and phenological support for specific status of *Crataegus suksdorfii* (Rosaceae). Madroño 37:274–282.

Dickinson, T.A., S. Belaoussoff, R.M. Love, and M. Muniyamma. 1996. North American black-fruited hawthorns (*Crataegus* sect. *Douglasii* Loud.): 1. Variation in floral construction, breeding system correlates and their possible evolutionary significance. Folia Geobot. Phytotax. 31: 355–371.

Greene, E.L. 1896. *Crataegus saligna* n. sp. Pittonia 3:99.

Harrington, H.D. 1964. Manual of the plants of Colorado - a biodiversity baseline, 2nd ed. Sage Books, Denver, Colorado.

Holmgren, N.H. 1997. *Crataegus*. In: A. Cronquist, N.H. Holmgren and P.K. Holmgren. Intermountain Flora 3A, pp. 154–158.

Kruschke, E.P. 1965. Contributions to the taxonomy of *Crataegus*. Milwaukee Public Mus. Public. Bot. 3:1–273.

Love, R. and M. Feigen. 1978. Interspecific hybridization between native and naturalized *Crataegus* (Rosaceae) in western Oregon. Madroño 25:211–217.

Nelson, A. 1902. *Crataegus wheeleri*, n. sp. Bot. Gaz. 34:369.

Palmer, E.J. 1925. Synopsis of North American *Crataegus*. J. Arnold Arbor.6:5–128.

Phipps, J.B. 1998. Synopsis of *Crataegus* Series *Apiifoliae*, *Cordatae*, *Microcarpae* and *Brevispinae* (Rosaceae subfam. Maloideae). Ann. Missouri. Bot. Gard. 85:475–491.

PHIPPS, J.B. 1999. Introduction to the red-fruited *Crataegus* of western North America. Canad. J. Bot. 76:1863–1899.

PHIPPS, J.B. and R.J. O'KENNON. 1998. Three new species of *Crataegus* (Rosaceae) from western North America: *C. okennonii*, *C. okanagenensis* and *C. phippsii*. Sida 18:169–181.

PHIPPS, J.B., K.R. ROBERTSON, P.G. SMITH, and J.R. ROHRER. 1990. A checklist of sub-family Maloideae (Rosaceae). Canad. J. Bot. 68:2209–2269.

SARGENT, C.S. 1889. *Crataegus douglasii* Lindl. var. *rivularis*, n. var. Gard. & Forest 2:401.

SARGENT, C.S. 1890. The Silva of North America, IV:87–88, t. 176. Houghton Mifflin, Boston, Mass. and New York, N.Y.

SARGENT, C.S. 1902. The Silva of North America. Suppl. XIII: 37-38, t. 636. Houghton Mifflin, Boston, Mass. and New York, N.Y..

SALLABANKS, R. 1993. Fruiting plant attractiveness to avian seed dispersers: native vs. invasive *Crataegus* in western Oregon. Madroño 40:108–116.

TORREY, J. and A. GRAY. 1843. *Crataegus rivularis*. In: A Flora of North America 1:464. New York, Wiley & Putnam.

WEBER, W.A. and R.C. WITTMANN. 1992. Catalog of the Colorado Flora. Univ. of Colorado Press, Niwot.

WELSH, S.L. 1982. *Crataegus*. In: Utah Flora, Rosaceae. Great Basin Naturalist. 42:9–10.

THE SEGREGATES OF *SENECIO*, S.L., AND *CACALIA*, S.L., IN THE FLORA OF NORTH AMERICA NORTH OF MEXICO

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ABSTRACT

The traditional, broadly conceived genera *Senecio*, s.l., and *Cacalia*, s.l., will be divided into several segregate genera in the forthcoming *Flora of North America North of Mexico*, (FNANM). Provided here are a synoptical key and annotated catalog for the genera, and a nomenclator for the specific and infraspecific epithets for *Senecio*, s.l., and *Cacalia*, s.l., that have been commonly used in North American floristics.

RESUMEN

Los géneros, tradicionalmente concebidos ampliamente, *Senecio*, s.l., y *Cacalia*, s.l., serán divididos en varios géneros segregados en la *Flora of North America North of Mexico*, (FNANM) de próxima aparición. Ofrecemos aquí una clave sinóptica, un catálogo anotado de los géneros y un índice de los epítetos específicos e infraespecíficos de *Senecio*, s.l., y *Cacalia*, s.l., que han sido usados normalmente en las floras norteamericanas.

In 1978, an account of the Senecioneae in North America north of Mexico was published in the North American Flora series (NAF) of The New York Botanical Garden, and therein Barkley (1978) and Pippen (1978), respectively, treated *Senecio* and *Cacalia* in the traditional, inclusive senses that derive from the works of Bentham (1873a, b) and Hoffmann (1892). In so doing, they were in agreement with the floristic botany of North American tradition. Since the time of the NAF publication, new information and rigorous phyletic notions of genera have combined to justify the acceptance of a greater number of more narrowly circumscribed genera. The notions leading to these narrower generic concepts are noted in Bremer (1994) and in several papers that were presented at the Compositae Conference at Kew in the summer of 1994 (Hind & Beentje 1996), particularly the paper by Barkley et al. (1996). Preparation of the treatments of *Senecio*, s.l., and *Cacalia* s.l., for *Flora of North America North of Mexico* (FNANM) has drawn attention to the matters of generic concepts, for a goal of the FNANM is to reflect current understanding as best as possible. In this paper I describe how the native and

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naturalized members of *Senecio*, s.l., and *Cacalia*, s.l., will be treated generically in the FNANM. Included is a key to the genera that are being recognized in the FNANM, an annotated catalog of the genera, plus a list of the species and infraspecific names that have been commonly used in recent floristic works, with their dispositions among the recognized genera.

Some of the genera recognized here are similar to infrageneric groups that have been used in the past, e.g., Bentham (1873 a, b) Greenman (1901), Pippen (1968), and Barkley (1978). What is new in North American floristic work is treating them as genera, rather than as subgenera or sections, or as informal groups within *Senecio*, s.l., or *Cacalia*, s.l. Morphological intergradation among many species of *Senecio*, s.l., has been documented repeatedly (cf. Barkley 1988 for species here treated in *Packera*); so far as I am aware, however, there is no intergradation between any pair of species that are treated here in different genera, i.e., the genera are biologically discrete.

Apart from the small and distinctive subtribe Blennospermatinae Rydb., the Senecioneae appear to be naturally divisable into two evolutionary lineages, the Tussilagininae (Cass.) Dumort. and the Senecioninae (Cass.) Dumort. The distinctions between these two lineages are noted in the first couplet of the key, and they are summarized by Bremer (1994). The Tussilagininae ("tussilaginoids") have been called the "cacalioids" and the "tephroseroids" in the past. Application of the name *Cacalia* has been confusing, with some consensus that it is best used for a group of Eurasian plants that are senecionoid in their affinities. Continued uncertainty about *Cacalia* has led to its formal rejection (Wagenitz 1995; Brummitt 1998), and so referring to the group as "cacalioid" is also rejected.

The key to genera presented here is essentially a synopsis rather than a practical key for identifying a plant-in-hand. No one doubts the biological significance of the first couplet in the key, but the characters used there are impractical for routine plant identification (Barkley et al. 1996). A key for easy identification will need to be a "collective key" that is admittedly artificial and that includes species of several genera. Such a key will be similar in structure to the species keys for *Senecio*, s.l., and *Cacalia*, s.l., in traditional floristic works of the recent past.

KEY TO GENERA

1. Stigmatic areas confluent on adaxial faces of style branches; anther collars cylindrical and cells not inflated; mostly n = 30 or polyploid/dysploid derivatives. (**Tussilagininae**)
  2. Shrubs with leaves concentrated distally on branches; AZ, NM. . **1. Barkleyanthus**
  2. Herbs with principal leaves basal and on proximal half of stem.
    3. Corollas yellow; capitula radiate or discoid.
      4. Capitula discoid; phyllaries notably yellow; WY. .... **2. Yermo**
      4. Capitula radiate; phyllaries green or grayish green to dirty white.

5. Principal leaves with blades lanceolate to ovate, pinnately veined and tapering to a winged petiole; boreal, WY and northward. .... 3. **Tephroseris**

5. Principal leaves with blades rounded to reniform, plamately or subpalmately veined and abruptly contracted to an unwinged petiole.

6. Flexible, soft herbs, rarely exceeding 3 dm tall; blades of principal leaves 1–2.5 cm across; BC. .... 4. **Sinosenecio**

6. Coarse, weakly ligneous herbs to 12 dm tall; blades of principal leaves 8–16(–20) cm across; AZ (NM). .... 5. **Roldana**

3. Corollas white, dirty white, or ochroleucous to slightly pinkish or greenish; capitula discoid.

7. Capitulescences elongate, racemiform clusters; Aleutian Islands. .... 6. **Parasenecio**

7. Capitulescences flat-topped, corymbiform clusters. Southern half of flora region.

8. Corolla lobes parted the whole length of the limb, the throat indistinct; leaf blades deeply pinnatisect; AZ. .... 7. **Psacalium**

8. Corolla lobes separate less than half the length of the limb, the throat cylindrical or funnelform, distinct; leaf blades subentire to merely toothed.

9. Florets 20–40; high Appalachians (above 1400 m) NC, TN. .... 8. **Rugelia**

9. Florets 5. Widespread in southeastern quarter of the region, below 1400 m. .... 9. **Arnoglossum**

1. Stigmatic areas marginal and distinct on distal, adaxial faces of style branches; anther collars swollen (balusterform) with basal cells inflated; n = (10) 20, or 22–23, or polyploid derivatives (n = 30 in **Pericallis**). (**Senecioninae**).

10. Scandent, scrambling vines.

11. Capitula radiate; corollas orange to brick-colored; apices of style branches with distinctive, elongate central appendages; FL. .... 10. **Pseudogynoxys**

11. Capitula discoid; corollas yellow; apices of style branches truncate-penicillate; CA. .... 11. **Delairea**

10. Plants erect and free standing.

12. Corollas white or dirty white; capitula discoid. .... 12. **Hasteola**

12. Corollas variously yellow to orange or anthocyanic, rarely white and then capitula radiate; capitula discoid or radiate.

13. Principal leaves with blades palmately veined and petioles with clasping, stipule-like bases; corollas anthocyanic, sometimes white, or both; capitula radiate; CA. .... 13. **Pericallis**

13. Principal leaves with blades not both palmately veined and with expanded-clasping petiole bases; corollas mostly yellow, sometimes orange or ochroleucous, rarely anthocyanic; capitula discoid or radiate; widespread.

14. Herbs with stems arising singly or clustered from a taproot, caudex, or rhizome and with abundant, thin, branching fibrous roots; principal leaves in a basal cluster, cauline leaves progressively reduced distally, margins without conspicuous callose denticles; n = 22 or 23, or polyploid derivatives. .... 14. **Packera**

14. Herbs, subshrubs or shrubs of various habits and leaf dispositions, but if herbs with stems arising from a cluster of

basal leaves and with cauline leaves progressively reduced distally, then the roots are fleshy and unbranched and/or the leaf margins have abundant callose denticles; n=(10) 20, or polyploid derivatives. .... 15. **Senecio** (s. str.)

THE TUSSILAGINOID GENERA

1. **Barkleyanthus** H. Rob. & Brettell

One species; a semi-weedy, hairless shrub that occurs from Honduras northward through Guatemala and Mexico and barely enters the FNANM range in southern Arizona and New Mexico. *Barkleyanthus salicifolius* (H.B.K.) H. Rob. & Brettell was widely known as *Senecio salignus* DC. in the past (Robinson & Brettell 1974). Included in *Senecio* by Barkley (1978).

2. **Yermo** Dorn

One species, *Yermo xanthocephala* Dorn, is known only from barren desert sites in central Wyoming. It was discovered and described in the past decade (Dorn 1991) and its phyletic affinities are not yet well understood. Superficially, it rests easily in the tussilaginoid assemblage. This distinctive species was given a color photograph on the cover of the magazine "Science News" 155(1), January 2, 1999. It was not treated by Barkley (1978) or Pippen (1978).

3. **Tephroseris** Rchb.

A group of some 40–50 boreal and alpine herbs, centered in Eurasia but with at least four species in the FNANM region. The group was revised by Cufodontis (1933), and since his time it has been treated chiefly in floristic studies with differing species concepts (e.g., Barkley 1978; Cody 1996, Hultén 1950 & 1968; Schischkin 1968; Scoggan 1979; Welsh 1974). The taxonomy of the group is complicated by intergradant species and unresolved nomenclatural problems. The species of *Tephroseris* superficially resemble certain species of *Senecio*, s. str., but the microcharacters are clearly tussilaginoid and the basal chromosome number is $x=24$, a number otherwise unknown in the Senecionoid lineage. Included in *Senecio* by Barkley (1978).

4. **Sinosenecio** B. Nord.

A group of about 30 species of low herbs, mostly of eastern and southeastern Asia, but with a single species in the New World, *Sinosenecio newcombei* (Greene) J.P. Janovec & T.M. Barkley. It is apparently restricted to the Queen Charlotte Islands, British Columbia (Janovec & Barkley 1996). Included in *Senecio* by Barkley (1978).

5. **Roldana** LaLlave

Fifty or more species of coarse herbs, shrubs, and small trees, most of which have broad, palmately or subpalmately veined leaves. The group is centered in the Trans-Mexican Volcanic Belt; it ranges through much of Mexico and

Central America. One species, *Roldana hartwegii* (Benth.) H. Rob. & Brettell, occurs northward to southern Arizona. The genus is under revision by A. Michele Funston. Included in *Senecio* by Barkley (1978).

6. Parasenecio W.W. Sm. & J. Small
A group of about 50 species, centered in eastern Asia, but one species, *Parasenecio auriculata* (A. DC.) J.R. Grant, barely enters the FNANM range on five islands at the western end of the Aleutian Island chain in Alaska. Our plant has been variously included in the past within *Cacalia, Koyamacalia, Ligularia*, or *Parasenecio* (Grant 1993). It was not treated by either Barkley (1978) or Pippen (1978).

7. Psacalium Cass.
About 45 species, mostly in Mexico, but one species, *Psacalium decompositum* (A. Gray) H. Rob. & Brettell, enters the FNANM region in southern Arizona. The group was treated by Pippen (1968), who included our plant in the segregate genus *Odontotrichum*, cf. Robinson and Brettell (1973). Included in *Cacalia* by Pippen (1978).

8. Rugelia R.S. Shuttlew. ex Chapm.
A single species, *Rugelia nudicaulis* Shuttlew. ex Chapm. occurs in the high mountains of central Appalachia along the Tennessee-North Carolina border. It has been treated as *Senecio rugelia* A. Gray in many floristic works of the past, but was included in *Cacalia* by Pippen (1978).

9. Arnoglossum Raf.
Eight species of tall herbs of the southeastern quarter of the FNANM region. They form the traditional core of *Cacalia*, as that genus has been conceived in North American floristics. A new species was recently described by Anderson (1998). Included in *Cacalia* by Pippen (1978).

THE SENECIONOID GENERA

10. Pseudogynoxys (Greenm.) Cabrera
A dozen or so species; scandent, scrambling vines with showy, orange or brick-colored corollas. They are native to the Caribbean region and southward as far as eastern Brazil. They are cultivated as ornamentals, and one species, *Pseudogynoxys chenopodioides* (Kunth) Cabrera, escapes from cultivation and persists in southern Florida and perhaps elsewhere along the Gulf Coast. It has been called *Senecio confusus* Britten in floristic works and the horticultural literature. The group was catalogued and a key was presented by Robinson and Cuatrecasas (1977), but the relationships among the species remain poorly understood and a revision is needed. Included in *Senecio* by Barkley (1978).

11. Delairea Lem.

One species; a scandent vine, *Delairea odorata* Lemaire, is native to southern Africa but is now established as an aggressive weed in coastal California. This plant has been known as *Senecio mikanioides* Otto, and was included in *Senecio* by Barkley 1978.

12. Hasteola Raf.

Two species; one is of the east-central U.S and the other was recently described from Florida. These plants have eradiate capitula and white corollas, which places them in the traditional concept of *Cacalia*, but they have the microcharacters and cytology of the Senecionoid lineage, cf. Anderson (1994). Included in *Cacalia* by Pippen (1978).

13. Pericallis D. Don

About a dozen species; native to the Canary Islands, Madeira, and the Azores, and some species are ancestral to the horticultural complex called "the florists' cineraria." A cultivar from the complex escapes and persists in favored sites in coastal California. Under current taxonomic concepts our plant is best treated as *Pericallis hybrida* B. Nord., but it has been widely known in the past as *Senecio cruentus* DC. *Pericallis* is alone among the Senecionoid genera in having n = 30, a number that is typical of the Tussilaginoid lineage. In all other characters, however, it fits comfortably among the Senecionoids (Nordenstam 1977, 1978). Included in *Senecio* by Barkley (1978).

14. Packera Á. Löve & D. Löve

About 60 species; centered in the western temperate half of North America but extending into southern Mexico and into the Arctic. Two arctic-alpine species extend into northern Siberia and central Asia. . The group has been known as the "aureoid complex" of *Senecio*, s.l., and although its members are superficially similar to many species of *Senecio*, it forms a distinct lineage. Intergradation among *Packera* species is well known (Barkley 1988), but there is no morphological intergradation or putative hybridization between any *Packera* and any species of *Senecio*, s.str., or segregate of *Senecio*. In addition to the characters used in the key, *Packera* is further distinguished from *Senecio* by having pollen grains of a helianthoid ultrustructural type rather than of a senecionoid type (Bain & Walker 1995). An ITS-based phylogeny has been estimated for *Packera* by Bain and Jansen (1995). Included in *Senecio* by Barkley (1978).

15. Senecio L.

Senecio, in the broadest sense, is a nearly world wide genus of some 3,000 species, and even after the exclusion of the currently accepted segregates, it still encompasses some 1,300 species. Clearly, *Senecio*, s.str., is a "mixed bag" that is defined largely as what remains after the rather precisely circumscribed segregate genera are removed. It includes numerous species of unknown affinity, and presumably the concept of "Senecio" will change as more is learned about the relationships of the currently included species. About 50 species of *Senecio*, s.str., occur in the FNANM region; some are native, some are introduced, and a few are notable weeds.

SENECIO AND *CACALIA* NAMES OF TRADITIONAL USE IN NORTH AMERICAN FLORISTICS AND THEIR DISPOSITION IN THE FNANM

Epithets with no alternative name remain as listed

SENECIO

actinella Greene
amplectens A. Gray
    var. *amplectens*
    var. *holmii* (Greene) H.D. Harr.
ampullaceus Hook.
anonymus A.W. Wood ≡ *Packera anonyma* (A.W. Wood) W.A. Weber & Á. Löve
antennariifolius Britton ≡ *Packera antennariifolia* (Brirron) W.A. Weber & Á. Löve
aphanactis Greene
arizonicus Greene
aronicoides DC.
astephanus Greene
atratus Greene
atropurpureus (Ledeb.) Fedtsch. ≡ *Tephroseris atropurpurea* (Ledeb.) Holub subsp. *atropurpurea*
    var. *frigidus* ≡ *T. a.* subsp. *frigida* (Richardson) Á. Löve & D. Löve
    var. *tomentosus* (Kjellm.) Hulrén = *Tephroseris kjellmanii* (A.E. Porsild) Holub
aureus L. ≡ *Packera aurea* (L.) Á. Löve & D. Löve
bernardinus Greene ≡ *Packera bernardina* (Greene) W.A. Weber & Á. Löve
bigelovii A. Gray
    var. *bigelovii*
    var. *hallii* A. Gray
blochmaniae Greene
bolanderi A. Gray ≡ *Packera bolanderi* (A. Gray) W.A. Weber & Á. Löve
    var. *bolanderi*
    var. *harfordii* (Greenm.) T.M. Barkley ≡ *P. b.* var. *harfordii* (Greenm.) D.K. Trock & T.M. Barkley
breweri Burtt = *Packera breweri* (Burtt Davy) W.A. Weber & Á. Löve
californicus DC.
cannabifolius Less.
canus Hook. ≡ *Packera cana* (Hook.) W.A. Weber & Á. Löve
cardamine Greene ≡ *Packera cardamine* (Greene) W.A. Weber & Á. Löve
castoreus S.L. Welsh (a *Packera*?)
clarkianus A. Gray
clevelandii Greene ≡ *Packera clevelandii* (Greene) W.A. Weber & Á. Löve
confusus Britten = *Pseudogynoxys chenopodioides* (Kunth) Cabrera
congestus (R.Br.) DC.
conterminus Greenm. ≡ *Packera contermina* (Greenm.) J.F. Bain

- *crassulus* A. Gray
- *crocatus* Rydb. ≡ *Packera crocata* (Rydb.) W.A. Weber & Á. Löve
- *cruentus* DC. = *Pericallis hybrida* B. Nord.
- *cymbalaria* Pursh ≡ *Packera cymbalaria* (Pursh) W.A. Weber & Á. Löve
- *cymbalarioides* Buek ≡ *Packera buekii* D.K. Trock & T.M. Barkley
- *cynthioides* Greene ≡ *Packera cynthoiides* (Greene) W.A. Weber & Á. Löve
- *debilis* Nutt. ≡ *Packera debilis* (Nutt.) W.A. Weber & Á. Löve
- *dimorphophyllus* Greene ≡ *Packera dimorphophylla* (Greene) W.A. Weber & Á. Löve
  - var. *dimorphophylla*
  - var. *intermedius* T. Barkley ≡ *P. d.* var. *intermedia* (T.M. Barkley) D.K. Trock & T.M. Barkley
  - var. *paysonii* T. Barkley ≡ *P. d.* var. *paysonii* (T.M. Barkley) D.K. Trock & T.M. Barkley
- *douglasii* DC. = *Senecio flaccidus* Less.
  - var. *douglasii* ≡ *S. f.* var. *douglasii* (DC.) B.L. Turner & T.M. Barkley
  - var. *longilobus* (Benth.) L.D. Benson = *S. f.* Less. var. *flaccidus*
  - *var. monoensis* (Greene) Jeps. ≡ *S. f.* var. *monoensis* (Greene) B.L.Turner & T.M. Barkley
- *elegans* L.
- *elmeri* Piper
- *eremophilus* Richardson
  - var. *eremophilus*
  - var. *kingii* (Rydb.) Greenm.
  - var. *macdougallii* (A. Heller) Cronquist
- *ertterae* T.M. Barkley
- *eurycephalus* Torr. & A. Gray ≡ *Packera eurycephala* (Torr. & A. Gray) W.A. Weber & Á. Löve
  - var. *eurycephala*
  - var. *lewisrosei* (J.T. Howell) T.M. Barkley ≡ *P. eurycephala*. var. *lewisrosei* (J.T. Howell) J.F. Bain
- *fendleri* A. Gray ≡ *Packera fendleri* (A. Gray) W.A. Weber & Á. Löve
- *flaccidus* Less.
  - var. *flaccidus*
  - var. *douglasii* (DC.) B.L. Turner & T.M. Barkley
  - var. *monoensis* (Greene) B.L. Turner & T.M. Barkley
- *flettii* Wiegand ≡ *Packera flettii* (Wiegand) W.A. Weber & Á. Löve
- *foetidus* Howell = *Senecio hydrophiloides* Rydb.
- *foetidus* var. *hydrophiloides* (Rydb.) T.M. Barkley ex Cronquist ≡ *Senecio hydrophiloides* Rydb.
- *franciscanus* Greene ≡ *Packera franciscana* (Greene) W.A. Weber & Á. Löve
- *fremontii* Torr. & A. Gray
  - var. *fremontii*
  - var. *blitoides* (Greene) Cronquist
  - var. *occidentalis* A. Gray
  - var. *inexpectans* Cronquist
- *frigidus* Less. ≡ *Tephroseris atropurpurea* subsp. *fridiga* (Richardson) Á. Löve & D. Löve
- *fuscatus* Hayek = *Tephroseris lindstroemii* Á. Löve & D. Löve
- *ganderi* T.M. Barkley & R.M. Beauch. ≡ *Packeri ganderi* (T.M. Barkley & R.M. Beauch.) W.A. Weber & Á. Löve
- *glabellus* Poir. *Packera glabella* (Poir.) C. Jeffrey
- *greenei* A. Gray ≡ *Packera greenei* (A. Gray) W.A. Weber & Á. Löve
- *hartianus* A. Heller ≡ *Packera hartiana* (A. Heller) W.A. Weber & Á. Löve
- *hartwegii* Benth. ≡ *Roldana hartwegii* (Benth.) H. Rob. & Brettell
- *hesperius* Greene ≡ *Packera hesperia* (Greene) W.A. Weber & Á. Löve
- *huachucanus* A. Gray ≡ *Senecio multidentatus* var. *huachucanus* (A. Gray) T.M. Barkley

hydrophiloides Rydb.
hydrophilus Nutt.
hyperborealis Greenm. ≡ *Packera hyperborealis* (Greenm.) Á. Löve & D. Löve
imparipinnatus Klatt = *Packera tampicana* (DC.) C. Jeffrey
indecorus Greene ≡ *Packera indecora* (Greene) Á. Löve & D. Löve
integerrimus Nutt.
  var. *integerrimus*
  var. *exaltatus* (Nutt.) Cronquist
  var. *major* (A. Gray) Cronquist
  var. *ochroleucous* (A. Gray) Cronquist
  var. *scribneri* (Rydb.) T.M. Barkley
ionophyllus Greene ≡ *Packera ionophylla* (Greene) W.A. Weber & Á. Löve
jacobaea L.
kjellmanii A.E. Porsild ≡ *Tephroseris kjellmanii* (A.E. Porsild) Holub
layneae Greene ≡ *Packera layneae* (Greene) W.A. Weber & Á. Löve
lemmonii A. Gray
lindstroemii A.E. Porsild ≡ *Tephroseris lindstroemii* (A.E. Porsild) Á. Löve & D. Löve
lugens Richardson
lyonii A. Gray
macounii Greene ≡ *Packera macounii* (Greene) W.A. Weber & Á. Löve
malmstenii S.F. Blake ex Tidestr. (a *Packera* ?)
megacephalus Nutt.
mikanioides Otto ex Walpers = *Delairea odorata* Lem.
millefolium T.& G. ≡ *Packera millefolia* (Torr. & A. Gray) W.A. Weber & Á. Löve
millelobatus Rydb. ≡ *Packera millelobata* (Torr. & A. Gray) W.A. Weber & Á. Löve
mohavensis A. Gray
moresbiensis (Calder & R.L. Taylor) G.W. Douglas & G. Ruyle-Douglas ≡ *Packera moresbiensis.* (Calder & R.L. Taylor) J.F. Bain
multicapitatus Greenm. ≡ *Senecio spartioides* var. *multicapitatus* (Greenm.) S.L. Welsh
multidentatus var. *huachucanus* (A. Gray) T.M. Barkley
multilobatus Torr. & A. Gray ex A. Gray ≡ *Packera multilobata* (Torr. & A. Gray ex A. Gray) W.A. Weber & Á. Löve
musiniensis S.L. Welsh (a *Packera* ?)
neomexicanus A. Gray ≡ *Packera neomexicana* (A. Gray) W.A. Weber & Á. Löve
  var. *neomexicanus* ≡ *P. n.* var. *neomexicana*
  var. *metcalfei* (Greene) T.M. Barkley ≡ *P. n.* var. *metcalfei* (Greene) D.K. Trock & T.M. Barkley
  var. *mutabilis* (Greene) T.M. Barkley ≡ *P. n.* var. *mutabilis* (Greene) W.A. Weber & Á. Löve
  var. *toumeyi* (Greene) T.M. Barkley ≡ *P. n.* var. *toumeyi* (Greene) T.M. Barkley & D.K. Trock
neowebsteri S.F. Blake
newcombei Greene ≡ *Sinosenecio newcombei* (Greene) J.P. Janovec & T.M. Barkley
obovatus Muhl. ex Willd. ≡ *Packera obovata* (Muhl.ex Willd.) W.A. Weber & Á. Löve
ogotorukensis Packer ≡ *Packera ogotorukensis* (Packer) W.A. Weber & Á. Löve
parryi A. Gray
pattersonensis Hoover
pauciflorus Pursh ≡ *Packera pauciflora* (Pursh) W.A. Weber & Á. Löve
pauperculus Michx. ≡ *Packera paupercula* (Michx.) W.A. Weber & Á. Löve
plattensis Nutt. ≡ *Packera plattensis* (Nutt.) W.A. Weber & Á. Löve

porteri Greene ≡ Packera porteri (Greene) C. Jeffrey
pseudaureus Rydb. ≡ *Packera pseudaurea* (Rydb.) W.A. Weber & Á. Löve
  var. *pseudaureus* ≡ *P. p.* var. *pseudaurea*
  var. *flavulus* (Greene) Greenm. ≡ *P. p.* var. *flavula* (Greene) W.A. Weber & Á. Löve
  var. *semicordatus* (Mack. & Bush) T.M. Barkley ≡ *P. p.* var. *semicordataus* (Mack. & Bush) T.M. Barkley & D.K. Trock
pseudo-arnica Less.
pudicus Greene
quaerens Greene ≡ *Packera quaerens* (Greene) W.A. Weber & Á. Löve
quercetorum Greene ≡ *Packera quercetorum* (Greene) C. Jeffrey
rapifolius Nutt.
resedifolius Less. = *Packera cymbalaria* (Pursh) W.A. Weber & Á. Löve
riddellii Torr. & A. Gray
robbinsii Oakes ex Rusby = *Packera schweintiziana* (Nutt.) W.A. Weber & Á. Löve
rugelia A. Gray ≡ *Rugelia nudicaulis* Shutlew. ex Chapm.
sacramentanus Wooton & Standl.
salignus DC. = *Barkleyanthus salicifolius* (Kunth) H. Rob. & Brettell
sanguisorboides Rydb. ≡ *Packera sanguisorboides* (Rydb.) W.A. Weber & Á. Löve
schweinitzianus Nutt. ≡ *Packera schweinitzianus* (Nutt.) W.A. Weber & Á. Löve
scorzonella Greene
serra Hook.
  var. *serra*
  var. *admirabilis* (Greene) A. Nelson
sheldonensis A.E. Porsild
smallii Britt. = *Packera anonyma* (A.W. Wood) W.A. Weber & Á. Löve
soldanella A. Gray
spartioides Torr. & A. Gray
  var. *spartioides*
  var. *multicapitatus* (Greenm.) S.L. Welsh
spellenbergii T.M. Barkley ≡ *Packera spellenbergii* (T.M. Barkley) C. Jeffrey
sphaerocephalus Greene
streptanthifolius Greene ≡ *Packera streptanthifolia* (Greene) W.A. Weber & Á. Löve
subnudus DC. ≡ *Packera buekii* D.K. Trock & T.M. Barkley
sylvaticus L.
tampicanus DC. ≡ *Packera tampicana* (DC.) C. Jeffrey
taraxacoides (A. Gray) Greene
tomentosus Michx. ≡ *Packera tomentosa* (Michx.) C. Jeffrey
triangularis Hook.
tridenticulatus Rydb. ≡ *Packera tridenticulata* (Rydb.) W.A. Weber & Á. Löve
viscosus L.
vulgaris L.
warnockii Shinners
werneriifolius A. Gray ≡ *Packera werneriifolia* (A. Gray) W.A. Weber & Á. Löve
wootonii Greene
yukonensis A.E. Porsild ≡ *Tephroseris yukonensis* (A.E. Porsild) Holub

CACALIA

atriplicifolia L. ≡ *Arnoglosum atriplicifoliium* (L.) H. Rob.
auriculata DC. ≡ *Parasenecio auriculata* (DC.) J.R. Grant
decomposita A. Gray ≡ *Psacalium decompositum* (A. Gray) H. Rob. & Brettell

diversifolia Torr. & A. Gray ≡ *Arnoglossum diversifolium* (Torr. & Gray) H. Rob.
floridana A. Gray ≡ *Arnoglossum floridanum* (A. Gray) H. Rob.
muehlenbergii Sch.Bip. = *Arnoglossum reniforme* (Hook.) H. Rob.
ovata Walt. ≡ *Arnoglossum ovatum* (Walter) H. Rob.
plantaginea (Raf.) Shinners ≡ *Arnoglossum plantigineum* Raf.
rugelia (Shuttlew. ex Chapm.) T. Barkley & Cronquist ≡ *Rugelia nudicaulis* Shuttlew. ex Chapm.
suaveolens L. ≡ *Hasteola suaveolens* (L.) Pojark.
sulcata Fernald ≡ *Arnoglossum sulcatum* (Fernald) H. Rob.

ACKNOWLEDGMENTS

Conversations on the matters of generic delimitations in the Senecioneae were had with many people over the years, including Loran Anderson, John Bain, Luc Brouillet, Bonnie Clark, Craig Freeman, Michele Funston, Hugh Iltis, Charles Jeffrey, Robert Kowal, Alison Mahoney, Guy Nesom, Bertil Nordenstam, John Packer, Harold Robinson, John Strother, Debra Trock, Billie Turner, Jose Luis Villaseñor, William Weber, and Alan Whittemore. It is my pleasure to acknowledge all of them. John Strother and Robert Kowal were also of great assistance in editorial and nomenclatural matters. It is also a pleasure to tip the hat to the memory of the late Arthur Cronquist, who so gladly shared with me his great knowledge of the North American Compositae.

REFERENCES

ANDERSON, L. 1994. A revision of *Hasteola* (Asteraceae) in the New World. Syst. Bot. 19:211–219.

__________. 1998. *Arnoglossum album* (Asteraceae): New species from northern Florida. Sida 18:377-384.

BAIN. J.F. and R.K. JANSEN. 1995. A phylogenetic analysis of the aureoid *Senecio* (Asteraceae) complex based on ITS sequence data. Pl. Syst. Evol. 195:209–219.

__________ and J. WALKER. 1995. A comparison of the pollen wall ultrastructure of aureod and non-aueroid *Senecio* species (Asteraceae) in North America. Pl. Syst. Evol. 195: 199–207.

BENTHAM, G. 1873a. Notes on the classification, history, and geographical distribution of the Compositae. J. Linn. Soc., Bot. 13:335–577.

__________. 1873b. Compositae. In: G. Bentham & J.D. Hooker, Genera Plantarum, vol.2, part 1. Reeves & Co. and Williams & Norgate, London.

BARKLEY, T.M. 1978. *Senecio*. N. Amer. Fl. II. 10:50–139.

__________. 1988. Variation among the aureoid senecios of North America: A geohistorical perspective. Bot. Rev. 54:82–106.

BARKLEY, T.M., B.L. CLARK, and A.M. FUNSTON. 1996. The segregate genera of *Senecio*, s.l., and *Cacalia*, s.l. (Asteraceae: Senecioneae) in Mexico and Central America. In: D.J.N. Hind and H.J. Beentje, eds. Compositae: Systematics. Proceedings of the International Compositae Conference, Kew 1994. 1:613–620. Royal Botanic Gardens, Kew, U.K.

BREMER, K. 1994. Asteraceae: Cladistics and classification. Timber Press, Portland, OR. U.S.A.

BRUMMIT, R.K. 1998. In: Nicolson, D.H., ed. Proposals to conserve or Reject. Report on the Committee for Spermatophyta. Taxon 47:444.

CODY, W.J. 1996. Flora of the Yukon Territory. NRC Research Press. Ottawa, Canada.

CUFODONTIS, G. 1933. Kritische Revision von *Senecio* sectio *Tephroseris*. Feddes Repert. Spec. Nov. Beih. 70:1–266.

DORN. R. 1991. *Yermo xanthocephalus* (Asteraceae: Senecioneae): A new genus and species from Wyoming. Madroño 38:198–201.

GRANT, J.R. 1993. A new combination for the single American element of *Parasenecio* (Asteraceae: Senecioneae). Novon 3:154–155.

GREENMAN, J.M. 1901. Monographie der nord- und centralamerikanischen Arten der Gattung *Senecio*. I. Allgemeines und Morphologie. Leipzig. (Reprinted in Bot. Jahrb. Syst. 32:1–33. 1902.)

HIND, D.J.N. and H.J. BEENTJE (eds.). 1996. Compositae: Systematics. Proceedings of the International Compositae Conference , Kew, 1994. Royal Botanic Gardens, Kew, U.K.

HOFFMANN, O. 1892. *Senecioneae*. In: A. Engler & K. Prantl, eds. Die natürlichen Pflanzenfamilien 4(5):283–303. Leipzig.

HULTÉN, E. 1950. Flora of Alaska and Yukon. X. Lunds Universitets Årrskrift, Avd. 2, Bd. 45, Nr. 1, pp. 1601–1623. C.W.K. Gleerup, Lund, Sweden.

____________. 1968. Flora of Alaska and neighboring territories. Stanford Univ. Press, Stanford, CA.

JANOVEC, J.P. and T.M. BARKLEY. 1996. *Sinosenecio newcombei* (Asteraceae: Senecioneae): A new combination for a North American plant in an Asiatic genus. Novon 6:265–267.

NORDENSTAM, B. 1977 (publ. 1978). Senecioneae and Liabeaeæ—Systematic review. In: V.H. Heywood, et al., eds. The biology and chemistry of the Compositae, Vol. 2. Academic press, London.

____________. 1978. Taxonomic notes on the tribe Senecioneae (Composirae). Opera Bot. 44:1–84.

PIPPEN, R. 1968. Mexican "Cacalioid" genera allied to *Senecio* (Compositae). Contr. U.S. Natl. Herb. 43:365–447.

____________. 1978. *Cacalia*. N. Amer. Fl. II. 10:151–159.

ROBINSON, H. and R.D. BRETTELL. 1973. Studies in Senecioneae (Asteraceae). III. The genus *Psacalium*. Phytologia 27:254–264.

____________ and ____________. 1974. Studies in Senecioneae (Asteraceae) V. The genera *Psacaliopsis*, *Barkleyanthus*, *Telanthophora*, and *Roldana*. Phytologia 27:402–439.

____________ and J. CUATRECASAS. 1977. Notes on the genus and species limits of *Pseudogynoxys* (Greenm.) Cabrera (Senecioneae, Asreraceae). Phytologia 36:177–192.

SCHISCHKIN, B.K. 1961. *Senecio*. In: B.K. Schischkin and E.G. Bobrov, eds. Flora URSS 26:699–788. Academy of Science of the USSR, Moscow and Leningrad.

SCOGGAN, H.J. 1970. The flora of Canada, part 4. National Museums of Natural Sciences, Ottawa, Canada.

WAGENITZ, G. 1995. Proposal to reject the name *Cacalia* L. (Compositae: Senecioneae). Taxon 44:445–446.

WELSH, S.L. 1974. Anderson's flora of Alaska. Brigham Young Univ. Press. Provo, Utah.

A NEW VARIETY OF *PHYSARIA NEWBERRYI* (BRASSICACEAE) FROM NEW MEXICO

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ABSTRACT

The new variety *Physaria newberryi* var. *yesicola* is described and illustrated. It is readily distinguished within *P. newberryi* by its very long styles. Variety *yesicola* occurs upon the gypseous Yeso Formation in the Sierra Lucero of west-central New Mexico.

RESUMEN

Se describe y se ilustra una nueva variedad *Physaria newberryi* var. *yesicola*. Se distingue fácilmente de *P. newberryi* por sus estilos muy largos. La variedad *yesicola* aparece en suelos gipsícolas de la Formación Yeso en la Sierra Lucero del cenrro-oeste de Nuevo México.

Physaria newberryi A. Gray var. **yesicola** Sivinski, var. nov. (**Fig. 1**). TYPE: U.S.A. NEW MEXICO. Valencia Co.: NE side of Sierra Lucero ca 37 km W of Los Lunas, T6N R3W Section 2 NW¼ NW¼, 34°46'54"N 107°7'48"W, elev. 1800 m, 4 May 1998, *R. Sivinski & C. McDonald 4335* (HOLOTYPE: UNM; ISOTYPES: ARIZ, BRY, CAS, GH, MO, NY, US).

A *Physaria newberryi* A. Gray var. *racemosa* Rollins stylis filiformibus (5–9 mm longis) et racemis fructiferis brevibus (2.5–5 cm longis) differt.

Long-lived caespitose perennial with diffusely branching caudex forming mounded clumps 10–30 cm in diameter; caudex branches thickly clothed with marcescent leaf bases and terminated by clusters of ascending to erect leaves; stems and leaves densely covered with overlapping stellate-discoid trichomes, trichome rays confluent for at least 1/2 their length and often to near their apex; basal leaves narrowly oblanceolate to broadly spatulate, 3–8 cm long (including petiole), acute to obtuse, margins entire or with a few broad teeth, the winged petiole less than to 2 times as long as the expanded blade; cauline leaves few, sessile, 1–1.5 cm long, linear-oblanceolate; stems numerous and arising from the axils of basal leaves, ascending to erect; *mature racemes 2.5–5*

SIDA 18(3): 673–677. 1999

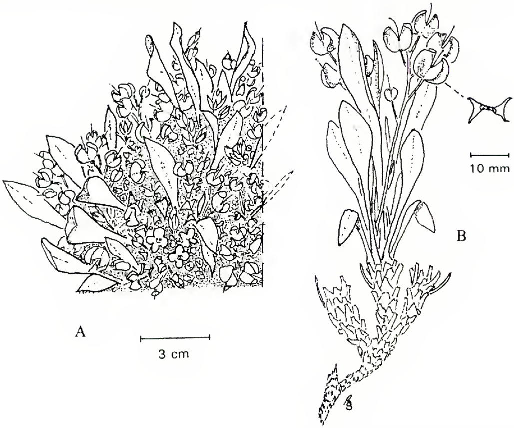

FIG. 1. *Physaria newberryi* var. *yesicola* Sivinski var. nov., (A) growth form (one-half of caespitose mound), (B) detail of plant and latitudinal cross-section of silicle from *Sivinski & McDonald 4335*.

cm long; fruiting pedicels straight, ascending or divergent, 6–11 mm long; sepals greenish yellow, pubescent, lanceolate and somewhat cucullate, 6–7 mm long and 1.0–1.5 mm wide; petals yellow, oblanceolate to spatulate, 7–8 mm long and 1.5–2.0 mm wide; *silicles* papery, pubescent, becoming purplish at maturity, *deeply cleft at the apex with a V-shaped sinus and with little or no basal cleft, fruit cross-section X-shaped with concave valve sides and dorsal surface, valve margins and sinus crests sharply keeled*, each valve 6–9 mm long and 4–7 mm wide; *repla 2.5–3.5 mm long*, narrow to nearly closed, acute at the apex; *fruiting styles thread-like, 5–9 mm long, surpassing the apical cleft of the silicle*; ovules 2 per valve; seeds ovate, slightly compressed.

Additional specimens examined: **NEW MEXICO: Cibola Co.:** canyon on the west side of Sierra Lucero, ca 47 km S of Laguna Pueblo, T5N R5W Section 36 NE¼, 34°37'13"N 107°18'55"W, elev. 2040 m, 14 May 1998, *R.C. Sivinski 4368* (ASC, COLO, ISTC, NMC, RENO, RM, UNM, UT). **Valencia Co.:** Laguna Pueblo Reservation, NE side of Mesa Lucero, 34°50'14"N, 107°6'43"W, elev. 1740 m, 24 Sep 1997, *R. Sivinski, T. Lowrey & B. Miller 4160* (UNM).

Distribution and Habitat.—Variety *yesicola* is presently known only from the Sierra Lucero Range (including Mesa Lucero) of Cibola and Valencia counties in west-central New Mexico (Fig. 2). This population is the extreme southeastern range limit for the species. It occurs on sandy gypsum and other silty strata of the Permian age Yeso Formation. The Yeso Formation is 200 to 300 meters thick in the Sierra Lucero. It is comprised of a soft, silty sandstone interbedded with gypsum, limestone, shale and siltstone strata of various thicknesses (Weber & Kottlowski 1959). Variety *yesicola* occurs on silty sand substrates that contain obvious quantities of gypsum. It is also locally abundant on adjacent siltstone and silty limestone strata which may be mildly gypseous, but have not been analyzed.

The habitat is nearly barren badlands and canyon sides of various slopes and exposures between the elevations of 1700 and 2100 m. *Juniperus monosperma* (Engelm.) Sarg. trees are scattered across this formation and the shrubby and herbaceous vegetation varies with the geologic strata. Common associates on sandy gypsum are *Tiquilia hispidissima* (Torr.) A. Richardson, *Selinocarpus lanceolatus* Wooton, *Calylophus hartwegii* subsp. *filifolius* (Eastw.) Towner & Raven, *Cryptantha fulvocanescens* S. Wats., *Artemisia bigelovii* A. Gray, *Tetradymia filifolia* Greene, *Lycium pallidum* Miers, *Sporobolus nealleyi* Vasey and *Stipa comata* Trin. & Rupr. The most frequent gypsum habitat associate is an undescribed *Phacelia* that is in preparation for publication by Tim Lowrey and Paul Knight (UNM) with Dwane Atwood (BRY). Associates on silty limestones or siltstones are more variable, but often consist of *Ephedra torreyana* S. Wats., *Rhus trilobata* Nutt., *Eriogonum corymbosum* Benth., *Nolina greenei* S. Wats., *Aristida purpurea* var. *fendleriana* (Steud.) Vasey and *Schizachyrium neomexicanum* Nash.

Taxonomic Relationships.—*Physaria newberryi* is broadly, but sporadically, distributed through northwestern New Mexico, northern Arizona and southern Utah (Rollins 1993). It is closely related to *Physaria acutifolia* Rydberg (Montana to New Mexico and Utah) and *Physaria chambersii* Rollins of the Great Basin (Mulligan 1967). These three species can usually be distinguished with the following key:

1. Dorsal margins of silicle valves acutely angled (nearly winged); replum apex acute to acuminate (observable after valves have shed); trichome rays confluent for 1/2 or more their length .... **P. newberryi**
1. Dorsal margins of silicle valves obtusely angled or broadly rounded; replum apex obtuse or rounded; trichome rays confluent or free .... (2)
    2. Silicles apically cleft with a deep, narrow or V-shaped sinus and with a shallow or no basal sinus at the point of pedicel attachment, valves often obtusely angled; trichome rays usually free (confluent in var. *membranacea*) .... **P. chambersii**
    2. Silicles narrowly cleft at both the apex and base, valves broadly rounded; trichome rays free or confluent for nearly 1/2 their length .... **P. acutifolia**

The taxonomic boundaries among these species are notably blurred by intergrading polyploid races, especially in central and southern Utah (Mulligan

1967; Welsh et al. 1993). The distinctively angled silicle valves of *Physaria newberryi* make it the most well-marked and distinguishable species of this group (Fig. 1).

KEY TO THE VARIETIES OF *PHYSARIA NEWBERRYI*

1. Styles filiform, 5–9 mm long, surpassing the crest of the apical silicle sinus; repla 2.5–3.5 mm long; racemes 2–5 cm long .... var. **yesicola**
1. Styles stout, <4 mm long, usually shorter than the silicle sinus; replum and racemes lengrhs not combined as above .... (2)
    2. Repla 4–10 mm long; racemes usually 2–5 cm long (rarely up to 10 cm) .... var. **newberryi**
    2. Repla 2–3.5 mm long; racemes 5–10 cm long .... var. **racemosa**

Variety *yesicola* and var. *racemosa* both have short repla and the latter has also been collected from gypseous substrate (*Gierish 4214*, ARIZ, BYU). Variety *racemosa* is a minor peripheral variant in northwestern Arizona and southwestern Utah that possesses a unique combination of replum and raceme lengths, but no single distinguishing morphological characteristic. Welsh (1993) considers *racemosa* an insignificant phase that grades into var. *newberryi*. In contrast, var. *yesicola* is an isolated disjunct with long, filiform styles that are unique within this species.

The combination of confluent trichome rays and V-shaped apical silicle sinus in var. *yesicola* is also similar to *P. chambersii* var *membranacea* Rollins (syn. *P. lepidota* Rollins) of south-central Utah. Yet the long slender styles and short repla of var. *yesicola* are nearly as unusual for *P. chambersii* as they are for *P. newberryi*. In this case, I place the utmost taxonomic importance on silicle shape. The valve margins of var. *yesicola* are sharply keeled from the silicle base to the crest of the apical sinus and the valve surfaces are concave and less inflated than *P. chambersii*. These silicle features are characteristic of *P. newberryi* and clearly place *yesicola* close to that species. The long styles of *P. newberryi* var. *yesicola* are a conspicuous departure from the usual circumscription of this species and further obscures the taxonomic boundaries between it and other related taxa. Additional study of this species group is needed and may find justification for reducing some species to infraspecific status within *P. newberryi* or else elevating var. *yesicola* to species level.

At present, var. *yesicola* is known only from the Sierra Lucero and appears to be geographically isolated from other *Physaria* taxa (Fig. 2). It is locally abundant and morphologically consistent in this 50 km range of low mountains. This unique plant is another addition to a growing list of taxa endemic to the gypsum formations of New Mexico.

Etymology.—This new variety dwells upon the Yeso Formation in the Sierra Lucero, hence the name *yesicola*. Yeso is the Spanish word for 'gypsum' which is a fitting name for this geologic feature.

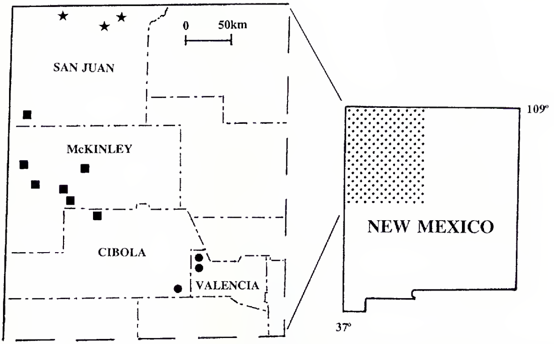

Fig. 2. Distribution of *Physaria newberryi* var. *newberryi*: ■, *P. newberryi* var. *yesicola*: •, and *P. acutifolia*: ★ in New Mexico.

ACKNOWLEDGMENTS

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REFERENCES

Mulligan, G.A. 1967. Cytotaxonomy of *Physaria acutifolia, P. chambersii*, and *P. newberryi* (Cruciferae). Canad. J. Bot. 45:1887–1898.

Rollins, R.C. 1993. The Cruciferae of continental North America. Standford Univ. Press, Standford, CA.

Weber, R.H. and F.E. Kottlowski. 1959. Gypsum resources of New Mexico. Bulletin 68, NM Institute of Mining and Technology, State Bureau of Mines and Mineral Resources, Socorro.

Welsh, S.L, N.D. Atwood, S. Goodrich, and L.C Higgins. 1993. A Utah flora. 2nd ed. Brigham Young Univ. Print Services, Provo, UT.

BOOK NOTICE

Lawrence R. Heaney and Jacinto C. Regalado, Jr. 1998. **Vanishing Treasures of the Philippine Rain Forest.** (ISBN 0-914868-19-5, pbk), The Field Museum, Roosevelt Road at Lake Shore Drive, Chicago, Illinois 60605-2496. $24 88 Pp.

This book "was published by The Field Museum, Chicago, on the occasion of "Vanishing Treasures of the Philippine Rain Forest" and "Voyage a Nation: The Philippines" -two exhibitions celebrating the biological diversity and culture of the Philippines."

As a semi-popular work, the book provides a wonderful introduction to the diversity, origins and prospects for survival of the highly endemic biota of the Philippines. Through highly illustrative examples, and fantastic photographs, the reader is led through some of the most striking elements of the remaining few extant forests. Most importantly, the balance of botanical and zoological examples of endangered taxa, and the economic consequences of their habitats' destruction, are illustrated in a practical way previously not seen in popular books. Every reader will be impressed with the extent of forest destruction, the catastrophic effects of deforestation on rural human populations, and mass extinction of species that were locally common in the past. While geographic and species coverages are slanted toward the Visayan and Mindanao regions of the country, examples are provided from all major faunistic areas in a well-balanced manner, complete with historical and present-day statistics. I have seen no better "coffee table" book that clearly and succinctly explains the horrific consequences of forest destruction, endangerment of species, and degradation of the environment. The case for the Philippines as the hottest of the "hot spots" is made in a striking manner. While I disagree that the Philippines is "megadiverse," (sensu Colombia or Brasil), it is certainly "mega-endemic" and the state of its forest cover is akin only to the that of Madagascar or Haiti. After serious reading of this book, I can scarcely imagine anyone who would not be ready to support research in basic systematics, conservation biology and sustainable development programs in the country. It is a book that should be on the bookshelf of every field biologist, conservationist and environmental enthusiast.—*John J. Pipoly III.*

SYNOPSIS OF NEW WORLD *COMMICARPUS* (NYCTAGINACEAE)

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ABSTRACT

Two new species of *Commicarpus* from México (*C. coctoris* and *C. praetermissus*) are described. A key to the five New World species is presented.

RESUMEN

Se describen dos nuevas especies de *Commicarpus* (Nyctaginaceae) de México. Se ofrece una clave para las cinco especies del Nuevo Mundo.

Commicarpus Standley, predominantly an African genus of 25–30 species (Meikle, 1978), was segregated from *Boerhavia* L. by Standley (1909), along with *Anulocaulis* Standley (1909) and *Cyphomeris* Standley (1911).

Fosberg (1978) reduced Standley's genera to subgenera under *Boerhavia*, though the combinations were never formally made and therefore have no nomenclatural standing (ICBN Art. 33.2). In modern floristic treatments, opinion is divided as to whether the segregate genera (or at least *Commicarpus*) deserve recognition. *Commicarpus* is recognized by, e.g., Breedlove 1986; González Elizondo et al. 1991; Liogier 1985; Brako and Zarucchi 1993. However, Acevedo-Rodríguez (1996) reduces *Commicarpus* to *Boerhavia*, as does Bogle (1974); Kellogg (in Howard 1988) likewise treats *Boerhavia* in the broader sense, to include *Commicarpus*, but acknowledges that cladistically there is no reason to choose one placement over the other—"We therefore include them in the same genus for convenience." I choose to recognize *Commicarpus*, but I have chosen specific epithets for the two new species which will not form homonyms if they are someday transferred to *Boerhavia*.

Study of some general collections from southwestern México, one communicated by courtesy of Paul A. Fryxell, the other long overlooked in herbaria, has revealed two novelties.

Commicarpus coctoris N.A. Harriman, sp. nov. (**Fig. 1**). Type: MÉXICO. Oaxaca: Municipio San Agustín Atenango, 14 km al SO de San Marcos Arteaga, carretera Huajuapan-Juxtlahuaca; laderas con matorral tropical caducifolia con unos encinos, *Brahea*, *Otatea*, *Bursera*, etc., suelo calizo, somero, alt. 1770 m, hierba pegajosa con ramas principales hasta 50 cm de largo, extendidas sobre el suelo, cálices guindas;

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10 ejem.
PLANTAS DE MEXICO

Commicarpus

EDO. OAXACA: Mpio. San Agustín Atenango, 14 km al SO de San Marcos Arteaga, carr. Huajuapan-Juxtlahuaca; laderas con matorral tropical caducifolio con unos encinos, *Branea*, *Otatea*, *Bursera*, etc., suelo calizo, somero, alt. 1770 m. Hierba pegajosa con ramas principales hasta 50 cm de largo, extendidas sobre el suelo, cálices guindas; en borde del matorral, escasa.

23 Noviembre 1989

Col. S.O. Koch y P.A. Fryxell 89220

FIG. 1. Holotype of *Commicarpus coctoris* N.A. Harriman.

en borde del matorral, escasa, 23 Nov 1989 (flowers and fruits), *Koch & Fryxell 89220* (HOLOTYPE: TEX!; ISOTYPES: CHAPA, OSH! and others to be distributed from TEX and CHAPA).

Haec species ob pilos glandulosos et perianthia rubra 12–16 mm longa et lata inter omnes species americanas peculiaris est.

Perennial herb, stems pink, to 50 cm long, sprawling over the ground, viscid, densely beset with multicellular, spreading, gland-tipped hairs, these mostly less than 0.5 mm long but some to 1 mm long. Leaves opposite, entire, isophyllous, blades 30–55 mm × 15-40 mm, ovate, basally cuneate to rounded, apically acute and cuspidate, without evident internal crystals, marginally glandular ciliate, adaxially glabrous, abaxially glandular hairy on the main veins only, on glandular-hairy petioles 8–12 mm long. Flowering branches hairy like the main stems, terminal and from the upper axils, with pedunculate, 4–6 flowered, simple umbels. Flowers on glandular-hairy pedicels 8–18 mm long, the portion near base of anthocarp without stipitate glands. Perianth funnelform, cherry red, 12–16 mm high and wide, glandular-hairy externally, glabrous internally; stamens 4, filaments glabrous, exserted; style glabrous, exserted well beyond the stamens, the stigma capitate. Fruits thickly clavate, glabrous, striate but not ribbed, 6–7 mm long, the pustular glands irregularly arrayed in the upper 1/2–2/3 of the fruit (anthocarp).

Flowering and fruiting.—November, so far as known.

Distribution and habitat.—Known solely from the type collection, in tropical deciduous forest. Possible paratype, the information communicated by Richard Spellenberg, the specimen not seen by me: México. Oaxaca. Laguna Encantada, ± 3 km al N de Justlahuaca, colinas yesosas con vegetacíon arbustiva dispersa de *Agave, Dasylirion,* Compositae, alt. 1600 m, *S. Zamudio & G. Ocampo 10951,* 22 Nov 1998 (IEB, NMC).

Etymology.—The epithet honors Stephen D. Koch (1940—), German for "cook," "coctor" in Latin, one of the collectors of the type material and most valued friend of Botany and botanists in México.

Commicarpus praetermissus N.A. Harriman, sp. nov. (**Fig. 2**). TYPE: MÉXICO. MICHOACÁN: Tizupan, Coalcomán, woods, 0.5 m high, flower red, alt. 50 m, 4 Sep 1941, *Hinton et al. 15911* (HOLOTYPE: LL!; ISOTYPES: K, NY, US and elsewhere).

A speciebus aliis pilis eglandulosis flexis, fere uncinatis, et perianthiis rubris glabrisque recedit.

Perennial herb, the slender stems probably sprawling, to 0.5 m tall or long, thinly to densely eglandular hairy, the hairs hooked and appearing almost uncinate, antrorsely inclined. Leaves opposite, isophyllous, blades 25–40 mm × 15–25 mm, ovate, apically retuse or rounded or acute, basally cuneate to rounded, with evident internal crystals, indistinctly ciliate, with a few hairs on the veins abaxially, otherwise glabrous, on hairy

FIG. 2. Holotype of *Commicarpus praetermissus* N.A. Harriman.

petioles 2–4 mm long. Flowering branches from the upper axils and terminal, bearing numerous pedunculate umbels, the peduncles and pedicels glabrous. Perianth above the ovary red, funnelform, 9 mm high and 12 mm broad, glabrous; stamens 2, the anthers exserted on glabrous filaments; style exserted, stigma capitate; fruit (anthocarp) slenderly clavate, 7.5–9 mm long, striate, glabrous, the prominent glands in 3–5 well-defined horizontal bands.

Flowering and fruiting.—September, so far as known.

Distribution and habitat.—Known solely from the type collection; from the Pacific coast at 18°11' N, 103°2' W (Hinton & Rzedowski 1972).

Etymology.—The epithet refers to the fact that the specimens have lain overlooked and neglected in numerous herbaria for over half a century; C.V. Morton in preparing the labels remarked that it was a new species; Meikle (1978) likewise remarked that it was a new species, though the material he had at hand from K was insufficient for a proper description.

KEY TO THE NEW WORLD SPECIES OF *COMMICARPUS*

1. Perianth above the developing fruit white or greenish-yellow, at most pink-veined in the sinuses; stamens 2.
    2. Perianth white or greenish-yellow, 3–4 mm long and wide, externally glabrous or obscurely puberulent; widespread from Texas to se Arizona and Baja California, s to Guatemala; West Indies; Bahama Archipelago; Colombia and Venezuela to Peru .... **Commicarpus scandens** (L.) Standley
    2. Perianth white, pink-veined in the sinuses, 10–15 mm long and 7–8 mm wide, hirtellous externally; endemic to Baja California, México .... **Commicarpus brandegeei** Standley
1. Perianth above the developing fruit light purple to mauve to cherry red; stamens 2, 3, or 4.
    3. Stems and leaves glabrous; perianth lilac, pink, or purplish red, puberulent at tip in bud, otherwise glabrous; stamens 3; Bolivia, Peru, Ecuador, and Galápagos Islands .... **Commicarpus tuberosus** (Lamarck) Standley, to include *C. crassifolius* Heimerl
    3. Stems and leaves variously hairy; perianth red, stipitate glandular or glabrous
        4. Stems viscid glandular with spreading hairs; perianth abundantly and shortly stipitate glandular externally, to 16 mm high and broad; stamens 4; thus far known only from Oaxaca, México .... **Commicarpus coctoris** N.A. Harriman
        4. Stems with abundant short, non-glandular hairs, these hooked at the tip and antrorsely inclined; perianth glabrous externally, to 9 mm high and 11 mm broad; stamens 2; thus far known only from Michoacán, México .... **Commicarpus praetermissus** N.A. Harriman

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REFERENCES

Acevedo-Rodríguez, P. 1996. Flora of St. John, U.S. Virgin Islands. Mem. New York Bot. Gard. 78:1–581.

Bogle, A. Linn. 1974. The genera of Nyctaginaceae in the southeastern United States. J. Arnold Arbor. 55:1–37.

Brako, L. and J. Zarucchi. 1993. Catalogue of the flowering plants and gymnosperms of Peru; Catálogo de las angiospermas y gimnospermas del Perú. Monogr. Syst. Bot. Missouri Bot. Gard. 45:1–1286.

Breedlove, D. 1986. Listados Florísticas de México. IV. Flora de Chiapas. Instituto de Biología, UNAM, México.

Fosberg, F.R. 1978. Studies in the genus *Boerhavia* L. (Nyctaginaceae), 1–5. Smithsonian Contr. Bot. 39:1–20.

González Elizondo, M., S. González Elizondo, and Y. Herrera Arrieta. 1991. Listados Florísticos de México. IX. Flora de Durango. Instituto de Biología, UNAM, México.

Hinton, J. and J. Rzedowski. 1972. George B. Hinton, collector of plants in southwestern Mexico. J. Arnold Arbor. 53:141–181.

Howard, R. 1988. Flora of the Lesser Antilles 4:1-673.

Liogier, H. 1985. Descriptive flora of Puerto Rico and adjacent islands. 1:1–352.

Meikle, R.D. 1978. A key to *Commicarpus*. Notes Roy. Bot. Gard. Edinburgh 36:235–249.

Standley, P.C. 1909. The Allioniaceae of the United States with notes on Mexican species. Contr. U.S. Natl. Herb. 12:303–389.

__________. 1911. The Allioniaceae of Mexico and Central America. Contr. U.S. Natl. Herb. 13:377–430.

MUHLENBERGIA JAIME-HINTONII (POACEAE: CHLORIDOIDEAE), A NEW SPECIES FROM NUEVO LEÓN, MEXICO

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ABSTRACT

Muhlenbergia jaime-hintonii P.M. Peterson & Valdés-Reyna, sp. nov., is described and illustrated. The new species occurs in gypsum soils in southern Nuevo León, Mexico between the municipalities of Aramberri and General Zaragoza. Based on anatomical and morphological features *Muhlenbergia jaime-hintonii* is placed in subgenus *Podosemum*, section *Epicampes*. The new species seems most closely allied with *Muhlenbergia pubigluma* but differs by its shorter culms (44–82 cm long), shorter truncate ligules (0.4–1.0 mm long) with ciliolare apices, shorter spikelets (1.5–2.1 mm long), shorter glumes (0.7–1.2 mm long), shorrer lemmas (1.5–2.0 mm long), shorter paleas (1.5–2.0 mm long), and shorter anthers (0.8–1.0 mm long).

RESUMEN

Se describe y se ilustra *Muhlenbergia jaime-hintonii* P.M. Peterson & Valdés-Reyna, sp. nov. Esta nueva especie se presenta en parte de las tierras gipsófilas en el sur del estado de Nuevo León, México, en los municipios de Aramberri y General Zaragoza. Basados en características anatómicas y morfológicas *Muhlenbergia jaime-hintonii* se ubica en el subgénero *Podosemum*, sección *Epicampes*. Esta nueva especie está fuertemente relacionada con *Muhlenbergia pubigluma* pero difiere de ella por sus cúlmenes más cortos (44–82 cm de largo), lígulas más cortas (0.4–1.0 mm de largo) rruncadas con ápices ciliolados, espiguillas más cortas (1.5–2.1 mm de largo), glumas más cortas (0.7–1.2 mm de largo), lemas más cortas (1.5–2.0 mm de largo), páleas más cortas (1.5–2.0 mm de largo), y anteras más cortas (0.8–1.0 mm de largo).

While working on a catalogue of the grasses of Northeastern México (Valdés-Reyna, Davila, & Carranza Pérez, in prep.) and while preparing a revision of the perennial *Muhlenbergia* for México (Peterson, in prep.), JVR suggested to PMP that a collection by Mr. Jaime Hinton from southern Nuevo León might represent an undescribed species. At first glance the lemmas of this

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specimen appeared to be 1-veined and the ligule appeared to be a line of hairs, both characteristics of *Sporobolus*. Two specimens (*Hinton 22698* & *Hinton 23766*) were previously sent to J.R. Reeder (ARIZ) who determined them to be *Sporobolus cryptandrus* (Torr.) A. Gray. However, upon closer inspection, the lemmas are usually 3-veined with faint lateral veins, these occasionally absent; and the ligule is very short with a membranous base and a truncate-ciliolate apex. The new species is clearly a member of the subfamily Chloridoideae, tribe Eragrostideae (Peterson et al. 1995, 1997). Therefore, we describe these specimens as a new species of *Muhlenbergia*, and name the species after the original collector, Jaime Hinton.

Muhlenbergia jaime-hintonii P.M. Peterson & Valdés-Reyna, sp. nov. **(Figs. 1, 2).** TYPE: MÉXICO. NUEVO LEÓN: Municipio General Zaragoza: La Joya, Cuesta Blanca, approximately 15 km S of Aramberri on road towards Zaragoza (23° 59' 37.1" N–99° 47' 38.7" W), 1345 m, 31 Oct 1998, *J. Valdés-Reyna & M. A. Carranza Pérez 2560* (HOLOTYPE: ANSM!; ISOTYPE: US!).

A *Muhlenbergia pubigluma* Swallen surculis extravaginalibus, rhizomatibus brevi-foliis, culmis 44–82 cm altis, ligulis 0.4–1 mm longis apicibus truncatis et ciliolatis, ramis inflorescentiae 0.5–6.0 cm longis, spiculis 1.5–2.1 mm longis, glumis 0.7–1.2 mm longis glabris, lemmatibus 1.5–2.0 mm longis leviter 3(1)-venis, paleis 1.5–2.0 mm longis, antheris 0.8–1.0 mm longis, recedit.

Loosely caespitose perennial with short, densely leafy rhizomes and extravaginal shoot initiation. Culms 44–82 cm tall, erect, compressed keeled near the base, densely white pubescence below the basal nodes, these hidden beneath the leafy sheaths, the hairs 0.8–1.3 mm long, upper nodes glabrous or puberulent; internodes puberulent below and mostly glabrous above. Sheaths 6–28 cm long, longer than the lower internode, puberulent to glabrous, stiff and brownish below, often curled; margins mostly smooth with a few short hairs near the summit. Ligules 0.4–1 mm long, membranous below; apex truncate, ciliolate. Blades 5–22 cm long, 1.8–5 mm wide, flat just above ligule to tightly conduplicate above, apically acuminate, somewhat stiff, pubescent above and glabrous below. Panicles 13–34 cm long, 0.7–7 cm wide, narrow to somewhat open, the ascending densely flowered branches tightly appressed or loosely spreading up to 40° from the culm axis; pedicels 0.5–2 mm long, ascending, scaberulous; inflorescence branches 0.5–6.5 cm long. Spikelets 1.5–2.1 mm long, appressed to branches, 1-flowered, reddish-gray. Glumes 0.7–1.2 mm long, oblong, shorter than the lemma, usually equal in length, faintly 1-veined, reddish, glabrous, scaberulous along the midvein; apex acute to obtuse, occasionally minutely erose. Lemmas 1.5–2.0 mm long, oblong to elliptic, unawned, faintly 3(1)-veined, greenish mottled with reddish areas; midvein, margins, and proximal 1/2 to 3/4 loosely to densely appressed pubescent to villous, often these hairs more numerous along the margins and midvein below, the hairs up to 0.5 mm long; apex

FIG. 1. *Muhlenbergia jaime-hintonii* (*Valdés-Reyna & Carranza Pérez 2560*). A. Habit. B. Sheath, ligule, and portion of a blade. C. Inflorescence. D. Secondary branch of inflorescence. E. Spikelet. F. Glumes. G. Lemma, dorsal view. H. Lemma, opened dorsal view. I. Lemma, lateral view. J. Palea. K. Palea with stamens, pistil, and lodicules. L. Stamens, pistil, and lodicules. Scale for C is shown in A; scale for F–L is shown in E.

acute, rarely minutely mucronate. Paleas 1.5–2.0 mm long, oblong, 2-veined, equal in length to the lemma, the proximal 2/3 to 3/4 densely appressed pubescent to villous between the veins and along the margins; apex acute to obtuse. Stamens 3; anthers 0.8–1.0 mm long, reddish at maturity, greenish when immature. Ovary 0.2 mm long; styles 2, separate, glabrous; stigmas 2, feathery, whitish. Caryopsis not seen.

Phenology.—Flowering in October through November.

Distribution.—*Muhlenbergia jaime-hintonii* is known only from southern Nuevo Leon between 1300–1850 m in the Municipio's Aramberri and General Zaragoza, and can be found growing in whitish, alkaline soils derived from gypsum with *Leucophyllum hintoniorum* G.L. Nesom, *Scutellaria lutilabia* T.M. Lane & G.L. Nesom, *Galium dempsterae* B.L. Turner, *Lobelia gypsophila* T.J. Ayers, *Geniostemon gypsophilum* B.L. Turner, *Callisia hintoniorum* B. L. Turner, *Agave striata* Zucc., and *Hechtia glomerata* Zucc.

Additional specimens examined: **MEXICO. Mpio. Aramberri:** Between La Escondida and Aramberri, 1425 m, 23 Oct 1993, *G.B. Hinton et al. 23707* (ANSM, US); San Francisco, 1835 m, 3 Sep 1993, *G.B. Hinton 22698* (ANSM, TEX); Mpio. General Zaragoza: Aramberri-El Salitre, 1325 m, 26 Oct 1993, *G.B. Hinton 23766* (ANSM, TEX); La Joya, Cuesta Blanca, approximately 15 km S of Aramberri on road towards Gral. Zaragoza, 1345m, 29 Jul 1998, *M.A. Carranza Pérez & J. Valdés-Reyna C-2981* (ANSM).

LEAF ANATOMY

Cross-sectional leaf blade anatomy was determined from hand sections of fresh field collected material (*Valdés-Reyna & Carranza Pérez 2560*) on temporary slides. The sections were stained in 0.05% toluidine blue. A diagrammatic cross-section was made with the aid of a camera lucida (Fig. 2).

The blades (Fig. 2) are typically kranz-C_4, NAD-me (nicotinamide adenine dinucleotide co-factor malic enzyme)-like in Hattersley and Watson's (1992) sense with tightly radiate arranged chlorenchyma and XyMS+ (presence of cells between the metaxylem vessel elements and laterally adjacent chlorenchymatous tissue, see also Hattersley and Watson 1976). The lamina are flat or conduplicate with primary and secondary vascular bundles about the same size. The primary vascular bundles are well differentiated into xylem with metaxylem, phloem, and a double bundle sheath (mestome and parenchyma bundle sheath). The phloem tissue is irregularly sclerosed. The ribs are flattened with angled sides (rectangular) and the furrows are 1/5 to 1/2 as deep as the width of the blade adaxially and usually less than 1/5 as deep abaxially. The medium vascular bundle structure consists of a simple keel with only a single primary vascular bundle. Per blade there are 9–15 primary vascular bundles and 16–24 secondary vascular bundles. There is one or two secondary or tertiary vascular bundles placed between each primary vascular bundle. All vascular bundles are situated in the median layer

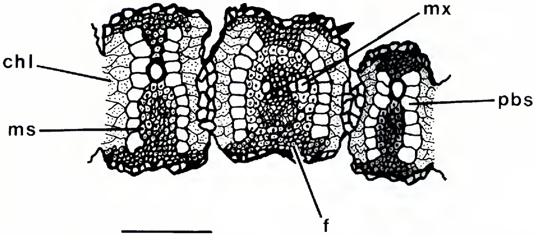

FIG. 2. Leaf blade cross section of a primary vascular bundle (center) and two secondary/ tertiary vascular bundles of *Muhlenbergia jaime-hintonii (Valdés-Reyna & Carranza Pérez 2560).* Scale bar = 25 (m; chl = chlorenchyma tissue; f = sclerenchyma fibers; ms = mestome sheath; mx = metaxylem vessel; pbs = parenchyma bundle sheath.

of the blade and are rectangular in outline. The xylem of the primary vascular bundles contains two wide metaxylem vessels that are about the same size as the parenchyma bundle sheath cells. The mestome, or inner sheath, is always present in the vascular bundles surrounding the xylem and phloem. The mestome is composed of small cells with thick walls and in primary, secondary and tertiary bundles it is interrupted abaxially and adaxially by sclerenchyma fibers forming a girder. The parenchyma bundle sheath, or outer layer, contains large, thin walled cells that are interrupted by the abaxial and adaxial sclerenchyma girder in the primary, secondary, and tertiary bundles. Chlorenchyma cells radiate just outside the parenchyma bundle sheath cells and are interrupted by a column of colorless cells forming a tightly radiate arrangement (NAD-me-like). Five to eight rows of sclerenchyma fibers form the abaxial and adaxial girders which are wide near the epidermis and narrow toward the vascular bundle. A few fibers form a rectangular to round cap along the margin of blade. Thick-walled colorless cells form a continuous column separating each vascular unit, these are not differentiated into bulliform cells.

DISCUSSION

The new species seems most closely allied to species of subgenus *Podosemum*, section *Epicampes* since it has culms with compressed keeled bases, conduplicate blades, primary and secondary vascular bundles both about the same size with sclerosed phloem, and shallow adaxial furrows (Peterson, in press; Peterson & Herrera-Arrieta, in review). *Muhlenbergia jaime-hintonii* differs from *M. emersleyi* and *M. pubigluma* (see Table 1) by quite a few characteris

Table 1. Salient features comparing *Muhlenbergia jaime-hintonii* with *M. emersleyi* and *M. pubigluma*.

Characters	*M. jaime-hintonii*	*M. emersleyi*	*M. pubigluma*
Shoot initiation	extravaginal	intravaginal	intravaginal
Rhizomes	short-leafy	absent	short-non leafy
Culm height	44–82 cm	100–150(–200) cm	75–125 cm
Ligule length (mid-culm)	0.4–1 mm	10–25 mm	5–13 mm
Ligule apex	truncate, ciliolate	acuminate, lacerate	acuminate, lacerate
Inflorescence 1° branch length	0.5–6.5 cm	(1–)9–17 cm	4–5 cm
Spikelet length	1.5–2.1 mm	2.2–3.2 mm	2.5–3.5 mm
Glume length	0.7–1.2 mm	2.2–3.2 mm	2.5–3.5 mm
Glume surface	glabrous	glabrous	pubescent
Lemma length	1.5–2.0 mm	2–3 mm	2.9–3.1 mm
Lemma veins	faintly 3(1)-veined	prominently 3-veined	faintly 3-veined
Lemma awn	absent	present or absent	present
Palea length	1.5–2.0 mm	1.8–2.9 mm	2.3–3.3 mm
Anther length	0.8–1.0 mm	1.2–1.6 mm	1.4–1.8 mm

tics, most notably: extravaginal shoot initiation, the presence of short-leafy rhizomes, short ligules (0.5–1 mm long) with a truncate and ciliolate apex, spikelets ranging from 1.5–2.1 mm long, short glumes (0.7–1.2 mm long) that are glabrous, short lemmas (1.5–2.0 mm long) that are faintly 3(1)-veined, short paleas (1.5–2.0 mm long), and short anthers (0.8–1.0 mm long). *Muhlenbergia distans* Swallen is also morphologically similar to *M. jaime-hintonii* but differs by having longer ligules (usually 5–10 mm long) that are firm below, longer spikelets (2.7–3.6 mm long), and short-awned (the awn 1.5–5 mm long) lemmas (Soderstrom 1967). The closest sister to *M. jaime-hintonii* appears to be *M. pubigluma* since they both share several characteristics, such as: densely white pubescence below the basal nodes, short-leafy rhizomes, reddish-gray spikelets, faintly 3-veined lemmas that are pubescent to villous on the lower 1/2 to 3/4, and simple keels (compound keels are the predominant character state in sect. *Epicampes*). In addition, *Muhlenbergia pubigluma* and *M. jaimie-hintonii* appear to be sympatric since the former species is known to occur just 10 km west of Aramberri between La Escondida and La Soledad [*A.A. Beetle M-406* (UC, US!)], and again west of Doctor Arroyo, approximately 60 km southwest of Zaragoza [*Shreve & Tinkham 9651* (GH)].

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REFERENCES

HATTERSLEY, P.W. and L. WATSON. 1976. C_4 grasses: An anatomical criterion for distinguishing between NADP-malic enzyme species and PCK or NAD-malic enzyme species. Austra. J. Bot. 24:297–308.

__________ and __________. 1992. Diversification of photosynthesis. In: C.P. Chapman, ed. Grass evolution and domestication. Cambridge University Press, Cambridge. Pp. 38–116.

PETERSON, P.M. 199_. Systematics of the Muhlenbergiinae (Chloridoideae: Eragrostideae). Proceedings of the Monocots II and Grasses III Conference (in press).

__________ and Y. HERRERA-ARRIETA. An anatomical survey of *Muhlenbergia* (Poaceae: Muhlenbergiinae). Syst. Bot. (in review).

__________, R.W. WEBSTER, and J. VALDÉS-REYNA. 1995. Subtribal classification of the New World Eragrostideae (Poaceae: Chloridoideae). Sida 16:529–544.

__________, __________, __________. 1997. Genera of New World Eragrostideae (Poaceae: Chloridoideae). Smithsonian Contr. Bot. 87:1–50.

SODERSTROM, T.R. 1967. Taxonomic study of subgenus *Podosemum* and section *Epicampes* of *Muhlenbergia* (Gramineae). Contr. U.S. Natl. Herb. 34:75–189.

BOOK NOTICE

RICHARD RABELER. 1998. Gleason's Plants of Michigan: A Field Guide. (ISBN 0-9663251-0-9, pbk) Oakleaf Press, 920 Vesper Road, Ann Arbor, MI 48103. 734-668-8579. $ 21.95. 398 Pp.

This book is a bargain. Don't miss it !! After a nice introduction, a preface with a short biographical sketch of Henry Allan Gleason, and a crystal-clear explanation of how to use the book, Rabeler presents a nice bibliography, a very simple phytography section, a list of illustrations, and then keys to the major groups of "plants" in the flora. The groups of plants in the keys include woody plants, unusual plants, monocots and dicots. While these are not the groupings one would normally encounter, they are, nonetheless, extremely useful, especially for the amateur or hobbyist.

The book contains 49 pages of bracketed keys, straightforward, simple, and nomenclaturally harmonious with the magnificent technical *Michigan Flora* volumes by the other temperate floristician at MICH, Dr. Ed Voss. Starting on page 93, there are descriptions for each family, and bracketed keys to the species within each family (ordered so the species of each genus are adjacent to each other). There are 45 simple line illustrations, judiciously chosen, an 11 page glossary, and finally, indices to subjects and plant names. There are also supplementary boxes scattered throughout the book, with extra information that the enthusiast will appreciate, such as that found on page 299 for *Galium* (Rubiaceae), the bedstraw, and for the infamous genus *Solidago* on page 331. These boxes explain points such as the difficulty of the group, recent changes in taxonomic concepts and other information that serve to encourage a user frustrated by notoriously complicated taxonomic groups. To top it off, the last page of the book is blank except for a handy metric ruler drawn on it along the edge. This is a wonderful field guide!

The cover is extremely attractive and sturdy, as is the binding. The paper is of high quality and I am sure it will weather significant use. It is obvious that the author has been a successful instructor for some time and has a knack for keeping someone interested even when keying out a difficult group. He is to be congratulated for revising Gleason's work and producing a field manual compatible with the Voss *magna opi*. The practicality, simplicity and clarity of the book will ensure its use by every plant enthusiast in the Great Lakes State, and most likely, in the adjoining ones as well (Wisconsin, Minnesota, Illinois, Indiana, Ohio). I heartily recommend this book to everyone who contemplates visiting any area near the Great Lakes Region!—*John J. Pipoly III.*

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A NEW SPECIES OF *EMORYA* (BUDDLEJACEAE)

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ABSTRACT

A new species of Buddlejaceae, ***Emorya rinconensis***, is described here as the second species of the genus. The species is known from a single collection from the Serranías del Burro in northern Coahuila, Mexico. Although associated with a more mesic flora than *Emorya suaveolens*, morphological adaptations and associated species suggest that *E. rinconensis* may grow in edaphically xeric, steep rock outcrops. The racemose inflorescences of the new species are unique among New World Buddlejaceae and appear to represent a reduction from the open, few-flowered axillary cymes found in *Emorya suaveolens*. In the context of North American Buddlejaceae, the long tubular corollas in open inflorescences, long styles, linear calyx lobes, and prolate pollen support the present generic placement of the new species with *Emorya*, but future confirmation of the phyletic position of both species in a larger geographic context is needed.

RESUMEN

En este trabajo se describe una nueva especie de Buddlejaceae, ***Emorya rinconensis***, como la segunda especie del género. La especie se conoce a partir de una sola colecta de las Serranías del Burro en el norte de Coahuila, México. Aunque asociada con una flora más mésica que *Emorya suaveolens*, las adaptaciones morfológicas y especies asociadas sugieren que *E. rinconensis* puede crecer en afloramientos rocosos, escarpados y xéricos. Las inflorescencias racemosas de la nueva especie son únicas entre las Buddlejaceae del Nuevo Mundo y parecen representar una reducción de las cimas axilares abiertas de pocas flores encontradas en *E. suaveolens*. En el contexto de las Buddlejaceae Norteamericanas, las largas corolas tubulares en inflorescencias abiertas, estilos largos, lóbulos del cáliz lineares, y polen prolado, apoyan la presente posición genérica de la nueva especie con *Emorya*, pero se necesita una futura confirmación de la situación filética de ambas especies en un contexto geográfico más amplio.

A set of plant specimens from northern Coahuila, Mexico[2] distributed to TEX for identification included an undescribed species which closely resembles *Emorya suaveolens* Torr. of the Buddlejaceae (f. 1). The stellate-tomentose vestiture, superior ovary, and four-merous, tubular corolla of the new species are characteristic in Buddlejaceae, a family with only two genera in the New World: *Emorya* and *Buddleja* (excluding *Polypremum* and *Peltanthera* which are better treated

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[2] Plants collected by S. Aguilar Ruiz in association with a study of populations of Black Bears in northern Coahuila, Mexico, at the Rancho El Rincón. The first set of specimens of the large collection from this study is at SRSC.

outside of Buddlejaceae, [Eliane Norman, pers. comm.]). Its racemose inflorescences with solitary flowers in the upper axils are unique in the family in the New World and appear to represent a reduction from the open cymose axillary flowers of *E. suaveolens*. The species has not been collected again since its initial collection in 1992, and the present collection is lacking fruits. Thus, although fruits are expected to corroborate the present placement in *Emorya*, the species is formally described here to advance its rediscovery and thereby facilitate future research on the genus.

Emorya rinconensis Mayfield, sp. nov. (**Fig. 1**). TYPE: MEXICO: Municipio Villa Acuña, Rancho El Rincón, SW margin of Serranías del Burro, in Cañon El Becerro, 28° 40' N 102° 15' W, 8 Aug 1991, *S. Aguilar Ruiz 164 with D.L. Doan-Crider* (HOLOTYPE: MEXU; ISOTYPES: SRSC, TEX).

Valde differt a *Emorya suaveolens* Torr. caulibus decumbentibus, floribus e foliorum summorum axillis solitaribus, corollis cinnibarinis exter trichomatibus stellatis multum densius vestitis inter pilosis, staminibus inclusis, stylis vix exsertis, polline tricolporato.

Spreading subshrubs with a conspicuous dense vestiture of 4-branched, stellate trichomes on the young stems, leaves, and flowers. *Stems* ascending distally to ca. 25 cm high; older woody branches to ca. 3 mm thick, with a light gray exfoliating bark; young growth of stems ca. 1.2 mm thick and densely stellate tomentulose. *Leaves* to ca. 2 cm long, opposite, estipulate, the blades broadly oblanceolate to subspatulate or subrhombic, essentially sessile or with a brief petiole; apices obtuse to rounded, with 1 to 4 broad teeth along the margins; bases attenuate and entire; leaf surfaces densely stellate tomentulose below, subglabrous above. *Flowers* solitary in the axils of the upper leaves (i. e., paired at each node); pedicels ca. 4 mm long, the pedicels each with pair of opposite, linear-elliptic, ascending bracteoles ca. 7 mm long closely subtending the calyx. *Calyx* 7.0–7.5 mm long, narrowly campanuliform with four erect to slightly spreading linear lobes 2.2–3.7 mm long, the tube 3.8–4.5 mm long, tapered to the base, with weak nerves along the midribs. *Corolla* 27–30 mm long, tubular, four-lobed, cinnabarine, the color externally obscured by the vestiture of stellate trichomes; tube ca. 1.2 mm wide at the base, scarcely expanded to the base of a short ampliate throat which is constricted at the base of the lobes; lobes valvate in bud, rounded-obtuse, spreading upwards at anthesis to ca. 4 mm across the top, with scattered orange capitate resiniferous glands within; the interior of the tube brick red, with a scattered pilosity of delicate, simple, minutely papillose orange trichomes to 0.3–1.2[–1.5] mm long. *Stamens* included within the throat or slightly surpassing in late anthesis; filaments ca. 2.0 mm long, inserted ca. four-fifths of the way up the tube (22–23 mm above the base); anthers 2 mm long, introrse, mucronate at the apex, the anther sacs separate below the attachment. *Ovary* narrowly oblong-elliptic, ca 4 mm long, glabrous on the lower third, stellate-pubescent above, borne on a short

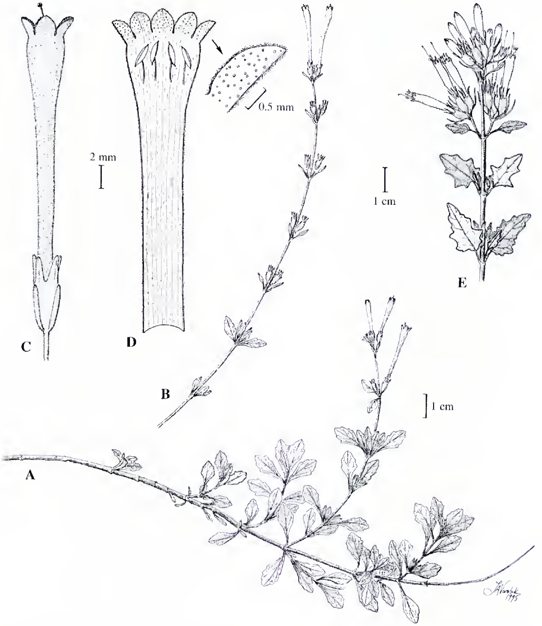

FIG. 1: A–D, *Emorya rinconensis*, from the type collection, *Aguilar Ruiz 164*. A. Branch showing probable habit B. Flowering branch; C. Flower with pedicel and subtending bracteoles; D. Corolla showing filament insertion; E. Flowering branch of *Emorya suaveolens* for comparison (from *Nesom 7379*).

stipe-like base ca 1.5 mm long; nectar disc present but inconspicuous; style 30–35 mm long, scarcely to evidently exserted from the corolla tube; stigma truncate, scarcely bilobate, the surface papillose. *Fruits* unknown. *Pollen* prolate, tricolporate, 31.5 µm × 18.5 µm.

Distribution.—The species is as yet known only from the type collection.

Emorya rinconensis is associated with a flora similar to that of the Edwards Plateau area of Texas. Its xeromorphic features are similar to other petrophilous species of Buddlejaceae (e. g., *Buddleja racemosa*, of central Texas), which inhabit dry limestone outcrops, often pendulous from steep slopes or ledges. Other potentially rock-outcrop-dwelling species collected by Ruiz at the type locality ("Cañon El Becerro") include *Ageratina potosina, Desmodium lindheimeri, Eucnide bartonioides, Geranium caespitosum, Hedeoma costatum, Oenothera macrosceles, Orbexilum oliganthum, Penstemon barbatus, Polygala scoparioides, Salvia regla, Salvia roemeriana, Solidago nemoralis, Solidago petiolaris,* and *Thelesperma simplicifolium*. Future attempts to relocate *Emorya rinconensis* should be concentrated in areas with limestone faces or ledges having these species.

Emorya suaveolens Torr. is distributed in the northern Mexican states of Nuevo León and Coahuila and in the United States along the Rio Grande in closely adjacent Texas (Fig. 2; Norman & Moore 1968; Norman 1964; Warnock 1964). It is a shrub or small tree to 2 m tall with flowers in open thyrses, with tubular, yellow corollas, exserted stamens with the filaments inserted on the lower half of the tube, deltoid leaves, and tetracolporate pollen (Norman & Moore 1968; Fig. 3). In contrast, *E. rinconensis* is a small spreading shrub with reddish-orange flowers in racemes, filaments inserted supramedially on the tube, included stamens, obovate to subspatulate leaves, and tricolporate pollen (Fig. 3b). These species share a combination of features that separate them from *Buddleja* in North America including: long tubular corollas, prolate pollen (Fig. 3), anthers on elongated filaments (vs. subsessile), linear bracteoles on the peduncles, linear calyx lobes, hypogynous nectaries, and leaves with repand margins and non-clasping bases.

The new species is somewhat intermediate between *Emorya suaveolens* and some species of *Buddleja*. Indeed, authorities on Buddlejaceae and related groups have suggested that *E. suaveolens* could be included within the genus *Buddleja* (e. g., Leenhouts 1963; Norman 1967; Rogers 1986). Despite this, *Emorya* has never been formally transferred nor has any species or group of species within *Buddleja* ever been cited as a potential close relative. At least some lines of evidence suggest that *Emorya* may not be so closely related to *Buddleja*. Although viable hybrids between distantly separated species of Buddlejaceae have been produced (e. g., *Nicodemia madagascariensis* [Madagascar] x *Buddleja globosa* [Chile] by Van de Weyer [1920]), Norman & Moore (1968) reported an inability to produce viable hybrids between *E. suaveolens* and some species of *Buddleja* (notably, seeds and seedlings were produced in crosses with *Buddleja alternifolia* [Asian] and *B. tubiflora* [South American], but the seedlings died prior to elongation of the hypocotyl). Norman & Moore also pointed out morphological, anatomical, and palynological features that suggest that *Emorya* may be phyletically distinct from *Buddleja* in Mexico. Norman (1967) has also indicated that most of the New World species of *Buddleja* are functionally dioecious, whereas *E. suaveolens* has perfect flowers. Punt and Leenhouts (1967) assigned a distinct pollen type to *Emorya* stating that

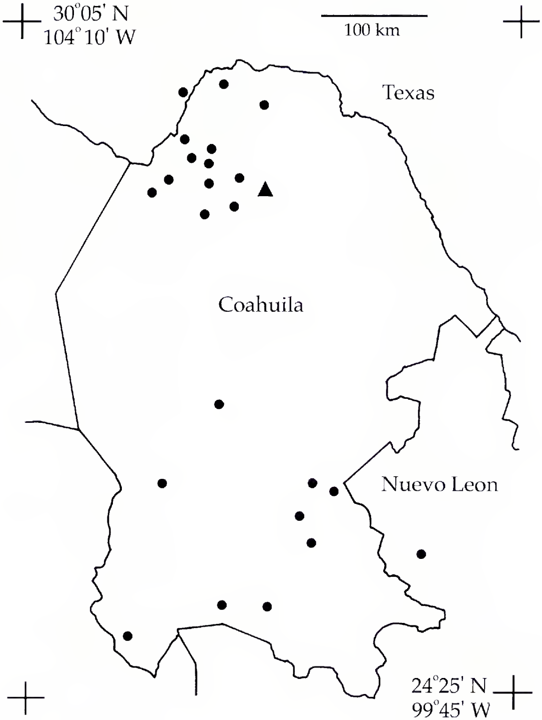

FIG. 2: Documented distribution of the genus *Emorya* based on specimens at TEX-LL. *Emorya suaveolens* (●); *E. rinconensis* (▲).

the pollen morphology "strongly supports" continued generic recognition for the species. In 1980, Punt reaffirmed this position and emphasized the large size of the grains (ca. 40 µm vs. 25 µm for *Buddleja*), the tetracolporate exine, and unique features of the columella (rather than the prolate shape).

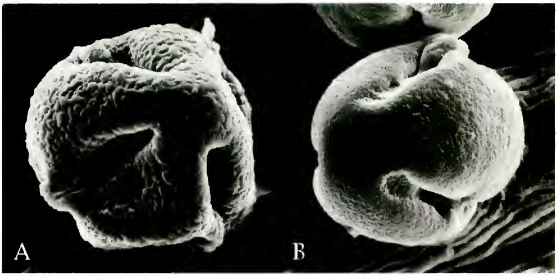

FIG. 3: A–B. Pollen (2070x) A. Pollen of *Emorya suaveolens*. B. Pollen of *E. rinconensis*.

Without mature fruits and knowledge of the reproductive biology of the new species, its generic placement with *Emorya* will remain somewhat equivocal. Thus, the description rendered here for the new species places it with *Emorya*, the Buddlejaceous genus in North America to which it bears the greatest similarity.

ACKNOWLEDGMENTS

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REFERENCES

NORMAN, E.M. 1964. Additional data concerning the distribution of *Emorya suaveolens*. SouthW. Nat. 9:206.

__________. 1967. The genus *Buddleja* in North America. Gentes Herb. 10:47–114.

__________ and R.J. MOORE. 1968. Notes on *Emorya* (Loganiaceae). SouthW. Nat. 13:137–142.

PUNT, W. 1980. Pollen morphology. In: Leeuwenberg, A.J.M., ed. Die natürlichen Pflanzenfamilien, Loganiaceae, 28b(1). 28b(1):162–191. Duncker & Humbolt.

__________ and P.W. LEENHOUTS. 1967. Pollen Morphology and taxonomy in the Loganiaceae. Grana Palynol. 7:469–516.

ROGERS, G.K. 1986. The genera of Loganiaceae in the southeastern United States. J. Arnold Arbor. 67:143–185.

SMITH, L.B., E.F. GUIMARÃES, J.F. PEREIRA, and E.M. NORMAN. 1976. Loganiaceas. In: Reitz, P.R. (ed.). Flora ilustrada Catarinense I. Itajaí, Santa Catarina, Brasil. Herbario Barbosa Rodrigues. 1–77.

TORREY, J. 1859. Botany of the boundary. V. 2, p. 1. In: Emory, W.H. Rep. US and Mex. Bound. Surv. Washington. A.O.P. Nicholson.

WEYER, VAN DE. 1920. Hybrid Buddlejas. Gard. Chron. ser. 3, 68:181.

WARNOCK, B.H. 1964. Verification of occurrence of *Emorya suaveolens* in western Texas. SouthW. Nat. 9:206.

YOUNGMAN, A.L. 1964. *Emorya* (Loganiaceae) a member of the Texas flora? SouthW. Nat. 8:210–212.

BOOK RECEIVED

KUCERA, CLAIR L. 1998. **The Grasses of Missouri.** Revised Edition. (ISBN 0-8262-1164-X, pbk). University of Missouri Press, 2910 LeMone Boulevard, Columbia, MO 65201. 573-882-0180, fax 573-884-4498. $34.95. 305 Pp. 269 Line drawings.

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Description of Genera and Species
Glossary
Bibliography
Index

DISCOVERY OF THE INDO-MALESIAN GENUS *HYMENANDRA* (MYRSINACEAE) IN THE NEOTROPICS, AND ITS BOREOTROPICAL IMPLICATIONS

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ABSTRACT

The taxonomic revision of a neotropical group of taxa formerly placed by Lundell in *Auriculardisia, Chontalesia*, and *Icacorea*, resulted in the discovery that they were actually members of the otherwise Indo-Malesian genus, *Hymenandra*. The genus is defined by its filaments fused at least basally to form a staminal tube, the tube adnate to the base of the corolla tube and anthers connate along their longitudinal dehiscence sutures at least until anthesis. It is also noted that all species of the genus exhibit Fagerlind's Architectural Model, a model that is otherwise extremely restricted, and one whose vegetative vs. reproductive shoot dimorphism has led to taxonomic overdescription. Nine species of *Hymenandra* are recognized in the Neotropics, bringing the total number of species in the genus to 16. Owing to a lack of complete material for Indo-Malesian species, and previous workers' hesitancy to unequivocally assign all of those species to a subgenus, the neotropical group is transferred to the genus without circumscription of any subgenera. It is postulated that the geography of *Hymenandra*, now considered an amphipacific taxon, is consistent with that predicted by the Boreotropics Hypothesis, and its logical extension postulated by Wendt (1993) and Lavin and Luckow (1993), especially when viewed in light of the biogeography for the rest of the tribe Ardisieae. Each neotropical *Hymenandra* species is fully described, newly illustrated, and provided with citations for all taxonomic and nomenclatural synonyms. In addition to the general section on morphology, biogeography and ecology provided for the genus, each species is accompanied by a discussion of its distribution, ecology and conservation status, along with citation of specimens examined. Five binomials are newly relegated to synonymy, and one taxon, *Hymenandra pittieri*, is lectotypified. The following new combinations are made: *Hymenandra stenophylla* (Donn. Sm.) Pipoly & Ricketson, *H. calycosa* (Hemsl.) Pipoly & Ricketson, *H. sordida* (Lundell) Pipoly & Ricketson, *H. squamata* (Lundell) Pipoly & Ricketson, *H. wilburiana* (Lundell) Pipoly & Ricketson, *H. pittieri* (Mez) Pipoly & Ricketson, *H. callejasii* (Pipoly) Pipoly & Ricketson, *H. acutissima* (Cuatrec.) Pipoly & Ricketson, *H. crosbyi* (Lundell) Pipoly & Rickerson. A complete list of exsiccatae is provided at the end for all collections examined.

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RESUMEN

Al llevar a cabo una revisión taxonómica de un grupo comprendiendo taxa anteriormente clasificados por Lundell como pertenecientes a los géneros *Auriculardisia, Chontalesia*, y *Icacorea*, se reveló que todos pertenecen al género indo-malesiano, *Hymenandra*. El género se define por sus filamentos conados, formándose un tubo estaminal, por lo menos en su base, adnado a la base del tubo corolino y con anteras conadas a lo largo de las hendiduras longitudinales de dehiscencia. Se note que todas las especies del género se caracterizan por exhibir el Modelo Arqutectural de Fagerlind, un modelo bastante único y cuyo dimorfísmo entre ramas vegetativas y reproductivas se ha ocasionado sobredescripción taxonómica. Se reconocen nueve especies neotropicales de *Hymenandra*, sumando el total para el género hasta 16. Debido al hecho de que el material indo-malesio es muy incompleto, no se han podido asignar a un subgénero todas las especies. Por lo tanto, se transfierren las especies neotropicales al género sin circumscribir subgéneros. Se postula que la geografía del género está de acuerdo con el patrón fitogeográfico proveniente del Hipótesis Boreotropical, especialmente en vista de la distribución y relaciones con el tribu Ardisieae. Además de la sección general sobre morfología, biogeografía, y ecología proveida para el género, se discute la distribución geográfica, ecología y estado de conservación, y se lista pliegos examinados para todos los taxa. Se relega cinco binomiales a la sinonímia, y se lectotipifica *Hymenandra pittieri*. Las nuevas combinaciones se incluyen a continuación: The following new combinations are made: *Hymenandra stenophylla* (Donn. Sm.) Pipoly & Ricketson, *H. calycosa* (Hemsl.) Pipoly & Ricketson, *H. sordida* (Lundell) Pipoly & Ricketson, *H. squamata* (Lundell) Pipoly & Ricketson, *H. wilburiana* (Lundell) Pipoly & Ricketson, *H. pittieri* (Mez) Pipoly & Ricketson, *H. callejasii* (Pipoly) Pipoly & Ricketson, *H. acutissima* (Cuatrec.) Pipoly & Ricketson, *H. crosbyi* (Lundell) Pipoly & Ricketson. Se provée una lista completa de exsiccata al final del trabajo.

INTRODUCTION

The pantropical genus *Ardisia* Sw. is by far the largest in the family Myrsinaceae, containing perhaps as many as 500 species (Chen & Pipoly 1996). Its circumscription has been problematic owing to a lack of comprehensive treatment since that of Mez (1902) in Engler's Pflanzenreich, almost a century ago. Several genera have been separated from *Ardisia sensu lato* since the Mez monograph, including *Chontalesia* Lundell (1982), described as a monotypic genus to accomodate the Central American *Ardisia calycosa* Hemsley. *Ardisia calycosa* may be immediately recognized by its unique large, coriaceous, narrowly lanceolate to lorate sepals that are longer than the corolla. While examining *Ardisia calycosa* to determine its relationships, we noted that its vegetative characters, such as the punctate and punctate-lineate, nitid leaves, the branchlet apices with varying amounts of furfuraceous lepidote scales, and most notably, the unusual leaf dimorphism between the floral and vegetative shoots (now known as an artifact of its morphogeneric program that exhibits Fagerlind's Architectural Model, *sensu* Hallé et al. 1978), were similar to a Central American suite of species that includes *A. stenophylla* Donn. Sm., *A. oblanceolata* Standl., *A. calvarioana* Lundell, and *A. wilburiana* Lundell. Careful study of this group of species revealed that their androecia have filaments connate throughout their length to form a staminal tube (therefore monadelphous) basally adnate to the corolla, and anther thecae connate along the suture line, at least in the basal portion, prior to anthesis, at which time at least the distal (abaxial) portion of the theca opens to permit release of pollen, or the anthers split completely apart from each other. This structure was also reported by Pipoly (1992a) in the description of *Ardisia callejasii* Pipoly, a species endemic to the Antioquian Chocó of northern Colombia. Careful reexamination of additional material of *Ardisia callejasii* has revealed that the anthers are also basally connate up to full anthesis, when they split apart completely. In addition, the combination of long-pedunculate panicles terminating in very long-pedicelled flowers in corymbs to subumbels and large fruits with thick, juicy exocarps common to all the aforementioned taxa indicated that other neotropical species with the same features, including *Ardisia crosbyi* Lundell, *A. pittieri* Mez, and *A. acutissima* (Cuatrec.) Lundell might also belong to the alliance. Finally, with the sole exception of *Ardisia callejasii*, it was striking to note that for all species, the inflorescence was borne terminally or subterminally (but behaving terminally) on the end of a long sylleptic shoot, bearing leaves similar in shape to those of the vegetative shoots, except much smaller in size. The latter phenonmenon was noted by Mez (1902) in *Ardisia* subgenus *Pyrgus* (Lour.) Mez, and by Stone (1991) in the genus *Hymenandra* A. DC. ex Spach. All of the aforementioned species except *Ardisia calycosa* have been referred by Lundell (1981) to his genus *Auriculardisia*, defined principally by the asymmetric sepals auriculate in outline. While surveying the rest of the neotropical *Ardisia* species attributed to *Auriculardisia*, we noted that *Ardisia squamata* (Lundell) J. F. Morales and *A. sordida* (Lundell) J. F. Morales possess all the features of the aforementioned group of taxa, but in a more diminutive form because they are subshrubs.

Given that *Ardisia* has traditionally been separated from its close congeners by filaments considered free from each other and from the corolla tube (Lundell 1966, 1971; Mez 1902; Ricketson & Pipoly 1997), the aforementioned group of species posed a serious problem in the circumscription of what was admittedly already a parapyletic group (Ståhl 1996). On the other hand, members of *Ardisia* subgenus *Graphardisia* (Pipoly & Ricketson 1998) have filaments basally fused for less than 1/5 their length, to form a short staminal tube free from the corolla tube, that is inconspicous because of its thinly membranaceous texture, and anthers that are totally free from each other. If *Ardisia* is defined by stamens with free anthers and filaments free or variously connate, but totally free from the corolla tube, the group of species related to *Ardisia calycosa* discussed above would still not fit. The inclusion of *Ardisia calycosa* and its relatives in *Ardisia* would significantly amplify the morphological circumscription of the genus. To answer whether further enlargement of *Ardisia*'s circumscription was warranted to maintain *A. calycosa* and its relatives relatives within *Ardisia*, a review of the related genera of the family was conducted. This led to the surprising conclusion that the relationships of this suite of species are clearly with the genus *Hymenandra*, heretofore considered an Indo-Malesian genus of seven species (Stone 1991).

THE GENUS *HYMENANDRA*

Hymenandra was described as a section of *Ardisia* by Alphonse de Candolle (1834, 1841) to accomodate two species, *A. hymenandra* Wall. and *A. glandulosa* Roxb., with filaments basally connate, but free apically, and anthers connate. De Candolle (1841) treated the group as a genus, a rank to which it had already been assigned by Spach (1840). Mez (1902) accepted the genus in his worldwide monograph of the family, using the same characters. Furtado (1958) transferred *Ardisia iteophylla* Ridley to the genus, on the basis of its fused filaments and anthers, but in the same paper described *A. calcicola* Furtado, distinguishing it from its sister species in subgenus *Pyrgus* by the fused filaments and anthers. Nayar and Giri (1975) described one new species, *Hymenandra narayanaswamii* Nayar & Giri, endemic to Myanmar (Burma). Stone (1991) revised the genus, transferred *A. calcicola* to *Hymenandra*, and described four new species, recognizing a total of seven species. Stone (1991) erected two subgenera, based on the degree of compaction of the inflorescence, the presence or absence of papillae on the adaxial calyx lobe surface, and general habit of the plants. *Hymenandra* subgenus *Lacrimophila* B. C. Stone was defined by caducous floral bracts, sepals hirtellous along the margins, glabrous or hirtellous (not papillose) within, but he included only *Hymenandra narayanaswamii* and *H. diamphidia* B. C. Stone in it, leaving the third species of the group from the second half of his key, *H. iteophylla* (Ridl.) Furtado, in subgenus *Hymenandra*. We have examined material of both groups and conclude that further material of the species will be necessary before accepting the subgeneric grouping.

Hymenandra, as defined by Stone (1991), is characterized by a staminal tube formed by filaments at least basally united and basally adnate to the corolla, concomitant with anthers connate, at least basally, by their longitudinal dehiscence sutures, until anthesis, at which time the distal flap of the theca may open or the anthers may split apart completely. All species have filaments basally connate and apically free, with anthers connate in anthesis along the entire length of the dehiscence sutures. In the Neotropics, the filaments are connate throughout their length, at least at first, and the anthers are connate in the basal half, separating early or just after the corolla lobes open, whereas in the paleotropical species, the filaments are connate in the basal half, free distally, and the anthers are connate along the deshiscence sutures throughout their length. As far as is known, all members of the genus exhibit Fagerlind's Architectural Model, as defined by Hallé et al. (1978). Given the uniqueness of the androecial structure, we here transfer the aforementioned *Ardisia* species to *Hymenandra*.

With the addition of the neotropical species transferred in this paper, the total number of species in *Hymenandra* reaches 16, distributed from Assam, Bangladesh, Myanmar, Malaya, Borneo, and Nicaragua through the Colombian Chocó. Given the scarcity of material available for study, we defer reexamination of subgeneric delimitation until a later time.

MORPHOLOGY

The following descriptions are based on the genus as a whole, with particular emphasis and detail among neotropical taxa.

Habit, Architecture, "Trunk" and Shoots

Most members of neotropical *Hymenandra* are shrubs or small trees to 8 m tall with a maximum known diameter at breast height (dbh) of 8 cm, with the exceptions of *H. squamata* and *H. sordida*, which are subshrubs less than one meter tall. This is much like the case among the Indo-Malesian species, where seven of the nine species are also subshrubs. Therefore, when we refer to a "trunk" in the following architectural model discussion, it is the principal axis of the plant, or "vegetative stem." So far as is known, all species of *Hymenandra* are terrestrial (i.e., not epiphytes).

Careful study of herbarium specimens and examination of photographs lead us to postulate that all *Hymenandra* species exhibit Fagerlind's Architectural Model (Hallé et al. 1978). Fagerlind's Model describes those trees whose architecture is determined by a monopodial, orthotropic, readily distinguishable, rythmically growing trunk that produces tiers of modular branches, each branch sympodial and plagiotropic by apposition, with spiral or decussate (never distichous) phyllotaxy. Branch modules are often hapaxanthic (dying after flower) or, as is the case in *Hymenandra*, they may exhibit sympodial growth by apposition, often branching several times without flowering. Deducing evidence we have pieced together from specimens, field observations, and collectors' notes, we might explain the morphogenetic program of *Hymenandra* individuals as follows: a) A "trunk" ("vegetative shoot") develops rythmically, producing successive pseudoverticels of "vegetative" leaves until the apex loses dominance and latent lateral ("axillary") buds are released, producing successive, monopodial pseudoverticels of shoots, each of which is sylleptic (and rarely attaining 5 mm in diameter), with a long hypopodium and exhibiting rapid extension growth. b) The sylleptic branch shoots produce first a prophyll, then pseudoverticels of "reproductive shoot" leaves (similar to the leaves of the "vegetative shoot" but notably smaller), and then may either lose dominance and once again branch sympodially by apposition growth (repeating the module) without flowering, or produce a terminal or pseudoterminal (acting as a terminal) inflorescence. Therefore, like the other species exhibiting Fagerlind's Model, and unlike other models, inflorescence production is usually not acropetal along a set of modular plagiotropic branches (although it can be). c) When a shoot flowers, the apex of the reproductive shoot will gradually lose dominance and may produce the remaining flowers of the inflorescence, or support ongoing fruit development, or the remaining flowers may abort. Following flower, a branch sympodial by substitution growth may (or may not) be produced, that will very slowly generate leaves in a high phyllotactic spiral (a pseudoverticel) and eventually abort. It is interesting to note that the apical region of the principal plant axis ("trunk", or "vegetative shoot") does not produce an inflorescence, and as Hallé et al. (1978) noted, leaves associated with the trunk (here termed "vegetative shoot leaves") are considerably larger than those of the branches (here termed "reproductive shoot leaves"). It is precisely this rare leaf dimorphism that caused us to further investigate the dynamics associated with Fagerlind's Model to see if they were consistent with what we could surmise about the developmental biology (morphogenetic program) of *Hymenandra* species. Clearly, more intensive field studies are needed to determine if any other activity occurs in the plant body's development among species of the genus.

Mez (1902) described the branching dynamics and flowering phenomena associated with Fagerlind's Model when he discussed the "inflorescences on special branches, with the principal axis indeterminate, [the inflorescences] terminal on lateral apices, with large subtending leaves subverticillate" for *Ardisia* subgenus *Pyrgus*. Subgenus *Pyrgus* is Indo-Malesian in origin and its species often occur sympatrically with individuals of *Hymenandra*. Likewise, Stone (1991) made the same comparison when he described *Hymenandra lilacina* distinguishing between vegetative and flowering shoots in that species. While both Mez and Stone noted that the leaves of the vegetative shoot (trunk) are usually slightly different from those of the flowering shoot, it was not correlated with a model for growth. During the period Mez worked, the concept of architectural models did not exist, and the herbarium material available to Mez was rather fragmentary or restricted to flowering shoots, at times accompanied from a single leaf from the trunk or an axis in vegetative state. Stone (1991) noted similarities in the "position and form of the inflorescence" between *Hymenandra* and *Ardisia* subgenus *Pyrgus* but did not state this in terms of architectural models. While there are several other architectural models present in *Ardisia* and within the tribe Ardisieae (Maasart's, Scarrone's, Roux's, based on unpubl. data), very few taxa have been examined, and architectural models are not necessarily correlated with subgeneric or other taxonomic groups. While *Hymenandra* species may share the same architectural model with *Ardisia* subgenus *Pyrgus*, the free anthers with apical or subapical pores with minute filaments, and the numerous, pluriseriate ovules of *Pyrgus* clearly preclude inclusion of the *Hymenandra* species within it.

Leaves

The leaves of *Hymenandra* are alternate, exstipulate and simple. As previously stated, leaves on the trunks ("stems" for small-statured taxa, "vegetative shoots" otherwise) are much larger than those of the reproductive ones, and also have a smaller length-to-width ratio. While both the "trunk" (or stem) and branches have spiral phyllotaxis, it is presumably by secondary twisting of the branches that make them plagiotropic, rather than by distichous arrangement. The blades may be chartaceous to coriaceous, elliptic, oblanceolate or oblong, apically acute to long-acuminate, basally cuneate to obtuse or rounded, decurrent on the petiole or not, conspicuously or inconspicuously black punctate and punctate-lineate, usually glabrous, but sometimes sparsely and minutely furfuraceous lepidote, the margins are entire, or rarely crenate (*Hymenandra calycosa*). The petioles are marginate and may bear the same tomentum as the branchlet apices, but they are glabrescent.

Inflorescence, Flowers and Fruit

The inflorescence may be terminal or pseudo-terminal (but behaving terminal), and variously bi- or tripinnately paniculate, with branches ending in loose to tight corymbs of flowers. The panicles are mostly pyramidal, but may be reduced to a columnar panicle of corymbs, thus appearing racemose in fruit (e.g., *Hymenandra sordida*). The inflorescence bract is foliose, membranaceous, nearly sessile and early caducous. The peduncle, primary rachis and branches are glabrous or furfuraceous lepidote, then glabrescent. The floral bracts are ovate, lanceolate or narrowly ellpitic, and membranaceous, sparsely to densely furfuraceous at first, then glabrescent. The pedicels are cylindrical and bear the same vestiture as the inflorescence branch. The flowers are perfect, bisexual, homomerous, and 5 (–6)-merous, and both perianth members may be membranaceous, chartaceous or coriaceous, with pellucid or black punctations and punctate-lineations. The calyx has lobes nearly free, lanceolate, linear-lanceolate, linear, oblong, or suborbicular, symmetrical or asymmetrical to slightly auriculate, apically acute, obtuse or rounded, the margin regular, irregular, or subapically notched, hyaline or scarious, sparsely glandular-ciliolate, minutely erose or entire (Fig. 1). The corolla is campanulate, the lobes nearly free, or free, ovate, lanceolate, oblong, or elliptic, symmetrical, apically acute or acuminate, erect or reflexed in anthe-

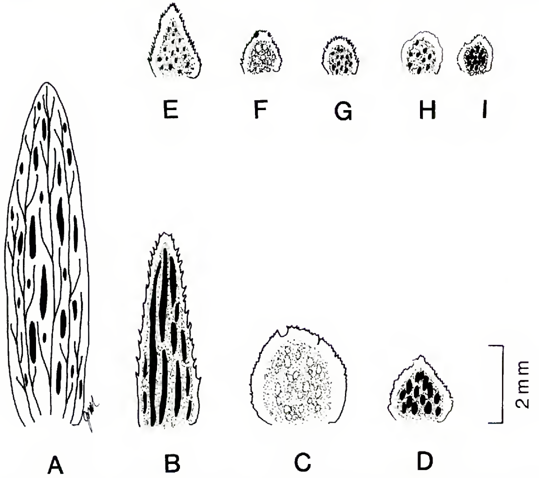

Fig. 1. Comparison of calyx lobes size, shape and punctations amoung the Neotropical species of *Hymenandra*. A. *Hymenandra calycosa*, drawn from *M. chinchilla 93*. B. *Hymenandra stenophylla*, drawn from *B. Hammel 13717*. C. *Hymenandra pittieri*, drawn from *K. Sytsma, W. Hahn & T. Antonio 2453*. D. *Hymenandra wilburiana*, drawn from *G. Davidse & G. Herrera 31379*. E. *Hymenandra callejasii*, drawn from *R. Callejas et al. 5683*. F. *Hymenandra crosbyi*, drawn from *K. Sytsma, L. Andersson & R. Dressler 4279*. G. *Hymenandra acutissima*, drawn from the holotype, *J. Cuatrecasas 17219*. H. *Hymenandra sordida*, drawn from the holotype, *T. Croat 43538*. I. *Hymenandra squamata*, drawn from the MO isotype, *W. Burger & R. Stolze 5853*.

sis, glabrous, the margin hyaline, and entire. The stamens are connate at least basally by their filaments to form a staminal tube, and by their anthers along the dehiscence sutures. The filaments are connate throughout their length in the neotropical species, but only basally in the Indo-Malesian species. The anthers are basifixed, connate along their dehiscence lines, either basally at first, or throughout their length, and lanceolate or ovate, apically long-attenuate to an acute or emarginate tip, or rounded with an apiculate tip, basally cordate, dehiscent by longitudinal slits, and with connectives ventrally darkened or prominently black punctate dorsally in the basal portion. The pistil may be obturbinate or ellipsoid, the style longer than the ovary, attenuate to a punctiform stigma. The placenta is subglobose to ellipsoid with relatively few to numerous, pluiseriate ovules in a high anthotactic spiral. The fruit is a globose to depressed-globose, one-seeded drupe, with a persistent style, sparsely or densely and prominently, conspicously or inconspicuously pellucid or black punctate.

ECOLOGY

Neotropical *Hymenandra* species are mostly small trees, most commonly found along ridgetops in moist, wet, cloud or pluvial forests, from near sea level to 1,400 m elevation. Two species, *Hymenandra sordida* and *H. squamata*, are subshrubs less than one meter tall, but they are ecologically distinct, the former is known only from cloud forests, and the latter known from swamp forests. Only one species, *Hymenandra stenophylla*, is found in lowland moist forests. *Hymenandra wilburiana* and *H. pittieri* are both found in forests transitional between lowland and premontane wet forests, but the former species is restricted to ridgetops, while the latter is found along the forest margin, particularly along watercourses. In the Colombian Chocó, two species occur that are easily separated ecologically. *Hymenandra callejasii* is from the lowland pluvial forest of the northern Antioquian Chocó, while *H. acutissima* is a riparian species along major rivers along the shores of the Pacific Ocean. *Hymenandra calycosa* is known only from premontane wet forests, from Nicaragua to Panama.

In Mesoamerica, the altitudinal compression or expansion of life zones is largely a result of exposure to winds, rain and other meteorological events. Therefore, absolute altitude often has little to do with the life zone present at a given site. For example, many areas in Nicaragua support vegetation otherwise found only at much higher altitudes, because there are no taller mountains around. Fieldwork has shown that even a small mountain of 800 m can support cloud forest. Such appears to be the case of *Hymenandra crosbyi*, which is restricted to the Caribbean Slope of Panama, at the junction of the premontane and cloud forest life zones, even though the altitudinal range of the species is only 100–850 m.

BIOGEOGRAPHY AND IMPLICATIONS FOR THE BOREOTROPICS HYPOTHESIS

Hymenandra, as now defined, is amphipacifically distributed, occurring from Bangladesh eastward through Malaya to Borneo, and in the Neotropics from Nicaragua southward through Costa Rica and Panama to the Chocó of Colombia. A distribution such as this, in particular with the majority of the species centered in Central America, most closely fits those groups cited as partial evidence to support what Wendt (1993) discovered in his study of lowland Mexican wet forests, and what Lavin and Luckow (1993) attributed to the Boreotropics Hypothesis, proposed by Wolfe (1975) and Tiffney (1985a, b) to explain the distribution of the "boreotropical flora." The hypothesis proposes that the biotas of North America and Europe, including tropical North America, were once more widespread in the northern hemisphere and transgressed the North Atlantic by direct land connections or over limited water gaps until the late Ecocene or early Oligocene (Lavin & Luckow 1993). A logical extension to Wolfe's and Tiffney's concept, presented by Wendt (1993) and Lavin and Luckow (1993) is that the boreotropical flora not only existed in the Eocene, but also left a significant number of direct descendant lines in present lowland tropical floras of northern Latin America. Therefore, we would expect that many of the early Tertiary fossil taxa from both North America and Europe were most closely related to extant species from tropical southeast Asia, and to some extent, Central America and the Greater Antilles (Lavin & Luckow 1993). It is the latter notion that is congruent with the Amphipacific distributional pattern like that found in our new concept of *Hymenandra*. This extension to the boreotropics hypothesis was cited by Wendt (1988, 1989, 1993), in discussing the relationships of *Chiangiodendron* (Flacourtiaceae), and by Zona (1990) in discussing the biogeography of *Sabal* (Arecaceae). A similar distribution for the genus *Alstonia* (Apocynaceae) was cited by Gentry (1983), but he did not invoke the hypothesis *per se*. Conran (1995), in his study of the Liliiflorae, found that three taxa defining the Southeast Asian/northern Australasian clade (Stemonaceae, Hanguanaceae and Uvulariaceae) were widespread northern taxa that have spread southwards.

The geographic distribution of *Hymenandra* is entirely consistent with the area cladogram presented by Lavin and Luckow (1993, Fig. 1), where South American elements are ultimately derived from among diverse North American lineages, these lineages having a sister group relationship to Paleotropical groups. While Wolfe's hypothesis could be correct even if no modern descendants of the boreotropical flora were found in the Neotopics owing to extinction, the three criteria proposed by Lavin and Luckow (1993) to test the hypothesis were: 1) a center of diversity in North America (including "tropical North America" as they define it), 2) an early Tertiary fossil record in North America, and 3) a pantropical distribution.

For the first test criterion, "North America" includes both tropical and temperate elements, the tropical ones south of the Tropic of Cancer. In the case of *Hymenandra*, it is clear that the majority of the neotropical members of the genus (*H. stenophylla*, *H. calycosa*, *H. sordida*, *H. squamata*, *H. wilburiana*, *H. crosbyi*) are centered in Nicaragua, Costa Rica, or the Caribbean slope of Panama, with only *H. pittieri* spanning the central montane of Costa Rica and Panama. *Hymenandra callejasii* and *H. acutissima* are restricted to the

Chocó of Colombia, a floristic province whose northern limit is southeastern Panama. Therefore, the pattern fits the first criterion.

Unfortunately, no data is available for use in the second test criterion owing to lack of fossils known for the group. As for the last criterion, a pantropical distribution, the closest related genus to *Hymenandra* appears to be the genus *Connandrium* Mez, known only from New Guinea, on the basis of possession of anthers fused along the sutures. In connection with New Guinea and adjacent Australia as significant sources of biota related to that of North America, Dobson (1996) cites the distribution of the termite genus *Mastotermes* and the sister poison frog genera, *Pitohui* and *Phyllobates*, as further evidence, but without citing the boreotropics hypothesis *per se*. It is unfortunate that the preliminary cladogram for genera of the family by Ståhl (1996) did not include *Hymenandra*. The other neotropical genera of the tribe *Ardisieae* include *Ardisia*, pantropically distributed with major centers of diversity in Malesia and Mesoamerica, *Ctenardisia* Ducke, with species from northern Mesoamerica and the Amazon Basin, *Synardisia* (Mast.) Lundell, a monotypic genus ranging from southern Mexico to Nicaragua, and *Gentlea* Lundell, with the majority of species in Mexico and Mesoamerica (only one, *G. venossisima*, in the Andes from Venezuela to Peru). Until a phylogenetic analysis is complete for the tribe, a rigorous test cannot be performed. However, the pattern of distribution among the genera of the tribe Ardisieae fit the general pattern one would expect if the distribution was boreotropical.

In summary, we hypothesize that *Hymenandra* appears to fit the overall pattern consistent with a boreotropical distribution. However, we must emphasize that until a cladistic analysis among the genera of Myrsinaceae is complete, there is no reliable way to unequivocally determine if the group is boreotropical or Gondwanan. However, at this point in our work, we find it useful to point out the strong correlation and call attention to the value of examining generic limts on a worldwide basis when preparing treatments for a large flora such as *Flora Mesoamericana*.

NOTES ON KEYS, DESCRIPTIONS, AND TERMINOLOGY

The keys are artificial and designed to expedite identification of herbarium specimens. An attempt has been made to emphasize vegetative characters to increase the keys' usefulness with sterile material. The numbers appearing before the taxa refer to their respective position in the key; any correlations with phylogenetic relationships are coincidental. Quantitative and qualitative data presented in keys and descriptions for floral parts and bracts were taken from organs rehydrated from herbarium specimens by boiling in water. Measurements from these range from 10% to 15% greater than those measurements taken directly from dried material. Data regarding shoot diameters, inflorescence rachises, pedicels, leaf and fruit shape and size were taken from dried herbarium specimens.

Morphological terms in this treatment follow Lindley (1848) and Pipoly (1987, 1992a) for the inflorescence, rachis pedicels and floral parts. Description of leaf morphology follows Hickey (1984), trichome description follows Theobald et al. (1984) and basic cell and tissue terminology follow Metcalfe (1984).

Because of branchlet and leaf dimorphism between shoots in vegetative vs. reproductive phases, the primary orthotropic axes (stems if a small statured plant, trunks if a treelet), are shoots not bearing inflorescences and are termed "*vegetative shoots*," while those plagiotropic branches actually or potentially bearing flowers or fruit are termed "*reproductive shoots*". Likewise, the leaves on the trunk or on the branches when they are in a vegetative state, will be termed, "*vegetative shoot leaves*" while those leaves on the shoots while they are in the reproductive phase will be termed, "*reproductive shoot leaves*."

All types cited here have been seen by the authors unless noted as "n.v."

KEY TO GENERA OF MYRSINACEAE IN MESOAMERICA

1. Calyx closed in bud, irregularly opening into 2–8 lobes among flowers within the same inflorescence .... **Geissanthus**

1. Calyx open in bud, with (3–)4–5(–6) lobes, the number of caylx lobes per flower consistent within one inflorescence.

  2. Calyx and corolla lobes valvate in bud; inflorescence axis never rufous glandular-papillate.

    3. Flowers bisexual; inflorescences paniculate, longer than the petioles; shoots tomentose with stellate or dendroid trichomes; calyx and corolla tomentose and glandular-papillose; anthers bright yellow; style elongate .... **Parathesis**

    3. Flowers unisexual; inflorescences glomerulate, umbellate or rarely in reduced corymbs, much shorter than the petioles; shoots glabrous or when tomentose, then with simple trichomes; calyx and corolla glabrous or the corolla sometimes glandular-papillose along the margin within; anthers cream to white; style obsolete or reduced .... **Myrsine**

  2. Calyx and corolla quincuncial, imbricate (although sometimes inconspicuously so), conrorted or rarely valvate in bud, when valvate, the inflorescence rachis rufous glandular-papillate.

    4. Filaments connate basally to form a staminal tube adnate to the corolla tube.

      5. Inflorescence lateral (axillary); corolla tube glandular-granulose within at least at the junction of the tube and lobes; staminal tube adnate to corolla at least 1/5 its length .... **Cybianthus**

      5. Inflorescence terminal or pseduoterminal functioing as terminal; corolla tube glandular-puberulent within at base; stamens free from or barely adnate to corolla at base.

        6. Anthers connate at least at base; filaments connate in a tube at least ½ their length; corolla lobes nearly free .... **Hymenandra**

6. Anthers free; filaments connate less than 1/5 length; corolla lobes united up to 3/4 their length .... Synardisia

4. Filaments free from each other and free from or variously adnate to the corolla tube, or filaments basally connate to form a staminal tube not adnate to the corolla tube.
   7. Filaments adnate to the corolla; anthers less than 3 times longer than wide.
      8. Filaments exserted, more than 6 times longer than the anthers; anthers obcordate; plants of elfin and cloud forests .... Gentlea
      8. Filaments included, shorter than or as long as the anthers; anthers ovate, lanceolate, elliptic or oblong; plants of montane to low land forests .... Stylogyne
   7. Filaments free from the corolla; anthers at least 3 times longer than wide.
      9. Corolla lobes connate 1/4 their length; ovules uniseriate, the placentation free-central .... Ctenardisia
      9. Corolla lobes nearly free or connate to 1/5 their length; ovules pluriseriate, the placentation basal .... Ardisia

TAXONOMIC TREATMENT

Hymenandra (A. DC.) A. DC. ex Spach, Hist. Veg. Phan. 9:374. 1840; A. DC., Ann. Sci. Nat., Bot., ser. 2, 16:79. 1841.; A. DC. in DC., Prodr. 8: 91. 1844. *Ardisia* sectio 2. *Hymenandra* A. DC., Ann. Sci. Nat., Bot., ser. 2, 2:297. 1834; Trans. Linn. Soc. London 17:126. 1837. Type: *Ardisia hymenandra* Wall. *in* Roxb. Fl. Ind. Ed. Carey 2:282. 1824, = *Hymenandra wallichii* A. DC., Ann. Sci. Nat. Bot., ser. 2, 16:79. 1841.

Chontalesia Lundell, Wrightia 7:41. 1982. Type: *Ardisia calycosa* Hemsl., Biol. Centr.-Amer., Bot. 2:292. 1882.

Subshrubs to small *trees* exhibiting Fagerlind's Architectural Model (Hallé et al. 1978) up to 8 m tall. *Leaves* pseudoverticillate, dimorphic; the blades of the orthotropic trunk or stem (i.e., primary axis) which are vegetative shoots larger with cuneate bases, those of the plagiotropic branches which are reproductive shoots basally obtuse to somewhat auriculate. *Inflorescence* terminal or pseudoterminal, bi- or tripinnately paniculate, pyramidal or columnar, the ultimate branches bearing flowers in loose to tight corymbs. *Flowers* perfect, bisexual, 5(–6)-merous, punctate and/or punctate-lineate; calyx lobes quincuncial, spreading at anthesis, nearly free, mostly papillose but sometimes hirtellous (Paleotropics) or glabrous (Neotropics), densely and prominently or conspicuously pellucid or black punctate, the margin glandular-ciliate; corolla white or pink, the lobes short-connate, quncuncial, lanceolate or oblong to ovate to narrowly ovate, glabrous or sparsely papillose within toward base, densely and prominently black punctate or inconspicuously pellucid punctate, the margin entire, erose or erose-fimbriate, sometimes subapically notched, glandular-ciliate or glabrous; stamens connate, shorter than the corolla lobes, the filaments monadelphous, fused basally 2/3 their length and reunited apically, fused basally but with apical portions free, or fused along entire length, adnate basally to the corolla tube, the anthers connate basally for 1/4–2/3, or along entire length along the thecal margins, narrowly oblong, linear-lanceolate or lanceolate, the connectives darkened or prominently black punctate abaxially; pistil obturbinate, the ovary ovoid, the style slender, elongate, the stigma punctiform; placenta subglobose, 5–24 ovules, at times appearing uniseriate (but in a high anthotactic spiral), or clearly pluriseriate. *Fruit* 1-seeded, globose or depressed-globose, the exocarp densely and prominently or conspicuously punctate, the style base persistent.

Distribution.—A genus of 16 species, from Bangladesh eastward to Myanmar, south to Malaya and Borneo in the Paleotropics; Nicaragua southward through Costa Rica and Panama to the Chocó of Colombia in the Neotropics, from near sea level–1,400 m elevation.

Ecology.—Members of *Hymenandra* are subshrubs to small trees in the lowest level of the forest understory, from the lowland to premontane transition to cloud forest, frequently on ridge tops or steep slopes, and near small water-courses. They are at best locally common [see ECOLOGY section].

Etymology.—*Hymenandra* is a Greek compound, derived from the words *Hymen*, or membrane, and *andros*, of the anthers, to describe the membranaceous connective tissue joining the anthers at their dehiscence suture.

KEY TO NEOTROPICAL SPECIES OF *HYMENANDRA*

1. Calyx lobes oblong or narrowly oblong to narrowly lanceolate, at least 3–5 times longer than wide at maturity.
  2. Calyx lobes shorter than the corolla lobes, 2.3–4.7 mm long, 0.9–1.1 mm wide, the margins erose, hyaline, densely glandular-ciliolate; corolla lobes 5–6.5 mm long .... **1. Hymenandra stenophylla**
  2. Calyx lobes longer than the corolla lobes, 6–9 mm long, (1.6–)2–2.5 mm wide, the margins entire, glabrous; corolla lobes 7–8.2 mm long .... **2. Hymenandra calycosa**
1. Calyx lobes ovate or suborbicular, usually less than 2 times longer than wide at maturity.
  3. Inflorescence a columnar panicle of corymbs, often appearing racemose in fruit .... **3. Hymenandra sordida**
  3. Inflorescence a pyramidal panicle of corymbs, appearing paniculate in fruit.
    4. Calyx lobes asymmetric, notched subapically.
      5. Subshrubs, 0.2–1 m tall; abaxial leaf surface densely and minutely furfuraceous lepidote, appearing velutinous; stamens 2.6–3 mm long, the anthers apically rounded, apiculate at tip, 1.6–1.8 mm long, 0.8 0.9 mm wide .... **4. Hymenandra squamata**
      5. Trees, 1–8 m tall; abaxial leaf surface glabrous to sparsely and minutely furfuraceous lepidote, not appearing velutinous; stamens 6–9.5 mm long, the anthers apically long-attenuate to an acute or emarginate tip, 5.5–8 mm long, 1.4–2.2 mm wide.

6. Calyx lobes 1.4–1.8 mm long; stamens 6–6.5 mm long; anthers 5.5–5.8 mm long; vegetative shoot leaf blades 5.5–22.2 cm long, 1.3–7.8 cm wide, reproductive shoot leaf blades 7.2–17.3 cm long, 2.1–4.7 cm wide .... **5. Hymenandra wilburiana**

6. Calyx lobes 2.2–2.8 mm long; stamens 8.7–9.5 mm long; anthers 7.5–8 mm long; vegetative shoot leaf blades 33.7–72.2 cm long, 5.3–16.5 cm wide; reproductive shoot leaf blades 3.9–34.3 cm long, 1.2–11.8 cm wide .... **6. Hymenandra pittieri**

4. Calyx lobes symmetric, not subapically notched.

7. Vegetative or flowering shoots 7–10 mm in diam.; petioles (0.6–)1–1.2 cm long; calyx lobes 2–2.8 mm long .... **7. Hymenandra callejasii**

7. Vegetative or flowering shoots 1.5–5.5 mm in diam.; petioles 1.6–3.9 mm long; calyx lobes 0.9–1.6 mm long.

8. Calyx lobes 1.4–1.6 mm long; inflorescences terminal, 9–16.5 cm long, secondary branches 5–5.5 cm long; fruit 8–12 mm in diam. .... **8. Hymenandra acutissima**

8. Calyx lobes 0.9–1.2 mm long; inflorescences subterminal, 2.7–8.8 cm long, secondary branches 1.3–3.5 cm long; fruit 4.5–6.5 mm in diam. .... **9. Hymenandra crosbyi**

1. Hymenandra stenophylla (Donn. Sm.) Pipoly & Ricketson, comb. nov. **(Figs. 1B, 2).** *Ardisia stenophylla* Donn. Sm., Bot. Gaz. 24:395. 1897. *Icacorea stenophylla* (Donn. Sm.) Lundell, Phytologia 49:351. 1981. Type. COSTA RICA. Limón: Forests of Shirores, Talamanca, 300 ft. [91 m], Feb 1895 (fl), *H. Pittier & A. Tonduz 9173* (holotype: US (LL Neg. # 71-109, US Neg. # 2388); isotypes: CR n.v., US).

Ardisia oblanceolata Standl., Publ. Field Colombian Mus., Bot. Ser. 4:249. 1929, syn. nov. Type. PANAMA. Bocas Del Toro: Region of Almirante, without elev., Jan–Mar 1928 (fr), *G. Cooper 370* (holotype: F (F Neg. # 68229, LL Neg. # 1971-75); isotypes: G (fragment), K, NY, US (US Neg. # 2378)).

Tree 2–6.1 m tall, to 7.5 cm in diam. *Trunk and vegetative shoots* terete, 7–9.5 mm in diam., minutely scattered furfuraceous lepidote, early glabrescent; *reproductive shoots* similar, but 1.5–4 mm in diam. *Vegetative shoot leaf blades* chartaceous, oblong to elliptic, 21.2–30.5 cm long, 3.5–8.5 cm wide, apically long-acuminate, the acumen 1–1.9 cm long, gradually tapering to a cuneate base decurrent to base of petiole, midrib slightly raised above, prominently raised below, secondary veins 22–32 pairs, slightly depressed or not visible above, slightly raised below, prominently punctate, scattered minutely furfuraceous lepidote, early glabrescent, the margins entire, flat; petioles marginate, 0.5–1.5 cm long, minutely scattered furfuraceous lepidote, early glabrescent; *reproductive shoot leaf blades* similar to the vegetative ones but 6.1–22.5 cm long, 2.1–5.2 cm wide, secondary veins 7–28 pairs; petioles similar to vegetative ones but 0.5–2.2 cm long. *Inflorescence* terminal, pinnately or bipinnately paniculate 3–10 (–15.5) cm long, pyramidal, secondary branches 0.8–3(–6.2) cm long, minutely scattered furfuraceous lepidote, early glabrescent, the branches ending in 4–8-flowered corymbs; inflorescence bracts early caducous, membranaceous, oblong, 5.6–8.8 mm

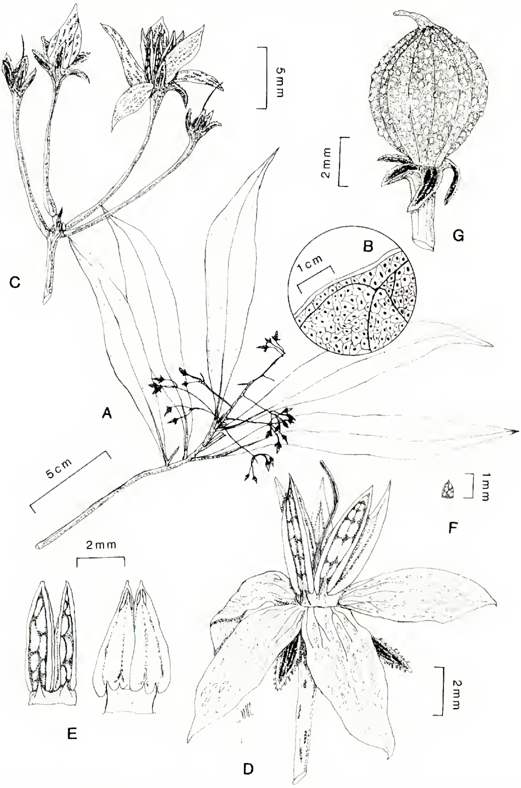

FIG. 2. *Hymenandra stenophylla* (Donn. Sm.) Pipoly & Ricketson. A. Reproductive shoot. B. Detail of abaxial leaf surface. C. Detail of inflorescence. D. Detail of flower. E. Detail of stamens, showing abaxial (left) and adaxial (right) surfaces. F. Ovules. G. Fruit. A–B drawn from the holotype, *H. Pittier & A. Tonduz 9173*. C drawn from *L.D. Gomez et al. 20415*. D–F drawn from *B. Hammel 13717*. G drawn from *J. Gomez-Laurito 9538*.

long, 0.6–1.2 mm wide, apically acute to rounded, midrib slightly raised above and below, secondary veins not visible, prominently punctate, scattered minutely furfuraceous lepidote, the margin entire, flat; floral bracts 0.5–2.2 mm long, 0.3–1.1 mm wide, otherwise as the inflorescence bracts; pedicels cylindrical, 0.6–1.2(–1.6) mm long, scattered minutely furfuraceous lepidote, early glabrescent. *Flowers* 5-merous, white or rarely pink; calyx lobes almost free, chartaceous, narrowly lanceolate to narrowly oblong, 2.3–4.7 mm long, 0.9–1.1 mm wide, symmetrical, apically very narrowly acute to subulate, densely and prominently black punctate and punctate-lineate, glabrous, the margin irregular, erose, hyaline, sparsely glandular-ciliolate; corolla lobes membranaceous, 5–6.5 mm long, the tube 0.2–0.5 mm long, the lobes lanceolate 4.5–6.3 mm long, 2–2.8 mm wide at base, apically acute, reflexed in anthesis, prominently pellucid punctate, the margins hyaline, entire, glabrous; stamens 3.5–5 mm long; filaments connate throughout their length into a chartaceous elobate tube, the tube 0.3–0.8 mm long, adnate to the corolla basally, epunctate, glabrous; anthers connate by their sutures, at least at first, lanceolate, 3–4.5 mm long, 0.7–1.1 mm wide at base, sessile on staminal tube, apically apiculate, basally cordate, longitudinally dehiscent by narrow, sublatrose slits, the connective densely and prominently black punctate; pistil obturbinate 5.3–7 mm long; ovary 1.2–1.5 mm long, glabrous; style 3.8–4.4(–5.8) mm long, erect, inconspicuously pellucid punctate, glabrous; stigma punctiform; placenta ellipsoid, 0.4–0.7 mm long, 0.2–0.5 mm in diam., apically apiculate; ovules 13–17, pluriseriate. *Fruit* obovoid to globose, 4.8–5.8 mm long, 3.8–4.5 mm in diam., densely and prominently punctate, the style base persistent.

Distribution.—Limón, Costa Rica and Bocas del Toro, Panama, from 25–500 m elevation.

Ecology and conservation status.—Known only from primary lowland tropical moist forests, collected from the understory along ridgetops, *Hymenandra stenophylla* should be considered threatened.

Etymology.—The epithet 'stenophylla' comes from the Greek "*stenos*" meaning narrow, and '*phyllus*' referring to the leaves. It describes the very narrow leaf blades of the taxon.

Specimens examined. COSTA RICA. Limón: Talamanca Valley, without elev., 1927 (ster.), *G. Cooper 12* (US); 7 km SW of Bribrí, 100–250 m, 4 May 1983 (fl), *L. Gómez et al. 20415* (LL, MO); Sitio de exploración petrolera, Suretka, Talamanca, 250 m, 6 Jul 1983 (fr), *J. Gómez-Laurito 9538* (F); Headwaters of Quebrada Mara de Limón, central fork, and hills between central and W forks, Finca Anai, Sixaola region, 09° 35' N, 82° 39' W, 25–40 m, 19 Nov 1984 (fr), *M. Grayum et al. 4486* (MO, NY); Hitoy Cerere Reserve and vicinity in Valle la Estrella, S of Finca Concepción, from station to top of ridge Miramaror Los Jabillos, 09° 42' N, 83° 02' W, 140–500 m, 1 Aug 1985 (fr), *B. Hammel & M. Grayum 14342* (MO); Reserve Biol. Hitoy-Cerere, near the station, Valle de la Estrella, 09° 40' 30" N, 83° 01' 30" W, 100 m, 20 Sep 1991 (fr), *A. Moreno 7* (MO); Forets de Tsâki, Talamanca, 200 m, Apr 1895 (fl) *A. Tonduz 9586* (G 3-sheets, US). **PANAMA. Bocas del Toro:** Along oil pipeline road between continental divide and Chiriquí Grande, second bridge over Río Guabo, along dirt acces[s] road, 08° 50–55' N, 82° 9–15' W, 120–200 m, 1–2 May 1985 (fl), *B. Hammel 13717* (MO); Filo Almirante along trail to Riscó Abajo, 3 km SW of town of Almirante, 100–200 m, 3 Jan 1975 (fr), *M. Nee & B. Hansen 14099* (MO); Vicinity San San River, Davao Farm, United Fruit Co., Almirante, 26 Aug 1940 (fr), *R. Seibert 1572* (MO, US).

Hymenandra stenophylla appears to be most closely related to *H. calycosa* by virtue of its oblong or narrowly oblong to narrowly lanceolate calyx lobes. However, the erose and sparsely glandular-ciliate calyx lobe margins, the calyx lobes smaller than the corolla lobes, and generally smaller flowers, easily separate the two species.

Populations corresponding to the type of *Ardisia oblanceolata* are notable only for the slightly larger and more prominient punctations on the leaves and slightly shorter pedicels. It is otherwise identical to *Hymenandra stenophylla*.

2. **Hymenandra calycosa** (Hemsl.) Pipoly & Ricketson, comb. nov. **(Fig. 1A, 3).** *Ardisia calycosa* Hemsl., Biol. Centr.-Amer., Bot. 2:292. 1882. *Chontalesia calycosa* (Hemsl.) Lundell, Wrightia 7:42. 1982. TYPE. NICARAGUA. CHONTALES: Chontales, without elev., 1867–1868 (fl), *R. Tate 239 {454}* (HOLOTYPE: K; ISOTYPES: BM, P n.v.).

Shrub or tree 1–4 m tall. *Trunk and vegetative shoots* terete, 4–7 mm in diam., minutely and densely furfuraceous lepidote at first, early glabrescent; *reproductive shoots* as in vegetative ones but 1–4 mm in diam., minutely scattered furfuraceous lepidote. *Vegetative shoot leaf blades* coriaceous, narrowly elliptic, 7.5–20.3 cm long, 2.8–5.2 cm wide, apically long-acuminate, the acumen 0.5–2.2 cm long, gradually tapering to the cuneate base, decurrent to petiole base, midrib slightly raised above, prominently raised below, secondary veins 7–21 pairs, slightly depressed or not visible above, prominently raised below, prominently punctate, glabrous above, minutely scattered furfuraceous lepidote below, early glabrescent, the margins crenate; petioles marginate, 0.2–0.8 cm long, glabrous above, minutely scattered furfuraceous lepidote below, early glabrescent; *reproductive shoot leaf blades* as in vegetative ones but 7.2–15.7 cm long, 1.6–4.1 cm wide, secondary veins 7–20 pairs; petioles like the vegetative ones but 0.3–0.9 cm long. *Inflorescence* terminal, pinnately or bipinnately paniculate, 4.5–14 cm long, pyramidal, secondary branches 2.7–4.3 cm long, minutely scattered furfuraceous lepidote, early glabrescent, terminating in 3–7-flowered corymbs; inflorescence bracts early caducous, membranaceous, oblong, 5.5–9 mm long, 0.7–1.1 mm wide, apically acute, basally sessile, midrib slightly raised above and below, secondary veins not visible, prominently punctate, mostly glabrous above, densely minutely furfuraceous lepidote below, the margins entire, flat; floral bracts similar to inflorescence bracts but lanceolate to narrowly elliptic 2.8–4.1 mm long, 0.4–1.2 mm wide; pedicels cylindrical, 7–15

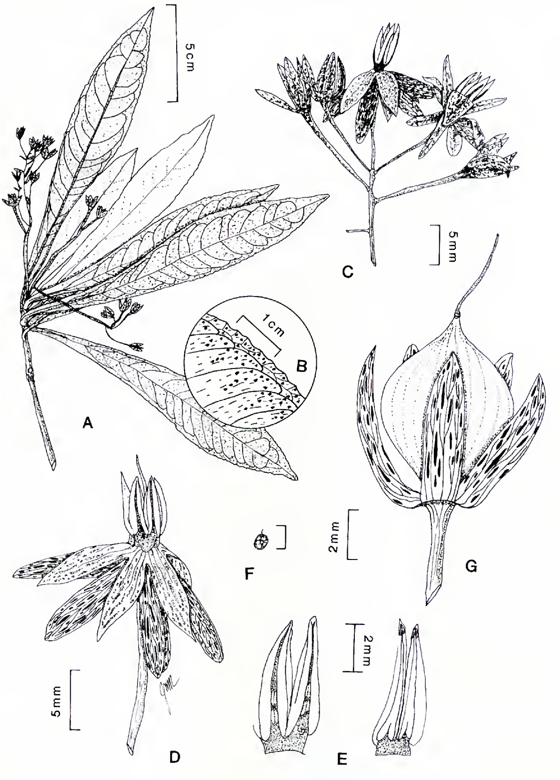

Fig. 3. *Hymenandra calycosa* (Hemsl.) Pipoly & Ricketson. A. Reproductive shoot. B. Detail of abaxial leaf surface. C. Detail of inflorescence. D. Detail of flower. E. Detail of stamens, showing abaxial (left) and adaxial (right) surfaces. F. ovules. G. Fruit. A–B drawn from BM isolectotype, *R. Tate 239 {454}*. C–F drawn from *M. Chinchilla 93*. G drawn from *R. Villalobos 37*.

mm long, minutely scattered furfuraceous lepidote, early glabrescent. *Flowers* 5-merous, 6.9–8 mm long; calyx lobes almost free, coriaceous, narrowly lanceolate to lorate, 4.2–9.7 mm long, 1.2–2.1 mm wide, symmetrical, apically acute to rounded, prominently punctate, appearing prominently because of the prominently brown punctations, scattered lepidote outside at the base, the margins entire; corolla lobes basally connate, membranaceous, the tube 1.5–1.8 mm long, elliptic, the lobes 5.4–6.2 mm long, 2.2–2.4 mm wide at the middle, apically acute to acuminate, reflexed in anthesis, prominently pellucide punctate, the margins hyaline, entire, glabrous; stamens 4.8–5.1 mm long; filaments connate into a chartaceous elobate tube, the tube 0.4–0.5 mm long, adnate to the corolla basally, epunctate, glabrous; anthers connate by their sutures, at least at first, lanceolate, 4.5–4.7 mm long, 1.2–1.5 mm wide at the base, sessile on the staminal tube, apically apiculate, basally cordate, longitudinally dehiscent by narrow, sublatrose slit, the connective conspicuously raised, pellucid punctate; pistil obturbinate 6.5–7.2 mm long; ovary 1.2–1.4 mm long, glabrous; style 5.3–5.8 mm long, erect, epunctate, glabrous; stigma punctiform; placenta ellipsoid, 0.6–0.8 mm in diam., apically apiculate; ovules 11–19, pluriseriate. *Fruit* elliptic, 6.2–7 mm long, 5.2–5.8 mm in diam., nearly epunctate, the style base persistent.

Distribution.—Jinotega, Chontales, Zelaya and Río San Juan, Nicaragua and Alajuela and Guanacaste, Costa Rica. It grows from (10–)450–1,100 m elevation.

Ecology and conservation status.—This species normally occurs in premontane wet forests, especially along ridgetops. The locations where the species has been found are actually premontane even though their absolute elevations are at times quite low. This phenomenon is due to the relative flatness of the Atlantic Slope in Nicaragua, where even elfin forest has been found under 1,000 m elevation. With increasing habitat destruction, and its consequent desertification, *Hymenandra calycosa* should be considered a threatened species.

Etymology.—The specific epithet refers to the calyx, which is always longer than the corolla and is accrescent in fruit.

Specimens examined. **NICARAGUA. Chontales:** Cerro Oluma, on ridge top of Cordillera Amerisque, 750 m, 4 Jan 1984 (fr), *A. Gentry et al. 43939* (DUKE, MO, NY); Cerro Oluma, ca 3 km SW de Ciudad Cuapa, 12° 18' N, 85° 20' W, 700–740 m, 3 Jan 1984 (fl), *A. Grijalva et al. 3393* (M); Cerro El Portillo, ca. 3 km al NE de Ciudad Cuapa, 758 m, 1 Mar 1984 (fl, fr), *A. Grijalva y D. Bradford 3652* (MO). **Jinotega:** Kilambé, Cerro San Pedro, 13° 36' N, 85° 39' W, ca. 600–800 m, 25 Mar 1981 (fl), *P. Moreno 7532* (MO, NY); Las Brisas, Comarca Kilambe, 13° 35–36' N, 85° 39' O, 930 m, 13 Jul 1980 (fl), *J. Sandino 159* (MO, NY). **Río San Juan:** Boca de Sábalo, trail to Buena Vista, 11° 03' N, 84° 27' W, ca. 70 m, 24 Mar 1985 (fl, fr), *P. Moreno 25630* (MO); Sábalo, 1 km al N de Río San Juan, 11° 02' N, 84° 27' W, ca. 100 m, 9–10 Jul 1985 (fr), *P. Moreno 26053* (MO); Bocas de Sábalo, 11° 03' N, 84° 27' W, 70–100 m, 14 Mar 1987 (ster.), *P. Moreno 26753* (MO). **Zelaya:** Río Punta Gorda, Atlanta, desembocadura del Caño el Guineo, 11° 33' N, 84°

02' W, ca. 10 m, 11 Nov 1981 (fr), *P. Moreno & J. Sandino 12853* (MO). COSTA RICA. **Alajuela:** Ca. 3 km NNE of Bijagua along the new road to Upala, 10° 45' N, 85° 03' W, 450 m, 7–8 Nov 1975 (fr), *W. Burger & R. Baker 9869* (F); E slopes of Volcán Miravilles, W of Bijagua, near the Río Zapote, 10° 44' N, 85° 05' W, ca. 600 m, 11–12 Feb 1982 (fl), *W. Burger et al. 11687* (F, LL, NY); Cataratas (Los Angeles) de San Ramon, without elev., 17 Apr 1925 (fl), *A. Brenes 21243* (NY); San Carlos Cantón, Betania de Cutris, 150 m, 26 Feb 1983 (fl), *A. Carvajal U. 392* (DUKE, LL, MO, NY); El Silencio de Tilarán, without elev., 31 May 1932 (fl, fr), *A. Brenes 15655* (F, NY); Upala Cantón, P.N. Guanacaste, Cordillera de Guanacaste, Estación San Ramón, Dos Ríos, 10° 52' 50" N, 85° 24' 05" W, 550 m, 3 Apr 1995 (fl), *M. Chinchilla 93* (MO), *100* (MO); Along road between Canas & Upala 4 km NNE of Bijagua on slopes leading into Río Zapote, ca. 400 m, 24 Jun 1976 (fl), *T. Croat 36246* (LL, MO, NY); Upala Cantón, P.N. Guanacaste, Cordillera de Guanacaste, Estación San Ramón, bosque en el sendero El Argentino, 10° 52' 40" N, 85° 24' 15" W, 550 m, 22 Mar 1994 (fl), *D. García 312* (MO); Santa María National Park, road down Caribbean slope 1 km E of summit of road, 4 km W of E side of park, 4 km E of colored house at junction of road to Hacienda Santa María, 10° 37' N, 85° 17' W, ca. 600 m, 7 Feb 1978 (fl), *R. Liesner 5066* (LL, MO, NY); 2 km N of Santa Rosa, 15 km N of Boca Arenal on Quesada-Muelle San Carls-Los Chiles road, 10° 38' N, 84° 31' W, ca. 100 m, 28 Apr 1983 (fl), *R. Liesner et al. 15041* (MO); Upala Cantón, P.N. Guanacaste, Cordillera de Guanacaste, Estación San Ramón, sendero El Argentino, camino al Volcán Cacao, 10° 53' 50" N, 85° 24' 29" W, 850 m, 27 Feb 1996 (fl), *J. Morales 5305* (MO); Moravia de Cutris-San Carlos, without elev., without date (ster.), *L. Poredat et al. 3681* (F); Cantón San Carlos, Cuenca de Pocosol, Escaleras, 20 km después de Pavón, Finca Elky María, 10° 52' 30" N, 84° 30' 25 W, 100 m, 16 Mar 1997 (fl), *A. Rodríguez & N. Zamora 2067* (CR, F, INB, MO); Villa Quesada, 850 m, 21 Feb 1939 (fl), *A. Smith 1630* (F, GH, MICH, NY), *1726* (F, MICH), *2609* (F, MO); On the slope of Volcán Rincón de la Vieja, along the road N from Liberia, ca. 5 km from the park, 400–700 m, 1 Mar 1985 (fl), *C. Taylor 4551* (DUKE, LL-frag. of DUKE); 2 km N of Bijagua along roadside and on trail to San Miguel or 7 km N of Río Naranjo, 400–500 m, 8 Jul 1976 (fl), *J. Utley & K. Utley 5318* (DUKE). **Alajuela-Guanacaste Border:** Border region on the slopes of Volcán Miravalles, along road N of Bagaces, from Guayabo to Aguas Claras, 400–600 m, 2 Mar 1985 (fl, fr), *C. Taylor & C. Skotak 4630* (DUKE). **Guanacaste:** La Cruz Cantón, Parque Nacional Guanacaste, Cordillera de Guanacaste, Estación Pitilla, Sedero los Memos, 10° 59' 26" N, 85° 25' 40" W, 740 m, 15 Apr 1995 (fl, fr), *E. Alfaro 169* (MO); Liberia Cantón, Parque Nacional Guanacaste, Cordillera de Guanacaste, Nueva Zelandia, Estación San Ramón, 10° 52' 50" N, 85° 24' 05" W, 550 m, 23 Mar 1994 (fl, fr), *D. García 112* (MO); Tilarán, ridge above town ca. 2.5 mi, without elev., 6 Oct 1971 (fr), *A. Gentry 2011* (LL, MO); Ridge to N of Río Las Flores, ca. 1 km E of Río Tenorío, Hacienda Montezuma, 10° 40.5' N, 85° 04.5' W, 475–500 m, 24 Jan 1985 (fr), *M. Grayum & G. Herrera 4852* (MO); Forest along Río San Juan, lower W Pacific slopes of Volcán Tenorío, Hacienda Montezuma, 10° 40.5' N, 85° 03' W, 600–700 m, 25 Jan 1985 (fl), *M. Grayum et al. 4969* (LL, MO); El Dos de Tilarán, 4 km N, Cerro La Chitripa, Atlantic slope, 10° 25' N, 84° 50' W, 1,000 m, 12 Apr 1986 (fl, fr), *W. Haber et al. 4430* (MO), *4432* (LL), *4447* (MO); La Chirripa ridge, 4 km NE El Dos de Tilarán, continental divide, 10° 25' N, 84° 53' W, 1,000 m, 8 May 1986 (fl), *W. Haber et al. 4752* (MO), *4759* (MO), *4848* (MO); Tilarán, Río Chiquito de Quebrada Grande, Zona Monteverde, Finca López, Vertiente Atlántica, 10° 25' N, 84° 53' W, 700–900 m, 6 Jun 1987 (fl), *W. Haber & E. Bello C. 7433* (MO); Parque Nacional Guanacaste, Estación Pitilla, camino al E de la Estación, 11° 02' N, 85° 25.3' W, 600 m, 24 May 1989 (fl, fr), *B. Hammel et al. 17370* (BRIT, MO); Santa Cecilia, La Cruz, Estación pitilla, Faldas Cerro Orosilito, 10° 57' N, 83° 28' W, 700 m, 14 Jun

1989 (fl), *Q. Jiménez et al. 709* (BRIT, MO); Santa Elena to Tilarán road, ca. 24 km from Santa Elena, ca. 1,000 m, 17 Feb 1984 (fl, fr) *Khan et al. 1141* (BM 2-sheets); Liberia Cantón, Parque Nacional Guanacaste, Cordillera de Guanacaste, Estación Cacao, El Cañon, 10° 55' 43" N, 85° 28' 10" W, 1,100 m, 10 Feb 1995 (fr), *M. Lobo 47* (MO); Estación pitilla, La Cruz, Parque Nacional Guanacaste, 10° 59' 26" N, 85° 25' 40" W, 700–1,000 m, 7 Nov 1990 (fr), *C. Moraga 214* (MO); Liberia Cantón, Parque Nacional Guanacaste, Cordillera de Guanacasre, Nueva Zelandia, Estación San Ramón, sendero al Volcán Cacao, 10° 53' 50" N, 85° 29' 29" W, 850–950 m, 23 Mar 1994 (fl), *J. Morales et al. 2544* (MO); Forest at top of divide, 4 km NW of Tilarán, without elev., 27 Feb 1972 (fl), *P. Opler 580* (F); Liberia Cantón, Parque Nacional Guanacaste, Cordillera de Guanacaste, Estación Cacao, Sendero Nayo, 10° 55' 43" N, 85° 28' 10" W, 1,000 m, 9 Feb 1995 (fl), *A. Picado et al. 51* (MO); Hacienda Tenorio, without elev., 17 Feb 1956 (fl), *B. Schubert 1079* (A, F); El Silencio, near Tilarán, ca. 450 m, 13 Jan 1926 (fl), *P. Standley & J. Valerio 45539* (US), *45545* (US); La Tejona, N of Tilarán, 600–700 m, 25 Jan 1926 (fr), *P. Standley & J. Valerio 45862* (US); Quebrada Serena, SE of Tilarán, ca. 700 m, 27 Jan 1926 (fl), *P. Standley & J. Valerio 46181* (US), *46221* (US); El Silencio, 800 m, 15 Aug 1923 (fr), *J. Valerio 147* (F); Liberia Cantón, Parque Nacional Guanacaste, Cordillera de Guanacasre, Estación Cacao, Cerro Cacao, 10° 55' 43" N, 85° 28' 10" W, 1,100 m, 8 Feb 1995 (fl, fr), *R. Villalobos 37* (MO).

Hymenandra calycosa is closely related to *H. stenophylla*, but is very easily recognized by the calyx lobes entire, longer than the corolla and accrescent in fruit, larger corollas and crenate leaf margins.

3. **Hymenandra sordida** (Lundell) Pipoly & Ricketson, comb. nov. (**Figs. 1H, 4**). *Auriculardisia sordida* Lundell, Wrightia 7:272. 1984. *Ardisia sordida* (Lundell) Lundell, Phytologia 61:66. 1986, nomen. invalidum. *Ardisia sordida* (Lundell) J.F. Morales, Phyrologia 83:111. 1997 [1998]. TYPE. COSTA RICA. ALAJUELA: Finca Los Ensayos, ca. 11 mi. NW of Zarcero, ca. 850 m, 15 Aug 1977 (fl), *T. Croat 43538* (HOLOTYPE: LL; ISOTYPES: CR n.v., MO).

Subshrubs 0.4–1 m tall. *Vegetative shoots* unknown; *reproductive shoots* terete, 4–7 mm in diam., densely appressed furfuraceous lepidote. *Vegetative shoot leaves* unknown; *reproductive shoot leaf blades* chartaceous, elliptic to oblanceolate, 16–29.5 cm long, 4.5–10.8 cm wide, apically acuminate, the acumen 0.5–1.8 cm long, basally attenuate, the midrib depressed above, prominently raised below, the secondary veins 35–70 pairs, slightly depressed or not visible above, prominently raised below, abaxially densely appressed furfuraceous lepidote along and near the midrib, adaxially glabrous, the margin entire, inrolled; petioles marginate, 0.5–2.1 cm long, glabrous above, densely appressed furfuraceous lepidote below. *Inflorescence* terminal, pinnately or bipinnately paniculate, 4.2–10.5 cm long, a columnar panicle of 7–14-flowered corymbs, appearing racemose in fruit, secondary branches 0.5–2.3 cm long, the rachis densely appressed furfuraceous lepidote, glabrescent; inflorescence bracts early caducous, membranaceous, lanceolate, 1.4–2.8 cm long, 2.2–4.4 mm wide, sessile, midrib slightly raised above and below, secondary veins obscure to not visable above and below, scattered furfuraceous lepidote to mostly glabrous below, densely appressed furfuraceous lepidote below,

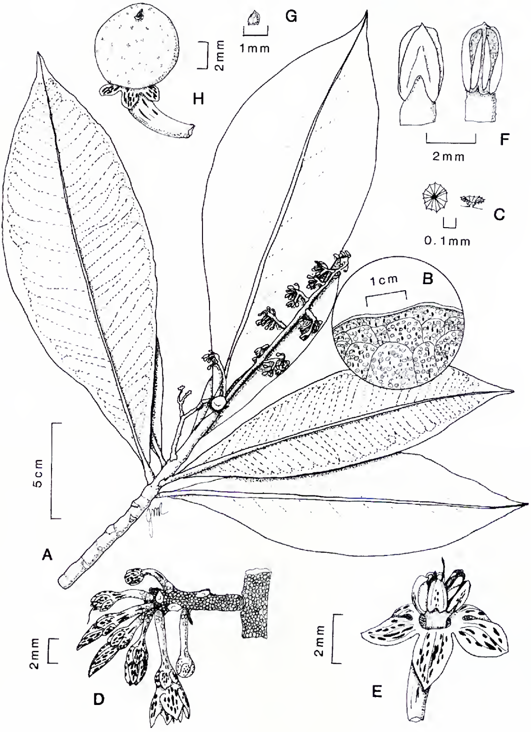

FIG. 4. *Hymenandra sordida* (Lundell) Pipoly & Ricketson. A. Reproductive shoot. B. Detail of abaxial leaf surface. C. Lepidote scale from above and from the side. D. Detail of inflorescence. E. Detail of flower. F. Detail of stamens, showing abaxial (left) and adaxial (right) surfaces. G. ovules. H. Fruit. A–D & G drawn from holotype, *T. Croat 43538*. E–F drawn from *B. Hammel et al. 14078*. H drawn from *A. Molina R. et al. 17525*.

the margins entire, ciliolate; floral bracts 1.1–1.7 mm long, 0.3–0.5 mm wide, otherwise as in the inflorescence bracts; pedicels cylindrical, 5.5–8.7 mm long, scattered to densely appressed furfuraceous lepidote, glabrescent with age, persistent. *Flowers* pendent, 5-merous, reddish-violet; calyx lobes almost free, chartaceous, suborbicular, 1.9–2.2 mm long, the lobes 1.2–1.5 mm long, 1–1.2 mm wide, asymmetric, apically rounded, subapically notched, conspicuously black punctate medially, sparsely furfuraceous lepidote, glabrescent, the margin irregular, somewhat erose, hyaline, densely glandular-cilioate, glabrescent; corolla lobes connate basally, membranaceous, lanceolate, 3.2–3.7 mm long, the lobes 2.3–2.5 mm long, 1.2–1.3 mm wide near the base, apically acute, reflexed in anthesis, conspicuously, black- punctate, the margin erose, hyaline, entire, glabrous; stamens 2.4–2.5 mm long; filaments connate into a chartaceous elobate tube, the tube 1.0–1.1 mm long, adnate to the corolla basally, epunctate, glabrous; anthers connate by their sutures, at least at first, ovate, 1.4–1.7 mm long, 0.7–0.9 mm wide at base, sessile on the staminal tube, apically apiculate, basally cordate, longitudinally dehiscent by narrow, sublatrose slits, the connective conspicuously reddish punctate; pistil obturbinate, 2.8–3.8 mm long; ovary 0.5–0.6 mm long, glabrous; style 2.3–3.2 mm long, erect, inconspicuously black punctate, glabrous; stigma punctiform; placenta ellipsoid, 0.1–0.3 mm long, 0.1–0.15 mm in diam., apically apiculate; ovules 6–9, pluriseriate. *Fruit* depressed-globose, 6–6.5 mm long, 6.5–7.5 mm in diam, inconspicuously black punctate, the style base persistent.

Distribution.—Alajuela and Guanacaste Provinces, Costa Rica, from 500–1,200 m elevation.

Ecology and conservation status.—*Hymenandra sordida* is a ridgetop species, known only from primary and mildly disturbed cloud forests, and should thus be considered threatened.

Etymology.—The epithet comes from the Latin word '*sordidus*', meaning dirty, soiled or ugly.

Specimens examined. **COSTA RICA. Alajuela:** Reserva Biológica Monteverde Río Peñas Blancas, Laguna Poco Sol, 10° 21' N, 84° 40' W, 500–800 m, 6 Aug 1989 (fl), *E. Bello C. 1059* (MO); San Carlos, San Miguel de San Isidro, 600 m, 29 Jun 1985 (fl), *W. Haber & E. Bello C. 1714* (MO); Peñas Blancas river valley NE of San Carlos, along road from Jabillos, 10° 22' N, 84° 38' W, 650 m, 29 Jun 1985 (fl), *B. Hammel et al. 14078* (MO); Cantón de Upala, Bijagua, Finca Montezuma, Ladera Sur de Cerro Montezuma, 10° 41' 10" N, 85° 03' 40" W, 600 m, 18 Jul 1993 (fl), *G. Herrera 6279* (F, K, MO); 15 km NW of Arenal by air, 2 km NW of Nuevo Arenal on road to Tilarán, then 3 km NE on road to San Rafael de Guatuso, then 2 km W on road to Finca Cote, 10° 34.5' N, 84° 54' W, 700 m, 30 Apr 1983 (fl), *R. Liesner et al. 15108* (MO); Near La Laguna, 6–8 k S of Villa Quesada, 1,200 m, 19 Feb 1966 (fr), *A. Molina R. et al. 17525* (F). **Guanacaste:** Parque Nacional Guanacaste, La Cruz, 9 km al S de Sanra Cecilia Esración Pitilla, 10° 59' 26" N, 85° 25' 40" W, 700 m, 13 Sep 1990 (fl), *C. Chávez 71* (MO); Parque Nacional Guanacaste, Esración Pitilla y Sendero

El Mismo, 10° 59' 26" N, 85° 25' 40" W, 700 m, 15 Jun 1991 (fl, fr), *P. Ríos 374* (INB, MO); Parque Nacional Guanacaste, Cordillera de Guanacaste, Estación Pitilla, Santa Cecilia, 9 km S, 10° 59' 00" N, 85° 25' 40" W, 700 m, 20 Aug 1993 (fl), *V. Ramírez et al. 62* (BRIT, CR, INB, MO); N slopes of the Volcán Orosí along lower reaches of broad ridge running to the N, 650 m, 18 Jan 1968 (fr), *R. Wilbur & D. Stone 9745* (LL).

Hymenandra sordida appears to be most closely related to *H. squamata* but may be immediately distinguished by the columnar shape of the panicle, and the larger sepals with merely erose (not erose-fimbriate) margins.

4. **Hymenandra squamata** (Lundell) Pipoly & Ricketson, comb. nov. (**Figs. 1I, 5**). *Auriculardisia squamata* Lundell, Phytologia 56:19. 1984. *Ardisia squamata* (Lundell) Lundell, Phyrologia 61:67. 1986, nomen. invalidum. *Ardisia squamata* (Lundell) J.F. Morales, Phytologia 83:111. 1997 [1998]. Type. COSTA RICA. Heredia: Original forest near the Río Puerto Viejo, ca. 2 km upstream from the confluence with Río Sarapiquí, formerly "Finca La Selva" of L.R. Holdridge, 10° 26' N, 84° 00' W, 100 m, 14–17 Jun 1968 (fl), *W. Burger & R. Stolze 5853* (holotype: F; isotypes: CR n.v., DUKE, F, LL, MO).

Subshrubs 0.2–1 m tall. *Trunk and vegetative shoots* terete, 3–5 mm in diam., densely appressed furfuraceous lepidote, glabrescent; *reproductive shoots* 1–2.5 mm diam., densely and minutely appressed furfuraceous lepidote, persistent. *Vegetative shoot leaf blades* membranaceous, elliptic, 7.4–22.4 cm long, (1.2–)3.5–6.9 cm wide, apically short to long-acuminate, the acumen 0.9–1.9 cm long, basally attenuate, midrib depressed above, prominately raised below, secondary veins 18–26 pairs, slightly depressed or not visible above, prominently raised below, densely appressed furfuraceous lepidote along and near the midrib below, appearing velutinous, glabrous above, the margin entire, inrolled; petioles marginate, 0.4–1.1 cm long, glabrous above, densely appressed furfuraceous lepidote below; *reproductive shoot leaf blades* similar to the vegetative ones but (3–)9.0–13.5 cm long, (0.9–)2.2–3.5 cm wide, tha acumen 0.6–1.1 cm long, basally obtuse; petioles like those of the vegetative but 0.2–0.6 cm long. *Inflorescence* terminal, pinnately or bipinnately paniculate, 1.4–5.2 cm long, pyramidal, secondary branches 0.6–1.8 cm long, the rachis densely appressed furfuraceous lepidote, glabrescent, terminating in 5–14-flowered corymbs; inflorescence bracts early caducous, membranaceous, lanceolate, 5.7–8.1(–20.2) mm long, 2.4–3.9 mm wide, apically acute, sessile, midrib slightly raised above and below, secondary veins obscure to not visable above and below, scattered furfuraceous lepidote to mostly glabrous below, densely appressed furfuraceous lepidote below, the margins entire, ciliolate; floral bracts like the inflorescence ones but reduced in size, 0.9–2.4 mm long, 0.2–0.8 mm wide, apically subulate; pedicels cylindrical, 4.1–6.9 mm long, scattered, appressed furfuraceous lepidote, usually persistent with age, persistent. *Flowers* 5-merous, reddish-violet; calyx chartaceous, suborbicular, 2–2.2 mm long, the tube 1–1.1 mm long, the

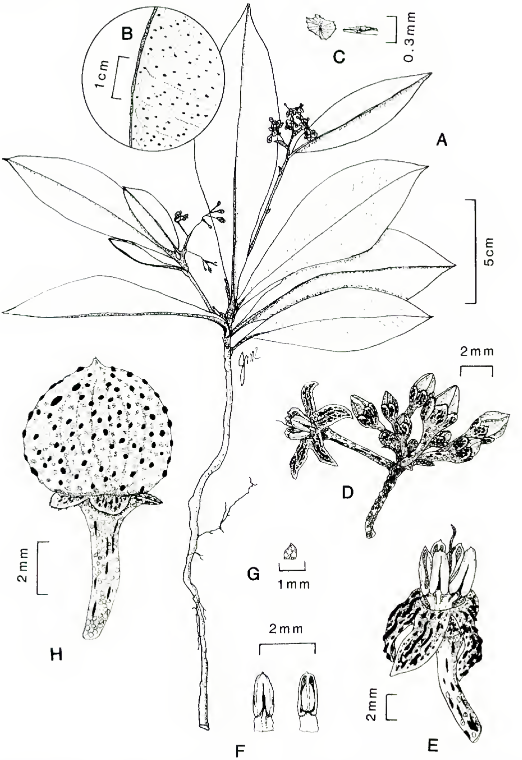

FIG. 5. *Hymenandra squamata* (Lundell) Pipoly & Ricketson. A. Reproductive shoot. B. Detail of abaxial leaf surface. C. Lepidote scale from above and from the side. D. Detail of inflorescence. E. Detail of flower. F. Detail of stamens, showing abaxial (left) and adaxial (right) surfaces. G. ovules. H. Fruit. A–G drawn from MO isotype, *W. Burger & R. Stolze 5853*. G drawn from *M. Grayum & G. Herrera 7857*.

lobes almost free 1–1.2 mm long, 0.9–1.1 mm wide, asymmetric, apically rounded, subapically notched, prominently black punctate medially, sparsely furfuraceous lepidote, glabrescent, the margin irregular, minutely erose-fimbriate, hyaline, densely glandular-cilioate; corolla membranaceous, 4.2–4.4 mm long, the tube 1–1.2 mm long, the lobes connate basally, lanceolate 3–3.2 mm long, 1.2–1.3 mm wide near the base, apically acute, reflexed in anthesis, prominently black punctate, the margin erose, hyaline, glabrous; stamens 2.6–3 mm long; the filaments connate into a chartaceous elobate tube, the tube 1–1.2 mm long, adnate to the corolla basally, epunctate, glabrous; anthers connate by their sutures, at least at first, ovate, 1.6–1.8 mm long, 0.8–0.9 mm wide at base, sessile on the staminal tube, apically apiculate, basally cordate, longitudinally dehiscent by narrow, sublatrorse slits, the connective prominently reddish punctate; pistil obturbinate, 2.1–3.4 mm long; ovary 0.5–0.7 mm long, glabrous; style (1.6–)2.5–2.7 mm long, erect, inconspicuously black punctate, glabrous; stigma punctiform; placenta ellipsoid, 0.1–0.3 mm long, 0.1–0.15 mm in diam., apically apiculate; ovules 7–10, pluriseriate. *Fruit* depressed-globose, 4.5–6 mm long, 5.5–6.8 mm in diam, conspicuously black punctate, the style base persistent.

Distribution.—Provinces of Heredia, Limón and San José, Costa Rica, at 90–1,400 m elevation.

Ecology and conservation status.—*Hymenandra squamata* is known only from the swamp forests of the Atlantic drainage in Costa Rica. It occurs just above the high water level. Because these forests yield high volumes of timber, the species should be considered under threat.

Etymology.—The epithet comes from the Latin "*squamatus*" which means "provided with scales," referring to the scales of the shoots and leaf blades.

Specimens examined. **COSTA RICA**. **Heredia:** Between Río Peje and Río Sardinalito, Atlantic slope of Volcán Barva, 10° 17' N, 84° 04.5' W, 800–1,000 m, 7 Apr 1986 (fr), *M. Grayum & R. Chazdón 6853* (MO); Finca La Selva, the OTS Field Station on the Río Puerto Viejo just E of its junction with the Río Sarapaquí, along E River Road near Holdridge Trail, ca. 100 m, 15 May 1978 (fl), *M. Grayum 1303* (DUKE); Finca la Selva, Puerto Viejo de Sarapiquí, along Quebrada El Taconazo, Between Quebrada El Sura and W boundary Trail, without elev., 15 Aug 1979 (fr), *M. Grayum 2371* (DUKE); Parque Nacional Braulio Carrillo, 10° 15.5' N, 84° 05' W, 1,200–1,400 m, 13 Nov 1986 (fr), *M. Grayum & G. Herrera 7857* (MO); Finca la Selva, Puerto Viejo de Sarapaquí along Quebrada El Santo, Hartshorn Trail, ca. 100 m, 17 May 1980 (fl), *B. Hammel 8693* (DUKE), 22 May 1980 (fl), *B. Hammel 8762* (DUKE); La Selva, on Río Puerto Viejo just E of its junction with Río Sarapaquí, Central Trail, 1,500 m S of edge of Trail, 100 m, 7 Jul 1981 (fr), *B. Hammel 10962* (DUKE); La Selva, just E of juction of Río Puerto Viejo and Río Sarapiquí, ca. 100 m, 20 May 1982 (fl), *B. Hammel 12372* (DUKE, LL), 7 Jun 1982 (fl), *B. Hammel & J. Trainer 12757* (DUKE, LL); Finca La Selva, El Swampo, 600 m, 16 Jun 1984 (fl), *B. Jacobs 2377* (DUKE); La Selva, Sendero El Peje, ca. 2,800 m line E-W, ca. 100 m, 18 May 1985 (fl), *B. Jacobs 3113* (DUKE); 9 km SE of San Ramín, 10° 16' N, 84° 05' W, 1,000 m, Sep 1985 (fr), *B. Loiselle 144* (MO); La Selva, near Puerto Viejo, along line B, 90 m, 29 May 1971 (fl), *P. Opler 188* (F), along line A, 4 Aug 1971 (ster.), *P. Opler 332* (F); Finca la Selva, Puerto Viejo, 1,600 Line Trail, without elev., 6 Jul 1979 (fr), *J. Sperry 790* (DUKE); Finca La Selva, Río Puerto Viejo just E of its junction with the Río Sarapaquí, S Research Trail, 19 May 1984 (fl), *R. Wilbur & B. Jacobs 34720* (DUKE), along S bounday of new property from the SE corner to the Sarapiquí Trail at about 4,000 m on grid system, ca. 100 m, 19 May 1984 (fl), *R. Wilbur & B. Jacobs 34747* (DUKE); La Selva, Jaguar Trail from Quebrada El Sura to the 3,000 m line, ca. 100 m, 14 Jul 1986 (fl, fr), *R. Wilbur 39948* (DUKE); La Selva, S Experimental Trail at the 700 m point on line; 100 m, 25 Jul 1986 (fr), *R. Wilbur 40442* (DUKE); La Selva, slopes just arising out of the swamp at about 200 m on the El Swampo Trail, ca. 100 m, 29 May 1995 (fl, fr), *R. Wilbur 64246* (DUKE) . **Limón:** Siquirres, Las Brisas de Pacuarito, 500 m, 17 Abr 1985 (fl), *L. Gómez et al. 23383* (BRIT, NY); Ridge E of Río Pacuare, ca. 15 km S of Pacuarito, in vicinity of community of Las Brisas, 10° 00' N, 83° 30' W, 200–500 m, 27 Jun 1988 (fl), *B. Hammel & M. Chavarría 17073* (MO). **San José:** Parque Nacional Braullio Carrillo, Carrillo station, 300–600 m, 31 May–5 Jun 1980 (fl), *C. Todzia 1302* (TEX).

Hymenandra squamata is very closely related to *H. sordida*, but easily separated from it by the smaller, minutely erose-fimbriate calyx lobes, the pyramidal panicle and the dense furfuraceous lepidote tomentum, appearing velutinous.

5. **Hymenandra wilburiana** (Lundell) Pipoly & Ricketson, comb. nov. **(Figs. 1D, 6).** *Auriculardisia wilburiana* Lundell, Phytologia 63:76. 1987. *Ardisia wilburiana* (Lundell) Lundell, Phytologia 63:463. 1987. TYPE. COSTA RICA. HEREDIA: Finca La Selva, the OTS Field Station on the Río Puerto Viejo just E of junction with the Río Sarapiquí, Paso Perdido Trail, ca. 3,200 m line (EW), ca. 100 m, 16 Jul 1984 (fl), *B. Jacobs 2917* (HOLOTYPE: LL; ISOTYPES: DUKE, MO).

Auriculardisia sarapiquiensis Lundell, Phytologia 63:74. 1987, SYN. NOV. *Ardisia sarapiquiensis* (Lundell) Lundell, Phytologia 63:463. 1987. TYPE. COSTA RICA. HEREDIA: Finca La Selva, the OTS Field Station on the Río Puerto Viejo just E of its junction with the Río Sarapiqui, in forest on ridge at SW corner of new property, ca. 100 m, 20 Jul 1982 (fl), *B. Hammel & J. Trainer 13262* (HOLOTYPE: LL; ISOTYPE: DUKE).

Tree 1–7 m tall, trunk to 3 cm in diam. *Vegetative shoots* terete, 4–6 mm in diam., minutely scattered furfuraceous lepidote below, densely furfuraceous apically at least when young; *reproductive shoots* similar to vegetative ones but 1.5–3.5 mm in diam. *Vegetative shoot leaf blades* coriaceous, elliptic to oblong, 5.5–22.2 cm long, 1.3–7.8 cm wide, apically acuminate, the acumen 2–3 cm long, basally acute, midrib slightly raised above, prominently raised below, the secondary veins 11–19 pairs, slightly depressed or not visible above, prominently raised below, minutely scattered furfuraceous lepidote along the midrib below and on the blade below, glabrescent with age, the margin entire, flat; petioles marginate, 0.5–2.2 cm long, glabrous above, scattered and minutely furfuraceous lepidote below; *reproductive shoot leaf blades* as in the vegetative except 7.2–17.3 cm long, 2.1–4.7 cm wide, secondary veins 9–15 pairs; petioles as in vegetative ones but 0.3–1.3 cm long. *Inflorescence* terminal, pendent, pinnately or bipinnately paniculate, 7–16.5 cm long, pyramidal, secondary branches 4–6.5 cm long, the rachis

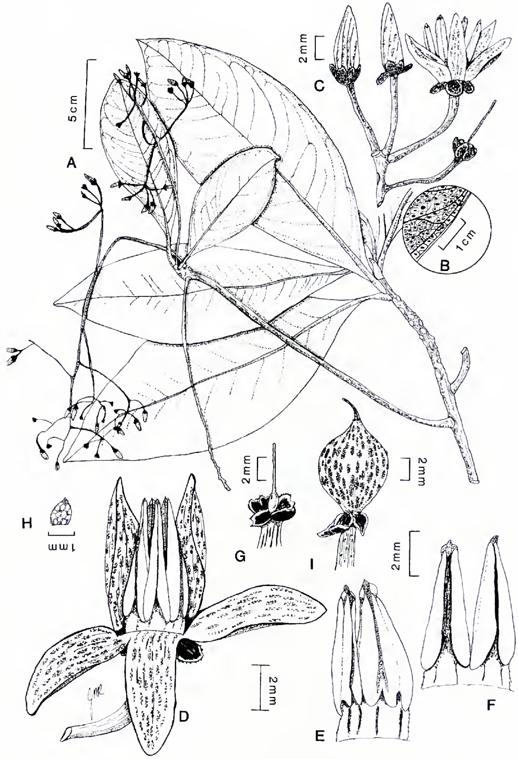

Fig. 6. *Hymenandra wilburiana* (Lundell) Pipoly & Ricketson. A. Reproductive shoot. B. Detail of abaxial leaf surface. C. Detail of inflorescence. D. Detail of flower. E. Detail of stamens, showing adaxial (left) surfaces. F. Detail of stamens, showing abaxial (right) surfaces. G. Detail of flower, showing seapls and pistil. H. Ovules. I. Fruit. A–B drawn from holotype, *B. Jacobs 2917*. C–H drawn from holotype of *Auriculardisia sarapiquiensis* Lundell, *B. Hammel & J. Trainer 13262*. I drawn from *R. Robles 1571*.

minutely scattered furfuraceous lepidote, glabrescent, terminating in 6–12-flowered corymbs; inflorescence and floral bracts unknown (presumably early caducous); pedicels cylindrical, 6.8–13.2 mm long, scattered furfuraceous lepidote, persistent. *Flowers* 5-merous, white; calyx lobes essentially free, chartaceous, suborbicular, 1.4–1.8 mm long, 1.6–2 mm wide, asymmetric, notched below the apex, apically obtuse, prominently black punctate medially, sparsely furfuraceous lepidote, the margin irregular, minutely erose, hyaline, densely glandular-cilioate; corolla lobes basally free, membranaceous, lanceolate, 5.5–6.5 mm long, 1.4–1.6 mm wide near the base, apically acute, reflexed in anthesis, prominently pellucid punctate without, sparsely so medially within, the margin erose, hyaline, glabrous; stamens 6–6.5 mm long; filaments connate into a chartaceous elobate tube, the tube 1.4–1.9 mm long, adnate to the corolla basally, epunctate, glabrous; anthers connate by their sutures, at least at first, lanceolate, 5.5–5.8 mm long, 1.9–2.2 mm wide at base, sessile on the staminal tube, apically apiculate, basally cordate, longitudinally dehiscent by narrow, sublatrose slits, the connective conspicuously brown or pellucid punctate; pistil obturbinate, 5.7–6.5 mm long; ovary 1.5–1.8 mm long, glabrous; style 4.2–4.7 mm long, erect, inconspicuously pellucid punctate, glabrous; stigma punctiform; placenta ellipsoid, 0.4–0.5 mm long, 0.2–0.3 mm in diam., apically apiculate; ovules 16–20, pluriseriate. *Fruit* subglobose, 7–8 mm long, 6–6.5 mm in diam., at times with noticeable longitudinal costae, densely and prominently punctate, the style base persistent.

Distribution.—Río San Juan, Nicaragua to Heredia and Limón, Costa Rica, from 0–700 m elevation.

Ecology and conservation status.—*Hymenandra wilburiana* is a ridgetop species in the lowland to premontane wet forest transition areas. It has a rather restricted distribution, but not enough is know of its population dynamics to determine its conservation status.

Etymology.–The species is named for Dr. Robert L. Wilbur, professor of botany at Duke University, expert in Mesoamerican Ericaceae and long-time student of the flora of the La Selva OTS station in Costa Rica.

Specimens examined. **NICARAGUA. Río San Juan:** Near Caño Chontaeno, 20 km NE of El Castillo, 200 m, 18–21 Apr 1978 (fr), *D. Neill & P. Vincelli 3506* (MO, NY). **COSTA RICA. Heredia:** Sarapiquí Cantón, trail between Canta Rana Camp and Río Peje, Magsasay, 400 m, 14 Jan 1983 (fr), *I. Chacón 80* (MO); Finca la Selva, on Río Puerto Viejo just E of its junction with Río Sarapaquí. Fila Río Peje, along the line at 3,600–2,200 m, 100 m, 21–22 Apr 1983 (fr), *I Chacón 717* (DUKE); N of Puerto Viejo, 10 km down road, then 7–8 km W, without elev., 2 Feb 1983 (fr), *N. Garwood et al. 936* (MO); Finca El Bejuco, S base of Cerros Sardinal, Chilamate de Sarapiquí, 10° 27' N, 84° 04' W, 70–100 m, 2 Jun 1985 (fr), *M. Grayum & B. Jacobs 5352* (BRIT, LL, MO); Sarapiquí Cantón, Parque Nacional Braulio Carrillo, Estación Magsasay, 10° 23' 03" N, 84° 03' 00" W, 200 m, *B. Hammel et al. 17829* (BRIT, F, MO); Finca La Selva, Sendero El Peje, 3,200 m–1,600 m on line along ridge, ca. 100 m, 28 May 1985 (fr), *B. Jacobs 3189* (DUKE); Sarapiquí Cantón, Horquetas, Estación El Plástico, 15 km de Horquetas, Sendero el Tigre, 10° 17' 03" N, 84° 02' 47" W, 700 m, 11 Jan 1994 (fr), *J. Sánchez et al. 308* (F, K); Sarapiquí Cantón, Zona Protectora La Selva, 6 km by road from Río Peje crossing, 5 km SSE of Magsasay, E from basecamp to ridge above Río Peje, then S, 10° 21' N, 84° 03–04' W, 300-500 m, 14 Jan 1983 (fr), *G. Schatz & M. Grayum 599* (DUKE); 500 m, 19 Jan 1983 (fr), *G. Schatz & M. Grayum 653* (DUKE, LL). Limón: SW-most ridge of Cerro Coronel, NW-facing slope, just S of the Río Colorado, 10° 40' N, 83° 39' 30" W, 10–80 m, 17–18 Sep 1986 (fl), *G. Davidse & G. Herrera 31379* (MO); Parque Nacional Tortuguero, Estación Agua Fría, ca. 7 km al SE Cerro Azules, 10° 27' N, 83° 34' W, 70 m, 21 Jan 1988 (fr), *R. Robles 1571* (MO, US); Parque Nacional Tortuguero, Estación Agua Fría, ca. 12 km al NE, on other side of Río Pueblo Nuevo, over the Lomas de Sierpe, 10° 26' N, 83° 32' W, 80–100 m, 2 Mar 1988 (fr), *R. Robles 1666* (MO); Cerro Coronel, E of Río Zapote, 10° 40' N, 83° 40' W, 10–100 m, 24 Jan 1986 (fr), *W. Stevens 23977* (MO); Cerro Coronel, E of Laguna Danto, 10° 41' N, 83° 38' W, 20–170 m, 15–20 Sep 1986 (fl), *W. Stevens & O. Montiel 24432* (MO); Cerro Coronel, along ridge from E of Laguna Danto SW toward hills E of Río Zapote, 10° 40–41' N, 83° 38–39' W, 30–170 m, 17 Mar 1987 (fr), *W. Stevens et al. 24972* (MO).

Hymenandra wilburiana is most closely related to *H. pitteri* but may be distinguished by the much shorter perianth and androecial parts, smaller leaves and much thinner stems.

Populations corresponding to the type of *Auriculardisia sarapiquiensis* are notable only for their slightly smaller inflorescence and slightly smaller leaves. The types of *Hymenandra wilburiana* and *Auriculardisia sarapiquiensis* were both collected at the Finca La Selva OTS Station.

6. **Hymenandra pittieri** (Mez) Pipoly & Ricketson, comb. nov. (**Figs. 1C, 7**). *Ardisia pittieri* Mez, Bull. Herb. Boissier, Ser. 2, 3:236. 1903. *Auriculardisia pittieri* (Mez) Lundell, Phytologia 49:345. 1981. Type. COSTA RICA. Cartago: Las Vueltas, Tucurrique, 635–700 m, May 1899 (fr), *A. Tonduz 13369* (lectotype here designated: US (US # 1339917, LL Neg. # 1971-83); isolectotypes: G 4-sheets, P 4-sheets, US (US # 1339916, LL Neg. # 1971-83)).

Ardisia cutteri Standl., J. Wash. Acad. Sci. 17:52. 1927, syn. nov. *Auriculardisia cutteri* (Standl.) Lundell, Wrightia 7:267. 1984. Type. COSTA RICA. Cartago: vicinity of Pejivalle, ca. 900 m, 7 Feb 1926 (fr), *P. Standley & J. Valerio 47122* (holotype: US, (US Neg. # 2368, LL Neg. # 1971-31)).

Ardisia coclensis Lundell, Ann. Missouri Bot. Gard. 28:453. 1941, syn nov. *Auriculardisia coclensis* (Lundell) Lundell, Phytologia 49:343. 1981. Type. PANAMA. Coclé: vicinity of El Valle de Antón, ca. 600 m, without date (fl), *P. Allen 2056* (holotype: MICH, (LL Neg. # 1971-4)). [Unicate].

Tree (0.9–)2–5(–8) m tall, 2–8 cm in diam. *Vegetative shoots* terete, 7–24 mm in diam., minutely scattered furfuraceous lepidote, glabrescent; *reproductive shoots* as in the vegetative but 2–9 mm in diam. *Vegetative shoot leaf blades* coriaceous, obovate to oblanceolate, 33.7–72.2 cm long, 5.3–16.5 cm wide, apically acute to rounded, gradually tapering to a cuneate base, decurrent to near the petiole base, midrib slightly raised above, prominently raised below, secondary veins 24–41 pairs, prominently raised above and

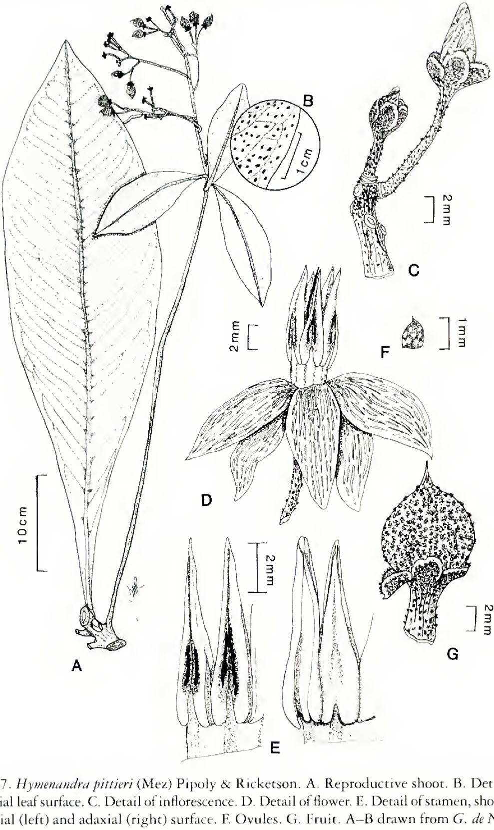

FIG. 7. *Hymenandra pittieri* (Mez) Pipoly & Ricketson. A. Reproductive shoot. B. Detail of abaxial leaf surface. C. Detail of inflorescence. D. Detail of flower. E. Detail of stamen, showing abaxial (left) and adaxial (right) surface. F. Ovules. G. Fruit. A–B drawn from *G. de Nevers 7203*. C, F–G drawn from P lectotype, *A. Tonduz 13369*. D–E drawn from *J. Morales & Y. Salazar 1195*.

below, prominately punctate above and below, glabrous above, minutely scattered furfuraceous lepidote below, glabrescent, the margin regular, entire, flat; petioles marginate 1.8–4.7 cm long, glabrous above, minutely scattered furfraceous-lepidote below; *reproductive shoot leaf blades* similar to the vegetative but 3.9–34.3 cm long, 1.2–11.8 cm wide, secondary veins 20–36 pairs, basally tapering to a rounded base appearing auriculate; petioles similar to the vegetative ones but 0.4–1.1 cm long. *Inflorescence* subterminal, pinnately or bipinnately paniculate, (7–)12–30(–36) cm long, pyramidal, secondary branches 3.5–12.5 cm long, the rachis densely and minutely furfuraceous tomentose, terminating in 8–13-flowered corymbs; inflorescence bracts early caducous, membranaceous, oblong, 7–13.5 mm long, 3.4–4.6 mm wide, apically acute to rounded, basally sessile, midrib slightly raised above and below, secondary veins not visible, prominently punctate, densely and minutely furfuraceous tomentose, the margin entire, flat; floral bracts 1.7–2.8 mm long, 1.1–2.1 mm wide, otherwise as in the inflorescences bracts; pedicels cylindrical, 7.5–14 mm long, densely and minutely furfuraceous tomentose. *Flowers* 5-merous, pink; calyx lobes almost free, chartaceous, suborbicular, 2.2–2.8 mm long, 2–2.4 mm wide, asymmetrical, subapically notched, apically obtuse to broadly rounded, prominently punctate, densely and minutely furfuraceous tomentose, the margin, irregular, minutely erose, hyaline, sparsely glandular-ciliolate; corolla lobes basally free, chartaceous, ovate to lanceolate, 9–10.5 mm long, 4–4.7 mm wide, apically acute, reflexed in anthesis, prominently pellucid punctate on both surfaces, the margin hyaline, entire, glabrous; stamens 8.7–9.5 mm long; filaments connate into a coriaceous elobate tube, the tube 1.2–1.5 mm long, free from the corolla basally, epunctate, glabrous; anthers connate by their sutures, at least at first, lanceolate, 7.5–8 mm long, 1.4–1.7 mm wide at base, sessile on the staminal tube, apically acute, at times with a minute emarginate tip, basally cordate, longitudinally dehiscent by narrow, sublatrose slits, the connective inconspicuously pellucid to black punctate; pistil 6.8–8.4 mm long; ovary 1.8–2.2 mm long, glabrous; style 5–6.2 mm long, erect, inconspicuously punctate, glabrous; stigma punctiform; placenta ellipsoid, 0.9–1.1 mm long, 0.8–0.9 mm in diam., apically apiculate; ovules 14–16, pluriseriate. *Fruit* globose, 0.7–1.6 cm in diam., densely and prominently black punctate, the style base persistent, the exocarp thick, juicy, bright red.

Distribution.—Limón, Cartago, San José and Puntarenas, Costa Rica and Coclé, Colon and San Blas, Panama, from 50–1,300 m elevation.

Ecology and conservation status.—*Hymenandra pittieri* is an understory tree along ridgetops in lowland and premontane wet forest. Throughout its range, this species is locally common and is not threatened at this time.

Etymology.—This species is named for Dr. Henri Pittier, early explorer in

Central America but also known for his work in South America and particularly, for establishing the Herbario Nacional de Venezuela.

Specimens examined. **COSTA RICA. Cartago:** Along Camino Raíz de Hule, SE of Platanillo (Tsipirí), 1,200–1,400 m, 1 Jul 1976 (fl), *T. Croat 36703* (LL, MO); 24 km NE of Turrialba on hwy. to Limón, then E at Tres Equis on jeep road 1.5 km, 09° 58' N, 83° 34' W, 450–525 m, 10 May 1983 (fl), *R. Liesner et al. 15348* (MO); Pavones, Turrialba, 650 m, 18 May 1972 (fl), *L. Poveda 106* (MO). **Limón:** Near the Río Catarata (Río Sand Box) in the hills between Bri Bri on the Río Sixaola and the Caribbean coastal plain, 09° 37' N, 82° 49' W, 50-100 m, 28–29 Nov 1975 (fr), *R. Baker & W. Burger 126* (F). **Puntarenas:** Cantón de Osa, Refugio Nacional Golfo Dulce, Península de Osa, Bahía Chal, entrance to Chocuaco, 08° 43' 00" N, 83° 34' 50" W, 200–350 m, 2 Nov 1994 (fr), *R. Aguilar et al. 3663* (MO); Region between Río Esquinas & Palmar Sur de Osa, sea level, 30 Jan 1951 (fr), *P. Allen 5828* (F), 75 m, 2 Feb 1951 (fr), *P. Allen 5828A* [sic] (F), 60 m, 18 Feb 1953 (fl), *P. Allen 6726* (F); Cantón de Coto Brus, P.I. La Amistad, Cordilleta de Talamanca, Las Cruces, 08° 47' 20" N, 82° 58' 30" W, 1,200–1,300 m, 30 Jun 1995 (fr), *L. Angulo 394* (MO); Forested slopes E of Las Cruces and 5–6 km S of San Vito on and around the property of Mr. Robert Wilson, 8° 47' N, 82° 58' W, 1,100–1,200 m, 15–16 Jan 1967 (fr), *W. Burger & G. Matta U. 4406* (F); Original forest ca. 10 km SE of Palmar Norte along the Interamerican Hwy., to Panama, 08° 54' N, 83° 02' W, 20 m, 26 Jan 1967 (fl), *W. Burger & G. Matta U. 4644* (F, G); Cantón de Osa, Rincón, Fila Casa Loma, 08° 43' N, 83° 32' W, 50–400 m, 22 Jul 1990 (fr), *A. Chacón 934* (MO); Quebradas Pastora, Arepa y Pintadora, Fila Esquinas-Osa, without elev., Nov 1983 (fr), *I. Chacón & G. Herrera 1758* (MO); Along Río Jaba S of San Vito de Coto Brus, 08° 47' N, 82° 58' W, 1,150 m, 1 Jul 1984 (fr), *M. Grayum et al. 3369* (MO); Refugio Nacional Golfito, both slopes of Fila Gamba and along crest of same, to ca. 0.7 km N of Golfito-Villa Briceño road, 08° 40.5' N, 83° 12' W, 160–260 m, 11 Dec 1988 (fr), *M. Grayum & G. Herrera 9200* (MO); Palmar Norte to Chacarita, along Interamerican Hwy., ca. 2 km N of Chacarita, 08° 48' N, 83° 18' W, 50 m, 25 May 1986 (fr), *B. Hammel et al. 15186* (MO); Alto La Palmera, Carretera Panamericana, 950 m, 28 Feb 1966 (fr), *A. Jiménez* (DUKE, F); Cantón de Osa, Rancho Quemado, sector E, Sierpe, 08° 40' 20" N, 83° 35' 15" W, 500 m, 6 Nov 1991 (ft),*J. Marín et al. 257* (MO); Finca las Cruces, along road to stream below OTS field station, without elev., 10 May 1973 (fl), *B. McAlpin 2250* (DUKE); Cantón de Osa, Camino a la toma de agua, Rancho Quemado Rincón, 08° 42' N, 83° 34' W, 200 m, 9 Dec 1990 (fr), *F. Quesada 320* (MO); Wilson's finca, 6 km S of San Vito de Java, 4,000 ft [1,219 m], 16 Aug 1967 (fr), *P. Raven 21829* (F 2-sheets, MO); Golfito, Parque Nacional Esquinas, margins of Quebrada Gamba, 08° 40' 30" N, 83° 12' 20" W, 70 m, 29 Sep 1995 (fr),*J. Sánchez 565* (CR, F). **San José:** Cantón de Pérez Zeledón, Tinamaste, Swiss farm, 09° 17' 40" N, 83° 46' 00" W, 1,000 m, 12 Jun 1997 (fr), *D. Argüello M. et al. 11* (CR, F, MO, NY); Valley of the Río Hondura, below La Palma, NE of San Jeronimo, 10° 3' N, 83° 58' W, 1,000 m, 15 May 1968 (fl), *W. Burger & R. Stolze 3738* (F, MO); El General Valley, vicinity of San Isidro El General, Alto San Juan, road to Dominical, 900 m, 28 Feb 1966 (fl, fr), *A. Molina R. et al. 18090* (F 2-sheets, NY, US); Z.P. La Cangreja, Santa Rosa de Puriscal, faldas de la Fila La Cangreja, 09° 42' 28" N, 84° 23' 38" W, 500 m, 8 Mar 1993 (fl),*J. Morales & Y. Salazar 1195* (MO); Cantón de Acosta, Fila Bustamante, by Fila San Jerónimo, headwaters of Quebrada Colorado, 09° 43' 20 N, 84° 16' 45 W, 1,040 m, 29 May 1994 (fr),*J. Morales & V. Ureña 2852* (INB-2 sheets, MO 2-sheets); Cantón de Amidrib, Fila Bustamante, Zoncuano, falda Sur de Fila Zoncuano, ca. del Río Partitilla, 09° 42' 02" N, 84° 13' 37" W, 700–900 m, 4 Jun 1995 (fr),*J. Morales 4354* (MO); Zapatón de Puriscal, 400 m, 1 Aug 1986 (fr), *N. Zamora & Q. Jiménez 1268* (MO). **PANAMA. Coclé:** Hills N of El Valle de Antón, 1,000 m, 23 Jun 1940 (fr), *P.*

Allen 2176 (F); Loma del Tigre, region N of El Valle de Antón, 1,000 m, 16 Nov 1946 (fl), *P. Allen 3806* (G, MO, NY); 7 km from Llano Grande on road to Coclesito near continental divide, 1,200 ft [366 m], Jul 1979 (fr), *T. Antonio 1364* (MO); On the Atlantic side, ca. 5 hr. walk from sawmill at El Cope, along slopes above Norte Río Blanco near small village of Caño Sucio, 400–500 ft [122–152 m], 2 Feb 1980 (fr), *T. Antonio 3627* (LL, MO), *3632* (MO); Area of El Valle, 2 km E of La Mesa, N slope of Cerro Gaital, 08° 38' N, 80° 07' W, 800 m, 16 Nov 1983 (fr), *H. Churchill 3867* (LL, MO, NY); *3876* (MO); Near continental divide along lumber road ca. 1.5 mi N of El Cope, ca. 900 m, 19 Jan 1978 (fr), *T. Croat 44581* (BRIT, MO); Hills above El Valle de Antón, without elev., 13 Aug 1972 (fr), *W. D'Arcy & J. D'Arcy 6749* (MO); Road from Penonome to Coclesito, 9 km N of Llano Grande, on tributary on Río Caseaja, without elev., 11 Oct 1978 (fr), *W. D'Arcy & B. Hammel 12292* (LL, MO); Area between Caño Blanco del Norte, Caño Sucio and Chorro del Río Tife, 08° 43' 06" N, 80° 36' 30"–38' 00" W, 200–400 m, 3 Feb 1983 (fr), *G. Davidse & C. Hamilton 23484* (MO); Hills N of El Valle de Antón, ca. 800 m, 17 Jan 1973 (fl, fr), *R. Dressler 4254* (MO); Near Aserradero El Copé, N of El Copé, E of sawmill, 700–800 m, 2 Nov 1980 (fl, fr), *R. Dressler 5962* (FLAS 2-sheets, MO); Slopes of Cerro Pilón near El Valle, 700–900 m, 10 Jun 1967 (fr), *J. Duke 12197* (MO); Summit of Cerro Pilón, above El Valle de Antón, 2,700 ft [823 m], 28 Mar 1969 (fr), *J. Dwyer et al. 4476* (LL, MO); Cerro Pilón, bottom of slope, ca. 2,500 ft [762 m], 19 Jan 1968 (fr), *J. Dwyer 8351* (MO), 13 Jul 1968 (fr), *J. Dwyer & B. Lallathin 8690* (F, MO), 14 Jul 1968 (ster.), *8690A* (MO); Adjacent to chicken farm, La Mesa, above El Valle, without elev., 3 Jan 1974 (fr), *J. Dwyer 11869* (MO); 7 km N of el Copa de Veraguas, near Rivera sawmill, Alto Calvario, 900–1,300 m, 11 Jan 1977 (fl), *J. Folsom 1242* (BRIT, LL, MO); New Works at Rivera sawmill, Alto Calvario, 600–800 m, 12 May 1977 (fr), *J. Folsom 3163* (MO); Area around Rivera sawmill, 7 km N of El Cope, Atlantic slope, N side of summit, Alto Calvario, 700–850 m, 3 Oct 1977 (fr), *J. Folsom et al. 5741* (MO); Vicinity of La Mesa, N of El Valle, 1,000 m, 23 Dec 1972 (fr), *A. Gentry 6854* (LL); Hills above El Valle, ca. 1,000 m, 24 Dec 1972 (fl), *A. Gentry 6872* (LL, MO); Near continental divide along lumber road, 8.4 km above El Cope, 1 km beyond sawmill, 900 m, 19 Jan 1978 (fr), *B. Hammel 958* (LL, MO); 7 km N of Llano Grande on road to Coclesito, 1,700 ft [518 m], 8 Mar 1978 (fr), *B. Hammel 1928* (MO); La Mesa region N of Cerro Gaital vicinity of El Valle, 2,400 ft [732 m], 2 Jul 1978 (fr), *B. Hammel 3898* (MO); Continental divide N of Penonome on road to Coclesito, 1,600 ft [488 m], 25–26 Jul 1978 (fr), *B. Hammel 4054* (MO); S of Cascajal along Continental Divide, 8° 45' N, 80° 25' W, 800–900 m, 7 Nov 1981 (fr), *S. Knapp 1965* (MO); Cerro Pilón, 2,700 ft [823 m], Jul 1968 (fr), *B. Lallathin 35A* (MO); Along road ca. 8 mi N of El Valle de Antón, without elev., 3 Aug 1970 (fr), *J. Luteyn & H. Kennedy 1704* (DUKE, GH, LL, MO); Vicinity of la Mesa, beyond El Valle, N slopes of Cerro Gaital, 8° 37' N, 80° 07' W, 850 m, 14 Jul 1987 (fr), *G. McPherson 11270* (MO); Ca. 3 km NE of El Valle, along farmers road, without elev., 2 Nov 1974 (fl, fr), *S. Mori & J. Kallunki 2978* (LL, MO); Continental Divide above El Copé, 8° 38' N, 80° 39' W, 650–750 m, 27 Nov 1985 (fl), *G. de Nevers et al. 6398* (LL, MO); Foot of Cerro Pilón, above El Valle de Antón, 2,000 ft [610 m], 27 Mar 1969 (fr), *D. Porter et al. 4422* (MO), 28 Mar 1969 (fr), *D. Porter et al. 4597* (LL, MO); La Mesa, 2 km NW of Cerro Pilón, 800 m, 22 Jul 1976 (fr), *G. Sullivan 553* (MO); Between Río Blanco and Caña Susio 1 hr. hike to the W, Río Blanco is ca. 5 hr. hike N down from Continental Divide above El Copé and El Petroso sawmill, 8° 38' N, 80° 36' W, 350–400 ft [107–122 m], 13 Dec 1980 (fr), *K. Sytsma et al. 2453* (LL, MO); Ca. 1 km E of Quebrada Amarillo in La Mesa, 2.5 km N of El Valle, 8° 37' N, 80° 07' W, 2,600 ft [792 m], 14 Feb 1981 (fr), *K. Sytsma & W. D'Arcy 3565* (LL, MO). **Colón:** Santa Rita lumber road, ca. 15 km E of Colón, without elev., 5 Oct 1969 (fl, fr), *R. Dressler & W. Lewis 3725* (LL, MO); Santa Rita Ridge, logging area 19 km in from Transisthmian Hwy., without elev., 28 Jan 1968 (fr), *J. Dwyer 8551* (F, MO); Río Escandaloso near the abandoned Manganese mine, 500 ft [152 m], 26 Apr 1978 (fr), *B. Hammel 2662* (LL, MO); S approach to Cerro Bruja from Río Escandaloso, ridge top, without elev., 20 May 1978 (fr), *B. Hammel 3220* (MO); On Santa Rita Ridge Trail, beyond end of Santa Rita Ridge Road (Panamanian Hwy. R2OD), 17–35 km from Boyd-Roosevelt Hwy, 400–800 m, 21 May 1975 (fr), *S. Mori & M. Crosby 6313* (LL, MO); Santa Rita Ridge, km 13.8, 9° 20' N, 79° 45' W, 350 m, 24 Feb 1986 (fr), *G. de Nevers 7203* (LL, MO). **San Blas:** Río Cangandi, pueblo Cangandi, camino de caballos al S del pueblo, 9° 27' N, 79° 07' O, 40 m, 17 May 1987 (fr), *H. Herrera & P. Perez 98* (MO); campamento Nusagandi, en la Carretera El Llano-Carti, a 19.1 km de la Carretera Panamericana, Cuadrante Nusagandi y Sendero Nusagandi, 9° 12' N, 78° 16' W, 350 m, 19 Mar 1993 (fr), *R. Paredes 944* (BRIT, F, MO, PMA, STRI).

Hymenandra pittieri is most closely related to *H. wilburiana*, but is a much more robust plant, with larger sepals, stems and androecial parts.

Populations corresponding to the type of *Ardisia cutteri* are notable according to Standley for their large leaves and fruits. The subsessile leaf bases appearing auriculate have also been used to recognize it. However, we have now found that the subsessile leaves are restricted to the flowering shoots of *Hymenandra pittieri*, so the confusion is the result of an incomplete specimen rather than due to biological difference. Lundell (1971) stated that *Ardisia coclensis* may have affinity to *A. pittieri*, but he only knew it from the brief description by Standley (1938).

7. **Hymenandra callejasii** (Pipoly) Pipoly & Rickerson, comb. nov. (**Figs. 1E, 8**). *Ardisia callejasii* Pipoly, Novon 2:389. 1992. Type. COLOMBIA. Antioquia: Municipio de Mutatá, N of Hacienda El Darién, right margin of Río Chontadural, without elev., 28 Jul 1978 (fl, fr), *R. Fonnegra G. & E. Renteria A. 953* (holotype: HUA; isotypes: COL, MEDEL, MO).

Tree to 7 m tall. *Vegetative shoots* terete, 7–10 mm in diam., densely and minutely furfuraceous lepidote; *reproductive shoots* unknown. *Vegetative shoot leaf blades* coriaceous, oblanceolate, (25–)31–45.5 cm long, (5–)7–12.2 cm wide, apically long-attenuate, the acumen 1.8–3.5 cm long, gradually tapering to a cuneate base, decurrent to petiole base, midrib slightly raised above, prominently raised below, secondary veins 16–20 pairs, slightly depressed or not visible above, prominently raised below, glabrescent, the margin regular, entire, flat; petioles marginate (0.6–)1–1.2 cm long, glabrous above, densely and minutely furfuraceous lepidote below; *reproductive shoot leaves* unknown. *Inflorescence* subterminal, pinnately or bipinnately paniculate, (7.5–) 12.5–24.5 cm long, pyramidal, secondary branches 3–12 cm long, the rachis minutely densely furfuraceous lepidote, glabrescent, terminating in 7–12-flowered corymbs; inflorescence bracts unknown (presumably early caducous); floral bracts early caducous, membranaceous, ovate to oblong, 2.3–2.5 mm long, 1.2–1.4 mm wide, apically acute to rounded, sessile bases, midrib slightly raised above and below, secondary veins not visible, prominently punctate, scattered and minutely furfuraceous lepidote, the margins erose,

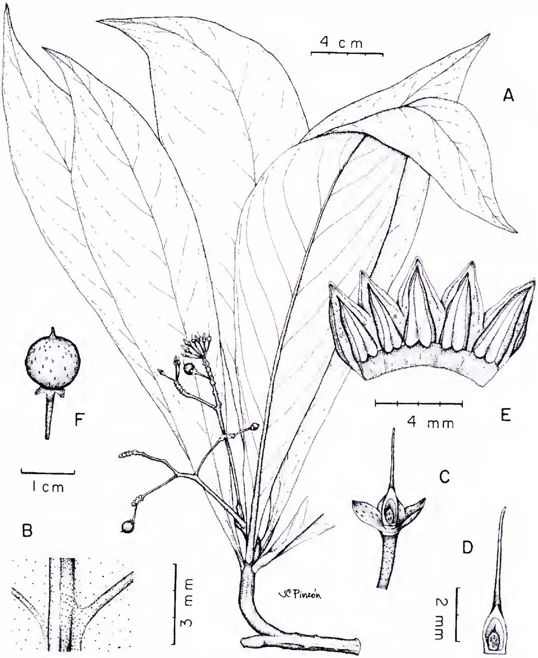

Fig. 8. *Hymenandra callejasii* (Pipoly) Pipoly & Ricketson. A. Reproductive shoot. B. Detail of abaxial leaf surface. C. Longisection of pistil and calyx, showing ovate calyx lobes, elongate style, and punctiform stigma. D. Longisection of pistil, showing apiculate placenta with pluriseriate ovules. E. Detail of flower, showing corolla lobes and stamens. F. Fruit. A–F drawn from holotype, *R. Fonnegra G. & E. Renteria A 953*. Original drawing from Pipoly (1992).

hyaline, entire, flat; pedicels cylindrical, 0.7–1.8 cm long, densely furfuraceous lepidote, persistent. *Flowers* 5-merous, pink; calyx lobes almost free, chartaceous, ovate, 2–2.8 mm long, 1–1.3 mm wide, symmetrical, apically obtuse, prominently punctate medially, densely and minutely furfuraceous lepidote, the margin irregular, erose, hyaline, sparsely glandular-cilioate; corolla lobes basally connivent, coriaceous, ovate, 5.3–5.9 mm long, apically acute, highly reflexed in anthesis, medially thickened, prominently pellucid punctate without, somewhat so medially within, the margin hyaline, entire, glabrous; stamens 4.9–5.4 mm long; filaments connate into a coriaceous elobate tube 1.2–1.3 mm long, epunctate, glabrous; anthers free, lanceolate, 3.5–4.2 mm long, 1.3–1.6 mm wide, sessile on the staminal tube, apically attenuate, basally cordate, longitudinally dehiscent by narrow, sublatrose slits, the connective inconspicuously pellucid punctate; pistil ellipsoid; ovary 1.5–1.7 mm long, glabrous; style 3.8–4 mm long, erect, inconspicuously pellucid punctate, glabrous; stigma punctiform; placenta ellipsoid, 0.8–1 mm long, 0.3–0.4 mm in diam., apically apiculate; ovules 12–15, pluriseriate. *Fruit* globose, 8–10 mm in diam., densely and prominently black punctate, the style base persistent.

Distribution.—Endemic to the Colombian Chocó Floristic Province, in the Municipio de Mutatá, Department of Antioquia, from 80–180 m elevation.

Ecology and conservation status.–This species is locally common on one farm, in lowland pluvial forest, but has not been found elsewhere. Therefore it should be considered threatened. The lowland pluvial forests of the Colombian Chocó are some of the wettest in the tropics, receiving annual precipitation well in excess of 8,000 mm per year.

Etymology.—The species was named in honor of Ricardo Callejas Posada, head of the graduate program in biology at the Universidad de Antioquia, Medellín, Colombia. Ricardo is the pre-eminent authority on the phylogeny and systematics of the Piperaceae on a worldwide basis.

Specimens examined. **COLOMBIA. Antioquia:** Corregimiento Longani, del Río Longani, 2 kms. N de Mutatá, 7° 20' N, 76° 30' O, 80–100 m, 19 Nov 1987 (fl), *R. Callejas et al. 5683* (NY); Municipio Mutatá, margin of Río León (Bucabá), Villa Arteaga, Las Caucheras, hill above water tap, 100–180 m, 2 Oct 1961 (bud), *J. Cuatrecasas 26156* (US); Hacienda El Darién, right bank of Río Chontadural, 20 Jun 1979 (fr), *R. Fonnegra et al. 1228* (COL, HUA, MO), (fl) *1249* (COL, HUA, MO), 13 Sep 1979 (fr), *R. Fonnegra et al. 1343* (COL, HUA, MO).

Hymenandra callejasii is rather isolated within the genus; its inflorescence is rather unusual, as is the fact that no leaves have been seen on reproductive shoots. Further field study will be necessary to document the entire life history of *Hymenandra callejasii*.

8. **Hymenandra acutissima** (Cuatrec.) Pipoly & Ricketson, comb. nov. (**Figs. 1G, 9**). *Parathesis acutissima* Cuatrec., Revista Acad. Colomb. Ci. Exact 8:324. 1951. *Ardisia acutissima* (Cuatrec.) Lundell, Wrightia 4:53. 1968. Type. COLOMBIA. Valle [de Cauca]: Costa del Pacifico, Río Cajambre, Barco, 5–80 m, 28 Abr 1944 (fr), *J. Cuatrecasas 17219* (holotype: F; isotypes: LL, US).

Tree 2–6 m tall. *Vegetative shoots* terete, 7.5–9.5 mm in diam., sparsely and minutely furfuraceous lepidote, glabrescent; *reproductive shoots* as in the vegetative ones but 2.5–3.5 mm in diam. *Vegetative shoot leaf blades* coriaceous, ovate to lanceolate, 15.4–27.2 cm long, 9.3–10 cm wide, apically acute to long-attenuate, the acumen when present 0.5–1.5 cm long, basally acute to cuneate, midrib slightly depressed above, prominently raised below, secondary veins 18–36 pairs, slightly depressed or not visible above, raised below, glabrous throughout, the margin entire, flat; canaliculate, 2.1–2.3 cm long, minutely appressed furfuraceous lepidote, glabrescent; *reproductive shoot leaf blades* as in the vegetative ones except 15.5–17.8 cm long, 5.6–6.8 cm wide, the secondary veins 18–32; petioles as in the vegetative ones but 2.1–2.5 cm long. *Inflorescence* terminal, pinnately or bipinnately paniculate, 9–16.5 cm long, obpyramidal, secondary branches 5–5.5 cm long, rachis glabrous throughout, terminating in 6–12-flowered corymbs; inflorescence and floral bracts unknown (presumably early caducous); pedicels cylindrical, 0.9–1 cm long, glabrous, persistent. *Flowers* 5-merous; calyx lobes almost free, chartaceous, oblate, 1–1.1 mm long, 1.4–1.6 mm wide, symmetrical, apically obtuse, prominently black punctate medially, glabrous, the margin irregular, erose-fimbriate along entire length, hyaline, sparsely glandular-ciliolate; corolla, stamens and pistil unknown. *Fruit* globose, 8–12 mm in diam., densely and prominently black punctate, the style base persistent.

Distribution.—From the central Chocó Floristic Province of Colombia, from 5–80 m elevation.

Ecology and conservation status.—This species occurs in coastal forests along rivers, an area frequently colonized by squatters. Therefore, the species should be considered threatened.

Etymology.—The epithet is the superlative form of the Latin word, "*acutus,*" referring to the apically acute to long-attenuate leaf apices.

Specimens examined. COLOMBIA. Chocó: Río San Juan Basin, Río Bicordó, above Noanamá; river margin; 04° 42' N, 76° 55' W, without elev., 6 Apr 1979 (fr), *E. Forero et al. 4713* (COL, MO).

Hymenandra acutissima is most closely related to the vicariant *H. crosbyi*, but easily recognized because of its much longer sepals, terminal inflorescence and much larger fruit.

9. **Hymenandra crosbyi** (Lundell) Pipoly & Ricketson, comb. nov. **(Figs. 1F, 10).** *Ardisia crosbyi* Lundell, Wrightia 6:73. 1979. *Icacorea crosbyi* (Lundell) Lundell, Phytologia 49:348. 1981. Type. PANAMA. Colón: On trail at end of Santa Rita Ridge Road, 18–30 km from Boyd–Roosevelt Highway, 600–800 m, 30 May 1975 (fr), *S. Mori & M. Crosby 6423* (holotype: LL (F Neg. # 55657); isotype: MO (LL Neg. # 1979-1)).

Ardisia calvarioana Lundell, Wrightia 6:66. 1979, syn nov. *Icacorea calvarioana* (Lundell) Lundell, Phytologia 49:347. 1981. Type. PANAMA. Coclé: Around Rivera Sawmill

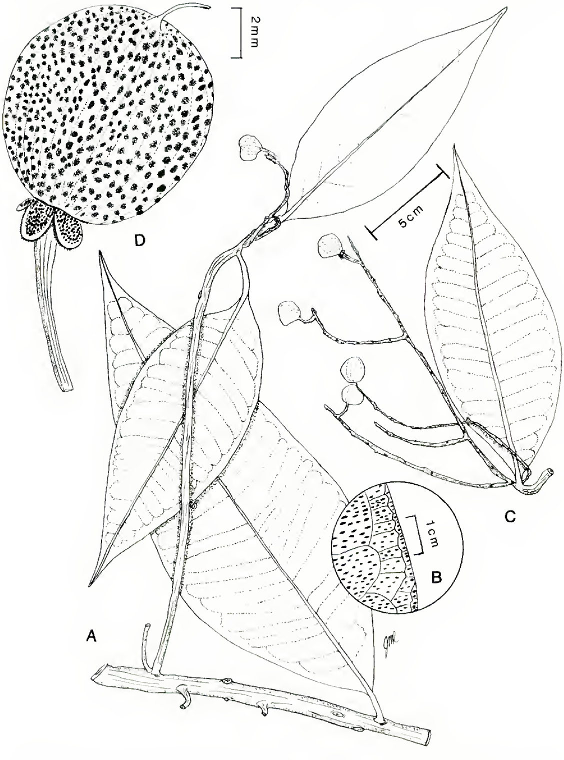

FIG. 9. *Hymenandra acutissima* (Cuatrec.) Pipoly & Ricketson. A. Reproductive shoot. B. Detail of abaxial leaf surface. C. Inflorescence. D. Fruit. A–B & D drawn from holotype, *J. Cuatrecasas 17219*. C drawn from isotype, *J. Cuatrecasas 17219*.

near to Alto Calvario, 7 km N El Cope, New Works, trout stream, 700–850 m, 20 Oct 1977 (fr), *J. Folsom & R. Page 5970* (HOLOTYPE: MO; ISOTYPE: LL).

Tree 1–3 m, 1–3 cm in diam. *Vegetative shoots* terete, 3–5 mm in diam., densely and minutely furfuraceous lepidote when young, glabrescent; *reproductive shoots* as in the vegetative ones but 1.5–3 mm in diam. *Vegetative shoot leaf blades* chartaceous, ovate or lanceolate to elliptic, 11.5–22 cm long, 3.2–7.6 cm wide, apically long-attenuate, the acumen 1.2–2.4 cm long, basally obtuse to rounded, only slightly decurrent, midrib slightly raised above, prominently raised below, secondary veins 12-30 pairs, slightly depressed above, or not visible above, prominently raised below, prominently pellucid to black punctate above and below, glabrous above, scattered and minutely furfuraceous lepidote below, the margin entire, flat; petioles marginate, 1.7–5.4 cm long, glabrous above, scattered and minutely furfuraceous lepidote below; *reproductive shoot leaf blades* as in the vegeative ones except 5.5–15.7 cm long, 1.7–5.2 cm wide, secondary veins 10–26 pairs; petioles like the vegetative ones except 1.6–3.9 cm long. *Inflorescence* subterminal, pinnately or bipinnately paniculate, 2.7–8.8 cm long, obpyramidal, secondary branches 1.3–3.5 cm long, rachis sparsely and minutely furfuraceous lepidote, early glabrescent, terminating in 4–6-flowered corymbs; inflorescence bracts membranaceous, lanceolate to elliptic, 1.4–2.4 mm long, 0.4–0.7 mm wide, apically acute, pellucid to black punctate medially, scattered and minutely furfuraceous lepidote below, the margin entire; floral bracts like the inflorescence bracts but 0.8–2.1 mm long, 0.4–0.8 mm wide; pedicels cylindrical, 0.8–12.2 cm long, scattered and minutely furfuraceous lepidote, glabrescent, persistent. *Flowers* 5(–6)-merous; calyx lobes (in fruit) almost free, chartaceous, ovate, 0.9–1.6 mm long, 0.9–1.2 mm wide, symmetrical, apically acute, conspicuously pellucid to black punctate, scattered and minutely furfuraceous lepidote, glabrescent, the margin irregular, erose, hyline, glandular-cilioate; corolla 3.5–3.7 mm long, membranaceous, lanceolate, the tube 0.3–0.5 mm long, the lobes (in young bud) basally connate, 3.1–3.3 mm long, 1.2–1.4 mm wide at base, apically acute, prominently pellucid punctate, somewhat so medially within, the margins erose, hyaline, glabrous; stamens (in young bud) 2.6–2.7 mm long; filaments connate into a membranaceous elobate tube, the tube 0.3–0.5 mm long, adnate to the corolla basally, epunctate, glabrous; anthers connate by their sutures, at least at first, lanceolate, 2.2–2.5 mm long, 0.4–0.6 mm wide at base, sessile on staminal tube, apically apiculate, basally cordate, longitudinally dehiscent by narrow, sublatrose slits, the connective prominently pellucid punctate; pistil 3–3.2 mm long; ovary 0.7–0.9 mm long, glabrous; style 2.1–2.5 mm long, erect, inconspicuously pellucid punctate, glabrous; stigma punctiform; ovules 22–24, pluriseriate. *Fruit* globose, 4.5–6.5 mm in diam., prominently raised pellucid to black punctate, glabrous, the style base persistent.

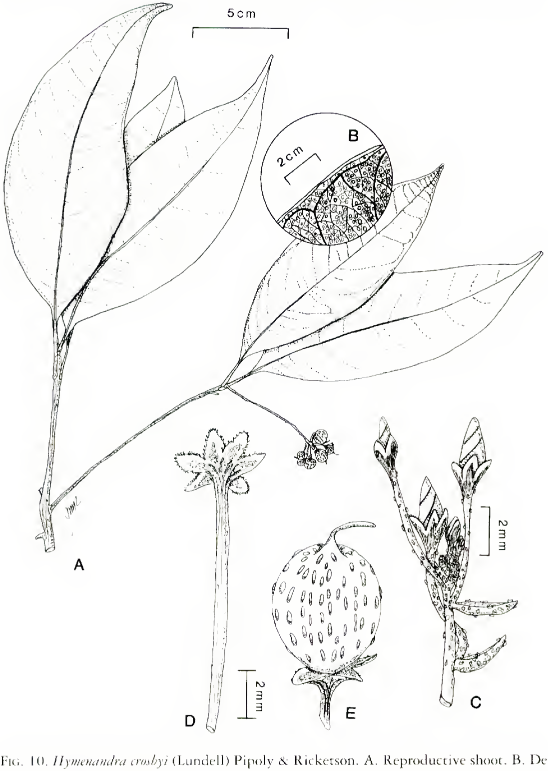

FIG. 10. *Hymenandra crosbyi* (Lundell) Pipoly & Ricketson. A. Reproductive shoot. B. Detail of abaxial leaf surface. C. Detail of inflorescence. D. Detail of calyx and pedicel. E. Fruit. A–B & D drawn from the holotype, *S. Mori & M. Crosby 6423*. C drawn from *G. de Nevers 6757*. E drawn from *K. Sytsma et al. 4279*.

Distribution.—Restricted to the Caribbean slope, in the provinces of Coclé, Colón and San Blas, Panama, from 100–850 m elevation.

Ecology and conservation status.—*Hymenandra crosbyi* occurs at the natural ecotone of premontane and cloud forest. Its conservation status cannot be determined owing to a lack of populational data.

Etymology.—The species is named for Dr. Marshall Crosby of the Missouri Botanical Garden, who collected the type specimen.

Specimens examined. **PANAMA. Coclé:** Coclecito Road, elevational transection from 1 mile beyond the divide to the ridge top, 08° 42' N, 80° 28' W, 300–500 m, 12 Jan 1986 (fr), *G. de Nevers et al. 6757* (LL, MO). **Colón:** Upper Río Piedras headwaters, along trail from end of Santa Rita Ridge Road, ca. 11 km SW of Cerro Braja, 09° 25' N, 79° 35' W, 600–700 m, 2 May 1981 (fr), *K. Sytsma et al. 4220* (LL, MO); Ridge between Río Piedras and Río Garun waterbeds, along trail from end of Santa Rita Ridge road, ca. 5–8 km SW of Cerro Bruja, 09° 27' N, 79° 36' W, 700–800 m, 2 May 1981 (fr), *K. Sytsma et al. 4279* (LL, MO). **San Blas:** El Llano-Carti Road, 17.4 km from Interamerican Hwy., 09° 19' N, 78° 55' W, 350 m, 27 Sep 1984 (fr), *G. de Nevers et al. 3941* (MO); Trail along Continental Divide, 5–10 km W of El Llano-Carti Road, 350 m, 10 Jan 1985 (fr), *G. de Nevers & H. Herrera 4490* (MO); Río Nergala, 9° 22' N, 79° 07' W, 100–300 m, 12 Jan 1985 (fl), *G. de Nevers & H. Herrera 4531* (MO).

Hymenandra crosbyi is most closely related to the vicariant *H. acutissima*, but may be recognized by the shorter and obtuse sepals, the subterminal inflorescence, shorter secondary branches, and smaller fruit.

ACKNOWLEDGMENTS

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REFERENCES

CANDOLLE, A. DE 1834. A review of the natural order Myrsineae. Trans. Linn. Soc. London 17:95–138.

———. 1841. Deuxieme memoire sur les Myrsinacees. Ann. Sci. Nat., Bot., ser. 2, 16:65–97.

C. CHEN, C. AND J. PIPOLY. 1996. Myrsinaceae. In: Wu Zheng-yi and P. Raven, eds. Fl. China 15:34–38. Science Press, Beijing and Missouri Botanical Garden, St. Louis, MO. USA.

CONRAN, J. 1995. Family distributions in the Liliiflorae and their biogeographical implications. J. Biogeography 22:1023–1034.

DOBSON, J. 1996. A paleogeographic link between Australia and eastern North America: a New England connection? J. Biogeog. 23:609–617.

FURTADO, C.X. 1958. Some new or noteworthy species of Malaysia. Gard. Bull. Sing. 17:279–311.

GENTRY, A. 1983. *Alstonia* (Apocynaceae): Another paleotropical genus in Central America. Ann. Missouri Bot. Gard. 70: 206–207.

HALLÉ, F., R.A. OLDEMAN & P. B. TOMLINSON. 1978. Tropical trees and forests. An architectural analysis. Springer-Verlag. New York.

HICKEY, L. 1984. A revised classification of the architecture of dicotyledonous leaves. Pp. 25–39. In: C.R. Metcalfe & L. Chalk (editors). Anatomy of the Dictyledons. Vol. 1. Syshooratic anatomy of leaf and shoot, with a brief history of the subject. Clarendon Press. Oxford, U.K.

LAVIN, M. & M. LUCKOW. 1993. Origins and relationships of tropical North America in the context of the Boreotropics Hypothesis. Amer. J. Bot. 80:1–14.

LINDLEY, J. 1848. Illustrated dictionary of botanical terms. Excerpt from illustrated dictionary of botanical terms by John Lindley. {Reprint, With an Introduction by Alice Eastwood, Stanford University, School of Earth Sciences, 1964}.

LUNDELL, C.L. 1966. Myrsinaceae. In: P.C. Standley & L.O. Williams, eds. Flora of Guatemala, Part VIII Number 1. Fieldiana, Bot. 24 (8/2):135–200.

———. 1971. Flora of Panama, Part VIII. Family 150. Myrsinaceae. Ann. Missouri Bot. Gard. 58:285–353.

———. 1981. Neotropical Myrsinaceae–VI. Phytologia 49:341–354.

———. 1982. Neotropical Myrsinaceae–VII. Wrightia 7:38–50.

METCALFE, C.R. 1984. Some basic types of cells and tissues. Pp. 54–62. In: C.R. Metcalfe and L. Chalk, eds. Anatomy of the Dictyledons. Vol. 1. Syshooratic anatomy of leaf and shoot, with a brief history of the subject. Clarendon Press. Oxford, U.K.

MEZ, C. 1902. Myrsinaceae. In: A. Engler, ed. Das Pflanzenreich IV. 236(Heft 9):1–437.

NAYAR, M.P. & G.S. GIRI. 1975 [1976]. A synopsis of the genus *Hymenandra* A. DC. (Myrsinaceae) and a new species from Burma. J. Bom. Nat. Hist. Soc. 72:818–821.

PIPOLY, J. 1987. A systematic revision of the genus *Cybianthus* subgenus *Grammadenia* (Myrsinaceae). Mem. New York Bot. Gard. 43:1–76.

———. 1992a. The genus *Cybianthus* subgenus *Conomorpha* (Myrsinaceae) in Guayana. Ann. Missouri Bot. Gard. 79:908–957.

———. 1992b. *Ardisia callejasii* (Myrsinaceae): A new species from the Antioquian Chocó of Colombia. Novon 2:389–391.

PIPOLY, J. AND J. RICKETSON. 1998. A revision of the genus *Ardisia* subgenus *Graphardisia* (Myrsinaceae). Sida 18:433–472

RICKETSON, J. AND J. PIPOLY 1997. A. synopsis of the genus *Gentlea* (Myrsinaceae) and a key to the genera of Myrsinaceae in Mesoamericana. Sida 17:697–707.

STAHL, B. 1996. The relationships of *Heberdenia bahamensis* and *H. penduliflora* (Myrsinaceae). Bot. J. Linn. Soc 122:315–333

STANDLEY, P.C. 1938. Flora of Costa Rica: Myrsinaceae. Publ. Field Mus. Nat. Hist., Bot. Ser. 18:884–900.

STONE, B.C. 1991 [1992]. New and noteworthy Malesian Myrsinaceae, VI. Revision of the genus *Hymenandra* A. DC. Gard. Bull. Sing. 43:1–17.

TIFFNEY, B. 1985a. Perspectives on the origin of the floristic similarity between eastern Asia and eastern North America. J. Arn. Arb. 66:73–94.

______________. 1985b. The Eocene North Atlantic land bridge: its importance in Tertiary and modern phytogeography of the northern hemisphere. J. Arn. Arb. 66:243–273.

THEOBALD, W.L., J. KRAHULIK & R.C. ROLLINS. 1984. Trichome description and classification. Pp. 40–53. In: C.R. Metcalfe & L. Chalk, eds. Anatomy of the Dictyledons. Vol. 1. Syshootatic anatomy of leaf and shoot, with a brief history of the subject. Clarendon Press. Oxford, U.K.

WENDT, T. 1988. *Chiangiodendron* (Flacourtiaceae: Pangieae), a new genus from southeastern Mexico representing a new tribe for the New World flora. Syst. Bot. 13:435–441.

______________. 1989. Las selvas de Uxpanapa, Veracruz-Oaxaca, Mexico: Evidencia de refugios florísticos cenozoicos. Anal. Inst. Biol. UNAM, Ser. Bot. 58:29–54.

______________. 1993. Composition, floristic affinities and origins of the canopy tree flora of the Mexican Atlantic slope rain forests. Pp.595–680. In: T. Ramawoorthy, R. Bye, A. Lot and J. Fa, eds. Biological Diversity of Mexico: Origins and Diversity. Oxford University Press, NY.

WOLFE, J. 1975. Some aspects of plant geography of the northern hemisphere during the late Cretaceous and Tertiary. Ann. Missouri Bot. Gard. 74:264–279.

ZONA, S. 1990. A monograph of *Sabal* (Arecaceae: Coryphoideae). Aliso 12:583–666.

NUMERICAL LIST OF *HYMENANDRA* TAXA

1. *H. stenophylla* (Donn. Sm.) Pipoly & Ricketson
2. *H. calycosa* (Hemsl.) Pipoly & Ricketson
3. *H. sordida* (Lundell) Pipoly & Ricketson
4. *H. squamata* (Lundell) Pipoly & Ricketson
5. *H. wilburiana* (Lundell) Pipoly & Ricketson
6. *H. pitt*ieri (Mez) Pipoly & Ricketson
7. *H. callejasii* (Pipoly) Pipoly & Ricketson
8. *H. acutissima* (Cuatrec.) Pipoly & Ricketson
9. *H. crosbyi* (Lundell) Pipoly & Ricketson

LIST OF EXSICCATAE

Figures in parentheses refer to the numbers from the numerical list of taxa. Collection numbers in **boldface** type indicate type specimens.

Aguilar, R., et al., 3663 (6); Alfaro, E., 169 (2); Allen, P., **2056** (6); 2176 (6); 3806 (6); 5828 (6); 5828A (6); 6726 (6); Angulo, L., 394 (6); Antonio, T., 1364 (6); 3627 (6); 3632 (6); Argüello M., D. et al., 11 (6).

Baker, R. & W. Burger, 126 (6); Bello C., E., 1059 (3); Brenes, A., 15655 (2); 21243 (2); Burger, W. & R. Baker, 9869 (2); Burger, W. & G. Matta U., 1106 (6); 1644 (6); Burger, W. & R. Stolze, 3738 (6); **5853** (4); Burger, W. et al., 11687 (2).

Callejas, R. et al., 5683 (7); Carvajal U., A., 392 (2); Chacón, A., 934 (6); Chacón, I., 80 (5); 717 (5); Chacón, I. & G. Herrera, 1758 (6); Chávez, C., 71 (3); Chinchilla, M., 93 (2); 100 (2); Churchill, H., 3867 (6); 3876 (6); Cooper, G., 12 (1); 370 (1); Croat, T., 36246 (2); 36703 (6); **43538** (3); **44581** (6); Cuatrecasas, J., **17219** (8); 26156 (7).

D'Arcy, W. & J. D'Arcy, 6749 (6); D'Arcy, W. & B. Hammel, 12292 (6); Davidse, G. & C. Hamilton, 23484 (6); Davidse, G. & G. Herrera, 31379 (5); Dressler, R., 4254 (6); 5962 (6); Dressler, R. & W. Lewis, 3725 (6); Duke, J., 12197 (6); Dwyer, J., 8351 (6); 8551 (6); 11869 (6); Dwyer, J. & B. Lallathin, 8690 (6); 8690A (6); Dwyer, J. et al.,4476 (6).

Folsom, J., 1242 (6); 3163 (6); Folsom, J. & R. Page, 5970 (9); Folsom, J. et al., 5741 (6); Fonnegra et al., 953 (7); 1228 (7); 1249 (7); 1343 (7).

García, D., 112 (2); 312 (2); Garwood, N. et al., 936 (5); Gentry, A., 2011 (2); 6854 (6); 6872 (6); Gentry, A. et al., 43939 (2); Gómez, L. et al., 20415 (1); 23383 (4); Gómez-Laurito, J., 9538 (1); Grayum, M., 2371 (4); Grayum, M. & R. Chazdon, 6853 (4); Grayum, M. & G. Herrera, 4852 (2); 7857 (4); 9200 (6); Grayum, M. & B. Jacobs, 5352 (5); Grayum, M. et al., 3369 (6); 4486 (1); 4969 (2); Grijalva, A. & D. Bradford, 3652 (2); Grijalva, A. et al., 3393 (2).

Haber, W. & E. Bello C., 1714 (3); 7433 (2); Haber, W. et al., 4430 (2); 4432 (2); 4447 (2); 4752 (2); 4759 (2); 4848 (2); Hammel, B., 958 (6); 1928 (6); 2662 (6); 3220 (6); 3898 (6); 4054 (6); 8693 (4); 8762 (4); 10962 (4); 2372 (4); 13717 (1); Hammel, B. & M. Chavarría, 17073 (4); Hammel, B. & M. Grayum 14342 (1); Hammel, B. & J. Trainer, 12757 (4); 13262 (5); Hammel, B. et al., 14078 (3); 15186 (6); 17370 (2); 17829 (5); Herrera, G., 6279 (3); Herrera, H. & P. Perez, 98 (6).

Jacobs, B., 2377 (4); 2917 (5); 3113 (4); 3189 (5); Jiménez, A., 3738 (6); Jiménez, Q. et al., 709 (2).

Khan et al., F. 1141 (2); Knapp, S., 1965 (6).

Lallathin, B., 35A (6); Liesner, R., 5066 (2); Liesner, R. et al., 15041 (2); 15108 (3); 15348 (6); Lobo, M., 47 (2); Loiselle, B., 144 (4); Luteyn, J. & H. Kennedy, 1704 (6).

Marín, J. et al., 257 (6); McAlpin, B., 2250 (6); McPherson, G., 11270 (6); Molina R., A. et al., 17525 (3); 18090 (6); Moraga, C., 214 (2); Morales, J., 4354 (6); 5305 (2); Morales, J. & Y. Salazar, 1195 (6); Morales, J. & V. Ureña 2852 (6); Morales, J. et al., 2544 (2); Moreno, A., 7 (1); Moreno, P., 7532 (2); (2); 26053 (2); 26753 (2); Moreno, P. & J. Sandino, 12853 (2); Mori, S. & M. Crosby, 6313 (6); 6423 (9); Mori, S. & J. Kallunki, 2978 (6).

Nee, M. & B. Hansen, 14099 (1); Neill, D. & P. Vincelli, 3506 (5); Nevers, G. de, 7203 (6); Nevers, G. de & H. Herrera, 4490 (9); 4531 (9); Nevers, G. de et al., 3941 (9); 6398 (6); 6757 (9).

Opler, P., 188 (4); 332 (4); 580 (2).

Paredes, R., 944 (6); Picado, A. et al., 51 (2); Pittier, H. & A. Tonduz, 9173 (1); Poredat, L. et al., 3681 (2); Porter, D. et al., 4422 (6); 4597 (6); Poveda, L., 106 (6).

Quesada, F., 320 (6).

Ramírez, V. et al., 62 (3); Raven, P., 21829 (6); Ríos, P. 374 (3); Robles, R., 1571 (5); 1666 (5); Rodríguez, A. & N. Zamora, 2067 (2).

Sánchez, J. et al., 308 (5); Sandino, J., 159 (2); Schatz, G. & M. Grayum, 653 (5); 1303 (4); Schubert, B., 1079 (2); Seibert, R., 1572 (1); Smith, A., 1630 (2); Sperry, J. 790 (4); 1726 (2); 2609 (2); Standley, P. & J. Valerio 44588 (2); 45539 (2); 45545 (2); 45862 (2); 46181 (2); 46221 (2); 47122 (6); Stevens, W., 23977 (5); Stevens, W. & O. Montiel, 24132 (5); Stevens, W. et al., 24972 (5); Sullivan, G., 553 (6); Sytsma, K. & W. D'Arcy, 3565 (6); Sytsma, K. et al., 2453 (6); 4220 (9); 4279 (9).

Tate, R., 239 [454] (2); Taylor, C., 4551 (2); Todzia, C., 1302 (4); Taylor, C. & C. Skotak 4630 (3); Tonduz, A., 9586 (1); 13369 (6).

Utley, J. & K., 5318 (2)

Valerio, J., 147 (2); Villalobos, R., 37 (2).

Wilbur, R., 39948 (4); 40442 (4); 64246 (4); Wilbur, R. & B. Jacobs 34720 (4); 34727 (4); Wilbur, R. & D. Stone, 9745 (3).

Zamora, N. & Q. Jiménez, 1268 (6).

MYRSINE LUAE (MYRSINACEAE), A NEW SPECIES FROM BRAZIL

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ABSTRACT

A review of herbarium specimens of *Myrsine* for the *Flora of the Venezuelan Guayana* project revealed the presence of a distinctive new taxon from the Serra de Lua in the adjacent Territorio do Roraima, Brazil. *Myrsine luae* is described and illustrated, and its relationship to its nearest congener, *Myrsine guianensis* is discussed. An outline map showing the type locality is provided.

RESUMEN

Al estudiar pliegos del herbario pertenecientes al género *Myrsine* de la guayana venezolana, se encontró una especie nueva para la ciencia proveniente de la Serra de Lua, del Territorio do Roraima, Brazil; la zona brasileña adyacente a la guayana venezolana. Se describe, se ilustre y se discute el parentezco de la nueva especie, *Myrsine luae*. También incluye un mapa mostrando la localidad tipa.

INTRODUCTION

The genus *Myrsine* R. Br. contains ca. 300 species of which nearly 1/4 remain undescribed. C. Chen and Pipoly (1996), Pipoly (1991, 1992a, 1992b, 1996), Pipoly and C. Chen (1995), and Ricketson and Pipoly (1997) have provided summaries of evidence for broader circumscription of the genus, especially to include *Rapanea* Aubl. *Myrsine* is pantropically distributed, occurring in diverse vegetation types, from mangroves to subalpine scrub, but always in moist, wet or pluvial habitats. The genus is defined by lateral (axillary), fasiculate or umbellate inflorescences, sessile or on short, perennating peduncles girdled by persistent floral bracts, thus forming "short shoots." In preparation for our treatment of the genus *Myrsine* for *Flora of the Venezuelian Guyana*, a new species from just out side the region in the state of Roraima in Brazil was discovered and is described herewith.

Myrsine luae Ricketson & Pipoly, sp. nov. (**Fig. 1**). TYPE. BRAZIL. RORAIMA: Summit of Serra da Lua, 02° 25–29' N, 60° 11–14' W, 1,400 m, 24 Jan 1969 (fr), *G. Prance, J. Steward, J. Ramos & L. Farias 9416* (HOLOTYPE: NY; ISOTYPES: BRIT, INPA n.v.).

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FIG. 1. Distribution of *Myrsine luae* Ricketson & Pipoly.

Quoad ramulos glabros, lamina coriacea nitidaque, petiolos marginatos, inflorescentiam 5–8-floribus, M. guianensi valde arcte affinis sed ab ea ramulis angulatis (non teretibus), necnon pedicelis angulatis (nec teretibus), periantiis coriaceis (non chartaceis), stigmatibus sinuato-capitatus (non conicis), denique fructibus ellipsoideis vel obovodeis (non globosis), praeclare distat.

Tree 4 m tall, 10 cm DBH. *Branchlets* ridged, 0.5 cm in diameter, glabrous apically. *Leaves* alternate; blades coriaceous, elliptic to oblanceolate, 4–9.5 cm long, 1.6–3.5 cm wide, apically acute, basally acute, decurrent on petiole, smooth, shiny and nited above, dull and inconspicuously black punctate below, the midrib slightly impressed above, prominently elevated below, the secondary nerves not prominent, 13–15 pairs, the margins entire, flat to subrevolute, opaque, minutely glandular-ciliolate in bud, glabrous at maturity; petioles marginate, 0.5–1 cm long, glabrous. *Staminate inflorescence* unknown. *Pistillate inflorescence* a subsessile, 5–8-flowered umbel; peduncle obsolete to 3 mm long; floral bracts, deltate, 1–1.2 mm long, 1–1.2 mm wide, apically acute, early caducous, glabrous, the margins ciliolate; pedicels angulate, 2–3 mm long, glabrous. *Staminate flowers* 5-merous; calyx coriaceous, cotyliform, 1–1.5 mm long, the tube 0.3–0.5 mm long, the lobes ovate, 1–1.2 mm long, 0.8–1 mm wide, apically acute, conspicuously punctate and punctate-lineate, glabrous, the margins entire, glandular-ciliolate; corolla chartaceous, subrotate, 1.8–2.1 mm long, the tube 0.5–0.6 mm long, the lobes lanceolate, 1.3–1.5 mm long, 0.7–0.9 mm wide, apically acute, densely and prominently punctate and punctate-lineate, glabrous, the margins

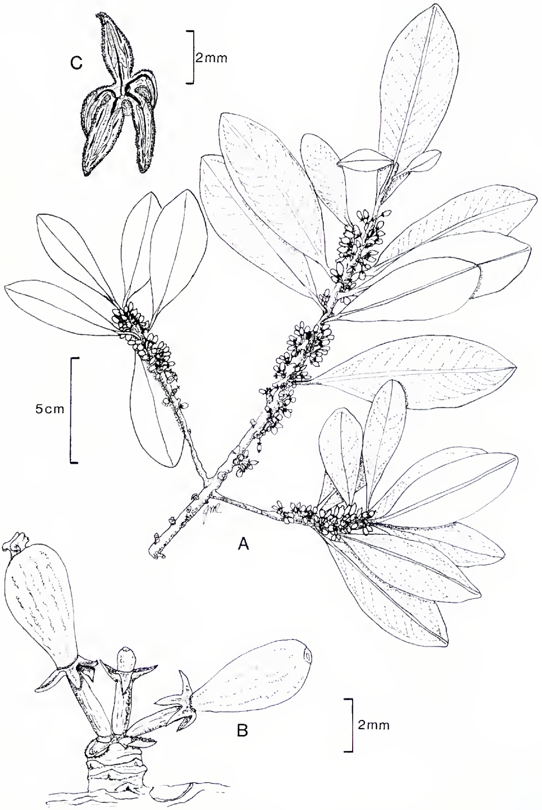

Fig. 2. *Myrsine luae* Ricketson & Pipoly. A. Branchlet. B. Infructescence, showing obovoid fruit shape. C. Pistillate corolla, showing hastate antherode and marginal glandular granules. A-C, drawn from holotype.

entire, minutely glandular-ciliolate; staminodes inserted at junction of corolla tube and lobe, the sterile anthers subsessile, oblong, 0.9–1 mm long, 0.1–0.2 mm wide at apex, 0.4–0.5 mm wide at base, apically apiculate, the apiculum proximally curved, basally deeply cordate, the connective epunctate; pistil 1–1.9 mm long, the ovary globose, 1–1.2 mm long, 0.7–0.9 mm in diameter, prominently pellucid punctate and punctate-lineate, the stigma sessile, sinuate-capitate, prominently vertically lobed, 0.5–0.7 mm long, 0.5–0.8 mm wide, persistent in fruit, placenta globose, 2-ovulate. *Fruit* green, cylindrical to obovate, 3.5–4 mm long, 2.4–3 mm in diameter at the apex, 1.2–1.7 mm in diameter at the base, prominently pellucid punctate and punctate-lineate, glabrous.

Distribution.—Known only from the type on the summit of Serra da Lua, Roraima, Brazil (Fig. 2), growing at 1,400 m elevation.

Ecology and conservation status.—*Myrsine luae* inhabits cloud forests in Serra da Lua, a somewhat isolated range of mountains. No ecological notes are on the type collection, but it is from an area known for granitic mountains inhabited by vine forests, with cloud forests above.

Etymology.—Names for the location of the type locality, Serra da Lua, Territorio do Roraima, Brazil.

Myrsine luae is most closely related to *M. guianensis*, but is easily recognized by its angulate branchlets and pedicels, coriaceous calyx sessile, sinuate-capitate stigma and ellipsoid or obovoid fruit.

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REFERENCES

C. CHEN, C. and J. PIPOLY. 1996. Myrsinaceae. In: Wu Zheng-yi and P. Raven, eds. Flora of China. Science Press, Beijing and Missouri Botanical Garden, St. Louis, MO. 15:34–38.

MEZ, C. 1902. Myrsinaceae. In: A. Engler, ed. Das Pflanzenreich IV. 236(Heft 9):1–437.

PIPOLY, J. 1991. Systematic studies in the genus *Myrsine* L. (Myrsinaceae) in Guayana. Novon 1:204–210.

———. 1992a. Estudios en el género *Myrsine* (Myrsinaceae) in Colombia. Caldasia 17:3–9.

———. 1992b. Notes on the genus *Myrsine* (Myrsinaceae) in Peru. Novon 2:392–407.

———. 1996. Contributions toward a new flora of the Philippines: I. A synopsis of the genus *Myrsine* (Myrsinaceae). Sida 17:115–162.

——— and C.C. CHEN. 1995. Nomenclatural notes on the Myrsinaceae of China. Novon 5:357–361.

RICKETSON, J. AND J. PIPOLY. 1997. Nomenclatural notes and a synopsis of the genus *Myrsine* (Myrsinaceae) in Mesoamerica. Sida 17:579–589.

BOTANICAL RESULTS FROM THE 1995 BISMARCK-RAMU EXPEDITION IN PAPUA NEW GUINEA

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ABSTRACT

Botanical results are presented from the 1995 biological survey of the Bismarck-Ramu tract, an area identified by multiagency assessment as a prime site for possible conservation action. The findings provide confirmation of the area's presumed biodiversity value. Over 610 distinct morphospecies and up to 15 confirmed or suspected plant novelties were documented by an intensive 24-day expedition. Three of the new species are formally described. General descriptions of the vegetation are also provided for the major floristic environments explored by the survey team. Adoption of special management and conservation measures is recommended for the subject territory.

ABSTRACT (MELANESIAN TOK PISIN)

Wanpela wok bus painimaut bilong ol saveman bilong ol bus diwai, rop, na gras, ibin kamap long Bismak - Ramu territori long Oktoba 2 igo 24, 1995. Ol saveman bilong bus ol i kaunim olsem moa long 610 ol kain kain diwai, rop, na gras i kamap long dispela hap. Na wok painimaut i kamapim olsem fiftinpela long ol diwai na gras i nupela kain olgeta. Dispela tupela ten na foa de wok i soim dispela ples Bismak - Ramu em i holim wanpela long ol kain ples bus we Papua New Guinea mas lukautim gut. Stori long dispela pepa i tok klia long olgeta samting mipela lukim long Bismak-Ramu bus.

INTRODUCTION

Papua New Guinea (PNG) is a well known center for biological endemism and diversification. It ranks among the world's most botanically diverse countries, with a species-level floristic content variously estimated as high as 15,000–20,000 (Johns 1993), 20,000+ (Womersley 1978), and to ca. 25,000 (Mathew 1995). As one of its principal missions, the Department of Environment and Conservation (DEC) is responsible for identifying specific areas of conservation value within PNG. Based on several DEC internal evaluations and the Conservation Needs Assessment Report (Beehler 1993), a 168,000 hectare tract between Mt. Wilhelm and the Ramu River was recently selected for potential designation as a conservation unit (Figs. 1–2). This poorly-known area of interest (AOI) was suspected of sequester-

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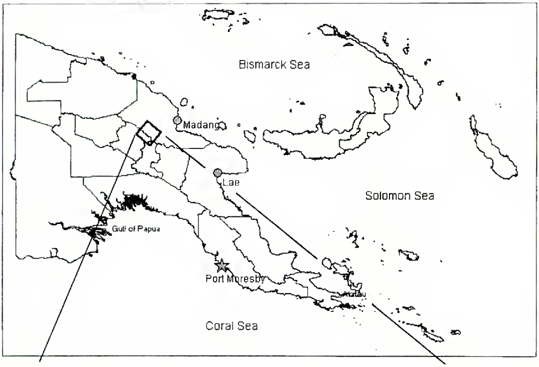

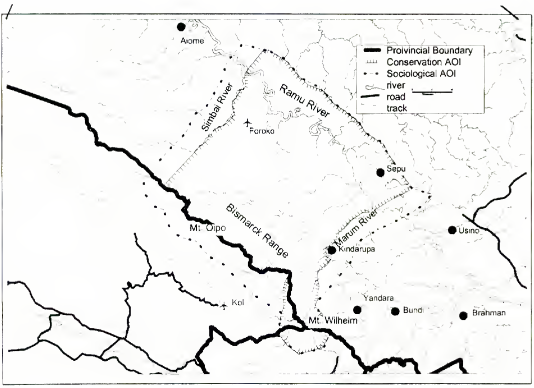

FIG. 1. Top. Papua New Guinea in aspect, showing the general location of the survey tract. FIG 2. Bottom. Exploded view of the area of interest (AOI). Figures from Hedemark et al. (1997).

ing high biodiversity, and a survey was deemed necessary to secure more information on its suitability for further development as a protected zone.

During October 2–26, 1995, a biological survey was thus conducted from 4 base camps established between 600–2400 meters elevation inside the AOI (Fig. 3). Ten scientific participants from Papua New Guinea evaluated the botany, entomology, and vertebrate zoology of the area. Survey protocols were consistent with the ICAD (Integrated Conservation and Development) model. Although a comprehensive account of the expedition was published by Hedemark et al. (1997), only a cursory description of the vegetation was included since the botanical specimens had not been examined. Recently completed determinations, an amended site by site overview of the vegetation, synopsis of notable collections, and an improved species list (Appendix 1) can now be provided. A wide range of organizational, socio-cultural, and physical site information is presented in Hedemark et al. (ibid, to which the reader is referred), and will not be repeated here.

METHODS

The botanical component of the survey consisted entirely of opportunistic general collecting, employing the 'Kostermans method' of field-packing duplicates in 70% surgical spirit for deferred processing. A complete set of the Bismarck-Ramu plant collections has been deposited at Lae National Herbarium (LAE). Principal recipients of duplicate sets are A, BRIT, K, and L; residual sheets are dispersed in no particular sequence and are likely to be at the institutions of family specialists.

In genera for which revisions are available, vouchers were keyed to species and the result confirmed against annotated sheets at LAE. For unrevised groups, exsiccatae were matched against authentically identified material and/or original descriptions. A number of specialists were also consulted; their identifications are provided with attribution on the attached species list (Appendix 1).

In the following account, taxa are referenced by the collection number on which the claim is based. The text has been expanded from Hedemark et al. (1997: 41–44) by addition of taxonomic detail resulting from the new determinations.

VEGETATION SUMMARIES

Camp 1

Location: Mt. Oipu, GPS 05° 35.5' × 144° 47.3', elevation 2360 m
Life zone: montane
Forest type: elfin or low stature mossy cloud forest
Collections sequence: 10381–10625

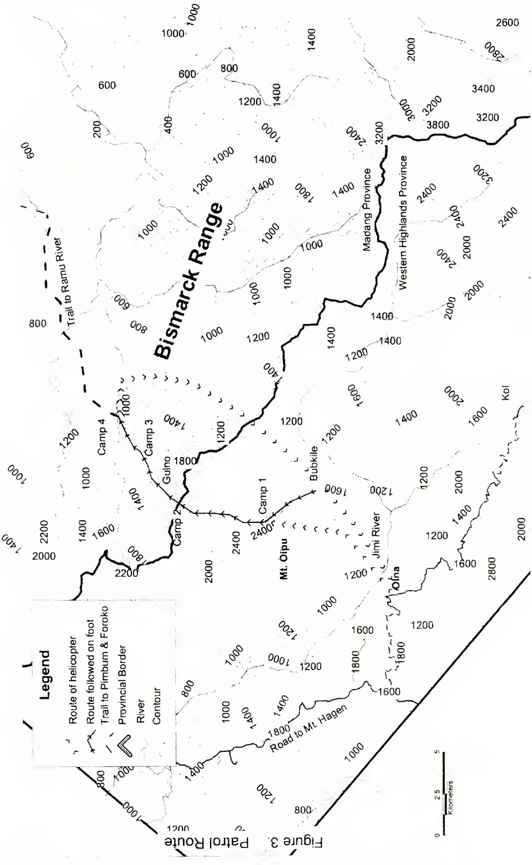

FIG 3. Trip route of the expedition. Reproduced from Hedemark et al. (1997).

At 2360 m, the expedition's highest camp was established in mossy ridgeline forest exposed to severe wind shear and constant misting. The vegetation at this site was generally stunted, taxonomically depauperate, and structurally unstratified. Stocking densities tended to be comparatively high due to the small size of most trees, with boles and crowns exhibiting the scraggly form and poor development typical of cloud stands. Due to steep slopes and everwet conditions, plant communities reflected the influence of frequent landslips and exposure of new earth. Successional montane taxa were prominent components of the vegetation on unstable terrain. A *Saurauia* complex with *S.* cf. *capitulata* (*10596*), *S. ilicifolia* (*10424*), *S.* cf. *naumannii* (*10539*), and a possible *Saurauia* sp. nov. (*10447*, *10570*), was characteristic of colonizing communities. *Trimenia papuana* (*10393*, *10402*) and the family Theaceae; including *Eurya* cf. *leptantha* (*10394*), *E. tigang* (*10421*, *10571*), and *Ternstroemia britteniana* (*10532*, *10624*), were also common in secondary growth. The regenerating facies was particularly striking and distinctive due to the towering inflorescences of *Harmsiopanax ingens* ssp. *ingens* (*10514*).

On the summit ridge beginning at ca. 2400 m, arborescent growth consisted of a stunted monolayer less than 4 m in height. The principal woody taxa were *Olearia rufa* (*10598*), *Prunus pullei* (*10608*), *Helicia microphylla* (*10609*), and *Ascarina philippinensis* (*10613*). *Acsmithia reticulata* (*10603*) was common in sheltered ravines off the crest.

On buttress ridges below the summit, the canopy layer was similarly reduced to dwarfed scrub. Phanerophytes typically included *Dillenia* cf. *schlechteri/quercifolia* (*10495*), *Elaeocarpus tariensis* (*10422*, *10591*), *Garcinia archboldiana* (*10494*), *Planchonella monticola* (*10589*), *Podocarpus* sp. (*10585*, sterile), *Schuurmansia henningsii* (represented by two distinct architectural morphs: *10515* robust arborescent, and *10409* dwarfed form), *Weinmannia* sp. (all sightings sterile), and *Xanthomyrtus montivaga* (*10602*). Two *Pandanus* species; one monocaulous and planted, the other branched and naturally regenerating (§ Intraobtutus, *10623*), were conspicuous emergents on summits and steep slopes, the latter species being otherwise scarce on level ground. The understory was occupied by various infraspecific forms of the highly variable *Symplocos cochinchinensis* (e.g., *10415*, *10566*, *10614*). *Schefflera* shrubs from the '*S. schumanniana* group' were also common, with representatives including *S. schumanniana* s. str. (*10643*, *10744*), and allied forms such as *S. aff. sparsidentata* (*10427*, *10471*). Lianes were relatively rare and inconspicuous.

Canopy statures increased progressively on the path descending towards Bubkile and lower slopes. However by elevation 2075 m, forest was replaced by grassland composed of weed and waif species characteristic of anthropogenic disturbance. *Eurya tigang* (*10571*), *Parasponia rigida* (*10567*), *Polyscias* *belensis* (*10580*), and *Rhodomyrtus novoguineensis* (*10568*), formed a seral border between forest and grassland.

From the standpoint of floristic richness, herbaceous plants collectively represented the most important elements in the summit forest. Orchids and ferns were undoubtedly the most speciose groups. The genus *Cyrtandra* had more morphospecies than any other dicot understory constituent. Urticaceae was especially varied; *Elatostema blechnoides* (*10450*, *10478*), *E. mongiense* (*10535*), *E. morobense* (*10433*), and *E. tridens* (*10475*) being particularly common. *Debregeasia* was also frequent, but the genus is unrevised and there are no available binomials for the Papuasian species.

Two new taxa were discovered on Mt. Oipu, including a *Pilea* sp. nov. (*10481*; also *10559*, *10740* from Camp 2), and *Prunus* sp. nov. (*10588*).

While the community composition was unarguably that of a well-preserved native forest, several cosmopolitan weeds have encroached along established trails on ridgelines and buttress crests. Although adventive species are often ignored in biological estimates of site value, such plants are convenient indicators of the proximity and intensity of human activity. At elevations above 2200 m, alien species were limited to *Bidens pilosa var. minor* (*10458*), *Ageratum conyzoides* (*10429*), and an unidentified subshrub (*10425*, *10431*) cultivated as a village ornamental. The introduced elements are benign herbs and not community-invasive taxa like *Piper aduncum* of disturbed lowland environments. A planted *Pandanus* (aff. *?jiulianettii*) was seen only as scattered individuals along footpaths, but is otherwise naturally-occurring in the Highlands region.

On Hammermaster and Saunder's (1995) system of vegetation classification, the Mt. Oipu communities are assigned to structural code 'L,' applied to lower montane forests (above 1000 m) having dense, small-crowned canopies. Such forests change progressively in composition and stature according ro elevation, eventually grading into the high montane formations (loc. cit.: 14). The expedition's ground survey indicates that the Mt. Oipu summit is structurally and taxonomically very close to subtype code 'Ls,' referring to very small-crowned forest where emergents (except *Pandanus*) are generally absent.

The Mt. Oipu vegetation would also be regarded as a 'lower montane rain forest' on the system of Grubb and Stevens (1985). However the apparent equivalence hides significant distinctions in the way the term is applied by the different authors. The Hammermaster and Saunders classification is derived primarily from stand-level characters determined from aerial survey, with the objective of identifying merchantable forest. Grubb and Stevens employ higher-resolution criteria applicable only by ground inspection (e.g., incidence of buttresses, woody climbers, cauliflory, drip tips, etc.) and is purely phytoecological in orientation. Irrespective of the distinctions, Mt.

Oipu is clearly a lower montane rain forest sensu Grubb and Stevens, and of the 'mixed forest' type with no single dominant component.

Camp 2

Location: Mt. Gulno, GPS 05° 32.7' × 144° 47.8', elevation 2045 m
Life zone: montane
Forest type: medium stature mossy cloud forest
Collections sequence: 10647–10768; 10626–10646 from transit between camps 1 to 2

On Mt. Gulno, the canopy was similar to that from the first site. Many taxa were present at both camps, though apparently differing in their frequencies. Because of logistical concerns, collections were generally not repeated between camps for plants thought to be conspecific.

Kania eugenioides (*10648*) was a dominant tree species around Camp 2. Other common trees included *Actinodaphne tomentosa* (*10752*), *Ascarina subsessilis* (*10760*), *Caldcluvia rufa* (*10673*), *Cryptocarya nothofagetorum* (*10652*, *10680*, *10728*), and *Sloanea brachystyla* (*10747*). The most frequent shrubs were *Acronychia ledermannii* (*10717*, *10750*), *Dysoxylum enantiophyllum* (*10751*), *Fittingia* sp. (*10661*, *10745*), *Myrsine leucantha* (*10573*, *10671*), *Pittosporum sinuata* var. *tenuivalve* (*10655*, *10689*), *Steganthera* cf. *insculpta* (*10672*), and *S. ilicifolia* (*10749*). Woody genera previously dominant on Mt. Oipu (*Weinmannia*, *Dillenia*, *Garcinia*, etc.), became less common at the second site. In general, phanerophyte taxa seemed more similarly abundant, though this was difficult to assess properly due to difficulties in making collections. Expedition climbers were rendered ineffective by rain, heavy misting, and thick bryophyte growth on tree trunks. Since the camp site was less exposed to wind, canopies generally exceeded 10 m, also making vouchers comparatively more difficult to secure.

As for camp 1, understory and epiphytic plants were very diverse, with ferns and herbs accounting for the majority of collections. Ericaceae was well-represented by *Diplycosia morobeensis* (10658), *Rhododendron anagalliflorum* s. str. (*10686*), *R. beyerinckianum* (*10685*), and *R. wrightianum* var. *insulare* (10656). The most notable find was a new species of *Bulbophyllum* (*10724*; det. N.H.S. Howcroft).

During the hike between camps 1 and 2, tall stature forest was encountered along the descent to the Kanel River and on the corresponding climb up opposing slopes to Mt. Gulno. A sharp structural break was evident at elevation 5700 feet aneroid (1740 m), with marked changes in epiphyte abundance, forest stature, and tree architectural form. This elevational level probably marks the lower limit of the cloud zone. The abruptness of physiognomic transition suggests that the cloud line is spatially fixed, at least locally.

The Mt. Gulno vegetation is assignable to the same forest classification units as discussed for Mt. Oipu.

Camp 3

Location: Wara Kanel (Kanel River), GPS 05° 31.8' × 144° 49.1', elevation 1545 m
Life zone: premontane
Forest type: tall stature ecotone forest with intermixed lowland and montane taxa
Collections sequence: 10769–10964

Camp 3 was sited in secondary vegetation extending along the Kanel riverbed and over adjacent slopes. *Saurania* and *Cyathea* were the most conspicuous members of this riverine formation. In the former genus, the major species included *Saurania* aff. *conferta* (*10815*), *S. congestiflora* (*10826*), *S.* cf. *naumannii* (*10904*), *S. schumanniana* (*10940*), and an unusual subglabrous species (*10829*, not *S. plurilocularis*). *Cyathea angiensis* (*10848*) and *C. werneri* (*10794*) were common tree ferns in heliophytic situations, while *C. hornei* (*10846*) was frequent in advanced regrowth. *Gastonia spectabilis* (*10956*) was a massive emergent. Other plants indicative of disturbance were repeatedly encountered throughout the area, their dominance the result of subsistence agriculture by Gulno villagers. Euphorbiaceae and Piperaceae were prominent in the successional vegetation, being represented by *Euphorbia plumerioides* var. *acuminata* (*10792*), *Homalanthus novo-guineensis* (*10957*), *Mallotus papuanus* (*10947*), *Piper lessertianum* (*10874B*, *10927*), *P. radatzii* (*10773*), and *P. subbullatum* (*10822*). In mid-seral phases, *Alphitonia excelsa* sensu Schirarend (no coll.), *Melicope* spp. (*10823*, *10892*), *Geunsia pentandra* (*10821*), and *Trema cannabina* (*10918*) became frequent, often forming dense stands. This regrowth association is found throughout northeastern PNG whenever human or natural agencies permit establishment of seral taxa. Phytogeographically, the weedy plants often range over the whole of Papuasia and also into the larger Malesian region. Several alien species were noted, mainly ephemerals such as *Crassocephalum crepidioides* (*10799*) and *Erechtites valerianifolia* (*10797*).

Away from the river, the primary forest canopy was diverse and more difficult to characterize. *Podocarpus* (*10952*, sterile) and *Calophyllum* (populations sterile) were common trees in a premontane assemblage also composed of Cunoniaceae, Elaeocarpaceae, Ericaceae, Lauraceae, Myrsinaceae, and Winteraceae. Intermixing with montane taxa were lowland representatives from Moraceae (principally *Ficus*) and Meliaceae (*Aglaia*). Urticaceae, Zingiberaceae, and various small ferns dominated the understory layer. Among the more abundant gingers were *Alpinia werneri* (*10869*), *Alpinia* sp. § *Dieramalpinia* (*10964*), *Etlingera* sp. (*10878*), *Pleuranthodium* sp. § *Psychanthus*

(*10849*, *10959*), and *Tapeinochilos* (populations sterile). Common urticates included *Elatostema beccarii* (*10894*), *E.* aff. *belense* (*10891*), *E. novo-guineense* (*10885*, *10896*), *Poikilospermum inaequale* (*10858*), and *Procris frutescens* (*10901*). In general however, the forest floor community was sparse and taxonomically depauperate. The most notable collections were possible new species in *Dendrobium* § *Grastidium* (*10856*; det. N.H.S. Howcroft) and *Myrsine* aff. *acrostica* (*10958*; det. J. Pipoly).

Unlike the montane camps, epiphytic loads were minimal and tree boles typically lacked mossy growth. Canopy species tended to be represented by trees with massive stems branching high above the ground (>20 m). There appeared to be sizable populations of merchantable *Elaeocarpus* and *Syzygium*, but this could not be confirmed by fertile gatherings. In contrast to the situation at the montane sites, virtually all the arborescent taxa in the mature growth forest were seen only in sterile condition. The few fertile individuals were often too high in the overstory for collection, the only exceptions being *Ceratopetalum succirubrum* (*10853*), *Flindersia pimenteliana* (*10944*), and *Lithocarpus* cf. *celebicus* (*10785*). According to local respondents, the forest trees begin flowering in November or December after the start of the rainy season, a claim consistent with climatic data reviewed in Hedemark et al. (1997).

The Kanal River forest is regarded as lower montane by Hammermaster and Saunders (1995), but differs from the previous sites in the appearance of lowland elements. Genera recorded from camp 3 which are characteristic of the lowland zone include *Caryota* (sightings), *Aceratium* (*10806*), *Leea* (*10825*), *Pometia* (sightings), and *Poikilospermum* (*10858*). Lowland rain forest can ascend to 1500 m (van Royen 1964), and the floristic composition of the Kanal locality is transitional to such forests. Unlike high elevation formations, the lowland-montane ecotone exemplified by the Kanal site has not received critical attention in Papuasia (Grubb & Stevens 1985). Future surveys in the Bismarck-Ramu tract could profitably focus on the transition, especially as unpublished findings from recent RAP (Rapid Assessment Protocol) surveys suggest that floristic richness in Papuasia peaks at or near this elevational level (e.g., Beehler 1997; Kulang et al. 1997).

Camp 4

Location: Wara Ikil (Ikil River), GPS 05° 30.8' × 144° 50.6', elevation 600 m

Life zone: lowland

Forest type: tall stature alluvial and foothill forest

Collections sequence: 10969–11110; 10965–10968 from transit between camps 3 to 4

Flanked by steeply ascending ridges, camp 4 was the most isolated expedition site and the least affected by disturbance. However on riverine flats, the vegetation was still subject to natural upsets and marked by the development of *Pometia* dominant canopy. Such communities are very typical of lowland environments throughout northern PNG. In addition to *Pometia pinnata*, the woody taxa on alluvial ground usually included *Bridelia penangiana* var. *penangiana* (*11020*), *Callicarpa longifolia* (*10973*), *Chisocheton lasiocarpus* (*11000*), *Dolicholobium oxylobum* (*11042*), *Endospermum labios* (*11048*), *Leucosyke capitellata* (*11044*), *Mussaenda scratchleyi* (*11097*), *Pipturus argenteus* (*10990*), *Prunus dolichobotrys* (*11037*), *Saurauia* aff. *conferta* (*11036*), and Anacardiaceae. The latter was represented primarily by sterile *Buchanania*, *Campnosperma brevipetiolata*, and *Semecarpus*. Subarborescent *Ficus* was represented by large populations of *F. arbuscula* (*11038*) and *F. comitis* (*11100*). The most common herbaceous plants were *Derris cuneifolia* (*11031*), *Desmodium sequax* (*11023*), *Pueraria pulcherrima* (*11029*), and *Stachytarpheta cayennensis* (*11028*). Urticaceae was also common, with many sightings of *Boehmeria platyphylla* (*11016*), *Cypholophus nummularis* (*11018*), *Elatostema novo-guineense* (*11022*), *E. weinlandii* (*11096*), *Laportea decumana* (*10974*), and *Poikilogyne macrophylla* (*11095*).

The slopes and ridges above Wara Ikil have taxa less common than those along the river and represent a more diverse forest. Proper botanical assessment of such communities requires considerably more time and effort than is possible with brief surveys such as ours. From general impression, the stands near Camp 4 could be the richest plant community encountered by the expedition. Both the Kanal and Ikil foothills would no doubt repay further efforts at exploration.

Notable collections were *Antidesma katikii* (*11054*, *11079*), formerly known only from a type collected in the Ramu area, *Garcinia* sp. nov. (*11098*, det. P.F. Stevens), *Psychotria* sp. nov. (*11090*), and *Syzygium* sp. nov. (*11068*).

The Kanal River vegetation is assigned to type code 'Hm' on Hammermaster and Saunders (1995), a category consisting of medium crowned forests on uplands below 1000 m. The camp 4 area has the most merchantable timber seen during the survey and represents the forest type of greatest interest to commercial operators.

NEW SPECIES, DISTRIBUTIONAL RECORDS, OR OTHER NOTEWORTHY COLLECTIONS

PTERIDOPHYTES

DENNSTAEDTIACEAE

Hypolepis scabristipes Brownsey; coll. *10778*. Apparently a rare fern, represented by few collections in the Malesian region (Brownsey 1987). **Hypolepis scabristipes** is a distinctive species, with yellowish-brown stipes marked by darker excrescences from the dilated hair bases (loc. cit.).

THELYPTERIDACEAE

Sphaerostephanos sp. ?nov.; colls. *10707* and *10733*. The genus is one of the most speciose in Malesia (Holttum 1981) and includes numerous localized endemics. Our expedition numbers are sessile-glandular on both lamina surfaces, lack indusia, and have laxly setose sporangia. Sori are multiserial and sometimes confluent. The collections are closest to *S. adenostegius* and *S. warburgii*.

MONOCOTS

ORCHIDACEAE

Bulbophyllum sp. nov.; coll. *10724*

Dendrobium sp., § **Grastidium**; possible sp. nov.; coll. *10856*. About 45 orchid species were collected during the survey, from which orchidologist N.H.S. Howcroft has determined two numbers as representing new species.

ZINGIBERACEAE

Alpinia sp. aff. **odontonema**, § **Pycnanthus**; coll. *10595*. This differs from *A. odontonema* s. str. in its sessile leaves with raised nervation on upper surfaces. The expedition's collection conforms to material cited by R.M. Smith (1978) as an undescribed species.

DICOTS

ARALIACEAE

Polyscias belensis Philipson; coll. *10580*. An uncommon montane tree, previously known from Bele River in West Iryan and from Morobe Province (Philipson 1979). Lae Herbarium has only one sheet of this taxon. Apparently a first record for the Highlands Provinces.

Resembles a *Gastonia* but the pedicels are distally articulated. The voucher agrees in detail with the single sheet annotated by Philipson at LAE.

Schefflera aff. **sparsidentata** Frodin; colls. *10427*, *10471*. A possible novelty in the *S. 'schumanniana-schraderiana* complex' from which a number of new species have been described by Frodin (1982).

Closest to *Schefflera sparsidentata* but differing in the more robust inflorescence with extended rachis, glabrescent axes, and much longer pedunculate umbellules. The flowers are distinctly pedicellate rather than sessile. The conspicuous peduncular and floral bracts are densely clothed with setiform innovations on margins and/or surfaces.

CLUSIACEAE/GUTTIFERAE

Garcinia sp. nov.; coll. *11098*. A *Garcinia* with cordate-based leaves has been preliminarily determined by P.F. Stevens as a novelty (pers. comm.).

The new species was seen as a single 10 m tree growing on the ridgeline above camp 4. Its leaves are sessile, decussate, firm-coriaceous, and abaxially glandular-lineate. It is vegetatively distinguishable from other species by the subovate blade, typically 11.5 × 7 cm, with reflexed margins and amplexicaulous cordate base. The flowers are deployed in numerous axillary or infrafoliar fascicles, seemingly bisexual but probably functionally unisexual and with the plants dioecious.

ERICACEAE

Rhododendron anagalliflorum Sleumer; colls. *10389*, *10686*. As delimited by Craven (1980), *R. anagalliflorum* is an uncommon species confined to the Carstenz Mts. and the Bismarck-Wahgi-Jimi Divide. It has the reduced leaves characteristic of Series Linnaeoidea.

The expedition vouchers were procumbent or decumbent epiphytes. Corollas were campanulate, chartaceous, white or pink, with erect lobes and outer surfaces exclusively lepidote. The ovary is densely clothed with patent hairs but also provided with a lesser indumentum of coarsely tuberculate scales. Styles did not exceed the ovary and were mostly glabrous.

EUPHORBIACEAE

Glochidion sp. nov.; coll. *11543*. The collection was from a subarborescent species seen in cloudy montane forest. It does not key out on Airy Shaw (1980). In appearance most like *Glochidion frodinii* and *G. urceolare*, but separable on the following combination of characters:

Vegetative parts hispidulous. Inflorescence axillary or internodal; pistillate flowers often solitary. Capsules globose, 1.5 cm diameter, subsessile, glabrous, exocarp somewhat verrucose.

The capsules are eaten raw by Bubkile villagers, a practice not usually encountered for Papuasian *Glochidion*. The fruit is crunchy in consistency and has a rather pleasant aftertaste. Unfortunately, this resulted in the village laborers consuming all the gatherings as they were made, leaving only a unicate for the press.

Macaranga reiteriana Pax & Hoffman; colls. *10496*, *10508*. *Macaranga reiteriana* was formerly known only from Morobe Province, Gulf Province, and the Idenburg River (Whitmore 1980). Lae Herbarium has material from each of the areas cited in Whitmore (ibid) but no new occurrences have been added to the national collection since then.

The species is distinguished by the single elongate stipule, narrow leaves, and solitary fruits on bare peduncles. It is frequent in regrowth communities on Mt. Oipu. Recent work at Crater Mt. in Simbu (Chimbu) Province has also documented the presence of the species from that area (e.g., *Takeuchi 12262*, *12274*). Although the expedition vouchers represent a distributional record for the Highlands region, the plant is almost certainly more common and widespread than herbarium specimens would indicate.

Mallotus papuanus (J.J. Sm.) Pax & Hoffman, or aff.; coll. *10947*. The species has paired leaves; each leaf pair consisting of a highly reduced, stipuliform lamina opposed to an unreduced caudate blade. An indumentum of fulvous hairs covers the apical parts and underleaves.

Mallotus papuanus was previously regarded as endemic to West Iryan (Airy Shaw 1980). The expedition collection is apparently a first record for Papua New Guinea. Although annotated specimens of *M. papuanus* have not been seen, the species' characteristics are sufficiently distinctive for a description-based identification.

EUPHORBIACEAE/STILAGINACEAE

Antidesma aff. **chalaranthum** Airy Shaw; coll. *10716* (fr). *Antidesma chalaranthum* is known with certainty only from the staminate type collection, obtained from Goroka subdistrict in the Eastern Highlands (Airy Shaw 1979). A second specimen (*Streimann & Kairo NGF 27636*), was referred to this species as an example of the female plant, though the assignment was explicitly provisional (loc. cit.). The expedition voucher is similar to NGF *27636*; both numbers being subappressedly puberulent on twigs, inflorescence axes, and abaxial midveins. Fruits are also identically glabrous, 5 mm in diameter, and with lateral styles. However our Bismarck collection has drupes distinctly oblique, compressed, and lacking a thin-crustaceous pericarp; characters unlike the number cited by Airy Shaw. There are possibly two taxa hidden in the *chalaranthum* facies.

Antidesma katikii Airy Shaw; colls. *11054*, *11079*. Supposedly a rare endemic, previously known only from the type specimen (*Coode & Katik NGF 32762*) originating near the Ramu River at 90 m elevation. The large linear-lanceolate leaves with pubescent midrib readily identify the species (Airy Shaw 1973, 1980). Unlike the type, the expedition collections include flowering material, from which the following accessory description is provided:

Inflorescence from leaf-bearing or defoliate nodes, axillary, racemose, 2–6 cm long, rachis patently pubescent; bracts ovate, 0.5 mm long; pedicels to 1 mm, provided with indumentum like the rachis; perigone cotyliform, typically 1 mm × 0.5 mm, glabrescent or puberulous, margins minutely toothed, otherwise truncate; disc tomentulose; ovary asymmetric, 0.8 mm × 0.6 mm, pilosulous; styles excentric, 2–4, divergent or reflexed, 2-fid.

Antidesma katikii is locally common and a characteristic taxon in the Kanal drainage. The label on the type indicates that the species was very abundant in disturbed forest at the original collection site. It is likely that the plant is not as rare as the scarcity of specimens would suggest, but is simply undercollected and of limited range.

LAMIACEAE/LABIATAE

Basilicum sp.; coll. *10626*. The collection is not *B. polystachyon*, the only *Basilicum* species recorded for Papuasia (cf. Keng, 1978). It may represent a new species or a distributional record. The plant's major characteristics are:

Suffrutescent and terrestrial. Leaves opposite, herbaceous, sub-bullate, adaxial surface dark green, abaxially purple. Inflorescence terminal only, racemiform, axes puberulent; verticellasters about 1.5 cm apart, short and sparingly branched; pedicels long. Calyx bilabiate, manifestly venose (also with intercostals), hairs subulate and septate; lower lip with 3 segments, midlobe furcate and biapiculate, lateral lobes much reduced, rounded or obtuse; upper lip wider, entire, shorter than the lower labium. Corolla blue to violet, bilabiate, tube contorted, shorter than the calyx; upper lip shallowly 4-fid; lower lip induplicate, entire, enlarged, enfolding the stamens; stamens didynamous, scarcely exserted, connate at the base, filaments glabrous but with some sort of median callosity, anthers discoid and centrifixed; stigma 2-fid.

MELASTOMATACEAE

Astronidium novoguineense Merrill & Perry; coll. *10762*. The species was formerly reported only from West Iryan and is now newly recorded for Papua New Guinea.

Collection *10762* keys out to couplets 71–72 in Maxwell & Veldkamp (1990) and best matches *A. novoguineense*. However the shape of the calyx tube also suggests *A. fragilissimum*. If the specimen is actually the latter species, it would represent a first record for Mamose (i.e., northern PNG) region, since *A. fragilissimum* is currently known only from Central Province (loc. cit.).

Medinilla sp. nov.; coll. *10408*. Keys to species 49–52 in Mansfeld (1925) but does not match the binomials there. The collection is somewhat like Merrill and Perry's '*mansfeldiana-markgrafii*' group except for the cernuous cauline inflorescence. Other salient characteristics are the following:

Epiphytic, erect, monocaulous or not. Stems and innovations setose. Leaves opposite, acroscopically directed, elliptic, to ca. 20 cm × 7.5 cm, glabrous except near the base of abaxial costae, 5–7 plinerved. Petioles proximally provided with large auriculiform alae, the auricles foliaceous, paired, purple, rounded but with margins erose. Inflorescence racemiform or sparingly ramifying, conspicuously and persistently bracteate.

MONIMIACEAE

Steganthera insculpta Perkins; colls. *10513*, *10672*. *Steganthera insculpta* is the only species in Philipson's (1986) conspectus with subsessile female inflorescences. It was previously known from two collections in the Sepik region (ibid).

MYRSINACEAE

Myrsine aff. **acrostica** (Mez) Pipoly; coll. *10958*. *Myrsine* is currently being reviewed by J. Pipoly, and Malesian taxa formerly included in *Rapanea* are being transferred to *Myrsine*.

Collection *10958* is either a new species or a very aberrant *Myrsine acrostica* (Pipoly, pers. comm.).

MYRTACEAE

Syzygium sp., aff. **megistophyllum** Merrill & Perry; coll. *11068*. The collection keys out to *S. megistophyllum* in Hartley and Perry (1973). It differs from that species in the linear-elliptic leaves, to 36 cm × 8.5 cm in size, with base subsessile-emarginate but not deeply cordate. The lateral veins are in 25–30 pairs, generally straight, and obliquely diverging to a commissural nerve 2 mm from the leaf margin.

Syzygium megistophyllum is apparently known only from a fruiting specimen obtained in West Iryan (loc. cit.). The inflorescence on *11068* was cauline, developing as abbreviate cymes ≤ 4 cm length at the base of a short stem. This is not too different from the description for *S. megistophyllum*, though the foliar characters are otherwise distinct. The expedition voucher probably represents a new species.

PIPERACEAE

Piper lessertianum (Miq.) C. DC.; colls. *10874B* and *10927*. The species is a laxly pubescent climber with auriculate leaves. It is infrequently collected and apparently uncommon; Lae Herbarium has only two sheets of this taxon.

ROSACEAE

Prunus gideonii Takeuchi, sp. nov. (**Fig. 4**). TYPUS: PAPUA NEW GUINEA. WESTERN HIGHLANDS PROVINCE: Bismarck Range, Mt. Oipu, ridge between 'Camp 1' and Bubkile, GPS lat. 05° 35.513' S, × long. 144° 47.252' E, elevation 2357 m, 07 Oct 1995 (fr), *W. Takeuchi 10588* (HOLOTYPE: LAE; ISOTYPE: L).

A *P. pulleo* laminis lanceolatis (non ellipticis vel oblongis) 15 cm longioribus (nec minoribus), atque glandularibus basalaribus obsoletis (non praeditis), denique habito monoaxiali (non polyaxiali) facile dignoscenda.

Understory shrub, monocaulous or hardly branched at the top; provided with fulvous to orange-brown indumentum on all vegetative parts. *Stem* ascending, weak, virgate, 2–3 m long, woody throughout. *Branchlets* few or none, if present short and obliquely ascending, tomentose. *Stipules* conspicuous, paired at the petiole base, free, lanate, persisting, acuminate, 12–20 mm × 5–10 mm. *Leaves* spirally arranged, firm, manifestly bullate; mature blades lanceolate to oblong-lanceolate, 18–27 cm × 9–11 cm, apex acute, margin reflexed, base obtuse or subequally notched, often induplicated; adaxial surfaces dark green, initially pilose on veins, later glabrescent, abaxially orange-brown and lanate, opaquely punctulate; lateral veins 6–9 pairs, obliquely diverging, supramedially looping and usually closing at 2–4 mm from the

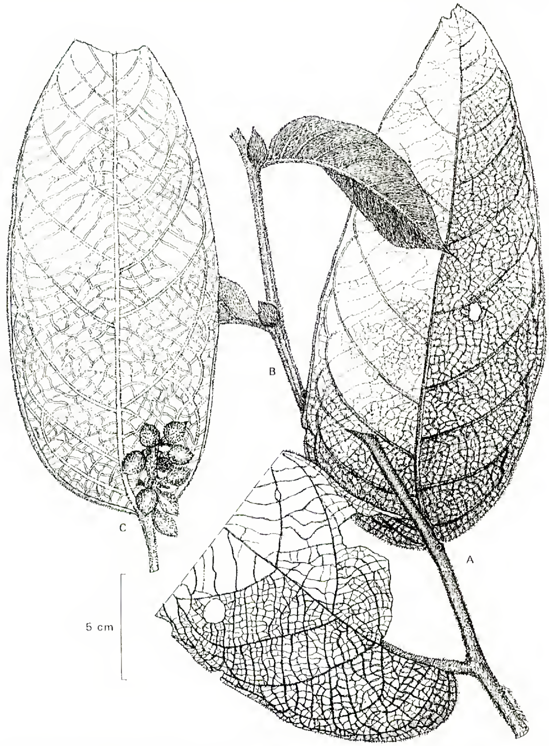

FIG. 4. *Prunus gideonii* Takeuchi, sp. nov. A: habit, mature leaves. B: shoot with stipules and immature leaves. C: infructescence.

margin, nervation deeply impressed above, on undersides very elevate, areolate and with blackened nerves; basal glands absent; petioles 12–15 mm long, entirely pubescent. *Inflorescence* not seen. *Infructescence* racemose, solitary, axillary from attached leaves, 4–8.5 cm long, rachis 3–4 mm thick, lanate; pedicels 4–12 mm long, densely pubescent. *Drupe* ovoid to subglobose, 12–13 mm × 9–10.5 mm, hypanthium residue 3–5 mm diam.; epicarp pinkish-red, appressedly hairy; style persisting, stigma capitate or somewhat discoid; endocarp glabrous. *Seed* single, abortive or immature, crispate; testa glabrous.

Distribution and ecology.—*Prunus gideonii* is known only from the type locality, in stunted montane forest within the cloud zone.

Etymology.—The new species is named for Dr. Osia Gideon, a specialist in Papuasian Rubiaceae and Costaceae, and currently the deputy director of the PNG Forest Research Institute.

Prunus gideonii has a distinctive aspect, with fulvous-lanate hairs on nearly all parts and large bullate leaves to 25 cm × 11 cm. Other diagnostic features are the sub-monocaulous habit and the conspicuous, persisting stipules.

The plant's sectional affinity is unclear because the type is apparently aglandular and lacks flowers. On the basis of phytogeography, *P. gideonii* probably belongs to subgenus *Laurocerasus* section *Mesopygeum* (cf. Kalkman 1965). The type keys out to *Prunus pullei* in Kalkman (1993) but is obviously not that species.

On Kalkman's (ibid: 322–26) key to fruiting specimens, the simplest way of accommodating the new binomial is by deleting *P. pullei* from fork 46 but retaining line 46b as the lead to the following couplet:

Ramiform trees or shrubs; leaves elliptic to oblong, 2–12 cm length, basal glands present .... **Prunus pullei**
Monocaulous or sparingly branched shrubs; leaves lanceolate, >15 cm length, basal glands absent .... **Prunus gideonii**

RUBIACEAE

Psychotria howcroftii Takeuchi, sp. nov. (**Fig. 5**). TYPUS: PAPUA NEW GUINEA. MADANG PROVINCE: Bismarck Range, ridge above 'Camp 4,' GPS lat. 05° 30.771' S, × long. 144° 50.646' E, elevation 900 m, 23 Oct 1995 (fl, fr), *W. Takeuchi 11090* (HOLOTYPE: LAE; ISOTYPES: A, BISH, BRIT).

Propter inflorescentiam trichotomam, stipulas valvatas, tubum corollinum 2 mm longiorum, denique fructum magnum, *P. solomonensi* valde arcte affinis, sed ab ea laminis 22–30 (non 17–20) cm longis, nerviis secundariis 15 minoribus (nec majoribus), denique floribus pedicellatis (non sessilibus) statim distinguitur.

Fruticose or subarborescent to 4 m height, vegetative parts entirely glabrous. *Stem* erect and laxly branching, basal swell absent. *Branchlets* terete, 4–7 mm diam., pithy, fleshy, moderately robust, collapsing when dry, surfaces smooth and nitid. *Stipules* valvate, basally connate, ±fugacious, at first

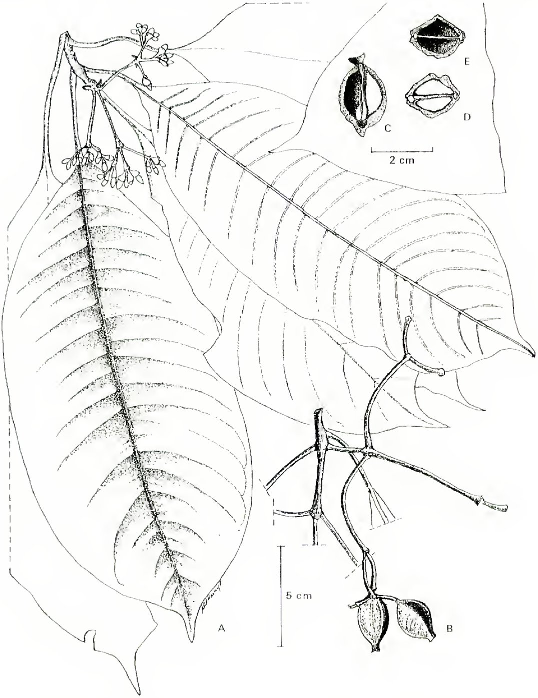

FIG. 5. *Psychotria howcroftii* Takeuchi, sp. nov. A: habit; mature leaves and young inflorescence. B: architectural form (ternate) of the infructescence. C: drupe in longisection. D and E: drupe in cross-section. Endosperm ruminations not shown.

acuminate and conduplicate, expanding and ovate when fully developed, 7–9 mm × 6 mm, undulate, margins entire. *Leaves* opposite, coriaceous, spreading, domatia lacking; mature lamina oblanceolate-oblong, 22–30 cm × 8–13 cm, apex abruptly acuminate, base cuneate; adaxial surfaces dark green, abaxially very pale green, in sicco bifacially fuscous; lateral veins in 16–19 pairs, equispaced, evenly arcuate, closing only rarely by marginal loops, major veins embossed on upper side, prominulous beneath; reticulum feeble, the crossing nerves subscalariform, otherwise with plexus irregular; petioles 4–6 cm. *Inflorescence* terminal, to 5 cm length, umbelliform, 3 rachises connivent and approximately 'trichotomous', primary branches ternate-verticellate, ultimately cymose, all axial surfaces light green and glabrous; bracts caducous, deltoid, minute, reflexed, adaxially pilosulous. *Flowers* sessile and externally glabrous; calyx cupular-turbinate, 5–6 mm × 4–6 mm, margins strictly truncate; corolla 4-merous, valvate, white, the bud acute, 9 mm × 2.5 mm prior to anthesis, lobes oblong, divided to 3 mm from the base (rehydrated bud 12.5 mm × 4.5 mm with segments 7.5 mm × 3 mm and divided to 5 mm from the base); throat pilose, hairs septate-moniliform; stamens 4, alternipetalous, adnate near the sinuses; anthers dorsifixed, oblong; style exceeding the anthers, glabrous, ?heterostylous; stigma 2-fid and fimbriate; disc annulate, glabrous, marked by a central excavation after stylar abscission; open flowers not seen. *Infructescence* diffusely paniculiform-umbelliform, flaccid, to 10 cm length, articulated at the ramifications; peduncle 2 cm. Drupes subglobose-ellipsoid, 19–22 mm (excluding calyx) × 15–17 mm, pericarp orange-red, convex, contracting and conspicuously angulate after drying; calyx tube persisting at the summit, vasiform to cylindric, 3–4 mm × 4–6 mm. *Pyrenes* 2, equal, plane on the commissural face, dorsally crested; endosperm ruminate.

Distribution and ecology.—Known only from the type locality, there occurring as scattered individuals in the understory of mature growth forest or in stands with advanced regrowth.

Etymology.—The new species is named for N.H.S. Howcroft; an orchidologist, silviculturist, and botanical illustrator, currently serving as the managing consultant of a balsa project in New Britain.

Psychotria howcroftii is immediately distinguished by the exceptionally large fruits borne on a diffuse, articulated infructescence. The oversized drupes are made even more conspicuous by persistence of the 4 mm long calycine tube. Among Papuasian *Psychotria* only *P. monopedicellata* has fruits as large but that species has calyptrate stipules and monoaxial inflorescences (Sohmer 1988).

The immature inflorescence on *P. howcroftii* appears trichotomous (sensu Sohmer), but since the mature infructescence is pedunculate, the initial trichotomous structure is merely due to delayed prolongation of the peduncle. Another developmental peculiarity is that stipular form becomes manifest only at the subapical node, the stipules being otherwise severely enfolded at the apex.

The new species will key to fork 36 on Sohmer (1988: 15). It can then be assimilated to the existing decision train by deleting lead 36b for *P. solomonensis* and adding the following:

36b. Corolla tube at least 2 mm long
  Mature blades >20 cm long; lateral veins >15 pairs; fruits >15 mm long .... **P. howcroftii**
  Mature blades <20 cm long; lateral veins <15 pairs; fruits smaller...... **P. solomonensis**

URTICACEAE

Pilea hedemarkii Takeuchi, sp. nov. TYPUS: PAPUA NEW GUINEA. BORDER OF WESTERN HIGHLANDS PROVINCE AND MADANG PROVINCE: Bismarck Range, near 'Camp 2' on Mt. Gulno, GPS lat. 05° 32.7' S, × long. 144° 47.8' E, elevation 2040 m, 12 Oct 1995 (fl, fr), *W. Takeuchi 10740* (HOLOTYPE: LAE; ISOTYPES: K, L).

Species haec inter se allis species generibus, laminis linearibusque uninerviis atque squamibus aurantiaco-lepidotibus indutis praeclare distat.

Weakly ascending monocauls or ramiform chamaephytes, <0.5 m height, terrestrial, monoecious. *Stems* slender, terete, glabrate, orange-brown, marked by parallel cystoliths or not. *Stipules* axillary, connate, caducous, obscure, 0.2–0.3 mm long, entire. *Leaves* paired, isomorphous but generally unequal, divergent, glabrous, chartaceous, bifacially squamulose; scales diffuse, peltately based, orange-hyaline with darkened centers; lamina linear, major blades usually 17–34 mm × 2–3 mm, apex acute, margins distally and distantly serrate, proximally entire, base obtuse; adaxial surfaces dark green, provided with linear cystoliths, these mostly transversal, less often randomly directed, on leaf margins abruptly longitudinal and congested; abaxial surfaces pale green to glaucous, collaterally glandular-lineate along the midrib; venation unicostate, other nervation invisible; petiole 1–3 mm long. *Inflorescence* axillary and solitary; cymes glomerulate, several together, occasionally simple; peduncle obsolete or to 9 mm long and filiform. *Male flowers* (rehydrated measurements) sessile or less commonly pedicellate, bracteolate, glabrous, entirely white; perigone 4-fid, typically 3 mm long, 1.5 mm wide at the base, ovoid in bud, segments lanceolate-ovate, each about 1.8 mm × 1.2 mm, costate, the rib excurrently corniculate or mucronulate; stamens 4, oppositi-tepalous, adnate to the tube, filaments inflexed; pistillode reduced to a minute flap. *Female flowers* glabrous, pedicelled or appearing sessile when immature; perigone 3-partite, fleshy, lateral segments vestigial, median segment enlarged and accrescent, acroscopic; staminodes 3, globular, oppositi-tepalous; ovary ellipsoid to cylindriform at first, later oblique and compressed; stigma penicillate, semi-persisting, directed at the major tepal. *Infructescence* entirely light green. *Fruits* basiscopic on a retrorsely turned stalk, asymmetrically ovoid, 1.2–1.0 mm × 1.0 mm, compressed, marginate; pericarp thin and smooth. *Seed* flattened, rostrate.

Distribution and ecology.—*Pilea hedemarkii* is known from montane forest in the Western Highlands, Madang, and West Sepik Provinces. During the expedition it was often seen along footpaths and forest margins. Another collection which is referable to this species (NGF 41691), has a label describing its habitat as 'broken forest,' further showing that the plant is found in successional situations.

Etymology.—The new species is named for Michael Hedemark, the expedition leader and a former conservation biologist with the United Nations Development Program. He is currently with the Wildlife Conservation Society in Laos.

Other Specimens Examined: **PAPUA NEW GUINEA. West Sepik Province:** Bli Mt. south of Oksapmin, broken forest on hillside, lat. 05° 20' S × 142° 15' E, elevation 7200' (2195 m), 22 Oct 1968 (fl), *E. Henty, R. Isgar, & M. Galore, NGF 41691* (A, BRI, CANB, K, L, LAE). **Western Highlands Province:** Bismarck Range, Mt. Oipu, subcrest slopes of main ridge in vicinity of 'Camp 1,' low stature montane forest in cloud zone, GPS lat. 05° 35.5' S, × long. 144° 47.3' E, elevation 2360 m, 05 Oct 1995 (fl), *W. Takeuchi 10481* (A, BISH, BRIT, CANB, L, LAE); Bismarck Range, Mt. Oipu, ridge community between 'Camp 1' and Bubkile, low stature montane forest in cloud zone, GPS lat. 05° 35.5' S, × long. 144° 47.3' E, elevation 2400 m, 07 Oct 1995 (fl), *W. Takeuchi 10559* (K, LAE).

Papuasian *Pilea* have been treated in Winkler (1922) and van Royen (1982). Although both authors provide keys to species the coverage of either account is incomplete. The genus still awaits a synthetical revision.

Pilea hedemarkii is distinguished from all other Papuasian congeners by the linear and uninerval leaves. The minute, orange-brown, and peltate scales are also distinctive, though not unique.

DISCUSSION

The expedition discovered about 15 confirmed or suspected new species, in addition to other noteworthy gatherings summarized in the preceding section. At least 613 distinct morphospecies were represented in the 730 collections made by the survey. It is instructive to compare the number of novelties reported here with two of the largest surveys recently concluded from other parts of Papuasia, both of which were also of approximately one month duration. The 1994 New Ireland survey produced only two new taxa (Takeuchi & Pipoly 1998), and a total of 8 novelties is suspected from the 1997 Lakekamu survey (Takeuchi & Kulang1998). Results from the present expedition support previous estimates of high biodiversity in the Bismarck-Ramu tract, and justify enactment of conservation measures for the area. Due to inclement weather and the overall scarcity of fertile sightings, the collections coverage was far from comprehensive. There is clearly considerable scope for further discovery.

APPENDIX 1

Expedition Plant List From Bismarck-Ramu. Numbers refer to exsiccatae vouchers. SR = sight record without exsiccatae; (m) = male plant; (f) = female plant. Determinations by the author unless otherwise indicated. Asterisk (*) preceding binomial indicates presence of discussion in text.

AVASCULAR PLANTS

BRYIDAE

genus indet., *10675*, *11003*

FERNS AND FERN ALLIES

ADIANTACEAE

Syngramma quinata (Hook.) Carruth., *11062*
Taenitis blechnoides (Willd.) Swartz, *10937*

ASPLENIACEAE

Asplenium acrobryum Christ, *10537*, *10970*, *11055*
Asplenium affine Swartz, *10526*
Asplenium bipinnatifidum Baker, SR from Camp 3
Asplenium caudatum Forst. f., *10777*, *10910*
Asplenium cuneatum Swartz, *11051*
Asplenium decorum Kunze, *10837*
Asplenium morobense Copel., *10643B*
Asplenium nidus L., SR from Camp 3
Asplenium phyllitidus Don subsp. *malesicum* Holttum, *10893-A*, *11050*
Asplenium steerei Harrington, *10445*, *10456*
Asplenium cf. steerei Harrington, *10479*
Asplenium subemarginatum Rosenst., *10996*
Asplenium tenerum Forst. f., SR from Camp 3
Asplenium unilaterale Lam., *11002*
Didymochlaena truncatula (Swartz) J. Smith, *10924*

ATHYRIACEAE

Diplazium bantamense Blume, *11064*
Diplazium cordifolium Blume, *10761*, *11056*
Diplazium esculentum (Retz.) Swartz, *10781*
Diplazium sp., *10779*

BLECHNACEAE

Blechnum acutiusculum (v.A.v.R.) C. Chr., *10435*
Blechnum cf. archboldii C. Chr., *10604*
Blechnum dentatum (Kuhn) Diels, *10828*, *11074*
Blechnum deorso-lobatum Brause, *10423*
Blechnum fraseri (A. Cunn.) Luerssen, *10576*
Blechnum orientale L., SR from Camps 1 & 3
Stenochlaena areolaris (Harr.) Copel., *10772*

CHEIROPLEURIACEAE

Cheiropleuria bicuspis (Bl.) Presl, *10942*

CYATHEACEAE

Cyathea angiensis (Gepp) Domin, *10848*
Cyathea cf. *cincinnata* Brause, *10763*
Cyathea geluensis Rosenst., *10551*, *10561*, *10706*
Cyathea hornei (Baker) Copel., *10846*
Cyathea perpelvigera v.A.v.R., *10635*, *10697*
Cyathea werneri Rosenst., *10794*
Dicksonia cf. *sciurus* C. Chr., *10765*

DAVALLIACEAE

Davallia divaricata Blume, *10776*
Humata sp., '*alpina-neoguineensis* group', *10572*
Humata sp., *11066*
Leucostegia pallida (Mett.) Copel., *10804*, *10820*

DENNSTAEDTIACEAE

Dennstaedtia glabrata (Cesati) C. Chr., *10688*, *11087*
Dennstaedtia sp., '*novoguineensis* group', *10533*
Histiopteris estipulata v.A.v.R., *10698*
Histiopteris integrifolia Copel., *10889*
Histiopteris squamulata Holttum, *10483*
Hypolepis hamleriana Rosenst., *10491*
**Hypolepis scabristipes* Brownsey, *10778*
Microlepia sp., *10646*
Paesia radula (Baker) C. Chr., *10574*

DIPTERIDACEAE

Dipteris conjugata Reinw., *10617*, *10803*

GLEICHENIACEAE

Dicranopteris linearis (Burm.) Underw., SR from Camp 1
Gleichenia brassii C. Chr., *10611*
Gleichenia dicarpa R. Br., *10616*

GRAMMITIDACEAE

Calymmodon clavifer (Hook.) Copel., *10557*
Ctenopteris sp., '*curtisii*-ctenoideum group', *10575*
Ctenopteris flagelliforme Brause, *10548*
Ctenopteris cf. *longiceps* (Rosenst.) Copel., *10594B*, *10946*
Ctenopteris millefolia (Blume) Copel., *10578*
Ctenopteris repandula Kunze, *11053*
Ctenopteris stellatosetosa Copel., *10668*
Ctenopteris (close to) *stellatosetosa* Copel., *11070*
Ctenopteris subsecundodissecta (Zoll.) Copel., *10549*, *10699*
Grammitis dolichosora (Copel.) Copel., *10594A*, *10664*
Grammitis cf. *dolichosora* (Copel.) Copel., *10915*
Grammitis interrupta (Baker) Copel., *10607*
Grammitis scabristipes (Baker) Copel., *10594D*
Grammitis sumatrana (Baker) Copel., *10546*, *10594C*

Scleroglossum juncifolium Copel., *10627*
Scleroglossum pusillum (Blume) v.A.v.R., *10390*

HYMENOPHYLLACEAE

Hymenophyllum sensu lato:
Mecodium sp., '*badium-bamlerianum* group', *10679*
Mecodium aff. *productum* (Kunze) Copel., *10839*
Meringium cf. *gorgoneum* (Copel.) Copel., *10621*
cf. *Meringium* sp., *10550*; sterile collection
Trichomanes sensu lato:
Cephalomanes oblongifolium Presl, *10916*
Macroglena meifolia Copel., *10739*
Macroglena schlechteri (Brause) Copel., *10651*
cf. *Macroglena* sp., *10721*
Nesopteris cf. *intermedia* (v.d.B.) Copel., *10969*, *11004*
Pleuromanes pallidum (Blume) Presl, *10628*

Lindsaea group

Lindsaea obtusa J. Smith, *10691*, *10844*
Lindsaea obtusa J. Smith, *10705*; pinnate form
Lindsaea pulchella (J. Smith) Mett. ex Kuhn, *10838*, *10932*
Lindsaea pulchella (J. Smith) Mett. ex Kuhn var. *blanda* (Mett. ex Kuhn) Kramer, *10525*
Lindsaea rigida J. Smith, *10696*
Sphenomeris chinensis (L.) Maxon, SR from Camps 3 & 4
Sphenomeris retusa (Cav.) Maxon, SR from Camps 1,3, & 4
Tapeinidium sp., *10565*

LOMARIOPSIDACEAE

Bolbitis heteroclita (Presl) Ching, *11021*
Bolbitis rivularis (Brackenridge) Ching, *10995*, *11007*
Bolbitis rivularis (Brackenridge) Ching, *11011*; large form
Elaphoglossum novoguineense Rosenst., *10590*
Lomagramma sinuata C. Chr., *10998*

LYCOPODIACEAE

Huperzia nummulariifolia (Blume) Jermy, *10771*
Huperzia phlegmaria (L.) Rothm., *11059*
Huperzia aff. *?pinifolia* Trevisan, *10877*
Huperzia squarrosa (Forst. f.) Trevisan, *10935*
Lycopodium volubile Forst. f., *10397*
Palhinhaea cernua (L.) Vasc. & Franco, SR from Camps 1 & 3

MARATTIACEAE

Angiopteris evecta (Forst.) Hoffman, *10816*
Marattia cf. *tafaensis* C. Chr., *10499*, *10501*

OLEANDRACEAE

Nephrolepis biserrata (Swartz) Schott, *10786*
Nephrolepis hirsutula (Forst. f.) Presl, *11030*
Nephrolepis lauterbachii Christ, *10605*
Nephrolepis rosenstockii Brause, *10812*
Nephrolepis schlechteri Brause, *10670*, *10769*
Oleandra cuspidata Baker, *10634*, *10758*, *10775*
Oleandra sibbaldii Grev., *10703*
Oleandra werneri Rosenst., *10814*

OPHIOGLOSSACEAE

Ophioglossum pendulum L., *10534*

POLYPODIACEAE

Aglaomorpha drynarioides (Hook.) Roos, SR from Camp *3*
Aglaomorpha heraclea (Kunze) Copel., SR from Camp *3*
Belvisia mucronata (Fée) Copel. var. *mucronata*, *11017*
Belvisia novoguineensis (Rosenst.) Copel., *10412*, *10467*, *10694*
Belvisia validinervis (Kunze) Copel. var. *longissima* (Holttum) Hovenkamp & Franken, *10509*
Colysis polysora (Brause) Copel., *10893*
Drynaria rigidula (Swartz) Bedd., SR from Camps 2 & 3
Goniophlebium demersum (Brause) Rödl-Linder, *10503*
Goniophlebium pseudoconnatum (Copel.) Copel., *10817*
Goniophlebium serratifolium Brackenridge, *10432*, *10484*, *10489*
Lecanopteris deparioides (Cesati) Baker, *10802*, distr. as *L. curtisii* Baker
Lemmaphyllum accedens (Blume) Donk, *10783*, *10925*, *11008*, *11010*
Loxogramme paltonioides Presl, *10487*
Microsorum papuanum (Baker) Parris, *10477*, = *Phymatosorus* sp.
Microsorum sp., *10987*, *11012*
Phymatosorus commutatus (Blume) Pichi Sermolli, *10801*
Selliguea albidosquamata (Blume) Parris, *10505*, *10782*, *10871*, sn, distr. as *Crypsinus* spp.
Selliguea enervis (Cav.) Ching, *10528*, *10759*; 'subgramineous,' distr. as *Crypsinus subundulatus*
Selliguea hellwigii (Diels) Hovenkamp, *10449*, *10558*, *10931*, distr. as *Crypsinus senescens*
Selliguea lauterbachii (Brause) Hovenkamp, *10439*, distr. as *S.* cf. *gibbsiae*
Selliguea plantaginea Brackenridge, *10492*; distr. as *Selliguea* sp.

PTERIDACEAE

Pteris blumeana Agardh, *10764*
Pteris wallichiana Agardh, *10493*
Pteris warburgii Christ, *10988*

SCHIZAEACEAE

Schizaea dichotoma (L.) J. Smith, *11057*
Schizaea fistulosa Labill., *10700*

SELAGINELLACEAE

Selaginella sp., '*angustiramea-hieronymiana* group', *10517*, *10930*

Tectaria group

Pteridrys cf. *microthecia* (Fée) C. Chr. & Ching, *10980*
Tectaria cf. *christovalensis* (C. Chr.) Alston, *11014*
Tectaria decurrens (Presl) Copel., *10997*

THELYPTERIDACEAE

Coryphopteris fasciculata (Fourn.) Holttum, *10620*
Plesioneuron marattioides (Alston) Holttum, *10547*
Pneumatopteris sogerensis (Gepp) Holttum, *10810*
Pneumatopteris sp., '*superba-subappendiculata* group', *10490*, *10545*
Pronephrium beccarianum (Cesati) Holttum, *10645B*
Pronephrium pentaphyllum (Rosenst.) Holttum, *10736*
Pronephrium cf. *scopulorum* Holttum, or aff., *10645A*, *10780*, *10880*
Pseudophegopteris aurita (Hook.) Ching, *10485*
Sphaerostephanos archboldii (C. Chr.) Holttum, *10416*
Sphaerostephanos cf. *arfakianus* (Baker) Holttum, *10993*
Sphaerostephanos dimorphus (Brause) Holttum, *10788*
Sphaerostephanos novoguineensis (Brause) Holttum, *10909*
Sphaerostephanos unitus (L.) Holttum var. *papilliferus* Holttum, *10784*
Sphaerostephanos cf. *veitchii* Holttum, *10808*, *10911*
**Sphaerostephanos* sp. ?nov., *10707*, *10733*
cf. *Sphaerostephanos* sp., *10809*

VITTARIACEAE

Antrophyum plantagineum (Cav.) Kaulfuss, *10542*
Antrophyum reticulatum (Forst.) Kaulfuss; s.l., *10898*
Vittaria elongata Swartz var. *angustifolia* Holttum, *10953*

GYMNOSPERMS

GNETACEAE

Gnetum gnemon L., *10805*

PODOCARPACEAE

Dacrydium cf. *imbricatus* (Blume) de Laub., *10899*; sterile specimen
Podocarpus sp. A, '*ledermannii-neriiformis* leaf type', *10952*; sterile collection
Podocarpus sp. B, *10585*; sterile collection

MONOCOTS

AGAVACEAE

Cordyline terminalis Kunth, SR from Camp 3

ARACEAE

Alocasia aequiloba N.E. Br., *11001*
Alocasia nicolsonii A. Hay, *10497*
Amydrium zippelianum (Schott) Nicolsen, SR from Camp 4
Colocasia esculenta (L.) Schott, *10807*
Cyrtosperma macrotum Becc. ex Engl., *11075*
Epipremnum amplissimum (Schott) Engl., SR from Camp 4
Epipremnum pinnatum (L.) Engl., SR
Holochlamys beccarii Engl., *10999*
Homalomena sp. A, *10642*, small short-stem herb
Homalomena sp. B, *11110*, robust cordate-leaf herb
Pothos sp., § *Pothos*, *11063*, sterile collection
Rhaphidophora sp., *10865*, Stone's architecture

ARECACEAE/PALMAE

Calamus cf. *reticulatus* Becc., *10569*
Caryota rumphiana Blume, SR from Camp 3
Heterospathe sp. A, *10766*
Heterospathe sp. B, *10676*, *10954*
Hydriastele sp., *11077*
Korthalsia cf. *zippelii* Blume, *11061*
Linospadix sp., *10712*; not *L. albertisiana*
Orania cf. *oreophila* Essig, *10875*

COMMELINACEAE

Commelina diffusa Burm. f., *10789*
Floscopa scandens Lour., *10873*
Forrestia mollissima (Blume) Kds., *10989*; as *Amischotolype* f. *marginata* (Blume) Backer
Pollia thyrsiflora (Blume) Steud., *11076*

COSTACEAE

Tapeinochilos hollrungii K. Schum., *10985*; det. O. Gideon

CYPERACEAE

Carex alopecuroides D. Don var. *chlorostachys* (D. Don) Clarke, *10455*
Carex graeffeana Boeck., *10714*
Carex lamprochlamys S.T. Blake, *10564*
Cyperus cyperinus (Retz.) Valck. Sur., *11086*
Cyperus distans L. f., *10795*
Cyperus kyllingia Endl., *10770*, *10774*
Eleocharis attenuata (Franch. & Sav.) Palla, *10629*
Fimbristylis dichotoma (L.) Vahl, *10835*
Hypolytrum compactum Nees & Mey., *10933*
Hypolytrum nemorum (Vahl) Spreng., *10900*, *10912*
Paramapania parvibractea (Clarke) Uittien, *10928*
Scleria scrobiculata Nees & Mey., *10842*

DIOSCOREACEAE

Dioscorea bulbifera L., *11035*

FLAGELLARIACEAE
Flagellaria indica L., SR from Camp 3

HELICONIACEAE
Heliconia papuana W.J. Kress, *11045*

JUNCACEAE
Juncus prismatocarpus R. Br. var. *indicus*, *10403*

LILIACEAE
Dianella ensifolia L., *10419*

MARANTACEAE
Phrynium cf. *macrocephalum* K. Schum., *11047*
Phrynium sp., *10882*

MUSACEAE
Musa sp., *11046*

ORCHIDACEAE (dets. by N.H.S. Howcroft)
Aglossorhyncha sp., *10641*
Bulbophyllum sp., § *Bulbophreatia*, *10384*
Bulbophyllum sp., § *Coelochilus*, *10460*
Bulbophyllum sp., § *Dialeipanthe*, *10921*
**Bulbophyllum* sp. nov., *10724*
Bulbophyllum sp., *10462*, *10754*, *10949*, *11091*
Bulbophyllum or *Mediocalcar* sp., *10461*
Cadetia aprina (J.J. Sm.) Schltr., *10387*
Ceratostylis sp., *10755*
Chitonochilus papuanum Schltr., *10936*
Coelogyne beccarii Rchb. f., *10861*
Coelogyne cf. *veitchii* Rolfe, *10864*
Dendrobium cuthbertsonii F.v.M., *10386*
Dendrobium lawesii F.v.M., *10950*
Dendrobium cf. *masarangense* Schltr., *10647*
Dendrobium otaguroanum A.D. Hawkes, *10640*
Dendrobium aff. *vexillarius* J.J. Sm., *10459*
Dendrobium sp., § *Calyptrochilus*, *10586*
Dendrobium sp., § *Eriopexis*, *10753*
**Dendrobium* sp., § *Grastidium*, *10856*; possible sp. nov.
Epiblastus sp., *10472*
Eria aff. *ramuana* or *javanica*, *10633*
Erythrodes sp., or *Eurycentrum*, *10732*; spur present
Glomera cf. *aurea* Schltr., *10639*
Glomera sp., *10417*, *10579*, *10653*
Glossorhyncha sp., *10682*
Goodyera sp., *10388*
Liparis subg. *Menoneuron*, cf. § *Platychilus*, *10833*
Liparis or *Malaxis* sp., *10923*
Mediocalcar sp., *10391*
Mediocalcar sp., *10610*
Mischobulbum lancilabium Schltr., *10939*
Oberonia sp., *10836*
Pedilochilus sp., *10669*
Phreatia cf. *petiolata* Schltr., *10650*
Phreatia sp., § *Bulbophreatia*, *10392*
Phreatia sp., *10693*
Platanthera papuana Schltr., *10692*
Podochilus sp., *10527*
Pseuderia cf. *pauciflora* Schltr., *11052*
Spathoglottis plicata Krzl., *10866*, *11024*
Zeuxine sp., § *Hetaeropsis*, *10560*

PANDANACEAE
Freycinetia cf. *angustissima* Ridley, *10725*
Freycinetia sp. A, *10881*
Freycinetia sp. B, s.n., Oct. *23*, *1995*
Pandanus sp., '*adinobotrys-setistylus* group', *10767*
Pandanus sp., § *Intraobtutus*, *10623*
Pandanus sp., *11071*

PHILESIACEAE
Geitonoplesium cymosum A. Cunn., *10592B*

POACEAE/GRAMINEAE
Bambusa cf. *forbesii* (Ridley) Holttum, *10962*
Isachne albens Trin., *10476*
Isachne albomarginata Jansen, *10448*
Isachne myosotis Nees, *10684*
Isachne pauciflora Hack., *10938*
Lophatherum gracile Brongn., *10847*
Pennisetum macrostachyum (Brongn.) Trin., *10798*
Saccharum officinarum L., *10800*
Setaria palmifolia (Koenig) Stapf, *10465*

SMILACACEAE
Smilax cf. *zeylanica* L., *11034*

ZINGIBERACEAE
Alpinia odontonema K. Schum., *10683*
Alpinia werneri Valeton, *10869*
Alpinia sp., § *Dieramalpinia*, *10964*
**Alpinia* sp., aff. *odontonema*, § *Pycnanthus*, *10595*
Etlingera angustifolia (Valeton) R.M. Smith, *10538*
Etlingera sp., *10878*; *Geanthus* (*Polyanthae*)
Pleuranthodium sp., § *Psychanthus*, *10849*, *10959*
Riedelia geluensis (Laut.) Valeton, *10597*
Riedelia monticola Valeton, *10619*, *10727*
Riedelia rosacea van Royen, or aff. *monticola*, *10708*, *10757*
Riedelia subulocalyx Valeton, *10723*

DICOTS

ACANTHACEAE
Hemigraphis aff. *primulifolia* (Nees) F. Vill., *11015*
Leptosiphonium sp., *10870*
Ptyssiglottis sp., *11006*
Rungia klossii S. Moore, *10524*

ACTINIDIACEAE
Saurauia cf. *capitulata* A.C. Smith, or aff., *10596*
Saurauia aff. *conferta* Warburg, *10815*, *11036*
Saurauia congestiflora A.C. Smith, *10826*
Saurauia ilicifolia van Royen, *10424*
Saurauia cf. *naumannii* Diels, or aff., *10539*, *10904*, *11043*
Saurauia schumanniana Diels, *10940*

Saurauia sp. A; ?sp. nov., *10447*, *10570*; no match at LAE

Saurauia sp. B, *10829*; subglabrous

AMARANTHACEAE

Iresine herbstii Hook. f., *10796*

ANACARDIACEAE

Campnosperma brevipetiolata Volk, SR from Camp 4

ANNONACEAE

Haplostichanthus longirostris (Scheffer) van Heusden, *11088*

genus indet., *10667*

APIACEAE

Hydrocotyle sibthorpioides Lamk, *10473*, *10520*

APOCYNACEAE

Alyxia markgrafii Tsiang, *11099*

Parsonsia cf. *sanguinea* (Wernham) Markgr., *11093*

Parsonsia sanguinea (Wernham) Markgr. var. *brassii* (Markgr.) D.J. Middleton, *10735*

Parsonsia warenensis Kanehira & Hatusima, *10906*

Parsonsia sp., *10860*

Tabernaemontana pandacaqui Lam., *10967*

AQUIFOLIACEAE

Ilex scabridula Merrill & Perry, *10841*

Ilex spicata Blume, *10583*

ARALIACEAE

Gastonia spectabilis (Harms) Philipson, *10956*

Harmsiopanax ingens Philipson ssp. *ingens*, *10514*

Mackinlaya celebica (Harms) Philipson, *10674*

Mackinlaya schlechteri (Harms) Philipson, *10710*

Osmoxylon novoguineense (Scheff.) Becc., *10968*

**Polyscias belensis* Philipson, *10580*

Schefflera schumanniana Harms ssp. *schumanniana*, *10643*, *10744*

**Schefflera* ?sp. nov., aff. *sparsidentata* Frodin, *10427*, *10471*

Schefflera cf. *straminea* Frodin, *10498*

Schefflera cf. *versteegii* Harms, *11109*; also possibly *S. forbesii*

ARISTOLOCHIACEAE

Aristolochia sp., *10920*; sterile collection

ASCLEPIADACEAE

Hoya sp., *10922*

Tylophora cissoides Blume, *11025*

ASTERACEAE/COMPOSITAE

Adenostemma lavenia (L.) O. Ktze., *10404*, *10480*

Ageratum conyzoides L., *10429*

Arrhenechthites novoguinensis (S. Moore) Mattf., *10482B* ssp. *novoguinensis*

Bidens pilosa L. var. *minor* (Blume) Sherff, *10458*

Blumea arfakiana Martelli, *10884*

Blumea arnakidophora Mattf., *10536*

Blumea sylvatica (Blume) DC., *10562*

Blumea sylvatica (Blume) DC. var. *macrophylla* (Blume) Randeria, *10434*, *10531*

Blumea sylvatica (Blume) DC. var. *sylvatica*, *10454*

Crassocephalum crepidioides (Benth.) S. Moore, *10799*

Erechtites valerianifolia (Wolf) DC., *10797*

Mikania cordata (Burm. f.) B.L. Rob., *10879*

Olearia platyphylla Mattf. var. *cinerea* (Mattf.) Koster, *10413*

Olearia *rufa* Koster, *10598*

Vernonia cuneata Less., *10831*

BALSAMINACEAE

Impatiens hawkeri Bull, *10381*, *10428*, *10872*

BEGONIACEAE

Begonia cf. *angustae* Irmscher, *10992*

Begonia sp., '*kaniensis* group', *10441*; climber, det. O. Gideon

Begonia tafaensis Merrill & Perry, or aff., *10502*, *10890*

BIGNONIACEAE

Tecomanthe dendrophila (Blume) K. Schum. & Laut., *10704*

BORAGINACEAE

Tournefortia sarmentosa Lamk, SR from Camp 4

BURSERACEAE

Haplolobus cf. *floribundus* (K. Schum.) H.J. Lam, *11092*; '*floribundus-versteeghii*'

CAMPANULACEAE

Peracarpa carnosa (Wallich) Hooker & Thompson, *10544*

CARDIOPTERIDACEAE

Cardiopteris moluccana Blume, *10793*

CARYOPHYLLACEAE

Drymaria cordata (L.) Willd. ex Roem. & Schult., SR from Camp 3

CASUARINACEAE

Gymnostoma papuana (S. Moore) L. Johnson, *10855*

CELASTRACEAE

Celastrus monospermoides Loes., *10851*

CHLORANTHACEAE

Ascarina philippinensis C.B. Rob., *10613*

Ascarina subsessilis Verdc., *10760*

CLUSIACEAE/GUTTIFERAE

Garcinia archboldiana A.C. Smith, *10494*

**Garcinia* sp nov., *11098*; det. P.F. Stevens

Garcinia sp., *10951*

CRYPTERONIACEAE

Crypteronia cumingii (Planch.) Planch. ex Endl., *11104*

CUCURBITACEAE

Trichosanthes sp., *10927A*; sterile collection
Zehneria cissymbium (Jacobs) Jeffrey, *10737*
Zehneria cf. *cissymbium* (Jacobs) Jeffrey, *10518*

CUNONIACEAE

Acsmithia reticulata (Schltr.) Hoogland, *10603*
Caldcluvia rufa (Schltr.) Hoogland, *10673*
Ceratopetalum succirubrum C.T. White, *10853*

DAPHNIPHYLLACEAE

Daphniphyllum gracile Gage var. *gracile*, *10584*

DILLENIACEAE

Dillenia cf. *schlechteri* Diels or cf. *quercifolia* White & Francis, *10495*

ELAEOCARPACEAE

Aceratium parvifolium Schltr., *10806*
Elaeocarpus tariensis Weibel, *10422*, *10591*
Sloanea brachystyla (Schltr.) A.C. Smith, *10747*
Sloanea velutina (Schltr.) A.C. Smith, *10553*

ELEAGNACEAE

Eleagnus triflora Roxb. cf. var. *brevilimbata* 'T Hart, *10811*, *10874*

ERICACEAE

Dimorphanthera cornuta J.J. Sm. var. *tenuiflora* Sleumer, *10395*
Dimorphanthera aff. *cornuta* J.J. Sm., *10743*; det. P.F. Stevens
Dimorphanthera elegantissima K. Schum. var. *splendens* (Sleumer) P.F. Stevens, *10632* (fl); det. P.F. Stevens
Dimorphanthera elegantissima K. Schum. var. *splendens* (Sleumer) P.F. Stevens, *11108* (fr)
Diplycosia edulis Schltr., *10908*
Diplycosia morobeensis Sleumer, *10658*
**Rhododendron anagalliflorum* Sleumer, *10389*, *10686*
Rhododendron beyerinckianum Koord., *10685*
Rhododendron aff. *beyerinckianum* Koord., *10396*; not the species
Rhododendron englerianum Sleumer, or aff., *10863*
Rhododendron cf. *macgregoriae* F.v.M. var. *glabrifilum* (J.J. Sm.) Sleumer, *11073*
Rhododendron superbum Sleumer, *10859*
Rhododendron wrightianum Koord. var. *insulare* Sleumer, *10656*
Vaccinium reticulato-venosum Sleumer, *10887*
Vaccinium sp., § *Oarianthe*; aff. *villosiflorum* J.J.Sm., *10907*

EUPHORBIACEAE

**Antidesma* aff. *chalaranthum* Airy Shaw, *10716*
**Antidesma katikii* Airy Shaw, *11054*, *11079*
Aporosa sp., '*brevicaudata*-squarrosa group', *10701* (f), *10722* (m)
Aporosa laxiflora Pax & Hoffman, *10582*
Breynia cernua (Poir.) Muell. Arg., *10529*
Bridelia penangiana Hook. f. cf. var. *penangiana*, *11020*
Claoxylon coriaceo-lanatum Airy Shaw, *10519*
Endospermum labios Schodde, *11048*
Euphorbia plumerioides Teijsm. ex Hassk. var. *acuminata* J.J. Sm., *10792*
**Glochidion* sp. nov., *10543*
Macaranga aleuritoides F. Muell., SR from Camp 4
Macaranga bifoveata J.J. Sm., *10972*
Macaranga caudata Pax & Hoffman, *10414*, *10470*
**Macaranga reiteriana* Pax & Hoffman, *10496*, *10508*
* *Mallotus papuanus* (J.J. Sm.) Pax & Hoffman, or aff., *10947*
Omalanthus novo-guineensis (Warburg) K. Schum., *10407*, *10957*

FAGACEAE

Castanopsis acuminatissima (Blume) A. DC., *11082*
Lithocarpus cf. *celebicus* (Miq.) Rehd., *10785*

FLACOURTIACEAE

Flacourtia zippelii Slooten, *11039*
Pangium edule Reinw., SR from Camp 4

GESNERICACEAE

Aeschynanthus sp. A, *10442*
Aeschynanthus sp. B, *10630*
Aeschynanthus sp. C, *10678*
Cyrtandra fusco-vellea K. Schum., *11009*
Cyrtandra aff. *janowskyi* Schltr., *10897*, *11078*
Cyrtandra sp., subgenus *Cyrtandra*, *10443*, *10741*
Cyrtandra sp., subgenus *Cyrtandra*, *10510*
Cyrtandra sp., § *Diplochiton*, *10469*, *10715*
Cyrtandra sp., cf. § *Diplochiton*, *10506*, *10599*
Cyrtandra sp., cf. § *Diplochiton* or § *Loxolobus*, *10440*
Cyrtandra sp., § *Geodesme*, *10383*, *10452*, *10681*
Cyrtandra sp., § *Loxophyllum*/*Phaeotrichium*, *10577*, *10637*, *10840*
Cyrtandra sp., cf. § *Loxophyllum*/*Phaeotrichium*, *10734*
Cyrtandra sp., § *Macrocyrtandra*, *10631*
Cyrtandra sp., *10709*; possibly = sp.*10443*
Dichrotrichum sp., *10636*, *10883*
Rhynchoglossum obliquum Blume, *10986*

GOODENIACEAE

Scaevola oppositifolia R. Br., *10832*

GROSSULARIACEAE

Polyosma aff. *subalpina* Schultz-Menz, *10555*, *10677*

HALORAGACEAE

Gonocarpus halconensis (Merrill) Orchard, *10600*

Gunnera macrophylla Blume, *10420*

HYDRANGEACEAE
Dichroa febrifuga Lour., *10426*; '*sylvatica* complex'

LAMIACEAE/LABIATAE
**Basilicum* sp., *10626*, *10972*
Orthosiphon aristatus (Blume) Miq., *10966*
Plectranthus parviflorus Willd., *10581*

LAURACEAE
Actinodaphne nitida Teschner, *11105*
Actinodaphne tomentosa Teschner, *10752*
Cinnamomum clemensii Allen, *10649*
Cinnamomum cf. *podagricum* Kostermans, *10845*
Cryptocarya aff. *fuscopilosa* Teschner, *10516*
Cryptocarya nothofagetorum Kostermans, *10652*, *10680*, *10728*
Litsea carrii Kostermans, *10444*

LEEACEAE
Leea indica (Burm. f.) Merrill, *10825*, *11040*

LEGUMINOSAE/FABACEAE
Derris cuneifolia sensu Verdc., *11031*
Desmodium repandum (Vahl) DC., *10457*
Desmodium sequax Wall., *10895*, *11023*
Inocarpus '*rubidus* morphotype', *papuanus* group, *11083*; sensu Verdcourt
Mucuna novo-guineensis Scheff., SR from Camp 4
Pueraria pulcherrima (Koord.) Koord.-Schumacher, *11029*

LOGANIACEAE
Fagraea cf. *ceilanica* Thunb., *10729*
Fagraea elliptica Roxb., *11106*
Geniostoma aff. '*rupestre* complex', *10644*

LORANTHACEAE
Amyema squarrosum (Krause) Danser ssp. *squarrosum*, *10468*
Macrosolen cochinchinensis (Lour.) Tiegh. var. *cochinchinensis*, *10854*

MAGNOLIACEAE
Elmerrillia tsiampaca (L.) Dandy ssp. *tsiampaca*, *10738*

MELASTOMATACEAE
Astronia atro-viridis Mansfeld, *10437*, *10612*
**Astronidium* cf. *novoguineense* Merrill & Perry, *10762*
Astronieae indet., *10523*; probably *Astronia* sp.
Beccarianthus sp., *10902*
Creochiton novoguineensis (Baker f.) Veldkamp & Nayar, *11094*
Dissochaeta angiensis Ohwi, *10790*
Medinilla albida Merrill & Perry, *10654*
Medinilla aff. *albida* Merrill & Perry, *10556*; but leaves sessile
Medinilla dentata Veldkamp, *10666*
Medinilla hollrungiana Mansfeld, *10852*
Medinilla aff. '*lorentziana-teysmannii* group', *10862*; closer to *lorentziana*
Medinilla sogeriensis Baker f., or aff., *10406*
Medinilla teysmannii Miq., *10977*
**Medinilla* sp. nov., *10408*
Melastoma malabathricum L., *10398*
Otanthera adpressa Mansfeld, *10888*
Poikilogyne furfuracea Markgr., *10400*
Poikilogyne macrophylla (Cogn.) Mansfeld, *11095*

MELIACEAE
Aglaia cf. *silvestris* (M. Roemer) Merrill, *10665*; but leaflets symmetric
Aglaia aff. '*tomentosa* group', *10813*; but inflo. pendant, ?new
Chisocheton lasiocarpus (Miq.) Valeton, *11000*; *formicarum-pachyrhachis*
Dysoxylum enantiophyllum Harms, *10438*, *10751*

MONIMIACEAE
Kibara karengana Philipson, *10554*
Levieria montana Becc., *11049*
Palmeria arfakiana Becc., *10401*
Palmeria gracilis Perkins, *10876*
Steganthera hospitans (Becc.) Kanehira & Hatusima, *11041*
Steganthera ilicifolia A.C. Smith, *10593*, *10749*
**Steganthera insculpta* Perkins, *10513*, *10672*

MORACEAE
Ficus adelpha Laut. & K. Schum., *10903*
Ficus arbuscula Laut. & K. Schum., *11038*
Ficus comitis King, *11100*
Ficus opposita Miq., *10726*, *10730*
Ficus pungens Reinw. ex Blume, SR from Camps 3 and 4
Streblus urophyllus Diels, *10601*

MYRISTICACEAE
Myristica pachyphylla A.C. Smith, *10660*
Myristica subalulata Miq., *10787*, *10929*
Myristica velutina Markgr., *10711*

MYRSINACEAE (dets. by J. Pipoly)
Ardisia forbesii S. Moore, or aff., *11060*
Ardisia sp., *10718*
Conandrium polyanthum (Laut. & K.Schum.) Mez, *10824*
Fittingia sp., *10661*, *10745*
Maesa papuana Warburg, *10960*; det. WT
Myrsine acrostica (Mez) Pipoly, *10857*
**Myrsine* aff. *acrostica* (Mez) Pipoly, *10958*; possible sp. nov.
Myrsine leucantha (K. Schum.) Pipoly, *10573*, *10671*

MYRTACEAE

Kania eugenioides Schltr., *10540*, *10648*
Metrosideros ramiflora Laut. var. *humilis* (Diels) Dawson, *10474*
Rhodomyrtus novoguineensis Diels, *10568*
Syzygium cf. *longipes* Merrill & Perry, *10914*
Syzygium malaccense (L.) Merrill & Perry, s. lat., *10719*
*Syzygium aff. megistophyllum Merrill & Perry, *11068*
Xanthomyrtus montivaga A.J. Scott, *10602*

NEPENTHACEAE

Nepenthes maxima Nees, *10592*, *10713*

OCHNACEAE

Schuurmansia henningsii K. Schum., *10515*; characteristic robust form
Schuurmansia henningsii K. Schum., *10409*; diminutive form

PIPERACEAE

Peperomia cf. *gurakorana* Dull, *11067*
Peperomia pellucida (L.) Kunth, *10695*
Piper bolanicum Chew, *10411*
Piper caninum Blume, *11072*
**Piper lessertianum* (Miq.) C. DC., *10874B*, *10927*
Piper cf. *pseudoamboinense* C. DC., or aff., *10975*
Piper radatzii K. Schum. & Laut., *10541*, *10702*, *10773*, *11032*
Piper subbullatum K. Schum. & Laut., *10822*
Piper subcanirameum C. DC., *10486*
Piper triangulare Chew, *10552*

PITTOSPORACEAE

Pittosporum pullifolium Burk. ssp. *ledermannii* (Pritzel) Schodde var. *ledermannii*, *10618*
Pittosporum sinuata Blume var. *sinuata*, *11058*
Pittosporum sinuata Blume var. *efuniculare* Steen., *10405*, *10655*, *10689*

POLYGALACEAE

Polygala paniculata L., *10834*

POLYGONACEAE

Muehlenbeckia platyclada (F. Muell.) Meissn., *10934*
Polygonum chinense L., *10466*

PROTEACEAE

Helicia cf. *forbesiana* F.v.M., *11103*
Helicia microphylla Diels, *10609*
Helicia obtusata Sleumer, *10638*
Helicia oreadum Diels, or aff., *10917*

RHAMNACEAE

Alphitonia excelsa (Fenzl) Reiss. ex Endl., SR from Camp 3
Ziziphus papuanus Laut., or *Z. djamuensis* Laut., SR from Camp 4

ROSACEAE

Prunus dolichobotrys (K. Schum. & Laut.) Kalkman, *11037*
Prunus pullei (Koehne) Kalkman, *10608*
Prunus sclerophylla Kalkman, *10742*
**Prunus* sp. nov., *10588*
Rubus archboldianus Merrill & Perry, *10451*, *10563*
Rubus moluccanus L. var. *moluccanus*, *11013*
Rubus moluccanus L. var. *obtusangulus* Miq., *10453*
Rubus trigonus Kalkman, *10463*

RUBIACEAE

Airosperma ramuense Laut. & K. Schum., *10905*
Argostemma sp., *10385*; not *A. bryophilum*
Dolicholobium oxylobum K. Schum., *11042*
Gardenia pallens Merrill & Perry, *10625*
Hedyotis congesta R. Br., *10965*
Hedyotis pubescens Valeton, *11080*
Hydnophytum radicans Becc., *10943*
Hydnophytum virgatum Valeton, *11069*
Ixora dolichothyrsa Brem., *10945*
Morinda umbellata L. var. *papuana* Valeton, *10886*
Mussaenda oreadum Wernham, *10867*; det. O. Gideon
Mussaenda scratchleyi Wernham, *11097*; conf. O. Gideon
Mycetia javanica (Blume) Reinw. ex Korth., *10978*
Myrmecodia melanacantha Huxley & Jebb, *10720*
Myrmecodia schlechteri Valeton, *10720B*
Nertera granadense (Mutis ex L. f.) Druce, *10504*
Ophiorrhiza aff. *?amoena* Valeton, *10991*, *11019*
Ophiorrhiza debruynii Valeton, *10382*
Ophiorrhiza tenelliflora Valeton, *10926*
Pavetta platyclada K. Schum., *10983*
Psychotria amplithyrsa Valeton, *10791*
Psychotria multicostata Valeton, *11065*
Psychotria aff. '*nanifrutex* group', *10662*
Psychotria olivacea Valeton, *11102*
Psychotria phaeochlamys (Laut. & K. Schum.) Valeton, *10982*
Psychotria ramadecumbens Sohmer, *10768*
Psychotria valetoniana Sohmer, *10399*, *10941*
**Psychotria* sp. nov., *11090*
Tarenna barbellata Valeton, or aff., *10830*
Timonius belense Merrill & Perry, *10587*
Timonius aff. *xanthocarpus* Merrill & Perry, *10418*
Uncaria bernaysii F.v.M., *10827*
Urophyllum brittanicum Wernham, or aff., *10756*

RUTACEAE

Acronychia ledermannii Laut., *10717*, *10750*
Flindersia pimenteliana F.v.M., *10944*
Melicope sp. A, *10606*; small trifoliolate leaves, congested inflorescence
Melicope sp. B, *10615*; subcaudate petiolate leaflets
Melicope sp. C, *10823*; gestalt like *Melicope*

mucronata; leaflets villous, sessile, to *37* cm × *20* cm
Melicope sp. D, *10892*; glabrous obovate leaflets

SABIACEAE

Sabia pauciflora Blume, *11026*
Meliosma pinnata (Roxb.) Maxim. ssp. *humilis* (Merrill & Perry) Beus., *10488*
Meliosma pinnata (Roxb.) Maxim. ssp. *macrophylla* (Merrill) Beus., *11107*

SANTALACEAE

Cladomyza cuneata Danser, *10436*

SAPINDACEAE

Arytera aff. *multijuga* or *macrobotrys*, *10976*
Cupaniopsis macropetala Radlk., *11089*
Guioa comesperma Radlk., *11094A*
Pometia pinnata Forst. & Forst. f., SR from Camps 3 and 4
Sarcopteryx crispata Welzen, *11101*

SAPOTACEAE

Planchonella monticola (Krause) H.J. Lam, *10589*; presumably better as *Sideroxylon monticola* Krause

SOLANACEAE

Solanum anfractum Symon, *10530*; det. Symon
Solanum rostellatum Merrill & Perry, *10663*; det. Symon

SPHENOSTEMONACEAE

Sphenostemon papuanus (Laut.) Steen. & Erdtman, *10731*

STERCULIACEAE

Sterculia ampla Baker f., *10963*
Sterculia schumanniana (Laut.) Mildbr., *11085*
Sterculia cf. *schumanniana* (Laut.) Mildbr., *11081*

SYMPLOCACEAE

Symplocos cochinchinensis (Lour.) S. Moore, *10566*
Symplocos cf. *cochinchinensis* (Lour.) S. Moore, *10415*
Symplocos cochinchinensis (Lour.) S. Moore ssp. *leptophylla* (Brand) Nooteb., *10614*, *10746*
Symplocos cochinchinensis (Lour.) S. Moore var. *schumanniana* (Brand) Nooteb., *10748*, *10843*, *10961*
cf. *Symplocos*; small leaves, ?uniflorous, *10507*

THEACEAE

Eurya cf. *leptantha* Diels, *10394*
Eurya sp., '*leptantha-merrilliana* group', *10657*
Eurya tigang K. Schum. & Laut., *10421*, *10571*
Ternstroemia britteniana F.v.M., *10532*, *10624*
Ternstroemia cherryi (F.M. Bail.) Merrill, SR between Camps 3 and 4

THYMELAEACEAE

Phaleria macrocarpa (Scheff.) Boerl., *10430*

TRIMENIACEAE

Trimenia papuana Ridley, *10393*, *10402*

ULMACEAE

Parasponia rigida Merrill & Perry, *10567*
Trema cannabina Lour., *10918*

URTICACEAE

Boehmeria platyphylla D. Don, s. lar., *11016*
Boehmeria sp., *10522* (m); ?*Cypholophus*
Cypholophus nummularis H. Winkler, *11018*
Debregeasia sp., *10464*
Elatostema beccarii Schroeter, *10894*
Elatostema aff. *belense* Perry, *10891*, *10994*
Elatostema blechnoides Ridley, *10450*, *10478*
Elatostema macrophyllum Brongn., *10979*
Elatostema mongiense Laut., *10535*
Elatostema morobense Perry, *10433*
Elatostema novo-guineense Warburg, *10885*, *10896*, *11022*
Elatostema tridens Perry, *10475*
Elatostema weinlandii K. Schum., *11096* (f)
Laportea decumana (Roxb.) Wedd., *10974*
Leucosyke capitellata (Poir.) Wedd., *11044*
Pilea effusa H. Winkler, *10512*
Pilea ledermanni H. Winkler, *10687*
Pilea stenoneura H. Winkler, *10521*, *10410*
**Pilea* sp. nov., *10481*, *10559*, *10740*
Pipturus argenteus (Forst. f.) Wedd., *10446* (m), *10500* (f), *10990* (f)
Pipturus pullei H. Winkler, or aff., *10511*
Poikilospermum inaequale Chew, *10858* (f), *10984* (m)
Procris frutescens Blume, *10901*
Procris sp., *10981*

VERBENACEAE

Callicarpa longifolia H.J. Lam, *10973*
Geunsia pentandra (Roxb.) Merrill, *10821*
Stachytarpheta cayennensis (Rich.) Vahl, *11028*

VITACEAE

Cayratia geniculata Blume, or aff., *11027*
Cayratia japonica (Thunb.) Gagn., SR from Camp 4
Cissus aristata Blume, *10948*
Cissus discolor Blume, SR from Camp 3
Tetrastigma lauterbachianum Gilg, *11033*

WINTERACEAE

Zygogynum oligocarpum (Schltr.) Vink, *11084*
Zygogynum cf. *sylvestre* (A.C. Smith) Vink, *10850*

FAMILY INDET., *10425*, *10431*

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REFERENCES

AIRY SHAW, H.K. 1973. New or noteworthy species of *Antidesma* (Stilaginaceae): III. Kew Bull. 28:269–281.

AIRY SHAW, H.K. 1979. New or noteworthy species of *Antidesma* (Stilaginaceae): V. Kew Bull. 33:423–427.

AIRY SHAW, H.K. 1980. The Euphorbiaceae of New Guinea. Kew Bull. Addit. Ser. 8.

BARLOW, B.A. 1981. Loranthaceae. In: Henty, E.E. (ed.), Handbooks of the flora of Papua New Guinea 2:206–254.

BARLOW, B.A. 1997. Loranthaceae. Flora Malesiana ser. I, 13:209–401.

BEEHLER, B.M. (ed.). 1993. Papua New Guinea conservation needs assessment, vol. 2. Corporate Press, Inc., Landover, Md.

BEEHLER, B.M. (ed.) 1997 (unpublished). Rapid Assessment Program Working Papers. A biodiversity assessment of southern New Ireland, Papua New Guinea. Conservation International, Washington DC.

BROWNSEY, P.J. 1987. A review of the fern genus *Hypolepis* (Dennstaedtiaceae) in the Malesian and Pacific regions. Blumea 32:227–276.

CRAVEN, L. 1980. A new *Rhododendron* (Ericaceae) from New Guinea. Notes Roy. Bot. Gard. Edinburgh 38:141–144.

FRODIN, D.G. 1982. *Schefflera*. In: Royen, P. van, The alpine flora of New Guinea 3:3040–3083.

GRUBB, P.J. and P.F. STEVENS. 1985. The forests of the Fatima Basin and Mt. Kerigomna, Papua New Guinea: with a review of montane and subalpine rainforests in Papuasia. Australian Nat. Univ./Anutech, Dept. Biogeogr. & Geomorph., Research School of Pacific Studies, Publ. BG/5, Canberra.

HAMMERMASTER, E.T. and J.C. SAUNDERS. 1995. Forest resources and vegetation mapping of Papua New Guinea. PNGRIS Publ. no. 4, Canberra, CSIRO and AIDAB.

HARTLEY, T.G. and L.M. PERRY. 1973. A provisional key and enumeration of species of *Syzygium* (Myrtaceae) from Papuasia. J. Arnold Arbor. 54:160–227.

HEDEMARK, M., S. HAMILTON, and W. TAKEUCHI. 1997. Report on the first Bismarck-Ramu biological survey with sociological and logistical comments. PNG Dept. of Environ. and Conserv., Port Moresby.

HOLTTUM, R.E. 1981. Thelypteridaceae. Flora Malesiana ser. II, 1 (5):331–599.

JOHNS, R.J. 1993. Biodiversity and conservation of the native flora of Papua New Guinea. In: B. Beehler, ed. Papua New Guinea conservation needs assessment report, vol. 2, Corporate Press, Inc., Landover, MD. Pp. 15–75.

KALKMAN, C. 1965. The Old World species of *Prunus* subg. *Laurocerasus* including those formerly referred to *Pygeum*. Blumea 13:1–115.

KALKMAN, C. 1993. Rosaceae. Flora Malesiana ser. I, 11 (2):227–351.

KENG, H. 1978. Labiatae. Flora Malesiana ser. I, 8 (3):301–394.

KULANG, J., O. GEBIA, and L. BALUN. 1997. A study on the biological diversity of the Hagahai area in the Madang Province, Papua New Guinea. Unpublished; informally distributed as photocopies.

MANSFELD, R. 1925. Die Melastomataceen von Papuasien. Bot. Jahrb. Syst. 60:105–148.

MATHEW, B. 1995. Editorial. Bot. Mag.12(2):51.

MAXWELL, J.F. and J.F. VELDKAMP. 1990. Notes on the Astronieae (Melastomataceae) - II. *Astronidium, Beccarianthus*. Blumea 35:115–164.

PHILIPSON, W.R. 1979. Araliaceae-I. Flora Malesiana ser. I, 9 (1):1–105.

PHILIPSON, W.R. 1986. Monimiaceae. Flora Malesiana ser. I, 10 (2):255–326.

ROYEN, P. VAN. 1964. Manual of the forest trees of New Guinea. Part 2 - Sapindaceae. Department of Forests, Division of Botany.

ROYEN, P. VAN. 1982. The alpine flora of New Guinea. Volume 3: taxonomic part Winteraceae to Polygonaceae. J. Cramer, Vaduz. Pp. 1233–2404.

SMITH, R.M. 1978. *Alpinia* sect. *Pycnanthus* and its New Guinea species. Notes Roy. Botanic Gard. Edinburgh 36:273–292.

SOHMER, S.H. 1988. The nonclimbing species of the genus *Psychotria* (Rubiaceae) in New Guinea and the Bismarck Archipelago. Bishop Mus. Bull. Bot. 1:1–339.

TAKEUCHI, W. and J. KULANG. 1998. Vegetation part 2: Botanical survey. In: Mack, A., ed. A biological assessment of the Lakekamu Basin, Papua New Guinea. Rapid Assessment Program Working Papers No. 9. Conservation International, Washington, DC. Pp. 36–39, 105–130.

TAKEUCHI, W. and J. PIPOLY. 1998. New flowering plants from southern New Ireland, Papua New Guinea. Sida 18:161–168.

WHITMORE, T.C. 1980. *Macaranga*. In: Airy Shaw, H.K., The Euphorbiaceae of New Guinea. Kew Bull. Addit. Ser. 8:123–162.

WINKLER, H. 1922. Die Urticaceen Papuasiens. Bot. Jahrb. Syst. 57:501–608.

WOMERSLEY, J.S. (ed.) 1978. Handbooks of the flora of Papua New Guinea. Vol. I. Melbourne University Press.

STUDIES IN NEW WORLD *AMARANTHUS* (AMARANTHACEAE)

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ABSTRACT

Amaranthus crassipes is recognized as consisting of two varieties: var. *crassipes* from the West Indies, coastal Mexico-Texas-Louisiana, and northern South America, and var. *warnockii* of the Chihuahuan Desert region of Texas and Mexico. *Amaranthus scleropoides* contains two morphs that are not taxonomically recognized. *Amaranthus* × *texensis*, considered of hybrid origin between *A. crassipes* and *A. scleropoides*, is described as new. *Amaranthus berlandieri* is not considered as distinct from the more wide ranging *A. polygonoides*. A new species, *Amaranthus tamaulipensis*, is described from southmost Texas and eastern Mexico. It is related to *A. dubius* and the poorly known *A. brandegei* of Sinaloa. An enigmatic *Amaranthus* × *tucsonensis* is described from the Tucson Mountains of southern Arizona, with related populations occurring in Sonora, Mexico.

RESUMEN

Se reconoce a *Amaranthus crassipes* como constituida por dos variedades: la var. *crassipes*, con distribución desde la costa de México, Texas y Louisiana, a través del Caribe hasta el norte de Sudamérica; y la var. *warnockii*, de la región del Desierto Chihuahuense. *Amaranthus scleropoides* consiste de dos fases morfológicas sin designación de rango taxonómico formal. La notoespecie nueva *Amaranthus* × *texensis* probablemente se originó de la hibridación entre *A. crassipes* y *A. scleropoides*. No se considera a *A. berlandieri* como diferente de *A. polygonoides*, especie de más amplia distribución. Se describe *Amaranthus tamaulipensis*, especie nueva del este de México y la parte más meridional de Texas. Esta especie está relacionada con *A. dubius* y con *A. brandegei*, taxon sinaloense pobremente conocido. Se describe la enigmática *Amaranthus* × *tucsonensis* como notoespecie nueva de la Sierra de Tucson, del sur de Arizona.

KEY WORDS: Amaranthus, Amaranthaceae, plant taxonomy, plant systematics, hybridization.

Studies in the Amaranthaceae in connection with the Chihuahuan Desert Flora have resulted in this paper on the systematics of the *Amaranthus crassipes-A. scleropoides* and *A. polygonoides* groups. Two additional taxa are described as new.

The *Amaranthus crassipes-A. scleropoides* group has dichasial clusters of flowers borne at all nodes from the base of the plant to the tip. The inflorescences are modified compound dichasia in which the terminal flowers are overtopped by opposite, sinuous peduncles that bear one to a few pairs of persistent bracts with mostly male flowers and terminate in pistillate flowers that are again overtopped by similar paired, sinuous peduncles. As the peduncles

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mature they become greatly thickened and indurated in some species and trap the fruit between the expanded peduncles (Fig. 3A, D). Gray (1862) considered thickened peduncles to be an abnormal character in *A crassipes*, but Holzinger (1892) showed they were consistently produced in that species, caused by a proliferation of expanded parenchyma cells that develop thickened walls. At maturity, the entire inflorescence falls from the plant and serves as a dispersal unit capable of flotation.

VARIATION WITHIN *AMARANTHUS CRASSIPES*

Amaranthus crassipes Schltdl. is a widespread New World species occurring from the West Indies, Bahamas, Florida Keys, Arizona, Texas, Mexico, Colombia, and Venezuela (Fig. 1)—its type locality is on St. Thomas in the Virgin Islands. The species consists of decumbent-procumbent, glabrous, monoecious annuals with ovate-obovate to lanceolate, long-petiolate leaves. The flowers are produced at each node usually from the base of the plant upwards in short dichasia 5–10 mm long (Fig. 2C, E). The dichasia develop the aforementioned greatly thickened, indurate, strongly sinuous lateral axes (Fig. 3A). The female flowers have 5 erect to spreading, narrowly spatulate sepals that are thickened and joined at the base (Fig. 3B). They are usually shorter than the fruit. The fruit wall is closely adherent to the seed and indehiscent, although it may develop a colored encircling line below the middle. It is usually smooth below and somewhat tuberculate above and along the margins. The 2(–3) styles are joined together into a distinctive lyrate-shaped neck before they taper and diverge as slender tips (Fig. 2A–C). The male flowers are produced on the sides of the developing inflorescence axes. They mature and fall away before the inflorescence axes thicken and they have 5 membranous sepals and three anthers.

Throughout the Caribbean region the plants are initially erect but usually become procumbent weeds in disturbed places. They usually have ovate, broadly ovate to obovate leaves that may either be uniformly small or, in fast growing plants, large in size. (Fig 2C). Similar ovate-leaved plants also occur in northern South America, the Yucatan Peninsula, northeast Mexico, coastal Texas, Louisiana, Key West (Florida) as well as Sonora and Arizona. In contrast, plants in inland Texas and in the Chihuahuan Desert region, develop narrower, more oblanceolate, grayish leaves (Fig. 2E). They also tend to be more erect or decumbent in growth habit, features that are shared with the related *A. scleropoides*. The grayish color of the leaves also make the reticulate pattern of the Kranz structure less conspicuous. In 1944 I.M. Johnston described these inland plants as *Amaranthus warnockii*, distinguishing the species by its elongate, somewhat thinner oblanceolate leaves, its less elongate, more slender stems, and smaller more compact cymes conspicuously crowded at the stem bases. Except for the narrower, more oblanceolate-lan-

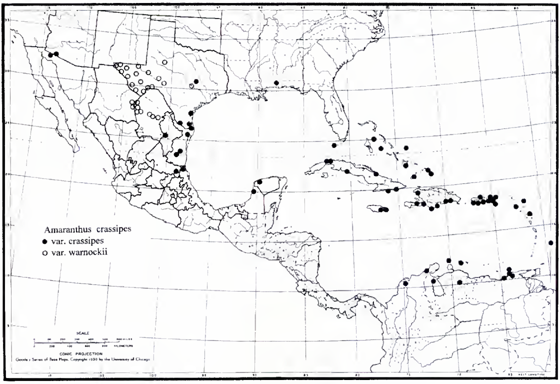

FIG. 1. Distibution of *Amaranthus crassipes* var. *crassipes* and var. *warnockii.*

ceolate leaves, all the other features noted by Johnston also occur in occasional plants of *A. crassipes* throughout its range. In all technical characters of flowers, fruit and inflorescence, *A. warnockii* and *A. crassipes* are identical.

Recognition of these two taxa at the species level is considered unjustified as the distinguishing features are minor and to some extent inconsistent and recognition would create poorly differentiated microspecies within this highly variable genus. But overall the group of specimens referable to *A. warnockii* can be recognized solely on the basis of the narrower, more oblanceolate, grayish leaves. Because of this *A. warnockii* is here retained at the varietal level as it represents a geographically based subunit of the species (Fig. 1). Correll and Johnston (1970), in contrast, considered *A. warnockii* synonymous with *A. crassipes.* The collections from southern Arizona and adjacent Sonora, however, have distinctly ovate leaves and fall within var. *crassipes*. A formal description of *A. crassipes* follows.

AMARANTHUS CRASSIPES

Low spreading, taprooted, procumbent to decumbent, basally branched, monoecious annuals, sometimes with the central stems erect-ascending; stems glabrous, striate, stramineous, moderately branched, 1–4(–9) dm long; internodes 1.5–4 cm long below, reduced to 5–15 mm long distally. Leaves alternate, ascending, (12–)30–55(–78) mm long, the petioles slender, (5–) 10–25(–47) mm long; leaf blades broadly to narrowly obovate to ovate, to oblanceolate or elliptical, (7–)20–30(–50) mm long, (5–)10–20(–28) mm wide, obtuse to rounded, usually retuse with the midvein short-excurrent at the tip, narrowly acuminate-cuneate at the base, the margins entire to erose-crisped, whitish, the veins curved towards the tip, but not extending to the margins, distinctly whitened beneath, the lamina glabrous, with distinct Kranz internal anatomy. Flowers borne in axillary, congested, tan or rarely dark brown, glomerate dichasia 5–9 mm long usually borne at all nodes from the base of the plant upwards, the dichasia decussately branching below each pistillate flower, the branches strongly sinuate-curved, becoming thickened and indurated, 0.9–1.2(–1.6) mm thick and crowding-enclosing the developing fruit; bracts and bracteoles broadly deltate, 0.5–0.9 mm long, green along the midrib, the margins scarious, broadly attached at the base, persisting on the sides of the thickened dichasia. Staminate flowers produced on the sides of the developing dichasia, with 5, subequal, lanceolate sepals 1.2–1.6 mm long, these membranous except where green along the midrib, acute; stamens 3; anthers 0.7–0.9 mm long; filaments 1.5–2 mm long. Pistillate flowers born at each branch of the dichasium; fruiting sepals 5, with 2 at each margin of the fruit and with a smaller sepal on one face, 2 on the other face, the sepals distinctly clawed or merely spatulate, 1.4–2.3 mm long, the claws narrowly linear, 0.1–0.2 mm wide, keeled, expanding to ovate, acute, slightly keeled, conduplicate, sometimes slightly reflexed tips 0.5–1 mm long and nearly as wide, the tips each with a green in a trullate patch medially and with membranous margins, the sepals expanding to become spongy-indurate, tan, united and truncated around the fruit base. Fruiting ovary compressed orbicular-obovate, 1.3–1.5 mm wide and long (excluding the style), the fruit wall somewhat thickened, closely surrounding the seed, indehiscent or in some plants with a darkened line in the lower half, usually but not consistently smooth below, distinctly tuberculate above and along the margins, topped with the persistent style; the styles 2(–3), about 1.5 mm long, connate and erect for 0.2–0.5 mm below, the yellowish lobes erect or usually lyrate, curving outward, then inward as they taper, terminating as slender outwardly curved appendages, the papillate-stigmas extending all along the inner surface of the styles onto the terminal slender portions. Seeds compressed-obovoid, 1.1–1.3 mm long, 0.9–1.1 mm wide, 0.6–0.7 mm thick, shinny, dark brown-black, the margin obtuse to somewhat rounded, the surface shiny, with a visible cellular surface pattern. With two varieties:

Amaranthus crassipes Schltdl. var. **crassipes (Figs. 2A–C, 2A–B)**. Linnaea 6:757. 1831 (as *Amarantus*). *Scleropus crassipes* (Schltdl.) Moq. in DC. Prod. 13^2:271. 1849; *Euxolus crassipes* (Schltdl.) Hieron., Bol. Acad. Nac. Córdoba 4:13. 1881. TYPE: WEST INDIES. St. Thomas Island. (Ad rivulos insulae St. Thomae, 1826–1828)

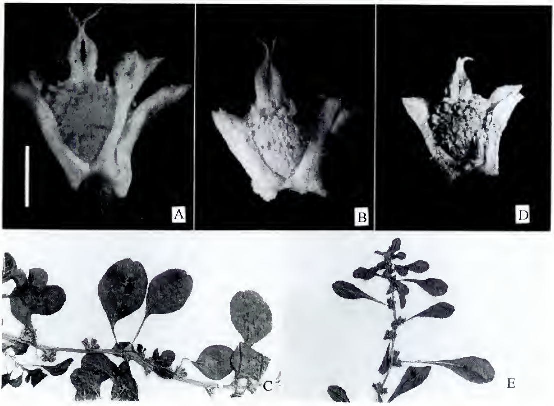

FIG. 2. Fruits and foliage of *Amaranthus crassipes*. A–C. *A. crassipes* var. *crassipes*. A. Mature fruit: note characteristic lyrate styles and clawed sepals that are united at the base (Cameron Co., Tex., *Runyon 658*, TEX). B. Mature fruit (Antigua, *Box 573*, NY). C. Characteristic ovate leaf blades (Apalachicola, Fla., *Chapman Herb. 3383*, (NY). D–E. *A. crassipes* var. *warnockii*. D. Mature fruit (Presidio Co. Tex., *Hinckley 129*, SRSC). E. Characteristic oblanceolate leaf blades (Terrell Co., Tex. *Warnock & Johnston 17209*, SRSC). White bar in A = 1 mm for A, B, D, = 2 cm for C, E.

Ehrenberg s.n. (HOLOTYPE: HAL). Dr. U. Braun has sent a xerox copy of the holotype from HAL, deposited TEX.

Scleropus amaranthoides Schrad., Index sem. Hort. gott. 1835; (reprinted in: Linnaea 11: Litt.-ber. 89. 1837). TYPE: unknown.

Plants typically erect when young but becoming procumbent, occasionally decumbent, *leaf blades ovate to broadly ovate, sometimes nearly orbicular or obovate*, (7–)15–30(–50) mm long, (5–)10–15(–28) mm wide, the *lower surface green to yellow-green*, distinctly marked by the whitish, arcuate veins.

Weed in roadsides, waste grounds, fields, pastures, in clay, silty, sometimes sandy flats, beaches, and rocky slopes in shaded or open habitats, widespread in the Caribbean region, south Florida, coastal Louisiana, Alabama (adventive), Texas, northeastern Mexico south to northern South America (Columbia, Peru), from sea level to 250(–1250) m (Fig. 1). It also occurs in Arizona, Sonora, Chihuahua at higher elevations. Collected throughout the year but expected to be vegetatively active during hot months due to C4 photosynthetic pathway.

Amaranthus crassipes Schltdl. var. **warnockii** (I.M. Johnston) Henrickson, comb. nov. (**Fig. 2D-E**). Basionym: *Amaranthus warnockii* I.M. Johnston, J. Arnold Arbor. 25:153. 1944. TYPE: MEXICO. COAHUILA: a mi SE of Ocampo, low place near mogote on plain, 8 Sep 1941, *I.M. Johnston 8886* (HOLOTYPE: GH!).

Plants initially erect when young, the lateral branches becoming decumbent, ascending terminally; *leaf blades oblanceolate to narrowly oblanceolate*, (12–)16–33(–44) mm long, (4–)6–10(–16) mm wide, the *surfaces more glaucous-green*, the veins of the lower surface slender, not conspicuous.

Open silty flats, mesquite thickets, muddy areas to 1300 m elevation, in south-west Texas and in the Chihuahuan Desert in Coahuila and eastern Chihuahua (Fig. 1).

AMARANTHUS SCLEROPOIDES

In 1895 Uline and Bray described a second species related to *A. crassipes* differing in its circumscissile, smooth utricle and 3 style branches. Uline and Bray considered *Amaranthus scleropoides* intermediate between *A. crassipes* and *A. graecizans auth. non* L. (now *A. albus* L.), the latter also having 3 styles and circumscissile utricles. Vegetatively and in inflorescence structure, *A. scleropoides* is very similar to *A. crassipes,* but *A. scleropoides* is a taller, bushier plant. While its mature utricles are uniformly circumscissile, the pistillate flowers are somewhat variable in sepal structure, style number and other features. Mature sepals vary from 1.2–2.5 mm in total length. As in *A. crassipes,* two sepals are usually distributed at each edge of the mature fruit, with a two on one face and a one smaller sepal on the other face. The sepals are clawed and vary greatly in development. In some specimens the blade portion is erect, green, rounded, apiculate and rather flattened, however, in others, including the type collection, the tips are distinctly thickened, keeled, conduplicate, recurved, and sharp pointed, with a central green rhomboid patch (Fig. 4C). Styles vary from two to three (Fig. 4A–B), or rarely five (1-flower on *Cory 2933* GH), with some plants being consistently two styled and others with varying numbers. In flowers with two styles, the styles are located directly over the margins of the compressed ovary and as the fruit mature the styles develop distinct decurrent ridges that extend down the fruit margins. When styles are three, the third, often reduced style, develops on one of the faces, again with a distinct decurrent base. The surfaces of the utricle may be smooth or tightly turberculed.

Among collections observed, two distinct forms are recognizable based on differences in the development of the styles and upper ovary wall. The most common form has distinctly spongy-thickened style bases and the upper

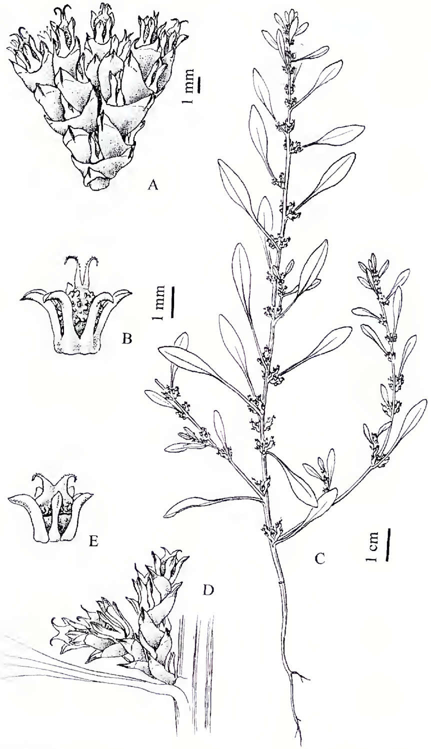

FIG. 3. *Amaranthus crassipes* and *A. scleropoides*. A–B. *A. crassipes* var. *crassipes*. A. Mature dichasial inflorescences have spongy-thickened, indurated lateral branches; the external bracts subtended male flowers, the female flowers are located at the base and tips of the inflorescence branches (Jamaica, *Proctor 23937*, NY). B. Mature fruit-calyx (Jamaica, *Proctor 23937*, NY). C–E. *A. scleropoides*. C. Young plant with characteristic narrow leaf blades, axillary inflorescences. D. Mature inflorescence. E. Mature fruit and calyx (all Williams Co., Tex., *Walcott 303*, TEX). Magnifications in A & B hold for D & E.

utricle is indurated and stramineous in color (Fig. 4A–B). The styles are papillate (stigmatic) along their inner margins and the papillae continue onto the slender terminal lobes. A second form does not develop expanded, indurated thickenings on the style bases and upper fruit and the two or three styles are thus clustered at the top of the fruit (Fig. 4C). The two forms both occur throughout the range of the species—they do not sort out geographically (Fig. 5). Because of this, and because this variation does not correlate with any other morphological or ecological variation, they are here recognized as unnamed forms. A description of the species follows.

Amaranthus scleropoides Uline & Bray, Bot. Gaz 19:316. 1894. **(Figs. 3C–E, 4A–C, 5).** TYPE: U.S.A. TEXAS: "Texas, Western Texas to El Paso," *Wright* 582; (LECTOTYPE: GH!; ISOLECTOTYPE GH!). Notation on lectotype by I.M. Johnston: "Texas: Val Verde County, *Wright* field number 798, Amaranth, Devil's River, summit of hills, 2 Aug 1849." The type has sepals with conduplicate, sharply divergent tips; the style base is not inflated as in some collections.

Very similar to *Amaranthus crassipes* vegetatively and in inflorescence and flower organization, but typically more erect, bushy, 2–5 dm tall and often as wide, with the lower stems ascending or decumbent and ascending to erect distally. Leaves with slender petioles (4–)10–25(–47) mm long; leaf blades lanceolate, oblanceolate to narrowly trullate, (5–)15–25(–42) mm long, (2) 5–10(–12) mm wide, glabrous, somewhat glaucous. Flowers borne in thickened, sinuate dichasia produced from the base to the top of the plant; staminate flowers with 5 sepals, 3 stamens. Pistillate fruiting sepals 5, with 2 at each margin of the fruit, two sepals on the one face, with one smallest sepal on the other face, the sepals moderately clawed to narrowly spatulate, in fruit (1.2–)1.5–2.2(–2.5) mm long, the claws 0.2–0.7 mm wide, the distal sepal blade typically broader, erect or variously reflexed, ± keeled and conduplicate, ± ovate-lanceolate, acute, with a small or large, central, green narrow to trullate green patch to 0.5–1 mm long, the margins membranous, the sepals expanding and becoming spongy-indurate, tan, and united around the fruit base. Fruiting ovary compressed orbicular-obovate, 1.1–1.3 mm wide and long (excluding the styles), the wall circumscissilly dehiscent, with a distinct brownish medial line, the body smooth or becoming closely turberculate above and less strongly tuberculate below the line of dehiscence, the styles 2–3(–5) [the third (fifth) one(s) smaller when present], arching outward from the upper margins of the fruit wall, the style bases continuing as decurrent ridges down the fruit wall, the lower portion of the styles and adjacent distal fruit wall (but not extending down to the line of dehiscence) often spongy-thickened, inflated, or the distal fruit wall and adjacent style bases only slightly inflated and ascending; the stigmas papillate, extending along the inner margin of the style lobes and continuing as slender tips for 0.4–0.5 mm. Seeds compressed obovoid, 1.0–1.1 mm long, 0.85–0.96 mm wide, 0.6–0.7 mm thick, dark brown–black, the margin obtuse to somewhat rounded, the surface shinny, with a slightly visible cellular surface pattern.

A NEW TAXON FROM SOUTHERN TEXAS

Within the complex of *A. crassipes* and *A. scleropoides*, a series of specimens from southern Texas are characterized by an erect-ascending growth habit and what appear to be circumscissile utricles as in *A. scleropoides*. However, the utricles are thick walled, weakly and closely tuberculate and are actually indehiscent as in *A. crassipes* although a distinct medial line is present. As in *A. crassipes*, the styles are united at the base into a distinct neck before they separate, but the 2–3 styles have distinct decurrent ridges that extend down the utricle wall as in *A. scleropoides* (Fig. 4E). These specimens also have rather narrowly lanceolate to linear-lanceolate, long petioled leaves, and they tend to have longer, more strongly reflexed pistillate sepals of a type sometimes found in *A. scleropoides*. The specimens, some of which are sterile and produce no mature seed, appear to represent hybrids or derivatives of hybridization, perhaps between *A. crassipes* and *A. scleropoides*. These collections are all from loose red sands to sandy loams in southern Texas in Duval, Webb, Hidalgo, and Atascosa counties of southern Texas, with one collection from adjacent Tamaulipas. They are of sufficient distinction to be recognized as a separate nothospecies.

Amaranthus × texensis Henrickson, nothosp. nov. (**Figs. 4D, 5**). TYPE: U.S.A. TEXAS. WEBB CO.: in red sand at roadside on Hwy. 83, 13 mi NW of Webb, 16 Jul 1957, *D.S. Correll & I.M. Johnston 18101* (HOLOTYPE: LL!; ISOTYPE: GH!).

A *Amarantho scleropoide* caulibus erecto-ascendentibus stylis (2–)3 et fructibus dehiscentibus semilis sed differt basibus stylaribus collum distinctum 0.2–0.4 mm longum formantibus (ut *A. crassipe*) et sepalis florum pistillatorum valde reflexis ad apices.

Annual herbs 10–35 cm tall; stems erect-ascending to decumbent, with scattered obscurely gland-tipped hairs to 0.3 mm long, glabrate. Leaf blades linear-oblanceolate, (5–)13–25(–40) mm long, 2–6(–8) mm wide, obtuse-emarginate with the midvein excurrent at the tip, narrowly cuneate, the margins extending well down the (3–)5–15(–20) mm long petiole, the margins whitish, crisped, the blades green to gray-green with the veins impressed above, stramineous and raised beneath. Flowers borne in short, thickened, axillary dichasial cymes produced at each node of the plant from base to tip, the cymes 3.5–6 mm long, the cyme axes sinuate, stramineous, spongy-thickened, indurate, 0.5–1 mm thick, bracteate, the bracts 1–1.5 mm long, green medially in a diamond pattern with broad clasping scarious bases, the staminate flowers early deciduous, the dichasial cymes bifurcating at the bases of each pistillate flower and terminating in pistillate flowers; staminate flowers: sepals 5, narrowly ovate, 1.5–1.8 mm long, membranous except along the excurrent midvein; stamens 3; mature pistillate flowers: sepals 5,

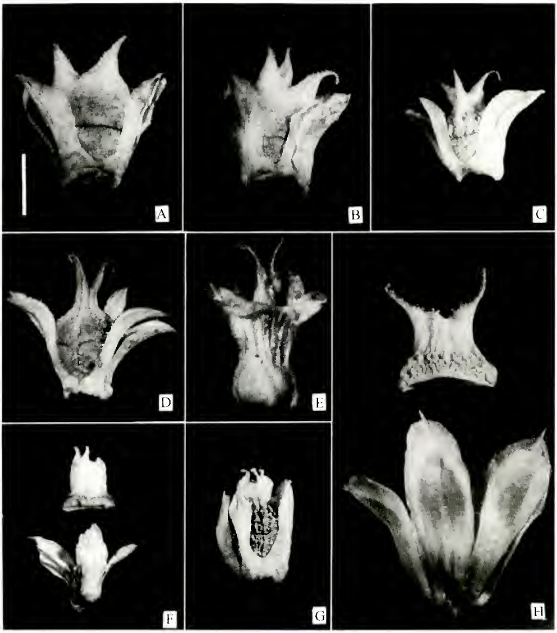

FIG. 4. Photographs of mature fruit and calyces. A–C. *Amaranthus scleropoides*. A–B. Fruit with inflated style bases, 2 or 3 styles (Cameron Co., Tex., *Runyon 2397*, F). C. Fruit with non-inflated style base, note recurved sepals (McLennon Co., Tex., *York 46249*, F). D. *A.* × *texensis*. Mature fruit; note narrow style base, sharply recurved sepals (Webb Co., Tex., *Correll & Johnston 18101*, LL-type). E. *A. polygonoides*. Mature fruit-sepals, note sepals have 3 veins and are inflated and indurated at base (Santo Domingo, *Ekman 1319.3*, US). F. *A. brandegei*. Mature calyx with reflexed, broad sepals, inflated top of pericarp (Sonora, México, *Brandegee s.n.*-TYPE, UC). G. *A. tamaulipensis*. Note spathulate, erect sepals, inflated pericarp top (Cameron Co., *Runyon 2170*, F). H. *A.* × *tucsonensis*. Mature calyx and pericarp top (Pima Co., Ariz., *Van Devender 88-876*, ARIZ). White bar in A = 1 mm holds for all figs.

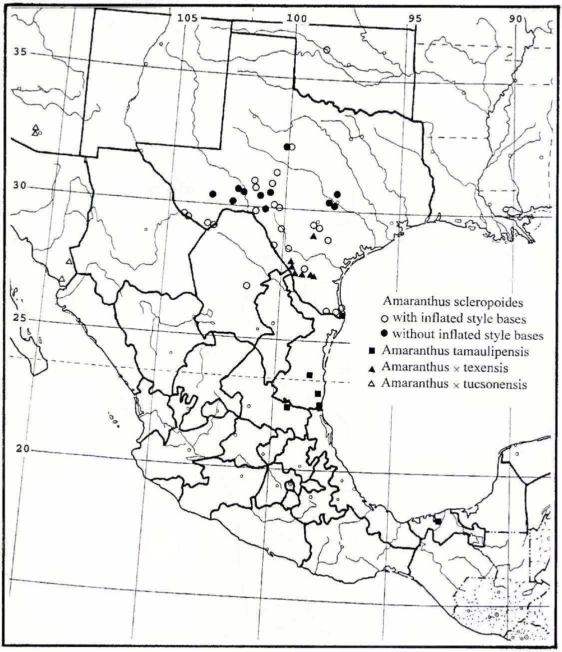

Fig. 5. Distribution of *Amaranthus scleropoides, A. tamaulipensis, A.* × *texensis, A.* × *tucsonensis* in southwestern U.S.A. and México.

clawed, 1.5–2.1 mm long, to 0.3–0.6 mm wide below the acute tips, spongy, thickened and all conjoined at the base, the distal portion expanded, strongly spreading, becoming nearly horizontal below the spinose tip, the base and claws stramineous, sometimes ciliate with slender gland-tipped hairs, the expanded tips with an elongate green patch 0.9–1.3 mm long, with narrow scarious margins. Fruiting ovary vertical, the wall initially smooth and with a medial encircling line, but in age becoming thickened, bullate-tuberculate in the upper half, remaining smooth below but indehiscent, the styles 3(–2), joined into a vertical neck for 0.2–0.5 mm before the tapered styles gradually arch outward, when styles 3, with two styles larger than the third, the styles papillate along their the inner surfaces.

The new nothospecies occurs with *A. crassipes* in Webb Co., Texas and some collections (i.e., *McCart 8559*) are mixed with that species. *Amaranthus × texensis* is similar to *A. scleropoides* in most features, but stands apart in the distinctive narrow neck produced by the combined style bases (Fig. 4D) and by the thickened utricle wall–in these characteristics it relates to *A. crassipes*. The strongly reflexed sepals, are overall of similar structure to those found in some specimens of *A. scleropoides*, but are much thicker, as in *A. crassipes*. The pistillate sepals of *A. crassipes* are erect and may or may not be reflexed at the tip.

Additional collections: U.S.A. **TEXAS. Atascosa Co.:** State Hwy. 140, 4 mi W of Charlotte, 3 Nov 1962, *McCart et al. 8538* (TEX). **Duval Co.:** Texas Hwy. 359, 6.5 mi E of Bruni, 4 Nov 1962, *McCart et al. 8559* (TEX, LL–mixed with *A. crassipes* var. *crassipes*). **Hidalgo Co.:** McAllen Ranch, 26 Jul 1951, *Tharp, Follansbee & Thompson 51-1628* (TEX). **Webb Co.:** State Hwy. 359, 1 mi E of Aguilares, 4 Nov 1962, *McCart et al. 8595* (LL); Farm Road 1472, 10 mi NW of Laredo, 23 Nov 1962, *Solis 93* (TEX). **MEXICO. Tamaulipas:** 34 mi S of Matamoros on road to San Fernando, 14 Sep 1960, *Johnston & Crutchfield 5488C* (TEX).

AMARANTHUS POLYGONOIDES VS. *AMARANTHUS BERLANDIERI*

Amaranthus polygonoides L. and *A. berlandieri* (Moq.) Uline & Bray are similar species readily distinguished from other *Amaranthus* by a number of features (Fig. 6). In both the flowers are borne in tight axillary dichasial clusters at each node that become distinctly crowded at the uppermost nodes. The peduncles are not thickened at maturity. The pistillate sepals are thin and distinctly three veined in the claw area, with the central vein extending into the expanded, obtuse-acute, spreading blade area. The sepals are united at the base and this basal area expands via cell enlargement to form a spongy, somewhat indurated flotation device. The fruit wall is thin, cylindrical, inflated, dehiscent or not, and is topped by three expanded style bases that are exserted above the spreading sepals.

Uline and Bray (1895), Standley (1917), Correll and Johnston (1970) and others have recognized both *A. polygonoides* and *A. berlandieri* as distinct species, basically repeating the characteristics given Uline and Bray (1895) and modified by Standley (1917) in his key as noted below:

Utricle circumscissile; leaf blades suborbicular to ovate or oval, the leaves not crowded; West Indies, Florida, Texas, Mexico, northern South America. .... **A. polygonoides**
Utricle indehiscent; leaf blades oblong-lanceolate, the leaves crowded at the ends of the branches; central-west Texas. .... **A. berlandieri**

Moquin-Tandon (1849), in his treatment of the "Amarantaceae" (sic) in DeCandolle's *Prodromus*, recognized the above two species in distinct gen-

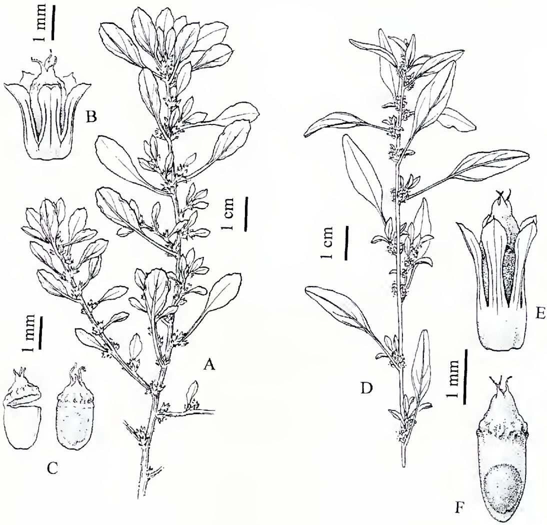

Fig. 6. Variation in *A. polygonoides*. A-C. Typical Caribbean specimen showing obovate leaf blades. B. Mature fruit with subtending calyx, note 3-veined sepals. C. Mature inflated, dehiscent fruit (all Monterrey, México, *Smith M375*, TEX). B-F. Typical Texas specimen showing more lanceolate leaf blades. E. Mature fruit with subtending calyx, note 3-veined sepals. F. Mature inflated, non-circumscissile fruit. (all Cameron Co., Tex., *Correll & Johnston 17935*, LL). Magnifications as indicated.

era in separate subtribes of his tribe Achyrantheae. He recognized taxon *polygonoides* in subtribe Aerveae, (with indehiscent utricles) as *Amblogyna polygonoides* Raf. (monoecious, staminate flowers with 3 sepals, 3 stamens, the pistillate calyx being subglobose-funnelform, 5-parted, and the inflorescence axis not becoming thickened as in *A. crassipes*). Moquin-Tandon's newly described taxon *berlandieri* was placed in subtribe Amaranteae (with utricles circumscissile) as a new genus *Sarratia* next to *Amarantus* (sic), differing in having staminate flowers with 5 sepals and pistillate calyces funnelform-urceolate. In his description he noted *Sarratia berlandieri* had 5 anthers per male flower and circumscissile utricles.

Moquin-Tandon made several errors in characterizing these taxa. In both taxa, staminate flowers have 5 (rarely 4) sepals and both taxa have only 2 anthers per staminate flower. My observations showed that, contrary to his data, the fruit of specimens referable to *A. berlandieri* are indehiscent (not dehiscent as he stated) while those of taxon *polygonoides* are usually, but not consistently dehiscent (not indehiscent as noted by Moquin-Tandon). These errors were caught by Gray (1861, p. 168) who, in expanding the genus *Amblogyne* to include two species previously placed in *Sarratia*, included taxon *berlandieri* within his *Amblogyne polygonoides* noting that the specimens upon which taxon *berlandieri* was founded were very poor. In contrast, both Uline and Bray (1895) and Standley (1917) recognized both taxa within the genus *Amaranthus*. Thellung (1914), in contrast, treated *berlandieri* as a subspecies of *A. polygonoides*.

During an initial study of these taxa it was noted that the characters in Standley's 1917 key did not work consistently and several specimens showed characteristics of both taxa. Regarding fruit dehiscence, an analysis of 118 collections from F, GH, NY, TEX-LL, and US revealed the following. Specimens attributable to *Amaranthus berlandieri* are mostly indehiscent (Fig. 6F), but occasional specimens (2 of the 42 collections examined) did show a distinct encircling line below the rugate cap of the utricle. In the 76 collections of *A. polygonoides* with mature fruit examined, 36 were noted to be actually circumscissile (Fig. 6D) or at least had developed a colored line encircling the fruit wall below the tuberculate cap (however, the fruits may or may not dehisce along this line) and 35 (49 percent) were clearly indehiscent. Indehiscent utricles occur in collections from coastal Texas, Cuba, and throughout the Caribbean region, often in localities where other collections clearly have circumscissile fruits. In all instances care was taken to insure that the fruit walls were mature when the dehiscence character was scored.

As noted in Standley's key, there are some recognizable differences in leaf shape. Most specimens from the Caribbean region to coastal Texas have ovate to broadly ovate, rarely obovate (Fig. 6A), slightly more greenish leaf blades and many specimens from interior Texas and Mexico have more narrowly trullate or trullate-lanceolate (Fig. 6D), somewhat bluish-gray leaf blades. To illustrate this a series of leaf-blade length-width ratios were taken. The ratios of specimens from the Caribbean and coastal Texas attributable to *A. polygonoides* range from 1.3 to 2.6 times longer than wide. Those of inland areas attributable to *A. berlandieri* have leaf-blade length-width ratios ranging from 2.1 to 4.2 times longer than wide. The problem is that when plants are mapped out based on these leaf characteristics we find several collections from Sutton, Edwards, Tom Greene, Terrell, Presidio and Pecos counties in Texas, as well as collections from Coahuila, that clearly have broad leaves as in taxon *polygonoides*. In many cases nearby specimens have narrow leaves as in taxon *berlandieri.* Recognition of two taxa on the basis of this characteristic would be quite arbitrary. Likewise leaves and inflorescences are crowded at the distal stems in both taxa and the taxa could not be separated on the basis of this characteristic. In fast growing stems, the leaves in both taxa are well separated by long internodes.

As the distinguishing characteristics of these taxa are very weak and variable, the two taxa are combined into a single variable species with recognition that there are some trends present, but they are insufficient for nomenclatural recognition. Thus only one species is recognized from this complex as follows.

Amaranthus polygonoides L. (Figs. 4E, 6, 7), Pl. jamiac. pug. 2:27. 1759. *Roemeria polygonoides* (L.) Moench. Meth. 314. 1794; *Amblogyna polygonoides* (L.) Raf., Fl. Tell. 3:42. 1837; *Albersia polygonoides* (L.) Kunth, Fl. Berol. ed. 2, 2:144. 1838. *Sarratia polygonoides* Moq. in DC. Prod. 13(2):270. 1849, as synonym. Type: JAMIACA: Linnaeus' 1759 protologue referenced "Sloan. jam. 1. t. 92. f2." (H. Sloane's *Voy. Madera Jamaica* 1:144 tab. 92, fig. 2. 1707) where the taxon was designated by a polynomial "*Blitum polygonoides virde, seu ex veridi & albo variegatum, polyanthos*". Linnaeus only saw Sloane's figure and not the specimen from which it was drawn, hence the specimen (Herb. Sloane 2:116, BM), can not be designated as lectotype. I herein designate the illustration in *Voy. Madera Jamaica* t. 92, fig. 2, as lectotype. The original Sloane plate 92, and the Sloane specimen, from which it was drawn, are at BM (C. Jarvis, pers. comm.). Sloane (l.c.) notes: "It grows in hard Claiy grounds, and amongst Rubbish, every where about the Town of St. Fago de la Vega." St. Fago de la Vega is now known as Spanish Town. Elizabeth A. Kellogg, *Fl. Lesser Ant.* 4:160. 1988, treated the Sloane specimen as "Type," however, for reasons noted above, it may not serve as lectotype.

Amaranthus verticillatus Pavon, Moq. in DC. Prod. 13(2):270. 1849, as synonym.

Sarratia berlandieri Moq. in DC., Prod. 13(2):268. 1849; *Amaranthus berlandieri* (Moq.) Uline & Bray, Bot. Gaz. 19:268. 1894. *Amaranthus polygonoides* subsp. *berlandieri* (Moq.) Thell. in Ascherson & Graebener, Syn. mitteleur. Fl. 5(1):352. 1914. Type: MÉXICO. Inter S. Fernando et Maramoros, *Berlandier 2279* (holotype: G-DC not seen; isotype: GH!).

Low spreading to erect-ascending, monoecious annuals 2–4 dm tall; stems branched below, the lateral (or all) branches decumbent, sometimes ascending, 1–4 dm long; internodes 2–5 cm long below, reduced to 2–5 mm long distally, stramineous, striate, puberulent-villous with crisped moniliform hairs 0.2–0.5 mm long, the lower stems glabrate. Leaves alternate, ascending, often crowded, larger in the upper half of the plant; petioles (2–)5–20(–40) mm long; leaf blades ovate to trullate-lanceolate, sometimes obovate or lanceolate, (4–)8–25(–42) mm long, (2.4–)5–15(–23) mm wide, rounded, obtuse or emarginate with the midvein excurrent at the tips, narrowly to broadly cuneate at the base, glabrous, the margins entire to erose, the veins and margins whitish beneath, the lamina with distinct Kranz internal anatomy, green

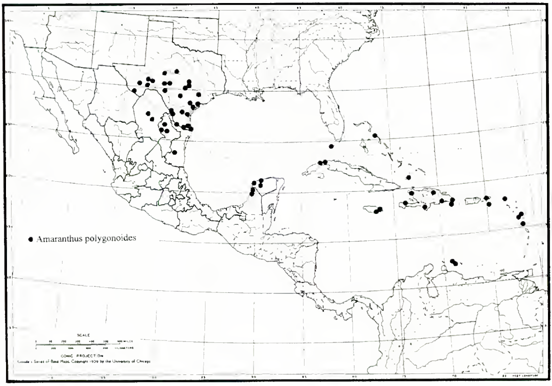

FIG. 7. Distribution of *Amaranthus polygonoides*.

to grayish in color. Flowers borne in axillary congested globose dichasia 3–8 mm in diameter, these remote on the lower branches but becoming aggregated as the internodes shorten above, the inflorescence axes thin, to 2 mm long; bracts and paired bracteoles lanceolate, 1–1.5 mm long, membranous, curved and cupped below, attenuate often with a long excurrent midvein at the tip; staminate flowers: sepals (4–)5, ± unequal, 0.7–1.3 mm long, membranous except for the midvein; stamens 2, anthers 0.4–0.6 mm long, filaments moderately thickened, to 1 mm long; pistillate flowers: mature calyx (1.6–)2.3–3.0 mm long, the sepals united and becoming spongy-thickened in the lower third forming an expanded float 0.9–1.2 mm long and wide that slightly extends over the subtending broad-tipped pedicel, the separate lobes clawed, spathulate, the claws 0.3–0.4 mm wide, notably 3-nerved, with scattered slender gland-tipped hairs, the lobes to 0.6–1.2 mm wide, erect to recurved-spreading, rounded to acute at the tips with the midvein sometimes excurrent, membranous except for the 3 veins, the lateral veins straight, slightly spreading outward, diminishing below the margin, the midvein strongest, unbranched, when young overlain with a narrowly oblanceolate central green patch. Mature ovary wall (the utricle) inflated, adnate to the spongy calyx in the lower third, the mid portion smooth, compressed, 0.7–0.9 mm long and wide, sometimes developing a darker encircling line just below the expanded tip (where dehiscence may occur), the distal tip portion variously roughened, sometimes distinctly expanded at the base, capped with the narrower, fused, obconate, expanded style bases 0.4–0.6 mm long and wide, the styles 3(–2), the papillate slender terminal portions 0.5 mm long. Seed vertical, lenticular, 0.8–0.9 mm long, ± 0.7 mm wide, 0.35–0.5 mm thick, reddish-brown, smooth, shiny, the margins thin.

The species ranges throughout the Caribbean region to coastal Central America, Key West Florida to central and western Texas and adjacent Mexico (Fig. 7) occurring mostly in disturbed habitats. Also cultivated in Germany, Italy and Egypt (Thellung 1914) . Collections from Sonora and Sinaloa with more erect, slender habits and similar staminate and pistillate flowers but with the central vein of the pistillate sepals conspicuously branching are referable to *Amaranthus venulosus* S. Wats.

A NEW *AMARANTHUS* FROM EASTERN MEXICO AND SOUTHMOST TEXAS

During initial observations of Mexican *Amaranthus*, a series of collections distinguished by inflated turret-like style bases and short, slender, basally connate, erect, well-separated, spatulate sepals, and bracts much shorter than the sepals were marked as possibly new. In Standley (1917), the taxon keyed closest to *A. brandegei* Standl., a species known only from a few collections in eastern Mexico (the type collection is from Sinaloa, México), with which it shared the characters of 3 stamens per male flower and short pistillate floral bracts. A loan of the type collection of *A. brandegei* from UC confirmed that our material is indeed is similar to *A. brandegei*, but *A. brandegei* actually has 5(–4) stamens per male flower, as previously noted by Sauer (1950), not 2–3 as stated by Standley (1917). In its small perianth and short bracts the new species also showed similarities with *A. dubius* Mart. ex Thell., which also has 5 stamens per staminate flower.

Amaranthus dubius is a tropical, sometimes temperate, New World weedy species common from the Caribbean region, southern Mexico to Panama and northern South America. It is adventive in Africa and tropical Asia and cultivated in Europe (Aellen 1959), Jamaica (Correll and Correll 1982), and elsewhere. It has been reported as one of the very few polyploid ($2n=64$) species in the genus (Grant 1959). Floral differences between *A. brandegei* and *A. dubius* are illustrated in Sauer (1950); pistillate flowers of *A. dubius* are illustrated in Aellen (1959), and both taxa are described in Standley (1917). In the material seen, both *A. brandegei* and *A. dubius* are more robust plants with larger, leaves to 12 cm long and 8 cm wide with distinct terminal inflorescences. I have seen additional material of *A. brandegei* from Tom Van Devender's recent collections from Sonora and Sinaloa, México, which have larger leaves than the type.

In *A. brandegei* the larger pistillate sepals are reflexed, thickened at the base at maturity and the midveins often branch distally, the fruit wall is smooth below the line of dehiscence but roughened above the line (Fig. 4F). In contrast in *A. dubius*, all pistillate sepals are erect, they do not thicken at the base at maturity and have distinct single green midveins bordered with thin membranous margins and the fruit walls are typically elliptical and often smooth throughout. In the new taxon (Figs. 4G, 8) the sepals are much thicker, the margins are often not membranous medially, the sepals are distinctly thickened and join together at the base of the developing fruit and are typically shorter than the developing fruit. They are somewhat contracted in the lower half and slightly broader below the acute to obtuse-rounded tips. The sepals are often green along the distal midvein and in the larger, marginal sepals, the midveins are branched distally. The fruit wall is irregularly rugose throughout and has a distinct smooth tower. Furthermore the plants are much more slender, with small leaves that continue, though diminished in size, well into the inflorescences—they do not develop distinct leafless terminal inflorescences as in the other two species. Also the new taxon has only three stamens per male flower not 4–5 as in the other species.

Amaranthus tamaulipensis Henrickson, sp. nov. (**Figs. 4G, 5, 8**). TYPE: MEXICO. TAMAULIPAS: 13 mi N of Aldama on road to Soto la Marina, 25 Sep 1960, *M.C. Johnston & J. Crutchfield* 5698 (HOLOTYPE: TEX!).

A *Amarantho brandegei-dubius* differt calyce pistillato sepalis binis ad margines ovarii quam tribus altera majoribus (vs.sepala abaxiali maxima), sepalis erectis (non distaliter reflexis ad maturitarem), et pericarpio maturo omnino inflati-tuberculato (vs. distaliter inflati-tuberculato).

Erect to ascending, sometimes decumbent monoecious annuals 1.5–3(–6) dm tall; stems branched at base, sparsely branched above or unbranched, striate, glabrous, slender, tan-stramineous or suffused with betalin red, 1–3.2 mm thick at base. Leaves largest near the base, reduced above, the petioles 3–15(–21) mm long, one-half (when small) to as long as the leaf-blades; leaf blades ovate, rhombic-ovate, (5–)10–27 mm long, (2–)5–11(–18) mm wide, tapering to an obtuse-rounded, typically emarginate tip topped with the excurrent midvein, the base cuneate, decurrent along the petiole, the margins rather crisped, white, the blades green above, gray-green with 3–4 arcuate white, raised veins beneath. Flowers in glomerate axillary dichasia from base of plant to the tip, either interrupted at the nodes, or crowded or interrupted in terminal leafy spike-like inflorescences, the 2 lateral branches of the dichasium unbranched, zig-zagged, to 4 mm long; bracts lance-ovate, acute, conduplicate-cupped, green along midvein, otherwise scarious-membranous, 0.9–1.2(–1.4) mm long, shorter than the sepals, persisting on inflorescence axis where 0.4–0.8 mm apart; bracteoles 2, similar to the bracts but 0.3–0.8 mm long, often membranous throughout, persistent or not;

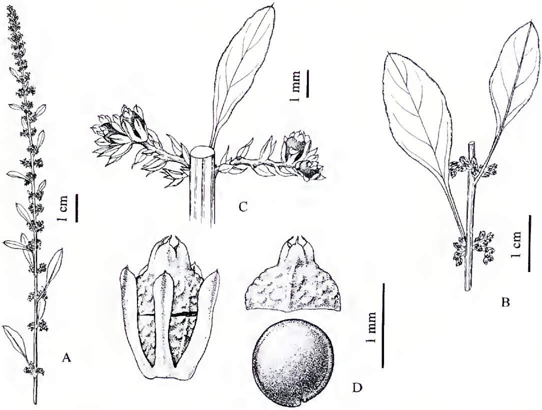

FIG. 8. *Amaranthus tamaulipensis*. A. Terminal stem. B. Older stem showing inflorescence development and leaves. C. Axillary inflorescence with most fruits gone showing persistent bracts, single leaf. D. Mature tuberculate, dehiscent pericarp with calyx; note inflated style bases, separate pericarp tip, seed. All from holotype (Aldama, Tamaulipas, Mex., *Johnston & Crutchfield 5698* , TEX, except C from Cameron Co., Tex., *Runyon 2170*, TEX). Magnifications as indicated.

staminate flowers: basal and scattered on the lateral dichasial shoots, sepals 4–5, oblong-ovate, acute-acuminate, 1.2–1.6 mm long, green along the excurrent midvein, otherwise scarious; stamens 3(–4); pistillate flowers: sepals 5, separate and not overlapping except where expanded and joined at the base, oblong-spatulate, subequal with the two marginal sepals usually larger (broader) than the other three, 1.1–1.6(–2.1) mm long, narrowed to 0.2–0.3(–4) mm wide in mid portion, expanded, obtuse-rounded, to 0.25–0.6 mm wide near the tip, rather scarious except along midvein, becoming gibbously thickened, spongy and joined around ovary at base, the smaller 3 sepals 1-veined and green along the vein above, the largest 2 sepals with the midvein green and weakly branching distally (in some specimens the veins in all sepals branching distally and the tips rounded to acute), the calyx shorter than the mature fruit, the sepal margins typically sparsely glandular-puberulent. Mature utricle obpyramidal, slightly biconvex, 1.5–1.7 mm long, to 1.1 mm wide, with age becoming brownish, rugose tuberculate throughout the body with ridge-like branched folds, medially circumscissile but no specific line of dehiscence evident, the utricle tipped by a distinct, lighter tan, smooth, rather inflated, dome-like style base 0.3–0.5 mm long, 0.5–0.6 mm wide, with 3 broadly conic lobes at tip each bearing a papillate stigmatic line along the inner margin that extends onto a slender 0.2–0.3 mm long tip. Seeds black to reddish-brown, smooth, shiny, lenticular, orbicular, 1.0–1.2 mm wide, 0.6 mm thick, margins edged, slightly notched at base.

Additional collections: U.S.A. **TEXAS. Cameron Co.:** 2 mi S San Benito, 4 Jul 1939, *Runyon 2170* (TEX); E of Brownsville, 28 Oct 1927, *Rose & Russell 24274* (US). **MEXICO. San Luis Potosí:** Vicinity of El Salto above El Naranjo, 6 Apr 1960, *Duke M3760* (NY). **Tabasco:** Arrozal experimental del Depto. de Agronomía, Colegio Superior de Agricultura Tropical, km 22 carretera Cárdenas-Coatzacoalcos, 14 Apr 1980, *Cowan 2913* (NY). **Tamaulipas:** 2 mi NE of Altamira, roadside weed, 3 Mar 1961, *King 4056* (F, NY, TEX, US-a more decumbent plant with slender stems); 2 mi E of Casas on new Victoria-Soto la Marina Hwy., 28 Sep 1960, *Johnston & Crutchfield 5770* (TEX).

As noted above, the species structurally is similar to *A. brandegei* and *A. dubius* but is immediately distinguished from *A. brandegei* by its erect, not reflexed calyx and from *A. dubius* by: 1) the narrow subequal, well-separated, firm (not membranous margined) spatulate, acute to round-tipped pistillate sepals that are shorter than the fruit and are expanded and united at the base; 2) the distinctive roughened (not smooth) utricle wall with its smooth, inflated, turban-like style bases; and 3); the 3 stamens. The sepals along the edges of the compressed fruit are usually largest and typically have veins branched below the tip. In *A. dubius* the bracts and pistillate sepals are larger, more elliptical, more membranous, stamens number 5(–4) in male flowers and the utricle wall more gradually expanded above. *Amaranthus dubius*, however, exhibits variability in bract length, sepal size, mature pericarp configuration and may be confused with unarmed individuals of *A. spinosus* L. with which it hybridizes (Grant 1959). Three varieties were described by Moquin-Tandon (1848) under *A. tristis* L. and transferred to *A. dubius* by Thellung (1914) (see Thellung 1914; Aellen 1959), but these are seldom accepted. They involve differences in inflorescence development, color and thickness.

A NEW TAXON FROM ARIZONA

Dr. Tom Van Devender requested identification of a series of *Amaranthus* collections from the Tucson Mountains and Organ Pipe National Monument west of Tucson, Arizona. The collections show a number of characteristics unlike any other southwestern *Amaranthus*. In Standley's (1917) key, the material, which has non-spatulate pistillate sepals, dehiscent utricles, a terminal inflorescence, no spines, bracts shorter or equal to the pistillate sepals, and the fruit shorter than the sepals, keys to the aforementioned *Amaranthus* *dubius*, a species with much shorter sepals, smaller seeds, etc. The Arizona specimens are small, erect, branched, monoecious annuals with coarse ovate leaves with dichasial cymes extending from the mid-leaf axils into a leafless terminal inflorescence. Staminate flowers have 5 sepals and 5 anthers; pistillate flowers have broad-based, acuminate bracts shorter than or about as long as the pistillate sepals (Fig. 9). The pistillate sepals are oblong, slightly spatulate, but not clawed; the outer sepals are usually acute, somewhat spine tipped, the inner ones are more obtuse or rounded. The sepals are distinctive in being green throughout most of the surface except for the moderately narrow scarious margins. As the sepals mature and dry, they reflex and become thick and rigid. The fruit is dehiscent, about as long as the sepals, with 3-2 styles, and is inflated and roughened above the line of dehiscence (Fig. 9C).

While this appears to be an unremarkable assortment of characters, the plants do not fall into any recognized taxon. Evidence of its possible relationship came from a specimen from Chiapas [32 km. N. Ocozocoautla along rd. to Mal Paso, 19 Oct 1965, *Breedlove & Raven 13572* (LL)] annotated by J.D. Sauer as *Amaranthus hybridus* L.—atypical. This specimen has an inflorescence arrangement characteristic of *A. hybridus*, but the pistillate flowers have small bracts and indurated sepals longer than the utricles—very similar to the Arizonan specimens. However, the Arizonan specimens differ in having axillary dichasia and terminate in a single spike of dichasia, an inflorescence type more characteristic of *Amaranthus* species with clawed spatulate pistillate flower sepals, e.g. *A. obcordatus* (Gray) Standley, *A. chihuahuensis* S.Wats, *A. torreyi* (Gray) S.Wats. Somewhat similar plants have been found near Alamos in southern Sonora, México. They are similar in development of the pistillate sepals, but in each the bracts are as long as or longer than the sepals and one collection, more reflexed. *Amaranthus hybridus* differs from the new taxon in the overall structure of the inflorescence, it produces a tight series of slender, ascending-spreading shoots, the slender, longer bracts that well exceed the flowers, and the membranous pistillate sepals that are typically green only along the midvein.

A question arises as to the origin of this taxon. Is it just an obscure taxon that has not been previously collected or is it a taxon of recent origin, perhaps a product of hybridization? A brief analysis of pollen stainability of the specimens revealed that pollen in Arizonan specimens varied greatly in stainability with Cotton-Blue in Lactophenol (Radford et al. 1974), with one collection having 99 percent stainability and other collections having 96, 89, 81, 51, and 47 percent stainability. The two collections from Sonora, both had high pollen stainability (97 and 95 percent). My conclusion is that the taxon may be of hybrid origin, perhaps with *A. hybridus* being one parent, the other parent unknown. The only other species known from the Tucson Mountains are *A. fimbriatus* (Torr.) Benth. and *A. palmeri* S.Wats. (Rondeau et al. 1996), which are not parental candidates based on their characteristics.

The Sonoran specimens both differ from the Arizona specimens. In *Van Devender 93-386* the pistillate sepals show green mostly along distinct secondary veins and subtending bracts have straight, long slender tips and a membranous ovate base. The other specimen (*Van Devender 92-1121*) has greenish sepals similar to the Arizonan specimens, but the subtending bracts are as long as the sepals, strong reflexed below the tip, and are sharp pointed.

Amaranthus × tucsonensis Henrickson, nothosp. nov. (**Figs. 5, 9**). Type: U.S.A. ARIZONA: Pima Co.: Tucson Mts., crest of Gates Pass, W of Tucson, T14S,R12E,S10,SW 1/4, 3250 ft, 16 Sep 1988, *T.R. Van Devender 88-676* (holotype: ARIZ; isotypes: to be distributed).

A *Amarantho hybridus* differt sepalis multo majoribus firmioribus viridibus scariosi-marginatis (non omnino tenuis scariosus), bracteis floralibus pistillatis sepalis pistillatis aequantibus vel brevioribus (non 1.5–2.0 plo longioribus), axe inflorescentia vestimento sparso trichomatorum glandulosi-capitatorum (non dense villosus eglanduloso) et seminibus 1.2–1.4 mm in diametro (non 1.0 mm in diametro).

Erect, taprooted, mostly single-stemmed or upwardly branched monoecious annuals to 1.5 dm tall; stems yellowish, sometimes tinged with red, striate, sparsely puberulent-pilose with crinkled, obscurely gland-tipped moniliform hairs to 0.3(–0.6) mm long, glabrate. Leaves alternate; petioles yellowish, 8–32 mm long; leaf blades rhombic to ovate, (13–)20–35(–45) mm long, (7–)10–22(–28) mm wide, obtuse to rounded, often mucronate at the tip, broadly cuneate with the margins narrowly decurrent along the distal petiole at the base, the margins crisped, the lamina grayish-green, glabrous to sparsely puberulent-pilose with crinkled, gland-tipped hairs to 0.3 mm long, the veins yellowish, impressed above, raised beneath. Flowers borne in axillary, compound dichasial cymes to 10 mm long, these forming discontinuous glomerules below, but coalescing into terminal, continuous inflorescences 6–15 cm long, 8–10(–16) mm wide, the basal (oldest) flower(s) staminate, developing lateral, sinuous, occasionally branching axes to 1 mm thick, covered with the persistent bracts and bracteoles that subtended the early deciduous male flowers. Staminate flowers: bracts broadly ovate at base, acuminate above with the midvein excurrent, 1.7–2.5 mm long, scarious except along the green midrib; sepals oblong-elliptical to lanceolate, 1.6–2.2 mm long, 0.6–1.0 mm wide, acute-acuminate, scarious except along the short excurrent midrib; stamens 5; filaments 1–1.8 mm long; anthers 0.8–1.0 mm long, yellow. Pistillate flowers: bracts lanceolate to basally ovate, 1.5–3.5 mm long, 0.8–1.4 mm wide, usually shorter than the sepals, broadly scarious below, the green midrib zone 0.2–0.5 mm wide, the midvein ex-

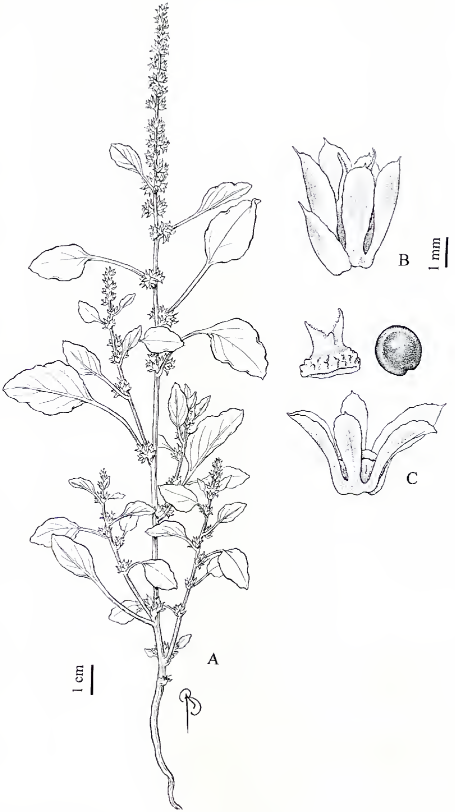

FIG. 9. *Amaranthus × tucsonensis*. A. Growth habit. B. Mature calyx showing short subtending bract. C. Calyx and base of pericarp, tip of pericarp and seed. All from holotype (Pima Co., Ariz. *Van Devender 88-676*, ARIZ). Magnifications as indicated.

current for 0.5–0.6 mm, bracteoles 2, similar but only 1.4–2.2 mm long; sepals 5, oblong, oblong-spatulate to oblong-elliptical, 2.2–3.1(–4) mm long, 0.6–1.2 mm wide, obtuse, rounded to emarginate, the outer ones more acuminate with the midvein excurrent 0.1–0.3 mm at the tip, entire to erose distally, green for 0.5–0.9 mm across the back, with scarious margins 0.15–0.2 mm wide, glabrous to sparsely puberulent-pilose with crinkled, obscurely gland-tipped hairs, unequal in size with the outermost sepal larger and more acute than the inner round-tipped sepals, at maturity all sepals strongly reflexing, thickening and uniting at the base and overall becoming indurate. Fruit 2.2–2.5 mm long, circumscissile, the base smooth, the top roughened, inflated above the zone of dehiscence, the 3 style bases with a U-shaped sinus; stigmatic surfaces 1.2–1.3 mm long, puberulent with moniliform hairs. Seeds broadly lenticular, slightly ovate, 1.2–1.4 mm wide, shiny black, with a slight marginal rim.

Additional collections. U.S.A. **ARIZONA. Pima Co.:** Javelina Wash, Saguaro National Monument, Tucson Mts., T13S,R11E,S35,NE 1/4, 2680 ft, 4 Sep 1989, *Bertelson 89-555* (ARIZ); Tucson Mts., crest of Gates Pass, T14S,R12E,S10,SW1/4, 3250 ft, 23 Sep 1988, *Van Devender 88-722* (ARIZ); Tucson Mts., crest near Radio Towers, NW of Trail's End Canyon, T14S,R12E,S4,NW 1/4, 4350 ft, 18 Sep 1988, *Van Devender et al. 88-693* (ARIZ). **MEXICO. Sonora.** Rancho La Junta, 3.0 km NNE of Burapaco, 27°35'15"N, 108°52'W, 220 m, 17 Mar 1993, *Van Devender et al. 93-386* (ARIZ); Mesa Masiaca, 6.5 km WNW of San José de Masiaca, 26°46.4'N, 109°17.9'W, 200 m, 8 Oct 1992, *Van Devender et al. 92-1121* (ARIZ).

In the Tucson Mountains, west of Tucson, Arizona, the taxon occurs on rocky slopes in desert scrub and grassland from 790–1430 m elevation (Rondeau et al. 1996). In northern Sonora it is known from elevations about 200 m in fields and roadsides. Flowering occurs from September to November or after rains.

ACKNOWLEDGMENTS

I thank F, GH, NY, TEX-LL, UC, US for loan of specimens, Charles Jarvis (BM) for information regarding the type of *A. polygonoides*, U. Braun (HAL) for information on the type of *A. crassipes*, Bobbi Angel (NY) for the line drawings, Thomas Wendt for comments on the manuscript and the Spanish translation of the abstract, Guy Nesom for the Latin translations, and the Plant Resources Center at the University of Texas, Austin for use of facilities.

REFERENCES

Aellen, P. 1959. *Amaranthus*. In: Hegi, G., Illustrierte flora von Mitteleuropa. 2nd ed. 3(2):465–516. (Republished 1979).

Correll, D.S. and H.B. Correll. 1982. Flora of the Bahama Archipelago. J. Cramer, Vaduz.

Correll, D.S. and M.C. Johnston. 1970. Manual of the vascular plants of Texas. Texas Research Foundation., Renner.

Fawcett, W. and A.B. Rendle. 1914. *Amarantus* L. Flora of Jamaica. 3:129–132.

Johnston, I.M. 1944. Plants of Coahuila, eastern Chihuahua, and adjoining Zacatecas and Durango, V.J. Arnold Arbor. 25:133–182.

Grant, W.F. 1959. Cytogenetic studies in Amaranthus II. Natural interspecific hybridization between *Amaranthus dubius* and *A. spinosus*. Canad. J. Bot. 37:1063–1070.

Gray, A. 1862. Enumeration of a collection of dried plants made by L. J. Xantus, at Cape San Lucas, &c. in Lower California, between August, 1859 and February, 1860, and communicated to the Smithsonian Institution. Proc. Amer. Acad. Arts. 5:153–173.

Holzinger, J.M. 1892. On *Amaranthus crassipes*. Bot. Gaz. 17:254–256, pl. xvii.

Radford, A.E., W.C. Dickison, J.R. Massey, and C.R. Bell. 1974. Vascular plant systematics. Harper & Row, New York. P. 219.

Rondeau R.J., T.R. Van Devender, C.D. Bertelsen., P.D. Jenkins, R.K. Wilson, and M.A. Dimmitt. 1996. Annotated flora and vegetation of the Tucson Mountains, Pima County, Arizona. Desert Pl. 12:3–46.

Sauer, J.D. 1950. The grain amaranths: A survey of their history and classification. Ann. Missouri Bot. Gard. 37:561–632.

Standley, P.C. 1917. *Amaranthus* L., N. Amer. Fl. 21(2):101–119.

Thellung, A. 1912. Amaratacées. In: La flore adventice de Montipellier. Mém. Soc. Nat. Sci. Nat. Math Cherbourg. 38:200-219.

Thellung A. 1914. Amarantus. In: Ascherson, P. and Graebner, P. Synopsis der Mitteleuropäischen flora, 5(1):225-356. (Republished 1919).

Uline E.B. and W.L. Bray. 1895. A preliminary synopsis of the North American species of *Amaranthus*. Bot. Gaz. 19:267–272, 313–320.

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BOOK RECEIVED

OLSON, RICHARD K. and THOMAS A. LYSON, eds. 1999. **Under the Blade. The Conversion of Agricultural Landscapes.** (ISBN 0-8133-3597-3, pb; 0-8133-3596-5, hbk). Westview Press, 5500 Central Avenue, Boulder, CO 80301-2877. $25.00 (pbk). 459 Pp. 15 Figures.

Under the Blade is about land use, rural land use in the United States. It is about farms and their conservation. From the back cover: "Under the Blade: The Conservation of Agricultural Landscapes proposes essential principles for sustainable land management. Its seven orienting chapters examine the loss of farmland and other rural lands from the interacting perspectives of law, economics, landscape characteristics, population growth, social and political forces, ethics, and aesthetics. The chapters present as well tools and strategies for preserving farmland and guiding rural development. The application of these tools is illustrated by 22 case studies of towns and regions throughout the United States, each posing variations of challenge, response, and degree of success (or failure)."

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TWO NEW SPECIES OF *TRIPOGON* (POACEAE) FROM INDIA

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ABSTRACT

Two new species of Poaceae, *Tripogon sivarajanii* Sunil and *T. vellarianus* Pradeep from the Western Ghats of Kerala, India are described and illustrated.

RESUMEN

Se describen e ilustran dos nuevas especies de Poaceae, *Tripogon sivarajanii* Sunil y *T. vellarianus* Pradeep de los Western Ghats de Kerala, India.

The genus *Tripogon* Roem. & Schult., with about 31 species, is distributed in the Old World tropics (Mabberley 1997). In India, the genus has ca. 12 species most of them occurring at an elevation above 900 m. Four species, *T. bromoides* Roem. & Schult., *T. narayanii* Sreekumar *et al.*, *T. ananthaswamianus* Sreekumar et al. and *T. capitellatus* Jaub. & Spach. are known from Kerala (Sreekumar & Nair 1991). During the course of floristic investigation on the Western Ghats of Kerala, the authors came across two interesting specimens of *Tripogon* which do not correspond to any of the previously described taxa. We conclude that they represent two new species and we describe them here.

Tripogon sivarajanii Sunil, sp. nov. (**Fig. 1**). TYPE: INDIA. KERALA. Idukki Dt.: Valakettimala near Moolamattam, 1020 m, 2 Sep 1997, *C.N. Sunil 2117* (HOLOTYPE: MH; ISOTYPES: BRIT, K, L, PBL).

Tripogoni trifido affinis, *T.sivarajanii* ligulis glabris, lemmatis aristis 3–3.5 mm longis, palea apicaliter 2-lobata facile distinguendus.

Tufted perennial herb. Culms 40–70 cm high; nodes glabrous. Leaves with the blades 15–40 cm long and 2–3 mm broad, linear, acuminate, villous

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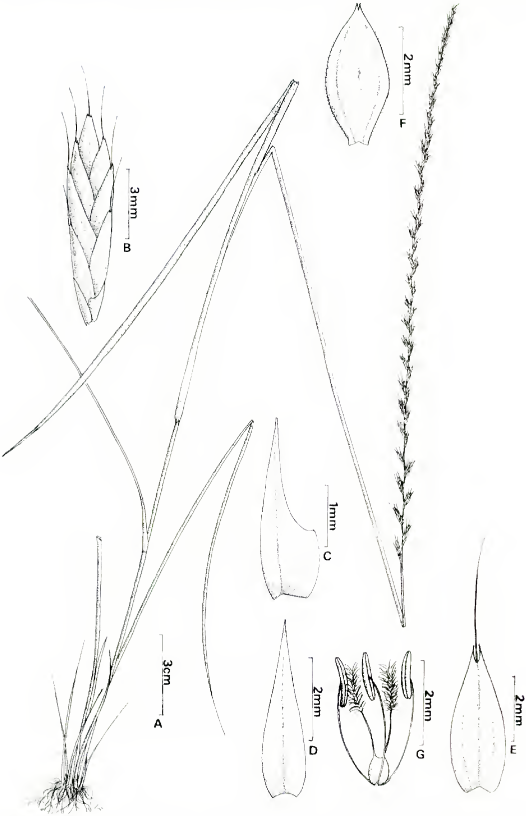

FIG. 1. *Tripogon sivarajanii* Sunil. A. Habit. B. Spikelet. C. Lower glume. D. Upper glume. E. Lemma. F. Palea. G. Stamens and Pistil. A–G, drawn from holotype.

on the upper surface with short dense hairs intermingled with long scattered shaggy hairs, glabrous below, the midrib inconspicuous; ligule a fine, glabrous membrane; sheath smooth. Racemes 20–45 cm long, with 25–60 spikelets; rachis smooth, glabrous. Spikelets 5–8-flowered, 7–8 mm long; callus hairy. Lower glume ca. 2 mm, lanceolate, shallowly notched on one side. Upper glume 3–4 mm long, lanceolate, acute or acuminate at the apex. Lemma 3–3.5 mm long, 3-nerved and 1-awned, glabrous, 2-lobed at the apex, the lobes acuminate, awned in the sinus; awns 3–3.5 mm, more or less equal to lemma, scabrid. Palea 2–3 mm, elliptic, 2-lobed at the apex, 2-keeled, winged, the wings narrow, the margins ciliate. Stamens 3; anthers ca. 1 mm, yellow tinged with pink. Ovary 0.25 mm, globose; styles 2; stigma feathery, purple. Grains unknown.

Distribution.—*Tripogon sivarajanii* is endemic to Kerala and is known only from the type locality, Valakettimala near Moolamattam in Idukki District of Kerala.

Ecology.—This species grows from 1000–1300 m elevation along grassy hill slopes and flowers from September to December.

Tripogon sivarajanii closely resembles, *T. trifidus* Munro ex Stapf, a species distributed in the eastern part of India in having 20–45 cm long racemes, 5–8-flowered spikelets, laterally lobed and notched lower glumes and the awns of the lemma being neither geniculate nor twisted. The two species can be separated as follows:

1. Ligules ciliate, densely on the margins towards the apex; upper glume 2-toothed with a short awn at the apex; lemma bearded at base, 2-lobed at apex, awned in the sinus, the lobes awned at the apex; median awn twice as long as lemma; palea obtuse at the apex .... T. trifidus
1. Ligules glabrous throughout; upper glume never 2-toothed or awned at apex; lemma glabrous at base, 2-lobed at apex, awned in the sinus, the lobes never awned at the apex, median awn as long as or shorther than lemma; palea 2-lobed at the apex .... T. sivarajanii

The specific epithet honors the late V.V. Sivarajan, one of the foremost authorities on the flowering plants of Kerala. As a staff member of the University of Calicut, he had published over 25 new species, thus the dedication of this new Poaceae to him is appropriate and well-deserved.

Tripogon vellarianus Pradeep, sp. nov. (**Fig. 2**). TYPE: INDIA. KERALA. Kozhikode Dt.: Vellarimala, 11°25.877'N, 76° 06.765'E, 1300 m, 17 Oct 1997 (fl), *A.K. Pradeep 56110* (HOLOTYPE: MH; ISOTYPES: BRIT, K, L, PBL).

Tripogon vellarianus sine cognato propinquo a congeneris aliis habitu valde caespitoso, foliis 8–15 mm latis, spiculis 10–17 mm longis, lemmate 2-lobato 3-aristato vel 1-aristato, aristis lateralibus minutis ad nullis distinguendus.

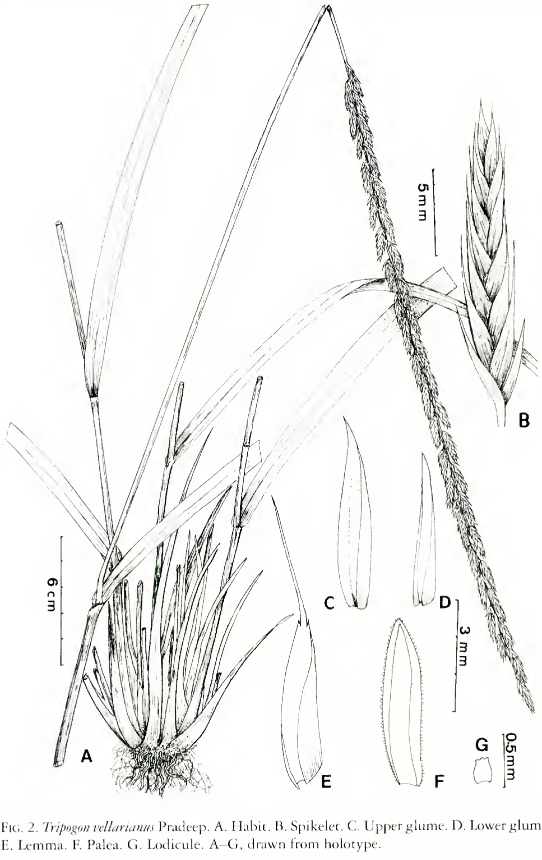

FIG. 2. *Tripogon vellarianus* Pradeep. A. Habit. B. Spikelet. C. Upper glume. D. Lower glume. E. Lemma. F. Palea. G. Lodicule. A–G, drawn from holotype.

Tufted perennial herb. Culms 30–90 cm tall, erect; nodes glabrous. Leaf blade 30–60 cm long, 8–15 mm wide, linear, base of blade glabrous. Sheaths closely clasping, rigid, glabrous; ligules indistinct. Racemes 30–40 cm long, rachis stout, glabrous. Spikelets 10–17 mm long, distant, dorsiventrally flattened, 8–10-flowered; callus bearded. Lower glumes 4 3 1.25 mm, lanceolate, acuminate at the apex, purplish tinged dorsally, glabrous. Upper glumes 5 3 1.5 mm, elliptic-lanceolate, acute at the apex, prominently 3-nerved, glabrous. Lemmas (excluding the awn) 5 3 2 mm, ovate-lanceolate, 3-nerved, median awn 3 mm long, lateral awns absent or up to 5 mm long often closely adpressed to the median awn, glabrous. Palea 4 3 2 mm, hyaline, narrowly elliptic, keeled and winged, keels minutely puberulous. Lodicules 2, ca 0.25 mm, quadrate, apex coarsely 3-toothed. Stamens 3; anthers 1.5 mm long, oblong; filaments 0.7 mm long, slender, glabrous. Ovary 0.25 mm, obovate; styles 2, slender, hyaline, 0.8 mm long; stigmas feathery, purplish, 0.6 mm long. Grains not seen.

Distribution.—Tripogon vellarianus is known only from Vellarimala on the Western Ghats of Kerala in India. This species is to be expected from adjacent hill ranges of Wayanad and Kannur districts.

Ecology.—This species occurs from 1000–1500 m in wet rocky grasslands adjoining evergreen forests. It flowers from October to January.

Tripogon vellarianus is a distinctive species characterised by its strongly tussock-forming habit, broad leaves and large spikelets. Thomas A. Cope (Kew, pers. comm.), after examining our material, commented "in majority of the lemmas the lateral awns are minute or absent altogether. I cannot recall another species in the genus that is so reluctant to produce lateral awns." It does not compare with any of the species so far known under the genus, although its entire lemma sometimes recalls that of *Tripogon major* Hook. f., a species widespread in tropical Africa. Dr. P.V. Sreekumar, Port Blair (pers. comm.) wrote "I find it extremely difficult to accommodate even under *Tripogon*; and I believe lemma is continuous with the awns." However, apart from the entire lemma, in every other respect it corresponds exactly with the genus *Tripogon*.

ACKNOWLEDGMENTS

We thank P.V. Sreekumar, Botanical Survey of India, Port Blair and Thomas A. Cope, Kew for useful comments on our materials. We also thank J.F. Veldkamp, Rijksherbarium, Leiden for various help. The work was supported by a grant from the Department of Science and Technology, New Delhi, ref. no. HR/SY/B-05/96.

REFERENCES

MABBERLEY, D.J. 1997. The plant-book. Ed. 2, Cambridge University Press.

SREEKUMAR, P.V. and V.J. NAIR, 1991. Flora of Kerala—Grasses. Botanical Survey of India. Calcutta.

BARNEBYDENDRON, A NEW GENERIC NAME (FABACEAE, CAESALPINIOIDEAE, DETARIEAE, BROWNEA GROUP)

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ABSTRACT

A new generic name, *Barnebydendron*, is proposed for *Phyllocarpus* Riedel ex Tul. which is an illegitimate, later homonym of *Phyllocarpus* Riedel ex Endl.

RESUMEN

Se propone el nuevo nombre genérico, *Barnebydendron*, para reemplazar a *Phyllocarpus* Riedel ex Tul., ya que, este nombre es ilegítimo y un homónimo posterior de *Phyllocarpus* Riedel ex Endl.

RESUMO

O novo nome genético, *Barnebydendron*, é proposto para substitutir a *Phyllocarpus* Riedel ex Tul., visto que este nome é ilegítimo e homônimo posterior de *Phyllocarpus* Riedel ex Endl.

In 1842 Endlicher (1842) presented the genus *Phyllocarpus* Riedel ex Endl. on page 97 of the second supplement to his *Generum plantarum*:

> 6720/1 **Phyllocarpus** *RID.*
>
> *Lonchocarpus pterocarpus* DC. Prodr. II. 260. typum distincti generis (*Phyllocarpus* Riedel msc.), a *Platymiscio* et *Miscolobio* (Gen. pl. n. 6719 et 6720) leguminis membranacei sutura vexillari alata diversi, constituit.

Endlicher validly published *Phyllocarpus* with a single element, *L. pterocarpus*, which is automatically the type of the genus. He distinguished it from *Platymiscium* Vogel and *Miscolobium* Vogel (=*Dalbergia* L. f.) by its membranous legume with the vexillary suture variously winged. *Lonchocarpus pterocarpus* DC. (=*Deguelia scandens* Aubl.) has winged fruits that are somewhat fragile (MacBride 1943), and so the diagnosis could well describe material of *L. pterocarpus.*

In 1843 Tulasne (1843) described *Phyllocarpus* Riedel ex Tul., specifically excluding Endlicher's *Phyllocarpus*, "non Endl. Gen. Supp II, p. 97, n. 6720." He also described *P. riedelii* Tul. with a short description using no.

1022 in Guillemin's Brazilian herbarium, and since it was the only species in the genus, it is the type of *Phyllocarpus* Riedel ex Tul. In 1844 Tulasne (1844) republished his generic description verbatim, amplified the description of *P. riedelii*, discussed the generic relations of *Phyllocarpus*, and illustrated the species. He also stated that specimen no. 1022 in the Guillemin herbarium was a Riedel collection. Apparently Tulasne examined Riedel's collection in Guillemin's herbarium, and noted that Endlicher's *Phyllocarpus* did not correspond to what Riedel had intended. Therefore he redescribed *Phyllocarpus* using the material of Riedel, and thereby created a second *Phyllocarpus* which is a later, illegitimate homonym.

Geesink (1984) separated *Deguelia* Aubl. from *Derris* Lour., and placed all the American species of *Derris* in *Deguelia*, including *L. pterocarpus*. He cited Endlicher's *Phyllocarpus* as a later synonym of *Deguelia*. The type of Endlicher's *Phyllocarpus* is now a later synonym of *Deguelia scandens* with the following synonymy:

Deguelia scandens Aubl., Hist. pl. Guiane 2:750, t. 300. 1775.
Lonchocarpus pterocarpus DC., Prodr. 2:260. 1825.
Derris guianensis Benth., J. Linn. Soc., Bot., 4, suppl.:106. 1860.
Derris scandens (Aubl.) Pittier, Contr. U.S. Natl. Herb. 20:41. 1917, non *Derris scandens* Benth., 1860.
Derris pterocarpa (DC.) Killip, J. Wash. Acad. Sci. 26(9):360. 1936.

This species is used as a fish poison (Killip 1936; Uphof 1968) in northern South America.

In 1912 Tulasne's *Phyllocarpus* was discovered in Guatemala, and John Donnell Smith (1913) mistakenly described it as a new species, *P. septentrionalis* Donn. Sm. It was later discovered as far south as Panama (Standley & Steyermark 1946; Woodson & Schery 1951; Holdridge & Poveda 1975). Barneby (1996) reviewed the genus, and concluded that it is monotypic and that *P. septentrionalis* is a later synonym of. *P. riedelii*.

Phyllocarpus in the sense of Tulasne has traditionally been accepted as a genus in the Fabaceae. It has been used in systems of legume classification (Bentham 1865; Hutchinson 1964; Cowan & Polhill 1981; Polhill 1994), floras (Bentham 1870; Britton & Rose 1930; Standley & Steyermark 1946; Woodson & Schery 1951; Holdridge & Poveda 1975; Isely 1975), and morphological studies (Gunn 1991). From the descriptions in these works, it is obvious that the authors mentioned above were referring to *Phyllocarpus* Riedel ex Tul. However, in Britton and Rose (1930) and Woodson and Schery (1951) its place of publication was given as the second supplement to Endlicher's *Generum plantarum* (1842), and also in Britton and Rose (1930) its type was cited as "*Phyllocarpus Pterocarpus* Riedel," an unpublished epithet.

Isely (1975) was the first to note that Tulasne's *Phyllocarpus* was a later homonym of Endlicher's *Phyllocarpus*, and therefore illegitimate. Barneby (1996) also recognized that Tulasne's *Phyllocarpus* was illegitimate. Therefore the following new name is presented for Tulasne's *Phyllocarpus*:

Barnebydendron J.H. Kirkr., nom. nov. *Phyllocarpus* Riedel ex Tul., Ann. Sci. Nat. Bor., sér. 2, 20:142. 1843, non *Phyllocarpus* Riedel ex Endl., 1842. TYPE: *Phyllocarpus riedelii* Tul. (=*Barnebydendron riedelii* (Tul.) J.H. Kirkbr.).

Barnebydendron riedelii (Tul.) J.H. Kirkbr., comb. nov. *Phyllocarpus riedelii* Tul., Ann. Sci. Nat. Bot., sér. 2, 20:143. 1843. TYPE: BRAZIL. Rio de Janeiro, *L. Riedel s.n.* (Catal. herb. Bras. Guillemin No. 1022 [Tulasne 1844]) (HOLOTYPE: P-n.v.; ISOTYPE: US!).

Phyllocarpus septentrionalis Donn. Sm., Bot. Gaz. 55:433. 1913. TYPES: GUATEMALA. Departamento Zacapa: Gualán, Feb 1912 (fl), *W.P. Cockerell s.n.* (LECTOTYPE, US861342! [Standley and Steyermark 1946; labelled by Standley as "type"]; ISOLECTOTYPES, US1337584! [fragments], US1337585! [fragments]); May 1912 (fr), *E. Morris s.n.* (PARATYPES, US1337586! [fragments], US1337587!, US1337588!).

I take great pleasure in dedicating this genus to Rupert C. Barneby who has contributed so much to legume systematics. During my doctoral studies, I shared an office with Rupert at the New York Botanical Garden, Bronx, New York. Rupert taught me many things, and significantly contributed to my botanical training.

In his review Barneby (1996) gave the distribution of *B. riedelii* as Central America from Guatemala to Panama, the Purús basin in the southwestern Brazilian Amazon, and the vicinity of Rio de Janeiro. It has recently been collected in Amazonian Peru (*N. Begarzo 150*, 20 May 1980 [US]) and Venezuela (*J. Lissot s.n.*, 24 Nov 1975 [US]) partially filling the gap between Central America and the southwestern Brazilian Amazon. Barneby (1996) cast doubt on whether it was native to the vicinity of Rio de Janeiro. As far as he knew, it has not been collected as a wild plant near Rio de Janeiro.

Barnebydendron has been reported as cultivated in southern Florida, Cuba, Guatemala, Costa Rica, and Panama. Wild trees are 15–35 m tall, and cultivated flowering specimens are 5–12 m tall. It flowers in the dry season without leaves, and is full of flowers that are described as various shades of intense red. Standley and Steyermark (1946) stated, "in general appearance and in the color of its blossoms this tree suggests poinciana (*Delonix*) and is almost equally showy," and Woodson and Schery (1951) wrote, "the abundant scarlet flowers rivaling in showiness those of the Royal Poinciana (*Delonix regia*)." This beautiful tree merits more widespread cultivation.

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REFERENCES

BARNEBY, R.C. 1996. Neotropical Fabales at NY: asides and oversights. Brittonia 48:174–187.

BENTHAM, G. 1865. Ordo LVII. Leguminosae. In: G. Bentham and J.D. Hooker, eds. Gen. pl. 1(2):434–600. Lovell Reeve & Co., London, England.

BENTHAM, G. 1870. XCV. *Phyllocarpus* Riedel. In: C.F.P. von Martius, ed. Fl. bras. 15(2):61–62, t. 19.

BRITTON, N.L. and J.N. ROSE. 1930. 9. *Phyllocarpus* Ried.; Endl. Gen. Suppl. 2:97. 1842. N. Amer. Fl. 23(4):219.

COWAN, R.S. and R.M. POLHILL. 1981. Tribe 4. Detarieae DC. (1825). In: R.M. Polhill and P.H. Raven, eds. Advances in Legume Systematics 1:117–134. Royal Botanic Gardens, Kew, England.

ENDLICHER, S.L. 1842. Gen. pl., suppl. 2. Fr. Beck, Wien, Austria.

GEESINK, R. 1984. Scala Millettiearum. Leiden Bot. Ser. 8:1–131.

GUNN, C.R. 1991. Fruits and seeds of genera in the subfamily Caesalpinioideae (Fabaceae). Techn. Bull. U.S.D.A. 1755:1–408.

HOLDRIDGE, L.R. and L.J. POVEDA A. 1975. Arboles de Costa Rica, vol. 1. Centro Cientifico Tropical, San José, Costa Rica.

HUTCHINSON, J. 1964. The genera of flowering plants, vol. 1. Oxford University Press, London, England.

ISELY, D. 1975. Leguminosae of the United States: II. Subfamily Caesalpinioideae. Mem. New York Bot. Gard. 25(2):1–228.

KILLIP, E.P. 1936. New plants mainly from western South America—V. J. Wash. Acad. Sci. 26:358–361.

MACBRIDE, J.F. 1943. Leguminosae. Bean family. In: J.F. Macbride, Flora of Peru. Field Mus. Nat. Hist., Bot. Ser. 13(part 3, no. 1):1–507.

POLHILL, R.M. 1994. Complete synopsis of legume genera. In: F.A. Bisby, J. Buckingham, and J.B. Harborne, eds. Phytochemical dictionary of the Leguminosae, pp. xlix–lvii. Chapman & Hall, London, England.

SMITH, J.D. 1913. Undescribed plants from Guatemala and other Central American republics, XXXVI. Bot. Gaz. 55:431–438.

STANDLEY, P.C. and J.A. STEYERMARK. 1946. *Phyllocarpus* Riedel. In: P.C. Standley and J.A. Steyermark, eds., Flora of Guatemala. Fieldiana, Bot. 24:144–145.

TULASNE, L.-R. 1843. Nova quaedam proponit genera in Leguminosarum classe. Ann. Sci. Nat. Bot., sér. 2, 20:136–144.

TULASNE, L.-R. 1844. Légumineuses arborescentes de l'Amérique du Sud. Arch. Mus. Hist. Nat. 4:65–195.

UPHOF, J.C.T. 1968. Dictionary of economic plants, ed. 2. J. Cramer, Lehre, Germany.

WOODSON, R.E. and R.W. SCHERY. 1951. 5. *Phyllocarpus* Riedel. In: R.E. Woodson and R.W. Schery, eds., Flora of Panama, part 5, fasc. 3, pp. 24–25. Ann. Missouri Bot. Gard. 38:324–325.

A NEW ENDEMIC SPECIES OF *MENTZELIA* SECT. BARTONIA (LOASACEAE) FROM NEW MEXICO

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ABSTRACT

Mentzelia conspicua T.K. Todsen, endemic to the Rio Chama basin of New Mexico, is illustrated and described. It is compared to a similar species, *Mentzelia laciniata* (Gray) Darl. The distribution of the two species in Rio Arriba County is shown.

RESUMEN

Se ilustra y se describe *Mentzelia conspicua* T.K. Todsen, endémica de la cuenca del Río Chama en Nuevo México. Se compra con la especie semejante, *Mentzelia laciniata* (Gray) Darl. Se muestra la distribución de las dos especies en el condado de Río Arriba.

KEY WORDS: *Mentzelia*, Loasaceae, New Mexico

Mentzelia conspicua T.K. Todsen, sp. nov. (**Fig. 1**). TYPE: U.S.A. NEW MEXICO. Rio Arriba Co.: W end of El Vado Dam in deep road cut on NM Hwy 112, T28N, R2E, 19 Aug 1991, *Todsen 91-8-11* (HOLOTYPE: NMC; ISOTYPE: LA).

Mentzeliae laciniatae (Rydb.) Darl. Similis sed differt. Differentiae sunt: staminum nonpetaloideum; lobos foliorum oppositos; staminum longitudine variante, verticillum intimum 7–10mm, verticillum extimum 25–30mm; paginae superae foliorum virides cum pilis dispersis.

Erect, strict, herbaceous perennial to 60 cm tall, pubescent with small retrorsely barbed hairs and long barbed hairs with tips acute and bases surrounded by support cells. Rosette leaves and cauline leaves pinnately lobed, rachis 2–3 mm wide, lobes usually opposite, 6–15 mm long, 2–3 mm wide, lower surfaces pubescent with stout curved, pointed hairs and fewer, smaller retrorsely barbed hairs, upper surfaces sparsely pubescent with few scattered pointed hairs. Bracts linear, usually entire but occasionally with 2 narrow lobes at base. Flowers opening late afternoon. Calyx lobes 5, 8–12 mm long, deltoid, acuminate, calyx tube 1.5–2 cm long; petals 10, in two whorls, the inner whorl of 5 petaloid staminodes, ovate to lanceolate, golden yellow, glabrous, outer whorl 25–40 mm long, 8–11 mm wide, inner whorl 22–35 mm long, 7–10 mm wide. Fertile stamens numerous, filaments all filiform, outermost whorl filaments 20–27 long, innermost 7–10 mm long, anthers 1 mm long; pistil 1; style 1, 24–32 mm long; stigma 1.5 mm long, at anthesis 9–12 mm above the anthers. Capsule cylindrical, 15–22 mm long, topped by persistent calyx lobes. Seeds lenticular, dark gray to black

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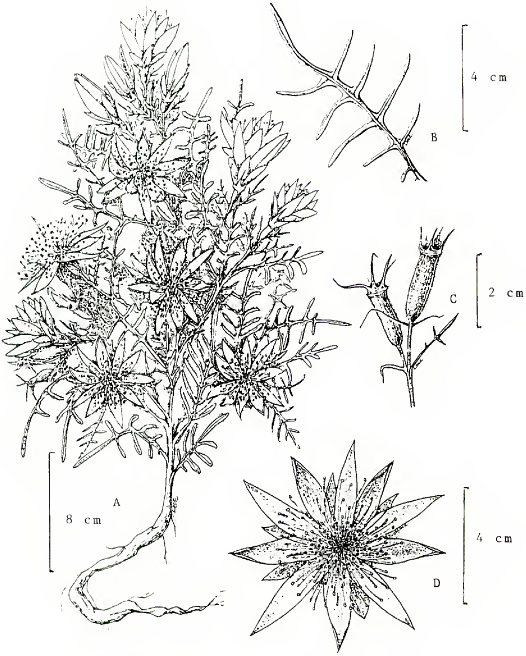

FIG. 1. *Mentzelia conspicua* (*Todsen 91-8-5*). A. Plant. B. Leaf. C. Capsule. D. Flower.

when mature, 2–2.8 mm long, wing narrow, to 0.1 mm wide. Chromosome number n = 10. Self compatible.

Distribution and ecology.—In the upper Rio Chama drainage of Rio Arriba County, New Mexico (Fig. 2), 1800–2250 m, on road cuts and steep barren hillsides of gray to red shales and clays of the Mancos and Chinle formations; flowering July to early October.

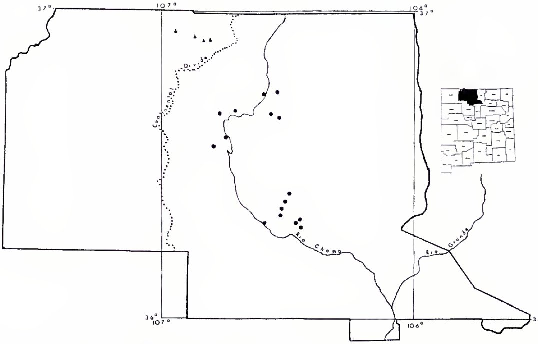

Fig. 2. Distribution of *Mentzelia conspicua* (circles) and *M. laciniata* (triangles) in Rio Arriba County, New Mexico.

Additional specimens: U.S.A. **NEW MEXICO. Rio Arriba Co.:** 8 mi S of Canjilon, 24 Jul 1928, *Wolf 2908* (CAS, CH, RSA); El Vado Dam, the Point, 22 Jul 1949, *Castetter and Dittmer 6559* (UNM); El Vado Dam, 22 Jul 1949, *Castetter and Dittmer 6565* (UNM); 22 mi S of Tierra Amarilla, 1954, *Waterfall 11126* (BRIT, COLO); 2.2 mi S of Ghost Ranch Museum, 21 Aug 1964, chromosome voucher n=10, *Atsatt 517* (LA); US84, 3.1 mi S of N turnoff to Canjilon, 21 Aug 1964, chormosome voucher n=10, *Atsatt 518* (LA, US); US 84, 2.4 mi S of Ghost Ranch Museum, fine red soil, 17 Sep 1968, *Thompson 3558* (LA); US64, 6 mi E of Tierra Amarilla, 30 Aug 1974, *Todsen s.n.* (NMC); Echo Amphitheater Campground,, 19 Aug 1991, *Todsen 91-8-1* (LA, NMC); US 84 1 mi S of entrance to Ghost Ranch, 19 Aug 1991, *Todsen 91-8-2* (LA, NMC, NY); US84, 4.3 mi S of jct. with US 64E, *Todsen 91-8-3* (NMC, LA, NY); US84, 9 mi S of Cebolla, 19 Aug 1991, *Todsen 91-8-4* (NMC); NM 95, just W of Rio Chama bridge, 19 Aug 1991, *Todsen 91-8-5* (LA, NMC, NY); NM 95, Heron Lake Park Visitor Center, 19 Aug 1991, *Todsen 91-8-6* (NMC); Ghost Ranch, Kitchen Mesa Trail, 8 Jul 1994, *Sivinsky and Lowery 2768* (NMC, UNM); NM 112, 5 mi W of El Vado Dam, 18 Aug 1994, *Todsen 94-8-3* (NMC); NM312, 3 mi E of US84, 18 Aug 1994, *Todsen 94-8-4* (NMC); NM95, NW end of El Vado Lake, 18 Aug 1994, *Todsen 94-8-5* (NMC); Forest Road 151, S of Big Eddy Pullout, Chama River Canyon Wilderness, 6 Oct 1997, *Todsen 97-10-1* (NMC). **Torrance Co.:** 16 mi E of Clines Corners, 17 Aug 1968, *Waterfall 15166* (BRIT, OSU, RSA).

Thirty-plus years ago, H.J. Thompson (personal communication) noted that *Mentzelia* specimens collected from the upper Rio Chama drainage differed from typical *Mentzelia laciniata* as described by Darlington (Darlington 1934), particularly in the presence of variable stamen lengths. He stated that the only other *Mentzelia* showing this characteristic was *M. crocea* Kellogg (=

M. lindleyi Torr. & Gray), so far as he knew. He later distributed a tentative description of what he called *M. conspicua*, but never published it.

Since all the earlier collections of *Mentzelia* from the upper Rio Chama basin were identified as *M. laciniata*, the differences between the latter species and *M. conspicua* are emphasized. For *M. conspicua*, 1) leaf lobes are usually opposite vs. usually alternate; 2) upper leaf surfaces and capsules have scattered pubescence vs. dense pubescence; 3) petaloid stamen filaments are absent vs. present; 4) stamen lengths for an individual flower are variable (7–22 mm) vs about three-fourths the length of the petals. Other more subjective differences are that *M. conspicua* plants are stouter and taller and the flowers are much larger (6–9 cm vs 3.5–4.5 cm).

There was an anomalous collection of *M. conspicua* from 16 mi E of Clines Corners in Torrance County (*Waterfall 15166*) 160 km SE of the nearest Rio Chama site. I have examined the specimens at BRIT and RSA and have a photocopy of the specimen at OSU and they are indeed *M. conspicua*. Attsatt, Thompson and I have independently searched the stated location and have found neither specimens nor characteristic habitat. The original site was along US Highway 66, which was completely redone to form Interstate Highway 40. It may be that the location was extirpated by that construction.

ACKNOWLEDGMENTS

I am indebted to H.J. Thompson for his sharing research data and advice on *Metzelia conspicua* as he called the taxon. My thanks go to Linda Reeves for her drawing and to friends and colleagues who have offered advice and encouragement. Finally, my appreciation to the reviewers and the editor for their cogent comments and criticisms.

REFERENCES

DARLINGTON, J. 1934. A monograph of the genus *Mentzelia*. Ann. Missouri Bot. Gard. 21:103–225.

NOMENCLATURAL NOVELTIES IN *NUPHAR* (NYMPHAEACEAE)

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ABSTRACT

Recent revisionary and cladistic studies in *Nuphar* Sm. resulted in the following nomenclatural amendmenrs: two novel sections are described (sect. *Nuphar* and sect. *Astylus*), five new combinations are proposed (*N. advena* subsp. *orbiculata*, *N. advena* subsp. *ozarkana*, *N. advena* subsp. *ulvacea*, *N. pumila* subsp. *sinensis*, *N. pumila* subsp. *oguraensis*), and one species, *N. oguraensis* Miki, is lectotypified.

RESUMEN

Los estudios recientes, cladísticos y revisiones de *Nuphar* Sm. dan por resultado las siguientes enmiendas nomenclaturales: se describen dos secciones nuevas (sect. *Nuphar* y sect. *Astylus*), se proponen cinco combinaciones nuevas (*N. advena* subsp. *orbiculata*, *N. advena* subsp. *ozarkana*, *N. advena* subsp. *ulvacea*, *N. pumila* subsp. *sinensis*, *N. pumila* subsp. *oguraensis*), y se lectotipifica *N. ogaraensis*.

Nuphar Sm. (Nymphaeaceae) is a relatively common genus in north temperate regions of North America, Europe and Asia. Inhabiting ponds, lakes, streams and slow moving rivers, these perennial herbs are characterized by floating and submersed leaves and solitary, globose, yellow flowers.

While conducting monographic research on *Nuphar*, morphological analyses initially suggested that the genus was represented by two sets of species, Old World and New World segregates (Padgett et al. 1996). Cladistic analyses of representative internal transcribed spacer (ITS) sequences (nrDNA) and *matK* (cpDNA) sequences subsequently offered strong support for the same two infrageneric lineages (Padgett 1997; Padgett et al., in press). Accordingly, the classification of *Nuphar* is emended to include two sections.

Nuphar sect. *Nuphar* is characterized by five sepals, anthers no more than half the length of the filaments, and urceolate fruits with elongated necks, or "styles" of some authors. It contains all Eurasian species with a single species (*N. microphylla* (Pers.) Fern.) represented in northeastern North America. *Nuphar* sect. *Astylus* is characterized by 6–12 sepals, anthers 1–2 times the

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length of the filaments, and ovoid fruits lacking apparent necks. It is entirely North American in distribution.

Nuphar sect. **Nuphar.** TYPE: *Nuphar lutea* (L.) Sm. in Sibth. & Sm., Fl. Graec. Prodr. 1:361. 1808 (1809).

Nuphar sect. **Astylus** D. Padgett, sect. nov. TYPE: *Nymphaea advena* Ait., Hort. kew. 2:226. 1789. *Nuphar advena* (Ait.) Ait. f., Hort. kew. ed. 2, 3:295. 1811.

Sepala 6–12; antherae elongatae, filamento suo duplo usque longiores; fructus ovoideus, haud infra discum constrictus; discus stigmaticus integer (rarius crenatus).

Sepals 6–12; anthers long, 1–2 times the length of the filaments, fruit barrel-shaped without a prominent neck, stigmatic disk entire (rarely crenate). North America. TYPE SPECIES: *Nuphar advena* (Ait.) Ait. f.

The synonymy of *Nuphar* is extensive and only recently has been assessed from a world-wide perspective (Beal 1956; Padgett 1997). However, since the primary purpose of this article is to make these new names available, complete synonymy will be withheld for a later publication (or see Padgett 1997). It should be noted, however, that Beal (1955; 1956) greatly broadened the species concept in his revision of *Nuphar*, thus placing into synonymy many previously recognized species under the type species *N. lutea* (L.) Sm. While information gleaned from the recent phylogenetic studies of the genus precludes any attempt to treat North American entities at a subspecific level under *N. lutea* (as urged by Beal [1956]), an alternative classification does adopt infraspecific taxa for some species (Padgett 1997). These taxa, as subspecies, are based on groups of populations with distinctive characters which exhibit geographical, and in some cases ecological, integrity but otherwise fall within the range of morphological variability for the species. A more detailed account of studies that support the taxonomic decisions reflected here will be forthcoming elsewhere (or see Padgett 1997).

As recognized by Padgett (1997), *Nuphar advena* sensu lato is a polymorphic species in section *Astylus* that ranges throughout most of southeastern North America. It is comprised of four recognizable, but morphologically strongly overlapping and inter-grading subspecies.

The reduction in rank of the three taxa that follow is based on examination of numerous herbarium specimens of this species complex from throughout its range, coupled with fieldwork, as well as multivariate statistical analyses (Padgett, in prep.). Infraspecific ranking of most of these formerly recognized species has been supported in opinion by other workers (e.g., Yatskievych & Turner 1990; Wiersema & Hellquist 1997).

Nuphar advena (Ait.) Ait. f. subsp. **orbiculata** (Small) D. Padgett, comb. nov. BASIONYM: *Nymphaea orbiculata* Small, Bull. Torrey Bot. Club 23:128. 1896. *Nuphar orbiculatum* (Small) Standl., Field Mus. Nat. Hist. Bot. Ser. 8:310–11. 1931. *Nuphar lutea* (L.) Sm. subsp. *orbiculata* (Small) E.O. Beal. J. Elisha Mitchell Sci. Soc.

72:338. 1956. "*orbiculatum*" TYPE: U.S.A. GEORGIA. THOMAS CO.: along or near the Ochlockonee River near Thomasville, *Small s.n.* (LECTOTYPE designated by Miller & Standley (1912): NY; ISOLECTOTYPES: F not seen, NY).

Nuphar advena (Ait.) Ait. f. subsp. **ulvacea** (Mill. & Standl.) D. Padgett, comb. nov. BASIONYM: *Nymphaea ulvacea* Mill. & Standl., Contr. U.S. Natl. Herb. 16:97. 1912. *Nuphar ulvaceum* (Mill. & Standl.) Standl., Field Mus. Nat. Hist. Bot. Ser. 8:310–11. 1931. *Nuphar lutea* (L.) Smith subsp. *ulvacea* (Mill. & Standl.) E.O. Beal., J. Elisha Mitchell Sci. Soc. 72:336. 1956. "*ulvaceum*". TYPE: U.S.A. FLORIDA: Blackwater River near Milton, *Curtiss 6409* (HOLOTYPE: US, not seen; ISOTYPES: BKL, CONN, F, GH, ILL not seen, MO, NY, UC, US, VT).

Nuphar advena (Ait.) Ait. f. subsp. **ozarkana** (Mill. & Standl.) D. Padgett, comb. nov. BASIONYM: *Nymphaea ozarkana* Mill. & Standl., Contr. U.S. Natl. Herb. 16:91–92. 1912. *Nuphar ozarkanum* (Mill. & Standl.) Standl., Field Mus. Nat. Hist. Bot. Ser. 8:310–311. 1931. *Nymphozanthus ozarkanus* (Mill. & Standl.) Palmer & Steyermark, Ann. Missouri Bot. Gard. 22:538. 1935. *Nuphar lutea* subsp. *ozarkana* (Mill. & Standl.) E.O. Beal, J. Elisha Mitchell Sci. Soc. 72:337. 1956. "*ozarkanum*" TYPE: U.S.A. MISSOURI: Along the White River in southern Missouri, *Smith s.n.* (HOLOTYPE: US).

As recognized by Padgett (1997), *Nuphar pumila* sensu lato is a polymorphic species within section *Nuphar*, largely of northern Eurasia, with three discernible subspecies. This subspecies and the following are restricted to warm regions in eastern Asia. *Nuphar pumila*, distinct from the American *N. microphylla* (Padgett 1998), is perhaps the most widely distributed species in the genus as a whole.

Nuphar pumila (Timm) DC subsp. **oguraensis** (Miki) D. Padgett, comb. et stat. nov. BASIONYM: *Nuphar oguraensis* Miki, Bot. Mag. (Tokyo) 48:334–335. 1934. TYPE: Fig. 7, p. 334 (LECTOTYPE, designated here).

This subspecies refers to a group of relatively rare plants confined to southern Japan. In the original protologue by Miki (1934) no type was designated. Although an effort was made to locate original material (four specimens cited by Miki), specimens of Miki's collections could not be located in Osaka (OSA). Therefore, the illustration in the original description (Miki 1934; Fig. 7, p. 334) of the taxon has been selected to serve as the lectotype. This plate clearly shows the diagnostic central lacuna of the petiole, a feature scarcely apparent on herbarium specimens.

Nuphar pumila subsp. **sinensis** (Hand.-Mazz.) D. Padgett, comb. et stat. nov. BASIONYM: *Nuphar sinense* Hand.-Mazz., Anz. Akad. Wiss. Wien, Math.-Naturwiss. Kl. 63:8. 1926. TYPE: CHINA. HUNAN: Tschangscha, in lacunis reg. subtropicae versus montem Gu-schan, s. arenaceo, *Handel-Mazzetti 11357* (TYPE: not located, possibly at WU).

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REFERENCES

BEAL, E.O. 1955. Taxonomic revision of the genus *Nuphar* Sm. Ph.D. Dissertation. State University of Iowa, Iowa City, Iowa.

———. 1956. Taxonomic revision of the genus *Nuphar* Sm. of North America and Europe. J. Elisha Mitchell Sci. Soc. 72:317–346.

MIKI, S. 1934. On fresh water plants new to Japan. Bot. Gaz. (Tokyo) 48:326–336.

MILLER, G.S. and P.C. STANDLEY. 1912. The North American species of *Nymphaea*. Contr. U.S. Natl. Herb. 16:63–108.

PADGETT, D.J. 1997. A biosystematic monograph of the genus *Nuphar* Sm. (Nymphaeaceae). Ph.D. Dissertation, University of New Hampshire, Durham, New Hampshire.

———. 1998. Phenetic distinction between the dwarf yellow water-lilies: *Nuphar microphylla* and *N. pumila* (Nymphaeaceae). Canad. J. Bot. 76:1–8.

———, D.H. LES and G.E. CROW. 1996. Systematic studies of *Nuphar* (Nymphaeaceae), the yellow water lilies. Amer. J. Bot. 83: 184-185.

———, D.H. LES and G.E. CROW (In Press). Phylogenetic relationships in *Nuphar* (Nymphaeaceae): Evidence from morphology, chloroplast DNA, and nuclear ribosomal DNA. Amer. J. Bot. 86.

WIERSEMA, J.H. and C.B. HELLQUIST. 1997. Nymphaeaceae. In: Flora North America north of Mexico. Vol. 3. Convening ed. N. T. Morin and Editorial Committee. Oxford University Press. New York, NY.

YATSKIEVYCH, G. and J. TURNER. 1990. Catalogue of the flora of Missouri. Missouri Botanical Garden. Saint Louis, Missouri.

A NEW HYBRID OF *SPIRAEA* (ROSACEAE) FROM OREGON

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ABSTRACT

A new naturally occurring hybrid between *Spiraea douglasii* var. *menziesii* and *S. splendens* var. *rosea* is described and named S. ×*hitchcockii* W. Hess & N. Stoynoff. Morphological, chromosome number, and pollen stainability evidence is presented. The hybrid is the first reported triploid for the genus *Spiraea*.

RESUMEN

Se describe un nuevo híbrido natural entre *Spiraea douglasii* var. *menziesii* y *S. splendens* var. *rosea* que se nombra S. ×hitchcockii W. Hess & N. Stoynoff. Se presentan evidencias morfológicas, número cromosómico y tinción del polen. El híbrido es el primer triploide citado del género *Spiraea*.

In the Pacific Northwest, areas where species of *Spiraea* overlap, hybrids have been produced (Hitchcock et al. 1961). Hess (1969) presented evidence that *S. douglasii* Hook. var. *menziesii* (Hook.) K. Presl and *S. betulifolia* Pallas var. *lucida* (Greene) C.L. Hitchc. hybridized to produce *S.* × *pyramidata* Greene. In at least one area, *S. douglasii* var. *menziesii* and *S. splendens* (Baumann) ex K. Koch var. *rosea* (Gray) Kartesz and Gandhi (syn. *S. densiflora* Nutt.) occur together and produce a naturally occurring hybrid herein named *Spiraea* ×*hitchcockii*.

Spiraea ×hitchcockii W. Hess & N. Stoynoff (*S. douglasii* var. *menziesii* × *S. splendens* var. *rosea*), hybrida nov. TYPE: U.S.A. OREGON: LANE CO.: Scott Lake, Willamette National Forest, 20 mi W of Three Sisters, on St. Hwy. 242; mixed coniferous forest with *Abies, Pinus monticola, Tsuga, Juniperus, Salix, Cassiope*, & *Vaccinium*; common shrub, scattered around lake, 10–12 dm tall, infl. pyramidal, petals rose-pink, Elev. 4700', 11 Aug 1995, *Hess & Stoynoff 7283* (HOLOTYPE: MOR; ISOTYPES: BRIT, MO, NA, NY, US).

Differt a *Spiraea splendens* var. *rosea* inflorescentia paniculata, pubescentia puberula et *Spiraea douglasii* var. menziesii lamina serrulata, calyces lobis puberula, et inflorescentia 1.3–2.8 longiora quam lata.

SIDA 18(3): 827–830. 1999

Shrubs, forming rhizomatous colonies, 10–12 dm tall. *Branches* pale brown, becoming dark brown when mature and slightly peeling, lightly puberulent. *Leaves* (20–)25–45(–60) mm long, (8–)12–18(–21) mm wide; mostly obovate to narrowly elliptic; lightly puberulent above, puberulent below; margins serrate, distal 1/2–1/3. *Inflorescences* pyramidal, 18–75(–95) mm long, 15–40(–45) mm wide; puberulent. *Flowers* many, in panicles; hypanthia green, 9–11 mm long, 14–16 mm wide, puberulent within and without; calyx lobes deltoid, 7–10 mm long, 7–9 mm wide, mostly reflexed, puberulent without, densely puberulent along margins within; petals rose-pink, broadly elliptic, 13–15 mm long, 11–13 mm wide; stamens many, pink; carpels 5, separate, follicles glabrous. $n=27$.

Additional specimen examined: **U.S.A. OREGON. Lane Co.**: 21 mi W of Three Sisters off St. Hwy. 242 to Scott Lake, approx. 7 mi W of McKenzie Pass, 22 Aug 1975, *W. Hess 3628* (MOR).

Distribution.—Scott Lake, in Oregon, is the main locality known to the authors where *Spiraea* ×*hitchcockii* occurs. It grows around the lake margin with its putative parents, *S. douglasii* var. *menziesii* and *S. splendens* var. *rosea*. The putative parents occur elsewhere in the Pacific Northwest and other hybrids of these species may be found in localities of overlap. Hess (1962) cited a collection from Pierce Co., WA (*Warren 1627*, WTU) as a possible hybrid between the putative parents.

Morphology.—The most obvious morphological difference between *Spiraea* ×*hitchockii* and its putative parents is a pyramidal inflorescence that is up to three times as tall as wide, versus the inflorescence of *S. douglasii* var. *menziesii* that is typically more than three times taller than wide and of *S. splendens* var. *rosea, which has* a flat-topped or slightly rounded inflorescence. The inflorescences and calyces of *S.* ×*hitchcockii* are somewhat puberulent and not tomentulose as those of *S. douglasii* var. *menziesii*, or glabrous to lightly puberulent as that *of S. splendens* var. *rosea*. The leaves of *S.* ×*hitchcockii* are mostly obovate to narrowly elliptical, 2.5–4.5 cm long, 1.2–1.8 cm wide, finely serrulate, and finely puberulent; those of *S. douglasii* var. *menziesi*i oblong-elliptic to obovate-lanceolate, 3–10 cm long, 2–8 cm wide, serrate, and glabrous to lightly pubescent; and leaves ovate-oval to oblong-elliptic, 2–5 cm long, 1–4 cm wide, serrulate to serrate, and finely puberulent for *S. splendens* var. *rosea*. The intermediate shape of the inflorescence of *S.* ×*hitchcockii*, when compared with the putative parents, suggest a hybrid. *Spiraea* ×*hitchcockii* shares the leaf vestiture, length, serrulate margins with those of *S. splendens* var. *rosea* and its leaf shape approaches that of *S. douglasii* var. *menziesii*. The shared features of the putative parents suggest the hybrid nature of *S.* ×*hitchcockii*.

Cytology.—Hess (1969) reported the chromosome numbers for *Spiraea douglasii* var. *menziesii* as $n=18$ and *S. densiflora* (= *S. splendens* var. *rosea*) as $n=9$. Until

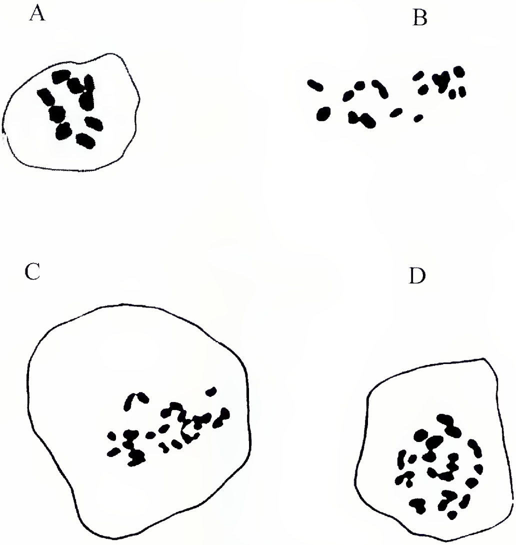

FIG. 1. Camera lucida drawings of chromosomes from microsporocytes of *Spiraea* (× 1000). A. *Spiraea splendens* var. *rosea*, *Hess & Stoynoff 7266:* Metaphase I, 9_{II}. B. *Spiraea douglasii* var. *menziesii*, *Hess & Stoynoff 7281:* Metaphase I, 18_{II}. C., D. *Spiraea* ×*hitchcockii. Hess & Stoynoff 7283*. C. Metaphase I, 4_{II},17_{I}. D. Metaphase I, 4_{II}, 17_{I}.

then, all of the chromosome counts of *Spiraea* in the new world were tetraploids. The count for *S. splendens* var. *rosea* was the first record of a diploid *Spiraea* in the new world. The collecting of flower buds, their preservation, and slide preparation procedures followed Hess (1969). All counts were made on a Zeiss Photomicroscope II with a camera lucida attachment. Chromosome counts were made from microsporocytes of *S. splendens* var. *rosea*, *S. douglasii* var. *menziesii*, and *S.* ×*hitchcockii.* Counts of $n=9$ for *S. splendens* var. *rosea* confirmed the earlier diploid record (Fig. 1, A). The tetraploid number of 18 bivalents obtained for *S. douglasii* var. *menziesii* (Fig. 1, B) also confirmed an earlier count of Hess (1969). Camera lucida illustrations of chromosomes are shown for *S.* ×*hitchcockii* (Fig. 1, C, D). The chromosomes for the hybrid had mostly univalents evident and a few bivalents. The haploid number is $n=27$. *Spiraea* ×*hitchcockii* would appear to be the first known triploid for the genus.

Pollen stainability.—Pollen grains were immersed in cotton blue-lactolphenol to test for pollen stainability (interpreted as pollen viability) based on procedures in Hess (1969). The percentage of pollen grains of *Spiraea douglasii* var. *menziesii* stained was 84–95%, similar to Hess's report for the same species in 1969. 84–98% of the pollen grains of *S. splendens* var. *rosea* were stained, similar to what Hess reported for the same species in his thesis (1962). *Spiraea* ×*hitchcockii* pollen grains stained from 2–14%. Low pollen stainability (i.e. viability) is suggestive of hybridity.

Etymology.—*Spiraea* ×*hitchcockii* is named in honor of the senior author's first mentor in taxonomy, C. Leo Hitchcock, one of the best taxonomy teachers of his era, a student par excellence on the flora of the Pacific Northwest, and a world class taxonomist.

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REFERENCES

HESS, W.J. 1962. M.S. Thesis. A taxonomic study of *Spiraea pyramidata* Greene. University of Washington, Seattle, WA.

———. 1969. A taxonomic study of *Spiraea pyramidata* Greene (Rosaceae). Sida 3:298–308.

HITCHCOCK, C.L., A. CRONQUIST, M. OWNBEY, and J.W. THOMPSON. 1961. Vascular plants of the Pacific Northwest 3. Saxifragaceae to Garryaceae. University of Washington Press, Seattle, WA.

A NEW COMBINATION IN *CROIZATIA* (EUPHORBIACEAE)

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ABSTRACT

The unispecific genus *Pseudosagotia* is placed in synonymy under *Croizatia* and a new combination, *Croizatia brevipetiolata* (Secco) Dorr, is proposed for its sole species. An emended description is provided for *C. brevipetiolata*, a dioecious species that was known previously only from female flowers and fruits. *Croizatia brevipetiolata* is compared to *C. neotropica* and *C. naiguatensis*, two species from coastal Venezuela, and to *C. panamensis*, a species from Panama and Pacific Colombia.

RESUMEN

Se ubica el género monoespecífico *Pseudosagotia* como sinónimo del género *Croizatia* y se propone una nueva combinación, *Croizatia brevipetiolata* (Secco) Dorr, para su única especie. Se presenta una descripción corregida de *C. brevipetiolata*, una especie dioica, de la cual previamente sólo se conocían las flores femeninas y los frutos. Se compara *C. brevipetiolata* con *C. neotropica* y *C. naiguatensis*, dos especies de la región litoral de Venezuela, y con *C. panamensis*, una especie de Panamá y el extremo occidental de Colombia.

When Secco (1985) described the genus *Pseudosagotia*, he failed to compare it to *Croizatia* Steyerm., which is not surprising given that the latter genus was then known from two imperfect collections that served as the types of two species. Had Secco read Steyermark's (1952, 1978) descriptions of these species or seen the accompanying figures he undoubtedly would have described his species of *Pseudosagotia* as a new species of *Croizatia* because the two genera are identical in all essential characters save one, which appears to have been misinterpreted. Subsequently, Webster et al. (1987) reviewed the genus *Croizatia*, which they placed in the Phyllanthoideae, and they described a third species. Most recently, Webster (1994) placed *Croizatia* in the Oldfieldioideae and created a new tribe, Croizatieae, to accommodate the genus, the correct placement of which he continued to debate. Webster and collaborators overlooked *Pseudosagotia* and its sole species and they cited no other generic synonyms of *Croizatia*.

Salient characters that Secco (1985) observed for *Pseudosagotia*, which also define *Croizatia*, included the following: pistillate flowers pedicellate; calyx 5-lobed, petaloid; petals 5, minute, alternisepalous; ovary 3-locular, with 2 ovules per locule; style 3-branched, each branch bifurcated; fruit capsular, with persistent sepal lobes; seeds ecarunculate. In addition, while not mentioned by Secco (1985), his illustration (Fig. 1) showed that the sepal lobes of *Pseudosagotia* are reflexed in fruit like those of *Croizatia*. Staminate flowers of *Pseudosagotia* were not available to Secco (1985), but these flowers (described below) also agree in shape, size, and ornamentation with those of *Croizatia*. Similarly, pollen of *Pseudosagotia* (described below) agrees with published descriptions (Webster et al. 1987; Levin & Simpson 1994; Simpson & Levin 1994) of pollen of *C. naiguatensis* Steyerm. (The number and nature of the pores of *Pseudosagotia* pollen were not visible with light microscopy). The only character of *Pseudosagotia* cited by Secco (1985) that does not agree with *Croizatia* (as defined by Webster et al. 1987; Webster & Huft 1988; Webster 1994) is the presence of endosperm, which has not been reconfirmed.

Croizatia Steyerm., Fieldiana, Bot. 28(2):308. 1952. TYPE: *Croizatia neotropica* Steyerm.

Pseudosagotia Secco, Bol. Mus. Paraense Emílio Goeldi, Sér. Bot. 2:23. 1985. TYPE: *Pseudosagotia brevipetiolata* Secco ≡ *Croizatia brevipetiolata* (Secco) Dorr.

Croizatia brevipetiolata (Secco) Dorr, comb. nov. BASIONYM: *Pseudosagotia brevipetiolata* Secco, Bol. Mus. Paraense Emílio Goeldi, Sér. Bot. 2:24, figs. 1, 2. 1985. TYPE: VENEZUELA. TRUJILLO: entre Boconó y Guaramacal, 2100–2300 m, 4 Sep 1966 (♀ fls., immature fr.), *Steyermark & Rabe 97322* (HOLOTYPE: NY n.v.; ISOTYPE: US!).

Tree, 3–6(–15) m tall; leaf blades elliptic to lanceolate or oblanceolate, long-acuminate at apex, long-attenuate at base, (5–)8.5–21 cm long, (2–) 3–6.5 cm broad, inconspicuously strigose or glabrous beneath, lateral nerves ca. 8–9 on each side, prominulous with the fainter and more delicate tertiary veins, glabrous above; petioles 4–6(–10) mm long, slender, canaliculate, strigose or glabrous; stipules subulate, ca. 4–5 mm long, scarious, sericeous, deciduous. Staminate flowers in dense axillary clusters; pedicel 5–8 mm long, strigose; sepals 5, elliptic, entire, more or less equal in size, 5.5–6 mm long, 4–5 mm broad, whitish-cream or yellowish-white; petals 5, obovate, subentire, ca. 1.25–1.8 mm long, ca. 1–1.2 mm broad, glabrous adaxially, densely sericeous abaxially; disk cupuliform, ca. 1 mm tall, 4–5 mm in diam., glabrous; stamens 5, free, filaments ca. 3 mm long, hirsutulous basally; anthers elliptic, ca. 1.5–2 mm long; pistillode 3–4-lobed, 4–5 mm tall, hirsutulous basally. Pollen spherical, ca. 40 µm in diam., and echinate (*Cuello et al. 992*, US!). Pistillate flowers in 2–3-flowered axillary clusters; pedicel strigose, 12–28 mm long at anthesis and in fruit; sepals (4) 5, elliptic, slightly carinate (hooded), 8–10 mm long, 3–5 mm broad, unequal in size (one larger than the others), strigose adaxially near the base, strigose abaxially, greenish, becoming reflexed and persistent in fruit; petals (4) 5, elliptic, ca. 1.25

mm long, ca. 0.75 mm broad, glabrous adaxially, densely sericeous abaxially, disk cupuliform, ca. 1 mm tall, ca. 5 mm in diam., glabrous; ovary sericeous, hairs white; styles spreading, ca. 3.5 mm long, twice bifid, the undivided portion ca. 1.5 mm long, the primary branches ca. 1.5 mm long, ultimate tips ca. 0.5 mm long. Capsule oblate, 3-lobed, 1–1.5 cm tall, 1.5–1.8 cm in diam., reticulate, strigose to glabrate; columella ca. 7–10 mm tall, wings persistent. Seeds ovoid, flattened on one side, ca. 10 mm long, ca. 6–8 mm broad, testa smooth, hilum medial, exalbuminous (*Cuello et al. 990*, US!), cotyledons folded (contortuplicate).

Distribution and ecology.—Locally common on the slopes of the Andes in Barinas, Lara, Portuguesa, and Trujillo states, Venezuela, where it occurs from 1400–2300 (–2600) m elevation in lower montane (cloud) forest often dominated by *Wettinia praemorsus* (Willd.) Wess. Boer (Palmae). In the Ramal de Guaramacal (Trujillo state) Cuello (1997) found that *Croizatia brevipetiolata* was the most abundant species in vegetation plots she established at 2100 and 2300 m elevation. Also, apparently frequent at 1650 m elevation in dense forest on the slope of Pico Renjifo, Meta, Colombia. In Venezuela, flowering from (April) May through July and fruiting in October and November. In Colombia, known only from fruiting material collected in June.

In some Venezuelan populations, male plants appear to be less common (less conspicuous?) than female plants (fide *Dorr & Barnett 8046*).

Additional material examined. **VENEZUELA. Barinas:** Dtto. Pedraza, NE of Alto de La Aguada (ca. 8° 37'N, 70° 40'W) in an area known locally as "Montañas de Tierra Blanca," 18 Apr 1988 (fl bud), *Dorr et al. 4858* (NY, PORT–2 sheets, VEN). **Lara:** Dtto. Morán, las cabeceras del Río Tocuyo, 20–21.5 kms al sur de Humocaro Alto, hacia Guaitó, 13 Oct 1974 (fr), *Steyermark & Carreño Espinoza 111112* (VEN); carretera desde Humacaro Alto hacia Guaitó, 14 Nov 1984 (fr), *van der Werff & Rivero 7915* (NY, PORT). **Portuguesa:** Dtto. Sucre, Parque Nacional Guaramacal, Sector El Paramito, Camino Real La Aguadita—El Baratal (ca. 9° 19'N, 70° 04'W), 8 Jul 1999 (st), *Dorr & Yustuz 8555* (PORT, US). **Trujillo:** Dtto. Boconó, 25 km al SE de Boconó, 26 Jul 1984 (♀ fls), *Aymard et al. 2948* (NY, PORT, US); Parque Nacional Guaramacal, vertiente norte, 17–18 Jun 1995 (♀ fls), *Cuello et al. 990* (MO, US), Ibid, 17–18 Jun 1995 (♂ fls), *Cuello et al. 992* (PORT, US); Parque Nacional Guaramacal, road from Boconó to Guaramacal, SE of Boconó, N slope of mountain, 13 Jul 1995 (♀ fls), *Dorr & Barnett 8044* (K, NY, PORT, US, VEN), Ibid, 13 Jul 1995 (♂ fls), *Dorr & Barnett 8046* (DAV, F, PORT, US, VEN); Páramo de Guaramacal, SE of Boconó on road from Boconó to Guaramacal, 19 Oct 1990 (fr), *Dorr et al. 7437* (NY, PORT); Parque Nacional Guaramacal, road from Boconó to Guaramacal, SE of Boconó and just above park headquarters, N slope of mountain, 5 Jul 1995 (♂ fls), *Dorr et al. 7963* (CANB, K, MO, NY, PORT, US, VEN); Parque Nacional Guaramacal, en la vertiente norte, 27 May 1995 (♀ fls), *Licata & Cuello 151* (COL, MO, PORT, US), Ibid, 27 May 1995 (♂ fls), *Licata & Cuello 152* (DAV, F, PORT, US), Ibid, 15 Jul 1995 (♀ fls), *Licata & Niño 304* (COL, PORT, US). Dtto. Carache, Burbusay, Sector El Alto, 27 Jul 1995 (fl), *Licata & González 412* (PORT). **COLOMBIA. Meta:** Sierra de la Macarena, Central Mountains, Pico Renjifo, 22 Jan 1950 (fr), *Philipson et al. 2154* (US).

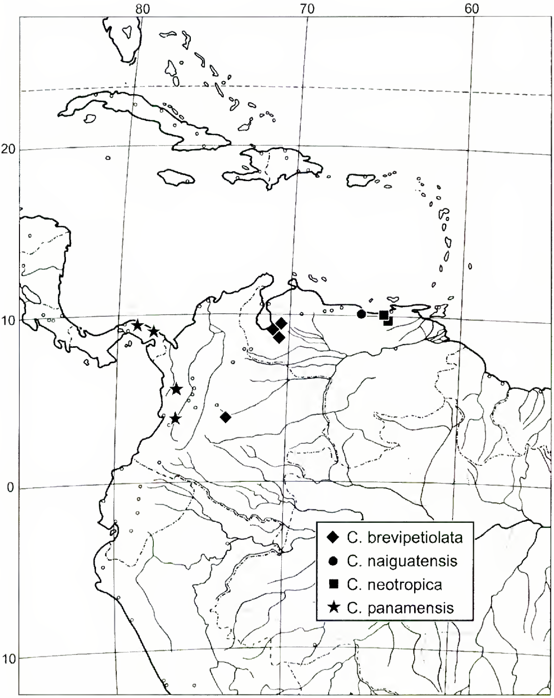

FIG. 1. Distribution of *Croizatia* species (Euphorbiaceae) in Central and northern South America.

The paucity and incompleteness of the available material make interpreting the species boundaries of *Croizatia* difficult. *Croizatia brevipetiolata* is very similar morphologically to *C. naiguatensis*, which is known from a few collections from the Cerro Naiguatá in the Coastal Cordillera of the D.F., Venezuela. *Croizatia brevipetiolata* differs from *C. naiguatensis*, however, in that the leaf apices are long-acuminate (versus acute or obtuse) and the leaf bases are long-attenuate (versus attenuate); the staminate flowers are larger in all measurable characters (pedicels 5–8 versus 3–4 mm long; sepals 5.5–6 × 4–5 versus 4–4.5 × 2.5–3 mm; disk 4–5 versus ca. 3 mm in diam.; filaments ca. 3 versus 2.2–2.5 mm long; anthers 1.5–2 versus 1.2–1.4 mm long; and pistillodes 4–5 versus 1.8–2.2 mm tall); and the pedicels of pistillate flowers are longer both in flower and fruit (12–28 versus 8–12 mm long). Collectors' notes also indicate that the perianth of pistillate flowers of *C. brevipetiolata* is greenish in color (fide *Licata & Cuello 152*, *Licata & Niño 304*, etc.), while that of *C. naiguatensis* is cream-colored (fide *Berry et al. 4121*, *4125*, US!). Both *C. brevipetiolata* and *C. naiguatensis* can be distinguished from *C. panamensis* G.L. Webster by having staminate flowers with free (versus connate) stamens. Likewise, the two species can be distinguished from the enigmatic *C. neotropica* by having shorter (8–28 versus 35–45 mm long) pistillate flower pedicels. Good flowering material (both staminate and pistillate) of *C. neotropica* is still lacking. *Croizatia brevipetiolata* and *C. naiguatensis* also can be distinguished from the other two described species by having fewer (7–10 versus 12–15) lateral nerves on each side of the midvein of the leaf blade.

The few collections of *Croizatia* begin to suggest distinct geographic ranges for the species (Fig. 1). *Croizatia brevipetiolata* evidently is restricted to forested slopes of the northern Andes at elevations ranging from 1400–2300(–2600) m. *Croizatia naiguatensis* and *C. neotropica* are both found in the Coastal Cordillera of northern Venezuela, but the former occurs in cloud forest at 1900–2150 m in the central portion of this cordillera, while the latter occurs at 1000–1350 m in the eastern portion of the same cordillera (Steyermark 1978). *Croizatia panamensis* has been collected only in primary forest at (50–) 300–500 m in Panama and the Chocó region of neighboring Colombia. Additional material from Amazonian Ecuador and Peru, which Webster et al. (1987) mentioned, may represent new species and could extend the range of *Croizatia* further south, but none of this material was examined for this note.

ACKNOWLEDGMENTS

I am indebted to Kenneth Wurdack for his observations on the identity of *Pseudosagotia* (although we part ways on the distinctiveness of *Croizatia brevipetiolata*), Basil Stergios for facilitating research in Venezuela, INPARQUES for granting permission to work in Guaramacal, and the Wildlife Conservation Fund of the National Museum of Natural History (supported by Molson Breweries U.S.A., Inc.) for funding field work. The curators of NY, PORT, and VEN were most gracious in lending or permitting me to study specimens in their care. Lynn Gillespie and Geoffrey A. Levin reviewed and made useful suggestions for improving the manuscript.

REFERENCES

Cuello A., N.L. 1997. Floristic diversity and structure of the montane forests of Cruz Carillo National Park in the Venezuelan Andes. M.S. Thesis, University of Missouri-St. Louis, St. Louis.

Levin, G.A. and M.G. Simpson. 1994. Phylogenetic implications of pollen ultrastructure in the Oldfieldioideae (Euphorbiaceae). Ann. Missouri Bot. Gard. 81:203–238.

Secco, R. de S. 1985. *Pseudosagotia*: um novo gênero de Euphorbiaceae para a Amazônia Venezuelana. Bol. Mus. Paraense Emílio Goeldi, Sér. Bot. 2:23–27.

Simpson, M.G. and G.A. Levin. 1994. Pollen ultrastructure of the biovulate Euphorbiaceae. Int. J. Plant Sci. 155:313–341.

Steyermark, J.A. and collaborators. 1952. Botanical exploration in Venezuela–II. Fieldiana, Bot. 28(2):243–447.

——— and ———. 1978. New taxa from the Avila and Naiguatá mountains, Venezuela. Brittonia 30:39–49.

Webster, G.L. 1994. Synopsis of the genera and suprageneric taxa of Euphorbiaceae. Ann. Missouri Bot. Gard. 81:33–144.

———, L. Gillespie, and J. Steyermark. 1987. Systematics of *Croizatia* (Euphorbiaceae). Syst. Bot. 12:1–8.

——— and M.J. Huft. 1988. Revised synopsis of Panamanian Euphorbiaceae. Ann. Missouri Bot. Gard. 75:1087–1144.

EIGHT NOVELTIES IN *ABILDGAARDIA* AND *BULBOSTYLIS* (CYPERACEAE) FROM SOUTH AMERICA

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ABSTRACT

One new species of *Abildgaardia*, *A. papillosa*, and seven of *Bulbostylis*, are described and illustrated, and their relationships to closely allied species are discussed. In addition, an updated description of the genus along with a key to the species of New World *Abildgaardia* is provided.

RESUMEN

Se describe e ilustra una nueva especie de *Abildgaardia*, *A. papillosa*, y siete nuevas especies de *Bulbostylis*, y se discute su relación con especies cercanas. Además, se ofrece una descripción actualizada del género, acompañada de una clave para identificar las especies del Nuevo Mundo de *Abildgaardia*.

In our ongoing field-and-herbarium work with American fimbristyloid Cyperaceae, we have eight new species to report, namely one *Abildgaardia* and seven *Bulbostylis*. These novelties are all South American, seven from the planalto of Brazil, and one from Bolivia. Decisions on placement of species to genus in this work are based on distinctions between *Abildgaardia*, *Bulbostylis* and *Fimbristylis* as given in Kral (1971).

Since the description of North American *Abildgaardia* given by Kral (l.c.) has to be amended to include two other taxa, one the new species, the other a species even today referred to by authors as *Fimbristylis bahiensis* Steudel, we give below a modification that now defines the genus in the New World.

Abildgaardia Vahl, Enum. Pl. 2:296. 1805.

Perennial or annual, glabrous, caespitose. Leaves with sheaths closed save at summit, lacking cilia or fimbriae at orifice, eligulate; blades narrowly

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linear to filiform, thickened, flat to variously involute or essentially lacking. Spikelets ovate to linear, either solitary and terminal on wiry culms or few to several in a loose to dense terminal cluster, rarely in a simple dichasium, in any case subtended by a single involucral bract, this shorter than inflorescence or spikelet; spikelet scales loosely imbricate, mostly keeled and subdistichous or arranged so that the spikelet appears compressed and with torque (twisted), the lower 1–2 scales sterile, those above subtending perfect flowers or apical ones male, all with dorsal/midcostal zone of 3–5 costae, these convergent at scale apex and either included or excurrent as a mucro. Florets produced on a short pedicel-joint; perianth absent. Stamens 2–3; filaments flat and twisted; anthers basifixed, narrowly oblong or linear, the two thecae at maturity longitudinally and laterally dehiscing. Style 3-branched, the base trigonous, smooth or glandular-puberulent, capping the nipple-like achene apex, dehiscing at achene maturity, upwardly slender, smooth or glandular-puberulent at junction with the linear, glandular-hairy stigma branches. Achene stipitate-obovoid, the stipe stout, the body globose to broadly obovoid, strongly tricostate, apically abruptly narrowed to a pyramidal or truncate-pyramidal nipple, the three convex faces finely lined longitudinally and indistinctly by narrow cancellae, conspicuously roughened by a combination of short, coarse, transverse rugae and/or uniform or uneven coarse, large, low and dome-shaped papillae.

There are, by conservative estimate and in the strictest sense, about 15 species of *Abildgaardia* worldwide in tropical or subtropical regions; only four seem to be known for the Americas. A key to the American species is provided below, followed by detailed descriptions of the two which have bladeless leaves, one of which is new to science.

KEY TO NEW WORLD *ABILDGAARDIA*

1. Plants perennial with well-developed leaf blades; culm bases swollen; spikelets ovate.
    2. Spikelets pale, frequently solitary at apex of culms or 2–3 per culm, in which case scattered toward scape apex .... **1. A. ovata**
    2. Spikelets red-brown, mostly few in clusters at apex of culms or rarely solitary .... **2. A. mexicana**
1. Plants with no leaf blades or at most a cusplike blade no longer than 5 mm; culm bases not swollen; spikelets linear.
    3. Scape and leaf sheath surfaces smooth; apices of leaf sheath and spikelet scales narrowly acute to acuminate; spikelets (5–)17–15 mm long; anthers 1.5–2 mm long .... **3. A. baeothryon**
    3. Scape and leaf surfaces uniformly papillose; apices of leaf sheath and spikelet scales emarginate; spikelets 15–20 mm long; anthers ca. 3 mm long. .... **4. A. papillosa**

1. **Abildgaardia ovata** (Burm. f.) Kral, Sida 4:77. 1971. Type: from Java, coll. ign. (holotype: G, n.v.). *Carex ovata* Burm.f., Fl. Indica 194. 1768. *Fimbristylis ovata* (Burm. f.) Kern, Blumea 15:126. 1967.

Cyperus monostachyus L., Mant. Pl. 180. 1771. *Abildgaardia monostachya* (L.) Vahl, Enum. P1. 2:296. 1805. *Fimbristylis monostachya* (L.) Hassk., P1. Jav. Rar. 61. 1848. *Iriba monostachya* (L.) Kuntze, Rev. Gen. Pl. 751. 1891.

This is the generic type from India. It is the only cosmopolitan taxon of the four treated herein. In the Americas, it ranges from peninsular Florida, U.S.A. southward through the West Indies and Mexico through Central America to southern South America (Argentina). It is a plant of basic or calcareous substrates in savannas, grasslands, landward edges of brackish or salt marsh, calcareous outcrop areas, and on dryish to seasonally dry sites, mostly at low to medium (1500 m) elevations.

2. **Abildgaardia mexicana** (Palla) Kral, Sida 4:71. 1971. Type: MEXICO: Bords de l'Alteseca, près de Puebla, 13 Jun 1907, *F. Arsène s.n.* (holotype: GZU, n.v.). *Fimbristylis mexicana* Palla, Oesterr. Bot. Z. 58:390–391. 1908.

Fimbristylis crassipes Boeck., Linnaea 38:392. 1874, nom. illeg., non Boeck., Flora 41:602. 1858.

So far as is presently known, this species is confined to the grasslands of the Mexican high plateau in Aguascalientes, Durango, Guanajuato, Guerrero, Distrito Federal, Jalisco, Mexico, Michoacan, Pubela, Queretaro, San Luis Potosi and Zacatecas. It is found on moist to wet, heavy dark clay earths, typically at elevations over 2000 meters.

It is noteworthy that the above two taxa have achenes over twice as long as those of the following two, but are otherwise so similar to them that drawings of them made equal in size would seem to be of the same species.

3. **Abildgaardia baeothryon** St. Hil., Voy. Distr. Diam. 2:389. 1833. (**Fig. 1**). Type: SOUTH AMERICA. Brazil: "... entre les arbrisseaux de la langue de terra du lac de Saquaréma, j'indiquerai les suivantes," *Saint-Hilaire s.n.* (holotype: P, n.v.).

Cyperus geminatus Schrad. ex Roem. & Schult., Mant. 2:95. 1824, nom. illeg., non K.D. Koenig ex Ainslie, Mat. Med. Hindoostan 250. 1813. [*Abildgaardia geminata* (Schrad. ex Roem. & Schult.) Schrad. ex Nees in Mart., Fl. Bras. 2(1):71. 1842, nom. in syn.]

[*Abildgaardia scirpoides* Nees, Linnaea 9:289. 1834, nom. nud.] *Abildgaardia scirpoides* (Nees) Lindl. & Nees in Mart., Fl. Bras. 2(1):71. 1842.

Abildgaardia aphylla Kunth, Enum. Pl. 2:248. 1837. *Iriba aphylla* (Kunth) Kuntze, Revis. Gen. Pl. 753. 1891.

[*Abildgaardia ternata* Schrad. ex Nees in Mart., Fl. Bras. 2(1):71. 1842, nom. in syn.]

Fimbristylis bahiensis Steud., Syn. Pl. Glumac. 2:108. 1855.

[*Cyperus scirpinus* Salzm. ex Steud., Flora 33:229. 1850, nom. nud.; Steud., Syn. Pl. Glumac. 2:108. 1855, nom. in syn.]. [*Pseudocyperus scirpinus* Steud., Flora 33:229. 1850, nom. nud.; Steud., Syn. Pl. Glumac. 2:108. 1855, nom. in syn.].

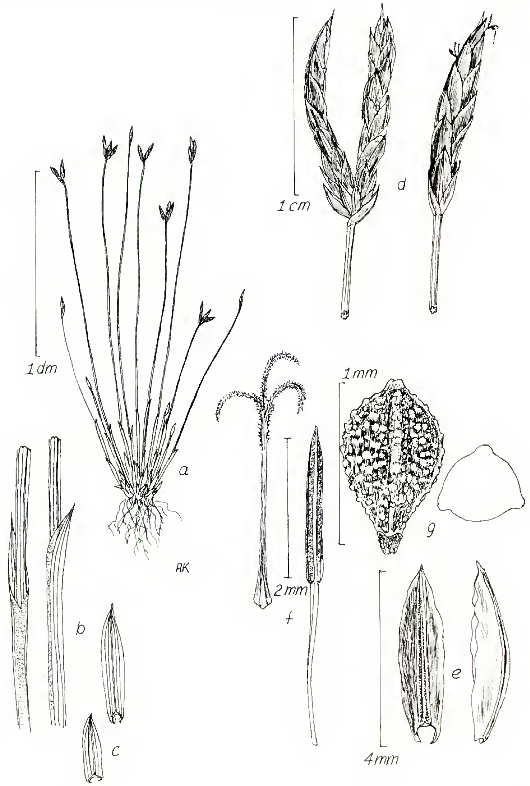

FIG. 1. *Abildgaardia baeothryon* St. Hil. (from *Kral et al. 72826*).–a. Habit sketch.–b. Section of culm showing ventral and dorsal view of leaf sheath.–c. Basal sheaths.–d. Inflorescence.–e. Dorsal and lateral view of spikelet scales.–f. Style (left) and stamen (right).–g. Achene.

Fimbristylis martii Boeck., Linnaea 37:24. 1871. *Iriha martii* (Boeck.) Kuntze, Revis. Gen. Pl. 753. 1891.

Annual or short-lived perennial, densely caespitose, 10–30 cm tall, glabrous. Roots slender, fibrous. Leaves few per culm, essentially sheath, distally opening with scarious entire borders convergent, the dorsal costae forming an acuminate tip or a cusplike blade no longer than 5 mm. Culms stiffly erect, slightly twisted, multicostate, smooth, the ribs interrupted by some deep sulci. Inflorescence terminal, of 1–4(–5) linear, sessile spikelets, 8–15 mm long, subtended by 2–3 short, persistent triangular bracts 3–4 mm long; spikelet scales arranged subdistichously in a long spiral; fertile scales ovate-triangular, navicular, 3–4(–5) mm long, narrowly acute to acuminate, the midzone (keel) thickened, tricostate, pale, the sides stramineous to pale brown, scarious. Stamens mostly 3, the anthers linear, 1.5–2 mm long, apiculate. Achene stipitate-obovoid, tricostate, 0.8–1 mm long, faces gray to white, lustrous, liberally dotted with separate or connected coarse papillae, these often arranged in interrupted, wavy transverse rugae, the ribs broad but low, mostly smooth.

Habitat and distribution.—*Abildgaardia baeothryon* is found on moist to dryish sands, peats and gravels of savanna and cerrado in the states of Bahia, Distrito Federal, Espírito Santo, Minas Gerais, Pernambuco, and Rio de Janiero, Brazil, 0–1200 m.

Representative material. **BRAZIL.** Hab. in siccis prope Ilheos, 1820, *Riedel s.n.* (US). **Bahia:** *Salzmann s.n.* (US); Coastal Zone, 11 km S of Santa Cruz Cabrália, restinga by the sea, with strand vegetation progressively developing into scrub and low forest further inland, 16°22'S, 39°01'W, sea level, 17 Mar 1974, *Harley, Renvoize, Erskine, Brighton & Pinheiro 17074* (US); Coastal Zone, on the coast between Alcobaça and Prado, 7 km NW of Alcobaça and 1 km N along road from the Rio Iranhentinga, restinga, 17°31'S, 39°13'W, sea level, 15 Jan 1977, *Harley, Mayo, Storr, Santos & Pinheiro 17972* (US); Serra das Almas, lower NE slopes of the Pico das Almas, ca. 25 km WNW of the Vila do Rio de Contas, sandstone, metamorphic and quartzite rock outcrops with associated marsh and damp flushes, 13°33'S, 41°57'W, 1500 m, 17 Feb 1977, *Harley, Mayo, Storr, Santos & Pinheiro 19556* (US); Serra do Sincorá, by Rio Cumbuca, ca. 3 km S of Mucugé, near site of small dam on road to Cascavel, riverside, damp sandy soil, sandstone rocks and partly burnt-over vegetation, ca. 13°01'S, 41°21'W, ca. 850 m, 4 Feb 1974, *Harley, Renvoize, Erskine, Brighton & Pinheiro 15947* (US); Serra do Sincorá, 9 km SW of Mucugé, on road from Cascavel, waste ground by Rio Paraguaçú, with damp grassland and scattered woodland, ca. 13°02'S, 41°25'W, 950 m, 7 Feb 1974, *Harley, Renvoize, Erskine, Brighton & Pinheiro 16101* (US); Serra do Sincorá, S of Andaraí, 16 km along road to Mucugé, near small town of Xique-Xique, sandstone rocks intersected by small streams, with some disturbed areas by roadside, 12°54'S, 41°19'W, 700-900 m, 14 Feb 1977, *Harley, Mayo, Storr, Santos & Pinheiro 18692* (US); Mun Rio de Contas, by road to Salto of Rio Brumado, 2 km SE of Rio de Contas, sandy peat of swale in arenaceous campo, ca. 900 m, 13 Jul 1985, *Kral, Wanderley, Cerati & Lima 72737* (SP, VDB); Mun. Palmeiras, moist sandy intervals in scrub-dotted arenaceous-rocky E-aspect campo, Serra da Larguinha, ca. 15 km S Palmeiras by the Palmeiras-Capão estrada, ca. 950 m, 19 Jul 1985, *Kral, Wanderley, Cerati & Lima 72826* (GH, K, NY, SP, US, VDB); In moist sandy intervals amongst arenaceous boulders and outcrops, campo by Mucujé-Andarai road, ca. 15 km N of Mucujé, just S of Rio Piaba bridge, ca. 940 m, 21 Jul 1985, *Kral, Wanderley, Cerati & Lima 72861* (MICH, MO, NY, SP, US, VDB); Rocky summit, E facing slope just below TV transmission tower N of BR 242, ca. 5 km W of paved road to Lençóis, damp sandy sites, ca. 1200 m, 9 Nov 1988, *Kral, Wanderley & Funch 75588* (GH, MO, NY, SP, TEX, US, VDB); Sandy-rocky campo along Rio Piaba, bridge area, by road to Mucujê from Andaraí, sandy areas between rocks, 900 m, 10 Nov 1988, *Kral, Wanderley & Lima 75616* (MO, NY, US, VDB, VSC); 5-7 km W of Alcobaça on road to Teixeira de Freitas, moist white sand clearings in coastal scrub, 0-50 m, 13 Nov 1988, *Kral, Wanderley & Lima 75685* (GH, MO, NY, SP, TEX, US, VDB, VPI, VSC). **Distrito Federal:** Praia de Sernambetiba (Recreio dos Bandeirantes), 23°00'13"S, 43°20'49"W, ao nivel de mar, 4 Apr 1952, *Smith 6377* (US). **Espírito Santo:** Município de Vila Velha, Lagoa do Milho, beira da lagoa, substrato encharcado, 14 Jan 1975, *Peixoto 369* (US); Mun. Linhares, Rod. BR-101, Res. Flor. da Sooretama, solo arenoso úmido, 8 Apr 1984, *Hatschbach 47722* (US). **Minas Gerais:** Sandy areas between sandstone boulders, cerrado ca. 2 km N of Cristalia on road to Grão Mogul, 2 Nov 1988, *Kral & Wanderley 75464* (GH, MO, NY, SP, US, VDB, VSC); Campos Rupestres, BA-Chapada Diamantina, summit near Fumaça Falls, campo rupestre, 16 May 1992, *Alves, Becker & Roppa 4148* (US). **Pernambuco:** Prazeres, 7 Sep 1924, *Pickel 798* (US); Prazeres, Litoralgegend, 30 Oct 1932, *Pickel 3140* (US); In sandy soil, Recife, Oct 1933, *Pickel 3140* (US). **Rio de Janiero:** 18 Aug 1896, *Ule 4155* (US); Município de Cabo Frio, Cabo Frio, Praia do Pontal, 22°56'48"S, 42°01'54"W, ao nivel do mar, 17 Apr 1952, *Smith 6563* (US).

4. Abildgaardia papillosa Kral & M. Strong, sp. nov. (**Fig. 2**). TYPE: SOUTH AMERICA. BRAZIL. Bahia: Mun. Palmeiras, sandy peaty seep areas around arenaceous boulders and outcrops, Serra do Larguinha (Sincorá?) ca. 20 km S of Palmeiras and due E of Capão by trail, ca. 1000 m, 19 Jul 1985, *Kral, Wanderley, Cerati & Lima 72808* (HOLOTYPE: SP; ISOTYPES: GH, K, MICH, MO, NY, TEX, US 3375813, VDB, VPI, VSC).

A. baeothryon St. Hil. species Brasiliae affinis, a qua imprimis differt habitibus altioribus; paginis foliorum et scaporum papillosis, apicibus vaginarum emarginatis; antheris longioribus (3 mm longis).

Plant annual or short-lived perennial, densely caespitose, 30–40 cm tall. Roots fibrous. Leaves entirely sheath, the outer ones more scale-like, ovate to lanciform, to 2 cm long, the principal ones 6–7 cm long, loosely tubular, papillate, multicostate save on scarious inner band, this distally becoming the scarious border of the open sheath apex, the margin entire, scabrous, converging retusely above a short mucro comprised of convergent costae. Culms slightly twisted, linear, stiff, 0.8–1 mm thick, multicostate, 1-2-sulcate, the costae fine or coarse, the surfaces dull gray-green, appearing glaucous because of dense papillosity. Inflorescence terminal, usually of 1 (rarely 2) lance-linear to elliptic-linear spikelet(s), 1.5–2 cm long, of many scales arranged subdistichously in a long spiral; sterile scales 4–5, narrowly ovate to oblong, 3.5–4 mm long, obtuse and slightly emarginate, the dorsal area thickened with 3–5 costae converging to a subapical blunt mucro; fertile scales mostly oblong to elliptic, 5–6(–7) mm long, apically narrowly rounded or emarginate, convex, the dorsal area likewise thickened, with 3

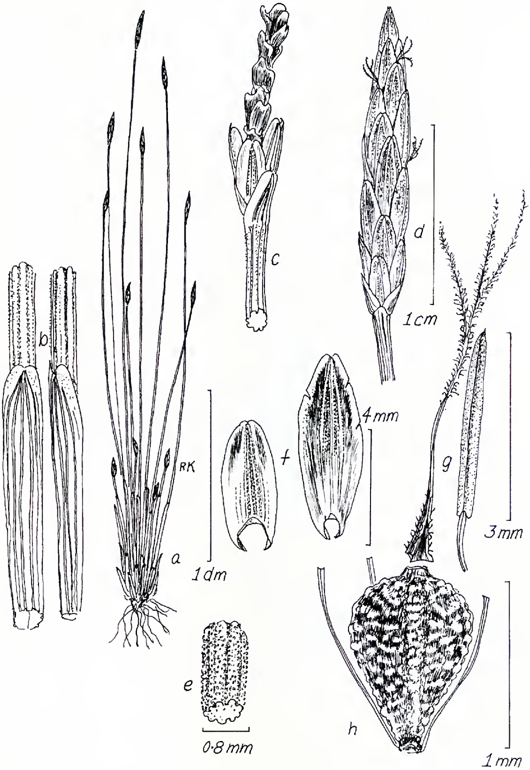

FIG. 2. *Abildgaardia papillosa* Kral & M. Strong (from the type, *Kral et al. 72808*).–a. Habit sketch.–b. Section of culm showing dorsal and lateral view of sheath.–c. Inflorescence after spikelet scales and achenes have shed.–d. Inflorescence (spikelet).–e. Detail of section of culm showing papillose surface.–f. Sterile basal spikelet scale (left) and fertile spikelet scale (right).–g. Stamen.–h. Achene and style.

coarse, usually pale costae, the scarious matrix pale brown to castaneous with a pale border. Stamens 3, the anthers narrowly linear, apiculate, ca. 3 mm long. Achene stipitate-obovoid, 1–1.2 mm long, apically obscurely trigonous but angles low, rounded, the faces convex, transversely irregularly pale-rugose with large variously interconnected papillae, ridges and papillae connected by gray, finely vertically striolate intervals.

While *Abildgaardia papillosa* is obviously closely related to *A. baeothryon*, it is at once distinguished by its taller habit, its papillose (rather than smooth) foliage and culms, its emarginate or retuse sheath apices and fertile scale tips (versus acuminate or cuspidate), its longer spikelets which are usually solitary (rather than clustered) at scape tips, and its longer spikelet scales and anthers. In the field, the papillate surfaces of leaf and scape make the plant appear glaucous.

BULBOSTYLIS Kunth, Enum. Pl. 2:205. 1837, nom. cons. (neither *Bulbostylis* Steven, 1817, nor DC, 1836, nom. rej.).

Stenophyllus Raf., Neog. 4, 1825, nom. rej.
Oncostylis Mart. ex Nees in Mart., Fl. Bras. 2(1):80. 1842.

These plants make up what must approach 100 species, mostly with wiry culms and leaves and of acidic, moist to dry, upland habitats in temperate to tropical climates worldwide. They have been considered by some as a section of *Abildgaardia*, by others as a part of *Fimbristylis*. However, in the *Bulbostylis* we have studied, there is but one example [*B. truncata* (Nees) M. Strong] in which the leaf sheath apex is not fimbriate. All save one of these tricarpellate species have a persistent tubercle that is seated above a distinct suture or atop an achenial "neck." In the latter instance there is a dramatic difference in texture and color between the achenial apex and the style base or tubercle. One becomes accustomed in the field to note a distinctive ecology for most *Bulbostylis*, nearly all of which are wiry-leaved-and-scaped physiological xerophytes, denizens of seasonally droughtly, mostly sandy and acidic sites, such as grassy uplands and fire-controlled open woodlands or savanna. Since these *Bulbostylis* are so uniform in surface characters and in ecology, we continue to treat such plants as a distinct genus. The species are given in alphabetical order.

Bulbostylis carajana Kral & M. Strong, sp. nov. (**Fig. 3**). TYPE: SOUTH AMERICA. BRAZIL. Para: Serra dos Carajas, 2 km west of AMZA camp N-5, 6°4'S, 50°8'W, ca. 700 m, scrubby vegetation on ferric rock outcrops, moist low area on outcrops, 13 May 1982, *Sperling, Condon, Mesquita, Ribeiro & Marinho 5649* (HOLOTYPE: INPA; ISOTYPES: NY, VDB).

Herba annua, dense caespitosa, subglabra, pumila, 9–15 cm alta. Radices delicatula, tenues. Folia polysticha, graciles, usque ad 5 cm longa; vaginae tubulosae, late dorsaliter viridicarinata, paucicostatae, glabrae, marginibus latis, scariosis, rufobrunneolis, ad apicem in laminas

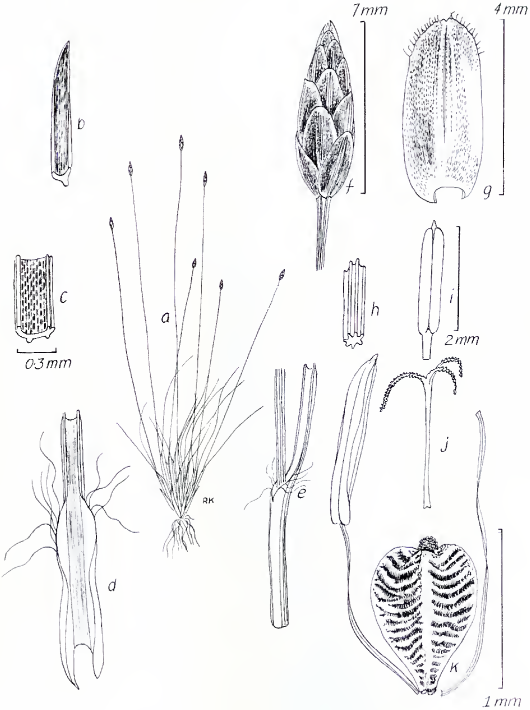

Fig. 3. *Bulbostylis carajana* Kral & M. Strong (from the type, *Sperling et al. 5649*).–a. Habit sketch.–b. Leaf apex.–c. Sector of leaf midblade.–d. Leaf sheath and lower blade, adaxial view.–e. Leaf sheath and lower blade, oblique view.–f. Spikelet.–g. Fertile spikelet scale.–h. Sector of scape.–I. Anther.–j. Style and stigmas.–k. Achene.

abrupte contractis, longifimbriatis; laminae capillares e basim canaliculatae, crassimarginatae, dorsaliter valde paucinervosae, apicem versus triquetrae, anguste acutae. Scapi tenues, leviter torti, 5–7–costati, 0.3–0.4 mm crassi, unispiculati. Spicae florosae, lanceolato-ovoideae, 6–9 mm longae, acutae; squamis fertilibus, tenuibus, spiraliter imbricatis, rufo-brunneolis, oblongis, 3–4 mm longis, convexis, mediane tricostatis, ad apicem ciliatis. Stamina 3; antherae anguste oblongae, ca. 2 mm longae, apiculatae. Achaenia obovoidea, ca. 1 mm longa (tuberculo incluso), valde trilobata et tricostata, atrobrunneola, faciebus valde transverse rugosis, angulatis umbonatis. Tuberculum globosum, ca. 0.2 mm longum, atrobrunneum.

Annual, densely caespitose, subglabrous, low, 9–15 cm tall. Roots delicate, slender. Leaves polystichous, few, slender, up to 5 cm long; sheaths tubular, broadly dorsally green-carinate, few-nerved, ventrally thin, pale red-brown, abruptly narrowed into leaf blade, there long-fimbriate; blades capillary, at base canaliculate, thick-margined, dorsally strongly few-nerved, triangulate towards tip, narrowly acute. Culms filiform, slightly twisted, 5–7-costate, 0.3–0.4 mm thick, unispiculate. Spikelets many-flowered, lance-ovoid, 6–9 mm long, acute; scales thin, spirally imbricate, the sterile ones usually 2, shorter than the fertile, acute, the fertile ones oblong, 3–4 mm long, broadly rounded, scarious save for median costal area, red-brown, apically ciliate. Stamens 3, the anthers narrowly oblong. ca. 2 mm long, apiculate, tetrasporangiate. Achene obovoid, ca. 1 mm long (tubercle included), strongly trilobed and tricostate, umbilicate, dark brown, the faces strongly transversely rugose, lustrous, the angles umbonate; tubercle round, ca. 0.2 mm long, dark brown.

Habitat and distribution.—Thus far known only from the type collection.

Bulbostylis carajana is very similar to the widespread savanna species *B. conifera* (Kunth) C.B. Clarke, but is definitely annual, the foliage and culms smooth, the spikelets lance-ovoid (rather than cylindric), the achene more lustrous, more coarsely rugose, and umbilicate.

Bulbostylis eleocharoides Kral & M. Strong, sp. nov. (**Fig.** 4). TYPE: SOUTH AMERICA. BOLIVIA. Prov. Iturralde. Depto. La Paz: Luisita, 13°05'S, 67°15'W, 180 m.s.n.m., sabana humeda, al W del rio Beni, 24 Feb 1988, *Hasse 899* (HOLOTYPE: LPB; ISOTYPE: VDB).

Herbe perennis, 60–80 cm alta, subglabrata, culmis basi sub-bulbosis, cum foliis exterioribus squamiformibus, glabris. Folia principalia 25–40 cm longa, vaginis proxime conduplicatis, glabris, ad apicem pallide longifimbriatis; laminis lineari-filiformis, involutis, 0.7–1 mm latis, vaginis 10-plo longiore. Scapi torti et flexuosi, teretes vel subtriquetrii, ca. 1 mm crassi, glabri. Spiculae solitariae, ovoideae, 8–10 mm longae, squamis numerosis, spiraliter imbricatis; squamis steriles plures infimis spiculis longiora vel breviora; squamis fertiles ellipticae vel obovatae, 4.5–5 mm longae, late acutae, convexae. Stamina tria; antheris 2.5 mm longis. Achaenia obovoidea, ca. 3 mm longa, obscure trigona, paginis concavis, minute foveolatis.

Perennial rhizomatous herb 60–80 cm tall. Roots fibrous. Culms closely set along an imbricate-scaly rhizome. Leaves erect or ascending, 25–40 cm

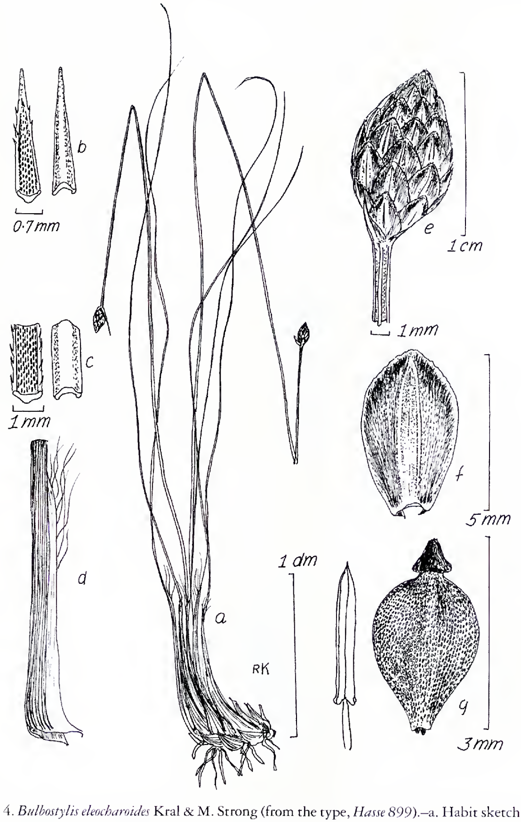

Fig. 4. *Bulbostylis eleocharoides* Kral & M. Strong (from the type, *Hasse 899*).–a. Habit sketch.–b. Leaf apex, adaxial side (left), abaxial side (right).–c. Sector of leaf blade adaxal side (left), abaxial side (right).–d. Leaf base.–e. Spikelet and upper scape.–f. Fertile spikelet scale.–g. Anther (left), achene (right).

long; the outermost appressed chaffy rhizomal scales, grading up culm to more erect, scale-like basal culm leaves; principal leaves 25–40 cm long, the sheaths proximally conduplicate with the convex backs striately multinerved, glabrous, tan, with broad scarious borders pale-fimbriate at convergence with blade; blades filiform-linear, to 10 times longer than sheaths, 0.7–1 mm wide, apex subulate, shallowly concave adaxially, the involute margin thickened, pale, proximally scabrid, otherwise smooth. Culms twisted, flexuous, terete to subtriquetrous, ca. 1 mm thick or wide, glabrous. Inflorescence a single erect to ascending, ellipsoid, acute spikelet 8–10 mm long, of many tightly spirally imbricate scales with pale firm centers, brown puberulent sides and broad, dark brown erose and ciliolate borders; sterile scales several, the lowermost broadly triangular, carinate-keeled, acute or with midcostae excurrent as a green cusplike blade, this shorter or slightly longer than the spikelet, those above gradually becoming longer, grading into the fertile; fertile scales elliptic to obovate, 4.5–5 mm long, broadly acute, convex, the midcostal zone thickened, with pale border and a green median. Stamens 3, the anthers linear, 2.5 mm long, apiculate. Achene ca. 3 mm long, the body obovoid, 2.5 mm long, obscurely trigonous, pale brown with transversely wavy lines of minute pits on the concave faces, the three angles broadly rounded and but slightly raised, the achene apex narrowed distally to a distinct neck ca. 0.2 mm long, this capped by a dark, conic tubercle ca. 0.3 mm long.

Paratypes. **BOLIVIA.** Depto. La Paz, Prov. Iturralde, Luisita, 13°05'S, 67°15'W, 180 m.s.n.m., sabana humeda, W del Río Beni, pastizal humedo con gramineas bajas en macollos, 28 Feb 1984, *Beck & Hasse 10111* (LPB, US). **PARAGUAY**. In altaplanitie et declivibus Sierra de Amambay, 1907-08, *Hassler & Rojas 10040* (MO).

Habitat and distribution. Humid grasslands, savannas, Bolivia and Paraguay.

The name of this species alludes to its significant difference from other *Bulbostylis*. Its single spikelet bears a strong resemblance to those of many *Eleocharis* except for the unusual cuspidate lower sterile bract. Its achenes are again similar to *Eleocharis* in that many of the latter are species with "necked" achenes. The strongest evidence for such a plant to be *Bulbostylis* is, of course, the strongly fimbriate leaf~sheath apex and the well-developed lamina above it.

Bulbostylis latifolia Kral & M. Strong, sp. nov. (Fig. 5). Type: SOUTH AMERICA. Brazil. Goias: sandy intervals in rocky sandy cerrado on E side BR 040, ca. 4 km N of Cristalina, ca. 900 m, 6 Dec 1988, *Kral, Wanderley & Pereira 75909* (holotype: SP; isotypes: MO, US 3375811, VDB).

Planta perennis, caespitosa, 70–90 cm alta, basibus culmorum subbulbosis cum foliis exterioribus squamiformibus. Folia propria plantam 1/5–1/3 aequantia; vaginis late convexis, glabris, ad apicem longifimbriatis; laminis vaginis 4–7-plo longiora, 1.5–2.2 mm latis, planis vel leviter involutis. Scapi anguste lineares, subtriangulares, ca. 1 mm crassi, glabri. Inflorescentia diffusa, anguste turbinata. Spiculae in parvis fasciculis [(1–)3–5(–6) per fasciculum],

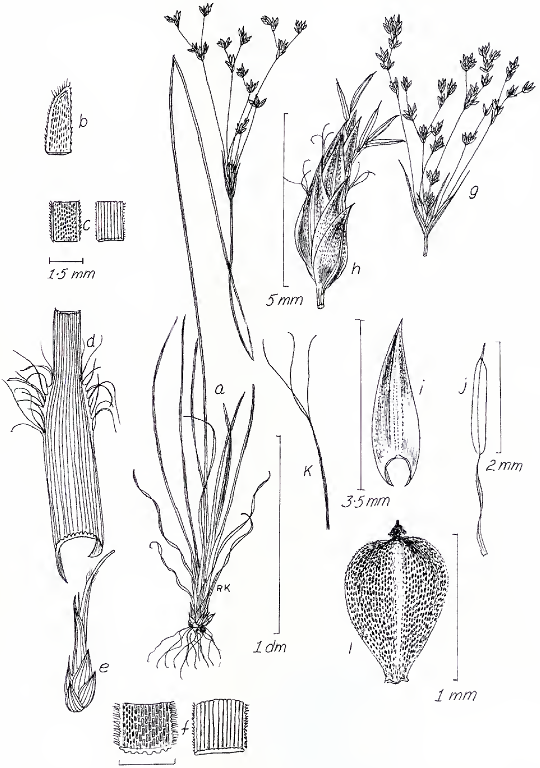

FIG. 5. *Bulbostylis latifolia* Kral & M. Strong (from the type, *Kral et al. 75909*).–a. Habit sketch.–b. Leaf apex.–c. Sectors of leaf midblade, adaxial (left), abaxial (right).–d. Leaf base, abaxial view.–e. Young offshoot from plant base.–f. Enlarged leaf blade sectors, adaxial (left), abaxial (right).–g. Inflorescence.–h. Spikelet.–i. Fertile spikelet scale.–j. Anther on filament apex.–k. Style and branches.–l. Achene.

anguste ovoideae vel lanceoloideae, 4–5 mm longae, acutae, brunneae vel pallide ferrugineae. Squamae fertiles anguste ovatae, 4–5 mm longae, acuminatae, naviculares. Staminae duo vel tria; antheris 2 mm longis, longiapiculatis. Achaenia trigono-obovoidea, trilobata, ca. 1 mm longa (tuberculo includens), subtiliter foveolata; tuberculo conico.

Perennial, caespitose, 70–90 cm tall. Roots diffuse-fibrous. Culm bases sub-bulbous, firm, with short, scaly bulbous offshoots. Leaves sub-basal, few per culm, the lowest scale-like, bladeless or with blades shorter than sheaths; principal leaves 1/5–1/3 as long as the plant, erect or ascending, 15–25 cm long; sheaths abaxially convex, strongly multi-ribbed, glabrous with broad scarious red-brown to brown borders acutely converging to blade, there long-fimbriate; blades linear, 4–7 times longer than sheaths, level or slightly concave adaxially, 1.5–2.2 mm wide, obliquely broadly acute, greenish-brown, margins slightly thickened, pale, densely ciliate or ciliolate, surfaces smooth save for scabrellous adaxial apex, abaxially multicostate. Culms narrowly linear, multi-costate, subtriangular, green, glabrous. Inflorescence a narrowly turbinate compound of variously peduncled fascicles, this much exceeding short-bladed lanceolate involucral bracts 1–3 cm long; branches several, mostly ascending around subsessile central fascicles, the longer ones 5–10 cm long, either terminating in single spikelet clusters or there re-branching in compact or open fashion; spikelets (1–)3–5(–6) per fascicle, narrowly ovoid or lanceoloid, 4–5 mm long, acute, brown to pale red-brown; fertile scales 3–6, narrowly ovate, 4–5 mm long, navicular, acuminate. Stamens (2–)3; anthers oblong, ca. 2 mm long, long-apiculate. Achenes trigonous-obovoid, ca. 1 mm long (tubercle included), apically trilobed, the faces dark-foveolate-puncticulate, gray, the angles paler, rounded; tubercle conic.

PARATYPES. **Brazil.** Goias: sandy intervals in rocky sandy cerrado on E side BR 040, ca. 4 km N of Cristalina, ca. 900 m., 6 Dec 1988, *Wanderley et al. 1877* (SP, VDB); rocky campo, 5–6 km by road N of Alto Paraiso, sandy peat of E and NE aspect, ca. 1000 m, 30 Nov 1988, *Kral, Wanderley, Cavalcanti & Pereira 75757* (SP, US, VDB); 4 km N of Cristalina off E side BR 050 sandy intervals in rocky cerrado, ca. 1000 m, 6 Dec 1988, *Kral, Wanderley & Pereira 75909* (SP, US, VDB).

Habitat and distribution.—Rocky, sandy cerrado, 900–1000 m, Goias.

This species is distinctly allied to *Bulbostylis junciformis* (Kunth) C.B. Clarke but is readily distinguished by its broader, smoother, ciliate-margined leaves and fertile spikelet scales with apex not excurved and midcosta not excurrent. The grayish achene surfaces are distinctly foveolate-puncticulate, the pits short-rectangular.

Bulbostylis lombardii Kral & M. Strong, sp. nov. (**Fig. 6**). TYPE: SOUTH AMERICA. BRAZIL. Minas Gerais: Serra do Cipo, Santana do Riacho, afloramento rochoso das Canela-de-Ema-Gigantea, proximo a portaria do IBAMA Alto Palacio, 16 Nov 1995, *J.A. Lombardi 1029* (HOLOTYPE: BHCB; ISOTYPE: VDB).

Planta perennis, 15–30 cm alta, rhizomatosa, rhizomate crasso, caudiciformis, dense piloso,

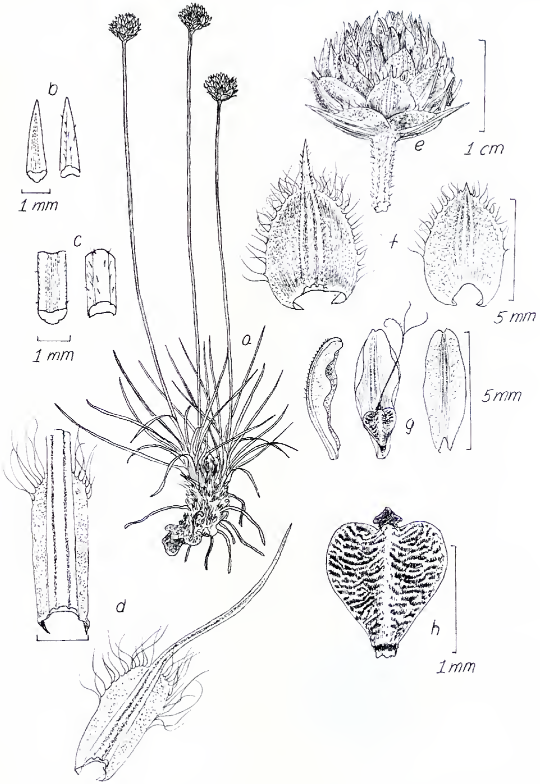

FIG. 6. *Bulbostylis lombardii* Kral & M. Strong (from the type, *Lombardi 1029*).–a. Habit sketch.–b. leaf apex.–c. Section through midblade showing adaxial and abaxial surface.–d. Detail of sheath apices.–e. Inflorescence.–f. Involucral bracts.–g. Fertile spikelet scales and achene.–h. Achene.

squamoso et fibroso. Folia exteriora squamiformia, margine dense albopilosis; folia principalia vulgo expansa, 5–8 cm longa; vaginis convexis, prominente 3-5-costatis, ad apicem longe ciliatis; laminis vaginis 4–6-plo longioribus, rigidis, 0.5–1 mm latis, dorsaliter scabridis. Scapi erecti, rigidi, subteretes, ca. 1 mm crassi, dense pallide puberuli. Inflorescentia capitata, involucrata, late ovoidea vel hemispherica aut subglobosa, 1–1.5 x 1–1.5 cm; bracteae involucralis extimae ovatae, 5 mm longae, piloso-ciliatae, mucronatae, mucrone 2–3 mm longae; bracteae involucralis interiores ovatae, 5 mm longae, mucronulatae. Squamae fertiles naviculares, ca. 5 mm longae, obtusae vel emarginatae. Stamina tria; antheris ca. 4 mm longis. Achaenia lata obovoidea, triloba et tricostata, 1.2–1.5 mm longa, umbilicata, valde transverse rugosa, tuberculo conico, ca. 0.3 mm longo.

Perennial densely caespitose rhizomatous herb, 15–30 cm tall. Roots thickened (for a *Bulbostylis*), fibrous. Rhizome stout, knotty, ascending, caudiciform, the newer surfaces (internodal) densely white-piliferous. Shoots numerous, densely spirally arranged around caudex, there persisting as an often burnt stubble of fibers, hairs, and old leaf sheaths, the newer (distal) caudex producing rosettes of a season. Outer rosette leaves invested in tufts of white trichomes, mostly scale-like, mostly sheath, white-pilose-ciliate, thence grading progressively longer distally on culm, the costae of the dorsal median area converging to form increasingly longer blades, the scarious sheath borders with ciliae concentrated more at apex; principal leaves spreading, 5–8 cm long, sheaths convex with 3(–5) broad costae and broad, scarious, brown, apically white-pilose borders; blades 4–6 times longer than sheaths, linear-filiform, 0.5–1 mm wide, adaxially shallowly involute or plane, with pale incrassate borders, abaxially convex 3(-5)-costate, sparingly scabrid, pale green. Culms stiffly erect, linear, subterete, ca. 1 mm thick, several-costate, costae densely pale-puberulent. Spikelets in dense broadly ovoid to hemispheric or subglobose involucrate heads 1–1.5 x 1–1.5 cm; involucral bracts in series, mostly broadly ovate, ca. 5 mm long, brown, ciliate, puberulent, convex, the lowermost with costal area excurrent as cusp 2–3 mm long, those above grading shorter to mucros, thence inward to fertile scales, these oblong to elliptic, navicular, ca. 5 mm long, obtuse or emarginate, the tricostate scabrellous keel not excurrent, the margin entire. Stamens 3; anthers linear, ca. 4 mm long, apiculate. Achene trigonous-obovoid, 1.2–1.5 mm long, apically strongly lobed, umbilicate, each lobe with a pale crest, the shallowly convex lobe faces dark brown to nearly nigrescent, strongly transversely rugose; tubercle nearly black, depressed-conic, 0.3 mm long.

Habitat and distribution.—This species of the planalto of Brazil is yet known only from the type.

Bulbostylis pachypoda Kral & M. Strong, sp. nov. (Fig. 7). TYPE: SOUTH AMERICA. BRAZIL. Minas Gerais: Cerro do Cabral, Armazin de Lage, ca. 15 km above and NNW of Joaquim Felicio, ca. 1100 m, sandy campo-cerrado transition, 30 Oct 1988, *Kral, Wanderley & Lima 75381* (HOLOTYPE: SP; ISOTYPES: GH, MO, NY, US, VDB).

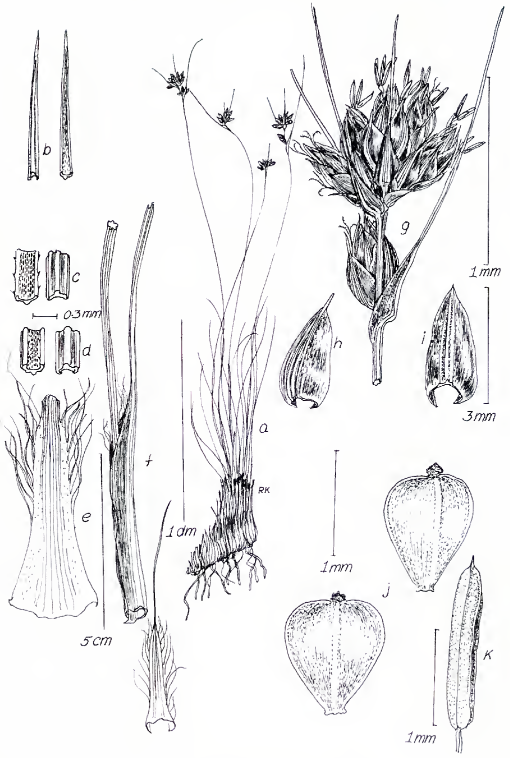

FIG. 7. *Bulbostylis pachypoda* Kral & M. Strong (from the type, *Kral et al. 75381*).–a Habit sketch–b. Leaf apex–c. Sector of leaf midblade, adaxial (left), abaxial (right).–d. Sector of leaf midblade (*Kral et al. 75175*).–e. Leaf base.–f. Upper portion of leaf sheath and scape base (upper left); idealized sketch of a young outer leaf transitional to inner principal leaf (lower right).–g. Inflorescence.–h. Lower fertile spikelet scale.–i. Fertile spikelet scale.–j. Two achenes.–k. Anther.

Plantae perenne, dense caespitosa, 20–35 cm altae, culmis basi bulbosis, arcte interconnectis, folia exteriora squamiforma, triangulata, valde nervosa, longifimbriata. Folia principalia (5–)8–15 cm longa; vaginis pallide brunneolis convexis, ad apicem parce longifimbriatis aut glabris; laminis filiformis involutis, vaginis 1–2-plo longiore, ca. 0.2–0.4 mm latis, margine remote scabriusculis. Scapi filiforme, flexuose, 0.4–0.5 mm crassi, paucicostati, glabre. Inflorescentia involucrata, pseudocapitata, terminales; fasciculi spicularum 1–2 (aut inferiore unam spiculam reducti), approximati, ovoidei, turbunati vel himispherici, usque ad 1.5 mm lati, bracteis infimis setaceis inflorescentiam leviter vel multo excedentes. Spiculae ovoideae, 4–5 mm longae, vulgo acutes, squamis spiraliter imbricatis, infimis valde carinatis, cuspidatis vel mucronatis; squamae fertiles latae ovatae, 3.5–4.5 mm longae, convexae, costis 3, pallidis, lateribus atrobrunneolis vel castaneis, nitidis, minute puberulentis. Stamina tria; antheris oblongo-linearis, ca. 2 mm longis, apiculatis. Achaenia obovoidea vel late obovoidea, ca 1–1.2 mm longa (tuberculo includens), trilobata, tricostata, superficiebus margaratacea aut cano-eburneis, subtiliter longitudine striolatis, costis prominentibus niveis.

Plants perennial, densely cespitose, 20-35 cm tall, the culm bases bulbous, closely interconnected at base, forming short thick lines radiating from clump center. Outer leaves scale-like, triangular, strongly nerved, the broad, scarious borders long-fimbriate. Principal leaves ascending to spreading, (5–)8–15 cm long, the sheaths pale brown, convex, sparsely fimbriate or smooth at the acute to acuminate apex; blades filiform, involute, 1–2 times longer than the sheaths, ca 0.2–0.4 mm wide, abaxially tricostate, the lateral costae forming smooth or remotely scabridulous margins. Culms filiform, flexuous, 0.4–0.5 mm thick, few-costate, glabrous. Inflorescence terminal, spikelets in an involucrate, head-like, ovoid to turbinate or hemispherical fascicle, or this directly subtended by an additional but smaller fascicle, sometimes reduced to a single spikelet. Involucral bracts several, setaceous-tipped, the lowest bract slightly to much exceeding the inflorescence, those at higher levels progressively shorter-bladed, those subtending individual spikelets mostly cuspidate or mucronate. Spikelets ovoid, 4–5 mm long, mostly acute, of several loosely spirally imbricate scales; fertile scales mostly ovate, 3.5–4.5 mm long, strongly convex, strongly curvate-keeled, the sides deep red-brown to castaneous, the keel area tricostate and conspicuously paler. Stamens 3; anthers oblong-linear, ca. 2 mm long, apiculate. Achenes narrowly to broadly trigonous-obovoid, ca. 1–1.2 mm long (tubercule included), slightly trilobed, tricostate, the surfaces a lustrous gray-white or pearl, finely longitudinally striolate, the costae strong, smooth, contrastingly pure white.

PARATYPES: **BRAZIL.** MATO GROSSO: 5 km E of Primavera by BR 070, sandy-gravelly campo-cerrado transition, 6 Oct 1988, *Kral, Wanderley & Lima 75175* (NY, SP, US, VDB).

The affinities of *Bulbostylis pachypoda* are perhaps most with the ubiquitous *B. juncoides* (Vahl) Kük. ex Osten, particularly examples from southern Brazil, Paraguay or Argentina, in which spikelets are often dark and crowded into head-like terminal involucral fascicles. However, *B. pachypoda* has thicker, more bulbous culm bases, these connected in ascending lines from a clump center; its leaves and culms tend to be narrower, more smooth; its achenes, which are paler, are usually a lustrous "pearly" white, and are so finely striolate as to appear smooth. The young lower (outer) leaves, usually concealed by a stubble of burned back or dried older foliage, tend to have completely fimbriate margins and appear to be transitional to the even hairier-sheathed *B. jacobinae* (Steud.) Lindm. and allies. The anthers reach 2 mm in length, which puts them in a range longer than that for *B. juncoides* (Vahl) Kük. ex Osten and allies.

Bulbostylis scirpoides Kral & M. Strong, sp. nov. (Fig. 8). Type: South America. Brazil. Goias: ca. 5 km N of jct. road W to Pires do Rio by BR 050, seep meadow and associated cerrado by pond, ca. 800 m, seep by pond, 900–1000 m, 7 Dec 1988, *Kral & Wanderley 75942* (holotype: SP; isotypes: US, VDB).

Planta perennis, 60–80 cm alta, caespitosa, culmis basi bulbosis, caudiciformibus, longipilosis, cum foliis exterioribus squamiformibus. Folia principalia propria plantam l/3–2/3 aequantia; laminis filiformis involutis, vaginis 4–6-plo longiora, tricostatis, triquetro-subulatis. Scapi lineares, subteretes, 0.6–0.7 mm crassi, glabri. Inflorescentia involucrata, receptaculo piloso, spiculis sessilis, (1–)2–3(–5), ovoideis vel lanceoloideis, rufobrunneolis, squamis fertiles anguste ovatis vel late ellipticis, curvato-carinoalis, obtusis, ad apicem ciliolatis. Stamina tria; antheris ca. 3 mm longis. Achaenia lato-obovoidea, ca. 1.2–1.4 mm longa, prominente tricostata.

Perennial, caespitose, 60–80 cm tall, the shoots arising from bulbous short stems; receptacle and lower shoot internodes with dense, pale, red-brown pilosity, 1–2 cm long. Roots fibrous. Lowest leaves scale-like, ovate to lanceolate, to 2 cm long, the inner ones cuspidate with sheath borders pilose apically; principal leaves ascending to erect, 40–60 cm long, the sheaths to 10 cm long, narrowly convex with 3–5 strong medial costae, the sides with several fainter costae and scarious red-mottled borders, gradually tapering, then abruptly joining blade, there long-villous-fimbriate; blades 4–6 times longer than sheaths, filiform, ca. 0.5 mm thick, adaxially concave with 2 pale costae marginally, abaxially strongly convex with 1 strong costa, the marginal costae with sparse, appressed, inward or retrorsely directed stiff hairs, distally tapering to triquetrous subulate tips. Culms erect, subterete, ca. 0.6–0.7 mm thick, coarsely 4-6-costate, glabrous. Inflorescence (1–)2–3(–5)-spicate, spikelets sessile above an involucre, the receptacular surface sparsely pilose, the lowest involucral bract longest, ovate to lanceolate, tricostate-keeled, slightly longer to slightly shorter than subtending spikelet(s), slightly to much exceeding the inflorescence, to 3 cm long, the base ovate, keeled, long-ciliate, the midcostae excurrent as a mucro, cusp, or linear blade; spikelets mostly ovate, 8–10 mm long, acute, with fertile scales narrowly ovate to broadly elliptic, mostly 5 mm long, curvate-keeled, obtuse or emarginate, apically ciliate. Stamens 3, the anthers linear, ca. 3 mm long, apiculate. Achene body obovoid-trigonous, 1.2–1.4 mm long, rib-angled, pale brown, angles

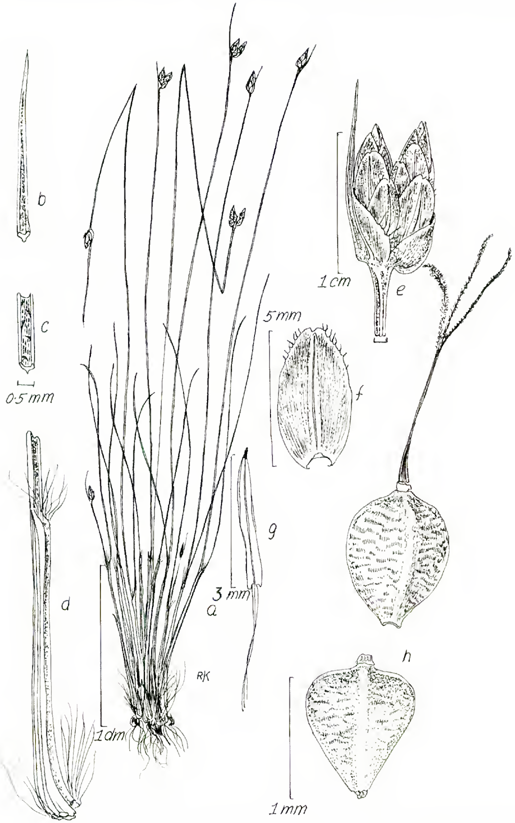

FIG. 8. *Bulbostylis scirpoides* Kral & M. Strong (from the type, *Kral & Wanderley* 75942).–a. Habit sketch.–b. Leaf apex.–c. Sector of leaf at midblade, adaxial view.–d. Leaf sheath, oblique view.–e. Inflorescence.–f. Fertile spikelet scale.–g. Anther.–h. Two achenes.

smooth, faces shallowly convex, lustrous, shallowly transversely rugulose with very fine vertical striolae; tubercle either deciduous or short-persistent, oblong, 0.3–0.4 mm long.

Paratypes. **BRASIL.** Distrito Federal: Chapada da Contagem, 23 km NNW do Centro de Brasilia, brejo estacional, a beira da estrada, 19 Apr 1979, *Rodrigues 16* (NY, VDB). Goias: ca. 5 km N of jct. road W to Pires do Rio by BR 050, seep meadow and associated cerrado by pond, ca. 800 m, seep by pond, 900–1000 m, 7 Dec 1988, *Wanderley 1910* (SP, VDB).

Habitat and distribution.—Sandy marshy grass-sedge campo, Goias.

This is again an example of that complex of *Bulbostylis* in which the central axis of the plant is compact, pilose-vestite, a feature also displayed on the inflorescence axis (receptacle).

Bulbostylis spectabilis Kral & M. Strong, sp. nov. **(Fig. 9).** Type: SOUTH AMERICA. Brazil. Parana: Vila Vellia, abundant in occasional wet sand, SW-facing slope covered by savanna type vegetation, 5 Mar 1970, *Koyama, Koyama, Hatschbach & E. de Lima 13848* (holotype: NY; isotype: VDB).

Planta perennis, 4–55 cm alta, caespitosa, subglabrata, crassirhizomatosa, culmis basi bulbosis, cum foliis exterioribus squamiformibus, glabris. Folia principalia 15–25 cm longa; vaginis pallide brunneolis, convexis; laminis filiformis involutis, multi- vel compluries vaginis longiore, ca. 0.3–0.5 mm latis. Scapi lineares, subteretes, ca. 1 mm crassi. Inflorescentia capitata, involucrata, ovoidea vel hemisphaerica, multispiculata, usque ad 1.5 cm lata, bracteis 1–3, valde caudati inflorescentiam excedens; spiculae lanceoloideae, 8–10 mm longae, squamis fertiles anguste ovatis, 4.5–5.5 mm longae, acuminatis. Stamina tria; antherae ca. 1 mm longis. Achaenia obovoidea, 1–1.2 mm longa, tricostata, minute cancellata.

Caespitose perennial 4–55 cm tall, producing rhizomes which are interconnected bulbous bases of culms. Roots fibrous. Outer culm leaves scale-like, 4–10 mm long, strongly nerved, brown, glabrous; inner leaves progressively elongating; principal leaves erect to strongly ascending, 15–25 cm long; sheaths pale brown, scarious, multicostate, convex-backed, the scarious, pale red-brown, friable borders acutely converging to blade, there pale-fimbriate; blades several to many times longer than sheaths, filiform, 0.3–0.5 mm wide at midblade, apex filiform-setaceous, triquetrous, subulate, surface pale yellow-green, essentially glabrous save for a few scabrellae toward blade base, adaxially concave to canaliculate, abaxially mostly tricostate, narrowly sulcate. Culms linear, several-costate, terete, ca. 1 mm thick, pale yellow-green. Inflorescence capitate, involucrate, broadly ovoid to hemispheric, 1–1.5 cm broad; outer involucral bracts lanciform or narrowly ovate, 5–7 mm long, slightly keeled, costae excurrent as cusp or narrowed acuminately to filiform-setaceous blades to 8(–9) cm long; fertile scales narrowly ovate or oblong, 4.5–5.5 mm long, acuminate, convex-based, apically keeled, with 3 costae. Stamens 3; anthers elliptic-linear, ca. 1 mm long, apiculate. Achenes narrowly obovoid, trigonous,

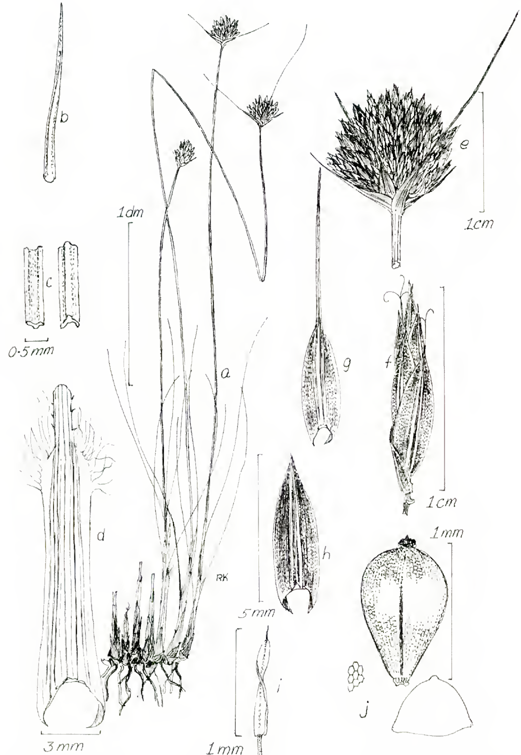

FIG. 9. *Bulbostylis spectabilis* Kral & M. Strong (from the type, *Koyama et al. 13848*).–a. Habit sketch.–b. Leaf blade apex.–c. Adaxial (left) and abaxial (right) sectors of leaf midblade.–d. Leaf sheath, abaxial side.–e. Inflorescence.–f. Spikelet.–g. Involucral bract.–h. Fertile spikelet scale.–i. Stamen.–j. Achene, abaxial faces (above), idealized enlargement of some cancellae (left), cross-section (right).

1–1.2 mm long (tubercle included), the adaxial side broadest, abaxial faces more convex, pale brown, angles dark brown, surfaces minutely cancellate.

Habitat and distribution.—Thus far known only from the type collection.

This plant, superficially resembling robust examples of *Bulbostylis sphaerocephala* (Boeck) C.B. Clarke or capitate forms of *B. junciformis* (Kunth) C.B. Clarke, differs most significantly in the peculiar rhizome of interconnected bulbous culm bases, in having perhaps the most glabrous foliage of its complex with hairs confined essentially to the pilosity of leaf sheath apex, and in the distinctive involucre, some bracts with setaceous tips to nearly 1 dm long.

ACKNOWLEDGMENTS

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REFERENCES

KRAL, R. 1971. A treatment of *Abildgaardia, Bulbostylis,* and *Fimbristylis* (Cyperaceae) for North America. Sida 4:57–227.

BOOKS RECEIVED

SCOTT, RICHARD W. 1995. **The Alpine Flora of the Rocky Mountains. Volume I. The Middle Rockies.** (ISBN 0-87480-482-5, hbk). University of Utah Press, Salt Lake City, UT. $110.00. 901 Pp. Line drawings. Maps.

From the Preface: The flora serves a dual purpose according to the author. First, it deals with the alpine plants within the political boundaries of the state of Wyoming; second, it treats the more natural physiographic unit, the Middle Rocky Mountains, which encompasses the states of Montana, Wyoming, and Utah, and a very small bit of Idaho.

From the Flora: All the flowering plants and vascular cryptogams known to occur above timberline in the Middle Rocky Mountains are described in the manual, as are the timberline conifers. The flora consists of 700 taxa including 55 subspecies and 314 varieties. The taxa included in this manual are based on specimens collected throughout the Middle Rocky Mountain region. The taxonomic treatment begins with a dichotomous key to all the families. The families are then presented in alphabetical order for ease of location, and each family is also organized alphabetically by genus and species. Dichotomous keys are provided for each taxonomic rank, ultimately leading to the species treatment. Infraspecific taxa are treated within the species. Each species description is based on personal observations of plants in the field, herbarium specimens, and references from regional manuals and floras. The species description is followed by a short habitat description. Next the Middle Rocky Mountain distribution is given by mountain range. Comments on infraspecific taxa and how to distinguish them follow the distribution information. The distribution maps show the distribution pattern of each species in the alpine flora. The dots are based on herbarium specimens and, in a very few cases, field observations when no specimens were available.

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THE FLORA OF INDIAN SHELL RINGS FROM COASTAL SOUTH CAROLINA TO NORTHERN FLORIDA

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ABSTRACT

Native American shell rings are composed almost exclusively of shellfish remains, and occupy coastal sites. The nine shell rings and one shell mound selected in this study range approximately 40 kilometers north of Charleston, South Carolina to 10 kilometers north of St. Augustine, Florida. The vascular flora consists of 241 species within 182 genera in 80 families. The Poaceae and Asteraceae are the largest families in the flora. Soil salinity and daily flooding affect the distribution of vascular plants at the tidal shell rings. Calcareous soils influence species distribution at inland shell ring sites. Each taxonomic entry in the checklist is accompanied by an annotation, which includes frequency of occurrence, rarity status and pertinent synonyms.

KEY WORDS: Indian Shell Rings, flora, distribution, biodiversity.

RESUMEN

Los "shell rings" nativos de América están compuestos casi exclusivamente de restos de conchas marinas y ocupan lugares costeros. Los nueve "shell rings" y un "shell mound" seleccionados en este estudio van aproximadamente desde 40 kilómetros al norte de Charleston, Carolina del Sur hasta 10 kilómetros al norte de St. Augustine, Florida. La flora vascular consiste en 241 especies agrupadas en 182 géneros de 80 familias. Las Poaceae y Asteraceae son las mayores familias de la flora. La salinidad del suelo y las inundaciones diarias afectan la distribución de las plantas vasculares en los "shell rings" intermareales. Los suelos calcáreos influencian la distribución de las especies en los "shell ring" inreriores. Cada entrada taxonómica del catálogo se acompaña de una anotación de la frecuencia, esrado de rareza y los sinónimos pertinentes.

INTRODUCTION

The shell rings of the South Atlantic Coast are ring or arch-shaped ridges consisting primarily of shellfish remains, which were constructed by prehistoric Native Americans. They are located approximately between 32° 55' N (Sewee Shell Ring, SC) to 30 ° 05' N (Guana River State Park, FL).

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All known shell rings are located on estuaries or tidal creeks. They occupy high ground immediately adjoining salt marshes or occasionally are isolated in salt marshes a few hundred feet offshore. Interiors of shell rings at tidal sites are marshy, while the higher sites usually support a heavy growth of vegetation. The circular shell ridges range from about 33 to 66 m in outside diameter, 0.5 to 2.5 m in maximum height and 6.4 to 17.8 m in basal width. They are covered with vegetation and are composed almost exclusively of shells, mainly those of oysters. Shells of periwinkle, knobbed whelks, clams and mussels are present in reduced amounts (Dorroh 1971; DePratter 1976; Trinkley 1985).

Rings occur in complexes as well as in isolation. The largest known ring is at Sapelo Island, Georgia and is associated with two smaller rings. At the Skull Creek Shell Ring, Hilton Head Island, South Carolina, the rims of two rings are superimposed at one point (Hemmings 1970). Shell specimens from rings in South Carolina and Georgia have been radiocarbon dated and are approximately 3900 to 3100 years old (Calmes 1967; Waring & Larson 1968).

Numerous uses for the rings have been postulated, including ceremonial, recreational, and exploitative functions, e.g. fish traps, (Edwards 1965). Recent investigations suggest that at least some of the rings were habitation sites, with the rings gradually developing from kitchen refuse associated with house middens arranged in a circular fashion (DePratter 1976; Trinkley 1985). The relatively clear interiors of the shell rings may have functioned as areas of communal activity (Trinkley 1985).

The objective of this study is to determine the vascular flora at shell rings on the coast of South Carolina, Georgia, and Florida, the only sites on the east coast where shell rings are known to exist. Several calcareous plants, including the rare *Sageretia minutiflora*, grow almost exclusively at these sites.

Several well known individuals have examined shell mounds or rings along the Atlantic coast. William Bartram described the flora of shell mounds along the coast of South Carolina bordering the sounds and inlets near Hilton Head in 1773. Among the plants listed by Bartram at shell mounds were *Magnolia grandiflora*, *Pinus taeda*, *Laurus borbonia* (*Persea borbonia*), *Quercus sempervirens* (*Quercus virginiana*), *Corypha palma* (*Sabal palmetto*), *Prunus laurocerasus*, *Ilex aquifolium* (*I. opaca*), and *Juniperus americana* (*Juniperus virginiana*).

There are several studies of the vascular flora of shell mounds along the southeastern and Gulf coasts of the United States. Brown (1936) reported that the most common plants found on Louisiana shell mounds are *Juncus roemerianus*, *Spartina patens*, *Scirpus olneyi*, *Fimbristylis castanea*, *Iva frutescens*, and *Salicornia* spp., all salt marsh species. Laessle (1942) noted that certain plants occupying the Orange Point shell mound in Florida, "seem to persist on the highly calcareous soil," and are found, "nowhere else in the area."

Griffen (1948) reported that the Florida shell middens are "extremely interesting," and that they support, "a more or less specialized vegetation." Kurz and Wagner (1957) studied the distribution of salt marsh vegetation along an elevation gradient at the Buzzards Island shell ring, South Carolina, but did not recognize the site as a shell ring. Eleuterius and Otvos (1979) surveyed a shell mound at Cedar Island, Mississippi, and reported a vascular flora of 62 species. They reported that a number of plants were calciphiles including *Aesculus pavia*, *Elymus virginiana*, *Matelea caroliniana*, *Sageretia minutiflora*, and *Yucca aloifolia*.

The most inclusive study of the vascular flora at Indian middens including shell mounds and rings is that by Dorroh (1971) along the South Carolina coast. A shell mound is a solid mass of shellfish remains; and a shell ring is a circular or arc-shaped ridge consisting of shellfish remains. Dorroh sampled eleven mounds and eight shell rings during the summer of 1970 by transects. At each site, a north south and east west compass line was followed, and species were identified if they were encountered at the transect and approximately two yards on either side of the transect. Dorroh's (1971) transect approach yielded 136 species in 59 families. The present study, a comprehensive inventory of 9 shell rings and one shell mound, yielded 241 species.

There are several archeological surveys of shell rings, including one by a future president, William McKinley, who described and measured three shell rings at Sapelo Island, Georgia, for the Smithsonian Institution in 1872 (Calmes 1967). Waring and Larson (1968) studied the shell rings at Sapelo Island and Porcher's Bluff, South Carolina, just north of Charleston. Cameron (1976) presented an ethnobotanical and floristic reconstruction of the Sapelo Island Shell Ring. Dr. Warren Moorehead examined the Chesterfield site, a horseshoe shaped structure along the Broad River near Port Royal Sound, South Carolina, (Flannery 1943). The Sewee Ring, a horseshoe shaped midden near the Santee River, South Carolina, was examined by Edwards (1965) who postulated that the site may have served as a fish trap by native Americans. Calmes (1967) examined the Ford's Skull Creek and Sea Pines rings at Hilton Head Island, South Carolina.

The Fig Island Shell Ring near the northeast end of Edisto Island, South Carolina, was examined by Hemmings (1970). Trinkley (1980, 1985) has done extensive work on the archeology of various shell rings and middens in South Carolina including Buzzards Island, and Crow Island at the Francis Porcher property north of Charleston.

METHODS

Nine shell rings and one shell mound were selected for the present study. These include four rings in South Carolina: Sewee, Buzzards Island, Ford's Skull Creek, Sea Pines and the Auld Mound; three rings in Georgia: Oemler, Romerly Marsh and Sapelo Island; and two rings in Florida: Fort George and Guana River State Park (Figure 1). Of the four shell rings extant in Florida; two are in this study. In South Carolina there were over 100 shell rings but many of these no longer exist due to shell removal for road building. Criteria for selecting sites include permission from private, state and federal authorities, lack of human disturbance and accessibility. The study was initiated in February 1993 and was completed in October 1994. Each site was sampled a minimum of 6 times during the growing seasons of 1993 and 1994 for a total of about 40 field days. Herbarium vouchers of each taxon were prepared and deposited at the University of South Carolina Herbarium: some are also housed at the Brooklyn Botanic Garden (BKL), Missouri Botanical Garden (MO), and the New York Museum at Albany, N.Y. (NYS).

The species checklist (Appendix I) contains an inventory of the vascular plants that reproduce spontaneously and persist for more than one year without cultivation, including native taxa, naturalized and adventive weeds, and escapes from cultivation. The checklist is divided into the following categories: vascular cryptograms, gymnosperms, dicots, and monocots. Nomenclature follows Kartesz (1994); when differences occur, the name as presented in Radford et al. (1968) is listed as a synonym and enclosed in brackets. The concept of families follows Kartesz (1994).

Mineral analysis of the soils of the shell rings was provided by the Cornell Nutrient Analysis Laboratory, Cornell University.

RESULTS AND DISCUSSION

The vascular flora of ten shell sites (9 rings, 1 shell mound) from South Carolina to Florida consists of 80 families, 182 genera, and 241 species of which 216 (89.6%) are native (Table 1). There is a higher percentage (89.6%) of native flora at the shell middens than at Fort Moultrie, South Carolina, where 77% of the flora are native (Stalter & Lamont 1993). The native flora at the Outer Banks of North Carolina, Ocracoke Island to the Virginia border, is 78% (Stalter & Lamont 1997).

The Poaceae, with 30 genera and 49 species and the Asteraceae, with 24 genera and 29 species are the largest families in terms of taxa. Together they comprise 30% of all genera and 33% of all species. Other large families are the Fabaceae and Cyperaceae. The largest genus is *Dichanthelium* with 8 species followed by *Quercus* with 6 species. The rarest species encountered is *Sageretia minutiflora* (Radford et al. 1971), though this species is common at shell ring sites examined in the present study. A summary of the vascular flora is given in Table 1.

The Sewee Shell Ring, South Carolina, was visited by Dr. R. Mohlenbrock in 1979. Notable species on Mohlenbrock's list at the Sewee Shell Ring included small-leaved buckthorn (*Bumelia tenax*) and basswood (*Tilia caroliniana*).

Table 1. A summary of the vascular flora identified at ten shell sites from South Carolina to Florida.

	Ferns	Conifers	Dicots	Monocots	Total
Families	2	2	63	13	80
Genera	2	2	129	49	182
Species	2	2	164	73	241
Native Species	2	2	142	62	208
Non-native Species	0	0	20	6	26

Shumard's oak (*Quercus shumardii*), as well as climbing hydrangea (*Ducumeria barbara*), grew only in the nearby forest. The forest was leveled by Hurricane Hugo, September 21 and 22, 1989, and was severely burned by a devastating wildfire in 1991. The vegetation on the shell ring escaped the fire, but not the powerful winds of Hurricane Hugo.

Several factors may account for the assemblage of species on the shell sites at the time this study was conducted. Hurricane Hugo, September 1989, savaged three shell middens: Sewee, Auld and Buzzard's Island, South Carolina. Four study sites, Auld, Buzzard's Island, Roemerly Marsh and the Oemler Ring are islands surrounded by a sea of *Spartina alterniflora*. Two shell rings, Sewee and Sapelo Island border salt marshes; the vegetation of these two rings and the four previously mentioned island rings are strongly influenced by tidal inundation. Sea Pines, South Carolina, Ford Skull Creek, South Carolina, Fort George and Guana River State Park, Florida are inland rings not influenced by tidal flooding. The calcareous nature of the soil also affects species distribution. Human activity (disturbance) in the form of occasional mowing at Sea Pines, archaeological excavation by Waring and Larson (1968) at Sapelo Island and light cattle grazing at Sapelo Island, play a role in species distribution at these shell rings. A final obvious factor is climatic differences. The winters at St. Augustine, Florida, are milder than the winter climate at the most northern Sewee Shell Ring site.

Sewee, Auld and Buzzards Island, South Carolina, were ravaged by Hurricane Hugo, September 21 and 22, 1989. Hurricane Hugo, a category 4 hurricane, was one of the most powerful storms of this century to strike the South Carolina coast. The hurricane surge in the vicinity of Charleston, South Carolina, was 4m; the surge reached 6m at McClellenville, 50km northeast of Charleston. Hurricanes with winds as severe as those of Hugo strike portions of the South Carolina coast approximately once every 200 years (Anonymous 1974). The vegetation on the above three shell rings was severely damaged by wind. Additional damage to shell ring vegetation may have occurred in one or more of the following ways: inundation by the storm surge; salt water immersion and residual effect of salt water desiccation; smothering by deposition of soil and rafts of vegetation (Stalter & Lamont 1993).

Stalter and Lamont (1993) recorded 218 species at Fort Moultrie, South Carolina, a site just north of Charleston, one year after Hurricane Hugo, including coastal plants, e.g. *Quercus virginiana*, *Ilex vomitoria*, and *Juniperus silicicola* that are common along the southeast coast. Stalter and Lamont (1993) reported that many of the plants at Fort Moultrie and Fort Sumter survived Hurricane Hugo. *Liriodendron tulipifera* and *Podophyllum peltatum*, two species recorded by Gregory (1925) and Dorrah (1971) at the Auld Shell site were probably killed by Hurricane Hugo. Yet many species identified by Dorroh (1971) at the Auld site, e.g. *Quercus virginiana*, *Smilax spp.* survived Hurricane Hugo.

The Sea Pines, South Carolina Shell Ring is maintained by occasional mowing as an "archeological show piece" of the Sea Pines Development community. Common shrubs, e.g. *Myrica cerifera* and *Quercus virginiana* and saplings of *Quercus laurifolia*, abundant in the surrounding forest, have been removed from this shell ring. *Dichanthelium spp.*, *Oplismenus setarius* and *Arisaema spp.* provide conspicuous seasonal ground cover at this site in the absence of dense shrub cover. The nearby Ford Skull Creek Shell Ring, a historically "disturbed" inland shell ring, was once used as a source of oyster shells, as building materials. At the time the present study was conducted, the Ford Skull Creek Shell Ring was undisturbed. Past oyster shell harvesting may have an effect on the present floristic composition at this shell ring.

The Sapelo Island, Georgia, Shell Ring, the most floristically rich shell ring of this study, has been disturbed in the past. Waring and Larson (1968) excavated shells from a portion of this shell ring bordering the salt marsh. Today, feral cattle occasionally graze portions of the shell ring, though grazing appeared to be negligible at the time of the present study. The presence of exclosures at this shell ring, might enable future investigators to determine the impact of cattle grazing on the flora of this shell ring.

Two Florida shell rings, Fort George, 23km east of Jacksonville and Guana River State Park, just north of St. Augustine, are undisturbed inland shell rings. *Vernonia gigantea*, *Psychotria nervosa*, *Peperomia humilis* and *Bidens alba* var. *radiata* were found only at the Florida shell rings; they were not observed at the other shell rings. *Corallorhiza wisteriana* was observed in flower in mid February, 1994, at the Guana River site, while at Fort George, 55km north, *C. wisteriana* did not flower until late March, 1994. Yet, the climatic differences between the two sites are minimal (Anonymous 1974). The difference in flowering of *C. wisteriana* at the two sites may reflect significant differences in minimum temperature at these sites during the winter of 1994.

Eleuterius and Otvos (1979) report that *Juniperus silicicola*, *Aesculus pavia*, *Erythrina herbacea*, and *Morus rubra* are reliable indicators of the shell deposits on Indian middens. All of the aforementioned species were found at one or more of the shell rings in the present study. *Sageretia minutiflora* and *Hexalectris spicata* may also be included as "indicator species" as these species favor the calcareous soils of Indian middens (Wunderlin 1998) but are found at non-ring sites as well.

The soils at the shell rings are neutral to slightly basic with a pH range of 6.82 at Sea Pines to 7.69 at Guana River State Park. Available Ca was high at all sites with a range of 1497 mg/Kg at Buzzard Island to 29,706 mg/Kg at Sea Pines. Available Mg ranged from 139.9 mg/Kg at Sapelo to 921.1 at Buzzards Island, while available Mn ranged from 5.4 at Fort George to 62.5 mg/Kg at Sea Pines. Available P ranged from 19.2 at Fort George to 221.0 mg/Kg at Sapelo, while K ranged from 42 at Guana River to 207 mg/Kg at Buzzards Island. Available nitrates ranged from undetectable at Buzzards Island to 190.61 at Sea Pines. The range of all these nutrients is highly variable among the sites.

Several shell rings occur as islands in salt marshes. The distribution of salt marsh species on the sides of these rings is related to tidal flooding and soil salinity. *Spartina alterniflora* occupies the lowest daily flooded base of the shell ring. Less flood tolerant salt marsh species are *Salicornia* spp., *Batis maritima*, *Distichlis spicata*, *Borrichia frutescens*, and *Spartina patens*. These form distinct zones above the more flood tolerant *Spartina alterniflora*. *Iva frutescens* and *Baccharis halimifolia* border *Borrichia* and *Spartina patens*, on the upland side. By contrast, the vegetation on shell rings not bordering salt marshes includes *Arisaema dracontium* and *A. triphyllum* at Sea Pines and Ford's Skull Creek, South Carolina, while *Corallorhiza wisteriana* and *Hexalectris spicata* were observed at the two Florida shell rings. *Psychotria nervosa*, *Peperomia humilis* and *Bidens alba* var. *radiata*, three subtropical species, were exclusively at the Florida shell ring sites, and are not part of the Carolina flora.

The most common woody species found on the salt marsh island shell rings are *Juniperus silicicola*, *Quercus virginiana*, *Sabal palmetto*, *Ilex vomitoria*, *Myrica cerifera* and *Smilax* spp. The most notable plant records, exclusive of the rare *Sageretia minutiflora*, are *Liriodendron tulipifera*, *Podophyllum peltatum*, and *Trillium* sp., known only from historical records at the Auld South Carolina Shell site (Gregorie 1925). Dorroh (1971) reported *Liriodendron* and *Podophyllum* at Auld in her study. These aforementioned taxa are usually not found at coastal barrier islands, although Stalter and Lamont (1987) reported a small population of *Podophyllum peltatum* and a single *Liriodendron tulipifera* at Assateague Island, Virginia. *Liriodendron*, *Podophyllum* and *Trillium* were absent at the Isle of Palms, South Carolina (Stalter 1976), Turtle Island, South Carolina (Stalter 1973), coastal Brookgreen Gardens, South Carolina (Stalter 1972), the Outer Banks of North Carolina (Stalter and Lamont 1997), and Fisherman Island, Virginia (Stalter et al. 1997). The *Liriodendron* at the Auld Shell mound may have been toppled by Hugo's hurricane winds while *Podophyllum* may have been killed by saltwater inundation during the storm surge associated with Hurricane Hugo, September 1989. Radford et al. (1971) report that *Liriodendron*, *Podophyllum* and *Trillium* are present at Charleston County, South Carolina, though these taxa may have been collected at inland sites.

Many plants may be "rare", rare being defined as scarce, less than 5 populations, at a study site (Stalter & Lamont 1997). Stalter and Lamont (1997) recorded 336 "rare" plants, 45.3% of the flora, at the Outer Banks of North Carolina.

Plants are rare for a multiplicity of reasons. Plants may be rare because they exist at the edge of their normal range. Plants may be rare if they have narrow habitat requirements that are met in only a few areas, such as the calciphile, *Sageretia minutiflora*. Plant succession, climatic events such as drought, severe cold or hurricanes can reduce the number of species, especially plants in restricted habitats such as shell rings. Human activities such as development, introduction of non-native plants, pollution and overcollection of attractive plants such as *Corallorhiza wisteriana* may also contribute to the rarity of species (Stalter & Lamont 1998).

Sea level along the Atlantic coast was 120 meters lower than today 12,000 years ago. Dolan et al. (1980) report that sea level continued to rise for 8,000 years, "reaching within a few meters of the present level 4–5000 years ago." Sea level has risen several meters in the past 2,000 years, and over the past 100 years, sea level has risen over 30 cm (Dolan et al. 1980). It is possible that some of the present salt marsh island shell rings may have been initially located on upland sites when they were built by Native Americans, several thousand years ago, when the sea level was several meters lower than it is today (Dolan et al. 1980). All the present shell ring sites selected in this study may have been built close to, or on the coast, where oysters were abundant. However, the precise location of the shell rings examined in this study relative to the coastline, salt marsh creeks and/or salt marshes at the time of their construction cannot be accurately determined.

APPENDIX I

ANNOTATED CHECKLIST OF SPECIES

The vascular plant taxa found at ten shell sites have been arranged according to the following categories: vascular cryptogams, gymnosperms, dicots, and monocots. Within each category, families and lower taxa are arranged alphabetically. Nomenclature primarily follows Kartesz (1994).

Each entry includes the following information sequence: scientific name; pertinent synonym, enclosed in brackets; and frequency relative to the shell rings, using the categories: rare (scarce, less than 5 populations), infrequent (uncommon, occasional, 5 to 20 populations), frequent (common, more than 20 populations).

POLYPODIOPHYTA

POLYPODIACEAE

Pleopeltis polypodioides (L.) Andrews and Windham spp. *michauxiana* (Weatherby) Andrews & Windham [*Polypodium polypodioides* (L.) Watt. var. *michauxianum* Weatherby]; infrequent

ASPLENIACEAE

Asplenium platyneuron (L.) BSP.; frequent

PINOPHYTA

CUPRESSACEAE

Juniperus virginiana L. var. *silicicola* (Small) E. Murray [*Juniperus silicicola* (Small) Bailey]; infrequent

PINACEAE

Pinus taeda L.; infrequent

MAGNOLIOPHYTA
MAGNOLIOPSIDA (DICOTS)

ACANTHACEAE

Ruellia caroliniensis (J.F. Gmel.) Steudel; infrequent

ACERACEAE

Acer rubrum L.; infrequent

AMARANTHACEAE

Iresine rhizomatosa Standley; rare

ANACARDIACEAE

Toxicodendron radicans (L.) Kuntze [*Rhus radicans* L]; frequent

Rhus copallinum L. [*Rhus copallina* L.]; infrequent

ANNONACEAE

Asimina triloba (L.) Dunal; rare

APIACEAE

Sanicula canadensis L.; infrequent

AQUIFOLIACEAE

Ilex vomitoria Aiton; infrequent

ARALIACEAE

Aralia spinosa L.; rare

ASCLEPIADACEAE

Cynanchum angustifolium Pers.; [*Cynanchum palustre* (Pursh) Heller]; infrequent

Matelea gonocarpa (Walter) Shinners [*M. suberosa* (L.) Shinners]; rare

ASTERACEAE

Ambrosia artemisiifolia L.; rare

Arnoglossum ovatum (Walt.) H.E. Robins. [*Cacalia lanceolata* Nutt.]; rare

Aster tenuifolius L.; infrequent

Baccharis angustifolia Michx.; rare

Baccharis halimifolia L.; frequent

Bidens alba (L.) DC. var. *radiata* (Schultz-Bip.) Ballard ex T.E. Melchert [*Bidens pilosa* L. var. *radiata* Schultz – Bip.]; frequent at Florida Shell Rings

Bidens bipinnata L.; infrequent

Borrichia frutescens (L.) DC.; frequent

Carduus smallii (Britton) Ahles. [*Cirsium horridulum* Michx.]; rare

Leucanthemum vulgare Lam. [*Chrysanthemum leucanthemum* L.]; infrequent

Conyza canadensis (L.) Cronq. var. *pusilla* (Nutt.) Cronq.; infrequent

Elephantopus tomentosus L.; frequent

Erechtites hieracifolia (L.) Raf.; frequent

Erigeron quercifolius Lam.; frequent

Eupatorium capillifolium (Lam.) Small; frequent

Eupatorium hyssopifolium L.; frequent

Eupatorium serotinum Michx.; rare

Euthamia graminifolia (L.) Nutt. [Solidago *graminifolia* (L.) Salisbury]; infrequent

Gamochaeta purpurea (L.) Cabrera [*Gnaphalium purpureum* L. var. *purpureum*]; infrequent

Hieracium gronovii L.; infrequent

Iva frutescens L.; infrequent

Lactuca floridana (L.) Gaertn.; infrequent

Lactuca graminifolia Michx.; infrequent

Mikania scandens (L.) Willd.; frequent

Smallanthus uvedalia (L.) MacKenzie ex Small [*Polymnia uvedalia* (L.) L.]; rare

Solidago sempervirens L. var. *mexicana* (L.) Fern.; frequent

**Sonchus asper* (L.) Hill; frequent

Verbesina occidentalis (L.) Walter; rare

Vernonia gigantea (Walt.) Trel.; rare

BATACEAE

Batis maritima L.; rare

BERBERIDACEAE

Podophyllum peltatum L. Reported by Gregorie (1925) and Dorroh (1971) at Auld, SC; not recently observed

BIGNONIACEAE

- *Bignonia capreolata* L.f. [*Anisostichus capreolata* (L.) Bureau]; infrequent
- *Campsis radicans* (L.) Seemann; infrequent

BORAGINACEAE

- *Heliotropium curassavicum* L.; rare

BRASSICACEAE

- **Cardamine hirsuta* L.; infrequent
- *Descurainia pinnata* (Walter) Britton ssp. *brachycarpa* (Richardson) Delting [*D. brachycarpa* (Richardson) O.E. Schultz]; rare
- *Lepidium densiflorum* Schader; rare
- *Lepidium virginicum* L.; frequent

BUDDLEJACEAE

- *Polypremum procumbens* L.; infrequent

CACTACEAE

- *Opuntia humifusa* (Raf.) Raf. [*O. compressa* J.F. Macbride]; infrequent
- **Opuntia monacantha* (Willd.) Haw. [*O. vulgaris* P. Mill.]; rare

CAMPANULACEAE

- *Triodanus perfoliata* (L.) Nieuwl. [*Specularia perfoliata* (L.) A. DC.]; frequent

CAPRIFOLIACEAE

- **Lonicera japonica* Thunb.; infrequent
- *Lonicera sempervirens* L.; infrequent
- *Viburnum nudum* L.; rare

CARYOPHYLLACEAE

- *Arenaria lanuginosa* (Michx.) Rohrb.; rare
- *Arenaria serpyllifolia* L.; infrequent
- **Cerastium fontanum* Baumg. subsp. *vulgare* (Hartman) Greuter & Burdet [*C. holosteoides* Fries var. *vulgare* (Hartman) Hylander; *C. vulgatum* L.]; infrequent
- *Silene antirrhina* L.; rare
- **Spergularia marina* (L.) Griseb. [*S. salina* J. & K. Presl]; infrequent

CELASTRACEAE

- *Euonymus americanus* L.; rare

CHENOPODIACEAE

- *Atriplex patula* L.; infrequent
- **Chenopodium album* L.; infrequent
- **Chenopodium ambrosioides* L.; frequent
- **Salicornia maritima* Wolff & Jefferies [*Salicornia europaea* auct.non L.]; infrequent
- *Salicornia virginica* L.; frequent
- *Suaeda linearis* (Elliott) Moq.; infrequent

CONVOLVULACEAE

- *Dichondra carolinensis* Michx.; infrequent
- *Ipomoea pandurata* (L.) G.F.W. Mey.; infrequent
- *Ipomoea sagittata* Poir.; frequent

CORNACEAE

- *Cornus asperifolia* Michx.; rare
- *Cornus florida* L.; rare
- *Cornus stricta* Lam. [*C. foemina* P. Mill.]; infrequent

CUSCUTACEAE (Formerly Convolvulaceae)

- *Cuscuta gronovii* Willd.; rare

ERICACEAE

- *Vaccinium corymbosum* L. [*V. atrococcum* (A. Gray) Porter]; rare

EUPHORBIACEAE

- *Acalypha gracilens* A. Gray; rare
- **Chamaesyce maculata* (L.) Small [*Euphorbia maculata* L.; *E. supina* Raf.]; infrequent
- *Cnidoscolus stimulosus* (Michx.) Engelm. & A. Gray; frequent
- *Euphorbia cyathophora* Murray [*E. heterophylla* L. var. *cyathophora* (Murray) Griseb.]; rare

FABACEAE

- *Cassia nictitans* L.; infrequent
- *Cercis canadensis* L.; rare
- *Clitoria mariana* L.; rare
- *Crotolaria rotundifolia* Walt. ex. J.F. Gmel. [*C. angulata* auct. non P. Mill.]; rare
- *Desmodium nudiflorum* (L.) DC.; rare
- **Desmodium tortuosum* (Sw.) DC.; infrequent
- *Erythrina herbacea* L.; frequent
- *Galactia regularis* (L.) BSP.; infrequent
- *Lespedeza* sp.; infrequent
- *Lespedeza stuevei* Nutt.; infrequent
- **Melilotus officinalis* (L.) Lam.; infrequent
- **Wisteria sinensis* (Sims) DC.; rare

FAGACEAE

- *Quercus laurifolia* Michx.; rare
- *Quercus myrtifolia* Willd.; rare
- *Quercus nigra* L.; rare
- *Quercus phellos* L.; rare
- *Quercus stellata* Wangenh.; rare
- *Quercus virginiana* Miller; frequent

GERANIACEAE

- *Geranium carolinianum* L.; infrequent

HAMAMELIDACEAE
Hamamelis virginiana L.; rare
Liquidambar styraciflua L.; rare

HIPPOCASTANACEAE
Aesculus pavia L.; frequent

JUGLANDACEAE
Carya glabra (P. Mill.) Sweet; infrequent
Juglans nigra L.; rare

LAMIACEAE
Salvia lyrata L.; frequent
Teucrium canadense L.; frequent
Trichostema dichotomum L.; rare

LAURACEAE
Persea borbonia (L.) Sprengel; infrequent
Sassafras albidum (Nutt.) Nees.; infrequent

LOGANIACEAE
Gelsemium sempervirens (L.) St.-Hil.; infrequent
Polypremum procumbens L.; infrequent
Spigelia marilandica L.; rare

MAGNOLIACEAE
Liriodendron tulipifera L. Reported by Gregorie (1925) and Dorroh (1971) at Auld, SC. Probably destroyed by Hurricane Hugo in 1989.
Magnolia grandiflora L.; infrequent
Magnolia virginiana L.; infrequent

MELIACEAE
**Melia azedarach* L.; rare

MENISPERMACEAE
Cocculus carolinus (L.) DC.; rare
Menispermum canadense L.; rare

MORACEAE
**Morus alba* L.; rare
Morus rubra L.; infrequent

MYRICACEAE
Myrica cerifera L.; frequent

NYSSACEAE
Nyssa sylvatica Marsh.; infrequent
Nyssa biflora Walt. [*N. sylvatica* Marsh. var. *biflora* (Walt.) Sarg.]; infrequent

OLEACEAE
Fraxinus caroliniana P. Mill.; rare
**Ligustrum amurense* Carr.; infrequent
Osmanthus americanus (L.) A. Gray; infrequent

ONAGRACEAE
Oenothera fruticosa L.; frequent
Oenothera laciniata Hill; infrequent

OXALIDACEAE
Oxalis dillenii Jacq.; infrequent
Oxalis stricta L.; infrequent

PASSIFLORACEAE
Passiflora lutea L.; infrequent

PHRYMACEAE
Phryma leptostachya L.; rare

PHYTOLACCACEAE
Phytolacca americana L.; frequent

PIPERACEAE
Peperomia humilis A. Dietr.; rare

PLUMBAGINACEAE
Limonium carolinianum (Walt.) Britt. [*L. nashii* Small]; infrequent

POLYGONACEAE
Rumex hastalalus Baldw.; frequent

RANUNCULACEAE
Clematis crispa L.; infrequent
**Clemantis terniflora* DC. [*Clematis dioscoreifolia* Levl. and Vaniot]; infrequent
Clematis virginiana L.; rare

RHAMNACEAE
Berchemia scandens (Hill) K. Koch; infrequent
Frangula caroliniana (Walt.) Gray [*Rhamnus caroliniana* Walt.]; rare
Sageretia minutiflora (Michx.) C. Mohr. [*Rhamnus minutiflora* Michx.]; infrequent

ROSACEAE
Crateagus uniflora Muenchh.; rare
Prunus caroliniana (P. Mill.) Ait. [*Laurocerasus carolinina* (P. Mill.) M. Roemer]; infrequent
Prunus serotina Ehrht.; infrequent
Rubus trivialis Michx.; frequent

RUBIACEAE
Galium pilosum Aiton; infrequent
Psychotria nervosa Sw. [*Psychotria undata* Jacq.]; rare

RUTACEAE
Zanthoxylum clava-herculis L.; infrequent

SAPOTACEAE
Sideroxylon tenax L. [*Bumelia tenax* (L.) Willd.]; infrequent

SCROPHULARIACEAE
Gratiola pilosa Michx.; rare
Nuttallanthus canadensis (L.) D.A. Sutton. [*Linaria canadensis* (L.) Chaz.], frequent
**Verbascum thapsus* L.; frequent
**Veronica arvensis* L.; frequent

SOLANACEAE
Physalis walteri Nutt. [*P. viscosa* L. subsp. *maritima* (M. A. Curtis) Waterfall]; infrequent

TILIACEAE
Tilia americana L. var. *caroliniana* (P. Mill.) Castigl. [*T. caroliniana* P. Mill]; rare

ULMACEAE
Celtis laevigata Willd.; infrequent
Celtis tenuifolia Nutt. [*C. oxidentalis* L. var. *georgiana* (Small) Ahles]; rare

VERBENACEAE
Callicarpa americana L.; infrequent
Verbena scabra Vahl; rare

VIOLACEAE
Viola sororia Willd.; rare

VITACEAE
Ampelopsis arborea (L.) Koehne; infrequent
Parthenocissus quinquefolia (L.) Planch.; frequent
Vitis aestivalis Michx.; infrequent
Vitis rotundifolia Michx.; infrequent

MAGNOLIOPHYTA - LILIOPSIDA

AGAVACEAE
**Yucca aloifolia* L.; infrequent

ARACEAE
Arisaema dracontium (L.) Schott; infrequent
Arisaema triphyllum (L.) Schott; rare

ARECACEAE
Sabal palmetto Lodd. ex. Schultes; infrequent

BROMELIACEAE
Tillandsia usneoides (L.) L.; infrequent

COMMELINACEAE
Tradescantia ohiensis Raf.; infrequent

CYPERACEAE
Cladium jamaicense Crantz [*C. mariscus* (L.) Pohl]; infrequent
Cyperus globulosus Aublet; infrequent
Cyperus retrorsus Chapm.; infrequent
Eleocharis albida Torr.; rare
Fimbristylis castanea (Michx.) Vahl; infrequent
Rhynchospora colorata (L.) H. Pfeiffer [*Dichromena colorata* (L.) Hitchc.]; rare
Scirpus robustus Pursh; rare
Scleria triglomerata Michx. [*S. nitida* Muhl.]; infrequent

DIOSCOREACEAE
Dioscorea villosa L.; rare

IRIDACEAE
Sisyrinchium rosulatum E. Bickn.; rare

JUNCACEAE
Juncus bufonius L.; infrequent
Juncus roemerianus Scheele; infrequent

LILIACEAE
**Alium vineale* L.; infrequent
Trillium sp. Reported by Gregorie (1925) at Auld site; not recently observed.

ORCHIDACEAE
Corallorhiza wisteriana Conrad; infrequent
Hexalectris spicata (Walt.) Barnh.; infrequent

POACEAE
Andropogon glomeratus (Walter) B.S.P. [*A. virginicus* L. var. *abbreviatus* (Hackel) Fern. & Griscom]; infrequent
Andropogon virginicus L.; frequent
Arundinaria gigantea (Walter) Muhl. subsp. *tecta* (Walter) McClure; infrequent
Arthraxon hispidus Thunb. var. *cryptatherus* (Hackel) Honda.; infrequent
**Bromus tectorum* L.; infrequent
Cenchrus carolinianus Walt. [*C. incertus* M.A. Curtis]; rare
Chasmanthium laxum (L.) Yates [*Uniola laxa* (L.) B.S.P.]; infrequent
**Dactyloctenium aegyptium* (L.) Willd.; infrequent
Dichanthelium acuminatum (Sw.) Gould & Clark [*Panicum acuminatum* Sw. (sensu lato) incl. *P. auburne* Ashe; *P. meridionale* Ashe; *P. leucothrix* Nash]; infrequent
Dichanthelium consanguineum (Kunth) Gould & Clark [*Panicum consanguineum* Kunth]; infrequent
Dichanthelium latifolium (L.) Gould & C.A. Clark [*Panicum latifolium* L.]; infrequent

Dichanthelium laxiflorum (Lam.) Gould [*Panicum laxiflorum* Lam.; *P. xalapense* H.B.K.]; rare
Dichanthelium malacophyllum (Nash) Gould [*Panicum malacophyllum* Nash]; rare
Dichanthelium oligosanthes var. *scriberanum* (Nash) Gould [*Panicum scriberianum* Nash]; rare
Dichanthelium sabulorum (Lam.) Gould & Clark var. *patulum* (Scribn. & Merr.) Gould & Clark. [*Panicum lancearium* Trin.]; infrequent
Dichanthelium scabriusculum (Ell.) Gould & Clark. [*Panicum scabriusculum* Ell. *P. aculeatum* A. Hitchc. & Chase]; rare
Distichlis spicata (L.) Greene; infrequent
Echinochloa walteri (Pursh) Heller; rare
Elymus virginicus L. var. *halophilus* (Bickn.) Wieg.; infrequent
Eragrostis hirsuta (Michx.) Nees; infrequent
Eragrostis spectabilis (Pursh) Steud. infrequent
Eustachys petraea (Swartz) Desv. [*Chloris petraea* Sw.]; infrequent
Melica mutica Walt.; infrequent
Muhlenbergia capillaris (Lam.) Trin.; infrequent
Muhlenbergia schreberi J. F. Gmel.; rare
Oplismenus setarius (Lam.) Roemer & Schultes [*O. hirtellus* (L.) Beauv. subsp. *setarius* (Lam.) Mez ex Ekman]; frequent
Panicum amarum Ell. [*P. amarulum* A. Hitchc. & Chase]; rare
Panicum boscii Poir. [*P. boscii* var. *molle* (Vasey) Hitchc. and Chase]; infrequent
Panicum dichotomiflorum Michx.; infrequent
Panicum virgatum L.; infrequent
Paspalum distichum L.; infrequent
Paspalum setaceum Michx. var. *ciliatifolium* (Michx.) Vasey [*P. ciliatifolium* Michx.; *P. longipedunculatum* LeConte]; rare
Phalaris caroliniana Walt.; rare
Piptochaetium avenaceum (L.) Parodi [*Stipa avenacea* L.]; infrequent
**Poa annua* L.; infrequent
**Polypogon monspeliensis* (L.) Desf.; frequent
Setaria geniculata (Lam.) Beauv.; infrequent
Sphenopholis intermedia (Rydb.) Rydb.; rare
Sphenopholis obtusata (Michx.) Scribn.; rare
Spartina alterniflora Loisel.; frequent
Spartina patens (Ait.) Muhl.; frequent
Sporobolus indicus (L.) R. Br. [*S. poiretti* (R. & S.) Hitchc.]; frequent
Sporobolus virginicus (L.) Kunth; infrequent
Stenotaphrum secundatum (Walt.) Kuntze; infrequent
Tridens flavus (L.) A. Hitchc. [*Triodia flava* (L.) Smyth]; infrequent
Triplasis purpurea (Walt.) Chapman; frequent
Vulpia octoflora (Walt.) Rydb. [*Festuca octoflora* Walt.]; infrequent

SMILACACEAE

Smilax bona-nox L.; infrequent
Smilax glauca Walt.; rare
Smilax laurifolia L.; infrequent
Smilax rotundifolia L.; infrequent

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REFERENCES

ANONYMOUS. 1974. Climates of the United States. Vols. 1 and 2. Water Information Center, Port Washington, New York.

BROWN, C.A. 1936. The vegetation of the Indian mounds, middens, and marshes in Plaquemines and St. Bernard Parishes. Department of Conservation-Louisiana Geological Survey 8:423–440.

CALMES, A. 1967. Test excavations at Two Late Archaic Sites on Hilton Head Island. Ms. on file, South Carolina Institute of Archeology and Anthropology, University of South Carolina, Columbia.

CAMERON, M.A. 1976. Sapelo Island: An ethnobotanical and floristic reconstruction. Unpublished report prepared for the Department of Natural Resources of the State of Georgia under the direction of Dr. Lewis Larson, State Archeologists. On File Department of Natural Resources, Sapelo Island, Georgia.

DEPRATTER, C.B. 1974. An archeological survey of Ossabaw Island, Chatham County, Georgia: Preliminary report. Ms. on file, University of Georgia, Laboratory of Archeology (Research Manuscript 344).

DORROH, R.J. 1971.The vegetation of Indian shell mounds and rings of the South Carolina Coast. Unpublished Masters of Science Thesis, Department of Biology, University of South Carolina, Columbia,

EDWARDS, W.E. 1965. Preliminary report on the Sewee Indian Mound. Ms. on file, South Carolina Institute of Archeology and Anthropology, University of South Carolina, Columbia.

ELEUTERIUS, L.N. and L.G. OTVOS 1979. Floristic and geologic aspects of Indian middens in salt marshes of Hancock County, Mississippi. Sida 8:102–112.

FLANNERY, R. 1943. Some notes on a few sites in Beaufort County, South Carolina. Bull. 133, U.S. Bureau of American Ethnology, Washington: U.S. Gov. Printing Office. Pp. 143–153.

FORD, J.A. 1966. Early formative cultures in Georgia and Florida. Amer. Antiquity 31:781–799.

GREGORIE, A.K. 1925. Notes on Sewee Indians and Indian remains of Christ Church Parish, Charleston County. Contributions from the Charleston Musuem.

GRIFFIN, J.W. 1948. Green mound-A chronological yardstick. Florida Naturalist 22:1–8.

HEMMINGS, E.T. 1970. Emergence of formative life on the Atlantic Coast of the Southeast Paper presented at the 27th Annual Southeastern Archaeological Conference, Columbia, S.C., October 30-31.

KARTESZ, J.T. 1994. A synonymized checklist of the vascular flora of the United States, Canada, and Greenland. 2nd ed. Volume 1 - Checklist. Timber Press, Inc. Portland, OR.

KURZ, H. and K. WAGNER. 1957. Tidal marshes of the Gulf and Atlantic coasts of Northern Florida and Charleston, South Carolina. Florida State Univ. Stud. 24:1–168.

LAESSLE, A.M. 1942. The shell mound at Orange Point. In the plant communities of the Welaka area. Univ. Florida Publ., Biol. Sci. 4:59–60.

Moore, C.B. 1897. Certain aboriginal mounds of the Georgia coast and certain aboriginal mounds of South Carolina. J. Acad. Nat. Sci. Philadelphia 11:146–166.

Radford, A.E., H.E. Ahles, and C.R. Bell. 1968. Manual of the vascular flora of the Carolinas. University of North Carolina Press, Chapel Hill.

Stalter, R. 1972. The summer and fall flora of Brookgreen Gardens, Murrells Inlet, South Carolina. Castanea 37:214–227.

__________. 1973. The flora of Turtle Island, Jasper County, South Carolina. Castanea 38:35–37.

__________. 1976. The flora of the Isle of Palms, South Carolina. Castanea 40:4–13.

Stalter, R. and E.E. Lamont. 1987. The vascular flora of Assateague Island, Virginia. Bull. Torrey Bot. Club 117:48–56.

__________. 1997. Flora of North Carolina's Outer Banks, Ocracoke Island to Virginia. J. Torrey Bot. Soc. 121:71–88.

Stalter, R., E.E. Lamont, and D.T. Kincaid. 1997. Non-native plants at Fisherman Island, Virginia, a 20 year comparison. Castanea 62:268–271.

Trinkley, M.B. 1980. Investigation of the Woodland Period Along the South Carolina Coast. Unpublished Ph. D. dissertation, Department of Anthropology, University of North Carolina, Chapel Hill.

__________. 1985. The form and function of South Carolina's early Woodland Shell Rings. In: Structure and process in sourheastern archeology, edired by Roy S. Dickens, Jr., and H. Trawick Ward, pp. 102-118. University of Alabama Press, Birmingham.

Waring, A.J. and L.H. Larson. 1968. The shell ring on Sapelo Island. In the Waring Papers, edited by Stephen Williams, Pap. Peabody Mus. Archaeol. Ethnol. 58:263–278.

Wunderlin, R. 1998. Guide to the vascular plants of Florida. University Press of Florida, Gainsville.

BOOKS RECEIVED

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Volume 29 of *Annual Review of Ecology and Systematics* is another excellent mix of articles on ecology and systematics. A total of 20 articles are presented followed by a Subject Index, Cumulative Index of Contributing Authors, and a Cumulative Index of Chapter Titles, Volumes 25–29.

Contents include:

Molecular Trans-Species Polymorphism
Principles of Phylogeography as Illustrated by Freshwater and Terrestrial Turtles in the Southeastern United States
The Functional Significance of the Hyporheic Zone in Streams and Rivers
Endangered Mutualisms: The Conservation of Plant-Pollinator Interactions
The Role of Introduced Species in the Degradation of Island Ecosystems: A Case History of Guam
Evolution of Helping Behavior in Cooperatively Breeding Birds
The Ecological Evolution of Reefs
Roads and Their Major Ecological Effects
Sex Determination, Sex Ratios, and Genetic Conflict
Early Evolution of Land Plants: Phylogeny, Physiology, and Ecology of the Primary Terrestrial Radiation
Possible Largest-Scale Trends in Organismal Evolution: Eight "Live Hypotheses"
Fungal Endophytes: A Continuum of Interactions with Host Plants
Floral Symmetry and Its Role in Plant-Pollinator Systems: Terminology, Distribution, and Hypotheses
Vertebrate Herbivores in Marine and Terrestrial Environments: A Nutritional Ecology Perspective
Carbon and Carbonate Metabolism in Coastal Aquatic Ecosystems
The Scientific Basis of Forestry
Pathways, Mechanisms, and Rates of Polyploid Formation in Flowering Plants
Bacterial Growth Efficiencies in Natural Aquatic Systems
The Chemical Cycle and Bioaccumulation of Mercury
Phylogeny of Vascular Plants

NOTEWORTHY VASCULAR PLANTS FROM ARKANSAS

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ABSTRACT

The authors provide a list of 41 additions, reinstatements, and significant range extensions for the flora of Arkansas. *Trautvetteria caroliniensis, Dalea gattingeri, Rhynchosia minima*, and *Setaria pumila* are reported as new and persistent elements, while *Magnolia macrophylla, Didiplis diandra, Valerianella locusta,* and *Sisyrinchium exile* are reinstated to the state flora. A number of alien weeds are noticed and documented for the first time, however, their persistence is not known.

RESUMEN

Los autores proporcionan una lista donde se enumeran 41 adiciones, confirmaciones, y extensiones significativas para la flora de Arkansas. *Trautvetteria caroliniensis, Dalea gattingeri, Rhynchosia minima*, y *Setaria pumila* se citan como componentes nuevos y persistentes en el área, mientras que *Magnolia macrophylla, Didiplis diandra, Valerianella locusta*, y *Sisyrinchium exile* se confirman para la flora del estado. Un número de malas hierbas de origen alóctono son mencionadas y documentadas por primera vez, sin embargo, no es conocida su persistencia.

The authors provide a list of 41 taxa representing additions and reinstatements to the Arkansas flora as well as noteworthy range extensions within the state. Herbarium abbreviations are taken from Holmgren et al. (1990).

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APIACEAE

Hydrocotyle sibthorpioides Lam. This invasive Asian pennywort occurs sporadically in the Southeast in wet, disturbed habitats. We add three county records to the two recorded by Smith (1988). **Ashley Co.:** *Sundell 11,104* (UAM). **Calhoun Co.:** *Thomas & Amason 157,168* (NLU, UAM). **Pulaski Co.:** *E. & M. Sundell 12,048* (UAM).

ASTERACEAE

Conyza bonariensis (L.) Cronq. This common and widespread horseweed has escaped notice, or at least collection, in southern Arkansas for years—the more remarkable because it forms extensive populations along our major highways that are easily recognized even at speeds of over 60 miles per hour. *Conyza bonariensis* was not discovered in the state until 1989, when Thomas and Amason collected plants in a railroad yard in El Dorado in Union County (Thomas et al. 1991). Voucher specimens taken from roadsides and river banks are recorded here for eight additional counties. **Arkansas Co.:** *Thomas, Sundell, & Amason 145,284* (NLU). **Calhoun Co.:** Thomas & Amason *157,214* (NLU, UAM). **Cleveland Co.:** *Thomas & Amason 157,108* (NLU, UAM). **Desha Co.:** *Thomas, Sundell, & Amason 145,498* (NLU). **Drew Co.:** *Sundell 12,110* (UAM). **Hempstead Co.:** *Thomas & Amason 155,483* (NLU). **Lafayette Co.:** *Thomas, Sundell, & Amason 150,931, 156,555* (NLU). **Miller Co.:** *Thomas, Sundell, & Amason 151,143* (NLU). The species should be considered an established element of the Arkansas flora.

Crepis setosa Haller f. is known from Missouri (Steyermark 1963) and the northeastern United States (Gleason and Cronquist 1991) as a waif. Although the species is unlikely to persist in Arkansas, its presence is documented by a collection from Russellville in Pope County, where it grew as a weed in pavement cracks, *E., M., & J. Sundell 12,105* (UAM).

BRASSICACEAE

Cardamine concatenata (Michx.) O. Schwartz. Like bloodroot and white trout lily, toothwort is rare enough on Arkansas' West Gulf Coastal Plain to have gone undetected except for a single report for Arkansas County (Smith 1988). We record it here from mesic woodlands in two additional localities. **Drew Co.:** *Sundell & Pagan 10,149* (UAM). **Union Co.:** *Thomas & Amason 109,031* (NLU).

Cardamine debilis D. Don is an unobtrusive and probably undercollected alien weed, sporadically introduced in greenhouses and warmer areas of North America (Rollins 1993). Plants were collected from a flower bed in Pulaski County, October 1997, marking the species' first occurrence in Arkansas. *Sundell 12,258* (UAM, UARK). Although Kartesz (1994) places *C. debilis* in synonymy with *C. flexuosa* With., the two appear to be distinct and are recognized as such by Rollins.

Cardamine flexuosa With. The alien *Cardamine flexuosa* grew in abundance at Daylite Nursery in Drew County, where it had escaped from containers to surrounding work areas. Rollins (1993) records this infrequently collected cress from several eastern states, Mexico, and Costa Rica. Smith's (1988) report of the species from Baxter County, Arkansas, was based on misidentification of material of *Sibara virginica* (Smith, pers. comm.). Thus we report it here as new to Arkansas. *Sundell 12,259* (NLU, UAM, UARK).

Lepidium oblongum Small. Although Rollins (1993) describes the range of this prostrate peppergrass as extending east to Arkansas, Smith (1988) has seen only a single specimen from Lonoke County. We here add Washington County to that short list, where it was growing in pavement cracks on the University of Arkansas campus in Fayetteville. *Sundell 12,264* (UAM, UARK). Collections at NLU document the species' presence in Mississippi and Louisiana as well.

Raphanus sativus L. Radish escapes from cultivation rather frequently in the cooler parts of North America where it is common and abundant in ruderal habitats (Rollins 1993). Although it apparently does not persist as a weed in Arkansas, its occurrence should be noted. In Drew County, a few plants were scattered along a newly seeded road construction site. *Sundell 12,260* (UAM).

Rorippa sylvestris (L.) Besser. A collection from inside the Mississippi River levee in Chicot County reconfirms the presence of this weedy crucifer in Arkansas, previously reported for Crittenden County by Wilcox in 1973. *Sundell, Thomas, & Amason 10,952* (UAM).

COMMELINACEAE

Murdannia keisak (Hassk.) Hand.-Maz. This species has been known in Arkansas only from Tucker's 1969 report for Conway County. In 1996, Thomas collected specimens on a shaded roadbank in nearby Pulaski County. *Thomas, Hunter, et al. 148,617* (NLU).

Murdannia nudiflora (L.) Brenan is an Asian introduction that has become rather common in disturbed sites on the Atlantic and Gulf Coastal Plain (Darwin et al. 1981, Wunderlin 1998). Thomas's collection from Hempstead County in southern Arkansas, where plants dominated a shaded lawn, represents its first record in the state. *Thomas, Amason, et al. 155,570* (NLU).

Tradescantia crassula Link & Otto. Amason has observed this spiderwort thriving out of doors at his home in Union County for several decades. *Thomas, Sundell, Amason, et al. 156,721* (NLU).

CYPERACEAE

Cyperus cuspidatus Kunth. This little flat sedge occurs sporadically on the eastern Gulf Coastal Plain (Godfrey & Wooten 1979) and is recorded here from two Arkansas counties. **Chicot Co.:** *Thomas 142,804* (NLU). **Drew Co.:** *E. & J. Sundell 10,435* (UAM).

EUPHORBIACEAE

Phyllanthus pudens L.C. Wheeler and **Phyllanthus tenellus Roxb.** Both *Phyllanthus pudens* (*E. & M. Sundell 12,037* [UAM]) and *P. tenellus* (*E. & M. Sundell 12,038* [UAM]) were found thriving at Daylite Nursery in Drew County where they were escaping to gardens and waste areas from plant containers brought in from Louisiana and Texas. Although both of these species reproduce out of doors in Ouachita Parish in north Louisiana, there is no evidence that they will persist in the Arkansas flora. *Phyllanthus* is largely a tropical and subtropical group with only a single species, *P. caroliniensis*, indigenous to the temperate regions of the southeastern United States. Nevertheless, the recent, successful invasion of southern Arkansas by *P. urinaria*, first reported by Smith for Union and Arkansas counties (Smith 1978-1980) and again by Sundell (1986) for additional localities, suggests that if transportation is available, other species of *Phyllanthus* might move north.

FABACEAE

Dalea gattingeri (Heller) Barneby. Known from cedar glades in Tennessee, Georgia, and Alabama (Isely 1990) and, more recently, from Howell County, Missouri, within 10 km of the Arkansas border (Summers et al. 1995), *Dalea gattingeri* was discovered by Logan in Fulton County, Arkansas, in June, 1997 (*Logan 97-20* [UAM, UARK]) and subsequently recorded in the Arkansas Natural Heritage Commission data base from six additional localities in that county, all dolomite glades (*Logan 98-34* [UAM]). The species resembles the widespread *D. purpurea*, differing in characters of the inflorescence and bracts.

Rhynchosia minima (L.) DC. This weedy vine was erroneously attributed to the Arkansas flora by Grear (1978) based on a specimen from Aransas (not "Arkansas") National Wildlife Refuge in Aransas County, Texas (Smith 1988). Collections from the shores of the Mississippi River in Chicot County here confirm its presence in the state. *Thomas, Sundell, & Amason 142,827* (NLU).

Trifolium striatum L. Arkansas is one of a few southeastern states where knotted clover, a European native, has had some success as an escape from cultivation (Isely 1990). We record here four new localities from three counties, nearly doubling its known presence in the state: **Pulaski Co.:** *Thomas &*

Amason 148,622 (NLU). **Saline Co.:** *Thomas & Amason 148,835, 148,850* (NLU). **Union Co.:** *Thomas & Amason 149,139* (NLU).

Vicia hirsuta (L.) S.F. Gray is a European native introduced to ruderal sites over much of the United States (Isely 1990). The species has two seeds per fruit and is often mistaken for the more common *V. tetrasperma*, with four seeds per fruit, and overlooked. In Arkansas, it has been documented only from Washington County in the northwest. We add two southern counties on the Louisiana border: **Lafayette Co.:** *Thomas, Sundell, & Amason 156,549* (NLU). **Union Co.:** *Thomas & Slaughter 104,337* (NLU, UAM).

GENTIANACEAE

Centaurium texense (Griseb.) Fern. Previous records of Texas centaury in Arkansas were limited to a few counties in the Ozark Mountains, however a recent collection from a blackland prairie site in Hempstead County in southwest Arkansas (*Sundell 12,368* [UAM]) represents an important (though not unexpected) range extension within the state. Several species of calcareous soils exhibit a similar pattern in Arkansas, for example, *Juniperus ashei* Buchholz and *Penstemon cobaea* Nutt.

IRIDACEAE

Sisyrinchium exile Bickn. Based on Hornberger's (1987) merging of *Sisyrinchium exile* with *S. rosulatum*, Smith (1988) excluded the former taxon from the Arkansas flora. Hornberger developed her concepts of *Sisyrinchium* species in the southeastern United States "mostly from herbarium materials" (pers. comm.). However, differences in stature and flower color between those taxa that are immediately apparent in the field are obscure in dried specimens. We recommend reinstatement of *S. exile* based on the following voucher specimens: **Ashley Co.:** *Thomas 92,053* (NLU, UAM). **Bradley Co.:** (where plants of *S. exile* were mixed with the larger and more common *S. rosulatum*): *Sundell & Amason 11,737* (UAM). **Union Co.:** *Thomas 133,595* (NLU).

LAMIACEAE

Clinopodium gracile (Benth.) Kuntze. Thieret reported *Clinopodium gracile* as new to the United States in 1964 from a Louisiana collection. The species has subsequently spread through much of Louisiana and into southern Arkansas. **Union Co.:** *Thomas & Amason 143,743* (NLU).

Scutellaria racemosa Pers. This recently introduced South American native is known from scattered localities on the Gulf Coastal Plain (Godfrey & Wooten 1981). Originally picked up in Arkansas in 1992 by Marie Locke during her work on the flora of Jefferson County (Smith, pers. comm.), its presence in Arkansas is documented here by three collections, all from gardens, where the plants were likely contaminants in horticultural material imported from further south. **Drew Co.:** *Sundell 11,601* (UAM). **Jefferson Co.:** *E. & M. Sundell 12,055* (UAM). **Union Co.:** *Thomas & Amason 155,860* (NLU). Time will tell whether this alien skullcap deserves resident status.

LILIACEAE

Erythronium albidum Nutt. Like bloodroot and toothwort, white trout lily in Arkansas is a common species of the Ozark and Ouachita highlands, recorded by Smith (1988) for only two counties on the West Gulf Coastal Plain. We here confirm his report for Arkansas County and add three stations from two other counties, all collections from richly wooded creek bottoms. **Arkansas Co.:** *Butcher s.n.* (UAM). **Cleveland Co.:** *Baker 20* (UAM). **Drew Co.:** *McDougald & Lincoln 15, Barbee, Lamb, & Pagan 36* (UAM).

LYTHRACEAE

Cuphea carthagenensis (Jacq.) J.F. Macb. was first collected in Arkansas in Ashley County by Thomas in 1985 and recorded by Hooks (1986). Like a number of others native to the Gulf Coastal Plain, the species is not unexpected in Arkansas' southern counties. However, blooming from mid-summer to fall, when field activities are typically less intense, it is probably underrepresented in herbarium collections. We report it from a wet site in Lafayette County in southwest Arkansas (*Sundell, Thomas, & Amason 11,852* [UAM]).

Didiplis diandra (Nutt. ex DC.) Wood. Water-purslane was collected at Felsenthal National Wildlife Refuge in Ashley County (*Sundell & McDonald 7623, 7630* [UAM]), where it grew both on mud and submerged in temporarily flooded habitat. It was reported for the state (as *Peplis diandra* Nutt.) by Branner and Coville in 1891 but, to our knowledge, has never been documented.

MAGNOLIACEAE

Magnolia macrophylla Michx. According to Tucker (1976), big leaf magnolia grew as a native plant in Arkansas only in Clay County on Crowley's Ridge in the northeast corner of the state, where a single grove had been reduced by natural hazards and local gardeners to a few small trees. Tucker predicted that the species would soon be extirpated at the site; two trees remained in 1981 (Figlar 1981); a survey of the site in 1995 failed to relocate the species (Meyer 1997). In 1994, Stuckey discovered a single tree of *Magnolia macrophylla* growing on a heavily wooded slope above a stream, in the vicinity of Mandeville near Texarkana in Miller County, in the southwest corner of Arkansas (*Stuckey s.n.* [UAM, UARK]). Wild populations of big leaf magnolia in northern Louisiana are the most likely seed source.

MORACEAE

Fatoua villosa (Thunb.) Nakai. Sundell reported this herbaceous Asiatic weed as new to Arkansas in 1986 based on a Drew County specimen. The species has persisted in southern Arkansas (our most recent collection was made in 1996), however, to our knowledge, it remains restricted to gardens and nurseries, growing vigorously to heights of three feet. **Pulaski Co.:** *Sundell 10,440, E. & M. Sundell 12,049* (UAM). **Union Co.:** *Sundell & Amason 7,461* (UAM), *Thomas & Amason 107,891, 111,269* (NLU).

PAPAVERACEAE

Sanguinaria canadensis L. Bloodroot is documented from almost every county in the Ozark and Ouachita highlands of Arkansas (Smith 1988) but is unknown from most of the southeastern half of the state. The phenomenon of more northern, highland species pioneering on the Coastal Plain was discussed by Kral (1966), who noted that their random distribution on some but not all richly wooded stream terraces in north Louisiana could best be explained by impediments to dispersal rather than environmental limitations. We record bloodroot from the mesic hardwood terrace of Hunger Run Creek in Drew County where it grew with two other highland associates, *Cardamine concatenata* (Michx.) Schwartz and *Viola pubescens* Ait.: *Sundell & Pagan 10,152* (UAM).

POACEAE

Eriochloa acuminata (J. Presl) Kunth var. **acuminata** is known in Arkansas at present from Conway and Mississippi Counties in the north central and northeastern parts of the state (Smith 1988). Recent records from five additional counties suggest that the species is probably undercollected. **Desha Co.:** *Thomas, Sundell, & Amason 145,466* (NLU). **Lafayette Co.:** *Thomas, Sundell, & Amason 150,961* (NLU). **Lee Co.:** *Thomas 134,402* (NLU). **Miller Co.:** *Thomas, Sundell, & Amason 151,107* (NLU). **St. Francis Co.:** *Thomas 131,382* (NLU, UAM).

Rottboellia cochinchinensis (Lour.) Clayton. This noxious Asiatic grass has become naturalized in the West Indies, Florida and Louisiana (Allen 1992). It appeared previously in Arkansas in Ashley County (Smith 1988) and was rediscovered as a weed in a soybean field in 1996 in Arkansas County by Brad Koen of the Arkansas Cooperative Extension Service. *Koen s.n.* (NLU, UAM, UARK).

Setaria pumila (Poir.) Roem. & Schult. This distinctive, narrow-spiked, European bristle grass was first reported for North America (as *S. pallidefusca* [Schum.] Stapf & Hubb.) from a Baton Rouge, Louisiana collection by Thieret and Allen in 1974. It is currently known in that state from twenty parishes (Thomas & Allen 1993). In addition, a collection at UAM documents its presence in Alabama. *Setaria pumila* has been found in weedy habitats in three southern Arkansas counties. **Ashley Co.:** (1997): *Sundell & Yeiser 12,108* (NLU, UAM, UARK). **Bradley Co.:** (1993): *Thomas 137,493* (NLU, UAM). **Calhoun Co.:** (1998): *Thomas & Amason 157,175* (NLU, UAM).

PORTULACACEAE

Portulaca umbraticola Kunth. Orzell and Bridges (1987) reported this distinctive purslane from Monroe County in eastern Arkansas, and we here note its occurrence at a second locality, in Miller County, in the southwestern corner of the state. *Thomas, Sundell, & Amason 151,119* (NLU).

PRIMULACEAE

Lysimachia japonica Thunb. was reported for Louisiana by Thomas and Allen in 1982. A 1997 collection from Union County documents its presence in southern Arkansas. *Thomas & Amason 155,858* (NLU).

PSILOTACEAE

Psilotum nudum (L.) Beauv. Whisk-fern has been reported by Peck and Taylor (1995) for three counties in southwest Arkansas: Clark, Lafayette, and Union. Thomas recently discovered the species at Grassy Lake in Hempstead County (*Thomas, Amason, Stuckey, et al. 155,572* [NLU]), where seventeen plants were counted around the base of a large baldcypress tree. The species is native in north Louisiana; in the older part of North Monroe, for example, plants are common behind shrubbery thar has not been replaced for several decades. All such plants are less than six inches tall and do not get bigger: they are the native diploid of Florida and the Gulf Coast, rather than the much larger greenhouse tetraploid. Based on size, Thomas's Hempstead County plants were diploids and more likely to be natives at the northern edge of their range than waifs.

PTERIDACEAE

Pteris multifida Poir. in Lam. et al. Spider brake was first reported for Arkansas in 1941 from Hot Springs National Park in Garland Counry, where ir has persisted to the present (Taylor 1984). We record a second locality for this naturalized fern. **Union Co.:** *Thomas & Amason 144,850* (NLU).

RANUNCULACEAE

Trautvetteria caroliniensis (Walt.) Vail. was discovered in Arkansas (on Brady Mountain in the Ouachita Highlands, Garland County) in the late 1980's by John Pelton of the Arkansas Native Plant Society. Pelton communicated the discovery to Vernon Bates and Burt Pittman, who were then conducting a floristic inventory of the Ouachita National Forest. Specimens collected at that time have never been cited in publication as documentation of the population (Bates & Pittman, pers. comm.), however, it is likely that the single Arkansas population of *Trautvetteria* mapped in *Flora of North America* (Parfitt 1997) is the same. The monotypic genus is disjunct in North America and eastern Asia, with North American populations of the eastern and western forests recognized (rather arbitrarily according to Parfitt) at the varietal level. Variety *caroliniensis* of the eastern United States was previously known to occur west of the Mississippi River only at several stations in Shannon County, Missouri (Steyermark 1963). Arkansas plants were growing in abundance on a richly wooded seepage slope with *Smilax laurifolia, Viburnum nudum, Osmunda cinnamomea,* and *O. regalis* under a closed canopy of mixed hardwoods and pine. *Sundell 10,473* (UAM, UARK), *10,585* (UAM).

ROSACEAE

Pyrus calleryana Dcne. When Sundell reported callery pear in 1986 as new to Arkansas from Drew and Ashley Counties, the species was already widespread on the state's Coastal Plain as an escape from cultivation to early successional habitats. The stout, thorny trees have proven to be a nuisance to pine reforestation practices. We here document its status as a wild plant in six additional counties, including two upland sites in the Ouachita Mountains. **Calhoun Co.:** *Sundell, Amason, & Etheridge 7,888* (UAM). **Cleveland Co.:** *Lunsford 12* (UAM). **Hempstead Co.:** *Thomas, Sundell, & Amason 139,840* (NLU). **Garland Co.:** *Sundell 10,650* (UAM, UARK). **Miller Co.:** *Thomas, Sundell, & Amason 151,152* (NLU). **Montgomery Co.:** *E. & M. Sundell 12,357* (UAM). In addition, specimens at HSU document callery pear as adventive in Clark County (Dan Marsh, pers. comm.).

SOLANACEAE

Datura ferox L. (*D. quercifolia* Kunth). This previously unreported species of thorn-apple appeared in a soybean field in Clay County. It is a southwestern species (Correll & Johnston 1970) probably brought into our area with agricultural seed and not likely to persist. (Thomas and McCoy reported it from East Carroll Parish, Louisiana, in 1982.) Appreciation is expressed to Andy Vangilder and John Boyd of the Arkansas Cooperative Extension Service for sending material (*Vangilder s.n.*) to UAM.

VALERIANACEAE

Valerianella locusta (L.) Latterade was reported for Arkansas by Demaree (1943) and Johnson (1971) but excluded by Smith (1988), who suggested that Arkansas reports were probably based on cultivated material. It is reinstated in the Arkansas flora with collections from a roadside in Sharp County, where plants grew in abundance on mounds of soil (*Sundell & Amason 12,074* [UAM, UARK]), and a graveyard in Howard County (*Lawson 1507* [NLU]).

VIOLACEAE

Hybanthus concolor (T.F. Forst.) Spreng. In Arkansas, green violet is well-documented from the Ouachita and Ozark highlands and from Crowley's Ridge. Collections from the wooded shores of Grassy Lake in Hempstead County mark its presence on the Gulf Coastal Plain. *Sundell, Amason, & Stuckey 10,874* (UAM), *Thomas & Amason 139,733*, *155,576* (NLU).

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REFERENCES

Allen, C.M. 1992. Grasses of Louisiana, ed. 2. Cajun Prairie Habit Preservation Society, Eunice, Louisiana.

Branner, J.C. and F.V. Coville. 1891. A list of the plants of Arkansas. Ann. Rep. Geol. Survey Arkansas for 1888. 4:155–242.

Correll, D.S. and M.C. Johnston. 1970. Manual of the vascular plants of Texas. Texas Research Foundation, Renner.

Darwin, S.P., E. Sundell, and A.S. Bradburn. 1981. Noteworthy vascular plants from Louisiana. Sida 9:70–75.

Demaree, D. 1943. A catalogue of the vascular plants of Arkansas. Taxodium 1:1–88.

Figlar, R.B. 1981. A last stand in Arkansas. J. Amer. Magnolia Soc. 17(1):17–20.

Gleason, H.A. and A. Cronquist. 1991. Manual of the vascular plants of northeastern United States and adjacent Canada, ed. 2. The New York Botanical Garden, Bronx.

Godfrey, R.K. and J.W. Wooten. 1979. Aquatic and wetland plants of the southeastern United States. Monocotyledons. The Univ. of Georgia Press, Athens.

__________. 1981. Aquatic and wetland plants of the southeastern United States. Dicotyledons. The Univ. of Georgia Press, Athens.

Grear, J.W. 1978. A revision of the New World species of *Rhynchosia* (Leguminosae-Faboideae). Mem. NewYork Bot. Gard. 31:1–168.

Holmgren, P.K., N.H. Holmgren, and L.C. Barnett. 1990. Index herbariorum. Part I: The herbaria of the world, ed. 8. New York Botanical Garden, Bronx.

Hooks, S.L. 1986. A preliminary survey of the vascular flora of Ashley County, Arkansas. M.S. Thesis, Northeast La. Univ., Monroe.

Hornberger, K.L. 1987. Systematics of the genus *Sisyrinchium* (Iridaceae) in the southeastern United States. Ph.D. Diss. Univ. of Arkansas, Fayetteville.

Isely, D. 1990. Vascular flora of the southeastern United States. Vol. 3, Part 2. Leguminosae. The University of North Carolina Press, Chapel Hill.

Johnson, M.I. 1971. A survey of the vascular flora of Poinsett County, Arkansas. Proc. Arkansas Acad. Sci. 25:42–52.

Kartesz, J.T. 1994. A synonymized checklist of the vascular flora of the United States, Canada, and Greenland, ed. 2. Vol. 2: Thesaurus. Timber Press, Inc., Portland, Oregon.

Kral, R. 1966. Observations on the flora of the southeastern United States with special reference to northern Louisiana. Sida 2:395–408.

MEYER, F.G. 1997. Magnoliaceae. In: Flora of North America Editorial Committee, eds. 1993+. Flora of North America north of Mexico. 3+ vols. Oxford University Press, New York and Oxford. Vol. 3, pp. 3–10.

ORZELL, S.L. and E.L. BRIDGES. 1987. Further additions and noteworthy collections in the flora of Arkansas, with historical, ecological, and phytogeographical notes. Phytologia 64:81–144.

PARFITT, B.D. 1997. *Trautvetteria*. In: Flora of North America Editorial Committee, eds. 1993+. Flora of North America north of Mexico. 3+ vols. Oxford University Press, New York and Oxford. Vol. 3, pp. 138–139.

PECK, J.H. and W.C. TAYLOR. 1995. Checklist and distribution of Arkansas pteridophytes. Proc. Arkansas Acad. Sci. 49:130–137.

ROLLINS, R.C. 1993. The Cruciferae of continental North America. Stanford University Press, Stanford, California.

SMITH, E.B. 1978. An atlas and annotated list of the vascular plants of Arkansas, and supplements (annually, 1979–1982). Published by the author, Fayetteville, Arkansas.

____________. 1988. An atlas and annotated list of the vascular plants of Arkansas, ed. 2. Published by the author, Fayetteville, Arkansas.

STEYERMARK, J.A. 1963. Flora of Missouri. The Iowa State University Press, Ames.

SUMMERS, B., M. SKINNER, and G. YATSKIEVYCH. 1995. *Dalea gattingeri,* a cedar glade endemic new to Missouri. Missouriensis 17:4–9.

SUNDELL, E. 1986. Noteworthy vascular plants from Arkansas. Castanea 51:211–215.

Taylor, W.C. 1984. Arkansas ferns and fern allies. Milwaukee Public Museum, Milwaukee, Wisconsin.

THIERET, J.W. 1964. *Lysimachia japonica* (Primulaceae) and *Clinopodium gracile* (Labiatae) in Louisiana: new to the United States. Sida 1:249–250.

THIERET, J.W. and C.M. ALLEN. 1974. *Setaria pallide-fusca* (Gramineae) in Louisiana. Castanea 39:290–291.

THOMAS, R.D. and C.M. ALLEN. 1982. A preliminary checklist of the dicotyledons of Louisiana. (Contrib. Herbarium Northeast Louisiana Univ. Number 3.) Department of Biology, Northeast Louisiana University, Monroe.

____________. 1993. Atlas of the vascular flora of Louisiana. Vol. I. Moran Colorgraphic Prinring, Baton Rouge, Louisiana.

THOMAS, R.D. and J.W. MCCOY. 1982. Significant collections of Louisiana plants. VIII: East Carroll Parish. Phytologia 50:175–176.

THOMAS, R.D., E.B. SMITH, E. SUNDELL, P.E. HYATT, and C. AMASON. 1991. Additions to the flora of Arkansas. Sida 14:483–491.

TUCKER, G.E. 1969. Some noteworthy species of the Arkansas flora. Proc. Arkansas Acad. Sci. 23:142–144.

____________. 1976. A guide to the woody flora of Arkansas. Ph.D. Diss. Univ. of Arkansas, Fayetteville.

WILCOX, W.H. 1973. A survey of the vascular flora of Crittenden County, Arkansas. Castanea 38:286–297.

WUNDERLIN, R.P. 1998. Guide to the vascular plants of Florida. University Press of Florida, Gainesville.

BOOK REVIEW

FERNANDO SANTOS-GRANERO and FREDERICA BARCLAY (translated by Elisabeth King). **Selva Central. History, Economy and Land Use in Peruvian Amazonia.** (ISBN 1-56098-761-8, hbk). Smithsonian Institution Press, 470 L'Enfant Plaza, Suite 7100, Washington, DC 20560. 202-287-3738, ext. 343. 351 Pp.

This book is a translation, originally published in Spanish as, *Ordenes y desórdenes en la Selva Central*, in 1995. Many thanks should go to the Smithsonian Tropical Research Institute, and especially Ira Rubinoff, for encouraging its translation.

The book covers the Selva Central region of Peru, also called the "central montaña, composed of portions from the western portions of: Oxapampa Province, in the Department of Pasco, and Chanchamayo and Satipo Provinces in the Department of Junín. This is one of the two most biologically interesting parts of the country because of its myriad of habitat types, from high altitude "jalca" on sandstone containing Guayana Highland floristic elements, to middle elevation "ceja de selva," largely comprised of cloud and montane forest with many endemic species. The book is largely a socio-economic history of the region, but it also contains extremely valuable information on the ecological characteristics, the effects of agropastoral and logging activities, and other aspects related to land tenure, including the unique "minifundios."

The book is divided in three parts: genesis of a regional space, the colonist economy, and indigenous integration. While this kind of book may not be a normal acquisition for the everyday monographer or floristician, anyone concerned with long-term conservation of any tropical area is well-served by reading this. I have found that to establish long-term studies, it is critical to understand the evolution of the local populations, (be they indigenous or otherwise) so that our in-country counterparts might better translate our concerns for basic science into information for the applied world of the local residents. The most important part for me was the second one, especially chapters four, five and six, where the land tenure systems, patterns and intensity of land use, and finally, economic articulation and environmental degradation themes are discussed, respectively. Having worked in Peru since 1990, reading of this book gave me a new appreciation for the complexities of managing the biotic resources of the region. While several portions of the "conclusions" chapter are now outdated, and support a particular political point of view, the three chapters of the second part certainly make this book a worthwhile investment for any botanist working in the Andes, and especially, in Amazonia. This book is not only appropriate for acquisition by botanical libraries, but also for ethnobotanists, and for anyone assisting in the establishment of Integrated Conservation and Development areas.—*John J. Pipoly III.*

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NOTEWORTHY RECORDS OF MISSISSIPPI VASCULAR PLANTS

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ABSTRACT

Herbarium study and field exploration, primarily in the Longleaf Pine and Coastal Pine Meadows regions, have yielded the following new species to Mississippi: *Chamaecrista deeringiana, Cladium mariscoides, Dichanthelium fusiforme, Dryopteris ludoviciana, Eleocharis elongata, E. melanocarpa, E. robbinsii, Isoetes louisianensis, Lobelia boykinii, Mitreola angustifolia, Rhynchospora decurrens, R. globularis var. pinetorum, R. harperi, Rhynchospora scirpoides, Sagittaria isoetiformis, Scleria reticularis sensu stricto, Spiranthes brevilabris var. floridana, Utricularia olivacea*. The following are previously known from the state, but are rarely collected, or represent significant range extensions within Mississippi: *Agrimonia incisa, Aristida condensata, A. simpliciflora, A. tuberculosa, Burmannia biflora, Calopogon multiflorus, Coelorachis cylindrica, Dichanthelium erectifolium, Elyoneurus tripsacoides, Gordonia lasianthus, Isoetes melanopoda, Juncus gymnocarpus, Marshallia trinervia, Myriophyllum laxum, Parnassia grandifolia, Polygala leptostachys, Potamogeton epihydrus, Rhynchospora curtissii, R. fascicularis var. distans, R. nitens, R. tracyi, Ruellia pedunculata* ssp. *pinetorum, Sorghastrum apalachicolense, Stylisma aquatica, S. pickeringii, Tridens carolinianus*.

RESUMEN

Los estudios de herbario y exploraciones de campo en las zonas de pino palustre y de prados costeros con pinos, han dado las siguientes especies nuevas para Mississippi: *Chamaecrista deeringiana, Cladium mariscoides, Dichanthelium fusiforme, Dryopteris ludoviciana, Eleocharis elongata, E. melanocarpa, E. robbinsii, Isoetes louisianensis, Lobelia boykinii, Mitreola angustifolia, Rhynchospora decurrens, R. globularis var. pinetorum, R. harperi, Rhynchospora scirpoides, Sagittaria isoetiformis, Scleria reticularis sensu stricto, Spiranthes brevilabris var. floridana, Utricularia olivacea*. Las siguientes se conocían previamente del estado, pero se colectan raramente o representan una ampliación significativa de su areal en Mississippi: *Agrimonia incisa, Aristida condensata, A. simpliciflora, A. tuberculosa, Burmannia biflora, Calopogon multiflorus, Coelorachis cylindrica*, Dichanthelium *erectifolium, Elyoneurus tripsacoides, Gordonia lasianthus, Isoetes melanopoda, Juncus gymnocarpus, Marshallia trinervia, Myriophyllum laxum, Parnassia grandifolia, Polygala leptostachys, Potamogeton epihydrus, Rhynchospora curtissii, R. fascicularis var. distans, R. nitens, R. tracyi, Ruellia pedunculata* ssp. *pinetorum, Sorghastrum apalachicolense, Stylisma aquatica, S. pickeringii, Tridens carolinianus*.

INTRODUCTION

Field work was conducted during 1995–98, primarily in a ten county area of southeastern Mississippi (Forrest, George, Greene, Hancock, Harrison,

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Jackson, Lamar, Pearl River, Perry, and Stone counties). From 1995–96 work was carried out by Bruce A. Sorrie (BAS) under a contract from the United States Fish and Wildlife Service, Endangered Species, to survey seepage bogs and wet savanna habitats of southern Alabama and Mississippi for selected Federal Species of Concern (formerly C2 candidates). In 1997, a rare species inventory was conducted by BAS on the 22,000+ acre University of Mississippi Forest Lands in George, Jackson, and Stone Counties, under a contract from The Nature Conservancy, Mississippi Field Office. From 1997-98 work was carried out by BAS under a contract from The Nature Conservancy, Southeast Region Office, to survey remaining high quality longleaf pine (*Pinus palustris* P. Miller) communities.

In 1993 the Mississippi Military Department signed a memorandum of agreement with the Mississippi Department of Wildlife, Fisheries, and Parks for a biological inventory of Camp Shelby Training Site (CSTS). Camp Shelby is located principally in Forrest and Perry Counties, and covers 134,000 acres, mostly leased from the DeSoto National Forest. The Mississippi Museum of Natural Science and the state's Natural Heritage Program hired contractors and coordinated field work at CSTS. From 1995-98 Steve W. Leonard (SWL) was field botanist on the inventory team.

Southeastern Mississippi lies within the Longleaf Pine and Coastal Pine Meadows Physiographic Regions, as defined by Lowe (1921). Although supporting a wide variety of habitat types, varying from xeric maritime dune scrub to salt marshes to mixed mesophytic ravine forests, the area is most notable for its extensive pine forests, pine savannas, and seepage bogs. Southward, and in wet sites northward, slash pine (*Pinus elliottii* Engelmann) is dominant; while northward, and in mesic to dry sites southward, longleaf pine is dominant. Mesic and moist sites usually support a mixture of the two. Beneath the pines is a fire-adapted, species-rich herbaceous layer dominated by grasses, composites, and legumes. Wet sites usually also support a dense, ericaceous shrub layer. North of the six southernmost counties, loblolly pine (*Pinus taeda* L.), shortleaf pine (*Pinus echinata* P. Miller), and to a lesser extent spruce pine (*Pinus glabra* Walter) become important components as the topography becomes more rolling and dissected.

The dramatic loss of the longleaf pine ecosystem over 97% of its former range has been documented by Ware et al. (1993) and Frost (1993). Although similar losses occurred in Mississippi, much of the southeastern portion of the state remains in a relatively natural condition. This is due to the presence of large public lands and the implementation of recurring fire management. The De Soto National Forest (which includes Camp Shelby within its borders), the Mississippi Sandhill Crane National Wildlife Refuge, and the University of Mississippi Forest Lands together form one of the largest and most ecologically significant blocks of longleaf pine ecosystem remaining (222,000 ha). Many of the taxa reported in this paper inhabit fire-maintained communities within these properties.

Knowledge of the flora of Mississippi is less well known than most other southeastern states (Bryson & Carter 1994). Published or draft atlases of vascular flora exist for Arkansas, Florida, Georgia, Louisiana, South Carolina, and Tennessee. Major revisions of state floras are well advanced in the Carolinas and Virginia (combined) and Texas. In Mississippi, and also in Alabama, a paucity of historical collecting coupled with a diverse and biogeographically complex flora has hindered the publication of modern floristic manuals. Lowe (1921), Small (1933), and Radford, Ahles, and Bell (1968) remain as basic references for Mississippi plants. The Flora of Mississippi Project was begun in the 1960s (Jones 1974) and has resulted in treatments of a number of families and genera [see references cited by Stevens (1991) and Bryson et al. (1996)]. Numerous county floras have added greatly to our knowledge of plant distribution (see Stevens 1991 for most titles). Currently, the PLANTS database provides a comprehensive list of taxa documented from the state (USDA, NRCS 1995). This database admits species based on vouchered specimens, monographic treatments, and literature reports.

In this paper, plants are listed alphabetically by genus and species. Nomenclature follows Kartesz (1994) unless noted otherwise. Herbarium abbreviations follow Holmgren et al. (1990), except for bas, ctb, MMNS, and swl (pers. herb. Bruce A. Sorrie, pers. herb. Charles T. Bryson, herbarium of the Mississippi Museum of Natural Science in Jackson, and pers. herb. Steve W. Leonard). Historical specimen data was derived from the Mississippi Natural Heritage Program database (MSNHP) and from rare species files developed by BAS. Specimen label data was transcribed exactly as the collector wrote it, except that lists of associated species have been omitted. For some taxa, where we have documented many current populations, only a few representative collections are cited. The abbreviation FS stands for Forest Service Road.

NOTEWORTHY COLLECTIONS

Agrimonia incisa Torrey & Gray (Rosaceae). Previous Mississippi collections are from Forrest, George, Harrison, and Simpson Counties (MSNHP); to these we add Perry and Stone Counties. Once considered a candidate for listing by the US Fish and Wildlife Service, incised groove-bur has a spotty distribution from South Carolina to central Florida to eastern Texas. Camp Shelby, straddling Forrest and Perry Counties, supports ten discreet occurrences. Habitats vary from mesic longleaf pine woodland to entrances to gopher tortoise burrows in dry pine-oak woodland, pine plantations, and cemeteries; but it is most abundant on roadside embankments. MacRoberts and MacRoberts (1997) cite similar habitats for *Agrimonia incisa* in Texas and suggest that fire suppression and subsequent habitat alteration have caused a widespread decline in this species.

Voucher specimens: **Perry Co.:** Camp Shelby, frequent along MS hwy. 29 in grassy road shoulder, 5.4 mi S of US 98 at New Augusta, 12 Jun 1996, *S.W. Leonard 9543* (FSU, MMNS, NCU); Camp Shelby, Training Area T-51, 28 Dec 1995, *S.W. Leonard 9363* (MMNS). **Stone Co.:** Univ. Miss. Forest Lands, dry-mesic longleaf upland with hardwood understory, N of Wire Road and W of Cablebridge Road, 22 Aug 1997, *B.A. Sorrie 9455 with J. Moore* (bas).

Aristida condensata Chapman (Poaceae). Lowe (1921) does not include this species of dry to xeric sandhills, but PLANTS does. Mississippi populations mark the western edge the species' range.

Voucher specimens: **Greene Co.:** Leaf River at hwy. 98, 2 Nov 1969, *K.E. Rogers 2510* (NCU, VDB). **Harrison Co.:** longleaf pine-oak-saw palmetto ridge on FS 415-A, De Soto National Forest, frequent, 13 Aug 1997, *B.A. Sorrie 9393* (MMNS, NCU). **Perry Co.:** infrequent in cut-over longleaf pine-oak scrub behind Mars Hill Church, Camp Shelby, 11 Jan 1996, *S.W. Leonard 9376* (MMNS); same place, 9 Oct 1996, *S.W. Leonard 9660* (NCU). **Wayne Co.:** common in xeric longleaf pine-turkey oak sandhills by Brewer Town Road, De Soto National Forest, 26 Sep 1997, *B.A. Sorrie 9552 with M. Pyne* (GH, NCU).

Aristida simpliciflora Chapman (Poaceae). This rare but easily overlooked grass is known from less than 25 counties range-wide (central Florida to southern Mississippi). Rogers (1977) collected it from the Ragland Hills in Forrest County; the following are the remaining collections known to us.

Voucher specimens: **Pearl River Co.:** McNeill, 18 Nov 1929, *H.R. Reed s.n.* (US); four mi S of Poplarville on US 11 at jct. of MS 26, base of longleaf pine slope, local, 30 Sep 1988, *S. McDaniel 30289* (IBE, VBD). **Perry Co.:** Camp Shelby, fairly abundant in pitcher plant seep along a secondary drainage into Flat Creek, 3.7 mi S of FS 385, 23 Oct 1996, *S.W. Leonard 9682* (MMNS).

Aristida tuberculosa Nuttall (Poaceae). Lowe (1921) does not include this species of semi-stable dunes and xeric sandhills, but PLANTS does. *Aristida tuberculosa* has a unique distribution pattern: upper Mississippi River and immediate tributaries; about the head of lake Michigan; coastal New Hampshire to Delmarva Peninsula; fall-line sandhills of the Carolinas and Georgia; plus scattered locations on the coastal plain from South Carolina to Florida and Louisiana. Some of these latter may represent adventive populations in disturbed soils and fallow fields.

Voucher specimens: **Forrest Co.:** James Street, E of Baptist Church, lake at old gravel and sand pit, in sandy open woods, 1971, *K.E. Rogers 7028* (VDB), *7030* (NCU). **Kemper Co.:** 5 mi S of DeKalb, sandhill with *Quercus incana, Q. margarettiae*, a few *Pinus palustris*, 13 Sep 1971, *S. McDaniel 15560* (FSU, IBE, VDB). **Jackson Co.:** Horn Island, 5 Sep 1891, *S.M. Tracy 1579* (US). **Wayne Co.:** common in xeric, deep white sands of hills along Brewer Town Road, De Soto National Forest, with *Pinus palustris, Quercus laevis, Aristida condensata, Rhynchospora megalocarpa*, 26 Sep 1997, *B.A. Sorrie 9553 and M. Pyne* (GH, MMNS, NCU, US).

Burmannia biflora L. (Burmanniaceae). This endemic to the Atlantic and Gulf Coastal Plains has rarely been collected in Mississippi. Jones (1976) lists four counties, but the specimen that he saw from Jackson County actually is *Apteria aphylla* [*Channell 1661* (MISSA)]. Jones also lists Pearl River Co., but we have not yet located a voucher. The primary habitat in Mississippi is seasonally ponded depressions and, occasionally, seepage bogs.

Voucher specimens: **Hancock Co.:** Bay St. Louis, Nov 1905, *A. Allison 1425* (MISS, photocopy at IBE). **Harrison Co.:** local in sphagnum tussocks in *Nyssa-Sphagnum* swamp along Tchoutacabouffa River, 3 mi N of Seymour, 20 Aug 1952, *J.D. Ray, Jr. 3468* (FSU, MISSA, NCU). **Jackson Co.:** Ocean Springs, 7 Sep 1889, *F.S. Earle s.n.* (DUKE).

Calopogon multiflorus Lindley (Orchidaceae). Lowe and PLANTS do not list *C. multiflorus* for Mississippi, but Luer (1972) maps it there. This essentially Floridian orchid has rarely been collected outside of that state.

Voucher specimens: **Hancock Co.:** three mi south of Necaise, 5 Apr 1967, *S.B. Jones, Jr. 11489* (MISS). **Jackson Co.:** Ocean Springs, 4 Apr 1888, *F.S. Earle s.n.* (AMES, SIU); Ocean Springs, Apr 1893, *J. Skehan 206* (BRIT); two mi W of Alabama state line, 6 May 1966, *R.D. Suttkus 66-2-11* (NO); circa 1 mi W of MS/AL line between I-10 and US 90 on Franklin Creek Road, recently burned savanna, rare, 20 Apr 1984, *C. Norquist 1774* (IBE); ca. 6.3 mi E of Moss Point, plants scattered in pine savanna, 15 Apr 1988, *M.W. Morris 3076 et al* (IBE).

Chamaecrista deeringiana (Small & Pennell) Macbride (Fabaceae). Reported herewith new to Mississippi. The following establishes a new western range limit for this essentially Floridian species.

Voucher specimen: **Harrison Co.:** Deer Island, W end, live oak woods over sand or shell, 29 Aug 1977, *M.B. Brooks 432 with S. McDaniel* (IBE).

Cladium mariscoides (Muhl.) Torrey (Cyperaceae). Reported herewith new to Mississippi. This species was not included for Mississippi by Bridges *et al.* (1993). This species occurs primarily within the southern portion of the glaciated region of eastern North America, with scattered occurrences in most southeastern states.

Voucher specimens: **Jackson Co.:** swamp ponds, Ocean Springs, 19 Aug 1953, *D. Demaree 33953* (GH); pine meadows between hwy. and RR, about halfway between Pascagoula and Fontainbleu [sic], 22 Aug 1962, *R.M. Harper 4530* (GA, GH); abundant on boggy margin of pond on N side of John Smith Road, just W of Huey Davis Road, 26 Sep 1996, *B.A. Sorrie 9066 with R.J. LeBlond* (MMNS, NCU); abundant in open wet slash pine flatwoods on E side of Trent Lott Airport, N of Sarracenia Road, 11 Nov 1997, *B.A. Sorrie 9633* (IBE, NCU).

Coelorachis cylindrica (Michaux) Nash (Poaceae). Although there are numerous records for Arkansas and Louisiana, this grass seems rare east of the Mississippi River. PLANTS lists this grass for the state, but the following are the only Mississippi specimens we are aware of.

Voucher specimens: **Forrest Co.:** 1/2 to 1 mi N of Petal, between N Railroad St. and hwy. 11, several plants at this site, 23 Jul 1971, *K.E. Rogers 6720* (NCU). **Monroe Co.:** just N of Lowndes County, where US 45 crosses Buttahatchee River, on roadside bank, 30 Jun 1991, *J. MacDonald 2771* (IBE).

Dichanthelium erectifolium (Nash) Gould & Clark (Poaceae). Lelong (1986) reports this grass only from Jackson County, the western range limit of the species. It is apparently rare, for we have not yet encountered a Mississippi specimen in searches of over a dozen southeastern herbaria. Once learned, *Dichanthelium erectifolium* is easy to distinguish from other congeners, and in Mississippi is restricted to seasonally ponded cypress depressions, usually acompanied by *D. wrightianum, Polygala cymosa, Sabatia bartramii, Ilex myrtifolia,* and *Hypericum myrtifolium.*

Voucher specimens: **Harrison Co.:** abundant in seasonally ponded depression in pine flatwoods off of FS 452, S of Wortham Road, De Soto National Forest, grass-sedge dominated, with *Nyssa biflora*, *Dichanthelium wrightianum* and *Lycopodiella alopecuroides*, 14 Aug 1997, *B.A. Sorrie 9404* (GH, IBE, NCU, MMNS). **Jackson Co.:** Cottonmouth Savanna, N side of Frank Snell Road, E of route 613, abundant in pond cypress depressions in pine flatwoods, 5 Jun 1996, *B.A. Sorrie s.n.* (bas).

Dichanthelium fusiforme (Hitchcock) Harvill (Poaceae). Reported herewith new to Mississippi. This combination was made by Harvill (1977), but is not included in synonymy under *D. aciculare* by Kartesz (1994). This plant's taxonomic status has long been in question, and recent authors have treated it as *D. aciculare* var. *ramosum* (Grisebach) Davidse (Davidse & Pohl 1992) or *Panicum aciculare* var. *arenicoloides* (Ashe) Beetle (Zuloaga *et al.* 1993). Lelong (1986) synonymized *Panicum fusiforme* under a related species, *P. angustifolium* Elliott. However, the very long (3.0 mm) fusiforme spikelets are strikingly different from the blunt spikelets of *D. aciculare* and *D. (Panicum) angustifolium*, and so we will use Harvill's combination until a comprehensive revision is undertaken. The following is the only specimen we have seen for Mississippi.

Voucher specimen: Jackson Co.: thickets near the coast, Ocean Springs,1952, *D. Demaree 32226* (GH). The specimen was originally determined to be *Panicum angustifolium*, but spikelets are 3.0 mm long and fusiform.

Dryopteris ludoviciana (Kunze) Small (Dryopteridaceae). Reported herewith new to Mississippi. This coastal plain endemic was not included for Mississippi by Evans (1978) or by Montgomery and Wagner (1993).

Voucher specimens: **Perry Co.:** Camp Shelby, about 100 plants on W side of Denham Creek, 2 air mi southwest of New Augusta, 14 Sep 1995, *S.W. Leonard 9082* (MMNS).

Eleocharis elongata Chapman (Cyperaceae). Reported herewith new to Mississippi. Although ranging from North Carolina to Florida and Texas (and scattered in the neotropics), this species is not listed by Lowe (1921) or PLANTS. This sedge usually inhabits seasonally to permanently ponded depressions. The rhizomes are unusually well developed in the Ocean Springs specimen, and the habitat is also unusual, but the specimen appears to be correctly identified, with slender spikes as wide as the culms and with red-margined scales.

Voucher specimens: **Hancock Co.:** Stennis Space Center, NASA, 13 km SE of Picayune, main canal near N-S roadway, 8 May 1992, *J.W. Wooten s.n.* (USM). **Jackson Co.:** 7 mi E of Ocean Springs, local colony on moist slope near longleaf covered hill, 27 May 1962, *S. McDaniel 3231* (IBE); Horn Island, abundant in freshwater marsh shortly S of Park Service pier, 3 Oct 1997, *B.A. Sorrie s.n. with R.J. LeBlond* (bas). **Lamar Co.:** Mossy Pond, 3 mi W of Purvis, uncommon, with *E. robbinsii*, 1 Sep 1998, *B.A. Sorrie 9932 with S.W. Leonard* (GH, NCU).

Eleocharis melanocarpa Torrey (Cyperaceae). Reported herewith new to Mississippi. This species is not listed by Lowe (1921) or PLANTS. Unlike other Mississippi species, the tips of the culms of *E. melanocarpa* often arch over and root in the moist or wet sandy substrate, thus forming a dense tangle. This sedge ranges from Massachusetts to Florida and Mississippi, disjunct to eastern Texas, southern Michigan, and northern Indiana.

Voucher specimen: **Perry Co.:** Camp Shelby, abundant in nearly dry gum pond behind Mars Hill Church, 23 Apr 1995, *J. MacDonald 8469 with A. Leidolf* (IBE); same place, 9 Oct 1996, *S.W. Leonard 9656 with J. Moore and J. MacDonald* (FSU, MMNS).

Eleocharis robbinsii Oakes (Cyperaceae). Reported herewith new to Mississippi. Although known from the state for over twenty-five years, this is the first published documentation. Mississippi marks the western range limit for the species. Plants usually form dense beds in shallow gum ponds with fluctuating water levels; two such ponds on Camp Shelby support populations. In contrast to *E. elongata*, the scales of *E. robbinsii* are green, often with a translucent scarious margin, and without any red coloring. Statements to the contrary in Godfrey & Wooten (1979) were based on misidentified specimens. In addition, scale length in *E. elongata* is 3.5-4.5 mm, in *E. robbinsii* 5.5-7.0 mm.

Voucher specimens: **Forrest Co.:** hwy. 49 about 3-5 mi N of Stone Co. line, shallow pond west of highway across fence, 30 Sep 1970, *K.E. Rogers 4658-B* (NCU); same place but actual distance is 1.2 mi N of county line, 19 Jun 1998, *B.A. Sorrie 9780* (GH, IBE, MMNS); vicinity of Maxie, edge of boggy area, 5 Jul 1971, *K.E. Rogers 6662-B* (NCU). **Lamar Co.:** about 3 mi W of Purvis, abundant, 29 Aug 1973, *K.E. Rogers 9225* (NCU); same place [Mossy Pond], 1 Sep 1998, *B.A. Sorrie 9931 with S.W. Leonard* (GH, bas). **Perry Co.:** Camp Shelby, very abundant around edge of gum pond behind Mars Hill Church, 20 Sep 1994, *J. MacDonald 7728 with D. Wyrick* (IBE); same place, 11 Sep 1995, *S.W. Leonard 9059* (FSU, MMNS).

Elyoneurus tripsacoides Humboldt & Bonpland ex Willd. (Poaceae). This primarily neotropical species is not listed by Lowe (1921), but is included in Hitchcock (1950) for Mississippi. That report may be based on a duplicate of the following. In the United States it is also known from Florida and southern Georgia.

Voucher specimen: **Harrison Co.:** Biloxi, 21 Aug 1898, *S.M. Tracy 4594* (NCU).

Gordonia lasianthus (L.) Ellis (Theaceae). Lowe (1921) cites loblolly bay only from Bay St. Louis in Hancock County. From then until 1994, only 12 sites were documented in George, Perry, and Stone Counties (MSNHP). Extensive searches on Camp Shelby have revealed it to be far more common—25 occurrences have been located there. All of these populations consist of small numbers of plants, primarily in seepage of toe slopes and along streams where organic soils are present. Mississippi marks the species' western range limit.

Voucher specimens: **George Co.:** bottomland at base of slope, E of dirt road in T2S R5W Sec. 26, 17 Nov 1978, *K.E. Rogers 46208 et al.* (IBE, MMNS). **Perry Co.:** Camp Shelby, occasonal in margin of swamp forest on W side of Deep Creek, near S end of FS 332-A, originally discovered by D. Wyrick, 8 Sep 1995, *S.W. Leonard 9048 with J. MacDonald* (MMNS), *J. MacDonald 9100* (IBE). **Stone Co.:** about 1/4 mi S of McHenry, 6 Aug 1952, *R.L. Diener 375* (MISSA).

Isoetes louisianensis Thieret (Isoetaceae). Reported herewith new to Mississippi. This quillwort was described from southeastern Louisiana by Landry and Thieret (1973). Prior to 1996, *I. louisianensis* was known from only eight populations in Washington and St. Tammany Parishes and was listed as endangered by the US Fish and Wildlife Service. In 1996 we independently collected unknown quillworts in the De Soto NF and Camp Shelby, which were verified as *I. louisianensis* by W. Carl Taylor and Neil Luebke of the Milwaukee Public Museum. Subsequently, an intensive search was conducted throughout the De Soto NF by Forest Service personnel and SWL, and elsewhere by SWL. To date, over 50 populations have been found in ten Mississippi counties. This species normally inhabits intermittent streams and stream edges, scour channels, and floodplain depressions beneath a canopy of *Quercus laurifolia* Michx., *Nyssa biflora* Walter, *Acer rubrum* L., and *Cyrilla racemiflora* L. Soils are mineral in content. Plants initiate growth during winter months and produce mature megaspores from April to July. Around mid-July, streams dry up and plants senesce and disappear until rains resume in November. In addition to the following, Louisiana quillwort has been vouchered by SWL from Hancock, Harrison, Pearl River, and Stone Counties.

Voucher specimens: **Forrest Co.:** Camp Shelby, abundant in tributary of Chaney Creek, 27 Jan 1997, *S.W. Leonard 9729* (NY). **Greene Co.:** infrequent in tributary of Waterfork Branch, 8.6 mi E of Bothwell on N side of Bothwell-Knobtown Road, 19 Jan 1997, *S.W. Leonard 9728* (NY). **Jackson Co.:** De Soto NF, local in braided streamhead of Bayou Billie, E side of Old Biloxi Road, 18 Jun 1996, *B.A. Sorrie 8932* (GH, MIL). **Jones Co.:** De Soto NF, shallow still water of scour channels S of FS 201, 0.5 mi SE of jct. with FS 201-F, 15 Feb 1997, *S.W. Leonard 9743* (NY). **Perry Co.:** Camp Shelby, abundant in scour channels at edge of floodplain of tributary of Joes Creek, mixed pine-hardwood bottomland, 22 May 1996, *S.W. Leonard 9511* (MMNS, NY). **Wayne Co.:** De Soto NF, abundant in Okey Branch, E of hwy. 63 and S of FS 207, 15 Feb 1997, *S.W. Leonard 9740* (NY).

Isoetes melanopoda Gay & Durieu (Isoetaceae). Taylor et al. (1993) include Mississippi in the range, but Evans (1978) does not and we have seen no earlier collections than those below. This quillwort grows in moist mixed hardwoods and in ephemeral streams, generally north of the range of *I. louisianensis*.

Voucher specimens: **Jasper Co.**: Bienville National Forest, ephemeral stream S of FS 507, berween FS 507-F and 507-C, 7 Apr 1997, *S.W. Leonard 9787* (NY). **Scott Co.**: Bienville NF, occasional in ephemeral stream W of FS 543, 3.1 mi SE of jct. with FS 551, 7 Apr 1997, *S.W. Leonard 9792* (NY). **Smith Co.**: Bienville NF, scarce in shallow depression of floodplain, N side of FS 520, 0.4 mi E of Ichusa Creek and 2.1 mi E of county road 515, 7 Apr 1997, *S.W. Leonard 9793* (NY). **Wayne Co.**: frequent in willow oak-sweetgum-winged elm-palmetto forest on E side of US 45, S of jct. of Hayes-Nute Road, between Hiwannee and Shubuta, 14 Dec 1996, *S.W. Leonard 9718* (NY).

Juncus gymnocarpus Coville (Juncaceae). This rush is not listed by Lowe (1921) nor by Pullen *et al.* (1968). Rogers (1973) is apparently the first to report this rush from the state. The geographical range consists of three disjunct areas: montane eastern Pennsylvania; montane North Carolina, South Carolina, and Tennessee; and the coastal plain of panhandle Florida, southern Alabama, and southern Mississippi. The long disjunction between the Appalachian Mountains and the Gulf Coastal Plain suggests the possibility of taxonomically different entities, but R. Kral has seen specimens from Camp Shelby and concurs with our identification (pers. comm. to SWL 1996). To date sixteen occurrences have been documented from Camp Shelby, and four from UMISS Forest Lands. In addition to the following, McDaniel (1987) reports it from Lamar County.

Voucher specimens: **Forrest Co.**: hwy. 98 a few mi SE of junction with hwy. 49, numerous at edge of farm pond, 26 Oct 1972, *K.E. Rogers 8841-E* (MISSA); large colony in black gum-sweetbay-pine swamp forest along Poplar Creek, Camp Shelby, 26 Sep 1996, *S.W. Leonard 9649* (MMNS). **Perry Co.**: occasional along West Fork of Denham Creek, Camp Shelby, 18 Sep 1995, *S.W. Leonard 9088* (MMNS); locally abundant on E side of Sweetwater Creek, N of FS 305-F1, Camp Shelby, 16 Apr 1996, *S.W. Leonard 9428* (NCU). **Stone Co.**: wet seepage in mesic hardwood-loblolly pine ravine by Long Branch, N of Wire Road, Univ. Miss. Foresr Lands, 12 Jun 1997, *B.A. Sorrie 9278* (GH, MMNS).

Lobelia boykinii Torrey & Gray ex A. DC. (Campanulaceae). Reported herewith new to Mississippi, disjunct from Houston County, Alabama, and Okaloosa County, Florida. This coastal plain endemic is most numerous in Georgia and the Carolinas, with a few populations in New Jersey, Delaware, the Florida panhandle, and Alabama.

Voucher specimens: **Jackson Co.**: Cottonmouth Savanna, N side of Frank Snell Road, E of route 613, locally numerous in pond cypress depressions in slash pine flatwoods, 5 Jun 1996, 10 Nov 1997, and 19 Jun 1998, *B.A. Sorrie 8871* (GH, NCU, MMNS), *9785* (FSU, IBE); uncommon in disturbed pond cypress depression at junction of Nut Bank Road and connector to route 613, about 3.5 mi SSW of Big Point village, 2 Oct 1997, *B.A. Sorrie 9587 with R.J. LeBlond* (bas).

Marshallia trinervia (Walter) Trelease (Asteraceae). This striking member of the genus was brought to the attention of SWL by Dr. Sam Rosso of the University of Southern Mississippi, who reported a station near the Lamar/Marion County line. Despite knowledge of its presence in Mississippi for nearly 150 years, *M. trinervia* has traditionally been considered rare in the state. Lowe (1921) lists it only from Greene and Tishomingo Counties, but Channell (1957) cites collections from Clarke, Forrest, Greene, Perry, and Scott Counties. Watson and Estes (1990) add Covington, Lee, and Pearl River Counties. At the University of North Carolina herbarium (NCU) there are specimens from seven sites in Covington, Forrest, and Pearl River Counties. Thus, it would seem that this species is not as rare in Mississippi as previously thought. Primarily a plant of creek banks, wooded slopes, and limestone cliffs from central Alabama and western Georgia to central Tennessee, recent collections suggest that *Marshallia trinervia* has exploited moist roadsides in the Gulf Coastal Plain. We here report stations not previously documented.

Voucher specimens: **Forrest Co.:** hwy. 11 and 49 cloverleaf, cleared area, 2 Jun 1965, *S.B. Jones, Jr. 2935* (NCU); about 1/2 mi S of Hattiesburg, edge of low pine woods, 24 Aug 1969, *K.E. Rogers 1350-C* (NCU). **Lamar Co.:** moist roadside, 6.0 mi S of US 98 on W side of MS hwy. 89 and 0.4 mi S of junction of WPA Road, N of Purvis, 22 Jun 1997, *S.W. Leonard 9833* (MMNS). **Pearl River Co.:** 4.4 mi S of Derby on US 11, roadsides and ditches, 30 May 1976, *D.E. Boufford 18652 et al* (NCU); wet ditches, hwy. 11, 1 mi N of McNeill, 2 Jun 1977, *C.F. Reed 103625* (NCU); low area on roadside of hwy. 26, about 15 mi E of Poplarville, 30 May 1976, *G. Nesom s.n.* (NCU) [this location probably is in Stone Co.]. **Perry/Forrest Co.:** Camp Shelby, edge of shrubs along small streams on E and W sides of Poplar Creek, at county line, 22 May 1998, *S.W. Leonard 9959* (MMNS).

Mitreola angustifolia (Torrey & Gray) J.B. Nelson (Loganiaceae). Reported herewith new to Mississippi. Godfrey and Wooten (1981) credit this plant only to southern Georgia and northern Florida. *Mitreola angustifolia* inhabits seasonally ponded depressions in pine flatwoods, often under a thin canopy of pond cypress.

Voucher specimens: **Jackson Co.:** savanna circa 1 mile W of Alabama state line on S side of US 90, 26 July 1983, *C. Norquist 1291* (IBE). Scattered in drying out cypress pond on E side of hwy. 63, 14.4 mi S of jct. of hwy. 26 in Lucedale, 4 Aug 1996, *S.W. Leonard 9596* (MMNS, NCU); Cottonmouth Savanna, N side of Frank Snell Road, E of route 613, cypress-bordered depression in pine flatwoods, 1 Oct 1997, *B.A. Sorrie and R.J. LeBlond 9583* (GH, MMNS).

Myriophyllum laxum Shuttleworth ex Chapman (Haloragaceae). Neither Lowe (1921) nor Jones (1975) includes it for Mississippi, but PLANTS does. Mississippi marks the species' western range limit. This southeastern United States endemic is often misidentified as *M. pinnatum* (Walter) BSP. or *M. heterophyllum* Michaux.

Voucher specimens: **Jackson Co.:** submersed aquatic in pond, about 7 mi NNE of Ocean

Springs, 18 Sep 1970, *S.B. Jones, Jr. 20548* (GA). **Lamar Co.:** Mossy Pond, 3 mi W of Purvis, 21 Jul 1973, *E. Decker 62-6* (USM); about 3 mi W of Purvis, abundant in lake, 29 Aug 1973, *K.E. Rogers 9224* (GA, NCU, NLU). **Perry Co.:** N end of unnamed pond NE of FS 321, Camp Shelby, population originally discovered by D. Wyrick, 11 Sep 1995, *S.W. Leonard 9060* (MMNS).

Parnassia grandifolia DC. (Saxifragaceae). Large-leaved grass-of-Parnassus is known from the state only from the southeastern quarter, where first collected in the late nineteenth century. Eakes (1989) cited two populations, in Forrest and Stone Counties. The Camp Shelby inventory has verified 17 occurrences, plus an additional station on private property. Populations occur in seepage communities at the base of slopes, in clayey soil.

Voucher specimens: **Pearl River Co.:** at least 100 plants in boggy drainage on N side of Hillsdale Road, 3.7 mi W of I-59, or 0.5 mi SE of US 11, between Poplarville and Lumberton, 27 Apr 1996, *S.W. Leonard 9447* (MMNS). **Perry Co.:** several colonies from a few plants to 400 or more, in seepages that drain into Dickey Creek, Camp Shelby, SE of New Augusta, 12 Nov 1996, *S.W. Leonard 9691* (MMNS).

Polygala leptostachys Shuttleworth (Polygalaceae). Lowe (1921) only lists one record, from Harrison County. This species ranges from central Florida to southwestern Georgia and southeastern Mississippi. *Polygala leptostachys* is even more slender than its close relative, *P. verticillata* L., and the difficulty of detecting it may explain the paucity of herbarium collections range-wide.

Voucher specimens: **Forrest Co.:** Camp Shelby, vicinity of Range 45, 0.5 mi NE of Lake Janney, along hillside slope of road, 19 Jul 1996, *J. MacDonald 9781* (IBE). **Stone Co.:** Univ. Miss. Forest Lands, diverse mesic uplands S of Wire Road and E of route 15, 20 Aug 1997, *B.A. Sorrie 9433 with R.G. Wieland* (bas).

Potamogeton epihydrus Raf. (Potamogetonaceae). Jones (1974) omits this species from Mississippi, but PLANTS includes it. Hellquist and Crow (1980) specifically state "northern Mississippi" in their range description. In any event, this pondweed is rarely collected in the state. The junior author found it in dense beds at several road crossings of a gravelly, fast-flowing stream in Lawrence County. In protected pools along the stream, the upper leaves have weakly expanded blades to 5 mm wide, but none floating. This site and those in two nearby Louisiana parishes (Thomas and Allen 1993), mark the southernmost locations for the species.

Voucher specimen: **Lawrence Co.:** swiftly flowing water of Tilton Creek at SW end of Tilton Road, about 0.4 mi from Sauls Valley Church; plants in clear water from a few cm deep to 0.5 m, 28 Dec 1996, *S.W. Leonard 9726* (IBE, MMNS).

Rhynchospora curtissii Britton (Cyperaceae). Kral (1996) maps only Jackson County for Mississippi. This rare sedge is an East Gulf Coastal Plain endemic, known from fifteen counties range-wide.

Voucher specimens: **Hancock Co.:** 3.5 mi NE of Santa Rosa, just N of Dead Tiger Creek, clearcut adjacent to hardwood hammock, clay soil, 23 May 1981, *S. McDaniel 25108* (FLAS). This specimen was originally determined as *R. pleiantha* (Kukenthal) Gale. **Jackson Co.:**

Ocean Springs, 1898, *S.M. Tracy 4891* (GH, NCU); wet depression in sandy longleaf pine savanna about 3 mi N of Ocean Springs, 20 Jul 1955, *Channell 3577* (DUKE); scattered populations in seepy powerline S of Semmes Road, about 1 mi W of Fort Bayou Creek, NE of Ocean Springs, locally common, 15 Aug 1997, *B.A. Sorrie 9410* (GH, MNNS, NCU, VDB).

Rhynchospora decurrens Chapman (Cyperaceae). Reported herewith new to Mississippi. This is a seldom collected species, although ranging from southeastern North Carolina to south Florida and Louisiana. Gale (1944) cites no Mississippi collections and PLANTS omits it. *Rhynchospora decurrens* inhabits temporarily flooded depressions in swamps, often with *Taxodium* and *Nyssa*.

Voucher specimen: **Pearl River Co.:** 2 mi W of Picayune, low woods, 9 Jun 1965, *F.H. Sargent 8629* (DUKE, VDB).

Rhynchospora fascicularis (Michaux) Vahl var. **distans** (Chapman) Small (Cyperaceae). Gale (1944) cites one Mississippi collection without specific location. This is still a poorly known and seldom collected taxon, despite distinctive achene morphology. It ranges from southeastern Virginia to south Florida to southeastern Mississippi; disjunct to Bermuda.

Voucher specimen: **Stone Co.:** disturbed roadside seepage in clayey soil, Univ. Miss. Forest Lands, uncommon, with *Aletris aurea, Lachnocaulon anceps*, 13 Jun 1997, *B.A. Sorrie 9285* (GH, NCU).

Rhynchospora globularis (Chapman) Small var. **pinetorum** (Small) Gale (Cyperaceae). Reported herewith new to Mississippi. Despite ample differences from other varieties of *R. globularis*, most authors have not recognized var. *pinetorum*. The achene characters noted by Godfrey and Wooten (1979) and Weakley (in prep.) are diagnostic. *Rhynchospora globularis* var. *pinetorum* ranges from North Carolina to southern Florida and eastern Texas; also western Cuba and Jamaica. This sedge often occurs on calcareous substrates.

Voucher specimen: **Jackson Co.:** low wet areas, Fountainbleau Point, P.O. Ocean Springs, 29 Apr 1954, *D. Demaree 35016* (GH).

Rhynchospora harperi Small (Cyperaceae). Reported herewith new to Mississippi. Kral (1996), and LeBlond (1997) do not credit this species to the state. Knowledge of the distribution of this species has increased dramatically during the past several years (LeBlond 1997). This sedge occurs exclusively in seasonally ponded depressions on the Atlantic and Gulf Coastal Plains.

Voucher specimens: **Jackson Co.:** Cottonmouth Savanna, N side of Frank Snell Road, E of route 613, common in pond cypress-slash pine depression in flatwoods, 10 Nov 1997, *B.A. Sorrie 9632* (GH, MMNS, NCU); same place, 19 Jun 1998, *B.A. Sorrie 9786* (FSU, IBE, VDB).

Rhynchospora nitens (Vahl) Gray (Cyperaceae). Lowe (1921) and PLANTS do not list it for Mississippi, but there are specimens at VDB from Forrest and Jackson Counties (Kral pers. comm.). *Rhynchospora nitens* is widespread on the southeastern United States coastal plain, probably overlooked in Mississippi.

Voucher specimen: **Forrest Co.:** Camp Shelby, NE of McLaurin, open wet area along and above Hartfield Creek, 15 Oct 1994, *C.T. Bryson 14511 et al.* (ctb). **George Co.:** circa 8 mi W of Ala. state line on hwy. 98, 25 Sep 1979, *K.L. Gordon 1495 with J. Burris* (IBE). **Harrison Co.:** Ship Island, small, seasonally inundated depressions, 7 Sep 1998, *B.A. Sorrie 9953* (IBE, NCU). **Jackson Co.:** Horn Island, 20 Jul 1894, *S.M. Tracy 2925* (MISSA); NE of US 90 and MS 63, Moss Point, open wet area and ditch along US 90 and frontage road, 1 Sep 1993, *C.T. Bryson 12838 with Newton* (ctb); dammed streamhead, now a *Nyssa biflora-Eleocharis equisetoides-Scirpus etuberculatus* dominated pond, W side of FS 404, 0.25 mi N of Larue Road, De Soto NF, 1 Oct 1997, *B.A. Sorrie 9578 with R.J. LeBlond* (GH, MMNS, NCU, bas). **Lamar Co.:** Mossy Pond, 3 mi W of Purvis, 1 Sep 1998, *B.A. Sorrie 9929 with S.W. Leonard* (FSU). **Perry Co.:** Camp Shelby, Leaf River Wildlife Management Area, T1S R9W Sect. 22, 15 Oct 1994, *C.T. Bryson 14533 with J. MacDonald* (ctb).

Rhynchospora scirpoides (Torrey) Gray (Cyperaceae). Reported herewith new to Mississippi. Like *R. nitens*, this species inhabits periodically inundated sites, but is much rarer in the southeastern United States. Lowe (1921) lists *Psilocarya corymbiformis* Bentham, a synonym of *R. scirpoides*, from Horn Island, but the specimen at MISSA is actually *R. nitens*.

Voucher specimens: **Forrest and Perry cos.:** frequent on moist sandbars along Black Creek, E of Brooklyn, 28 Sep 1997, *B.A. Sorrie 9569 and M. Pyne* (GH, IBE, VDB). **Jackson Co.:** Gator Pond (dammed streamhead), just NE of jct. of Wire Road and FS 404-A, Univ. Miss. Forest Lands, two robust plants on exposed pond bottom, 24 Aug 1997, *B.A. Sorrie 9546* (MMNS, NCU). **Lamar Co.:** 2.1 mi N of Lumberton on US 11, sandy clay of seepage area around pine woods pond, 4 Sep 1965, *R. Kral 25854* (VDB); Mossy Pond, 3 mi W of Purvis, 1 Sep 1998, *B.A. Sorrie 9930 with S.W. Leonard* (NCU).

Rhynchospora tracyi Britton (Cyperaceae). Lowe (1921) reports this sedge on the authority of Small, but gives no localities. The following will serve to document its presence in Mississippi.

Voucher specimens: **Jackson Co.:** cypress pond between Ocean Springs and Gautier, 28 Jul 1955, *R.K. Godfrey 53700 with R.B. Channell* (FSU, GH); hwy. 90 just W of Ala. line, wet soil at edge of sawgrass marsh, 26 Sep 1970, *K.E. Rogers 4612-A* (SMU), *4612-B* (NCU); same place, in shallow water, no date, *K.E. Rogers 4627-A* (NCU); edge of *Cladium* marsh along US 90, circa 1 mi N of Orange Lake, 11 Sep 1980, *K. Gordon 2255* (ctb, MMNS); common in disturbed cypress depression at junction of Nut Bank Road and connector to route 613, about 3.5 mi SSW of Big Point village, 2 Oct 1997, *B.A. Sorrie 9588 with R.J. LeBlond* (GH, IBE, NCU).

Ruellia pedunculata Torrey ex Gray ssp. **pinetorum** (Fern.) R.W. Long (Acanthaceae). This seldom collected taxon is vouchered from about 25 counties range-wide (South Carolina to panhandle Florida to western Louisiana); half of which are concentrated in a small area from Washington County, Alabama to Tangipahoa Parish, Louisiana. Previously, this plant had been collected in Harrison and Wayne Counties (MSNHP); here we add four more counties. Because it is difficult to detect when not in flower, we suggest that *R. pedunculata* ssp. *pinetorum* is probably not as rare in Mississippi as previously assumed.

Voucher specimens: **Forrest Co.:** frequent in pine savannas in Ranges 43 and 45, Camp Shelby, 22 May 1998, *S.W. Leonard 9954* (MMNS). **Hancock Co.:** Stennis Space Center, NASA, 13 km SE of Picayune, pipeline at mi 2, off main canal, W of spillway, 29 Apr 1992, *J.W. Wooten s.n.* (USM). **Marion Co.:** occasional in powerline right-of-way through low grounds, 1.2 mi N of hwy. 35 on E side of hwy. 13, 5 Sep 1998, *S.W. Leonard 10085* (MMNS). **Pearl River Co.:** about 5.5 mi N of McNeill, clearcut, 18 Aug 1980, *S. McDaniel 24337* (FSU); frequent in grassy roadside 0.2 mi E of jct. of MS 26 and MS 43, 30 Apr 1998, *S.W. Leonard 9928* (MMNS). **Perry Co.:** about 30 plants in moist pine plantation on S side of Dickey Creek and E of North Tank Trail, Camp Shelby, 1 May 1998, *S.W. Leonard 9929* (MMNS); burned-over hillside drains of Impact Area Buffer Zone, N of South Tank Trail and 1.0 mi E of Middle Creek, Camp Shelby, 11 May 1998, *S.W. Leonard 9952* (MMNS).

Sagittaria isoetiformis J.G. Smith (Alismataceae). Reported herewirh new to Mississippi. This is one of the more difficult species of *Sagittaria* to find, because plants are often obscured by dense colonies of *Eleocharis robbinsii*, *Leersia hexandra*, or other aquatics. Two locations are known from Camp Shelby, a range extension westward from Covington County, AL.

Voucher specimen: **Perry Co.:** mostly submerged and not abundant in dense vegetation fringing gum pond behind Mars Hill Church, Camp Shelby, 20 Sep 1994, *J. MacDonald 7728b with D. Wyrick* (IBE); same place, 8 Sep 1995, *S.W. Leonard 9057 with J. MacDonald* (MMNS), *J. MacDonald 9107* (IBE).

Scleria reticularis Michaux (Cyperaceae). Reported herewith new to Mississippi. We here treat *S. reticularis* in the strict sense, without var. *pubescens* Britton (= *S. muehlenbergii* Steudel). The two warrant treatment as full species, based on morphological characters, habitat, and distribution, as treated by Weakley (in prep.). *Scleria reticularis sensu stricto* ranges discontinuously on the coastal plain from southern New Hampshire to the Florida panhandle to Mississippi, disjunct to Michigan and Indiana. It is very rare south of the Carolinas. *Scleria muehlenbergii* ranges continuously from southern New Jersey to south Florida, west to Texas and Oklahoma, with scattered records inland, in the West Indies, and in Central America. It is abundant in the southern Atlantic and Gulf Coastal Plains.

Voucher specimen: **Forrest Co.:** hwy. 49 ca. 3.5 mi N of Stone County line, shallow pond W of hwy. across fence, 1970, *K.E. Rogers 4660-B* (VDB), *4660-C* (NCU). **Lamar Co.:** Mossy Pond, 3 mi W of Purvis, uncommon on sandy-peaty shelf on NW shore, 1 Sep 1998, *B.A. Sorrie 9936 with S.W. Leonard* (GH, IBE, NCU).

Sorghastrum apalachicolense D.W. Hall (Poaceae). Shortly after this species was named and described from Florida (Hall 1982), S. McDaniel found it in Lamar Co., Mississippi (specimens at FSU, IBE) and K. Gordon found it in Pearl River County (MSNHP database). Until our survey work, *Sorghastrum apalachicolense* was thought to be a rare disjunct in Mississippi, but it now has been documented from nine counties. Moreover, this grass is quite common in suitable habitat: frequently burned, mesic longleaf pine-oak-bluestem communities with diverse herbaceous layers. We observed several thousand plants in 1997 and 1998.

In 1997, SWL spent many hours observing the inflorescence development of *S. apalachicolense, S. secundum* (Ell.) Nash, and *S. elliottii* (Mohr) Nash, species often misidentified on specimen labels and annotations. Because of the arching-drooping panicle axis, even soon after breaking the sheath, *S. elliottii* differs markedly from the other two, in which the axis is straight to slightly arching. Furthermore, *S. elliottii* flowers a month later than *S. apalachicolense* (in southern Mississippi) and about two weeks later than *S. secundum* (in southern Alabama).

As the inflorescence emerges from the apical leaf sheath of *S. apalachicolense*, it takes the form of a compact plume with mostly ascendant branches. The branches and branchlets diverge in an irregular pattern as anthers reach maturity; later, as seeds develop and are shed, the branches return to the ascendant position. In *S. secundum*, the branches and branchlets diverge in a very regular manner so as to form a secund inflorescence in which the florets line up uniformly along one side of the axis. Each floret appears equidistant from each other and from the axis. After seed maturation, the branches return to the ascendant position. Thus, specimens taken prior to full anthesis, or toward the end of seed dispersal, are superficially similar in these two species. In addition to the spikelet width character given in Hall (1982), *S. apalachicolense* specimens possess a short collar of bristles at each panicle branch node; these bristles are greatly reduced or absent in *S. secundum*.

Our observations of *Sorghastrum* reveal other important points. First, *S. secundum* is absent from Mississippi; specimens so labeled from Lamar County [*S.B. Jones, Jr. 2460* (FSU)] are *S. apalachicolense*. In fact, we are unaware of any verified record of *S. secundum* from west of the Mobile-Tensaw Delta, Alabama. Second, flowering of *S. apalachicolense* occurs about three weeks later in Mississippi (late August to early September) than in the Florida panhandle. We can offer no explanation for this discrepancy. Thus, in Florida, flowering and fruiting of *S. apalachicolense* overlaps no other species, but in Mississippi, it overlaps the onset of *S. nutans* (L.) Nash. Third, the very short life cycle—maximum of four weeks from breaking sheaths to seed set—gives *S. apalachicolense* a short detection window.

Voucher specimens: **Forrest Co.:** longleaf pine woodland, 1.0 mi WSW of Grapevine Road along FS 310-B, Camp Shelby, 6 Sep 1996, *S.W. Leonard 9622* (MMNS). **George Co.:** mixed pine-hardwood stand N of Walker Road, Univ. Miss. Forest Lands, 22 Sep 1997, *B.A. Sorrie 9518* (US, bas). **Harrison Co.:** frequent in powerline right-of-way in sandy soil, about 1 mi NE of Lizana along Saucier-Lizana Road, 7 Sep 1997, *S.W. Leonard 9883* (swl); rare in mesic longleaf/slash pine woods by CC Camp Road Bog, S side of route 43 between Lyman and Lizana, 27 Sep 1996, *B.A. Sorrie 9069 with R.J. LeBlond* (bas). **Jackson Co.:** uncommon in multi-age longleaf pine-oak uplands N of Larue Road about 0.5 mi NW of Old Biloxi Road, De Soto NF, 1 Oct 1997, *B.A. Sorrie s.n. with R.J. LeBlond* (bas); cut-over pinelands 0.3 mi S of Wire Road on east side of hwy. 57, 7 Sep 1997, *S.W. Leonard 9879* (MMNS). **Lamar Co.:** very large population in thinned longleaf pine-bluestem upland along Dobson Road, 1 Sep 1998, *B.A. Sorrie 9938 with S.W. Leonard* (FSU, IBE, US); same place, 4 Sep 1998, *B.A. Sorrie 9944* (BRIT, GA, GH). **Marion Co.:** infrequent in pinelands along hwy. 13, 0.6 mi NW of Lamar Co. line, 5 Sep 1998, *S.W. Leonard 10082* (MMNS). **Perry Co.:** scattered in longleaf pine woods S of pipeline on both sides of FS 327, 3.2 mi S of FS 309, Camp Shelby, 8 Sep 1996, *S.W. Leonard 9052 with J. MacDonald* (IBE). **Stone Co.:** frequent in mesic well-burned longleaf pine uplands, Univ. Miss. Forest Lands, sheaths swelling and inflorescences opening 21-23 Aug 1997, spikelets nearly all dropped by 23 Sep, *B.A. Sorrie 9444* (MMNS, bas), *9446* (GH, NCU, bas), *9451* (IBE), *9452* (NCU, US), *9454* (DUKE, FSU, GH), *9533* (US).

Spiranthes brevilabris Lindley var. **floridana** (Wherry) Luer (Orchidaceae). Reported herewith new to Mississippi. In a treatment of the *Spiranthes* of the state, Morris (1989) could find no documentation of its occurrence, but suggested that *S. brevilabris* and its var. *floridana* might occur. Although the variety *floridana* supposedly ranges from North Carolina to Florida and Texas, current information on distribution and abundance is virtually nonexistent. Most botanists have never seen this orchid and the Florida Natural Areas Inventory (the state with the most historical records) does not track it. Knowledge of the range and current abundance of the nominate variety is even poorer. Furthermore, confusion with *S. lacera* (Raf.) Raf. var. *gracilis* (Bigelow) Luer has clouded specimen records, literature reports, and range maps, including those of Luer (1972). Observations in 1997 suggest that this orchid appears in the first growing season following a fire, when competition from coarser herbs and shrubs is at a minimum. Plants mature and senesce in only a few weeks, providing a brief window for detection. Mississippi populations all support less than twenty individuals. The Jackson County specimen at AMES was originally determined as *S. gracilis*, and is mounted on a sheet with other specimens of that taxon from Connecticut, Illinois, and Vermont.

Voucher specimens: **Harrison Co.:** lobe of large seepage bog near FS 424, De Soto NF, burned in winter/spring 1997, 22 May 1997, *B.A. Sorrie 9251* (AMES). **Jackson Co.:** Ocean Springs, 29 April 1889, *F.S. Earle s.n.* (AMES); seepage bog near FS 409-E, De Soto NF, burned winter 1997, 16 Apr 1997, *B.A. Sorrie 9157* (bas). **Stone Co.:** mesic longleaf pine-oak-grass upland with hardwoods mostly removed, very diverse herb layer, E of route 15 and S of Wire Road, Univ. Miss. Forest Lands, 16 May 1997, *B.A. Sorrie 9231 with R.G. Wieland* (MMNS, NCU).

Stylisma aquatica (Walter) Raf. (Convolvulaceae). PLANTS lists this species for Mississippi, but Myint (1966) does not map it there. This, our only pink flowered *Stylisma*, inhabits intermittently ponded depressions, often with *Taxodium ascendens* and *Nyssa biflora* in the canopy.

Voucher specimens: **Harrison Co.:** locally common in seasonally ponded depression in pine flatwoods, off of FS 452, S of Wortham Road, De Soto NF, grass-sedge dominated, with *Dichanthelium erectifolium, D. wrightianum, Lycopodiella alopecuroides*, 27 Sep 1997, *B.A. Sorrie 9558 with S.W. Leonard and J. Moore* (MMNS, NCU). **Jackson Co.:** disturbed cypress depression at jct. of Nut Bank Road and connector to route 613, about 3.5 mi SSW of Big Point village, abundant, 2 Oct 1997, *B.A. Sorrie 9586 with R.J. LeBlond* (GH, IBE, NCU); Cottonmouth Savanna, N side of Frank Snell Road, E of route 613, cypress-bordered depression in pine flatwoods, 1 Oct 1997, *B.A. Sorrie with R.J. LeBlond 9582* (GA, DUKE). **Perry Co.:** frequent in and around a wet weather pond on E side of FS 322, 0.5 mi N of FS 307 in Camp Shelby Training Area 63, 4 Jun 1996, *S.W. Leonard 9529* (MMNS).

Stylisma pickeringii (Torrey ex M.A. Curtis) Gray (Convolvulaceae). Lowe (1921) and Myint (1966) do not include this species for Mississippi, but PLANTS does. The subspecific disposition of Mississippi specimens is problematic—characters they possess do not fit the published descriptions or the key provided by Myint (1966). Supposedly, *S. pickeringii* var. *pattersonii* (Fern. & Schub.) Myint can be separated from var. *pickeringii* by style branches 1.0–1.5 mm long vs. 2–3 mm, style branches definitely unequal vs. mostly equal or slightly unequal, stylopodia 1–2 mm long vs. up to 3–4 mm, and sepals mostly acute or acutish vs. mostly obtuse. In Mississippi plants, style branches are all less than 0.7 mm and vary from equal to definitely unequal, stylopodia are all less than 2 mm, and sepals vary from acute to obtuse. The resolution of this problem must await more detailed studies. The nominate variety ranges discontinuously on the coastal plain from New Jersey to central Alabama; var. *pattersonii* ranges from western Louisiana and southern Arkansas to eastern Texas, Kansas, and Iowa. The following document the known extant populations.

Voucher specimens: **Forrest Co.:** abundant in extensive sand deposits in old floodplain of Leaf River, N of Faulkner Street and E of James Street Baptist Church, Hattiesburg, 18 Jun 1998, *B.A. Sorrie 9779 with S.W. Leonard* (FSU, GH, MMNS, NCU). **Perry Co.:** rare in white sand in cut-over longleaf pine scrub behind Mars Hill Church, Camp Shelby, 15 Oct 1994, *J. MacDonald 7953 with C.T. Bryson* (IBE); same place, 10 Jul 1996, *S.W. Leonard 9556* (MMNS); same site, 25 Sep 1997, *B.A. Sorrie 9549* (bas, NCU). **Wayne Co.:** xeric, deep white sands of hills along Brewer Town Road, De Soto NF, uncommon, with *Pinus palustris, Quercus laevis, Aristida tuberculosa, Rhynchospora megalocarpa*, 26 Sep 1997, *B.A. Sorrie 9551 with M. Pyne* (bas).

Tridens carolinianus (Steudel) Henrard (Poaceae). Lowe (1921) does not include this species (nor under any synonym), but PLANTS does. This striking grass ranges from southeastern North Carolina to northwestern Florida to western Louisiana, apparently nowhere common.

Voucher specimens: **George Co.:** mesic longleaf-oak upland N of Walker Road, Univ. Miss. Forest Lands, rare, *with Tridens chapmanii, Sorghastrum apalachicolense, S. nutans, Paspalum bifidum, P. floridanum* var. *floridanum, Aristida lanosa*, 22 Sep 1997, *B.A. Sorrie s.n.* (bas).

Pearl River Co.: Poplarville, 1932, *H.R. Reed 324* (FSU), specimen originally determined as *Triodia drummondii* Scribner & Kearney; McNeill, 23 Sep 1931, *H.R. Reed 147* (FSU), specimen originally determined as *Triodia elliottii* Bush. **Stone Co.:** mesic longleaf-oak upland N of Wire Road in Henley Park, Univ. Miss. Forest Lands, uncommon, associated with high diversiry of graminoids and herbs, 23 Sep 1997, *B.A. Sorrie 9535* (MMNS, NCU). **Wayne Co.:** De Soto NF, rare in mesic longleaf pine-oak upland by FS 245, burned in 1996 and 1997, with diverse herbaceous layer, 26 Sep 1997, *B.A. Sorrie s.n. and M. Pyne* (bas).

Utricularia olivacea C. Wright ex Grisebach (Lentibulariaceae). New to Mississippi. This neotropical species occurs in the United States as scattered populations on the coastal plain from New Jersey to Florida. The plant's extremely small size, even when flowering, makes detection difficult. Moreover, *U. olivacea* is sensitive to changes in water level, so that it may not appear annually at a given site. The Hinds County specimen names three lakes, at least one of which was a natural arm of the Pearl River (R. Wieland, Mississippi Natural Heritage Program, pers. comm.). The 1935 date represents the second oldest collection in the United States and the first outside of Florida.

Voucher specimens: **Hinds Co.:** "Spring Lake; Clinton Lake; Hederman Lake", 1935–1945, *F. Cook s.n.* (MMNS). **Jackson Co.:** ponded gum swamp at FS 404, 0.25 mi N of Larue Road, DeSoto NF, common in very shallow water and becoming stranded with *U. biflora*, 18 Aug 1997, no sign of any plants on 1 Oct 1997, *B.A. Sorrie 9416* (GH, NCU, FSU, MISSA).

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REFERENCES

Bridges, E.L., S.L. Orzell, and J.R. Burkhalter. 1993. *Cladium mariscoides* (Cyperaceae) in the western Florida panhandle and its phytogeographic significance. Phytologia 74:35–42.

Bryson, C.T. and R. Carter. 1994. Notes on *Carex, Cyperus,* and *Kyllinga* (Cyperaceae) in Mississippi with records of eight species previously unreported to the state. Sida 16:175–186.

Bryson, C.T., J.R. MacDonald, R. Carter, and S.D. Jones. 1996. Noteworthy *Carex, Cyperus, Eleocharis, Kyllinga,* and *Oxycaryum* (Cyperaceae) from Alabama, Arkansas, Georgia, Louisiana, Mississippi, North Carolina, Tennessee, and Texas. Sida 17:501–518.

Channell, R.B. 1957. A revisional study of the genus *Marshallia* (Compositae). Contr. Gray Herb. 181:41–132.

Davidse, G. and R.W. Pohl. 1992. New taxa and nomenclatural combinations of Mesoamerican grasses (Poaceae). Novon 2:81–110.

Eakes, C.B. 1989. Studies on the life history and habitat of the bogstar (*Parnassia grandifolia* DC.) in south Mississippi. M.S. thesis, University of Southern Mississippi, Hattiesburg.

Evans, A.M. 1978. Mississippi flora: a guide to the ferns and fern allies. Sida 7:282–297.

Frost, C.C. 1993. Four centuries of changing landscape patterns in the longleaf pine ecosystem. Proc. 18th Tall Timbers Fire Ecology Conf.:17–43.

Gale, S. 1944. *Rhynchospora* sect. *Eurhynchospora* in Canada, the United States, and the West Indies. Rhodora 46: 80–134, 159–197, 255–278.

Godfrey, R.K. and J.W. Wooten. 1979. Aquatic and wetland plants of the southeastern United States. Monocotyledons. Univ. Georgia Press, Athens.

Godfrey, R.K. and J.W. Wooten. 1981. Aquatic and wetland plants of the southeastern United States. Dicotyledons. Univ. Georgia Press, Athens.

Hall, D.W. 1982. *Sorghastrum* (Poaceae) in Florida. Sida 9:302–308.

Harvill, A.M., Jr. 1977. New combinations in *Dichanthelium* (Poaceae). Castanea 42:177.

Hellquist, C.B. and G.E. Crow. 1980. Aquatic vascular plants of New England: Part 1. Zosteraceae, Potamogetonaceae, Zannichelliaceae, and Najadaceae. New Hampshire Agric. Exp. Sta. Bull. no. 515, Durham, NH.

Hitchcock, A.S. 1950. Manual of the grasses of the United States. Second edition, revised by A. Chase. USDA Misc. Publ. No. 200, Washington, DC.

Holmgren, P.K., N.H. Holmgren, and L.C. Barnett (eds.). 1990. Index herbariorum. Part 1: the herbaria of the world, 8th ed. New York Botanical Garden, Bronx.

Jones, S.B., Jr. 1974. Mississippi flora. I. Monocotyledon families with aquatic or wetland species. Gulf Research Reports 4:357–379.

Jones, S.B., Jr. 1975. Mississippi flora. IV. Dicotyledon families with aquatic or wetland species. Gulf Research Reports 5:7–22.

Jones, S.B., Jr. 1976. Mississippi flora. VI. Miscellaneous families. Castanea 41:189–212.

Kartesz, J.T. 1994. A synonymized checklist of the vascular flora of the United States, Canada, and Greenland. Second ed., 2 vols. Timber Press, Portland, OR.

Kral, R. 1996. Supplemental notes on *Rhynchospora crinipes* and related species in section *Fuscae* (Cyperaceae). Sida 17:385–411.

Landry, G. and J.W. Thieret. 1973. *Isoetes louisianensis* (Isoetaceae), a new species from Louisiana. Sida 5:129–130.

LeBlond, R.J. 1997. Distribution of *Rhynchospora harperi*. Castanea 62:137–141.

Lelong, M. 1986. A taxonomic treatment of the genus *Panicum* (Poaceae) in Mississippi. Phytologia 61:251–269.

Lowe, E.N. 1921. Plants of Mississippi. Mississippi State Geological Survey, Bulletin 17, Jackson.

Luer, C.A. 1972. The native orchids of Florida. New York Botanical Garden, Bronx.

MacRoberts, M.H. and B.R. MacRoberts. 1997. The ecology of *Agrimonia incisa* Torrey & A. Gray (Rosaceae) in the West Gulf Coastal Plain. Phytologia 82:114–128.

McDaniel, S. 1987. Guide to the natural areas of the Crosby Arboretum. Publ. by the Crosby Arboretum, Picayune, MS.

MONTGOMERY, J.D. and W.H. WAGNER, JR. 1993. *Dryopteris*. In: Flora of North America Editorial Committee, eds. 1993+. Flora of North America North of Mexico. 3+ vols. Oxford Univ. Press, New York.

MORRIS, M.W. 1989. *Spiranthes* (Orchidaceae) in Mississippi. Selbyana 11:39–48.

MYINT, T. 1966. Revision of the genus *Stylisma* (Convolvulaceae). Brittonia 18:97–117.

PULLEN, T.M., S.B. JONES, JR., and J.R. WATSON, Jr. 1968. Additions to the flora of Mississippi. Castanea 33:326–334.

RADFORD, A.E., H.E. AHLES, and C.R. BELL. 1968. Manual of the vascular flora of the Carolinas. University of North Carolina Press, Chapel Hill.

ROGERS, K.E. 1973. Notes on plants of Mississippi. I. Castanea 38:199–203.

ROGERS, K.E. 1977. Vascular flora of the Ragland Hills area, Forrest and Perry Counties, Mississippi. Sida 7:51–79.

SMALL, J.K. 1933. Manual of the southeastern flora. Published by the author, New York.

STEVENS, M.P. 1991. The botanical literature of Mississippi: a taxonomic, geographic, and subject guide 1854 through 1984. Mississippi Museum of Natural Science, Jackson.

TAYLOR, W.C., N.T. LUEBKE, D.M BRITTON, R.J. HICKEY, and D.F. BRUNTON. 1993. *Isoetes*. In: Flora of North America Editorial Committee, eds. 1993+. Flora of North America North of Mexico. 3+ vols. Oxford Univ. Press, New York.

THOMAS, R.D. and C.M. ALLEN. 1993. Atlas of the vascular flora of Louisiana. Vol. 1. Louisiana Dept. of Wildlife & Fisheries and The Nature Conservancy, Baton Rouge.

USDA, NRCS. 1995. The PLANTS database. Developed by J. Kartesz of the Biota of North America Program. National Plant Data Center, Baton Rouge, Louisiana.

WARE, S., C. Frost, and P.D. Doerr. 1993. Southern mixed hardwood forest: the former longleaf pine forest. In: Martin, W.H., S.G. Boyce, and A.C. Echternacht: Biodiversity of the southeasrern United States. Lowland terrestrial communities. J. Wiley & Sons, New York. Pp. 447–493.

WATSON, L.E. and J.R. ESTES. 1990. Biosystematic and phenetic analysis of *Marshallia* (Asteraceae). Syst. Bot. 15:403–414.

WEAKLEY, A.S. in prep. Flora of the Carolinas and Virginia. Working draft. The Nature Conservancy, Southeast Regional Office, Chapel Hill, NC.

ZULOAGA, F.O. R.P. ELLIS, and O. MORRONE. 1993. A revision of *Panicum* subg. *Dichanthelium* sect. *Dichanthelium* (Poaceae: Panicoideae: Paniceae) in Mesoamerica, the West Indies, and South America. Ann. Missouri Bot. Gard. 80:119–190.

DOCUMENTED CHROMOSOME NUMBERS 1999:1. CHROMOSOME NUMBERS AND POLLEN DIAMETER VARIATION IN *THELESPERMA* (ASTERACEAE)

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ABSTRACT

Diploid and tetraploid chromosome numbers and pollen measurements are reported for 95 collections from five taxa of *Thelesperma* (Asteraceae). These chromosome counts include the first 17 diploid (2*x*) reports for *T. megapotamicum* var. *ambiguum*. A correlation between ploidy level (2*x*, 4*x*) and pollen diameter (mm) is found in diploid and polyploid plants of *T. megapotamicum* and *T. simplicifolium*. In both taxa, multivalent configurations (IV, V, VI, X) are found. A recurring oversized bivalent (II) was observed in up to 23 of the 103 collections from four of the five taxa studied.

RESUMEN

En este estudio se contaron números cromosomáticos diploides y tetraploides, y medidas de polen de 95 colecciones, las cuales en total agrupan cinco táxones de *Thelesperma* (Asteraceae). Los recuentos de cromosomas incluyen 17 de diploides (2*x*) de *T. megapotamicum* var. *ambiguum*, publicados ahora por primera vez. En plantas diploides y poliploides de *T. megapotamicum* y *T. simplicifolium* se encontró una correlación entre el nivel de ploidía (2*x*, 4*x*) y el diámetro del polen (mm). Además ambos táxones presentaron configuraciones multivalentes (IV, V, VI, X). Posiblemenre en 23 de las 103 colecciones se observó una recurrencia de bivalentes (II) con tamaño incrementado, en cuatro de los cinco táxones.

Melchert (1963) included approximately 169 documented chromosome counts for 10 taxa of *Thelesperma*. Prior to the Melchert (1963) study, chromosome numbers were known for 10 of the 15 taxa recognized in his treatment, and counts of n = 8, 9, 10, 11, 12 and 22 were already established for *Thelesperma*. The pre-1963 counts led erroneously to the notion that every taxon of *Thelesperma* was characterized by a single chromosome number. Melchert discovered 2*x* dysploid series in four taxa of *Thelesperma* and dysploid diploid and polyploid plants in three taxa. The documented counts reported by Melchert (1963) were never published. About 27 chromosome counts for *Thelesperma* published in 15 papers since 1966 (see Goldblatt & Johnston

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1990, and earlier Indices to Plant Chromosome Numbers) also revealed chromosome number variation in the genus. Certain meiotic irregularities in *Thelesperma*, mostly one to five rings-of-four in diploids and polyploids, were reported by Melchert (1963), Strother (1976), Keil and Pinkava (1976), and others.

We document numerous chromosome counts from five taxa of *Thelesperma*. Most of the counts resulted from a populational study of the diploid-tetraploid *T. megapotanicum*-*T. ambiguum* complex, which was the focal point of thesis research (Greer 1997). We comment on meiotic irregularities and the correlation between ploidy level and pollen diameter in *Thelesperma*.

METHODS AND MATERIALS

Capitula for meiotic analysis were fixed in Modified Carnoy's Solution (4 chloroform: 3 ethanol: 1 glacial acetic acid; v:v:v). Standard squash techniques (Turner & Johnston 1961) and acetocarmine stain were employed in chromosomal observations. The sources of pollen for pollen size comparisons were the same as those for meiotic analyses. Pollen sizes were measured by ocular micrometer calibrated with slide micrometer such that 1 ocular unit equaled 1 µm (Greer 1997). Often up to 10–30 pollen grains were measured for a given collection.

Correlations between pollen diameter and ploidy level were established by a two-step process. A consensus measurement was estimated for the most frequent ranges of pollen diameters found in each voucher collection (inclusive and exclusive of the pollen exine, i.e., mm exinate and intinate). These consensus measurements (in mm exinate and intinate) were then plotted against the inferred ploidy levels of the respective specimens (Fig. 1).

All the voucher specimens are preserved at the Sul Ross State University Herbarium (SRSC) except for the B.L. Turner collections of *T. filifolium* var. *filifolium*, which are housed in the Herbaria of the University of Texas at Austin (TEX and LL).

RESULTS

Included are 95 original chromosome number reports for four species (five taxa) of *Thelesperma*. Specimen citations are accompanied by meiotic chromosome numbers, configurations, irregularities, and pollen diameters in Table 1. Certain capitulum characters of *T. megapotamicum* var. *megapotamicum* and *T. megapotamicum* var. *ambiguum* are included, e.g., heads radiate or discoid and disc corolla coloration, because the putative hybrids of these taxa are thought to be distinguishable by variation in these characters (Melchert 1963; Greer 1997). It is important to note that both 2*x* and 4*x* chromosome numbers and pollen grains with variable diameter were often observed

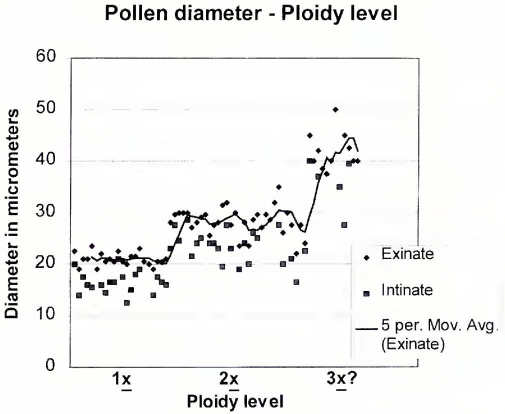

FIG. 1. Plot of exinate (small diamonds) and intinate (small squares) pollen diameter consensus measurements versus putative ploidy levels (for 60 voucher collections, Table 1): 1*x* pollen measurements (mean = 21 mm, s.d. = 1.23); 2*x* pollen measurements (mean = 28, s.d. = 2.7); 3*x* pollen measurements (m = 42, s.d. = 3.6). Trend line follows a five percent moving average for exinate diameters.

in the same populations and even in the same individual plants (Table 1).

The Turner collection of *T. filifolium* var. *filifolium* in Kimbel County yielded the rare euploid cytotype of *n* = 11 (Greer 1997). Most collections of *T. filifolium* var. *filifolium* have the dysploid cytotypes of *n* = 9 and *n* = 8 (Melchert 1963). This chromosome number (Greer 1997) confirms the continued existence of this rare cytotype in Kimbel County which was first reported by Melchert (1963).

DISCUSSION

The 17 diploid (2*n* = 22) chromosome counts obtained for *T. megapotamicum* var. *ambiguum* (RESULTS) represent the first diploid (2*x*) chromosome numbers reported for the taxon. Previous reports (Melchert 1963; Turner & Flyr 1966) suggested that var. *ambiguum* was exclusively tetraploid throughout its range. Melchert (1963) recognized *T. megapotamicum* and *T. ambiguum* as distinct species. He listed 42 counts for the complex, 17 diploid and tetraploid counts for *T. megapotamicum*, 19 tetraploid counts for *T. ambiguum*, and six tetraploid

TABLE 1. The meiotic chromosome numbers, configurations, irregularities, and pollen diameters with the respective taxon, source specimen collection numbers, and locations. Collections are arranged alphabetically by taxa. Observed multivalent configurations and both exinate and intinate pollen diameters are included. The putative presence of the oversized bivalent is designated by (*II*). Chromosome counts or pollen measurements from more than one plant are indicated as (populational). Authorities for the taxonomy are noted below[1].

Taxon & capitular characters	Locality & collection no.	Ploidy level (x=11)	Chromosome number	Pollen diameter (µm) (exinate & intinate)
T. filifolium var. *filifolium* Red-brown disc, radiate	Tex.: Harper County *Turner s.n. (a,b)*	$2x$	$2n$ = 9II (*II*) $2n$ = 10II (*II?*)	
T. filifolium var. *filifolium* Red-brown disc, radiate	Tex.: Kimbel County *Turner s.n.*	$2x$	n = 11	(Anaphase I: Only one side countable)
T. longipes Yellow discoid	Tex.: Crockett County 5 mi N of Ozona *Greer 122a,b* (populational)	$\approx 2x$ $\approx 4x$		18–20–24 µm exinate 14–16–18 µm intinate 26–28 µm exinate 22–23 µm intinate
T. megapotamicum var. *megapotamicum* Yellow disc, radiate. (red-brown 75%, orange & yellow, ca. 12% each)	Tex.: Terrell County 5.5 mi E of Longfellow *Powell, 2671c* (populational)	$2x$	$2n$ = 11II	
T. megapotamicum var. *megapotamicum* Yellow discoid	Tex.: Brewster County ~11.6 mi NE of Alpine *Greer 111*	$\approx 2x$ $\approx 4x$, $6x$?		20–23(–25) µm exinate 16–18(–22–24) µm intinate 29–30(–45) µm exinate 26–29(–40) µm intinate
T. megapotamicum var. *megapotamicum* Yellow discoid, reddish disc lobes (red-brown at maturity)	Tex.: Brewster County ~25 mi S of Ft. Stockton *Powell 2735*	$2x$	$2n$ = 11II	
T. megapotamicum var. *megapotamicum*	Tex.: Pecos County 3 mi E of TX 1776/11 *Greer 114*	$2x$ $\approx 4x$, $6x$	$2n$ = 11II (*II*)	18–20 µm exinate (10–)15–18 µm intinate 30 µm exinate few to 40 µm exinate
T. megapotamicum var. *megapotamicum* Yellow discoid	NMex.: Socorro County~34 mi E of San Antonio Powell 2528	$2x$	$2n$ = 11II	

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[1] Taxonomy with authorities: *Thelesperma* Lessing; *T. filifolium* (Hook.) A. Gray var. *filifolium*; *T. longipes* A. Gray; *T. megapotamicum* (Spreng.) O. Kuntze var. *megapotamicum*; *T. megapotamicum* (Spreng.) O. Kuntze var. *ambiguum* (A. Gray) Shinners; *T. simplicifolium* A. Gray var. *simplicifolium*.

Taxon & capitular characters	Locality & collection no.	Ploidy level ($x = 11$)	Chromosome number	Pollen diameter (mm) (exinate & intinate)
T. megapotamicum var. *megapotamicum* Yellow discoid	Tex.: Hudspeth County 12.5 mi E of Dell City *Powell 2831*	$4x$	$2n \approx$ 22II	
T. megapotamicum var. *megapotamicum* Yellow disccoid (~ 50% red and yellow discs)	Tex.: Presidio County 32 mi S of Marfa *Powell 2522*	$4x$	$2n \approx$ 18II + 2IV	
T. megapotamicum var. *megapotamicum* Yellow discoid	Tex.: Brewster County 5 mi W of Marathon *Sloan and Powell 2542*	$4x$	$2n \approx$ 18II + 2IV	
T. megapotamicum var. *megapotamicum* Yellow discoid	Tex.: Brewster County W side of Alpine *Greer 96*	$4x$	$2n =$ 18II + 2IV (*2II?*) $2n =$ 22II $2n =$ 21II?	
T. megapotamicum var. *megapotamicum* Rich, golden yellow discoid.	Tex.: Brewster County W side of Alpine *Greer 100*	$4x$	$2n =$ 22II $2n =$ 13II + 4IV? (*II?*)	
T. megapotamicum var. *megapotamicum* Yellow discoid	Tex.: Brewster County ~10 mi NE of Alpine *Greer 110*	$4x$	$2n =$ 22II Anaphase I dicentrics	25–30(–31) µm exinate 18–23(–28) µm intinate Immat.: 10 µm exinate 6 µm intinate
T. megapotamicum var. *megapotamicum* Yellow discoid	Tex.: Pecos County 2 mi E of Imperial *Greer 116a,b,c* (populational)	$\approx 4x$	$2n =$ 20–21II (?)	
T. megapotamicum var. *megapotamicum* Yellow discoid	Tex.: Pecos County 12.9 mi E of Imperial *Greer 119*	$\approx 4x$ $\approx 2x$	$2n =$ 20–21II (?)	25–35(–49 crushed) µm exinate 20–22 µm exinate 15–18–20 µm intinate Dimorphic pollen in 1:1 ratio. 26–29(–31) µm intinate
T. megapotamicum var. *megapotamicum* Yellow disc, radiate	Tex.: Terrell County E side of Lozier Canyon *Greer 169*	$4x$ {≈4x?} $\approx 6x$?	$2n =$ 22II 1–3 IV	23–24 µm exinate 19–21mm intinate 40–50 µm exinate 25–33 µm intinate
T. megapotamicum var. *megapotamicum* Yellow disc, radiate	Tex.: Terrell County W side of Lozier Canyon *Greer 171*	$2x$ $4x$	$2n =$ 11II $2n \approx$ 22II	19–22 µm exinate {≈2x} 25–29 µm exinate {^{a}4x?}

Table 1 continued

Taxon & capitular characters	Locality & collection no.	Ploidy level (x=11)	Chromosome number	Pollen diameter (mm) (exinate & intinate)
T. megapotamicum var. *megapotamicum*	Tex.: Ward County 8 mi N of Jct. TX 1776/1450 *Greer 175*	$2x$	$2n$ = 9II+1IV (?)(*II*)	
T. megapotamicum var. *megapotamicum*	Tex.: Ward County, TX 2 mi N of Monahans *Greer 177*	$2x$	$2n$ = 11II (*II*) $2n$ = 12II? (?) $2n$ = 9II + 1IV	
T. megapotamicum var. *megapotamicum* Young appearing plants (1st year perennials?)	Tex.: Winkler County, TX 14.7 mi N of Monahans *Greer 179*	$2x$ ≈$4x$	$2n$ = 11II	Avg.: 20 μm exinate Avg.: 29–30 μm exinate
T. megapotamicum var. *megapotamicum*	Tex.: Winkler County 4.5 mi NE of Kermit *Greer 181*	$2x$	$2n$ = 11II	
T. megapotamicum var. *megapotamicum*	Tex.: Winkler County 14 mi NE of Kermit *Greer 182* (populational)	$2x$	$2n$ = 11II (*II*) $2n$ = 9II + 1IV $2n$ = 5II + 3IV or 6II + 3IV (?) $2n$ = 4II + 2IV + 1VI $2n$ = 11II or 9II 1IV	1st head: Most 18–20 μm exinate (13?–)14–15 μm intinate few clusters: 27–30 μm exine 18–20 μm intinate {≈4x?} 2nd head clusters: –32 μm exinate {≈4x} 3rd +head: –35 μm exinate 25–30 μm intinate
T. megapotamicum var. *megapotamicum* Young plants (1st year perennials?)	Tex.: Winkler County 16.3 mi NE of Kermit *Greer 183* (populational)	$2x$ $4x$	$2n$ = 9II $2n$ = 11II (*II*) $2n$ = 9II + 1IV $2n$ = 18II + 2IV	
T. megapotamicum var. *megapotamicum* Reddish involucres	Tex.: Andrews County N of Winkler-Andrews County line *Greer 185*	$2x$	$2n$ = 11II (*II*)	
T. megapotamicum var. *megapotamicum*	Tex.: Andrews County 24.3 mi NE of Kermit *Greer 186a*	$2x$	$2n$ = 11II $2n$ = 9II + 1IV $2n$ = 10II? (*II*)	
T. megapotamicum var. *megapotamicum*	Tex.: Andrews County 24.3 mi NE of Kermit *Greer 186b*	$2x$	$2n$ = 11II $2n$ = 10II? (*II*)	

Taxon & capitular characters	Locality & collection no.	Ploidy level ($x = 11$)	Chromosome number	Pollen diameter (mm) (exinate & intinate)
T. megapotamicum var. *megapotamicum* Yellow discoid	Tex.: Brewster County 36.4 mi S of I-10, US 67 31 May 1995 *Greer 187*	$4x$	$2n$ = 11II + 3IV + 1X $2n$ = 18II + 2IV $2n$ = 17II + 1IV + 1VI + 1VI (*II?*) $2n$ = 17II + 1IV	
T. megapotamicum var. *megapotamicum* Yellow discoid	Tex.: Brewster County 9.6 mi E of Marathon *Greer 195*	$4x$	$2n$ = 22II (?)	
T. megapotamicum var. *megapotamicum* Yellow disc, radiate	Tex.: Pecos County 40.5 mi E of Marathon *Greer 206*	$\approx 2x$		(19–)21–22 µm exinate 17~18 µm intinate
T. megapotamicum var. *megapotamicum* Orange-yellow disc, radiate; large trilobate ray florets	Tex.: Terrell County 41.7 mi E of Marathon *Greer 216*	$2x$	$2n$ = 11II	
T. megapotamicum var. *megapotamicum* Yellow disc, reduced radiate	Tex.: Terrell County 42.4 mi E of Marathon *Greer 217*	$2x$	$2n$ = 11II	
T. megapotamicum var. *megapotamicum* Yellow discoid	Tex.: Terrell County >46 mi E of Marathon *Greer 222*	$4x$?	$2n$ ≈ 22II (?)	
T. megapotamicum var. *megapotamicum* Dark yellow disc, minute ray florets	Tex.: Terrell County 51 mi E of Marathon *Greer 226*	$2x$	$2n$ = 11II	
T. megapotamicum var. *megapotamicum* Yellow, red-tinted discoid	Tex.: Terrell County 52.4 mi E of Marathon *Greer 228*	$4x$	$2n$ = 22II (?)	
T. megapotamicum var. *megapotamicum* Yellow disc, radiate	Tex.: Terrell County 51.5 mi E of Marathon *Greer 234a*	$2x$	$2n$ = 11II	
T. megapotamicum var. *megapotamicum* Yellow disc, radiate	Tex.: Terrell County 51.5 mi E of Marathon *Greer 234b*	$2x$ $4x$	$2n$ = 11II (*II*) $2n$ = 22II $2n$ = 20II + 1IV	
T. megapotamicum var. *megapotamicum* Yellow discoid	Tex.: Terrell County 29.1 mi W of Lozier Canyon *Greer 262* (populational)	$4x$	n = 22 Anaphase I ≥21IVs per meiocyte	25, 28–30, ~40 µm exinate {≈4x, 6x?}

Table 1 continued

Taxon & capitular characters	Locality & collection no.	Ploidy level ($x = 11$)	Chromosome number	Pollen diameter (mm) (exinate & intinate)
T. megapotamicum var. *megapotamicum* Golden disc, very reduced radiate	Tex.: Terrell County 32.6 mi W of Lozier Canyon *Greer 263*	$4x$	$2n = 22$II lagging chromos.	
T. megapotamicum var. *megapotamicum* Reddish yellow disc, radiate (somewhat reduced), yellow style branches	Tex.: Terrell County 32.6 mi W of Lozier Canyon *Greer 264*	$4x$	$2n = 22$II (?) lagging chromos.	
T. megapotamicum var. *megapotamicum* Yellow disc, radiate (dark colored disc florets)	Tex.: Terrell County 34.0 mi W of Crozier Canyon *Greer 268*	$4x$	$2n \approx 21$II	
T. megapotamicum var. *megapotamicum* Yellow discoid	Tex.: Terrell County ~40+ mi W of Lozier Canyon *Greer 271b*	$4x$	$2n = 22$II (?) {≈$2x$?, $4x$, $6x$?}	22–26, 40 µm exinate 20–25 µm intinate
T. megapotamicum var. *megapotamicum* Dark yellow discoid	Tex.: Val Verde County 5 mi W of Del Rio *Greer 155*	$4x$ {$6x$?}	$2n \approx 22$II	25–26(–30) µm exinate (16–)18–20(–22) µm intinate (up to 35 µm intinate)
T. megapotamicum var. *megapotamicum* and var. *ambiguum* Yellow discoid; 2 orange discoid (one clump)	Tex.: Terrell County 52.4 mi E of Marathon *Greer 231* (mixed populational)	$4x$	$2n = 17$II + 2IV + 1 dicentric Anaphase I: Separated $2n = 11$II + 4IV + 1VI $2n = 12$II + 5IV	
T. megapotamicum var. *ambiguum* Orange disc, radiate	Tex. Brewster County 5 mi W of Marathon *Powell 2683*	$2x$	$2n = 11$II	
T. megapotamicum var. *ambiguum* Reddish-brown disc, radiate (mixed population of radiate & discoid)	Tex.: Brewster County near Terlingua *Powell 2512*	$4x$	$2n \approx 18$II + 2IV	
T. megapotamicum var. *ambiguum* Red discoid	Tex.: Brewster County ~17.1 mi NE of Alpine *Greer 113*	≈$4x$		(26–)30–33(–34) µm exinate (20–24)27–29 µm intinate variable

Taxon & capitular characters	Locality & collection no.	Ploidy level (x=11)	Chromosome number	Pollen diameter (mm) (exinate & intinate)
T. megapotamicum var. *ambiguum* Red disc, radiate; double layer ray florets	Tex.: Pecos County 40.5 mi E of Marathon *Greer 207*	$2x$	$2n$ = 11II (*II*)	
T. megapotamicum var. *ambiguum* Red discoid	Tex.: Terrell County 41.7 mi E of Marathon *Greer 213*	$2x$	$2n$ = 11II	
T. megapotamicum var. *ambiguum* Orange disc, radiate (slender ray florets)	Tex.: Terrell County 32.6 mi W of Lozier Canyon *Greer 265*	$4x$	$2n$ = 22II (?)	
T. megapotamicum var. *ambiguum* Red-brown discoid	Tex.: Brewster County Marathon *Powell and Powell 2540*	$2x$	$2n$ = 18II + 2IV	
T. megapotamicum var. *ambiguum* Red-brown discoid	Tex.: Brewster County 5 mi W of Marathon *Powell and Powell 2541*	$4x$	$2n \approx$ 18II + 2IV	
T. megapotamicum var. *ambiguum* Orange disc, radiate; some double ray florets	Tex.: Terrell County 51.5 mi E of Marathon *Greer 235*	$2x$ $4x$	$2n$ = 11II (*II?*) $2n$ = 22II (2 meiocytes)	
T. megapotamicum var. *ambiguum* Light orange disc, radiate	Tex.: Terrell County 10.2 mi W of Lozier Canyon *Greer 255*	$4x$	$2n$ = 22II (*II*) $2n$ = 18II + 2IV (*II*)	
T. megapotamicum var. *ambiguum* Orange discoid almost: 2 minute ray florets	Tex.: Terrell County 29.1 mi W of Lozier Canyon *Greer 259*	$4x$	$2n \approx$ 18–19II + 1IV $2n$ = 22II (?)	
T. megapotamicum var. *ambiguum* Small red disc, radiate	Tex.: Terrell County 0.9 mi W of Sanderson *Greer 280*	$2x$	$2n$ = 11II	
T. megapotamicum var. *ambiguum* Red disc, radiate	Tex.: Terrell County 1.1 mi W of Sanderson *Greer 283*	$2x$	$2n$ = 11II (*2–4II*)?	
T. megapotamicum var. *ambiguum* Reddish-brown disc, radiate	Tex.: Brewster County 70 mi S of Alpine *Powell and Powell 2540*	$4x$	$2n \approx$ 18II + 2 IV	
T. megapotamicum var. *ambiguum* Red-brown disc, radiate (red-brown 75%, orange & yellow, ca. 12% each)	Tex.: Terrell County 5.5 mi E of Longfellow *Powell, 2671a* (populational)	$2x$	$2n$ = 11II	

Table 1 continued

Taxon & capitular characters	Locality & collection no.	Ploidy level (x=11)	Chromosome number	Pollen diameter (mm) (exinate & intinate)
T. megapotamicum var. *ambiguum* Orange disc, radiate (red-brown 75%, orange & yellow, ca. 12% each)	Tex.: Terrell County 5.5 mi E of Longfellow *Powell, 2671b* (populational)	$2x$	$2n = 11$II	
T. megapotamicum var. *ambiguum* Red discoid	Tex.: Brewster County 36.4 mi S of I-10, US 67 31 May 1995 *Greer 188a*	$4x$	$2n = 13$II + 4IV $2n = 15$II + 1IV + 1X	
T. megapotamicum var. *ambiguum* Reddish-tinged discoid	Tex.: Brewster County 36.4 mi S of I-10, US 67 31 May 1995 *Greer 188b*	$4x$	$2n = 20$II + 1IV	
T. megapotamicum var. *ambiguum* Red discoid, yellow style branches	Tex.: Brewster County 12.9 mi N of Jct. US 67/90 *Greer 191a,b* (populational)	$4x$	$2n = 22$II $2n \approx 20$II lagging chromos.	
T. megapotamicum var. *ambiguum* Red discoid	Tex.: Brewster County 3.5 mi E of Marathon *Greer 192*	$4x$	$2n = 18$II + 2IV	
T. megapotamicum var. *ambiguum* Deep orange disc, radiate	Tex.: Terrell County 42.4 mi E of Marathon *Greer 218*	$2x$	$2n = 11$II	
T. megapotamicum var. *ambiguum* Orange discoid	Tex.: Terrell County >46 mi E of Marathon *Greer 220*	$2x$ $4x$ $\approx 4x$	$2n = 11$II (?) $2n = 22$II (?) $2n \approx 22$II	20–21 µm exinate 15–18 µm intinate 26 µm exinate (1 pollen) 20 µm intinate (1 pollen) 30 µm exinate (1 shattered pollen)
T. megapotamicum var. *ambiguum* Reddish discoid	Tex.: Terrell County 52.4 mi E of Marathon *Greer 229*	$4x$	$2n \approx 21$II $2n = 22$II?	20–22, 24–26(–31) µm exinate (16–)20–22 µm intinate {≈2x, 1x}
T. megapotamicum var. *ambiguum* Orange disc, large ray florets	Tex.: Terrell County 52.4 mi E of Marathon *Greer 230*	$2x$	$2n = 11$II	

Table 1 continued

Taxon & capitular characters	Locality & collection no.	Ploidy level ($x = 11$)	Chromosome number	Pollen diameter (mm) (exinate & intinate)
T. megapotamicum var. *ambiguum* Red discoid; some heads more reddish than others on the same plant	Tex.: Pecos County 33.7 mi E of Marathon *Greer 200a,b* (populational)	$4x$	$2n = 22$II (?)	
T. megapotamicum var. *ambiguum* Red disc, radiate	Tex.: Pecos County 38.8 mi E of Marathon *Greer 201*	$2x$	$2n = 11$II	
T. megapotamicum var. *ambiguum* Orange disc, radiate (large ray florets some double layered)	Tex.: Pecos County 38.8 mi E of Marathon *Greer 202*	$2x$	$2n = 11$II	
T. megapotamicum var. *ambiguum* Reddish-tinted discoid, orange discoid, reduced radiate	Tex.: Terrell County E side of Lozier Canyon *Greer 170* (populational)	$4x$	$2n \approx 22$II	1st Head: 26–31mm exinate 23–29 µm intinate
		$\approx 6x$?		37–48 µm exinate 34, 42 µm intinate
		$\approx 2x$		2nd Head: 17–26 µm exinate 15–21 µm intinate
		$\approx 2x$		3rd Head: 23 µm exinate 19 µm intinate
		$\approx 4x$		28–31 µm exinate 23–27 µm intinate
T. megapotamicum var. *ambiguum* Reddish discoid	Tex.: Maverick County 4 mi NW of Eagle Pass *Greer 144a,b,c,d* (popuational)	$4x$	$2n = 22$II (?) two Anaphase I dicentrics	
T. megapotamicum var. *ambiguum* Radiate	Tex.: Maverick County 4.3 mi NNW of Quemado *Greer 145*	$\approx 4x$	$2n \approx 20$II	
T. megapotamicum var. *ambiguum* Discoid	Tex.: Maverick County Rio Grande Valley, US 277 *Greer 146*	$\approx 4x$		25–31mm exinate (18–19–)23–30 µm intinate
		$\approx 4x$		28–30 µm exine (20–)22–30 µm
		$\approx 6x$?		–36 µm (few)–39 µm
T. megapotamicum var. *ambiguum* Discoid, orange style branches	Tex.: Maverick County 8.1 mi NNW of Quemado *Greer 149*	$\approx 2x$		19–22 µm exinate 11–18 µm intinate
		$\approx 4x$	$2n \approx 15$II + 2IV + 1VI	20–31 µm exinate 20–22, 25, 28 µm intinate

Table 1 continued

Taxon & capitular characters	Locality & collection no.	Ploidy level ($x = 11$)	Chromosome number	Pollen diameter (mm) (exinate & intinate)
		$\approx 4x$?		one cluster: 25–30 µm exinate 22–26 µm intinate
T. megapotamicum var. *ambiguum* Red discoid	Tex.: Val Verde County Del Rio, US 90 *Greer 151*	$\approx 4x$ {$6x$?}	$2n$ = 22II? (*II*) At least 1 IV + II	28–29(–35) µm exinate 19–20 µm intinate
T. megapotamicum var. *ambiguum* Orange disc, radiate	Tex.: Val Verde County 5 mi W of Del Rio *Greer 152*	$\approx 2x$	$2n \approx$ 10–12II (?) Anaph. I dicentric lagging chromos.	20–21 µm exinate (11–)15–18 µm intinate Immat.: 13–15 µm exinate
		$\approx 4x$	$2n \approx$ 22II (one cluster)	20–25(–32) µm exinate 20–22, 26–29 µm intinate Immat.: 20–21 µm w/o exinate
T. megapotamicum var. *ambiguum* Red discoid	Tex.: Val Verde County 5 mi W of Del Rio *Greer 153*	$\approx 2x$?	$2n$ = 11II (?)	21–20 µm exinate (15–)18–20 µm intinate
		$4x$	$2n$ = 22II $2n \approx$ 20II	25–30 µm exinate 20–26 µm intinate
		$6x$? $8x$?	Anaphase I dicentric	–40 µm exinate –<50 µm exinate
T. megapotamicum var. *ambiguum* Red disc, reduced radiate	Tex.: Val Verde County 5 mi W of Del Rio *Greer 154*	$\approx 4x$		25–31(–35) µm exinate 18–24(–29) µm intinate
T. megapotamicum var. *ambiguum* Red disc, radiate	Tex.: Val Verde County 5 mi W of Del Rio *Greer 157a,b,c,d,e* (populational)	$4x$	$2n$ = 22II (?)	
T. megapotamicum var. *ambiguum* Red-orange disc, radiate	Tex.: Val Verde County 2.0 mi W of Comstock *Greer 162*	$\approx 4x$	$2n \approx$ 22II	
T. megapotamicum var. *ambiguum* Orange discoid	Tex.: Pecos County 40.5 mi E of Marathon *Greer 204*	$2x$	$2n$ = 11II $2n$ = 10II (?)	
T. megapotamicum var. *ambiguum* Reddish-brown disc lobes, corolla throats yellow, radiate	Tex.: Brewster County Terlingua Creek *Powell 2509*	$4x$	$2n \approx$ 18II + 2 IVs	

Table 1 continued

Taxon & capitular characters	Locality & collection no.	Ploidy level ($x=11$)	Chromosome number	Pollen diameter (mm) (exinate & intinate)
T. megapotamicum var. *ambiguum* Red-brown disc, radiate	Tex.: Brewster County 5 mi W of Marathon *Powell 2684*	$2x$	$2n = 11$II	
T. simplicifolium var. *simplicifolium*	Tex.: Val Verde County25.7 mi W of Pecos River *Greer 166*	$2x$	$2n = 10$II or 11II (?)(*II*) (one II may two IIs overlapping)	
T. simplicifolium var. *simplicifolium* Yellow disc, radiate	Mexico: Coahuila, *Powell, D. Patterson, D. Ittner 1584*	$4x$	$2n = 20$II	
T. simplicifolium var. *simplicifolium*	Tex.: Crockett County 4.8 mi E of Jct. TX 163/190 *Greer 127*	$2x$	$2n = 10$II (*II*)	(22–)24–25 µm exinate 14–17 µm intinate
		$\approx 4x$?		27 µm exinate 20–21(–23) µm intinate
		$\approx 6x$?		42? µm exinate 37? µm intinate
T. simplicifolium var. *simplicifolium*	Tex.: Val Verde County23.8 mi W of Del Rio *Greer 158*	$\approx 2x$		Avg.: 20 µm exinate (10–12)15 µm intinate
T. simplicifolium var. *simplicifolium*	Tex.: Kinney County 21.1 mi NW of Quemado *Greer 150*	$2x$ $\approx 4x$	$2n = 10$II; $2n = 10$? 13?	20–22 µm exinate 15–18 µm intinate a few cells: 25, 31mm exinate, ~23 µm
T. simplicifolium var. *simplicifolium* Yellow disc, radiate Curvicarpum achene form	Tex.: Menard County 1 mi E of TX 29/83 *Greer 137*	$2x$	$2n = 10$II Anaphase I lagging chromosomes of one bivalent (*II*)	
T. simplicifolium var. *simplicifolium* Yellow disc, radiate Curvicarpum achene form	Tex.: Menard County 1 mi E of TX 29/83 *Greer 138*	$\approx 2x$		18–20 µm exinate
		$\approx 6x$?		35–36(–40) µm exinate base of echinations: 30 µm
T. simplicifolium var. *simplicifolium*	Tex.: Maverick County Rio Grande Valley, US 277 *Greer 147*	$2x$ {$\approx 4x$?}	$2n = 11$II (*II*)	20–23(–29, 30) µm exinate 15–17 µm intinate
T. simplicifolium var. *simplicifolium* Yellow disc, large overlapping ray florets	Tex.: Terrell County 0.2 mi W of Lozier Canyon *Greer 243*	$2x$	$2n \approx 11$II	
		$4x$	$2n = 20$II	20–21–24 µm exinate (13–)16–20 µm intinate

Table 1 continued

Taxon & capitular characters	Locality & collection no.	Ploidy level ($x = 11$)	Chromosome number	Pollen diameter (mm) (exinate & intinate)
T. simplicifolium var. *simplicifolium*	Tex.: Val Verde County 0.7 mi W of Pecos River *Greer 163*	$2x$	$2n = 20(?)$ $2n \approx 10\mathrm{II}\ (3\mathit{II}?)$	21–22 µm exinate 14–16 µm intinate
		$\approx 4x$		26–28(–29–30) µm exinate 22–24(–26) µm intinate

counts for putative hybrids between the taxa. Because of their remarkable morphological similarity, identical meiotic cytologies ($2n = 22$, 44 with multivalents), and the ease with which they apparently interbreed where sympatric, *T. megapotamicum* and *T. ambiguum* are best treated as varieties (Greer 1997). The only reliable distinguishing characteristics are range, the slightly reduced habit of var. *ambiguum*, and disc coloration. Disc florets of var. *megapotamicum* are yellow and heads generally are discoid; disc florets of var. *ambiguum* are red-brown and heads are generally yellow-radiate.

The reports (Table 1) for the *T. megapotamicum* complex provide an expanded understanding of how diploid and polyploid distribution in the species is structured, especially in Texas. *Thelesperma megapotamicum* var. *megapotamicum* is almost exclusively diploid ($2n = 22$) with yellow, discoid heads in most of its range, which extends from Nebraska, Colorado, and Wyoming west to Arizona, south across Trans-Pecos Texas into central Mexico, and east to northwest Texas (Melchert 1963). In the predominant portion of its range which extends from south Texas and near the Rio Grande Valley west into Val Verde County, *T. megapotamicum* var. *ambiguum* is largely tetraploid ($2n = 44$) with red-brown disc corollas and large, yellow ray florets. However, west of the Pecos River, mixed diploid and tetraploid populations of var. *ambiguum* occur from western Val Verde County through Terrell and Brewster counties (Greer 1997). The floral morphology of these populations of var. *ambiguum* vary from radiate with red-brown discs, discoid orange, radiate orange, to discoid red-brown. Along this same axis, var. *megapotamicum* plants are also often diploid ($2n = 22$) with yellow discs and ray corollas. Populations of var. *megapotamicum* elsewhere in the Trans-Pecos are mostly tetraploid ($2n = 44$) with yellow discoid heads, although there are occasional plants with yellow discs and yellow ray florets, often reduced in length.

Melchert (1963) interpreted plants from this area resembling both var. *megapotamicum* and var. *ambiguum* as hybrids or intergrades between the taxa. He found only tetraploids in this area. This region of apparently extensive morphological intergradation seems to mark the sympatric overlap of the ranges of var. *megapotamicum* and var. *ambiguum* from western Val Verde County west into Brewster County. The intergradation is so smooth and continuous that morphotypes were difficult to assign taxonomically.

Origins of polyploidy. The origins of polyploidy in *T. megapotamicum* remain uncertain. Variation in floral character combinations in the sympatric region, high fertility, and the absence of univalents or trivalents in meiotic observations, suggest that alloploidy is more likely than autoploidy in var. *ambiguum* (Greer 1997). Because of the lack of morphological differentiation between diploids and tetraploids, however, polyploidy in the typical yellow discoid var. *megapotamicum* seems more likely to be autoploid. For similar reasons, autoploidy also seems more likely in other polyploid taxa of *Thelesperma* such as *T. simplicifolium* and *T. longipes* (Greer 1997).

Multivalent configurations have been observed at meiosis in diploid (Keil & Pinkava 1976; Greer 1997; Results) and in tetraploid (Melchert 1963; Strother 1976; Powell & Powell 1977; Greer 1997; Results) cytotypes of both *T. megapotamicum* var. *megapotamicum* and *T. megapotamicum* var. *ambiguum*. Melchert (1963) reported that in tetraploids, two rings-of-four (IV) were most common, and that one and three rings-of-four also were observed. In this study, we report that widely variable numbers of apparent ring and chain quadrivalents (IV), hexavalents (VI), and even decavalents (X) were found in populations of var. *megapotamicum* and var. *ambiguum* (Greer 1997). Anaphase segregation was essentially balanced and fertility remained high in spite of the multivalents (Melchert 1963) and the occasional occurrence of dicentric chromosomes (Table 1; Greer 1997).

Large bivalent. A persistent large bivalent (II) was observed in meiotic preparations in up to 23 of the 103 collections (Table 1; Greer 1997), most noticeably in preparations from diploid plants. Such an oversized bivalent has been observed in *T. megapotamicum* var. *megapotamicum*, *T. megapotamicum* var. *ambiguum*, *T. simplicifolium* var. *simplicifolium*, and *T. filifolium* var. *filifolium* (Greer 1997). An oversized bivalent is also plainly visible in Melchert's (1963) meiotic camera lucida figures of the above taxa as well as in *T. longipes*, *T. filifolium* var. *intermedium*, and possibly also in *T. burridgeanum* (Greer 1997). Melchert (1963) did not call attention to the large bivalent. In one collection of *T. simplicifolium* var. *simplicifolium* (*Greer 137*; Table 1), the chromosomes of an oversized bivalent lagged in anaphase I. The lagging and dicentric chromosomes observed (Table 1) may be associated with the large bivalent. A large bivalent would be more frequently expected to lag and to undergo paracentric inversions because of its length. The large bivalent may be a result of a massively unequal reciprocal translocation that occurred early in the evolution of *Thelesperma* (Greer 1997).

Pollen diameter variation. Pollen diameter size variations seem to reflect the ploidy levels of the plants that produced them (Greer 1997). From diploid plants (2*x*) of *T. megapotamicum*, the broad range of pollen diameters for presumed 1*x* pollen (1*x* gametophytes) was 17–26 µm exinate and 11–21 µm intinate. From tetraploid plants, the range of pollen diameters for presumed 2*x* pollen (2*x* gametophytes) was approximately 20–35 µm exinate and 18–29 µm intinate. Rare pollen found in preparations with even larger diameters, 30–50 µm exinate and 25–42 µm intinate, have been attributed tentatively to 3*x* pollen (3*x* gametophytes). (See Fig. 1).

Diploid plants of *T. megapotamicum* occasionally were found to produce unreduced 2*x* pollen (ca. 24–30 µm exinate) along with the more abundant 1*x* pollen (18–24 µm exinate). In Andrews and Winkler counties where var. *megapotamicum* is known to occur only as a diploid, discrete clusters of larger pollen were seen in meiotic preparations, suggesting that localized tetraploid (4*x*) microsporangial tissues are producing clusters of unreduced 2*x* gametophytes. Plants of both var. *megapotamicum* and var. *ambiguum* from Brewster, Terrell, and Val Verde counties, where populations are typically tetraploid, consistently produce pollen of both sizes (ca. 24–30 µm; ca. 18–22 µm) in a nearly 1:1 ratio of putative 1*x* and 2*x* pollen. In tetraploids of *T. megapotamicum* larger than normal pollen (30–35 µm) were occasionally observed, suggesting that tetraploids also may be producing unreduced gametophytes (3*x*?, Fig. 1).

The same kind of ploidy level—pollen diameter variation was also observed in *T. simplicifolium* var. *simplicifolium*, which has both diploid and tetraploid cytotypes. The correlation between known chromosome numbers and pollen sizes suggests that in certain species of *Thelesperma* a given ploidy level may predominate in a specific population or plant, while gametophytes of different ploidy levels are being also produced (Greer 1997). Similar production of unreduced gametes has been reported by Beaman (1957) in *Townsendia* (Asteraceae) and Powell and Sikes (1975) in *Perityle* (Asteraceae).

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REFERENCES

Beaman, J.H. 1957. The systematics and evolution of *Townsendia* (Compositae). Contr. Gray Herb. 183:1–151.

Goldblatt, P. and D.E. Johnson (eds). 1990. Index of plant chromosome numbers (series of monographs from 1975–1987). Missouri Botanical Garden, St. Louis, Missouri.

Greer, L.F. 1997. Origins of polyploidy in *Thelesperma* (Asteraceae). M.S. thesis, Sul Ross State University, Alpine, Texas.

Keil, D.J. and D.J. Pinkava. 1976. Chromosome counts and taxonomic notes for Compositae from the United States and Mexico. Amer. J. Bot. 63:1393–1403.

Melchert, T.E. 1963. Systematics of the genus *Thelesperma* (A cytotaxonomic and chemotaxonomic study). Ph.D. dissertation, University of Texas, Austin.

Powell, A.M. and S.A. Powell. 1977. Chromosome numbers of gypsophilic plant species of the Chihuahuan Desert. Sida 7:80–90.

Powell, A.M. and S.W. Sikes. 1975. On the origin of polyploidy in *Perityle rupestris* (Asteraceae) Sci. Biol. J. 1:132–137. (Oct–Nov).

Strother, J.L. 1976. Chromosome studies in Compositae. Amer. J. Bot. 63:247–250.

Turner, B.L. and D. Flyr. 1966. Chromosome numbers in the Compositae. X. North American species. Amer. J. Bot. 53:24–33.

Turner, B.L. and M.C. Johnston. 1961. Chromosome numbers in the Compositae. III. Certain Mexican species. Brittonia 13:64–69.

BOOK REVIEW

BRIAN E. S. GUNNING AND MARTIN W. STEER. 1996. **Plant Cell Biology: Structure and Function.** (ISBN 0-86720-504-0, pbk.; 0-86720-509-1 (hbk). Jones and Bartlett Publishers, 40 Tall Pine Drive, Sudbury, MA 01776. 800-443-5000. $37.50. (plate numbers, no page numbers)

This book replaces the classic work, "Plant Cell Biology-An Ultrastructural Approach," published in 1975. It includes photographs made using the following microscopic techinques: conventional light, phase contrast, differential interference contrast, fluorescence (including fluorescence antibody and immuno-fluorescence), confocal laser scanning, transmission electron (TEM) and scanning electron (SEM). Many techniques involving anticlonal antibodies, serial optical sections, shadow casting, freeze-fracturing, freeze-etching, ultra-thin, freeze substitution, and a variety of ancillary ones, are explained in detail in thetext as well as in the legends.

The book is comprised of 60 plates in an 8.5 x 12" format, on high-gloss paper, with sometimes oversized labels for the sub-plates, and an accompanying text for each. Several black and white drawings scattered throughout the text are original artwork, but are not numbered. There is also one figure of a "generalised plant cell" that places the organelles and ultrastructural features of our beloved tetradodecahedron in perspective. The 60 plates are arranged in groups according to subject, and include the following sections: an introductory survey, nucleus, endoplasmic reticulum, Golgi apparatus and coated vesicles, vacuoles, mitochondria, nucleic acids in mitochondria and plastids, plastids, microbodies, cytoskeleton, cell division, transport between cells, vascular tissue, the plant surface, plant reproduction, the plant as a multicellular organism and the index.

Like its predecessor, this book is an instantaneous classic and a MUST for anyone teaching general biology or plant biology. The clear, concise text and fantastic images would serve the needs of everyone from high school biology advanced placement students to advanced undergraduate biology majors taking a cell biology course. I unhesitatingly recommend this excellent bargain to everyone!—*John J. Pipoly III.*

SALVINIA MOLESTA (SALVINIACEAE), NEW TO TEXAS AND LOUISIANA

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Initially discovered at a schoolyard demonstration pond in southeastern Texas, the Federal noxious weed *Salvinia molesta* Mitchell has recently been found in abundance at Toledo Bend Reservoir. This 75,300 ha impoundment of the Sabine River forms a 145 km border between Texas and Louisiana and is a popular bass fishing lake.

Native to a small region of southeastern Brazil (Forno 1983), *S. molesta* has dominated water bodies over an expansive range including regions of Africa, Asia, Australia and the South Pacific (Mitchell 1972; Forno & Harley 1979). Vegetative reproduction and rapid growth rates contribute to the invasiveness of this plant, typically resulting in dense surface mats that cover open water, degrade aquatic habitat, and constrain the use of reservoirs and waterways (Mitchell & Tur 1975; Thomas & Room 1986). Until now, *S. molesta* has been successfully intercepted at nurseries, botanical gardens, and at a private pond (Myers 1982; Johnson 1995), precluding naturalization in the United States. Likely sources for the introduction are local nurseries found distributing the species as an ornamental water garden plant (Rhandy Helton, Texas Parks and Wildlife Department, personal communication).

This is the second *Salvinia* species introduced to these states. *Salvinia minima* was first reported from Louisiana in 1980 (Landry 1981) and from Texas in 1993 (Hatch 1995). Its distribution has increased extensively since these reports (Montz 1989). The two species are readily distinguished by the multicellular hairs on the upper frond surface. The apex of each hair is divided into four branches. In *S. molesta*, the tips of the branches are joined to form a cage-like structure, while in *S. minima*, branches are spreading and free at the tips. Leaf hair features may be viewed with a 10X lens and can be used by biologists for early field detection.

This report documents an introduction that constitutes a serious threat to aquatic systems throughout the southern United States. *Salvinia molesta* has been found above the high water level at public ramps and roads along Toledo Bend Reservoir, likely dragged there by boat trailers, known vectors for overland spread (Miller and Wilson 1989).

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Voucher specimens: U.S.A. **TEXAS. Harris Co.:** Houston, wetland demonstration pond of Robert Browning Elementary School, forming dense surface cover, apiculate sporocarps in an elongated cymose system, 4 May 1998, *Ronald K. Jones* (FLAS, PIHG, TAES). **LOUISIANA. Sabine Parish:** Many, Toledo Bend Reservoir, abundant in coves and shallows, apiculate sporocarps in an elongated cymose system, 30 Nov 1998, *James M. Hyde* (FLAS).

ACKNOWLEDGMENTS

The author gratefully acknowledges assistance in identification from Nancy Coile, Wendy Forno, and David Mitchell.

REFERENCES

Forno, I.W. 1983. Native distribution of the *Salvinia auriculata* complex and keys to species identification. Aquat. Bot. 17:71-83.

Forno, I.W. and K.L.S. Harley. 1979. The occurrence of *Salvinia molesta* in Brazil. Aquat. Bot. 6:185–187.

Hatch, S.L. 1995. *Salvinia minima* (Salviniaceae), new to Texas. Sida 16:595.

Johnson, B. 1995. Giant salvinia found in South Carolina. Aquatics 17:22.

Landry, G.P. 1981. *Salvinia minima* new to Louisiana. Amer. Fern J. 68:95.

Miller, I.L. and C.G. Wilson. 1989. Management of *Salvinia* in the Northern Territory. J. Aquat. Plant Manage. 27:40–46.

Mitchell, D.S. 1972. The Kariba weed: *Salvinia molesta*. Brit. Fern Gaz. 10:251–252.

Mitchell, D.S. and N.M. Tur. 1975. The rate of growth of *Salvinia molesta* (*S. auriculata* auct.) in laboratory and natural conditions. J. Appl. Ecol. 12:213–225.

Montz, G.N. 1989. Distribution of *Salvinia minima* in Louisiana. Proc. 23rd Annual Meeting Aquatic Pant Control Research Program, 4–17 November 1988, West Palm Beach, Florida, Misc. Paper A-89-1, U.S. Army Corps of Engineers, Vicksburg, MS, pp. 312–316.

Myers, F.D. 1982. Memo to state and territory agricultural regulatory officials. U.S. Dept. of Agriculture, Plant Protection and Quarantine, DA #82-12.

Thomas, P.A. and P.M. Room. 1986. Taxonomy and control of *Salvinia molesta*. Nature 320: 581–584.

ORTHODON VS *MOSLA* (LAMIACEAE)

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The generic name *Orthodon* Bentham & Oliver (Lamiaceae) has never gained widespread acceptance. *Mosla* (Bentham) Buchanan-Hamilton ex Maximowicz has been used almost universally for this Asian genus of about 22 species, several of them quite weedy. Indeed, Bentham himself (1876) adopted *Mosla* and cited his own generic name in synonymy, without comment.

The relevant data are these:

Orthodon R. Brown, Trans. Linn. Soc. London 12:578. 6 April–August 1819, Musci.

Orthodon Bentham & Oliver, J. Linn. Soc., Bot. 9:167. 12 October 1865, Lamiaceae.

Mosla (Bentham) Buchanan-Hamilton ex Maximowicz, Bull. Acad. Imp. Sci. Saint Pétersbourg, sér. 3, 20:456. 1875, based on *Hedeoma* Persoon sect. *Mosla* Bentham, Labiat. Gen. Spec. 366. 1834.

Orthodon Bentham & Oliver is an illegitimate homonym of *Orthodon* R. Brown, easily discoverable from *Index Nominum Genericorum (Plantarum)*. However, before plant taxonomy was blessed with such invaluable compilations, there was no practical and reliable way to discover the existence of duplicated generic names. This was what led Bau and Nayar (1969) to propose conservation of *Mosla* against *Orthodon* Bentham & Oliver; McVaugh (1970) replied (as Secretary for the Committee on Spermatophyta) that the existence of *Orthodon* R. Brown (Musci) made *Orthodon* Bentham & Oliver (Lamiaceae) a later homonym—the proposal was therefore superfluous, and was withdrawn by its authors.

There the matter rested. Since 1970, no proposal to conserve *Orthodon* Bentham & Oliver against *Orthodon* R. Brown has been submitted to Taxon, Dan Nicolson informs me (pers. comm., 4 December 1998). One expects none would arise, because *Mosla* is so widely used that to return to a conserved *Orthodon* would be destabilizing to nomenclature.

However, *Orthodon* Bentham & Oliver has now resurfaced: Gleason, H.A. and A. Cronquist (1991, p. 445) adopt it in place of *Mosla*. Its "impropriety" is not remarked upon in Hammond (1992).

The name cannot be used; I surmise (following the suggestion of Paul Fryxell) that its appearance may stem from the entry in Airy Shaw (1973), wherein

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Orthodon is accepted in generic status and *Mosla* is reduced to synonymy, the compiler having been unaware of the existence of the priorable *Orthodon* R. Brown (Musci).

Mosla is represented in the United States of America only by the weedy annual *Mosla dianthera* (Roxburgh) Maximowicz, the type species of the genus; its known range is Georgia, Kentucky, New Jersey, North Carolina, and Tennessee (data from www.mip.berkeley.edu/bonap/checklist_intro.html), but it can be expected to spread much more widely. It would be most unfortunate if the illegitimate name *Orthodon dianthera* were to become weedy in the literature.

REFERENCES

AIRY SHAW, H.K. 1973. A dictionary of the flowering plants and ferns, 8th ed. Cambridge University Press.

BENTHAM, G. 1876. *Mosla.* In: G. Bentham & W.J. Hooker. Genera Plantarum 2:1182.

BAU, C.R. and M.P. NAYAR. Proposal to conserve the generic name 7333. *Mosla* Buch.-Ham. ex Maxim. (1875) (LAMIACEAE) against *Orthodon* Benth. & Oliver (1865). Taxon 18:596. 1969.

GLEASON, H.A. and A. CRONQUIST. 1991. Manual of vascular plants of northeastern United States and adjacent Canada, ed. 2, p. 445.

HAMMOND, H.D. 1992. Corrections and additions for and errors found in the *Manual of vascular plants of northeastern United states and adjacent Canada, Second Edition,* by Henry A. Gleason (late) and Arthur Cronquist. Bull. Torrey Bot. Club 119:88-89.

MCVAUGH, R. 1970. Report of the Committee for Spermatophyta. Conservation of generic names, XIII. Taxon 19:818.

TRIOSTEUM (CAPRIFOLIACEAE) IN TEXAS

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Triosteum is a genus of about six species distributed in eastern North America and Asia. These are coarse, perennial, erect herbs with one to many stems arising from a woody crown. Many authors recognize three species from North America, *T. angustifolium* L., *T. perfoliatum* L., and *T. aurantiacum* Bickn. (Small 1933; Fernald 1950; Steyermark 1963; Radford et al. 1968; Strausbaugh & Core 1978). *Triosteum angustifolium* is characterized by narrowed leaf bases, whereas *T. perfoliatum* and *T. aurantiacum* have connate-perfoliate leaf bases. The latter two are segregated primarily on the nature and amount of pubescence and glandular hairs. Although recognizing the two species, Voss (1996) mentions that "pubescence characters are not as consistent as some keys suggest ..." Brooks (1986) treats them as infraspecific taxa, maintaining that "The characters typically used to distinguish the two varieties, especially stem vestiture and leaf shape, intergrade with some degree of frequency in both the GP [Great Plains] and extraregional material examined. This suggests that separation of the two entities is dubious."

Correll and Johnston (1970), as well as Hatch et al. (1990) and Jones et al. (1997), include only *Triosteum angustifolium* within the flora of Texas. Therefore, the collection cited below is the first report of *T. perfoliatum* (*T. perfoliatum* var. *perfoliatum* sensu Brooks, 1986) in the state. The species is known from MA and NY, west to MN, eastern NE and KS, northeastern OK, south to northern GA, AL, MS and AR (Fernald 1950; Brooks 1986). There is also

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one record from Natchitoches Parish in northwestern LA (Thieret 1969; Thomas & Allen 1996).

The Anderson County location, located at the western limits of the Pineywoods, is a mature hardwood-pine forest dominated by *Pinus taeda* L., *P. echinata* Mill. (Pinaceae), *Quercus stellata* Wang., *Q. falcata* Michx. (Fagaceae), *Acer rubrum* L. (Aceraceae), and *Liquidambar styraciflua* L. (Hamamelidaceae). Common understory plants include *Rhynchosia latifolia* Nutt. ex T.&G. (Leguminosae), *Polygala polygama* L. (Polygalaceae), *Oplismenus hirtellus* (L.) Beauv., *Chasmanthium sessiliflorum* (Poir.) Yates (Gramineae), and *Elephantopus carolinianus* Raeusch. (Compositae).

The leaves of the specimen are distinctly panduriform and have margins that vary from entire to conspicuously crenate-sinuate. Small (1933), Fernald (1950), Radford et al. (1968), and Brooks (1986) all report strictly entire leaf margins for all species of *Triosteum* in the United States with the exception of the bases. *Thieret 26855* (LAF, TEX!), the only Louisiana collection of the species, has similar crenate-undulate margins on some of its leaves.

Voucher specimen. Texas. Anderson Co.: 3 mi WNW of Elkhart at Ivy's Preserve, 9 May 1998, *Singhurst, Fleming, Loper, & Loper 6832* (BAYLU).

The following key, based upon Texas material, may be used to distinguish between the two species of the genus now known from the state.

1. Flowers yellow, 1 per axil; bracts subtending flowers two, exceeding the length of flowers or fruits; calyx long hirsute, glandular hairs few; bases of midstem leaves narrowed. .... T. angustifolium
1. Flowers reddish to orange, (1–)2 or more per axil; bract subtending flowers one, ca. one-half the length of flowers or fruits; calyx densely puberulent, glandular hairs numerous; bases of midstem leaves perfoliate. .... T. perfoliatum

Triosteum angustifolium occurs from central CT, Long Island (NY), and PA, west to MO, southeastern KS, eastern OK, and east TX, south to GA and northern LA. Correll and Johnston (1970) give the distribution as east Texas, specifically Smith and Cass counties, both within the Pineywoods Vegetational Region. Hatch et al. (1990) list the species as occurring only in the Pineywoods. However, *T. angustifoium* is now known from the northern part of the Pineywoods and also from the northern part of the Post Oak Savannah in Lamar County.

Specimens examined. TEXAS. **Cass Co.:** between Linden and Avinger, 15 Jul 1969, *Amerson & Watson s.n.* (LL); same location, 3 Aug 1969, *Amerson s.n.* (SMU); 1 mi W of Linden, off Hwy 155, 17 May 1970, *Correll & Correll 38689* (TEX). **Lamar Co.:** 500–1000 ft W of Co. Rd. 34950 from a point ca. 1.8 mi NW of its jct with U.S. Rt. 271, ca. 2.9–3.0 air mi NNW of jct. U.S. Rt. 271 and FM 2648 N of Paris, Camp Maxey (Texas National Guard), N 33° 49' 25", W 95° 32' 55", 4 May 1994, *Carr & Wolfe 13737* (TEX). **Smith Co.:** Swan, 17 Sep 1902, *Reverchon 3208* (SMU).

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We wish to thank the curators of the following herbarium for the loan of specimens or other information that made this study possible: BRIT/SMU, SHSU, TAMU, and TEX/LL.

REFERENCES

Brooks, R.E. 1986. Caprifoliaceae. In: Great Plains Flora Association. Flora of the Great Plains. University of Kansas Press, Lawrence.

Correll, D.S. and M.C. Johnston. 1970. Manual of the vascular plants of Texas. Texas Research Foundation, Renner.

Fernald, M. L. 1950. Gray's manual of botany. American Book Co., New York, NY.

Hatch, S.L., K.N. Gandhi, and L.E. Brown. 1990. Checklist of the vascular plants of Texas. Texas Agricultural Experiment Station pub. MP-1655, Texas A&M University, College Station.

Jones, S.D., J.K. Wipff, and P.M. Montgomery. 1997. Vascular plants of Texas: A comprehensive checklist including synonymy, bibliography, and index. University of Texas Press, Austin.

Radford, A.E., H.E. Ahles, and C.R. Bell. 1968. Manual of the vascular flora of the Carolinas. University of North Carolina Press, Chapel Hill.

Small, J. K. 1933. Manual of the southeastern flora. University of North Carolina Press, Chapel Hill.

Steyermark, J.A. 1963. Flora of Missouri. Iowa State University Press, Ames.

Strausbaugh, P.D. and E.L. Core. 1978. Flora of West Virginia, 2nd ed. Seneca Books, Grantsville, WV.

Thieret, J.W. 1967. Twenty-five species of vascular plants new to Louisiana. Proc. Louisiana Acad. 32:78–82.

Thomas, R.D. and C.A. Allen. 1996. Atlas of the vascular flora of Louisiana. Vol. II, Dicotyledons. Acanthaceae-Euphorbiaceae. Louisiana Department of Wildlife and Fisheries Natural Heritage Program, Baton Rouge.

Voss, E.G. 1977. 1996. Michigan flora, Part III, Dicots (Pyrolaceae-Compositae), Bloomfield Hills, Michigan: Cranbrook Inst. of Sci. Bull. 61 and University of Michigan Herbarium.

BOOK REVIEWS

Diggs, George M., Jr., Barney L. Lipscomb, and Robert J. O'Kennon 1999. **Shinners & Mahler's Illustrated Flora of North Central Texas.** (ISBN 1-889878-01-04), hbk). Botanical Research Institute of Texas (509 Pecan Street, Fort Worth, TX 76102-4060) and Center for Environmental Studies (Austin College, Sherman, TX 75091). Sida, Botanical Miscellany 16. xiv + 1626 pp. $89.95. 174 color photos, 2,300 line drawings, color maps.

It has been a good many years since a genuine, bonafide complete hard-copy flora has appeared for Texas or any substantial part of Texas. Thus it is with some excitement that we received this new book. The reviewer of this new FLORA was daunted by the heft (at almost 10 pounds it builds up the deltoids etc.) and 1600 pages crammed with information. Obviously one cannot read every word and examine every illustration in a few hours of perusal. My notes are pretty effusive—with a lot of overused adjectives they'll rate a goose-egg in any journalism class—but who cares, so here goes: INCREDIBLE, FANTASTIC, WONDERFUL, BEAUTIFUL, ETC. WOW! To be more specific: COMPREHENSIVE, ENCYCLOPEDIC, INNOVATIVE. With every species illustrated—it's a new departure in Texas floras, a breath of fresh air. More than any other flora of the region, it approaches the oft-stated goals of floristic workers to combine professional soundness and completeness with usefulness and accessibility for people of all levels of botanical expertise, and for all sorts of consumers of botanical information. In short, this is a super-fine product of a dedicated, skilled, industrious and deeply knowledgeable team of experts, who are to be praised and congratulated along with their contributors and sponsoring institutions and publishers.

Now among the gushing words a little rain must fall. Perfection has been closely approached, not fully attained. In some hours of review, about 20 misspellings have been detected, all falling into the category of minor inconveniences, none resulting in serious misunderstanding. One literature citation was repeated under two different authorships. But even a nit-picker like me can find very little to carp about.

Naturally one can differ with the authors on some of their taxonomic judgments. (Whenever 10 taxonomists are present, 30 opinions exist on any given issue.) But no need to belabor that here. The authors' judgments are all defensible, even those that differ from mine.

The beauty of the volume itself, including the section on superb color photographs, bespeaks much loving attention to the details of lay-out, typography, binding, etc., and will add to its appeal to the general public, those elusive intelligent lay persons who may spot the book in Barnes and Nobles and be captivated for the first time by a meaty type of wild-plant botany, as opposed to the pabulum in the "wildflower" books.

Praise belongs not only to the team that produced the work, but to those nameless technoids who have given us electronic sending and processing of data, words and illustrations, and electronic layout and setting of type and illustrations. This reviewer thinks back to the almost totally unillustrated Texas flora that came out in 1970. Every word was written longhand, typed manually, edited, re-typed, edited, re-typed, edited and retyped. Finally, the huge typescript was taken personally (by Donovan Correll, on the train) to a vast print shop in Wisconsin where it was set (clackety-clack, clackety-clack) in hot lead on old Linotype machines. Then the galley proofs were mailed to this reviewer in Munich, corrected by him and by Correll, then sent back to Wisconsin for re-setting. Then the work was printed

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in an initial run of 3,000 copies. The signatures were assembled by hand and sewn together and the books bound (about one in three was defective on the first go-round). How blessed we are to have a brand-new publishing industry in the last few decades in which a lot of the processes are streamlined and quality is so much better controlled.

So let us praise and congratulate everybody involved in this effort, and publicize this great work vigorously so that it can become a part of the collections of every institutional library and many thousands of private individuals. And let us encourage these authors and others to produce equally useful floristic accounts for the rest of Texas and surrounding regions (as they say they already plan to do), and to produce not only hard-copy but CD-ROM versions and cyberversions subject to constant up-dating. And let us encourage even more foundations to support this type of work so that it may accelerate and flourish as a background informational field on which conservation efforts may proceed and so that public awareness and enjoyment of our wild treasures may accelerate. And all the people said: AMEN.—*Marshall Johnston.*

TAYLOR, RICHARD B., JIMMY RUTLEDGE, and JOE G. HERRERA. 1997. **A Field Guide to Common South Texas Shrubs.** (ISBN 1-885-696-14-0, pbk.) A "Learn about Texas" publication from Texas Parks & Wildlife Press, Wildlife Division. Distributed by: University of Texas Press, P.O. Box 7819, Austin, TX 78713-7819. $19.95. 106 pp, 116 color photos, 9 illustrations, 1 color map, 5 3/4" x 8 1/4".

An informative, easy-to-use plant identification field guide to 44 of the more common woody plants and cacti of South Texas. This handy field guide for landowners, land managers, conservationists and sportsmen provides a comprehensive reference on the most common species of woody vegetation found in the South Texas Plains, and includes information on their value to livestock, wildlife and humans.

The South Texas Plains area is a triangular region, roughly south and east of the line from Del Rio to San Antonio to Rockport. Also called the Rio Grande Plains or south Texas "brush country", it encompasses about 20.5 million acres, covering fifteen counties and portions of fourteen others. Over 281 species of woody plants and 32 species of cacti are recognized in the south Texas ecological region. The vast majority of these plants are found in the lower Rio Grande Valley. The 44 described in this book represent an estimated 75% of the overall brush and cacti biomass of the south Texas ecological region, including the Rio Grande Valley.

In the 1400s and 1500s, this area was dominated by grasslands, but woody plants were often present in thickets, upland areas, major drainage's and river bottoms. Natural fires helped maintain the region as a grassland or savannah, reducing woody plant densities. With the migration of early settlers and their livestock in the 1800s, brush densities increased due to overgrazing, along with other factors such as lack of natural fires, soil compaction and periodic droughts. This increase of brush density was eventually considered detrimental by ranchers. Brush control and range reseeding began in the late 1930s and early 1940s, however, by the 1960s, research by wildlife biologists indicated extensive brush control was detrimental to wildlife. White-tailed deer hunting was on the increase by the 1950s giving landowners an economic incentive into providing quality habitats. Since then, brush removal has been reduced or applied in a manner that is not detrimental to wildlife, thus improving the habitat for deer and other wildlife species such as birds, reptiles, rabbits, ground squirrels, bobwhite quail and wild turkey.

Identification of these key food plants and knowing their nutritional value becomes an important aspect of evaluating habitat, range condition and ecosystem health of the South Texas Plains area.

Grouped into thorned and thornless categories, the plants are alphabetized by family with common and scientific names given. Each plant is laid out in a two page spread with often three color photos showing habit, flowers and fruit. Text includes the description and values of the plant to wildlife, cattle, goats, as well as humans and a nutritional Crude Protein Value chart for each plant. A summary chart is provided showing the percentage of nutritional values of crude protein (CP), digestible protein (DP), and digestible dry matter (DMD) for each season of the year. In addition, a bibliography, illusrrated glossary and index are provided.

With the ever increasing need to conserve our resources, it would seem to me that many of these plants could be incorporated into the South Texas homeowner's landscape. Native plants not only provide beauty and ease of care, they can provide a welcomed food source to some of the most coveted visitors into our gardens … butterflies and hummingbirds.—*Linny Heagy.*

PAUL KENRICK AND PETER R. CRANE. 1997. **The Origin and Early Diversification of Land Plants A Cladistic Study.** (ISBN 1-56098-729-4, pbk; 1-56098-730-8, hbk). Smithsonian Institution Press, 470 L'Enfant Plaza, Suite 7100, Washington, DC 20560. 202-287-3738, ext. 343. $27.50 pbk, $55.00 hbk. 441 Pp.

This book represents the first attempt to synthesize the classical approach to land plant evolution with the modern approaches offered by morphogenetic and molecular evidence presented in a phylogenetic context. The book is divided into 7 chapters, followed by 5 appendices, an exhaustive bibliography, taxonomic and subject indices.

The first two chapters give a historical background, a primer on phylogenetic systematics, and the applications of paleobotanical data to modern systematic studies. It is followed by a cogent summary of our current understanding of the kingdoms of organisms and the higher ranks containing "plants". The subsequent three chapters cover the Embryobiota, Polysporangiophytes, Zosterophyllopsida and Lycophytes, and Lycopsida. Each section deals with the origins of the group's concept, systematics, phylogenetic questions and aims of analysis, choice of taxa, character descriptions and coding, analysis, results and discussion. This organization of data is the first of its kind, and clearly points out the depth or dearth of our current knowledge for each character, its origin, morphogenesis, evidence from the fossil record, and systematic utility. For each analysis and result, step-by-step explanations are clearly given, limits of available data are thoroughly discussed, and suggestions for future work outlined. The purpose of the series, "...to publish innovative studies in the fields of comparative evolutionary biology, especially by authors willing to introduce new ideas or challenge or expand views now accepted." is truly fulfilled in these chapters. I can think of no more cogent summary of what we know, what questions remain, and how we might proceed to answer them.

The last chapter, "Perspectives on the early evolution of land plants" is the most illuminating of all. In addition to the proposed classification of the Chlorobiota to the level of infraclass, it offers a clear explanation of such concepts as the annotated Linnaean conventions recommended by Wiley, with several additions that logically permit the systematic positioning of fossil groups. Comparison of the phylogentic classification presented for the land plants, together with the historical and modern processes underlying character analyses, give all students of plant evolutionary biology a fundamental understanding of the strengths or weaknesses of competing concepts. I found the discussion of microphyll evolution in lycopods particularly complete, in which the three competing hypotheses: reduction, enation and sterilization, are explained in detail, first in ontogenetic, then in taxic homologous terms.

The appendices are detailed and give us a picture of how reliable fossil evidence is for key groups, followed by complete character and character state coding tables. The bibliography is extensive, as are the taxonomic and subject indices. This book is a must as a foundation for any major graduate course in plant comparative morphology or systematic and evolutionary biology. I wish it had existed when I was preparing for my doctoral comprehensive exam!—*John J. Pipoly III.*

James Mauseth. 1998. **Botany. An Introduction to Plant Biology, 2nd Ed. {Multimedia Enhanced Edition}.** (ISBN 0-7637-0746-5, hbk; ISBN 0-7637-0406-7, CD ROM). Jones and Bartlett Publishers, 40 Tall Pine Drive, Sudbury, MA 01776. $75.00. 794 Pp. text, 20 Pp. glossary, 23 Pp. index.

Marshall Sundberg. 1995. **Instructor's Resource Manual to Accompany Botany: An Introduction to Plant Biology, Second Edition/** Ann M. Mickle and James E. Mickle. **Test Bank and Bio Art.** (ISBN 0-03-005892-9, pbk). Harcourt Brace & Company. No separate price given. 387 Pp. text; 37 Pp. illustrations.

This textbook, CD-ROM, instructor's manual, and enhanced web site (http://www.jbpub.com/botanylinks) provides the most comprehensive set of modern, multimedia course materials this reviewer has ever seen. It is truly impressive!

The textbook is constructed in one of the most logical, easiest-to-use ways imaginable. The preface clearly states that "three topics are so important, so fundamental, that they must permeate every aspect of an introductory botany textbook and should be mentioned or alluded to on every page: they are evolution by natural selection, analysis of botanical phenomena, and diversity of organisms and all their components."

The book is divided in four parts: plant structure, plant physiology and development, genetics and evolution, and ecology. The "part openers" section that introduces each part summarizes the chapters belonging to each part, and how those themes relate to the other respective parts. Within each of the 27 chapters, a "concepts" section comprises several

---

pages and provides an annotated outline of the subjects that will follow. There are "plants and people" boxes in each chapter, that serve to explain the way in which the information in the chapter relates to our everyday lives. These boxes are surely an "autapomorphic character state." In addition to the plants and people boxes, there are 27 boxed readings scattered throughout the text that represent ancillary reading related to the subject treated in the chapter. The accompanying interactive CD-ROM is referenced in the preference and each sector of the CD-ROM is associated with a chapter or part of the book. The text is richly illustrated with high-quality, full color photographs; SEM, TEM or light photomicrographs; and finally, color or black-and-white original artwork, illustrating significant structures and concepts. Other features, including the marginal notes, summary, important terms section, review questions and BotanyLinks.net questions combine to provide a formidable set of learning tools.

What immediately set this texr apart from any other I have seen is the nesting of the informarion. Depending on the level of the students taking the course, selected parts of the introduction can be used or skipped, and the supplementary materials provided on the CD-ROM can be required or used as a supplement. The coverage of topics, coordination among the text, CD-ROM and net resources (including movie shorts), tables, charts, boxes, artwork and photographs sum to immerse the student in a truly multimedia experience. The text is written in an extremely clear and concise style that painlessly introduces complicated material in a step-by-step fashion. The book has obviously been tested and retested for ease-of-use, clarity of presentation, and thoroughness, based not only on feedback given to Mauseth in the years he has used this ever-evolving text, but through the comments of the thirty reviewers he thanks in the preface. Each subject area is absolutely current and is meshed with those that preceded it and those that follow. The book is printed on high-quality glossy paper with a sturdy cover and attractive binding.

Ancillary materials for the instructor include the *Instructor's Resource Manual*, the *Test Bank and Bio-Art*, a set of 150 full-color overhead transparencies, the *Plant Biology Tutor CD-ROM*, the *Instructor's CD-ROM*, and a Video Resource Library.

The Instructor's Resource Manual contains 27 chapters, corresponding to the text, with detailed instructions for setting up a lab to correspond with the chapter treated in the text. In addition, the Resource Manual contains two appendices, "Tree Keys" and "Field Trips." The keys are for common trees of either the northeastern or southeastern U. S., while the field trips cover areas including the Pacific Northwest, the Desert Southwest, the Southeastern Forests, and the Northeastern Forests. Each of the field trip sections includes specific directions to major parks that show selected habitats, a material, equipment and preparation section, and a reference section. The Plant Biology Tutor CD-ROM is menu-driven, easy to install, and a treasure chest of information closely linked to the principal text. I have not seen the overhead transparencies or the Instructor's CD-ROM, but I assume that they are of the same excellent quality as the other components of this fantastic set of teaching tools.

In summary, I can unhesitatingly recommend adoption of this book by any department offering inrroductory plant biology. It covers the subject in an exhaustive manner, has its information uniquely nested, uniquely presented among written text, fantastic photographs and artwork, an interactive CD-ROM and web site, and materials that require very little if any modification for use in any geographical area.—*John J. Pipoly III.*

Karl Niklas. The Evolutionary Biology of Plants. 1997. (ISBN 0-226-58083-0, pbk) The University of Chicago Press, 11030 South Langley Avenue, Chicago, IL 60628. $24.00. 449 Pp.

As stated by the author in Chapter 2, "The concept that individuals can be grouped into populations and that populations can be grouped into discrete biological units called species is a central tenet in biology." Niklas is to be commended for a treatment of both micro- and macro- evolutionary theory that combines basic elements covered in the classic works on biological and evolutionary species, (Carlquist, Cronquist, Dobzhansky, Erhlich, Gould, Grant, Stebbins, et al.) with those of the phylogenetic school, (Eldredge, Cracraft, Wiley, Mishler, et al.), in a refreshingly new, synthetic way. The book is divided into four parts, including a comprehensive review of "evolutionary basics", "life's chronicles: the fossil record," adaptive walks: a hypothesis," and "long-term trends." The book is the first I have seen that has a strong botanical morphogenetic and paleobotanic emphasis, as well as a presentation of the adaptive walk concept.

The first part, dominated by a discourse on population genetics, is aimed at the advanced undergraduate or beginning graduate student, and is written in a clear, concise manner. I found relatively few omissions, with the exception of a discussion of character displacement vs. the Wallace Effect. However, the early introduction of phylogentics is to be applauded, as is the historical review of Sewall Wright's and others' work with fitness. His introduction to species and speciation, with emphasis on heterochrony are rare in textbooks of this kind. While I would have liked to see more detail regarding morphogenetic abbreviations and additions (sensu Takhtajan and later, Funk and Brooks), the relationship of those concepts to that of the puctuated equilibrium hypothesis offer a balanced review. The concepts of hybridization, polyploidy and introgression are dealt with in a particularly straightforward manner.

The second part deals with the origins and early events in plant evolution, concomitant with the invasion of land and air. Using molecular evidence, paleobotanical evidence, and morphogenetic evidence, Niklas strings together a picture of early land plant evolution that brings the student through the basics of molecular, cellular, histological, vascular and reproductive evolution, first in their historical, then in their modern contexts. It presupposes that the student possesses a firm grasp of the comparative morphology of land plants, but it is, nonetheless, a synthesis that does not exist elsewhere.

The third part of the book, dealing with adaptive aquatic and terrestrial "walks" is the most unique because of its physiological aspects. It is far from light reading, because it contains some of the most complicated of subjects, including physical, physiological and morphogenetic principles rarely discussed in an introductory text. However, it is written so that one logically progresses from the unicellular to multicellular, then the aquatic to the terrestrial habitat, with extensive discussion of the physiological, ontogenetic and anatomical changes necessary to make those transitions. The only oversight I detected is a consequence of my preference to present discussions of genetic spirals and contact parastichal sets simultaneously when teaching phyllotaxy.

The final portion of the book covers long-term trends, including divergence vs. convergence, and tempos vs. events. In the section on divergence and convergence, homology and analogy are clearly differentiated, with examples ranging from the classic paleobotanical and modern morphogenetic. While most texts in this area are dull and boring, the many illustrative examples, and the quotations from Ernst Mayr and Yogi Berra certainly make it entertaining as well as instructive. While the discussion contains more inductive than deductive reasoning than the chapters that preceded it, the synthesis of evidence from paleobotanical to modern examples informs the student of the historical bases for modern opinions. The final chapter, including explanations of cpDNA, mtDNA and nDNA, rates of genomic evolution, molecular clocks, species orogeny and demise, followed by the fossil record of speciation and extinction, offers another unique synthesis of information normally scattered between micro- and macro-evolutionary course texts.

In summary, this book is an excellent choice for any one-semester course in plant evolution. It is a bargain that should not be missed. With supplementary reprints from pertinent works in population genetics, morphogenesis, and phylogenetic theory, it could easily serve as the backbone of a two-semester graduate course in plant phylogeny. I heartily recommend it to any university biology instructor or student of evolutionary biology. —*John J. Pipoly III.*

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NEW PLANTS FROM CRATER MT., PAPUA NEW GUINEA, AND AN ANNOTATED CHECKLIST OF THE SPECIES

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ABSTRACT

An exploratory survey of the Crater Mt. Wildlife Management Area (CMWMA) has revealed the presence of at least 1,200 vascular plant taxa within the 2,700 sq. km reserve. Included among the findings are several new species and a significant number of distributional records. Three novelties are formally described and illustrated. The new species are *Glochidion beehlerii*, *Jasminum pipolyi*, and *Psychotria matambuai*. An annotated checklist of the collections is also provided.

The botanical documentation for the CMWMA is one of the most substantial for any locality in Papuasia. The preservation status and floristic richness of surveyed communities are very high, comparing favorably with the best sites in Papua New Guinea. Continued application of the ICAD (Integrated Conservation and Development) strategy is recommended for the subject area.

ABSTRACT (TRANSLITERATED JAPANESE)

Crater zan yaseiseibutu kanri chitai chousa niyori 1,200 ijou no ikansoku (kansoku) shokubutsu bunrui guntai no sonzai ga 2,700 heihou kilometoru inai de kiroku shoumei sareta. Hakken saretamono no nakani fukumareteirumono wa kazukazu no shinshu to soutou naru kazu no mezurashi ishu shokubutsu to bunpukuiki kiroku dearu. Mittsu no mezurashii shokubutus wa seishiki ni kijyutsu oyobi zukai ni yori shimesareta. Shinshu wa *Glochidion beehlerii*, *Jasminum pipolyi*, soshite *Psychotria matambuai* dearu. Chushaku tuki no shushu butsu ichiranhyou mo futai sareru.

Crater zan yaseiseibutu kanri chitai no shokubutusgakuteki bunken wa Papuasian chihou nitotte mottomo kuwashi monono hitotus de aru. Chosa sareta shkubutsu gunraku no hozonjotai oyovi shokubutussou no yutakasa wa soutou ni takaku, Papua New Guinea no sairyou na basho ni masaru hododearu. Kadai to sareteiru chiiki ni taisuru tougouteki hogo oyobi kaihatu doryoku wo zokkou surukoto ga shourie sareru.

INTRODUCTION

Papua New Guinea's (PNG) biotic environments are a focal point for numerous specialist studies, in large part due to the extraordinary diversification and endemism of its flora. In an effort to preserve this biota, conservation initiatives in PNG have been recently defined and prioritized by a number of

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multiagency evaluations, of which the most consequential are the Conservation Needs Assessment Report (Beehler 1993), and the Papua New Guinea Country Study on Biological Diversity (Sekhran & Miller 1995). The Crater Mt. Wildlife Management Area (CMWMA) is listed by these appraisals in their site portfolio of localities with critical floristic or biodiversity significance (Johns 1993: 26; Sekhran & Miller 1995: 121). Despite its pristine condition and high-value biotic estimates, little information on the CMWMA's botanical resources had previously been available. A floristically-oriented census was thus initiated in 1997 to acquire data for determining the diversity and population status of CMWMA plants.

SITE SUMMARY

The 2,700 sq. km territory of the CMWMA (Fig. 1) encompasses a mosaic of floristic environments ranging from alluvial communities at 150 meters elevation to montane cloud forest at 2,100 meters. Except for scattered and localized seres resulting from subsistance agriculture, the forest formations are primary. Life zones from the lowland, premontane, and montane contours are fully represented within the project boundaries. Surveys conducted to date have examined alluvial swamp forest, lowland everwet forest, premontane foothill forest, and stunted montane forest. Within the premontane and montane zones, there are various topographic-edaphic subunits with distinctive floristic assemblages and taxonomically characteristic seral sequences. The CMWMA also includes aquatic habitats represented by lakes, oxbows, springs, permanent streams, and waterfalls. The various elements collectively comprise an unusually comprehensive habitat suite, all located within an administratively cohesive conservation unit accessible only by air.

GENERAL DISCUSSION

The following account of plant resources in the CMWMA is based on intensive collections from a two-year period of exploration. Forests near the villages of Haia and Maimafu served as principal venues for the botanical survey.

In Appendix 1, plant taxa are referenced by the specimen voucher or other source for the occurrence claim. Nearly all registers are supported by fertile collections made in multiple sets for international and local distribution. The Lae National Herbarium (LAE) is the repository for unicates, first sets, and holotypes. Recipients of duplicate sets have been designated in accordance with LAE's exchange protocols, on which Kew (K), Rijksherbarium (L), and Harvard (A), are the primary receiving institutions. Residual sets will be allocated by LAE under their auspices, in compliance with previous agreements made with our PNG host organization.

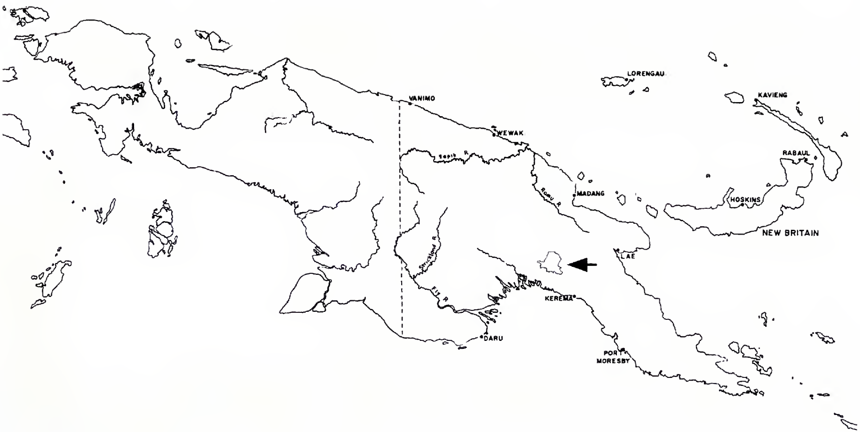

FIG. 1. Island of New Guinea. Arrow: Crater Mt. Wildlife Management Area.

Collections were field-preserved with 70–75% isopropyl alcohol and transported in plastic wrap to facilities of the PNG Forest Research Institute (PNGFRI) for subsequent processing. Taxa encountered only in sterile condition or otherwise not obtainable, were enumerated as a sight record if the plant was unequivocally known to the writer (viz. 'SR' in Appendix 1). Whenever possible, such sightings are referenced against LAE collections made by other botanists within the Purari drainage; primarily by the former Department of Forests or by CSIRO botanists L.A. Craven and/or R. Schodde. Other collector citations are provided in Appendix 1.

The survey's original intention of developing a baseline census along the CMWMA's full elevational gradient remains out of reach. In view of the 2,700 sq. km area of the reserve, this objective is an ambitious one under any scenario. Although the total species content of the CMWMA remains conjectural, establishing an estimate is still attainable with respect to checklisting the plants likely to be encountered by researchers working in the area. No empirical measure has yet been developed for the total number of plant species enclosed by Papuasian habitat gradients, whether or not assessed on vertical or horizontal lines, though Johns (1993: 26) estimates 2,000+ taxa for the Crater Mt. area. The Johns' estimate appears reasonable and is probably conservative. But if accurate, this should mean that the present itinerary has yielded up to 60% coverage of the CMWMA's total taxonomic content.

Of the floristic environments examined thus far, the forests around Maimafu have received the most complete attention. As the CMWMA's high-elevation antipode, the Maimafu area was expected *a priori* to have the lowest richness and to be the easiest to achieve collections saturation. Mid-montane stations like Herowana are not included in this summary, but since such sites are ecologically interposed between Haia and Maimafu, many of its plants are probably already checklisted by existing collections. The conspicuous lacuna is the alluvial formation represented by Wabo and comparable sites at the CMWMA's low elevations, where floristic documentation is still generally inadequate. The largest potential advances toward a comprehensive understanding of the CMWMA's flora will be made through critical examination of the lowland alluvial zone, notwithstanding the earlier work done by LAE and CSIRO in the Purari drainage.

A salient aspect of general appraisals of the Papuasian flora is the recognition of a remarkably diverse orchid component with more than 2,000 species (Schlechter 1911–1914, Johns 1993) and the existence of a comparably rich complement of ferns (Parris 1974). Orchidaceous and pteridophytic elements should normally peak in montane forests like Maimafu, but this has not been demonstrated by the survey because of the unfortunate circumstances imposed by the el Niño disturbance. The CMWMA was severely impacted by the recent drought, with considerable losses noted among epiphytic plants.

Enumeration of orchids, ferns, and other herbs was severely preempted. Because these assemblages are typically among the richest groups in the Papuasian montane zone, it is certain that the survey coverage was less comprehensive than if a comparable evaluation had been conducted under the conditions usually prevailing. In comparison, fruticose and phanerophytic plants were less affected by drought and responded to the resumption of rainfall with mass flowering and fruit production. The woody plants are thus better represented in the expedition gatherings.

The checklist in Appendix 1 incorporates results from earlier surveys in the Purari basin, conducted during the 1970's by CSIRO and LAE botanists. The LAE gatherings were made primarily in the Wabo area by what was then the Department of Forests, and were part of the LAE institutional number series. The CSIRO sets originate mainly from the lower part of the drainage bordering the CMWMA proper, from areas subject to the same habitat and forest conditions as are present at Pio-Wabo. These latter collections were more extensive than the LAE survey and are numbered under L.A. Craven and R. Schodde's personal number sequences. The cumulative CMWMA checklist presently includes 167 vascular plant families, 592 genera, and ca. 1,200 morphospecies, but it is obvious that an undetermined number of taxa remain unrecorded.

On a comparative percentage basis, the low elevation ecosystem at Crater Mt. is still unexplored and likely to reward future investigators with a disproportionate number of discoveries. It can be noted in this connection that the Maimafu collections consist largely of taxa already well-documented from the Highlands region. The montane affinity of the CMWMA is clearly with the general Highlands flora. However from the status of the Central Ranges as a floristic barrier, it can be surmised that lowland forests of the CMWMA should contain peculiarized and endemic elements, as has been shown by the novelty value of the CSIRO collections from low elevations.

DESCRIPTIONS OF NEW SPECIES

EUPHORBIACEAE

Glochidion beehlerii Takeuchi, sp. nov. (**Fig. 2**). TYPUS: PAPUA NEW GUINEA. CHIMBU (SIMBU) PROVINCE: Crater Mt. Wildlife Management Area, E of Haia village, hill forest with some anthropogenic disturbance, 6° 43' S, 145° 00' E, 775 m, 15 Mar 1997 (fr), *W. Takeuchi 11,796* (HOLOTYPE: LAE; ISOTYPES: A, K, L).

Arbor mediocris, circiter 15 m alta, habitu caulifloro, ramulis teretibus. Folia (matura) fere ovata vel elliptica, usque 17.5 cm longa, 8 cm lata. Capsula breviter obovato-pyriformis, 10–15 mm longa, 14–18 mm lata.

Subcanopy tree, 15 m height. *Stem* unbuttressed, outer bark pale brown, not furrowed, slash pinkish-red, wood dense, straw. *Branchlets* slender, weak, terete, distally fracriflex, indumentum hirtellous, brunneous, harsh. *Stipules*

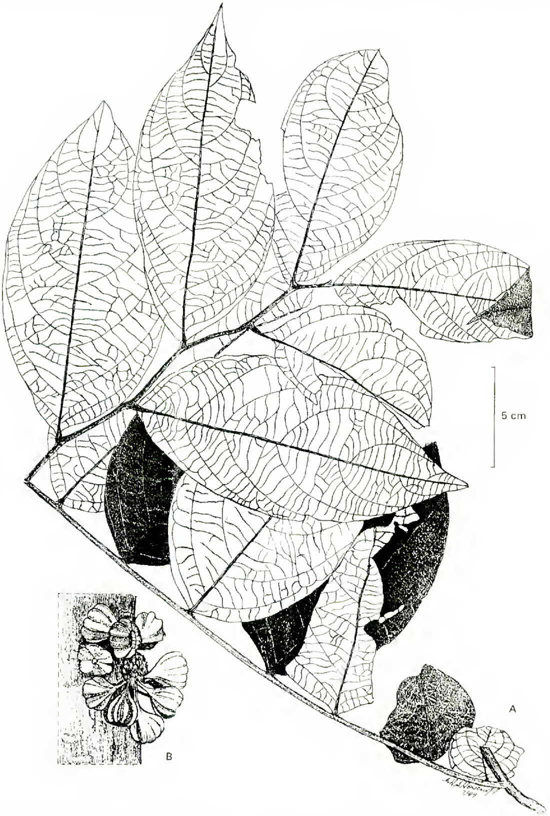

FIG. 2. *Glochidion beehlerii* Takeuchi, sp. nov. A. Branchlet. B. Fruit cluster on main stem. Drawn from holotype by N.H.S. Howcroft.

linear-acuminate to subulate, caducous or persisting through several nodes, typically 3.5–4.0 mm × 0.3–1.0 mm, hirtellous. *Leaves* alternate, distichous, decrescent on the branch, the lower ones orbicular-subcordate, 3.5–5.0 cm wide, acroscopically with the leaves ovate and ultimately elliptic, to 10.5–17.5 cm × 5–8 cm; blades thin-coriaceous or papery, sub-bullate, bichromatic, adaxially dark green and glabrescent, abaxial surfaces strikingly blue-green glaucous and with densely hirtellous nervation, larger blades gradually acuminate, margin entire, base equal and obtuse; venation pinnate, laterals 4–7 antrorsely directed pairs, arcuate, closing with commissural loops or not, crossing nerves subscalariform, major veins prominulous above, more raised beneath, reticulum ventrally obscure or invisible, dorsally manifest, areoles pulverulent; petiole 3–4 mm long, slightly swollen, articulated at base. *Inflorescence* not seen. *Infructescence* cauline from base of trunk, arranged in congested hemispherical clusters on moundlike eruptions of the wood. *Schizocarp* obovoid, pyriform, or depressedly globose, solitary or several together on a short ramification, mature fruits 10–15 mm × 14–18 mm, 8–9 ribbed, 1–2 mm stipitate or not, exterior surfaces subappressedly puberulous, rather hyaline, soft pink in vivo, summit broadly recessed and centrally pitted, style column deciduous, not seen; fruiting pedicel concolorous with exocarp, 2–12 mm long, puberulent; calyx persistent, 6-partite, sepals lanceolate, 2–3 mm × 0.5–1.25 mm, laxly hirtellous. *Seeds* 2 per cell, enveloped with a smooth orange arilloid.

Distribution and ecology.—*Glochidion beehlerii* is apparently a mid- or late-seral species in forest regrowth. It is locally common at the type locality but has thus far not been collected elsewhere. The ripe fruits are said to be eaten by cassowaries.

Etymology.—The new binomial recognizes Dr. Bruce Beehler, a noted ornithologist and frequent contributor to our knowledge of Papuasian natural history. Dr. Beehler was formerly a senior ecologist for Conservation International and is currently the Director for Environmental Conservation at Counterpart International.

PARATYPE: PAPUA NEW GUINEA. CHIMBU (SIMBU) PROVINCE: Crater Mt. Wildlife Management Area, vicinity of Haia, near the Wara-oo streamcourse (first river E of Mt. Widau), alluvial forest, 6° 43' S, 145° 00' E, 640 m, 30 Sep 1996 (fr), *W. Takeuchi 11,303* (BRIT, LAE).

Glochidion beehlerii will not enter Airy Shaw's (1980: 92–96) key because of the cauliflory, a condition previously unknown for Papuasian representatives of the genus. There are two cauliflorous species from western Malesia (*G. oxygonum* Airy Shaw from the Moluccas, and *G. cauliflorum* Merr. of the Philippines, cf. Airy Shaw 1969: 12), but the present taxon is incompatible with either one.

The new *Glochidion* produces large clusters of pyriform fruits at the base of the trunk. Except for the fructification, it is superficially similar to *G. caloneurum* in overall appearance.

OLEACEAE

Jasminum pipolyi Takeuchi, sp. nov. (**Fig. 3**). TYPUS: PAPUA NEW GUINEA. BORDER OF CHIMBU (SIMBU) AND GULF PROVINCE: Crater Mt. Wildlife Management Area, alluvial forest near Pio River, 6° 47' S, 145° 02' E, 440–460 m, 23 Mar 1997 (fl, fr), *W. Takeuchi 11,866* (HOLOTYPE: LAE; ISOTYPES: A, K, L).

Inter congeneribus Jasmino Papuasiae differt fructus maximus, cocco usque 35 mm diametro. Foliis trifoliolatis et glabris, inflorescentiis lepidotis.

Sprawling suffrutescent, or scandent vines. *Stems* terete, glabrous, glossy green, inermous, virgate, without exudate. *Leaves* opposite, exstipulate, epunctate, entirely glabrous, pinnately trifoliolate, very rarely unifoliolate but then with an articulated petiole; rachis and petiolules green, adaxially sulcate; leaflets induplicate, coriaceous, adaxial surfaces dark green nitid, abaxially medium green, apex gradually acuminate, margin closely reflexed, base cuneate or rounded, lateral blades generally lanceolate, 6.5–9.0 cm × 1.75–3.0 cm, terminal blades elliptic, 8–12 cm × 2.5–5.0 cm; venation pinnatiform, midrib channelled above, prominent beneath, laterals 5–8, thin, plane or prominulous, undersides with domatia-bearing axils, the domatia distinctly immersed, crateriform, bearded, reticulum lax and irregular, dried leaves typically developing characteristic indentations along nerves; petioles 12–23 mm long, concolorous with stems, not grooved. *Inflorescence* terminal or from subapical axils, cymose, monochasial or more often dichasial, obliquely ascending, the larger ones paniculiform and leafy, to 17 cm length, all axes peltately squamulate, bracts linear, to 6.5 mm long, persistent, granular, pedicels 4–7 mm long, gradually thickened distally, weakly constricted at the calyx. *Flowers* (rehydrated measurements) bisexual, brevistylous, heterostyly not seen; calyx funnelform, 2.0–3.0 mm long (exclusive of teeth) to 2.5 mm wide, slightly accrescent, light green, tube glabrous, limb 5–6 denticulate, obscurely fimbriate, denticulations linear-subulate, 0.2–1.0 mm long; corolla salverform, imbricate, white, entirely glabrous, obtuse in bud, tube 10 mm × 2.0 mm, costate, laxly tuberculate at first, lobes 5 sometimes 4, elliptic-oblong, 6–8 mm × 3–5 mm, mucronulate; androecium included, stamens 2–3, adnate to tube 2.5 mm from its base, filaments 0.5 mm long, anthers oblongoid, 3.5 mm long, connective inconspicuously apiculate; gynoecium glabrous, superior, 1 mm height, ovary undulate at the summit, style 0.5 mm long, weakly compressed and tapered, stigma punctiform, presented below the filaments. *Berry* geminate (aberrantly with cocci 3 or 1), lobes rounded, monospermous, 31–35 mm diameter, connate for ca. 20 mm, exocarp very smooth, nitid, glabrous, hyaline, pearly white with suffused green mottling, pericarp pulpy, greenish within. *Seed* white, hollowed.

Distribution and ecology.—Diffusely spread and locally frequent at the type locality. Conspicuous in edge situations along streambanks and forest margins but also seen in otherwise closed forest environments.

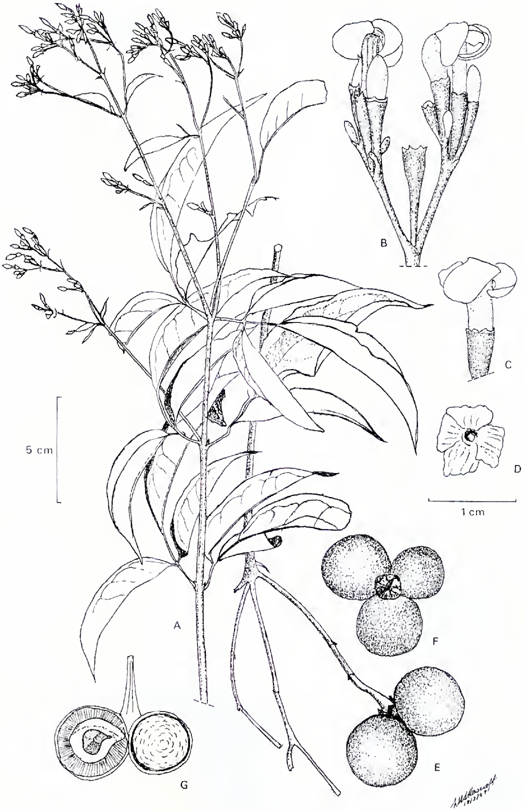

FIG. 3. *Jasminum pipolyi* Takeuchi, sp. nov. A. Habit of flowering plant. B. Dichasium. C. Flower from side. D. Flower, distal view of limb. E. Infructescence habit, with typical bilobed fruit. F. Berry, aberrant trilocular form. G. Fruit in cross-section. Drawn from holotype by N.H.S. Howcroft.

Etymology.—The new binomial recognizes John J. Pipoly III, a specialist in Myrsinaceae and Clusiaceae. John Pipoly is a colleague and Head of Floras at the Botanical Research Institute of Texas.

Malesian *Jasminum* have been checklisted by Kiew (1994) with 9 species accepted for Papuasia. Lingelsheim's outdated key (1928: 18) is still the only one extant.

Fruiting specimens of *Jasminum pipolyi* are immediately distinguished by the exceptionally large fruits, which are strikingly translucent mottled. Also characteristic is the combination of squamulate inflorescence and glabrous, trifoliolate leaves which are crinkled along nerves when dried.

RUBIACEAE

Psychotria matambuai Takeuchi, sp. nov. (**Fig. 4**). TYPUS: PAPUA NEW GUINEA. EASTERN HIGHLANDS PROVINCE: Crater Mt. Wildlife Management Area, ridge complex above Abegarema village on the crestline to Mt. Mopahveh, short-stature montane forest, near GPS coordinates 92802843 N, 28240 E, elev. 1,768 m, 02 Aug 1998 (fl, fr), *W. Takeuchi 12.920* (HOLOTYPE: LAE; ISOTYPE: BRIT).

Psychotria bowcroftii Takeuchi affine, sed ramulis ad nodis furfuracea, inflorescentia subcondensata, non glabra, cum pedunculo breviori (non trichotoma ex basi).

Shrub or subarborescent in mature forest understories. *Branchlets* green, fleshy, pithy, cylindrical and robust, collapsed in sicco, furfuraceous with pale brown innovations at nodes, otherwise glabrescent. *Stipules* valvate, hyaline or opaque, fugacious or semipersistent at subapical nodes, deltate, to 16 mm × 13 mm, entire, weakly carinate, laxly provided with setuliform hairs on dorsal and ventral surfaces. *Leaves* decussate, glabrous, spreading, whether or not conferted; blades fleshy-coriaceous, lacking domatia, elliptic to oblanceolate, more often broadest above the middle, 11.0–23.5 cm × 4.25–9.0 cm, ±concolorous, adaxially very dark green, abaxially medium green, bifacially somewhat fuscous with drying, apex acuminate from an obtuse or tapered summit, the acumen generally 1–2 cm long, base gradually narrowing to a petiole 3–4 cm long; venation pinnatiform, major veins elevated, laterals equispaced, 15–19 pairs, divergent, arcuate, abruptly turned near the margin but generally not closing, reticulum irregular, obscure or hardly raised above, prominulous beneath. *Inflorescence* contracted, strictly terminal, paniculiform, 2–4 cm long, ramifications verticelled or not from a peduncle at most 1.5 cm long, ultimately cymose, caducously bracteate, rachises greenish, provided with scalelike ±crisped hairs, commissures furfuraceous. *Flowers* (rehydrated measurements) seen in advanced bud only, cymes crowded, glabrous without on all parts, pedicels proximally articulate; calyx turbinate, 7–8 mm × 6 mm, margin truncate or tearing irregularly, tube smooth, base passing insensibly to the pedicel; corolla white, gamopetalous, obtuse in bud, valvate, penta- or hexamerous, petals ligulate, 9–10 mm x 3.0–3.5

Fig. 4. *Psychotria matambuai* Takeuchi, sp. nov. A. Habit. B. Furfuraceous nodes on branchlet. C. Stipule. D. Drupe, exterior aspect. E. Drupe in cross-section, with pyrenes and ruminations. Drawn from holotype by N.H.S. Howcroft.

mm, tube cylindrical, 4–5 mm × 4–5 mm, throat marked with a 3 mm ring of uniseriate-septate hairs, otherwise glabrous; stamens alternipetalous, inserted in the sinuses, glabrous, filaments 2.5 mm long, anthers introrse, basifixed, exserted, oblongoid, 3.0–3.5 mm x 1 mm; style 8 mm long, but ?heterostylous, stigma 2-fid, 3 mm long, papillate, presented at the level of the anthers; disk glabrous, shallowly excavated in the center. *Drupes* obovoid, 19–21 mm × 14–16 mm (exclusive of calyx), orange-brown, pericarp at first entire, angulate and blackened after drying, apex crowned by the erect calyx remnant, the calycine residue 4–5 mm long, tubular, cylindrical to infundibular. *Pyrenes* 2, equal, triquetrous, crested, endosperm filling the entire cavity, ruminations transversal.

Distribution and ecology.—*Psychotria matambuai* is a montane umbrophile restricted to understories of mature forest stands. It is known thus far from Mt. Bosavi and the Crater Mt. area, being especially plentiful at the latter locality.

Etymology.—The new binomial recognizes Karol Matambuai Kisokau, a former Secretary of the PNG Department of Environment and Conservation. Karol Kisokau had also served as the first General Manager of the Crater Mt. WMA and is currently Director of Conservation and Research of the Lae-based Village Development Trust.

Other specimens examined: **PAPUA NEW GUINEA. Southern Highlands Province:** Northern slopes of Mt. Bosavi, primary montane forest dominated by *Syzygium* and *Nothofagus*, 06° 28' S, 142° 50' E, elev. 1,800 m, 22 Aug 1986 (fr), *O. G. Gideon in LAE 57,347* (BRI, K, L, LAE). **Eastern Highlands Province:** Crater Mt. Wildlife Management Area, ridge above Maimafu airstrip to base of cascade at Mt. Mopahveh, montane forest near GPS coordinates 92802843 N, 28240 E, elev. 1,495–1,585 m, 16 Jul 1998 (fl), *W. Takeuchi 12,130* (A, K, L, LAE); Crater Mt. Wildlife Management Area, buttress ridge to Mt. Aretame above Hauneabäbo village, natural growth montane forest, near GPS coordinates 9281348 N, 284190 E, elev. 1,677–1,830 m, 25 Jul 1998 (fl), *W. Takeuchi 12,602-B* (BRIT, LAE).

The new species is allied to the recently described *Psychotria howcroftii* Takeuchi of the Bismarck-Ramu foothills of northern PNG. The large drupes with cyathiform calycine residue are characteristic of both taxa. Since *P. matambuai* is apparently confined to the southern (Papuan) side of PNG, the species pair provides yet another example of the evolutionary floristic separations imposed by the Central Ranges.

Although similar to *P. howcroftii* in foliar, stipular, and fruit characters, *P. matambuai* is distinguishable by the furfuraceous nodes and a congested inflorescence with an indumentum of setiform hairs. On Sohmer's (1988) revision of non-climbing *Psychotria*, the new species should key to couplet 60 (ibid: 19). It can then be incorporated into the decision train by introducing a third line into the otherwise dichotomous sequence:

60. Fruit 4–5 mm in length 61
Fruit 10–12 mm in length 62

Fruit ≥20 mm in length .... **Psychotria matambuai**
.... **P. howcroftii**

The sister species *P. howcroftii* was erroneously reported in the type description as keying to Sohmer's couplet 36 (Takeuchi 1999). The proper result should have been to fork 60 together with *P. matambuai*. The two species can be differentiated with the following couplet:

Branchlets furfuraceous at nodes; inflorescence to 4 cm overall length, monopedunculate, rachises hairy, cymes congested .... **P. matambuai**
Branchlets glabrous; inflorescence to 10 cm overall length, trichotomous, rachises glabrous, cymes loose .... **P. howcroftii**

There is a minor complication at fork 57, since the leaves of *P. matambuai* and *P. howcroftii* can have more than 18 lateral veins, being typically 15–19 penninerved. However the suggested outcome is more plausible than the alternative branch on the Sohmer key.

DISTRIBUTIONAL RECORDS AND OTHER NOTEWORTHY COLLECTIONS

ADIANTACEAE

Coniogramme sp. nov., aff. **macrophylla** (Bl.) Hieron.; coll. *12,197*. Differs from Papuasian populations of *Coniogramme macrophylla* by the longer, narrower pinnae and lax venation. The collection needs to be checked against *C. macrophylla* populations from western Malesia, to ensure that the character states are outside the range of variation for the species as a whole. The CMWMA plants are potentially new if the differences can be maintained against extra-Papuasian material.

ANACARDIACEAE

Rhus lenticellosa Laut.; coll. *11,301*, det. P.F. Stevens & WT. An undetermined Haia collection was placed to genus by P.F. Stevens (pers. comm. 6/98) and was subsequently keyed to the given result.

Rhus lenticellosa is apparently a rare vining species, formerly known only from the Sepik and Southern Highlands Provinces (Ding Hou 1978). The conspicuously cuspidate leaves are defining. Lae Herbarium previously had no specimens determined to this binomial.

BEGONIACEAE

Symbegonia parvifolia Gibbs; coll. *11,701*. Apparently endemic to western New Guinea, with the few LAE sheets of this taxon all originating in Irian Jaya. Barkley (1972) had listed the species' range simply as 'New Guinea.' Possibly a record for the eastern side.

BURSERACEAE

Canarium sp. ?nov.; coll. *11,886*. What appears to be a new species of *Canarium* was encountered during the recent survey. The suspected novelty has a deciduous phenology, 2.5 cm acuminate stipules, and large leaflets up to 43 cm long and 14 cm wide: unusual features which should ordinarily have resulted in identification. However the plant cannot be made to key out on the Flora Malesiana and does not conform to the description of any known Papuasian *Canarium*.

CLUSIACEAE/GUTTIFERAE

Mammea papuana (Laut.) Kosterm.; coll. *11,905*, det. P.F. Stevens. Two collections of this species were previously known, both from E. Sepik Province (Stevens 1974).

CONVOLVULACEAE

Erycibe carrii Hoogl.; coll. *12,619*. Keys to this result on van Ooststroom (1955). Apparently rare. Lae Herbarium has a single sheet of this distinctive species.

Erycibe hollrungii Hoogl.; coll. *11,762*.Twigs with longitudinal cork lines and the densely strigose sepals readily distinguish *E. hollrungii* from close congeners like *E. hellwigii*.

Hoogland (1953a) described the species on the basis of a collection from NE New Guinea. In the van Ooststroom revision (1953), the taxon was characterized as being known only from the type, though Hoogland himself later found the species along the Puria River in Madang (Hoogland 1953b). Since then there has been nothing reported on this apparently rare plant. Lae Herbarium has a single sheet, consisting of the Hoogland number from Madang.

Erycibe hollrungii is relatively common around Haia and many duplicates were secured during the recent expedition. The CMWMA collections are a first record for Papua.

ELAEOCARPACEAE

Elaeocarpus lingualis Knuth, 'sepikanus group;' coll. *11,672*. A member of a complex including *E. elatus*, *E. sarcanthus*, and *E. sepikanus* sensu stricto. Coode (1981) shows how to separate the species with flowering material, but acknowledges the taxonomy of this group is still problematic.

The species is known from only a small number of localities and had not been definitely reported from the Papuan districts.

EUPHORBIACEAE

Aporosa lamellata Airy Shaw; coll. *11,826*. Large oblongish leaves and persisting auriculiform stipules indicate a relationship to *A. petiolaris* but the conspicuously ridged capsules are unique in the genus (Airy Shaw 1978). The fruiting collection keys unequivocally to the given species and matches the type description in Airy Shaw (ibid).

Aporosa lamellata was formerly regarded as endemic to West Irya (ibid) although a recent determination (by A. Schot, 1996) on NGF 42,544 places the taxon in the West Sepik as well. The species is now recorded for the Papuan side.

Baccaurea papuana F.M. Bailey; colls. *12,563*, *12,948*. (**Fig. 5**). The Maimafu collection from 1,768 m is the highest elevation of record for the species, which is ordinarily characteristic of lowland and coastal environments. CMWMA montane populations have a number of nonconformist features, including leaves smaller than the low elevation form and much larger fruits 35–40 mm long and 27–42 mm wide. The collections were initially prepared as sp. nov., but Airy Shaw (1980) adopts a broad circumscription of *B. papuana* and his conservative view is followed.

Macaranga reiteriana Pax & Hoffm.; colls. *12,262, 12,274, 12,507*. (**Fig. 6**). A subarborescent from Whitmore's (1980) 'Longistipulata group,' *Macaranga reiteriana* is distinguished by a dense sericeous indumentum and by solitary sessile fruits inserted on bare peduncles.

The species is known only from Morobe Province, Gulf Province, and the Idenburg River in West Ityan (ibid). Collections *12,262* and *12,274* key directly to this binomial and agree with cited material. The species was also recently reported from the Bismarck Mts., Western Highlands (Takeuchi 1999), and is probably much more widespread than the number of collection localities would suggest.

FABACEAE/LEGUMINOSAE

Inocarpus sp. nov. ('rubidus' morphospecies fide Verdcourt); colls. *11,139*, *12,054*. This cryptic species has been discussed by Verdcourt (1979) and keys out to the given result. We have several collections from various expeditions to the Papuan districts, so the taxon is apparently not particularly rare.

An unusual feature is the red sap. Leaves are distichous and with conspicuous raised areolations on the underside. The rather small stipules are another identification aid, being subpersistent and often conferted at the apical bud.

Our several sheets of the undescribed taxon all dried to a distinctive orange-brown color.

FLACOURTIACEAE

Ryparosa calotricha Mildbr.; coll. *12,008*. The species is recognizable in sterile condition, due to its distinctive foliar characteristics. Not previously recorded from Papua (Sleumer 1954), and although other Papuan collections may have been obtained since Sleumer's revision, the tree is probably uncommon in the southern provinces.

MONIMIACEAE

Palmeria gracilis Perkins var. ?nov.; coll. *12,431*. The collection is atypically strigose on leaves and infructescence. Possibly a new variety.

FIG. 5. *Baccaurea papuana* F.M. Bailey. A. Branchlet, habit. B. Infructescence on old wood. Drawn from *Takeuchi 12,948* by N.H.S. Howcroft.

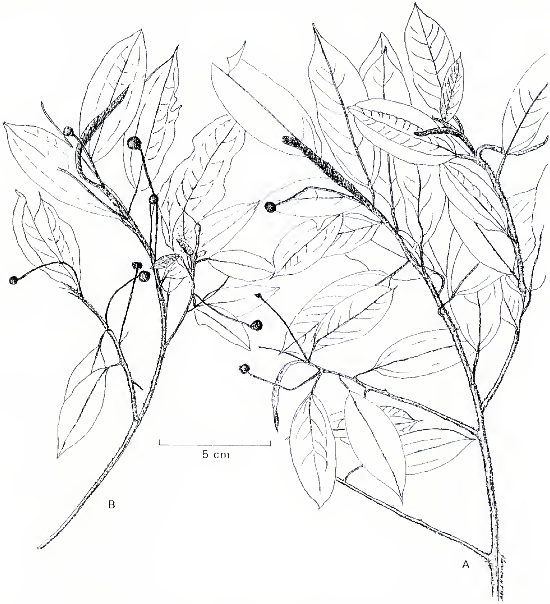

FIG. 6. *Macaranga reiteriana* Pax & Hoffm. A. & B. Habit of fruiting branch. Drawn from *Takeuchi 10,496* by N.H.S. Howcroft.

Steganthera sp. ?nov., aff. 'myrmecophilous group;' coll. *12,742*. Branchlets are nodose and ant-inhabited but the surfaces are manifestly muricate, immediately distinguishing the plant from the related *S. hospitans*. The large leaves are also distantly toothed rather than entire. Female receptacles are distinctively 3-lobed and crenate. Possibly a new species.

MYRSINACEAE

Loheria reiniana (Jacobs) Sleum.; coll. *11,921*. There are two endemic species of *Loheria*, both of which are rare and little-represented in herbaria.

Sleumer (1988) cites a total of 5 collections of this species. Most of the existing specimens have originated from the Papuan districts, but the species is apparently nowhere very common. Lae Herbarium has nearly all the exsiccatae known to Sleumer, including an isotype. There is no published information on the ecology of the Papuasian taxa.

Loberia reiniana is locally common near Haia, where it was seen growing as a terrestrial monocaul with leaves crowded in a terminal coma. The species is always found only in sciophytic situations sequestered within mature stands and is never in seral environments. Blossoms fall quickly after opening, generally on the same day that the perianth deploys.

Population-based studies have never been made of Papuasian *Loberia* and the CMWMA occurrences afford that opportunity.

MYRTACEAE

Syzygium sp. ?nov.; colls. *11,235, 11,719*. The collections are from a very distinctive species which does not key on Hartley and Perry (1973) on any couplet permutation. The suspected novelty is a subcanopy monocaul with flowers in condensed cauline cymes.

OLEACEAE

Chionanthus sp. ?nov.; aff. **salicifolius** (Lingelsh.) Kiew; coll. *12,965*. The herbaceous leaves with closely set venation are unusual for this genus. Similar to Carr 14,121, annotated by Kiew as *Chionanthus* aff. *salicifolius*.

ORCHIDACEAE

Vanilla wariensis Schltr.; coll. *11,842*, det. N.H.S. Howcroft. *Vanilla* is the basis for a local commercial industry which has thus far relied entirely on alien species. Endemic *Vanilla* have potential value as breeding stock for introducing genetic improvements into the current horticultural base (Howcroft, pers. comm.)

Vanilla wariensis is a rare orchid with exceptionally large blades and was not previously represented at Lae Herbarium by any specimens. There are no extant populations known of this species except for the Haia colonies (ibid).

RUBIACEAE

Psychotria dieniensis Merr. & Perry; coll. *12,343*. Previously known only from the Fly and Sepik drainages (Sohmer 1988).

Psychotria polita Valeton, or aff.; coll. *12,397*. *Psychotria polita* is known from the single surviving collection cited by Valeton (1927). Sohmer (1988) does not include the species in his key since the plant is not sufficiently understood. However there is a plate of the only extant sheet and a brief description of its salient characters (ibid).

The Maimafu voucher agrees with the available information on this binomial, including the particulars of its leaves and the extremely delicate axes of the inflorescence. It is either the elusive *P. polita*, or a new taxon allied to it.

Psychotria sphaerothyrsa Valeton; coll. *12,979*. A rare species. Known previously only from the lectotype and isolectotype from West Sepik Province and from a citation by Merrill & Perry (1946) from Central Province (Sohmer 1988).

Psychotria womersleyi Sohmer; colls. *12,028, 12,056*. Previously known from only two specimens originating in Eastern Highlands Province, above 1500 m (Sohmer 1988).

RUTACEAE

Wenzelia tenuifolia Swingle; coll. *12,958*. The entire genus is rare; all 5 species being known from very few specimens. Stone (1985) had discussed the difficulty of evaluating *Wenzelia* due to the scarcity of collections available for study. He also commented on the elevational range of the genus, noting that Swingle (1967) had not thought it possible for the aurantioid taxa to ascend above 1,220 m.

The present collection from 1,770 m is the highest elevation of record for *Wenzelia* and is the fifth specimen known.

SAPINDACEAE

Alectryon myrmecophilus Leenh.; coll. *12,746*. Previously known only from Morobe Province (Leenhouts 1994).

Harpullia camptoneura Radlk.; coll. *11,889*. A species of NE New Guinea (Leenhouts & Vente 1994). Newly recorded for the Papuan districts.

SOLANACEAE

Solanum dendropilosum Symon; coll. *11,854*, det. D.E. Symon. The Crater Mt. number was originally distributed as 'sp. ?nov. aff. *dendropilosum*' but has been more recently determined to the species by Symon (pers. comm. 7/98).

Solanum dendropilosum is represented by few collections and the atypical features of the survey voucher probably represent juvenile characters. However the indumentum is unusual and possibly cannot be accommodated under the present name (ibid).

Solanum peranomalum Wernham; coll. *11,204*, conf. D.E. Symon. Collection 11,204 was keyed to this species, formerly known only by the type specimen from Mt. Carstensz in West Iryan. The determination has been confirmed by Symon (pers. comm. 7/98).

A new record for Papua New Guinea.

STERCULIACEAE

Sterculia monticola Mildbr. var **laxiflora** Tantra; colls. (fr) *12,148, 12,647*.

The collections key to the given result on available characters. Since the fruits from this species were previously unknown (Tantra 1976), an accessory description is provided from the present material:

Fructescence racemiform, axillary, pendulous, ebracteate, fruiting stalk to 11 cm long and 4.5 mm thick, tomentulose, the hairs densely and appressedly stellate, mostly 4–8 armed; pedicels 20 mm long, articulated above the middle, indumentum like the rachis; follicles 1–4, free, shortly stipitate, divergent, coriaceous, mucilaginous, oblong-acuminate, to 9.0 cm long and 2.0 cm wide, arcuate along the dorsal suture, ventrally somewhat plane; valves 3–5 mm thick, exterior surfaces at first brown, later orange, striate with drying, scabridulous, covered by minute stellate hairs, these with arms ±erecto-patent and setiform, interior surfaces glabrous; seeds 8–11, black.

APPENDIX 1. LIST OF PLANT TAXA FROM CRATER MOUNTAIN

Voucher source for occurrence record: AM = Andy Mack, C&S = L.A. Craven & R. Schodde, GW = George Weiblen, Ha = village collectors ex Haia, He = village collectors ex Herowana, LAE = staff collections from the Lae Herbarium number series, S&C = R. Schodde & L.A. Craven, WT = W. Takeuchi; sn = sin numéro (without number); SR = sight record of taxon known to the project botanist. Other collectors indicated by name. Determinations by WT unless otherwise noted.

FERNS AND FERN ALLIES

ADIANTACEAE

Coniogramme sp. nov., aff. *macrophylla* (Bl.) Hieron., *WT 12197*

Syngramma schlechteri Brause, *WT 11168*

Taenitis blechnoides (Willd.) Swartz, SR, Maimafu

ASPLENIACEAE

Asplenium acrobryum Christ, *WT 11852, 12181, 12554*

Asplenium bipinnatifidum Baker, *WT 11816, 12487, 12552*

Asplenium cuneatum Lam., SR, Haia; possibly *A. affine* Sw.

Asplenium decorum Kunze, *WT 11962, 12741*

Asplenium keysserianum Rosenst., *WT 12910*

Asplenium morobense Copel., *WT 12114*

Asplenium nidus L. var. *nidus*, *WT 11798*

Asplenium pellucidum Lam., *WT 11742*

Asplenium phyllitidus Don subsp. *malesicum* Holrtum, *WT 11115*

Asplenium cf. *sancti-christofori* Christ, *WT 11723*; possibly *A. keysserianum* Ros.

Asplenium scandens J. Smith ex Mett., *WT 11861, 12157, 12167, 12534*

Asplenium steerei Harrington, *WT 12104, 12227; 'cromwellianum'*

Asplenium (close to) *steerei* Harrington, *WT 12250, 12433, 12491, 12493*

Asplenium subemarginatum Rosenst., *WT s.n.*

Asplenium tenerum Forst., *WT 12483*

Asplenium unilaterale Lam., *WT 12166*

Didymochlaena truncatula (Swartz) J. Smith, *WT 12170, 12972-A*

Diplora sp., *LAE 61104*, Purari R., det. Croft & Leiden, = *Phyllitis longifolia* (Presl) O. Ktze.

Diplora sp., *C&S 794*, Purari, det. Croft, = *Phyllitis* sp., aff. *?longifolia*

ATHYRIACEAE

Callipteris prolifera (Lam.) Bory, SR, Haia

Diplazium acrocarpum Rosenst., or aff., *WT 11159*

Diplazium aff. '*bantamense* group', *WT 11726, 11825*

Diplazium cordifolium Bl., SR, Haia

Diplazium schlechteri Hieron., *WT 11794*

AZOLLACEAE

Azolla pinnata R. Br., SR, Maimafu

BLECHNACEAE

Blechnum acutiusculum (v.A.v.R.) C. Chr., WT 12354, 12806
Blechnum dentatum (Kuhn) Diels, *WT 11734*
Blechnum cf. *deorso-lobatum* Brause, *WT 12323*
Blechnum orientale L., SR, Haia; cf. *LAE 61165*, above Purari R.
Stenochlaena areolaris (Harr.) Copel., SR, Haia
Stenochlaena milnei Underwood, SR, equiv. to *WT 11523*
Stenochlaena palustris (Burm. f.) Beddome, SR, Haia; cf. *LAE 61111*, Purari R.

CYATHEACEAE

Cyathea contaminans (Wall.) Copel., SR, Maimafu
Cystodium sorbifolium (Sm.) J. Smith, *WT s.n.*
Dicksonia sp., SR, upper Maimafu

DAVALLIACEAE

Davallia solida (Forster) Swartz, SR, cf. *C&S 783*, Purari, det. Croft
Davallia trichomanoides Bl., *WT 12703*
Davallodes novoguineense (Rosenst.) Copel., *WT 12526, 12989*
Humata dimorpha Copel., *WT 11777*
Humata pectinata (Sm.) Desv., SR, O-Pio
Humata tenuis Copel., *WT 11780. 12223, 12614*
Scyphularia cf. *dorsalis* Copel., *WT 11949*; '*dorsalis - sinusora* group'
Scyphularia pentaphylla (Bl.) Fée, *LAE 61153*, Purari R.

DENNSTAEDTIACEAE

Dennstaedtia novoguineensis (Rosenst.) Copel., *WT 11822*
Dennstaedtia scandens (Bl.) Moore, *WT 11744*
Histiopteris incisa (Thunb.) J. Smith, *WT 11685*
Pteridium aquilinum (L.) Kuhn, *WT 12799*, approaching *P. esculentum*

DIPTERIDACEAE

Dipteris conjugata Reinwardt, *WT 12232*
Dipteris novo-guineensis Posthumus, SR, Maimafu; less common than congener

DRYOPTERIDACEAE

Arachniodes aristata (Forst. f.) Tindale, *WT 12696*
Dryopolystichum phaeostigma (Ces.) Copel., *LAE 61158*, Purari River; det. Grimes
Polystichum aculeatum (L.) Schott, s. lat., *WT 11757*

EQUISETACEAE

Equisetum ramosissimum Desf. subsp. *debile* (Vauch.) Hauke, *WT s.n.*; O-Pio

GLEICHENIACEAE

Dicranopteris linearis (Burm. f.) Underwood var. *linearis*, *WT 12215*
Gleichenia dicarpa R. Br., SR, upper Maimafu
Gleichenia hirta Bl. var. *candida* (Rosenst.) Holttum, *WT 12320*
Gleichenia cf. *sordida* Copel., *WT 12225*, subg. *Diplopterygium*

GRAMMITIDACEAE

Calymmodon clavifer (Hooker) Moore, SR, Maimafu
Ctenopteris multicaudata (Copel.) Copel., *WT 12849*
Ctenopteris repandula Kunze, *WT 11817*
Ctenopteris subsecundodissecta (Zoll.) Copel., *WT 12053, 12368*
Ctenopteris sp. A, '*taxodioides-yoderi* group', SR, upper Maimafu
Ctenopteris sp. B, *WT 12907*
Grammitis sumatrana (Baker) Copel., *WT 11278*
Grammitis spp., *WT 12833, 129096*
Loxogramme scolopendrioides (Gaud.) Morton, *WT 11964*
Prosaptia alata (Bl.) Christ, *WT 12224*; prob. syn. with *Ctenopteris*

HYMENOPHYLLACEAE

Crepidomanes bipunctatum (Poiret) Copel., *WT 11935*
Trichomanes aphlebioides Chr., *LAE 61147*, Purari River, det. Croft
Trichomanes atrovirens (Presl) Kunze, *LAE 66281*, Wabo dam site
Trichomanes intermedium v.d.B., *LAE 66314*, near Wabo

LINDSAEA GROUP

Lindsaea cf. *lobata* Poiret, *WT 12115*, possibly *L. obtusa* complex

Lindsaea lucida Bl., SR, Pio
Lindsaea microstegia Copel., *WT 11737, 11788*
Lindsaea obtusa J. Smith, *WT 11722, 12194, 12701*
Lindsaea pulchella (J. Smith) Mettenius ex Kuhn var. *blanda* (Mettenius ex Kuhn) Kramer, *WT 12889*
Lindsaea pulchra (Brackenridge) Carruthers ex Seemann, *WT 12896*
Lindsaea tenuifolia Bl., *LAE 66296*, Wabo dam site
Sphenomeris chinensis (L.) Maxon, SR, Maimafu airstrip
Sphenomeris retusa (Cav.) Maxon, *WT 12612*
Tapeinidium longipinnulum (Cesati) C. Chr., SR, Haia
Tapeinidium novoguineense Kramer, *WT 11824, 12344*
Tapeinidium cf. *novoguineense* Kramer, *WT 12317*

LOMARIOPSIDACEAE

Bolbitis heteroclita (Presl) Ching, *WT 11819, 12409*
Bolbitis quoyana (Gaud.) Ching, *WT 11154*; miniature form
Bolbitis rivularis (Brackenridge) Ching, *WT 12569*
Elaphoglossum novoguineense Rosenst., *WT 11246*
Lomagramma sinuata C. Chr., *WT 11755*; cf. *LAE 61095*, Purari
Lomariopsis kingii (Copel.) Holttum, SR, Haia; cf. *S&C 4644*

LYCOPODIACEAE

Huperzia aff. *?carinata* (Poiret) Trevisan, *WT 11120*
Huperzia nummulariifolia (Bl.) Jermy, SR, Haia
Huperzia phlegmaria (L.) Rothm., *WT 12442; C&S 878*, Purari
Huperzia cf. *phlegmaria* (L.) Rothm., *WT 12139*
Huperzia squarrosa (Forst. f.) Trevisan, *WT 12055*
Huperzia (near) *squarrosa* (Forst. f.) Trevisan, *LAE 66309*, Wabo dam site
Lycopodium volubile Forst. f., *WT 12811, 12851*
Palhinhaea cernua (L.) Vasc. & Franco, SR, Haia & Maimafu

MARATTIACEAE

Angiopteris evecta (Forst.) Hoffman, *WT 12230*
Marattia brassii Copel., *LAE 61162*, Purari River, det. Leiden list
Marattia cf. *novoguineensis* Rosenst., *WT 11832*

OLEANDRACEAE

Nephrolepis acuminata (Houtt.) Kuhn, *WT 11790, 12435, 12496, 12602, 12610, 12624, 12626, 12638*
Nephrolepis biserrata (Swartz) Schott, *WT 11753*
Nephrolepis cf. *falcata* (Cav.) C. Chr., *WT 11118*; indumentum close to *falcata*
Nephrolepis lauterbachii Christ, *WT 12067, 12340*
Oleandra cuspidata Baker, *WT 11714, 12970*
Oleandra werneri Rosenst., *WT 11116*

OPHIOGLOSSACEAE

Ophioglossum pendulum L., SR; cf. *C&S 796*, Purari

OSMUNDACEAE

Leptopteris alpina (Baker) C. Chr., *WT 12363*, 'typical form' sensu Johns

POLYPODIACEAE

Aglaomorpha drynarioides (Hook.) Roos, *WT 11147*
Aglaomorpha heraclea (Kunze) Copel., SR, Maimafu
Aglaomorpha hieronymi (Brause) Copel., *WT 12527, 12611*
Aglaomorpha cf. *novoguineensis* (Brause) C. Chr., *WT 12213, 12292, 12513, 12535*
Belvisia mucronata (Fée) Copel. var. *mucronata*, *WT 11111, 11845, 12467, 12783*
Drynaria sparsisora (Desvaux) T. Moore, SR, Haia
Goniophlebium persicifolium (Desvaux) Beddome, *WT 11119*
Goniophlebium subauriculatum (Bl.) Presl, *WT 11117, 12313, 12501, 12512*
Lecanopteris mirabilis (C. Chr.) Copel., *WT 12758*
Lemmaphyllum accedens (Bl.) Donk, *AM 403; WT 11725*

Leptochilus decurrens Bl., *WT 11963*
Microsorum glossophyllum (Copel.) Copel., *WT 12521*
Microsorum linguiforme (Mettenius) Copel., *LAE 61161*, Purari River, det. Grimes
Microsorum papuanum (Baker) Parris, *WT 12457, 12568, 12631, 12805*, = *Phymatosorus* sp.
Microsorum punctatum (L.) Copel., *WT 11953*
Microsorum rampans (Baker) Parris, *WT 11775*
Microsorum subgeminatum (Christ) Copel., *WT 11745*, = *Phymatosorus* sp.
Phymatosorus commutatus (Bl.) Pichi Sermolli, *WT 11735, 11881, 12025, 12426*
Phymatosorus nigrescens (Bl.) Pichi Sermolli, *WT 12726*
Phymatosorus cf. *nigrescens* (Bl.) Pichi Sermolli, *WT 12736*
Pyrrosia foveolata (Alston) Morton var. *foveolata*, *WT 11946*
Pyrrosia foveolata (Alston) Morton var. *lauterbachii* (Chir.) Hovenkamp, *LAE 66321*, det. Leiden list
Pyrrosia princeps (Mettenius) Morton, *WT 11931*
Selliguea albidosquamata (Bl.) Parris, *WT 11792, 12613, 12727*
Selliguea enervis (Cav.) Ching; sensu Hovenkamp, *WT 12151, 12832*, 'gramineous' form
Selliguea enervis (Cav.) Ching; sensu Hovenkamp, *WT 12315*, 'typical' form
Selliguea ferrea (Brause) Hovenkamp, or aff., *WT 11781*

PSILOTACEAE
Psilotum complanatum Swartz, SR, Haia
Psilotum nudum (L.) Beauv., SR, Haia

PTERIDACEAE
Acrostichum speciosum Willd., *S&C 4481*, det. Leiden
Pteris excelsa Gaud., *WT 12377, 13002*
Pteris gardneri (Fée) Hooker, *WT 12438*
Pteris moluccana Blume, SR, Haia
Pteris orientalis v.A.v.R., *WT 12608, 12730, 13001*
Pteris pacifica Hieron., *WT 11910*
Pteris schlechteri Brause, *WT 12161*
Pteris tripartita Swartz, *WT 11778*
Pteris wallichiana Agardh, *WT 13003*
Pteris werneri (Rosenst.) Holttum, *WT 12876*

SCHIZAEACEAE
Lygodium circinnatum (Burm. f.) Swartz, SR; cf. *C&S 736*, det. Croft
Lygodium salicifolium Presl, *WT 11155*
Schizaea dichotoma (L.) Sm., SR; cf. *S&C 4229*, det. S&C
Schizaea digitata (L.) Swartz, *LAE 66355*, det Leiden list

SELAGINELLACEAE
Selaginella 'velutina-wallichii group', *WT 11774*; interspecific distinction not clear

TECTARIA GROUP
Tectaria beccariana (Cesati) C. Chr., SR, Haia
Tectaria pleiosora (Alderw.) C. Chr., *WT s.n.*
Tectaria repanda (Willd.) Holttum, *WT 12437*
Tectaria cf. *repanda* (Willd.) Holttum, *WT 12415*, '*crenata-repanda* group'

THELYPTERIDACEAE
Amphineuron aff. *immersum* (Bl.) Holttum, *WT 11911*
Chingia imponens (Ces.) Holttum, *WT 11687*
Plesioneuron marattioides (Alston) Holttum, *WT 12400*
Pneumatopteris cf. *sogerensis* (Gepp) Holttum, *WT 11686*, but keys to *P. rodigasiana*
Sphaerostephanos atasripii (Rosenst.) Holttum, *WT 11932*
Sphaerostephanos heterocarpus (Bl.) Holttum, *WT 11793*
Sphaerostephanos invisus (Forst. f.) Holttum, *LAE 61122*, Purari R., det. Leiden list
Sphaerostephanos multiauriculatus (Copel.) Holttum, *WT 11918*
Sphaerostephanos novoguineensis (Brause) Holttum, *WT 10909*
Sphaerostephanos pilososquamatus (v.A.v.R.) Holttum, *WT 11823*
Sphaerostephanos unitus (L.) Holttum, SR, Haia

THYRSOPTERIDACEAE
Culcita sp.; *straminea* or *villosa*, SR, upper Maimafu

VITTARIACEAE
Antrophyum alatum Brackenridge, *WT 11933; LAE 61094*, Purari, det. Croft

Antrophyum subfalcatum Brackenridge, *LAE 66327*, det. Croft
Vittaria elongata Swartz, SR, Haia

GYMNOSPERMS

ARAUCARIACEAE

Araucaria hunsteinii K. Schum., SR, Maimafu

CUPRESSACEAE

Libocedrus papuana F.v.M. var. *papuana*, *WT 12203*

CYCADACEAE

Cycas scratchleyana F.v.M., *LAE 61174*, Purari River, det. K.D. Hill, also *C&S 750*

GNETACEAE

Gnetum gnemon L. or *G. costatum* K. Schum., *WT s.n.*
Gnetum latifolium Bl., *WT 12079*

PODOCARPACEAE

Dacrycarpus imbricatus (Bl.) de Laubenfels, *WT s.n.*
Podocarpus neriifolius D. Don, SR, Pio; cf. *S&C 4237*, det. de Laubenfels
Prumnopitys amara (Bl.) de Laubenfels, *WT 12304, 12827*

DICOTS

ACANTHACEAE

Calophanoides angustata (Warb.) Brem., *WT 12265-A*
Dicliptera papuana Warb., *WT 12510*
Graptophyllum cf. *pictum* (L.) Griff., *WT 11126*
Hemigraphis reptans T. Anders., or aff., SR of common herb, Haia
Lepidagathis sp., *WT 12033*
Peristrophe sp., *WT11260*
Ptyssiglottis pubisepala (Lindau) B. Hansen, *WT 11269*
Rungia klossii S. Moore, *WT 12072, 12890*

ACTINIDIACEAE

Saurauia aff. *?calyptrata* Laut., *WT 12918*
Saurauia congestiflora A.C. Smith, *WT 12017*
Saurauia cf. *dufaurii* (F. v. M.) Bailey, *WT 12107-R*
Saurauia naumannii Diels, or aff., *WT 11124, 11689, 12200, 12475, 11124, 11689*, distr. as aff. *conferta*
Saurauia schumanniana Diels, s.l., *GW 716B; WT 11811, 12022*
Saurauia stichophlebia Diels or aff., *WT 11166, 11184*
Saurauia sp., series ?Obtectae, *WT 12217, 12302* (form 1); *12690, 12769* (form 2)
Saurauia sp., series Obvallatae, aff *?conferta* Warb., *WT 12042, 12078*, not the sp.
Saurauia sp., series Ramiflorae, *WT 12476*
Saurauia sp., series Setosae, *WT 11810*
Saurauia sp. A, unplaced aff., *WT 12013, 12169*
Saurauia sp. B, unplaced aff., *WT 12097, 12916*
Saurauia sp. C, unplaced aff., *Sands et al. 1482*, Purari R.

AMARANTHACEAE

Achyranthes aspera L., SR, O-Pio
Achyranthes bidentata Bl., *WT 12576*
Celosia argentea L., *WT 11967*
Iresine herbstii Hook. f., *WT 12801*

ANACARDIACEAE

Buchanania arborescens (Bl.) Bl., *AM 336, 589; WT 12091*
Buchanania macrocarpa Laut., SR, Haia & Pio; cf. *C&S 765*, det. Ding Hou
Campnosperma brevipetiolata Volkens, SR, Haia
Dracontomelon dao (Blanco) Merr. & Rolfe, *AM 252*
Gluta papuana Ding Hou, *S&C 4492*, E. Purari, det. Ding Hou
Pleiogynium timoriense (DC.) Leenh., *WT 12092*
Rhus lenticellosa Laut., *WT 11301*, det. Stevens & WT, distr. as indet.
Rhus taitensis Guillemin, *WT 12404*
Semecarpus aruensis Engl., *WT 11243*
Semecarpus bracteatus Laut., *WT 12543, 12841*
Semecarpus magnificus K. Schum., *WT 12678*
Semecarpus papuanus Laut., *WT 12048, 12063, 12065, 12693 (fr), 12749 (fr)*
Semecarpus rostratus Valeton, *LAE 61120*, Purari R., det. Ding Hou
Semecarpus schlechteri Laut., *WT 11828*

ANNONACEAE

Cananga odorata Hook. f. & Thoms., SR; cf. *S&C 4499*, E. Purari, det. S&C

Cyathocalyx papuanus Diels, SR; cf. *S&C 4230*, 4385, det. Leiden

Goniothalamus aruensis Scheffer, *WT 11234*

Goniothalamus imbricatus Scheffer, *WT 11206, 11800*

Haplostichanthus longirostris (Scheffer) van Heusden, *WT 11272*

Polyalthia 'glauca-discolor group', *WT 12094*

Polyalthia aff. *?'oblongifolia* group', *WT 11160, 11215, 11913*, distinctive; laterals acroscopic, leaves areolate

Popowia cf. *pisocarpa* (Bl.) Endl., *WT 11248*

Popowia aff. '*pisocarpa* group', *WT 11901*

Pseuduvaria cf. *grandifolia* (Warb.) J. Sinclair, *WT 12024*

Xylopia malayana (Hook. f.) & Thoms., or *papuana* Diels, *WT 11994*

APOCYNACEAE

Alstonia macrophylla Wall., ex G. Don, *WT 12643*

Alstonia scholaris (L.) R. Br., *WT 12071*

Alyxia markgrafii Tsiang, *WT 11740*

Alyxia sp.; cf. series Floribundae, *WT 12300*

Anodendron oblongifolium Hemsl., SR, Pio; cf. *S&C 4380*, det. Middleton

Cerbera floribunda K. Schum., *AM 1; WT 12006, 12695*

Finlaysonia obovata Wallich, *C&S 813*, E. Purari, det. Forster

Ichnocarpus frutescens (L.) W.T. Aiton, *WT 11756*

Lepiniopsis ternatensis Valeton, *C&S 825*, Purari

Melodinus acutus (Markgraf) Markgraf, *WT 12468 (fr), 12978*

Melodinus forbesii Fawc., *WT 11710; LAE 61102*, Purari R.

Neisosperma ficifolium (S. Moore) Fosb. & Sach., *WT 11237, 11997*

Papuechites aambe (Warb.) Markgraf, SR, Pio; cf. *LAE 66354*, det. Middleton

Parsonsia lata Markgraf, *WT 12309 (fr), 12511*

Parsonsia oligantha (K. Schum.) D.J. Middleton, SR, O-Pio

Parsonsia sanguinea (Wernham) Markgraf var. *brassii* (Markgraf) D.J. Middleton, *WT 12387, 12880*

Parsonsia (closest to) *sanguinea* var. *brassii*, *WT 11760*

Parsonsia warenensis Kanehira & Hatusima, *WT 12731-A*

AQUIFOLIACEAE

cf. *Ilex*, *WT 12634*

ARALIACEAE

Gastonia spectabilis (Harms) Philipson, SR, Haia

Harmsiopanax harmsii K. Schum., *WT 12205*

Mackinlaya celebica (Harms) Philipson, *WT 11164*

Mackinlaya schlechteri (Harms) Philipson, *WT 11298, 11772*

Osmoxylon boerlagei (Warb.) Philipson, *WT 12700*

Osmoxylon micranthum (Harms) Philipson, *WT 12171*

Osmoxylon novoguineense (Scheffer) Becc., SR; cf. *C&S 789*, Purari, det. Philipson

Polyscias cf. *ledermannii* Harms, *WT 11982*

Schefflera schumanniana Harms ssp. *schumanniana*, *WT 11130*

ARISTOLOCHIACEAE

Pararistolochia momandul (K. Schum.) M.J. Parsons, *GW 743, 813*; based on GW det.

ASCLEPIADACEAE

Asclepias physocarpa Schltr., *WT 12796*

Dischidia ovata Benth., *S&C 4480*, E. Purari, det. Liddle

Dischidia torricellensis (Schltr.) P.I. Forster, *WT 11736*; det. P.I. Forster

Heterostemma acuminatum Decne., *WT s.n.; S&C 4705*, det. P.I. Forster

Hoya australis R. Br. subsp. *tenuipes* (K.D. Hill) P.I. Forster & Liddle, *WT 11867, 11947*; det. P.I. Forster

Hoya lauterbachii K. Schum., *WT 11185, 11205*; det. P.I. Forster

Hoya litoralis Schltr., *S&C 4482*, Purari, det. Green, (not seen)

Hoya piestolepis Schltr., *WT 11945*; det. P.I. Forster

Marsdenia velutina R. Br., *WT 11748*; det. P.I. Forster

Marsdenia sp., cf. *venusta* P.I. Forster, cf. *C&S 700* (type coll.), det. P.I. Forster

Sarcolobus globosus Wallich subsp. *peregrinus* (Blanco) Rintz, *S&C 4461*, E. Purari, det. P.I. Forster

Sarcolobus kaniense (Schltr.) P.I. Forster, *WT 11843*; det. P.I. Forster

Sarcolobus oblongus Rintz, cited by Rintz (1980) from Purari R.

Tylophora flexuosa R. Br., *S&C 4490*, E. Purari, det. P.I. Forster

ASTERACEAE (COMPOSITAE)

Adenostemma lavenia (L.) Kuntze, SR, Haia; also *S&C 4500*

Adenostemma macrophyllum (Bl.) DC., *WT 12024, 12062*

Ageratum conyzoides L., *WT 12797*

Bidens pilosa L. var. *minor* (Bl.) Sherff, *WT 12606*

Blumea arfakiana Martelli, *WT 11223*

Blumea arnakidophora Mattfeld, SR, Maimafu

Blumea riparia (Bl.) DC., *WT 11743, 12245*

Blumea sylvatica (Bl.) DC., *WT 12271, 12848, 12981*

Cosmos caudatus HBK, *WT s.n.*

Crassocephalum crepidioides (Benth.) S. Moore, *WT 12605, 12640*

Emilia sonchifolia (L.) DC. var. *javanica* (Burm.) Mattfeld, *WT 12795-A*

Erechtites valerianifolia (Wolf) DC., SR, Haia

Erigeron sumatrensis Retz., *WT 12604*

Ethulia conyzoides L.f. ex L., *WT 12878*

Gynura procumbens (Lour.) Merr., *WT 12931*

Microglossa pyrifolia (Lamk.) O. Ktze, *WT 12089*

Mikania cordata (Burm. f.) B.L. Rob., *WT 12630*

Senecio sp. ?nov., *WT 12322*; vining, fulvous lanate underleaf

Tagetes minuta L., SR, Hauneababo track

Tithonia diversifolia (Hemsl.) A. Gray, SR, Haia & Maimafu

BALANOPHORACEAE

Balanophora papuana Schltr., *WT 12755*

BALSAMINACEAE

Impatiens hawkeri Bull, *WT 12518*

Impatiens linearifolia Warb., *WT 12256*; or as Grey-Wilson's 'group 10'

BARRINGTONIACEAE

Barringtonia calyptrata (Miers) R. Br. ex Bailey, cited in Payens (1967)

BEGONIACEAE

Begonia aff. *?angustae* Irmscher, *WT 11195, 12628*

Begonia pinnatifida Merr. & Perry, *WT 11290*

Begonia aff. *pseudolateralis* Warb., *WT 11125*, '*brachybotrys-pseudolateralis*'

Begonia serratipetala Irmscher, *WT 11171*

Begonia sp. '*kaniensis* group', *WT 12082, 12458*, det. Gideon

Begonia sp., '*tafaensis* group', *WT 12080, 12852*

Begonia sp. A, unknown aff., *LAE 61187*, above Purari R.

Begonia sp. B, unknown aff., *WT 12030, 12142-A*

Symbegonia fulvo-villosa (Warb.) Warb., *WT 12029, 12086, 12154, 12913*

Symbegonia geraniifolia Ridl., *WT 12178, 12321, 12392, 12395*

?Symbegonia papuana Merr. & Perry, *WT 12176*

Symbegonia parvifolia Gibbs, *WT 11701*

BIGNONIACEAE

Dolichandrone spathacea (L.f.) K. Schum., *C&S 871*, Purari, det. van Steenis

Pandorea pandorana (Andr.) Steenis ssp. *pandorana*, *WT 12460*

Tecomanthe dendrophila (Bl.) K. Schum., *WT 11137, 12429, 12687, 12821, 12853*

BIXACEAE

Bixa orellana L., SR, Haia

BOMBACACEAE

Camptostemon schultzii Mast., *C&S 799*, Purari

BORAGINACEAE

Cordia subcordata Lam., *C&S 872*, Purari, det. collectors

Cynoglossum hellwigii Brand, *WT 12255*

Tournefortia minutiflora Riedl, cited in Riedl (1996)

Tournefortia sarmentosa Lamk., SR, Haia

Trigonotis inoblita F.v.M. var. *inoblita*, *WT 12032, 12087, 12834*

BURSERACEAE

Canarium acutifolium (DC.) Merr. var. *acutifolium*, *LAE 61090*, Purari, det. Leiden

Canarium cf. *asperum* Benth., SR, O-Pio

Canarium maluense Laut. ssp. *maluense*, SR; cf. *C&S 699, S&C 4393*, dets. Leiden

Canarium vitiense A. Gray, *WT 11250, 11894, 12294, 12078*
Canarium sp. nov., *WT 11886*

CANNABIDACEAE
Cannabis sativa L., SR, cultivated

CAPPARACEAE
Capparis lanceolaris Lesch. ex Steud., *GW 814*, det. GW

CAPRIFOLIACEAE
Sambucus canadensis L., *WT 12074*

CARDIOPTERIDACEAE
Cardiopteris moluccana Bl., SR; cf. *C&S 845*, Purari, det. Leiden

CARICACEAE
Carica papaya L., SR, ?naturalized Maimafu area, also cult.

CARYOPHYLLACEAE
Drymaria cordata (L.) Willdenow ex Roemer & Schult., *WT 12001, 12566*
Stellaria media L., *WT 12763*

CASUARINACEAE
Casuarina cf. *oligodon* L.A.S. Johnson, *WT 12243*
Gymnostoma papuana (S. Moore) L.A.S. Johnson, *WT s.n.*

CECROPIACEAE
Poikilospermum inaequale Chew, *AM 542; WT 12100, 12365, 12729*
Poikilospermum paxianum (Winkler) Merr., *AM 215; WT 11158*

CELASTRACEAE
Celastrus monospermoides Loes., *WT 12351, 12356*
Celastrus novoguineensis Merr. & Perry, *WT 12238, 12524, 12616*
Lophopetalum sp., *WT 12046*
Perrottetia alpestris (Bl.) Loes. ssp. *moluccana* (Bl.) Ding Hou, *WT 12775*
Salacia sororia Miq., *WT 12037*
Siphonodon celastrineus Griff., SR, Pio; cf. *S&C 4393*, Gulf

CHLORANTHACEAE
Ascarina philippinensis C.B. Robinson, *WT s.n.*
Ascarina subsessilis Verdcourt, SR, Maimafu; ID from sessile leaves
Chloranthus erectus (Buch.-Ham.) Verdcourt, *WT 12004*

CHRYSOBALANACEAE
Maranthes corymbosa Bl., SR, Pio
Parastemon versteeghii Merr. & Perry, SR, Pio
Parinari papuana C.T. White, *WT 11890*

CLUSIACEAE (GUTTIFERAE)
Calophyllum 'goniocarpum complex' sensu Stevens, *WT 11836, 12874*
Calophyllum papuanum Laut., *AM 254*
Calophyllum sil Laut., *WT 12874*
Calophyllum suberosum Stevens, *C&S 832*, Purari, det. Stevens
Garcinia archboldiana A.C. Smith, *WT 10494, 12407*
Garcinia celebica L., *WT 11906; S&C 4218*, det. Stevens
Garcinia aff. *celebica* L., *WT 12561, 12866, 12941*
Garcinia dulcis (Roxb.) Kurz, *WT 11981, 12084*
Garcinia fusiformis Stevens, *AM 296*
Garcinia hollrungii Laut., *WT 11973, 12041*
Garcinia aff. *hunsteinii* Laut., *WT 11797*
Garcinia aff. *?jaweri* Laut., *WT 12047*
Garcinia cf. *klinkii* Laut., *WT 12792*
Garcinia latissima Miq., *AM 40; S&C 4454*, E. Purari; *WT 12311*
Garcinia ledermannii Laut., *WT 11980*
Garcinia maluensis Laut., *WT 11255, 11716, 11887*
Garcinia mammeoides Kosterm., *WT 11247*
Garcinia warrenii F.v.M., *WT 12618*
Garcinia sp. A, unplaced aff., *WT 12282, 12964*
Garcinia sp. B, unplaced aff., *WT 12651, 12943*
Mammea papuana (Laut.) Kosterm., *WT 11905*, det. Stevens

COMBRETACEAE
Quisqualis indica L., *WT 11996*
Terminalia complanata K. Schum., *AM 240*
Terminalia impediens Coode, SR; cf. *S&C 4310*, det. Coode
Terminalia kaernbachii Warb., *WT 11983, 12016*
Terminalia cf. *macadamii* Exell, *WT 12037*
Terminalis microcarpa Decne subsp. *microcarpa*, *S&C 4509*, E. Purari, det. Coode

CONVOLVULACEAE
Erycibe carrii Hoogl., *WT 12619*

Erycibe hollrungii Hoogl., *WT 11762*
Ipomoea batatas (L.) Lamk, SR, cultivated
Merremia sp., (probably) *peltata* (L.) Merr., SR, Haia-Pio

CORYNOCARPACEAE
Corynocarpus cribbianus (F.M. Bailey) L.S. Smith, SR, Pio; cf. *S&C 4452*, Purari, det. Molloy

CUCURBITACEAE
Cucumis sativus L., SR, cultivated
Luffa cylindrica (L.) Roemer, *C&S 843*, Purari, det. Frodin
Zehneria mucronata (Bl.) Miq., *WT 11813*

CUNONIACEAE
Acsmithia sp., SR, upper Maimafu
Caldcluvia celebica (Bl.) Hoogl., *WT 12214*
Caldcluvia nymanii (K. Schum.) Hoogl., *WT 12772*
Pullea glabra Schltr. var. *glabra*, *WT 12257*; typical form
Pullea glabra Schltr. var. *glabra*, *WT 12770*; abberant form, cf. '*perryana*'
Schizomeria ilicina (Ridl.) Schltr., *WT 12813*
Schizomera (probably) *parvifolia* Perry, SR, upper Maimafu, sterile
Weinmannia sp., SR, Maimafu, sterile

DATISCACEAE
Octomeles sumatrana Miq., SR, Pio

DICHAPETALACEAE
Dichapetalum papuanum (Becc.) Boerl., *WT 11878*
Dichapetalum sessiliflorum Leenh., *WT 11849*
Dichapetalum (probably) *timoriense* (DC.) Boerl., cf. *S&C 4427*, det. Leiden

DILLENIACEAE
Dillenia castaneifolia (Miq.) Diels, SR; cf. *S&C 4370*, det. Hoogland
Dillenia schlechteri Diels, *WT 12310, 12867*
Tetracera nordtiana F.v.M. var. *moluccana* (Mart.) Hoogl., SR on sp., Haia-Pio; cf. *S&C 4365* for var.

DIPTEROCARPACEAE
Vatica papuana Dyer, SR, Pio

EBENACEAE
Diospyros cf. *elliptica* (J.R. & G. Forst.) P.S. Green, *WT 11850, 12014, 12663, 12839*
Diospyros ferrea (Willdenow) Bakh., s.l., *WT 11986*
Diospyros hebecarpa A. Cunn. ex Benth., *WT 12764*

ELAEAGNACEAE
Elaeagnus triflora Roxb. var. *triflora*, *WT 12581*

ELAEOCARPACEAE
Aceratium ledermannii Schltr., *WT 11840, 12919*
Aceratium muelleranum Schltr., *WT 12079*
Aceratium oppositifolium DC., *WT 12099*
Elaeocarpus culminicola Warb., *WT 12098*
Elaeocarpus dolichodactylus Schltr., SR, Pio; cf. *S&C 4326, 4401*, det. Coode
Elaeocarpus ledermannii Schltr., SR, Pio; cf. *Pullen 6455* near Purari R.
Elaeocarpus lingualis Knuth, *WT 11672*, '*sepikanus* complex'
Elaeocarpus multisectus Schltr., *S&C 4446*, E. Purari R.; also *NGF 41138*, Purari R., dets. Coode
Elaeocarpus nouhuysii Koorders, *S&C 4463*, E. Purari R., det. Coode
Elaeocarpus polydactylis Schltr., *WT 12622 (fr)*, Coode's 'group 4'
Elaeocarpus (closest to) *schlechteranus* A.C. Smith, *WT 12538*, possible sp. nov.
Elaeocarpus sepikanus Schltr., s.l., *AM 311*
Elaeocarpus sericoloides A.C. Smith, *GW 809*, det. GW
Elaeocarpus sphaericus (Gaertn.) K. Schum., *WT 11942*
Elaeocarpus sp., '*sepikanus* complex', *WT 12842 (fr)*, can't separate spp. with fruits
Elaeocarpus sp., '*sphaericus-altisectus* group', *WT 12942 (fr)*, can't separate without flowers
Sericolea micans Schltr., *WT 12374*
Sloanea cf. *nymanii* K. Schum., *WT 12766*, but leaf size atypical
Sloanea aff. *pulleniana* Coode, *AM 669*
Sloanea forbesii F.v.M., *GW 732*, det. GW

ERICACEAE
Dimorphanthera aff. *anchorifera* J.J.Sm., *WT 12822*
Dimorphanthera brevipes Schltr., *WT 11721*; det. P.F. Stevens

Dimorphanthera dekockii J.J. Sm. var. *chlorocarpa* (Sleumer) Sleumer, *WT 12184, 12403*

Dimorphanthera cf. *elegantissima* K. Schum. var. *splendens* (Sleumer) Stevens, *WT 12041, 12305, 12406*

Dimorphanthera kempteriana Schltr., *WT 12147, 12937, 11783*; det. Stevens

Dimorphanthera viridiflora Stevens, pers. com. P.F. Srevens

Gaulrherieae indet., *?Gaultheria*, *WT 12451*, could be new

Rhododendron dielsianum Schltr. var. *dielsianum*, *WT 12252, 12450, 12845*

Rhododendron macgregoriae F.v.M. var. *macgregoriae*, *WT 12420, 12514, 12555, 12625-A/B, 12800*

Rhododendron multinervium Sleumer, *WT 12026*

Rhododendron phaeochitum F.v.M., *WT 12278*

Rhododendron scabridibracteum Sleumer, *WT 12314*

Rhododendron zoelleri Warb., *WT 11239*

Vaccinium acrobracteatum K. Schum., *WT 12318*

Vaccinium carneolum Sleumer, *WT 12316*

Vaccinium cyclopense J.J. Sm. f. *cyclopense*, *WT 12381*

Vaccinium finisterrae Schltr., *WT 12378*

EUPHORBIACEAE

Acalypha grandis Benth., *AM 211*

Acalypha hellwigii Warb., *WT 11197, 12629, 12672, 12675*

Antidesma olivaceum K. Schum., *WT 12074*

Antidesma aff. *rhynchophyllum* K. Schum., *WT 11287, 11715*; no result on Airy Shaw

Antidesma cf. *sarcocarpum* Airy Shaw, *WT 11257*, *?'jucundum-concinnum* group'

Aporosa lamellata Airy Shaw, *WT 11826*

Aporosa petiolaris Airy Shaw, *WT 12001*

Baccaurea papuana F.M. Bailey, *WT 12563, 12948*; also *LAE 61083*, Purari River, det. Dockrill

Bischofia javanica Bl., SR, Pio; cf. *S&C 4688*, det. Leiden

Blumeodendron tokbrai (Bl.) Kurz, *WT 13009*

Breynia cernua (Poir.) Muell.-Arg., *WT 11691, 12506*

Breynia vestita Warb., *WT 12798*

Claoxylon lutescens Pax & Hoffm., *WT 12258, 12574-A, 12992*

Claoxylon cf. *microcarpum* Airy Shaw, *WT 11844*; '*ledermannii-microcarpum* group'

Claoxylon sp., '*Purpurascentia* group', *AM 598*

Codiaeum variegatum (L.) Bl. var. *moluccanum* (Decne.) Muell.-Arg., *WT 11191, 12702*

Drypetes aff. *lasiogynoides* Pax & Hoffm., *WT 12082, 12083*

Endospermum labios Schodde, *WT 11803*

Euphorbia plumerioides Teijsm. ex Hassk. var. *acuminata* J.J. Sm., *WT 12702*

Excoecaria indica (Willdenow) Muell.-Arg., *WT s.n.; NGF 41139*, Purari R.

Galearia celebica Koorders var. *celebica*, SR; cf. *S&C 4240*, det. Leiden

Glochidion chlamydogyne Airy Shaw, or aff., *WT 11211*

Glochidion delticola Airy Shaw, *S&C 4504*, E. Purari R., det. Leiden list

Glochidion fulvirameum Miq., or aff., *WT 12632, 12778*

Glochidion mitrastylum Airy Shaw, *AM 650*

Glochidion novo-guineense K. Schum., *AM 590; WT 12231, 12635*

Glochidion perakense Hook. f. var. *supra-axillare* (Benth.) Airy Shaw, *AM 619*

Glochidion sp. nov.; aff. *caloneurum* Airy Shaw, *WT 11303, 11796*

Macaranga aleuritoides F.v.M., *GW 755, 756*, det. GW

Macaranga angustifolia Laut. & K. Schum., *WT 11238*

Macaranga chrysotricha Laut. & K. Schum., *WT 12204, 12264*

Macaranga ducis Whitmore, *WT 12087*

Macaranga cf. *ducis* Whitmore, *WT 12088*

Macaranga fallacina Pax & Hoffm., *WT 11934*

Macaranga papuana (J. J. Sm.) Pax & Hoffm. var. *glabristipulata* Whitmore, *AM 609*

Macaranga pleiostemon Pax & Hoffm., *WT 12208, 12962*

Macaranga quadriglandulosa Warb., *WT 11752*

Macaranga reiteriana Pax & Hoffm., *WT 12262, 12274, 12507*

Macaranga tanarius (L.) Muell.-Arg., *GW 722*, det. GW
Macaranga sp.; aff. *?hoffmannii* Perry, *WT 12558, 12515*; sp. dubiae Whitmore
Mallotus didymochrysens Airy Shaw, *LAE 61115*, Purari R., det. Airy Shaw
Mallotus paniculatus (Lam) Muell.-Arg., *WT 11771, 12266*
Mallotus sp. nov.; § Mallotus, *WT 12159, 12454*
Manihot esculenta Crantz, *WT 12795-B*
Octospermum pleiogynum (Pax & Hoffm.) Airy Shaw, SR, Haia
Omalanthus novo-guineensis (Warb.) K. Schum., *WT 11713, 12259*
Phyllanthus ciccoides Muell.-Arg., *WT 12247, 12281, 12809*
Phyllanthus cf. *ciccoides* Muell.-Arg., *WT 12263*
Phyllanthus clamboides (F.v.M.) Diels, *WT 11148*
Phyllanthus flaviflorus (Laut. & K. Schum.) Airy Shaw, *WT 12210, 12572, 12707*
Phyllanthus rheophilus Airy Shaw, SR, Haia
Phyllanthus (closest to) *rubriflorus* J.J. Sm., *WT 11259*
Phyllanthus urinaria L., *WT 12676*
Pimelodendron amboinicum Hassk., *WT 11995*
Ricinus communis L., SR, naturalized Maimafu area

EUPOMATIACEAE
Eupomatia laurina R. Br., *WT 11698, 12043*

FAGACEAE
Castanopsis acuminatissima (Bl.) A. DC., SR, Maimafu
Lithocarpus celebicus (Miq.) Rehder, *WT s.n.*, carpological coll.
Lithocarpus lauterbachii (von Seemen) Markgraf, *WT 13010*
Lithocarpus rufovillosus (Markgraf) Rehder, *WT 11944, 12219, 12472, 12777*
Lithocarpus schlechteri Markgraf, *WT 12306*
Lithocarpus cf. *schlechteri* Markgraf, *WT 11718*

FLACOURTIACEAE
Casearia clutiaefolia Bl., *WT 12125*
Casearia cf. *clutiaefolia* Bl., *WT 12042*
Casearia grewiaefolia Vent., or aff., *WT 12835*
Casearia cf. *papuana* Sleumer, *WT 11805, 12699*; possibly *C. clutiaefolia*
Casearia ripicola Sleumer, or aff., *WT 12162*
Flacourtia rukam Zoll. & Mor., *WT 13011*
Homalium foetidum (Roxb.) Benth., *WT s.n.*
Osmelia philippina (Turcz.) Benth., SR, Pio; cf. *S&C 4214, 4282*, det. Leiden
Pangium edule Reinw., *AM 356, 629; WT 12002, 12744*
Ryparosa calotricha Mildbr., *WT 12008*
Trichadenia philippinensis Merr., *WT s.n.*
Xylosma papuanum Gilg., *WT 12685*, det. Damas

GESNERIACEAE
Aeschynanthus spp., *WT 11112, 11113, 11266, 11961*
Cyrtandra bracteata Warb., *WT 11162, 11299*
Cyrtandra cf. *decurrens* de Vriese, *WT 11151*
Cyrtandra aff. *?elata* Schltr., *WT 11270*
Cyrtandra fusco-vellea K. Schum., *WT 11181, 11196, 11273, 11703*
Cyrtandra hispidissima Schltr., *WT 11157*
Cyrtandra cf. *janowskyi* Schltr., *WT s.n.*
Cyrtandra sp. A, § Centrosiphon, *WT 11176, 11230, 12163*
Cyrtandra sp. B, § Centrosiphon, *WT 11275, 11294, 12914*
Cyrtandra sp. C, § Centrosiphon, *WT 11267, 11276, 11292, 12996*
Cyrtandra sp. D, § Centrosiphon or Loxanthe, *WT 11289, 12711*
Cyrtandra sp.E, § Diplochiton, *WT 12149*
Cyrtandra sp.F, cf. § Diplochiton, *WT 11209, 11245, 11274, 12358*
Cyrtandra sp. G, § Geodesme, *WT 12776*
Cyrtandra sp. H, § Geodesme, *WT 12027, 12141, 12492*
Cyrtandra sp. I, § Leucocyrtandra, *WT 12052, 12138, 12346*
Cyrtandra sp. J, (*Cyrtandropsis*), § Leucocyrtandra, *WT 11282, 11960, 12854*
Cyrtandra sp. K, (*Cyrtandropsis*), cf. § Leucocyrtandra, *WT 11265*
Cyrtandra sp. L, § Loxophyllum/Phaeotrichium, *WT 11170, 11183*
Cyrtandra sp. M, § Macrocyrtandra, *WT 11293*

Cyrtandra sp. N, § Prosthecisiphon, *WT 12708*

Cyrtandra sp. O, § Rhabdocyrtandra, *WT 11174, 11291, 11769*

Cyrtandra sp. P, unplaced, *WT 12091, 12477*

Cyrtandra sp. Q, unplaced, *WT 11172* (*filibracteata* facies)

Cyrtandra sp. R, unplaced, *WT 12092*

Dichrotrichum spp., or as *Agalmyla*, *WT 11128, 11226, 11708, 11807*

Rhynchotechum discolor (Maxim.) B.L. Burtt, *WT 12671, 12735*

GOODENIACEAE

Scaevola oppositifolia R. Br., *WT 11138, 12593, 12983*

GROSSULARIACEAE

Carpodetus arboreus (Laut. & K. Schum.) Schltr., *AM 616*

Polyosma aff. *amygdaloides* Reeder, *WT 12073, 12386*, keys to *P. stenosiphon* but not that sp.

Polyosma '*cestroides-induta* group', SR, Maimafu

Polyosma forbesii Valeton, or aff., *WT 11249, 11841*

HALORAGACEAE

Gonocarpus halconensis (Merr.) Orchard, SR, upper Maimafu

Gunnera macrophylla Bl., *WT 12183*

HERNANDIACEAE

Hernandia ovigera L., SR, Pio; cf. *C&S 758*, det. Croft

HYDRANGEACEAE

Dichroa febrifuga Lour., *WT 12559*, '*sylvatica* complex'

ICACINACEAE

Citronella suaveolens (Bl.) Howard, *WT 11739, 12036*

Gomphandra montana (Schellenb.) Sleumer, *AM 431; WT 11280, 11937*

Gomphandra sp., '*australiana-montana* group', *WT 12692*; flowers required to differentiate

Gonocaryum litorale (Bl.) Sleumer, *WT 12652*

Platea excelsa Bl. var. *borneensis* (Heine) Sleumer, *WT 11815, 12132*

Pseudobotrys cauliflora (Pulle) Sleumer, or *P. dorae* Moeser, *WT 12771*; flowers required to differentiate

Rhyticaryum longifolium K. Schum. & Laut., *WT 11670, 12113, 12222, 12419, 12575, 12731-B*

Stemonurus monticolus (Schellenb.) Sleumer, *WT 13012*

LAMIACEAE

Plectranthus scutellarioides (L.) R. Br., *LAE 66358*, det. Henty

LAURACEAE

Alseodaphne umbelliflora (Bl.) Hooker f., *WT 12012*

Beilschmiedea cf. *schoddei* Kosterm., *WT 11198, 11814*

Cryptocarya aff. *aureosericea* Kosterm., *WT 11799*

Cryptocarya cf. *depressa* Warb., *WT 11922*

Cryptocarya aff. *depressa* Warb., *WT 11862*

Cryptocarya aff. *multipaniculata* Teschn., *WT 11202*

Endiandra forbesii Gamble, *WT 13013*

Endiandra magnilimba Kosterm., *WT 11920, 12007*

Endiandra cf. *papuana* Laut.; '*papuana-glauca* group', *WT 11251, 12040*

Litsea calophyllantha K. Schum., *WT 11699*

Persea americana Mill., SR, Maimafu, cultivated

LEEACEAE

Leea coryphantha Laut., *WT 11731*

Leea (close to) *heterodoxa* K. Schum. & Laut., *WT 12949*; '*coryphantha-heterodoxa* group'

Leea heterodoxa K. Schum. & Laut., *LAE 66334*, Purari River; det. Leiden

Leea indica (Burm. f.) Merr., *AM 486; WT 11738, 12633*

LEGUMINOSAE/CAESALPINIACEAE

Caesalpinia crista L., *C&S 808*, Purari, det. Leiden

Cassia alata L., SR, Haia-Pio

Crudia papuana Kosterm., *C&S 804*, Purari, det. Verdcourt

Intsia bijuga (Colebr.) O. Kuntze, SR, Haia-Pio; cf. *S&C 4545*, det. collectors

Kingiodendron sp., SR, Pio

Maniltoa schefferi K. Schum. & Hollrung, SR, Haia-Pio; cf. *S&C 4406*, det. Verdcourt

LEGUMINOSAE/FABACEAE

Aganope heptaphylla (L.) Polhill, *S&C 4464*, E. Purari, det. Verdcourt
Arachis hypogaea L., SR, cultivated
Crotalaria lanata Beddome, *WT 12018*
Crotalaria sp., (possibly) *pallida* Aiton, cf. *C&S 811*, E. Purari, det. Verdcourt
Dalbergia albertisii Prain, *C&S 830*, Purari, det. Verdcourt
Dalbergia beccarii Prain, *S&C 4491*, E. Purari, det. Verdcourt
Derris cf. *cuneifolia* Grah. ex Benth. (sensu Verdcourt), *WT 11939*
Derris trifoliata Lour., *C&S 815*, E. Purari, det. Verdcourt
Desmodium laxum DC., *WT 11773*
Desmodium repandum (Vahl) DC., *WT 12244, 12803*
Desmodium sequax Wall., *WT 12573, 12607*
Desmodium umbellatum (L.) DC., SR; cf. *C&S 724, S&C 4556*, det. Leiden
Desmodium sp., (possibly) *D. heterocarpon* (L.) DC., cf. var. *strigosum* in *C&S 740, S&C 4512*
Gliricidia sepium (Jacq.) Walp., SR, cultivated
Inocarpus fagifer (Parkinson) Fosb., *C&S 795*, Purari, det. Leiden
Inocarpus sp. nov., '*rubidus* morphospecies' sensu Verdcourt, *WT 11139, 12054*
Macropsychanthus lauterbachii Harms, *WT 11839*
Mucuna aff. *?lamii* Verdcourt, *WT 11837 (fl)*, key uncertain without fruit
Mucuna novo-guineensis Scheffer, SR; cf. *LAE 61103*, Purari; *S&C 4400*
Phaseolus vulgaris L., SR, cultivated
Pongamia pinnata (L.) Pierre, *C&S 828, 867*, Purari, det. collectors
Pterocarpus indicus Willdenow, SR; cf. *S&C 4249; C&S 869*, det. collectors
Strongylodon decipiens Verdcourt, *WT 11131*
Tephrosia vogelii Hook. f., *WT 12016*
Tephrosia sp., (possibly) *vestita* Vog., SR; cf. the sp. in *C&S 905*, det. Verdcourt

LEGUMINOSAE/MIMOSACEAE

Entada phaseoloides (L.) Merr., *WT s.n.*, carpological
Mimosa pudica L., SR, Haia & Maimafu
Paraserianthes falcataria (L.) Nielsen, SR; cf. *S&C 4242*, det. Nielsen

LINACEAE

Hugonia jenkinsii F.v.M., *WT s.n.*

LOGANIACEAE

Fagraea amabilis S. Moore, *WT 11695*
Fagraea berteriana A. Gray ex Benth., *WT 12790*
Fagraea ceilanica Thunb., *AM 662*
Fagraea elliptica Roxb., SR, O-Pio
Fagraea racemosa Jack ex Wall., SR, O-Pio
Fagraea woodiana F.v.M., SR, Wara Navarah
Geniostoma rupestre J.R. & G. Forst., *WT 11907*
Geniostoma weinlandii K. Schum., *WT 12012, 12071, 12416*
Neuburgia celebica (Koorders) Leenh., *S&C 4451, 4507*, Purari R., det. Conn
Neuburgia corynocarpa (A. Gray) Leenh., *AM 507; WT 12830*
Neuburgia kochii (Valeton) Leenh., *WT 11225, 11706*
Strychnos minor Bl., *GW 799*, det. GW; cf. also *S&C 4394*

LORANTHACEAE

Amyema friesiana (K. Schum.) Danser, *WT 12295*
Amyema rigidiflora (K. Krause) Danser, *WT 11869*
Amyema squarrosa (K. Krause) Danser, *WT 12578, 12883*
Dactyliophora verticillata (Scheffer) Tiegh., *WT 11954*
Decaisnina hollrungii (K. Schum.) Barlow, *WT 12236, 12541*
Dendrophthoe curvata (Bl.) Miq., SR, Haia
Macrosolen geminatus (Merr.) Danser, *WT 12828*

MAGNOLIACEAE

Elmerrillia tsiampaca (L.) Dandy ssp. *tsiampaca* var. *tsiampaca*, *AM 237, 392; WT 11976, 12691*
Magnolia candollii (Bl.) H. Keng var. *candollii*, *WT 12585, 12650*

MALPIGHIACEAE

Ryssopterys timoriensis (DC.) Jussieu var. *discolor* (Gand.) Jacobs, *WT 12564*

MALVACEAE

Hibiscus archboldianus Borss., *WT 11194, 12086*

Hibiscus tiliaceus L., SR; cf. *C&S 730; S&C 4522*, det. collectors

Thespesia populnea (L.) Sol. ex Corr., *WT 11971*

Urena lobata L., *WT 12459*

MELASTOMATACEAE

Catanthera lysipetala F.v.M., *WT 11302*

Creochiton novoguineensis (Baker f.) Veldk. & Nayar, *WT 12038*

Dissochaeta angiensis Ohwi, *WT 11200, 11220*

Heteroblemma sp., *WT 11242*

Medinilla aff. *albida* Merr. & Perry, *WT 12530*

Medinilla aff. *compacta* Bakh. f., *WT 11169*

Medinilla crassinervis Bl., *AM 622; WT 11675, 12044, 13000*

Medinilla dentata Veldk., *WT 12068*

Medinilla 'ramiflora group', *WT 12373*; keys to Mansfeld's spp. 14-16

Medinilla rubrifructus Ohwi, *AM 665; WT 11241*

Medinilla sogerensis Bak. f., or aff., *WT 12375*

Medinilla tenuipedicellata Bak. f., *WT 11782, 12057, 12083*

Medinilla teysmannii Miq., *WT 12077, 12098*

Medinilla aff. *?versteegii* Mansf., *WT 11114*

Memecylon 'hepaticum' sensu Mansf., *WT 12189, 12557*; keys to *hepaticum*

Memecylon cf. *schraderbergense* Mansf., *WT 11219, 11895, 12957*

Memecylon torricellense Mansf., *WT 12045*

Ochthocharis bornensis Bl., SR, Pio; cf. *S&C 4200*, det. Hansen

Otanthera bracteata Korth., *WT 12102*

Otanthera cyanoides Triana, *WT 11129, 12007, 12609*

Poikilogyne multiflora Maxw., *WT 12140, 12644*

Poikilogyne cf. *robusta* Mansf., *WT 12034, 12391-A*, '*robusta-macrophylla*'

Poikilogyne villosa Maxw., *WT 11692*

MELIACEAE

Aglaia (nearest) *agglomerata* Merr. & Perry, *AM 700*

Aglaia agglomerata Merr. & Perry, *WT 11879, 11902, 12062*

Aglaia argentea Bl., *WT 11956, 12025*

Aglaia lepidopetala Harms, *WT 11851*

Aglaia rimosa (Blanco) Merr., *WT 12782*

Aglaia sapindina (F.v.M.) Harms, *WT 11187, 11700*

Aglaia subminutiflora C. DC., *WT 11809, 11919*

Aglaia cf. *subminutiflora* C. DC., *WT 12882, 12956*; atypical indumentum

Aglaia tomentosa Teijsm. & Binn., *WT 11991, 12049*

Aglaia aff. *tomentosa* Teijsm. & Binn., *WT 11776*

Aglaia sp. ?nov., aff. '*grandis-ramotricha* group', *AM 695*

Aglaia sp., (possibly) *A. silvestris* (Roemer) Merr., *cf. C&S 798*, Purari

Anthocarapa nitidula (Benth.) T.D. Penn. ex Mabb., *WT 11952, 12058*

Aphanamixis polystachya (Wall.) R.N. Parker, SR; cf. *S&C 4297*

Chisocheton ceramicus (Miq.) C. DC., *WT 11916, 12060*

Chisocheton lasiocarpus (Miq.) Valeton, *WT 11966, 11998*; entity '*weinlandii*'

Chisocheton lasiocarpus (Miq.) Valeton, *WT 11938*; entity '*caroli*'; = *C. caroli* Harms

Chisocheton sayeri (C. DC.) Stevens, *LAE 61176*, Purari R., det. Stevens

Chisocheton stellatus Stevens, *WT 11975*

Dysoxylum arborescens (Bl.) Miq., SR; cf. *C&S 788*, Purari, det. Mabberley

Dysoxylum excelsum Bl., or aff. '*alliaceum* group', *WT 11891, 11897, 12013*

Dysoxylum gaudichaudianum (A. Juss.) Miq., *LAE 61125*, Purari R., det Leiden

Dysoxylum inopinatum (Harms) Mabb., *WT 11912*

Dysoxylum cf. *kaniense* Harms, *WT 11732, 12946*

Dysoxylum mollissimum Bl. ssp. *molle* (Miq.) Mabb., *WT 12646*

Dysoxylum papuanum (Merr. & Perry) Mabb., *WT 11993*

Dysoxylum parasiticum (Osb.) Kosterm., *WT 11733, 12174, 12954*

Dysoxylum pettigrewianum F.M. Bailey, *WT 11923; LAE 66295*

Dysoxylum ?randianum Merr. & Perry, or aff., *WT 12562*

Dysoxylum setosum (Span.) Miq., *WT 12126, 12591*

Dysoxylum cf. *sparsiflorum* Mabb., *WT 11829*

Dysoxylum variabile Harms, *WT 11694, 12021, 12291, 12739, 12982*

Dysoxylum aff. *variabile* Harms, *WT 12101*

Vavaea amicorum Benth., *WT 12103*

Xylocarpus granatum Koen., *S&C 4484*, E. Purari, det. Leiden

Xylocarpus moluccensis (Lam.) M. Roem., *S&C 4483*, E. Purari, as *X. australasicus*

MENISPERMACEAE

Arcangelisia tympanopoda (Laut. & K. Schum.) Diels, *WT s.n.*, carpological coll.

Chlaenandra ovata Miq., *LAE 61110*, Purari R., det. Forman

Legnephora minutiflora (K. Schum.) Diels, *WT 11948*

Stephania japonica (Thunb.) Miers var. *japonica*, *WT 12887*

Stephania japonica (Thunb.) Miers var. *timoriensis* (DC.) Forman, *WT 12680*

Stephania zippeliana Miq., *WT 11212, 12464*

Tinomiscium petiolare Hook. f., *WT 12096*

Tinospora dissitiflora (Laut. & K. Schum.) Diels, *WT 11853*

MONIMIACEAE

Kibara archboldiana A.C. Smith, *LAE 66299*, Wabo dam site, det. Philipson

Kibara cf. *papuana* A.C. Smith, *WT 12722, 12728*, '*coriacea-papuana* group'

Levieria (closest to) *acuminata* (F. v. M.) Perkins, *WT 12550*

Levieria montana Becc., *WT 12417*

Levieria nitens Perkins, *WT 12494*

Palmeria brassii Philipson, *WT 12595*

Palmeria gracilis Perkins, *AM 376*

Palmeria gracilis Perkins var. ?nov., *WT 12431*; nonconformist indumentum

Steganthera hirsuta (Warb.) Perkins, *WT 12164, 12923*

Steganthera hospitans (Becc.) Kanehira & Hatusima, *WT 11795*

Steganthera sp. nov., aff. 'myrmecophilous group', *WT 12742*

MORACEAE

Ficus adenosperma Miq., *AM 209; GW 808*, det. GW

Ficus amblisyce Corner, *AM 408*, det. GW

Ficus ampelas Burm. f., *GW 713*, det. GW

Ficus arbuscula Laut. & K. Schum., *WT 12093*

Ficus archboldiana Summerh., *GW 764*, det. GW

Ficus arfakensis King, *GW 780*, det. GW

Ficus augusta Corner, *GW 791*, det. GW

Ficus aurita Bl., *GW 714*, det. GW

Ficus bernaysii King, *GW 712, 728, 784*, det. GW

Ficus botryocarpa Miq., *GW 753*, det. GW

Ficus caesaroides King, *Dodson s.n.*, det. GW

Ficus comitis King, GW pers. comm.

Ficus congesta Roxb., *GW 720, 818*, det. GW

Ficus congesta Roxb. var. *chalmersii* (King) Corner, *GW 711*, det. GW

Ficus copiosa Steud., *AM 501*, det. GW

Ficus crassiramea Miq., *GW 805B*, det. GW

Ficus dammaropsis Diels, *AM 273, 313*, det. GW; *WT s.n.*

Ficus distichoidea Diels, GW pers. comm.

Ficus edelfeltii King, GW pers. comm.

Ficus erythrosperma Miq., *GW 736*, det. GW

Ficus glaberrima Bl., *WT 12051*

Ficus gul Laut. & K. Schum., *WT 13014*

Ficus hahliana Diels, GW pers. comm.

Ficus homobroniana Corner, GW pers. comm.

Ficus homodroma Corner, *WT 11827*

Ficus iodotricha Diels, GW pers. comm.

Ficus irritans Summerh., GW pers. comm.

Ficus itoana Diels, *WT 11121*

Ficus macrorrhyncha Laut. & K. Schum., GW pers. comm.

Ficus megalophylla Diels, *GW 776*, det. GW

Ficus microcarpa L. f., GW pers. comm.

Ficus mollior F.v.M. ex Benth., *WT 11679*; also GW pers. comm.

Ficus mollior F.v.M. ex Benth. var. *sessilis* Corner, *LAE 66331*, Purari River; det. Corner

Ficus nasuta Summerh. var. *glabrata* Corner, *GW 792*, det. GW

Ficus nodosa Teysm. & Binn., *WT 11987; LAE 61098*, Purari, det. Corner

Ficus ochrochlora Ridl., *GW 735, 752*, det. GW
Ficus odoardi King, *GW 718, 782, 793*, det. GW; *WT 11864*
Ficus aff. *ovatacuta* Corner, *WT 11834*, ?sp. nov., does not key
Ficus pachyrrhachis Laur. & K. Schum., GW pers. comm.
Ficus pachysycia Diels ex Corner, GW pers. comm.
Ficus phaeosyce Laut. & K. Schum., pers. comm. GW based on *JE 18 & 30* at A
Ficus phatnophylla Diels, GW pers. comm.
Ficus polyantha Warb., GW pers. comm.
Ficus pseudojaca Corner, GW pers. comm.
Ficus pungens Reinw. ex Bl., *GW 717, 750*, det. GW
Ficus robusta Corner, GW pers. comm.
Ficus scratchleyana King, *GW 800*, det. GW
Ficus scratchleyana King var. *rhopalosycia* (Diels) Corner, GW pers. comm. based on *JE 27* at A
Ficus semivestita Corner, GW pers. comm.
Ficus septica Burm. f., *LAE 61123*, Purari R., det. Corner
Ficus sterrocarpa Diels, *GW 709, 715*, det. GW
Ficus sterrocarpa Diels var. *pubigemma* Diels, *GW 734*, det. GW
Ficus sterrocarpa Diels var. *sterrocarpa*, *GW 715*, det. GW
Ficus subcuneata Miq., *AM 207*, det. GW
Ficus sublimbata Corner, *WT 11123*
Ficus subulata Bl., *GW 779, 805A*, det. GW
Ficus subulata Bl. var. *gracillima* (Diels) Corner, *GW 801*, det. GW
Ficus tenella Corner, GW pers. comm.
Ficus ternatana Miq., GW pers. comm.
Ficus trachypison K. Schum., *AM 536; GW 721*, det. GW
Ficus trichocerasa Diels, GW pers. comm.
Ficus virgata Reinw. ex Bl., GW pers. comm.
Ficus wassa Roxb., *GW 796*, det. GW
Ficus xylosycia Diels var. *cylindrocarpa* (Diels) Corner, *WT 11189*
Ficus sp., sect. Conosycea, GW pers. comm.
Ficus sp., sect. Rhizocladus, GW pers. comm.

MYRISTICACEAE

Endocomia macrocoma (Miq.) de Wilde subsp. *prainii* (King) de Wilde, *WT 11958, 12003, 12057*
Gymnacranthera farquhariana (Hook. f. & Th.) Warb. var. *zippeliana* (Miq.) R. Schouten, *WT 11908, 12050*
Horsfieldia hellwigii (Warb.) Warb., *WT 13015A*
Horsfieldia laevigata (Bl.) Warb., *WT 13015B*
Horsfieldia pulverulenta Warb., *WT 11957*
Horsfieldia subtilis (Miq.) Warb. var. *subtilis*, *AM 661; WT 11883*
Horsfieldia subtilis (Miq.) Warb. var. *aucta* de Wilde, *WT 11674*
Horsfieldia sylvestris (Houtt.) Warb., *WT s.n.*, sterile
Horsfieldia cf. *tuberculata* (K. Schum.) Warb., *WT 11892, 11940*; possibly *H. hellwigii*
Myristica cornutiflora J. Sinclair, *WT 11261, 12000*
Myristica cf. *cucullata* Markgraf, *WT 13016*
Myristica globosa Miq., *WT 11254*
Myristica aff. *globosa* Miq., *WT 11144, 11929*
Myristica ingens (Foreman) W.J. de Wilde, *WT 10251*
Myristica cf. *inutilis* Rich. ex A. Gray subsp. *papuana* (Markgraf) W.J. de Wilde, *WT 11865, 12067*
Myristica subalulata Miq., *WT 11262*

MYRSINACEAE

Ardisia aff. *squarrosa* Mez, *WT 11281, 11904, 12076*, det. Pipoly
Loheria reiniana (Jacobs) Sleumer, *WT 11921*
Maesa haplobotrys F.v.M., *WT 11855*
Maesa protracta F.v.M., *LAE 66330*, Purari River
Myrsine aff. *acrostica* (Mez) Pipoly, *WT 11612*, possible sp. nov., det. Pipoly
Myrsine leucantha (K. Schum.) Pipoly, *WT 11693*, det. Pipoly

MYRTACEAE

Acmena acuminatissima (Bl.) Merr. & Perry, *WT 12100*
Decaspermum bracteatum (Roxb.) A.J. Scott, SR, Haia & Pio; cf. *S&C 4373*
Decaspermum exiguum Merr. & Perry, *WT 12582*
Decaspermum neurophyllum Laut. & K. Schum., *AM 625; WT 11216*
Metrosideros ramiflora Laut., SR, Maimafu, also cult. by Maimafu villagers

Octamyrtus behrmannii Diels, *WT 11677*

Octamyrtus pleiopetala (F.v.M.) Diels var. *pleiopetala*, *WT 12424 (fr), 12617 (fl), 12759 (fl)*

Rhodamnia latifolia (Benth.) Miq., *WT 11231*

Rhodomyrtus novoguineensis Diels, *WT 12421*

Syzygium acutangulum K. Schum., *WT 12076*

Syzygium buettnerianum (K. Schum.) Niedenzu, SR, Maimafu, possibly *S. subcorymbosum*

Syzygium callianthum Merr. & Perry, *WT 12193*

Syzygium decipiens (Koorders & Valeton) Merr. & Perry, or aff., *WT 11767, 12118*

Syzygium dictyophlebium Merr. & Perry, *WT 11277*

Syzygium effusum (A. Gray) C. Muell., *WT 12173, 12844*

Syzygium furfuraceum Merr. & Perry, SR, Maimafu

Syzygium cf. *hylochare* (Diels) Merr. & Perry, *WT 12525*, '*hylochare-phaeostictum* group'

Syzygium iteophyllum Diels, or aff., *WT 12698, 12947*

Syzygium longipes Merr. & Perry, *WT 12655*

Syzygium malaccense (L.) Merr. & Perry, sensu lato, *WT 11943, 12017, 12940, 12944*

Syzygium megalospermum (Laut. & K. Schum.) Merr. & Perry, *WT11676*, or aff. *megalospermum*

Syzygium porphyrocarpum (Greves) Merr. & Perry, *WT 12000, 12497-A, 12877*

Syzygium aff. *roseum* Merr. & Perry, *WT 11847*, possible sp. nov.

Syzygium cf. *rubro-punctatum* (Ridl.) Merr. & Perry, or aff., *WT 11235, 11719, 13004*; ?new

Syzygium subalatum (Ridl.) Merr. & Perry, *WT 12075*

Syzygium '*tierneyanum* group', SR, Haia & Maimafu, with diffuse inflorescence

Syzygium trachyanthum (Diels) Merr. & Perry, or aff., *WT 11990*

Syzygium tympananthum (Diels) Merr. & Perry, *WT 12598*

Syzygium aff. *womersleyi* Hartley & Perry, *WT 11258*, possible sp. nov.

Xanthomyrtus spp., SR, Maimafu, sterile, more than one taxon

NEPENTHACEAE

Nepenthes maxima Nees, *WT 12284, 12319*

Nepenthes cf. *papuana* Dans., *WT 11779*

NYCTAGINACEAE

Pisonia longirostris Teysm. & Binn., *WT 12010*

Pisonia umbellifera (Forst.) Seem., *LAE 61114*, Purari, det. Hyland

OCHNACEAE

Schuurmansia henningsii K. Schum., *WT 12129*

OLACACEAE

Anacolosa papuana Schellenb., SR, near Pio

Olax imbricata Roxb., *C&S 829*, Purari

OLEACEAE

Chionanthus riparius (Lingelsh.) Kiew, *WT 11909*

Chionanthus ?sp. nov., aff. *salicifolius* (Lingelsh.) Kiew, *WT 12965*

Chionanthus sessiliflorum (Hemsl.) Kiew, *WT 12921*

Chionanthus aff. *sessiliflorum* (Hemsl.) Kiew, *WT 11175*

Jasminum sp. nov., *WT 11866*

ONAGRACEAE

Ludwigia hyssopifolia (Don.) Exell, *LAE 66357*, det. Kerenga

Ludwigia octovalvis (Jacq.) Raven, *WT 11751, 12818*

PASSIFLORACEAE

Passiflora foetida L., SR, Haia & lower Maimafu; cf. *S&C 4596*

PENTAPHRAGMATACEAE

Pentaphragma grandiflorum Kurz, *WT 11163*

PIPERACEAE

Peperomia cf. *gurakorana* Dull, '*purpurea* group', *WT 11818*; matches L-annotated sheet

Peperomia laevifolia (Bl.) Miq., *WT 12342*

Peperomia pellucida (L.) Kunth, SR, Haia

Piper aduncum L., SR, Haia

Piper betle L., SR, cultivated

Piper caninum Bl., *WT 12505*

Piper celtidiforme Opiz, or aff., *WT 12106, 12124*

Piper gibbilimbum C. DC., *WT 12393, 12455*; hirtellous form

Piper gibbilimbum C. DC., *WT 12268*; typical glabrous form

Piper macropiper Pennant, *WT 11683, 12109*

Piper majusculum Bl., SR, Pio; cf. *S&C 4331*, det. Leiden

Piper mestonii Bailey, *WT 12879*; 'form *stenocarpum*'

Piper novo-guineensis Warb., *WT 12090*

Piper rodatzii K. Schum. & Laut., *WT 11681, 12911*

Piper subbullatum K. Schum. & Laut., *AM 232; WT 11143*

Piper subcanirameum C. DC., *WT 11741*

Piper triangulare Chew, *WT 12211, 12273, 12553, 12892*

Piper umbellatum L. var. *subpeltatum* (Willdenow) C. DC., *AM 655; WT 11224*

Piper versteegii C. DC., *WT 12150*

Piper wilhelmense Chew, SR, Maimafu

Piper sp. ?nov., *WT 12453*; unusual filiform peduncle

PITTOSPORACEAE

Pittosporum ferrugineum Aiton f. subsp. *ferrugineum*, *WT 12670*

Pittosporum pullifolium Burk., *WT 11285, 11749*

Pittosporum pullifolium ssp. *ledermannii* (Pritzel) Schodde var. *ledermannii*', *WT 12539, 12580*

Pittosporum sinuatum Bl., *WT 11153, 11279*

Pittosporum sinuatum Bl. var. *sinuatum*, *WT 12177*

POLYGALACEAE

Epirixanthes (probably) *papuana* J.J. Sm., SR, Maimafu

Polygala paniculata L., *WT 12265-B*

Securidaca ecristata Kassau, SR, Haia

Xanthophyllum papuanum Whitmore ex Meijden, *WT 11764, 12032*

POLYGONACEAE

Polygonum chinense L., *WT 12009*

PROTEACEAE

Helicia cf. *latifolia* C.T. White, *WT 12035*

RANUNCULACEAE

Clematis papuasica Merr. & Perry, SR, Pio; cf. *S&C 4399*, det. Tamura

Clematis phanerophlebia Merr. & Perry var. *simplicifolia* Tamura, *WT 12390, 12567, 12780*

Clematis phanerophlebia Merr. & Perry cf. var. *tomentosa* Eichler, *WT 11256*

Ranunculus sp., SR, upper Maimafu

RHAMNACEAE

Alphitonia excelsa (Fenzl) Reiss. ex Endl., *WT 12218*; sensu Schirarend

Alphitonia macrocarpa Mansf., SR, Pio

Emmenosperma alphitonioides F.v.M., SR, Haia

Gouania javanica Miq., *WT 11711*

Rhamnus nipalensis (Wallich) Lawson ex Hook., *WT 11690, 12,277, 12674, 12716, 12718*

Ventilago ?papuana Merr. & Perry, SR, Pio

Zizyphus angustifolius (Miq.) Hatusima, *WT 11985*

Zizyphus djamuensis Laut., *LAE 66318* near Wabo, det. Frodin

RHIZOPHORACEAE

Carallia brachiata (Lour.) Merr., SR, Pio; cf. *S&C 4503*

Gynotroches axillaris Bl., *AM 428, 522; WT 12089*

ROSACEAE

Prunus arborea (Bl.) Kalkman, SR, Haia

Prunus dolichobotrys (Laut. & K. Schum.) Kalkman, SR, Haia

Prunus gazelle-peninsulae (Kanehira & Hatusima) Kalkman, *WT 12642, 12661, 12858*

Prunus oligantha Kalkman, *WT 12802*

Prunus schlechteri (Koehne) Kalkman, *AM 328*

Rubus moluccanus L. var. *moluccanus*, *WT 12022*

Rubus rosifolius J.E Smith, *WT 12095*

RUBIACEAE

Airosperma aff. *ramuense* Laut. & K. Schum., *WT 11877*

Amaracarpus brassii Merr. & Perry, *WT 12908*

?*Amaracarpus* aff. *grandifolius* Valeton, *WT 12495*

Antirhea sp., (possibly) *megacarpa* Merr. & Perry, SR, Pio; cf. *S&C 4293*, det. Darwin

Argostemma bryophilum K. Schum., *AM 513; WT 11132, 11150*

Argostemma callitrichum Valeton, *WT 12364, 12422*

Canthium aff. *cymigerum* (Valeton) B.L. Burtt, *WT 11868, 12128, 12737*, not the species

Canthium cf. *longifolium* (Valeton) Merr. & Perry, *WT 12106-R*

Diplospora sp., *WT 12934*; also diff. sp. in *S&C 4233*, Gulf

Dolicholobium gertrudis K. Schum., *WT 12110, 12498*

Dolicholobium oxylobum K. Schum., *WT 11965*

Gardenia hansemannii K. Schum., SR, Pio; cf. *C&S 768*

Gardenia lamingtonii F.M. Bailey, SR, Haia; cf. *S&C 4388*, det. Leiden

Gardenia pallens Merr. & Perry, *WT 12399, 12447, 12479, 12829*

Hedyotis auricularia L., *WT 12666*

Hedyotis schlechteri (Valeton) Merr. & Perry, *WT 11820*

Hydnophytum radicans Becc., *LAE 61087*, Purari R., det. Leiden

Hydnophytum terrestris Huxley & Jebb, or aff., *WT 12587, 12831*

Ixora leptopus Valeton, or aff., *WT 11926*

Ixora aff. *moszkowskii* Brem., *WT 11936*

Lasianthus chlorocarpus K. Schum., or aff., *WT 12410, 12734*

Lasianthus tomentosus Bl., *WT 12158, 12220, 12732*

Lasianthus (closest to) *tomentosus* Bl., *WT 12885, 12894*

Maschalodesme arborea K. Schum. & Laut., or aff., *WT 11213*; = *M. simplex* Merr. & Perry

Mastixiodendron pachyclados (K. Schum.) Melch., SR; cf. *S&C 4278*, Gulf D., det. Darwin

Morinda citrifolia L., *C&S 821*, E. Purari, det. Gideon

Morinda umbellata L. var. *papuana* Valeton, *WT 12058*

Mussaenda bevani F.v.M., *AM 214, 379; GW 723*, det. Gideon

Mussaenda ferruginea K. Schum., *WT 12049*

Mussaenda oreadum Wernh., *WT 12615*, det. Gideon

Mussaenda scratchleyi Wernh., SR; cf. *S&C 4238, 4306*, det. Gideon

Mycetia javanica (Bl.) Reinw. ex Korth., *WT 11182, 11221*

Myrmecodia platytyrea Becc. subsp. *platytyrea*, *WT 11193*

Myrmecodia sp., SR, Maimafu near clinic, not *platytyrea*

Nauclea orientalis L., *GW 803*, det. GW

Neonauclea acuminata Ridsd., *WT 12055*

Neonauclea gordoniana (F.M. Bailey) Ridsd., *WT 12462*

Neonauclea cf. *perspicuinervia* Merr. & Perry, *WT 11951*

Ophiorrhiza aff. *amoena* Valeton, *WT 11271, 12088*

Ophiorrhiza aff. *?debruynii* Valeton, *WT 12010, 12084, 12246-B*

Ophiorrhiza tenelliflora Valeton, *WT 11149*

Ophiorrhiza sp., unplaced aff., *WT 12411*

Pachystylus guelcherianus K. Schum., *AM 541; WT 12160, 12721*

Psychotria amplithyrsa Valeton, *WT 12099, 12900*

Psychotria aff. *amplithyrsa* Valeton, *WT 12028*, vining, not the sp., not in Valeton

Psychotria cf. *chrysantha* Merr. & Perry, '*micralabastra* group', *WT 12070, 12102, 12891*, keys to fork 44

Psychotria dieniensis Merr. & Perry, *WT 12343*

Psychotria cf. *hollandiae* Valeton, *WT 12014*

Psychotria leonardii Merr. & Perry, or aff., *WT 12960*

Psychotria aff. *leptothyrsa* Miq., *WT 12662*, best result on key, not the sp.

Psychotria micralabastra (Laut. & K. Schum.) Valeton, *LAE 61167*, Purari River, det. Sohmer

Psychotria multicostata Valeton, *WT 11152*

Psychotria myrmecophila Laut. & K. Schum., *LAE 66280*, Wabo dam, det. Sohmer

Psychotria olivacea Valeton, *WT 11765*; cf. also *S&C 4317*, Gulf

Psychotria aff. *polita* Valeton, *WT 12397*

Psychotria purariensis Sohmer, *LAE 66298, 66349*, det. Sohmer

Psychotria ramadecumbens Sohmer, *WT 12122, 12904*

Psychotria cf. *ramulosa* Merr. & Perry, '*micrococca* group', *WT 12035*, keys to 77-78, stipule *ramulosa*

Psychotria sphaerothyrsa Valeton, *WT 11678, 12979*
Psychotria valetoniana Sohmer, *WT 12817, 12843, 12893*
Psychotria womersleyi Sohmer, *WT 12028, 12056*
Psychotria sp. nov., aff. *howcroftii* Takeuchi, *WT 12130, 12602-B, 12920*
Psychotria sp., unplaced aff., *WT 12706*
'Randia' decora Valeton, *WT 11915*, genus name is problematic
'Randia' schumanniana Merr. & Perry, *WT 11122*
'Randia' sessilis F.v.M., *WT 11917*
Rhadinopus papuana S. Moore, *WT 11630*
Tarenna buruensis (Miq.) Valeton, *WT 11684*
Timonius belensis Merr. & Perry, *AM 415; WT 12961*
Timonius grandifolius Valeton, *WT 11925, 11236*
Timonius timon (Spreng.) Merr., *GW 758*
Timonius trichanthus Merr. & Perry, *WT 12187, 12548, 12808*
Timonius sp., '*laevigatus-pulposus* group', *WT 12352*
Uncaria lanosa Wall. var. *appendiculata* (Benth.) Ridsd., *AM 378; WT 11199*
Uncaria nervosa Elmer, *WT 12993*
Urophyllum aff. *?brittanicum* Wernh., *WT 11680*
Versteegia minor Valeton, *WT 11188, 11930*
Wendlandia paniculata (Roxb.) DC., *AM 514, 532, 553; WT 11252*
genus indet., *WT 12926*, monospermous shrub

RUTACEAE

Acronychia sp., SR, Haia
Euodia hortensis J.R. & G. Forst., *WT 12490, 12497-B*
Melicope denhamii (Seem.) T. Hartley, or aff., *WT 12280, 12636*
Melicope grandifolia B.L. Burtt, or aff., *WT 11671*
Melicope (probably) *mucronata* Merr. & Perry, SR, upper Maimafu
Melicope cf. *nova-guineensis* Valeton, *WT 12212*, keys to here but can't confirm
Melicope sp., as *Euodia* §§ Coriaceae, SR; cf. *S&C 4704*, Gulf
Flindersia amboinensis Poir., SR; cf. *S&C 4656*, Gulf, det. Leiden
Flindersia sp., (possibly) *laevicarpa* C.T. White & Francis, SR, Haia-Pio
Halfordia drupifera F.v.M. Laut., *WT 11857*
Lunasia amara Blanco var. *amara*, *WT s.n.*
Micromelum minutum (Forst. f.) W. & A., SR; cf. *S&C 4542; C&S 1003*, Gulf
Tetractomia tetrandrum (Roxb.) Merr., *WT 12285, 12594*
Wenzelia tenuifolia Swingle, *WT 12958*
Zanthoxylum conspersipunctatum Merr. & Perry, *WT 12465*
Zanthoxylum spp., SR, Haia-Pio
(possibly) *nitidum* (Roxb.) DC., *S&C 4246*, Gulf, det. Streimann
(possibly) *ovalifolium* Wight, *C&S 1019*, Gulf

SABIACEAE

Meliosma pinnata (Roxb.) Maxim. ssp. *humilis* (Merr. & Perry) Beus., SR, upper Maimafu
Meliosma pinnata (Roxb.) Maxim. ssp. *macrophylla* (Merr.) Beus., *WT 11190, 12085*
Sabia pauciflora Bl., *WT 12226, 12959, 12976*

SANTALACEAE

Cladomyza aff. *uncinata* Danser, *WT 12359*, keys to *uncinata* but not the sp.
Dendromyza reinwardtiana (Bl.) Danser, *WT 12348*
Dendrotrophe amorpha Stauffer, *WT 11856*
Scleropyrum aurantiacum (Laut. & K. Schum.) Pilg., *AM 679; WT 11253, 11707*

SAPINDACEAE

Alectryon myrmecophilus Leenh., *WT 12746*
Allophylus cobbe (L.) Raeuschel, SR, Pio; cf. *S&C 4680*, det. Leiden
Cupaniopsis macropetala Radlk., *WT 11146*
Cupaniopsis platycarpa Radlk., ID based on fruits on ground, Haia
Cupaniopsis rhytidocarpa Adema, *WT 12864*
Dictyoneura obtusa Bl., *WT 11201*
Dodonaea angustifolia L.f., *WT 12418*
Guioa molliuscula Radlk., or aff., *WT 12664, 12995*
Guioa subsericea Radlk., *WT 12276, 12283*
Harpullia arborea (Blanco) Radlk., SR; cf. *S&C 4641*, Gulf
Harpullia camptoneura Radlk., *WT 11889*
Harpullia cf. *camptoneura* Radlk., *WT 12723*, possibly *H. cupanioides*

Harpullia longipetala Leenh., *LAE 61175*, Purari R., det. Leiden

Harpullia petiolaris Radlk. (close to) subsp. *petiolaris*, *WT 12922*

Harpullia sp., (probably) *ramiflora* Radlk., SR, Haia-Pio

Jagera javanica (Bl.) Kalkman ssp. *javanica*, SR, Haia

Lepidopetalum xylocarpum Radlk., *WT 11950, 11988, 11989*

Lepisanthes senegalensis Leenh., SR, Pio; cf. *S&C 4337*, det. Leiden

Mischocarpus largifolius Radlk., *AM 597*

Mischocarpus pyriformis (F.v.M.) Radlk. subsp. *retusus* (Radlk.) R.W. Ham, *WT 12249, 12443*

Mischocarpus sp., *WT 12589*

Pometia pinnata Forst., *WT s.n.*

Sarcotechia crispata Welzen, *WT 11885*

genus indet., *WT 12413, 12694, 12784*; alate rachis

SAPOTACEAE

Pouteria anteridifera (C.T. White & Francis) Baehni, *AM 221*

SAXIFRAGACEAE

Quintinia sp., SR, upper Maimafu

SOLANACEAE

Capsicum annuum L., SR, cultivated Haia & Maimafu

Lycopersicon esculentum Mill., SR, cultivated, also as *L. lycopersicum*

Nicotiana tabacum L., SR, cultivated

Physalis peruviana L., *WT 12301*

Solanum americanum Mill., *WT 12015*

Solanum anfractum Symon, *WT 12912, 12928*

Solanum biflorum Lour., *WT 12508, 12688*

Solanum cladotrichotum Bitter, *WT 12379*

Solanum cf. *dallmannianum* Warb., *WT 12705*; possibly *S. icanoalabastrum*

Solanum dendropilosum Symon, *WT 11854*, det. Symon

Solanum dunalianum Gaud., SR, Pio; cf. *S&C 4244*, det. Symon

Solanum oliverianum K. Schum. & Laut., *C&S 848*, Purari, det. Symon

Solanum peranomalum Wernh., *WT 11204*, conf. Symon

Solanum pustulatum Symon, *WT 11704, 11804*, conf. Symon

Solanum cf. *pustulatum* Symon, or aff., *WT 12085*; does not key out

Solanum torvoideum Merr. & Perry, *WT 12549*

Solanum sp., (possibly) *leptacanthum* Merr. & Perry, cf. *C&S 714; S&C 4625*, dets. Symon

SPHENOSTEMONACEAE

Sphenostemon papuana (Laut.) Steen. & Erdtman, *WT 12308, 12444*

STAPHYLEACEAE

Turpinia pentandra (Schltr.) v.d. Linden, *AM 474; WT 11858, 12119, 12432, 12478*

STERCULIACEAE

Brachychiton carruthersii F.v.M., or *B. velutinosus* Kosterm., *WT 12021*

Commersonia bartramia (L.) Merr., SR, Haia

Melochia odorata L.f., *WT s.n.*, partial sheet

Pterocymbium beccarii K. Schum., *C&S 770; WT s.n.*, carpological coll.

Pterygota horsfieldii (R. Br.) Kosterm., SR, Haia

Sterculia ampla Bak. f., *WT 11186, 12056*

Sterculia gilva Miq., or aff., *WT 12814*

Sterculia macrophylla Vent., *WT 11984*

Sterculia monticola Mildbr. var *laxiflora* Tantra, *WT 12148, 12647*

Sterculia schumanniana (Laut.) Mildbr., SR, Haia

Sterculia shillinglawii F.v.M. var. *shillinglawii*, *WT s.n.*, partial sheet

Sterculia urceolata J. Smith, *S&C 4467*, E. Purari R., det. Tantra

STYRACACEAE

Bruinsmia styracoides Boerl. & Koorders, *WT 12423*

Styrax argreste (Lour.) G. Don, SR, Pio & lower Maimafu

SYMPLOCACEAE

Symplocos cochinchinensis (Lour.) S. Moore ssp. *leptophylla* (Brand) Nooteb., *AM 659; WT 11233*

THEACEAE

Adinandra forbesii Bak. f., *WT 12120*

Eurya aff. *kanehirai* Kobuski, *WT 11848*; keys to here but leaf not crenate

Eurya tigang K. Schum. & Laut., *WT 12063, 12299*

Gordonia papuana Kobuski, *WT 12767*
Ternstroemia britteniana F.v.M., *WT 12405*
Ternstroemia cherryi (F.M. Bail.) Merr., *WT s.n.*

THYMELAEACEAE
Phaleria macrocarpa (Scheffer) Boerl., SR, Haia; cf. *LAE 61132*, Purari R.
Phaleria pilistyla Stevens, *WT 12069*
Phaleria sogerensis S. Moore, *WT 11808, 11888, 12182, 12659*
Phaleria cf. *sogerensis* S. Moore, *WT 12786*

TILIACEAE
Grewia aff. *brassii* Burrett, *WT 13017*
Microcos cf. *grandiflora* Burrett, *WT 11903, 12004*
Microcos tetrasperma Merr. & Perry, *WT 11682*
Trichospermum tripyxis (K. Schum.) Kosterm., *WT 12366, 12743*
Triumfetta sp., '*nigricans-pilosa* group', *WT 12396*

TRIMENIACEAE
Trimenia papuana Ridl., *WT 12857*

ULMACEAE
Celtis hildebrandii Soepadmo, *WT 12095*
Celtis sp., '*latifolia-philippensis* group', *WT s.n.*, sterile
Gironniera (probably) *hirta* Ridl., SR, Haia
Parasponia rigida Merr. & Perry, *WT 12206*
Parasponia rugosa Bl., *WT 12080, 12260*
Trema cannabina Lour., *WT 11838*
Trema orientalis (L.) Bl., SR, Haia

URTICACEAE
Cypholophus aff. *decipiens* Winkler, *WT 12384*
Cypholophus cf. *latifolius* (Bl.) Wedd., *WT 11728*
Cypholophus cf. *pachycarpus* Winkler, *WT 11750*
Cypholophus rotundifolius Winkler, or aff., *WT 12165, 12188*
Cypholophus cf. *velutinus* Winkler, *WT 12823*; keys to *velutinus* on Winkler
Debregeasia longifolia (Burm. f.) Wedd., *WT 12577*
Debregeasia sp., *WT 12207, 12846, 12868*
Dendrocnide peltata (Bl.) Chew, *LAE 61082*, Purari R.
Dendrocnide ternatensis (Miq.) Chew, *WT 12019*
Elatostema beccarii Schröter, *WT 12031, 12152*
Elatostema blechnoides Ridl., or aff., *WT 12153*; ?=*E. rudicaule* H. Winkler
Elatostema cf. *macrophyllum* Brongn., *WT 11229, 12090, 12246-A*
Elatostema aff. *macrophyllum* Brongn., *WT 12584*
Elatostema mongiense Laur., *WT 12270*
Elatostema morobense Perry, *WT 12380*
Elatostema cf. *novoguineense* Warb., *WT 12089*
Elatostema polioneurum Hall. f., SR, Maimafu
Elatostema tridens Perry, *WT 12385*
Laportea decumana (Roxb.) Wedd., *WT 12936*
Leucosyke capitellata (Poir.) Wedd., SR, Pio; or related species
Nothocnide mollissima (Bl.) Chew, *WT 12389*
Nothocnide repanda (Bl.) Bl., *S&C 4501; WT 11746*
Oreocnide trinervis (Bl.) Miq., *AM 527, 618; WT 11177, 12681*
Pilea caudata Winkler, *WT 12254*
Pilea cuneata Winkler, sensu Chew, *WT 12279*
Pilea effusa Winkler, *WT 12175, 12529*
Pilea papuana Winkler, *WT 12267*
Pilea venulosa Bl., *WT 12117*
Pipturus argenteus (Forst. f.) Wedd., *WT 11806, 12520, 12627*
Pouzolzia sp., SR, Maimafu
Procris frutescens (Winkler) Schröter, *WT 12096*
Procris pedunculata (Forst.) Wedd., *WT 12039*
Procris cf. *pedunculata* (Forst.) Wedd., *WT 12367*

VERBENACEAE
Callicarpa longifolia Lamk., *WT 12412, 12785*
Callicarpa pedunculata R. Br., *WT 12003*
Clerodendrum brassii Beer & H.J. Lam, *AM 217; WT 11227*
Clerodendrum buruanum Miq., *WT 11297*
Clerodendrum inerme (L.) Gaertn., SR, Pio; cf. *S&C 4474*
Clerodendrum ?sp. nov., *WT 12209*; no result on Lam, no LAE match

Faradaya splendida F.v.M., SR, Pio; cf. *C&S 853*, Purari

Geunsia pentandra (Roxb.) Merr., *WT 12425*

Gmelina dalrympleana (F.v.M.) H.J. Lam, SR, Pio

Premna serratifolia L., SR; cf. *C&S 818*, E. Purari

Teijsmanniodendron ahernianum (Merr.) Bakh., *WT s.n.*

Vitex cofassus Reinw. ex Bl., SR; cf. *S&C 4497*, Purari R.

VITACEAE

Ampelocissus sp., SR, Haia

Cayratia japonica (Thunb.) Gagn., *WT 11712*

Cayratia (close to) *japonica* (Thunb.) Gagn., *WT 12108*

Cayratia sp., cf. *C&S 855*, Purari, indet., '*trifolia* facies'

Cissus aristata Bl., *WT 11759*

Cissus sp., aff. *aristata* Bl., *WT 12094, 12985*; not the species

Cissus bauerleni Planch., or aff., SR, Haia; cf. *S&C 4505*

Nothocissus penninervis (F.v.M.) Lattiff, *LAE 61100*, Purati R., det. Leiden

Tetrastigma sp., *WT 12456, 12645*

WINTERACEAE

Zygogynum aff. *?glaucum* (A.C. Smith) Vink, *WT 11268*

MONOCOTS

AGAVACEAE

Cordyline cf. *fruticosa* (L.) A. Chev., *WT 12574-B*

AMARYLLIDACEAE

Crinum asiaticum L., *LAE 61096*, Purari R., det. Leiden list

Curculigo capitulata (Lour.) Kuntze, *WT 11688*

Curculigo cf. *capitulata* (Lour.) Kuntze, *WT 12789*; leaves emarginate, inflorescence erect

ARACEAE

Alocasia lancifolia Engler, SR, Pio

Alocasia macrorrhizos (L.) G. Don, *WT 11296*

Alocasia nicolsonii A. Hay, *WT 12202*

Alocasia cf. *nicolsonii* A. Hay, *WT 12145, 12859*

Amorphophallus galbra F.M. Bailey, *WT 11228, 11786*

Amydrium zippelianum (Schott) Nicolson, *WT 12048*

Colocasia esculenta (L.) Schott, SR, cultivated

Cryptocoryne ciliata (Roxb.) Schott, *S&C 4449*, E. Purari R., det. N. Jacobsen

Cyrtosperma cf. *cuspidispathum* Alderw., *WT 11208*

Epipremnum pinnatum (L.) Engl., *AM 600*

Holochlamys beccarii Engl., *WT 12097*

Pothos falcifolius Engl. & K. Krause, *AM 509*, det. A. Hay

ARECACEAE (PALMAE)

Areca catechu L., SR, cultivated

Calamus hollrungii Becc., *WT s.n.*

Caryota rumphiana Mattelli, *WT 12665*

Cocos nucifera L., SR, cultivated

Metroxylon sagu Rottb., SR, Haia

COMMELINACEAE

Aneilema cf. *acuminatum* R. Br., *LAE 66362*, Wabo

Commelina diffusa Burm. f., SR, Haia

Floscopa scandens Lour., *LAE 66360*, Wabo

Forrestia mollissima (Bl.) Koords., s. lat., *WT 11863*, = *?Amischotolype*

Pollia thyrsiflora (Bl.) Steud., *WT 11784*

COSTACEAE

Costus speciosus (Koen.) J.E. Sm., SR, Haia

Tapeinochilos ananassae (Hassk.) K. Schum., *WT 11859*, det. Gideon

Tapeinochilos brassii Gideon, pers. comm. Gideon

Tapeinochilos versteegii Valeton, *AM 596; WT 11156, 11179*, det. Gideon

CYPERACEAE

Cyperus cf. *nutans* Vahl var. *eleusinoides* (Kunth) Haines, *LAE 66361*, Wabo, det. Leiden

Paramapania parvibractea (Clarke) Uittien, *LAE 66307*, Wabo dam site, det. Henty

Scleria polycarpa Boeck., *WT 11747*

Scleria terrestris (L.) Fass., *WT 12686, 12787*

DIOSCOREACEAE

Dioscorea bulbifera L., *WT 13006*

Dioscorea (probably) *esculenta* (Lour.) Burk., SR, Pio & lower Maimafu

Dioscorea cf. *nummularia* Lamk., *WT 11768, 12677*

FLAGELLARIACEAE

Flagellaria indica L., *WT 12216*

GEITONOPLESIACEAE

Geitonoplesium cymosum (R. Br.) Hook., *WT 12571*

HELICONIACEAE

Heliconia papuana W.J. Kress, *WT 11882*

IRIDACEAE

Tritonia x *crocosmiflora* (Lemoine) Nichols, *WT 12807*

LILIACEAE

Dianella ensifolia (L.) DC., *WT 12287, 12482*

Dianella javanica (Bl.) Kunth, or aff., *WT 12658*

MUSACEAE

Ensete glaucum (Roxb.) Cheesman, SR, common giant herb, Maimafu

Musa maclayi F.v.M., *WT s.n.*

ORCHIDACEAE (dets. N.H.S. Howcroft)

Bulbophyllum antennatum Schltr., *He 38*

Bulbophyllum cf. *cavibulbum* J.J. Sm., *He 8*

Bulbophyllum intersitum J.J. Vermeulen, *He 1*

Bulbophyllum lepanthiflorum Schltr., *Ha 1*

Bulbophyllum (close ro) *nematapodium*, *He 33*

Bulbophyllum pidacanthum J.J. Vermeulen, *He 37*

Bulbophyllum trifilum subsp. *trifilum* J.J. Sm., *WT 12810, 12903, 12975*

Bulbophyllum wakoi N.H.S. Howcroft, *type coll.*

Calanthe ventrilabrum Rchb. f., *He 21*

Calanthe werneri Schltr., *WT 11133*

Coelogyne beccarii Rchb. f., *WT 12774*

Coelogyne fragrans Schltr., *WT 12536, 12579, 12824*

Coelogyne cf. *fragrans* Schltr., *He 13, 30; Ha 8*

Corymborkis veratrifolia (Reinw.) Bl., *WT 11240*

Cystorchis cf. *dentifera* Schltr., *WT 11165*

Dendobium bulbophylliodes Schltr., *WT 12825*

Dendrobium cf. *dillonianum*, §Grastidium, *WT 12872, 12899*; ?authority

Dendrobium finisterrae Schltr., *WT 12967*

Dendrobium glebulosum Schltr., *WT 12812*

Dendrobium cf. *obtusipetalum* J.J. Sm., § Calyptrochilus, *WT 12290, 12372*

Dendrobium pleianthum Schltr., *He 33*

Dendrobium pseudoglomeratum Reeve and J. Woods, *WT 12673*

Dendrobium pseudopeloricum J.J. Sm., *WT 12371*

Dendrobium rupestre J.J. Sm., *He 17*

Dendrobium aff. *subclausum* Rolfe, § Calyptrochilus, *WT 12773*

Dendrobium torricellianum Krzl., § Oxystophyllum, *WT 12357*

Dendrobium aff. *vexillarius* J.J. Sm., § Oxyglossum, *WT 12398*

Dendrobium sp. A, § Calyptrochilus, *He 16, 28*

Dendrobium sp. B, § Grastidium (mixed coll.), *WT 12712*

Dendrobium sp. C, § Grastidium, *WT 12986*

Dendrochilum longifolium Rchb. f., *He 2; WT 12134, 12229, 12517, 12988*

Diplocaulobium chrysotropis Schlrr., *WT 12135, 12298*

Diplocaulobium sp., *WT 12856*

Dipodium pandanum Bail., *WT 12603; LAE 66276*, Wabo dam site

Epiblastus sp., *WT 12045*

Eria imbricata J.J. Sm., *He 36*

Eucosia papuana Schlrr., *WT 12136*

Glomera sp., *WT 12376*

Habenaria or *Peristylus*, sp. A, *WT 12101*

Habenaria or *Peristylis*, sp. B, *WT 12195*

Habenaria or *Peristylus*, sp. C, *WT 12484*

Habenaria or *Peristylus*, sp. D, *WT 12586*

Liparis caespitosa Lindl., *WT 12327*

Liparis aff. *gibbosa* Finet, *He 25*

Liparis sp., § Distichum, *WT 12714*

Mediocalcar quadrifolium Schuipman, *WT 12855*

Mediocalcar sp. A, *WT 12446*

Mediocalcar sp. B, *WT 12815*

Neuwiedia veratrifolia Bl., *WT 11770*

Octarrhena angraecoides Schltr., *He 12*

Peristylus dolichocaulon (Schltr.) Schltr., *WT 11284*

Phaius montanus Schltr., *WT 12233*
Phaius cf. *montanus* Schltr., *WT 12760, 12826*
Phaius sp., *WT 12286*
Phreatia ?caulescens Ames, *WT 12297*
Phreatia elata Schltr., *WT 12933*
Phreatia sp. A, *WT 12794*
Phreatia sp. B, *WT 12816*
Oberonia sp., *WT 12288*
Robiquetia cf. *mooreana* (Rolfe) J.J. Sm., *WT 11127*
Spathoglottis paulinae F.v.M., *WT 12289*
Spathoglottis plicata Krzl., *WT 11286*
Spathoglottis plicata Bl. subsp. *puberula* N.H.S. Howcroft, *WT 11207*
Vanilla wariensis Schltr., *WT 11842*
Vrydagzynea cf. *albostriata* Schltr., *WT 12383*
Vrydagzynea cf. *albostriata* Schltr., or *salomonensis* Schltr., *WT 12251*
Vrydagzynia sp., *WT 12341*

PANDANACEAE

Freycinetia angustissima Ridl., SR of common climber
Freycinetia aff. *?lagenicarpa* Warb., *WT 11761*
Freycinetia marantifolia Hemsl., *WT 11955*
Pandanus leptocarpus Martelli, *S&C 4493*, Purari, cited by Stone (1987)
Pandanus spp., *WT s.n.*

POACEAE (GRAMINEAE)

Apluda mutica L., SR; cf. *C&S 1065*
Centotheca latifolia (Osb.) Trin., *WT 11717*
Chrysopogon aciculatus (Retz.) Trin., SR; cf. *S&C 4593*, det. collectors
Coix lachryma-jobi L., *WT 12019*
Cyrtococcum accrescens (Trin.) Stapf, *WT 12639*
Garnotia stricta Brongn. var. *longiseta* Hack., *WT 12470*
Ichnanthus vicinus (F.M. Bailey) Merr., *WT 12717*
Imperata conferta (Presl) Ohwi, *WT 12408*
Imperata cylindrica (L.) P. Beauv., *WT 12599*
Isachne albomarginata Jansen, *WT 12054, 12059, 12064*
Isachne myosotis Nees, *WT 12565*
Nastus longispicula Holttum, *WT 12600*
Oplismenus hirtellus (L.) P. Beauv., *WT 12002, 12715*
Pennisetum sp., (probably) *macrostachyum* (Brongn.) Trin., SR, Maimafu
Saccharum edule Hassk., SR, cultivated
Saccharum officinarum L., SR, cultivated
Saccharum sp., '*robustum - spontaneum* complex', *WT 12597*
Scrotochloa urceolata (Roxb.) Judziewicz, SR
Setaria palmifolia (Koen.) Stapf, *WT 12006*
Zea mays L., SR, cultivated

TRIURIDACEAE

Sciaphila densiflora Schltr., *LAE 66347*, det. Leiden list
Sciaphila tenella Bl., *LAE 66268*, Wabo dam site, det. Leiden

ZINGIBERACEAE

Alpinia werneri Valeton, § Pycnanthus, *WT 11787*
Alpinia sp., § Dieramalpinia, *WT 11831*
Curcuma australasica Hook. f., *AM 382: WT 11295*
Etlingera dekockii, or *E. versteegii*, *WT 11705*; need flower color
Hornstedtia scottiana (F.v.M.) K. Schum., *WT s.n.*
Phrynium aff. *pedunculatum* Warburg, *WT 11880*
Pleuranthodium macropycnanthum (Valeton) R.M. Smith, *WT 11136*
Riedelia corallina Valeton, *WT 11141*
Riedelia macrantha K. Schum., *WT 11173*

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REFERENCES

Airy Shaw, H.K. 1969. Notes on Malesian and other Asiatic Euphorbiaceae. Kew Bull. 23:1–131.

Airy Shaw, H.K. 1978. Notes on Malesian and other Asiatic Euphorbiaceae. Kew Bull. 33:25–77.

Airy Shaw, H.K. 1980. The Euphorbiaceae of New Guinea. Kew Bull. Addit. Ser. 8:1–243.

Barkley, F.A. 1972. Begoniaceae: the genera, sections and known species of each. Buxtonian 1, suppl. 4:1–20.

Beehler, B.M. (ed.). 1993. Papua New Guinea conservation needs assessment report, vol. 2. PNG Dept. of Environment and Conservation, Boroko.

Coode, M.J.E. 1981. Elaeocarpaceae. In: E.E. Henty, ed. Handbooks of the flora of Papua New Guinea 2:38–185.

Ding Hou. 1978. Anacardiaceae. Flora Malesiana ser. 1, 8(3):395–548.

Hartley, T.G., and L.M. Perry. 1973. A provisional key and enumeration of species of *Syzygium* (Myrtaceae) from Papuasia. J. Arnold Arbor. 54:160–227.

Hoogland, R.D. 1953a. Florae Malesianae Precursores II. The Convolvulaceae of Malaysia IX. New species of *Erycibe*. Blumea 7:310–319.

Hoogland, R.D. 1953b. A review of the genus *Erycibe* Roxb. Blumea 7:342–361.

Johns, R.J. 1993. Biodiversity and conservation of the native flora of Papua New Guinea. In: B. Beehler, ed. Papua New Guinea conservation needs assessment report, vol. 2, PNG Dept. of Environment and Conservation, Boroko. Pp. 15–75.

Kiew, R. 1994. Checklist of *Jasminum* species (Oleaceae) in Malesia. Sandakania 5:1–14.

Leenhouts, P.W. 1994. *Alectryon*. In: Sapindaceae. Flora Malesiana ser. 1, 11(3):450–458.

Leenhouts, P.W., and M. Vente. 1994. *Harpullia*. In: Sapindaceae. Flora Malesiana ser. 1, 11(3):509–614.

Lingelsheim, A.v. 1927. Die Oleaceen Papuasiens. Bot. Jahrb. 61:1–22.

Merrill, E.D., and L.M. Perry. 1946. Plantae Papuanae Archboldianae, XVII. J. Arnold Arbor. 27:193–233.

Ooststroom, S.J. van. 1953. Convolvulaceae. Flora Malesiana ser. 1, 4(4):388–512.

Ooststroom, S.J. van. 1955. The Convolvulaceae of New Guinea. Nova Guinea 6:1–32.

Parris, B.S. 1974. The fern habitats of Mt. Wilhelm, New Guinea. Fern Gaz. 11:15–23.

Payens, J.P.D.W. 1967. A monograph of the genus *Barringtonia* (Lecythidaceae). Blumea 15:157–263.

Riedl, H. 1996. New taxa in the genus *Tournefortia* (Boraginaceae) from the Malesian region. Blumea 41:443–444.

RINTZ, R.E. 1980. A revision of the genus *Sarcolobus* (Asclepiadaceae). Blumea 26:65–79.

SCHLECHTER, R. 1911-14. Die Orchidaceen von Deutsch-Neu-Guinea. Fedde Repert. Spec. Nov. Regni Veg., Beih. 1:1–1079. English translation 1982, D.F. Blaxell (ed)., The Australian Orchid Foundation, Melbourne.

SEKHRAN, N., and S. MILLER (eds.) 1995. Papua New Guinea country study on biological diversity. Dept. of Environment and Conservation and the Africa Centre for Resources and Environment, reprinted 1996.

SLEUMER, H. 1954. Flacourtiaceae. Flora Malesiana ser. 1, 5(1):1–106.

SLEUMER, H. 1988. The genera *Discocalyx* Mez, *Fittingia* Mez, *Loheria* Merr., and *Tapeinosperma* Hook. f. (Myrsinaceae) in New Guinea. Blumea 33:81–107.

SOHMER, S.H. 1988. The nonclimbing species of the genus *Psychotria* (Rubiaceae) in New Guinea and the Bismarck Archipelago. Bishop Mus. Bull. Bot. 1:1–139.

STEVENS, P.F. 1974. *Mammea* L. and *Mesua* L. (Guttiferae) in Papuasia. Aust. J. Bot. 22:413–423.

STONE, B.C. 1985. New and noteworthy paleotropical species of Rutaceae. Proc. Aca. Natl. Sci. Phil. 137:213–228.

STONE, B.C. 1987. New taxa of *Pandanus* (Pandanaceae) from Malesia and Papuasia. Blumea 32:427–441.

SWINGLE, W.T. 1967 (revised edition). The botany of *Citrus* and its wild relatives. In: W. Reuther, H.J. Webber, and L.D. Batchelor, eds. The Citrus industry, vol. 1. History, world distribution, botany, and varieties. University of California, Berkeley. Pp. 190–430.

TAKEUCHI, W. 1999. Botanical results from the 1995 Bismarck-Ramu expedition in Papua New Guinea. Sida 18:751–782.

TANTRA, I.G.M. 1976. A revision of the genus *Sterculia* L. in Malesia. Forest Research Institute Communication. Bogor, Indonesia.

VALETON, Th. 1927. Die Rubiaceae von Papuasien. II. Zweiter Teil: Coffeoideae. Bot. Jahrb. 61:32–163.

VERDCOURT, B. 1979. A manual of New Guinea legumes. Papua New Guinea Office of Forests, Div. Bot. Bull. 11:1–645.

WHITMORE, T.C. 1980. *Macaranga*. In: H.K. Airy Shaw. The Euphorbiaceae of New Guinea. Kew Bull. Addit. Ser. 8:123–162.

WINKLER, H. 1922. Die Urticaceen Papuasiens. Bot. Jahrb. 57:501–608.

VASCULAR PLANTS ON A GYPSUM OUTCROP IN SOUTHERN NEW MEXICO: A LISTING, A NEW VARIETY AND TAXONOMIC REALIGNMENTS IN THE *ANULOCAULIS LEIOSOLENUS* COMPLEX (NYCTAGINACEAE), AND A NEW VARIETY OF *MENTZELIA HUMILIS* (LOASACEAE)

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ABSTRACT

A survey of the flora on a hitherto unexplored gypsum outcrop on the west face of the Guadalupe Mountains in southern New Mexico has revealed a new variety of *Anulocaulis* (Nyctaginaceae), *A. leiosolenus* (Torr.) Standl.var. *howardii* Spellenb. & Wootten (var. nov.). This variety has a combination of characteristics in various degrees intermediate to other taxa, an observation that results in the inclusion of *A. gypsogenus* Waterf. into *A. leiosolenus* as *A. leiosolenus* var. *gypsogenus* (Waterf.) Spellenb. & Wootten (comb. nov.). Also from this outcrop is described *Mentzelia humilis* (A. Gray) J. Darl. var. *guadalupensis* Spellenb. (var. nov.). Fifty-nine species in 29 families were observed to occur on the gypsum outcrop. A key is provided to all known *Anulocaulis* taxa and a list is presented documenting the other plant species that occur with it and the new variety of *M. humilis*.

RESUMEN

La exploración de la flora en un afloramiento de yeso, inexplorado previamente, en la ladera oeste de las Montañas Guadalupe en el sur de Nuevo México ha revelado una variedad nueva de *Anulocaulis* (Nyctaginaceae), *A. leiosolenus* (Torr.) Standl. var. *howardii* Spellenb. & Wootten (var. nov.). Esta variedad tiene una combinación de caracteres intermedios en varios grados con otros taxa, una observación que da como resultado la inclusión de *A. gypsogenus* Waterf. en *A. leiosolenus* así como *A. leiosolenus* var. *gypsogenus* (Waterf.) Spellenb. & Wootten (comb. nov.). También, *Mentzelia humilis* (A. Gray) J. Darl. var. *guadalupensis* Spellenb. (var. nov.) está descrita de este afloramiento. Cincuenta y nueve especies de 29 familias de plantas fueron observadas en este afloramiento de yeso. Se ofrece una clave para todos los taxa conocidos de *Anulocaulis* y se presenta una lista documentando las otras especies de plantas que conviven con las dos variedades nuevas.

INTRODUCTION

While deer hunting in southern Otero County, New Mexico, about a decade ago, Michael Howard of the Bureau of Land Management, Las Cruces District, traversed a gypsum outcrop on the western slope of the northern portion of the Guadalupe Mountains and noted an *Anulocaulis*. In the summer of 1996 he showed the plant to Wootten, who collected a voucher, identified

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the plant as *Anulocaulis gypsogenus* Waterf., and brought it to the New Mexico State University herbarium for deposition. Spellenberg immediately recognized the plant as near *A. gypsogenus* but somewhat different. That collection also brought attention to a previously unbotanized area on the west face of the Guadalupe Mountains.

Wootten and Howard visited the southern portion of the gypsum outcrop in September and November, 1996, and escorted Spellenberg to that site in early August 1997. Spellenberg and Wootten returned to the southern portion of the outcrop in September 1997 and April 1998, and to the northern, more lengthy portion of the outcrop in July, 1998. Our survey re-vealed new varieties of *Anulocaulis leiosolenus* and *Mentzelia humilus*, herein described, and resulted in a collection of plants documenting the flora of this gypsum outcrop (Appendix 1).

CHARACTERISTICS AND FLORA OF GYPSUM OUTCROP

This gypsum outcrop is part of the Permian age Yeso Formation (Hunt 1977). Most of the outcrop consists of limestone rubble, the stones 2–10 cm in diameter, or larger, overlying a pale tan, sandy, gypseous clay. In a few places, when walked upon, the gypsum makes the hollow sound characteristic of other gypsum outcrops in the Southwest. On the steeper slopes there is little limestone rubble, the gypseous matrix being completely exposed.

The outcrop is not continuously exposed and consists of two main sections. The southern section extends for about 5 km in a NNW - SSE direction, and perhaps up to 3/4 km in an E-W direction, with an elevational range of about 250 meters beginning at about 1350 m. It occurs on the lower slopes of the western escarpment of the Guadalupe Mountains, beneath The Rim, at the upper edge of the bajadas that extend westward to Crow Flats. The southern end of this section lies about 48 air km NNE of Dell City, Texas, centered on about 32°22'N, 105°04'W (Sec. 25 to estimated Sec. 11, T22S, R18E), just north of the mouth of Pup Canyon. Most of the outcrop has a very steep western exposure, the slopes 30–45° and steeper. Near the base of the outcrop at the southern end of the outcrop, and also about 2 km to the south, there are a few low, gypseous hills that have slopes of all exposures, and within the major portion of the outcrop, gullys and arroyos provide northern and southern exposures.

The southern portion of the outcrop disappears near the northern end of a small south-facing box canyon. It or a similar gypseous outcrop reappears on the western slopes of the mountains about 3 km to the NNW. From there the outcrop continues in a northwesterly direction in a discontinuous manner for about 12 km (Sec. 33, T21S, R18E northward to Sec. 25, T20S, R17E).

This outcrop occurs in an remote area where access is comparatively difficult. The entire outcrop lies on public lands, some portions entirely on those of the Bureau of Land Management, Las Cruces District, in other areas the eastern portions on the Guadalupe Ranger District of the Lincoln National Forest. Browsing of a few of the species that occur on this outcrop, probably by deer and rabbits, was noted; no sign of domestic livestock, common in the valley below, was observed. According to a local rancher, Mr. George Rauch, the livestock simply do not get up to this rather inhospitable site (he was speaking of the southern section, but conditions are similar along the length of the outcrop). The two new endemics discovered here presently do not seem to be impacted by human-related activities.

The *Anulocaulis* and the *Mentzelia* are both common and conspicuous on the outcrop. Because there are no records in collections of these taxa from here, we believe that the outcrop had not been explored by botanists prior to our work. Only a minor portion of the outcrop consists of highly concentrated gypsum, and here obligate gypsophiles such as *A. leiosolenus, M. humilus*, and *Selinocarpus lanceolatus* occur. On this portion we document 59 plant species in 29 families (Appendix 1), including the two new varieties described below. We stopped noting species when we crossed off the gypsum and onto the cobbly limestone bajadas that support Chihuahuan Desert vegetation consisting of *Larrea tridentata* (DC.) Cov., *Parthenium incanum* Kunth, *Acacia neovernicosa* Isely, *Fouquieria splendens* Engelm., *Yucca torreyi* Shafer, *Ephedra aspera* Engelm., *Dasylirion wheeleri* S. Wats., *Echinocereus pectinatus* (Scheidw.) Engelm., *Krameria erecta* Willd. ex Schultes, *Allionia incarnata* L., *Stenandrium barbatum* Torr. & A. Gray, *Polygala macradenia* A. Gray, among numerous other species.

A NEW VARIETY AND TAXONOMIC REALIGNMENTS IN *ANULOCAULIS*

Spellenberg (1993) provided a taxonomic review of *Anulocaulis* and recognized five species, one of them, *A. leiosolenus*, with two varieties. Turner (1993) described a sixth species. This present paper reduces one of the species recognized by Spellenberg to a variety in *A. leiosolenus*, and adds a fourth variety to that species. We now consider *Anulocaulis* to have five species, one with four varieties.

Anulocaulis leiosolenus (Torr.) Standl. var. **howardii** Spellenb. & T. Wootten, var. nov. Type: UNITED STATES. New Mexico. Otero Co.: 48 km NNE of Dell City, Texas, W base of Guadalupe Mts., N of mouth of Pup Canyon, ca. 50 m SW of NE corner S26, T22S, R18W, 32°22.14'N, 105°03.92'W, elev. 1360 m, 5 Aug 1997, *Spellenberg, Wootten, and Howard 12433* (holotype: NMC; isotypes: NY, TEX, UNM).

A Anulocaule leiosoleno var. leiosoleno perianthiis rubro-roseis (vs. albis vel subroseis dilutis) foliis leviter glaucis et parce tuberculatis (vs. viridis non glaucis et dense tuberculatis) differt.

Strong perennial from gnarled woody root. *Stems* 1-ca. 6, ascending, branched in upper 70%, up to ca. 1.2 m tall, glabrous, glaucous. *Leaves* usually in 2–3 pairs in basal 1/4 of plant; petioles 35–50 mm long, blades more or less orbicular, commonly wider than long, 45–105 mm long, 45–135 mm wide, semi-glaucous, bluish-green, with sparse purplish pustules, pustules slightly denser on abaxial surface. *Inflorescences* widely paniculate, forming the upper 2/3 of the plant, the flowers borne terminally and on short side branches in more or less congested clusters. *Buds* with minute hairs at the apex. *Perianth* deep rose-pink, obliquely funnelform, 22–32 mm long, limb 10–17 mm wide, stamens exserted ca. 20 mm, the style 25 mm. *Fruit* biturbinate, 4.3–5.9 mm long, 3.7–4.5 mm wide, with 10 irregular longitudinal ridges and an equatorial wing 0.2–0.9 mm wide.

At present, the new *Anulocaulis* is known only from the western slope of the Guadalupe Mountains in south-central New Mexico on tannish, shaley, gypseous clays, and then only from the southern portion of the gypsum outcrop, immediately north of Pup Canyon. Exploration of the outcrop to the north revealed no other populations. We name the plant for its discoverer, Michael Howard, of the Las Cruces District of the Bureau of Land Management, whose attention to natural biota resulted in the discovery of this *Anulocaulis*. Mike has a strong sense of responsibility for the nation's natural resources, shares his knowledge willingly with the public, and works toward making land-use in the Southwest compatible with needs for conservation.

PARATYPES: **NEW MEXICO. Otero Co.:** ca. 30 air mi NE of Dell City, Texas, foothills of Guadalupe Mtns. at mouth of Pup Canyon, extreme SE corner of Sec 23, T22S, R18E, 26 Sep 1996, *Wootten and Howard s.n.* (NMC); 48 km NNE of Dell City, Texas, W base of Guadalupe Mts., N of mouth of Pup Canyon, edge of Lincoln National Forest, ca. 300 m ENE of SW corner S24 T22S R18W, 32°22.22'N, 105°74'W, elev. 1360 m, 5 Aug 1997, *Spellenberg, Wootten and Howard 12435* (ARIZ, NMC, UC); 49 km NNE of Dell City, Texas, W base of Guadalupe Mts., N of mouth of Pup Canyon, NE Sec 23, T22S, R18W, 32°22.75'N, 105°03.99'W, elev 1460 m, 5 Aug 1997, *Spellenberg, Wootten and Howard 12438* (NMC).

Anulocaulis leiosolenus var. *howardii* is immediately distinguishable from close relatives by the combination of the semi-glaucous leaves with only a few large multicellular trichomes, the reddish-pink perianth, and the moderately broad rim on the fruit (Table 1). The fruit is most similar to that illustrated in Spellenberg (1993, Fig. 1F), a fruit from a Texas race of *A. leiosolenus* var. *leiosolenus*. Within the complex, minute hairs at the tip of the perianth, best seen in bud, were previously known only in the var. *lasianthus*.

As illustrated in Table 1, the new variety has some of the characteristics that are used alone or in combination to distinguish among other members of the *A. gypsogenus-leiosolenus* complex (Spellenberg 1993). For this reason we believe the newly discovered entity is best recognized as a variety in a more broadly reconstructed *A. leiosolenus*, in which *A. gypsogenus* is included at the varietal level. The entire complex presents a classic representation of completely allopatric, closely related, more or less distinguishable races, this structure commented upon by Spellenberg (1993). Mayr (1969, ch. 3) dis-

Table 1. A comparison of some characteristics used to distinguish varieties within *Anulocaulis leiosolenus.*

Variety of *A. leiosolenus*	Perianth limb color	Perianth pubescence	Leaves	Fruit wing
gyspsogenus	white to very pale pinkish	none	pale bluish green, glaucous, smooth, pale gray or whitish when dried	0.8–1.2 mm
howardii	deep rose pink	minute trichomes at tip in bud	bluish green, semi-glaucous, few largeconical tubercules, grayish green when dried	0.2–0.9 mm
lasianthus	pale pink to pink	minute trichomes at tip in bud	green, semi-glaucous, dense conical tubercules, dull green when dried	0.2–0.6 mm
leiosolenus	white to pale pink	none	green, not especially glaucous, dense conical tubercules, dull green when dried	0.2–0.6 mm

cussed problems with deciding taxonomic divisions in allopatric populations; Stuessy (1990, ch. 12) discussed problems with assigning infraspecific taxa to varieties or subspecies. With regard to *Anulocaulis,* the tradition of using variety is followed for taxonomic recognition of closely related, internally rather homogeneous populations that can be distinguished from other, similar populations.

Spellenberg (1993) noted the similarity between the large, pale perianth of the western race of *A. leiosolenus* var. *leiosolenus* and that of *A. gypsogenus.* On a more subtle note, the var. *howardii* has flowers clustered in the inflorescence reminiscent of var. *lasianthus*. This characteristic is somewhat developed in *A. gypsogenus* and much less so in the var. *leiosolenus*. The leaves of the var. *howardii* are more similar to *A. gypsogenus.* The fruits are rather intermediate between *A. leiosolenus* and *A. gypsogenus*, as traditionally recognized. It is our view that with the discovery of the easily recognizable race now named as *A. leiosolenus* var. *howardii*, the other phases in this complex of gypsophilic endemics are best recognized as belonging to one geographically fragmented (Fig. 1) species of variably differentiated allopatric races. For that reason, we transfer *A. gypsogenus* into *A. leiosolenus* as a variety restricted to the gypsum along the Pecos River, slightly to the east of, but completely disjunct from var. *howardii*.

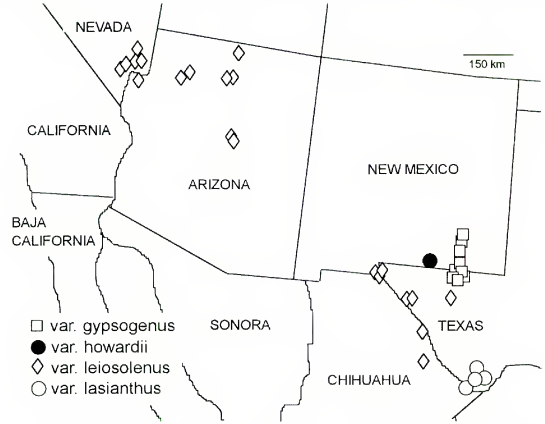

FIG. 1. Map of states of southwestern United States and northwestern Mexico showing the distribution of *Anulocaulis leiosolenus* varieties.

Anulocaulis leiosolenus (Torr.) Standl. var. **gypsogenus** (Waterf.) Spellenb. & T. Wootten, comb. nov. BASIONYM: *Anulocaulis gypsogenus* Waterf., Rhodora 47:329. 1945. TYPE: UNITED STATES. NEW MEXICO. Chaves Co.: Comanchean Bluffs, 7 mi E of Roswell, 9 Oct 1944, *Waterfall 5701* (HOLOTYPE: GH!; ISOTYPES: NY! MO!).

KEY TO TAXA OF *ANULOCAULIS*

1. Anthocarp without a prominent equatorial ridge or wing; perianth less than 16 mm long, the lobes flaring but not reflexed.
   2. Perianth 15–16 mm long at anthesis, purplish, the tube externally glabrous, minutely glandular-pubescent near the apex; anthocarp ellipsoid or broadly fusiform (southern Coahuila). .... **A. hintoniorum** B. L. Turner
   2. Perianth less than 10 mm long at anthesis, whitish to rose-lavender, the tube externally villous; anthocarp fusiform or turbinate.
      3. Flowers usually 5–15 in umbel-like clusters; tube of perianth not elongating after anthesis; anthocarp broadly fusiform (southeastern California). .... **A. annulatus** (Coville) Standl.
      3. Flowers usually borne singly; tube of perianth markedly elongating after anthesis; anthocarp turbinate, bluntly 5-angled, ridges indefinite (southern Texas, western Coahuila, possibly eastern Chihuahua). .... **A. eriosolenus** (A. Gray) Standl.
1. Anthocarp with a prominent equatorial ridge or wing; perianth 10–35 mm long, the lobes flaring or sharply reflexed.

4. Perianth ca. 10 mm long, the lobes sharply reflexed (northeastern Chihuahua and immediately adjacent Texas). .... **A. reflexus** I. M. Johnst.

4. Perianth 22–35 cm long, the lobes flaring, not reflexed .... **A. leiosolenus** (Torr.) Standl.

  5. Leaves smooth, glaucous; perianth glabrous externally at apex (Pecos River in southestern New Mexico and western Texas). .... var. **gypsogenus** (Waterf.) Spellenb. & T. Wootten

  5. Leaves at least sparsely tuberculate; perianth minutely puberulent or glabrous at the apex.

    6. Perianth glabrous externally at the apex (extreme western Texas, south-central New Mexico, north-central Arizona, and southern Nevada) .... var. **leiosolenus**

    6. Perianth minutely pubescent externally at the apex (visible best when in late bud).

      7. Leaves grayish green; purplish tubercules on leaves sparse; perianth deep rose-pink (south-central New Mexico, W face of Guadalupe Mts. .... var. **howardii** Spellenb. & T. Wootten

      7. Leaves green or dark green; purplish tubercules on leaves dense; perianth pale pink to pink (Big Bend region of Texas and immediately adjacent Chihuahua) .... var. **lasianthus** I.M. Johnston

A NEW VARIETY OF *MENTZELIA HUMILIS*

Mentzelia humilis (Urb. & Gilg) J. Darl. is a variable yet distinctive member of sect. *Bartonia* Torr. & A. Gray restricted to gypseous substrates in southeastern New Mexico and western Texas (Thompson 1997). Leaves vary from pectinate to entire. Usually leaves in a population are similar, but occasionally populations will have pectinate and entire leaves (*Sivinski and Lightfoot 2634;* cited *Mentzelia* specimens comprise Appendix 2). Leaves may be clearly pectinate, the lobes distantly spaced and linear, 1–2 mm wide and about 15 mm long, or lobes may be much shorter. Lobes may be straight or somewhat falcate, curving toward the leaf apex. In either case, the margins of a lobe are approximately parallel and the apex of the lobe is almost always rounded. In some cases lobes are completely absent and leaves are entire and linear. Basal leaves may be much less lobed than cauline leaves (*Higgins 6845*). Other than by flower color (not given, but presumably white) *Higgins 6845*, from western Texas, cannot be distinguished from a pectinately lobed form of *M. perennis* H. J. Thompson (ined.) from central New Mexico (*Edwards and Repass 4726; Spellenberg and Willson 4233; Ward et al. 81-281*), leaving one to ponder the distinction of these two taxa.

Specimens of this complex in NMC have been annotated as either *M. humilis* or *M. perennis* by H. J. Thompson. Martin and Hutchins (1981) separated these two taxa in their key on a vegetative character, tufted (*M. perennis*) vs. not tufted (*M. humilis*), a feature that will not distinguish them. They give flower color of the former as "pale lemon-yellow," which is approximately correct, vs. "yellow" for *M. humilis*, which is incorrect (pale ochroleucuous to white). Perhaps Martin and Hutchins were following to some degree Wooton and Standly (1915) who noted petals to be "pale yellow" (in *Nuttallia gypsea* Wooton & Standl., a synonym of *M. humilus*), or Darlington (1934), who "keyed" *M. humilis* under "flowers lemon-yellow to golden." This assumption of yellow-colored flowers is understandable because buds are cream and dried petals in fresh specimens are definitely yellowish. Thompson and Zavortink (1970) may be the first to have indicated that *M. humilis* corollas and androecia were white. Later Thompson (1997) described the petals as "white or very pale yellow." *Mentzelia perennis* has pale yellow petals.

In Thompson (1997) and Thompson and Zavortink (1970), *Mentzelia* specimens from the gypsum outcrop discussed earlier key to *M. strictissima* (Wooton & Standl.) J. Darl., but this is a very different, tall plant that occurs in (often) sandy soil. It has dentate leaves and cylindrical capsules. Leaves of the novel *Mentzelia* much more closely resemble those of *M. mexicana* H. J. Thomps. & Zavort. or *M. saxicola* H. J. Thomps. & Zavort. as illustrated in Thompson and Powell (1981, fig. 7). These are yellow-flowered species of western Texas and northern Mexico once confused with *M. multiflora* (Nutt.) A. Gray. Unfortunately, Thompson and Powell did not discuss the relationship of *M. humilis* to any of these species. In a survey of other specimens, leaves from the novel plants from the gypsum outcrop on the western slope of the Guadalupe Mountains more closely resemble those of some specimens of *M. multiflora*, and also resemble that illustrated in Thompson and Powell (1981, fig. 7) for this species.

Thompson and Powell (1981) illustrated, described, and compared the seed coats of *M. multiflora* with seed coats of *M. mexicana* and *M. saxicola*. They noted the first to have cells with swollen outer walls covered by numerous small papillae. This gives the seed coat a coarsely granular appearance or, as stated in Thompson (1997), it is "rough with papillae." Seed coats of the latter two have fewer papillae and appear "smooth" (Thompson 1997), but actually are very finely granular under a microscope at about 20x. Thompson did not give the characteristics of seed coats of *M. humilis*; we note them to be very similar to those of *M. multiflora*, as are the seed coats of the novel *Mentzelia* in question.

Thompson, in attempting to work out distinctions between New Mexico populations of *M. multiflora*, *M. jemezensis*, *M. humilis*, and *M. strictissima* sent Spellenberg a letter (29 Apr 1980), a map, and color photographs (without provenance) explaining his interpretation (filed at NMC, accession #60536, in *M. jemezensis* folder). *Mentzelia multiflora* and *M. humilis* have very distinct flowers, the first yellow (Thompson's photo is more yellow than most races in southern New Mexico, which may be pale yellow), *M. humilis* near white. More important *M. multiflora* has broader petals with the transition to stamens with expanded filaments comparatively abrupt, whereas *M. humilis* has narrower petals, the transition to stamens more gradual. Flowers from the new *Mentzelia* in question very strongly resemble those of the photo and of specimens of *M. humilis* and are not like those of *M. multiflora.*

Thompson (1997) indicated capsules of *M. multiflora* to be cylindrical, 15–25 mm long, whereas he wrote that *M. humilis* has capsules cup-like, 6–13 mm long. The novel *Mentzelia* has capsules that are cup-shaped and in the lower range of length for those of *M. humilis*. Plants of the new population are densely clumped, like some races of *M. humilis,* and leaves are sub-entire, dentate, or pinnatisect, reminiscent of those of *M. multiflora.* When the leaves are pinnatisect, the lobes taper from a broad base to a narrow, acute or even acuminate tip. The flowers and capsules are like those of *M. humilis.* The inflorescence is much more congested than in any of the species mentioned.

The map Thompson provided with his letter to Spellenberg (29 Apr 1980) shows *M. humilis* to occur in western Texas and eastern New Mexico in the Pecos River drainage, distinctly, but not distantly, east of the population in question. He maintained this distribution for *M. humilis* in his 1997 manuscript. On his map accompanying the letter, *M. perennis* is shown to occur in a limited area to the northwest of the site from which the new *Mentzelia* originates. *Mentzelia multiflora,* in contrast, is widespread in the western United States and northern Mexico (Thompson 1997). It is known from robust to smaller plants in the Guadalupe Mountains (*e.g., Spellenberg 3660, Wooton s.n.*). Both these specimens have broad petals and cylindrical capsules representative of the species; Spellenberg noted flower color as "pale yellow" on the specimen label. In his letter Thompson alluded to the possibility of gene flow between isolated edaphic endemics and more widespread edaphically unrestricted species. Such a process might explain in the new variety the leaves similar to *M. multiflora* and the flowers and capsules similar to *M. humilis.* Observations from these populations reveal that flowers and capsules of the novel *Mentzelia* are consistent, foliage and habit are variable. Nevertheless, the race is consistently distinct from *M. humilis* var. *humilis* and is geographically isolated from it: var. *humilis* east of the Guadalupe Mountains, var. *guadalupensis* restricted to the western slope.

Mentzelia humilus (A. Gray) Darl. var. **guadalupensis** Spellenb., var. nov. (**Fig. 2**).TYPE: UNITED STATES. NEW MEXICO. Otero Co.: 48 km NNE of Dell City, Texas, W base of Guadalupe Mts., N of mouth of Pup Canyon, S14 T22S R18W, 32°22.74'N, 105°04.26'W, elev. 1460 m., 22 Sep 1997, *Spellenberg & Wootten 12455* (HOLOTYPE: NMC; ISOTYPES: NY, TEX, UC, UNM).

A Mentzeliae humili var. humili foliis dentatis vel pinnatisectis (vs. pectinatis vel integris), rachidibus 2–8 mm (vs. 1–2 mm) latibus, inflorescentiis congestibus (vs. noncongestibus), et plerumque pedicellis capsulis brevioribus (vs. aequantibus vel longioribus) differt.

Plants 0.5–2.5 dm tall; basal leaves spatulate, dentate, with 2–4 teeth

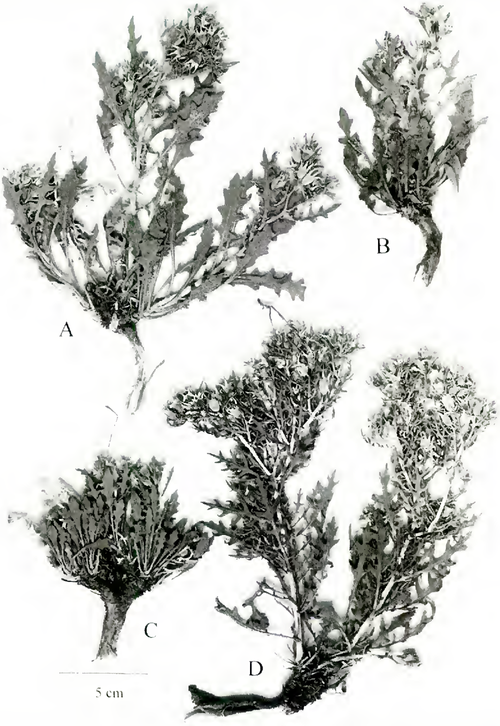

FIG. 2. Illustration of plants comprising the type collection of *Mentzelia humilis* var. *guadalupensis* (*Spellenberg & Wootten 12455*). Collection was made with the intent of illustrating the major aspects of variation in the population: habit and leaf dissection. All plants are clearly identified in distributed specimens by small tags affixed to them. All plants in photograph are at NMC. Plant A is the holotype plant, which has been mounted separately from isotypes at NMC; other portions of plant A have been distributed with other isotype plants to NY, UC; plant B, NMC, NY; plant C, NMC, NY; plant D, NMC, TEX, UC, UNM. Plants similar to A–C are common in the population; plants with leaves dissected to the extent of plant D are less common.

per side, or sometimes the smallest basal leaves nearly entire; midstem leaves, 3.0–8.5 cm long, 8–21 mm wide, the blade spatulate or lanceolate in outline, tapering gradually to a slender petiole, the blade from shallowly to deeply dentate or pinnatisect, 3–7 teeth or lobes per side, when pinnatisect or deeply dentate the rachis 2–8 mm wide and the lobes straight or sometimes falcate, tapering from base to acute tip; bracts beneath the heads pinnatisect, 2–4 lobes per side; petals white or pale ochroleucous when fresh (drying ochroleucous), about 10 (intergrading with the outer stamens with broad filaments), 10–13 mm long, 1.6–2.1 mm wide, acute; capsules cupulate, 5–8 mm long, 5–6 mm wide, the length 1–1.7 times the width, the calyx lobes on capsules 4–9 mm long, narrowly triangular-subulate; seeds 1.8–2.2 mm long with a wing 0.5 mm wide, the seed coat conspicuously papillate (use 20x), the papillae hemispheric and minutely granular.

As far as is known, *Mentzelia humilis* var. *guadalupensis* is restricted to the west slope of the Guadalupe Mountains on gypsum of the Yeso Formation, probably occurring throughtout the outcrop as described in the introduction. The varietal epithet refers to its presence in the Guadalupe Mountains.

Paratypes: **NEW MEXICO. Otero Co.:** 49 km NNE of Dell City, Texas, W base of Guadalupe Mts., N of mouth of Pup Canyon, NE S23, T22S, R18W, 32°22.75'N, 105°03.99'W, elev. 1460 m, 5 Aug 1997, *Spellenberg, Wootten, and Howard 12440* (NMC); 2.5 km S of the Chaves Co. line, just west of The Rim on the west slope of the Guadalupe Mts., about 100 m inside the Lincoln National Forest, center S7, T21S, R18E, 32°29.65'N, 105°08.28'W, elev. 1540 m, 27 Jul 1998, *Spellenberg & Wootten 12500* (NMC, RM).

APPENDIX 1

The following list provides the names of plants that we collected or observed on the outcrop; collection numbers are Spellenberg's. Deposition of specimens is indicated by herbaria codes as presented in Holmgren et al. (1990). Each name is also followed by "C, O, or U," signifying generally "common, occasional, or uncommon," respectively, on the outcrop.

Agavaceae: *Dasylirion wheeleri* S. Wats. [O]; *Yucca elata* Englem. [U]; *Yucca torreyi* Shafer [O]

Amaranthaceae: *Tidestromia suffruticosa* (Torr.) Standl. var. *suffruticosa*, *12481* (NMC) [U]

Anacardiaceae: *Rhus microphylla* Engelm. [U]

Apocynaceae: *Amsonia longiflora* Torr. var. *salpignatha* (Woodson) McLaughlin, *12434* (NMC, NY, UNM), *12441* (NMC, NY), *12474* (NMC, NY), *12501* (NMC, NY) [C]

Asclepiadaceae: *Asclepias macrotis* Torr., *12507* (NMC, NY) [U]

Asteraceae: *Brickellia laciniata* A. Gray [U]; *Gaillardia multiceps* Greene [U]; *Gutierrezia microcephala* (DC.) A. Gray [O]; *Haploësthes greggii* A. Gray, *12437* (NMC) [C]; *Machaeranthera pinnatifida* (Hook.) Shinners var. *pinnatifida*, *12505* (NMC) [U]; *Porophyllum scoparium* A. Gray, *12436* (NMC, UC) [C]; *Sartwellia flaveriae* A. Gray [U]; *Thelesperma megapotamicum* (Spreng.) Kuntze [U]; *Thymophylla acerosa* (DC.) Strother, *12484* (NMC) [U]; *Thymophylla pentachaeta* (DC.) Small var. *hartwegii* (A. Gray) Strother, *12475* (NMC, NY), *12483* (BRIT) [O]; *Viguieria stenoloba* S. F. Blake [O]

Boraginaceae: *Tiquilia hispidissima* (Torr.) A. Richardson, *12502* (NMC) [O]

Brassicaceae: *Nerisyrenia camporum* (A. Gray) Greene, *12442* (NMC) [C]

Cactaceae: *Coryphantha tuberculosa* (Engelm.) A. Berger, *12482* (NMC) [U]; *Echinocactus horizonthalonius* Lemaire [U]; *Echinocereus dasyacanthus* Englem., *12486* (NMC) [O]; *Opuntia imbricata* (Haw.) DC. [U]; *Opuntia macrocentra* Engelm., *12487*, spineless (NMC), *12488*, spines (NMC) [O]; *Opuntia phaeacantha* Englem. var. *phaeacantha* [U]

Chenopodiaceae: *Atriplex canescens* (Pursh) Nutt. [U]

Ephedraceae: *Ephedra aspera* S. Wats., *12473* (NMC) [O]

Euphorbiaceae: *Chamaesyce fendleri* (Torr. & Gray) Small, *12458* (NMC), *12471* (NY) [O]; *Croton dioicus* Cav. [O]

Fabaceae: *Acacia neovernicosa* Isely [O]

Fouquieriaceae: *Fouquieria splendens* Engelm. [O]

Hydrophyllaceae: *Nama carnosum* C. L. Hitchc., 12503 (NMC), [O]

Krameriaceae: *Krameria erecta* Schult., *(12478)* [O]

Lamiaceae: *Hedeoma nanum* (Torr.) Briq., *12479* (NMC) [U]

Linaceae: *Linum vernale* Wooton, *12480* (NMC) [U]

Loasaceae: *Cevallia sinuata* Lag. [U]; *Mentzelia humilis* (A. Gray) J. Darl. var. *guadalupensis* Spellenb., *12440* (NMC), *12455* (NMC, NY, TEX, UNM),*12500* (NMC, RM) [C]

Malvaceae: *Sphaeralcea coccinea* (Nutt.) Rydb., *12476* (NMC) [U]

Nyctaginaceae: *Allionia incarnata* L. var. *incarnata* [O]; *Anulocaulis leiosolenus* (Torr.) Standl. var. *howardii* Spellenb. & T. Wootten, *12433, 12435, 12438* [C]; *Mirabilis linearis* (Pursh) Heimerl, *12506* (NMC) [U]; *Selinocarpus lanceolatus* Wooton var. *lanceolatus*, *12452* (NMC), 12499 (NMC) [O

Oleaceae: *Menodora scabra* A. Gray [U]

Onagraceae: *Gaura coccinea* Nutt. [U]; *Calylophus hartwegii* (Benth.) Raven subsp. *filifolius* (Eastw.) Towner & Raven, *12472* (NMC) [O]

Poaceae: *Aristida purpurea* Nutt. var. *nealleyi* (Vasey) Allred, *12453* (NMC) [U]; *Aristida pansa* Wooton & Standl. var. *pansa*, *12456* (NMC) [U]; *Bothriochloa laburoides* (DC.) Herter subsp. *torreyana* (Steud.) Allred & Gould, *12459* (NMC) [U]; *Bouteloua warnockii* Gould & Kapadia, *12443* (NMC) [O]; *Dasyochloa pulchella* (Kunt.) Steud. [U]; *Digitaria cognata* (Schult.) Pilg. subsp. *pubiflora* Wipff & Hatch, *12457* (NMC) [U]; *Setaria leucopila* (Scribn. & Merr.) K. Schum. [U]; *Sporobolus cryptandrus* (Torr.) A. Gray, *12504* (NMC) [O]; *Stipa curvifolia* Swallen, *12477* (NMC, NY) [U]; *Tridens muticus* (Torr.) Nash var. *muticus*, *12454* (NMC) [U]

Polygonaceae: *Eriogonum havardii* S. Wats., *12439* (NMC) [C]

Pteridaceae: *Astrolepis cochisensis* (Goodd.) D. M. Benham & Windham, *12444* (NMC) [O]

Rosaceae: *Fallugia paradoxa* (D. Don) Endl. [U]

Rubiaceae: *Hedyotis nigricans* (Lam.) Fosberg, *12445* [O]

Solanaceae: *Nicotiana trigonophylla* Dunal (NMC) [U]

APPENDIX 2

Collections of *Mentzelia* cited in discussion of *M. humilus* var. *guadalupensis*. Deposition of specimens is indicated by herbaria codes as presented in Holmgren et al. (1990).

Mentzelia humilis (A. Gray) Darl.—*Higgins 6845*. Texas, Culberson Co., 26 mi E of Hwy. 62-180 along Hwy 652, gypsum soil, 21 May 1973 (NMC); *Sivinski & Lightfoot 2634*, New Mexico, Guadalupe Co., 2.3 mi S of Pecos River bridge at Puerto de Luna, 21 Oct 1993 (NMC, UNM).

Mentzelia multiflora (Nutt.) A. Gray.—*Spellenberg 3660*, New Mexico, Otero Co., Guadalupe Mts. on Guadalupe Rim Rd #67, 8 Sep 1973 (NMC); *Wooton s.n.*, New Mexico, [without county], Guadalupe Mts., west slope, 3 Aug 1909 (NMC).

Mentzelia perennis Wooton.—*Edwards & Repass 4726*, New Mexico, Socorro Co., ca. 8 mi E of Socorro, 23 Jul 1977 (NMC); *Spellenberg & Willson 4233*, New Mexico, Socorro Co., 8 mi (by air) ENE of Bingham, W edge Chupadera Mesa, 8 Jul 1976 (NMC); *Ward, Spellenberg, & Soreng 81-281*, New Mexico, Lincoln Co., W base of Cerro Tecolote Peak, 12 mi SSW of Corona, roadside or US 54, 3 Jul 1981 (MO, NMC, NY–originally identified as *M. pumila* (Nutt.) Torr. & A. Gray).

ACKNOWLEDGMENTS

We thank several individuals for assisting in various ways with this study. Mike Howard brought the *Anulocaulis* to our attention and accompanied us to the site on our first visits. Jane Shafer and George Rauch, ranchers on Crow Flats in southern New Mexico, allowed access to the site across deeded land. Manual Tanner and J.T. Tanner allowed access from their leased land to the gypsum outcrop to the north of the Pup Canyon outcrop. Photocopies of specimens of *Mentzelia mexicana* from SRSC were supplied by A. Michael Powell. Richard Worthington supplied information from UTEP. Help with Latin diagnoses was received from John Strother and Alan Smith, and Strother carefully read a preliminary version of the manuscript. Robert Kiger assisted with a nomenclatural problem. A thoughtful and very helpful review of the manuscript was provided by Denis Kearns.

REFERENCES

DARLINGTON, J. 1934. A monograph of the genus *Mentzelia*. Ann. Missouri Bot. Gard. 21:103–222.

HOLMGREN, P.K., N.H. HOLMGREN, and L.C. BARNETT. 1990. Index Herbariorum, Part I: The Herbaria of the World, 8th ed. Regnum Veg. 120:1–693.

HUNT, C.B. 1977. Surficial geology of southeast New Mexico. Map GM-41. N. M. Bureau of Mines. N. M. Institute of Mining and Technology. Socorro, NM.

MARTIN, W.C., and C.R. HUTCHINS. 1981. A flora of New Mexico, vol. 2. J. Cramer, Vaduz.

MAYR, E. 1969. Principles of systematic zoology. McGraw Hill, Inc., NY.

SPELLENBERG, R. 1993. Taxonomy of *Anulocaulis* (Nyctaginaceae). Sida 15:373–389.

STUESSY, T.F. 1990. Plant taxonomy. Columbia University Press, NY.

THOMPSON, H.J. 1997. Loasaceae. In: J. Henrickson and M.C. Johnston. A flora of the Chihuahuan Desert Region, draft edition 1.2, Vol. 1, published by J. Henrickson, Los Angeles, CA. Pp. 513–520.

__________ and A.M. POWELL. 1981. Loasaceae of the Chihuahuan Desert Region. Phytologia 49:16–32.

__________ and J.R. ZAVORTINK. 1970. Loasaceae. In: D.S. Correll and M.C. Johnston. Manual of the vascular plants of Texas, Texas Research Foundation, Renner, Texas. Pp. 1082–1087.

TURNER, B.L. 1993. A new species of *Anulocaulis* (Nyctaginaceae) from southern Coahuila, Mexico.

WOOTON, E.O. and P.C. STANDLEY. 1915. Flora of New Mexico. Contr. U.S. Natl. Herb. 19:1–794.

BOOK REVIEW

ANNE ORTH EPPLE and LEWIS E. EPPLE. 1995. **A Field Guide to the Plants of Arizona.** (ISBN 1-56044-314-6, pbk.) LewAnn Publishing Co., Mesa, Arizona, with SkyHouse Publishers, an imprint of Falcon Press Publishing Co., Helena, MT. Distributed by Falcon Press Publishing Co., Inc., P.O. Box 1718, Helena, MT 59624. $24.95. 347 pp., 899 color photos.

This ambitious field guide boasts almost 900 color photos picturing 850 of Arizona's over 3,000 species of plants. It covers wildflowers, cacti, trees, shrubs, vines, and ferns. The grasses and "weeds," as is often the case, are left out. After a brief introduction on scope and use, the six life zones of Arizona are delineated by altitude, rainfall, and vegetation parameters. Thereafter follows a captivating 176 pages of color photos. Anywhere from three to seven photos are pleasingly laid out in horizontal and vertical formats on each page. I found the photos to be a well-executed variety of what appears to be totally naturally lit, fill flash, and pleasantly "natural" full flash images. Many species are represented by two photos: one habit shot and a close up, or fruiting shot etc.

The photo section begins with the ferns and is followed by the trees, which are grouped by leaf shape. The cacti, grouped by general pad morphology, then logically segue into the agaves. Wildflowers and shrubs with conspicuous flowers are next, grouped by flower color, number of segments (basically number of petals), and sometimes regular versus irregular flowers. These and other additional sub-groupings make the photo section more diagnostic and useful compared to the simply color grouped format found in many field guides. Each photo is sequentially numbered, followed by a common name, and referenced to a text page where the description is found.

Next come the 295 pages of descriptions. Though some entries are somewhat brief all offer useful and interesting information. The text section is grouped phylogenetically by family. Each family entry has a common name, the scientific name (with phonetic pronunciation) and a general description of the family. Each species entry has one or more common names, the scientific name, description, elevation, habitat, and a comments section. The description sections vary in length and in some cases are somewhat spare but in other cases are very informative and botanical, requiring some facility with technical terms. What ever the descriptions may lack is more than made up by the comments section of each entry. I found them chocked full of wonderful little bits of information such as wildlife uses, medicinal uses, toxicity, derivation of the plant names, and addition curiosities of the plant. Also included is a pronunciation of the genus and the number of different species of that genus found in Arizona, and finally the location and date of the photo.

I really like the glossary that follows. Besides containing the usual defined botanical terms, it also includes the definitions of many Latin descriptors used in scientific plant names along with their various endings (Bravo!). This is a real plus for the amateur attempting to tackle the mumbo jumbo of the Latin lingo. And, no, I wouldn't leave out the index, the real proof of the pudding. Thirty-two pages of wonderfully readable and uncluttered bold-faced genera and scientific family names interspersed among the regular type faced common names and specific epithets.

This is a must have for anyone interested in the flora of Arizona. Practically every photo is a masterpiece and there is plenty of information in the text to keep anyone interested. Congratulations on a huge project so well-executed.—*Robert J. George.*

A NEW SPECIES OF *PORTULACA* (PORTULACACEAE)

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ABSTRACT

Portulaca yecorensis is described from the conglomeritic mudflow barrens at 1500–1600 m elevation in the Yécora valley in the Sierra Madre of eastern Sonora, Mexico. This annual is related to *P. oleracea* and *P. retusa* but differs in small size, strong reddish pigmentation, smaller seeds, larger flowers and pollen, distribution, and habitat.

RESUMEN

Se describe la especie nueva *Portulaca yecorensis* del Valle de Yécora de la Sierra Madre Occidental en la parte oriental de Sonora, México; crece en áreas con conglomerados de lodolita casi sin vegetación. Esta especie anual está relacionada con *P. oleracea* y *P. retusa*, pero difiere de éstas por su tamaño pequeño, pigmentación rojiza fuerte, semillas más pequeñas, flores y polen más grandes, distribución, y hábitat.

KEY WORDS: *Portulaca*, Portulacaceae

INTRODUCTION

As part of their floristic surveys in the Sierra Madre Occidental of eastern Sonora, México, Tom Van Devender and Ana L. Reina G. encountered a surprisingly rich flora on gentle hills and level areas at about 1500–1600 m elevation near Yécora, Sonora. The plants growing on barren, apparently edaphically severe sites, are of particular interest. These surfaces are on debris and conglomerate deposits in the Báucarit Formation that formed as mudflows sometime after the beginning of the modern basin and range morphology (17 million years ago, Cochemé & Demant 1991).

With a mean annual rainfall of 913 mm/yr at Yécora (Búrquez et al. 1992), the vegetation is grassland in the valley bottom and pine-oak forest on the surrounding slopes (Reina et al. 1999). Dominant trees in pine-oak forest are *Pinus engelmannii* (Apache pine) and *P. yecorensis* (Yécora pine). Other common forest trees include *P. chihuahuana* (Chihuahua pine), *Quercus arizonica* (Arizona oak), *Q. chihuahuensis* (Chihuahua oak), *Q. durifolia*, *Q. oblongifolia* (Mexican blue oak), *Q. viminea* (willowleaf oak), and *Juniperus deppeana* (táscate, alligator bark juniper). East of Yécora, shallow soils on mudflow surfaces support open oak woodland-grassland transition with common *Q. chihuahuensis* and *Q. toumeyi* (Toumey oak).

Considering the moderately high rainfall at Yécora, bare areas without vegetation and minimal soil development on the mudflow surfaces are not easily understood. Perhaps erosion rates are excessive. In the spring, the surfaces are very dry with few visible plants. However, from July through September, heavy rainfall keeps the surfaces wet and a diverse dwarf herb flora flourishes including sedges (10 species in 7 genera), succulents (*Agave polianthiflora*, *Echinocereus stoloniferus* var. *tayopensis*, *Mammillaria saboae* var. *haudeana*, *M. wrightii* var. *wilcoxii*, *Sedum vinicolor*, *Talinum marginatum*), grasses (*Microchloa kunthii*, *Muhlenbergia annua*, *M. shepherdii*, *M. texana*), legumes (*Aeschynomene americana* var. *glandulosa*, *Dalea confusa*, *D. filiformis*, *Stylosanthes* sp.), and many others. Thus far, four taxa have been described as new from the mudflow areas including *Mammillaria saboae* var. *haudeana* (A. Lau & Wagner) Glass & R. Foster, *Menodora yecorana* T. Van Devender & B.L. Turner, *Pectis vandevenderi* B.L. Turner, and *Tridax yecorana* B.L. Turner. A new *Boerhavia* known only from these mudflow surfaces is under study by Richard Spellenberg and Luis A. Pérez. To this list, we add a small, reddish, annual succulent *Portulaca*.

TAXONOMY

Portulaca yecorensis Henrickson & T.Van Devender, sp. nov. (**Figs. 1, 2**).

TYPE: MEXICO. SONORA: Municipio de Yécora, 5.0 km NW of Yécora on road to Mesa Grande, sparse pine-oak forest on level mudflow deposits, 28°24'27"N, 108°57'32"W, 1600 m, 29 Sep 1998, *T. R. Van Devender 98-1942, with A.L. Reina G., W. Trauba* (HOLOTYPE: ARIZ; ISOTYPES: CAS, TEX, MEXU).

Plantae annuae, rubro-marroniae; folia leviter compressae, 2–7.5 mm longae, 1.5–3.5 mm latae, petioli curtae; flores 10–20 mm diametro, petala aureae, fortiter emarginatae; stamina 12–17; lobi styli 3–4; seminae 0.7–0.8 mm longae, parum compressae.

Apple red to nearly maroon, succulent, low, spreading-ascending annuals, locally common on exposed shallow-soiled mudflow surfaces, the plants (1–)2.5–5.0(–10.5) cm in diameter; stems 0.7–1.0 mm in diameter, alternate or opposite branched, with internodes 0.5–8 mm long. Leaves fleshy, the blades ovate to obovate, 2–7.5 mm long, 1.5–3.5 mm wide, slightly compressed, obtuse to rounded at the tip, broadly obtuse-rounded at the base above obscure petioles 0.2–0.7 mm long; axillary hairs very sparse, obscure, to 0.3 mm long. Flowers 2–3(–4) at the stem tips where subtended by clusters of sessile leaves; bracts 3, fleshy-membranous, ovate, reddish, conduplicate, attached along a broad base, obtuse, the bracts 1–1.8 mm long, the paired bractlets 0.9–1.2 mm long, all persistent; pedicels ca. 0.5–0.7 mm long, ca. 0.7 mm wide, expanding to 1.5–2.5 mm wide at the lower hypanthial margin; sepals 2, apple red, glabrous, conduplicate with one external

FIG. 1. *Portulaca yecorensis*, from the type collections 5 km NW of Yécora, Sonora, 29 Sep 1998, *T.R. Van Devender et al., 98-1942*, showing the large flowers and contrasting reddish foliage. Horizontal bar = 1 mm.

to the other, fleshy with membranous margins, obtuse at the cucullate tip, slightly keeled above, but not crested below the tip, 3–3.5 mm long in flower, enlarging to 5.5 mm long in fruit, the two sepals connate for 0.5 mm at the base; petals 5, spreading, bright yellow, obovate, (4.5–)6–8(–9) mm long, to (4–)5–6(–7) mm wide at the tip, strongly emarginate with an apical notch to ca. 1.0–1.8 mm deep, the flowers averaging 14.7 mm in total diameter (range 10–20 mm, n = 30, field measured), the petals connate and adnate to the sepals for about 0.4 mm at the sepal base; stamens (12–)15–17; filaments 5.5–6.5 mm long, bright yellow, ascending, glabrous, adnate to the petal-sepal bases for ca. 0.4 mm; anthers ca. 0.8–1.0 mm long, bright yellow, with 4 elongate thecae, each ca. 0.2 mm in diameter (wet), the two pair of anther sacs slightly twisted (i.e., not perfectly parallel); pollen globose, polyporate, (72–)90–98(–119) µm in diameter, light to strong yellow; style exserted beyond the stamens, bright yellow, 7.6–9 mm long, the lobes 3–4, 1.5–2.5 mm long, the stigmatic surfaces long papillae with some hairs to 0.3 mm long; ovules to 24. Ovary top obconic, to 1 mm long in flower to 2.5 mm long, and 2.5 mm in basal diameter in fruit, the fruit wall thin, with a slight constriction in the upper third; seeds (5–)10–19 per ovary, reddish-black with a slight oil sheen, cucullate with a whitish patch

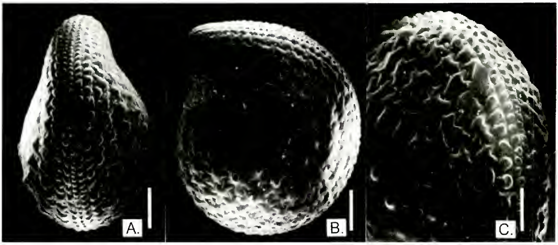

FIG. 2. SEM of seed sculpturing patterns of *Portulaca yecorensis:* A. Edge view, showing series of small papilli across the rim. B. Face view, showing outline of fruit, and the multiradiate cells in the lower left. C. Oblique view, enlarged showing the cells with branched radii and the taller papillate cells in the lower left. White bars = 1 mm in A and B, 0.3 mm in C.

where attached to the funiculus at the radicle bulge, 0.7–0.8(–0.86) mm wide, to 0.5–0.56 mm thick, with some lateral cells tuberculate (Figs. 1, 2).

Additional specimens: **MÉXICO. Sonora. Municipio de Yécora:** 2 km E of Yécora 28°22'51"N, 108°54'53"W, 1600 m, 3 Sep 1996, *A. Flores M. 4930, J. Sánchez E.* (USON); 3.4 km N of Yécora on road to Agua Blanca, oak woodland on bare volcanic hilltops, 28°29'35"N, 108°55'11"W, 1520 m, 23 Sep 1997, *A. L. Reina G. 97-1194, T. R. Van Devender, W. Trauba*(ARIZ, HUNT, NY, TEX, USON); ca. 1 km ESE of La Otra Banda (the Pima Indian portion of Yécora) on road to Talayotes, open pine-oak forest on locally bare mudflow surfaces, 28°21'42"N, 108°54'12"W, 1600 m, 19 Nov 1997 *A. L. Reina 97-1519, with T. R. Van Devender, A. M. Rea, C. Cassa, A. E. Gondor* (ARIZ); 2 km E of Yécora; 28°22'51"N, 108°54'53"W, 1600 m, 3 Sep 1996, *A. Flores M. 4930, J. Sánchez* (USON).

The new taxon appears related to the *Portulaca oleracea* complex. Like *P. oleracea*, the plant is largely glabrous, moderately branched, and has crested sepals, small axillary hairs, and yellow flowers. The new taxon differs from *P. oleracea* in its much smaller size, smaller leaves, the distinctive reddish color on all vegetative portions, the smaller and more sparse axillary hairs, much larger flowers, larger pollen grains, poorly developed crest or keel on the sepals, and seed shape and sculpturing (Fig. 1). The small size and smaller leaves are, of course, a factor of its exposed, shallow-soil habitat and are features not restricted to this species, as *P. oleracea*, in similar habitats, may be equally reduced. The red coloration caused by the presence of betalain pigments in the outermost epidermis layer, is apparently a genetically fixed feature allowing adaptation to the exposed, high-insolation habitat. Axillary hairs are few and very short, measuring to 0.3 mm in length. In *P. oleracea* they are slightly more conspicuous, extending to 1 mm in length. *Portulaca oleracea* has very small flowers (5–10 mm in diameter) while those of the new species are 10–20 mm in diameter, as measured in the field by Van Devender and Reina.

Portulaca oleracea is commonly reported as autogamous with flowers opening for only about four hours during a day (Matthews et al. 1993; Geesink 1969). The larger and more showy flowers of *P. yecorensis* are more conspicuous, a feature that may be associated with attracting pollinators and possibly outbreeding. The sphaeroidal, polyporate, pollen grains of *P. yecorensis* are very large, measuring (72–)90–98(–119) µm in diameter; pollen of *P. oleracea* is much smaller, 55–69 µm in diameter, but otherwise similar in structure. Anthers in the new species are also much larger, 0.8–1 mm long (wetted). Anthers of *P. oleracea* are about 0.5 mm in length (similarly wetted). Seeds in the new species measure 0.68–0.83 in maximum diameter, which is comparable to those of *P. oleracea*, but the body of the seed is more globose, not compressed as in *P. oleracea*. The seed surface sculpturing pattern observed in the new taxon gives evidence of its relationship. There are rows of cells on the lateral surfaces of the body that are used to characterize the sculpturing of the seeds (Danin 1978). The surface patterns found in the new species are not entirely consistent, however, most lateral surface cells have a slight metallic sheen and are stellate, to 0.2 mm wide, and have broad or narrow, unbranched to forked or truncated radii that interlock with those of adjacent cells (Fig. 2). In some seeds this pattern is very similar to that of *P. retusa* Engelm. (=*P. oleracea* L. subsp. *impolita* Danin & H.G. Baker) except that distinct tubercules are absent except from some cells on the lateral walls. In other seeds the sculpturing pattern is more obscure, but the pattern found is more like that of *P. retusa* than those of *P. oleracea*. This leads me to consider that the new species may be more closely related to *P. retusa* than *P. oleracea*, if relationship indeed falls within this group. Matthews et al. (1993) recently combined *P. retusa* with *P. oleracea*; the senior author is in strong disagreement with this action.

The contrasting dark red foliage and large, bright yellow petals make the plant very conspicuous. Red vegetative pigmentation is a common stress response in many succulent and non-succulent species (e.g., *Amaranthus, Portulaca, Sedum*) in answer to high insolation. This commonly develops over a season as light stress increases. However, its development can be controlled genetically. Danin et al. (1978) note that some cultivated subspecies of *P. oleracea* characteristically developed pigmentation of the sepals, etc., while other subspecies would not, which would indicate genetic control of pigment placement. The red pigments are betalains (Clement & Mabry 1996) and, in this taxon, are largely confined to epidermal layers. Such red pigments would reflect red and absorb green wavelengths of light, while the green chlorophyll pigment would absorb the remaining red and reflect green wavelengths; this to some extent reduces absorptivity of solar radiation (Von Willert et al. 1992). In areas of high insolation, however, this does not impede the light available for photosynthesis. The result is dark (apple) red or maroon foliage. In the new species all vegetative portions of the plant (stems, leaves, sepals) had the distinctive, dark red coloration and this developed from the beginning–it was present throughout seedling stage into the adult plant, irregardless of the amount of light given to the plant. Even seedlings grown in the senior author's shaded, north-facing office window developed and retained the characteristic apple-red pigmentation on all vegetative structures.

The mudflow barren habitat is so open that the plants are fully exposed throughout their two to three month life span. Surveys in this habitat on August 17, 1998, revealed seedling *Sedum vinicolor* but not *Portulaca yecorensis*. Peak flowering collections were made on September 23, 1997, and September 29, 1998, nearing the end of the summer monsoon rains. The November 19, 1997, collection was mostly of dead, dried plants. It is interesting to note that the life cycle of *P. yecorensis* appears to be delayed compared to the annual composites (*Pectis vandevenderi*, *Tridax yecorana*) which senesce in October. Likely the succulent leaves allow it to persist longer than non-succulent annuals after the summer rains taper off.

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REFERENCES

BÚRQUEZ, M., A.A. MARTÍNEZ Y. and P.S. MARTIN. 1992. From the high Sierra Madre to the coast: changes in vegetation along highway 16, Maycoba-Hermosillo. In: K.F. Clark, J. Roldán, and R. H. Schmidt, eds. Geology and mineral resources of the northern Sierra Madre Occidental. Guidebook, El Paso Geological Survey Publication No. 24, El Paso. Pp 239–252.

CLEMENT, J.S. and T.J. MABRY. 1966. Pigment evolution in the Caryophyllales: a systematic overview. Bot. Acta 109:360–367.

COCHEMÉ, J. and A. DEMANT. 1991. Geology of the Yécora area, northern Sierra Madre Occidental, Mexico. Geol. Soc. America Special Pap. 254.

DANIN, A., I. BAKER and H.G. BAKER. 1978. Cytogeography and taxonomy of the *Portulaca oleracea* L. complex. Israel J. Bot. 27:177–211.

GEESINK, R. 1969. An account of the genus *Portulaca* in Indo-Australia and the Pacific (Portulacaceae). Blumea. 17:275–301.

MATTHEWS, J.F., D.W. KETRON, and S.F. ZANE, 1993. The biology and taxonomy of *Portulaca oleracea* L. (Portulaceace) complex in North America. Rhodora 95:166–183.

Reina, G.A.L., T.R. Van Devender, W. Trauba, and A. Búrquez M. 1999. Caminos de Yécora. Notes on the vegetation and flora of Yécora, Sonora. In: M. Ortega N., ed. Symposium internacional sobre la utilización y aprovechamiento de la flora de zonas aridas, Universidad de Sonora, Hermosillo.

Von Willert, D.J., B.M. Eller, M.J.A. Werger, E. Brinckmann, and H.D. Ihlenfeldt. 1992. Life strategies of succulents in deserts. Cambridge University Press, Cambridge.

BOOK REVIEW

ROBERT H. MOHLENBROCK 1999. **The Illustrated Flora of Illinois: Ferns. Second Edition.** (ISBN 0-8093-2255-2, hbk.). Southern Illinois University Press, P.O. Box 3697, Carbondale, IL 62902-3697. Tel.: 618-453-6633; Fax: 618-453-1221; email: danseit@siu.edu. $39.95. 240 pp., 163 illus.

This second edition of a truly classic floristic work includes 25 species not previously reported in the 1967 edition, has additional illustrations for all of those taxa, and provides a key to the additions and to supplement the other keys in the main section of the book when (as in the Lycopods) generic concepts in the family have changed. The small size of the book and its simple terminology, concise descriptions, literature citation, common name, habitat, range and distribution within the state, all make this an ideal field tool, just as its author intended. The simple yet clear illustrations, with accompanying dot-distribution maps are also very useful.

The introduction and keys to the orders and also, the genera, of ferns and their allies contain information requisite for any pteridology course. The Appendix of 47 pages, including additions, changes to keys, descriptions of taxa not previously included, distribution maps, etc. is a little cumbersome, but I can imagine that it would have been extraordinarily time-consuming to have integrated the updated information into the appropriate niche within the main text body. The glossary is short, simple and concise.

Certainly, the first edition of this book is already dog-eared, taped many times with library repair tape, and otherwise patched, on the shelves of everyone who botanizes in the vicinity of Illinois. Certainly I will have mine in the car when I go back to those septentrional stomping grounds in and around the *Land of Lincoln*. There is nothing as welcome as an update to a classic and this book fits the bill perfectly. I am delighted that Mohlenbrock was able to update this classic work so that younger botanists and "Phern Physicians" might better enjoy the marvelous fern flora. Southern Illinois Press deserves a salute for printing this fine book; truly a bargain!!! I hope more institutions in the state and adjacent ones will consider teaching a pteridology course if they are not presently doing so, given the importance of the group and its abundance in the state.—*John J. Pipoly III.*

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REVIEW OF EARLY NOMENCLATURE IN *EUTHAMIA* (ASTERACEAE: ASTEREAE)

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ABSTRACT

A review of the early nomenclature of *Euthamia* summarizes observations by Sieren (1981) and Reveal (1991) and adds other perspectives. Nuttall published the group in 1818 in the format of a new subdivision of *Solidago*, interpreted here at sectional rank, but noted it as "a subgenus, or rather genus." Cassini in 1825 provided the elements for validation of *Euthamia* at generic rank, but he did so unintentionally and ascribed the name to Nuttall. In this interpretation, separate citations of lectotype and type are required for the two names (sect. *Euthamia* Nutt. and genus *Euthamia* Nutt. ex Cass., respectively). Also in this interpretation, Nuttall in 1841 validated nomenclatural combinations for *E. graminifolia* (L.) Nutt. and *E. tenuifolia* (Pursh) Nutt. and added *E. occidentalis* Nutt. as a new species. The name *Euthamia caroliniana* (L.) Greene ex Porter & Britt. was validated in 1894, based on *Erigeron carolinianus* L., and includes *E. tenuifolia* as a synonym. There is reason to maintain *Euthamia galetorum* Greene at specific rank rather than as a variety of *E. caroliniana* or *E. graminifolia*. The discussion includes application of several potentially controversial interpretations of the ICBN: disposition of "alternative names;" "the term type or an equivalent" in typification; and conditions of "indirect reference" for valid publication.

RESUMEN

Una revisión de la nomenclatura previa de *Euthamia* resume las observaciones de Sieren (1981) y Reveal (1991) y añade otras perspectivas. Nuttall publicó el grupo en 1818 como una nueva subdivisión *Solidago*, que se interpreta aquí en el rango de sección, pero la citó como "un subgénero o quizás género." Cassini en 1825 dio los elementos para la validación de *Euthamia* en el rango genérico, pero lo hizo así sin querer y adscribió el nombre a Nuttall. En esta interpretación se requieren citaciones separadas de lectotipo y tipo para los dos nombres (sect. *Euthamia* Nutt. y género *Euthamia* Nutt. ex Cass., respectivamente). También en esta interpretación, Nuttall en 1841 validó combinaciones nomenclaturales para *E. graminifolia* (L.) Nutt. y *E. tenuifolia* (Pursh) Nutt. y añadió *E. occidentalis* Nutt. como una nueva especie. El nombre *Euthamia caroliniana* (L.) Greene ex Porter & Britt. fue validado en 1894, basado en *Erigeron carolinianus* L., e incluye *E. tenuifolia* como sinónimo. Hay una razón para mantener *Euthamia galetorum* Greene en el rango específico en vez de variedad de *E. caroliniana* o *E. graminifolia*. La discusión incluye la aplicación de varias interpretaciones potencialmente controvertidas del ICBN: disposición de "nombres alternativos;" "el término tipo o un equivalente" en la tipificación y condiciones de "referencia indirecta" para la publicación válida.

Reveal (1991) clarified the application of the Linnaean name *Erigeron*

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carolinianus L., confirming earlier opinions that it represents a species of *Euthamia* and that this species is correctly treated as *Euthamia caroliniana* (L.) Greene ex Porter & Britton, of which *Euthamia tenuifolia* (Pursh) Nutt. is a synonym. Reveal also noted that the name for *Euthamia* at generic rank should be cited as *Euthamia* (Nutt.) Nutt. ex Cass. (see below) and that the choice of lectotype for the genus by Britton and Brown in 1913 should stand as *Euthamia graminifolia* (L.) Nutt. Except for details regarding the generic authorship and typification and the authorship of *E. tenuifolia*, his observations are firm, but several other associated nomenclatural points were left unresolved, these discussed here. Previous perspectives regarding authorship are summarized, additional comments are provided, and a nomenclatural summary of the names involved follows at the end of the comments. Other published comments regarding *Euthamia* on a more limited or regional basis have not touched upon the nomenclatural topics discussed here.

Euthamia at generic rank

Euthamia was ambiguously described by Nuttall (1818, p. 162) as "A subgenus, or rather genus, reciprocally allied to *Solidago* and *Chrysoma*." Various botanists (e.g., Elliott 1823; de Candolle 1836; Greene 1902; Gleason & Cronquist 1991, Cronquist 1994, as inferred from citation of the genus simply as "*Euthamia* Nutt.") have tacitly accepted 1818 as the validation date for the genus, but others have not (e.g., Nuttall himself in 1841; Sieren 1981, monographer of the genus, who cited "(Nutt.) Nutt." as the authority, regarding 1841 as the date of validation). The only other previous, explicit, and published consideration (Reveal 1991) of this problem concluded that the elements of validation were not provided in 1818. The implication of the 1994 ICBN Article 34.2 regarding identical, simultaneously published names at different ranks ("alternative names") after 1 January 1953 appears to be that such names are not necessarily invalid if published before that date. The position here, however, and that perhaps implicitly taken by Reveal, is that a name at only one of the ranks should be recognized as valid, if a balance of evidence regarding the author's intention suggests a resolution to the ambiguity.

Nuttall in 1818 placed two species under the heading of *Euthamia*, which was marked by an "asterisk" (indicating a new taxon) near, but before, the end of the *Solidago* treatment. Thus *Euthamia* was not in the numbered sequence of genera treated by Nuttall (*Solidago*, including *Euthamia*, is genus 560; *Brachyris* is genus 561). Nor is *Euthamia* included in the index to generic names in the Genera of North American Plants. The two *Euthamia* species are numbered "50" and "51," terminating the numbering sequence for species of *Solidago*. After the comments on *Euthamia*, Nuttall returned to *Solidago* in a summary paragraph (provided in a manner and position similar to such summaries for many other genera) that noted the overall geographic distribution of the genus and suggested that arborescent species of St. Helena and New Zealand probably should be excluded from *Solidago*. In contrast to the other species of *Solidago*, however, and lending to the ambiguity, Nuttall provided basionyms and author and publication citations for the *Euthamia* species, listing "50. graminifolia. *Chrysocoma graminifolia*" and "51. tenuifolia. *S[olidago]. tenuifolia*," giving an impression of his intention to make new nomenclatural combinations for these two species. The manner in which the treatment of *Euthamia* is imbedded within *Solidago*, however, is viewed here as more explicit evidence for regarding *Euthamia* of 1818 at infrageneric rank.

Nuttall's description of *Euthamia* as a "subgenus, or rather genus" was in the second paragraph of description following the "EUTHAMIA" heading, but the format for the delimitation of *Euthamia* is identical with other infrageneric names proposed in the same volume and long-accepted at sectional rank (see comments below, "*Euthamia* at infrageneric rank"). Nuttall (p. 151) applied almost exactly the same description to his group "II" of *Inula* sect. *Chrysopsis*, noting that "This genus, or subgenus, appears to be peculiar to North America." This heterogeneous group (as now seen) was composed of white-rayed species of *Aster* (compared to typical yellow-rayed *Chrysopsis*) with a double pappus, and it seems clear that the description here of "genus, or subgenus" was meant to be taken informally. The situation in *Euthamia* is analogous: the species were treated as a section within *Solidago*, but Nuttall's accompanying comment suggests that a higher rank for them is reasonable. In fact, it is the directness of this suggestion (and its close proximity to the listing of the new name) that has created the ambiguity of interpretation.

More than 20 years later, Nuttall (1841, pp. 325–326) provided a more definite account of *Euthamia*, explicitly treating it at generic rank. Here he cited the basionym for *Euthamia* "As a section of *Solidago*, Nutt., Gen. Am., Vol. II., p. 162. Decand. Prod., Vol. V., p. 341.)," indicating that he regarded the *Euthamia* of his 1818 publication to have been at infrageneric rank, as was *Euthamia* of de Candolle. Nuttall apparently intended to recognize the name at generic rank, with the authority understood to be "(Nutt.) Nutt." Remarkably, however, his ambiguity regarding the status of the name was perpetuated even here, as he did not provide *Euthamia* (in the "header") with an asterisk characteristic of the new names (e.g., *Ericameria* Nutt.) and new combinations (e.g., *Amphiachyris* (DC.) Nutt.) at generic rank elsewhere in the treatise. His treatment of *E. graminifolia* and *E. tenuifolia* (see below) also might be taken to imply that he assumed those names had already been incorporated into the valid nomenclature for *Euthamia*.

Meanwhile, as pointed out by Reveal, Cassini (1825) had preceded Nuttall's 1841 comments in providing the elements of validation for *Euthamia* at generic rank. Here Cassini referred to "Le genre *Euthamia* de M. Nuttall" (a clear but indirect reference), apparently assuming that Nuttall in 1818 had effectively established it at generic rank and giving Nuttall credit for its publication. In his associated description and comments, Cassini unambiguously treated *Euthamia* as a genus, although he surely did so without the specific intention of publishing a formal validation at that rank. In contrast to the suggestion of Reveal (1991) that the authority for the genus *Euthamia* be cited as "(Nutt.) Nutt. ex Cass.," its citation simply as "Nutt. ex Cass." acknowledges Cassini's role in validating the name as well as his explicit recognition that the name should be ascribed to Nuttall. This appears to be in accord with guidelines for citation outlined in Article 46.4 of the 1994 ICBN. Cassini did not furnish the necessities for any nomenclatural combinations in *Euthamia* at specific rank.

In summary, evidence indicates the name *Euthamia* was originally published at infrageneric rank (interpreted here to be sectional), and despite Nuttall's ambiguity both in 1818 and 1841, the most explicit parts of his treatments suggest that the validation of *Euthamia* at generic rank was effected by Cassini (as "Nutt. ex Cass."). Or, if Cassini's protologue were considered an insufficient basis for validation, Sieren's interpretation could be followed by citing the authority as "(Nutt.) Nutt." Other interpretations would read the evidence as favoring validation of the name in 1818 as a genus rather than section or subgenus or else perhaps find the evidence so evenly equivocal that the name from 1818, with Nuttall as sole author, could be regarded as valid at two or even three ranks (as noted above, according to ICBN Article 34.2). Or, perhaps any degree of ambiguity should lead to the formal acceptance of alternative names.

Euthamia at infrageneric rank

Although Nuttall's descriptive phrase for *Euthamia* in the 1818 publication was "a subgenus, or rather genus," he stated in 1841 that *Euthamia* was positioned "as a section of *Solidago*" in 1818. The latter rank is accepted here for the original publication of the name, as it is Nuttall's most unambiguous taxonomic characterization and one that is the most consistent with his 1818 format for analogous names in other genera. Other supraspecific taxa, securely accepted at sectional rank, were described by Nuttall in 1818 with exactly the same format as *Euthamia* (e.g., *Inula* sect. *Chrysopsis* Nutt., p. 150; *Erigeron* sect. *Caenotus* Nutt., p. 148; see Semple 1981 and Cronquist 1947, respectively). Each of these names was given in small-sized capital letters, preceded by an asterisk to indicate that it was a newly proposed name, and followed by a period and a dagger, referring to a footnote providing the name's derivation.

Alternatively, in view of ambiguity regarding the rank of Nuttall's 1818

Euthamia, it nevertheless may be considered validly published as an unranked subdivision of *Solidago*, according to ICBN Article 35.2: "A new name or combination published before 1 January 1953 without a clear indication of rank is validly published provided that all other requirements for valid publication are fulfilled; ... it may serve as a basionym or replaced synonym for subsequent combinations. ..."

De Candolle (1836, p. 341) explicitly treated *Euthamia* as a section of *Solidago*, citing both Nuttall (1818) and Cassini (1825) as having treated it at generic rank, although he acknowledged that the group might be acceptable as a genus ("An genus proprium ut innuit Nuttall et asserit Cassini?"). De Candolle's choice of a less than fully forceful verb ("innuo") for Nuttall's description appears to signal a degree of uncertainty about the rank, especially as the phrase is ended with a question mark.

Erigeron sect. *Multiflori* G. Don in Loudon (1830) comprised only two species in its original description, *Erigeron villarsii* Bell. (= *Erigeron atticus* Villars) and *Erigeron carolinianus* (= *Euthamia caroliniana*). Sect. *Multiflora* was lectotypified (Nesom 1989) by *Erigeron carolinianus* partly to avoid displacing the widely used *Erigeron* sect. *Trimorpha* (Cass.) DC. (Prodr. 5:290. 1836), of which *E. villarsii* is a member, and partly because, at the time, the identity of *Erigeron carolinianus* appeared to have little chance of being removed from the realm of ambiguity.

Discussion of infrageneric categories within *Euthamia* is largely academic, because the distinctiveness of the genus, apart from any other, is now generally accepted, and marked homogeneity among the relatively few species (6–8 total) suggests that formally designated categories will hardly be necessary or useful.

Typification of *Euthamia*

If valid publication of *Euthamia* at generic rank is attributed to Cassini as a new name (as in the interpretation here) rather than a new combination, typification of the genus also was effected by Cassini. His technical description of *Euthamia* (1825, p. 471) was explicitly drawn from *Chrysocoma graminifolia* L. ("en traccant ici les caractères genériques observés par nous sur la *Chrysocoma gramifolia* de Linné") and only that species. The position of this species in fixing the application of the name *Euthamia* in Cassini's discussion is unambiguous. At the time of Cassini's work, his short phrase "indicating the generic characters," in reference to *C. graminifolia*, was a clear and concise "equivalent" to the term "type," as that term is understood today in botanical nomenclature, apparently satisfying the requirements of the 1994 ICBN (Article 7.11).

In the description of *Solidago* sect. *Euthamia*, Nuttall in 1818 did not specify which of the two included species should serve as the type. Nor did he in 1841 make a choice among the three species included in *Euthamia* at generic rank. De Candolle (1836) included only two species in his treatment of *Solidago* sect. *Euthamia* and did not indicate which was to be regarded as the type. As noted by Reveal, Britton and Brown (1913) cited *E. graminifolia* as the generitype, which can be taken as an effective lectotypification; Sieren (1981) cited *E. tenuifolia* as the generitype. Alternately, if Reveal's interpretation of the validation of *Euthamia* as a new combination by Cassini were accepted, Cassini's presentation and documentation apparently can be be taken as the first effective lectotypification, based on *Chrysocoma graminifolia* (= *Euthamia graminifolia*), assuming that he provided an acceptable equivalent to the term "type."

Discussions of the process of lectotypification and its formal codal (ICBN) requirements have outlined ambiguities of interpretation (e.g., Barrie et al. 1992a, 1992b; Winter et al. 1992; Zijlstra 1992). A summary example of the problem of "the term type or an equivalent" is given in Brummit (1994), referring to a proposal by Reveal (1991). The course suggested here for the lectotypification of "*Euthamia* (Nutt.) Cass." does not appear to be contradicted by the current Code (ICBN 1994), unless unwritten interpretations or implications are brought to the fore. In any case, *Euthamia graminifolia* is the lectotype of any name based on *Solidago* sect. *Euthamia* Nutt., whether designated by Cassini or by Britton & Brown.

Authorship of *Euthamia* species

Various botanists have used the names *Euthamia graminifolia* (L.) Nutt. and *Euthamia tenuifolia* (Pursh) Nutt., interpreting Nuttall's epithets from 1818 as validly published in *Euthamia*. In one of the earliest examples, Elliott (1824) cited both names as such in lists of synonyms under their accepted names in *Solidago*. Greene, both in 1894 (in Porter and Britton) and in his later overview of the genus (1902), regarded 1818 as the date of valid publication for the genus and for Nuttall's two names at specific rank. Sieren (1981) regarded *E. graminifolia* as validated by Nuttall in 1841 but *E. tenuifolia* in 1818. Cronquist (1980) referred to *E. tenuifolia* (Pursh) Greene but later (in Gleason and Cronquist 1991) changed the citation to *E. tenuifolia* (Pursh) Nutt. Reveal (1991) regarded the latter to have been validated by Greene (1902) as *E. tenuifolia* (Pursh) Greene.

In Nuttall's 1841 treatment of *Euthamia*, he included three species, *E. graminifolia*, *E. tenuifolia*, and *E. occidentalis* (sp. nov.), each epithet associated with the generic name. Nuttall did not cite basionyms or citations of earlier publication for *E. graminifolia* and *E. tenuifolia*, but it is clear that he was referring to the taxa originally published by Linnaeus and Pursh, respectively, as an update of the descriptions in his 1818 publication. The 1841 descriptions for these two species are rewritten and somewhat expanded compared to the earlier ones, where the earlier sources of the names were cited. In contrast, *E. occidentalis* Nutt. was marked as a newly proposed name by an asterisk preceding the epithet, this symbol lacking from the other two names. Despite omission of basionyms for the first two species, Nuttall's 1841 treatment of *Euthamia* provided a specific reference to his 1818 publication, and there can be little doubt that he regarded the first two names in *Euthamia* to be in parallel with those of his previous manuscript, which included the basionyms and publication citations. This appears to satisfy the condition of "indirect reference" for valid publication of names (1994 ICBN Articles 32.4 and 32.5), and the validation of *E. graminifolia* and *E. tenuifolia* in 1841 is accepted here.

After Nuttall's formal treatment of *Euthamia* in 1841, this group of plants apparently was not again recognized at generic rank until 1894, when Porter and Britton (1894) provided E.L. Greene's view of the group in a formal nomenclatural summary for the species in northeastern North America. The three species listed were *E. caroliniana* (including *E. tenuifolia* as a synonym), *E. graminifolia*, and *E. leptocephala*; the first and third are regarded here as receiving formal validation at specific rank in the 1894 publication. In a more comprehensive treatment of *Euthamia*, Greene (1902) separated the concepts of *Euthamia caroliniana* and *E. tenuifolia*, but it is now generally acknowledged that the types of these two names represent a single species.

Status of *Euthamia galetorum*

With acknowledgment that the correct name of *Euthamia tenuifolia* is *E. caroliniana*, a decision is required regarding a varietal combination within *E. tenuifolia*. *Euthamia galetorum* Greene has been treated as a variety of both *E. tenuifolia* (Fernald 1921, as *Solidago tenuifolia* var. *pycnocephala* Fern.) and *E. graminifolia* (House 1924, as *Solidago graminifolia* var. *galetorum* (Greene) House). Friesner (1933) and Harris (1943), as well as the recent monographer of *Euthamia* (Sieren 1981), maintained *E. galetorum* at specific rank. While Roland and Smith (1969) noted that *S. tenuifolia* and *S. galetorum* are "evidently closely related," they also maintained both entities at specific rank. In contrast, Taylor and Taylor (1983) formalized the varietal status of *E. galetorum* within *E. tenuifolia* (as var. *pycnocephala* (Fern.) C.&J. Taylor), noting that "field studies along with examination of types and other herbarium specimens support Fernald's treatment as a variety of *tenuifolia*" (p. 178).

Fernald (1921, pp. 143–144) observed that *Solidago tenuifolia* var. *pycnocephala* is "a very distinct goldenrod … everywhere dominant [in southern Nova Scotia] and thoroughly characteristic of these sandy and cobbly lake-margins" but that "Too many collections … show direct transition [to var. *tenuifolia*] in all these characters to allow the specific separation of the Nova Scotian plant." Most of the intermediacy described by Fernald involves features of habit and leaf morphology. In later descriptions, Fernald (1950) noted that heads of *E. galetorum* have 25–50 flowers, in contrast to the 12–20 flowers per head in *E. tenuifolia* (this comparison modified to 20–50 vs. 10–20 by Sieren).

Sieren (1981, p. 560) noted that *Euthamia galetorum* "is readily separated from [*E. tenuifolia*] by its large numbers of flowers, especially the disc, its wider, ascending leaves, and the absence of axillary fascicles. In its gross morphology, *E. galetorum* most closely approaches the wide, bluntish-leaved variety of *E. graminifolia*, variety major." In specimens of *E. galetorum* I have examined, its few-branched stems, relatively short leaves, and small, compact inflorescences of few, large heads with numerous flowers, appear to be distinct from *E. tenuifolia* in the same region, in agreement with the view of Sieren and others. Until stronger evidence is presented to counter the observations and broadly based consideration of Sieren, it seems reasonable to maintain *E. galetorum* at specific rank rather than placing it varietally under *E. caroliniana*.

Euthamia galetorum was known only from Nova Scotia by Sieren (1981), but it has subsequently been identified from Maine and New Hampshire (Bruce Sorrie, pers. comm.), and House (1924) described the entity from various parts of New York, distinguishing it from *E. tenuifolia* and other related taxa.

NOMENCLATURAL SUMMARY

Taxa listed are those included in the present discussion. Those in bold, with accompanying authorship, are as accepted in the interpretation here.

Euthamia Nutt. ex Cass. in Cuvier, Dict. Sci. Nat. 37:471. 1825. TYPE: *Chrysocoma graminifolia* L. (= *Euthamia graminifolia* (L.) Nutt.).

Solidago sect. *Euthamia* Nutt., Gen. N. Amer. Pl. 2:162. 1818. Lectotype: *Euthamia graminifolia* (L.) Nutt., as designated by Britton & Brown (1913).

Euthamia (Nutt.) Nutt., Trans. Amer. Philos. Soc. ser. 2, 7:325. 1841. (nom. superfl.).

Solidago sect. *Euthamia* (Nutt.) DC., Prodr. 5:341. 1836. (nom. superfl.).

Solidago subg. *Euthamia* (Nutt.) House, Bull. New York State Mus. 254:694. 1924.

Erigeron sect. *Submultiflori* G. Don in Loudon, Hort. Brit. 343. 1830. Lectotype: *Erigeron carolinianus* L. (= *Euthamia caroliniana* (L.) Greene ex Porter & Britton), as designated by Nesom (1989).

Euthamia caroliniana (L.) Greene ex Porter & Britton, Mem. Torrey Bot. Club 5:321. 1894.

Erigeron carolinianus L., Sp. Pl. 863. 1753.
Solidago caroliniana (L.) B.S.P., Prelimin. Cat. N.Y. 26. 1888.
Solidago tenuifolia Pursh, Fl. Amer. Septent. 2:540. 1814.
Euthamia tenuifolia (Pursh) Nutt., Trans. Amer. Philos. Soc. ser. 2, 7:326. 1841.

Euthamia galetorum Greene, Leafl. Bot. Observ. Crit. 2:152. 1911.

Solidago tenuifolia var. *pycnocephala* Fern., Rhodora 23:293. 1921.

Euthamia tenuifolia var. *pycnocephala* (Fern.) C. & J. Taylor, Sida 10:177. 1983.
Solidago graminifolia var. *galetorum* (Greene) House, N.Y. State Mus. Bull. 243–244:45. 1923.
Solidago galetorum (Greene) Friesner, Butler Univ. Bot. Stud. 3:58. 1933.

Euthamia graminifolia (L.) Nutt., Trans. Amer. Philos. Soc. ser. 2, 7:325. 1841.

Chrysocoma graminifolia L., Sp. Pl. 841. 1753.
Solidago graminifolia (L.) Salisb., Prodr. 109. 1796.

Euthamia leptocephala (Torr. & Gray) Greene ex Porter & Britton, Mem. Torrey Bot. Club 5:321. 1894.

Solidago leptocephala Torr. & Gray, Fl. N. Amer. 2:226. 1841.

Euthamia occidentalis Nutt., Trans. Amer. Philos. Soc. ser. 2, 7:326. 1841.

Postscript.—After review and revision of the present manuscript, a commentary by K.N. Gandhi appeared in print, covering many of the same topics and reviewing similar rationale. Gandhi (1999) also concludes that the 1818 publication of *Euthamia* was at infrageneric (but subgeneric) rank and credits Cassini with its validation at generic rank, although he interprets the authorship as "(Nutt.) Cass.," noting that Cassini's indirect reference to Nuttall's earlier work brings the basionym into consideration. As noted by Gandhi, this brings the number of possibilities for formal citation of the generic authorship to four. Validation of *E. graminifolia* and *E. tenuifolia* is attributed to Nuttall in 1841, as in the interpretation here.

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I am grateful to Rogers McVaugh for his ideas regarding various points discussed in the present paper, Jim Reveal for information on concepts of lectotypification, Ken Wurdack for comments on an early version of the manuscript, and to an anonymous reviewer for a different point of view, which helped to focus the presentation here. A discussion with John Strother also illuminated different interpretations and was helpful.

REFERENCES

BARRIE, F.R., C.E. JARVIS, and J.L. REVEAL. 1992a. The need to change Article 8.3 of the Code. Taxon 41:508–512.

BARRIE, F.R., J.L. REVEAL, and C.E. JARVIS. 1992b. Two proposals to amend Article 8 of the Code. Taxon 41:600–601.

BRITTON, N.L. and A. BROWN. 1913. An illustrated flora of the northern United States (ed. 2). Scribner, New York.

BRUMMITT, R.K. 1994. Report of the Committee for Spermatophyta: 41. Taxon 43:271–277.

CANDOLLE, A.-P. de. 1836. *Solidago*. Prodr. 5:330–342.

CASSINI, H. 1825. *Euthamia*. Dict. Sci. Nat. 37:470–472.

CRONQUIST, A. 1947. A revision of the North American species of *Erigeron*, north of Mexico. Brittonia 6:121–302.

CRONQUIST, A. 1990. Asteraceae. Volume I. Vascular flora of the southeastern United States. Univ. of North Carolina Press, Chapel Hill.

CRONQUIST, A. 1994. Intermountain flora. Volume Five: Asterales. The New York Botanical Garden, Bronx, New York.

ELLIOTT, S. 1823. *Solidago*. In: Sketch of the botany of South-Carolina and Georgia. Vols. 1 and 2. Reprinted 1971 by Hafner Publishing Co., New York. Pp. 368–392.

FARR, E.R., J.A. LEUSSINK, and F.A. STAFLEU (eds.). 1979. Index nominum genericorum (Plantarum). Bohn, Scheltema & Holkema, Utrecht.

FERNALD, M.L. 1921. The Gray Herbarium expedition to Nova Scotia, 1920. Rhodora 23:89–111, 130–152, 153–171, 184–195, 223–245, 257–278, 284–300.

FERNALD, M.L. 1950. Gray's manual of botany (ed. 8). American Book Company, New York.

FRIESNER, R. 1933. The genus *Solidago* in northeastern North America. Butler Univ. Bot. Studies 3:1–63.

GANDHI, K.N. 1999. Nomenclatural novelties for the Western Hemisphere plants–II. Harvard Pap. Bot. 4:295–299.

GLEASON, H.A. and A. CRONQUIST. 1991. Manual of vascular plants of northeastern United States and adjacent Canada (ed. 2). The New York Botanical Garden, Bronx, NY.

GREENE, E.L. 1902. A study of *Euthamia*. Pittonia 5:72–80.

HARRIS, S.K. 1943. Notes on *Solidago*, section *Euthamia*. Rhodora 45:413.

HOUSE, H.D. 1924. Annotated list of the ferns and flowering plants of New York state. Bull. New York State Mus. 254:5–759.

LOUDON, J.C. 1830. Loudon's hortus brittanicus. Printed for Longman et al., London.

NESOM, G.L. 1989. Infrageneric taxonomy of New World *Erigeron* (Compositae: Astereae). Phytologia 67:67–93.

NUTTALL, T. 1818. The genera of North American plants. Vols. 1 and 2. Printed for the author by D. Heartt, Philadelphia. Reprinted 1971 by Hafner Publishing Co., New York.

NUTTALL, T. 1841. Descriptions of new species and genera of plants in the natural order of the Compositae. Trans. Amer. Philos. Soc. ser. 2, 7:283–453.

PORTER, T.C. and N.L. BRITTON. 1894. Compositae. Pp. 310–351. In: N.L. Britton et al. List of Pteridophyta and Spermatophyta growing without cultivation in northeastern North America. Mem. Torrey Bot. Club 5:1–377.

REVEAL, J.L. 1991. *Erigeron carolinianus* Linnaeus (1753), an earlier name for *Euthamia* (*Solidago*) *tenuifolia* (Pursh, 1814) E. Greene (Asteraceae). Taxon 40:505–508.

REVEAL, J.L. 1991b. Proposal to conserve the type of *Gnaphalium plantaginifolium* Linnaeus (Asteraceae). Taxon 40:658–660.

ROLAND, A.E. and E.C. SMITH. 1969. The flora of Nova Scotia. Part 2. The Dicotyledons. Proc. Nova Scotian Inst. Sci. 26:277–743.

SEMPLE, J.C. 1981. A revision of the genus *Chrysopsis* (Nutt.) Ell. nom. cons. Rhodora 83:323–384.

Sieren, D.J. 1981. The taxonomy of the genus *Euthamia*. Rhodora 83:551–579.

TAYLOR, C.E.S. and R.J. TAYLOR. 1983. New species, new combinations and notes on the goldenrods (*Euthamia* and *Solidago*–Asteraceae). Sida 10:176–183.

WINTER, B. de, G.E. GIBBS RUSSELL, D.J.B. KILLICK, J.P. ROURKE, E.G.H. OLIVER, and L.C. LEACH. 1992. (93) Proposal to limit the retroactivity of Article 8.3. Taxon 41:359.

ZIJLSTRA, G. 1992. (91–92) Two proposals to amend Art. 8.3. Taxon 41:357–358.

A NEW *BULBOPHYLLUM* (ORCHIDACEAE) SPECIES FROM THE CRATER MOUNTAIN AREA IN PAPUA NEW GUINEA

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ABSTRACT

A new species *Bulbophyllum wakoi*, section *Brachystele* Schltr., collected from the Crater Mountain Wild Life Management Area in Papua New Guinea is described. It resembles *B. foetidum* Schltr. and its variety *B. foetidum* Schltr. var. *grandiflorum* J.J. Smith. However, it differs from these in the size and the shape of the sepals, petals, labellum, and column arms.

ABSTRACT (MELANESIAN TOK PISIN)

Niupela kain orchid *Bulbophyllum wakoi*, sekson *Brachystele* Schltr., ol bin kisim long Creta Mauntein Wail Laif Management Eria insait long Papua New Guinea em ol bin diskraibim. Em i wankain long *B. foetidum* Schltr. na wantaim variety *B. foetidum* var. *grandiflorum* J.J.Smith. Dispela em minim olsem long dispela insait long sais na seip long sepals, petals, labellum, na colum ams.

INTRODUCTION

The section *Brachystele* Schltr. in New Guinea comprises about three taxa. These are *B. foetidum* Schltr., *B. foetidum* Schltr. var. *grandiflorum* J.J.Sm. and *B. pachyanthum* Schltr. The Crater Mountain species is closely related to *B. foetidum* Schltr., to which it has been compared with, but differs in size and shape of the floral parts and more specifically in the some features of the column and the labellum. The newly recognised taxon is described here.

Bulbophyllum wakoi Howcroft, sp. nov. (**Fig. 1**). Typus: PAPUA NEW GUINEA. Simbu Province: Ex Herowana, Crater Mountain Wildlife Management Area, *S. Wako 105*, 10 Apr 1995 (holotypus: LAE 79035).

Species nova affinis *B. foetidum* Schltr, et *B. foetidum* var. *grandiflorum* J.J.Smith sed floribus majoribus, sepalis et petalis latioribus, labello non oblongo sed cordato et majoribus, brachiis spathulatis et majoribus.

Epiphytic, the creeping and branching habit typical of the section. *Pseudobulbs* ca. 3–4 cm x 1.4 cm, oblong, transversely elliptic, slightly flattened. *Leaves* petiolate, the petiole semi-conduplicate. *Inflorescence* 33 cm or more long, 9 or more flowers; *rachis* short, 2.5 cm long, glabrous, nodding; *peduncle* more than 31 cm long, 0.59 cm in diameter, sheaths more than 4, glabrous, tubular; *floral bracts* ovate to oblong-ovate, 2.7 cm long, 1.2 cm wide, concave, acute, glabrous. *Flowers* positioned in all directions, more or less patent, very large,

FIG. 1. *Bulbophyllum wakoi*. A. Leaf and apex of pseudobulb. B. Inflorescence, 5 cm scale. C. Flower. D–G. Floral bract, dorsal sepal, lateral sepal, petal, 1 cm scale. H. Column and labellum, lateral view. I–K. Labellum back, dorsal and ventral views, 1 cm scale. L–M. Column, ventral and lateral view.

moderately to wide opening; *dorsal sepal* ovate, 4.3 cm long, 1.6 cm wide, glabrous, tip acuminate, semi-conduplicate slightly recurved; *lateral sepals* free, obliquely triangular 5.0 cm long, 2.1 cm wide; glabrous, lower basal margin obliquely triangular or lobed, tip acuminate, semi-conduplicate; *petals* ovate-lanceolate to elliptic, slightly concave, glabrous, 3.7 cm long, 1.1 cm wide, tip long acuminate; *labellum* mobile, thick, fleshy, in general outline cordiform or broadly ovate, 1.8 cm long, 1.2 cm wide near base, apex blunt but ventrally bilobed, convex above with a longitudinal groove producing 2 slight longitudinal ridge and terminating in a mildly raised cushion at apex, margin slightly papillose; adaxial side slightly concave with an inconspicuous median ridge; *column* dorsally slightly curved, from ovary to tip of stelid 1.2 cm long, to tip of rostellum 1.0 cm long; *dorsal stelid* short and blunt, *stelids* on lower margin conspicuous, subulate; *basal arms* of column porrect, equal in length to stelids, spathulate, from column foot ca. 1.0 cm long, ca. 0.5 cm broad; *column foot* at the right angles to column, ca. 1.0 cm long curved towards base, broad, quadragular, truncate ca.1.0 cm wide, with a lateral falcate lobe, internal face longitudinally convexed with a raised ridge; *anther* hooded; *stigma* more or less quadrangular; *ovary* ca. 1.0 cm long, glabrous; *pedicel* ca. 4.0 cm long, glabrous; *pollen* not seen; *fruit* not seen.

Distribution.—Papua New Guinea. Herowana area in the Crater Mountain wild life management area, Simbu Province.

Habitat.—Upper montane rainforest zone. No records accompanied the holotype specimen, but all the New Guinea species come from areas with rainfalls between 2,000–4,000 mm per annum. Species of this section *Brachystele* are found growing in the thick root and leaf litter of rainforests and as epiphytes climbing the trunks of trees. Information on altitude was not available but Herowana is located at 850 m altitude and Crater Mountain rises to 2100m. The most likely altitude for this species is around 1,500 m.

This new species is a closely allied to *B. foetidum* Schltr. (Fig. 2) including *B. foetidum* var. *grandiflorum* J.J.Sm., but has larger flowers, wider sepals and petals; the labellum is not oblong but is cordate and larger; arms of column are spathulate and larger. The most important differences between *B. wakoi* and *B. foetidum* lie in the shape of the labellum (Figs. 1 C, I, J and Figs. 2 B, H–J) and the differences in the size, shape and posture of the basal arms of the column (Figs. 1 H, L and Figs. 2 F, M, N, L; Figs. 2 M and L represent two specimens from different locations).

The illustration of *B. foetidum* by Schlechter (1913) and Smith's illustration of variety *grandiflorum* (1929) compare fairly well with Figure 2, but the differences between the basal arms of the column, in length and shape, in both illustrations, do not fit that of *B. wakoi*. Smith's variety was also described as having pustules on the rachis. These are not present in the new species.

Bulbophyllum foetidum, as the name suggests, produces as foul odor. When

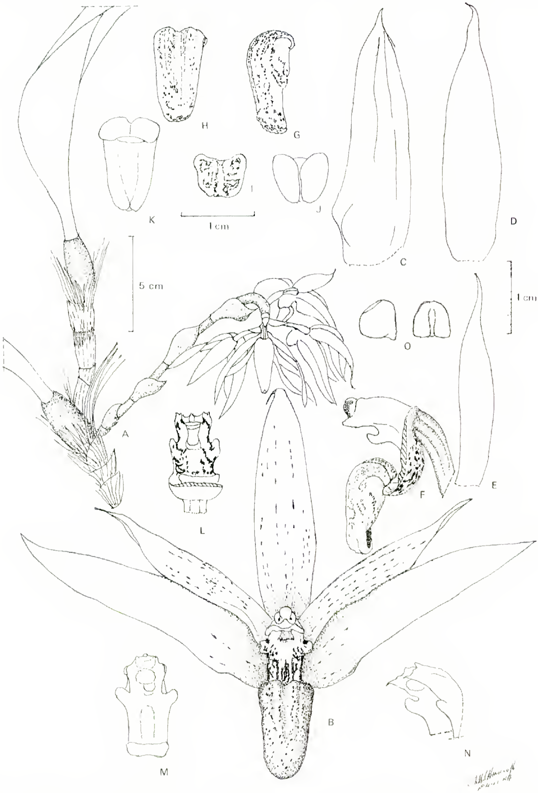

Fig. 2. *Bulbophyllum foetidum*. A. Habit, 5 cm scale. B. Flower. C–E. Lateral sepal, dorsal sepal, petal, 1 cm scale. F Column and labellum, lateral view. G–H. Labellum, lateral and dorsal views. I–J. Labellum, back view of two speciemns. L–M. Column, ventral view of Oomsis and Morobe patrol post specimens. N. Column, 1 cm scale. O. Anther cap, lateral and front views (left to right).

extracting the specimen of *B. wakoi* from the alcohol, in which it has been preserved, it was noted that the alcohol gave off a fairly strong foul odor as well. Since the production of a foul odor is common with other members of this section, it is presumed that the new species does the same.

Etymology.—The new species has been named for Mr. Simon Wako who collected and submitted the specimen to me—along with many other specimens—for identification. Mr. Wako comes from Crater Mountain area where he and others from that area are involved with the Wild Life Management project there.

Notes.—Only spirit material of the new species was available and the illustration of *B. wakoi* (Fig. 1) was drawn from this material. Based on color photos provided by Mr. Wako and Crater Mountain Project staff, and by Dr. Geoff Stocker of a flowering specimen in his private collection, the petals and sepal are glossy olive-green with purple to maroon veins and deep purple to maroon at their base; externally they are darker, almost glossy brown in color. The labellum is deep glossy red with the two dorsal ridges paler, almost pink. The column is dorsally white to pink with some red lines near its base and ventrally deep red. The anther is red and the pedicel and ovary are green. The new species differs from *B. foetidum*, in the color and color patterns of the sepals, petals, and column. The pedicel and ovary of the latter species is purple black with white spots whilst that of the *B. wakoi* is green.

ACKNOWLEDGMENTS

I wish to thank Mr. Simon Wako for providing the specimen of *B. wakoi*. Dr J. Stocker made valuable comments and suggestions during the preparation of this paper. To Mr. R.J.F. Henderson, Queensland Herbarium, Brisbane, I owe a special thanks for providing assistance with the Latin text.

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REFERENCES

Schlechter, R. 1911–1914. Die Orchidacee von Deutsch-Neu-Guinea. Rep., Beih.1:748.
Smith, J.J. 1929. Nova Guinea XIV, 475. Plate 7, No.121.

BOOK REVIEW

WILLIAM F. LAURENCE and RICHARD O. BIERREGAARD, JR. (Editors). 1997. **Tropical Forest Remnants. Ecology, Management and Conservation of Fragmented Communities.** (ISBN 0-226-46898-4, hbk; ISBN 0-226-46899-2, pbk.). The University of Chicago Press, 11030 South Langley Avenue, Chicago, IL 60628. $27.50. 525 pp. text, 6 pp. contributors, 55 pp. references, 28 pp. indices.

This book contains a series of summary papers from a symposium held in 1995 during the annual meeting of the Ecological Society of America. While the information may be somewhat dated, the volume is clearly a well-balanced summary of the most important concepts involved with habitat fragments, their restoration and long-term management of the biota resident therein. Given that tropical habitats are increasingly fragmented, the basic principles outlined in this book become a pre-requisite element in the formation of every new conservation biologist. It is important to note that while the papers presented in the book were written for 1995, they have all been supplied with updated references, so that frequent references to material published in 1997 is included.

The book is divided in seven sections, including: 1) The scale and economics of tropical deforestation, 2) physical processes and edge effects, 3) tropical forest faunas, 4) plants and plant-animal interactions, 5) restoration and management of fragmented landscapes, 6) site selection and design of tropical nature reserves, and 7) summary and new perspectives.

Tropical Forest Remnants would be an ideal book for a graduate seminar series. Given that our planet is largely comprised of a mosaic of remnant landscapes, varying in size, aspect, slope, hydrology, climate and proximity to other fragmented landscapes, specific training in fragment dynamics is increasingly important. To introduce the concept of tropical forest fragmentation to student conservation biologists, I heartily recommend that papers from Section VII, summary and new perspectives, be presented first, especially Chapter 32, "Tropical Forest Fragmentation: Synthesis of a Diverse and Dynamic Discipline." From there, reading of the chapters cited therein provide the most useful way to present the copious material of this book, the large reference list, and indeed, supplementary material published since 1997. The book covers, like no other I have seen, a cogent summary of how landscapes have become fragmented, how fragmentation among various elements of the biota should be measured, and what the long-term effects of fragment size, shape, location, etc., mean to each of those phyla for which we have data. Whether one is strictly concerned with tropical phenomena or not, there are valuable lessons for application in understanding habitat fragmentation for other biomes as well. I highly recommend this book to all who concern themselves with natural history, conservation biology, natural resource management, ecology and systematic biology.—*John J. Pipoly III.*

NEW COMBINATIONS IN THE MELASTOMATACEAE FROM HISPANIOLA

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ABSTRACT

Eighteen new combinations are made in the Hispaniolan Melastomataceae, transferring the species of *Ossaea* and two species of *Clidemia* into the genera *Henriettea*, *Leandra*, and *Sagraea*.

RESUMEN

Se hacen diez y ocho nuevas combinaciones en las Melastomataceae de la Española, transfiriendo las especies de *Ossaea* y dos especies de *Clidemia* a los géneros *Henriettea*, *Leandra* y *Sagraea*.

Several years ago, Walter S. Judd and J. Dean Skean (Judd 1986, 1989; Judd & Skean 1991) pointed in several publications to the genus *Ossaea* DC. as an arbitrary group; the genus was originally described as having narrowly triangular to ovate petals with more or less acute apices. I had already observed that the species considered as belonging to this genus did not show consistent characters that would help to keep them in the same genus.

As Judd studied the problem further, he concluded that the species of *Ossaea* had to be transferred to several other genera, taking into account the inflorescence position and structure and other characters of generic importance. He separated the species into several groups belonging to different genera. After studying the herbarium specimens available and with the type specimens at hand, I am now able to place these species in their proper genera: *Clidemia* D. Don, *Leandra* Raddi, and *Sagraea* DC.; I have also determined one species in *Henriettea* DC. I am also transferring two species of *Clidemia* to *Sagraea*. My work is based on Judd's and Skean's publications and conclusions. Several species have already been transferred either by Judd or by his associate, James D. Skean, Jr.

In this paper, I am transferring these species originally described in *Ossaea* from the island of Hispaniola to their proper taxonomic position, primarily according to the inflorescence position and structure, and to the number of petals in the flowers, in the preparation for my forthcoming treatment of the family Melastomataceae.

Leandra has terminal inflorescences with relatively long calyx-lobe projections, and 4–6-merous flowers.

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Sagraea has lateral inflorescences which may occur below the leaves on former nodes, shorter calyx-lobes; the 4-merous flowers are solitary or paniculate.

Clidemia has terminal inflorescences which may appear axillary or pseudoaxillary or occur below the leaves on former nodes, with 4–9-merous flowers and rounded or retuse petals.

Henriettea has acute to acuminate petals, with lateral inflorescences, the flowers solitary or in glomerules, 4–6-merous.

I have not been able to see all of the type specimens; some were obviously lost in the Berlin Herbarium. In some cases, the isotypes are available in several herbaria.

Henriettea hotteana (Urb. & Ekm.) Alain, comb. nov. BASIONYM: *Ossaea hotteana* Urb. & Ekm., Ark. Bot. 22A(17):58. 1929. TYPE: HAITI. DEPT. SUD-EST: Morne Delcour, near Pestel, *Ekman 9008* (HOLOTYPE: S; ISOTYPE: US).

This plant has been collected several times by E.L. Ekman in Massif de la Hotte and near Jérémie, in Haiti. It fits in *Henriettea* by its axillary glomerate inflorescences and its acuminate petals; it is 4-merous. Several collections are from the same area as the type collection. It is endemic to Hispaniola.

Leandra humilis (Urb. & Ekm.) Alain, comb. nov. BASIONYM: *Ossaea humilis* Urb. & Ekm., Ark. Bot. 22A(17):66. 1929. TYPE: HAITI: DEPT. SUD-EST: Grand Gosier, Massif de la Selle, *Ekman 6780* (HOLOTYPE: S; ISOTYPE: US).

Ossaea parvifolia Alain, Brittonia 20:158. 1968.

Leandra humilis is a small shrub with terminal solitary sessile 4-merous flowers, and acuminate petals. It has been collected several times both in Haiti and in the Dominican Republic. Endemic to Hispaniola.

Leandra hybophylla (Urb.) Alain, comb. nov. BASIONYM: *Ossaea hybophylla* Urb., Ark. Bot. 21A(5):51. 1927. TYPE: HAITI: DÉPT. CENTRE: Pérodin, Massif des Cahos, *Ekman 3440* (HOLOTYPE: S; ISOTYPE: NY).

This is a small tree with corymbose terminal inflorescences and 4 acuminate petals. Known only from the type collection. Endemic to Hispaniola.

Leandra marigotiana (Urb. & Ekm.) Alain, comb. nov. BASIONYM: *Ossaea marigotiana* Urb. & Ekm., Ark. Bot. 22A(17):65. 1929. TYPE: HAITI: DEPT. SUD-EST: Marigot, Massif de la Selle, *Ekman 10071* (HOLOTYPE: S; ISOTYPES: US, NY).

This shrub has terminal paniculate inflorescences with 4 acuminate petals. Known only from the type collection. Endemic to Hispaniola.

Leandra polychaeta (Urb. & Ekm.) Alain, comb. nov. BASIONYM: *Ossaea polychaeta* Urb. & Ekm., Ark. Bot. 23A(11):27. 1931. TYPE: DOMINICAN REPUBLIC. PROV. LA VEGA: Loma La Campana, Cordillera Central, *Ekman 11522* (HOLOTYPE: S; ISOTYPE: NY).

Ossaea urbaniana Alain, Brittonia 20:58. 1968.

A shrub with terminal head-like inflorescnces, the flowers 5-merous with lanceolate petals. The species has been collected several times in the same region. Endemic to Hispaniola.

Note.—Urban described two species in *Ossaea* with quite similar names: *Ossaea polychaeta,* now *Leandra polychaeta,* and *Ossaea polychaete* now *Sagraea polychaete.* This was the reason for a new name published by me as *Ossaea urbaniana* Alain (1968), now obsolete.

Sagraea abbottii (Urb.) Alain, comb. nov. BASIONYM: *Ossaea abbottii* Urb., Ark. Bot. 22A(17):57. 1929. TYPE: DOMINICAN REPUBLIC. PROV. DUARTE: Loma Quita Espuela, San Francisco de Macorís, *Abbott 182* (HOLOTYPE: ?).

A small tree with axillary, pedunculate head-like inflorescences, 4-merous flowers and acuminate petals. Known only from the type specimen. Endemic to Hispaniola.

Sagraea barahonensis (Urb. & Ekm.) Alain, comb. nov. BASIONYM: *Ossaea barahonensis* Urb. & Ekm., Ark. Bot. 22A(17):61. 1929. TYPE: DOMINICAN REPUBLIC. PROV. BAORUCO: Sierra de los Comisarios, *Ekman 6778* (HOLOTYPE: S).

A 2 m tall shrub with axillary, racemose or paniculate inflorescences, 4-merous flowers and petals narrowed at apex, not acuminate. Rare in the area. Endemic to Hispaniola.

Sagraea cinerea (Cogn.) Alain, comb. nov. BASIONYM: *Ossaea cinerea* Cogn., Urb., Symb. Ant. 7:316. 1912. TYPE: HAITI: DEPT. GRAND'ANSE: Morne Vandeveld, Plaine des Cayes, *P.E. Christ 1953* (ISOTYPE: NY).

A shrub with sessile, glomerate, 4-merous flowers; the petals are acute, not acuminate. It has been collected several times in southern Haiti. Endemic to Hispaniola.

Sagraea curvipila (Urb. & Ekm.) Alain, comb. nov. BASIONYM: *Ossaea curvipila* Urb. & Ekm., Ark. Bot. 22A(17):61. 1929. TYPE: HAITI. DEPT. GRAND'ANSE: Formon in Massif de la Hotte, *Ekman 7581* (HOLOTYPE: S; ISOTYPE: US).

A shrub up to 2 m tall, with axillary, subcymose, subsessile inflorescences 1–3-flowered, 4-merous flowers. Known from the type collection and from Formon (*Judd 3469*, FLAS). Endemic to Hispaniola.

Sagraea ellipsoidea (Urb. & Ekm.) Alain, comb. nov. BASIONYM: *Ossaea ellipsoidea* Urb. & Ekm., Ark. Bot. 22A(17):63. 1929. TYPE: HAITI. DEPT. GRAND'ANSE: near Les Roseaux, Massif de la Hotte, *Ekman 10190* (HOLOTYPE: S; ISOTYPE: NY).

A shrub up to 2 m tall with axillary, subsessile cymose inflorescences, 1–5-flowered; the flowers are 4-merous, the petals ovate. It has also been collected in the Dominican Republic: Prov. Pedernales, Bahoruco Mountains. Endemic to Hispaniola.

Sagraea fuertesii (Cogn., Urb.) Alain, comb. nov. BASIONYM: *Clidemia fuertesii* Cogn., Urb., Symb. Ant. 7:529. 1913. TYPE: DOMINICAN REPUBLIC. PROV. LA VEGA: Jarabacoa, Central Cordillera, *Fuertes 1677* (ISOTYPE: NY).

A slender shrub with axillary 1-flowered capillary peduncles, 4-merous flowers and triangular petals. It is fairly common both in the Central Mountains and in the Bahoruco Range. Endemic to Hispaniola.

Sagraea gracilis (Alain) Alain, comb. nov. BASIONYM: *Ossaea gracilis* Alain, Phytologia 22:167. 1971. TYPE: DOMINICAN REPUBLIC. PROV. BARAHONA: Monteada Nueva, Sierra del Bahoruco, *Alain H. Liogier 11622* (HOLOTYPE: NY).

A small shrub, about 1.5 m tall with axillary solitary pedunculate flowers, these 4-merous, the petals acute. It is fairly common in the area. Endemic to Hispaniola.

Sagraea lanceifolia (Urb.) Alain, comb. nov. BASIONYM: *Ossaea lanceifolia* Urb., Ark. Bot. 22A(17):62. 1929. TYPE: HAITI. DEPT. GRAND'ANSE: Dame-Marie, Massif de la Hotte, *Ekman 10318* (HOLOTYPE: S).

Shrubby with axillary, subsessile, cymose, 1–3-flowered inflorescences; the flowers are 4-merous, the petals acuminate. Known only from the type collection. Endemic to Hispaniola.

Sagraea oligantha (Urb.) Alain, comb. nov. BASIONYM: *Clidemia oligantha* Urb., Ark. Bot. 21A(5):45. 1927. TYPE: HAITI. DEPT. NORD: Morne Brigand, Massif du Nord, *Ekman 2943* (ISOTYPE: NY).

A shrub 2–3 m tall with axillary, paniculate, 3–7-flowered inflorescences, 4-merous flowers and ovate, obtuse petals. It has been collected several times, both in Haiti and in the Dominican Republic. Endemic to Hispaniola.

Sagraea polychaete (Urb. & Ekm.) Alain, comb. nov. BASIONYM: *Ossaea polychaete* Urb. & Ekm., Ark. Bot. 22A(17):60. 1929. TYPE: HAITI. DEPT. SUD-EST: near Jérémie, Massif de la Hotte, *Ekman 10401* (HOLOTYPE: S).

Shrubby with flowers in axillary sessile groups, 4-merous, the petals rectangular, rounded and minutely acuminate. Known only from the type collection. Endemic to Hispaniola.

Sagraea pusilliflora (Cogn., A. & C.DC.) Alain, comb. nov. BASIONYM: *Clidemia pusilliflora* Cogn. in A. & C. DC., Mon. Phan. 7:1010. 1891. TYPE: DOMINICAN REPUBLIC. PROV. PUERTO PLATA: Río Mameyes, near Puerto Plata, *Eggers 2531* (ISOTYPE: NY).

A small shrub about 1 m tall, with axillary nearly sessile, subsolitary flowers, these 4-merous. This plant is fairly common, both in Haiti and in the Dominican Republic. Endemic to Hispaniola.

Sagraea setulosa (Urb.) Alain, comb. nov. BASIONYM: *Ossaea setulosa* Urb., Ark. Bot. 17:7. 1921. TYPE: HAITI. DEPT. GRAND'ANSE: Morne La Hotte, *Ekman 157* (HOLOTYPE: ?).

A shrub with axillary paniculate few-flowered inflorescences, the flowers are 4-merous, the petals acute. Another collection from Torbec; also numerous collections from the Formon region, Haiti, by Judd and Skean. Endemic to Hispaniola.

Sagraea woodsii (Judd & Skean) Alain, comb. nov. BASIONYM: *Ossaea woodsii* Judd & Skean, Bull. Florida State Mus., Biol. Sci. 32:141. 1987. TYPE: HAITI: DEPT. GRAND'ANSE: Morne Formon, Massif de la Hotte, *J.D. Skean 1367* (HOLOTYPE: FLAS).

A shrub or small tree to 4 m tall, with axillary fasciculate few-flowered cymes; the flowers are 4-merous, the petals acute. There are numerous collections from the Formon area at FLAS. Endemic to Hispaniola.

NOTE: GENERIC STATUS IS UNCERTAIN

Ossaea rubrinervis Urb. & Ekm., Ark. Bot. 22A(17):59. 1929. TYPE: HAITI: DEPT. GRAND'ANSE: Les Roseaux, Massif de la Hotte, *Ekman 10120* (HOLOTYPE: S). Known only from the type collection which is a sterile specimen.

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REFERENCES

JUDD, W. S. 1986. Taxonomic studies in the Miconieae (Melastomataceae). I. Variation in inflorescence position. Brittonia 38:150–161.

———. 1987. Floristic study of Morne La Visite and Pic Macaya National Parks, Haiti. Bull. Florida State Mus., Biol. Sci. 32:1–36.

———. 1989. Taxonomic studies in the Miconieae (Melastomataceae). III. Cladistic analysis of axillary-flowered taxa. Ann. Missouri Bot. Gard. 76:476–495.

——— and J.D. SKEAN, JR. 1991. Taxonomic studies in the Miconieae (Melastomataceae). IV. Generic realignments among terminal-flowered taxa. Bull. Florida State Mus., Biol. Sci. 36:25–84.

BOOK REVIEW

MICHAEL A. POWELL. 1998. **Trees and Shrubs of the Trans-Pecos and Adjacent Areas. Revised Edition.** (ISBN 0-292-76579-7, hbk.; ISBN 0-292-7653-8, pbk.). The University of Texas Press, P. O. Box 7819, Austin, TX 78713-7819. $34.95, pbk; $75.00, hbk. 464 pp., 35 B & W photos, 370 line drawings.

The Trans-Pecos region of Texas, with its numerous montane habitats and low, arid basins is substantially different from other regions of the state. The Trans-Pecos is defined geographically rather than floristically in this work, such that portions of the Edwards Plateau Vegetational Area, and the Chihuahuan Desert are also included. Of course, the Davis Mountains are also home to a great number of interesting and endemic species. Five general vegetation types are recognized.

The present revision of the first edition includes taxonomic or nomenclatural updates in 62 genera treated, and new distributional or taxonomic data for another 60. The nomenclature and presentation more closely correspond to hierarchies recognized by John Kartesz and others, with supplements from monographers and other sources. In some significant cases, keys were re-written. The book covers 447 species of woody plants in 203 genera and 70 families, and is divided into 6 functional parts, including the 1) introduction, 2) key to the classes and subclasses, 3) descriptive flora, 4) selected glossary, 5) literature cited, and 6) index.

Trees and Shrubs of the Trans-Pecos and Adjacent Areas is very straightforward, easy to use, and will surely be useful to all who visit, botanize, study, or otherwise witness the beauty of the Trans-Pecos area of Texas. If we can overlook a few typesetting errors (Ju N glandaceae and not Juglandaceae), the book is perfect for a floristic seminar, any nature study tour, or just to have along to botanize. The glossary is concise and useful, although it is not illustrated, the literature cited is extensive, and the index is very helpful and easy to use. As one might expect, the revision of a classic work has produced something BIGGER AND BETTER, a handy field guide and yet another volume to fit in the side pocket of one's car, so it can be drawn more quickly. I recommend it for everyone in the region!!—*John J. Pipoly III.*

PENNISETUM ADVENA SP. NOV. (POACEAE: PANICEAE): A COMMON ORNAMENTAL GRASS THROUGHOUT THE SOUTHERN UNITED STATES

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ABSTRACT

Pennisetum advena Wipff & Veldkamp, a common ornamental grass in the southern United States, is described and illustrated. A key is provided to separate it from similar taxa (*P. macrostachys*, *P. orientale*, and *P. setaceum*). *Pennisetum advena* is readily distinguished from *P. setaceum*, its closest putative relative, by vegetative, inflorescence, fascicle, and spikelet characters.

RESUMEN

Se describe e ilustra *Pennisetum advena* Wipff & Veldkamp, una gramínea ornamental frecuente en el sur de los Estados Unidos. Se ofrece una clave para separarla de taxa similares (*P. macrostachys*, *P. orientale*, y *P. setaceum*). *Pennisetum advena* se distingue fácilmente de *P. setaceum*, la especie más próxima, por los caracteres vegetativos, de la inflorescencia, del fascículo y de la espiguilla.

Pennisetum Rich., a genus of ± 80 species, is found in tropical, subtropical, and temperate regions (Clayton & Renvoize 1986). It occupies a diverse range of habitats, including riparian, savanna, desert, forest, and montane. Of the ± 80 species, 40 are known to occur in the New World. Twenty-six of the 40 are native to México, Central and/or South America, 14 are introduced into the New World. Seventeen species have been introduced into the United States. This genus contains species that are important as grain (cereals) [e.g. *P. glaucum* (L.) R.Br.], forage [e.g. *P. ciliare* (L.) Link, *P. flaccidum* Griseb., *P. glaucum*, *P. orientale* Willd. ex Rich., and *P. purpureum* Schumach.], soil binding and lawns (e.g. *P. clandestinum* Hochst. ex Chiov.; and orna-

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mentals [e.g. *P. advena* Wipff & Veldkamp, *P. alopecuroides* (L.) Spreng., *P. macrostachys* (Brongn.) Trin., *P. orientale*, *P. purpureum*, *P. setaceum* (Forssk.) Chiov., and *P. villosum* R.Br. ex Fresen.].

Aposporous apomixis has been reported in Old World species of *Pennisetum* [e.g. *P. advena* (reported under the name *P. setaceum* purple-type, by Simpson & Bashaw 1969), *P. ciliare*, *P. flaccidum*, *P. orientale*, *P. setaceum*, and *P. villosum*]. Research is still needed to understand the intricate morphological patterns and relationships, that are complicated by the presence of aposporous apomixis. The genus is morphologically and nomenclaturally complex and is in need of revision. In some cases the relationship of *Pennisetum* to allied genera (e.g. *Cenchrus* L.) is unresolved.

Since *Pennisetum* is not native in the United States, it is not well known to American agrostologists. This, in part, has lead to the overlooking of *P. advena* as a distinct species which has become a common ornamental grass in the United States. This overlooked species will be referred to as *P. setaceum* 'Rubrum,' its current horticultural name.

The first record of *P. setaceum* 'Rubrum' in the United States was reported by Hitchcock (1916) as a form of *P. ruppelii* Steud. (= *P. setaceum*). Hitchcock (1916) wrote, "A half-hardy form with dark purplish foliage and purplish crimson spikes has recently been intro. under the name *P. cupreum*. It does not reproduce reliably from seed." The name *P. 'cupreum'* is a horticulture name and was never validly published [see also the index to Bailey (1917), where *P. 'cupreum'* is cited as a horticultural name and a form of *P. ruppelii*]. The use of *P. cupreum* Hitchc. (or Hitchc. ex L.H. Bailey) is incorrect, since Hitchcock and other authors have only accepted it as a horticulture name for a "form" or "horticultural variety" of *P. setaceum* and not as a validly published combination (Greuter et al. 1994: Article 34.1). Since its introduction in 1916, *P. setaceum* 'Rubrum' has since become one of the most popular ornamental grasses in the United States (Greenlee 1992). Darke (1994) commented that *P. setaceum* 'Rubrum' might not belong to *P. setaceum*.

Simpson and Bashaw (1969) published cytological and reproductive characteristics of *P. setaceum*. The two morphological types of plants studied were designated as "green" or "purple." The description of the "purple" type appeared to refer to *P. setaceum* 'Rubrum'. Fortunately, Simpson (Texas Agricultural Experiment Station, Stephenville, Texas) had maintained a clone of this plant in a greenhouse. In 1987, Kenneth Hignight and the senior author were able to examine this plant and confirmed that it was *P. setaceum* 'Rubrum'. So began a 10-year search for a valid scientific name for *P. setaceum* 'Rubrum'.

In 1987, a specimen of *P. setaceum* 'Rubrum' sent to the Royal Botanical Gardens (K) was reported as being "similar" or "with affinities" to *P. macrostachys*, a robust species from Malesia which also has purple leaves. This research into *P. setaceum* 'Rubrum' continued as time permitted. In November 1992, while working on the treatment of *Pennisetum* for the forthcoming *Manual of North American Grasses*, photographs of the plate of *Gymnotrix macrostachys* Brongn. (= *Pennisetum macrostachys*) in Duperrey (1829) and of the type specimen from the Muséum National d'Histoire Naturelle (P), were obtained. Upon examination, it was obvious that *P. setaceum* 'Rubrum' and *P. macrostachys* were not the same taxon. *Pennisetum macrostachys* has only antrorsely scaberulous bristles in a fascicle, one spikelet per fascicle, and a puberulous inflorescence axis. *Pennisetum setaceum* 'Rubrum' has two kinds of bristles in a fascicle; an inner series of plumose, ciliate bristles and an outer series of antrorsely scaberous bristles, 1–3 spikelets per fascicle and a papillose pubescent infloresence axis.

Germplasm of *P. macrostachys* from National Germplasm Center in Georgia was obtained. This accession (PI 354266), originally collected in New Guinea (Malesia), is actually a green form of *P. setaceum* 'Rubrum'. In 1995, the senior author sent a specimen of *P. setaceum* 'Rubrum' to the junior author, who is an authority on the grasses of Malesia. The junior author spent two years searching for the validly published name for this taxon. Also, in 1995, W.D. Clayton (K) was contacted for assistance, but he too was not able to put a name to this mysterious taxon.

After years of unsuccessful searching for a satisfactory identification and careful examination of the species of *Pennisetum* known to science, we believe that this is an undescribed species.

Pennisetum advena Wipff & Veldkamp, sp. nov. (**Fig. 1**). Typus: UNITED STATES. Texas. Brazos Co.: Cultivated at Texas A&M University, College Station, Texas, commonly used ornamental grass in the area, 18 Sep 1990, *Joseph K. Wipff 1723* (holotype: L; isotypes: K, MO, US, UTC).

Pennisetum advena a P. setaceo cognatio sua proxima ut videtur facile distinctum in folii laminis 6–11 mm latis planis costa non-incrassata, culmo in nodis aeriis plerumque iterum ramoso, inflorescentiae medio involucris 10–17 per sectionem 1 cm ramo primario 1–2 mm longo, involucro setarum serie interiore setis 8–16 ciliatis vel plumosis, gluma primaria 0.5–1 mm longa, flore inferiore staminaro.

Plants perennial (annual in temperate climates), cespitose, without rhizomes or stolons. *Culms* 100–150 cm tall, erect; *nodes* glabrous, usually with some secondary branching at aerial nodes. *Leaves*: (measurements taken from the 2nd and 3rd uppermost leaves); *sheaths* glabrous, margins ciliate; *ligules* 0.5–0.8 mm long, a ciliate membrane; *blades* 33–52 cm long, 6–11 mm wide, flat, burgundy (rarely green), mid-vein not noticeably thickened, margins antrorsely scaberulous and ciliate at base. **Panicles** 23–32 cm long, 30–58 mm wide, flexuous and drooping, burgundy (rarely pale or whitish-green); *central axis* terete, pubescent with papillose trichomes. **Fascicles (Involucres):** 10–17 per 1 cm section (mid-inflorescence), with 1–3 spikelets. *Primary branch* 1–2 mm long (the length from base of branch to uppermost bristle (primary bristle). *Fascicle stalk (or stipe)* 0.5–1.1 mm long [the length

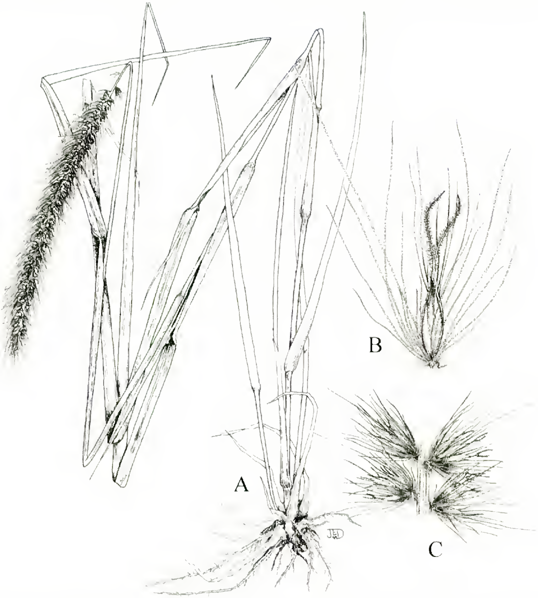

FIG. 1. *Pennisetum advena* (*Wipff 1723*). A. Habit. B. Fascicle. C. 1 cm section of panicle showing central axis and fascicle arrangement.

from base of primary branch to first (or lowermost) bristle]. *Primary bristle* 21.3–33.6 mm long, noticeably longer than the other bristles, papillose ciliate. Two types of bristles in fascicle: an *outer bristles series* of 43–68 bristles, 1.2–18.5 mm long, antrorsely scaberulous; an *inner bristles series* of 4–10 bristles, 11.7–25 mm long, papillose ciliate. *Spikelets* subsessile or pedicelled in fascicle. **Central Spikelet** 5.3–6.5 mm long; *pedicel* 0.1–0.3 mm long. *Glumes* unequal; *first glume* 0.5–1 mm long, 0-veined; *second glume* 1.9–3.6 mm long, 0–1-veined, about 1/2 as long as spikelet; **Lower Floret** staminate. *First lemma* 4.7–6.1 mm long, 5(–6)-veined. *Palea* 4.5–5.0 mm long.

Anthers 3, 2–2.5 mm long. **Upper Floret:** *second lemma* 5.2–6.1 mm long, 5-veined. *Palea* 4.7–5.6 mm long, 2-veined. *Anthers* 3, 2.5–2.7 mm long. *Caryopses* infrequently produced in United States plants.

Chromosome number.—$2n = 54$ [reported under the name *P. setaceum* purple-type (Simpson & Bashaw 1969)].

Method of reproduction.—aposporous apomixis [reported under the name *P. setaceum* purple-type (Simpson & Bashaw 1969)].

Phenology.—May until first freeze.

Distribution.—Cultivated throughout the United States. Will not persist in areas where winter temperatures fall below freezing for any length of time. In areas with below freezing temperatures, it is used as an annual and replanted every year or moved into a greenhouse. In southern Florida, Texas, and California, and Hawaii it will persist, but rarely escapes.

Etymology.—The specific epithet, *advena*, is Latin for "visitor" or "stranger"; referring to its mistaken identity and unknown origin. It is believed to have originated from the Old World.

KEY TO SIMILAR TAXA OF *PENNISETUM*

1. Fascicle with two types of bristles: an inner series (bristles closest to spikelet) with bristles long-ciliate, and an outer series of antrorsely scaberulous bristles. Primary bristle noticeable longer than other bristles in fascicle. Fascicles with 1–10 spikelets per fascicle. Inflorescence axis pubescent 2
1. Fascicle with all bristles antrorsely scaberulous. Fascicles with only 1 spikelet per fascicle. Primary bristle not noticeably longer than other bristles in fascicle. Inflorescence axis puberulous .... **P. macrostachys**
  2. Mid-culm leaf blades (3–)3.5–11 mm wide, flat, green or burgundy; mid-vein not noticeably thickened 3
  2. Mid-culm leaf blades 2–3.5 mm wide, convolute or folded, green; mid-vein noticeably thickened .... **P. setaceum**
    3. Culm nodes pubescent. Plants with rhizomes. Ligule 1–2 mm long. Fascicles white. Outer bristle series of fascicle with 0–24 terete, scaberulous bristles. Leaf blades green. Inflorescence erect or arching .... **P. orientale**
    3. Culm nodes glabrous. Plants without rhizomes. Ligule less than 1 mm long. Fascicles burgundy (rarely pale green). Outer bristle series of fascicle with 43–58, terete, scaberulous bristles. Leaf blades burgundy (rarely green). Inflorescence flexuous and drooping .... **P. advena**

Pennisetum advena is readily distinguished from *P. setaceum*, its closest putative relative, by the following characters. *Pennisetum advena*: 1) leaf blades 6–11 mm wide; flat, mid-vein not thickened; 2) usually with secondary branching at aerial culm nodes; 3) 10–17 fascicles per 1 cm section (mid-inflorescence); 4) primary branch of fascicles (mid-inflorescence) 1–2 mm long; 5) inner bristle series of fascicle with 4–10 ciliate or plumose bristles; 6) first glume 0.5–1 mm long; and 7) lower floret staminate. *Pennisetum setaceum*: 1) leaf blades 2–3.5 mm wide, convolute, mid-vein conspicuously thickened; 2) no secondary branching at aerial culm nodes; 3) 8–10 fascicles per 1 cm section (mid-inflorescence); 4) primary branch of fascicles (mid-inflorescence) 2.3–4.5 mm long; 5) inner bristle series of fascicle with 8–16 ciliate or plumose bristles; 6) first glume absent (rarely present, up to 0.3 mm long); and 7) lower floret neuter (rarely staminate).

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REFERENCES

BAILEY, L.H. 1917. The standard cyclopedia of horticulture, Vol VI-Z (Vol. 6). The MacMillan Company, New York.

CLAYTON, W.D. and S.A. RENVOIZE. 1986. Genera graminum: Grasses of the World. Kew Bull., Addit. Ser. XIII. Her Majesty's Stationery Office; London.

DARKE, R. 1994. Manual of the grasses. In: M. Griffiths, ser. ed. The new royal horticultural society dictionary of gardening series. Timber Press, Portland, OR.

DUPERREY, L.I. 1829. Voyage autour du monde. Phanerogamie. Arthur Bertrand, Paris.

GREENLEE, J. 1992. The encyclopedia of ornamental grasses. Rodale Press, Emmaus, PA.

GREUTER, W., ET AL. 1994. International code of botanical momenclature (Tokyo Code). Koeltz Scientific Books, Königstein, Germany.

HITCHCOCK, A.S. 1916. *Pennisetum*. In: L.H. Bailey. The standard cyclopedia of horticulture. Vol. V-PR (Vol. 5). The MacMillan Company, NY.

SIMPSON, C.E. and E.C. BASHAW. 1969. Cytology and reproductive characteristics in *Pennisetum setaceum*. Amer. J. Bot. 56:31–36.

NEW COMBINATIONS IN *SETARIA* (POACEAE: PANICEAE)

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ABSTRACT

Setaria subgenus *Reverchoniae* is proposed. New combinations in subgenus *Reverchoniae*, *Setaria reverchonii* (Vasey) Pilg. subsp. *ramiseta* (Scribn.) W.E. Fox, *S. reverchonii* (Vasey) Pilg. subsp. *firmula* (Hitchc. & Chase) W.E. Fox are proposed. New combinations in subgenus *Paurochaetium*, *S. utowanaea* (Scribn.) Pilg. var. *ophiticola* (Hitchc. & Ekman) W.E. Fox, *S. utowanaea* (Scribn.) Pilg. var. *subtransiens* (Hitchc. & Ekman) W.E. Fox are also proposed. Keys separating the subgenera, subspecies of *S. reverchonii*, species of subgenus *Paurochaetium*, and varieties of *S. utowanaea* are included.

RESUMEN

Se propone *Setaria* subgénero Reverchoniae. Son propuestas combinaciones nuevas en el subgénero *Reverchoniae*, *S. reverchonii* (Vasey) Pilg. subsp. *ramiseta* (Scribn.) W.E. Fox y *S. reverchonii* (Vasey) Pilg. subsp. *firmula* (Hitchc. & Chase) W.E. Fox,. Son también propuestas combinaciones nuevas en el subgénero *Paurochaetium*, *S. utowanaea* (Scribn.) Pilg. var. *ophiticola* (Hitchc. & Ekman) W.E. Fox y *S. utowanaea* (Scribn.) Pilg. var. *subtransiens* (Hitchc. & Ekman) W.E. Fox. Se incluyen claves para separar los subgéneros, subespecies de *S. reverchonii* y las variedades de *S. utowanaea*.

INTRODUCTION

Setaria P. Beauv. is a cosmopolitan genus important in cultivated crops {*S. italica* (L.) P. Beauv.}, perennial forage grasses {*S. macrostachya* H.B.K.} and noxious weeds {*S. viridis* (L.) P. Beauv.}.

Setaria (Poaceae:Paniceae) is one of several genera closely related to *Panicum*. Tribal and generic arrangement of the species of the Poaceae as classified by Häckel (1887) has been revised by Prat (1936), Pilger (1954), Stebbins (1956), Clayton and Renvoize (1986) and Soderstrom (1986). However, the circumscription of the Paniceae has remained rather stable. For additional discussion of previous work see Fox (1999). Most taxa in *Setaria* can be easily differentiated from its closest relatives *Panicum* and *Paspalum* by the presence of bristles subtending the spikelets, these representing modified inflorescence branches.

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Rominger (1962) monographed the species of *Setaria* from North America and classified 43 species occurring in three subgenera: *Ptychophyllum* (6 species), *Setaria* (27 species) and *Paurochaetium* (10 species). Twenty-five are native to North America, ten originate from South America and eight are from the Old World (Rominger 1962).

The subgenus *Paurochaetium* forms an "artificial group" (Rominger 1962) distinguished from the remainder of the genus by the occurrence of only one bristle usually below the terminal spikelet of the primary branches. The subgenus occurs as two separate complexes. The first complex ranges from southern Florida through the West Indies and into the Yucatan region of Mexico and Belize. The complex includes *Setaria distantiflora* (A. Richard) Pilg., *S. pradana* (Léon) Léon, *S. leonis* (Ekman) Léon, *S. ophiticola* (Hitchc. & Ekman) Léon, *S. subtransiens* Hitchc. & Ekman, *S. utowanaea* (Scribn.) Pilg., and *S. chapmanii* (Vasey) Pilg.. The second complex occurs from northeastern Mexico through the western two-thirds of Texas, into southern Oklahoma and west into New Mexico. It extends from the Balcones Escarpment of Texas to Chaves County, New Mexico. The complex includes *S. firmula* (Hitchc. & Chase) Pilg., *S. ramiseta* (Scribn.) Pilg. and *S. reverchonii* (Vasey) Pilg.. Not included in Rominger (1962) is the species *S. variifolia* (Swallen) G. Davidse found in the Yucatan Peninsula of Mexico and south.

Rominger (1962) separated the subgenus from the remainder of *Setaria* by the presence of a single bristle "usually" below the terminal spikelet of each primary branch. Gould (1975) used the same character to separate the species that occur in Texas; however, he reported a problem with the identification of specimens based on this character. These problems led to the current research in the subgenus.

The objectives of the research were to 1) determine the relationships of the taxa in the Texas/Mexico/Oklahoma/New Mexico complex and 2) provide a taxonomic treatment of all taxa recognized by Rominger (1962) in the subgenus *Paurochaetium* and *S. variifolia*.

MATERIALS AND METHODS

Field collections were made during the flowering periods of the species throughout Texas, Florida and Belize. To insure isolation between the populations, a minimum distance of five miles was traveled between successive collection sites. Ten independent specimens from each site were semi-randomly collected and pressed; selection was biased in favor of mature plants that did not show any signs of damage from insects, herbivores, trampling, etc. The West Indies species were studied from herbaria specimens. In some cases sufficient samples were available of a single collection to serve as a "real" population. In others, "artificial" populations were created based upon similar geographic location. A total of 78 populations were studied for the subgenus.

Table 1 lists the 52 characters measured from representative populations to determine the relationship between the 11 species. All characters of selected populations were measured and statistically analyzed to determine significant characters for the detailed study of the subgeneric relationships. Nineteen characters were determined to be significant and included in that analysis. The following hypothesis was tested: taxa of subgenus *Paurochaetium* should be classified in one subgenus versus the need to describe a new subgenus. Two hundred and ninety two operational taxonomic units (OTU's), representing all species included in the study, were measured.

Univariate statistics (mean, standard deviation and range) were obtained using the PSI-Plot software package (Poly Software International 1996). Multivariate statistics of principal component analysis (PCA) was obtained using the NT-SYS software package (Rohlf 1990). Principal components were derived using correlation matrices.

RESULTS AND DISCUSSION

SUBGENERIC STUDY

Based upon the analysis of the 11 species classified in *Setaria* subgenus *Paurochaetium*, two distinctly separate entities were discovered. These differences matched the two complexes within subgenus *Paurochaetium* mentioned earlier. Figure 1 illustrates the separation between the two complexes.

Based upon the relationships revealed through the PCA, geographical separation, consistent morphological differences and similar habitat requirements of the complexes, the subgenus *Reverchoniae* is proposed.

Setaria subgenus **Reverchoniae** W.E. Fox, subgenus nov. BASIONYM: *Panicum reverchonii* Vasey, Bull. U.S. Dept. Agric. Div. Bot. 8:25. 1889. TYPE: *Reverchon s.n.* (US!). TYPUS: *Setaria reverchonii* (Vasey) Pilg.

Setaria subgeneris *Reverchoniae* ab subgeneri *Paurochaetio* per absentiam paleae flosculi inferior, paniculam erectam, spiculam grandiorem (2.1–4.5 mm logan, 1.2–2.6 mm latam) fortuito dispositam (non dispositam), atque axe inflorescentiae scabro differt.

Setaria subgenus *Reverchoniae* differs from subgenus *Paurochaetium* in the absence of a palea of the lower floret, erect panicle, larger spikelets (2.1–4.5 mm long, 1.2–2.6 mm wide) that are randomly disposed (not distichous), and the scabrous axis of the inflorescence.

Setaria subgenus *Reverchoniae* contains three taxa previously classified in the subgenus *Paurochaetium* (Rominger 1962) including the proposed subspecies: *Setaria reverchonii* (Vasey) Pilg. subsp. *reverchonii*, *S. reverchonii* (Vasey) Pilg. subsp. *ramiseta* (Scribn.) W.E. Fox and *S. reverchonii* (Vasey) Pilg. subsp. *firmula* (Hitchc. & Chase) W.E. Fox. *Setaria variifolia* was included in the subgenus, but was not treated originally by Rominger (1962). The lack of a palea in the lower floret best circumscribes the subgenus *Reverchoniae*

TABLE 1. Fifty-two characters used to assess morphological and reproductive variation in *Setaria* subgenus *Paurochaetium*. All characters were measured for quantitative variation except those labeled as TS [two-state (binary)] and MS [multi-state qualitative]. Italicized characters were found as significant and used in the final analysis.

Vegetative: *growth habit* (MS), *culm height*, culms branched/unbranched (BS), internodes hollow/solid (BS), node pubescence present/absent (BS), leaves basal/throughout (BS), leaf sheath pubescence present/absent (BS), leaf sheath pubescence length (if present), *leaf length*, *leaf width* (widest point), *leaf base width*, *leaf inrolled/not inrolled* (BS), leaf pubescence abaxial present/absent (BS), leaf pubescence adaxial present/absent (BS), leaf pubescence margin present/absent (BS), collar pubescence present/absent (BS), collar pubescence length (if present), auriculate trichomes present/absent (BS), *auriculate pubescence length* (if present), ligule type (MS), *ligule length*

Inflorescence: *inflorescence length*, inflorescence axis pubescence present/absent (BS), distance between lower primary branches, distance between upper primary branches, terminal bristle length lowest branch, terminal bristle length upper primary branches, terminal bristle length terminal primary branch, bristle exceeding spikelet lowest branch (BS), bristle exceeding spikelet upper branch (BS), bristle exceeding spikelet terminal branch (BS)

Spikelet: *spikelet length*, *spikelet width*, *lower glume clasping* (BS), lower glume apex shape, lower glume # of veins (MS), *lower glume length*, upper glume equal/not equal fertile lemma, *upper glume length*, lower glume # veins (MS), sterile lemma equal/not equal fertile lemma (BS), *sterile lemma length*, sterile lemma # veins (MS), sterile palea present/absent (BS), *sterile palea length*, fertile lemma rugose (BS), *fertile lemma length*, *fertile palea length*, *caryopsis length*, *caryopsis width*, filament length, *anther length*, anther width

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(exception *S. variifolia* that shares other characters aligning it with the subgenus). None of the members of subgenus *Reverchoniae* are sympatric with subgenus *Paurochaetium*. For further detail of the relationships of the two subgenera refer to Fox (1999).

KEY TO SUBGENERA OF *SETARIA*

1. Bristles one to many below each spikelet (some without bristles); leaf blades plicate 2
  2. Leaf blades plicate; bristles present below only some of the spikelets .... **Ptychophyllum**
  2. Leaf blades not plicate; bristles below all spikelets (rarely missing) .... **Setaria**
1. Bristles present usually only below the terminal spikelet of branch as an extension of branch; leaf blades not plicate 3
  3. Panicles nodding (except *S. pradana*), bearing remote, appressed, mostly racemose branches with spikelets two ranked on an undulating axis; central inflorescence axis glabrous; palea of lower florets present and conspicuous .... **Paurochaetium**
  3. Panicles erect; spikelets arranged randomly on branch; central inflorescence axis scabrous; palea of lower florets absent (except *S. variifolia*) .... **Reverchoniae**

SUBGENUS *REVERCHONIAE*

Four taxa are classified in the subgenus *Reverchoniae*: *Setaria reverchonii* subsp. *reverchonii*, *S. reverchonii* subsp. *ramiseta*, *S. reverchonii* subsp. *firmula* and *S. variifolia*. Figure 2 illustrates the relationship of the taxa in *Reverchoniae*.

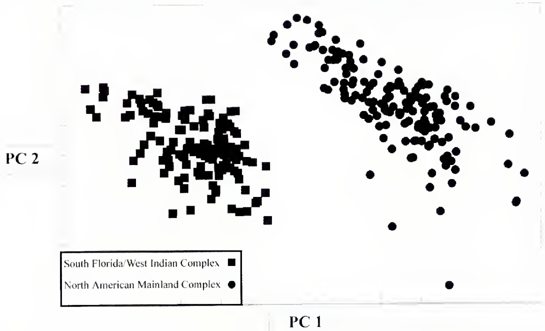

Fig. 1. Two-dimensional representation of all populations measured for the genus *Setaria* subgenus *Paurochaetium* (Rominger 1962).

Rominger (1962) classified *S. reverchonii, S. ramiseta,* and *S. firmula* as separate species following the combinations proposed by Pilger (1940). Other authors who have classified these taxa as species include Hitchcock (1935), Silveus (1942), Hitchcock (1951) and Gould (1975). When using the keys prepared by these authors, it becomes evident that the characters used do not result in consistent identifications. This problem resulted in the study of this complex and the following combinations.

Setaria reverchonii (Vasey) Pilg. subsp. **ramiseta** (Scribn.) W.E. Fox, comb. nov. Basionym: *Panicum ramisetum* Scribn., Circ. U.S. Dept. Agric. Agrost. 27:9. 1900. *Setaria ramiseta* (Scribn.) Pilg., Engler & Prantl, Die Nat. Pflanzenf. 14e:72. 1940. Type: *G. Nealley s.n.* (lectotype: US!, by Rominger 1962).

Panicum subspicatum Vasey, Bull. U.S. Dept. Bot. 8:25. 1889, non *Panicum subspicatum* Desv., Opusc. Sci. Phys. Nat. 84. 1831.

Additional references and illustrations.—Hitchock & Chase, Contr. U.S. Natl. Herb. 15:24, fig. 5. 1910; Hitchcock, Man. Grasses U.S. 611, fig. 1271. 1935.

Setaria reverchonii (Vasey) Pilg. subsp. **firmula** (Hitchc. & Chase) W.E. Fox, comb. nov. Basionym: *Panicum firmulum* Hitchc. & Chase, Contr. U.S. Natl. Herb. 15:27, fig. 9. 1910. *Setaria firmula* (Hitchc. & Chase) Pilg. in Engler & Prantl, Die Nat. Pflanzenf. 14e:72. 1940. Type: *D. Griffiths 6446* (holotype: US!)

Additional references and illustrations.—Additional reference and illustration: Hitchcock, Man. Grasses U.S. 612, fig. 1273. 1935.

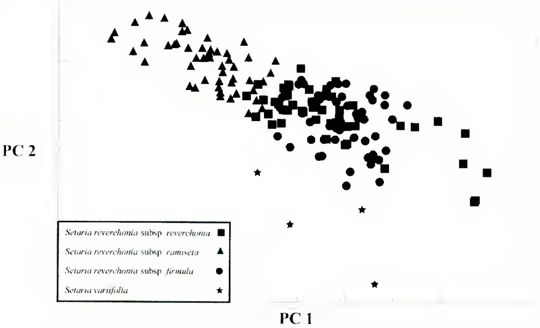

FIG. 2. Two-dimensional representation illustrating the relationships of the taxa described in *Setaria* subgenus *Reverchoniae*.

Setaria reverchonii subsp. *ramiseta* can be separated from the other taxa of the subgenus *Reverchoniae* with a shorter culm length, shorter penultimate leaf length, narrower leaf width, shorter second glume, shorter upper and lower lemma and shorter palea of the upper floret. *Setaria reverchonii* subsp. *reverchonii* is separated from subsp. *firmula* by a longer, narrower and usually involute leaf blade, a narrower leaf blade base above the collar and a longer lemma of the lower floret. Further references to the subspecies can be found in Fox (1999).

KEY TO SUBGENUS *REVERCHONIAE*

1. Palea of lower florets present and well developed; palea of upper (fertile) florets 3.0–3.1 mm long; distribution Yucatan peninsula of Mexico and Central America .... S. variifolia

1. Palea of lower florets absent or rudimenrary; palea of upper florets (1.0–)1.8–2.5(–3.1) mm long; distribution Texas, New Mexico, Oklahoma and northern Mexico 2

  2. Spikelets (2.4–)2.7–2.8(–3.4) mm long, (1.1–)1.5–1.6(–1.9) mm wide; second glumes (1.9–)2.4–2.5(–3.1) mm long; lemma of lower florets (1.0) 2.3–2.5(–3.2) mm long; lemma of upper florets (1.0-)2.2-2.3(-2.9) mm long; penultimate leaf blades (3.0–)6.8–7.6(–12.1) cm long; panicles (3.7) 17.7–20.7(–38.1) cm long .... **S. reverchonii subsp. ramiseta**

  2. Spikelets (2.9–)3.2–3.4(–4.0) mm long, (1.2–)1.8–2.0(–3.6) mm wide; second glumes (2.4–)2.8–3.0(–3.6) mm long; lemma of lower florets (1.4) 2.8–3.0(–3.7) mm long; lemma of upper florets (2.2–)2.7–2.9(–3.4) mm long; penultimate leaf blades (3.6–)7.9–13.3(–28.6) cm long; panicles (9.5) 25.3–32.6(–64.8) cm long 3

3. Penultimate leaf blades (3.6–)11.7–13.3(–28.6) cm long, (1.4–)2.1–2.3(–3.4) mm wide, involute; leaf blade bases above collar (0.7–)1.3–1.5(–2.1) mm wide; lemma of lower florets (1.4–)2.9–3.0(–3.7) mm long ...... **S. reverchonii** subsp. **reverchonii**
3. Penultimate leaf blades (5.1–)7.9–8.8(–15.4) cm long, (2.7–)4.4–4.7(–9.2) mm wide, flattened; leaf bases above collar (1.4–)3.0–3.2(–5.3) mm wide; lemma of lower florets (1.9–)2.8–2.9(–3.2) mm long .... **S. reverchonii** subsp. **firmula**

SUBGENUS *PAUROCHAETIUM*

The remaining seven taxa are retained the subgenus *Paurochaetium* as described by Rominger (1962). These include the original species of *Setaria distantiflora*, *S. leonis*, *S. ophiticola*, *S. pradana*, *S. subtransiens*, *S. utowanaea* and *S. chapmanii*. Taxonomic interpretation was difficult in the subgenus *Paurochaetium* due to a small sample size. Unfortunately, few specimens have been collected over time and available for the study. Hitchcock (1936) and Rominger (1962) classified *S. utowanaea*, *S. ophiticola* and *S. subtransiens* as distinct species. However, based upon the specimens examined in this study the following combinations are proposed.

Setaria utowanaea (Scribn.) Pilg. var. **ophiticola** (Léon) W.E. Fox, comb. nov. Basionym: *Panicum ophiticola* Hitchc. & Ekman ex Hitchcock, U.S. Dept. Agric. Misc. Publ. 243:293, fig. 282. 1936. *Setaria ophiticola* (Hitchc. & Ekman) Léon in Fl. Cuba 163. 1946. Type: *E.L. Ekman 12712* (holotype: US!).

Setaria utowanaea (Scribn.) Pilg. var. **subtransiens** (Hitchc. & Ekman) W.E. Fox, comb. nov. Basionym: *Panicum subtransiens* Hitchc. & Ekman ex Hitchcock, U.S. Dept. Agric. Misc. Publ. 243:351, fig. 323. 1936. Type: *E.L. Ekman 16828* (holotype: US!).

Based upon the mid-leaf width, leaf base width, spikelet length, lower lemma length and palea length of the upper floret, the varieties of *Setaria utowanaea* are classified separately from the remainder of subgenus *Paurochaetium*. Figure 3 illustrates the relationship of the three taxa in the *Setaria utowanaea* complex. *Setaria utowanaea* var. *subtransiens* differs from the other members of the species with a single bristle present below most spikelets on the branch, bristle length exceeding the spikelet, and spikelet width. *Setaria utowanaea* var. *utowanaea* is separated from *S. utowanaea* var. *ophiticola* by blade length, spikelet width, lack of tufted basal leaves and the presence of involute leaves on the upper culm. *Setaria utowanaea* var. *ophiticola* has shorter leaf blades, narrower spikelets, a tufted lower leaf arrangement and upper leaves that are slightly folded or flat. The following key separates the species of subgenus *Paurochaetium*. A key to separate the varieties of *Setaria utowanaea* will follow. Further reference to the taxa of subgenus *Paurochaetium* can be found in Fox (1999).

FIG. 3. Two-dimensional representation of the relationship between *Setaria utowanaea* var. *utowanaea*, *S. utowanaea* var. *ophiticola* and *S. utowanaea* var. *subtransiens*.

KEY TO SUBGENUS *PAUROCHAETIUM*

1. Spikelets (1.8–)2.0–2.2(–2.4) mm long, (1.0–)1.1–1.2(–1.3) mm wide, ovate, lacking palea of lower florets; penultimate leaf blades (9.3–)15.1–19.1(–34.4) cm long, (2.3–)3.2–3.9(–7.7) mm wide; leaf blade bases above collar (1.1–)1.2–2.7(–6.0) mm wide; second glumes subequal to equal fertile lemmas .... **S. chapmanii**

1. Spikelets (1.3–)1.4–2.4(–2.5) mm long, paleas of lower floret conspicuously present; leaf blade bases above collar (0.3–)0.4–1.4(–1.8) mm wide; second glumes conspicuously shorter than fertile lemmas 2

  2. Panicles erect; spikelets (1.7–)1.8–2.0(–2.5) mm long, spreading; lower lemmas (1.4–)1.6–1.8(–2.1) mm long; lower paleas (0.4–)0.8–1.1(–1.4) mm long; upper paleas (1.2–)1.3–1.5(–1.9) mm long .... **S. pradana**

  2. Panicles subflexuous; spikelets (1.8–)2.2–2.4(–2.5) mm long [except *S. distantiflora* (1.3–)1.4–1.5(–1.7)], not spreading; lower lemmas (1.6–)1.9–2.2(–2.4) mm long; lower paleas (0.8–)1.2–1.8(–1.9) mm long; upper paleas (1.4–)1.6–1.9(–2.1) mm long 3

    3. Spikelets (1.3–)1.4–1.5(–1.7) mm long; first glumes (0.4–)0.6–0.7(–0.9) mm long; second glumes (0.6–)0.9–1.1(–1.3) mm long; lower lemmas (1.1–)1.3–1.4(–1.5) mm long; palea of lower florets (0.3–)0.9–1.1(–1.3) mm long; palea of upper florets (0.9–)1.0–1.1(–1.3) mm long .... **S. distantiflora**

    3. Spikelets (1.6–)1.8–2.4(–2.5) mm long; first glumes (0.6–)0.7–1.3(–1.4) mm long; second glumes (0.7–)1.2–1.7(–2.1) mm long; palea of lower florets (1.2–)1.6–2.2(–2.4) mm long; palea of upper florets (1.2–)1.4–1.9 (–2.1) mm long 4

      4. Penultimate leaf blades (3.6–)4.7–5.9(–7.4) mm wide; leaf blade base above collar (1.1–)1.3–1.5(–1.8) mm wide; spikelet (1.6–)1.8–2.0(–

2.3) mm long; lemma of lower florets (1.2–)1.6–1.8(–2.2) mm long; palea of upper florets (1.2–)1.4–1.5(–1.7) mm long .... **S. leonis**

4. Penultimate leaf blades (0.9–)1.1–1.3(–4.2) mm wide; leaf blade above collar 0.4–1.3(–1.4) mm wide; spikelets (1.8–)2.2–2.4(–2.5) mm long; lemma of lower florets (1.6–)1.9–2.2(–2.4) mm long; palea of upper florets (1.4–)1.6–1.9(–2.1) mm long .... **S. utowanaea**

KEY TO VARIETIES OF *SETARIA UTOWANAEA*

1. Bristles present below most spikelets on branch, (2.5–)4.0–5.1(–6.4) mm long, exceeding spikelet .... **S. utowanaea var. subtransiens**
1. Bristles present below only terminal spikelet of branch, (0.4–)0.5–3.3(–3.9) mm long, not exceeding spikelet 2
   2. Leaf blades (7.8–)13.1–16.0(–21.9) mm long; spikelets 0.7–0.8(–0.9) mm wide; basal leaves not tufted, upper leaves involute .... **S. utowanaea var. utowanaea**
   2. Leaf blades 3.3–5.4(–6.2) mm long; spikelets 0.5–0.7 mm wide; basal leaves tufted, upper leaves flat or slightly folded toward apex .... **S. utowanaea var. ophiticola**

CONCLUSIONS

Rominger (1962) stated that the separate classification of *Setaria* subgenus *Paurochaetium* is "artificial." However, based upon this study and input from various others, it is our opinion that, although "artificial" by definition, the eleven taxa form a distinct group distinguishable from the remainder of *Setaria.* Based upon this analysis, keys have been developed that consistently separate the taxa from the subgenera *Setaria* and *Ptychophyllum.*

However, our understanding of the relationships within what was originally classified as *Setaria* subgenus *Paurochaetium* have changed based upon these analyses. The proposal of the new subgenus, *Setaria* subgenus *Reverchoniae*, provides a natural separation of the original taxa recognized by Rominger (1962). With the proposal of the new subgenus, *Setaria* now has four recognized subgenera.

The inclusion of *Setaria variifolia* with the remainder of *Setaria* subgenus R*everchoniae* added a little known taxon to the subgenera of *Setaria* that has a single bristle usually only below the terminal spikelet of the branch. Davidse (1981) suggested that *S. variifolia* was closely related to taxa of subgenus *Paurochaetium* as defined by Rominger (1962). This taxon provides a challenge to its classification due to the overlapping characteristics with several of the subgenera. However, based upon these analyses, the taxon is best classified with the subgenus R*everchoniae. Setaria variifolia* warrants further study to determine if this classification is truly defined. A comparative analysis of all of the subgenera would determine if the classification is correct.

Within *Setaria* subgenus *Reverchoniae* two name combinations have been proposed. Based upon numerical study of morphology, leaf anatomy and

DNA content analyses *S. reverchonii* subsp. *firmula* and *S. reverchonii* subsp. *ramiseta* have been proposed (Fox 1999). The taxa of the subgenus (excluding *S. variifolia*) show a substantial amount of intergradation.

The remainder of the species originally classified by Rominger (1962) are retained in the subgenus *Paurochaetium*. However, name combinations have been proposed for two of the taxa, *S. utowanaea* var. *ophiticola* and *S. utowanaea* var. *subtransiens*.

There is a need for the study of the reproductive behavior of the three subspecies of *S. reverchonii*. The results of such research would help better understand the relationship of the taxa. If these taxa do not hybridize, it may indicate a trend towards speciation.

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REFERENCES

CLAYTON, W.D. and S.A. RENVOIZE. 1986. Genera graminum: Grasses of the world. Her Majesty's Stationary Office. London.

DAVIDSE, G. 1981. *Setaria variifolia* (Swallen) G. Davidse, a new combination (Gramineae: Panicoideae). Ann. Missouri Bot. Gard. 68:226.

FOX, W.E. 1999. A biosystematic study of the genus *Setaria* subgenus *Paurochaetium* and the newly proposed subgenus *Reverchonia*. Ph.D. Dissertation. Texas A&M University, College Station.

GOULD, F.W. 1975. The grasses of Texas. Texas A&M University Press, College Station.

HÄCKEL, E. 1887. Echte Graser. In: Engler & Prantl, Die Natürlichen Pflanzenfamilien. 2(2):1–97.

HITCHCOCK, A.S. 1935. Manual of the grasses of the United States. U.S. Dept. Agric. Misc. Publ. 200. U.S. Government Printing Office, Washington, D.C.

HITCHCOCK, A.S. 1936. Manual of the grasses of the West Indies. U.S. Dept. Agric. Misc. Publ. 243. U.S. Government Printing Office, Washington, D.C.

HITCHCOCK, A.S. 1951. Manual of the grasses of the United States. 2nd Ed. U.S. Dept. Agric. Publ. 200. U.S. Printing Office, Washington, D.C.

PILGER, R. 1940. Granimeae III: Unterfamilie Pancoideae. In: Engler & Prantl Die. Nat. Pflanzen. 143:70–73.

PILGER, R. 1954. Das system der Gramineae. Bot. Jahresb. 76:281–384.

PRAT, H. 1936. La systématiques des Graminées. Ann. Sci. Nat. Bot., Ser. 10, 18:165–258.

POLY SOFTWARE INTERNATIONAL. 1996. Psi–Plot Ver. 5.02, Salt Lake City, Utah.

Rohlf, F.J. 1990. NTSYS–pc: Numerical taxonomy and multivariate analysis system, Ver. 1.8. Exeter Software, New York.

Rominger, J.M. 1962. Taxonomy of *Setaria* (Gramineae) in North America. Illinois Biol. Monogr. 29. University of Illinois Press, Urbana.

Silveus, W.A. 1942. Grasses: classification and description of species of *Paspalum* and *Panicum* in the United States. Published by author, San Antonio, Texas.

Soderstrom, T.R.; K.W. Hilu; C.S. Campbell, and M.E. Barkworth (eds.) 1986. Grass systematics and evolution. Smithsonian Institution Press, Washington, D.C.

Stebbins, G.L. 1956. Cytogenetics and evolution of the grass family. Amer. J. Bot. 43:890–905.

BOOK REVIEW

LAURENCE C. WALKER 1996. **Forests: A Naturalist's Guide to Woodland Trees.** (ISBN 0-292-79112-7, pbk.). The University of Texas Press, P. O. Box 7819, Austin, TX 78713-7819. $19.95. 302 pp., 68 B & W photos, 12 figures, 3 tables.

This book is aimed at the amateur naturalist, to introduce the major groups of timber trees, their uses, and the forests they grow in. While I have difficulty with terms such as "male flowers" of Spruce and Fir (microsporangiate strobili), I understand that the author is purposely trying to keep as many of the species descriptions parallel throughout the text, which he accomplishes. The text is filled with interesting trivia, important general ecological concepts, important dendrological and morphological features of the trees, many of their uses and distribution. It is copiously illustrated and extremely easy to "leaf" through. There are numerous editorial comments, akin to those sometimes made by senior distinguished lecturers, but they do not seriously affect the delivery of important information in the text. It is obvious that Walker is a pragmatic practitioner, and while the theoretical concepts may be slightly out of date, the general summary information for each group of species is very useful, particularly to those unfamiliar with which species are commercial, where they grow, and what is important about them.

Perhaps because I am not a forester, I found such terms as "stink-bomb tree" for *Gingko* amusing, as I did the discussion of its "leaf spigots" and "living scissors" (Chapter 28). While the terminology may be "folksy" and very informal, it is aptly suited to the intended audience and painlessly injects some biological knowledge directly into the reader. The "Projects for the Amateur Naturalist" section at the end of every chapter are cleaver exercises that teach the audience how foresters do their work. While most are very straightforward, they are all time- and resource-consuming, but again, most things worth doing are. The reading lists and glossary are extremely useful.

In summary, I recommend this book for every backyard naturalist who is curious to know how the forestry community views the most important kinds of timber trees and their environments.—*John J. Pipoly III.*

THE TAXONOMY OF *CYPERUS VIRENS* AND *CYPERUS DRUMMONDII* (CYPERACEAE) IN THE SOUTHEASTERN UNITED STATES

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ABSTRACT

Data for 20 morphological characters taken from recent collections of the *Cyperus virens* group from the southeastern United States were statistically analyzed using principal components analysis and discriminant analysis. Based upon results of the analyses and recent field observations, it is concluded that *C. drummondii* and *C. virens* are distinct at the tank of species. The taxonomy is revised accordingly. A taxonomic key, technical descriptions, distributional, and ecological data on the two species are presented.

RESUMEN

Los datos de 20 caracteres morfológicos de colecciones recientes del grupo de *Cyperus virens* del sureste de los Estados Unidos fueron analizados estadísticamente usando el análisis de componentes principales y el análisis discriminante. En base a los resultados de los análisis y de recientes observaciones de campo, se concluye que *C. drummondii* y *C. virens* son distintas en el rango de especie. Se revisan de acuerdo con esto la taxonomía. Se presentan una clave taxonómica, descripciones técnicas, datos ecológicos y sobre la distribución de las dos especies.

INTRODUCTION

Cyperus virens and *C. drummondii* are closely related and belong to section *Luzuloidei* and are characterized by persistent rachillas; bicarinate, deciduous scales; and 1–2 stamens per floret (Kükenthal 1935–1936; Denton 1978).

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Both taxa have sharply three-angled (triquetrous) culms, which, in combination with the characteristics listed above, easily separates them from all other *Cyperus* species in the southeastern United States. Carter (1990) provides a key separating *C. virens* and *C. drummondii* from other members of section *Luzuloidei*.

Cyperus virens Michx. has historically presented a taxonomic problem because of its complex pattern of variation and wide distribution. According to Denton (1978), *C. virens* consists of four varieties: *C. virens* var. *virens*, *C. virens* var. *drummondii* (Torr. & Hook.) Kükenthal, *C. virens* var. *minarum* (Boeck.) Denton, and *C. virens* var. *montanus* (Boeck.) Denton. Of these taxa, only *C. drummondii* and *C. virens* var. *virens* occur in the United States. *Cyperus drummondii* was first described in 1836 based upon a specimen collected in Texas by Thomas Drummond (Torrey 1836). *Cyperus drummondii* has been treated variously since.

Chapman (1889), like Torrey (1836), recognized *Cyperus drummondii*. Subsequently, several floristic manuals include only *C. virens* with no mention of *C. drummondii* as either a taxon or a synonym (Chapman 1897; Mohr 1901; Small 1933; Correll & Johnston 1970; Correll & Correll 1975; Godfrey 1979; Wunderlin 1982, 1998; Clewell 1985; Thomas & Allen 1993). Hatch et al. (1990) did not recognize *C. drummondii* at any rank, while Tucker (1994) treated it as a synonym of *C. virens*. *Cyperus drummondii* was first treated as a variety of *C. virens* by Kükenthal (1935–1936); this view was upheld by McGivney (1938), Denton (1978), and Adams (1994). Koyama (1970) treated *C. drummondii* as a subspecies of *C. virens*. Other recent authors (Bryson & Carter 1994; Jones et al. 1997) recognized *C. drummondii* at the rank of species.

Cyperus virens and *C. drummondii* are widely distributed in the New World and are sympatric in the coastal plain of the southeastern United States. Although *C. drummondii* has been known from Louisiana and Texas (Torrey 1836; McGivney 1938), it is infrequently collected elsewhere in the southeastern United States. Recently, it was reported new from Mississippi (Bryson & Carter 1994). Kükenthal (1935–1936) and Denton (1978) documented the distribution of *C. drummondii* outside the United States in Nicaragua, Jamaica, Surinam, Ecuador (Galapagos Islands), and Brazil.

MATERIALS AND METHODS

We examined 57 specimens of *C. virens* and 44 specimens of *C. drummondii*. Specimens were reproductively mature and from the southeastern United States. Initially, each specimen was identified by a unique number and after preliminary examination was assigned to *C. drummondii* or *C. virens*.

After a survey of the critical literature (Kükenthal 1935–1936; Denton 1978) and a preliminary study of our collections 20 characters were selected

TABLE 1. List of characters used in analysis.

PPEDN	number of primary peduncles
BRACNL	number of primary infloresence bracts exceeding longest ray
CULML	culm length (cm)
BRACTL	maximum primary inflorescence bract length (cm)
RAYL	maximum ray length (cm)
INFLW	maximum inflorescence width (cm)
SPKW	maximum spike width (cm)
CULMW	mid-culm width (mm)
BRACTW	maximum mid-bract width (mm)
LEAFW	maximum mid-leaf width (mm)
SPKLTW	spikelet width (mm)
SCALL	scale length (mm)
ACHNL	achene length (mm)
ACHNW	achene width (mm)
ANTHL	anther length (mm)
SCALN	scale number per spikelet
CIRAT	ratio of culm length to inflorescence width
ASRAT	ratio of achene length to scale length
ACHLW	ratio of achene length to width
BCRAT	ratio of longest primary inflorescence bract to culm length

for analysis. The characters are listed in Table 1, and all character states are continuous quantitative. These data were subjected to principal components analysis (PCA) and discriminant analysis (DA) using Minitab© release 11.21 (Sneath & Sokal 1973; Seber 1984; Anonymous 1996). Data points plotted using PCA were identified by specimen number and their *a priori* species categories, and eigenvectors generated from a PCA were used to determine which characters most accounted for the variance observed. All characters were analyzed using DA to determine order of reliability of characters and which minimal combination of characters would allow classification of our specimens into the taxonomic groups defined by PCA.

RESULTS

Results of PCA, shown in Table 2 and Figure 1, indicate the specimens form discrete clusters corresponding with our *a priori* classification and that no single character is outstanding in accounting for the variation in principle components one and two. Variation in principal component one is primarily due to SCALL, INFLW, BCRAT, BRACTW, RAYL, BRACNL, CIRAT, ACHNL, ACHNLW, SPIKLTW, PPEDN, and ASRAT, and variation in principle component two is primarily accounted for by CULML and CULMW. The results of DA are used to rank individual characters (Table 3) in order of taxonomic reliability and to determine which combinations of characters (Table 4) best classify our specimens into their categories as determined by PCA.

TABLE 2. Eigenvectors and cumulative variance for first six principal components in principal components analysis.

	Eigenvectors					
Variable	PC1	PC2	PC3	PC4	PC5	PC6
PPEDN	-0.245	-0.165	-0.155	-0.061	-0.232	-0.070
BRACNL	-0.254	0.102	-0.065	0.001	0.140	0.147
CULML	0.167	-0.485	0.097	-0.039	0.275	0.007
BRACTL	-0.226	-0.270	-0.134	-0.081	-0.014	0.049
RAYL	-0.255	-0.244	0.061	-0.042	-0.246	-0.077
INFLW	-0.269	-0.117	0.170	-0.017	-0.237	-0.060
SPKW	-0.192	-0.111	0.354	-0.293	-0.402	-0.100
CULMW	-0.197	-0.410	0.005	0.224	0.113	-0.029
BRACTW	-0.258	-0.181	-0.077	0.158	0.082	-0.090
LEAFW	-0.196	-0.355	-0.060	0.230	0.254	-0.054
SPKLTW	-0.248	0.172	0.151	-0.017	0.296	0.168
SCALL	-0.274	0.182	0.149	0.041	0.150	0.147
ACHNL	-0.252	0.131	-0.029	0.212	0.091	0.342
ACHNW	0.075	0.026	0.415	0.700	-0.241	0.272
ANTHL	-0.137	0.256	0.054	0.316	0.161	-0.825
SCALN	0.007	-0.060	0.676	-0.297	0.245	-0.037
CIRAT	0.253	-0.190	0.033	0.006	0.318	0.016
ASRAT	0.242	-0.187	-0.212	0.110	-0.187	0.042
ACHLW	-0.249	0.087	-0.160	-0.181	0.278	0.102
BCRAT	-0.262	0.123	-0.165	-0.049	-0.110	0.071
Cumulative variance	0.544	0.654	0.728	0.785	0.831	0.867

DISCUSSION

Kükenthal (1935–1936) treated *Cyperus drummondii* as a variety of *C. virens* with no justification other than brief diagnoses of the taxa. Denton (1978), in a numerical taxonomic analysis of the *Luzulae* group of *Cyperus*, came to the same conclusion as Kükenthal (1935–1936). Denton (1978, p. 257) stated that *C. drummondii* and other varieties of *C. virens* could not be elevated in rank because of overlap in scale and achene dimensions in some collections. However, Denton's research involved little fieldwork and included few *C. drummondii* specimens from the southeastern United States.

Our analysis included numerous recent collections of *Cyperus drummondii* from the southeastern United States, not seen by Denton (1978). Discrete clusters obtained with PCA indicate our specimens can be readily identified as either *C. drummondii* or *C. virens* based upon our character set and that *C. drummondii* and *C. virens* are distinct species. Further, DA shows that six characters (SCALL, SPKLTW, ACHNL, ASRAT, CIRAT, BCRAT) are particularly effective in correctly classifying our specimens and that these six

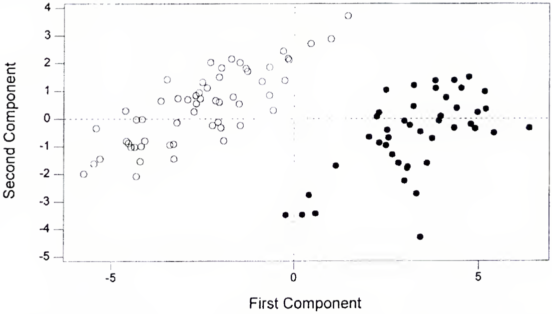

FIG. 1. Results of principle components analysis of *Cyperus virens* (open circles) and *C. drummondii* (closed circles).

TABLE 3. Proportion of specimens correctly classified in discriminant analysis by individual characters.

Individual Characters	Proportion Correctly Classified	Individual Characters	Proportion Correctly Classified
SCALL	0.986	BRACNL	0.832
SPKLTW	0.968	PPEDN	0.828
ACHNL	0.953	RAYL	0.780
ASRAT	0.946	BRACTL	0.752
BCRAT	0.915	ANTHL	0.726
CIRAT	0.905	SPKW	0.720
ACHLW	0.885	LEAFW	0.695
CULML	0.875	CULMW	0.649
BRACTW	0.849	ACHNW	0.615
INFLW	0.833	SCALN	0.548

characters are the minimum combination required to classify all of our specimens into the two groups defined by PCA. Our specimens were classified with 99.3% accuracy using two combinations of four characters each (SCALL, SPKLTW, ACHNL, ASRAT and SPKLTW, CIRAT, ASRAT, BCRAT), two combinations of three characters (SCALL, SPKLTW, ACHNL and ASRAT, BCRAT, CIRAT), and three combinations of two characters (SCALL, ASRAT; SCALL, CIRAT; and SCALL, BCRAT). Moreover, DA showed the combination of key characters (SCALL, SPKLTW, PPEDN, RAYL, LEAFW, ASRAT) used by Denton (1978) correctly classifying 99.1% of our specimens. Ad-

TABLE 4. Proportion of specimens correctly classified in discriminant analysis by selected groups of characters.

Grouped Characters	Proportion Correctly Classified
SCALL, SPKLTW, ACHNL, ASRAT, BCRAT, CIRAT, ACHLW, BRACTW, INFLW, BRACNL, PPEDN, RAYL	1.000
SCALL, SPKLTW, ACHNL, ASRAT, CIRAT, BCRAT	1.000
SCALL, ACHNL, BCRAT, CIRAT, BRACTW, INFLW, BRACNL, RAYL	0.993
SCALL, SPKLTW, ACHNL, ASRAT	0.993
SPKLTW, CIRAT, ASRAT, BCRAT	0.993
SCALL, SPKLTW, ACHNL	0.993
ASRAT, BCRAT, CIRAT	0.993
SPKLTW, ASRAT	0.993
SCALL, ASRAT	0.993
SCALL, CIRAT	0.993
SCALL, BCRAT	0.993
SCALL, SPKLTW, ASRAT, CIRAT, BCRAT	0.986
SCALL, SPKLTW, ACHNL, BCRAT	0.986
SCALL, SPKLTW, ACHNL, CIRAT	0.986
BCRAT, CIRAT, BRACTW, INFLW, BRACNL, RAYL	0.981
SPKLTW, CIRAT	0.981
SPKLTW, BCRAT	0.980

ditionally, the qualitative character, scale shape, was observed to be markedly and consistently different between the two taxa and is included in the dichotomous key.

In summary, of the six key characters used by Denton (1978), we found three (SCALL, SPKLTW, ASRAT) to be highly reliable and concur with their relative placement in Denton's dichotomous key. Because of substantial overlap between the two taxa, Denton's remaining three key characters (PPEDN, RAYL, LEAFW) proved to be of limited use in our study. Additionally, we have identified four other taxonomically useful characters: ACHNL, BCRAT, CIRAT, and floral scale outline.

CONCLUSIONS

Results of PCA and DA show six characters are taxonomically useful in separating *Cyperus drummondii* and *C. virens*. These in ranked order as determined by PCA and DA are SCALL, SPKLTW, ACHNL, ASRAT, BCRAT, and CIRAT. Additionally, we have determined that the qualitative character, scale outline, is useful in separating the two taxa. Further, the discrete clusters obtained in PCA indicate *C. virens* and *C. drummondii* are distinct in the southeastern United States and support recognition of *C. drummondii* at the rank of species as follows.

TAXONOMIC TREATMENT

Key to *Cyperus virens* and *Cyperus drummondii*

1\. Floral scales oblanceolate, at least 1.7 mm long; spikelets at least 2.25 mm wide; achenes less than 0.7 times as long as subtending floral scale; achenes 1.2–1.5 mm long; longest primary inflorescence bract length at least 0.45 times as long as culm; culm less than 8 times longer than inflorescence width; primary peduncles 5–10. .... **1. C. virens**

1\. Floral scales ovate, less than 1.7 mm long; spikelets less than 2.25 mm wide; achenes at least 0.7 times as long as subtending floral scale; achenes 1.1–1.2 mm long; longest primary inflorescence bract less than 0.45 times as long as culm; culm (8–)10–33 times longer than inflorescence width; primary peduncles 3–5. .... **2. C. drummondii**

1. Cyperus virens Michx., Fl. Bor.-Amer. 1:28. 1803. **(Fig. 2).** Type: "Carolina," *Herb. A. Michaux* (holotype: P, microfiche!).

Cespitose perennial herb. Roots fibrous, reddish brown. Culms 16–100 cm high, 3–13 times longer than inflorescence width, 2.4–6.9 mm wide, triquetrous, scabrid. Leaves basal, blades 3.5–13.2 mm wide. Primary inflorescence bracts 4–8, longest 17–75 cm long, up to 0.3–1.5 times as long as culm, 2.7-13.2 mm wide. Inflorescence usually diffuse, (4.2–)7–18.4 cm wide, rays 5–10, longest 2.4–12 cm long. Spikes globose, 1.2–7.3 cm wide. Spikelets flattened, 1.7-3.2 mm wide. Floral scales 12–38, distichous, spreading to ascending, bicarinate, oblanceolate, (1.35–)1.9–2.4 mm long, pale grayish-green, turning brown. Stamens 1–2, anthers 0.8–1.3 mm long. Style 3-branched, exserted, deciduous. Achene oblong-ellipsoidal, 2.7–4.1 times as long as wide, (0.9–)1.2–1.5 × 0.3–0.4 mm, trigonous, stipitate, brown.

Distribution and habitat.—Widely distributed in the New World: southeastern United States, Caribbean, Mexico, Central America, and South America (Denton 1978; Kükenthal 1935–1936). In the coastal plain of the southeastern United States, from Texas through Florida into North Carolina (Fig. 3). Common in a variety of disturbed, low, intermittently wet habitats, such as ditches, stream bottoms, edges of ponds and lakes.

Phenology.—Flowering and fruiting April through December.

Specimens examined. **U.S.A. ALABAMA. Baldwin Co.:** Point Clear, 22 May 1975, *Kral 55724* (VSC); Battleship Parkway, 1.1 mi E Mobile city limit, 8 Aug 1989, *Carter 8100* (ctb, VSC). **Butler Co.:** SE Greenville, 12 Jul 1995, *Kral 85208* (VSC). **Clarke Co.:** SW Jackson, 1 Jun 1972, *Kral 47088* (VSC). **Crenshaw Co.:** N Rutledge, 23 Jul 1995, *Kral 82944* (VSC). **Dallas Co.:** SE Selma, 4 Oct 1994, *Kral 84302* (VSC). **Houston Co.:** ca. 2.5 mi SW Cottonwood, 26 Sep 1994, *MacDonald 7812* (ctb, VSC). **Lee Co.:** Uchee Creek, 4 Aug 1960, *Wills s.n.* (SWSL); Spring Villa, 25 Jul 1977, *H. McIntyre s.n.* (VSC). **Mobile Co.:** Bayou la Batre, 7 Jun 1971, *Kral 53056* (VSC). **Montgomery Co.:** WSW Montgomery, 10 Oct 1970, *Kral 41573* (VSC). **Pike Co.:** 5 mi SE Troy, 12 Aug 1973, *Kral 51217* (VSC). Florida. **Alachua Co.:** NW Gainesville, 29 Jul 1978, *Dunn 43* (ctb),

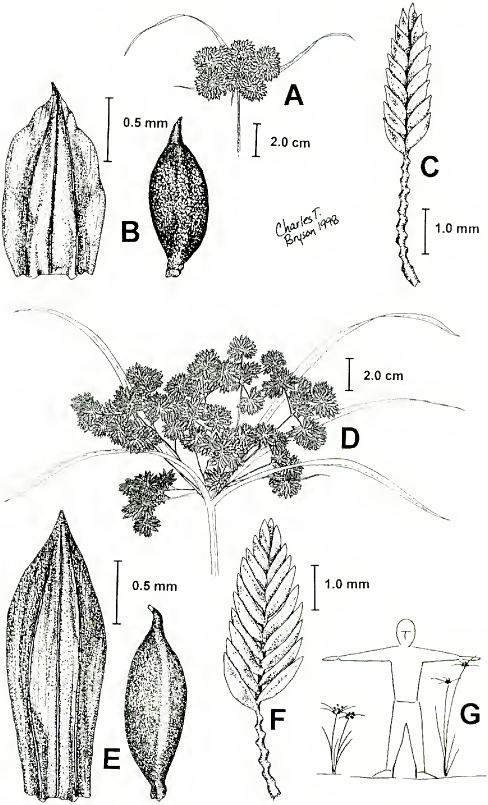

FIG. 2. *Cyperus drummondii*: A. Inflorescence. B. Floral scale and achene. C. Spikelet. Drawn from *Carter 10738* (ctb). *Cyperus virens*: D. Inflorescence. E. Floral scale and achene. F. Spikelet. Drawn from *Carter 6961* (ctb). G. Habit: *C. virens* (left) and *C. drummondii* (right).

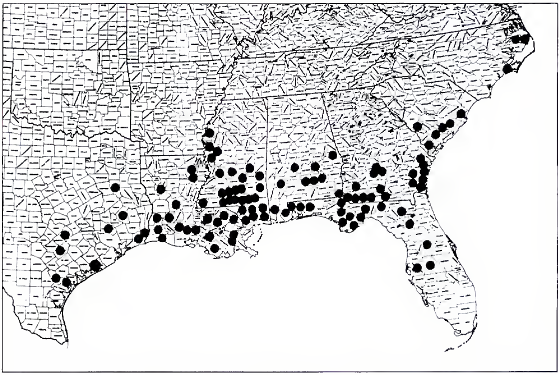

FIG. 3. Distribution of *Cyperus virens* in the United States.

6 May 1979, *Dunn 595* (ctb); Paynes Prairie, 19 May 1979, *Smith 15* (FSU). **Calhoun Co.:** E Bountstown, 6 Jun 1956, *Redfearn 2197* (FSU). Columbia Co.: N Providence, 21 May 1964, *Godfrey 63797* (FSU). **Escambia Co.:** Pensacola, 24 Jul 1974, *Godfrey 73759* (FSU). **Franklin Co.:** NW Apalachicola, 29 Jun 1956, *Kral 2737* (FSU); St. Vincent Island, 29 Jan 1987, *Anderson 10290* (FSU). **Gulf Co.:** 6.5 mi NW Apalachicola, 12 May 1986, *Anderson 9401* (FSU). **Hillsborough Co.:** ca. 1.5 mi NE of bridge, 18 May 1974, *Burch 6825* (FSU). **Jackson Co.:** S Sneads, 23 Sep 1976, *Godfrey 75663* (FSU). **Lake Co.:** E Bartow, 10 Apr 1962, *Godfrey 61885a* (FSU). **Leon Co.:** near Lake Bradford, 23 Jul 1957, *Godfrey 55675* (FSU); Apalachicola National Forest, 25 Jun 1993, *Godfrey 84612* (VSC); Tallahassee, 22 Jun 1989, *Godfrey 83318* (VSC). **Liberty Co.:** N Bristol, 30 Sep 1964, *Godfrey 64661* (FSU). **Madison Co.:** Greenville, 24 Jun 1956, *Godfrey & Kral 54922* (FSU); 14 Jun 1991, *Godfrey 84184* (VSC). **Okaloosa Co.:** Niceville, 12 Oct 1974, *Godfrey 73974* (FSU). **Polk Co.:** N Lake Weohyakapka, Nalcrest, 7 May 1980, *E.M. Wheeler s.n.* (ctb, VSC). **Santa Rosa Co.:** Milton, 2 Sep 1976, *Godfrey 75489* (FSU). **Wakulla Co.:** Newport, 23 Jul 1961, *Ward 2737* (FSU). GEORGIA. **Baker Co.:** Newton, 28 Sep 1991, *Carter 9379* (ctb, VSC). **Ben Hill Co.:** Red Bluff, 19 Aug 1967, *Faircloth 4640* (VSC). **Brantley Co.:** 0.8 mi W Nahunta, 4 Jul 1988, *Carter 6961* (ctb, VSC). **Bryan Co.:** Ft. Stewart Military Reservation, 24 Jun 1992, *Carter 9930* (VSC). **Camden Co.:** Kinlaw, 7 Jul 1995, *Carter 12523* (VSC). **Cook Co.:** 6 mi W Adel, 19 Jul 1965, *Faircloth 2406* (VSC). **Decatur Co.:** 2.7 mi N state line, 20 May 1967, *Faircloth 4466* (VSC). **Glynn Co.:** Sterling, Hwy. GA 99, 23 May 1997, *Carter 14032 with Alexander* (VSC); 7.72 mi SE Mt. Pleasant, Hwy. US 341, 23 May 1997, *Carter 14037 with Alexander* (VSC). **Grady Co.:** 4 mi N Cairo, 7 Aug 1987, *Carter 6010* (ctb, VSC). **Liberty Co.:** Ft. Stewart Military Reservation, 16 Jul 1992, *Carter 10177* (VSC). **Lowndes Co.:** N Valdosta, 20 Jul 1988, *Carter 7092* (ctb, VSC); 11 Jun 1989, *Carter 7892* (VSC). **McIntosh Co.:** Butler Island, 1.4 mi SW Darien, Hwy. US 17, 23 May 1997, *Carter*

14030 with Alexander (VSC). **Seminole Co.:** 0.4 mi E Iron City, 5 Aug 1989, *Carter 8023* (ctb, VSC). **Thomas Co.:** 3.1 mi NE Metcalf, 2 Aug 1965, *Faircloth 2628* (VSC). **Turner Co.:** 2.6 mi N Cravey, 28 Jun 1993, *Carter 10843 with Kral* (VSC). **Wayne Co.:** Gardi, 23 May 1977, *Carter 14054 with Alexander* (VSC). **Wilcox Co.:** 8.8 mi. N Abbeville, Hwy. US 129, 9 Aug 1987, *Carter 6060* (ctb, VSC); 1.5 mi N jct. Hwys. US 280 and GA 215, 30 May 1998, *D. Alexander s.n.* (VSC). **LOUISIANA. Acadia Parish:** 0.5–1.0 mi E jct. Hwys. LA 124 and US 90 in Estherwood, 3 Sep 1992, *Carter 10444* (VSC). **Allen Parish:** ca. 8 mi N Elton, *Thieret 29557* (FSU). **Assumption Parish:** Platternville, ca. 1 mi. N jct. Hwys. LA 70 and 308, 19 Sep 1986, *Bryson 5054* (ctb). **Beauregard Parish:** near DeQuincy, 13 Jul 1963, *Brown 17793* (ctb). **Calcasieu Parish:** ca. 1.5 mi NNW Starks, 18 Jun 1968, *Thieret 29424* (FSU); Chloe, 3 Sep 1992, *Carter 10517* (VSC). **Cameron Parish:** ca. 10 mi W Holly Beach: 14 Dec 1957, *Reese & Harris 1536* (FSU). **East Baton Rouge Parish:** E Baton Rouge, 17 Nov 1993, *McKenzie 1333* (VSC); Burden Research Center, S Hwy. I-10, 28 Sep 1994, *Bryson 14487* (ctb). **Franklin Parish:** SW Holly Grove, 17 Sep 1981, *Thomas 78546* (ctb). Jefferson Parish: 5 mi S Marrero, 5 Jun 1948, *Ewan 17710K* (FSU). **Lafayette Parish:** ca. 5 mi S Lafayette, 5 Oct 1957, *Reese 1414* (FSU); 5 mi S Raynes, 15 May 1967, *Wooten 1042* (FSU); Lafayette, 16 Jun 1993, *Carter 10739* (ctb, VSC). **Livingston Parish:** 1.3 mi N Bayou Manchac, 11 Sep 1979, *Carter 2084* (VSC). **Natchitoches Parish:** Chestnut, Hwy. LA 9, 19 Sep 1981, *Joye 2224 & Nielsen* (ctb). **Orleans Parish:** New Orleans, 15 Oct 1993, *Carter 11537* (VSC). **Rapides Parish:** Pineville, 16 May 1994, *Bryson 13452* (ctb, VSC). **Richland Parish:** W Rayville, Hwy. US 80, 21 Aug 1990, *Bryson 10203 & Newton* (ctb). **St. Martin Parish:** NW Duck Lake, 30 Oct 1963, *Thieret 16611* (FSU); St. Martinville, 16 Jun 1993, *Carter 10751* (VSC). **St. Tammany Parish:** 2.7 mi N Hwy. US 11 at Pearl River, 26 Aug 1991, *Carter 8994* (ctb, VSC); W Slidell, 3.1 mi. W jct. Hwys. I-12 and US 11, 17 May 1994, *Bryson 13496* (ctb). **Tangipahoa Parish:** 4 mi SW Hammond, 2 May 1963, *Wilson 160* (FSU); Lees Landing, 17 Sep 1993, *Carter 11351* (VSC). **Terrebonne Parish:** Brule, 7 Jul 1977, *Webster 800* (ctb); Cocodrie, S Houma, 12 Aug 1989, *Thomas 112004* (VSC). **MISSISSIPPI. Bolivar Co.:** S Shaw, 25 Jul 1994, *Bryson 13982 with MacDonald* (ctb, VSC). **Clarke Co.:** Pachuta, 28 Aug 1991, *Carter 9087 & Bryson* (ctb, VSC). **Covington Co.:** Collins, 7 Dec 1994, *Bryson 14705* (ctb, VSC). **Forrest Co.:** W Brooklyn, 4 Aug 1992, *Bryson 11840* (ctb), *Bryson 11852* (ctb, VSC); Camp Shelby, NE McLaurin, Hartfield Creek, 15 Oct 1994, *Bryson 14506 et al.* (ctb); Camp Shelby, NE McLaurin, S of Forrest Ave, 15 Oct 1994, *Bryson 14522 et al.* (ctb). **George Co.:** 7.5 mi. ESE Lucedale, 19 Jul 1988, *Morris 3224* (ctb). **Hancock Co.:** Buccaneer State Park, 26 Aug 1991, *Carter 8976 & Bryson* (ctb, VSC); Hwy. MS 607, 1.4 mi ESE Hwy. US 90W, 26 Aug 1991, *Carter 8979* (ctb, VSC); Mississippi Welcome Center, S Hwy. I-10, W Hwy. MS 607, 26 Aug 1991, *Carter 8988* (VSC), 17 May 1994, *Bryson 13529* (ctb); W Mill Creek, 18 Oct 1993, *Bryson 13264 & Carter* (ctb, VSC). **Harrison Co.:** Gulfport, 6 Aug 1992, *Bryson 11985* (VSC), *Bryson 11991* (ctb, VSC), *Bryson 11997* (ctb, VSC), *Bryson 11998* (ctb); Orange Grove Community Center, 13 Oct 1993, *Lockley s.n.* (ctb), 16 Oct 1993, *Bryson 13165* (ctb, VSC), 27 Jul 1994, *Bryson 14004* (ctb); jct. Hwys. I-10 and MS 67, 27 Aug 1991, *Carter 9052* (ctb, VSC). **Hinds Co.:** Jackson, S of Lakeland Dr., 0.3 mi. W of Pearl River on Hwy. MS 25, 29 Oct 1993, *Bryson 13300* (ctb); Lefluers Bluff State Park, 26 Aug 1995, *MacDonald 9090 et. al.* (ctb). **Humphreys Co.:** 1.5 mi SW Isola, 23 Jun 1988, *Bryson 8141* (ctb, VSC). **Jackson Co.:** 7 mi E Moss Point, 24 Jul 1989, *Bryson 8666* (ctb, VSC); Pascagoula, 16 Sep 1991, *Bryson 11043* (ctb, VSC); 4 Aug 1992, *Bryson 11879* (VSC), 9 Aug 1993, *Bryson 12597* (ctb, VSC); Moss Point, 1 Sep 1993, *Bryson 12841* (ctb, VSC); Moss Point, 16 Sep 1993, *Carter 11316* (VSC). **Jefferson Davis Co.:** S Prentiss, 12 Aug 1993, *Bryson 12705* (ctb, VSC). **Lamar Co.:** 1 mi. N Lumberton, Hwy. US 11, 18 May 1994, *Bryson 13568* (ctb).

Lawrence Co.: NE jct. Hwys. MS 27 and 44, 29 Jul 1994, *Bryson 14094* (ctb, VSC). **Lincoln Co.:** S Brookhaven, 29 Jul 1994, *Bryson 14103* (ctb, VSC). **Marion Co.:** 4.6 mi. S jct. Hwys. US 98 and MS 13, 0.3 mi. S Upper Little River, S Columbia, 29 Jul 1994, *Bryson 14059* (ctb). **Newton Co.:** 4 mi E Newton, 31 May 1985, *Bryson 3943* (ctb, VSC). **Pearl River Co.:** 3 mi W Picayune, 27 Jun 1967, *Sargent & Jones 13766* (FSU); Picayune, 18 Oct 1993, *Bryson 13248* (ctb, VSC); 2.5 mi N Carriere, 26 Aug 1991, *Carter 9005* (ctb, VSC). **Perry Co.:** New Augusta, 19 Oct 1994, *Bryson 14640* (ctb, VSC). **Pike Co.:** Percy Quinn State Park, 9 Jun 1967, *Jones 13229* (FSU), 28 Sep 1994, *Bryson 14462* (ctb, VSC). **Rankin Co.:** 0.5 mi S jct. Hwys. 49 and I-20, 22 Oct 1976, *Barnes 790* (FSU); Flowood, 7 Sep 1993, *Bryson 12973* (ctb, VSC); Richland, W Hwy. US 49, 1.2 mi. S jct. Hwys. I-20 and US 49, 27 Sep 1994, *Bryson 14429* (ctb). **Sharkey Co.:** ca. 9 mi ENE Anguilla, 14 Aug 1988, *Bryson 8348* (ctb, VSC); Delta National Forest, 3 Aug 1993, *Bryson 12544* (ctb, VSC). **Smith Co.:** SW Raleigh, 3.2 mi. W jct. Hwys. MS 35 and 540, 26 Jul 1995, *Bryson 14952* (ctb). **Stone Co.:** Flint Creek Water Park, 18 Oct 1993, *Bryson 13280* (ctb). **Walthall Co.:** NW Tylertown, 0.8 mi. W jct. Hwys. US 98 and MS 583, 29 Jul 1994, *Bryson 14089* (ctb). **Washington Co.:** Leroy Percy State Park, 2–6 May 1975, *Gunn 10637* (SWSL), 1 Jul 1977, *Barnes 964* (SWSL), 16 Jul 1993, *Bryson 12505* (ctb, VSC). **Wayne Co.:** Waynesboro, 1 Sep 1993, *Bryson 12934* (ctb, VSC). **Wilkinson Co.:** Little Buffalo Creek, N of Hiram McGraw Rd., 9 Jun 1991, *Rosso 91-271* (ctb), *Rosso 91-274* (ctb); ca. 8 mi N Woodville, 29 Sep 1994, *Bryson 15002* (ctb, VSC). **NORTH CAROLINA. Carteret Co.:** 3.6 mi NE Beaufort, Hwy. US 70, 30 Jul 1988, *Carter 7202* (VSC). **Dare Co.:** 2.6 mi W Alligator Point, Hwy. US 64, 29 Jul 1988, *Carter 7199* (ctb, VSC). **Tyrrell Co.:** 10.2 mi E Columbia, Hwy. US 64, 29 Jul 1988, *Carter 7185* (ctb, VSC). **SOUTH CAROLINA. Barnwell Co.:** NW Barnwell, 12 Jun 1987, *Horn 1904* (VSC). **Berkeley Co.:** Rte. 41, 5 mi. N Rte. 17, 18 Jun 1983, *McNeilus 35* (ctb). **Colleton Co.:** ca. 1 mi. N Green Pond, Rte. 17, 20 Aug 1993, *McNeilus 93-1921* (ctb); vic. Green Pond, Rte. 303, 29 Aug 1994, *McNeilus 94-857* (ctb). **Dorchester Co.:** SW Summerville, 17 May 1957, *Ahles 26402* (FSU). **Georgetown Co.:** Cat Island, 26 Jul 1990, *Nelson 9392* (VSC). **Jasper Co.:** 4.6 mi NW Tillman, 9 Sep 1968, *Leonard 1928* (VSC). **TEXAS. Aransas Co.:** Lamar, 13 Sep 1992, *Carter 10620* (VSC). **Bastrop Co.:** 1.8 airmiles N 37° W of RR trestle at Sayersville, 13 Jun 1986, *Carr 7567* (VSC). **Bee Co.:** Naval Air Station Chase Field, 30 Sep 1991, *Carr 11539* (VSC). **Cherokee Co.:** 2.6 mi W Reklaw, 17 Aug 1989, *Carter 8240* (VSC). **Gonzales Co.:** N Hwy. US I-10 and W Hwy. US 90, 11 Aug 1989, *Carter 8151* (ctb, VSC). **Jefferson Co.:** Port Arthur, 10 Aug 1989, *Carter 8140* (ctb, VSC). **Matagorda Co.:** NNE Palacios, Fm. Rd. 521, 13 Sep 1992, *Carter 10632* (ctb, VSC). **Montgomery Co.:** ca. 9 mi. S Conroe, 28 Jun 1988, *Hatch 5449* (ctb). **Orange Co.:** along Hwy. I-10, milemarker 868, 19 Jun 1987, *Lievens 2616* (ctb). **Polk Co.:** 7.7 mi. S on Hwy. 59 from jct. with Hwy. 190 in Livingston, 11 May 1988, *Jones 1494 & Wipff* (ctb).

2. **Cyperus drummondii** Torr. & Hook. in Hook., Ann. Lyceum Nat. Hist. New York 3:437 (and errata). 1836. *Cyperus virens* subsp. *drummondii* (Torr. & Hook.) Koyama, Madroño 20:254. 1970. *Cyperus virens* var. *drummondii* (Torr. & Hook.) Kük., Pflanzenreich IV. 20 (Heft 101):181. 1936. TYPE: U.S.A. TEXAS: *Drummond 449* (LECTOTYPE, typified by Denton (1978): K; ISOLECTOTYPES: B, GH, NY-fragment!, OXF!).

Cyperus robustus Kunth, Enum. Pl. 2: 41. 1837. *Cyperus virens* Michx. var. *robustus* (Kunth) Kük., Pflanzenreich IV. 20 (Heft 101): 181. 1936. TYPE: BRAZIL: Brasilia, *Sello s.n.* (B, HOLOTYPE, *fide* Denton 1978).

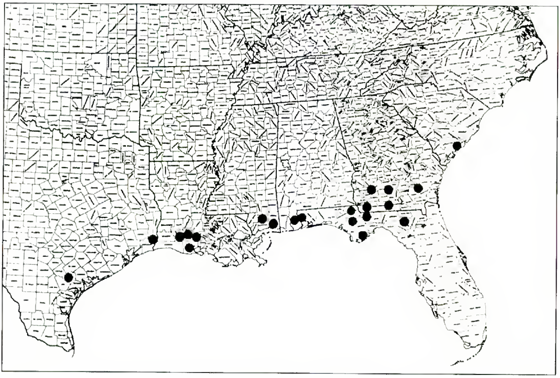

FIG. 4. Distribution of *Cyperus drummondii* in the United States.

Cespitose perennial herb. Roots fibrous, reddish brown. Culms 35–170 cm high, (8–)10–35 times longer than inflorescence width, 2–4.7 mm wide, triquetrous, scabrid. Leaves basal, blades 2.4–11.2 mm wide. Primary inflorescence bracts 3–5, longest 11.3–47.9 cm, up to 0.523 times as long as culm, 1.9–6.7 mm wide. Inflorescence usually tight, 2.1–8(–11.9) cm wide, rays 3–5, longest 0.9–7.7 cm long. Spikes globose, 1.1–7 cm wide. Spikelets flattened, 1.5–2.2 mm wide. Floral scales 18–42, distichous, spreading to ascending, bicarinate, ovate, 1.4–1.6 mm long, pale grayish-green, turning brown. Stamens 1–2, anthers 0.8–1.2 mm long. Style 3-branched, exserted, deciduous. Achene trigonous, oblong-ellipsoidal, 2.4–3.9 times as long as wide, 1.0–1.2 × 0.3–0.5 mm, stipitate, brown. Fig. 2.

Distribution and habitat.—Southern Georgia and northern Florida westward through southern Mississippi and southern Louisiana into southeastern Texas (Fig. 4). Also, known from Nicaragua, Jamaica, Surinam, Ecuador (Galapagos Islands), and Brazil (Kükenthal 1935–1936; Denton 1978). In the southeastern United States, found in the lower coastal plain along the margins of flatwoods ponds, seepage slopes, and coastal prairies.

Phenology.—Flowering and fruiting May through October.

Because of its greater height and tighter inflorescence *Cyperus drummondii* has a strikingly different habit from *C. virens*; this is best observed in the field. *Cyperus drummondii* does not appear to be as weedy as *C. virens*. *Cyperus* *virens* is much more common and widely distributed in the southeastern United States, occurring in a variety of low wet disturbed habitats, especially ditches. In contrast, *C. drummondii* is less common and tends more to be restricted to less disturbed systems such as margins of flatwoods ponds, seepage slopes, and coastal prairies. Also, as summarized in the key, *C. drummondii* differs from *C. virens* in its narrower spikelets, greater achene length to scale length ratio, ovate scales, and fewer primary inflorescence bracts.

Specimens examined. U.S.A. **ALABAMA. Baldwin Co.:** Gulf Shores, S Intercoastal Waterway, 3 Aug 1996, *Kral 86381* (VSC); Gulf Shores, N Intercoastal Waterway, 4 Aug 1996, *Kral 86382* (VSC). **FLORIDA. Calhoun Co.:** ca. Ocheesee Landing, 10 Jul 1976, *Godfrey 75220* (FSU). **Escambia Co.:** near Pensacola, Hwy. I-10, E of Hwy. FL 291, 8 Aug 1989, *Carter 8085* (ctb, VSC). **Franklin Co.:** 3 airmiles N Apalachicola, 19 Jun 1986, *Anderson 9577* (FSU). **Gadsden Co.:** between Quincy and Gretna, 3 Nov 1965, Godfrey 67556 (FSU). **Jackson Co.:** 4.9 mi N Sneads jct. Hwys. US 90 and FL 271, 19 Sep 1988, *Carter 7627* (ctb, VSC); Lake Seminole, 6 Aug 1977, *H. McIntyre s.n.* (VSC). **Suwannee Co.:** E Live Oak, 19 Aug 1976, *Godfrey 75398* (FSU). **GEORGIA. Brooks Co.:** W Dixie, old Hwy. US 84, 22 Jul 1995, *Carter 12532* (ctb, VSC). **Decatur Co.:** Hwy. US 27, 4.3 mi S Ausmac, 5 Aug 1989, *Carter 8019* (ctb, GA, MO, SWSL, VDB, VSC); E Bainbridge, Hwy. US 84, 13 Oct 1992, *Kral 80044* (VSC). **Dougherty Co.:** 6 mi S Albany, Thorne 5002 (US); ca. 4 mi SE Putney, 18 Aug 1989, *Norris & Owsley 5854* (personal herbarium R.A. Norris). **Pierce Co.:** 3.4 mi NE jct. Hwys. GA 15-121 and US 84 in Blackshear, 19 Jun 1992, *Carter 9861* (ctb, VSC); Hwy. US 84, 1.4 mi N Blackshear jct. with Hwy. GA 15-121, 19 Jun 1992, *Carter 9863* (ctb, VSC); SW Blackshear, 2.67 mi NE Hwy. US 84 Satilla River bridge, 17 May 1997, *Carter 14024* (VSC); *Carter 14055 with Alexander* (VSC). **Tift Co.:** 1.6 mi W Tyty, Hwy. US 82, 26 Jun 1993, *Kral 82744 with Carter* (VSC); *Carter 10863 with Kral* (ctb, VSC). **LOUISIANA. Acadia Parish:** 0.5–1.0 mi E jct. Hwys. LA 1124 and US 90 in Estherwood, 3 Sep 1992, *Carter 10455* (ctb, VSC); 0.95 mi W Midland, 17 Jun 1993, *Carter 10761* (ctb, VSC); 5 mi. S Eunice and 5 mi. NE Iota near Frey, 16 May 1994, *Bryson 13478, Allen, Cascio & Geter* (ctb, VSC). **Jefferson Davis Parish:** 2.1 mi N jct. Hwys. US 165 and LA 101 in Woodlawn, 7 Sep 1992, *Carter 10533* (VSC); E Jennings, 1.0 mi W jct. Hwys. US 90 and LA 1126, 8 Sep 1992, *Carter 10542* (VSC). **Lafayette Parish:** between Duson and Scott, 0.5 mi E jct. Hwys. US 90 and LA 724, 6 Sep 1992, *Carter 10508* (ctb, VSC); Lafayette, Moore Park, 16 Jun 1993, *Carter 10738* (ctb, VSC). **Vermilion Parish:** Abbeville, *A.B. Langlois 855c* (US); ca. 7.5 mi SW Gueydan, 8 Sep 1992, *Carter 10546 with McInnis & Smith* (VSC). **MISSISSIPPI. Jackson Co.:** Moss Point, Hwy. MS 63 between Frederick St. and Martin Luther King Dr., 0.5 mi. S Escatawpa River bridge, 16 Sep 1993, *Carter 11314* (VSC), *11315* (ctb, SWSL, VSC); 16 Oct 1994, *Bryson 14544 & MacDonald* (ctb, SWSL, VSC). **Stone Co.:** Hwy. 49 at 2.7 mi S jct. with Hwy. 26 in Wiggins, 20 Aug 1999, *MacDonald 13422 with Warren & Leonard* (VSC). **SOUTH CAROLINA. Charleston Co.:** N McClellanville, *Godfrey & Tryon 724* (US). **TEXAS. Goliad Co.:** 8 mi S Coleto Creek, S Victoria, Hwy. 77, Jones 719 (US); **Orange Co.:** 5.5 mi W Orange, *Cory 50890* (US).

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REFERENCES

ADAMS, C.D. 1994. *Cyperus*. In: Davidse, G., M.S. Sousa and A.O. Chater, eds. Flora Mesoamericana, Vol. 6: Alismataceae a Cyperaceae. Universidad Nacional Autónoma de México, Cuidad Universitaria, Pp. 423–440.

ANONYMOUS. 1996. Minitab reference manual: release 11 for Windows™. Minitab Inc., State College, PA.

BRYSON, C.T. and R. CARTER. 1994. Notes on *Carex*, *Cyperus*, and *Kyllinga* (Cyperaceae) in Mississippi with records of eight species previously unreported from the state. Sida 16: 171–182.

CARTER, R. 1990. *Cyperus entrerianus* (Cyperaceae), an overlooked species in temperate North America. Sida 14: 69–77.

CHAPMAN, A.W. 1889. Flora of the southern United States, 2nd ed. Ivison, Blakeman, and Company, NY.

CHAPMAN, A.W. 1897. Flora of the southern United States, 3rd ed. Cambridge Botanical Supply Company. Cambridge, MA.

CLEWELL, A.F. 1985. Guide to the vascular plants of the Florida panhandle. University Presses of Florida, Tallahassee.

CORRELL, D.S. and H.B. CORRELL. 1975. Aquatic and wetland plants of the southwestern United States. Stanford University Press, Stanford, CA.

CORRELL, D.S. and M.C. JOHNSTON. 1970. Manual of the vascular plants of Texas. Texas Research Foundation, Renner, TX.

DENTON, M.F. 1978. A taxonomic treatment of the *Luzulae* group of *Cyperus*. Contr. Univ. Michigan Herb. 11:197–271.

GODFREY, R.K. and J.W. WOOTEN. 1979. Aquatic and wetland plants of southeastern United States: Monocotyledons. University of Georgia Press, Athens.

HATCH, S.L., K.N. GANDHI, and L.E. BROWN. 1990. Checklist of the vascular plants of Texas. MP-1655. Texas Agricultural Research Station, College Station.

JONES, S.D., J.K. WIPFF, and P.M. MONTGOMERY. 1997. Vascular plants of Texas: A comprehensive checklist including synonymy, bibliography, and index. University of Texas Press, Austin.

KOYAMA, T. 1970. New combinations in the Cyperaceae of the Galapagos Islands. Madroño 20:254.

KÜKENTHAL, G. 1935–1936. *Cyperus*. In: A. Engler and L. Diel, eds. Das Pflanzenreich IV. 20 (Heft 101):1–671.

MCGIVNEY, M.V. 1938. A revision of the subgenus *Eucyperus* found in the United States. Cath. Univ. Amer. Biol. Ser. 26:1–74.

MOHR, C. 1901. Plant life of Alabama. Contr. U.S. Natl. Herb. 6:1–921.

SEBER, G.D.F. 1984. Multivariate observations. John Wiley & Sons. New York.

SMALL, J.K. 1933. Manual of the southeastern flora. New York.

SNEATH, P.H.A. and R.R. SOKAL. 1973. Numerical Taxonomy. W. H. Freeman and Company. San Francisco.

Thomas, R.D. and C.M. Allen. 1993. Atlas of the vascular flora of Louisiana, Vol. I: the ferns & fern allies, conifers, & monocotyledons. Moran Colorgraphic Printing, Baton Rouge, LA.

Torrey, J. 1836. Monograph of North American Cyperaceae. Ann. Lyceum Nat. Hist. New York 3:1–448.

Tucker, G.C. 1994. Revision of the Mexican species of *Cyperus* (Cyperaceae). Syst. Bot. Monogr. 43:1–213.

Wunderlin, R.P. 1982. Guide to the vascular plants of central Florida. University Presses of Florida, Tallahassee.

Wunderlin, R.P. 1998. Guide to the vascular plants of Florida. University Press of Florida, Gainesville.

BOOK NOTICE

Philip W. Hendrick. 1984. **Population Biology, The evolution and ecology of populations. 1998 printing.** (ISBN 0-86720-043-X, pbk.) Jones and Bartlett Publishers International, 7 Melrose Terrace, London W6 7RL, ENGLAND and Boston, MA. $47.50. 445 pp., numerous figures.

This text is a comprehensive resource for the study of population genetics and population ecology. Now in its 15th year, it has been reorganized into three parts that explore I) Basic principles of genetics, II) Population biology, and III) The interrelationship between these two fields. In each chapter you will find theoretical explanations, case studies, examples for relevant models, and graphics selected to highlight important topics. Short problem sets at the end of each chapter provide students the opportunity to practice using the models presented in the text. Part one provides students with a solid foundation in the field of genetics, with discussions covering major topics such as chromosomal variation, the Hardy-Weinberg Principle, and gene flow. The section on Population Biology begins with a discussion of factors influencing species distribution and abundance, and of population density and dispersion before entering into a discussion of demography. This provides a useful context for understanding growth models and population dynamics. A thorough presentation of interspecific competition, predator-prey interactions, and the theoretical models used to describe these processes concludes part two. Part three builds on lessons from the first parts of the book to explore major topics in the fields of evolutionary ecology, ecological genetics, and applied population biology. The text illustrates the combined use of established theories and models with modern technologies to solve current problems in ecology or applied biology. It is a useful resource for students of genetics, ecology, and evolutionary ecology alike.

Contents for *Population Biology, The evolution and ecology of populations*: Preface, Introduction, Genetic Variation, Allelic and Genotypic Frequencies, Selection, Mutation, Gene Flow, Genetic Drift, Nonrandom Mating, Quantitative Traits, Factors Affecting Distribution and Abundance, Population Density and Dispersion, Population Growth, Demography, Interspecific Competition, Predator-Prey Interactions, Ecological Models of Selection, Adaptation and Speciation, Molecular Variation and Evolution, The Evolution of Social Behavior, Demographic Genetics and Life-History Evolution, Coevolution and the Evolution of Interspecific Interactions, Applied Population Biology, Conclusions to Part 3, Glossary, Bibliography, Answers to Numerical Questions, Author Index, and Subject Index.—*Charlotte Bryant.*

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STRIKING SEXUAL DIMORPHISM IN *LINDERA SUBCORIACEA* (LAURACEAE)

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ABSTRACT

Male and female flower morphology is documented for Florida plants, augmenting the original floral analysis of this rare, dioecious species *(Lindera subcoriacea)*. Sexual dimorphism is readily apparent; leaves on male plants are much larger than those on female plants. Leaf surfaces of the two sexes also contrast strongly in features of trichome size, epicuticular wax (abundance and pattern), and development of peristomatal rims. Such dimorphism has not been previously reported for the Lauraceae.

RESUMEN

Se documenta la morfología de flores masculinas y femeninas de *Lindera subcoriacea* en plantas de Florida, aumentando el análisis floral de esta especie rara y dioica. El dimorfismo sexual es muy aparente; las hojas de las plantas masculinas son mucho mayores que las de las plantas femeninas. Las superficies foliares de los dos sexos también contrastan fuertemente en cuanto a las características del tamaño de los tricomas, ceras epicuticulares (abundancia y patrón), y desarrollo de los bordes peristomáticos. Este dimorfismo no había sido citado previamente en las Lauraceae.

INTRODUCTION

Wofford described *Lindera subcoriacea*, the bog spice bush, in 1983. This species is now known to occur in at least eight states, ranging in coastal states from Louisiana to Florida north to Virginia (Bridges & Orzell 1989; Bryson et al. 1988; McCartney et al. 1989; Sorrie 1993). Although the range appears extensive, the plant is nowhere common. Most occurrences consist of one or a few plants. McCartney et al. (1989) signaled its possible presence in Florida by listing some peninsular populations as "*Lindera* affin. *subcoriacea*." Sorrie (1993) stated they have proven to be *L. benzoin* (L.) Blume, but these problematic peninsular plants need further study. Unequivocal *L. subcoriacea* was reported by Anderson (1995) from a population in the Florida panhandle.

More attention to the Florida panhandle plants is warranted because Wunderlin (1998) did not list the species for Florida, and additional field surveys since the initial report (Anderson 1995) have revealed new dimensions in the species' morphology.

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MATERIALS AND METHODS

The original plant upon which the Florida panhandle record was based (Anderson 1995) was destroyed by brush removal under the *Cliftonia* canopy along Metts Creek in Okaloosa County shortly after the collection was made. Intensive survey along Metts Creek and nine similarly nearly pristine clearwater streams in the general area (on Eglin Air Force Base) for additional bog spice bushes yielded a count of 12 plants (six of each sex, restricted to Metts Creek). James R. Burkhalter collected a sample (originally identified only as *Lindera*) from a presumably male shrub (sterile) on the campus of the University of West Florida in Escambia County. After being alerted to its identity, he searched the area thoroughly and reported (pers. comm.) that the plants were no longer extant as a result of habitat alteration.

Flowering materials were preserved in FPA (5 pts formalin, 5 pts proprionic acid, 90 pts 70% ethanol). Living plants were tagged at blooming time so that they could be more easily located later in the season. Samples with mature leaves were taken from only a few plants because of the species' rareness. Vouchers are at FSU unless otherwise noted. Leaf morphology (of the largest leaf per specimen) was studied from samples representing the geographical range of the species. Leaf samples were cleared in NaOH and stained in safranin for study of venation and trichomes. Other samples were sputter coated with gold palladium, and micrographs were taken on a Joel JSM-840 scanning microscope operated at 10KV.

RESULTS

Wofford (1983) reported the plants were up to 2 m tall (his original description was based solely on specimens from Mississippi and Louisiana as this species was not known to occur elsewhere at that time), whereas Sorrie (1993) said that in North Carolina the plants grew up to 4 m tall and were multistemmed. At Metts Creek (Florida) the blooming shrubs were 1.5–4.2 m tall with only 2–4 stems per clump. These deciduous shrubs bloom in mid-March (as they do in Mississippi) before leaf development.

Florida flowers of this dioecious species differ in several aspects from Wofford's description. Some of the differences in size may have arisen because his measurements came from restored (boiled) flowers, whereas mine came from preserved flowers. Wofford (1983) stated flower buds were ca. 2.5 mm wide and tepals were 2.2 by 1.8 mm. Further, in staminate flowers, stamens were 2.5 mm long, and the pistillodium was 1.2 mm long (Wofford 1983). In our plants, staminate flowers were generally larger (2.8–3.2 mm long by 3.8–4.5 mm wide at anthesis); outer tepals were 2.4–2.8 by 1.8–2.0 mm, whereas inner tepals were slightly smaller (2.2–2.5 by 1.5–1.7 mm). The nine stamens were 2.7–2.9 mm long; the innermost series of three had a pair of stalked (1 mm) glandular outgrowths. The glandular heads were 0.8 mm wide and had 3–4 irregular lobes.

The original description (Wofford 1983) stated pistillate flowers were on pedicels 1.5 mm long, with tepals slightly smaller that those of staminate flowers, and stamens (staminodes) variously developed, often reduced to glands. The style was 1 mm long, and the ovary elliptic and 1.0 by 0.6 mm. In our plants, pistillate flowers were on pedicels 1.5–2.5 mm long. Flowers were 1.8–2.2 mm long (style excluded) by 2.2–2.6 mm wide. The outer tepals were 2.0–2.2 by 1.1–1.4 mm, and the inner tepals were 2.0 by 1.4–1.5 mm (relatively wider than the outer tepals). The six outer staminodes (in two series) were reduced to naked filaments 1.4 mm long (no vestige of anthers), whereas the three innermost staminodes (also filaments 1.4 mm long) had a pair of flattened, stalked glands fused basally to the filament. The glands differed from those of the staminate flowers in that the heads (0.8 mm wide) were broadly cordate and lacked irregular lobes. Styles were 1.4–1.8 mm long and often curved. The elliptic ovaries were 1.6–1.8 mm long by 0.9–1.0 mm wide. Mature fruits were scarlet, elliptical, and 10 mm by 6 mm.

Wofford and Sorrie both gave the same range of 4–7.5 cm long by 2–3.5 cm wide for leaves of *L. subcoriacea* (Fig. 1). Leaves of female shrubs in the Metts Creek population fall in that size range; the largest leaves per sample (usually the penultimate on any given branch) measured 5.6–6.8 cm long by 2.4–2.8 cm wide (Figs. 2–4). This dioecious species exhibits sexual dimorphism, however; leaves on the male shrubs are 9.0–10.5 cm long by 3.5–4.6 cm wide (Figs. 5–7). The ranges in leaf size of the two sexes are almost completely nonoverlapping, if one discounts the very small broadly obovate leaves that occur basally on the branches (they are 1–2 cm long on female shrubs and 3.3–5 cm long on male shrubs). Incidentally, female plants of *L. benzoin* var. *pubescens* from Florida have leaves larger than any seen in *L. subcoriacea*.

Mature leaves were dark green adaxially, whereas the abaxial (undersurface) area was generally pale, grayish, glaucescent, and moderately appressed pubescent. Venation is brochidodromous (Figs. 1–7; Hickey 1979), and the areoles are well developed. Trichomes were nonglandular and unicellular (Figs. 8–9), as is typical for the Lauraceae (Metcalfe & Chalk 1979). Average trichome length on leaves of four Florida female shrubs ranged from 0.19 to 0.22 mm long [and 0.23 on *Wofford 82-121* (TENN), an isotype], whereas trichomes on Florida male shrubs averaged 0.29–0.32 mm long. The longer trichomes on male shrubs also appear to be somewhat thicker than those on female shrubs (Figs. 11–13).

Stained, partially cleared leaves showed the epidermal cells were thin-walled; stomatal guard cells were 24–26 μm long, and the stomata were paracytic (similar to those of fossil forms of *Lindera* illustrated by Bandulska

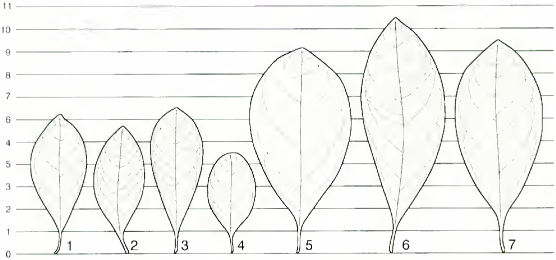

FIG. 1–7. Comparative size (scale in cm) and shape of leaves (largest per branch) in *Lindera subcoriacea*, showing brochidodromous venation (i.e., secondary veins joined together in a series of prominent arches). Fig. 1. Leaf from female plant from George Co., MS, *Wofford 82-121* (A, holotype). Fig. 2–4. Leaves from female plants from Okaloosa Co., FL. Fig. 2. *Anderson 14452*. Fig. 3. *Anderson 14920*. Fig. 4. *Anderson 13851*. Fig. 5–6. Leaves from male plants from Okaloosa Co., FL. Fig. 5. *Anderson 14922*. Fig. 6. *Anderson 14921*. Fig. 7. Leaf from male plant from Escambia Co., FL, *Burkhalter 5658*.

1926). The two subsidiary cells tended to be unequal in size on female leaves; one cell was somewhat rectangular and lay parallel to the guard cell, whereas the other subsidiary cell was more triangular in outline. Conversely, stomata on male leaves had more evenly shaped, triangular subsidiary cells.

The grayish appearance of the leaf undersurface was due to wax accumulation more than to indumentum (Figs. 10–16) as demonstrated by scanning electron microscopy (SEM). The thick layer of cuticular wax obscures epidermal cell outlines. A papillose abaxial leaf surface is characteristic of the Lauraceae (Metcalfe &Chalk 1979). The stomata on *L. subcoriacea* leaves are sunken and surrounded by prominent stomatal rims; peristomatal rims are also evident—see Wilkinson (1979) for overview of these stomatal structures. Stomatal rims and peristomatal rims may prove to be frequent among woody taxa that have relatively firm (subcoriaceous) leaves in the southeastern United States flora; elaborate rims have also been reported for *Gordonia* (Anderson 1983) and *Sideroxylon* (Anderson 1996).

Sexual dimorphism is also evident at the micromorphological level. Leaves of female plants have extensive epicuticular wax papillae over the epidermal cells and the massive peristomatal rims (Figs. 10–12, 14–15). Leaves of male plants have scattered epicuticular flecks of wax that do not hide the cuticle, and peristomatal rims are not massive, but are present as 1–3 ridges lying parallel to the long axis of the stomatal rim (Figs. 13, 16).

Unisexual flowers are, by definition, dimorphic, but in *L. subcoriacea* the

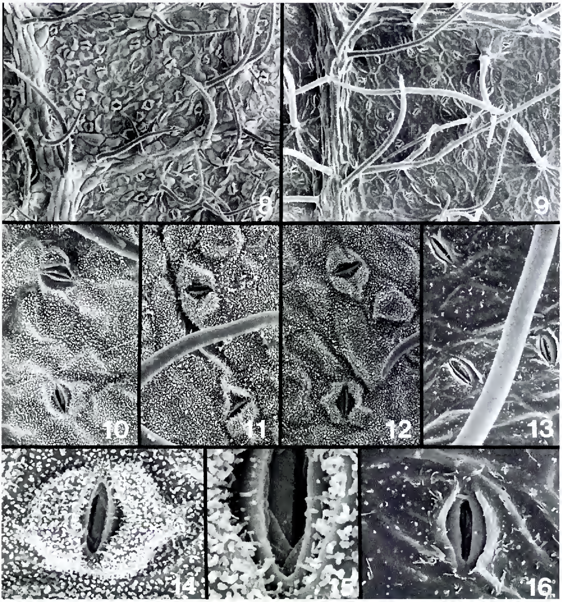

Fig. 8–16. Electron micrographs of leaf surfaces in *Lindera subcoriacea*. Figs. 8–9. Venation and trichomes, × = 100 . Fig. 10–13. Leaf surfaces showing cuticle and stomatal features, × = 500 . Fig. 8. Leaf from female plant, *Anderson 14452*. Fig. 9. Leaf from male plant, *Anderson 14921* showing trichomes slighrly longer and thicker than those on female leaf (Fig. 8). Fig. 10. Female from George Co., MS, *Wofford 82-121* (TENN, isotype). Fig. 11. Female from Hoke Co., NC, *Carter s.n.* Figs. 12. Female from Okaloosa Co., FL, *Anderson 14452*, showing nearly continuous layer of epicuticular papillae and large peristomatal rims (as in Fig. 10–11). Fig. 13. Male from Okaloosa Co., FL, *Anderson 14921* showing scattered epicuticular flecks, reduced development of peristomatal rims, and thicker trichomes (than female leaves, Fig. 10–12). Fig. 14. Leaf suraces of *Anderson 14452* (female plant) showing massive peristomatal rims covered with epicuticlar papillae with stomatal rim barely visible, × = 1500. Fig. 15. Portion of Fig. 14 showing detail of epicuticular papillae and part of stomatal rim with the peristomatal rim, × = 3500. Fig. 16. Leaf surface of *Anderson 14921* (male plant) showing sparse eipcuticular flecks of wax and partial development of peristomatal rim (forming brackets or ridges parallel to the stomatal rim), × = 1500.

dimorphism extends to nonsexual parts of the flower with the different shapes of glandular heads on staminodes. Sexual dimorphism in the Florida plants is expressed vegetatively in leaf size, trichome length, epicuticular wax patterns, stomata (subsidiary cells), and peristomatal rim development. Vegetative sexual dimorphism has been reported for *L. benzoin* (Cipollini & Whigham 1994), in which leaves on male shrubs averaged 1.3 times longer than those on female shrubs. In *L. subcoriacea* the dimorphism is more pronounced; male leaves average 1.7 times longer than those on female shrubs. Apparently, vegetative sexual dimorphism at the microscopic level has not been previously reported for *Lindera* or any other dioecious members of the Lauraceae (Wood 1958; van der Werff 1991).

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REFERENCES

ANDERSON, L.C. 1983. Trichomes and stomata of *Gordonia lasianthus* (Theaceae). Sida 10:103–113.

__________. 1995. Noteworthy plants from north Florida. Sida 16:581–587.

__________. 1996. New geographical and morphological data for *Sideroxylon thornei* (Sapotaceae). Sida 17:343–348.

BRIDGES, E.L. and S.L.ORZELL. 1989. *Lindera subcoriacea* (Lauraceae) new to Alabama. Phytologia 67:214–216.

BRYSON, C.T., W. MCDEARMAN, and K.L. GORDON. 1988. *Carex exilis* Dewey (Cyperaceae) in Mississippi bogs. Sida 13:171–175.

CIPOLLINI, M.L. and D.F. WHIGHAM. 1994. Sexual dimorphism and cost of reproduction in the dioecious shrub *Lindera benzoin* (Lauraceae). Amer. J. Bot. 81:65–75.

HICKEY, L.J. 1979. A revised classification of the architecture of dicotyledonous leaves. Pp. 25–39, In: C.R. Metcalfe and L. Chalk, eds. Anatomy of the dicotyledons, Vol. 1, 2nd ed. Clarendon Press, Oxford.

METCALFE, C.R. and L. CHALK. 1979. Anatomy of the dicotyledons, Vol. 1, 2nd ed. Clarendon Press, Oxford.

MCCARTNEY, R.B., K. WURDACK, and J. MOORE. 1989. *Lindera* in Florida. Palmetto 9(2):3–8.

SORRIE, B.A. 1993. *Lindera subcoriacea* Element Stewardship Abstract. The Nature Conservancy, Sandhills Field Office, Southern Pines, North Carolina.

VAN DER WERFF, H. 1991. A key to the genera of the Lauraceae in the New World. Ann. Missouri Bot. Gard. 78:377–387.

WILKINSON, H.P. 1979. The plant surface (mainly leaf). In: C.R. Metcalfe and L. Chalk, eds. Anatomy of the dicotyledons, Vol. 1, 2nd ed. Clarendon Press, Oxford. Pp. 97–165.

WOFFORD, B.E. 1983. A new *Lindera* (Lauraceae) from North America. J. Arnold Arbor. 64:325–331.

WOOD, C.E.,JR. 1958. The genera of the woody Ranales in the southeastern United States. J. Arnold Arbor. 39:296–346 (Lauraceae, pp. 326–346).

NEW PLANTS FROM PAPUASIA. NOVELTIES FROM THE LAKEKAMU AND BISMARCK-RAMU EXPEDITIONS

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ABSTRACT

Two species are formally described from the 1996 survey of the Lakekamu basin. The new plants are *Medinilla sapoi-riverensis* (Melastomataceae) and *Trichospermum stevensii* (Tiliaceae). *Medinilla bismarck-ramuensis* is described from the 1995 biological survey of the Bismarck-Ramu tract. Taxonomic and ecological notes are provided with the diagnoses.

ABSTRACT (MELANESIAN TOK PISIN)

Wanpela wok bus painimaut kamap pinis long ples Lakekamu, long Oktoba 14 igo Novemba 12, 1996. Dispela wok i kamapim tupela liklik diwai we i nupela samting olgeta. Lain saientis givim ol nem olsem: *Medinilla sapoi-riverensis* na *Trichospermum stevensii*. Narapela nupela samting kamapim long graun long Bismak-Ramu, na nem bilong dispela em i *Medinilla bismarck-ramuensis*.

INTRODUCTION

The Lakekamu basin was botanically surveyed between October 14 and November 12, 1996, as part of a general biological assessment organized by Conservation International and the Foundation for People and Community Development. The survey territory is regarded as one of Papua New Guinea's 16 terrestrial unknown areas (Sekhran & Miller 1995: 114) and is also ranked among the highest value sites for biodiversity preservation in Papuasia (ibid: 121). A synopsis of scientific results from the expedition was previously published (Mack 1998). The present paper provides a formal description for two of the plants listed as new species in the earlier publication (Takeuchi & Kulang in Mack 1998).

A third species (*Medinilla bismarck-ramuensis*) is described from an expedition reviewed by Hedemark et al. (1997) and Takeuchi (1999).

DESCRIPTION OF NEW SPECIES

MELASTOMATACEAE

Medinilla bismarck-ramuensis Takeuchi, sp. nov. (**Fig. 1**). TYPE: PAPUA NEW GUINEA. WESTERN HIGHLANDS PROVINCE: Bismarck Range, Mt. Oibo, ridgeline

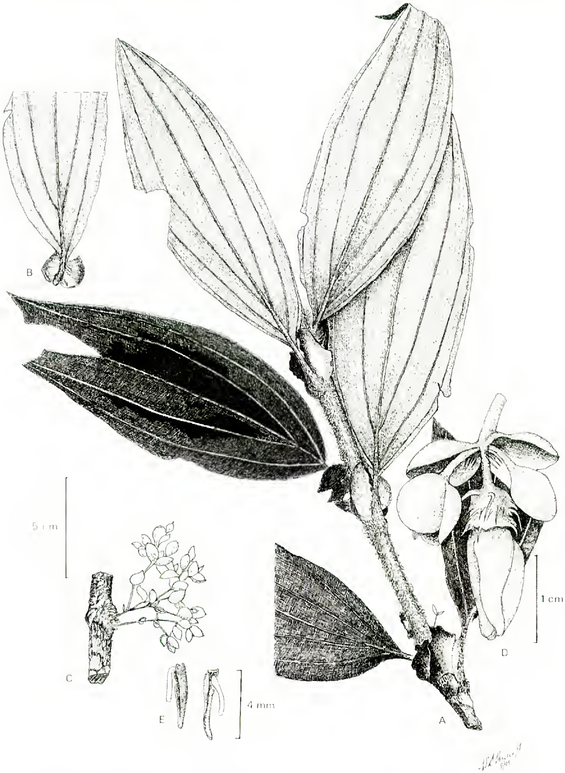

FIG. 1. **Medinilla bismarck-ramuensis** Takeuchi. A. Vegetative habit. B. Leaf and petiolar auricles. C. Inflorescence: flowers obscured by bracts. D. Cyme. E. Major stamen; perspectives from the bud. Drawn from the type by N.H.S. Howcroft.

near 'Camp 1,' GPS 05° 35.513' S, 144° 47.252' E, elev. 2,357 m, 4 Oct 1995 (fl), *W. Takeuchi 10,408* (HOLOTYPE: LAE; ISOTYPES: A, K, L).

Medinillae schlechtero Mansfeld et *M. mansfeldianae* Merrill & Perry affinis sed abiea petiolis auriculatis differt.

Erect epiphytic shrub to 2 m in height. *Branchlets* robust, terete, obliquely ascending, indumentum setiform, spreading or subappressed, ± dense; nodal innovations crowded, setose, acroscopic, 10 mm long, glabrous and smooth or at most obscurely plumulose near the base. *Leaves* isomorphic; blades fleshy or coriaceous, elliptic or broadly lanceolate, 13.8–20.0 cm × 4.3–9.0 cm, apex acute or gradually acuminate, base equal, cuneate to obtuse, margin entire, not or hardly reflexed, lamina epunctate, bichromatic, adaxial surface dark opaque green, abaxially pale purple-suffused, bifacially alveolate in sicco; venation 5–7 plinerved, ventrally prominulous, more or less channelled, raised dorsally and distinctly purple, the lateral pairs of veins diverging from at most 22 mm above the base, at first subsericeous, progressively setose towards the petiole, later glabrate on the mature lamina, reticulating nerves invisible; petioles to 25 mm long, setose, proximally alate, the wings paired, auriculiform, to 31 mm × 15 mm, foliaceous, the margins usually entire, rarely erulose, surfaces purple and glabrous. *Inflorescence* dichasial, 2–12 cm long, solitary or fascicled, variably inserted, infrafoliar and lateral to cauline, occasionally from the axils of attached leaves, all parts dark reddish-purple except for the corolla, rachises cernuous, terete, not or only sparingly branched, setulose at nodes, glabrous in between, conspicuously and persistently bracteate; bracts geminate, orbicular, ca. 8 mm broad, involute, infrequently with margins distantly fimbriate, surfaces glabrous, venulose, nervation anastomosing; pedicels 3–4 mm, subtended by paired bracteoles. *Flowers* (measurements from spirit-preserved material) acute in bud; hypanthium setose, cupuliform-ovoid, typically 5 mm × 4–5 mm, margin denticulate or irregularly notched; corolla 5-merous, choripetalous, white, imbricate, petals 13 mm × 9 mm, asymmetric; stamens 10, glabrous, isomorphic but of differing lengths, 5 long stamens alternating with 5 short ones, the longer outer stamens: filament ca. 2.3 mm, anthers ca. 4.1 mm; shorter inner stamens: filament ca. 1.9 mm, anthers ca. 3.0 mm; all stamens with anthers at first inwardly retrorse and contiguous with the filament, dorsally ecalcarate or nearly so, ventral appendages minute; style 7–8 mm long, glabrous, cylindrical, apically tapering, stigma discolorous and punctiform. *Fruits* not seen.

Distribution and ecology.—*Medinilla bismarck-ramuensis* is known only from montane forests in Western Highlands and Morobe Provinces. The type was found as scattered plants in fog-swept clearings, growing on mossy stumps and logs.

Etymology.—The new species commemorates the 1995 Bismarck-Ramu expedition.

PARATYPE. PAPUA NEW GUINEA. MOROBE PROVINCE: Aseki Patrol Area near Haumga, elev. 5,900 ft (1,800 m), 4 Apr 1966 (fl), *L.A. Craven & R. Schodde 1157* (A, CANB, K, L, LAE).

Medinilla is comparable to *Cyrtandra* in its pattern of endemic diversification. Even at the time of the first revision of Papuasian taxa (Mansfeld 1925), *Medinilla* was already one of the larger woody genera, with a conspectus of 53 species. Merrill and Perry (1943) later added 16 species using a key patterned on Mansfeld. Baker (1916), Ohwi (1943), and Bakhuizen (1943) also contributed species from the Wollaston expedition, the Kanehira-Hatusima collections, and Dutch New Guinea, respectively. Numerous contemporary gatherings cannot be accommodated by these earlier contributions, suggesting that the number of undescribed species is substantial.

In Mansfeld (1925: 115–18) the new species will key to *M. schlechteri* Mansfeld. Unlike most treatments from the 'Beiträge zur Flora von Papuasien' series, Mansfeld's key is written in Latin rather than German. Although outdated, Mansfeld's treatment still stands as the most comprehensive available account. *Medinilla bismarck-ramuensis* can be inserted into the couplet train at species 50, in the following manner:

Folia supra glabra, subtus nervis pilis nonnullis vestitis
Petiolus auriculatus: .... **Medinilla bismarck-ramuensis** Takeuchi
Petiolus non auriculatus: .... **Medinilla schlechteri** Mansfeld

In Merrill and Perry (1943: 427–28), *M. mansfeldiana* Merrill & Perry is the closest match to the new species, but the longer and manifestly auricled petioles on *M. bismarck-ramuensis* are distinctive. The novelty's affinity is actually to a group consisting of four species (fork G, ibid: 427).

Medinilla bismarck-ramuensis may be connected to the complex characterized by persistent bracts and bracteoles, and regarded by Merrill and Perry (ibid: 422) as comprising a distinct section. In Papuasia, this alliance is characteristic of the archipelagic stations from New Britain to the Solomons and (unlike the new species) is usually markedly anisophyllous. It was not previously thought to occur on the New Guinea mainland.

Medinilla sapoi-riverensis Takeuchi, sp. nov. (**Fig. 2**). TYPE: PAPUA NEW GUINEA. GULF PROVINCE: Lakekamu, near Sapoi River, first ravine on the track above Ivimka Research Station, 07° 44' S, 146° 30' E, elev. 183 m, 22 Oct 1996 (fl, fr), *W. Takeuchi & J. Kulang 11,398* (HOLOTYPE: LAE; ISOTYPES: A, BISH, BRIT, CANB, K, L).

Medinilla warica Mansfeld similis sed inflorescentiis non terminalibus.

Epiphytic shrub, ascending or with branches extended and hanging. *Stems* quadrangulate, tetrapterous, weak, hollow, surfaces green, minutely and distantly stellate-furfuraceous on apical intervals, older parts glabrous and pustulate, nodal innovations light-brown setose, 15–25 mm long, the youngest ones

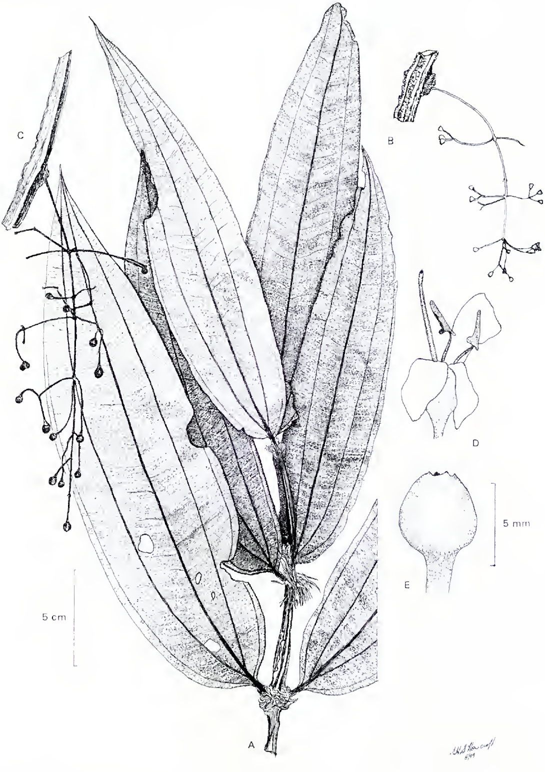

FIG. 2. **Medinilla sapoi-riverensis Takeuchi**. A. Vegetative habit. B. Immature infructescence. C. Mature infructescence. D. Flower, showing 3 petals, 2 stamens, and the style; other parts removed for clarity. E. Fruit. Drawn from the type by N.H.S. Howcroft.

somewhat plumulose but with the hairs fugacious. *Leaves* equal, obliquely diverging; blades linear-elliptic or narrowly lanceolate, subcoriaceous, 23–33 cm × 5.2–8.0 cm, adaxial surfaces opaque green, abaxially pale green; apex attenuate, prolonged into a filiform cauda or not, margins reflexed, base cuneate to obtuse, lamina reddish-purple in flush, initially stellate-pubescent on veins, glabrous when mature; venation 5-plinerved, the lateral pairs diverging from less than 12 mm above the petiole, raised on both sides, tertiary nervation transversal, scalariform, ventrally prominulous, dorsally less apparent; petiole 8–15 mm long, glabrescent. *Inflorescence* ramigerous, paniculiform, ultimately cymose, lax, pendulous, 10–18 cm long, ternate or quaternate on the first order ramification, lateral branches to 4 cm long, all axes nitid, red, flaccid, delicate, inconspicuously and stellately pubescent, eventually glabrate; floral bracts linear, persisting, hardly visible; pedicels 1–3 mm long. *Flowers* (measurements from spirit-preserved material): hypanthium cylindric to narrowly ovoid, 3.0–3.5 mm × 2.5–2.8 mm, margin truncate or 4-denticulate, exterior surfaces light green, at first very sparsely lepidote like the pedicel, glabrate at anthesis; corolla 4-parted, acute in bud, petals pink, reflexed, ecostate, asymmetric, distally oblique, apiculate, 4.0 mm × 2.5–2.8 mm; stamens 8, equal, glabrous, filaments 2.3–2.6 mm long, apically attenuate, anthers 1.9–2.0 mm long, distinctly calcarate and bi-appendiculate, dorsal spur ca. 0.4 mm long, linear, basally directed, ventral appendages lobulate, introrsely projecting, deltoid, ca. 0.2 mm long; style 6.5–6.9 mm long, stigma discolorous and punctiform, receptive surface obscurely papillate. *Fruit* globose, 5–6 mm in diameter, baccate, polyspermous, exocarp green turning black when ripe; seeds oblongoid, 1.0–1.2 mm × 0.5 mm, testa pale, verruculose.

Distribution and ecology.—Known with certainty only from the type locality. *Medinilla sapoi-riverensis* is infrequent in natural growth foothill forest, favoring mainly the wetter sites afforded by dark draws and gullies, especially near flowing creeks with closed overstories. It is shade-loving and does not occur in seral situations. A collection from Western Province (*Henty et al. in NGF 42788*) may be *M. sapoi-riverensis*, extending its range further west towards the border with Irian Jaya. The vegetative characters are consistent with the new species, but the specimen lacks the fertile structures required for reliable identification.

Etymology.—*Medinilla sapoi-riverensis* is named after the type locality in the Lakekamu basin.

Medinilla sapoi-riverensis is distinguished by its elongate leaves and quadrangular-alate branchlets. Other salient characters are the lax, pendulous inflorescences with verticellate branching. Innovations are setose at older nodes and only caducously plumulose in the apical tufts.

Medinilla sapoi-riverensis keys to *M. warica* Mansfeld (Mansfeld 1925) but the latter species has a terminal inflorescence. There is also an apparent affinity to *M. mansfeldiana* Merrill & Perry, and *M. schlechteri* Mansfeld. The new species differs from *M. mansfeldiana* by the nature and density of the indumentum, length of the inflorescence, and size of the bracts. From *M. schlechteri*, it differs in having clearly petiolate leaves, smaller bracts, and esetose calyces.

TILIACEAE

Trichospermum stevensii Takeuchi, sp. nov. (**Fig. 3**). Type: PAPUA NEW GUINEA. Gulf Province: Lakekamu, Sapoi River, streambanks near base camp, 07° 44' S, 146° 29.5' E, elev. 105 m, 7 Nov 1996 (fl bud, fr, xylarium collection), *W. Takeuchi & J. Kulang 11,589* (holotype: LAE; isotypes: A, BISH, BRIT, CANB, K, L).

Folia subter consperce stellato-pilosa et costa media nervisque minute stellato-lepidotis differt.

Small tree to 8 m tall. *Stem* without buttress or basal swell, exterior surfaces pale grayish-brown, unfissured, not lenticellate; bark thick, fibrous, extractable in flexible strips or plates; wood white, weak, very light in weight. *Branchlets* flexuous, terete, sparingly mucilaginous from cut surfaces, pithy, indumentum stellate, squamulate, scales dark brown, at most 0.3 mm diameter, coarsely-armed, crowded, occasionally accompanied by larger ascending hairs especially at the stem apices. *Stipules* caducous or persisting through several nodes, oblong-ovate, typically 10 mm × 4 mm, rarely to 14 mm × 10 mm, foliaceous, yellow-green, cordately-based or auriculate, proximally and laxly provided with indumentum like the branchlets, otherwise glabrescent. *Leaves* distichous, membranaceous, adaxially dark dull green, abaxially medium green and marked by opaque punctulations, ventral surfaces puberulous, the hairs simple or stellate, following veins, dorsal surfaces stellate-pilosulous, hairs 4–8 armed, ascending, processes short, ca. 0.2 mm long, the midrib also provided with a secondary indumentum of smaller appressedly stellate scales; mature blades oblong, weakly constricted near the middle, 22–32 cm × 10.5–14 cm; apex long-acuminate, more or less abruptly developed, the acumen 2.0–3.5 cm long; leaf margins entire to the naked eye, remotely and minutely toothed under magnification, serrulations glandular-thickened from excurrent nervules; leaf base truncate or more commonly broadly cordate, the sinus when present to 1.5 cm deep, basal glands marginal, occurring as linear callosities flanking the petiole insertion; lateral veins 7–9 above a basal nervation, often in opposite pairs, acutely diverging (ca. 45° from the midrib), generally straight, ending in commissural looping nerves or not, major veins plane or hardly raised ventrally, dorsally prominulous and with primary axils stellately comose, higher order axils clear, intercostals obliquely scalariform, tertiary venation lax; petiole 14–25 mm long, unchannelled, indumentum as the branchlets. *Inflorescence* axillary, to 8.5 cm length, axes texturally scabrid, variably covered by stellate scales and occasional interspersed hairs, rachides unequal, often fractiflex,

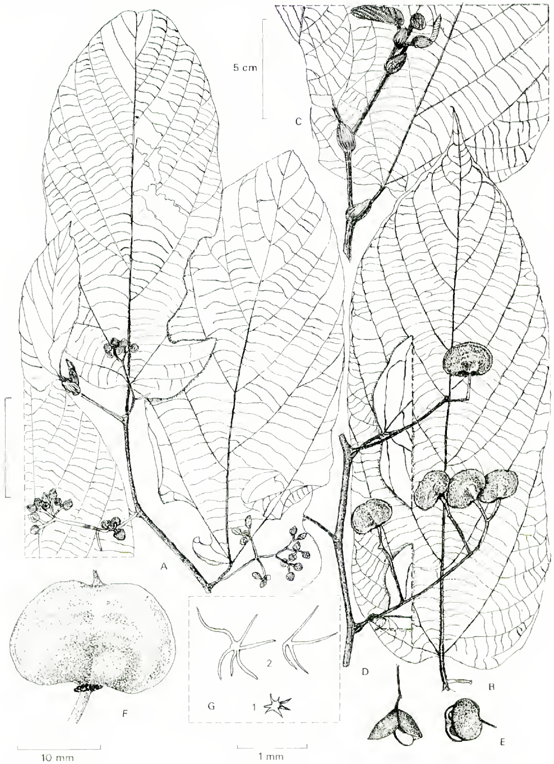

FIG. 3. **Trichospermum stevensii** Takeuchi. A. Flowering branchlet. B. Mature leaf. C. Vegetative branchlet and stipules. D. Infructescence. E. Dehisced fruits. F. Detail of capsule from side. G. Capsule hairs, showing the 2 stellate types discussed in the text. Drawn from the type by N.H.S. Howcroft.

bifurcate or ternate at the first branch, ultimately cymose, peduncle 5–30 mm long; bracts deciduous, free, linear-acuminate or ligulate, usually 2–3 mm long, sparsely stellate-hairy, the cymes subtended by 6 bracteoles. *Flowers* not seen at anthesis, immature buds (all measurements from rehydrated material) ovoid to subglobose, 4.5–5.5 mm × 5.5–6.0 mm, yellow-green; sepals 5, valvate, fleshy, ovate, 5 mm × 3 mm, outer surfaces coarsely and minutely stellate-hairy, inside non-stellately pilosulous with submoniliform hairs; corolla included, imbricate, 5-choripetalous, chartaceous, reticulately venose, elliptic to oblong, ca. 4 mm × 2 mm, dorsally with indumentum like the contiguous calycine surface, ventrally glabrate; androecium polyandrous, congested, glabrous, anthers medifixed, arcuate; ovary compressed, pulverulent, style 4-lobulate; receptacle pilose; pedicels ca. 1.5 mm long. *Capsules* 2-celled, loculicidal, polyspermous, distinctly broader than long, 13–15 mm × 20–23 mm, compressed but with otherwise weakly inflated lobes, summit retuse, style persisting, capsular base obscurely stipitate, androecium residue present on the fruit, valves 2, thin-crustaceous, marginate, brownish-green turning black after seed dispersal, persistently and basally connate, inside glabrous, smooth or intermittently striate, outside somewhat harshly tomentulose, the indumentum stellate, dimorphous, bilayered, the larger hairs lax, 4–8 armed, processes 0.5–1.0 mm long, radiate, underneath with a congested layer of coarse scales 0.3 mm diameter . *Seeds* obovate or oblanceolate, dorsally convex and ventrally ±cotyloid, ca. 1.4 mm × 1.0 mm, testa brown, shaggy-fimbriate on equatorial margins, fimbriae fulvous, 3–4 mm long.

Distribution and ecology.—*Trichospermum stevensii* is thus far known only from lowland rainforests of Gulf Province. The new species is characteristic of regrowth environments such as gaps, landslides, forest margins, and surge zones along open streambeds. It is most commonly seen in association with various species of *Macaranga*, or as a co-dominant in early riverine successions. Nearly all sightings were in sterile condition during the survey.

Etymology.—The new species is named after Professor P.F. Stevens, an authority on the Malesian flora and a specialist in Ericaceae and Clusiaceae.

PARATYPE. **PAPUA NEW GUINEA. Gulf Province:** subdistrict Baimuru, above Purari River, 63 km at 65° from Baimuru, 07° 15' S, 145° 20' E, elev. 240 m, 26 Mar 1974 (fr, wood), *J.R. Croft et al. in LAE 61143* (A, BRI, CANB, K, L, LAE).

In Kostermans' (1972) revision of *Trichospermum*, *T. stevensii* arguably keys closest to the extra-Papuasian *T. morotaiensis* Kosterm. and *T. fosbergii* Kosterm. Although Kostermans' reliance on underleaf indumentum is useful for primary separations, *Trichospermum stevensii* falls between the cracks on the first order couplets. It is nearest to fork 1c (ibid: 405–406) but the combination of dorsal scales with scattered, erect hairs is not covered by any of the principal leads. The strictest solution for integration into the existing key is to introduce another descriptor for the new species, as follows:

1f. Lower leaf surface squamulate on costae, and with scattered, erect stellate hairs on intervenia and higher order nervation .... **T. stevensii** Takeuchi

If the underleaf hairs on the new species are generously interpreted, it can be forced into Kostermans' conspectus, in which case an apparent connection to *T. morotaiensis* and *T. fosbergii* will emerge. Substantive distinctions in leaf and capsule size would still provide separation against the preceding taxa. Among Papuasian representatives, *T. stevensii* appears close to *T. tripyxis* (K. Schum.) Kosterm., but the latter species has trivalved capsules. The compressed bivalved fruits of *T. stevensii* also suggest affinity to *T. peekelii* Burret, but the indumentum is clearly inconsistent with that species. The type collection has branchlets with appressed stellate scales rather than the erecto-patent vestiture on most Papuasian taxa.

The bast of *Trichospermum stevensii* is very resilient; the entire bark is stripped in sheets from the trunk and the resulting mats applied as flooring by Lakekamu villagers. Other species of *Trichospermum* are noted for their fiber value (ibid: 403).

ACKNOWLEDGMENTS

Funding for my participation on the Lakekamu survey was provided by Conservation International. Andrew Mack and the Foundation for People and Community Development were the principal organizers for the survey. The 1995 Bismarck-Ramu Expedition was funded by the Global Environment Facility and the United Nations Development Program. My work in Papuasian botany was supported by the Liz Claiborne and Art Ortenberg Foundation. Processing and identification of plant specimens occurred at the Lae National Herbarium and PNG Forest Research Institute. Emily Wood and Michael Bartley of Harvard Herbaria kindly responded to requests for specimen information. Neville Howcroft provided illustrations of the new species. John Pipoly III, my colleague at the Botanical Research Institute of Texas, corrected the Latin. My sincere thanks to all these individuals and organizations.

REFERENCES

Baker, E.G. 1916. Melastomataceae. In: Ridley, N.H. Report on the botany of the Wollaston Expedition to Dutch New Guinea, 1912–13. Trans. Linn. Soc. London, Bot. 9:50–57.

Bakhuizen van den Brink, R.C. 1943. A contribution to the knowledge of the Melastomataceae occurring in the Malay Archipelago, especially in the Netherlands East Indies. Thesis Utrecht (reprinted in Recueil Trav. Bot. Néerl. 40:1–391. 1946).

Hedemark, M., S. Hamilton, and W. Takeuchi. 1997. Report on the first Bismarck-Ramu biological survey with sociological and logistical comments. PNG Dept. of Environment and Conservation, Port Moresby.

KOSTERMANS, A.J.G.H. 1972. A synopsis of the Old World species of *Trichospermum* Blume (Tiliaceae). Trans. Bot. Soc. Edinb. 41:401–430.

MACK, A. (ed.). 1998. A biological assessment of the Lakekamu Basin, Papua New Guinea. Rapid Assessment Program Working Papers no. 9, Conservation International, Washington, D.C.

MANSFELD, R. 1925. Die Melastomataceen von Papuasien. Bot. Jahrb. Syst. 60:105–148.

MERRILL, E.D. and L.M. PERRY. 1943. Plantae Papuanae Archboldianae, XIII. J. Arnold Arbor. 24:422–439.

OHWI, J. 1943. The Kanehira Hatusima 1940 collection of New Guinea plants. XVI. Melastomataceae. Bot. Mag. (Tokyo) 57 (673):6–16.

SEKHRAN, N. and S. MILLER (eds.) 1995. Papua New Guinea country study on biological diversity. Dept. of Environment and Conservation and the Africa Centre for Resources and Environment, reprinted 1996.

TAKEUCHI, W. 1999. Botanical results from the 1995 Bismarck-Ramu expedition in Papua New Guinea. Sida 18:751–782.

TAKEUCHI, W. and J. KULANG. 1998. Vegetation Part 2: Botanical survey. In: Mack, A., ed. A biological assessment of the Lakekamu Basin, Papua New Guinea. Rapid Assessment Program Working Papers no. 9, Conservation International, Washington, D.C. Pp. 36–39, 105–130.

BOOK NOTICES

LORRAINE DASTON and KATHARINE PARK. 1997. **Wonders and the Order of Nature, 1150–1750.** (ISBN 0-942299-90-6, hbk.). Zone Books, 611 Broadway, Suite 608, New York, NY 10012. Distributed by MIT Press, Cambridge, MA. $34.00. 511 pp., illustrated.

From dustjacket: "*Wonders and the Order of Nature* is about the ways in which European naturalists from the High Middle Ages through the enlightenment used wonder and wonders, the passion and its objects, to envision themselves and the natural world. Monsters, gems that shone in the dark, petrifying springs, celestial apparitions—these were the marvels that adorned romances, puzzled philosophers, lured collectors, and frightened the devout. Drawing on the histories of art, science, philosophy, and literature, Lorraine Daston and Katharine Park explore and explain how wonder and wonders fortified princely power, re-wove the texture of scientific experience, and shaped the sensibility of intellectuals. This is a history of the passions of inquiry, of how wonder sometimes inflamed, sometimes dampened curiosity about nature's best-kept secrets. Refracted through the prism of wonders, the order of nature splinters into a spectrum of orders, a tour of possible worlds."

Contents for *Wonders and the Order of Nature, 1150–1750*: Preface, Introduction: At the Limit, The Topography of Wonder, The Properties of Things, Wonder Among the Philosophers, Marvelous Particulars, Monsters: A Case Study, Strange Facts, Wonders of Art, Wonders of Nature, The Passions of Inquiry, The Enlightenment and the Anti-Marvelous, Epilogue, Photo Credits, Notes, Bibliography, and Index.

ADEL JALILI and ZIBA JAMZAD. 1999. **Red Data Book of Iran. A Preliminary Survey of Endemic, Rare & Endangered Plant Species in Iran.** With Contributions from S.C. Shaw, A.A. Maassoumi, U. Assri, N. Mazhari and A. Rahmanpour. (ISBN 964-473-061-5, hbk.) Research Institute of Foresrs and Rangelands, P.O. Box 13185-116, Tehran, IRAN. Iran 85000 R; Outside $100.00. 748 pp., 85 mostly color drawings and a few color photos.

Iran supports a total of around 8,000 plant species, and is one of the major centers of endemism (1,727 endemic in Iran) in that part of the world. The total number of listed taxa based on defined IUCN categories, endemics, vulnerable, and endangered is 2,405. For the category Vulnerable, 432 taxa are listed and 21 listed for Endangered. Contents for *Red Data Book of Iran. A Preliminary Survey of Endemic, Rare & Endangered Plant Species in Iran*: List of Figures, Introduction, The Phytogeographical Regions of Iran, Data Collection and Analysis, Results and Discussion, Concluding Remarks, Species Description, Appendix 1, References, and Index. For each species, the following information is provided: **Status** (Endangered, Vulnerable, Lower Risk, Data Deficient; **Life Form**; **Distribution**; and **Habitat**. The book is printed on quality paper and the color paintings and photos are very nice.

A NEW VARIETY OF *PINUS GREGGII* (PINACEAE) IN MEXICO

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ABSTRACT

A new variety of *Pinus greggii* is described. Variety *australis* is endemic to east central Mexico and represenrs the southern disjunct region of the natural range of the species. Variety *greggii* represents the northern population of the species. Characters that segregate rhe varieties are presented.

RESUMEN

Se describe una nueva variedad de *Pinus greggii*. La variedad *australis* es endémica del cenrro-este de México, y abarca la distribución natural austral de la especie. La variedad *greggii* representa la población localizada en el norte de su distribución natural. Se incluyen características que distinguen las dos variedades.

Pinus greggii Engelm. occurs in two disjunct regions in Mexico (Fig. 1) separated by approximately 300 km, or four degrees latitude. Northern and southern populations of *P. greggii* grow in distinct environments. Northern populations occur in the northern Mexico states of Coahuila and Nuevo Leon, at elevations ranging from 1900 to 2600 meters above sea level. The average annual temperature at the northern sites is 14° C, and they receive an average annual precipitation of 650 mm (Donahue & Lopez Upton 1996). Topsoils at northern *P. greggii* sites are predominately neutral or slightly alkaline (Donahue 1993).

Southern populations of *P. greggii* occur in the central Mexico states of Hidalgo, Puebla, Queretaro, San Luis Potosi and Veracruz at elevations ranging from 1100 to 2400 meters above sea level. The average annual temperature at the southern sites is 17° C, and they receive an average annual precipitation of 800–1600 mm (Donahue & Lopez Upton 1996). Topsoils at the southern *P. greggii* sites are predominately acidic (Donahue 1993).

A comprehensive study of the species began after differences in growth rate, needle length and needle color became apparent in genetic trials planted

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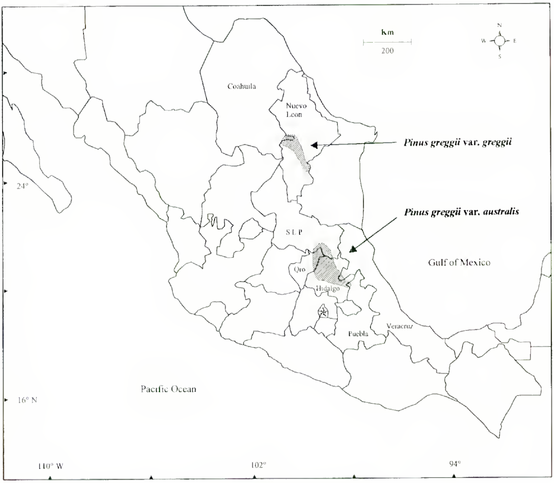

FIG. 1. Geographic distribution of *Pinus greggii* in Mexico.

in Brazil, Chile, Colombia, South Africa (Dvorak et al. 1996) and Mexico (Lopez Ayala 1998; Alba Landa et al. 1998), where trees from northern and southern populations were planted side-by-side. The differences observed in these field trials suggested that two distinct, unrelated taxa had been planted by mistake. Studies of geographic variation in leaf, cone and seed morphology, seed production and terpene chemistry were performed to determine what differences existed, and to quantify them. Results from our comprehensive study indicated that only *P. greggii* was included in the trials, but several character differences exist between northern and southern populations suggesting recognition taxonomically.

MATERIALS AND METHODS

Field sampling was done in six northern populations and six southern populations from a wide range of geographic locations and elevations (Table 1). Leaf specimens were collected from 172 trees, and cones from 177 trees of *Pinus greggii*. The samples were collected from the upper 1/3 of the crown from healthy dominant and co-dominant trees in the stands, at least 100 meters apart. Leaf and cone specimens were collected from five distinct as-

Table 1. Summary of the sampling of *Pinus greggii* sites included in the leaf, cone and seed morphology, seed production and terpene chemistry studies.

	Latitude-Longitude	Elevation (m)	Number of trees sampled a	b	c
Southern populations					
Cerro Perico, Hidalgo	20°44' N – 99°02' W	1830-1970	14	15	24
Laguna Atezca, Hidalgo	20°49' N – 98°46' W	1250-1420	15	15	16
Laguna Seca, Hidalgo	21°02' N – 99°10' W	1670-1830	12	12	0
El Madroño, Queretaro	21°16' N – 99°10' W	1650-1730	15	15	17
San Joaquin, Queretaro	20°56' N – 99°34' W	2310-2380	15	15	15
Valle Verde, Queretaro	21°29' N – 99°12' W	1150-1250	15	15	0
		total	86	87	72
Northern populations					
Cerro Perico, Hidalgo	20°44' N – 99°02' W	1830-1970	14	15	24
Cañon Los Lirios, Coahuila	25°22' N – 100°29' W	2260-2460	14	15	0
Mesa del Rosario, Coahuila	25°26' N – 100°28' W	1920-2325	12	12	13
Santa Anita, Coahuila	25°27' N – 100°34' W	2515-2620	18	18	20
La Tapona, Nuevo Leon	24°43' N – 100°10' W	2090-2350	15	15	24
Las Placetas, Nuevo Leon	24°55' N – 100°11' W	2370-2520	13	15	22
Loma El Oregano, Coahuila	25°22' N – 100°55' W	2310-2350	14	15	19
		total	86	90	98

a = leaf characters b = cone & seed characters c = terpene analysis

pects in the crown, and leaves were sampled only from first-order branches, prior to elongation. The five cones collected per tree were used in both the morphology and seed production studies. Stem-xylem oleoresin was collected from 170 trees for analysis of terpene chemistry using standard procedures. Details of the sampling procedure and chemical analysis for the terpene study are given in Donahue et al. (1995).

Leaf and Cone Morphology

For the morphology study ten leaf characters were analyzed: number of needles per fascicle, fascicle sheath length, needle length and width, number of ventral and dorsal surface stomatal lines, number of stomata per 3 mm length on dorsal surface, number of medial and internal resin canals and total number of resin canals. Ten needles per tree were measured for length, width and number per fascicle (1720 needles total). Five needles per tree were analyzed for the resin canal and stomata information (860 needles total). Five fascicle sheaths per tree were measured for length (860 sheaths total). Leaf width and stomatal counts were taken at the mid-point of the leaf, as well as the resin canal assessment, using standard microtechniques.

The ten cone characters measured were cone length and width, cone scale apophysis height and width, seed length and width, seed wing length and width, seed coat thickness and seed weight. Five cones per tree were measured for length and width. Cone length was measured in a straight line from the base to the top; cone curvature was excluded. Cone width was the average of two perpendicular measurements taken at the widest point of the cone. Cone scale apophysis height and width were measured on four sides, perpendicular to each other, located at the widest part of the cone. Seed wing width was measured at the widest point of the wing.

The leaf and cone data were analyzed using statistical procedures of the Statistical Analysis System (Donahue & Lopez Upton 1996). First a multivariate stepwise discriminant analysis was performed on the data to determine which traits would be most useful in separating trees from the two regions. A canonical discriminant analysis was conducted on the variables selected by the stepwise discriminant analysis to look at patterns of differentiation among populations, and calculate spatial Mahalanobis distances.

Analyses of variation by region were done on each individual variable to determine which varied significantly between the northern and southern groups of populations. Next a multivariate analysis of variation was conducted on the subset of variables that were significantly different between the two regions. Means and coefficients of variation were calculated and a correlation analysis was conducted on all morphological traits.

Seed Production

For the seed production study, five cones per tree were assessed (885 cones total). The extracted seeds were counted and classified as filled, empty, first-year aborted, second-year aborted, or insect-damaged. The number of fertile cone scales was counted to calculate seed potential and determine seed efficiency. Of the seed production criteria, the number of fertile cone scales is least affected by environmental variation. Population and individual tree means and coefficients of variation were computed for each seed-yield trait (Lopez Upton & Donahue 1995). An analysis of variance was conducted on the individual tree means with a nested model: trees, populations and populations within region (north and south regions). Waller-Duncan comparisons were performed on population means to detect differences among them, and to look for trends across regions.

Terpene Chemistry

The terpene chemistry analysis was performed on one resin sample from each of 170 trees by gas chromatography (Donahue et al. 1995). The chemical components were identified by comparison with known chemical standards, and also compared to results from gas chromatography/mass spectrometry analyses run on one sample from each of nine populations in the study. The chemical compositions were reported as "percent of terpenes." This included all the monoterpenes and longifolene, a sesquiterpene, which was of particular interest. Since myrcene and carene were not separated, a combined amount was reported for both. Population means were calculated for six terpenes. To characterize individual trees as "high" or "low" types for specific terpenes, frequency distributions were examined to help establish threshold values as criteria for determining the point of separation for the concentration classes. Threshold values were established at points where the trees' frequency distributions might be separated into two modes.

Herbarium specimens examined

Of the specimens collected for and examined in the comprehensive study, the following vouchers, which are now considered variety *australis*, are located in the indicated herbaria:

MEXICO. Hidalgo: Laguna Atezca, 26 May 1993, *Donahue & Lopez Upton F85* (A) *F84* (F) *F77, F90* (MICH) *F76, F80, F83, F86, F89* (MO) *F75, F81, F82* (NCSC) *F78, F87* (TEX). Laguna Seca, 24 May 1993, *Donahue & Lopez Upton D56* (A) *D50* (F) *D47* (MICH) *D49, D51, D57, D55, D53* (MO) *D54* (NCSC) *D46* (TEX). **Queretaro:** Mpio. Landa de Matamoros, Ejido El Madroño, 19 May 1993, *Donahue & Lopez Upton B27* (A) *B20* (F) *B19* (MICH) *B18, B28, B26, B22* (MO) *B23* (NCSC) *B17* (TEX); San Joaquin, 17 May 1993, *Donahue & Lopez Upton A1, A13* (A) *A2, A11* (F) *A5, A9* (MICH) *A6, A8, A10, A12, A15* (MO) *A14* (NCSC) *A3, A7* (TEX); Valle Verde, 22 May 1993, *Donahue & Lopez Upton C44* (A) *C43* (F) *C38* (MICH) *C35, C37, C39, C42, C45* (MO) *C36* (TEX).

The following vouchers from the comprehensive study, are considered variety *greggii*, and are located in the indicated herbaria:

MEXICO. Coahuila: Loma El Oregano, 5 Jun 1993, *Donahue & Lopez Upton I158* (A) *I156* (F) *I150* (MICH) *I153, I155, I157* (MO) *I152, I166* (NCSC) *I146* (TEX); Los Lirios, 4 Jun 1993, *Donahue & Lopez Upton H 139* (A) *H136* (F) *H132, H144* (MICH) *H134, H138, H140, H143, H145, H148, H151* (MO) *H135* (NCSC) *H131, H142* (TEX); Mesa del Rosario, 3 Jun 1993, *Donahue & Lopez Upton G129* (A) *G107, G114* (F) *G104, G112* (MICH) *G102, G105, G108, G111, G115* (MO) *G106, G113* (NCSC) *G101, G110* (TEX); Santa Anita, 3 Jun 1993, *Donahue & Lopez Upton G129* (A) *G123* (MICH) *G120, G122, G124, G127, G130* (MO) *G119, G126* (NCSC) *G121* (TEX). **Nuevo Leon:** La Tapona, 7 Jun 1993, *Donahue & Lopez Upton K184* (A) *K128* (F) *K179, K188* (MICH) *K177, K180, K183, K186, K190* (MO) *K181* (NCSC) *K178, K187* (TEX); Las Placeras, 6 Jun 1993, *Donahue & Lopez Upton J170* (A) *J167* (F) *J164* (MICH) *J162, J165, J168, J171, J174* (MO) *J163, J175* (TEX).

In addition to the 860 specimens from the comprehensive study, the authors have also examined the following additional herbarium material:

MEXICO. Coahuila: Mountain sides, San Antonio near Saltillo, 30 Aug 1848, *J. Gregg 402* (MO). **Hidalgo:** 8 km al este de Cardonal, Mpio. Ixmiquilpan, 21 Oct 1979, *D. Cibrian T. 2687* (CHAP); Rio Malila, Mpio. Molango. 1 Sep 1983 *J., Lopez Garcia 359* (CHAP); Molango. 7 Jan 1978, *J. Perez Fitz 1258* (CHAP). **NUEVO LEON**: Cerro del Potosi, 20 km al oeste de Galeana, 2 Nov 1973, *Castillo y Villar 1257* (CHAP); Cerro del Potosi, Mpio. Galeana, 4 Mar 1978, T. *Eguiluz 1261* (CHAP). **Queretaro:** Minas Viejas, Mpio. Zimapan, 14 Jan 1978, *A. Cabrera A. 1259* (CHAP); Carr. Jalpan-Xilita Km. 230, 2 Mar 1978, *T. Eguiluz 1260* (CHAP); Zona arqueologica Las Ranas, Mpio. San Joaquin, 20 Feb 1987, *J. Rzedowski 42515* (CHAP).

During the course of several years of field study, the authors visited a number of sites and examined material that was not archived in herbaria.

Table 2 summarizes details of those additional sites where trees of *Pinus greggii* were observed and information gathered for this work.

RESULTS AND DISCUSSION

The results from the morphology study given in Table 3 showed that based on population means, the southern populations had significantly longer needles, more stomata per unit of leaf length, lighter seeds and five times greater frequency of internal resin canals than northern populations (Donahue & Lopez Upton 1996). Although the number of leaves per fascicle did not differ significantly between northern and southern trees, four-needle fascicles did occur more frequently in the north. The total number of resin canals did not differ between north and south, however trees from southern populations had five times more internal resin canals. The values shown for the northern and southern "regions" in Table 3 are means of the six individual population means that were part of that region. The values shown for (range) indicate the range of those six population means.

While both the northern and southern populations had the same number of lines of stomata on ventral and dorsal surfaces, the number of stomata per 3 mm length of leaf was greater in southern trees. On average, southern trees had narrower needles and wider seed wings. Northern trees had thicker seedcoats and heavier seeds. In the morphology study, northern and southern population means for needle length were significantly different, without overlapping values.

In the seed production study, no traits were significantly different between north and south, however the number of fertile cones scales showed a clear trend. Cones from southern trees had 28% more fertile cone scales than those from northern trees. The number of fertile cone scales is considered to be under more genetic control than the other criteria.

Table 4 gives a summary of the terpene chemistry results. β-phellandrene was found to be the single most abundant terpene in the chemistry analysis of *Pinus greggii* (51%) (Donahue et al. 1995). Southern populations had significantly higher proportions of α-pinene and myrcene and lower proportions of limonene and longifolene than northern populations. Northern populations had almost no variation in the frequency of high and low concentration types of trees; all trees within a population were either "high" or "low". In this respect, trees from southern populations had varying numbers of high and low concentrations of a-pinene, myrcene and limonene.Results of this study indicated that genes that control these terpenes appearto be fixed in the northern populations. Longifolene is the sole terpene that distinguishes trees from northern and southern populations. Southern trees had a near-zero content of longifolene, while northern trees had an average content of 5%.

Table 2. List of additional sites observed but not included in the comprehensive study.

State	Locality	Latitude	Longitude	Elevation
Northern populations				
Coahuila	Agua Fria	25° 26' N	100° 30' W	2400
Coahuila	Cañon de Caballos	25° 15' N	100° 55' W	2410
Coahuila	Cerro El Potosi	24° 53' N	100° 13' W	2430-2500
Coahuila	Jame	25° 21' N	100° 35' W	2450
Coahuila	Puerto Chapultepec	25° 15' N	100° 56' W	2410
Coahuila	Puerto Los Conejos	25° 28' N	100° 34' W	2380–2700
Coahuila	Puerto San Juan	25° 25' N	100° 33' W	2630–2680
Nuevo Leon	La Chona	24° 17' N	99° 58' W	2300
Nuevo Leon	Ojo de Agua	24° 54' N	100° 12' W	2200
Southern populations				
Hidalgo	Cieneguilla	20° 44' N	99° 02' W	1860
Hidalgo	El Piñon	20° 56' N	99° 12' W	1830
Hidalgo	Elochoxitlan	20° 45' N	98° 47' W	1710–1860
Hidalgo	Jalamelco	20° 47' N	98° 42' W	1800–1950
Hidalgo	Minas San Francisco	20° 48' N	99° 20' W	1950–2100
Hidalgo	Molango	20° 50' N	98° 44' W	1400
Hidalgo	Pemuxtitla	20° 49' N	98° 46' W	1400
Hidalgo	Xochicoatlan	20° 50' N	98° 43' W	1840
Puebla	Patoltecoya	20° 13' N	98° 03' W	1440
Veracruz	Carrizal Chico	20° 26' N	98° 20' W	1580

Table 3. Means by region and (ranges of means within region) and p-values for the characteristics which varied significantly by geographic location.

Population (region)	Needle Length (cm)	Needle Width (mm)	# of Stomata	# of Internal Resin Canals	Wing Width (mm)	Seed Weight [1]	Seed Coat Thickness (mm)
Northern	11.3 (10.4–11.8)	1.28 (1.19–1.35)	35.6 (34.1–36.8)	0.09 (0.0–0.18)	5.95 (5.55–6.37)	1.73 (1.61–1.87)	0.146 (0.138–0.156)
Southern	12.5 (12.0–13.3)	1.18 (1.09–1.24)	38.8 (36.2–41.3)	0.48 (0.28–0.91)	6.4 (6.06–6.65)	1.47 (1.18–1.58)	0.138 (0.128–0.145)
Significance level	0.002	0.016	0.01	0.002	0.012	0.005	0.037

[1] weight of 100 seeds (gms)

Table 4. A comparison of terpene composition (%) of southern and northern populations of *Pinus greggii.*

Pinus greggii	α-pinene	β-pinene	Myrcene/ Carene	Limonene	β-phellandrene	Longifolene
Southern populations	17	0.8	15	10	58	0.3
Northern populations	5	0.7	3	41	54	5

In summary, trees from northern populations of *P. greggii* can be distinguished from southern ones using needle length, number of stomata, number of internal resin canals, seed wing width, seed weight, seed coat thickness, number of fertile cone scales and terpene composition. Of these, needle length, number of stomata, number of internal resin canals and percent content of longifolene had non-overlapping population means in the studies.

Leaf Characteristics

Subsequent to the comprehensive study, the authors and colleagues made informal observations of leaf color in native stands in Mexico, and trials planted outside the species natural distribution both within and outside of Mexico. Differences in leaf color were reported in exotic trials (Dvorak et al. 1996), where color was noted as dark green for northern populations and pale green for southern. Using Munsell® color charts for plant tissues, which assign a code based on the hue, value and chroma of an object, an attempt was made to characterize the differences seen on live trees in native stands in Coahuila and Queretaro, Mexico, and planted trials in Veracruz, Mexico, and Louisiana, USA. Leaf color was found to be variable both within and among trees, but variation could be generalized as differences between hue classes. Northern populations were predominately hue class "5 GY", value & chroma combinations 4/6, 4/8 and 5/6, while southern populations were predominately hue class "7.5 GY", value & chroma combinations 4/4, 4/6 and 5/6 (light green vs yellowish green). In addition to color differences it was observed that needles of northern trees are stiffer, more erect than those of southern trees. Figure 2 is a photograph of two branches that illustrate the differences in leaf color, length and rigidness between var. *greggii* and var. *australis*. The eighteen-inch long branches were collected from the lower third portion of the crown of three-year-old trees planted in Singer, Louisiana, USA. The trees were planted in field plots located adjacent to each other, and are typical of the rest of the trees (approximately 400) planted in the same plots. They are also representative of the differences in foliage characteristics seen in the twelve native populations cited in this study.

Distinguishing characters for the two varieties are summarized in Table 5. Most of the quantitative characters reflect the statistical results presented in Table 3, except for leaf length. Table 3 shows mean leaf lengths, whereas Table 5 gives a range of values that takes into consideration individual leaves and trees from our study.

Other characteristics distinguish southern from northern populations of *P. greggii*. In genetic field trials planted in Brazil, Colombia and South Africa, progeny from southern populations grew significantly taller than northern progeny, and maintained their differences in foliage color and stiffness. Southern trees planted in Brazil and Colombia were 100% taller than northern trees ar

Table 5. Summary of the characters that distinguish northern and southern populations of *Pinus greggii.*

CHARACTER	var. *greggii*	var. *australis*
Leaves		
position	erect	frequently drooping
rigidness	stiff	flexible
color	light green	yellowish green
length (cm)	7–12	10–15
stomata number[1]	34–36	36–41
internal resin canals	lacking	sometimes 1 or 2
Seeds		
wing width (mm)	5.5–6.4	6.0–6.7
Terpenes (%)		
a-pinene	low	high
limonene	high	low
longifolene	high	low
myrcene	low	high

[1] per 3 mm leaf length

three years of age, and in South Africa they were 17 to 30 % taller than northern trees (Dvorak et al. 1996). Similar results were observed in field trials in Mexico, where southern populations grew 106% taller at two years of age (Alba Landa et al. 1998) and 118% taller at nearly three years of age (Lopez Ayala et al. 1999). Trees from southern populations showed greater resistance to pine pitch canker disease caused by *Fusarium subglutinans* f.sp. *pini* than northern trees in a greenhouse screening trial (Hodge & Dvorak 2000). Although it has not been demonstrated that the cause is genetic, flowering and pollination of *P. greggii* in Mexico occurs in April–May in southern populations, and in May–June in northern populations (Lopez Upton & Donahue 1995).

Recent taxonomic works on Mexican pines by Perry (1991) and Farjon and Styles (1997) did not recognize a distinction between the two populations either because they did not observe a large enough sample size to detect the differences, or attributed them to climatic effects. The differences in internal leaf characteristics and terpene composition cited here are least likely caused by environmental changes, while differences in leaf size and color remained when the two populations were planted side by side in the same environment.

CONCLUSION

Based on the results of the aforementioned studies and observations, the authors believe that trees from southern populations located in the states of Hidalgo, Puebla, Queretaro, San Luis Potosi and Veracruz constitute a separate taxon treated as follows:

Pinus greggii Engelm. ex Parl. var. **australis** Donahue & Lopez, var. nov. **(Figs. 1, 2).** TYPE: MEXICO. QUERETARO: Mpio. Landa de Matamoros, El Madroño, 21° 16' N, 99° 10'W, 1690 m, 19 May 1993, *Donahue & Lopez Upton B30* (HOLOTYPE: MO).

Varietas *australis* ab *Pinus greggii* var. *greggii* distinguibilis est foliis elongatis, flavovirentibus, cum stomatibus plus per 3 mm longitudione, interdum canalibus resiniferis internis uno vel duobus, et terpene compositis myrcene altis et longifolene demissis, et endemicis ad Mexico centralis.

The variety *australis* has leaves in fascicles of 3, 10–15 cm long, 1.0–1.3 mm wide, with 36–41 stomata per 3–mm leaf length. Resin canals are 3–4(–6) in number, predominantly medial, and occasionally 1–2 internal. Cone length is 8–13(–14) cm and cone widths are 3–5 cm. Seeds are 5–7 mm in length and 3–4 mm wide. Seed wing length is 11–16 mm, and width is 6–8 mm.

PARATYPES: MEXICO. Queretaro: Mpio. Landa de Matamoros, El Madroño, 21° 16' N, 99° 10'W, 1690 m, 19 May 1993, *Donahue & Lopez Upton B27* (A) *B20* (F) *B19* (MICH) *B18* (MO) *B23* (NCSC) *B17* (TEX).

The variety *greggii* has leaves in fascicles of 3, 7–12 cm long, 1.2–1.4 mm wide, with 34–37 stomata per 3 mm leaf length. Resin canals are (2–)3–4(–6) in number, medial. Cone length is 8–12 cm and cone widths are 3–5 cm. Seeds are 5–8 mm in length and 3–4 mm wide. Seed wing length is 13–16 mm, and width is 5–7 mm.

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REFERENCES

ALBA LANDA, J., L. MENDIZABAL HERNANDEZ, and A. APARICIO RENTERIA. 1998. Respuesta de un ensayo de procedencia/progenie de *Pinus greggii* Englem. en Coatepec, Veracruz, Mexico. Foresta Veracruzana 1:25–28.

DONAHUE, J.K. and J. LOPEZ UPTON. 1996. Geographic variation in leaf, cone and seed morphology of *Pinus greggii* Engelm. in native forests. Forest Ecol. Managem. 82:145–157.

FIG. 2. A comparison of leaf characteristics of (A) *Pinus greggii* var. *greggii* from La Tapona, Nuevo Leon, and (B) *Pinus greggii* var. *australis* from El Madroño, Queretaro. The trees are growing in Louisiana, USA, produced from seed from the corresponding native stands in Mexico.

DONAHUE, J.K., J.P. PERRY, A.E. SQUILLACE, and S. LIU. 1995. Geographic variation in stem-xylem terpene chemistry in native populations of *Pinus greggii* Engelm. Forest Genet. 2:217–225.

DONAHUE, J.K. 1993. Geographic variation in *Pinus greggii* seedlings in relation to soil acidity. In: Resolving tropical forest resource concerns through tree improvement, gene conservation and comestication of new species. Proceedings, IUFRO Conference; 1993 October; Cali, Colombia. Pp. 172–177.

DVORAK, W.S., E. KIETZKA, and J.K. DONAHUE. 1996. Three-year survival and growth of provenances of *Pinus greggii* in the tropics and subtropics. Forest Ecol. Managem. 83:123–131.

FARJON, A. and B.T. STYLES. 1997. *Pinus* (Pinaceae). Flora Neotropica. Monograph 75. New York Botanical Garden, New York.

HODGE, G.R. and W.S. DVORAK. 2000. Pitch canker resistance of Central American and Mexican pine species and *Pinus radiata* from Chile and New Zealand. New Forests (In press).

LOPEZ AYALA, J.L. 1998. Variación intraespecifica en el crecimiento en altura en el brote terminal de *Pinus greggii* Engelm. Tesis profesional. División de Ciencias Forestales, Universidad Autónoma de Chapingo. Chapingo, Mexico.

LOPEZ UPTON, J. and J.K. DONAHUE. 1995. Seed production of *Pinus greggii* in natural stands in Mexico. Tree Pl. Notes 46(3):86–92.

PERRY, J.P. 1991. The pines of Mexico and Central America. Timber Press, Inc. Portland.

BOOKS RECEIVED

D. LAYTEN DAVIS and MARK T. NIELSEN (Editors). 1999. **Tobacco: Production, Chemistry and Technology.** (ISBN 0-632-04791-7). Blackwell Science Ltd., Osney Mead, Oxford OX2 0EL, UK. $164.95. 467 pp.

A collection of 30 agricultural and technological papers intended to document the status of tobacco and its products today. The fourteen subject chapters include: 1) seed to smoke, 2) breeding and genetics, 3) biotechnology: uses and applications in tobacco improvement, 4) agronomy and physiology, 5) production practices, 6) major tobacco diseases, 7) tobacco insect pests, 8) leaf chemistry, 9) physical properties of leaf tobacco, 10) marketing, processing and storage, 11) cigarette manufacturing, 12) smoke chemistry, 13) cigars and cigarillos, 14) smokeless tobacco.

P.J.M. KNIPPELS. 1999. **Growing Bulbs Indoors.** (ISBN 90-5410-4678). A.A. Balkema, P.O. Box 1675, Rotterdam, NETHERLANDS (Fax: 31-104-413-4947), published in the United States by A. A. Balkema Publishers, Old Post Rd., Brookfield, VT 05036 (Fax: 802-276-3837). $25.00. 88 pp. text, 13 pp. glossary, appendices and index, 65 color photos.

A horticultural guide to ornamental bulbs and their cultivation, including chapters on: 1) main growing areas, 2) cultivation, 3) bulbs from A to Z (alphabetically arranged by genus), 4) glossary, 5) bibliography, 6) classification of genera in terms of cultivation difficulty, 7) classification of genera and species in terms of ornamental value, 8) useful addresses.

STANLEY D. JONES, JOSEPH K. WIPFF, and PAUL M. MONTGOMERY. 1997. **Vascular Plants of Texas. A Comprehensive Checklist including Synonymy, Bibliography, and Index.** (ISBN 0-292-74044-1, hbk.). The University of Texas Press, P.O. Box 7819, Austin, TX 78713-7819, U.S.A. $55.00. 404 pp.

"This comprehensive list also includes crops, persistent perennials, and naturalized plants." The table of contents includes: Preface, Acknowledgments, Introduction, Format, Scientific Names: Species and Infraspecific Rank, Authors of Taxa, Common Names, Abbreviations and Special Designations, Conserved Names, Cultivated Plants, Endangered and Threatened Taxa, Federal Noxious Weeds, Hybrid Taxa, Misapplied Names, Orthography, State Symbols, Synonyms, Unpublished Names, Summary of Taxa, Summary Table, Checklist, Bibliography, and Index. A full review is forthcoming.

THE GENUS *MYRSINE* (MYRSINACEAE) IN VENEZUELA

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ABSTRACT

A synopsis of the genus *Myrsine* in Venezuela is provided. The generic description is updated, along with discussions of its morphology and ecology in Venezuela. A key to the species and subspecies is provided, along with descriptions, discussions of distribution, ecology and conservation, and etymology for all species. Each of the 12 species known for the country (one with two subspecies) is newly illustrated and its distribution is mapped. Four binomials: *Rapanea ambigua* Mez in Engl. (a synonym of *Myrsine coriacea* R. Br. ex Roem. & Schult. subsp. *coriacea*), *Rapanea andina* Mez (*Myrsine andina* (Mez) Pipoly), *Rapanea nitida* Mez (*Myrsine nitida* (Mez) Pipoly), and *Rapanea guianensis Aubl.* (*M. guianensis* (Aubl.) Kuntze) are lectotypified. Three additional binomials are relegated to synonymy.

RESUMEN

Se presenta una sinopsis del género *Myrsine* para Venezuela. Se actualiza la descripción genérica, acompañada por discusiones sobre su morfología y ecología dentro del país. Se provee una clave para separar las especies y subespecies, descripciones, discusiones sobre distribución, ecología, conservación y etimología. Se ilustran y se ofrecen mapas de distribución de cada una de las 12 especies (incluyendo una con dos subespecies). Se lectotipifican cuatro binomios: *Rapanea ambigua* Mez in Engl.(=*Myrsine coriacea* R. Br. ex Roem. & Schult. subsp. *coriacea*), *Rapanea andina* Mez (=*Myrsine andina* (Mez) Pipoly), *Rapanea nitida* Mez (=*Myrsine nitida* (Mez) Pipoly), y *Rapanea guianensis Aubl.* (=*M. guianensis* (Aubl.) Kuntze) y tres especies adicionales se relegan a la sinonimia.

INTRODUCTION

The genus *Myrsine* L. contains about 300 species, of which nearly one fourth remain undescribed. C. Chen and Pipoly (1996), Pipoly (1991, 1992a, 1992b, 1996), Pipoly and C. Chen (1995), and Ricketson & Pipoly (1997) have provided summaries of evidence for broader circumscription of the genus, especially to include *Rapanea* Aubl. This circumscription has most recently been accepted by Otegui (1998a) in her treatment of *Myrsine* for the Southern Cone of South America, and tentatively by Anderberg and Ståhl (1995)

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in their preliminary analysis of phylogeny in the entire order Primulales. While Anderberg and Ståhl (1995) were relatively noncommital regarding the circumscription of *Myrsine*, later work by Ståhl (1996) in determining the systematic position of species formerly placed in *Heberdenia* Banks ex DC., revealed that the genus would be paraphyletic if taxa formerly assigned to *Rapanea* were removed from it, so the best circumscription of the group is in its broadest sense. The conclusion was based on a cladogram using three species from morphological extremes within the genus. Otegui (1998b) constructed another cladogram in a paper discussing anemophily in the genus, in which *Myrsine* was most closely related to the Papuasian endemic genus *Fittingia* Mez. However, it should be noted that *Fittingia* is a group whose species have been described from very incomplete material, and that there has not been any analysis to include all genera in the family, so these cladograms should be considered very tentative.

Myrsine is pantropically distributed, occurring in diverse vegetation types, from mangroves to subalpine scrub, but always in moist, wet or pluvial habitats. The genus is defined by lateral (axillary), fasiculate or umbellate inflorescences, sessile or on short, perennating peduncles girdled by persistent floral bracts, thus forming "short shoots." In preparation for our treatment of the genus for *Flora of the Venezuelan Guyana*, it became necessary to assemble specimens from the entire country with complete synonymies and bibliographic references, and to lectotypify several species. Because of the somewhat abbreviated format of that flora, the present synopsis is intended to provide a complete nomenclator and a preliminary treatment for *Flora de Venezuela* for this often misunderstood and nomenclaturally complex genus.

MORPHOLOGY

Habit and Architecture

The majority of *Myrsine* species in Venezuela are shrubs to small trees to 10 m tall, but occasional individuals of *M. dependens* (Ruíz & Pav.) Spreng., *M. coriacea* (Sw.) R. Br. ex Roem. & Schult. subsp. *coriacea*, and *M. guianensis* (Aubl.) Kuntze, have been known to reach heights of 15 m, 30 m, and 15 m, respectively. All species of *Myrsine* are terrestrial, with positively geotropic roots, although those in cloud forests occasionally occur on deep humus formed by decaying organic matter over large boulders.

All Venezuelan species of *Myrsine*, with the notable exception of *M. dependens*, exhibit Rauh's Model of architecture (Hallé et al. 1978), characterized by a polyaxial, monopodial, rhythmically growing, readily distinguishable trunk, that develops tiers of branches morphogenetically identical to itself. All branches are orthotropic and monopodial, with spiral phyllotaxy and lateral (axillary) inflorescences that do not affect shoot development. As was found for

Myrsine cubana A. DC. (called *M. floridana* A. DC. in the paper), all branches are sylleptic (Wheat 1980) producing two prophylls followed by adult leaves.

Myrsine dependens exhibits Massart's Model of architecture (Hallé et al. 1978), characterized by a polyaxial, monopodial, rythmically growing, readily distinguishable trunk, that develops regular tiers of branches at levels established by the growth of the trunk meristem. Branches are plagiotropic by leaf symmetry (distichous in this case), but never by apposition. The position of the inflorescence is not significant in the definition of the model. Like branching in Rauh's Model, the branching is sylleptic. This model is typical of many Myristicaceae, and is also known in *Ardisia crenata* Sims and *A. polycephala* Wall. in the Myrsinaceae. Most species of the genus *Embelia* Burm. f. also exhibit Massart's Model. Symmetry of the entire plant is striking, and allows immediate recognition of *Myrsine dependens* among the other species in its subpáramo thicket and páramo margin habitat, even though most branches will fall due to lack of light in the compact canopy of the thicket. With long-lived branches (when light conditions permit), Massart's Model is most often confused with Roux's Model, differing only by its rythmic (and not continuous or diffuse) branching. Field work conducted in Venezuela, Colombia, and Ecuador has shown that the branch tiers consist of pseudoverticels, most often comprised of three branch units. It is notable that Massart's Model is typical in extreme environments, where wind-shearing of orthotropic trunk axes produce the characteristic "Krummholz Effect" in taxa such as *Abies balsamea* Mill. (Hallé et al. 1978). That resilience inherent in Massart's Model may be significant in the species' ability to withstand extreme conditions of high winds, extreme diurnal temperature fluctuations, soil compaction from overgrazing, and lack of oxygen due to high altitude, all typical of the páramo margin and subpáramo thicket habitats.

Branchlets

A branchlet is here defined as the distal 10 cm of any branch. Branchlets in Venezuelan *Myrsine* are straight, terete, smooth, glabrous, rufous or ferrugineous villous- or floccose-tomentose, or rufous glandular-papillose, lenticellate or not. Most species have thin outer bark, but in *Myrsine guianensis*, an extremely active cork cambium results in significant cork accumulation, linked to dryness of the habitat.

Leaves

Species of *Myrsine*, like all Myrsinaceae, are exstipulate and have simple leaves. The leaves are mostly spiral, except in *Myrsine dependens*, where they are distichous. In Venezuela, all species have petiolate leaves. A study of ptyxis (Cullen 1978) showed that four Asian and Pacific species of *Myrsine* surveyed had supervolute ptyxis, but a survey among the Venezuelan species has not as yet been conducted, nor has the vernation been studied thus far. The leaf blade texture may be chartaceous, coriaceous, thickly coriaceous or cartilaginous. The difference between thickly coriaceous and cartilaginous is that the leaf is rubbery and will not snap on bending perpendicular to the plane of the midrib in the former, while it will easily snap with application of moderate bending perpendicular to the plane of the midrib in the latter. The shape is most often obovate, oblanceolate, elliptic or oblong, but may rarely be ovate (*Myrsine maguireana* Pipoly), or linear-lanceolate, narrowly elliptic or lorate (*M. resinosa* (A. C. Sm.) Pipoly). The apex may be attenuate, acuminate, acute, obtuse, rounded, broadly rounded, or emarginate, with or without a short, often blunt, bulbous, mucron formed by an extension of the midrib, while the base may be acute, cuneate, obtuse, or broadly rounded, usually decurrent on the petiole. The adaxial surface may be glabrous, smooth or scrobiculate, with or without a villous-tomentum of uniseriate hairs or glandular-papillae along the length of the midrib above; the secondary venation may be conspicuous, inconspicuous or not visible, and on the lower surface, the punctation may be black or pellucid punctate or black punctate and punctate-lineate; the margin is usually entire, and may be flat, merely inrolled, or revolute at least basally. The petioles may be flat on the adaxial surface, canaliculate, marginate or canaliculate and marginate distally, near the leaf blade base.

Inflorescence, Flowers and Fruit

The inflorescence in *Myrsine* consists of a sessile to subsessile umbel, or a fascicle. The inflorescence bract is very early caducous and is rarely seen on herbarium specimens. The "peduncle" consists of an accrescent, perennating rachis that mimics a shoot, gradually built up by persistent, girdling floral bracts to form a "short shoot." The floral bracts may be early caducous or persistent, chartaceous or coriaceous, orbicular, ovate, widely ovate, deltate, obovate, apically acute, rounded or obtuse, inconspicuously pellucid punctate, brown punctate, black or red punctate and/or punctate-lineate, the margin most often entire, but may be erose and usually with glandular cilia, but sometimes glabrous. In Venezuela, all pedicels are terete, and vary mostly by their length and relative thickness. In most species the pedicel is accrescent in fruit, but not exceeding approximately 5% of its original length.

The flowers are 4–5(–6)-merous, perfect and normally functionally unisexual. When they are bisexual, the androecium is smaller than that of a staminate flower and the gynoecium is smaller than that of the pistillate flower of the same species. Flower texture is chartaceous for all species in Venezuela, except in *Myrsine picturata*, whose corolla is membranaceous. The calyx may be cotyliform, or rarely, campanulate or cupuliform, with valvate lobes nearly free to fused 1/3 their length. The lobes may be triangular-ovate, widely ovate, or deltate, apically rounded, obtuse, acute, acuminate, short-acuminate or long-attenuate, long-acuminate, flat or prominently keeled abaxially, inconspicously pellucid punctate, brown punctate, or densely and prominently black punctate, and punctate-lineate, with margins entire or apically erose or roughly dentate, glabrous, villous-ciliate, long-glandular-ciliate, or glandular-ciliolate. The corolla may be cotyliform, campanulate or cupuliform, except for *Myrsine minima*, where the nearly free lobes erect in anthesis make it appear tubular. The lobes are valvate and may be linear-lanceolate, lanceolate, ovate, elliptic, or oblong, apically rounded, obtuse, subacute, sharply acute to attenuate, or acute. The ornamentation ranges from inconspicuously pellucid punctate and punctate-lineate, densely and prominently black punctate and punctate-lineate, or medially brown punctate. The margins are usually entire, and glandular-granulose along its length.

The stamens and staminodes are similar but the latter are reduced in size. The stamens are monodelphous (united into a tube by their filaments), and the tube developmentally fused to the corolla tube, the stamens thus appearing epipetalous, or rarely are visible (*M. maguireana*), or readily apparent (*M. minima*, *M. resinosa*). The anthers may be broadly ovate, elliptic, or oblong; apically acute to obtuse, and apiculate or not; basally cordate, subcordate, deeply cordate, or sagittate, and the connective punctate or epunctate dorsally. The antherodes may be lanceololate, obcordate, widely ovate, or ovate, apically acute or obtuse and apiculate or not, basally sagittate or deeply cordate, and the connective epunctate or punctate dorsally. The pistil may be obnapiform or ellipsoid, or rarely conical (*M. andina*) or globose (*M. resinosa*). The style in the Venezuelan species is obsolete. The stigma may be morchelliform, prismatic with 2–3 lobes, conic and spirally lobed with 4 lobes, or rarely umbraculiform (*M. resinosa*) with 4 vertically spirally twisted lobes, or lacinate (*M. nitida*) and 4-lobed. The pistillode is most often conic and hollow.

The fruits are usually globose to subglobose, or rarely ellipsoid (*M. dependens*) or obovoid (*M. picturata*), prominently black punctate and punctate-lineate, or obscurely pellucid punctate, not costate or with inconspicuous longitudinal costae.

ECOLOGY AND BIOGEOGRAPHY

Myrsine species, throughout their range, are most often associated with moist or wet montane life zones. In Venezuela, one may find *Myrsine dependens* through the Andes, mostly in páramo along the margins, at the upper limit of the supáramo thicket habitat, but rarely also at the subpáramo-cloud forest transition zone as long as the site is open and exposed to wind. Where the cloud forest life zone is well-defined, one may expect *Myrsine andina* in the cloud forest just below the subparamo thicket, where *M. coriacea* subsp. *coriacea* may also occur in gaps and more disturbed places, along with *Myrsine pellucida*. While *Myrsine dependens* and *M. andina* are less tolerant of disturbance, *M. pellucida* is more tolerant, and *M. coriacea* subsp. *coriacea* is essentially a "weed."

Along the Atlantic coastal range and into the Guayana Region, *Myrsine guianensis* occurs mostly in primary and secondary riparian forests, but also rarely in premontane forests and upland tepui savannas. Below this life zone in the eastern portion of the Guayana Region (Pantepui Floristic Province sensu Huber 1995), *Myrsine nitida* is found in the same premontane forests, *Clusia-Magnolia*, or *Mora* riparian forests. At the upper limit of that same zone, *Myrsine coriacea* subsp. *reticulata* is found in the riparian formations. Immediately below these Guayana formations, but in the drier savannas, *M. resinosa* occurs.

Among the endemic upland tepui taxa, two species are endemic to Cerro de la Neblina and vicinity, including *Myrsine maguireana* and *M. perpauciflora*, while two others also known from Neblina, *M. minima* and *M. picturata*, are also found in the easternmost area of Pantepui, near the border of Guyana. *Myrsine macrocarpa* is restricted to the area around Cerro Huachamacari, in Estado Amazonas, an area known for high numbers of endemics (Pipoly 1992c).

NOTES ON KEYS AND TERMINOLOGY

The keys are artificial and designed to expedite identification of herbarium specimens. An attempt has been made to emphasize vegetative characters to increase the keys' usefulness with sterile material. The numbers appearing before the taxa refer to their respective position in the key; any correlations with phylogenetic relationships are coincidental. Quantitative and qualitative data presented in keys and descriptions for floral parts and bracts were taken from organs rehydrated from herbarium specimens by boiling in water. Measurements from these range from 10% to 15% greater than those measurements taken directly from dried material. Data regarding stem diameters, inflorescence rachises, pedicels, leaf and fruit shape were taken from dried herbarium specimens.

Description of general morphological features follows Lindley (1848), Pipoly (1987, 1991, 1992a, 1992b, 1996), Pipoly and C. Chen (1995), and Ricketson & Pipoly (1997) for the inflorescence, rachis pedicels and floral parts. Description of leaf morphology follows Hickey (1984), trichome description follows Theobald et al. (1984), and basic cell and tissue terminology follow Metcalfe (1984).

TAXONOMIC TREATMENT

Myrsine L., Sp. Pl. 1: 196. 1753, Gen. Pl. ed 5: 90. 1754; Roem. & Schult., Syst. Veg. 503. 1819; A. DC., Trans. Linn. Soc., London, Bot. 17: 104.

1834; Ann. Sci. Nat. Bot. 9: 292. 1841; Ann. Sci. Nat. Bot. 16: 65–97, 129–196, t. 1–3, 8–9, 1841; A. DC. in DC., Prodr. 8:92. 1844; Miq. in Mart., Fl. Bras. 10:306. 1856; Hook. f. in Benth. & Hook., Gen. Pl. 2:642. 1876; Mez in Engl., Pflanzenr. IV. 236(Heft 9):338. 1902; E. Walker, Philipp. J. Sci. 73:184. 1940, Bot. Mag. Tokyo 67:249. 1954, Bull. Ag. Home Ec. Univ. Ryuku 2:76, Quart. J. Taiwan Mus. 12:164. 1959; Stearn, Bull. Brit. Mus. (Nat. Hist.), Bot. 4:174. 1969; Fosberg & Sachet, Smithsonian Contr. Bot. 21:3–11. 1975; Lundell, Phytologia 48:137. 1981, Phytologia 56:418. 1984; Pipoly, Novon 1:204. 1991, Caldasia 17:1. 1992, Novon 2:392. 1992; Pipoly & C. Chen, Novon 5:360. 1995; Y.B. Harvey & Pipoly, Fl. Pico das Almas 487. 1995; C. Chen & Pipoly, Fl. China 15:34–38. 1996; Pipoly, Sida 17:115–162. 1996; Ricketson & Pipoly, Sida 17:579–589. 1997. Type (by monotypy): *Myrsine africana* L.

Rapanea Aubl., Hist. Pl. Guiane 1:121. t. 46. 1775; A. Juissieau. Gen. Pl. 288. 1789; Miq. in Mart., Fl. Bras. 10:306. 1856; Mez in Urb., Symb. Antill. 2:427. 1901; Mez in Engl., Pflanzenr. IV. 236(Heft 9):342. 1902; Pitard in LeComte, Fl. Gen. Indoch. 3(6):786. 1930; Standl., Publ. Field Mus. Nat. Hist. Ser 18(2):898. 1938; Bâthie, Fl. Madagascar 161:138. 1953; Lundell, Fieldiana, Bot. 24 (8-1):190. 1966, Fl. Panama 8:286. 1971; Fournet, Fl. Ilus. Phan. Guadeloupe et Martinique 1046. 1978; Taton, Fl. Aft. Cent. Myrs. 53. 1980; Kupicha, Fl. Zambesiaca 7:201. 1983; Halliday, Fl. Trop. E. Afr. Myrs. 2:8. 1984; Little et al. Arbol. Puerto Rico y Islas Virg. 2:872. 1988.

Duhamelia Dombey ex lam., Encycl. 1:245. 1783.

Samara Sw., Prodr. 1:120. 1788, *pro parte. non* L.

Manglilla A. Juss., Gen. Pl. 151. 1789.

Arthrophyllum Lour., Fl. Cochinch. 1:120. 1790.

Caballeria Ruíz & Pav., Fl. Peruv. Prodr. 1:141. 1794.

Roemeria Thunb. (*non alior*) Nov. Gen. Pl. 9:130. 1798.

Scleroxylum Willd., Ges. Naturf. Freunde Berlin Mag. Neuesten Entdeck. Gesammten Naturk. 3:57. 1809.

Suttonia A. Rich., Ess. Fl. Nouv.-Zel. 349. pl. 38. 1832.

Merista Banks & Sol. ex A. Cunn. in A. DC. in DC., Prodr. 8:95. 1844.

Shrubs or small trees. *Leaves* alternate, exstipulate. *Inflorescences* lateral (axillary), umbellate or fasciculate, sessile or on short, perennating, accrescent peduncles girdled by persistent floral bracts (thus forming "short shoots"). *Flowers* 4–5(–6)-merous, bisexual or unisexual (the plants then bisexual, monoecious, dioecious, or polygamous); sepals nearly free or united to 1/2 their length, imbricate or valvate, usually ciliate, punctate, persistent; petals nearly free or rarely united to 1/2 their length, usually ciliate, glandular-granulose at least along margin and often throughout within, punctate; stamens and staminodes similar, subequalling corolla length, the filaments free or connate basally to form a tube, the tube with or without sterile appendages alternating with the filaments, and all merely adnate to the corolla tube; or developmentally fused throughout, the anthers or antherodes thus appearing epipetalous, the anthers and antherodes similar, ovate or reniform, elliptic or oblong, rarely sagittate, 2-celled, dehiscing by longitudinal slits, or rarely by subterminal pores opening later into wide longitudinal slits; pistil and pistillode similar; conic, ellipsoid, obturbinate, obnapiform, or variously subglobose; ovary globose, costate or not, glabrous or glabrescent; ovules few, uniseriate, completely immersed in placenta or seated below apical pores in placenta or variously projecting; style obsolete to present, tapering into stigma; stigma morchelliform (morel-shaped), liguliform, sinuate to lobate, prismatic and 3 (–4)-lobed, or rarely conical. *Fruit* a globose, subglobose, ellipsoid, ovoid, or obovoid or subovoid drupe, with somewhat fleshy exocarp and crusty or leathery endocarp, 1-seeded; seed occupying cavity, the endosperm horny, ruminate; embryo cylindric, transverse.

Myrsine, as here defined, contains ca. 300 species and is pantropically distributed. In Venezuela, 12 species are known, separable by the following key.

KEY TO *MYRSINE* OF VENEZELA

1\. Branchlets, petioles and/or leaf midrib densely ferrugineous or tufous villous-tomentose or floccose-tomentose, at times early glabrescent, the trichomes uniseriate.

  2\. Branches plagiotropic; leaves distichous, the blades (0.6–)1.5–2(–3.5) cm long, apically mucronate, scrobiculate above, the secondary veins not visible; flowers 4(very rarely 5)-merous; calyx widely ovate to deltate, glabrous without, the margins villous glandular-ciliate; fruit ellipsoid. .... **1. M. dependens**

  2\. Branches orthotropic; leaves spiral, the blades (1.5–)3.5–13 cm long, without apical mucron, smooth above, the secondary veins prominulous to prominently raised at least adaxially; flowers 5(rarely 4)-merous; calyx triangular-ovate, scattered papillose-puberulent or glabrate without, the margins erose, glandular-ciliate; fruit globose. .... **2. M. coriacea.**

    3\. Leaf blades 6–13 cm long; inflorescences (3–)5–9(–11)-flowered; caylx lobes longer than wide .... **2a. M. coriacea subsp. coriacea**

    3\. Leaf blades (1.5–)3.5–5.5 (–5.8) cm long; inflorescences 2(–3)-flowered; calyx lobes deltate .... **2b. M. coriacea subsp. reticulata**

1\. Branchlets, petioles and leaf midrib glabrous or reddish glandular-papillose.

  4\. Petioles obsolete to 5 mm long.

    5\. Leaf blades cartilaginous, (2.3–)3–5(5.4) cm wide; petioles thick, 2–3 mm diam.; calyx lobes prominently keeled, apically long-acuminate, the margins roughly dentate. .... **3. M. maguireana**

    5\. Leaf blades coriaceous to thickly coriaceous, 1–2(–2.9) cm wide; petioles thinner, obsolete to 1.5 mm diam.; calyx lobes flat, apically obtuse or acute, the margins minutely erose or entire.

      6\. Leaf blades (1.7–)2–3 cm long, 1–1.5 cm wide; calyx lobes obtuse apically, the margins minutely erose toward the apex, glabrous. .... **4. M. minima**

6. Leaf blades (2.8–)3–5.5(–6) cm long, 1.5–2.5(–2.9) cm wide; calyx lobes acute apically, the margins entire, long glandular-ciliate toward apex or densely glandular-ciliate throughout.
    7. Branchlets red glandular papillose-tomentose apically; leaf blades emarginate apically; pedicels 0.5–0.8 mm long; calyx lobe margins long glandular-ciliate toward the apex. .... **5. M. andina**
    7. Branchlets glabrous apically; leaf blades acute or rounded apically; pedicels 1.2–2 mm long; calyx lobe margins densely glandular-ciliate througout. .... **6. M. perpauciflora**

4. Petioles 5–20 mm long.
    8. Leaf blades 1–2(–3) cm wide.
        9. Leaf blades (3–)4–5 times longer than wide, 4–15 cm long, 1–2(–2.7) cm wide, lower leaf surface sparsely but conspicuously black punctate-lineate, the lines (5–)20–40 mm long; petioles flat above, marginate; pistillate pedicels 3.5–5 mm long; calyx lobes apically short-acuminate, the margins sparsely glandular-ciliolate; fruit subglobose, longer than broad. .... **7. M. resinosa**
        9. Leaf blades 2–3 times longer than wide, (3–)4–6 cm long, 1.8–2(–3) cm wide, lower leaf surface densely and prominently black punctate and very short punctate-lineate, the lines0.5–1 mm long; petioles canaliculate; pistillate pedicels 0.9–1 mm long; calyx lobes apically long-attenuate, the margins glabrous; fruit obovoid. .... **8. M. picturata**
    8. Leaf blades (2.7–)3–9.2 cm wide.
        10. Pistillate pedicels obsolete to 1.4 mm long; secondary veins of the leaf blades inconspicuous.
            11. Branchlets, petioles and leaf midrib glabrous or glandular-granulose; pedicels 1.1–1.4 mm long; calyx lobes 1.2–1.4 mm long, wider than long; fruits 8–12 mm in diam., obscurely pellucid punctate. .... **9. M. macrocarpa**
            11. Branchlets, petioles and midrib of leaf blade reddish glandular-papillose; pedicels obsolete to 1 mm long; calyx lobes 1 mm long, longer than wide; fruits 3–3.5 mm in diam., obscurely punctate and punctate-lineate. .... **10. M. pellucida**
        10. Pedicels 1.5–3 mm long; secondary veins of the leaf blades conspicuous.
            12. Leaf apices acute, rarely obtuse; lower leaf surfaces conspicuously reddish punctate and punctate-lineate; calyx lobes deltate; fruit 3–3.5 mm diam., obscurely pellucid punctate; gallery, *Mora* and *Clusia-Magnolia* forests. .... **11. M. nitida**
            12. Leaf apices obtuse to broadly rounded; lower leaf surfaces inconspicuously black punctate to punctate-lineate; calyx lobes ovate; fruit 3.5–5 mm diam., prominently black punctate; cloud forests to lowland savannas. .... **12. M. guianensis**

1. Myrsine dependens (Ruíz & Pav.) Spreng., (**Figs. 1H, 1I, 1J, 3**), Syst. Veg. 1:664. 1825. *Caballeria dependens* Ruíz & Pav., Syst. Veg. Fl. Peruv. Chil. 281. 1798. *Manglilla dependens* (Ruíz & Pav.) Roem. & Schult., Syst. Veg. 4:506. 1819. *Rapanea dependens* (Ruíz & Pav.) Mez in Engl., Pflanzenr. IV. 236(Heft 9):377. 1902. TYPE: PERU. HUÁNUCO: Near Muña, without elev., *H. Ruíz & J. Pavón s.n.* (HOLOTYPE: MA; ISOTYPES: F, G-DEL).

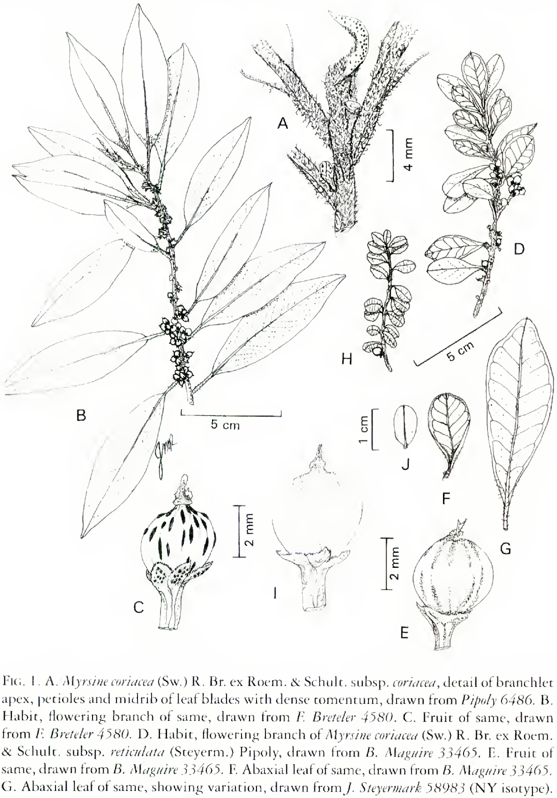

FIG. 1. A. *Myrsine coriacea* (Sw.) R. Br. ex Roem. & Schult. subsp. *coriacea*, detail of branchlet apex, petioles and midrib of leaf blades with dense tomentum, drawn from *Pipoly 6486*. B. Habit, flowering branch of same, drawn from *F. Breteler 4580*. C. Fruit of same, drawn from *F. Breteler 4580*. D. Habit, flowering branch of *Myrsine coriacea* (Sw.) R. Br. ex Roem. & Schult. subsp. *reticulata* (Steyerm.) Pipoly, drawn from *B. Maguire 33465*. E. Fruit of same, drawn from *B. Maguire 33465*. F. Abaxial leaf of same, drawn from *B. Maguire 33465*. G. Abaxial leaf of same, showing variation, drawn from *J. Steyermark 58983* (NY isotype). H. Habit, flowering branch of *Myrsine dependens* (Ruíz & Pav.) Spreng., drawn from *L. Marcano-Berti 804*. I. Fruit of same, drawn from *L. Marcano-Berti 804*. J. Abaxial leaf of same, drawn from *L. Marcano-Berti 804*.

Myrsine ciliata Kunth in H.B.K., Nov. Gen. Sp. 3:248. 1819. *Rapanea dependens* (Ruíz & Pav.) Mez in Engl. var. *ciliata* (Kunth) Cuatrec., Rev. Acad. Colomb. Ci. Exact. 8:324. 1951. Type: COLOMBIA. Without locality, without elev., without date, *A. von Humboldt & A. Bonpland 326* (holotype: P).

Samara myrtifolia Willd. ex Schult. & J.H. Schult. in Roem. & Schult., Mant. 3:220. 1827. *Myrsine myrtifolia* (Schult. & J.H. Schult.) A. DC. in DC., Prodr. 8:103. 1844. Type: COLOMBIA. Without locality, without elev., without date, *A. von Humboldt & A. Bonpland s.n.* (holotype: P). According to TL-2, the third volume of *Mantissa* was co-authored by Julius Herman Schultes, son of Josef August Schultes, in their revision of the Syst. Veg. that Josef and Johann Jakob Roemer had written earlier. Therefore, we have changed the literature citation customarily used for the basionym accordingly.

Caballeria myrtifolia Ruíz & Pav., ex A. DC. in DC., Prodr. 8:102. 1844. pro syn, nom. inval. Type: PERU. Without locality, without elev. without date, *H. Ruíz & J. Pavón s.n.* (holotype: G-DEL; isotypes: G-BOIS, MA).

Rapanea pittieri Mez in Engl., Pflanzenr. IV. 236(Heft 9):378. 1902. *Myrsine pittieri* (Mez) Lundell, Phytologia 48:142. 1981. Type: COSTA RICA. Cartago: Volcán Irazú, 3,000 m, *H. Pittier 14111* (holotype: B-destr., 1943; lectotype: by Pipoly 1992b, BR; isolectotype: US).

Rapanea peruviana Lundell, Wrightia 6:117. 1980. *Myrsine peruviana* (Lundell) Lundell, Phytologia 48:142. 1981. Type: PERU. Cuzco: Tres Cruces, upper edge of Parque Nacional de Manú, 1–13 km NW of Paucartambo-Pilcopata Road, 3,300–3,500 m, 29 Jun 1978, *A. Gentry et al. 23478* (holotype: LL-TEX; isotypes: MO, USM).

Rapanea pittieri Mez var. *chirripoensis* Suessenguth, Bot. Jahrb. Syst. 72:281. 1942. Type: COSTA RICA. San José: Chirripó Grande, without elev., 28 Apr 1932, *W. Kupper 1140* (holotype: M; isotype: M).

Shrubs or *small trees* to15 m tall and 16 cm DBH; trunk orthotropic, the branches plagiotropic. *Branchlets* terete, rufous puberulent or short villous to densely villous-tomentose apically, at least when young, usually glabrescent, nodes congested, lenticels generally small and obscure. *Leaves* distichous; blades coriaceous to cartilaginous, ovate to elliptic, obovate or suborbicular, (0.6–)1.5–2.0(–3.5) cm long, 0.5–2 cm wide, apically rounded or emarginate, with a short, often blunt, bulbous, mucron formed by an extension of the midrib, basally obtuse to rounded, the midrib impressed and puberulent to short-villous toward base above, prominently raised below, the secondary venation not visible, nitid and scrobiculate above, bearing numerous hydropotes, punctate and punctate-lineate below, the margin entire, densely punctate flat to inrolled; petioles canaliculate, 0.1–0.3(–0.4) cm long, puberulent to short villous within, extending up the midrib of the blade, outside often puberulent to short villous, usually glabrescent. *Staminate inflorescence* fasciculate, 1–3(–4)-flowered; peduncles forming short shoots 1–1.5 mm long, 1–1.2 mm diam., floral bracts chartaceous, oblate, 0.8–1 mm long, 1–1.5 mm wide, apically rounded, densely short-villous above, glabrous below, the margins entire, densely glandular-ciliate; pedicels 1–1.8 mm long, glabrous. *Staminate flowers* 4(rarely 5 [*Pipoly et al. 6466*])-

merous, chartaceous, 3–3.5 mm long; calyx cotyliform, 1–1.2 mm, long, the tube ca. 0.2 mm long, the lobes widely ovate to deltate, 0.8–1 mm long and wide, apically acute, prominently black punctate and punctate-lineate, the margin entire, villous-ciliate, especially toward apex; corolla campanulate, 2.5–3 mm long, the tube ca. 0.5 mm long, the lobes lanceolate to ovate, 2–2.5 mm long, 0.8–1 mm wide, apically subacute to obtuse, inconspicuously punctate and punctate-lineate, the margins entire, minutely glandular-granulose; stamens 1.9–2.3 mm long, the filaments obsolete, the anthers broadly ovate to elliptic, 1.4–1.8 mm long, 0.4–0.6 mm wide, attached dorsally at apex of corolla tube and thus appearing epipetalous, apically apiculate, basally cordate, the connective epunctate dorsally; pistillode conic, hollow, glabrous, the style obsolete, the stigma morchelliform, 0.1–0.2 mm long. *Pistillate inflorescence* as in staminate but 1–3-flowered; peduncle 1–1.2 mm long, 0.8–1 mm diam.; floral bracts 0.8–1 mm long and wide, densely ciliate along the margins; pedicels 1.7–2.2 mm, glabrous. *Pistillate flowers* as in staminate but corolla 2.4–2.6 mm long, the tube 0.2–0.4 mm long, the lobes lanceolate, 2–2.2 mm long, 0.6–0.7 mm wide; staminodes resembling stamens but abortive, the filaments obsolete, the antherodes lanceolate, 1–1.4 mm long, 0.3–0.4 mm wide, apically apiculate, basally sagittate; pistil obnapiform, the ovary subglobose to conical, glabrous the style obsolete, the stigma morchelliform, 0.8–1 mm long, the placenta globose, the ovules 2–4, uniseriate. *Fruit* ellipsoid, 3–3.5 mm long, 2.5–3 mm diam., densely and prominently black punctate and punctate-lineate, with inconspicuous longitudinal costae.

Distribution.—*Myrsine dependens* is known from Costa Rica and Panama, and in the Andes from Venezuela to Bolivia, from 2,500–3,800 m elevation. In Venezuela, it is found in the Andean states of Mérida, Táchira, and Trujillo, and along the coastal cordillera in and north of Caracas, in the Distrito Federal and Miranda states. We expect it should also occur in the Serranía de Turumiquire, in the states of Anzoátegui, Monagas and Sucre.

Ecology and conservation status.—*Myrsine dependens* is known from subpáramo, páramo margins, and subpáramo-cloud forest transition areas, and withstands moderate to heavy disturbance. The principal obstacle to successful seedling establishment appears to be compaction of the soil from overgrazing by sheep and goats. The species is locally common, often forming dense thickets, and is not threatened at this time.

Etymology.—The specific epithet comes from the latin 'dependens', meaning suspended or hanging down, and refers to the often lax, narrow branchlets that hang due to weight with age.

Specimens examined. **VENEZUELA. Distrito Federal:** Caracas, without elev., 1843 (fl), *H. Funck 481* (P); "crescit in declivitate meridionali montis Silla de Caracas, 800 hex, without date (fr), *A. von Humboldt & A. Bonpland s.n.* (P); Caracas, without elev., without date (fl), *J. Linden 958* (K); Parque Nacional El Avila, Pico Naiguatá, without elev., 5 Jan 1976 (fr), *B. Manara s.n.* (MO, NY, VEN); Cordillera del Avila, between Los Venados and Pico Oriental, 1,675–2,640 m, 27–28 Feb 1944 (fl), *J. Steyermark 55646* (F, NY); Silla de Caracas, without elev., 1891–1892 (fr), *J. Warmings s.n.* (C). **Mérida:** Páramo de Mucuquí, 3,100 m, 7 Dec 1952 (fr), *L. Bernardi 214* (G, NY, VEN); Near Alto del Aguada, 3,300–3,500 m, 4 Nov 1976 (fr), *L. Bernardi et al. 17136* (NY, VEN), *17144* (NY, VEN); Distrito Libertador, Páramo El Escorial, vicinity of El Valle, NE of Mérida, ca. 2,800 m, 9 Sep 1982 (fl), *S. Clemants & J. Dugarte 2411* (F, NY, VEN); Distrito Miranda, road from Páramo La Aguila to Piñango, at bridge, 3,400 m, 16 Sep 1982 (fr), *S. Clemants & D. Díaz M. 2435* (MERF, NY); Quebrada de Saisay, 3,220 m, 5 Apr 1930 (fr), *H. Gehriger 28* (F, MO, NY, VEN); Páramo near Hotel Los Frailes, N of the Mèrida-Barinas Hwy, 08° 49' N, 70° 47' O, 3,000–3,300 m, 29 Dec 1991 (fl), *W. Meier 1097* (MO, VEN n.v.); Distrito Libertador, Sierra de Culata, 20 kms NE of Mèrida, 2,800–3,800 m, 19 Dec 1983 (fr), *J. Pipoly et al. 6466* (MER, MO, NY); Distrito Libertador, Sierra de Culata, 18 kms NE de Mérida, 2,800–3,800 m, 19 Dec 1983 (fr), *J. Pipoly et al. 6512* (MER, MO, NY); Distrito Libertador, Parque Nacional Simón Bolívar, La Mucuy, Laguna del Coromoto, 3,400 m, 22 Dec 1983 (fr), *J. Pipoly & G. Aymard 6566* (MER, MO, NY); Disrriro Libertador, Municipio Tabay, near Laguna de la Coromoto, Parque Nacional Simón Bolívar, 3,100–3,400 m, 19 Jun 1963 (fl), *L. Ruíz Terán 1669* (MERF, MO). **Miranda:** Ascent of Pico de Naiguatá, above Los Chorros, 2,200–2,865 m, 16–17 Jun 1945 (fl), *J. Steyermark 63007* (F, MO). **Táchira-Mérida border:** Páramo, La Negra, 3,000 m, 7 Oct 1965 (fr), *J. Breteler 4629* (F, NY); Páramo La Negra, ca. 3,080 m, 7 Oct 1965 (fl, fr), *L. Marcano-Berti 804* (MER, MO). **Trujillo:** Páramo Guirigay, toward Peña Blanca, 3,400 m, Aug 1958 (fl), *L. Aristeguieta 3606* (NY, VEN); Arriba de Jají, Paramito, toward Tuñame, rocky mounrains, 3,100–3,200 m, 29 Oct 1969 (fr), *J. Cuatrecasas et al. 28185* (F); Along highway berween Flor de Patria and Boconó, 64 km from Boconó, 500 m, 24 Feb 1971 (fl, fr), *J. Steyermark 104785* (MO, NY). **Without location:** Venezuela, without elev., 1842–1843 (fl), *H. Funck 550* (BM); 1845 (fl), *H. Funck & L. Schlim 58* (BM).

As here interpreted, *Myrsine dependens* includes a wide range of growth forms, all restricted to Andean subpáramo and páramo habitats, extending to the Caribbean coastal cordillera. The *Myrsine ciliata* growth form is the most striking variant, chiefly because of its cartilaginous leaf blades with a plicate habit. Further study is needed through the subpáramos and jalca habitat margins, from Colombia to Peru, to determine whether this variant deserves subspecific recognition.

Among all Venezuelan species, *Myrsine dependens* is easily distinguished because it exhibits architecture corresponding to Massart's Model (Hallé et al. 1978), characterized by an orthotropic trunk and plagiotropic branches bearing distichous leaves. Fieldwork has shown it forms large populations with high densities. The ellipsoid fruit is also distinctive. At this time, its relationships are not certain, but the small-leaved taxa, including, *M. microdonta* Pipoly, *M. fosteri* Pipoly, and *M. brevis* (J. F. Macbr.) Pipoly of Peru; *M. lehmannii* (Standl.) Pipoly, and *Myrsine paramensis* (Cuatrec.) Pipoly of Colombia, seem to form a monophyletic group defined by mucronulate to mucronate leaf apices and Massart's Model of architecture. All are high-altitude taxa growing in harsh environments.

2. Myrsine coriacea (Sw.) R. Br. ex Roem. & Schult.

Shrubs or *small trees* to 8(–30) m tall; trunk and branches orthotropic. *Branchlets* terete, ferrugineous to rufous villous tomentose to floccose tomentose, at least apically, usually persistent, the trichomes uniseriate; lenticels small and obscure to large and conspicuous. *Leaves* spiral; blades membranaceous, chartaceous or coriaceous, lanceolate, oblanceolate, obovate, elliptic or oblong, (1.5–)6–13 cm long, (0.8–)1–3 cm wide,apically acute or acuminate, rarely obtuse to emarginate, basally acute, cuneate to obtuse or rarely rounded, decurrent on the petiole, nitid and smooth above, pallid below, the midrib flat or impressed above, prominently raised below, the secondary veins prominulous to prominently raised above and/or below, conspicuously but not prominently punctate and punctate-lineate below, villous at first, at least along the midrib, glabrescent, the margins entire, flat or rarely revolute basally; petioles canaliculate or marginate at least distally, 0.1–2 cm long, thick, densely to sparsely ferrugineous or rufous villous tomentose, often glabrescent with age. *Staminate inflorescence* fasciculate, 5–12-flowered; peduncles forming short shoots 1–4 mm long, 1–2 mm diam., glabrous or pilose; floral bracts deltate to very widely ovate, 0.4–0.8 mm long and wide, apically obtuse to rounded, the margin glandular-ciliate; pedicels obsolete to 1.5 mm long, papillose-puberulent at first, glabrescent. *Staminate flowers* 5-merous, very rarely with a few, scattered 4-merous ones on some inflorescences, 2.5–4 mm long; calyx chartaceous, cotyliform, 0.4–1.5 mm long, the tube 0.1–0.3 mm long, the lobes triangular-ovate, 0.4–1.2 mm long, 0.3–0.6 mm wide, apically acute to obtuse, densely and prominently black punctate or rarely epunctate, scattered papillose-puberulent without or glabrate, the margins subentire to erose, glandular-ciliate; corolla chartaceous, campanulate, 2.5–4 mm long, the tube 0.5–1 mm long, the lobes lanceolate, 2.5–3.5 mm long, 0.8–1.1 mm wide, apically subacute to obtuse, prominently black punctate-lineate, the margin entire, glandular-granulose; stamens 2–2.8 mm long; filaments obsolete and anthers attached at the apex of corolla tube, thus appearing epipetalous; anthers oblong, 1.5–1.8 mm long, 0.9–1 mm wide, apically acute to obtuse, basally deeply cordate to subsagittate, the connective epunctate dorsally; pistillode conic, hollow. *Pistillate inflorescence* as in staminate but 3–9-flowered. *Pistillate flowers* as in staminate but 1.8–4 mm long; corolla 1.7–3.3(–3.9) mm; staminodes similar to stamens but anthers ovate, 0.5–1 mm,apically acuminate, basally slightly sagittate, the connective epunctate; pistil obturbinate, the ovary 0.5–1 mm, globose to subglobose; the style obsolete, the stigma morchelliform, (1–)1.2–1.4 mm long; ovules 3, uniseriate. *Fruit* globose, 2.5–3.5(–4) mm diam., punctate to punctate-lineate, glabrous, costa not prominent, brown or black at maturity.

As here circumscribed, *Myrsine coriacea* is the most widespread neotropical species and perhaps the only "weedy" neotropical member of the Myrsinaceae.

It is the most polymorphic of the ochlospecies (sensu White 1962; Prance 1982; Pipoly 1983) found in any myrsinaceous genus. While vegetative plasticity is greater in this species than in any other in the family, the morchelliform stigma is shared only with *M. dependens*. It is not certain whether the morchelliform stigmas of both species are identical, or two states of what could be a transformation series, and more study of this is needed. Among the other distinguishing features of *Myrsine coriacea* are the few-flowered, sessile, faciculate inflorescences, subsagittate anther and antherode bases, the persistent ferrugineous tomentum of the vegetative organs and pedicels, and the small, globose fruits.

2a. **Myrsine coriacea** (Sw.) R. Br. ex Roem. & Schult. subsp. **coriacea, (Figs. 1A, 1B, 1C, 2)**, Syst. Veg. 4:511. 1819. *Samara coriacea* Sw., Prodr. 1:32. 1788. *Rapanea coriacea* (Sw.) Mez in Urb., Symb. Antill. 2:428. 1901. TYPE: JAMAICA. Without locality, without elev., without date, *O. Swartz s.n.* (HOLOTYPE: BM).

Caballeria ferruginea Ruíz & Pav., Syst. Veg. Fl. Peruv. Chil. 280. 1798. *Manglilla ferruginea* (Ruíz & Pav.) Roem. & Schult., Syst. Veg. 4:506. 1819. *Myrsine ferruginea* (Ruíz & Pav.) Spreng., Syst. Veg. 1:664. 1825. *Rapanea ferruginea* (Ruíz & Pav.) Mez in Urb., Symb. Antill. 2:429. 1901. TYPE: PERU. HUÁNUCO: Near Muña, without elev., without date, *H. Ruíz et J. Pavón s.n.* (HOLOTYPE: MA; ISOTYPE: G).

Myrsine popyananensis Kunth in H.B.K., Nov. Gen. Sp. 3:249. 1819. TYPE: COLOMBIA. CAUCA: Near Popayán, 1,000 m, without date, *A. von Humboldt & A. Bonpland 1908* (HOLOTYPE: P).

Myrsine jelskii Zahlbr., Ann. K. K. Naturhist. Hofmus. 7:3. 1892. *Rapanea jelskii* (Zahlbr.) Mez in Engl., Pflanzenr. IV. 236(Heft 9):379. 1902. TYPE: PERU. CAJAMARCA: Near Cutervo, without elev. without date, *C. von Jelski 15* (HOLOTYPE: W; ISOTYPES: KRA, n.v., PR).

Samara saligna Willd. ex Schult. & J.H. Schult. in Roem. & Schult., Mant. 3:220. 1827. *Myrsine saligna* (Schult. & J.H. Schult.) A. DC., Prodr. 8:103. 1844. TYPE: *Herb. Willd. 1039* (HOLOTYPE: B-WILLD, n.v.). According to TL-2, the third volume of *Mantissa* was co-authored by Julius Herman Schultes, son of Josef August Schultes, in their revision of the Syst. Veg. that Josef and Johann Jakob Roemer had written earlier. Therefore, we have changed the literature citation customarily used for the basionym accordingly.

Myrsine myricoides Schltdl., Linnaea 1833:525. 1833. *Rapanea myricoides* (Schltdl.) Lundell, Wrightia 3:109. 1964. TYPE: MEXICO. VERACRYZ: Jalapa: without locality, without elev., without date, *H. Galeotti 521, 522, 526* (SYNTYPES BR, F, G, HAL). We defer lectotypification of this binomial until all material cited in the protologue and their duplicates can be assembled.

Myrsine tomentosa Presl, Reliq. Haenk. 2:63. 1835. TYPE: PERU. HUÁNUCO: without locality, without elev. without date, *T. Haenke s.n.* (HOLOTYPE: PR).

Myrsine viridis Rusby, Mem. Torrey Bot. Club 6:74. 1896. TYPE: BOLIVIA. LA PAZ: Mapiri, without elev., Jul–Aug 1892, *M. Bang 1476* (HOLOTYPE: NY).

Rapanea ambigua Mez in Engl., Pflanzenr. IV. 236(Heft 9):380. 1902. SYN. NOV. TYPE. VENEUELA. DISTRITO FEDERAL: Caracas bei der Kolonie Továr, without elev., without date (fl), *G. Karsten s.n.* (HOLOTYPE: B-destroyed, 1943 (F Neg. # 4886); LECTOTYPE: here designated W (F Neg. # 31985).

Myrsine guatemalensis Gand., Bull. Soc. Bot. France 65:57. 1918. TYPE: GUATEMALA.

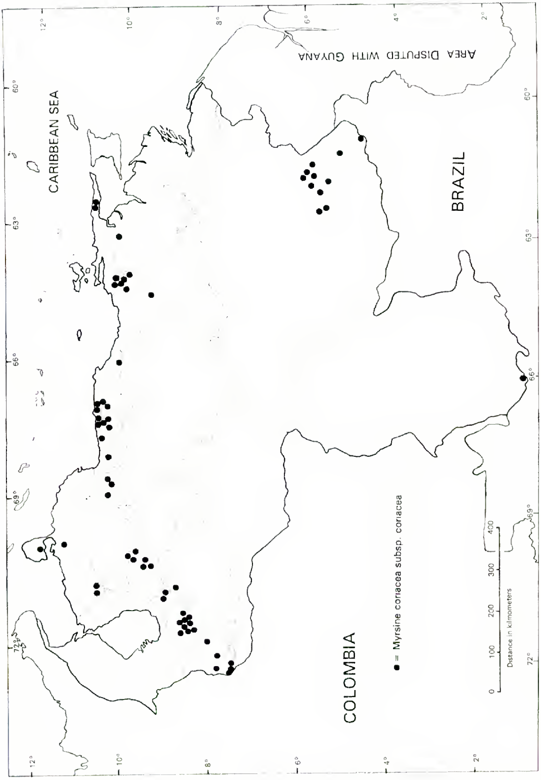

FIG. 2. Distribution of *Myrsine coriacea* subsp. *coriacea* (•) in Venezuela.

ALTA VERAPAZ: Coban, 1350 m, Dec 1906, *H. von Türckheim 1001* (HOLOTYPE: P; ISOTYPES: F, G, LL-TEX, MICH, MO).

Rapanea rufa Lundell, Wrighria 5:298. 1976. *Myrsine rufa* (Lundell) Lundell, Phytologia 48:142. 1981. TYPE: COSTA RICA. SAN JOSÉ: Cordillera de Talamanca, Pacific Slope of the Chirripó Massif, 2,700–3,000 m, 6 Apr 1969, *G. Davidse & R. Pohl 1635* (HOLOTYPE: LL-TEX; ISOTYPE: MO).

Myrsine vestita Lundell, Wrightia 7:274. 1984. *Rapanea vestita* (Lundell) Lundell, Phyrologia 58:490. 1985. TYPE: COSTA RICA. PUNTARENAS: Cordillera de Talamanca, slopes between Cerro Echandí and Cerro Burú, 2,600–2,700 m, 24 Aug 1983, *G. Davidse et al. 24018* (HOLOTYPE: LL-TEX; ISOTYPES: CR n.v., MO).

Myrsine microcalyx Lundell, Phytologia 58:277. 1985. *Rapanea microcalyx* (Lundell) Lundell, Phytologia 58:490. 1985. TYPE: PANAMA. CHIRIQUÍ: Cerro Colorado, 24 mi on gravel road from bridge over Río San Félix, 1,430 m, 22 Nov 1979, *T. Antonio 2619* (HOLOTYPE: LL-TEX; ISOTYPE: MO).

Shrubs or small *trees* to 5(–30) m tall, 15(–50) cm DBH. *Branchlets* rufous or ferrugineous villous- or floccose- tomentose, persistent at least apically, rarely glabrescent. *Leaf blades* membranaceous, chartaceous or subcoriaceous, 6–13 cm long, 1–3 cm wide, the secondary veins prominulous to prominently raised above, often conspicuously but rarely prominently punctate and punctate-lineate, sometimes villous at first, especially along the midrib on both surfaces, usually glabrescent with age the margins flat to revolute; petioles 0.1–2 cm, thick, punctate, usually puberulent or short villous to densely villous-tomentose with reddish trichomes, often glabrescent. *Fruit* globose, 2.5–3.5(–4) mm diam.

Distribution.—*Myrsine coriacea* subsp. *coriacea* is known from Mexico and the West Indies through Central America, through the Andes from Venezuela to Argentina, and in montane or premontane areas in the Atlantic coastal forest of Brazil, from 700–3,000 m elevation. In Venezuela (Fig. 2), the species is known from the Guayana Region (Bolívar), the eastern states of Anzoátegui, Monagas and Sucre, the Coastal Range north of Caracas, including Aragua, Carabobo, Distrito Federal and Miranda, and the entire Andean region from Falcón to the Colombian border.

Ecology.—*Myrsine coriacea* subsp. *coriacea* occurs in primary and secondary elfin, cloud, and wet montane (including montane tepui savanna), and subpáramo thickets. While no statistical analyses have been carried out, fieldwork has shown that within a range from slight to heavy disturbance (mostly from sheep grazing), *Myrsine coriacea* subsp. *coriacea* seems to increase in population density with disturbance.

The subspecies' range overlaps with that of subsp. *reticulata* only in the state of Bolívar, where subsp. *coriacea* occurs in the talus slope forests, while subsp. *reticulata* occurs in riparian gallery forests on the tepui summits. Given its ability to thrive in disturbed habitats, subsp. *coriacea* it is not subject to threat at this time.

Etymology.—The subspecific epithet, 'coriacea' refers to the coriaceous nature of the leaf blades, an especially common feature in Caribbean populations.

Specimens examined. **VENEZUELA. Amazonas:** Departmento Río Negro, Cerro de La Neblina, Expedition Camp VII, 00° 50' N, 65° 58' W, 1,850 m, 2 Dec 1984 (fl), *W. Anderson 13461* (F, NY, US). **Anzoátegui:** Disitrito Libertad, summit of Montañas Negras, along the Sucre and Anzoátegui border, 20 airline km NE of Bergantín, NE of Buenos Aires, Serranía de Turimiquire, 10° 04' 30" N, 64° 11' W, 2,000–2,350 m, 28 Nov 1981 (fr), *G. Davidse & A. González 19540* (F, MO, NY, VEN); (fl, fr), *19606* (MO, NY, VEN); Cerro Corona, near radio installation, 2,000–2,200 m, 7 Jan 1987 (fl), *W. Hahn & F. Grifo 3460* (MO, US); Distrito Freites, Serranía de Turumiquire, Cerro Peonía, ca. 10° 06' N, 64° 06' W, 2,200–2,400 m, 8 Dec 1983 (fr), *J. Pipoly 6450* (NY, VEN); Along forested slopes of headwaters of tributaries of Río Neverí, between Río León and "Carmelita", NE of Bergantín, 800–1,200 m, 5 Mar 1945 (fl), *J. Steyermark 61355* (F); Slopes of Montaña de las Palomas tributary of Río Neverí, between "Carmelita" and "Natalia", NE of Bergantín, 900–1,000 m, 9 Mar 1945 (fl), *J. Steyermark 61445* (F); S-facing steep slope, knife-edge ridge above tree zone, Cerro Peonía (Cerro Los Pajaritos), above Santa Cruz, headwaters of Río Manantiales, E of Bergantín, 1,800–2,000 m, 20 Mar 1945 (fl, fr), *J. Steyermark 61615* (F). **Aragua:** Distrito Girardot, near Alto de Choroní, 1,400 m, 11 May 1977 (fr), *V. Badillo 7339* (MY, NY); Carretera las Tejerías-La Tiara, highest point of Carretera, 14–15 km S of junction to Carretera Las Tejerías-Los Teques, 1,150–1,200 m, 4 Jan 1978 (fl), *G. Bunting & M. Fucci 6050* (NY); Summit, Pico Guacamaya, Parque Nacional Henri Pittier, 1,850 m, 25 Jan 1990 (fl), *A. Cardozo & H. Rodríguez 1218* (MO); Summit, Cerro Chimborazo, Parque Nacional Henri Pittier, 2,230 m, 23 Feb 1990 (fl), *A. Cardozo et al. 1278* (MO); On steep slope, N slope of Pico Guacamaya, Parque Nacional Henri Pittier, 1,800 m, 23 Mar 1990 (fl), *A. Cardozo et al. 1344* (MO); Parque Nacional Henri Pittier, without elev., 26 May 1990 (fr), *A. Cardozo & H. Meneses 1421* (MO); Near Colonia Tovar, without elev., 1854–1855 (fr), *A. Fendler 758* (MO, NY); Distrito Ricaurte, after arch toward Colonia Tovar, without elev., 22 Jul 1987 (fr), *C. de Rojas y F. Rojas 3682* (MY n.v., NY). **Aragua:** Lagunita, Colonia Továr, without elev., without date (fl), *J. Moritz 1175* (BM); Vicinity of Tovar, 1,200 m, 31 Jan 1928 (fl), *H. Pittier 12793* (NY); Sabanas de Agua Negra, 1,500–1,600 m, 18 Dec 1936 (fl), *H. Pittier 13793* (US); S-facing slopes of Cordillera del Avila, just above Caracas, along trail towards Los Venados, 1,520–1,675 m, 27 Dec 1943 (fl), *J. Steyermark 55022* (F). **Barinas:** Distrito Pedraza, SW of Carrizal, "La Escaza"on the S bank of the Río Canaguá, Parque Nacional Sierra Nevada, 08° 39' N, 70° 46' W, 26 Jun 1988 (fr), *L. Dorr et al. 5693* (NY, PORT). **Bolívar:** Distrito Piar, Macizo del Chimantá, wide valley in the SE sector of Apacará-tepui, in contact zone between Roraima Sandsrone and extensive metamorfic (diabasic) intrusions, in the N sector of the Macizo 05° 19' N, 62° 07' W, 2,150 m, 7 Feb 1984 (fl), *M. Colella & O. Huber 451* (MYF, NY); Distrito Piar, Kuaipia Min. Pedro Cova, 05° 37' N, 61° 46' W, ca. 1,000 m, 14 Apr 1986 (fr), *S. Elcoro y N. Vera 225* (MYF, NY); Distrito Sifontes, Mun. Urdaneta, Cuencas del Caroní, "Sabanita" 11 km E of San Ignacio, 05° 00' 00" N, 61° 00' 30" W, 1,120 m, 30 Jan 1985 (fr), *L. Hernández y N. Dezzeo 114* (MYF, NY); Distrito Piar, ca. 6 km NE of Kavanayén, 05° 38' N, 61° 40' W, 1,300 m, 6 Mar 1983 (fr), *O. Huber & C. Alarcón 7375* (MYF, NY); Distrito Roscio, montane savannas above "Piedra de Canaimé," ca. 5 km SE of Santa Elena de Uairén, 04° 35' N, 61° 06' W, 1,100–1,200 m, 28 Jul 1983 (fr), *O. Huber & C. Alarcón 7931* (MYF, NY); Distrito Piar, Macizo del Chimantá, wide valley located in SE section of Apacará-tepui, in the contact zone between Roraima Sandstones and extensive metamorphic (diabasic) in the N sector of the Macizo, 05° 19' N, 62° 07' W, 2,150 m, 6–9 Feb 1984 (fl), *O. Huber et* *al. 8786* (MYF, NY 2-sheets); 11 kms E of Kavanayén, ca. 1,200 m, 26 Jul 1983 (fr), *R. Kral & A. González 70455* (MO, VDB); Entre Estación y Aeropuerto CVG de Parupa, 1,250 m, 14 Sep 1983 (fr), *G. Morillo et al. 9606* (VEN); Gran Sabana, Vía Kavanayén, El Jardin, between Campamento Parupa and Kavanayén, ca. 55 km E of Fuerte Luepa, without elev., 23 Jun 1983 (fl), *N. Ramírez 796* (VEN); Gran Sabana, Rastrojo, behind Campamento Río Parupa at junction with Río Parupa, Parque Nacional Canaima, without elev., 23 Nov 1993 (ft), *N. Ramírez et al. 4666* (MO); Ptari-tepui, steep forested slopes at base of first line of sandstone bluffs, on S-facing part, E of "Cave Rock", 2,130 m, 4 Nov 1944 (fl), *J. Steyermark 59826* (F, MO, NY, US); Río Karuai bordering savanna between base of Ptari-tepui and Sororopán-tepui, 1,220 m, 28 Nov 1944 (bud), *J. Steyermark 60737* (F); Ridge above La Laja at base of Sororopán-tepui, 1,375–1,460 m, 30 Nov 1944 (bud), *J. Steyermark 60808* (F). **Carabobo:** Above Hacienda Cura, between Valencia and Maracay, 1,400 m, 8 Jan 1939 (fl), *A. Alston 6172* (BM). **Distrito Federal:** Las Flores, Sierra de El Avila, 1,600 m, 15 Dec 1938 (fl), *A. Alston 5515* (BM); Ecological study site, Silla de Caracas, without elev., 29 Jan 1969 (fl), *Z. Baruch 95* (NY); Bajo Seco, Facultad de Agronomía Station, 2,000 m, 26 Jan 1983 (fl), *L. C. de Guevara 3261* (BM); Parque Nacional El Avila, trail from end of road to La Silla de Caracas, ca. 10° 35' N, 66° 50' W, 1,951–2,316 m, 29 Jan 1984 (fl), *J. Luteyn et al. 9386* (NY, VEN), (ster.), *9387*; Fila del Avila, 10° 32' 8" N, 66° 53' W, 2,060 m, 11 Jun 1991 (fr), *W. Meier 14* (MO); Cerro El Avila, S slope, along ridge to Hotel Humboldt-Papelón, 10° 32' 03" N, 66° 52' 05" W, 1,930 m, 10 Jan 1992 (fl), *W. Meier 1317* (MO); Fila del Avila, 10° 32' 07" N, 66° 53' W, 2,050–2,100 m, 7 Jan 1992 (fr), *W. Meier 1414* (MO); Headwaters of Quebrada Chacaito, 10° 33' N, 66° 52' O, 2,090 m, 5 Feb 1992 (fr), *W. Meier 1603* (MO); Colinas W of Río Macarao Basin, 1,200 m, 4 mar 1971 (fl), *G. Morillo 592* (NY, VEN); 6 km ENE of Colonia Tovar, 1,900 m, 21 May 1960 (fl) *J. Steyermark 86192* (NY, VEN); Fila de Agua Negra, without elev., Feb 1938 (fl), *F. Tamayo 436* (US, VEN); Carretera de El Junquito, 1,700 m, May 1950 (fr), *VEN Herb. No. 3879* (MO); Caracas, without elev., 1891–1892 (fl), *J. Warmings 553* (C); along Carretera de Los Flores y Boca del Tigre, 1,600 m, without date (fl), *L. Williams & A. Alston 314A* (BM); Agua Negra, 1,400 m, 18 Mar 1938 (fl), *L. Williams 9938* (F, US); Along road to Las Flores a Caligan, 1,700 m, 16 Dec 1938 (fl), *L. Williams & A. Alston 10940* (F). **Falcón:** Cerro Santa Ana , Península Paraguaná, near top, 800 m, 15 Dec 1964 (fl), *F. Breteler 4289* (NY); Cerro Santa Ana, Península Paraguaná, 800–840 m, Dec 1953 (fl), *T. Lasser y L. Aristeguieta 3418* (F, VEN); Península de Paraguaná, Cerro Santa Ana, isolated mountain, without elev., 17 Feb 1980 (fl), *G. Sobel et al. 2021* (NY); Sierra de San Luís, La Chapa y Uria, 1,400 m, 19 Jul 1967 (fl), *J. Steyermark 99182* (F, MO, NY, VEN). **Falcón and Lara:** Disputed area between Falcón and Lara, Cerro Cerrón, W part, 1,800–2,000 m, 27 Jun 1979 (fr), *R. Liesner et al. 8202* (MO, VEN); (fl), *8232* (MO, VEN); Cerro Socopo, 1,400–1,560 m, 29 Jun 1979 (fr), *R. Liesner et al. 8389* (MO, NY, VEN). **Lara:** Distrito Morán, Carretera de Humocaro Bajo via Buenos Aires, 09° 36' N, 70° 03 W, 1,600 m, 13 Nov 1985 (fl,fr), *H. van der Werff & R. Rivero 7838* (MO, NY); (fl), *7859* (MO, NY); Distrito Morán, Carretera de Humocaro Bajo, via Las Palmitas, without elev., 16 Nov 1985 (fl), *H. van der Werff & R. Rivero 8009* (MO, NY). **Mérida:** 10 km NE of Mérida, near village of Tabay, native coffee plantation, 1,900 m, 28 Oct 1963 (fl), *F. Breteler 3218* (NY); 19 km W of Mérida, 1,700 m, 31 Oct 1963 (fl), *F. Breteler 3242* (NY); 5 km NW of Mérida along road to El Valle, 1,920 m, 27 Feb 1964 (fl), *F. Breteler 3635* (NY); 10 km NE of Mérida, near village Tabay, 1,900 m, 9 Sep 1965 (fr), *F. Breteler 4580* (MO, NY); NW of Mérida, on slope near Barrio Los Chorros, 1,950 m, 16 Jul 1966 (fr), *J. de Bruijn 988* (MO); Valle Grande from the stream to the páramo, 3,100–3,200 m, 8 Nov 1976 (fr), *A. Charpin & F. Jacquemoud 13136* (NY); Vicinity of Mérida, Río Chama, without elev., 14 Jul 1951 (fr), *H. Curran 2114* (NY); Distrito

Rangel, Cuenca del Quebrada de La Mitisús, Parque Nacional Sierra Nevada, ca. 08° 51–52' N, 70° 39' W, 2,400–2,750 m, 19 Jun 1988 (fl, fr), *L. Dorr & L. Barnett 5602* (NY); Tabay, 2,200–2,300 m, 2 Sep 1930 (fr), *H. Gehriger 401* (F, MO, NY); Parque Nacional Sierra Nevada, de La Mucuy, 13 km air miles NNE of Mérida, 08° 38' N, 71° 2' W, 2,400–2,600 m, 9 May 1991 (fl), *W. Meier & O. Carrero 869* (MO); Galipán, Manteco Fac., without elev., without date (fl), *J. Moritz 153* (BM); Distrito Libertador, Sierra de Culata, 18 km al NE de Mérida, 2,000–2,500 m, 19 Dec 1983 (fr), *J. Pipoly et al. 6486* (MO, NY, VEN); Distrito Campo Elias, Municipio Zerpa, Bosque Experimental de San Eusebio, 2,100–2,400 m, 23 Jan 1963 (fl), *L. Ruiz Terán 1297* (MERF, MO); Distrito Campo Elias, Municipio Zerpa, El Molinillo-San Luis, between El Salado and the village of La Azulita, ca. 1,680 m, 18 Mar 1963 (fl), *L. Ruiz Terán 1436* (MERF, MO); Distrito Sucre, Municipio Estanques, along Quebrada de Quirorá, unos 4 km E of Quirorá, 700–1,000 m, 21 Feb 1970 (fl), *L. Ruiz-Terán & M. Lopez-Figueiras 126* (MERF, MO, NY); Estanques-Páramos de los Colorados road, Mérida, 1,750 m, 12 Mar 1980 (fr), *G. Sobel & J. Strudwick 2151* (NY); NW- & NE-facing slopes above "La Isla", above Tabay, 2,285–2,745 m, 18 May 1944 (fl), *J. Steyermark 56588* (F); Distrito Montezerpa, valley above La Hechicera Mérida, 2,000–3,000 m, 4 Sep 1985 (fr), *E. Tanner & V. Kapos 107* (MO); Ridge behind la Montaña teleférico station, ca. 2,600 m, 24 Nov 1985 (fr), *E. Tanner & V. Kapos 246* (MO); *251* (MO); Spur ridge behind Estación La Montaña del Teleférico de Mérida, Tanner sites, 2,600–2,750 m, 13 Jul 1986 (ster.), *E. Tanner & V. Kapos 402* (MO); La Trampa, Carretera San Juan-Azulita, 2,500 m, 2 Feb 1987 (fl), *H. van der Werff et al. 8779* (MO, VEN); Disitrito Sucre, along the road from Santa Cruz de Mora to Canaguá, along road 11.5 km from turn off paved road to Guayabal, 08° 20' N, 71° 36' W, 1,660 m, 15 Dec 1984 (ster.), *A. Weitzman & N. Holbrook 183* (MO, NY). **Miranda:** Altos de Pipe, 10° 23.7' N, 67° 0.1' W 1,500 m, 10 May 1963 (fl), *G. Agostini 174* (F, NY, VEN); Open sites near de San Antonio de los Altos, without elev., Feb 1965 (fl), *L. Aristeguieta 5498* (MO, VEN); Reserva Biológica, Instituto Venezolano de Investigaciones Científicas (IVIC), Interior Branch of Cordillera de la Costa NE de Venezuela, 10° 00' N, 66° 00' W, 1,700 m, 7 Jan 1987 (fr), *N. Ramírez 2084* (NY, VEN). **Monagas:** Summit of Cerro de la Cueva de Doña Anita, S of & bordering valley of Caripe, 1,300 m, 7 Apr 1945 (fr), *J. Steyermark 61927* (F). **Sucre:** Península de Paria, trail from Los Pocitos de Santa Isabel to Cerro Humo, 25 km NW de Irapa, 10° 41' N, 62° 36' W, 900–1,250 m, 12 Jul 1972 (fr), *K. Dumont et al. 7611* (NY); Cerro Turimiquire, 10° 07' N, 63° 53' W, 2,000–2,150 m, 14–16 Mar 1993 (fl, fr), *W. Meier & G. Bronner 3523* (MO); Península de Paria, trail to Los Pocitos de Santa Isabel to Cerro Humo, 25 km NW de Irapa, 10° 41' N, 62° 36' W, 900–1,250 m, 12 Jul 1972 (fr), *G. Morillo 2626* (F, VEN); Valley between base of Cerro de Diablo (W extention of S peak of Cerro Turumuquire), and Cerro de Neverí, along headwaters of Río de Amana, 2,000 m, 11 May 1945 (fl), *J. Steyermark 62721* (F, NY); Península de Paria, Cerro de Humo, NW de Irapa, between Roma and Santa Isabel, ca. 12 kms N of Río Grande Arriba, 1,273 m, 2 Mar 1966 (fr), *J. Steyermark 94902* (NY, VEN); Distrito Marino and Distrito Arismendi, Peninsula de Paria, trail between crossing of Río Tacarigua to summit of slopes E of Cerro Humo, descending to Las Melena N of Río Grande Arriba, 10° 41' N, 62° 36–37' W, 760–1,000 m, 24 Feb 1980 (fl), *J. Steyermark et al. 121737* (MO, NY). **Táchira:** Distrito Junín, entre Villa Paéz y Betania, near Colombian border, 2,000–2,400 m, 15 Nov 1975 (fr), *G. Bunting 4915* (NY); to above the right bank of Río Táchira on the Colombian border, ca. 2,300 m, 13 Nov 1976 (fr), *A. Charpín & F. Jacquemoud 13296* (NY); 7 km W of Rubio, 07° 42' N, 72° 25' W, 900–1,000 m 18 Mar 1981 (fl), *R. Liesner & A. González 10713* (NY, VEN); Slopes at base of Páramo de Tamá, 2,475–2,550 m, 19 May 1967 (fl), *J. Steyermark 98431* (MO, NY, VEN); Forest of the small páramo of the Universidad Nacional Experimental del Táchira, San Cristóbal, without elev., 10 Jun 1988 (fl), *L. Valverde & I. Peña 1021* (MO); Distrito

Uribante, ca. 5 km outside Siberia along old road to Pregonero, ca. 1,300 m, 20 Nov 1985 (fl), *H. van der Werff & F. Ortega 8082* (MO, NY, PORT). **Trujillo:** Distrito Boconó, Guaramacál, 20 km al E de Boconó, 09° 14' N, 70° 11' W, 1,900–2,300 m, 7 Feb 1987 (fl), *G. Aymard et al. 5190* (F, MER, MO); Distrito Boconó, Parque Nacional Guaramacal, 09° 15' 07" N, 70° 13' 34" W, 1,950 m, 2–4 Jun 1995 (fl bud), *N. Cuello et al. 931* (MO, PORT); N slopes, 09° 14' 48" N, 70° 12' 15" W, 1–3 Jul 1995 (ster.), *N. Cuello 1107* (MO, PORT); S slopes, 09° 13' 32" N, 70° 10' 01" W, 2,400 m, 13–15 Dec 1995 (ster.), *N. Cuello et al. 1256* (MO, PORT); 09° 12' 45" N, 70° 09' 51" W, 2,300 m, 03–05 Jan 1996 (ster.), *N. Cuello et al. 1335* (MO, PORT), *1348* (MO, PORT); Distrito Carache, above Mesa Arriba, between Pico de Jabón and Páramo de Turmál, SE of Laguna de Turmál, 12 km SE of Carache, 09° 35' N, 70° 09' W, 2,550–2,600 m, 12 May 1988 (fl), *L. Dorr & L. Barnett 5157* (NY, PORT), *5162* (NY, PORT); Distrito Boconó and Disitrito Trujillo border, Quebrada La Honda, SW of Arbol Redondo on the Boconó-Flor de Patria road, 09° 25' N, 70° 20' W, 1,800–2,200 m, 2 Nov 1990 (fl), *L. Dorr & L. Barnett 7598* (MO, VEN); Mpio. Boconó, Parque Nacional Guaramacal, S slopes, 09° 13' N, 70° 07' W, 2,100 m, 20–22 Jan 1996 (ster.), *A. Licata et al. 650* (MO, PORT); Distrito Boconó, Páramo Guaramacal, 4.4–4.8 kms beyond jct. NE of Boconó, 09° 15' N, 70° 14' W, 1,860 m, 19 Jan 1984 (fl), *J. Luteyn & J. Pipoly 9280* (F, MER, MO, NY); Distrito Boconó, vicinity Páramo Arbol Redondo, ca. 40 km N of Boconó, 09° 24' N, 70° 18' W, 2,073 m, 20 Jan 1984 (fl), *J. Luteyn & J. Pipoly 9328* (MER, MO, NY), *9330* (MER, MO, NY); Distrito Carache, ca. 9 km NE of Carache on Hwy. 2, 09° 38' N, 70° 09' W, 1,890 m, 21 Jan 1984 (fl), *J. Luteyn & J. Pipoly 9335* (MO, NY, VEN). **Yaracuy:** Distrito Nirgua-Distrito San Felipe border, Cerro La Chapa, 7 km N of Nirgua by road, 10° 12' N, 68° 35' W, 1,200–1,300 m, 21 Oct 1982 (fl), *G. Davidse et al. 20813* (MO, NY, VEN); Sierra de Aroa, Cerro Negro, forest 8 km SW of San Felipe, 10° 17' N, 69° 01' W, 1,200–1,800 m, 1–2 Apr 1980 (fr), *R. Liesner & A. González 9933* (MO, VEN); El Amparo hacia Candelaria, a 7 km al N de Salom, 1,220–1,250 m, 17–19 Jun 1972 (fr), *J. Steyermark 106283* (NY, VEN). **Without Location:** Venezuela, without elev., 1845 (fl), *H. Funck & L. Schlim 140* (BM); Venezuela, without elev., without date (fl), *J. Moritz 360* (BM); Venezuela, 1,400 m, without date (fl), *P. Vogel 177* (F); Venezuela, 1,400 m, 17 Mar 1946 (fr), *P. Vogel 309* (F).

As noted above, this highly variable species exhibits great variation in quantitative features of its vegetative parts, and also in such features as the degree of curvature of the leaf base (obtuse, rounded or acute), leaf shape, vestiture thickness and trichome lenght, number of flowers and internode length. All of these factors are responsible for the various segregates that have been recognized in the past, including the new one synonymized above. We believe we have assembled material from throughout subsp. *coriacea*'s range for the first time since Mez's work in 1902 and only for that reason have we been able to appreciate how broadly variation occurs within and among populations. Given this broad plasticity, we have adopted a very broad species concept. One of the synonyms, *Myrsine microcalyx*, is a bisexual growth form with consequent quantitative floral variation, but with qualitative features of the vegetative organs within the normal range of variation for the subspecies.

2b. **Myrsine coriacea** (Sw.) R. Br. ex Roem. & Schultes subsp. **reticulata** (Steyerm.) Pipoly, (**Figs. 1D, 1E, 1F, 1G, 6**), Novon 1:210. 1991. *Rapanea reticulata* Steyerm., Fieldiana, Bot. 28:477. 1953. TYPE. VENEZUELA. BOLÍVAR: Mount

Roraima, SW-facing forested slopes between Rondón Camp and base of sandstone bluffs, 2,040–2,255 m, 30 Sep 1944 (fl), *J. Steyermark 58983* (HOLOTYPE: F (NY Neg. no. 12122): ISOTYPES: NY, US, VEN).

Shrubs or small *trees* to 3 m tall. *Branchlets* densely rufous villous-tomentose, often glabrescent. *Leaf blades* coriaceous, obovate to oblanceolate, (1.5–)3.5–5.5(–5.8) cm long, (0.8–)1–2.5 cm wide, apically emarginate or obtuse, basally acute, decurrent on the petiole, nitid above, pallid below, essentially glabrous or with a few scattered hairs over the midrib above the petiole, the margin revolute toward the base; petioles marginate, 4–5(–8) mm long, densely villous along the margin, early glabrescent. *Fruit* globose, 3–3.5 mm diam.

Distribution.—*Myrsine coriacea* subsp. *reticulata* (Fig. 6) is endemic to the Guayana Region, Pantepui Floristic Province in the state of Bolívar, Venezuela, growing at 2,000–2,750 m elevation.

Ecology and conservation status.—Subsp. *reticulata* occurs in gallery forests along streams on the summits of tepuis, where it forms considerable stands with several species of *Ternstroemia, Bonnetia, Clusia*, *Gleasonia* and *Cybianthus quelchii*. Given the protection afforded the tepuis in the state of Bolívar, the only threat to it is occasional fire. Therefore, it is not considered threatened.

Etymology.—The subspecific epithet, 'reticulata' refers to the prominent secondary veins of the leaf.

Specimens examined. **VENEZUELA. Bolívar:** Distrito Piar, Macizo del Chimantá, wide valle in the SE section of Apacará-tepui, 05° 19' N, 62° 07' W, 2,150 m, 7 Feb 1984 (fl), *M. Colella & O. Huber 465* (MYF, NY); Distrito Cedeño, Sierra de Maigualida, NW sector, tepui plateau over dissected granite, at the headwaters of the Río Chajura, W branch of the Río Erebato, ca. 100 km directly SW of the Campamento Entreríos, 05° 33' N, 65° 13' W, 2,100 m, 18 Nov 1988 (fl), *O. Huber & L. Izquierdo 12802* (MYF, US); Ilú-tepui, Gran Sabana, 7,000–8,000 ft [2,134–2,438 m], 17 Mar 1952 (fr), *B. Maguire 33465* (F, NY, US); Gran Sabana, Sororopán-tepui, near the C.V.G. Antenna, Parque Nacional Canaima, without elev., 17 Aug 1993 (fr), *N. Ramírez et al. 4452* (MO, VEN); Chimantá Massíf, E branch of headwaters of Río Tirica, 2,150–2,200 m, 12 Feb 1955 (fr), *J. Steyermark & J. Wurdack 806* (BRIT, F, NY); Chimantá Massíf, Toronó-tepui, NW-facing forested slope between Summit Camp and base of escarpment, 1,880–1,970 m, 27 Feb 1955 (fl), *J. Steyermark & J. Wurdack 1194* (F, MO, NY).

Subspecies *reticulata* is poorly known, but easily distinguished from subsp. *coriacea* by its shorter leaf blades, fewer-flowered inflorescences, deltate calyx lobes, and riparian gallery forest habitat.

3. Myrsine maguireana Pipoly, **(Figs. 3, 4A, 4B)**, Novon 1:204. 1991. TYPE. VENEZUELA. AMAZONAS: Cerro de La Neblina, Río Yatua, *Bonnetia* forest NE of Cañon Grande, 1,200–2,200 m, 8–9 Dec 1957 (fr), *B. Maguire, J. Wurdack & C. Maguire 42318* (HOLOTYPE: VEN; ISOTYPES: MO, NY 3-sheets, US).

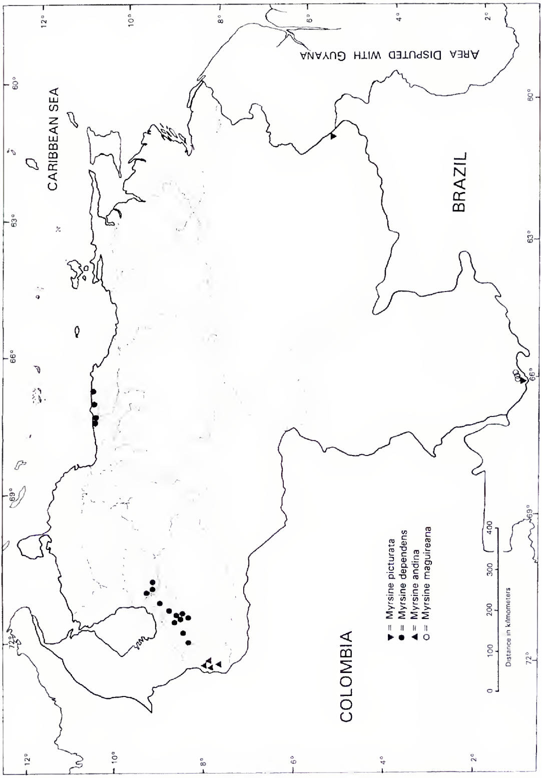

FIG. 3. Distribution of *Myrsine picturata* (▼), *M. dependens* (•), *M. andina* (▲) and *M. maguireana* (○) in Venezuela.

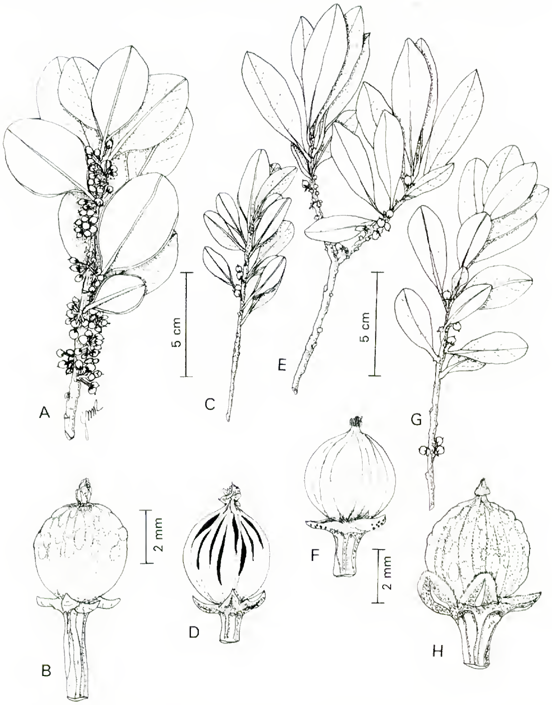

FIG. 4. A. Habit, flowering branch of *Myrsine maguireana* Pipoly, drawn from *B. Maguire et al. 42318* (NY isotype). B. Fruit of same, drawn from *B. Maguire et al. 42318* (NY isotype). C. Habit, flowering branch of *Myrsine minima* (Steyerm.) Pipoly, drawn from *R. Liesner 23107*. D. Fruit of same, drawn from *R. Liesner 23107*. E. Habit, flowering branch of *Myrsine perpauciflora* Pipoly, drawn from *M. Nee 30697* (US isotype). F. Fruit of same, drawn from *M. Nee 30697* (US isotype). G. Habit, flowering branch of *Myrsine andina* (Mez) Pipoly, drawn from *J. Steyermark et al. 100998*. H. Fruit of same, drawn from *J. Steyermark et al. 100998*.

Shrubs to 1.5(–2) m tall; trunk and branches orthotropic. *Branchlets* terete, 5–7 mm diam., glabrous. *Leaves* spiral; blades cartilaginous, elliptic to ovate, (4–)5–9 cm long, (2.3–)3–5.4 cm wide, apically and basally obtuse, decurrent on the petiole, nitid above, pallid and scrobiculate below, the midrib impressed above, prominently raised below, the secondary venation obscure, conspicuously black punctate and punctate-lineate, the margin membranous, hyaline, revolute, prominently black punctate, glandular-ciliate at first when young, glabrescent, entire; petiole canaliculate, 0.4–0.9 cm long, 2–3 mm diam., glabrous. *Staminate inflorescence*: unknown. *Pistillate inflorescence*: an umbelliform glomerule, 4–9-flowered, the peduncle glabrous, epunctate, 1.7–2.5 mm long, built up by a series of floral bract bases; floral bracts obovate, 0.5–0.6 mm long, 0.9–1 mm wide, apically obtuse, the margins entire, densely glandular-ciliate; pedicels cylindrical, 1–1.5 mm long, accrescent in fruit to 2 (–2.5) mm long, glabrous, brown punctate. *Pistillate flowers* 5-merous; calyx chartaceous, cupuliform, erect, translucent, unequally divided, 1.6–1.8 mm long, the tube 0.6–0.8 mm long, the lobes ovate, 1.1–1.3 mm long, 0.4–0.5 mm wide, apically long-acuminate, glabrous, medially brown punctate, and prominently keeled, the margins hyaline, roughly dentate, highly irregular, glabrous; corolla chartaceous, campanulate, 2.8–3.2 mm long, translucent, the tube 0.8–1 mm long, the lobes linear-lanceolate, 2–2.4 mm long, 1.2–1.4 mm wide, asymmetric, apically acute, medially brown punctate, the margin glandular-granulose; staminodes 1.9–2 mm long, the anthers appearing epipetalous, filaments thin, hyaline, 0.1–0.3 mm long, the antherodes widely ovate, 1.2–1.5 mm long, 0.9–1.0 mm wide, the apically apiculate, basally deeply cordate, the connective epunctate; pistil obnapiform, ca. 1.5 mm long, 1 mm diam., the ovary 0.8 mm long, costate, densely pellucid punctate, glabrous, the style 0.2 mm long, costate, the stigma prismatic, 0.5 mm long, 2–3-lobed, the placenta hemispherical, the ovules 3, completely imbedded. *Fruit* globose, 3–5 mm long and diam., densely pellucid punctate.

Distribution.—*Myrsine maguireana* (Fig. 3) is known from Cerro de la Neblina and Sierra de Maigualida, Amazonas, Venezuela, growing at 1,200–2,200 m elevation.

Ecology and conservation status.–*Myrsine maguireana* is restricted to dense, open marshy scrub plateaus and on open tepui summits. While it has a highly restricted distribution and narrow ecological tolerance, the remoteness of these areas has thus far ensured that it is not threatened.

Etymology.—The specific epithet honors the late Bassett Maguire, indefatigable explorer, collector and student of the Guayana Region's flora.

Specimens examined. **VENEZUELA. Amazonas:** Departamento Río Negro, Cerro de La Neblina, camp 9, 1.2 km NE of waterfall on E headwaters of Río Mawarinuma, 35 km E of Base Camp, 01° 00' N, 65° 53' W, 1,780–1,820 m, 2 Feb 1985 (fr), *B. Boom et al.*

5535 (NY, US, VEN); Cerro Neblina Valle de Titricó, N of Pico Phelps, 00° 56' N, 65° 58' W, 2,200 m, 1 Dec 1984 (fr), *T. Croat 59551* (MO, VEN); Departamento Atures, Sierra de Maigualida, NW sector, dissected granitic mesa on the headwaters of Río Iguana, tributary of the Río Ventuari, 05° 40' N, 65° 08' W, 2,150 m, 24 Nov 1989 (fr), *O. Huber 13071* (MYF, MO); Cerro de La Neblina, Río Yatua, E escarpment of upper Cañon Grande, summit, 1,200–2,200 m, 13 Dec 1957 (fr), *B. Maguire et al. 42393* (NY 2-sheets); 14 Dec 1957 (fr), *B. Maguire et al. 42403* (F, MO, NY 2-sheets, US, VEN).

Myrsine maguireana appears to be most closely related to *M. glazioviana* Warm., a taxon known from the Planalto of Brazil. However, *Myrsine maguireana* is easily recognized by the glabrous leaves, glandular-ciliate leaf bud margins, longer, glabrous pedicels, costate ovary and glabrous corolla lobe margins.

4. **Myrsine minima** (Steyerm.) Pipoly, **(Figs. 4C, 4D, 6, 9)**, Novon 1:210. 1991. *Rapanea minima* Steyerm., Fieldiana, Bot. 28:477. 1953. TYPE. VENEZUELA. BOLÍVAR: Summit, Cerro Roraima, 2,620–2,740 m, 27 Sep 1944 (stam. fl), *J. Steyermark 58848* (HOLOTYPE: F; ISOTYPES: NY, VEN).

Shrubs 1.8–2.8 m tall; trunk and branches ortotropic. *Branchlets* terete, glabrous. *Leaves* spiral; blades thickly coriaceous, obovate, widely oblong or suborbicular, (1.7–)2–3 cm long, 1–1.5 cm wide, apically obtuse to broadly rounded, basally obtuse to broadly rounded, nitid above, pallid below, the secondary veins not visible, bearing numerous hydropotes in pits and conspicuously black punctate below, the margins scarious, flat, decurrent on the petiole; petiole marginate, 3–6 mm long, essentially glabrous. *Staminate inflorescence* a fascicle (3–)5-flowered; pedicels 0.9–1.2 mm long. *Staminate flowers* chartaceous, 3–3.2 mm long; calyx cotyliform, chartaceous, 0.9–1.1 mm long and wide, the tube ca. 0.1 mm long, the lobes very widely ovate to suborbicular, 0.9–1.1 mm long and wide, apically obtuse, prominently black punctate, the margins entire except minutely erose apically, hyaline, glabrous; corolla cotyliform, 3–3.2 mm long, the tube 0.2–0.3 mm long, the lobes oblong, 2.8–3 mm long, 1.2–1.3 mm wide, apically acute to obtuse, cucullate, prominently black punctate abaxially, the margins densely glandular-granulose throughout; stamens 2–2.2 mm long, the filaments 0.5–0.6 mm long, the anthers oblong, 1.3–1.5 mm long, 0.7–0.8 mm wide, apically apiculate, basally cordate, deshiscent by extremely wide longitudinal slits, connective epunctate dorsally; pistillode lageniform, hollow, not differentiated into ovary and style, 1.3–1.5 mm long, 0.3–0.4 mm wide. *Pistillate inflorescence* as in staminate but (2–)3–5-flowered, pedicels 0.7–1 mm long. *Pistillate flowers* as in staminate but 2–2.2 mm long; calyx cotyliform, hyaline, 0.8–1.1 mm long, the tube ca. 0.1 mm long, the lobes very widely ovate to suborbicular, 0.9–1 mm long and wide, apically obtuse, prominently black punctate, the margin entire except minutely erose apically, hyaline, glabrous; corolla appearing tubular, but lobes nearly free, 2.0–2.2 mm long, the tube 0.1–0.2 mm long, the lobes oblong, 1.8–1.9 mm long, 0.5–0.6

mm wide, apically obtuse to broadly rounded, densely and prominently black punctate and punctate-lineate abaxially, densely glandular-granulose along entire margin; staminodes 1–1.2 mm long, the filaments 0.7–0.8 mm long, the antherodes obcordate, 0.8–0.9 mm long, 0.5–0.6 mm long, sterile, apically acute, basally deeply cordate, the connective prominently brown puctate apically; pistil ellipsoid, 1.7–1.8 mm long, the ovary 1.2–1.3 mm long, 0.6–0.7 mm wide, opaque beige in color when dried, the stigma conic and spirally lobed, 0.5–0.6 mm long, with 4 slight lobes; placenta ellipsoid, 0.4–0.5 mm long, 0.2–0.3 mm diam., bearing 3 uniseriate ovules, fully exposed on the side of the placenta. *Fruit* globose, (2.5–)3–4.5 mm long and in diam.

Distribution.—*Myrsine minima* (Figs. 6, 9) is endemic to the Guayana Region, and is known from eastern Bolívar and adjacent Guyana, and from the Brazilian side of Cerro de la Neblina, growing from 1,900–2,800 m elevation.

Ecology and conservation status.—*Myrsine minima* is known only from extremely remote and well-protected areas. It occurs in scrub forest and exposed areas in upland tepui savannas. Therefore the species is not under threat at this time.

Etymology.—The epithet “minima” refers to the diminutive size of the leaf blades.

Specimens examined. **BRAZIL.** Amazonas: Parque Nacional do Pico da Neblina, rocky formation of Pico da Neblina, 2,600 m, 21 Aug 1985 (fl), *C. Farney et al. 905* (MO); Serra da Neblina, summit to Pico Phelps, 9,000 ft [2,743 m], 2 Dec 1965 (fr), *B. Maguire et al. 60450* (BRIT, NY, US). **GUYANA**. Mazaruni-Potaro: Roraima, summit, La Proa camp, E of border, near Lake Gladys, 05° 15' 36" N, 60° 13' W, 2,800 m, 14 Apr 1988 (fr), *R. Liesner 23296* (MO, US). **VENEZUELA.** Bolívar: Distrito Piar, Macizo del Chimantá, north mesa of Abacapá-tepui, located in the SW sector of the masssif, 05° 10' N, 62° 16' W, 2,200 m, 31 Jan–2 Feb 1984 (bud), *O. Huber & N. Dezzeo 8590* (MYF, NY); Distrito Piar Macizo del Chimantá, sector SE, central SE section of Churí-tepui, 05° 15' N, 61° 58' W, 2,250 m, 28 Mar 1984 (fl), *O. Huber 9269* (MYF, NY); Distrito Piar, Macizo del Chimantá, sector SE, mesa slightly sloping toward the SSE, in the central-SE portion of Churí-tepui, 05° 15' N, 61° 58' W, 2,250 m, 6–8 Feb 1985 (fr), *O. Huber et al. 10100* (MYF, NY); Distrito Piar, Macizo del Chimantá, NW sector, superposed mesa on the summit of the central part of Murey-(Eruoda-) tepui, 05° 22' N, 62° 05' W, 2,600 m, 15–17 Mar 1986 (fl), *O. Huber 11593* (MO, MYF, NY 2-sheets); Distrito Piar, W summit of Angasima-(Adanta-) tepui, 10 km SSE from the W limit of Amurí-tepui (Macizo del Chimantá) and ca. 40 km WNW of the Mission of Wonkén, 05° 03' N, 62° 07' W, 2,100 m, 9 Aug 1986 (fl), *O. Huber 11698* (MYF, NY); Kukenán-tepui, summit, 05° 13' N, 60° 18' W, 2,550 m, 11 Apr 1988 (fr), *R. Liesner 23107* (BRIT, MO, NY, US, VEN); (fl, fr), *23210* (MO, US, VEN); Ilu-tepui, lower plateau, 05°, 25' 36" N, 60° 29' W, 2,500 m, 16 Apr 1988 (fr), *R. Liesner 23426* (BRIT, MO, US, VEN); Distrito Piar, Macizo del Chimantá, sector SE, mesa slightly sloping toward the SSE, in the central SW section of Churí-tepui, 05° 15' N, 61° 58' W, 2,250 m, 6–8 Feb 1985 (fr), *J. Pipoly et al. 7141* (MO, MYF, NY, US); Chimantá Massif, E-central portion of summit of Apácara-tepui, 2,450–2,500 m, 21–22 Jun 1953 (fr), *J. Steyermark 75931* (F, NY); Chimantá Massif, along tributary valley of E branch of headwaters of Río Tírica, 2,120 m, 13 Feb 1955 (fl), *J. Steyermark & J. Wurdack 843* (BRIT, F, NY); Meseta de Jáua, Cerro Jaua, summit of the Central-Western portion of the Meseta, 36 nautical miles or 60 kms NW of the mission at the medical camp of Río Kanarakuni, 1,922–2,100 m, 22–27 Mar 1967 (fl), *J. Steyermark 97985* (MO, NY, VEN); Distrito Sucre, Meseta de Jáua, 04° 35' N, 64° 15' W, 2,020 m, 14 Feb 1981 (fl), *J. Steyermark et al. 124328* (BRIT, MO, NY, VEN); Distrito Piar, Macizo del Chimantá, mesa at the southern base of the upper walls of Apacará-tepui, N sector of Macizo, exposed knolls near stream, 05° 20' N, 62° 12' W, 2,200 m, 30 Jan–1 Feb 1983 (fl), *J. Steyermark et al. 128268* (MO, NY, VEN); Roraima, 2,500 m, Jul 1910 (fl), *E. Ule 8721* (US).

Myrsine minima appears to be closely related to *Myrsine andina*, but is easily separated by its glabrous branchlets, shorter leaves and longer pedicels.

5. **Myrsine andina** (Mez) Pipoly, (**Figs. 3, 4G, 4H**), Caldasia 17:3. 1992. *Rapanea andina* Mez in Engl., Pflanzenr. IV. 236(Heft 9):378. 1902. TYPE. ECUADOR. Without location, without elev., 1857–1859, *R. Spruce 5588* (LECTOTYPE, here designated: K (pist. fl, fr); ISOLECTOTYPES: (pist. fl) BM, NY, (stam. fl) P-2 sheets, W-2 sheets, (unknown, n.v.) F, G, OXF).

Mez' description clearly indicates that the branchlets of *Myrsine andina* are ferrugineous-pilose tomentose, although they are often early glabrous. Also, the floral description matches those of all sheets except *C. von Jelski 12* (W). Given that Mez saw all the duplicates of the Spruce collection, that they are the most numerous, and include staminate and pistillate individuals, we designate its duplicate at Kew (K) as the lectotype.

Shrubs or *trees* to 5 m tall; trunk and branches orthotropic. *Branchlets* terete, rufous glandular papillose-tomentose at first, glabrescent. *Leaves* spiral; blades coriaceous, elliptic to oblong, (2.8–)3–5.2(–5.5) cm long, 1.5–2.5(–2.9) cm wide, apically emarginate, basally obtuse to subacute, nitid, the midrib impressed above, prominently raised below, the secondary venation not visible, densely and prominently black punctate above and below, sparsely red-papillate along midrib above at first, early glabrescent, the margin densely black punctate below, inrolled, entire, decurrent on the petiole; petioles marginate, 5–7 mm long. *Staminate inflorescence* fasciculate, (3–)5–8-flowered, on short perrennating shoots girdled by floral bracts, 1–1.5 mm long; floral bracts ovate, 1–1.3 mm long, 0.5–0.7 mm wide, apically acute, the margins somewhat erose, long glandular-ciliate; pedicels 0.5 mm long. *Staminate flowers* 2–2.2 mm long; calyx chartaceous, cotyliform, the tube ca. 0.1 mm long, the lobes ovate, 0.8–1 mm long, 0.5–0.7 mm wide, apically acute, minutely and prominently black punctate, the margin entire, long glandular-ciliate apically, glabrescent; corolla campanulate, 2–2.2 mm long, the tube 0.2 mm long, the lobes ovate, 1.8–2 mm long, 0.6–0.7 mm wide, apically acute, densely and prominently black punctate and punctate-lineate without, glabrous within, the margin entire, densely glandular-ciliate apically; stamens 1.8–2 mm long, the filaments not discernible, developmentally fused to corolla tube, the anthers appearing epipetalous, broadly ovate, 1.5–1.6 mm long, 0.6–0.8 mm wide, apically apiculate, basally cordate, the connective slightly dark brownish dorsally; pistillode conic, hollow or absent. *Pistillate inflorescence* as in staminate but on shoots to 1.5 mm long; pedicels 0.7–0.8 mm long. *Pistillate flowers* as in staminate but 2.8–3 mm long; calyx cupuliform, 1.3–1.5 mm long, the tube ca. 0.3 mm long, the lobes ovate, 0.9–1 mm long, 0.7–0.8 mm wide; corolla campanulate, 2.6–2.9 mm long, the tube ca. 0.5 mm long, the lobes 2.1–2.3 cm long, 0.6–0.8 mm wide; staminodes like the stamens but 1–1.3 mm long; pistil conical, 0.8–1.0 mm long, 0.7–0.8 mm diam., the stigma sessile, conical, pristmatic, with 4 lobes; placenta globose; ovules 2–3, uniseriate. *Fruit* globose, 3.5–5 mm diam, the stigma persistent, prominently punctate.

Distribution.—In Venezuela, *Myrsine andina* (Fig. 3) is only known from secondary and dry forests in Estado Táchira, but is well known otherwise from Venezuela, southward through Colombia, Ecuador, and Peru to Bolivia, growing at (400–)1,200–2,500 m elevation.

Ecology and conservation status.—*Myrsine andina* is restricted to primary cloud forest margins just below the subpáramo thicket transition throughout its range. Because many montane roads through the Andes follow the páramo-cloud forest contour, it should be considered threatened.

Etymology.—The specific epithet refers to its place of description and range, throughout the Andes.

Specimens examined. **VENEZUELA**. Táchira: 5 km E of San Antonio del Táchira, 07° 50' N, 72° 25' W, 1,400 m, 3 Jan 1989 (fl), *W. Hahn & F. Grifo 4971* (MO, NY, US); Parque Cazadero, Quebrada Cazadero, 16 km NW of San Cristóbal, 400–650 m, 2 May 1981 (fr), *R. Liesner & M. Guariglia 11655* (MO, VEN); Paramito between Quebrada de Palmar & Quebrada de Paramito, at base of Páramo de Tamá, 2 kms above Betania & 7 kms above Villa Paéz, 2,500 m, 14 Jun 1944 (fl), *J. Steyermark 57205* (F, NY); Along path between "Las Copas" and peak of Fila de Tierra Negra, toward Cerro de Segeta and Fundación Bélgica, on the narrow range that divides the headwaters of Río Quinimarí, Río Frío and Uribante and Río Talco (Oirá), 20–25 km S of San Vicente de la Revancha, 35–40 km S of Alquitrana, SW of Santa Ana, 2,870–2,880 m, 16 Jan 1968 (fr), *J. Steyermark et al. 100998* (NY, VEN). **Without Locality**: Without locality, without elev., 1848 (fl), *J. Linden 108* (P).

Myrsine andina appears to be closely related to *M. minima*, but is easiliy separated by its glandular-papillate branchlets, emarginate leaf blades and subsessile flowers.

6. **Myrsine perpauciflora** Pipoly, (**Figs. 4E, 4F, 9**), Novon 2:176. 1992.
TYPE. VENEZUELA. AMAZONAS: Cerro de La Neblina, Camp VII, 5 km NE of Pico Phelps, vicinity of heliport on rock outcrop, 00° 50' 40" N, 65° 58' 10" W, 1,850 m, 1 Feb 1985 (fr), *M. Nee 30697* (HOLOTYPE: VEN; ISOTYPES: F, NY, US).

Trees to 4 m tall; trunk and branches orthotropic. *Branchlets* terete, 2.5–3 mm diam., glabrous. *Leaves* spiral; blades chartaceous, oblanceolate to elliptic, (4–)4.8–5.5(–6) cm long, (1.5–)1.8–2 cm wide, apically acute, basally cuneate to rounded, decurrent on the petiole, asymmetric, somewhat nitid above, pallid and black punctate-lineate below, the midrib impressed above, prominently raised and brown punctate-lineate below, the secondary veins prominulous above and below, the margin revolute, translucent but not hyaline, entire, brown punctate, glandular-ciliate at first, early glabrescent; petiole marginate, 0.3–0.5 mm long. *Staminate inflorescence*: unknown. *Pistillate inflorescence*: unknown. *Infructescence*: glomerulate, apparently 1–3-flowered, the peduncle glabrous, epunctate, (1.2–)1.6–2.4 mm long; floral bracts orbicular, 0.8–1 mm long, 0.8–1 mm wide, apically obtuse, densely pellucid punctate, the margins densely erose-ciliate; pedicels cylindrical, 1.2–2 mm long, glabrous, sparsely pellucid punctate-lineate. *Pistillate flowers*: unknown. *Fruiting calyx* chartaceous, cotyliform, unequally divided, 1.2–1.3 mm long, translucent, densely and prominently brown punctate and punctate-lineate, with darkened glandular areas at the calyx lobe/tube sinus, the tube 0.2–0.3 mm long, the lobes very widely ovate to deltate, 1–1.2 mm long, 0.8–1 mm wide, apically acute, prominently brown punctate and punctate-lineate, flat, the margin hyaline, entire, densely glandular-ciliate. *Fruit* globose, 3–5 mm long and in diam., when dried, densely pellucid punctate and punctate-lineate.

Distribution.—*Myrsine perpauciflora* (Fig. 9) is endemic to the Cerro de La Neblina, 1,500–1,730 m elevation.

Ecology and conservation status.— *Myrsine perpauciflora* is restricted to low shrubland on saturated soils. Because Cerro de la Neblina is extremely remote and protected, the species is not threatened.

Etymology.—The specific epithet refers to the fact that the inflorescences are infrequent and very few-flowered.

Specimens examined. **VENEZUELA. Amazonas:** Departmento Río Negro, Cerro de La Neblina, Camp VII, 00° 52' N, 65° 58' W, 1,730–1,850 m, 10 Feb 1985 (fr), *S. Renner 2096* (US); Cerro de La Neblina, Camp 2, Neblina massif, 2.8 km NE of Pico Phelps, 00° 49' 40" N, 65° 59' W, 2,100 m, 15 Apr 1984 (fr), *B. Stein & A. Gentry 1525* (MO, NY, VEN).

Myrsine perpauciflora is most closely related to *M. lancifolia* Mart., but is separated by the smooth upper leaf blade surface, the prominent brown punctations of the calyx, and inflorescences with 1–3 flowers. Within the Guayana Region, it may be confused with *Myrsine picturata*, but is easily recognized by the abaxial leaf surface less conspicuously (not densely and prominently) black punctate-lineate, 1–3 (not 3–5)-flowered inflorescence, calyx lobes brown (not black) punctate, and globose (not obovoid) fruit.

7. **Myrsine resinosa** (A.C. Sm.) Pipoly, (**Figs. 5A, 5B 6**), Novon 1:210. 1991. *Rapanea resinosa* A.C. Sm., Bull. Torrey Bot. Club 67:297. 1940. TYPE. VENEZUELA. BOLÍVAR: Río Arabapu, near Arabapu, 4,200 ft [1,280 m], 17 Jan 1939 (fl), *A. Pinkus 84* (HOLOTYPE: NY (pist. fl.); ISOTYPES: F, GH, NY (2-sheets, US).

FIG. 5. A. Habit, flowering branch of *Myrsine resinosa* (A.C. Sm.) Pipoly, drawn from *R. Liesner 23534.* B. Fruit of same, drawn from *R. Liesner 23534*. C. Habit, flowering branch of *Myrsine picturata* Pipoly, drawn from *B. Maguire et al. 42375* (NY isotype). D. Fruit of same, drawn from *B. Maguire et al. 42375* (NY isotype).

Shrubs 1–1.5(–3) m tall; trunk and branches orthotropic. *Branchlets* terete, glabrous. *Leaves* spiral; blades chartaceous to thinly coriaceous, linear-oblanceolate, lorate or narrowly elliptic, (4–)6–12(–15) cm long, (1–)1.7–2(–2.7) mm wide, apically acute to attenuate, basally acute to attenuate, midrib prominulous above, prominently raised below, the secondary venation prominulous above and below, nitid above, pallid below, with conspicuous black punctate-lineations (5–)20–40 mm long below, the margins entire, inrolled and revolute at least basally; petioles flat above, marginate, 6–9 mm long. *Staminate inflorescence* a sessile, 4–8-flowered umbel; floral bracts ovate, 0.8–1 mm long, 0.6–0.7 mm wide, apically acute, inconspicuously red punctate, the margins entire, densely glandular-ciliolate; pedicels 2.5–3.5 mm long. *Staminate flowers* 5(–7)-merous, chartaceous; 2.5–3 mm long; calyx cotyliform, 1.2–1.4 mm long, the tube ca. 0.2 mm the lobes ovate, 1–1.2 mm long, 0.9–1 mm wide, apically short-acuminate, essentially epunctate or with one or two scattered glands, the margin irregular, sparsely glandular-ciliolate; corolla campanulate, 2.6–2.7 mm long, the tube 0.4 mm long, the lobes ovate, 2.2–2.3 mm long, 1.6–1.7 mm wide, apically sharply acute to attenuate, sparsely brown punctate and punctate-lineate, the margins densely glandular-granulose; stamens 2–2.2 mm long, the filaments not visible, the anthers oblong, 2–2.2 mm long, apically apiculate, basally subcordate, the connective dark brownish punctate-lineate dorsally; pistillode conic, 0.9–1 mm long, hollow. *Pistillate inflorescence* a sessile 5–7-flowered umbel, as in staminate but pedicels 3.5–5 mm long. *Pistillate flowers* as in staminate but 2–2.2 mm long; calyx lobes ovate, 1.3–1.4 mm long, 0.9–1 mm wide; corolla 2–2.2 mm long, the tube, 0.2 mm long, the lobes 1.8–2 mm long, 0.7–0.9 mm wide; staminodes 1.3–1.5 mm long, the filaments 0.3 mm long, the antherodes 1.1–1.3 mm long, 0.5–0.6 mm wide, apically apiculate, basally sagittate; pistil globose, 2–2.2 mm long, the ovary 1–1.1 mm long, 1.2–1.4 mmm wide, the stigma umbraculiform, with 4 vertical spirally twisted lobes, 1–1.2 mm long; placenta globose, 0.6–0.7 mm long, 0.5–0.6 mm wide; ovules 2–3, uniseriate, immersed. *Fruit* subglobose, longer than broad, 3.5–5 mm long and broad, black at maturity, the exocarp thick, juicy, densely and conspicuously black punctare-lineate when dried.

Distribution.—*Myrsine resinosa* (Fig. 6) is known only from the eastern portion of Pantepui Floristic Province in the state of Bolívar in Venezuela, and the adjacent Mazaruni-Potaro region in Guyana, growing at 470–1,000 m elevation.

Ecology and conservation status.—This species is known from gallery forests along rivers in lowland dry savannas. Because these forests house the relatively scarce source of construcrion materials, *M. resinosa* should be considered threatened.

Specimens examined. **GUYANA. Mazaruni-Potaro:** Upper Mazaruni River basin, Kukui River between Mokay River and Suru-agu-puh River, 470 m, 11 Sep 1960 (fl), *S. Tillett & C. Tillett 45380* (FDG, NY, US). **VENEZUELA. Bolívar:** Gran Sabana, ca. 10 km SW of Karaurin-tepui at junction of Río Karaurin and Río Asadon (Río Sanpa), 05° 19' N, 61° 03' W, 900–1,000 m, 20 Apr 1988 (fr), *R. Liesner 23465* (BRIT, MO, NY, US, VEN); 21 Apr 1988, *23534* (BRIT, MO, NY, US, VEN); Gran Sabana, orillas del Río Aponguao, without elev., 18 Jan 1973 (fl), *G. Morillo et al. 2887* (VEN 2-sheets); Along Río Karuai, between base of Ptari-tepui and Sororopán-tepui, 1,220 m, 28 Nov 1944 (fr), *J. Steyermark 60726* (F, NY, US).

Myrsine resinosa may be confused with *M. picturata*, but is easily separated by the linear-oblanceolate, lorate or narrowly elliptic leaf blades with long, conspicuous punctate-lineations, and the longer pedicels.

8. Myrsine picturata Pipoly, (Figs. 3, 5C, 5D, 6), Novon 1:204. 1991. Caño Grande, 1,200–2,200 m, 13 Dec 1957 (fl, fr), *B. Maguire, J. Wurdack & C. Wurdack 42375* (HOLOTYPE: VEN; ISOTYPES: F, MO, NY 2-sheets, US).

Trees to 8 m tall. *Branchlets* terete, 4–5 mm diam., glabrous; trunk and branches orthotropic. *Leaves* spiral; blades coriaceous, elliptic to oblong, (3) 4–6 cm long, (1.5–)1.8–2(–3) cm wide, apically obtuse to slightly emarginate, basally cuneate, decurrent on the petiole, the midrib strongly impressed above, raised and ribbed below, the secondary veins prominulous below, nitid above, pallid below, prominently and densely black punctate and short-lineate, translucent glandular-lepidote above in bud, glabrescent; the margin revolute, entire, hyaline, with prominently raised black punctations, densely red glandular-ciliate in bud, glabrescent; petiole canaliculate, (0.7–)0.8–1 cm long, glabrous. *Staminate inflorescence*: unknown. *Pistillate inflorescence* glomerulate, 3–5-flowered, the peduncle glabrous, epunctate, 1.2–2.1 mm long; floral bracts membranaceous, very widely ovate to deltate, 0.7–1.0 mm long, 0.8–1.2 mm wide, apically obtuse, densely and prominently black punctate and punctate-lineate, the margin entire, glandular-ciliate; pedicels cylindrical, 0.9–1.0 mm long, glabrous, densely and prominently black punctate-lineate. *Pistillate flowers* 5-merous, translucent green; calyx chartaceous, cotyliform, 1.3–1.5 mm long, the tube 0.1–0.2 mm long, the lobes ovate, 1.1–1.2 mm long, 0.6–0.8 mm wide, apically long-attenuate, glabrous, densely and prominently black punctate-lineate, medially crassate, the margin hyaline, flat, irregular, glabrous; corolla membranaceous, campanulate, 1.8–2.0 mm long, the tube 0.5–0.6 mm long, the lobes ovate, 1.2–1.4 mm long, 0.6–0.7 mm wide, apically rounded to obtuse, densely and prominently black punctate and punctate-lineate, hyaline, the margin densely glandular-granulose, entire; staminodia 1.2–1.4 mm long, the filaments obsolete to 0.1 mm long, the antherodes ovate, 0.9–1 mm long, 0.3–0.4 mm wide, apically apiculate, basally sagittate, epunctate, but the connective darkened dorsally; pistil ellipsoid, 2.1–2.4 mm long, the ovary 1.5–1.8 mm long, 1.0–1.2 mm diam., densely and prominently black punctate and punctate-lineate, the stigma subsessile, conical, ca. 0.6 mm long, 2–3-lobed longitudinally, pellucid punctate, apically cuspidate, ovules 3, immersed in a globose placenta. *Fruit* obovoid, 4–5 mm long, 3–3.5 mm diam. when dried, densely and prominently black punctate and punctate-lineate.

Distribution.—Myrsine picturata (Figs. 3, 6) is endemic to Cerro de la Neblina

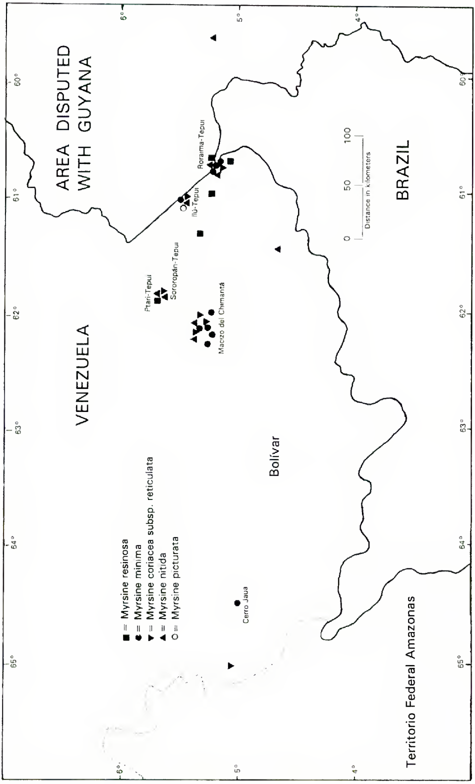

FIG. 6. Distribution of *Myrsine resinosa* (■), *M. minima* (•), *M. coriacea* subsp. *reticulata* (▼), *M. nitida* (▲) and *M. picturata* (O) in Venezuela and bordering Guyana region. Note that this map is essentially a close-up of the eastern portion of Figure 9, with *M. minima* repeated to eastern range more precisely.

of Amazonas and the Ilú-tepui on the Gran Sabana of Bolívar, growing at 1,200–2,450 m elevation.

Ecology and conservation status.—This species grows in low woodlands in cloud forests on saturated soil. Despite its restricted distribution, the protected status and remoteness of the Cerro provide it adequate protection.

Etymology.—The specific epithet refers to the dense and prominent black punctate lineations of the leaf blades, perianth parts and fruits.

Specimens examined. **VENEZUELA.** Amazonas: Departmento Río Negro, Cerro de La Neblina, Cumbre Camp Swale, 1,200–2,200 m, 19 Nov 1957 (fr), *B. Maguire et al. 42090* (F, NY-2 sheets, US); Cerro de La Nebina, Río Yatua, S rim of upper basin of Cañon Grande, 1,200–2,200 m, 13 Dec 1957 (fr), *B. Maguire et al. 42376* (NY 3-sheets). **Bolívar:** Gran Sabana, Ilú-tepui, slopes below upper most W-facing escarpment, 7,000–8,000 ft [2,134–2,438 m], 21 Mar 1952 (fl), *B. Maguire 33535* (NY).

Myrsine picturata may be confused with *M. perpauciflora*, but is separated by the more densely and prominently black punctate-lineate abaxial leaf surface, the 3–5 (not 1–3)-flowered inflorescences, calyx lobes black (not brown) punctate, and obovoid (not globose) fruit.

9. **Myrsine macrocarpa** Pipoly, (**Figs.** 7A, 7B, 9), Novon 1:207. 1991. TYPE. VENEZUELA. AMAZONAS: Serranía Parú, Río Parú, Cerro Parú, valley above camp and valley draining eastward through cumbre, 2,000 m, 10 Feb 1951 (fr), *R. Cowan & J. Wurdack 31372* (HOLOTYPE: VEN; ISOTYPES: F, NY-2 sheets, US).

Tree to 7 m tall; trunk and branches orthotropic. *Branchlets* terete, 7–10 mm diam., glabrous. *Leaves* spiral; blades coriaceous, elliptic to obovate, 9.5–16 cm long, 6.5–9.2 cm wide, apically obtuse, basally acute, decurrent on the petiole, pallid and scrobiculate above and below, midrib impressed above, prominently raised below, the secondary vein pairs 13–26, mostly inconspicuous, but somewhat visible below, not evidently punctate, the margin opaque, highly revolute basally, glabrescent, entire; petioles marginate, 1.5–2 cm long, glabrous. *Staminate inflorescence*: unknown. *Pistillate infloresecence*: unknown. *Infructescence*: glomerulate, apparently 4–8-flowered, the peduncle glabrous, epunctate, 1.2–4.2 mm long, made up of floral bract bases; floral bracts very widely ovate to oblate, 0.5–0.7 mm long, 1.0–1.2 mm wide, apically obtuse, densely pellucid punctate, the margin entire, densely glandular-ciliate; pedicels cylindrical, 1.1–1.4 mm long, glabrous, epunctate. *Pistillate flowers* unknown. *Fruiting calyx* cotyliform, coriaceous, 1.2–1.4 mm long, the tube 0.2–0.3 mm long, the lobes very widely ovate to oblate, 1.0–1.2 mm long, 1.1–1.3 mm wide, the apically acute, densely pellucid punctate, the margin irregular, opaque, entire, glabrous. *Fruit* globose, 0.8–1.2 cm long and diameter, purplish at maturity, inconspicuously pellucid punctate.

Distribution.—*Myrsine macrocarpa* (Fig. 9) is endemic to the state of Amazonas, Venezuela, growing at 1,500–2,000 m elevation.

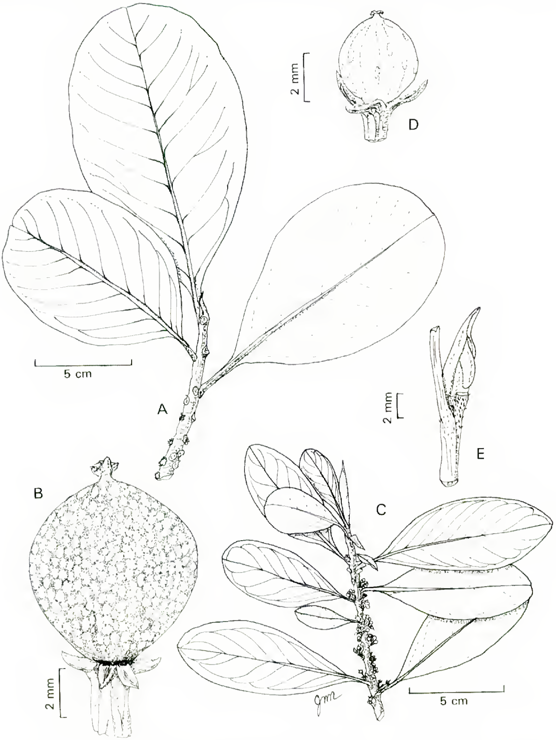

FIG. 7. A. Habit, flowering branch of *Myrsine macrocarpa* Pipoly, drawn from *R. Cowan & J. Wurdack 31372* (NY isotype). B. Fruit of same, drawn from *R. Cowan & J. Wurdack 31372* (NY isotype). C. Habit, flowering branch of *Myrsine pellucida* (Ruiz & Pav.) Spreng., drawn from *J. Luteyn & J. Pipoly 9370*. D. Fruit of same, drawn from *A. Gentry et al. 11090*. E. Detail of branchlet apex and partial petiole with reddish glandular-papilae of same, drawn from *A. Gentry et al. 11090*.

Ecology and conservation status.–Myrsine macrocarpa is a riparian species, occuring at the margins of gallery forests in upland, wet savannas. Because its known localities are so remote, and so wet, they are not particularly subject to dangers from human intervention nor fire. Therefore, the species should not be considered threatened.

Specimens examined. **VENEZUELA. Amazonas:** Cerro Huachamacari, Río Cunucunuma, below Camp II, 1,000 m, 20 Dec 1950 (fr), *B. Maguire et al. 29969* (NY-2 sheets); In vicinity of Summit Camp, 1,800 m, 6 Dec 1950 (fr), *B. Maguire et al. 30005* (NY); Along right fork of Caño de Dios in cumbre near Summit Camp, 13 Dec 1950 (fr), *B. Maguire et al. 30180* (NY-2 sheets); Depatamento Atures, lomas graníticas, Caño Piedra, 115 km al SE de Puerto Ayacucho, 04° 54' N, 66° 54' W, 1,500 m, Sep 1989 (ster.), *E. Sanoja et al. 2988* (MO).

Myrsine macrocarpa is most closely related to the vicariant *M. pellucida* (Ruíz & Pav.) Spreng., but is easily separated by the prominulous secondary veins and pellucid punctations of the leaf blades, shorter pedicels, glabrous calyx lobe margins, and the large fruits.

10. Myrsine pellucida (Ruíz & Pav.) Spreng., **(Figs. 7C, 7D, 7E, 9)**, Syst. Veg. 1:664. 1825. *Caballeria pellucida* Ruíz & Pav., Syst. Veg. Fl. Peruv. Chil. 1:280. 1798. *Manglilla pellucida* (Ruíz & Pav.) Roem. & Schult., Syst. Veg. 4:506. 1819. *Rapanea pellucida* (Ruíz & Pav.) Mez in Engl., Pflanzenr. IV. 236(Heft 9):394. 1902. TYPE. PERÚ. HUÁNUCO: Muña, without elev., 1778–1788 (stam. fl), *H. Ruíz & J. Pavón 5/35* (HOLOTYPE: MA; ISOTYPES: F (NY Neg. # 12120), G-BOIS).

Rapanea perforata Mez in Engl., Pflanzenr. IV. 236(Heft 9):395. 1902, SYN. NOV. TYPE. PARAGUAY. PARAGUARI: Paraguari, without elev., Mar 1875 (fr), *B. Balansa 2378* (HOLOTYPE: G; ISOTYPE: P).

Trees to 5(–10) m tall; trunk and branches orthotropic. *Branchlets* terete, reddish glandular-papillose. *Leaves* spiral; blades coriaceous, elliptic, oblong, oblanceolate or obovate, (6.5–)7.5–18 cm long, (2.7–)3.3–7.9 cm wide, apically obtuse to subacute, basally acute, nitid above, densely reddish glandular-papillate along the midrib above, the midrib impressed above, prominently raised below, the secondary veins inconspicuous above and below, pellucid or black punctate and punctate-lineate below, the margin flat, slightly decurrent on the petiole; petiole marginate, 0.5–1.0 cm long, densely red glandular-papillate, glabrescent. *Staminate inflorescence* sessile, 8–12-flowered; floral bracts coriaceous, ovate, ca. 1.3–1.5 mm long, 1.2–1.4 mm wide, apically broadly rounded, long reddish glandular-ciliolate; pedicels obsolete to 1 mm long. *Staminate flowers* chartaceous, 2–2.2 mm long; calyx cotyliform, ca. 1 mm long, the tube 0.2–0.3 mm long, the lobes ovate, unequally divided, longer than wide, 0.7–0.8 mm long. 0.5–0.7 mm wide, apically obtuse to subacute, densely and prominently black punctate and punctate-lineate, the margin sparsely glandular-ciliate, irregular, entire; corolla broadly campanulate, 2–2.2 mm long, the tube ca. 0.3 mm long, the lobes elliptic, 1.7–1.9 mm long, 0.7–0.8 mm wide, apically acute, densely and prominently black punctate and punctate-lineate, the margin entire, densely glandular-granulose throughout; stamen 1.4–1.7 mm long, filaments not obvious, venation visible, ca. 0.3 mm long; anthers ovate to oblong, 1.5–1.7 mm long, apically apiculate, the apiculum darkened, recurved ventrally, basally subcordate, the connective black lineate; pistillode conic, hollow, ca. 1 mm long, 0.5 mm diam. *Pistillate inflorescence* as in staminate. *Pistillate flowers* as in staminate but antherodes 1–1.1 mm long; pistil 2–2.3 mm long, 1–1.3 mm diam., the ovary subglobose, 1.2–1.3 mm long and in diam., the stigma carnose, prismatic, 1–1.1 mm long and in diam., the placenta ellipsoid, 1 mm long, the ovules 3–4, uniseriate. *Fruit* globose, 3–3.5 mm diam., obscurely punctate and punctate-lineate.

Distribution.—*Myrsine pellucida* (Fig. 9) is known from the Venezuelan coastal range in the state of Falcón, south and westward through the Andes of Venezuela, Colombia, Ecuador, and Peru to Bolivia and adjacent Paraguay, growing at (400–)1,000–2,600 m elevation. There are a few disjunct populations in the western portion of the state of Bolívar, Venezuela, growing on diabasic intrusion areas in the tepuis.

Ecology and conservation status.—*Myrsine pellucida* is found along disturbed roadsides through cloud forest and subpáramo life zones, and along margins of cloud forests. The disjunct populations in the state of Bolívar are on diabasic intrusions in otherwise superimposed Roraima Sandstone formations.

Etymology.—The epithet 'pellucida' refers to the pellucid punctations of the abaxial leaf blades and fruits.

Specimens examined. **VENEZUELA. Barinas:** Distrito Pedraza, trail from Mesa de Canagua (ca. 08° 34' N, 70° 37' W) to Pozo Negro (ca. 08° 32' N 70° 37' W), 400–600 m, 25 Nov 1990 (fr), *L. Dorr et al. 7872* (MO, PORT); Ca. 32 km NE of Altamira & 3 km NE of Caldas, 08° 55' N, 70° 25' W, 1,000 m, 24 Jan 1984 (fr), *J. Luteyn & J. Pipoly 9377* (BRIT, MO, NY, PORT). **Bolívar:** Distrito Cedeño, near Minería El Guaniamo, 06° 27' N, 65° 52' W, 300 m, May 1993 (ster.), *E. Diaz 1756* (MO); near small Minería El Guaniamo, 06° 27' N, 65° 52' W, 300 m, May 1993 (ster.), *W. Diaz 1759* (MO); Municipio Raul Leoni, 64 km al SE de Pijiguaos, 06° 09' N, 66° 23' W, 550 m, Jul 1989 (fl), *L. Delgado 282* (MO). **Falcón:** Distrito Bolívar, mesa of Sierra de San Luís, ca. 1 km S of caserío Carrizalito, 11° 05' N, 69° 42' W, 1,100 m, 31 Aug 1985 (fr), *O. Huber & W. Morawetz 10823* (BRIT, MYF, MO, W); Cucaire, Sierra de San Luís, 134 km post, 11° 08' N, 69° 46' W, 1,000 m, 20 Jun 1979 (fr), *R. Liesner et al. 7661* (MO, VEN). **Lara:** Distrito Torres, Páramo Agua Linda, near television repeating towers and el Fundo Orion, above the village of Palmarito, along the Carrretera Lara-Zulia ca. 35 km E of El Venado, between Km 12–15, 10° 10' N, 70° 42' W, 6–7 Sep 1980 (fr), *G. Bunting & A. Stoddart 9745* (NY); Distrito Morán, trail from Humocaro to Buenas Aires, Caserío, below Páramo Los Rosas, 09° 40' N, 70° 05' W, 2,600 m, 25 Jun 1979 (fr), *R. Liesner et al. 7949* (MO); Distrito Morán, ca. 4.4 km W of Humacaro Alto, 09° 36' N, 70° 01' W, 1,400–1,500 m, 22 Jan 1984 (stam. fl), *J. Luteyn & J. Pipoly 9357* (MO, NY, PORT). **Mérida:** Mucurubá, without elev., 12 Nov 1952 (fr), *L. Bernardi 11* (NY); Antes de la Palmita, 700 m, 4 Feb 1955 (fr), *L. Bernardi 1881* (NY, VEN); Pueblos del Sur, 1,450 m, Jun 1955 (fr), *L. Bernardi 2292* (NY 2-sheets); 26 km NE of Mérida along road to Valencia, right bank of Chama River, 2,000 m, 18 Nov 1963 (fl), *F. Breteler 3313* (NY); Mucurubá, Quebrada del pueblo, 2,700–2,800 m, 27 Jun 1930 (fl), *H. Gehriger 270* (F, MO, NY); Distrito Rangel, E edge of town of Santo Domingo, 08° 52' N, 70° 43' W, 1,646 m, 24 Jan 1984 (fl), *J. Luteyn & J. Pipoly 9370* (F, MER, MO, NY); Distrito Rivas Dávila, páramo de La Negra, 23–30 km above (SSW) Bailadores on road to La Grita, 2,500–2,900 m, 12 Apr 1984 (fl), *J. Luteyn & M. Lebrón-Luteyn 9776* (NY); Along Hwy. 7, 21 km by road NE of Mérida and 9 km SW of Mucurubá, 1,900 m, 29 Jul 1979 (fr), *M. Nee & M. Whalen 17016* (F); Anden, Umgebung von Timotes, 2,020 m, 22 Aug 1968 (fl, fr), *B. Oberwinkler & F. Oberwinkler 12472* (M); Anden, Straße Mérida, Apartaderos, zwischen Tabay und Mucuruba, 2,000 m, 15 Dec 1968 (fl), *B. Oberwinkler & F. Oberwinkler 13909* (M); Vicinity of Timotes, 2,000 m, 20 Jan 1928 (fl), *H. Pittier 12652* (M, NY); Disitrito Libertador, Caserío El Chabá, entre Los Nevados y la población de El Morro, a orillas de la quebrada de El Hato, vertiente meridional de la Sierra Nevada, 2,400 m, 14 Dec 1961 (fl), *L. Ruiz Terán 824* (MERF, MO); Disitrito Campo Elias, San José de Acequias a Orillas de Quebrada de Minanon, 2,350–2,400 m, 24 Mar 1967 (fl), *L. Ruiz Terán, et al. 3916* (MERF, NY). **Táchira:** Páramo Zumbador, 14 km S of El Cobre, 2,500 m, 31 Mar 1974 (fr), *A. Gentry et al. 11090* (MO); Páramo Zumbador, 07° 58' N, 72° 05' W, 2,250–2,600 m, 4 Jan 1989 (fr), *W. Hahn & F. Grifo 4983a* (MO, NY); Cazadero, Quebrada Cazadero, 16 km of San Cristóbal, 07° 54' N, 72° 18' W, 650–900 m, 4 May 1981 (fl), *R. Liesner & M. Guariglia 11812* (MO); Distrito Jauregi, 40 km S of La Grita along road to San José de Bolívar, 07° 56' N, 71° 57' W, 1,560 m, 14 Apr 1984 (pist. fl, fr), *J. Lutyen & M. Lebrón-Luteyn 9913* (MO, NY, VEN); Distrito Junín, Municipio Delicias, Caserío Villa Páez and vicinity, 1,900–2,300 m, 7 Mar 1962 (fr), *L. Ruiz Terán 935* (MERF, MO); Lower slopes of Paramo de Tamá to Paramo de Tamá, 2,800 m, 20 May 1967 (fl, fr), *J. Steyermark 98562* (NY, VEN); Cabeceras del Río Quinimarí, steep slopes and cliffs of El Banco, belos Cerro Las Copas, below Páramo de Judío, 20 kms al S de San Vicente de la Revancha, 35 kms S of Alquitrana, SW of Santa Ana, 2,500–2,700 m, 15 Jan 1968 (fl, bud), *J. Steyermark et al. 100966* (NY 2-sheets); Sierra El Casadero, 13 km N of Rubio, between Las Dantas and Las Adjuntas, 07° 43' N, 72° 23' W, 900–1,050 m, 12 Nov 1979 (fr), *J. Steyermark et al. 120141* (MO). **Trujillo:** Distrito Carache, en Cuicas, La Guajira, 900 m, 25 Jun 1972 (fr), *C. Benítez de Rojas 1459* (F, MY).

Myrsine pellucida is a common plant throughout the Andes, particularly easy to distinguish because of the sessile umbels and reddish glandular papillae of the terminal bud and apical zone of the branchlets. This species, along with *Myrsine latifolia* (Ruíz et Pav.) Spreng. have been misidentified as *M. guianensis*, which does not occur in the Andes. Within Venezuela, it may be confused with *Myrsine macrocarpa*, but is easily distinguished by the red glandular-papillate branchles petioles and leaf midrib, smaller fruits and shorter petioles. Another siginificant difference is that *Myrsine pellucida* is restricted to soils on metamorphic rock, while *M. macrocarpa* is a tepui species.

11. **Myrsine nitida** (Mez) Pipoly, (**Figs. 6, 8A, 8B**), Novon 1:210. 1991. *Rapanea nitida* Mez, Repert. Spec. Nov. Regni Veg. 16:424. 1920. Type. GUYANA [VENEZUELA]. Mt. Roraima, 2,000 m, Dec 1909, (fl), *E. Ule 8725* (holotype: B-destroyed, 1943; lectotype here designated K).

Rapanea roraimensis A.C. Sm., Bull. Torrey Bot. Club 67:296. 1940. Syn. nov. *Myrsine roraimensis* (A.C. Sm.) Pipoly, Novon 1:208. 1991. Type. VENEZUELA. Bolívar: Mount Roraima, SW slopes, 7,800 ft. [2,377 m], 11 Jan 1939 (fl), *A. Pinkus 132* (holotype: NY; isotypes: F, GH, MO, NY, US 2-sheets).

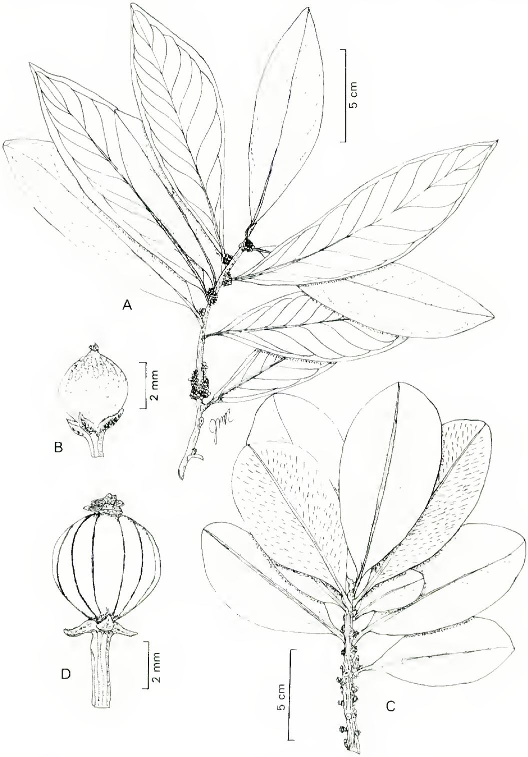

FIG. 8. A. Habit, flowering branch of *Myrsine nitida* (Mez) Pipoly, drawn *from A. Pinkus 132* (NY, holotype of *Rapanea roraimensis* A.C. Sm). B. Fruit of same, drawn from *J. Steyermark 75834* C. Habit, flowering branch of *Myrsine guianensis* (Aubl.) Kuntze, drawn from *J. Aublet s.n.* (BM isolectotype). D. Fruit of same, drawn from *L. Delgado 215*.

Shrub or *tree* to 10 m tall; trunk and branches orthotropic. *Branchlets* terete, glabrous. *Leaves* spiral; blades coriaceous, elliptic or oblanceolate, (5.5)12–17 cm long (2.7–)3.5–5.7(–7) cm wide, apically acute or rarely, obtuse, basally acute to obtuse, slightly decurrent on the petiole, the secondary veins prominulous above, obviously brochidodromous, the loop connections visible dull to somewhat nitid above, conspicuously reddish punctate and punctate-lineate below, the margin entire, flat; petioles marginate, 0.7–1.5 cm long, glabrous. *Staminate inflorescence* fasciculate, 5–9-flowered, the short shoots sessile to 3 mm long; floral bracts ovate, 1–1.2 mm long, 0.7–0.8 mm wide, apically acute, densely and prominently black punctate-lineate; pedicels 1–1.3 mm long. *Staminate flowers* 5-merous, chartaceous, 3.4–3.6 mm long; calyx cotyliform, 1.2–1.4 mm long, the tube 0.2–0.3 mm long, the lobes ovate to deltate, 1–1.2 mm long, and wide, prominently black punctate-lineate medially, apically acute, the margin entire, minutely glandular-ciliolate; corolla campanulate, 3.4–3.6 mm long, the tube 0.7–0.9 mm long, the lobes oblong to elliptic, 2.5–2.7 mm long, 1.2–1.3 mm wide, apically acute to obtuse, densely and prominently black punctate and punctate-lineate, the margin entire, glandular-granulose throughout; stamens 2.9–3.1 mm long; filaments not obvious, ca. 0.7–0.9 mm long, the anthers ovate to oblong, 2–2.1 mm long, 1.1–1.3 mm wide, apically apiculate, basally subcordate, the connectives black punctate-lineate dorsally; pistillode conic, 2 mm long, 1 mm wide, the sterile stigma conic, 4-lobed, hollow. *Pistillate inflorescence* as in staminate but pedicels 1–1.5 mm long. *Pistillate flowers* as in staminate but 2.5–2.9 mm long; calyx 1.5–1.7 mm long, the tube ca. 0.5 mm long, the lobes ovate to deltate, 0.9–1 mm long and wide, apically acute; corolla 1.8–2 mm long, the tube 0.7–0.8 mm long, the lobes elliptic, 1.1–1.3 mm long, ca. 0.5 mm wide; staminodes ca. 1.5 mm long, the filaments not obvious but venation visible, ca. 0.7–0.8 mm long, the antherodes malformed, 0.5–0.8 mm long, ca. 0.5 mm wide, apically acute, basally subsagittate; pistil 2.5–2.7 mm long, the ovary globose, 1.1–1.3 mm long and diam., the stigma lacinate, 4-lobed, translucent, carnose, 1.5–1.7 mm long, 1–1.2 mm diam, the placenta ellipsoid; ovules 3–4, uniseriate. *Fruit* globose, 3–3.5 mm long and in diam., obscurely pellucid punctate.

Distribution.—*Myrsine nitida* (Fig. 6) is known from the state of Bolívar in Venezuela, and adjacent Guyana, growing at (830–)1,800–2,450 m elevation.

Ecology and conservation status.—*Myrsine nitida* occurs in rocky knolls in savannas, along the margins of premontane forests, *Clusia-Magnolia* riparian forests, and in *Mora* forests. Because these forests produce more timber than any of those surrounding them, this species should be considered threatened.

Etymology.—The specific epithet refers to the shiny nature of the adaxial leaf surface.

Specimens examined. **GUYANA**. **Cuyuni-Mazaruni:** Pakaraima Mts., NE plateau of Ayanganna, 05° 23' N, 59° 58' W, 1,500–1,650 m, 3 Nov 1992 (ster.), *B. Hoffman 3230* (BRIT, US). **VENEZUELA**. **Bolívar:** 0–1 km NE of El Paují, 04° 30' N, 61° 35' W, 830–900 m, 5 Nov 1985 (fl), *R. Liesner 19543* (MO, NY, VEN); Gran Sabana, Ilú-tepui, W-facing slopes below low escarpment, 7,000–8,000 ft [2,134–2,438 m], 17 Mar 1952 (fl), *B. Maguire 33468* (BRIT, NY), slopes below upper most W-facing escarpment, 21 Mar 1952 (fr), *33497* (NY); Mount Roraima, SW-facing slopes between Rondón Camp and base of bluffs, 2,040–2,255 m, 30 Sep 1944 (fr), *J. Steyermark 58948* (F, NY); Ptari-tepui, along base of E-facing bluff, 2,410–2,450 m, 7 Nov 1944 (fl), *J. Steyermark 59948* (F, NY); Sororopán-tepui, crest of cerro between E & W end, 2,255 m, 14 Nov 1944 (fl), *J. Steyermark 60108* (F, NY, US); Chimantá Massif, above SE-facing upper shoulder on slope leading to summit of Apácara-tepui, 2,200–2,300 m, 20 Jun 1953 (fl), *J. Steyermark 75834* (F, MO, NY); Chimantá Massif, Agparamán-tepui, SE- facing forested slopes below escarpment, 1,880–1,955 m, *J. Wurdack & J. Steyermark 1160* (NY).

Myrsine nitida appears to be most closely related to *M. guianensis*, but is separated by the conspicuously reddish punctate-lineate abaxial leaf surface, the acute or rarely, obtuse leaf apices and habitat.

12. **Myrsine guianensis** (Aubl.) Kuntze, (**Figs. 8C, 8D, 9**), Revis. Gen. Pl. 2:402. 1891. *Rapanea guianensis* Aubl., Hist. Pl. Guiane. Fr. 1:121, t. 46. 1775. Type. FRENCH GUIANA. Without locality, without elev., without date (fl); *J. Aublet s.n.* (LECTOTYPE: P, here designated (BRIT & MO Neg.); ISOLECTOTYPE: BM (MO Neg. # 4321)).

Rapanea oblonga Pohl ex Miq. in Mart., Fl. Bras. 10:308. 1856. Type. BRAZIL. Without locality, without elev., without date (fl, fr), *Pohl 4384, 6077* (SYNTYPES W; photo SI). We defer lectotypification of this binomial until all material cited in the protologue and their duplicates can be assembled.

Myrsine ovalifolia Miq. in Mart., Fl. Bras. 10:313. 1856. *Rapanea ovalifolia* (Miq.) Mez in Engl., Pflanzenr. IV. 236(Heft 9):391. 1902. Type. BRAZIL. Alagoas, without elev., Jun 1838 (fl), *Gardner 1350* (HOLOTYPE: G; ISOTYPE: BM).

Trees to 6(–15) m tall; trunk and branches orthotropic. *Branchlets* terete, glabrous, the bark of lower branches thick and corky. *Leaves* spiral; blades coriaceous, elliptic, oblong, oblanceolate or obovate, 7–18 cm long, (2.7–)3–7.5 cm wide, apically obtuse to broadly rounded, basally acute, the midrib impressed above, prominently raised below, the secondary veins prominulous above, penninerved, not obviously brochidodromous, nitid above, pallid below, inconspicuously black punctate or black punctate-lineate below, the margin entire, flat, somewhat revolute basally; petioles marginate, 0.5–1.5 cm long, glabrous. *Staminate inflorescence* fasciculate, 5–8-flowered, on short perrennating shoots accrescent by accumulating girdling floral bracts; floral bracts chartaceous, oblate, 0.5–0.6 mm long, 0.9–1.0 mm wide, apically broadly rounded, the margin entire, densely long glandular-ciliate; pedicels 1.2–2 mm long. *Staminate flowers* 5-merous, chartaceous, hyaline, 3.5–3.8 mm long; calyx campanulate, 1–1.2 mm long, the tube ca. 0.3 mm long, the lobes widely ovate to deltate, 0.7–0.9 mm long and wide, apically narrowly

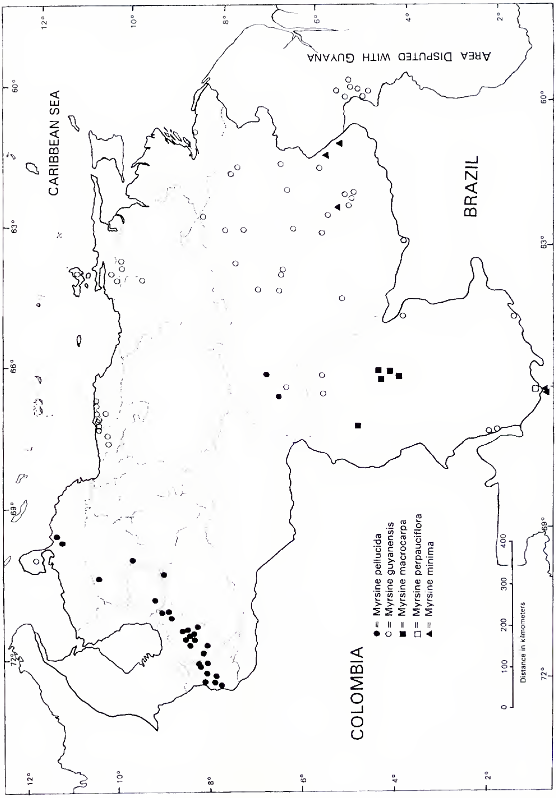

FIG. 9. Distribution of *Myrsine pellucida* (•), *M. guianensis* (○), *M. macrocarpa* (■), *M. perpauciflora* ( ) and *M. minima* (▲) in Venezuela and bordering Guyana region.

acute to attenuate, prominently black punctate and punctate-lineate medially, the margin entire, glabrous; corolla campanulate, 3.5–3.8 mm long, the tube 0.7–0.9 mm long, the lobes elliptic to lanceolate, 2.7–3 mm long, 0.9–1 mm wide, apically sharply acute to attenuate, densely and prominently black punctate and punctate-lineate, the margin entire, glandular-granulose throughout; stamens 2.2–2.5 mm long, the filaments not obvious (but veins visible) 0.7–0.9 mm long, the anthers ovate, 1.5–1.7 mm long, 0.7–0.8 mm wide, apically apiculate, the apically curved inward, basally subcordate, the connective with one prominent black punctation at point of attachment; pistillode conic, 1.3–1.5 mm long, 0.7–0.8 mm diam., hollow or bearing a sterile placenta. *Pistillate inflorescence* as in staminate but on perrenating shoots to 6 mm long; pedicels 1.5–2 mm long. *Pistillate flowers* as in staminate but calyx 1.1–1.8, the tube ca. 0.2 mm the lobes ovate, 1.1–1.3 (–1.5) mm long, 0.7–0.9 mm wide; corolla 2.5–3.5 mm long; the tube as in staminate, the lobes 2.5–3 mm long, 0.8–1.2 mm wide; staminodes resembling stamens except antherodes broadly ovate 1.0–1.3 mm long, 0.6–0.8 mm wide; pistil conic, 1.5–2.5 mm long,0.8–1 mm diam, the stigma conical, with 4 twisted lobes, the placenta conical, the ovules 3–5, uniseriate. *Fruit* globose, 3.5–5 mm long and in diam., prominently black punctate.

Distribution.—*Myrsine guianensis* is known from French Guiana and adjacent Brazil westward through Suriname and Guyana to Venezuela (Fig. 9), growing at (100–)400–1,400(–2,800) m elevation. Reports of this species from Colombia, Ecuador, Peru, Bolivia and Paraguay are based on misidentifications. In Venezuela, it is found throughout the states of Bolívar, around the margins of Amazonas, in Delta Amacuro, Monagas, Sucre, Nueva Esparta, Anzoátegui, Miranda, D.F., Aragua, and Falcón growing in sandy, savanna-like situations.

Ecology and conservation status.—In Venezuela, *Myrsine guianensis* is known from primary and secondary lowland riparian forests on reddish or quartzite sands, premontane forest, cloud forests and rarely, upland savannas.

Etymology.—The epithet refers to the species' type locality, French Guiana.

Specimens examined. **GUYANA. Mazaruni-Potaro:** Upper Potaro River region, summit of Mt. Wokomung, 05° 05' N, 59° 50' W, 9 Jul 1989 (fr), *B. Boom & G. Samuels 9138* (MO, NY); Upper Potaro River region, trail Kopinang-Orinduik, ca. 1.5 hr walk from Koponang, 04° 57' N, 59° 53' W, 790 m, 22 Jul 1989 (fr), *B. Boom & G. Samuels 9285* (MO, NY); Kaieteur Plateau, forest along trail from Plane-landing to Kaieteur Falls, ca. 1,400 m, 11 Feb 1962 (fl), *R. Cowan & T. Soderstrom 1826* (K, US); E Berbice-Corentyne Region: Digitima Savanna; Canje River, 10 km S of Mora, 185 km S or mouth of Canje, 05° 33' N, 57° 40' W, 10–20 m, 29 Oct 1989 (stam. fl), *L. Gillespie et al. 2510* (US); Potaro-Siparuni Region, at southern base of Mt. Kopinang along trail from Kopinang to Orinduik, 05° 00' N, 59° 55' W, 500–600 m, 9 Apr 1988 (fr), *W. Hahn et al. 4435* (MO, US); Potaro-Siparuni Region, Kato, 04° 40' N, 59° 55' W, 750 m, 11 Mar 1989 (fr), *W. Hahn et al. 5603* (MO, US); E. Berbice-Corentyne Region: W bank of Canje Rive, Cow Savanna, ca. 1 km N of Digitima Creek, 1–20 m, 14 Apr 1987 (fr), *J. Pipoly et al. 11582* (FDG, MO, NY, US)Upper Mazaruni River basin, Mt. Ayanganna, on shoulder of E flank, ca. Thompson camp, 1,418 m, 12 Aug 1960 (fr), *S. Tillett et al. 45118* (NY-2 sheets); Upper Mazaruni River basin, Kukui River, in Mora forest bordering river at Adaro river mouth, ca. 500 m, 5 Sep 1960 (fr), *S. Tillett & C. Tillett 45290* (NY-2 sheets, US). **VENEZUELA. Amazonas:** Beyond soccer field, San Carlos de Río Negro, 115 m, 17 Sep 1975 (fr), *P. Berry 1367* (MO); San Carlos de Río Negro, ca. 20 km S of confluence of Río Negro and Brazo Casiquiare, near radar site, 3.4 km NE of San Carlos on Solano road, 01° 56' N, 67° 03' W, 119 m, 13 Mar 1979 (fr), *H. Clark 7094* (MO, NY); Serranía de Tapirapecó, Campamento Tamacuari, trail between 2 camps, 01° 14' N, 64° 40' W, 1,400 m, 10 Feb 1989 (fr), *A. Henderson et al. 1022* (BRIT, NY); Department Atures, cumbre del Cerro Yaví, en las cabeceras del Río Parucito, afluente oriental del Río Manapiare, en el sector NE de la cumbre, 05° 43' N, 65° 52' W, 2,100 m, 29 Oct 1986 (fr), *O. Huber 11853* (NY); Department Atures, cumbre del Cerro Coro-Coro, en las cabeceras nor-occidentales del Río Manapiare, sector NW de la Serranía Yutajé, 05° 46' N, 66° 12' W, 2,200 m, 12 Nov 1987 (fr), *O. Huber 12318* (US); Sierra Parima, Vecindades de Simarawochi, Río Matacuni, a unos 6–7 km al O de la frontera Venezolana-Brasilera, 03° 49' N, 64° 36' O, 795–830 m, 18 Abr–23 May 1973 (fl), *J. Steyermark 106968* (MO, NY); *107113* (F, MO, NY). **Anzoátegui:** Distrito Bolívar, just S of El Zamuro, Fila El Purgatorio, 9 airline km NE of Bergantín, 10° 02' N, 64° 17' W, 1,100 m, 24 Nov 1981 (fr), *G. Davidse & A. González 19400* (MO, NY, VEN), *19402* (US). **Aragua:** Maracay, without elev., 1934 (fl, fr), *P. Vogel 1118* (M); Arriba de Guamitas, P. N. Aragua, 780 m, 15 Jun 1939 (fr), *L. Williams 11125* (F, MO). **Bolívar:** Near summit of Cerro Bolívar, ironstone area, Ciudad Piar, 750 m, 10 Apr 1954 (fl), *L. Aristeguieta 2178* (NY 2-sheets); Disitrio Raul Leoni, Río Ariza, 55 km NE of San Francisco de la Paragua, 07° 11' N, 64° 13' W, 485 m, Jun 1989 (fr), *L. Delgado 215* (MO, NY); Disitrito Gran Sabana, Zona Minera El Polaco, 04° 32' N, 61° 26' W, 950 m, Jul 1993 (ster.), *W. Diaz y S. Elcoro 1580* (MO); Disitrito Raul Leoní, Bajo Caroní, Sector III, Cerro Altamira, 07° 27' N, 63° 13' W, 300 m, May 1994 (fl), *W. Diaz 2515* (MO); Municipio Piar, 3 km NE of Hato Las Nieves, 07° 28' N, 62° 36' W, 280 m, May 1986 (fr), *A. Fernández 2946* (US); Distrito Piar, Serranía Quiribay, 07° 49' N, 62° 43' W, 280 m, 26 Jul 1989 (fr), *F. Flores & E. Pérez 557* (MO); Guyana, villa de Upata, without elev., 1864 (fl), *D. de Grosourdy 13* (P); Distrito Heres, Meseta del Guaiquinima, S-sloping plain near edge of NE section of the meseta, near the summit, 05° 58' N, 63° 29' W, 1,400 m, 27 Mar 1985 (fr), *O. Huber 10389* (MYF, MO, NY); Distrito Heres, Meseta del Guaiquinima, SE sector of the summit, 05° 51' N, 63° 25' W, 1,350 m, 26 Sep 1985 (fr), *O. Huber & G. Medina C. 10916* (MYF, NY); Distrito Cedeño, Serranía Guanay, NE sector, sloping toward the S and SW, at the easternmost headwaters of Río Parguaza, 05° 55' N, 66° 23' W, 1,700 m, 20–28 Oct 1985 (fl bud), *O. Huber 11062* (MYF, NY); Distrito Piar, Macizo del Chimantá, W sector, SW range of Apacará-tepui, near the connection with Abacapá-tepui, at NW headwaters of Río Tírica, 05° 17' N, 62° 16' W, 2,100 m, 8–10 Mar 1986 (fr), *O. Huber 11456* (BRIT, MYF, MO, NY 2 sheets); Disitrito Roscio, savannas at W foothills and SW summit of the Altiplanicie de Nuria, ca. 50 km N of Tumeremo, 07° 37' N, 61° 37' W, 300–450 m, 7 May 1986 (fl buds), *O. Huber 11640* (MYF, NY); Distrito Heres, Meseta del Guiquinima, plain sloping SE, along the SE border of the meseta, at W headwaters of Río Aberaima, 05° 47' N, 63° 48' W, 1,400 m, 20 May 1987 (fl), *O. Huber & V. Rull 12273* (MYF, MO, US); Distrito Cedaño, Meseta de Jaua, headwaters of Río Marajano, tributary of Río Cácaro, 04° 48' N, 64° 32' W, 1,750–1,800 m, 20 Nov 1989 (fr), *O. Huber 13005* (MYF, MO); Uaipan-tepui, between the W & E Peaks of Uaipan, ca. 1,500 m, 4 Mar 1967 (fr), *T. Koyama & G. Agostini 7474* (NY, VEN); Cerro Guaiquinima, Río Paragua, laterial S drainage of "North Valley", 1,700 m, 2 Jan 1952 (fl), *B. Maguire 32917* (NY); Ptari-tepui, NW slopes, 1,500–2,000 m, 17 Dec 1952 (FR), *B. Maguire & J. Wurdack 33896* (NY); Ptari-tepui, in vicinity of "Cave Rock" camp, below S face of mountain, 1,600–2,000 m, 14–19 Aug 1970 (bud), *H. Moore et al. 9738* (F, NY, US); Ptari-tepui, S slope, 2,600 m, 24 Nov 1983 (fr), *J. Pipoly 6399* (NY, VEN); Ptari-tepui, S-facing slopes, just NE of "Cave Rock", 1,800–1,850 m, 4 Nov 1944 (fr), *J. Steyermark 59808* (F, NY); Ptari-tepui, at base of cerro along Río Karuai, 1,220 m, 27 Nov 1944 (ster.), *J. Steyermark 60621* (F, MO); Chimantá Massif, NW part of summit of Abácapa-tepui, 2,125–2,300 m, 13 Apr 1953 (fr), *J. Steyermark 74954* (F, MO, NY); Chimantá Massif, on plateau of SE-facing upper shoulder of Apácara-tepui, 2,000 m, 19 Jun 1953 (fr), *J. Steyermark 75738* (F, MO, NY); Chimantá Massif, below Upper Falls of Río Tirica above Summit Camp, 1,940 m, 7 Feb 1955 (fr), *J. Steyermark & J. Wurdack 594* (BRIT, F, MO, NY); Altiplanicie de Nuria, vicinity of campamento Nuria, NE of Hato de Nuria, 530 m, 17 Jul 1960 (ster.), *J. Steyermark 86438* (NY); Altiplanicie de Nuria, vicinity of camp, 5 kms from Hato de Nuria, E of Miamo, 400 m, 12 Jan 1961 (fr), *J. Steyermark 88366* (NY); along Río Churún at foot of "Second Wall" of sandstone, N from camp, 5 km to the NE, 1,660 m, 12 May 1964 (fl), *J. Steyermark 93748* (NY); Distrito Heres, Cerro Marutaní, 1,420 m, 13 Jan 1981 (fl bud), *J. Steyermark et al. 124036* (NY); Distrito Piar, Cerro Torribio, Bajo Caroní, Sector III, 07° 04' N, 62° 05' W, 100 m, May 1994 (fr), *A. Valera 563* (MO). **Delta Amacuro:** Departamento Antonio Díaz, vicinity Caño Jotajana, tributary of Caño Guiniquina, NW of España near boundary with Departamento Tucupita, 09° 15' N, 61° 10' W, 50 m, 20 Oct 1977 (ster.), *J. Steyermark et al. 115090* (MO). **Distrito Federal:** Colonia Tovar, without elev., Dec 1924 (fl), *A. Allart 513* (NY), Parque Nacional "El Avila," near Los Venados, 1,650 m, 22 Dec 1975 (fl), *L. Aristeguieta & O. Huber 300* (NY); Reforested hills of the Caracas Botanical Gardens, 870–980 m, 1 Jul 1974 (fr), *P. Berry 213* (MO); Calvarío de Caracas, without elev., without date (fr), *Ernst 1088* (BM); Prope coloniam Tovar, without elev., 1854–1855 (fl), *A. Fendler 760* (MO, NY); Parque Nacional El Avila, above Naiguatá, along the right of way for Electricidad de Caracas between the stream of the Río Camurí and the stream of the Río Mazares en selva, 10° 34.5' N, 66° 42.3' O, 800 m, 11–12 Apr 1992 (ster.), *W. Meier et al. 2069* (BRIT); Jardin Botanico, Caracas, reforested slopes facing N, without elev., 14 Jun 1960 (fr), *J. Steyermark 86309* (NY). Caracas, without elev., 14 Jan 1892 (fl), *J. Warming 560* (C 2-sheets). **Falcón:** Península Paraguaná, Cerro Santa Ana, 650 m, 15 Dec 1964 (fl), *F. Breteler 4292* (MO, NY); *4299* (F, MO, NY); Península Paraguaná, Cerro Santa Ana, 650 m, Dec 1953 (fl), *T. Lasser & L. Aristeguieta 3410* (F 2-sheets, VEN); Cerro Santa Ana, ascensión del lado S desde el pueblo de Santa Ana, 750 m, 24 Jan 1966 (fl), *J. Steyermark & A. Braun 94642* (NY); Península Paraguaná, Cerro Santa Ana, without elev., Jan 1939 (fl, fr), *F. Tamayo 797* (F). **Miranda:** Carretera de Tacata-Loma del Hierro sabana antrópica, without elev., 1 Jan 1988 (fl), *N. Ramirez 2477* (MO, NY). **Monagas:** San Antonio-Cumaná Road, without elev., 24 Oct 1948 (fl, fr), *B. Maguire et al. 27251* (NY); Cerro Negro, above La Sabana de las Piedras, NW of Caripe, 1,500–2,180 m, 15 Apr 1945 (fl), *J. Steyermark 62075* (F). **Nueva Esparta:** Isla de Margarita, Cerro Copey, 500–900 m, Jul 1984 (fl), *F. Delascio & A. González 12223* (MO); (fr), *12255* (MO); Copey, 900 m, Dec 1951 (fl), *H. Gines 2815* (US), *3461* (US); Isla de Margarita, Cerro Copey, S of Santa Ana, at and near summit, 11° 02–03' N, 63° 55' W, 800–850 m, 24 Mar 1985 (fr), *J. Steyermark et al. 131074* (MO). **Sucre:** Valley of Cocollar, 820 m, 28 Apr 1945 (fr), *J. Steyermark 62377* (F); Cerro Turumuquire, N-facing slopes above La Trinidad, SW of Cocollar, 2,100–2,200 m, 5 May 1945 (fr), *J. Steyermark 62560* (F); Distrito Sucre, La Lomita, between La Sabana and Zurita, 500–600 m, 18 Aug 1973 (fl), *J. Steyermark et al. 107789* (MO, NY). WITHOUT LOCALITY: Coticita, without elev., 17 Jun 1917 (fl, bud), *H. Curran & M. Haman 1069* (NY).

Myrsine guianensis (Aubl.) Kuntze has long been confused with *M. pellucida* and *M. latifolia* (Ruíz & Pav.) Spreng., both Andean species. In the Caribbean and Central America, including the coast of the state of Delta Amacuro, it has been confused with *Myrsine cubana* A. DC. (often reported as *M. floridana* A. DC., a *nomen superfluum,* or *M. punctatum* (Lam.) Stearn, non (H. Lév.) Wilbur). In Brazil, it has been confused with several other species, including *Myrsine monticola* Mart. (Harvey & Pipoly 1995) and *M. umbellata* Mart. In Venezuela, *Myrsine guianensis* is most easily confused with *M. nitida*, from which it is easily distinguished by the obtuse to broadly rounded leaf apices, with inconspicuously black punctate and punctate-lineate abaxial surfaces, the ovate calyx lobes, larger, black punctate fruits and the cloud forest to lowland savanna habitats.

DOUBTFUL AND EXCLUDED TAXA

Myrsine schomburgkiana Miq. in Mart., Fl. Bras. 10:315. 1856.= *Elaeoluma schomburgkiana* (Miquel) Baill., Hist. Pl. 11:293. 1892, (Sapotaceae). Type. GUYANA. Without further locality, without elev., without date, *R. Schomburgk 968* (holotype: U; isotype: BM). See T. Pennington, Fl. Neotrop. 52:240. 1990.

Rapanea duidae Gleason, Bull. Torrey Bot. Club 58:447. 1931. Type. VENEZUELA. Amazonas: Summit of Mount Duida, 4,800 ft [1,463 m], 5 Jan 1929 (fl), *G. Tate 594* (holotype: NY).

This taxon is actually a species of *Micropholis* (Sapotaceae), and the type was annotated "*Micropholis sp.*" by Pennington in 1985. However, disposition of this name was not made in his Sapotaceae monograph (Pennington 1990).

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REFERENCES

Anderberg, A. and B. Ståhl 1995. Phylogenetic interrelationships in the order Primulales, with special emphasis on the family circumscriptions. Canad. J. Bot. 73:1699–1730.

C. Chen and J. Pipoly. 1996. Myrsinaceae. In: Wu Zheng-yi and P. Raven, eds. Flora of China. Science Press, Beijing and Missouri Botanical Garden, St. Louis, MO. 15:34–38.

Cullen, J. 1978. A preliminary survey of ptixis in the Angiosperms. Notes Royal Bot. Gard. Edinburgh 37:161–214.

Hallé, F., R.A. Oldeman, and P.B. Tomlinson. 1978. Tropical trees and forests. An architectural analysis. Springer-Verlag. New York.

Harvey, Y. and J. Pipoly. 1995. Myrsinaceae. In: B. Stannard, ed. Flora of the Pico das Almas, Chapada Diamantina, Bahia, Brazil. Royal Botanic Gardens, Kew, Richmond, U.K. Pp. 487–491.

HICKEY, L. 1984. A revised classification of the architecture of dicotyledonous leaves. In: C.R. Metcalfe and L. Chalk, eds. Anatomy of the dicotyledons. Vol. 1. Systematic anatomy of leaf and stem, with a brief history of the subject. Clarendon Press. Oxford, U.K. Pp. 25–39.

HUBER, O. 1995. Vegetation. In: J. Steyermark, P. Berry, and B. Holst, eds. Flora of the Venezuelan Guayana. Vol. 1. Introduction. Missouri Botanical Garden & Timber Press. St. Louis. Pp. 97–160.

LINDLEY, J. 1848. Illustrated dictionary of botanical terms. Excerpt from illustrated dictionary of botanical terms by John Lindley. [Reprint, With an Introduction by Alice Eastwood, Stanford University, School of Earth Sciences, 1964].

METCALFE, C.R. 1984. Some basic types of cells and tissues. In: C.R. Metcalfe and L. Chalk, eds. Anatomy of the dicotyledons. Vol. 1. Systematic anatomy of leaf and stem, With a Brief History of the Subject. Clarendon Press. Oxford, U.K. Pp. 54–62.

MEZ, C. 1902. Myrsinaceae. In: A. Engler, ed. Das Pflanzenreich IV. 236(Heft 9):1–437.

OTEGUI, M. 1998a. Sinopsis del género *Myrsine* L. (Myrsinaceae) en el Cono Sur de América del Sur. Candollea 53:133–157.

___________. 1998b. Flower morphology and biology of *Myrsine laetvirens*, structural and evolutionary implications of anemophily in Myrsinaceae. Nord. J. Bot. 19:71–85.

PENNINGTON, T. 1990. Sapotaceae. Flora Neotropica Monograph 52. The New York Botanical Garden. Bronx. pp771.

PIPOLY, J. 1983. Contributions towards a monograph of *Cybianthus* (Myrsinaceae): III. A revision of subgenus *Laxiflorus*. Brittonia 35:61–80.

___________. 1987. A systematic revision of the genus *Cybianthus* subgenus *Grammadenia* (Myrsinaceae). Mem. New York Bot. Gard. 43:1–76.

___________. 1991. Systematic studies in the genus *Myrsine* L. (Myrsinaceae) in Guayana. Novon 1:204–210.

___________. 1992a. Estudios en el género *Myrsine* (Myrsinaceae) in Colombia. Caldasia 17:3–9.

___________. 1992b. Notes on the genus *Myrsine* (Myrsinaceae) in Peru. Novon 2:392–407.

___________. 1992c. The genus *Cybianthus* subgenus *Conomorpha* (Myrsinaceae) in Guayana. Ann. Missouri Bot. Gard. 79:908–957.

___________. 1996. Contributions toward a new flora of the Philippines: I. A synopsis of the genus *Myrsine* (Myrsinaceae). Sida 17:115–162.

___________ and C.C. CHEN. 1995. Nomenclatural notes on the Myrsinaceae of China. Novon 5: 357–361.

PRANCE, G.T. 1982. Forest refuges: evidence from woody angiosperms. Pp. 137–156. *In*: G. Prance, editor. Biological Diversification in the Tropics. Columbia University Press, New York.

RICKETSON, J. and J. PIPOLY. 1997. Nomenclatural notes and a synopsis of the genus *Myrsine* (Myrsinaceae) in Mesoamericana. Sida 17:579–589.

STÅHL, B. 1996. The relationships of *Heberdenia bahamensis* and *H. penduliflora* (Myrsinaceae). Bot. J. Linn. Soc. 122:315–333.

THEOBALD, W.L., J. KRAHULIK, and R. ROLLINS. 1984. Trichome description and classification In: C.R. Metcalfe and L. Chalk, eds. Anatomy of the dicotyledons. Vol. 1. Systematic anatomy of leaf and stem, with a brief history of the subject. Clarendon Press. Oxford. U.K. Pp. 40–53.

WHEAT, D. 1980. Sylleptic branching in *Myrsine floridana* (Myrsinaceae). Amer. J. Bot. 67:490–499.

WHITE, F. 1962. Geographic variation and speciation in Africa with particular reference to *Diospyros*. In: D. Nichols, ed. Taxonomy and geography. The Systematics Association Publ. London. 4:71–103.

NUMERICAL LIST OF *MYRSINE* TAXA

1. *Myrsine dependens*
2a. *Myrsine coriacea* subsp. *coriacea*
2b. *Myrsine coriacea* subsp. *reticulata*
3. *Myrsine maguireana*
4. *Myrsine minima*
5. *Myrsine andina*
6. *Myrsine perpauciflora*
7. *Myrsine resinosa*
8. *Myrsine picturata*
9. *Myrsine macrocarpa*
10. *Myrsine pellucida*
11. *Myrsine nitida*
12. *Myrsine guianensis*

LIST OF EXSICCATAE

Figures in parentheses refer to the numbers from the numerical list of taxa. Collection numbers in **boldface** type indicate type specimens.

Agostini, G. 174 (2a); Allart, A. 513 (12); Alston, A. 5515 (2a); 6172 (2a); Anderson, W. 13461 (2a); Aristeguieta, L. 2178 (12); 3606 (1); 5498 (2a); Aristeguiera, L. & O. Huber 300 (12); Aublet, J. s.n. (12); Aymard, G. et al. 5190 (2a).

Badillo, V. 7339 (2a); Baruch, Z. 95 (2a); Bernardi, L. 11 (10); 214 (1); 1881 (10); 2292 (10); Bernardi, L. et al. 17136 (1); 17144 (1); Berry, P. 213 (12); 1367 (12); Boom, B. & G. Samuels 9138 (12); 9285 (12); Boom, B. et al. 5535 (3); Breteler, F. 3218 (2a); 3242 (2a); 3313 (10); 3635 (2a); 4289 (2a); 4292 (12); 4580 (2a); Breteler, J. 4629 (1); Bruijn, J. de 988 (2a); Bunting, G. & M. Fucci 6050 (2a); Bunting, G. & A. Stoddart 9745 (10).

Cardozo, A. & H. Meneses 1421 (2a); Cardozo, A. & H. Rodriguez 1218 (2a); Cardozo, A. et al. 1278 (2a); 1344 (2a); Charpin, A. & F. Jacquemoud 13136 (2a); 13296 (2a); Clark, H. 7094 (12); Clemants, S. & D. Díaz M. 2435 (1); Clemants, S. & J. Dugarte 2411 (1); Colella, M. & O. Huber 451 (2a); 465 (2b); Cowan , R. & T. Soderstrom 1826 (12); Cowan, R. & J. Wurdack 31372 (9); Croat, T. 59551 (3); Cuatrecasas, J. et al. 28185 (1); Cuello, N. 931 (2a); 1107 (2a); 1256 (2a); 1335 (2a); 1348 (2a); Curran, H. 2114 (2a); Curran, H. & M. Haman 1069 (12).

Davidse, G. & A. González 19400 (12); 19402 (12); 19540 (2a); 19606 (2a); Davidse, G. et al. 20813 (2a); Delascio, F. & A. González 12223 (12); 12255 (12); Delgado, L. 215 (12); 282 (10); Diaz, E. 1756 (10); Diaz, W. 1759 (10); 2515 (12); Diaz, W. & S. Elcoro 1580 (12); Dorr, L. & L. Barnett 5157 (2a); 5162 (2a); 5602 (2a); 7598 (2a); Dorr, L. et al. 5693 (2a); 7872 (10); Dumont, K. et al. 7611 (2a).

Elcoro, S. & N. Vera 225 (2a); Ernst, A. 1088 (12).

Farney, C. et al. 905 (4); Fendler, A. 758 (2a); 760 (12); Fernández, A. 2946 (12); Flores, F. & E. Pérez 557 (12); Funck, H. 481 (1); 550 (1); Funck, H. & L. Schlim 58 (1); 140 (2a).

Gehringer, H. 28 (1); 270 (10); 401 (2a); Gentry, A. et al. 11090 (10); Gillespie, L. et al. 2510 (12); Gines, H. 2815 (12); 3461 (12); Grosourdy, D. 13 (12); Guevara, L. C. de 3261 (2a).

Hahn, W. & F. Grifo 3460 (2a); 4971 (5); 4983a (10); Hahn, W. et al. 4435 (12); 5603 (12); Henderson, A. et al. 1022 (12); Hernández, L. & N. Dezzeo 114 (2a); Hoffman, B. 3230 (11); Huber, O. 9269 (4); 10389 (12); 11062 (12); 11456 (12); 11593 (4); 11640 (12); 11698 (4); 11853 (12); 12318 (12); 13005 (12), 13071 (3); Huber, O. & C. Alarcón 7375 (2a); 7931 (2a); Huber, O. & N. Dezzeo 8590 (4); Huber, O. & L. Izquierdo 12802 (2b); Huber, O. & G. Medina C. 10916 (12); Huber, O. & W. Morawetz 10823 (10); Huber, O. & V. Rull 12273 (12); Huber, O. et al. 8786 (2a); 10100 (4); Humboldt, A. von & A. Bonpland s.n. (1).

Karsten, G. s.n. (2a); Koyama, T. & G. Agostini 7474 (12); Kral, R. & A. González 70455 (2a).

Lasser, T. & L. Aristeguieta 3410 (12); 3418 (2a); Licata, A. et al. 650 (2a); Liesner, R. 19543 (11); 23107 (4); 23210 (4); 23296 (4); 23426 (4); 23465 (7); 23534 (7); Liesner, R. & A. González 9933 (2a); 10713 (2a); Liesner, R. & M. Guariglia 11655 (5); 11812 (10); Liesner, R. et al. 7661 (10); 7949 (10); 8202 (2a); 8232 (2a); 8389 (2a); Linden, J. 108 (5); 958 (1); Luteyn, J. & M. Lebrón-Luteyn

9776 (10); 9913 (10); ; Luteyn, J. & J. Pipoly 9280 (2a); 9328 (2a); 9335 (2a); 9357 (10); 9370 (10); 9377 (10); Luteyn, J. et al. 9386 (2a); 9387 (2a).

Maguire, B. 32917 (12); 33465 (2b); 33468 (11); 33497 (11); 33535 (8); Maguire, B. & J. Wurdack 33896 (12); Maguire, B. et al. 27251 (12); 29969 (9); 30005 (9); 30180 (9); 42090 (8); **42318 (3)**; **42375 (8)**; 42376 (8); 42393 (3); 42403 (3); 60450 (4); Manara, B. s.n. (1); Marcano-Berti, L. 804 (1); Meier, W. 14 (2a); 1097 (1); 1317 (2a); 1414 (2a); 1603 (2a); Meier, W. & G. Bronner 3523 (2a); Meier, W. & O. Carrero 869 (2a); Meier, W. et al. 2069 (12); Moore, H. et al. 9738 (12); Morillo, G. 592 (2a); 2626 (2a); Morillo, G. et al. 2887 (7); 9606 (2a); Moritz, J. 153 (2a); 360 (2a); 1175 (2a).

Nee, M. **30697 (6)**; Nee, M. & M. Whalen 17016 (10).

Oberwinkler, B. & F. Oberwinkler 12472 (10); 13909 (10).

Pinkus, A. **84 (7)**; **132 (11)**; Pipoly, J. 6399 (12); 6450 (2a); Pipoly, J. & G. Aymard 6566 (1); Pipoly, J. et al. 6466 (1); 6486 (2a); 6512 (1); 7141 (4); 11582 (12); Pittier, H. 12652 (10); 12793 (2a); 13793 (2a).

Ramirez, N. 796 (2a); 2084 (2a); 2477 (12); Ramirez, N. et al. 4452 (2b); 4666 (2a); Renner, S. 2096 (6); Rojas, C. de & F. Rojas 3682 (2a); Rojas, C. Benítez de 1459 (10); Ruíz Terán, L. 824 (10); 935 (10); 1297 (2a); 1436 (2a); 1669 (1); Ruíz Terán, L. & M. Lopez-Figueiras 126 (2a); Ruíz Terán, L. et al. 3916 (10).

Sanoja, E. et al. 2988 (9); Sobel, G. & J. Strudwick 2151 (2a); Sobel, G. et al. 2021 (2a); Stein, B. & A. Gentry 1525 (6); Steyermark, J. 55022 (2a); 55646, (1); 56588 (2a); 57205 (5); **58848 (4)**; 58948 (11); **58983 (2b)**; 59808 (12); 59826 (2a); 59948 (11); 60108 (11); 60621 (12); 60726 (7); 60737 (2a); 60808 (2a); 61355 (2a); 61445 (2a); 61615 (2a); 61927 (2a); 62075 (12); 62377 (12); 62560 (12); 62721 (2a); 63007 (1); 74954 (12); 75738 (12); 75834 (11); 75931 (4); 86192 (2a); 86309 (12); 86438 (12); 88366 (12); 93748 (12); 94902 (2a); 97985 (4); 98431 (2a); 98562 (10); 99182 (2a); 100998 (5); 104785 (1); 106283 (2a); 106968 (12); 107113 (12); Steyermark, J. & A. Braun 94642 (12); Steyermark, J. & J. Wurdack 594 (12); 806 (2b); 843 (4); 1194 (2b); Steyermark, J. et al. 100966 (10); 107789 (12); 115090 (12); 120141 (10); 121737 (2a); 124036 (12); 124328 (4); 128268 (4); 131074 (12).

Tamayo, F. 436 (2a); 797 (12); Tanner, E. & V. Kapos 107 (2a); 246 (2a); 402 (2a); Tillett, S. & C Tillett 45290 (12); 45380 (7); Tillett, S. et al. 45118 (12).

Ule, E. 8721 (4); **8725 (11)**.

Valera, A. 563 (12); Valverde, L. & I. Peña 1021 (2a); VEN Herb. No. 3879 (2a); Vogel, P. 177 (2a); 309 (2a); 1118 (12).

Warming, J. s.n. (1); 553 (2a); 560 (12); Weitzman, A. & N. Holbrook 183 (2a); Werff, H. van der & F. Ortega 8082 (2a); Werff, H. van der & R. Rivero 7838 (2a); 7859 (2a); 8009 (2a); Werff, H. van der et al. 8779 (2a); Williams, L. 9938 (2a); 11125 (12); Williams, L. & A. Alston 314A (2a); 10940 (2a); Wurdack, J. & J. Steyermark 1160 (11).

ADDITIONS TO THE GENUS *ARDISIA* SUBGENUS *GRAPHARDISIA* (MYRSINACEAE)

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ABSTRACT

Revision of the group of species formerly placed in *Zunilia* Lundell revealed that the group is synonymous with *Ardisia* subgenus *Graphardisia* Mez. This paper incorporates those taxa in the subgenus, necessitating further revision of *Graphardisia*, including an emended description of the subgenus, a key to the species and subspecies, along with updated descriptions of the two added taxa and new illustrations for each. Two additional taxa are recognized, including one new combination: *Ardisia verapazensis* subsp. *cucullata* (Lundell) Pipoly & Ricketson. Six binomials are relegated to synonymy within *A. verapazensis* Donn. Sm. *Ardisia hyalina* Lundell [*Zunilia hyalina* (Lundell) Lundell] is excluded from subgenus *Graphardisia*, and placed in subgenus *Ardisia*.

RESUMEN

Una revisión del grupo de especies anteriormente clasificadas dentro del género *Zunilia* Lundell, reveló que *Zunilia* es sinónimo del género *Ardisia* subgénero *Graphardisia* Mez. Se incorporan dichos taxa dentro del subgénero *Graphardisia*, y se incluye una descripción actualizada, una clave para separar todos los taxa, acompañados de dos descripciones actualizadas y nuevas ilustraciones para ellos. Se reconocen dos taxa adicionales, incluyendo la nueva combinación: *Ardisia verapazensis* subsp. *cucullata* (Lundell) Pipoly & Ricketson. Se relegan seis binomios a la sinonimia bajo *A. verapazensis* Donn. Sm.. Se excluye *Ardisia hyalina* Lundell [*Zunilia hyalina* (Lundell) Lundell] del subgénero *Graphardisia*, y se la ubica dentro del subgénero *Ardisia*.

INTRODUCTION

In preparing our treatment of the Myrsinaceae for *Flora Mesoamericana*, we critically reexamined taxa segregated by Lundell from *Ardisia*, including *Gentlea* (Ricketson & Pipoly 1997), *Graphardisia* (Pipoly & Ricketson 1998a). *Chontalesia* and species related to it, now known to belong to the genus *Hymenandra* A. DC. ex Spach. (Pipoly & Ricketson 1999). Since our study of subgenus *Graphardisia* (Pipoly & Ricketson 1998a), it has become

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evident that the taxa comprising the segregate genus *Zunilia* (Lundell 1981) are best placed within *Ardisia* subgenus *Graphardisia*.

In Lundell's description of the genus *Zunilia* (Lundell 1981), he separated it from the genus *Ardisia* based on the following key:

1. Panicles of flowers in corymbs, the mature inflorescences heteromorphic with strongly accrescent elongated pedicels arranged either in whorls or opposite or alternate below the apical corymbs .... Zunilia
1. Panicles of flowers consisting of simple racemes or spikes, the inflorescences with flowers uniformly distributed, either pedicellate or sessile .... Ardisia

However, we noted that Lundell failed to compare or distinguish *Zunilia* from his genus *Graphardisia*. As we studied the group of species assigned by Lundell (1981) to *Zunilia*, we noted their raised or sessile glandular-papillate filaments, the large accrescent, densely and prominently black punctate and punctate-lineate sepals that clasped the developing fruit, the black punctations and punctate-lineations of all abaxial leaf surfaces, the lanceolate, concolorous, apiculate anthers with subapically poricidal dehiscence, and the style 2–3 times longer than the ovary, all features we used (Pipoly & Ricketson 1998a) to define subgenus *Graphardisia*. Therefore, we find it necessary to relegate the genus *Zunilia* to synonymy under *Ardisia* subgenus *Graphardisia*, specifically as an emended concept of *Ardisia verapazensis* Donn. Sm.

NOTES ON KEYS, TAXONOMIC CONCEPTS, TERMINOLOGY

The key is artificial and designed to expedite identification of herbarium specimens. An attempt has been made to emphasize vegetative characters to increase the key's usefulness with sterile material. The respective positions of taxa in the key and correlations with phylogenetic relationships are coincidental. Quantitative and qualitative data presented in keys and descriptions for floral parts and bracts were taken from organs rehydrated from herbarium specimens by boiling in water. Measurements from these range from 10% to 15% greater than those measurements taken directly from dried material. Data regarding stem diameters, inflorescence rachises, pedicels, leaf and fruit shape and size were taken from dried herbarium specimens.

Our concept of subspecies follows that of Pipoly (1987) who defined subspecies as: "groups of populations within a single lineage of ancesror-descendant populations that show variation by unique combinations of plesiomorphies, or homoplasic apomorphies, correlated with biogeography and/or ecology. This rank is primarily used to convey information regarding variation in the life histories of these populations and character state differences hypothesized to be the result of this variation. The subspecific rank in no way attempts to predict speciation events."

Morphological terms in this treatment follow Lindley (1848) and Pipoly (1987, 1992) for the inflorescence, rachis pedicels and floral parts. Description of leaf morphology follows Hickey (1984), trichome description follows Theobald et al. (1984) and basic cell and tissue terminology follow Metcalfe (1984).

TAXONOMIC TREATMENT

Ardisia subgenus **Graphardisia** Mez in Engl., Pflanzenr. IV. 236 (Heft 9):78. 1902; Lundell, Wrightia 3:192–198. 1966. *Graphardisia* (Mez) Lundell, Phytologia 48:139. 1981; Lundell, Phytologia 59:429–433. 1986. Type: *Ardisia opegrapha* Oerst.(lectotype, by Lundell, Phytologia 48:139. 1981).

Zunilia Lundell, Phytologia 49:353. 1981, Syn. Nov. Type: *Ardisia sexpartita* Lundell, Wrightia 3:29. 1962. Zunilia sexpartita (Lundell) Lundell, Phytologia 49:354. 1981.

Subshrubs to *trees*. *Branchlets* mostly terete, glabrous or rarely, glandular-granulose. *Leaves* petiolate; blades membranaceous to subcoriaceous, densely and conspicuously or inconspicuously black (rarely pellucid-) punctate and punctate-lineate, the margins entire to crenulate, rarely sharply and irregularly dentate. *Inflorescence* terminal, uni- to tripinnately paniculate, pyramidal to obpyramidal, rarely globose, the ultimate branches corymbose, at times in high anthotactic spirals and thus appearing umbellate, the rachis often densely and prominently black punctate and punctate-lineate; inflorescence and floral bracts foliaceous, mostly persistent, resembling the vegetative leaves but acropetally reduced in size. *Flowers* with perianth white, pink, lavender or purple, densely and prominently black punctate and punctate-lineate; calyx with sepals free or nearly free, large, accrescent and clasping fruits at maturity; corolla rotate, the lobes imbricate in bud, basally short-connate and sparsely to densely yellow glandular-granulose or papillose within; stamens inserted at corolla tube base, the filaments basally connate to form an inconspicuous tube, the tube free from the corolla tube, the apically free portions of the filaments glabrous or glandular-granulose or glandular-papillate, less than half the length of the anthers, the anthers ovate-lanceolate, linear or lanceolate, prominently apiculate, dehiscent by subapical pores; ovary globose to depressed-globose, the style slender, 2–3 times longer than the ovary, the placenta apiculate, the ovules pluriseriate, biseriate, or apparently uniseriate (few in number and in a very high anthotactic spiral). *Fruit* globose or oblongoid, densely conspicuously punctate and punctate-lineate, usually basally surrounded by persistent, clasping sepals.

Distribution.—Four species with seven subspecies found from Mexico to Bolivia and adjacent Brazil.

Ecology.—Members of the subgenus occur in diverse vegetation types, including wet and pluvial lowland, premontane, montane, and cloud forests.

The subgenus is defined by: 1) glabrous branchlets and inflorescence rachises; 2) dense and prominently raised or conspicuous black, or rarely, reddish-black, punctations or punctate-lineations on all leaf and/or floral parts; 3) sepals often accrescent and usually clasping the developing fruit; 5) linear-lanceolate, concolorous, apiculate anthers with subapically poricidal dehiscence; and 6) style 2–3 times longer than the ovary. Species of the subgenus are often used for home decoration and for use in Christian churches for religious holidays (Pipoly, pers. obs.).

KEY TO TAXA OF *ARDISIA* SUBGENUS *GRAPHARDISIA*

1. Stoloniferous subshrubs mostly less than 1 (–2) m tall; leaf blade margins sharply and irregularly dentate; corolla tube and filaments yellow glandular-granulose; Ecuador to Bolivia and adjacent Brazil. .... **A. weberbaueri**

1. Shrubs to small trees (0.5–)2–6(–30) m tall without stolons; leaf blade margins entire, undulate or crenulate; corolla tube yellow glandular-granulose; filaments glabrous or sessile to stalked glandular-papillate; Mexico to Colombia.

2. Sepals membranaceous, oblong, 4.2–8 mm long, apically broadly rounded to obtuse, hyaline throughout, the margins entire .... **A. opegrapha**

3. Inflorescence obpyramidal; leaf blades oblanceolate or rarely obovate, 3.5–7.5(–8) cm wide, 3 or more times longer than wide.

4. Floral bracts caducous; stamens 5.2–6.5 mm long; filaments 2.5–3 mm long; sepals 5–8 mm long .... **A. opegrapha subsp. opegrapha**

4. Floral bracts persistent; stamens 3.8–5 mm long; filaments 1.5–2 mm long; sepals 4.2–5.2 mm long .... **A. opegrapha subsp. wagneri**

3. Inflorescence globose; leaf blades elliptic to broadly elliptic (7.5–)8–14.5 cm wide, 2–2.5 times longer than wide. ..... **A. opegrapha subsp. paquitensis**

2. Sepals chartaceous, ovate, 1.5–3.2(–4.0) mm long, apically acute to rounded, opaque except at margin, the margins subentire to erose.

5. Corolla lobes ovate, elliptic or lanceolate; filaments glabrous; ovules 13–16; Panama and Colombia .... **A. bartlettii**

6. Sepals 1.5–1.8 mm long; petal lobes 6–6.5 mm long; stamens 3.5–4.8 mm long; style base tapering; tall wet forests. .... **A. bartlettii subsp. bartlettii**

6. Sepals 2–2.5 mm long; petal lobes 7–8 mm long; stamens 4.5–5.7 mm long; style base stylopodic; strand vegetation and beach forests. .... **A. bartlettii subsp. lilacina**

5. Corolla lobes oblong; filaments sessile- to stalked-glandular-papillate; ovules 22–35; Oaxaca, Mexico to Honduras .... **A. verapazensis**

7. Corolla lobes 6.5–6.7 mm long; free portion of filaments 3.3–3.4 mm long; style 3–3.1 mm long; fruit 6.5–9 mm in diam., fruiting style 7–8.6 mm long, usually only the basal portion persistent .... **A. verapazensis subsp. verapazensis**

7. Corolla lobes 5.7–5.9 mm long; free portion of filaments 2.6–2.8 mm long; style 5.5–5.9 mm long; fruit 5–6.1 mm in diam., fruiting style 8.8–9.4 mm long, entire style usually persistent ...... **A. verapazensis subsp. cucullata**

Ardisia verapazensis Donn. Sm.

Shrub or *small tree* to 30 m tall, 33 cm DBH. *Branchlets* slender to stout, (3–)5–8 mm in diam., glabrous. *Leaves* with blades membranaceous to chartaceous, elliptic to oblong or oblanceolate, 7.4–34.5 cm long, 3.2–9.7 cm wide, apically acute to acuminate, basally acute to acuminate, decurrent on the petiole, midrib impressed above, prominently raised below, the secondary veins prominulous above, conspicuous to inconspicuous below, at times prominently reticulate, mostly inconspicuously punctate and punctate-lineate, glabrous, the margins entire, undulate to regularly or irregularly crenulate; petioles canaliculate or marginate, 0.4–1.4 cm long, glabrous. *Inflorescence* terminal, bipinnately paniculate, 4.8–16.2 cm long, 3.9–22.4 cm wide, the rachis glabrous, the branches terminating in corymbs; peduncle 0.9–4.2 cm long; secondary inflorescence bracts early caducous, membranaceous, ovate or oblong, (5.4–)9.9–14.8 cm long, 3.7–4.8 cm wide, apically acute or rounded, otherwise similar to the leaves; floral bracts very early caducous, not leaving detectable scars axillant to pedicel (aborted at primordial stage?), or early caducous, membranaceous, ovate, 0.8–0.9 mm long, 0.7–0.8 mm wide, apically rounded, the midrib inconspicuous, the secondary veins not visible, densely and prominently black punctate and punctate-lineate, the margins hyaline, sparsely glandular-ciliolate; pedicels stout or slender, 0.4–1.8 cm long, accrescent in fruit or not, glabrous. *Flowers* 5(–6)-merous, membranaceous, chartaceous to coriaceous, 8.4–10.2 mm long; calyx with sepals free, broadly ovate, 3.4–4.0 mm long, the lobes 2.7–3.2 mm long, 2.3–3.0 mm wide, apically acute to rounded, conspicuously and prominently punctate and punctate-lineate, sparsely scattered glandular-glandulose within near the base, often sparsely lepidote medially outside, the margins hyaline, erose to entire or subentire, ciliolate with multicellular hairs; corolla rotate, 7.7–9.2 mm long, the tube 1.9–2.5 mm long, the lobes oblong, 5.7–6.7 mm long, 3.3–4.1 mm wide, apically rounded, conspicuously and prominently punctate and punctate-lineate, yellow glandular-glandulose and or papillose at base between corolla lobe and tube junction and above staminal tube, otherwise glabrous; margins entire; stamens 5.9–7.7 mm long, the filaments 3.4–5.0 mm long, united basally into a staminal tube 0.7–1.6 mm long, the apically free portions 2.6–3.4 mm long, 0.5–0.7 mm diam., slender or stout, epunctate, sessile or stalked glandular-papillate, the anthers lanceolate, 3.0–3.2 mm long, 1.2–1.4 mm wide at base, apiculate, basally sagittate, dehiscent by subapical pores; ovary glabrous, the style 3.0–5.9 mm long, slender, inconspicuously punctate and punctate-lineate, glabrous, the ovules 22–35, pluriseriate. *Fruit* globose to depressed-globose, 5–9 mm in diam., style 7–9.4 mm long, persistent at least basally, densely and conspicuously punctate, glabrous.

Within subgenus *Graphardisia, Ardisia verapazensis* is most closely related to *Ardisia opegrapha*, because of its large, foliaceous inflorescence bracts and glandular-papillate filaments.

1a. Ardisia verapazensis Donn. Sm. subsp. verapazensis, (Fig. 1, 2). *Ardisia verapazensis* Donn. Sm., Bot. Gaz. 46:113. 1908. *Zunilia verapazensis* (Donn. Sm.) Lundell, Phytologia 49:354. 1981. TYPE: GUATEMALA. ALTA VERAPAZ: In monte silvoso prope Cobán, 1,600 m, Jan 1908 (fl), *H. von Türckheim II2093* (HOLOTYPE: US; ISOTYPES: BR, F 2-sheets, G, GH, MO, NY, US 2-sheets).

Ardisia sexpartita Lundell, Wrightia 3:29. 1962, SYN. NOV. *Zunilia sexpartita* (Lundell) Lundell, Phytologia 49:354. 1981. TYPE: GUATEMALA. QUEZALTENANGO: lower S-facing slopes of Volcán Santa Maria, near San Juan Patzulin, 1,300–1,500 m, 6 Jan 1940 (fl), *J. Steyermark 33608* (HOLOTYPE: LL).

Ardisia escuintlensis Lundell, Wrightia 3:98. 1964, SYN. NOV. TYPE: GUATEMALA. ESCUINTLA: without further locality, without elev., 1942 (fl), *J. Ignacio Aguilar 1679* (HOLOTYPE: F).

Ardisia alba Lundell, Wrightia 3:195. 1966, SYN. NOV. *Zunilia alba* (Lundell) Lundell, Phytologia 49:353. 1981. TYPE: MEXICO. CHIAPAS: Municipio Jitotol, steep wooded slope on bank of Río Hondo, 4 mi N of Jitotol on road to Pueblo Nuevo Solistahuacan, 5,500 ft [1,676 m], 12 Feb 1965 (fl), *D. Breedlove 8962* (HOLOTYPE: LL; ISOTYPES: DS, MICH).

Zunilia eciliata Lundell, Phytologia 58:490. 1985, SYN. NOV. *Ardisia eciliata* (Lundell) Lundell, Phytologia 61:63. 1986, (nomen invalidum). *Ardisia eciliata* (Lundell) Pipoly & Ricketson, Sida 18:512. 1998. TYPE: MEXICO. CHIAPAS: Municipio Ocozocoautla de Espinosa, steep slopes of Cerro del Ocote, 30 km NW of Ocozocoautla, montane rain forest, 1,500 m, 14 Oct 1972 (fl), *D. Breedlove 28973* (HOLOTYPE: LL; ISOTYPES: DS, MEXU, MICH, MO).

Zunilia purpusii Lundell, Phytologia 58:491. 1985, SYN. NOV., non *Ardisia purpusii* Brandeg., Univ. Calif. Publ. Bot. 6:189. 1915. *Ardisia feniana* Lundell, Phytologia 61:64. 1986, (nomen invalidum). *Ardisia feniana* Pipoly & Ricketson, Sida 18:512. 1998. TYPE: MEXICO. CHIAPAS: Mountains near Fenia, without elev., May 1925 (fr), *C. Purpus 100* (HOLOTYPE: US).

Shrub or small tree to 30 m tall, 33 cm DBH. *Branchlets* stout, (3–)6–8 mm in diam. *Leaves* with blades 7.4–34.5 cm long, 3.2–9.7 cm wide, the secondary veins inconspicuous below, the margins entire, undulate to regularly crenulate; petioles marginate, 0.6–1.3 cm long. *Inflorescence* 4.8–16.2 cm long, 3.9–22.4 cm wide; peduncle 1.3–4.2 cm long; secondary inflorescence bracts early caducous, membranaceous, ovate or oblong, (5.4–)9.9–14.8 cm long, 3.7–4.8 cm wide, apically acute or rounded, otherwise similar to the leaves; floral bracts very early caducous, not leaving detectable scars axillant to pedicel (aborted at primordial stage?); pedicels stout, 4–18 cm long, accrescent in fruit. *Flowers* chartaceous to coriaceous, 10–10.2 mm long; calyx 3.7–4.0 mm long, the lobes 2.8–3.0 mm long, 2.6–3.0 mm wide, often lepidote medially without; corolla 9.0–9.2 mm long, the tube 2.4–2.5 mm long, the lobes 6.5–6.7 mm long, 3.8–4.1 mm wide; stamens 7.5–7.7 m long, the filaments 4.8–5.0 mm long, united basally into a staminal tube 1.5–1.6 mm long, the apically free portions 3.3–3.4 mm long, 0.5–0.6 mm diam., slender, scattered yellow stalked or rarely sessile glandular-papillate, the anthers 3.0–3.2 mm long, 1.2–1.4 mm wide at base; style 3.0–3.1 mm

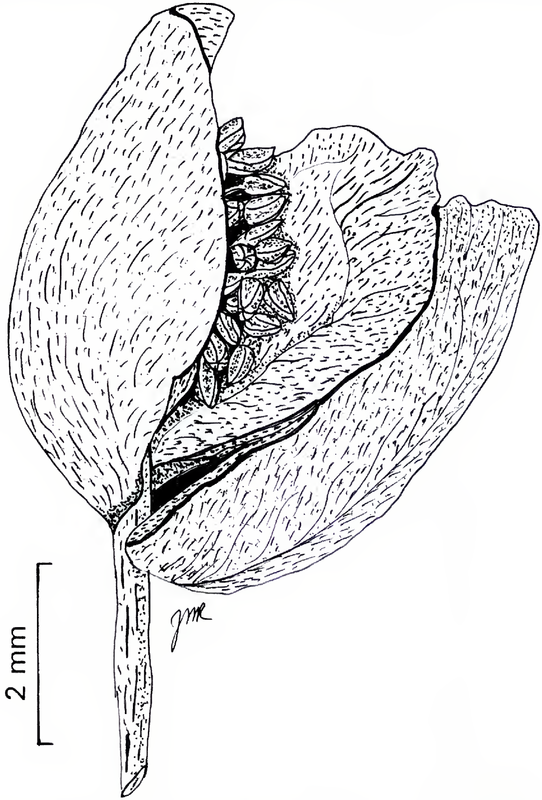

FIG. 1. *Ardisia verapazensis* subsp. *verapazensis*, showing foliaceous secondary inflorescence bracts enclosing the immature inflorescence. Drawn from *A. Méndez Ton 4488* (MO).

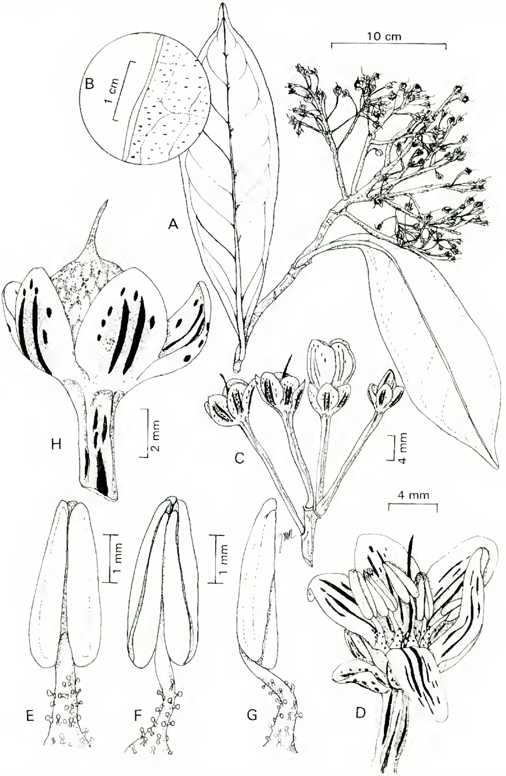

FIG. 2. *Ardisia verapazensis* Donn. Sm. subsp. *verapazensis*. A. Reproductive shoot. B. Detail of abaxial leaf surface. C. Detail of inflorescence. D. Detail of flower. E. Detail of stamens, showing adaxial surface. F. Detail of stamens, showing abaxial surface. G. Detail of stamens, showing laterial surface. H. Fruit. A–H drawn from *H. von Türckheim II2093* (GH isotype).

long; ovules 22–26. *Fruit* 6.5–9 mm in diam.; style 7–8.6 mm long, usually only basal portion of style persistent.

Distribution.—*Ardisia verapazensis* subsp. *verapazensis* is known from Oaxaca, Mexico through central Chiapas to Guatemala (Alta Verapaz, Quiché, Huehuetenango, Quezaltenango, San Marcos, Suchitepéquez) and with one disjunct population in Copán, Honduras. It grows from 500–3,000 m elevation.

Ecology and conservation status.—*Ardisia verapazensis* subsp. *verapazensis* is known from primary premontane and montane wet forests, and cloud forest margins. It is locally common, but not known to grow in large populations. Given its relatively wide ecological tolerance, this species is not considered threatened at this time.

Etymology.—The epithet 'verapazensis' refers to the type locality, near Cobán, Department of Verapaz (now Alta Verapaz) in northern Guatemala.

Local names.—"Shyash tililja" (Tzeltal), (*A. Méndez T. 4404*); "niwektililjaz" (Tzeltal), *A. Méndez T. 4488*); "b'shyashtililjas," (*A. Shilom T. 7451*); "huesito blanco," (*J. Steyermark 33631*); "palo cruz," (*J. Steyermark 37367*); "camaco," (*T. Hawkins & D. Mejía 241*).

Specimens examined. **MEXICO. Chiapas:** Municipio Berriozábal, 13 km N of Berriozábal near Pozo Turipache and Finca El Suspiro, 900 m, 9 Oct 1971 (fr), *D. Breedlove 20251* (DS, LL, MICH, MO, NY), 1,000 m, 2 Nov 1971 (fr), *D. Breedlove & A. Smith 21680* (DS, LL, MICH, MO), 900 m, 26 Dec 1972 (fr), *D. Breedlove & R. Thorne 30777* (DS, LL, MICH, MO, NY, TEX), 900 m, 15 May 1973 (fr), *D. Breedlove 35294* (DS, LL, MICH, MO, NY), 1,000 m, 10 Oct 1980 (fr), *D. Breedlove & J. Strother 46019* (CAS, LL, MO), 1,020 m, 28 Sep 1988 (fl, fr), *D. Breedlove 70218* (CAS); SE side of Volcán Tacaná above Talquian, 2,200 m, 16 Jan 1973 (fr), *D. Breedlove & A. Smith 31707* (DS, LL, MICH, MO) Cerca de El Suspiro, al NNW de Berriozabal, 900 m, 6 Sep 1953 (fl), *F. Miranda 7887* (DS, US); Municipio Bochil, along the river E of Bochil, 5,200 ft [1,585 m], 27 Jun 1967 (fr), *A. Shilom T. 2574* (DS, F, LL, MICH); Municipio Cintalapa, ridge SE of Cerro Baul on the border of the state of Oaxaca, 16 km NW of Rizo de Oro along a logging road to Colonia Figaroa, 1,600 m, 27 Apr 1972 (fr), *D. Breedlove 24916* (DS), On Oaxaca-Chiapas border near La Cienega de Leon, 1,080–1,230 m, 1 Dec 1980 (fr), *D. Breedlove & F. Almeda 48217* (CAS, GH, LL, NY); Municipio Pueblo Nuevo Solistahuacán, near Clinica Terba Buena, 3 km NW of Pueblo Nuevo Solistahuacán, 1,700 m, 14 Dec 1971 (fr), *D. Breedlove 23201* (DS, MICH, MO), 2.5 mi N of Pueblo Nuevo Solistahuacán, 5,300 ft {1,615 m}, 19 Jun 1970 (fr), *E. Lathrop & R. Thorne 7233* (DS), near Clinica Terba Buena, 2 km NW of Pueblo Nuevo Solisrahuacán, 5,400 ft [1,646 m], 23–24 Jan 1965 (fr), *P. Raven & D. Breedlove 19918* (DS, F, MICH, US), 3 km NW of Pueblo Nuevo Solistahuacán, on the slopes below Highway 195 in the vicinity of Clinica Yerba Buena, 17° 30" N, 92° 40" W, 5,400 ft (1,646 m), 7 Oct 1971 (fr), *R. Thorne & E. Lathrop 46084* (MICH, NY), 17° 30" N, 92° 40" W, 5,800 ft [1,646 m], 20 Sep 1970 (fl), *H. Zuill 398* (DS); 9 Oct 1970 (fl), *H. Zuill 650* (DS); Municipio Rayón, in the Selva Negra, 10 km above Rayón, Mezcalapa, along road to Jitotol, 1,700 m, 13 Jul 1972 (fr), *D. Breedlove 26072* (DS, LL, MICH, MO, NY), 10 Jan 1981 (fl-bud), *D. Breedlove & B. Keller 49316* (CAS, LL, MO, NY), 9 mi NW of Pueblo Nuevo Solistahuacán along the road between Rincon Chamula and Rayón, slope near Puerto del Viento, 17° 30" N, 93° 40" W, 5,800 ft [1,768 m], Sep 1971 (fl), *R. Thorne & E. Lathrop 41689* (DS); Municipio

San Cristobal de Las Casas, Santa Cruz en San Filipe, without elev., 15 Nov 1986 (fr), *A. Méndez T. & M. C. Martínez. de López 9844* (CAS, MO, NY, TEX); Municipio Tenejapa, near Paraje Yashanal, 2,460 m, 28 Jan 1981 (fr), *D. Breedlove 49645* (CAS); 2,300 m 22 Apr 1981 (fr), *D. Breedlove 51046* (CAS); 1,980 m, 13 Jul 1981 (fr), *D. Breedlove 51463* (CAS, LL); Municipio Tenejapa, Ojo del Río Yashanal, 1,700 m, 10 Jul 1982 (fr), *A. Méndez T. 4404* (MEXU, MO), 20 Aug 1982 (fl-bud), *A. Méndez T. 4488* (MEXU, MO); Municipio Tila, Colonia Kokijaz, 1,000 m, 20 Mar 1983 (fr), *A. Méndez T. 5700* (MEXU, MO), 5 May 1983 (fr), *5965* (MEXU, MO, TEX), Finca Morelia, without elev., 20 Mar 1984 (fr), *A. Shilom T. 7451* (LL, MEXU, MO); Mt. Tacana, 2,000–4,038 m, Aug 1938 (fr), *E. Matuda 2392* (F, GH, LL, MICH, MO, NY, UC, US); Barr. Alpujarrez, without elev., 3 Dec 1941 (fl), *F. Miranda 1746* (MEXU, TEX); Mts. near Fenix, without elev., Apr–May 1930 (fr), *C. Purpus 10100* (GH, NY);. **Oaxaca:** Distrito Ixtlán: Municipio Comaltepec, SW slope of Cerro Relámpago, just above Río Soyolapan, near Federal Electricity Commission Camp, near Highway 175, 17° 29' 15" N, 96° 24' 05" W, 1,750–1,780 m, 3 Dec 1993 (ster.), *E. Boyle et al. 2643* (MO); 15 mi N of San Gabriel along road from Puerto Escondido to Oaxaca, 6,000 ft (1,829 m), 9 May 1965 (fr), *D. Breedlove 9880* (LL), La Esperanza, 17° 37' N, 96° 21' W, ca. 1,600 m, 9 Jan 1988 (fr), *R. López L. & G. Martin 193* (MO), 17° 37' N, 96° 21' W, 1,600 m, 27 Jul 1989 (fl), *R. López L. & G. Martin 491* (MO), Vista Hermosa, trail to camp, 48.8 km SW of Valle Nacional, 17° 39' N, 96° 19' W, 1,460 m, 23 Jan 1988 (fr), *R. Torres C. & L. Cortes 11623* (BRIT, MEXU); Distrito Miahuatlán: Municipio San Jerónimo Coatlán, 18 km NE of Piedra Larga, road to San Jerónimo Coatlán, 16° 09' N, 97° 01' W, 1,950 m, 16 Jan 1988 (fr), *A. Campos V. 957* (F, MEXU, MO), 11.5 km SW of San Jerónimo Coatlán, trail to Piedra Larga, 16° 20' N, 96° 57' W, 2,050 m, 17 May 1988 (fr), *A. Campos V. 1819* (F, MEXU, MO, Espuelas de San Antonio, 13.5 km SW of San Jerónimo Coatlán, trail to Piedra Larga, 16° 12' N, 96° 57' W, 1,950 m, 17 May 1988 (fr), *A. Campos V. 1834* (F, MEXU, MO), 17.9 km SW of San Jerónimo Coatlán, trail to Piedra Larga, 16° 12' N, 96° 58' W, 1,890 m, 17 May 1988 (fr), *A. Campos V. 1853* (F, MEXU, MO), 19.2 km SW of San Jerónimo Coatlán, trail to Piedra Larga, 16° 12' N, 96° 58' W, 1,900 m, 13 Aug 1988 (fl, bud), *A. Campos V. & L. Cortés 2242* (F, MEXU, MO); 6 km NE of logging camp Cerro Sol, trail to Progreso, 16° 11' N, 97° 00' W, 1,400 m, 6 Oct 1988 (fl), *A. Campos V. 2585* (F, MEXU, MO); 20 km W of San Jerónimo Coatlán, 1,680 m, 26 Oct 1982 (fl, fr). *E. Martínez et al. 2501* (BRIT, MEXU); Municipio Valle Nacional, Cerro Mirador, 15 km NNW of Valle Nacional, 17° 93' N, 96° 22' W, 1,000–1,200 m, 15 Oct 1992 (fr), *J. Meave del Castillo et al. 1491* (MEXU, MO); Cafetál Santa Lucía, 1,300 m, 9 Sep 1919 (fl), *B.Reko 441* (US), 20.5 km SW of San Jerónimo Coatlán, trail to Piedra Larga, 16° 12' N, 96° 58' W, 2,000 m, 15 Mar 1989 (fr), *G. Toriz A. & A. Campos V. 818* (F, MEXU, MO); Cerro Baúl, 23 km NE of Rizo de Oro, road to Colonia Rodolfo Figueroa, without elev., 28 Mar 1984 (fr), *R. Torres C. & C. Martínez 4869* (MEXU, MO); 9.6 km SE of Cerro de Vidrio, Oaxaca-Puerto Escondido Highway, 1,850 m, 1 Aug 1984 (fr), *R. Torres C. & C. Martínez 5824* (MEXU, MO); Distrito Mixe, Municipio Totontepec, 10.5 km N of Totontepec, road to Choapán, 17° 17' 00" N, 95° 59' 00" W, 1,760 m, 27 Oct 1988 (fl, fr), *R. Torres C. & L. Cortes 10388* (BRIT, MEXU); Municipio San Miguel Chimalapa, Cerro Salomón, ca. 2 km in straight line NNW of Cerro Guayabitos, ca. 43 km in straight line N of San Pedro Tapanatepec, 16° 45' N, 94° 11' 30" W, 1,850 m, 23 Dec 1985 (fl, fr), *T. Wendt et al. 5149* (BRIT, LL, MEXU); Distrito Sola de Vega, Municipio Santa Cruz Zenzontepec, El Carrizal, 16° 31' 75" N, 97° 26' 06" W, 1,040 m, 14 Apr 1993 (ster.) *J. Weiss 118* (TEX). **GUATEMALA. Alta Verapaz-Quiché:** Chamá to Chihob, 3,000 ft [914 m], 15 Oct 1920 (fl), *H. Johnson 865* (F, LL-fragment, US). **Huehuetenango:** Cerro Huitz, between Mimanhuitz and Yulhuitz, Sierra de los Cuchumatanes, 1,500–2,600 m, 14 Jul 1942 (fr), *J. Steyermark 48602* (F, US).

Quezaltenango: Volcán Zunil, 5,500 ft [1,676 m], 3 Aug 1934 (fl), *A. Skutch 931* (F, GH); Volcán Santa María, between Santa María de Jesús and Calahuaché, along great barranco between Finca Pirineos and San Juan Patzulín, slopes at San Juan, 1,300–1,500 m, 6 Jan 1940 (ster.), *J. Steyermark 33631* (F); Between Quebrada Chicharro and Montaña Chicharro, on SE-facing slopes of Volcán Santa María, 1,300–1,400 m, 18 Jan 1940 (fr), *J. Steyermark 34363* (F). **San Marcos:** Finca Armenia, Rafael de Cuesta, ca, 5,000 ft [1,524 m], 6–7 Jul 1977 (fr), *J. Dwyer 14458* (LL, MO); Río Vega, near San Rafael and Guatemala-Mexico boundary, Volcán Tacaná, 2,500–3,000 m, 20 Feb 1940 (fr), *J. Steyermark 36261* (F); Above Finca El Porvenir, up Loma Bandera Shac, lower S-facing slopes of Volcán Tajumulco, 1,300–1,500 m, 9 Mar 1940 (fr), *J. Steyermark 37367* (F, LL); Near Aldea Fraternidad, between San Rafael Pie de la Cuesta and Palo Gordo, W-facing slope of the Sierra Madre Mountains, 1,800–2,400 m, 10–18 Dec 1963 (fl), *L. Williams et al. 25769* (BM, F, UC), *26085* (F, NY), *26278* (F, GH, US); Outer slopes of Tajumulco Volcano, Sierra Madre Mountains about 8–10 km W of San Marcos, ca. 2,300 m, 31 Dec 1964–1 Jan 1965 (fl), *L. Williams et al. 26799* (F, NY, US), (fr), *L. Williams et al. 27188* (F). **Suchitepéquez:** Slopes of Volcán Zunil, vicinity of Finca Las Nubes, along Quebrada Chita, E of Pueblo Nuevo, 500–800 m, 2 Feb 1940 (fl), *J. Steyermark 35431* (F); Volcán Santa Clara, between Finca El Naranjo and upper slopes, 1,250–2,650 m, 23 May 1942 (fr), *J. Steyermark 46650* (F, US). **Without department:** Las Nubes, without elev., Nov 1877 (fl, fr), *K. Bernoulli & A. Cario 1975* (GOET). **HONDURAS. Copán:** S slope of Cerro Azul, 12 km NW of Florida, Cerro Azul National Park, 15° 6' N, 88° 55' W, 1,500 m, 11 Feb 1992 (fr), *T. Hawkins & D. Mejía 241* (EAP, HEH, MO, TEFH).

Ardisia verapazensis subsp. *verapazensis* exhibits great quantitative variation among relative size of its organs within individuals and among populations. Even though its distribution is somewhat restricted, this had led to taxonomic overdescription, much like what Pipoly and Ricketson (1998a) noted for species such as *Ardisia opegrapha* Oerst.

The type of *Ardisia sexpartita* was collected from populations whose inflorescences are smaller than average and whose flowers are more waxy pink than the average. *Ardisia escuintlensis*'s type is a fragmentary collection whose flowers (in bud) have thinner perianth parts, but whose organs otherwise fall well within the size range of variation for the taxon. *Ardisia alba* was described only because of its white flowers and inflorescences that dry almost white, its relatively larger anthers and less conspicuous punctations. The holotype of *Zunilia eciliata*, mostly in fruit, is notable for anthers slightly smaller than the average for the species, and calyx lobe margins that are entire and without glandular cilia. However, reexamination of the MO isotype clearly shows small scattered cilia present on young calyx lobes in bud. *Zunilia purpusii*, whose type is a fruiting collection, was separated by its larger calyx lobes with acutish apices. However, both of these features lie well within the range of variation for the subspecies.

It is notable that Lundell's combinations of *Ardisia eciliata* (Lundell) Lundell and *Ardisia feniana* (Lundell) Lundell are both invalid names. We subsequently validated these names with our combinations *Ardisia eciliata* (Lundell)

Pipoly & Ricketson and *Ardisia feniana* (Lundell) Pipoly & Ricketson (Pipoly & Ricketson 1998b). However, our current studies show that these taxa are clearly synonyms of *Ardisia verapazensis* subsp. *verapazensis*.

1b. Ardisia verapazensis Donn. Sm. subsp. **cucullata** (Lundell) Pipoly & Ricketson, comb. et stat. nov. **(Fig. 3).** *Ardisia cucullata* Lundell, Wrightia 3:26. 1962. *Zunilia cucullata* (Lundell) Lundell, Phytologia 49:354. 1981. TYPE: MEXICO. CHIAPAS: Fraylesca, near Siltepec, 2,000 m, 7 Mar 1945 (fl), *E. Matuda 5201* (HOLOTYPE: LL; ISOTYPES: F, MEXU).

Zunilia mirandae Lundell, Phytologia 58:491. 1985, SYN. NOV., non *Ardisia mirandae* Merr., Philipp. J. Sci. 12:154. 1917. *Ardisia neomirandae* Lundell, Phytologia 61:66. 1986, (nomen invalidum). *Ardisia neomirandae* Pipoly & Ricketson, Sida 18:514. 1998. TYPE: MEXICO. CHIAPAS: Finca Prusia, along road from Mapastepec to near Triunfo (S. Jaltenango), without elev., 24 Feb 1951 (fl), *F. Miranda 7004* (HOLOTYPE: MEXU).

Shrub or small trees to 12 m tall. *Branchlets* slender, 3.5–5(–7) mm in diam. *Leaves* with blades 9.2–20.6 cm long, 3.5–8.2 cm wide, the secondary veins conspicuous below, prominently reticulate, the margins entire to undulate, to irregularly crenulate; petioles canaliculate, slender, 0.4–1.4 cm long. *Inflorescence* 6.5–11.5 cm long, 7–15 cm wide; peduncles 0.9–2.5 cm long; secondary inflorescence bracts early caducous, unknown; floral bracts early caducous, membranaceous, ovate, minute, 0.8–0.9 mm long, 0.7–0.8 mm wide, apically rounded, the midrib inconspicuous, the secondary veins not visible, densely and prominently black punctate and punctate-lineate, glabrous, the margins entire, hyaline, sparsely glandular-ciliolate; pedicels slender, 0.8–1.7 cm long, not accrescent. *Flowers* membranaceous, 8.4–8.6 mm long; calyx 3.4–3.9 mm long, the lobes 2.7–3.2 mm long, 2.3–2.5 mm wide, glabrous without; corolla 7.7–7.9 mm long, the tube 1.9–2.1 mm long, the lobes 5.7–5.9 mm long, 3.3–3.5 mm wide; stamens 5.9–6.0 mm long, the filaments 3.4–3.6 mm long, united basally into a staminal tube 0.7–0.9 mm long, the free portion 2.6–2.8 mm long, 0.6–0.7 mm in diam., stalked or rarely sessile glandular-papillate, the anthers, 3.0–3.1 mm long, 1.3–1.4 mm wide at base; style 5.5–5.9 mm, ovules 10–16. *Fruit* 5.0–6.1 mm in diam., style 8.8–9.4 mm long, entire style usually persistent.

Distribution.—*Ardisia verapazensis* subsp. *cucullata* is endemic to the southwestern region of Chiapas, Mexico, around the Sierra Madre de Chiapas and the Area Natural de Reserva El Triunfo. It grows from 700–2,540 m elevation.

Ecology and conservation status.—This subspecies grows in wet montane and cloud forests. Although its geographic range is very restricted, it appears to be common, especially in the Reserva de El Triunfo, where it is presumably protected.

Etymology.—The epithet 'cucullata' refers to what Lundell (1981) interpreted as hooded inner petals. The misinterpretation was based on Lundell's belief that the corolla was fused at the base into a tube, with two larger

FIG. 3. *Ardisia verapazensis* Donn. Sm. subsp. *cucullata* (Lundell) Pipoly & Ricketson. A. Reproductive branchlet. B. Detail of abaxial leaf surface. C. Detail of inflorescence. D. Detail of stamens, showing adaxial surface. E. Detail of stamens, showing abaxial surface. F. Detail of stamens, showing lateral surface. G. Fruit. A–F drawn from *E. Matuda 5201* (F isotype). G drawn from *R. Hapshire et al. 500* (MEXU).

outer lobes and three inner lobes that were "cucullate" or hooded at the apex. Reexamination of the type revealed that the corolla is simply imbricate and any hooded appearence comes from drying effects.

Specimens examined. **MEXICO. Chiapas:** Municipio Angel Albino Corzo, along Río Cuztepeques, near Finca Cuztepeques, 2,400 ft [732 m], 26 Mar 1968 (fr), *A. Shilom T. 3867* (DS, F, LL 2-sheets, MICH, NY). Municipio Jaltenango, Reserva del Triunfo, Cañada del Pavón NW of Triunfo, 1,800 m, 10 May 1982 (fr), *J. Calzada et al. 8739* (LL), trail NNW from El Triunfo Camp to Palo Gordo Camp, 1 km from El Triunfo Camp, 15° 39' N, 92° 50' W, 2,000 m, 20 Feb 1990 (fr), *R. Hampshire et al. 500* (BM, MEXU), 1–3 km from El Triunfo Camp, 15° 39' N, 92° 50' W, 2,000 m, 21 Feb 1990 (fl, fr), *R. Hampshire et al. 519* (BM 2-sheets, MEXU, NY); trail WSW from Palo Gordo towards Finca Catarina, 15° 40' N, 92° 51' W, 2,000 m, 25 Feb 1990 (fr), *R. Hampshire et al. 699* (BM 2-sheets, MEXU); Municipio Jaltenango-Mapastapec, Reserva El Triunfo, near HQ, 15° 39' N, 92° 48' W, 1,900 m, May 1989 (fr), *M. Heath & A. Long 31* (BM, CHIP), Cañada Honda, near Camp Headquarters, 15° 39' N, 92° 48' W, 1,400 m, May 1989 (fr), *M. Heath & A. Long 40* (CAS, CHIP); Municipio Mapastepec, Area Natural de Reserva El Triunfo, Cañada Honda, 7 km S of camp, 1,500 m, 1 Mar 1990 (fr), *R. Hampshire et al. 1680* (BM 2-sheets, MO), Cañada Honda, 7 km S of camp, 1,500 m, 01 Mar 1990 (fr), *A. Reyes G. et al. 1680* (BM 2-sheets, MO); Municipio Motozintla de Mendoza, steep canyon, SW side of Cerro Mozotal, 11 km NW of the junction of the road to Motozintla along road to El Porvenir and Siltepec, 2,100 m, 22 Nov 1976 (fr), *D. Breedlove 41758* (DS); 23 Nov 1981 (fl), *D. Breedlove & B. Bartholomew 55766* (CAS); Municipio Siltepec, on ridge above Siltepec along road to Huixtla, 2,000–2,400 m, 1 Feb 1982 (fr), *D. Breedlove & F. Almeda 58249* (CAS, LL, MO, NY); Pasitar, without elev., 29 Dec 1936 (fl), *E. Matuda 393* (LL, US); Boquerón, Motozintla, 2,450–2,540 m, 5 May 1945 (fr), *E. Matuda 5416* (F, LL 3-sheets); Mt. Ovando, Escuintla, without elev., 14 Nov 1945 (fl), *E. Matuda 16228* (MO, US).

Zunilia mirandae Lundell is known only from the holotype. It is notable only for its short petioles, smaller inflorescence and smaller sepals, but is otherwise indistinguishable the type of the subspecies.

Subspecies *cucullata* is distinguished from subspecies *verapazensis* by its shorter corolla lobes and free portion of the filaments, the style much longer in flower and fruit, and smaller fruit. It appears to be geographically isolated, occurring only in the southwestern region of Chiapas.

EXCLUDED NAME

Ardisia hyalina Lundell, Wrightia 3:99. 1964. *Zunilia hyalina* (Lundell) Lundell, Phytologia 49:354. 1981. TYPE: MEXICO. SAN LUIS POTOSI: vicinity of Xilitla, Cerro Miramar, 4,400 ft (1,531 m), 15 Jul 1947 (fl), *R.J. Newman 19* (HOLOTYPE: US).

The ovate anthers with subapical pores, opening into slits, and paniculate inflorescences bearing racemose branchlets, all indicate that this species belongs to *Ardisia* subgenus *Ardisia*, and not subgenus *Graphardisia*.

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REFERENCES

HICKEY, L. 1984. A revised classification of the architecture of dicotyledonous leaves. In: C.R. Metcalfe and L. Chalk, eds. Anatomy of the dictyledons. Vol. 1. Systematic anatomy of leaf and stem, with a brief history of the subject. Clarendon Press. Oxford, U.K. Pp. 25–39.

LINDLEY, J. 1848. Illustrated dictionary of botanical terms. Excerpt from illustrated dictionary of botanical terms by John Lindley. Pp. 346–383. [Reprint, with an introduction by Alice Eastwood, Stanford University, School of Earth Sciences, 1964].

LUNDELL, C.L. 1981. Neotropical Myrsinaceae–VI. Phytologia 49:341–354.

METCALFE, C.R. 1984. Some basic types of cells and tissues. In: C.R. Metcalfe & L. Chalk, eds. Anatomy of the dictyledons. Vol. 1. Systematic anatomy of leaf and stem, with a brief history of the subject. Clarendon Press. Oxford, U.K. Pp. 54–62.

PIPOLY, J. 1987. A systematic revision of the genus *Cybianthus* subgenus *Grammadenia* (Myrsinaceae). Mem. New York Bot. Gard. 43:1–76.

__________. 1992. The genus *Cybianthus* subgenus *Conomorpha* (Myrsinaceae) in Guayana. Ann. Missouri Bot. Gard. 79:908–957.

__________ and J. RICKETSON. 1998a. A revision of the genus *Ardisia* subgenus *Graphardisia* (Myrsinaceae). Sida 18:433–472.

__________. 1998b. New names and combinations in neotropical Myrsinaceae. Sida 18:503–517.

__________. 1999. Discovery of the Indo-Malesian genus *Hymenandra* (Myrsinaceae) in the Neotropics, and its boreotropical implications. Sida 18:701–746.

RICKETSON, J. and J. PIPOLY. 1997. A synopsis of the genus *Gentlea* (Myrsinaceae) and a key to the genera of Myrsinaceae in Mesoamerica. Sida 17:697–707.

THEOBALD, W.L., J. KRAHULIK, and R.C. ROLLINS. 1984. Trichome description and classification. In: C.R. Metcalfe and L. Chalk, eds. Anatomy of the dictyledons. Vol. 1. Systematic anatomy of leaf and stem, with a brief history of the subject. Clarendon Press. Oxford, U.K. Pp. 40–53.

NUMERICAL LIST OF TAXA

1a. *Ardisia verapazensis* Donn Sm. subsp. *verapazensis*
1b. *Ardisia verapazensis* Donn. Sm. subsp. *cucullata* (Lundell) Pipoly & Ricketson

LIST OF EXSICCATAE

The figures in parentheses refer to the numbers from the numerical list of taxa. Collection numbers in **boldface** type indicate type specimens.

Bernoulli, K. & A. Cario 1975 (1a); Boyle, B. et al. 2643 (1a); Breedlove, D., **8962 (1a)**; 9880 (1a); 20251 (1a); 23201 (1a); 24916 (1a); 26072 (1a); **28973 (1a)**; 35294 (1a); 41758 (1b); 49645 (1a); 51046 (1a); 51463 (1a); 70218 (1a); Breedlove, D. & F. Almeda 48217 (1a); 58249 (1b); Breedlove, D. & B. Bartholomew 55766 (1b); Breedlove, D. & B. Keller 49316 (1a); Breedlove, D. & A. Smith 21680 (1a); 31707 (1a); Breedlove, D. & J. Strother 46019 (1a); Breedlove, D. & R. Thorne 30777 (1a).

Calzada, J. et al.8739 (1b); Campos V., A., 957 (1a); 1819 (1a); 1834 (1a); 1853 (1a); 2585 (1a); Campos V., A. & L. Cortés 2242 (1a).

Dwyer, J., 14458 (1a).

Hampshire, R. et al. 500 (1b); 519 (1b); 699 (1b); 1680 (1b); Hawkins, T. & D. Mejía 241 (1a); Heath, M. & A. Long 31 (1b); 40 (1b).

Ignacio Aguilar, J., **1679 (1a)**.

Johnson, H., 865 (1a).

Lathrop, E. & R. Thorne 7233 (1a); López L., R. & G. Martin 193 (1a); 491 (1a).

Martínez, E. et al. 2501 (1a); Matuda, E., 393 (1b); 2392 (1a); **5201 (1b)**; 5416 (1b); 16228 (1b); 2392 (1a); Meave del Castillo, J. et al. 1491 (1a); Méndez T., A., 4404 (1a); 4488 (1a); 5700 (1a); 5965 (1a); Méndez T., A. & M. C. Martínez. de López 9844 (1a); Miranda, F., 1746 (1a); **7004 (1b)**; 7887 (1a).

Purpus, C., **100 (1a)**; 10100 (1a).

Raven, P. & D. Breedlove 19918 (1a); Reko, B., 441 (1a); Reyes G., A. et al. 1680 (1b).

Shilom T., A., 2574 (1a); 3867 (1b); 7451 (1a); Skutch, A., 931 (1a); Steyermark, J., **33608 (1a)**; 33631 (1a); 34363 (1a); 35431 (1a); 36261 (1a); 37367 (1a); 46650 (1a); 48602 (1a).

Thorne, R. & E. Lathrop 41689 (1a); 46084 (1a); Toriz A., G. y A. Campos V. 818 (1a); Torres C., R. & C. Martínez 4869 (1a); 5824 (1a); Torres C., R. & L. Cortés 10388 (1a); 11623 (1a); Türckheim, H. von, **112093 (1a)**.

Wendt, T. et al. 5149 (1a); Williams, L. et al. 25769 (1a); 26085 (1a); 26278 (1a); 26799 (1a).

Zuill, H., 398 (1a); 650 (1a).

NOTES ON SECTIONAL DELIMITATIONS IN *ERIGERON* (ASTERACEAE: ASTEREAE)

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ABSTRACT

Erigeron sect. *Linearifolii* is narrowed to a monotypic taxon, comprising only *Erigeron hyssopifolius* of northern North America. *Erigeron* sect. *Pycnophyllum* is restricted to the 14 species of the *E. foliosus* group, which are primarily Californian in distribution. The Mexican species *E. exilis* is transferred from sect. *Cincinnactis* to sect. *Lamprocaules*. *Erigeron rhizomatus* (New Mexico) and *E. lepidopodus* (Chihuahua and Durango, Mexico) are consolidated as *Erigeron* sect. *Geronpternix* Nesom & Noyes, sect. nov. The two species are distinct from other erigerons in their scaled-leaved, rhizomiform caudex branches, large, solitary heads, and long, narrowly oblong cypselas. Sect. *Geronpternix* is the most primitive phylogenetic element of *Erigeron* and of subtribe Conyzinae.

RESUMEN

Erigeron sect. *Linearifolii* se reduce a un taxon monotípico, que comprende sólo *Erigeron hyssopifolius* del norte de Norte América. *Erigeron* sect. *Pycnophyllum* se restringe a las 14 especies del grupo *E. foliosus*, que primariamente tienen una distribución Californiana. La especie mexicana *E. exilis* se transfiere de la sect. *Cincinnactis* a la sect. *Lamprocaules*. *Erigeron rhizomatus* (Nuevo México) y *E. lepidopodus* (Chihuahua y Durango, México) se consolidan como *Erigeron* sect. *Geronpternix* Nesom & Noyes, sect. nov. Las dos especies se distinguen de otros erigeron por sus ramas rizomiformes con hojas escamosas, capítulos grandes solitarios y cipselas largas estrechamente oblongas. La Sect. *Geronpternix* es el elemento filogenético más primitivo de *Erigeron* y de la subtribu Conyzinae.

Upon consideration of the morphology and systematics of North American *Erigeron* species, we observe that modifications in sectional alignments should be made. Changes discussed here deal primarily with species regarded as "peripheral to sect. *Linearifolii*" in the treatment by Nesom (1992).

1. The placement of *Erigeron hyssopifolius*

Cronquist (1947) included *Erigeron hyssopifolius* Michx. within the *E. foliosus* group (sect. *Pycnophyllum* sensu stricto; sect. *Linearifolii* sensu lato, including *E. hyssopifolius*) but noted (p. 277) that "it certainly is not approached by anything else in the section." Nesom (1989) maintained *E. hyssopifolius* within the group (as sect. *Linearifolii*) but later (1992) viewed it as peripheral to species of that group. With additional perspective on the genus, the disparity between *E. hyssopifolius* and the *E. foliosus* group suggests that it is more realistic to recognize the former at sectional rank, coordinate with the species of the *E. foliosus* group in its strict sense.

Erigeron hyssopifolius differs from *E. foliosus* and related species in several features, including cauline leaves abruptly reduced in size below the peduncles, short, axillary, leafy shoots often produced, heads solitary on bracteate peduncles 5–10 cm above the level of the leaves, phyllaries 3-nerved and all nearly equal in length, and lamina of the ray corollas not coiling. Further, sect. *Pycnophyllum* sensu stricto is almost completely restricted to areas along the Pacific coast of the U.S.A. and Baja California, while *E. hyssopifolius* ranges across northern North America (mostly Canada) from Newfoundland, Nova Scotia, and various New England states to Yukon and Alberta.

The nomenclature for the two sections concerned is now as follows.

Erigeron L. sect. **Linearifolii** (G. Don) Nesom, Phytologia 67:79. 1989. *Aster* L. sect. *Linearifolii* G. Don in Loudon, Hort. Brit. 346. 1830. LECTOYPE (Sundberg & Jones 1987): *Aster graminifolius* Pursh [= *Erigeron hyssopifolius* Michx.]

Species included: *Erigeron hyssopifolius* Michx.

Erigeron L. sect. **Pycnophyllum** Cronq., Brittonia 6:141. 1947. TYPE: *Erigeron foliosus* Nutt.

Species included: the 14 species of the *E. foliosus* group (sensu Nesom 1992).

2. The placement of *Erigeron exilis*

Erigeron exilis, a species of the Mexican states of Jalisco and Nayarit, was previously included within sect. *Cincinnactis* Nesom (Nesom 1989), but its greater similarity to the species of sect. *Lamprocaules* (Nesom 1994a) has been recognized in recent study and review of Mexican *Erigeron*. The other species of sect. *Lamprocaules* (discussed as possible relatives of sect. *Linearifolii* by Nesom 1992) also are restricted to Mexico but occur in the northeastern states of Coahuila, Nuevo Leon, and Tamaulipas, compared to the more southwestern distribution of *E. exilis*.

The section, as newly amended, is as follows.

Erigeron L. sect. **Lamprocaules** Nesom, Phytologia 76:99. 1994. TYPE: *Erigeron scoparioides* Nesom

Species included: *E. chiangii* Nesom, *E. exilis* Gray ex S. Wats., *E. pattersonii* Nesom, and *E. scoparioides* Nesom.

These plants are perennials with stems simple or few-branched, slender to wiry, shiny-textured, leaves all cauline, shiny-textured, narrow, and relatively even-sized, buds erect, and heads relatively small. The scale-leaved rhizomes of *E. exilis* are similar to those of *E. chiangii* and *E. scoparioides*; the thick, woody, non-rhizomatous base of the gypsum endemic, *E. pattersonii*, probably is specialized within the section. The stipitate-glandular stems and involucre of *E. exilis* are similar ro those of *E. chiangii*.

The ray flowers with coiling lamina of *Erigeron exilis* are unusual in sect. *Lamprocaules*, because the rays in other three species apparently do not coil. Still, the overall similarity among *E. exilis* and other species suggests that they are closely related. Non-coiling (and non-reflexing) rays are uncommon in *Erigeron* and may represent a shared specialized state in the northeastern species of this group.

3. The status of *E. rhizomatus* and *E. lepidopodus*

Erigeron rhizomatus and *E. lepidopodus* were placed by Nesom (1989) as members of the *E. foliosus* group (*Erigeron* sect. *Linearifolii* sensu lato), where their relationship as sister species was noted. *Erigeron lepidopodus* occurs from central Chihuahua to northern Durango, Mexico; *E. rhizomatus* is endemic to Catron and McKinley counties, New Mexico, where it is considered rare and endangered (U.S. Fish and Wildlife Service 1988; Sivinski and Lightfoot 1995). In a detailed treatment of the *E. foliosus* group (Nesom 1992, p. 205), under the heading "Species peripheral to sect. *Linearifolii*," it again was observed that these two species are closely similar in geographic range and morphology and almost certainly related as sister species. Plants of both produce stems from rhizomelike caudex branches, usually without clustered basal leaves (similar to plants of the *E. foliosus* group), and both species produce large, solitary heads erect in bud, long, non-coiling ray corollas, and long cypselas, unlike plants of the *E. foliosus* group. Cronquist (1947, p. 275) observed that "Although clearly belonging to the small section *Wyomingia*, [*E. rhizomatus*] does not seem closely related to any other known species. Its subglabrous leaves and involucres separate it from anything else in the section, and its peculiar habit is unique in the genus." Indeed, of the characters noted by Cronquist to link *E. rhizomatus* to sect. *Wyomingia* (i.e., imbricate involucral bracts, 4–14-nerved cypselas), the cypsela morphology apparently was emphasized; they have little else in common. *Erigeron rhizomatus* and *E. lepidopodus* warrant formal taxonomic recognition as a distinct and discrete group.

Erigeron L. sect. **Geronpternix** Nesom & Noyes, sect. nov. TYPE SPECIES: *Erigeron rhizomatus* Cronq.

Ramis caudicis longis squamifoliatis rhizomiformibus, capitulis grandibus solitariis in alabastro erectis, ligulis non circinnatis, et acheniis longis anguste oblongis distinctus.

Perennial herbs arising from thick, fibrous roots and long, slender, decumbent, often buried, rhizomiform, scale-leaved caudex branches. Stems erect, 6–45 cm tall, simple or with 1-3 short branches on the upper half, stipitate-glandular at least on the peduncles, otherwise sparsely pubescent with appressed to spreading or deflexed hairs, bearing ascending, linear to narrowly oblong leaves. Heads large, 12–20 mm wide; ray flowers 14-45, the lamina 6-14 mm long, white or blue-tinged with an abaxial lilac midstripe, apparently neither coiling nor reflexing at maturity. Cypselas narrowly oblong, 3.5–4.5 mm long, slightly compressed radially and 2- or 4-nerved (*E. lepidopodus*) or subterete and 5–6-nerved (*E. rhizomatus*), densely strigose to sericeous; pappus a single series of 25–50 bristles of unequal length, with a few outer setae. Flowering vernal. Base chromosome number, x = 9. For *E. lepidopodus*: chromosome number, 2n = 18 (Ward & Spellenberg 1988); illustration (Nesom 1981). For *E. rhizomatus*: chromosome number, 2n = 18 (Ward & Spellenberg 1986); photographs of habit, heads, and habitat (New Mexico Native Plants Protection Advisory Committee 1984; Heil 1995). The name is from Greek, *geron* (old) and *pternix* (stem of a plant), alluding to the name *Erigeron*, to the peculiar stems, and to the phylogenetically basal position (lower or "old stem") of this group.

Species included: *E. lepidopodus* (B. Rob. & Fern.) Nesom and *E. rhizomatus* Cronq.

Recent studies by Noyes (1999) show that *E. rhizomatus* and *E. lepidopodus* together apparently form the most basal phyletic element within *Erigeron* as well as within the entire subtribe Conyzinae. All of the species at more basal levels of the subtribe are *Erigeron*, as are most of the terminal species. Interpolated at various points in the subtribal topology, however, are other generic-level taxa, including *Conyza*, which apparently is biphyletic, and a group of South American genera (*Leptostelma*, *Apopyros*, *Neja*, and *Hysterionica*) recently recognized by Nesom (1994b), as well as the long-accepted and morphologically divergent genus *Aphanostephus*. The taxonomic implications of the Noyes analysis are complex, but morphological differences among various phyletically divergent infrageneric groups of species traditionally identified as *Erigeron* are in most cases so subtle that attempts to recognize segregate genera would be virtually impossible in actual practice. The two species of sect. *Geronpternix* are relatively easily distinguished as a group, and they are justifiably recognized at sectional rank.

ACKNOWLEDGMENTS

We appreciate review comments from Richard Spellenberg and John Strother.

REFERENCES

CRONQUIST, A. 1947. A revision of the North American species of *Erigeron*, north of Mexico. Brittonia 6:121–302.

Heil, K.D. 1995. The Farmington District [New Mexico]. Endangered, Threatened and Sensitive Plant Field Guide. Ecosphere Environmental Services, Inc. Farmington, NM.

Nesom, G.L. 1989. Infrageneric taxonomy of New World *Erigeron* (Compositae: Astereae). Phytologia 67:67–93.

Nesom, G.L. 1992. Revision of *Erigeron* sect. *Linearifolii* (Asteraceae: Astereae). Phytologia 72:157–208.

Nesom, G.L. 1994a. *Erigeron pattersonii* (Asteraceae: Astereae), a new species from Nuevo Leon, Mexico. Phytologia 76:96–100.

Nesom, G.L. 1994b. Subtribal classification of the Astereae (Asteraceae). Phytologia 76:193–274.

New Mexico Native Plants Protection Advisory Committee. 1984. A handbook of rare and endemic plants of New Mexico. Univ. of New Mexico Press, Albuquerque.

Noyes, R.D. 1999. Biogeographical and evolutionary insights on *Erigeron* and allies (Asteraceae) from ITS sequence data. Pl. Syst. Evol. (In press).

Sivinski, R.C. and K. Lightfoot (eds.). 1995. Inventory of rare and endangered plants of New Mexico. New Mexico Forestry and Resources Conservation Division. Energy, Minerals and Natural Resources Department. Misc. Pub. No. 4.

Sundberg, S.D. and A.G. Jones. 1987. Loudon's Hortus Brittanicus (1830): An early source of sectional names, necessitating nomenclatural changes in many genera–*Aster*: A case in point. Taxon 36:97–98.

U.S. Fish and Wildlife Service. 1988. Zuni fleabane (*Erigeron rhizomatus*) recovery plan. U.S. Fish and Wildlife Service, New Mexico Ecological Services Field Office, Albuquerque, New Mexico.

Ward, D.E. and R.W. Spellenberg. 1986. Chromosome counts of angiosperms of western North America. Phytologia 61:119–125.

Ward, D.E. and R.W. Spellenberg. 1988. Chromosome counts of angiosperms from New Mexico and adjacent areas. Phytologia 64:390–398.

BOOKS RECEIVED

Joe Liggio and Ann Orto Liggo. 1999. **Wild Orchids of Texas.** Photographs by Joe Liggio; Scientific Advisior, David H. Riskind. (ISBN 0-292-74712-8, hbk.). The University of Texas Press, P.O. Box 7819, Austin, TX 78713-7819, U.S.A. $29.95. 228 pp., 87 color photos, distribution maps.

"This beautifully illustrated book presents all [known] 54 wild orchids of Texas." Contents include: Preface, Acknowledgments, Texas Treasures: Fifty-four Types of Orchids, An Infinite Variety, The Discriminating Orchid, The Natural Regions of Texas, How Texas Orchid Habitats are Described in This Book, Orchids of the Bogs and Savannahs, Orchids of Open Sunny Habitats, Orchids of Forests and Woodlands, Orchids of the Mountains and Canyons, Texas Orchids by Flower Color, Texas Orchids by Genus and Species, Appendix A. Sources of Scientific Names, Appendix B. Excluded Species, Appendix C. Species Distribution by County, Literature Cited, and Index. A full review is forthcoming in the next issue.

Warren L. Wagner and V.A. Funk (Editors). 1995. **Hawaiian Biogeography: Evolution on a Hot Spot Archipelago.** (ISBN 1-56098-463-5, pbk.). Smithsonian Institution, 470 L'Enfant Plaza, Suite 7100, Washington, D.C. 20560 (Marketing Dept. 202-287-3738). $45.00 hbk, $25.00 pbk. 467 pp., numerous figures.

"*Hawaiian Biogeography* compares the biogeographic patters of many of the archipelago's species—various flowering plants, birds, spiders, and insects, including fruit flies—with its known geological history. Contributors apply, for the first time, a consistent phylogenetic methodology, using modern cladistic techniques, to a variety of lineages to identify common or discordant evolutionary and biogeographic patters among the constituent species." Contents include: Preface, Acknowledgments, Contributors, Introduction, Geology and Biogeography of the Hawaiian Islands, Cladistic Methods, Biogeographic Patterns of Two Independent Hawaiian Cricket Radiations (*Laupala* and *Prognathogryllus*), Chromosome and Male Genitalia of Hawaiian Drosophila: Tools for Interpreting Phylogeny and Geography, Molecular Approaches to Biogeographic Analysis of Hawaiian Drosophilidae, Evolution of *Sarona* (Heteroptera, Miridae): Speciation of Geographic and Ecological Islands, Comparison of Speciation Mechanisms in Web-Building and Non-Web-Building Groups within a Lineage of spiders, Evolutionary Relationships of the Hawaiian Honeycreepers (Aves, Drepanidinae), Biogeography of Seven Ancient Hawaiian Plant Lineages, Phylogeny, Adaptive Radiation, and Biogeography of Hawaiian *Tetramolopium* (Asteraceae, Astereae), Phylogeny and Biogeography in *Schiedea* and *Alsinidendron* (Caryophyllaceae), Historical Biogeography and Ecology of the Hawaiian Silversword Alliance (Asteraceae): New Molecular Phylogenetic Perspectives, Molecular Evolution, Adaptive Radiation, and Geographic Speciation in *Cyanea* (Campanulaceae, Lobelioideae), Patterns of Speciation and Biogeography in *Clermontia* (Campanulaceae, Lobelioideae), Phylogenetic Analysis of Hawaiian and Other Pacific Species of *Scaevola* (Goodeniaceae), Biogeographic Patterns in the Hawaiian Islands, Postscript, Literature Cited, and Index.

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NOVELTIES IN THE MYRSINACEAE FROM THE VENEZUELAN GUAYANA

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ABSTRACT

Preparation of a taxonomic treatment of the Myrsinaceae for the *Flora of the Venezuelan Guayana* project resulted in the discovery of a new species, *Cybianthus liesneri* Pipoly & Ricketson, which is described, illustrated, and its systematic relationships discussed. A key to distinguish *Cybianthus liesneri* from the other species of *Cybianthus* subgenus *Weigeltia* of the Venezuelan Guayana is provided. In addition, *Parathesis viridis* Lundell is found to be a member of the genus *Stylogyne*. The combination, *Stylogyne viridis* (Lundell) Ricketson & Pipoly is proposed, the species is newly illustrated and an updated description is provided. In addition, a key to the species of *Stylogyne* found in the Venezuelan Guayana is presented.

RESUMEN

Estudios para preparar un tratamiento taxonómico de la familia Myrsinaceae para la *Flora of the Venezuelan Guayana* dieron como resultado el descubrimiento de una especie nueva para la ciencia. Se describe, se ilustra y se discute el parentesco de la nueva especie, *Cybianthus liesneri* Pipoly & Ricketson. Se ofrece una clave taxonómica para separar *Cybianthus liesneri* de las otras especies pertenecientes al género *Cybianthus* subg. *Weigeltia* dentro de la Guayana venezolana. Además, se encontró que *Parathesis viridis* Lundell se ubica mejor dentro del género Stylogyne. Se propone la nueva combinación, *Stylogyne viridis* (Lundell) Ricketson & Pipoly, se ilustra la especie, y se discute su parentesco. Se aporta una clave para distinguir las especies del género *Stylogyne* en la Guayana venezolana.

NOTES ON *CYBIANTHUS*

Of the 56 species known to occur in the area covered by the *Flora of the Venezuelan Guayana* (Steyermark et al. 1995), 42 taxa, comprising 39 species, belong to the genus *Cybianthus* Mart. In studying the specimens collected from the region, we noted that one represented an entity we had not seen previously. Several characters, including the abruptly basally swollen petioles, pinnate panicles, stems with appressed brownish furfuraceous lepidote scales and prominently long black punctate-lineations, and 4-lobed calyx

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placed the new species in *Cybianthus* subgenus *Weigeltia* (A. DC.) G. Agost., a group consisting of approximately 46 species in South America and the Caribbean (Pipoly 1998). In the Guayana of Venezuela, subgenus *Weigeltia* is represented by six species, separable in the following key.

KEY TO *CYBIANTHUS* SUBGENUS *WEIGELTIA* IN THE VENEZUELAN GUAYANA

1. Leaves narrowly oblong to oblanceolate (3.1–)4–5(–7.5) cm wide.
  2. Petiole subterete; leaf blades not black punctate-lineate below; staminate pedicels ca. 1 mm long; pistillate pedicels 0.5–0.6 mm long. ..... **C. longifolius** Miq.
  2. Petiole canaliculate to base; leaf blades conspicuously black punctate-lineate below; staminate pedicels ca. 1.5–2.5 mm long; pistillate pedicels (0.7) 1.0–1.5 mm long .... **C. surinamensis** (Spreng.) G. Agost.
1. Leaves elliptic to obovate, (6.3–)8–10(–14) cm wide.
  3. Leaves membranaceous, prominently black punctate or conspicuously black punctate-lineate below, base acuminate or tapering gradually, decurrent on petiole to base; petiole deeply canaliculate; pistillate pedicels thin, 2–2.5 mm long.
    4. Branchlets terete, not brittle, not semi-succulent, with numerous, minute, appressed reddish lepidote scales, inconspicuously black punctate-lineate; leaves conspicously black punctate-lineate below, the quaternary veins not visible; petioles 3–4.5 cm long, not decurrent. ....**C. multicostatus** Miq.
    4. Branchlets angulate, brittle, semi-succulent, with scattered, minute, appressed, brownish lepidote scales, densely and prominently long black punctate-lineate, leaves densely and prominently black punctate below, the punctations one per areole, formed by prominently raised quaternary veins; petioles 1.5–2 cm long, decurrent on the branchlet onto rounded ridges on branchlet. .... **C. liesneri** Pipoly & Ricketson, sp. nov.
  3. Leaves chartaceous to subcoriaceous or thickly coriaceous to cartilaginous, obscurely pellucid punctate below, base acute, barely decurrent on petiole; petiole subterete with a narrow, shallow channel barely discernible above; pistillate pedicels obsolete to thicker than long and subobsolete.
    5. Branchlets angulate, with few, rounded angles below decurrent petiole bases; petioles 1.3–7 cm long, decurrent onto rounded angles on branchlets; leaves thickly coriaceous to cartilaginous; pistillate calyx lobes deltate, apically acute; staminate calyx lobes linear-lanceolate, apically narrowly acute to attenuate. .... **C. grandifolius** (Mez) G. Agost.
    5. Branchlets terete, with numerous, raised narrow longitudinal ridges not corresponding to petiole bases; petioles (1.7–)2–3 cm long, not decurrent onto branchlet; leaves chartaceous to subcoriaceous; pistillate calyx lobes very widely ovate to oblate, apically subacute to obtuse; staminate calyx lobes ovate, apically obtuse with a small acumen at tip. .... **C. potiaei** (Mez) G. Agost.

The new species is described herewith.

Cybianthus liesneri Pipoly & Ricketson, sp. nov. (**Fig. 1**). TYPE: VENEZUELA. AMAZONAS: Departamento Río Negro; Cerro de la Neblina Camp V; valley N of base of Pico Cardona, 00° 49' N, 66° 00' W, 1,250 m, 21–24 Mar 1984 (fr), *R. Liesner & B. Stannard 16866* (HOLOTYPE:VEN; ISOTYPES: K, MO).

Quoad folia membranacea, subter manifeste atro-punctata atque atro-punctato-lineata, ad bases gradate decrescens, ad bases petiolaris decurrentes, petiolos profunde canaliculatos, pedicellos pistillatos graciles, 2–2.5 mm longos, *C. multicostatam* valde arcte affinis, sed ab ea ramulis angulatis (non teretibus), fragilibus (nec flexilibus), semi-succulentis (nec non-succulentis), sparse deminuteque adprese brunei (nec rubigni) squamis lepidotis indutis, necnon dense atque prominente (nec inconspicue) longo-atro-punctato-lineatis, foliis subter dense manifesteque atro-punctatis cum punctis uno in quoque areola (non lineatis), denique petiolis 1.5–2 (non 3–4.5) mm longis, ad ramulis decurrentis (nec non-decurrentis) statim distinguitur.

Shrub or *small tree* to 4 m tall. *Branchlets* angulate, brittle, semisucculent, 7–10 mm diam., apically with scattered, minute, appressed brownish lepidote scales, densely and prominently long-black punctate-lineate, glabrescent. *Leaves* pseudoverticillate; blades membranaceous, obovate, 30–43 cm long, 10–14 cm wide, apically acuminate, the acumen 8–10 mm long, gradually tapering to a cuneate base, decurrent to base of petiole; midrib slightly raised above, prominently raised below, the principal secondary veins arcuate from the midrib toward apex, prominulous above, prominently raised below, 13–19 pairs, the tertiary veins prominulous below, perpendicular to the secondary ones, prominently black punctate below, the punctations no more than one per each areole formed by the prominently raised quaternary venation, with scattered conspicuous (but not prominently raised) black punctate-lineations; the margin entire, glabrous; petioles deeply canaliculate, 1.5–2 cm long, decurrent onto the rounded ridges of the branchlet, glabrous. *Staminate inflorescence*: unknown. *Pistillate inflorescence* a columnar, pinnate panicle 10–19 cm long, to 6 cm wide, the peduncle, rachis and pedicels densely rufous papillate; inflorescence bract unknown; peduncle 1–2 cm long; pedicels cylindrical, thin, 2–2.5 mm long; floral bracts unknown. *Pistillate flowers* unknown; fruiting calyx cotyliform, spreading, 0.8–1 mm long, the tube ca. 0.1 mm long, the lobes ovate, 0.7–0.9 mm long, 0.5–0.7 mm wide, apex obtuse to rounded, bearing 3–5 prominently raised black punctations medially, the margins irregular, erose to erose-dentate, glabrous. *Fruit* (immature) 2.5–3.5 mm diam., scattered translucent glandular-lepidote, the style persistent, the stigma subcapitate, 4-lobed.

Distribution and ecology.—Known only from the type, growing at 1,200–1,300 m elevation, *Cybianthus liesneri* occurs in premontane wet forest, dominated by *Iriartea* (Arecaceae) and several Burseraceae species.

Etymology.—This species is dedicated to Ronald L. Liesner, of the Missouri Botanical Garden, prodigious collector of Amazonian plants.

PARATYPES. **VENEZUELA. Amazonas:** Departamento Río Negro, trail S from Cerro Neblina Camp V, 00° 49' N, 66° 00' W, 1,200–1,300 m, 12 Apr 1984 (fr), *A. Gentry & B. Stein 46352* (MO 2-sheets, VEN n.v.).

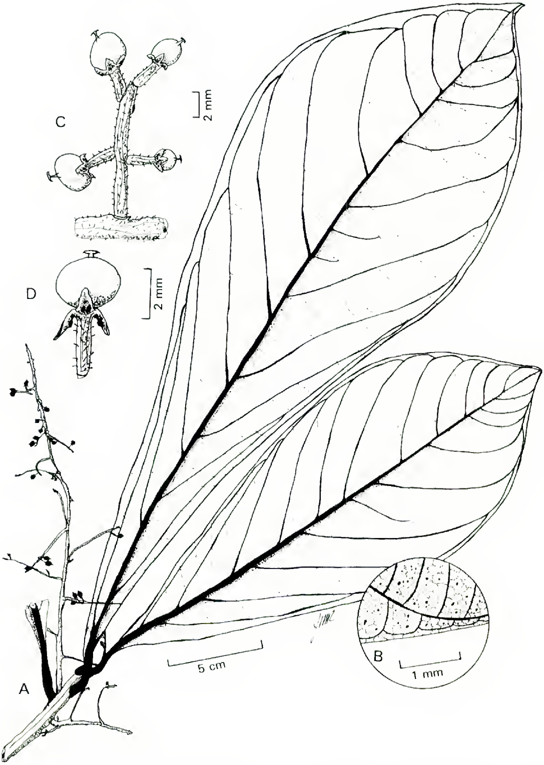

FIG. 1. *Cybianthus liesneri* Pipoly & Ricketson. A. Flowering branchlet, habit. B. close up of abaxial leaf surface, showing prominent black punctations, one per areole. C. Inflorescence branch close up, showing dense papillae. D. Close up of fruit, calyx and pedicel, showing the ovate calyx lobes, persistent subcapitate, 4-lobed stigma. A–D, drawn from type.

The following characters: chartaceous to subcoriaceous leaf blades that are obscurely pellucid punctate below with acute bases; subterete petiole with a narrow, shallow channel barely discernible above, and the flowers that are either sessile or with short, stout pedicels, all indicate that *C. liesneri* is most closely related to *C. multicostatus*. However, the angulate, brittle, semi-succulent branchlets, with scattered minute, appressed, brownish lepidote scales, and dense and prominent black punctate-lineations, leaves black punctate below with one punctation per areole, shorter petioles decurrent on the rounded ridges of the branchlet, all serve to distinguish *C. liesneri* from *C. multicostatus*.

NOTES ON *STYLOGYNE*

While examining *Parathesis viridis* Lundell, described from the Guayana region, we suspected that it was, in fact, a member of the genus *Stylogyne* A. DC. The species was previously known only from fruit and some poorly preserved flower buds. A new collection provided us with new characters, such as the contorted corolla, linear-lanceolate anthers with sagittate bases and longitudinal dehiscence, long style with punctiform stigma, leaving no doubt that *Parathesis viridis* should be transferred to *Stylogyne*. Therefore, we propose the new combination here and include the new data gleaned from the second collection known for the species. A key to the species of the genus in the Venezuelan Guayana is provided first, below.

KEY TO SPECIES OF *STYLOGYNE* IN THE VENEZUELAN GUAYANA

1. Inflorescence, peduncle, rachis and/or pedicels sparsely to densely papillose, of simple to few-celled papillae, often obscure.
    2. Anthers narrowly lanceolate, reddish-concolorous when dried; inflorescence opaque; ovary minutely rufous puberulent apically. .... **S. viridis** (Lundell) Ricketson & Pipoly, comb. nov.
    2. Anthers oblong, whitish-yellow when dried; inflorescence translucent pink or pinkish-red; ovary glabrous apically .... **S. orinocensis** (Kunth) Mez
1. Inflorescence, peduncle, rachis and/or pedicels glabrous.
    3. Leaf margins conspicuously crenate; growing in gallery forests on slopes near streams, ca. 500 m elevation .... **S. lasseri** (Lundell) Pipoly
    3. Leaf margins entire, occasionally obscurely crenate; growing in wet or swampy lowland forests, 30–450(–800) m elevation.
        4. Mature fruits 10–14 mm diam., depressed-globose; leaf blades chartaceous to coriaceous, usually nitid above**S. atra** Mez
        4. Mature fruits 4–7(–9) mm diam., globose; leaf blades membranaceous, usually dull above .... **S. micrantha** (Kunth) Mez

The transfer and new description is included herewith.

Stylogyne viridis (Lundell) Ricketson & Pipoly, comb. nov. (**Fig. 2**). *Parathesis viridis* Lundell, Phytologia 56:26. 1984. TYPE. VENEZUELA. AMAZONAS: 0–1 km S of San Carlos de Río Negro, 01° 51' N, 67° 03' W, 120 m, 4 Feb 1980 (fr), *R. Liesner 9046* (HOLOTYPE: MO; ISOTYPE: VEN n.v.).

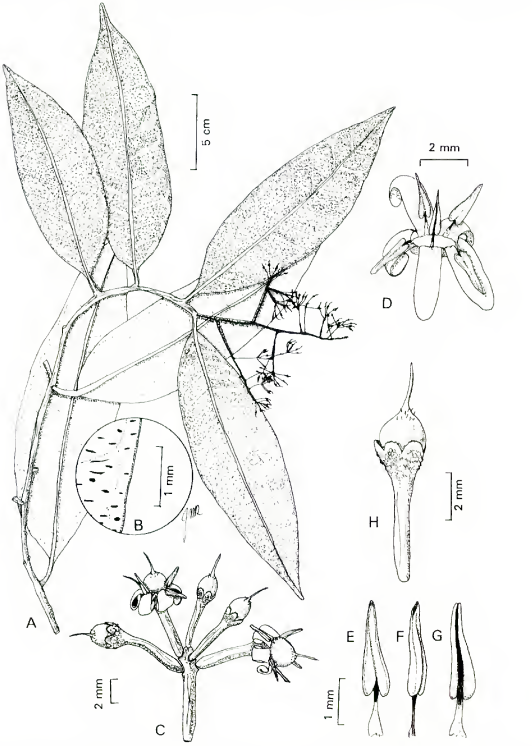

FIG. 2. *Stylogyne viridis* (Lundell) Ricketson & Pipoly. A. Flowering branchlet habit, showing wings, and leaf punctations. B. Close up of abaxial leaf survce, showing punctations and punctate-lineations. C. Corymb detail, showing reflexed corollas and persistent styles. D. Corolla and adroecium, separated from calyx and developing fruit. E. Stamen, adaxial view, showing hastate base and longitudinal slits. F Stamen, lateral view. G. Stamen, abaxial view, showing darkened connective. H. Pedicel, calyx and young fruit, showing minute rufous puberulent ovary summit. A–H, drawn from *R. Liesner 4182.*

Tree to 4 m tall. *Branchlets* 2–2.5 mm diam., angulate, with ridges forming "wings" ca. 3 mm high, spiralled around the stem to follow the margins of the decurrent petiole bases, glabrous. *Leaves* alternate, chartaceous, lanceolate to elliptic, 14–19 cm long, 4.0–4.7 cm wide, apically long acuminate-attenuate, the acumen 1–1.8 cm long, basally acute to obtuse, midrib prominulous apically, then canaliculate basally above, prominently raised below, the secondary veins 20–24 pairs, prominulous above and below, connected by a submarginal looping vein ca. 4 mm from margin, with periodic secondary veins extending to a second minor submarginal connecting vein 1 mm from margin, minutely scrobiculate above, densely and prominently orange punctate and punctate-lineate below, the margins flat, entire, decurrent to base of petiole; petiole marginate, roughly trigonal in transverse section, marginate, 6–9 mm long, glabrous. *Bisexual inflorescence* a terminal, pyramidal, bipinnate panicle 5.5–8 cm long, 6–7.5 cm wide; inflorescence bract unknown; peduncle 1.1–1.5 cm long; floral bracts coriaceous, minute, linear, 0.4–0.6 mm long, 0.1–0.2 mm wide, apex rounded, densely orange punctate, the margin glandular-ciliate, early caducous; pedicels 4–6 mm long, minutely glandular-papillate. *Bisexual flowers* chartaceous: calyx campanulate, the sepals free, ovate, 1.1–1.3 mm long, 0.7–0.9 mm wide, apex rounded to obtuse, the margins irregular, somewhat erose apically, very sparsely and minutely glandular-ciliolate; corolla chartaceous, very openly rotate, 4.4–5 mm long, the tube 0.9-1.1 mm the lobes reflexed distally and rolled at anthesis, oblong, 3.5–3.9 mm long, 1.3–1.5 mm wide, apex very broadly rounded to a short acumen, densely and prominently orange punctate and punctate-lineate, the margin entire, opaque, glabrous; stamens 3.3–3.6 mm long, the filaments flat, 1.8–2 mm long, adnate to the corolla tube 0.9–1.1 mm, the apically free portion ca. 0.9 mm long, the anthers concolorous, linear-lanceolate, 2–2.3 mm long, 0.3–0.5 mm wide basally, apically attenuate, basally deeply sagittate, dehiscent by wide longitudinal slits, the connective dark brown; pistil obturbinate, 4.7–4.9 mm long, the ovary obovoid, 2–2.2 mm long, 1.5–1.7 mm diam. toward apex, narrower below, apically rufous puberulent, the style thin, 2.6–2.8 mm long, the stigma punctiform. *Fruit* unknown.

Distribution.—Endemic along the Río Negro, south of San Carlos de Río Negro. It grows at 120 m in elevation. No collections are known from the Colombian side of the river, however it should be expected.

Ecology and conservation status.—Seasonally flooded primary forests and secondary areas. Because of its restricted distribution, it should be considered threatened.

Etymology.—The specific epithet comes from the latin meaning "green," presumably because of the leaf color.

Specimens examined. **VENEZUELA.** Amazonas: S of airstrip of San Carlos de Río Negro and along river for 2 km, 01° 55' N, 67° 05' W, 120 m, 4 Dec 1977 (fl, fr), *R. Liesner 4182* (MO).

The minute glandular-papillae of the pedicels makes it most easy to confuse *Stylogyne viridis* with *S. orinocensis*. However, the concolorous, linear-lanceolate anthers, opaque inflorescence rachis and ovary minutely glandular-puberulent apically all easily distinguish *Stylogyne viridis* from *S. orinocensis*.

ACKNOWLEDGMENTS

This paper is a result of the Flora of the Venezuelan Guayana project at the Missouri Botanical Garden, under the auspices of the Julian A. Steyermark Fund and NSF grants BSR-8717303. BSR 9045532, and BSR 9201044. The illustrations were prepared by Jon Ricketson.

REFERENCES

PIPOLY, J. 1998. The genus *Cybianthus* in Ecuador and Peru. Sida 18:1–160.

STEYERMARK, J., P. BERRY, and B. HOLST (eds). 1995. Flora of the Venezuelan Guayana. Vol. 1. Introduction. Missouri Botanical Garden and Timber Press. Pp. 320.

NEW SPECIES OF *CLUSIA* (CLUSIACEAE) FROM THE CORDILLERA OCCIDENTAL OF COLOMBIA

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ABSTRACT

Fieldwork conducted during a survey of Las Orquídeas National Park in Antioquia, Colombia, resulted in the discovery of two undescribed species of *Clusia* section *Anandrogyne*. *Clusia deminuta* Pipoly & Cogollo and *C. paisarum* Pipoly & Cogollo are described and illustrated, and their respective distributions, ecology, conservation status, etymology of epithets and phylogenetic relationships are elucidated.

RESUMEN

El trabajo de campo durante una investigación de la flora del Parque Nacional Natural "Las Orquídeas," ubicado en el Departamento de Antioquia, Colombia, dio como resultado el descubrimiento de dos especies nuevas, pertenecientes al género *Clusia* sección *Anandrogyne*. Se aportan descripciones, ilustraciones, comentarios sobre sus respectivas distribuciones geográficas, ecología y condiciones en cuanto a la conservación, así como la etimología de los epítetos específicos y el parentesco de *Clusia deminuta* Pipoly & Cogollo y de *C. paisarum* Pipoly & Cogollo.

The genus *Clusia* section *Anandrogyne* Planch. and Triana is now known to contain more than 70 species (Pipoly 1995, 1998) and is defined by the largely anantherous staminodes of the pistillate flowers and the pluriseriate, acropetally longer stamens of the staminate flowers, the latter with anthers dehiscent by wide longitudinal slits. While carrying out fieldwork to document the plant diversity of Las Orquídeas National Park, two new species were encountered and are desctibed herewith.

Clusia (§Anandrogyne) deminuta Pipoly, sp. nov. (**Fig. 1**). Type. COLOMBIA. Antioquia: Mpio. Urrao; Corregimiento La Encarnación; Trail to Parque Nacional Natural "Las Orquídeas," first hill between Quebrada el Aguacate and Quebrada San

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Sida 18(4): 1175–1182. 1999

José, 06° 27' N, 76° 13' W, 2,200–2,400 m, 8 Feb 1995 (fr), *J. Pipoly, J. Ramírez & J. Arias 18595* (HOLOTYPE: JAUM; ISOTYPES: BRIT, FMB).

Quoad paniculam 5-floridam, folia subsessiles vel sessilies, petiolos late marginatos sepala 4, petala 6, *C. popayanensi* valde arcte affinis sed ab ea ramulis tetragonis (non teretibus), laminis linearibus oblongis vel loratis (non ellipticis) ad apices acuminatis (nec rotundatis), pedicellis tetragonis 2.8–3.2 mm longis (non obsoletis), necnon habitu epiphytico (non terrestri) perfacile cognoscitur.

Epiphytic shrub to 3 m tall; latex white. *Branchlets* tetragonal, with the angles formed by small rounded ridges running from the side of each petiole base to the center of the petiole above it, 2.5–3 mm diam. between nodes, 3–4 mm diam. at the nodes; semisucculent, the bark smooth, shiny, exfoliating, glabrous. *Leaves* subsessile to very short petiolate; blades thinly coriaceous, linear, oblong or lorate, (5.2–)6.0–11.5 cm long, (1.2–)2.0–2.4 cm wide, apically acuminate, the acumen 4–8 mm long, basally broadly rounded, the midrib prominently raised above and below, the secondary veins numerous, perpendicular to the midrib, prominently raised above and below, the submarginal collecting vein perpendicular to the secondaries, prominently raised above and below, the tertiary veins not visible from above, prominulous below, glabrous and dull above, pallid below, the latex canals not obvious, bearing numerous rubiginous dots below, the margin revolute, decurrent on the petiole; petiole subobsolete to 4 mm long, deeply canaliculate and widely marginate throughout, glabrous, decurrent on either side of the stem and almost touching the petiole base of the opposite leaf. *Staminate inflorescence* and *flowers* unknown. *Pistillate inflorescence* terminal, dichasial, 5-flowered, with two basal lateral flowers followed by a rachis segment and 3 terminal flowers; peduncle tetragonal, 1.7–2.5 cm long, inflorescence bracts 2, qualitatively identical to foliage leaves but membranaceous, 15–17 mm long, 3–3.5 mm wide, midrib raised in a sunken furrow above, prominently raised below, the secondary venation not visible, the petioles obsolete to 2 mm long; upper peduncle tetragonal, 9-11 mm long; floral bracteoles 2, below the two basal, lateral flowers, stiffly coriaceous, widely ovate, 3–3.5 mm long, 2.4–2.6 mm wide, apex broadly rounded but with a small acuminate-mucronulate tip, ventrally (abaxially) keeled medially, the margin opaque, entire; pedicels of basal lateral flowers like the peduncle; upper bracteoles as in lower bracteoles but 3–3.2 mm long, 2.8–3 mm wide, terminal flower cluster pedicels as in peduncle except 2.8–3.1 mm long. *Pistillate flowers* with sepals 4, decussate, chartaceous, the outer suborbicular, cucullate 4–4.2 mm long, 3–3.2 mm wide, apically broadly rounded, the margin opaque, entire, inner sepals as in outer except margin irregularly notched; petals 6, contorted, membranaceous, obovate-spathulate, as in sepals except constricted basally; staminodes 5, alternate with the carpels (opposite carpel suture), minute, anantherous, subulate, ca. 1 mm long,

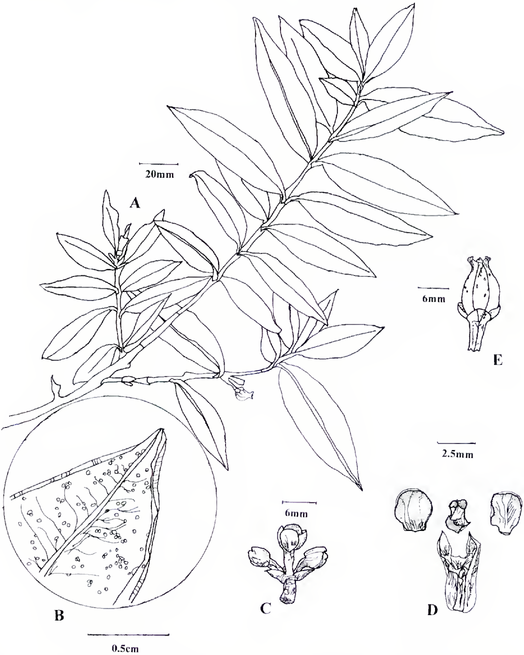

Fig. 1. *Clusia deminuta* Pipoly. A. Fruiting branchlet. B. Close up of abaxial leaf surface, showing revolute margin and rubiginous dots. C. Pistillate inflorescence in bud. D. Dissection, showing sepal (left), pistil (upper center), petal (right), and pedicel with floral bracteoles (lower center). E. Fruit. A–E, drawn from type.

0.3 mm wide, early caducous; pistil 5-carpellate, oblongoid, ca. 3 mm long, 1.3 mm diam., the styles obsolete, the stigmas 5, cuneiform, brick red, the surface appearing papillate. *Mature fruit* ovoid, 1.3–2 cm long, 0.8–1 cm diam. when dried, sutures furrowed, the styles stout, ca. 1.5 mm long, the stigma concave, deltoid (triangular with rounded corners), the seeds small, numerous, with orange arils.

Distribution.—Apparently endemic to Parque Nacional "Las Orquídeas," in the Municipio of Urrao and the Corregimiento of La Encarnación, Department of Antioquia, Colombia, on the Cordillera Occidental of the Andes, growing from 1,300–2,400 m elevation.

Ecology and conservation status.—*Clusia deminuta* is a canopy epiphyte in the pluvial premontane, cloud and elfin forest, where it forms large individuals that often acquire a weight sufficient enough to break the branches of the host tree. In the premontane forest, it is restricted to the tops of emergent trees, whereas higher, in the cloud and elfin forest, it may be found in tangles of fallen vegetation. It requires nearly open light, so is very susceptible to the periodic, catastrophic "blowdowns" seen on radar imagery for the region, mostly attributable to seismic activity. Even though the species has a locally common distribution, I would still consider it threatened because the entire region is prone to frequent and violent seismic activity. It should be noted that the "elfin forests" inhabited by *Clusia deminuta* are some of a very few true elfin forests found on the South American continent, mostly because the mountains on which they occur are not high enough to permit existence of subpáramo and páramo formations.

Etymology.—The epithet "deminuta" refers to the small stature of the plant, its leaves, branchlets, flowers and fruit.

PARATYPES. **COLOMBIA. Antioquia:** Mpio. Urrao; Corregimiento La Encarnación; Parque Nacional Natural "Las Orquídeas," Sector Calles, Quebrada La Bironda, 06° 31' N, 76° 19' W, 1,300-1,500 m, 3 Apr 1992 (fr), *D. Cárdenas & E. Álvarez 3261* (FMB, JAUM, MO), Vereda Calles, right bank of Río Calles, on the mountain range NW of Cabaña Calles, 06° 32' N, 76° 19' W, 1,450 m, 1 Dec 1993 (fr), *A. Cogollo et al. 7637* (BRIT, FMB, JAUM); permanent premontane pluvial forest inventory plot, 06° 32' N, 76° 19' W, 1,450–1,500 m, 28 Nov 1993 (ster.), *J. Pipoly. A. Cogollo et al. 17292* (BRIT, FMB, JAUM); Zona limitrofe del Parque Nacional Natural "Las Orquídeas," Vereda Calles, 06° 32' N, 76° 19' W, 1,450–1,500 m, 30 Nov 1993 (pist. fl bud), *J. Pipoly et al. 17369* (BRIT, FMB, JAUM).

The cuneiform stigmas, appearing papillate, with 5 carpels and 5 very reduced, subulate staminodes without antherodes, clearly place *Clusia deminuta* within section *Anandrogyne* Planch. & Triana. Section *Anandrogyne* is by far the largest and the most complex within the genus, containing 75 species (Pipoly et al. 1995, 1998), including at least 21 as yet undescribed. The five-flowered panicle, subsessile or sessile leaves, widely marginate petioles (when these are developed), calyx of four sepals and corolla of six petals indicate that *Clusia deminuta* is most closely related to the vicariant *C. popayanensis* Planch. & Triana. *Clusia popayanensis* is a poorly known species, from the Chocó floristic region of western Cauca Department, growing in the subpáramo thicket life zone. *Clusia deminuta* is easily separated from *C. popayanensis* by its tetragonal branchlets, linear, oblong or lorate leaf blades with acuminate apices, tetragonal pedicesl 2.8–3.2 mm long, and epiphytic habit.

Clusia deminuta is an important, locally common endemic from Las Orquídeas National Park. The elfin forest area at the Park's northern boundary is extensive and our exploration was very limited. Based on collections from the area, the northernmost areas of the Cordillera Occidental of Colombia is home to large numbers of undescribed, yet ecologically important and very conspicuous species of flowering plants.

Clusia (§Anandrogyne) paisarum Pipoly, sp. nov. (**Fig. 2**). TYPE. COLOMBIA. ANTIOQUIA: Mpio. Urrao; Corregimiento La Encarnación; Trail to Parque Nacional Natural "Las Orquídeas," first hill between Quebrada el Aguacate and Quebrada San José, 06° 27' N, 76° 13' W, 2,200–2,400 m, 8 Feb 1995 (fr), *J. Pipoly, J. Ramírez & J. Arias 18585* (HOLOTYPE: JAUM; ISOTYPES: BRIT, COL, FMB).

Propter inflorescentiam terminalem atque flores congestos, lamina coriaceaque elliptica vel oblonga, pedunculos quadratos, ovarium 7-carpellarum, denique fructus globosusque rostratus, *C. cassinoidi* valde arcte affinis, sed ab ea ramulis quadraris (non tereribus), laminis acuminaris (non rotundatis), petiolis 1.1–2.2 (non usque ad 1.0) cm longis, necnon sepalis 5 (non 4), atque petalis 6(nec 5), statim separabilis.

Terrestrial *shrub* to 3 m tall; latex yellow. *Branchlets* tetragonal, the angles formed by acute angles running from each petiole base to the center of the petiole 90° from and above it, 4.5–5(–7) mm diam., not swollen at the nodes; semisucculent, the bark smooth, sordid, not exfoliating, glabrous. *Leaves* petiolate; blades coriaceous, elliptic to narrowly oblong or rarely lanceolate, (7.0–)11.5–15(–17) cm long, (3.2–)4–5.5(–6) cm wide, apically short acuminate, the acumen 5–10 mm long, basally acute, midrib raised but canaliculate above, the channel decurrent to petiole base, prominently raised below, the secondary veins 28–34 pairs, diverging at approxmately 45° from the midrib and arcuate, barely prominulous or inconspicuous above, prominulous below, the submarginal connecting vein barely prominulous above, prominulous below, the secondary veins alternating with shorter intersecondary veins that terminate before reaching the connecting vein, the tertiary veins inconspicuous, the latex canals numerous, linear, black, conspicuous below only on immature leaf blades, glabrous and dull above, pallid below, the margin entire, flat, decurrent on the petiole; petiole deeply canaliculate and marginate throughout, (1.1–)1.3–1.5(–2.2) cm long, glabrous. *Staminate inflorescence and flowers* unknown. *Pistillate inflorescence* terminal, a 6-flowered, congested cyme; peduncle tetragonal, (1.7–)4.0–5.5 cm long; inflorescence bracts 2, qualitatively identical to the vegetative leaves except blades (2.0–)3.0–8.5 cm long, (0.7–)1.2–3 cm wide, the petioles 0.5–1.0 cm long; upper peduncle tetragonal, 5–8 mm long; floral bracts 2, cartilaginous, ovate, 10–12 mm long, 6.5–7 mm wide, apically acute to attenuate, prominently keeled, medially strongly rugose, the margin stramineous, entire; floral bracteoles

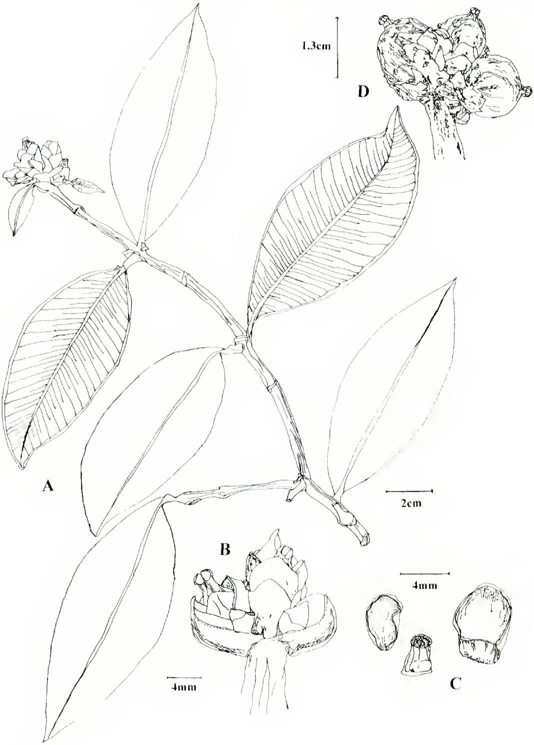

FIG. 2. *Clusia paisarum* Pipoly. A. Fruiting branchlet. B. Inflorescence, lateral view. C. Dissected pistillate flower bud, showing sepal (left), pistil (center) and petal (right). D. Infructescence. A–D, drawn from type.

2, as in floral bracts but widely ovate, 6.8–7.2 mm long, 5,8–6.2 mm wide, apically broadly rounded to an acute tip, prominently rugose medially, the margin stramineous, entire; pedicels obsolete. *Pistillate flowers*: sepals 5, the outer two opposite, the inner three contorted; outer sepals stiffly cartilaginous, suborbicular, 8.8–9.2 mm long, 10.1–10.5 mm wide, apically very broadly rounded, somewhat cucullate, medially somewhat rugose, the margin opaque, entire; inner sepals acropetally larger, chartaceous, stramineous, ovate, to 9.4 mm long, 7.3 mm wide, apex broadly rounded, the upper margin thin, translucent, irregularly incised; petals 6, coriaceous, contorted, oblong, 13–14.1 mm long, 6–7.5 mm wide, apically slightly cucullate, the margin opaque, entire; staminodes 7, alternate with the carpels, anantherous, connate into a small ring, oblate, 0.7 mm long, 1.3–1.5 mm wide, apically sharply acuminate; pistil 7-carpellate, obovoid, 9.8–10.2 mm long, the ovary ca. 7–7.3 mm long, 7.3–7.5 mm wide, the styles 2–3 mm long, the stigmas concave, black, cuneiform, 1.3–1.5 mm long, 1.2–1.4 mm wide, smooth. *Mature fruit* globose, 1.3–2 cm long and wide, the carpels 7, not obvious, without obvious suture lines, the styles thin, 2–3 mm long, giving a beaked (rostrate) appearance to the fruit, the stigmas as in the flowers, the seeds small, numerous.

Distribution.—Apparently endemic to the type area near Parque Nacional "Las Orquídeas," in the Municipio of Urrao and the Corregimiento of La Encarnación, Department of Antioquia, Colombia, along the western slopes of the Cordillera Occidental of the Andes, growing from 2,200–2,400 m elevation.

Ecology and conservation status.—*Clusia paisarum* is a terrestrial tree growing in remnant montane pluvial forest, near small watercourses. It is locally common along the margins of remnant forest, but particularly abundant on the ridges above roadcuts. It is also an important element of these remnants because it is deeply rooted and in fact, is often used to tie pack animals to as they rest along the paths. However, it does not attain a diameter over 10 cm DBH, and perhaps for that reason, and its copious, sticky yellow latex, it is rarely cut down. Despite significant effort, no staminate plants were found, but there were significant numbers of trees not in flower, some of which may have been staminate.

Etymology.—The specific epithet "paisarum" is derived from the local Spanish adjective "Paisa," a colloquialism for Colombians inhabiting the coffee-growing region comprised of the Departments of Antioquia, Risaralda, Caldas and Quindío. The region around Urrao, Antioquia is particularly noteworthy for its production of coffee and grenadilla, a species of *Passiflora*.

Paratype. **COLOMBIA. Antioquia:** Mpio. Urrao; Corregimiento La Encarnación; Trail to Parque Nacional Natural "Las Orquídeas," first hill between Quebrada el Aguacate and Quebrada San José, 06° 27' N, 76° 13' W, 2,200-2,400 m, 8 Feb 1995 (fr), *J. Pipoly, J. Ramírez & J. Arias 18580* (BRIT, COL, FMB, JAUM).

Clusia paisarum is most closely related to *C. cassinoides* Planch. & Triana, with which it shares of its yellow latex, terminal, congested inflorescence, coriaceous usually elliptic or oblong leaf blades, tetragonal peduncles, 7-carpellate ovaries and globose, beaked fruits. However, *Clusia paisarum* can immediately be separated from *C. cassinoides* by the tetragonal stems, short acuminate leaf apices, longer petioles, more numerous sepals and petals.

This species belongs to a group of species within the large *Clusia* section *Anandrogyne* with yellow latex. This group includes such problematic taxa as *Clusia stenophylla* Standl. and *C. longistyla* Cuatrec., the former found from Mesoamerica to the Darien of Panama, and the latter from the northern pluvial lowland forests of Antioquia and the Choco of Colombia, southward to Esmeraldas, Ecuador, an area still within the Choco Floristic Province. However, both *Clusia stenophylla* and *C. longistyla* have much larger oblong or elliptic leaf blades with broadly rounded apices and bases, pyramidal panicles, extremely long, alate petioles (3–8 cm long), 5-carpellate fruits and long, thin, persistent styles, clearly distinguishing them from both *Clusia paisarum* and *Clusia cassinoides.*

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REFERENCES

PIPOLY, J. 1995. *Cybianthus fabiolae*, a new species, with a synopsis of *Clusia* section *Anandrogyne* (Clusiaceae) in Guayana. Sida 16:737–755.

————, D. KEARNS and P. BERRY. 1998. *Clusia*. In: P. Berry, B. Holst and K. Yatskevich, eds. Flora of the Venezuelan Guayana. Vol. 4, Caesalpiniaceae–Ericaceae. Missouri Botanical Garden Press. St. Louis, Missouri. Pp. 260–294.

SARRACENIA ROSEA (SARRACENIACEAE), A NEW SPECIES OF PITCHER PLANT FROM THE SOUTHEASTERN UNITED STATES

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ABSTRACT

Sarracenia rosea is described as a new species from the Gulf Coastal Plain of southern Alabama, northwestern Florida, southwestern Georgia, and southeastern Mississippi. Pink petals, large flowers, short scapes, pitchers with thick lips, and lips deeply concave in dorsiventrally pressed pitchers are among the features that distinguish *S. rosea* from its closest relative, *S. purpurea*. *Sarracenia rosea* most often grows in sunny to lightly shaded, wet, acid sites in pinelands. Its infrequent occurrence within a small geographic range makes its conservation of concern.

RESUMEN

Se describe como nueva *Sarracenia rosea* de la Llanura Costera del Golfo del sur de Alabama, noroeste de Florida, sudoeste de Georgia, y sudeste de Mississippi. Los pétalos rosas, flores grandes, escapos cortos, utrículos con labios gruesos, y labios muy cóncavos en los utrículos aplastados dorsiventralmente son las mejores características que distinguen *S. rosea* de su pariente más cercano, *S. purpurea*. *Sarracenia rosea* crece la mayoría de las veces en lugares húmedos ácidos en pinares abiertos, de soleados a ligeramente sombríos. El vivir en un área geográfica pequeña, donde aparece con poca frecuencia hace que su conservación sea de interés.

INTRODUCTION

The Western Hemisphere pitcher plants (Sarraceniaceae) are a small family (15–17 species in 3 genera) of perennial herbs endemic to North America and northern South America. Tubular, pitcher-like leaves ("pitchers") enable these plants to lure, trap, digest, and absorb nutrients from a wide variety

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of prey, usually arthropods. Most of these pitcher plant species inhabit sunny, wet, nutrient-poor sites such as bogs, seepages, and wet savannas. The carnivorous habit, peculiar morphology, and unusual ecology of these plants have attracted much interest from horticulturists, ecologists, and systematists. Despite such attention, the ecology, taxonomy, and phylogeny of the Sarraceniaceae remain poorly understood.

The largest genus in the family is *Sarracenia* (10 or 11 species). The most morphologically divergent member of *Sarracenia* is *S. purpurea* L. It is the only species with erect hoods and, consequently, the only species whose pitchers collect rainwater. Other *Sarracenia* species have hoods that cover the mouths of the pitchers, which are moist inside, but not full of water. *Sarracenia purpurea* is the only species in which the pitcher tube is curved, the widest part of the tube is near the middle, and the style expansion is glandular-puncticulate. Congeners have straight tubes, tubes widest at or near their mouths, and nonglandular style expansions. Only *S. purpurea* and *S. psittacina* possess short, decumbent pitchers with wide wings. Other species of *Sarracenia* have relatively long, erect pitchers with relatively narrow wings.

Sarracenia purpurea is often locally abundant within its vast geographic range, which is the largest in the family. Its reported natural range spans 32 degrees of latitude (30–62° N) and 70 degrees of longitude (53–123° W), from southeastern Louisiana, southern Alabama, and northern Florida north in the southern Appalachian mountains and along the Atlantic Coast to eastern Newfoundland and then west across the northeastern United States of America and much of southern Canada to northeastern British Columbia (Macfarlane 1908; McDaniel 1971; Cody & Talbot 1973; Rouleau & Lamoureux 1992).

Largely because of its distinctive morphology, relative frequency, and wide range, *S. purpurea* has a four-century history of study and is the best known member of its genus (Lloyd 1976). Authors have described several infraspecific taxa of *S. purpurea* (Schnell 1979, 1993; Schnell & Determann 1997; Hanrahan & Miller 1998). In our ongoing field, greenhouse, and herbarium studies of the taxonomy of *S. purpurea*, we have discovered that one of these taxa (*S. purpurea* var. *burkii* D.E. Schnell) is more distinct than previously recognized and deserves recognition as a new species.

MATERIALS AND METHODS

We have investigated the morphology, distribution, and habitats of *S. purpurea* and the new species in the field at as many sites as possible throughout its geographic range. For the new species, we studied it at 26 sites in Alabama, Florida, and Mississippi. We studied *S. purpurea* in 4 Canadian provinces and 12 states of the U.S.A. We also borrowed specimens from or studied specimens at the following 20 herbaria: AUA, DHL, FLAS, FSU, IBE, KNK, KY, LSU, MICH, MO, NCU, NY, OS, PH, TENN, US, USAM, USCH, VDB, and WKU. Abbreviations of herbaria are those of Holmgren et al. (1990).

Previous authors vary in their terminology for the morphology of *Sarracenia purpurea*. In order to standardize terminology and make our descriptions of characters unambiguous, we picture and use the following terms for portions of the pitchers: hood, mouth, lip, tube, wing, and petiole (Fig. 1A). Terms for the description of reproductive morphology are relatively straightforward, with the exception of style expansion, which we have illustrated in Fig. 1B.

Of the herbarium specimens we examined, including our own collections, we selected a representative subset to measure for statistical analyses. We chose only mature specimens that had grown in sunny or lightly shaded habitats because pitchers etiolate and pitcher plants exhibit reduced growth in heavily shaded habitats. For specimens collected by others, we used habitat information on labels and the presence of reddish venation strongly contrasting with the ground color of pitchers as evidence of growth in high-light environments. We also chose specimens that exhibited the full range of morphologic variation for *S. purpurea* and the new species and that originated from throughout the ranges of the two taxa. The set of specimens we measured includes all of the subspecies and varieties currently recognized in *S. purpurea*. Each measured specimen of the new species is denoted by an asterisk following its herbarium of deposit in the citation of types and of representative specimens. Citations of measured specimens of *S. purpurea* can be found in the Appendix. Specimen citations have been purposely abbreviated because of conservation concerns.

We measured at least 74 specimens for most characters of *S. purpurea* and at least 39 specimens for most characters of the new species. Sample sizes vary for the characters since some collections lacked a particular feature or the manner of specimen preparation made measurement impossible. We measured each character only once per specimen. When measuring a structure that is present more than once on a specimen (e.g. petals), we measured the one with the greatest value for a measurement. When measuring the width or thickness of a structure, we measured it at its widest or thickest point. We measured maximum distance of the lip from the horizontal, lip thickness, and style arm length as in Fig. 2. For style arm length and petal length, we measured only styles and petals that were fully expanded. To assess the degree to which *S. purpurea* and the new species differed from each other for each character, we used the independent-samples *t*-test. Because the variances of several characters are heterogeneous (as determined

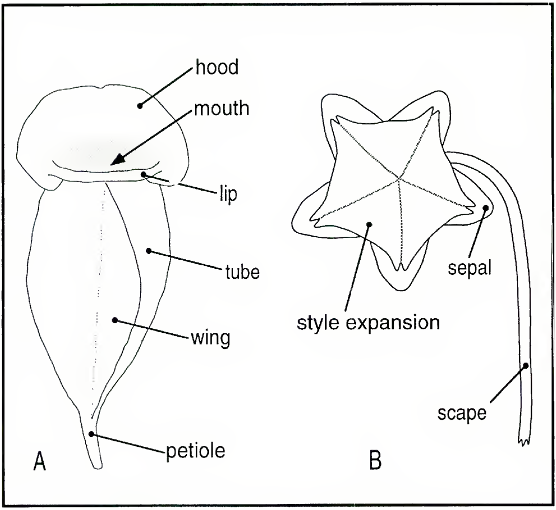

Fig. 1. Morphology of *Sarracenia purpurea* and *S. rosea*. A. Pitcher. B. Flower after shedding of petals. The flower is turned to reveal the style expansion, which faces the ground in these pendent flowers.

by the Bartlett chi-square test for homogeneity of group variances), we transformed the data with the common logarithm before conducting the *t*-tests. All statistical analyses were performed on a Macintosh computer using SYSTAT version 5.1 (Wilkinson 1989). In Table 1, we report sample sizes, summary statistics, and *t*-values for the measurements of the characters we discovered that best distinguish *S. purpurea* and the new species.

To study the lectotype of *S. purpurea* (McDaniel 1971), which is plate 70 of Catesby (1738), we measured the plate directly as if it were a pressed specimen. Direct measurement is justified because Catesby's depictions of *S. purpurea* and a frog on the plate are life-sized. In text accompanying plate 70, Catesby states, "These frogs are of various sizes, tho' commonly about the bigness of the figure. ..." We did not include measurements of the lectotype in the data or analyses presented in Table 1.

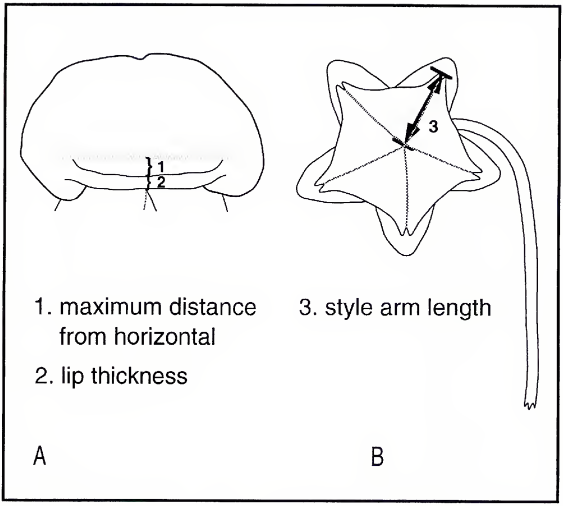

FIG. 2. Methods of measurement of specific diagnostic features of *Sarracenia purpurea* and *S. rosea*. A. Distal portion of pitcher, with diagnostic features of the lip indicated. B. Flower after shedding of petals, with style arm length indicated.

As an additional means of studying the morphology of *S. purpurea* and the new species, we cultivated plants of them under common conditions in the Case greenhouse in Saginaw, Michigan. In the greenhouse, we grew plants from 8 populations of *S. purpurea* (3 from the southern Appalachians, 3 from the Coastal Plain of North and South Carolina, and 2 from Michigan) and 7 populations of the new species (Alabama and Florida). Plants were cultivated for 15–25 years in pots with soil from the same source and watered from a common supply, as described by Case and Case (1976).

For determination of the flowering period of the new species, we considered only specimens bearing at least one fully expanded petal. To determine the geographic range of the new species, we used only herbarium specimens that we examined; each point on the map is based on at least one herbarium specimen.

RESULTS AND DISCUSSION

Sarracenia rosea Naczi, F.W.Case, & R.B.Case, sp. nov. (**Figs. 3, 8**). TYPE: U.S.A. FLORIDA. Liberty Co.: SW of Telogia, Apalachicola National Forest, 17 May 1993, *Naczi 3016* (HOLOTYPE: MICH*; ISOTYPES: NY*, US*).

Sarracenia purpurea ssp. *venosa* (Raf.) Wherry var. *burkii* D.E.Schnell, Rhodora 95:8. 1993. TYPE: U.S.A. ALABAMA. Washington Co.: off U.S. 45 near Deer Park, 4 Apr 1992, *Schnell s.n.* (HOLOTYPE: NCU, n.v.). Schnell's taxonomic concept is clear from his color photograph (Schnell 1993:7).

A *Sarracenia purpurea* petalis roseis, scapis brevioribus (16.3–35.1 cm longis), floribus grandioribus (bracchiis stylorum 2.6–4.1 cm longis), labiis ascidiorum crassioribus (2.6–7.5 mm crassis), labiis ascidiorum profunde curvis bases versus ascidiorum in speciminibus exsiccatis dorsiventraliter complanatis differt.

Perennial herb. **Rhizomes** usually horizontal, occasionally vertical, 1.2–5.8 cm long, 0.8–1.8 cm wide. **Pitchers** decumbent to ascending, in basal rosettes, 4–9 in each rosette, 5.9–28.1 cm long, 2.3–6.8 cm wide at tube, 2.1–5.3 times as long as wide, hooded terminally, lipped at mouth, tube arcuate, winged exteriorly on adaxial surface of tube, petiolate. **Hood** erect, reniform to broadly cordate, apex usually slightly recurved and thus often emarginate in dorsiventrally pressed pitchers, otherwise entire, usually coarsely wavy in abaxial-adaxial plane in life, unconstricted at base and broadly attached to tubular portion of pitcher, 1.8–6.1 cm high, 3.3–13.4 cm wide, 1.5–3.7 times as wide as high, extending laterally from pitcher mouth 0.8–4.2 cm on each side, extending basally from pitcher mouth 0.7–2.8 cm on each side; adaxial surface pubescent with moderately dense, coarse, stiff, decurved hairs 1.0–2.1 mm long, coarsely reticulately veined with veins usually deep red or purple-red and contrasting with background, background pale green or pale green suffused with purple-red; abaxial surface pubescent with moderately dense, fine, soft, appressed hairs 0.3–0.8 mm long, color as on adaxial surface except color of veins usually contrasting less with background color. **Mouth** 1.9–5.3 cm wide; lip 2.6–7.5 mm thick, curved basally in dorsiventrally pressed pitchers, with maximum distance from horizontal at junction of lip and wing, this maximum distance 2.4–9.7 mm. **Tube** obovate in dorsiventrally pressed pitchers, slightly constricted apically to wide mouth, gradually tapered basally to narrow petiole, 3.3–17.0 cm long, 2.3–6.8 cm wide; ventricose in laterally pressed pitchers, strongly outcurved abaxially, plane or slightly incurved adaxially; pubescent with moderately dense, fine, soft, appressed hairs 0.3–0.8 mm long except glabrous or sparsely pubescent on abaxial surface; pale green or pale green suffused with dull purple-red, frequently with longitudinal veins and some cross-veins dull red and contrasting with paler background. **Wing** semi-oblanceolate to semicircular, 3.2–16.6 cm long, 0.6–5.4 cm wide, pubescence and color as on tube. **Petiole** solid, 0.2–6.3 cm long, decurved or straight, glabrous. **Flowers** pendent, borne singly on scapes, bracteate. **Scape** 16.3–35.1 cm high, 1.1–

2.8 times as long as longest pitcher per plant, 2.5–5.4 mm wide at mid-height, distally abruptly decurved to point of attachment with flower. **Bracts** appressed to calyx, 3, broadly ovate, obtuse, entire, 5–8 mm long, 4–7 mm wide, glabrous, persistent through death of scape and shedding of seeds. **Calyx** 5.7–10.6 cm wide in pressed flowers; sepals proximally imbricate, distally non-overlapping, 5, ovate, obtuse, entire, 3.1–4.7 cm long, 1.7–3.8 cm wide, 1.4–2.3 times as long as wide, glabrous; adaxial surface usually very pale green, with deep purple-red margin at anthesis and for a short time afterward, purple-red margin fading to pale green with age; abaxial surface usually deep purple-red to pale purple-red, rarely pale green; persistent as long as scape and pericarp remain green. **Corolla** 8.7–13.2 cm wide in pressed flowers; petals non-overlapping, 5, pandurate, obtuse, entire, 4.5–6.4 cm long, limb 2.9–4.2 cm long and 2.0–3.5 cm wide, base 1.5–2.3 cm long and 1.5–2.2 cm wide, isthmus 1.1–1.8 cm wide, glabrous, very pale to deep pink or very rarely pale yellow in life, rose to lavender or rarely nearly white when recently dried, fading to pale brown or whitish when dry for a longer time, color of adaxial surface same as color of abaxial surface, shed soon after pollen release. **Androecium** of numerous stamens, 2.4–3.1 cm wide in pressed flowers; filaments 6–13 mm long; anthers 2.7–4.0 mm long, 2.0–3.5 mm wide, yellow to red-brown; shed soon after pollen release. **Gynoecium** of 5 connate carpels; ovary globose, 0.9–1.3 cm high, 1.1–1.4 cm wide, very densely verrucose, pale green or whitish; style basally styliform, styliform portion 0.8–1.0 cm long, apically abruptly expanded and umbraculiform, persistent through death of scape and shedding of seeds; stigmas 5. **Style expansion** pentagonal, each angle slightly elongated and forming a short and emarginate lobe, otherwise entire, 4.8–7.4 cm wide, adaxial surface pubescent and glandular-puncticulate, abaxial surface pubescent and glandular-puncticulate, ribbed, membranous during anthesis, thickening soon after anthesis and becoming coriaceous, pale green to nearly white and sometimes lightly suffused with purple-red; lobes 0.4–1.0 cm long, 0.2–0.3 times as long as style arms, notches 2.9–6.2 mm deep; hairs on adaxial surface of style expansion moderately dense, erect, fine, 0.2–0.6 mm long; hairs on abaxial surface of style expansion sparsely to moderately dense, erect, fine, 0.2–0.5 mm long; glands sparsely to moderately dense on adaxial surface of style expansion, moderately dense on abaxial surface of style expansion, slightly raised, depressed-dome-shaped, 0.06–0.13 mm wide, usually pale to deep red-brown, most prominent during anthesis, becoming obscure with thickening of style expansion; ribs 5, each radiating from center of style expansion and terminating in stigma; style arms 2.6–4.1 cm long, 0.078–0.20 as long as scapes. **Stigmas** 0.2–0.6 mm long, 0.4–0.5 mm wide, each restricted to apex of papilla; papillae 5, each in base of notch of style expansion, perpendicular to lobes of style expansion, 0.8–1.6 mm long. **Capsule**

TABLE 1. Morphologic characters that best distinguish *Sarracenia rosea* from *S. purpurea*. Quantitative data are means ± 1 SD and ranges for measurements. *N* = number of specimens measured. The two species differ significantly for all quantitative characters (*t*-test, $P < 0.001$). The quantitative characters are listed in descending order of *t*-value.

Character	*S. rosea*	*S. purpurea*	*t*-value
1. lip thickness (mm)	4.5 ± 1.1 (2.6–7.5) *N* = 48	1.8 ± 0.5 (0.7–3.1) *N* = 85	19
2. scape height/style arm length	8.2 ± 1.8 (4.9–13) *N* = 52	18 ± 4.5 (9.5–33) *N* = 86	18
3. scape height (cm)	25.9 ± 5.03 (16.3–35.1) *N* = 52	44.2 ± 11.3 (22.3–79.1) *N* = 86	13.4
4. style arm length (cm)	3.2 ± 0.34 (2.6–4.1) *N* = 52	2.5 ± 0.44 (1.7–3.8) *N* = 86	9.9
5. lip concavity, maximum distance from horizontal (mm)	5.0 ± 1.7 (2.4–9.7) *N* = 34	0.7 ± 1 (0–5.3) *N* = 65	8.4
6. hairs on adaxial surface of hood, length (mm)	1.5 ± 0.21 (1.0–2.1) *N* = 47	1.2 ± 0.3 (0.6–2.2) *N* = 83	7.5
7. petal length (cm)	5.1 ± 0.48 (4.5–6.4) *N* = 18	4.1 ± 0.45 (3.3–5.3) *N* = 25	7.4
8. scape height/longest pitcher length	2.0 ± 0.47 (1.1–2.8) *N* = 17	3.3 ± 0.74 (1.9–5.2) *N* = 37	7.1
9. sepal length (cm)	3.8 ± 0.41 (3.1–4.7) *N* = 34	3.2 ± 0.42 (2.2–4.2) *N* = 74	6.8
10. mouth width (cm)	3.3 ± 0.72 (1.9–5.3) *N* = 39	2.4 ± 0.44 (1.4–3.6) *N* = 74	6.5
11. petal width (cm)	2.7 ± 0.35 (2.0–3.5) *N* = 18	2.1 ± 0.32 (1.6–2.9) *N* = 25	5.8
12. petal color	usually pink	usually maroon or red	

depressed-globose, 1.1–1.4 cm high, 1.6–2.1 cm wide, densely verrucose, brown, dehiscing basipetally. **Seeds** obovate or oblong in outline, compressed, narrowly ridged along one lateral margin, pyriform in cross-section, 1.8–2.3 mm long, 1.0–1.4 mm wide, brown, verruculose, often slightly glaucous because of a thin coating of wax.

FIG. 3. (Left) *Sarracenia rosea* flowering in the field. Florida, Liberty Co., 15 March 1994, *Naczi 3651*.

FIG. 4. (Right) *Sarracenia purpurea* flowering in the field. Michigan, Chippewa Co., 1995.

Diagnostic Features

Several morphologic features distinguish *S. rosea* from *S. purpurea* (Table 1). The most obvious diagnostic feature is petal color. *Sarracenia rosea* usually has pink petals (Fig. 3), whereas *S. purpurea* has maroon or red petals (Fig 4). Closely correlated with the paler petals of *S. rosea* are paler gynoecia (Schnell 1993), though we have observed *S. purpurea* with pale gynoecia, too. While Schnell (1993) emphasized the pink coloration of the petals in his diagnosis of *S. purpurea* var. *burkii*, previous researchers believed pink petals were the result of a mutation (Wherry 1933) or of a phenotypic response to low light levels (Bell 1949). Through field observations and greenhouse cultivation, we confirm that pink is the predominant color for petals of *S. rosea*. Indeed, among the species (not hybrids) of *Sarracenia*, pink petals are unique to *S. rosea*.

In *S. rosea*, petal color ranges from very pale pink (almost white) to deep pink. Most commonly, the pink is of medium saturation (as in Fig. 3). Bell (1949: 157) mentioned observing *S. rosea* (as *S. purpurea*) near Bay Minette, Alabama that had dark red petals. We agree with Schnell (1993) that such plants are likely introgressants with one of the species that possesses maroon petals, most likely *S. leucophylla* Raf. Putative hybrids of *S. leucophylla* and *S. rosea* (as *S. purpurea*) are reported from several localities, including Bay Minette (Bell 1949, 1952; Bell & Case 1956; McDaniel 1971). Very rarely, plants of both *S. purpurea* and *S. rosea* produce yellow petals, due to failure of anthocyanin production (Sheridan & Mills 1998a, 1998b; Hanrahan & Miller 1998). These yellow-flowered plants also lack reddish coloration

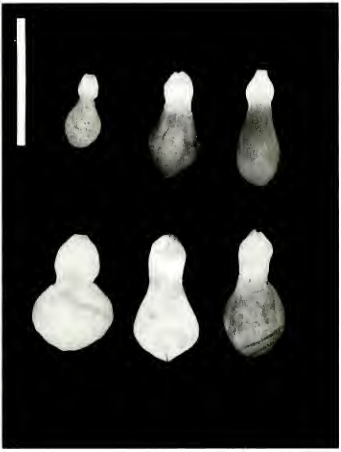

FIG. 5. Petals of *Sarracenia purpurea* (top row) and *S. rosea* (bottom row). Petals pressed and dried from wild, sun-grown plants. Top row (left to right): Pennsylvania, Bradford Co., *Naczi 4322*; Ontario, Thunder Bay Distr., *Garton 18798*; New Jersey, Burlington Co., *Naczi 156A*, 5 Jun 1982. Bottom row (left to right): Florida, Liberty Co., *Kral 63291*; Florida, Liberty Co., *Naczi 3651*; Alabama, Mobile Co., *Kral 16530*. Scale bar = 5cm.

in pitchers and calyces. This variation of *S. purpurea* is *S. purpurea* f. *heterophylla* (Eaton) Fernald. For *S. rosea*, the analogous form has been described by Hanrahan and Miller (1998), but must be transferred from *S. purpurea*, as we do here.

Sarracenia rosea f. **luteola** (Hanrahan & Miller) Naczi, F.W.Case, & R.B.Case, comb. nov. BASIONYM: *Sarracenia purpurea* ssp. *venosa* var. *burkii* f. *luteola* Hanrahan & Miller, Carniv. Pl. Newslett. 27:16. 1998.

In addition to petal color, we found that nearly every feature of the flower is substantially larger in *S. rosea* than in *S. purpurea*. The sepals of *S. rosea* are 3.1–4.7 cm long, whereas those of *S. purpurea* are only 2.2–4.2 cm long. The petals of *S. rosea* are longer and wider than those of *S. purpurea* (Fig. 5): 4.5–6.4 cm long and 2.0–3.5 cm wide for *S. rosea* versus 3.3–5.3 cm long and 1.6–2.9 cm wide for *S. purpurea*. Style size, as measured by style arm length, is greater for *S. rosea* (2.6–4.1 cm) than *S. purpurea* [1.7–2.9(–3.8) cm].

The scapes of *S. rosea* are relatively short, only 16.3–35.1 cm high versus 22.3–79.1 cm high for *S. purpurea*. These short scapes are remarkable in

FIG. 6. Fruiting plant of *Sarracenia purpurea* (left) and of holotype of *S. rosea* (right). Collected from sunny habitats in the wild and pressed and dried. Left: Ontario, Dufferin Co., *Naczi 4514*. Right: Florida, Liberty Co., *Naczi 3016*. Scale bar = 5cm.

light of the comparatively large flowers of *S. rosea*. As a result, the ratio of scape height/style arm length is a particularly strong quantitative character in separating *S. rosea* from *S. purpurea* (Table 1). The values of this ratio are 4.9–13 for *S. rosea* and 9.5–33 for *S. purpurea*. The visual difference between the two species in flower size-scape height proportions is striking (Fig. 6).

Several vegetative characters are also diagnostic. First, the lips of *S. rosea* are thicker than those of *S. purpurea* (Fig. 7): 2.6–7.5 mm thick for *S. rosea* versus 0.7–3.1 mm thick for *S. purpurea*. Second, in dorsiventrally pressed pitchers, the lips of *S. rosea* curve basally, forming a relatively deep concavity. The lips of *S. purpurea* are horizontal or form a shallow concavity. Thus, the maximum distance of the lip from horizontal (the maximum depth of the concavity) is greater in *S. rosea* than *S. purpurea* (Fig. 7): 2.4–9.7 mm for *S. rosea* versus 0–5.3 mm for *S. purpurea*. A third diagnostic feature from the pitchers is the length of the stiff, decurved hairs on the adaxial surface of the hoods. In *S. rosea*, these hairs are (1.0–)1.3–2.1 mm long, whereas they are 0.6–1.6(–2.2) mm long in *S. purpurea*. Fourth, the pitchers of *S. rosea* are relatively thin-walled, while those of *S. purpurea* are thicker. Probably as a result of this difference in thickness, overwintered pitchers of *S. rosea* exhibit slight to extensive winter-kill. Pitchers of *S. purpurea* are evergreen, even on plants in the northern portion of its range.

The pitchers of *S. rosea* tend to be larger than those of *S. purpurea* (Fig. 7).

FIG. 7. (Left) Pitchers of *Sarracenia purpurea* (top row) and *S. rosea* (bottom row). Pitchers pressed and dried from wild, mature, and sun-grown plants. Top row (left to right): Ontario, Dufferin Co., *Naczi 4514*; New Jersey, Burlington Co., *Naczi 4433*; North Carolina, Montgomery Co., *Naczi 1975*. Bottom row (left to right): Florida, Liberty Co., *Naczi 3016*; Mississippi, George Co., *Naczi 3057*; Alabama, Mobile Co., *Naczi 3066*. Scale bar = 5cm.

FIG. 8. (Right) Pitchers of *Sarracenia rosea*. Pitchers pressed and dried from wild, mature, and sun-grown plants. Top row (left to right): Alabama, Mobile Co., *Naczi 3053*; Alabama, Mobile Co., *Naczi 2809*; Florida, Escambia Co., *Naczi 3051*. Bottom row (left to right): Alabama, Mobile Co., *Naczi 3066*; Mississippi, George Co., *Naczi 3057*. Scale bar = 5cm.

As a result, the ratio of scape height/longest pitcher length differs for the two species: 1.1–2.8 for *S. rosea* and 1.9–5.2 for *S. purpurea*. Also, pitchers of *S. rosea* have wider mouths (1.9–5.3 cm wide) than those of *S. purpurea* (1.4–3.6 cm wide). However, we find most pitcher dimensions and shapes to be practically useless in unambiguously separating *S. rosea* and *S. purpurea*. Pitchers of both species are quite variable in size and shape (Figs. 7, 8). Measurements of many pitcher characters we studied (pitcher length, pitcher width, hood height, hood width, width of the portion of the hood that extends laterally from the mouth, wing width, pitcher length/pitcher width, hood width/hood height, hood height/pitcher length, hood width/pitcher length, hood height/mouth width, hood width/mouth width, mouth width/pitcher length, mouth width/pitcher width, wing width/pitcher length) overlap extensively for *S. rosea* and *S. purpurea*. The *t*-values for measurements of these characters are all lower than for any of the characters listed in Table 1.

Some of the quantitative characters exhibit clinal variation across the combination of *S. purpurea* and *S. rosea* (Fig. 9A). For example, style arm length is highly correlated with latitude in the combined data set (r =

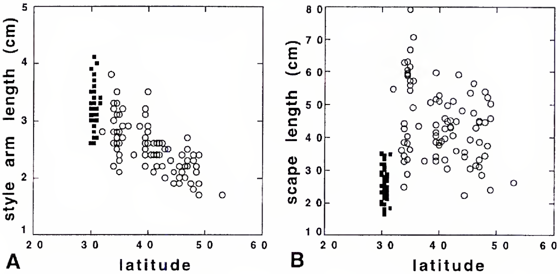

FIG. 9. Scatter plots of some diagnostic features vs. latitude for *Sarracenia purpurea* (open circles) and *S. rosea* (solid squares). A. Cline in style arm length. B. Absence of cline in scape length.

-0.76, $p < 0.001$, $N = 138$), as is length of hairs on the adaxial surface of the hoods ($r = -0.75$, $p < 0.001$, $N = 130$). However, several other characters do not exhibit clinal variation (Fig. 9B). For example, scape length has a very low correlation with latitude ($r = 0.377$, $p < 0.001$, $N = 138$), as does the ratio of scape length/longest pitcher length ($r = 0.34$, $p = 0.012$, $N = 54$). The diagnostic characters that are nonclinal indicate *S. rosea* is not merely the extreme of a cline of *S. purpurea*, but rather a taxon distinct from it.

In summary, several characters can be used to separate *S. rosea* from *S. purpurea* (Table 1). The quantitative features that are the best for distinguishing the species, based on having the highest t-values, are both vegetative (lip thickness) and reproductive (scape height/style arm length). Though ranges of measurements for all of the quantitative characters overlap for both species, a scatter plot of scape height/style arm length versus lip thickness separates specimens of *S. rosea* and *S. purpurea* (Fig. 10). This plot and the wealth of other diagnostic features for *S. rosea*, including qualitative characters, clearly indicate *S. rosea* is distinct from *S. purpurea* at the rank of species.

Evidence from additional sources also indicates *S. rosea* deserves recognition as a species. In greenhouse cultivation, the differences between *S. rosea* and *S. purpurea* are maintained. Under common greenhouse conditions for 15 years or more, plants from 7 populations of *S. rosea* continue to possess pink petals, short scapes, thick lips, and deeply concave lips while plants of *S. purpurea* from 8 populations continue to possess maroon petals, tall scapes, thin lips, and horizontal or shallowly concave lips, as examples of some of the differences that are maintained during common cultivation. These re-

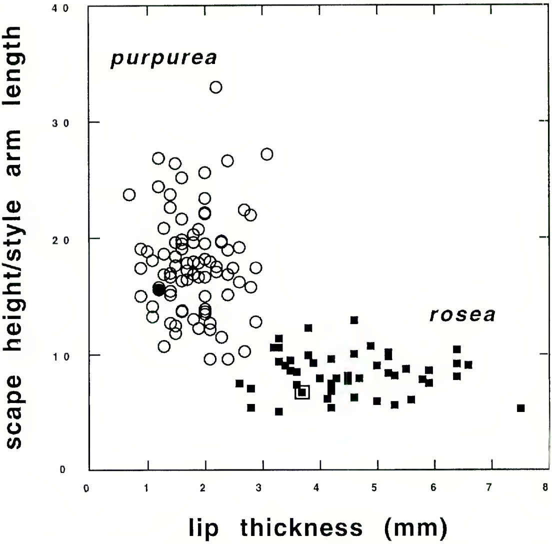

FIG. 10. Scatter plot of scape height/style arm length vs. lip thickness for *Sarracenia purpurea* and *S. rosea*. Open circles represent specimens of *S. purpurea*. The solid circle represents the lectotype of *S. purpurea*, plate 70 of Catesby (1738). Solid squares represent specimens of *S. rosea*, with the boxed square depicting the holotype.

sults suggest the differences we have noted between the species are genetically-based. A second additional source of support for recognizing *S. rosea* comes from allozyme analysis of the *S. purpurea* complex. Godt and Hamrick (1999) discovered that *S. rosea* (as *S. purpurea* var. *burkii*) is the most genetically divergent member of the complex. In addition, the genetic distance between *S. rosea* and *S. purpurea* is relatively large and is similar to that found between many congeneric species (Gottlieb 1977, 1981; Crawford 1983).

Nomenclature

We are unaware of any prior names at the rank of species that apply to *S. rosea*. None of Rafinesque's (1840) names for *Sarracenia* (as "*Sarazina*") appear to apply to *S. rosea*, though the applications of these names are some what uncertain. Geographically, four of these new names could fit *S. rosea*. Rafinesque stated his *S. venosa*, "...differs from *S. gibbosa* [a northern-ranging new species of his, under which he lists *S. purpurea* as a synonym], by ... flowers smaller—Virg. ad Florida." Clearly, *S. venosa* cannot apply to the large-flowered *S. rosea*. As well, *S. parviflora* Raf. ("... appendice [hood] concavo fornicato ... very distinct sp. of Florida, yet akin to the last [*S. venosa*], leaves 3 to 6 inches long, nervose, flowers very small, purplish.") does not apply to *S. rosea*. Most likely, *S. parviflora* is a synonym of *S. psittacina* Michx. (a quite distinctive species having small flowers and relatively short pitchers with strongly arched and concave hoods), though McDaniel (1971) placed *S. parviflora* in synonymy with *S. purpurea*. Both *S. acuta* Raf. ("fol. tubul. longiss. nervosis ala angustissima ... Alabama ...") and *S. adunca* Raf. ("... fol. tubul. longis ... ala angust. ... Florida ...") do not apply because *S. rosea* has short pitchers with wide wings. Also, *S. adunca* Raf. is preoccupied by *S. adunca* Sm., 1805, a synonym of *S. minor* Walter. Unfortunately, botanists probably will never know the application of Rafinesque's names in *Sarracenia*.Most of Rafinesque's herbarium was discarded soon after his death in 1840 (Stuckey 1971). Previous workers have not located types of Rafinesque's names in *Sarracenia*. Searches by us and herbarium curators for Rafinesque specimens at DWC, G, NY, P, PH, and WIS have been fruitless.

McDaniel (1971) lectotypified *S. purpurea* with plate 70 of *The Natural History of Carolina, Florida and the Bahama Islands* (Catesby 1738). Catesby did not mention the provenance of the illustrated specimen, but most likely it was outside the range of *S. rosea*. His "Map of Carolina, Florida and the Bahama Islands, with the Adjacent Parts" indicates the Florida of his day ranged only as far west as the present-day Aucilla River, east of the range of *S. rosea*. Nevertheless, the possibility that Catesby obtained the plant from further west means the plate must be evaluated before *S. rosea* can be accepted as a correct name. Although the petals are anomalously purplish pink (though described by Catesby as "...of a purple colour..." in text accompanying plate 70), the species illustrated in the plate is otherwise typical *S. purpurea*. Measurements of the plate for nearly every diagnostic character lie within the range for *S. purpurea*, but several are outside the range for *S. rosea*. For example, lip thickness is 1.2 cm, style arm length is 2.1 cm, and the ratio of scape height/style arm length is 16. In addition, the lips appear to be horizontal, not concave, though the partially obscuring hoods make the determination of this condition somewhat uncertain. Measurements of the Catesby plate fall well within the cluster of specimens of *S. purpurea* in the plot of scape height/style arm length versus lip thickness (Fig. 10).

Etymology

We have chosen "rosea," meaning pink, as the epithet for this new species because of its distinctively colored petals. This epithet is descriptive, easily comprehended, and is in the tradition of several other specific epithets in the genus by applying to flower color (e.g. *S. flava* L., *S. rubra* Walter, and *S. purpurea*). We use a new epithet for this species, rather than transfer the epithet used when this taxon was treated as a variety (Schnell 1993), as permitted by article 11.2 of the *International Code of Botanical Nomenclature* (Greuter et al. 1994). Our choice is intended to avoid confusion of ranks that may ensue from using the same epithet for both variety and species. Furthermore, by using a new epithet, we underscore the recognition of *S. rosea* as a species with a suite of features that differentiate it from *S. purpurea*.

Phenology

The flowering period of *S. rosea* extends from mid-March to mid-April, with the peak in the last 10 days of March. The earliest flowering date of herbarium specimens is 14 March and the latest is 20 April. At the time of flowering, pitchers of the current season are usually undeveloped or incompletely developed. Overwintered pitchers are present at the time of flowering, but these are often slightly to nearly completely brown and withered due to winter-kill (Fig. 3).

Typification

For the holotype of *S. rosea* (Fig. 6), we have selected a post-anthesis specimen because it has fully developed pitchers of the current season. In addition, the holotype has the thickened style expansion typical of post-flowering plants. Such a style expansion is less prone to damage than the fragile ones of plants during anthesis. The holotype is quite representative of *S. rosea* for key quantitative features (Fig. 10). Plants observed from the same population as the holotype in the following year uniformly bore flowers with pink petals (*Naczi 3639*).

Distribution

Sarracenia rosea ranges from southwestern Georgia (Tift County) and northwestern Florida (Gadsden County) west to George and Jackson counties, southeasternmost Mississippi (Fig. 11). It occurs solely on the Coastal Plain in the drainage of the Gulf of Mexico. Most populations are within 120 km (75 mi) of the coastline. McDaniel (1966) cites a specimen of *S. purpurea* from Taylor County, Georgia, which we have not seen, that is probably *S. rosea*. The collection locality lies within the Gulf of Mexico drainage, but it is farther north than any other population known and about 300 km (185 mi) from the coast. The range of *S. rosea* is almost identical to that of *S. leucophylla* (McDaniel 1971), with which it often grows.

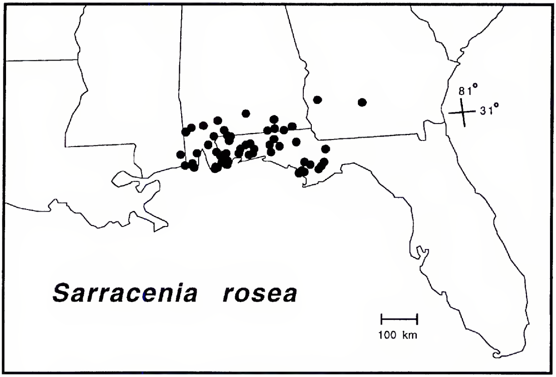

FIG. 11. Distribution of *Sarracenia rosea*, based on voucher specimens we examined.

Sarracenia rosea and *S. purpurea* are allopatric. *Sarracenia purpurea* ranges further north and east of *S. rosea*. The collection of *S. purpurea* that is closest to the range of *S. rosea* is from Tattnall County, Georgia (*Harper 2151*). Thus, a minor disjunction of about 135 km (85 mi) separates the ranges of *S. rosea* and *S. purpurea*. More significantly, *S. purpurea* is apparently absent from the Gulf of Mexico drainage, the Tarrnall County site and all other localities in the southeastern U.S.A. being in the Atlantic drainage.

Based on two specimens, *S. purpurea* is reported from Louisiana (MacRoberts & MacRoberts 1988). One would expect these collections to be *S. rosea*, since Louisiana is in the Gulf of Mexico drainage and far from the range of *S. purpurea*. The attribution of *S. rosea* to Louisiana based on these collections is problematic, though. The original label of one of these collections (US 782242) reads, "Sarracenia purpurea/wet pine woods/St. Helena, La." With its lip 1.4 mm thick, lip's maximum distance from horizontal of 1.6 mm, scape height of 42.4 cm, and style arm length of 2.4 cm, this collection is clearly *S. purpurea*, not *S. rosea*. The second collection reputed to be a voucher from Louisiana (LSU 006607) has "Saraceniaceae [sic]/Sarracenia rubra Walt./Red flowered Trumpetleaf/Covington/AF. ["AL."?]" handwritten on the original label. The specimen is quite fragmentary; it consists of two isolated, laterally pressed pitchers and a portion of a scape bearing only 2 sepals (3 sepals, corolla, androecium, and gynoecium are all lacking). This specimen is also

S. purpurea, since the lip is only 1.1 mm thick. The scape fragment is 30.1 cm high and the longer sepal is 3.3 cm long, both of which are inconclusive since these measurements fall within the range of overlap between *S. purpurea* and *S. rosea*. The collection locality of this specimen may not be Louisiana. The script leaves determination of the final pair of letters equivocal. Instead of "...Covington/AF. [Americus Featherman, a collector in late 19th-century Louisiana]" (MacRoberts & MacRoberts 1988), the label may actually read "...Covington/AL." Thus, the label may actually indicate Covington County, Alabama. The single period after the final pair of letters (*not* after each letter, as one would expect if the correct reading is "A.F.") supports this interpretation. Further support is the fact that *S. rubra* is unknown from Louisiana (Murry & Urbatsch 1979), but does occur in Covington County, Alabama (e.g., *MacDonald 13556*, IBE). Whatever its origin, the specimen does not appear to belong with its label since it is neither *S. rubra* nor *S. rosea*, which would be expected if the collection came from either Covington, Louisiana or Covington County, Alabama. In light of the evidence, we advise caution when considering the inclusion of *S. purpurea* in the flora of Louisiana. It seems more reasonable to discount the two specimens because of possible labeling errors than to accept the disjunct occurrence of *S. purpurea* in Louisiana, a disjunction of about 800 km (500 mi) southwest from the nearest population in Tattnall County, Georgia.

Habitats

Sarracenia rosea usually grows in sunny to lightly shaded, wet, sandy, acid soil in relatively open sites, often with scattered pines and shrubs. Populations of *S. rosea* also occur in ditches, shrubby thickets, edges of swamps, and the dense shade of swamp interiors. In swamps, population densities and the proportion of flowering or fruiting plants are lower than in sunnier habitats. Using the terminology for pitcher plant habitats of Folkerts (1991), most populations of *S. rosea* we have observed inhabit seepage bogs and savannas, though we have also observed them in stream terraces and swales. Usually, *S. rosea* grows with other *Sarracenia* species. We have observed it growing with *S. alabamensis* F.W.Case & R.B.Case ssp. *wherryi* F.W.Case & R.B.Case, *S. alata* (A.W.Wood) A.W.Wood, *S. flava*, *S. leucophylla*, *S. psittacina*, and *S. rubra* ssp. *gulfensis* D.E.Schnell.

Conservation

Most populations of *S. rosea* are in the western panhandle of Florida and adjacent southernmost Alabama. It is very rare in Mississippi. We have seen neither populations nor recent collections from Georgia. Where they occur, plants of *S. rosea* can be numerous. However, populations are infrequent and local in the small geographic range of *S. rosea*.

Folkerts (1977, 1982, 1990) has documented the extensive destruction of pitcher plant habitats and the consequent decline of pitcher plant abundance. Our experiences have shown habitat destruction and fire suppression to be among the most serious threats to *S. rosea*. Many other menaces exist, though. Despite the availability of reasonably priced, commercially cultivated plants of *S. rosea*, overcollection from the wild damages many populations. Twice, when visiting a locality where we had studied *S. rosea* populations, we discovered recently-dug holes and most of the plants missing. Since *S. rosea* appears to be an uncommon species, is exceptionally attractive, and faces many threats to its survival, we recommend its current conservation status be reviewed and it be considered for protection throughout its range.

KEY TO *SARRACENIA ROSEA* AND *PURPUREA*

Petals usually pink, lip 2.6–7.5 mm thick at thickest point, lip usually deeply curved toward pitcher base, scape 16.3–35.1 cm high, style arm 2.6–4.1 cm long, scape height/style arm length = 4.9–13 .... **Sarracenia rosea**

Petals usually maroon or red, lip 0.7–3.1 mm thick at thickest point, lip usually horizontal or shallowly curved toward pitcher base, scape 22–79 cm high, style arm 1.7–2.9(–3.8) cm long, scape height/style arm length = 9.5–3 .... **Sarracenia purpurea**

Representative Specimens

Specimens marked with an asterisk are those we measured for statistical analyses. **U.S.A. ALABAMA. Baldwin Co.:** Gateswood, 1 May 1903, *Tracy s.n.* (NY, US*); near Bay Minette, 30 May 1932, *Thut s.n.* (OS); 2 mi W of Seminole along route 90, 3 Apr 1966, *Kral 26187* (IBE, MICH*, VDB*); 5 mi N of Romar Beach, 26 Jul 1969, *Ellis 90* (VDB*); ca. 5 mi S of Foley on route 56, 19 Apr 1970, *Kral 38766* (VDB*); 2.6 mi S of Bay Minette, 18 May 1975, *LeLong 8482* (USAM); Gulf shores, 22 May 1975, *Kral 55708* (VDB*); Along highway 90, between Elsanor and Seminole, 23 Aug 1975, *LeLong 8631* (USAM); Off S side route 90, 14 May 1983, *Wilhelm 11333* (VDB*); N of Perdido, 18 Aug 1984, *Naczi 691 & Folkerts* (KNK); By route 112, ca. 10 mi N of Perdido River bridge, 3 May 1987, *Kral 73905* (VDB*); ca. 11 mi N of Stockton, 17 May 1987, *Naczi 1605* (KNK); N of Elberta, 28 Apr 1988, *Naczi 1803* (KNK); Perdido, 22 May 1993, *Naczi 3070* (KNK*). **Coffee Co.:** 1.5 mi NE of Kinston, 9 Jul 1932, *Wherry s.n.* (PH). **Conecuh Co.:** Highway 31 at Travis Bridge, Sepulga River, 2 Aug 1985, *Diamond 1367* (AUA). **Covington Co.:** highway 4, 13 Apr 1998, *MacDonald 11048* (IBE). **Escambia Co.:** ca. 1.5 mi E of Wawbeek, 8 Jun 1969, *Kral 35147*(IBE, VDB*); interstate 65 between routes 21 and 17, 16 May 1971, *Evans 46180* (NCU, TENN, VDB*); Little River State Park, 30 May 1982, *Whilhelm 10132* (VDB*); WNW of Flomaton, S of Big Escambia Creek, 27 Jun 1993, *Anderson 14411* (FSU). **Geneva Co.:** 2 mi S of Hartford, 14 May 1972, *Hanning155* (AUA); ca. 9 mi SW of Samson, 29 May 1998, *MacDonald 11314* (IBE). **Mobile Co.:** Whistler, 18 Apr 1895, *Mohr s.n.* (US 782237*); Whistler, 18 Apr 1895, *Mohr s.n.* (US 782240*); Whistler, Mar 1918, *Graves s.n.* (MO*); Irvington, 30 Mar 1951, *Liggett 1711* (FLAS*); ca. 7 mi W of Citronelle, 7 Apr 1963, *Kral 16530* (FSU, VDB*); 3.3 mi N of Citronelle, by route 45, 3 Jun 1970, *Kral 39598* (VDB*); Along highway 188 to Coden, 23 Mar 1974, *Lelong 7450* (USAM, VDB*); W of Citronelle, along Escatawpa River, 30 Mar 1974, *Lelong 7512* (USAM, VDB*);

along highway 90, E of state line, 24 Mar 1976, *Lelong 9046* (USAM*); ESE of Bayou La Batre, 29 Apr 1988, *Naczi 1804* (KNK), 27 Apr 1991, *Naczi 2809* (KNK), 21 May 1993, *Naczi 3053* (KNK*); W of Citronelle, 22 May 1993, *Naczi 3066* (KNK*). **FLORIDA. Bay Co.:** Mill Bayou, St. Andrews Bay, 17 Mar 1926, *Banker 3556* (NY); Youngstown, 16 Mar 1937, *Exploration Party 1937* (FLAS); Panama City, 20 Mar 1943, *Sargent s.n.* (US*); 8 mi E of Panama City, 25 Mar 1949, *Hood 1699* (FLAS); Parker, 15 Apr 1971, *Athey s.n.* (WKU). **Calhoun Co.:** Myron, 5 May 1930, *Moldenke 1158* (MO*, NY); ca. 0.5 mi N of Kinard, 14 Sep 1979, *Judd 2382* (FLAS*). **Escambia Co.:** Bluff Springs, 13 Apr 1935, *Tisdale s.n.* (FLAS); 3 mi N of Cantonment, 22 Jun 1963, *McDaniel 3553* (IBE); 3 mi ESE of Pleasant Grove, 5 May 1978, *Hansen & Hansen 4784* (FSU*); Pensacola, 19 May 1993, *Naczi 3051* (KNK*). **Gadsden Co.:** inter Quincy et Aspalaga, in pinetis, May 1843, *Rugel s.n.* (US*), in uliginosis ad rivulos, May 1843, *Rugel s.n.* (FLAS, NY); [no additional locality data], [no date], *Chapman s.n.* (NY); SW of Quincy, 23 Apr 1924, *Small 11214, DeWinkeler, & Mosier* (NY). **Holmes Co.:** E of Ponce de Leon, 29 Nov 1929, *Hume s.n.* (FLAS); Ponce de Leon, 18 Mar 1937, *Exploration Party 1937* (FLAS*); SW of Leonia, 4 Apr 1958, *Godfrey 56393* (FSU*, NCU). **Liberty Co.:** 6 mi N of Vilas, 26 Feb 1956, *Kral 1965, Godfrey, & Kurz* (FSU); 4 mi N of Sumatra, 6 Oct 1963, *McDaniel 3795* (IBE); 4.2 mi N of Wilma, 6 May 1976, *Kral 57908* (IBE, VDB*); *Kral 63291* (VDB); S of junction of route 65 and route 20, 20 May 1976, *Solomon 2159* (MO*); N of Wilma, 20 May 1976, *Solomon 2180* (MO*); 21.3 mi S of Hosford, 6 Aug 1980, *Chancellor 18* (USCH*); 6 mi S of Telogia, 16 Apr 1987, *Godfrey 82347* (FSU*); S of Wilma, 21 May 1987, *Naczi 1614* (KNK); SW of Telogia [type locality], 14 Mar 1994, *Naczi 3639* (KNK*); N of Wilma, 15 Mar 1994, *Naczi 3651* (KNK*, MICH*, MO*, NY*), 4 Aug 1994, *Naczi 4502* (KNK*, MICH*); S of Wilma, 4 Aug 1994, *Naczi 4503* (KNK*). **Okaloosa Co.:** 4 mi N of Dorcas, 2 Aug 1954, *Ford 3973* (FLAS); ca. 3 mi SW of Crestview, 9 Jun 1960, *McArthur s.n.* (FLAS*); 1 mi E of Crestview, 7 Apr 1963, *Godfrey 62693* (FSU*); Eglin Air Force Base, Malone Creek, 30 Jul 1992, *Anderson 13814* (FSU); ca. 5 mi NW of Niceville, 18 May 1993, *Naczi 3026* (KNK*, MICH*); ca. 3.5 mi S of Crestview, 18 May 1993, *Naczi 3027* (KNK*); Eglin Air Force Base, Metts Creek, 24 Mar 1994, *Anderson 14698* (FSU). **Santa Rosa Co.:** N of Holt, 20 Apr 1960, *Godfrey 59425, Adams, & Henderson* (FSU, NCU); ca. 11 mi N of Holley, Eglin Air Force Reservation, 21 Jun 1967, *Smith 1549* (FLAS); ca. 6 mi N of Holley, 21 Jul 1977, *Perkins 329* (FLAS); NE of Holley, Eglin Air Force Base, 27 Mar 1994, *Anderson 14723* (FSU). **Walton Co.:** [no additonal locality data], summer 1885, *Curtiss s.n.* (NY); N of DeFuniak Springs, 30 Mar 1949, *Hood 1784* (FLAS); ca. 12 mi S of DeFuniak Springs, 4 Mar 1956, *Godfrey 54407* (FSU, NY); ca. 14 mi NE of Niceville, Eglin Air Force Reservation, 29 Jun 1966, *Beckner 1429* (FLAS*); ca. 2.5 mi S of Mossy Head, Eglin Air Force Reservation, 23 Oct 1966, *Chapman 171 & Chapman* (FLAS). **Washington Co.:** 4–5 mi SW of Chipley, 16 Apr 1937, *Hobbs s.n.* (FLAS). **GEORGIA. Randolph Co.:** SW of Coleman, 28 Oct 1902, *Harper 1783* (NY, US*). **Tift Co.:** Cycloneta [now Sunsweet], 4 Feb 1892, *Rolfs* (FLAS). **MISSISSIPPI. George Co.:** S of Agricola, 28 Mar 1964, *McDaniel 4044* (IBE); Movella, 21 May 1993, *Naczi 3057* (KNK*). **Jackson Co.:** ca. 1.5 mi NE of Orange Grove, near Jackson Creek, 16 Jun 1963, *McDaniel 3539* (IBE, TENN*).

APPENDIX

Measured Specimens of *Sarracenia purpurea*

CANADA. NEW BRUNSWICK. Restigouche Co.: Charlo, 1 Aug 1894, *Fowler s.n.* (US). **NEWFOUNDLAND.** Whitbourne, 16 Aug 1894, *Robinson & Schrenk 64* (US). 15 mi W of Gander, along shoreline of Gander River, 16 Jul 1949, *Bassett 498* (MO). **Placentia West Distr.:** Pipers Hole River Bridge, route 11, 25 Jul 1960, *Rouleau 5770* (US). **St. Mary's Distr.:** ca. 3.5 mi N of Riverhead, 16 Aug 1961, *Rouleau 7068* (US). **Labrador:** Goose Bay, 26 Jun 1950, *Gillett 5123 & Findlay* (US).

NOVA SCOTIA. Canso, 12 Jul 1901, *Fowler s.n.* (US). Cape Breton National Park, west side, 1 Sep 1947, *Swallen 9880* (US). **Inverness Co.:** Cape Breton Highlands National Park, White Capes region, 16 Jul 1970, *Uttal 7415* (FSU). **ONTARIO. Algoma Distr.:** 3 mi past Anjigami along road following powerline, 20 mi NE of highway 17, T28, R22, 47° 53'N, 84° 37'W, 15 Aug 1971, *Garton 14741 et al.* (MICH). **Bruce Co.:** 8 mi N of Southampton, South Sauble Beach, in Silver Lake, 17 Jun 1948, *Soper 3935 & Dale* (US). **Carleton Co.:** Carlsbad Springs, 25 Jun 1947, *Cody & Calder 517* (US). **Dufferin Co.:** ca. 5 mi NW of Grand Valley, Luther Marsh Wildlife Area, Wylde Lake, 19 Aug 1994, *Naczi 4514* (KNK). **Parry Sound Distr.:** Opposite Shawanaga Township, Big Island, off Eagle Lake, 23 Jul 1942, *McDonald 244* (US). **Renfrew Co.:** 5 mi E of Deux Rivieres, Gibson Lake, along S side of route 17, 18 Jun 1987, *Naczi 1701* (KNK). **Thunder Bay Distr.:** Sibley Provincial Park, SE side of Sibley Peninsula, back of Middlebrun Bay, 20 Jul 1961, *Voss 10138* (MICH); ca. 12–14 mi NW of Manitouwadge, 10 mi N of Nama Creek bridge on Manitouwadge-Caramat Industrial Road, 19 Jul 1964, *Voss 11639* (MICH); Thunder Bay City, just N of Northwood Park area, 26 Jun 1975, *Garton 16525* (MICH); 18 km. NW of Dotion on Spruce River cut-off, 1 Jul 1979, *Garton 18798* (MICH). **Wellington Co.:** 2.1 mi S of junction of Watson Road and Arkell Road in Arkell, 18 Aug 1994, *Naczi 4513* (KNK). **QUEBEC.** Magdalen Islands, Grindstone Island, Grindstone, 17 Jul 1912, *Fernald 7531 et al.* (US). **SAINT-PIERRE ET MIQUELON.** Ile Saint-Pierre, vicinité de ville Saint-Pierre, 24 Nov 1993, *Etcheberry s.n.* (KNK). **U.S.A. CONNECTICUT. Tolland Co.:** Stafford, Jul 1898, *Morris s.n.* (US). **DELAWARE. Sussex Co.:** E of Millsboro, 21 Jun 1924, *Tidestrom 12115* (US). **GEORGIA. Tattnall Co.:** Sand-hills of Ohoopee River near Reidsville, 26 Apr 1904, *Harper 2151* (MO). **INDIANA. Wells Co.:** Jackson Township, 24 Jul 1905, *Deam 91* (US). **MAINE. Hancock Co.:** Between Brooklin and Sedgwick, 8 Jul 1915, *Safford 83* (US). **MASSACHUSETTS. Norfolk Co.:** Canton, 26 May 1894, *Churchill s.n.* (MO); Canton, 11 Aug 1926, *Standley & Blake s.n.* (US). **MICHIGAN. Cheboygan Co.:** N of Riggsville, 8 Jul 1986, *Naczi 1400* (KNK). **Livingston Co.:** ca. 4.5 mi W of Brighton, 22 Aug 1994, *Naczi 4515* (KNK). **Mackinac Co.:** ca. 5 mi N of Epoufette, 6 Jul 1987, *Naczi 1742* (KNK). **MINNESOTA. Cass Co.:** Gull Lake, Jun 1893, *Ballard s.n.* (US). **St. Louis Co.:** 18 mi N of Duluth, 18 Jun 1939, *Lakela 2983* (MO). **NEW HAMPSHIRE. Coös Co.:** Shelburne, 19 Jun 1915, *Deane s.n.* (US). **Cheshire Co.:** Chesterfield, 21 Jul 1972, *Boufford 7243* (MO). **NEW JERSEY. Atlantic Co.:** 2 mi NW of Pleasant Mills, 26 May 1932, *Hermann 3054* (MICH); Pleasant Mills, 26 Nov 1993, *Naczi 3573 & Naczi* (KNK). **Bergen Co.:** Demarest, 30 May 1876, *Brown 1294* (MICH). **Burlington Co.:** Martha, along E side of Oswego River, 5 Jun 1982, *Naczi 156A* (KNK), 26 Nov 1993, *Naczi 3572 & Naczi* (KNK); ca. 4 mi N of Chatsworth, 26 Nov 1993, *Naczi 3563 & Naczi* (KNK); Quaker Bridge, ca. 5 mi N of Batsto, 21 Jun 1994, *Naczi 4432 & Thieret* (KNK), *Naczi 4433 & Thieret* (KNK), *Naczi 4434 & Thieret* (KNK). **Camden Co.:** Spring Garden, 4 Jul 1868, *Redfield s.n.* (MO). **Cumberland Co.:** ca. 2 mi N of Newport, 21 Jun 1994, *Naczi 4392 & Thieret* (KNK). **Gloucester Co.:** Malaga, 15 Aug 1926, *Adams 458* (MO). **Middlesex Co.:** 2 km N of Helmetta, 6 Jun 1966, *Kane & Coyne s.n.* (US). **Morris Co.:** Succasunna, 13 Jun 1909, *Mackenzie 4119* (US). **Ocean Co.:** Lakehurst, 30 May 1904, *Dowell 3670* (MO), ca. 4 mi S of Whiting, 26 Nov 1993, *Naczi 3570 & Naczi* (KNK). **Sussex Co.:** Budd's Lake, 12–14 Aug 1890, *Small s.n.* (US). **NEW YORK. Onondaga Co.:** Cicero Swamp, Jun 1901, *House s.n.* (US). **Rensselaer Co.:** Taborton, Cranberry Vly Creek, 25 Jul 1994, *Tucker 10058 & Miller* (KNK). **NORTH CAROLINA. Brunswick Co.:** 1 mi E of Brunswick-Columbus Co.: 7 May 1965, *Chen 442* (USCH); ca. 9 mi NW of Supply, 20 Dec 1994, *Naczi 4539* (KNK); 5.0 mi NW of Supply, 20 Dec 1994, *Naczi 4541* (KNK). **Catawba Co.:** Near Hickory, 23 Jun 1893, *Heller 1014* (MO). **Carteret Co.:** near the town of Sealevel, 24 Aug 1979, *Angerman s.n.* (USCH). **Columbus Co.:** Delco, 26 Jul 1938, *Braun s.n.* (US). **Harnett Co.:** Lillington, 24 Mar 1966, *Coyne & Coyne s.n.* (US). **Henderson Co.:** swamps of Muddy Creek, 21 Aug 1881, *Smith s.n.* (US); ca. 10.5 mi SW of Hendersonville, 12 Dec 1994, *Naczi & Hill 4520* (KNK). **Jackson Co.:** S of Cashiers, 11 Dec 1994, *Naczi 4519 et al.* (KNK). **Montgomery Co.:** Black Ankle, 26 May 1988, *Naczi 1975* (KNK). **New Hanover Co.:** near Wilmington, Apr 1888, *McCarthy s.n.* (US); S of Kirkland, 15 May 1930, *Moldenke 1238* (US). **Onslow Co.:** 3.5 mi SW of Maysville, 28 May 1977, *Kral 60229* (VDB). **Pender Co.:** 1 mi N of Burgaw, 11 May 1960, *Kral 10101* (VDB); Holly Shelter Wildlife Refuge, 19 May 1962, *Kral 14723* (VDB); Burgaw bog, 6 May 1968, *Wiggs & Jenkins s.n.* (USCH). **Robeson Co.:** N side of Lumberton off route 74, 27 Aug 1963, *Kral 19135* (VDB). **Tyrell Co.:** near Kilkenny, 8 May 1938, *Kerr & Godfrey 3864* (US). **OHIO. Lorain Co.:** Camden, 18 Jun 1894, *Oberlin s.n.* (US). **PENNSYLVANIA. Bradford Co.:** ca. 2.2 mi SSW of Leroy, Barclay Mountain, 17 Jun

1994, *Naczi 4322 & Thieret* (KNK). **Tioga Co.:** ca. 3 mi S of Leetonia, 25 Jun 1994, *Keener 94026* (KNK). **SOUTH CAROLINA. Chesterfield Co.:** 6 mi SSW of Cheraw, 20 Dec 1994, *Naczi 4523* (KNK). **Darlington Co.:** Hartsville, 29 Jul 1920, *Norton s.n.* (US); Hartsville, Along E side of Kilgore's Branch, 20 Jul 1941, *Smith 877* (USCH). **Georgetown Co.:** 5.5 mi S of Georgetown, 29 Jun 1939, *Godfrey & Tryon 211* (MO). **Greenville Co.:** E of Caesars Head, 11 Dec 1994, *Naczi 4518 et al.* (KNK); E of Caesars Head, 31 May 1995, *Naczi 4755A & Naczi* (KNK). **Horry Co.:** Cotton Patch Bay area, 19 May 1987, *Batson & Thompson s.n.* (USCH). **Kershaw Co.:** E of Camden, 25 Jun 1984, *Salim et al. 4* (USCH). **Lexington Co.:** Platte Spring's Road, 4 May 1939, *Hechenbleikner s.n.* (USCH). **VIRGINIA. Chesterfield Co.:** near Chester, 6 Jun 1936, *Wilmouth* (US). **Greensville Co.:** ca. 1 mi NW of Dahlia, 7 Jun 1946, *Fernald & Moore 15090* (MO).

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REFERENCES

BELL, C.R. 1949. A cytotaxonomic study of the Sarraceniaceae of North America. J. Elisha Mitchell Sci. Soc. 65:137–166.

BELL, C.R. 1952. Natural hybrids in the genus *Sarracenia*: I. History, distribution, and taxonomy. J. Elisha Mitchell Sci. Soc. 68:55–80.

BELL, C.R. and F.W. CASE. 1956. Natural hybrids in the genus *Sarracenia*: II. Current notes on distribution. J. Elisha Mitchell Sci. Soc. 72:142–152.

CASE, F.W. and R.B. CASE. 1976. The *Sarracenia rubra* complex. Rhodora 78:270–325.

CATESBY, M. 1738. The natural history of Carolina, Florida and the Bahama Islands, vol. 2. Printed at the expense of the author, London.

Cody, W.J. and S.S. Talbot. 1973. The pitcher plant *Sarracenia purpurea* L. in the northwestern part of its range. Canad. Field-Naturalist 87:318–320.

Crawford, D.J. 1983. Phylogenetic and systematic inferences from electrophoretic studies. In: Tanksley, S.D. and T.J. Orton, eds. Isozymes in plant genetics and breeding, Part A. Elsevier, Amsterdam. Pp. 257–287.

Folkerts, G.W. 1977. Endangered and threatened carnivorous plants of North America. In: Prance, G.T. and T.S. Elias, eds. Extinction is Forever. New York Botanical Garden, Bronx. Pp. 301–313.

Folkerts, G.W. 1982. The Gulf Coast pitcher plant bogs. Amer. Sci. 70:260–267.

Folkerts, G.W. 1990. The white-topped pitcher plant—a case of precarous abundance. Oryx 24:201–207.

Folkerts, G.W. 1991. A preliminary classification of pitcher plant habitats in the southeastern United States. J. Alabama Acad. Sci. 62:199–225.

Godt, M.J.W. and J.L. Hamrick. 1999. Genetic divergence among infraspecific taxa of *Sarracenia purpurea*. Syst. Bot. 23:427–438.

Gottlieb, L.D. 1977. Electrophoretic evidence and plant systematics. Ann. Missouri Bot. Gard. 64:161–180.

Gottlieb, L.D. 1981. Electrophoretic evidence and plant populations. Progr. Phytochem. 7:1–46.

Greuter, W., F.R. Barrie, H.M. Burdet, W.G. Chaloner, V. Demoulin, D.L. Hawksworth, P.M. Jørgensen, D.H. Nicolson, P.C. Silva, P. Trehane, and J. McNeill. 1994. International code of botanical nomenclature (Tokyo Code). Regnum Veg. 131.

Hanrahan, B. and J. Miller. 1998. History of discovery: yellow-flowered *Sarracenia purpurea* L. subsp. *venosa* (Raf.) Wherry var. *burkii*. Carniv. Pl. Newslett. 27:14–17.

Holmgren, P.K., N.H. Holmgren, and L.C. Barnett (editors). 1990. Index Herbariorum. Part I. The Herbaria of the World, 8th ed. New York Botanical Garden, Bronx.

Lloyd, F.E. 1976. The carnivorous plants. Dover Publications, New York.

Macfarlane, J.M. 1908. Sarraceniaceae. In: Engler, A., ed. Das Pflanzenreich, IV. 110, 1–39. Wilhelm Engelmann, Leipzig.

MacRoberts, M.H. and B.R. MacRoberts. 1988. A note on *Sarracenia purpurea* L. in Louisiana. Phytologia 65:191–194.

McDaniel, S. 1966. A taxonomic revision of *Sarracenia* (Sarraceniaceae). Ph.D. dissertation, Florida State Univ.

McDaniel, S. 1971. The genus *Sarracenia* (Sarraceniaceae). Bull. Tall Timbers Res. Sta. 9:1–36.

Murry, R.E. and L.E. Urbatsch. 1979. Preliminary reports on the flora of Louisiana. III. The families Droseraceae and Sarraceniaceae. Castanea 44:24–27.

Rafinesque, C.S. 1840. Autikon Botanikon. Philadelphia.

Rouleau, E. and G. Lamoureux. 1992. Atlas of the vascular plants of the Island of Newfoundland and of the Islands of Saint-Piere-et-Miquelon. Fleubec, Saint-Henri-de-Lévis, Québec.

Schnell, D.E. 1979. A critical review of published variants of *Sarracenia purpurea* L. Castanea 44:47–59.

Schnell, D.E. 1993. *Sarracenia purpurea* L. ssp. *venosa* (Raf.) Wherry var. *burkii* Schnell (Sarraceniaceae)—a new variety of the Gulf Coastal Plain. Rhodora 95:6–10.

Schnell, D.E. and R.O. Determann. 1997. *Sarracenia purpurea* L. ssp. *venosa* (Raf.) Wherry var. *montana* Schnell & Determann (Sarraceniaceae): a new variety. Castanea 62:60–62.

Sheridan, P. M. and R.R. Mills. 1998a. Genetics of anthocyanin deficiency in *Sarracenia* L. HortScience 33:1042–1045.

Sheridan, P.M. and R.R. Mills. 1998b. Presence of proanthocyanidins in mutant green *Sarracenia* indicate blockage in late anthocyanin biosynthesis between leucocyanidin and pseudobase. Pl. Science 135:11–16.

Stuckey, R.L. 1971. The first public auction of an American herbarium including an account of the fate of the Baldwin, Collins, and Rafinesque herbaria. Taxon 20:443–459.

Wherry, E.T. 1933. The geographic relations of *Sarracenia purpurea*. Bartonia 15:1–6.

Wilkinson, L. 1989. SYSTAT: the system of statistics. SYSTAT, Evantson, IL.

THE VASCULAR FLORA OF BISCAYNE NATIONAL PARK, FLORIDA

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ABSTRACT

The vascular flora of Biscayne National Park, Florida consists of 372 species within 277 genera and 92 families. The largest families in the flora are the Poaceae (47 species), Asteraceae (34 species), and Fabaceae (28 species). The largest genera are *Tillandsia* (7 species), *Chamaesyce* (7 species), and *Cyperus*, *Eugenia*, *Kalanchoe* and *Paspalum*, each with 5 species. Each taxonomic entry in the checklist is accompanied by an annotation, when appropriate, which includes: C = cultivated species, not escaped; H = historical record, now extirpated; X = naturalized exotic species; E = Florida endangered; T = Florida threatened; CE = Florida commercially exploited.

Key words: flora, distribution, biodiversity, Biscayne National Park, Florida.

RESUMEN

La flora vascular del Biscayne National Park, Florida, está formada por 372 especies pertenecientes a 277 géneros y 92 familias. Las mayores familias de esta flora son las Poaceae (47 especies), Asteraceae (34 especies), y Fabaceae (28 especies). Los mayores géneros son *Tillandsia* (7 especies), *Chamaesyce* (7 especies), *Cyperus*, *Eugenia*, *Kalanchoe* y *Paspalum*, con 5 especies cada uno. Cada entrada taxonómica al catálogo está acompañada de una anotación, cuando es apropiada, que incluye: C = especie cultivada, no escapada; H = cita histórica, rechazada ahora; X = especie exótica naturalizada; E = en peligro en Florida; T = amenazada en Florida; CE = explotada comercialmente en Florida.

INTRODUCTION

Biscayne National Park, (BNP) comprising 181,000 acres /73,000 hectares, is located between 25° 17' and 25° 40' N Latitude and 80° 05' and 80° 21' W Longitude (Fig. 1). The Park was designated in 1968 as a National Monument, and, in 1980, the Monument was expanded and redesignated as a National Park. The park is located approximately 20 miles (32 km) south of Miami, Florida. The park's northern boundary is near the southern end of Key Biscayne, while the southern boundary is near the northern end of Key Largo. Most of the land, (171,925 acres/69,577 ha) is submerged.

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FIG. 1. Map of Biscayne National Park. Shown here are the plant communities referred to in the flora.

The largest islands, listed in decreasing order of size are Elliott Key (1,651 acres/668 ha), Old Rhodes Key (641 acres/259 ha), Sands Key (416.7 acres/169 ha), Totten Key (379.9 acres/154 ha), Little Totten Key (196.7 acres/80 ha) and Long Arsenicker Key (124.9 acres/50.5 ha). There are 42 islands in the park.

The University of Georgia developed a map of major shoreline and upland vegetation units at the park in the summer of 1997 (Madden et al. 1999). These include mangrove (6905 acres/2794.4 hectares), hammock hardwoods (126 acres/40.5 hectares), grasslands and marshes (197 acres/79.7 hectares). The total area of the shoreline and upland communities is 7416 acres/3001 hectares.

Climate

Climatological data presented is from the nearest weather station, Miami Beach, 25 miles (40 km) north of the park headquarters. The climate of Biscayne National Park is subtropical marine characterized by dry mild winters and long warm summers (Jordan 1985; Winsberg 1990, 1992). Mean annual temperature is 76.0° F (24.4 degrees C). January is the coolest month with a mean temperature of 68.4° F (20.2° C) while August is the warmest month averaging 83.1° F (28.4° C). Annual rainfall, generally a product of convective sea breezes, is 46.02 inches (1169 mm). Occasional tropical storms and hurricanes may produce heavy amounts of precipatation. Most of the rain falls during the summer. August is the wettest month averaging 7.11 inches (180.6 mm) while March is the driest month averaging 1.56 inches (39.6 mm). No frost was recorded at the Miami weather station between 1951 and 1974 (Anonymous 1974).

Detailed climatological data for Miami Beach and Tavernier, stations north and south of Biscayne National Park, can also be found in the monthly publication of the National Oceanographic and Atmospheric Administration. Temperature data from 1980 to 1997 indicate that the temperature at Miami Beach reached freezing on March 3, 1980 and on December 24, 1989. The lowest temperature recorded at Tavenier was 35° F/1.1° C on December 25, 1989. A freeze was recorded at the Turkey Point Weather Station, "for a few seconds" on December 24, 1989 (personal communication with Ralph Heistand, Florida Power and Light, Turkey Point Power Plant Meteorological Data Manager) (see Fig. 2 for location of the Turkey Point weather Station).

Hurricanes

Hurricanes have ravaged Florida since time immemorial. Between 1900–1989, Florida experienced 56 hurricanes. The strongest, a category 5 storm, (see Fernald & Purdum (1992) for an explanation of Saffir/Simpson Hurricane Categories) struck the Florida Keys September 3, 1935, killing 408 people. Other storms of note in the vicinity of BNP since 1960 were Donna (1960), Betsy (1965), and most recently Andrew (1992). The major effects of hurricanes on vegetation are wind damage and flooding associated with the storm surge and/or heavy rainfall. Hurricane Andrew, a category 4 storm, struck Elliott Key at 4:55 a.m. August 24, 1992. Hurricane Andrew's sustained winds reached 230 kph (145 mph) with gusts in excess of 280 kph

(175 mph) (Howard & Schokman 1995). Damage to vegetation on Elliott Key was excessive. Twenty to thirty percent of the trees were downed and large branches were sheared off almost all trees. Most small trees survived with less structural damage, though many of the small trees were completely defoliated. The trees at Adam's Key, Biscayne National Park, were deunded of leaves; most trees were broken off at 10–15 feet above the ground (Howard & Schokman 1995).

Schinus terebinthifolius, a highly invasive exotic, suffered severe initial damage from Hurricane Andrew. Many *Schinus* were blown down and nearly all were defoliated. Individual *S. terebinthifolius* that survived the hurricane leafed out more readily than the native surviving mangroves. Howard and Schokman (1995) observed that *S. terebinthifolius* appeared to have been spread by Hurricane Andrew.

Native *Rhizophora mangle* fared poorly after Hurricane Andrew, especially the dwarf forms, which were killed by the powerful storm. *Avicennia germinans* and *Laguncularia racemosa* were also uprooted and killed by the hurricane, although the surviving trees left standing sprouted soon after the hurricane (Howard & Schokman 1995).

Water Salinity

Water quality monitoring sites in the park are shown in Figure 2. Water salinity ranged from 25.4 ppt at Turkey Point to 39.4 ppt at Caesar's Creek, in 1997. There is little variation in water salinity at Alina's Reef where salinity ranged from 33.9 to 37.0. Salinity values are generally highest during June when rainfall is low and evaporation high. Low salinity values have been recorded near land during run-off immediately after heavy rains (Anonymous 1995).

Historical Information

Prior to the Spanish cession of Florida to the United States in 1821, Native Americans, Spaniards, Bahamians, and Americans established temporary salvage camps in the Florida Keys (Leynes & Cullison 1998). The land presently encompassing Biscayne National Park was sparsely settled in 1870; only eighty five people were recorded in Dade Counry by the U.S. census at that time (Niemec 1992). In 1877 Commodore Ralph Munroe reported that there were "but a few dozen settlers," in the Biscayne Bay area. The Florida keys in the 1800s were valued for their mahogony. Because of the thin soil, early settlers generally viewed the tropical key hammocks as "worthless" for farming (Leynes & Cullison 1998). However settlers found that pineapple could be grown here, and by 1890 pineapple was well established as a successful crop.

One of the earliest homesteaders on Elliott Key was Asa Sweeting, a Bahamian immigrant, who moved to Key West in 1866. He emigrated to Elliott Key

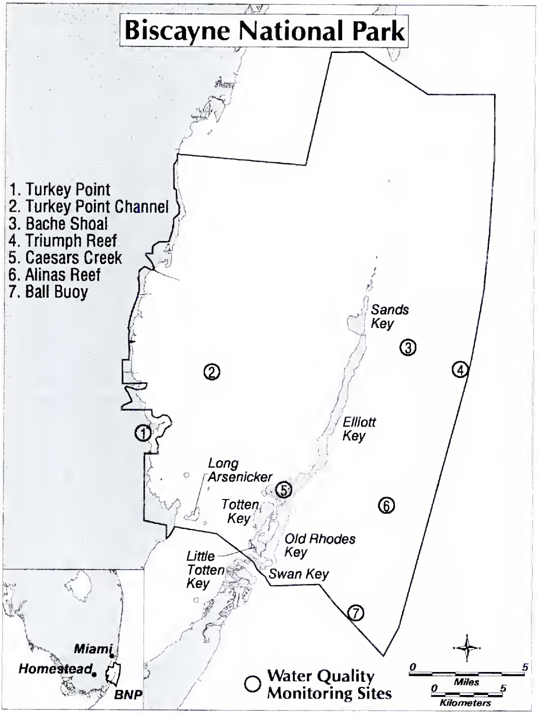

FIG. 2. Water quality monitoring stations and the Turkey Point meteorological station. Southern Florida with the park boundary identified.

from Key West in 1882, claiming 154.4 acres. The Sweeting holdings were gradually enlarged to 238.8 acres. By 1887 he cleared and planted 30 acres, gradually increasing his cultivated land to 100 acres. Pineapples and key limes were raised as the main crops (Leynes & Cullison 1998), along with bananas and tomatoes (Niemec 1992). A devastating hurricane in 1906 signaled the end of profitable pineapple production. Key lime production peaked in 1923 when more than 40,000 boxes were harvested. The destructive hurricane of 1926 destroyed Sweeting's lime groves, and the depression (1930s) and competition with lime production in the West Indies and Mexico hindered recovery. In 1935 lime production in the Florida Keys was a quarter of the production of 1923. Moreover, the demand for other fruits and vegetables declined. By the late 1930s, sale of Elliott Key produce was nonexistent (Niemec 1992).

Development of land around Biscayne Bay and the Upper Florida Keys grew rapidly as Miami Beach grew and prospered. The introduction of the motorboat enabled wealthy individuals easy access to the nearby Keys, and millionaires purchased the land on the Keys for weekend retreats (Leynes & Cullison 1998). In 1904, Henry Flagler opened a fishing lodge on Soldier Key. Carl Fisher established a vacation lodge on Adams Key in 1916, and with several business associates, purchased Boca Chita Key as well. Dr. John Gifford, subdivided and sold twenty-acre lots on Elliott Key stretching from the bay to the ocean. Charles Brookfield operated a fishing camp, Ledbury Lodge, on Elliott Key during the 1930s.

During the late 1950s, land "promoters" proposed to connect the Keys to the mainland. After several years of wrangling over road construction, Dade County officials decided against the construction of a causeway to the islands, and stated, if a road were to be built, it would be financed by island landowners. The island landowners incorporated, and created the City of Islandia in 1960. Conservationists blocked Islandia's efforts to build a causeway to the islands, and in 1965 conservationists secured the support of the Hoover Foundation to preserve the upper Keys. To foil the conservationists, the Islandia governing officials approved the bulldozing of a highway, a 120'-wide strip down the middle of Elliott Key, in the fall of 1967. The road, known as "Spite Highway," passed through a county park without authorization, and destroyed 6.3 acres of vegetation. Remnants of this road persist today.

Congress approved the creation of Biscayne National Monument, and President Johnson signed the bill into law on October 18, 1968. The bill authorized the National Park Service to purchase and develop the park over a five year period at the cost of twenty-five million dollars.

History of Floristic Work in the Park

Avery (1978) prepared an annotated list of 276 vascular plants on thirteen keys of Biscayne National Park. Included on his list were frequency of occurrence (common, uncommon and rare, cultivated and non-native taxa) and the distribution of the species on thirteen keys. The next study of importance was that of Hammer and Bradley (1997) who reported 302 species; no cultivated plants were included on their list. Four species, *Spiranthes* *polyantha* (*Mesadenus polyanthus*), *Microgramma heterophylla*, *Neurodium lanceolatum*, and *Zamia pumila* spp. *pumila* are known only from historical records. The native status of six plants on the list prepared by Hammer and Bradley (1997) is disputed: *Acacia farnesiana*, *Carica papaya*, *Commelina diffusa*, *Cordia sebestena*, *Oeceoclades maculata* and *Yucca aloifolia*. In addition, Lockwood et al. (1997) prepared a list of the vascular plants at Biscayne National Park during the summer of 1997.

Geology and Soils

Biscayne Bay is a shallow-water estuary along the southeast coast of Florida ranging in depth from approximately one to three meters (Anonymous 1995). An elongated ridge of Key Largo Limestone forms a border on the eastern boundary of the park. Eleven bottom types are described from Biscayne Bay including some spoil margins and mangrove soils (Anonymous 1995). The soils on the Keys at Biscayne National Park are generally classified as Entisols (Meyers & Ewell 1990). Soils are generally very shallow. The underlying rock is porous Miami Oolite (Oolite limestone) of Pleistocene origin (Robertson 1955). Much of the rainfall is lost by runoff, or is leached through the porous parent material (Stalter 1993).

METHODS

Collecting trips were made to the park in January, February, July and December, 1997 and February, 1998. Objectives for each trip included the collection of voucher specimens and accumulation of information on abundance and apparent habitat preferences for each species.

More than 500 specimens collected above, herbarium specimens at Everglades National Park and Fairchild Tropical Garden, and plant lists generated by Avery (1978), Hammer and Bradley (1997) and Lockwood et al. (1997), form the basis for this study. Taxonomically problematic specimens were sent to various experts for identification; experts consulted include Steve Clements (Amaranthaceae and Chenopodiaceae), Ihsan Al-Shehbaz (Brassicaceae), Richard Mitchell (Polygonaceae), Robert Meyer (Poaceae), James Montgomery (ferns), Charles Sheviak (Orchidaceae), Gordon Tucker (Cyperaceae), Bruce Hansen, and Richard Wunderlin (various taxa). Voucher specimens collected in the present study will be deposited in the herbarium at Everglades National Park, Homestead, Florida, and partial duplicate sets have been deposited in the herbaria of Brooklyn Botanic Gardens (BKL), University of Michigan (MICH), Missouri Botanical Gardens (MO), New York State Museum (NYS), University of South Florida (USF), James Montgomery's private herbarium (JM), and Fairchild Tropical Garden (FTG). Accession numbers will be assigned by the staff at Everglades National Park to the primary set of specimens at the herbarium at Homestead and will be available upon request from the National Park Service.

The annotated checklist contains an inventory of the vascular plants that reproduce spontaneously and persist for more than one year without cultivation, and includes native taxa, naturalized and adventive weeds, escapes from cultivation and historical records. In the checklist, plants are arranged using the Cronquist (1988) system first by division, and then alphabetically by family and by species. Nomenclature follows Wunderlin (1998). Synonyms are listed only for names used by Kartesz (1994).

RESULTS AND DISCUSSION

The vascular flora of the Biscayne National Park consists of 372 species within 277 genera and 92 families. Ninety-three species, including nine cultivated plants, or 25% of the flora, are not native to the region. A statistical summary is given in Table 1, and an annotated list of species is included at the end of the paper.

The major families include the Poaceae (47 species), Asteraceae (34 species) and Fabaceae (28 species). Other large families are the Euphorbiaceae (16 species) and Rubiaceae (13 species). Twenty-two percent of the species comprising the total flora are contained in the Poaceae and Asteraceae. The largest genera are *Tillandsia* (7 species) and *Chamaesyce* (7 species).

Plant Communities

The flora of the Florida Keys has much in common with the West Indies (Stalter 1993; Austin et al. 1987; Murphy & Lugo 1986; Correll & Correll 1982; Loope 1980; McGuire & Brown 1974; Thorhaug 1976; Robertson 1955). Davis (1942) recognized four major communities: strand-beach zone, dune zone, scrub zone and hammock forest. Only the hardwood hammock community is an important community at BNP. Two additional communities, the mangrove forest and submerged aquatic communities exist at Biscayne National Park.

The strand-beach community is dominated by halophytes (Stalter 1993). Some species tolerate flooding, such as *Cakile lanceolata* and *Sporobolus virginicus*, while others (e.g. *Spartina patens)* tolerate salt spray. Additional plants of this community include: *Chamaesyce* spp., *Ipomoea pes-caprae*, *Panicum* spp., *Sesuvium maritimum*, *S. portulacastrum* and *Argusia gnaphalodes*.

A poorly developed dune community exists in back of the strand-beach zone. Common species here tolerate high concentrations of salt spray. *Chamaesyce mesembrianthemifolia*, *Spartina patens*, *Sporobolus* sp., *Suriana maritima*, *Argusia gnaphalodes* and *Waltheria indica* grow in this community. This community is insignificant at BNP.

A xeric scrub ecotone, a transition zone of shrubs is poorly developed on the Florida Keys (Davis 1942; Stalter 1993). *Suriana maritima*, *Borrichia arborescens*, *Lantana involucrata*, *Solanum bahamense* and members of the Cactaceae family are generally found here.

Table 1. Statistical summary of the vascular flora of Biscayne National Park, Florida.

	Pteridophyta	Gymnospermae	Magnoliopsida	Liliopsida	Total
Families	5	1	70	16	92
Genera	8	1	195	56	277
Species	9	1	265	97	372
Native Species	8	1	206	64	288
Non-Native Species	1	0	59	33	93

The hardwood hammock community contains a greater diversity of species than the other plant communities. Many of the broad-leaved evergreen trees that grow at BNP are typical of the Bahamas and Greater Antilles (Davis 1942; Correll & Correll 1982; Fernald & Purdum 1992). Seven species of *Tillandsia* are found in this community. *Schinus terebinthifolius*, a highly invasive exotic is common here. *S. terebinthifolius* is a serious threat to native South Florida species, and is most abundant along the upland fringe of the mangrove community. Some of the trees of this community are: *Amyris elemifera*, *Canella winterana*, *Coccoloba diversifolia*, *Coccoloba uvifera*, *Conocarpus erectus*, *Cordia sebestena*, *Drypetes diversifolia*, *Eugenia foetida*, *Krugiodendron ferreum*, *Lysiloma latisiliquum*, *Metopium toxiferum*, *Panicum* spp., *Piscidia piscipula*, *Pithecellobium* spp., *Schaefferia frutescens*, *Smilax auriculata*, *Suriana maritima*, *Swietenia mahagoni*, and *Thrinax morrisii*. For additional information on the plant species comprising the hammock community, the reader is directed to Harper (1927), Davis (1942), Forsgren and Kephant (1978), Robertson (1955), Stalter (1993), and Myers and Ewell (1990).

Extensive mangrove forests are found in the intertidal zone. Mangroves are sensitive to tidal flooding and are found in distinct zones. These species, listed in order of their tolerance to tidal flooding are, *Rhizophora mangle*, *Avicennia germinans*, and *Laguncularia racemosa*. Buttonwood, *Conocarpus erecta*, is considered by Tomlinson (1986) as a mangrove associate, and is on the upland fringe of the mangroves. Hurricane Andrew (1992) caused extensive damage to this community, especially to *Rhizophora mangle* (Howard & Schokman 1995). Extensive information on this community are in publications by Davis (1942), Tomlinson (1986) and Anonymous (1995).

The submerged "sea grass" community is the most extensive community of the park comprising slightly more than 50% of the park. The sea grass community is one of the most productive and important inshore marine communities (Fernald & Purdum 1992; Myers & Ewell 1990). The "sea grasses" of importance are Turtle Grass, *Thalassia testudinum*, Manatee Grass, *Syringodium filiforme* and Shoalweed *Halodule wrightii*. Sea grasses are distributed in accordance to their tolerance of salinity, and substrate preference (Fernald & Purdum 1992; Anonymous 1995). There is little salinity variation in the bay near the islands where freshwater runoff during storms is minimal (Fig. 2). Water salinity is more variable near the mainland when runoff from torrential rains is substantial.

Several species in the flora are noteworthy because of their special status. *Pseudophoenix sargentii*, Sargent's Palm, is believed to be planted in the Florida Keys by early Bahamian settlers; it is not native to Florida according to Avery (1978). Bruce Ledin in an unpublished manuscript disputed the native status of Sargent's Palm in 1950. Avery (1978) reports that *Aristolochia pentandra*, formerly known from Soldier Key is now restricted to Elliot Key. *Bucida buceras*, Black Olive, and *Spiranthus polyantha*, Florida Keys Ladies Tresses, were historically recorded on Elliot Key, though Avery (1978) believed that *B. buceras* was planted on Elliot Key. *Kalanchoe-fedtschenkoi*, Lavender Scallops, *K. gastronis-bonnieri*, Palm Beachbells, and *K. tubiflora*, Chandelier Plant were cultivated on Adams Key and persist after cultivation (Avery 1978). *Clusia rosea* was, "probably originally native to the Florida Keys," though at present it is only known from introductions (Wunderlin 1998). *Microgramma heterophylla* was historically present on Adams Key, and is now only extant at Key Largo (Avery 1978).

Three species, *Schinus terebinthifolius*, *Casuarina equisetifolia*, and *C. glauca* are on the Florida prohibited plant Dist. 9 (DEP Chapter 62C-52). *Coccoloba uvifera* is on Florida's protected plant list. Plants, designated by the letter E (Endangered) in the annotated checklist are on the State endangered list.

Species of foreign origin are only a minor component of the natural vegetation. Most non-native plants occur principally in ruderal sites, lawns, and along the edges of trails and roads. Several exotics, *Schinus terebinthifolius*, *Casuarina equisetifolia* and *Colubrina asiatica* pose a threat to the native species in the park. The introduction of seventeen non-native species of grasses (Poaceae), 18.3% of the non-native species, is especially noteworthy in the flora. Other families containing a high number or high percent of non-native plants are the Agavaceae, Arecaceae, Crassulaceae, Fabaceae, and Sapotaceae.

ANNOTATED CHECKLIST OF SPECIES

The vascular plant taxa have been arranged according to the following categories: ferns and fern allies, gymnosperms, dicots, and monocots. Within each category, families and lower taxa are arranged alphabetically. Nomenclature primarily follows Wunderlin (1998) and Kartez (1994). Each entry includes the following information sequence: native or non-native status (C = cultivated species; not escaped, H = historical record, now extinct, X = naturalized exotic species, E = Florida endangered, T = Florida threatened, CE = Florida commercially exploited); scientific name; pertinent synonym, enclosed in brackets.

PTERIDOPHYTA

ADIANTACEAE/PTERIDACEAE—Maidenhair Family
- *Acrostichum aureum* L. Golden Leather Fern
- *Acrostichum danaeifolium* Langsd.& Fisch. Giant Leather Fern
- *Pteris* vittata (L.) Chinese Ladder Brake; **X**

NEPHROLEPIDACEAE/DRYOPTERIDACEAE—Sword Fern Family
- *Nephrolepis biserrata* (Sw.) Schott, [*N. falcata* (Cav.) C. Christens.] Sword Fern; T

POLYPODIACEAE—Polypody Family
- *Microgamma heterophylla* (L.) Wherry. Climbing Vine Fern Historically present on Adams Key; now the only extant site in Florida is on Key Largo. Hammer and Bradley 1997; **E,H**
- *Nevrodium lanceolatum* (L.) Fée, [*Paltonium lanceolatum* (L.) K.Presl]. Ribbon Fern; **E,H**
- *Pleopeltis polypodioides* var. *michauxiana* (Weath.) E.G. Andrews & Windham, [*Polypodium polypodioides* (L.) Watt. var. *michixianum* Weath.] Resurrection Fern

PSILOTACEAE—Whiskfern Family
- *Psilotum nudum* (L.) P. Beauv., Whisk-Fern

THELYPTERIDACEAE—Marsh Fern Family
- *Thelypteris kunthii* (Desv.) C.V. Morton, Southern Shield Fern

GYMNOSPERMAE

ZAMIACEAE—Zamia Family
- *Zamia pumila* L., [*Zamia integrifolia* L.f.] Florida Arrowroot; Coontie; **EX**

MAGNOLIOPHYTA-MAGNOLIOPSIDA

ACANTHACEAE—Acanthus Family
- *Blechum pyramidatum* (Lam.) Urb., Browne's Blechum; **X**
- *Dicliptera sexangularis* (L.) Juss., Sixangle Foldwing

AIZOACEAE—Mesembryanthemum Family
- *Sesuvium maritimum* (Walt.) Britton, Sterns, & Poggenb., Slender Seapurslane
- *Sesuvium portulacastrum* (L.) L., Shoreline Seapurslane

AMARANTHACEAE—Amaranth Family
- *Alternanthera flavescens* Kunth, Yellow Joyweed
- *Amaranthus hybridis* L., Slim Amaranth; Pigweed
- *Blutaparon vermiculare* (L.) Mears, Samphire; Silverhead
- *Celosia nitida* Vahl, West Indian Cock's Comb
- *Iresine diffusa* Humb. & Bonpl. ex Willd., Juba's Bush

ANACARDIACEAE—Cashew Family
- *Mangifera indica* L., Mango; **X**
- *Metopium toxiferum* (L.) Krug & Urb., Poisonwood
- *Schinus terebinthifolius* Raddi, Florida prohibited plant; Brazilian Pepper; **X**

ANNONACEAE—Custard-Apple Family
- *Annona glabra* L., Pond Apple

APOCYNACEAE—Dogbane Family
- *Catharanthus roseus* (L.) G. Don, Madagascar Periwinkle; **X**
- *Echites umbellata* Jacq. Devils Potato; Rubbervine
- *Nerium oleander* L., Oleander; **C**
- *Pentalinom luteum* (L.) B.F. Hansen & Wunderlin, Wild Allamanda; Hammock Viperstail
- *Rhabdadenia biflora* (Jacq.) Muell. Arg., Rubbervine; Mangrovine
- *Thevetia peruviana* (Pers.) K. Schum., Luckynut; C
- *Vallesia antillana* Woodson, Tearshrub; E

ARALIACEAE—Ginseng Family
- *Schefflera actinophylla* (Endl.) Harms, Australian Umbrella Tree; Octopus Tree; **X**

ARISTOLOCHIACEAE—Birthworth Family
- *Aristolochia pentandra* Jacq., Marsh's Dutchman's-Pipe; now restricted to Elliot Key; formerly known from Soldier Key Tropical hammock's; Rare; Dade County; **E**

ASCLEPIADACEAE—Milkweed Family
- *Cynanchum bahamense* (Griseb.) Gillis, Bahamium Swallowwort; Bahama Cynanchum
- *Cynanchum scoparium* Nutt., Leafless Swallowwort
- *Sarcostemma clausum* (Jacq.) Roem. & Schult., White Twinevine; **X**

ASTERACEAE—Aster Family

Ambrosia artemisiifolia L., Common Ragweed

Aster tenuifolius L., Perrenial Saltmatsh Aster

Baccharis angustifolia Michx., Saltwater Falsewillow

Baccharis halimifolia L., Groundsel Tree; Sea Myrtle

Bidens alba (L.) DC. var. *radiata* (Sch. Bip.) Ballard ex. T.E. Melchert, Beggarticks

Borrichia arborescens (L.) DC., Tree Seaside Oxeye

Borrichia frutescens (L.) DC., Bushy Seaside Oxeye

Chromolaena odorata (L.) R.M. King & H. Rob., [*Eupatorium odoratum* L.] Jack-in-the-Bush

Complaya trilobata (L.) Strother, Creeping Oxeye

Conyza canadensis (L.) Cronq. var. *pusilla* (Nutt.) Cronquist, Dwarf Canada Horseweed

Eclipta prostrata (L.) L., False Daisy

Emilia fosbergii Nicolson, Florida Tassel flower

Eupatorium capillifolium (Lam.) Small, Dogfennel

Eupatorium leptophyllum DC., Falsefennel

Flaveria trinervia (Spreng.) C. Mohr, Clustered Yellowtops

Flaveria linearis Lag., Narrowleaf Yellowtops

Gamochaetum pensylvanicum Willd., Pennsylvania Everlasting

Helianthus debilis Nutt., Duneflower

Iva imbricata Walter, Seacoast Marshelder

Launaea intybacea (Jacq.) Beauv., Achicoria Azul; **X**

Melanthera nivea (L.) Small, [*M. aspera* (Jacq.) Small] Snow Squarestem

Mikania scandens (L.) Willd., Climbing Hempvine

Parthenium hysterophorus L., Santa Maria Feverfew

Pectis glaucescens (Cass.) D.J. Keil, Sanddune Cinchweed

Pectis prostrata Cav., Spreading Cinchweed

Pluchea carolinensis (Jacq.) D. Don, [*Neurolaena lobata* (L.) Cass.] Cure-For-All

Pluchea odorata (L.) Cass., Sweetscent

Pluchea rosea R.K. Godfrey, Rosey Camphorweed

Solidago sempervirens L., Seaside Goldenrod

Sonchus oleraceus L., Common Sowthistle; **X**

Tridax procumbens L., Coat Buttons; **X**

Vernonia cinerea (L.) Less., Little Ironweed; **X**

Wedelia trilobata (L.) A.S. Hitchc., creeping oxeye

Youngia japonica (L.) DC., Oriental False Hawksbeard; **X**

AVICENNIACEAE

Avicennia germinans (L.) L., Black Mangrove

BATACEAE—Saltwort Family

Batis maritima L., Saltwort; Turtleweed

BORAGINACEAE—Borage Family

Argusia gnaphalodes (L.) Heine, Sea Rosemary; Sea Lavender; **R**

Bourreria succulenta Jacq., [*B. ovata* Miers] Bahama Strongbark

Cordia sebestena L., Largeleaf Geigertree; **C**

Heliotropium angiospermum Murray, Scorpionstail

Heliotropium curassavicum L., Seaside Heliotrope; Salt Heliotrope

Heliotropium polyphyllum Lehm., Pineland Heliotrope

Tournefortia volubilis L., Twining Soldierbush

BRASSICACEAE—Mustard Family

Cakile lanceolata (Willd.) O.E. Schulz, Coastal Searocket

Coronopus didymus (L.) Sm., Lesser Swinecress

Erucastrum gallicum (Willd.) O.E. Schulz, Common Dogmustard

Lepidium virginicum L., Virginia Pepperweed

BUDDLEJACEAE—Butterfly Bush Family

Polypremum procumbens L., Rustweed; Juniperleaf

BURSERACEAE—Gumbo-Limbo Family

Bursera simaruba (L.) Sarg., Gumbo-Limbo

CACTACEAE—Cactus Family

Acanthocereus tetragonus (L.) Hummelinck, Triangle Cactus; Dildoe Cactus; **T**

Harrisia aboriginum Small ex Britton & Rose, Prickly Applecactus; **R**

Opuntia stricta (Haw.) Haw., [*O. stricta* var. *dillenii* (Ker-Gawl.) L.D.Benson] Erect Pricklypear; **T**

CANELLACEAE—Canella Family

Canella winterana (L.) Gaertn., Pepper Cinnamon; Cinnamon Bark; **E**

CAPPARACEAE—Caper Family
Capparis cynophallophora L., Jamaican Capertree
Capparis flexuosa L., Bayleaf Capertree

CARICACEAE—Papaya Family
Carica papaya L., Papaya; **X**

CASUARINACEAE—Sheoak Family
Casuarina equisetifolia L., Australian-Pine; Horsetail Casuarina Florida prohibited list; **X**
Casuarina glauca Sieb. ex Spreng., Gray Sheoak; Suckering Australian Pine Florida prohibited list; **X**

CELASTRACEAE—Stafftree Family
Crossopetalum rhacoma Crantz, Maidenberry; **E**
Maytenus phyllanthoides Benth., Florida Mayten; T
Schaefferia frutescens Jacq., Florida Boxwood; E

CHENOPODIACEAE—Goosefoot Family
Atriplex pentandra (Jacq.) Standl., Crested Saltbush
Salicornia bigelovii Torr., Annual Glasswort; Dwarf Glasswort
Salicornia perennis Mills., [*S. virginica* L.] Perennial Glasswort
Suaeda linearis (Elliott) Moq., Sea Blite; Annual Seepweed

CLUSIACEAE—Mangosteen Family
Clusia rosea Jacq., Pitchapple; Hammer and Bradley (1997) contend this taxon was, "erroneously recorded as a native species to the lower Florida Keys"; **X**

COMBRETACEAE—Combretum Family
Bucida buceras L., Black Olive. Records indicate this was planted on Elliott Key; "It is now believed that *B. bucerus* was planted on the islands." Hammer and Bradley (1997).
Conocarpus erectus L., Buttonwood
Laguncularia racemosa (L.) C.F. Gaertn., White Mangrove
Terminalia catappa L., West Indian Almond; **X**

CONVOLVULACEAE—Morningglory Family
Dichondra carolinensis Michx., Carolina Ponysfoot
Ipomoea alba L., Moonflowers; Tropical White Morningglory
Ipomoea indica (Burm.) Merr., Oceanblue Morningglory
Ipomoea pes-caprae (L.) R. Br. spp. *brasiliensis* (L.) Ooststr., Railroad Vine; Bayhops
Ipomoea violacea L., Heavenlyblue Morningglory

CRASSULACEAE—Orpine family
Kalanchoe daigremontiana Raym.-Hamet & H.Perrier, Devils Backbone; **X**
Kalanchoe fedtschenkoi Raym.-Hamet & H.Perrier, Lavender Scallops; **X**
Kalanchoe gastonis-bonnieri Raym.-Hamet & H.Perrier, Palm Beachbells; **X**
Kalanchoe pinnata (Lam.) Pers., Cathedral Bells; Life Plant; **X**
Kalanchoe tubiflora (Harv.) Raym.-Hamet, Chandelier Plant; **X**

CUCURBITACEAE—Gourd Family
Melothria pendula L., Creeping Cucumber
Momordica charantia L., Balsampear; **X**

EUPHORBIACEAE—Spurge Family
Acalypha chamaedryfolia (Lam.) Muell. Arg., Bastard Copperleaf
Chamaesyce blodgettii (Engelm. ex, Hitchc.) Small, Limestone Sandmat
Chamaesyce hirta (L.) Millsp., Pillpod Sandmat
Chamaesyce hypericifolia (L.) Millsp., Graceful Sandmat
Chamaesyce hyssopifolia (L.) Small, Hyssopleaf Sandmat
Chamaesyce mesembrianthemifolia (Jacq.) Dugand, Coastal Beach Sandmat
Chamaesyce ophthalmica (Pers.) D.G.Burch Florida Hammock Sandmat
Chamaesyce porteriana Small Porter's Sandmat; **E**
Drypetes diversifolia Krug & Urb., Whitewood; Milkbark; **E**
Drypetes lateriflora (Sw.) Krug & Urb., Guiana Plum; T
Gymnanthes lucida Sw., Crabwood; Oysterwood
Hippomane mancinella L., Manchineel; **E**
Jatropha multifida L., Coralbush; **X**
Phyllanthus amarus Schumach. & Thonn., Gale-of-Wind; Carry-Me Seed; **X**
Pointsettia cyathophora (Murray) Bartl., [*Euphorbia cyathophora* Murr.] Paintedleaf;

Fire-On-The-Mountain
Ricinus communis L., Castorbean; **X**

FABACEAE—Pea Family
Acacia farnesiana (L.) Willd., Sweet Acacia
Caesalpinia bonduc (L.) Roxb., Gray Nicker
Caesalpinia major (Medik.) Dandy & Exell Hawaii Pearls; **E**
Canavalia rosea (Sw.) DC., Baybean; Seaside Jackbean
Crotalaria pumila Ortega Low Rattlebox
Dalbergia brownii (Jacq.) Schinz, Brown's Indian Rosewood; **E**
Dalbergia ecastophyllum (L.) Taub., Coinvine
Desmanthus virgatus (L.) Willd., Wild Tantan
Desmodium incanum DC., Ticktrefoil
Galactia striata (Jacq.) Urb., Florida Hammock Milkpea
Gliricidia sepium (Jacq.) Kunth ex Walp.; **X**
Indigofera spicata Forssk., Trailing Indigo; **X**
Leucaena leucocephala (Lam.) de Wit, White Leadtree; **X**
Lysiloma latisiliquum Benth., False Tamarind
Medicago lupulina L., Black Medick; **X**
Meliotis albus Medick., White Sweetclover
Melilotis officinalis (L.) Lam., Yellow Sweetclover; **X**
Parkinsonia aculeata L., Mexican Palo Verde; Jerusalem Thorn; **X**
Piscidia piscipula (L.) Sarg., Florida Fishpoison Tree; Jamaican Dogwood
Pithecellobium dulce (Roxb.) Benth., Monkeypod; **X**
Pithecellobium keyense Britton ex Britton & Rose, Florida Keys Blackbead; **T**
Pithecellobium unguis-cati (L.) Benth., Catclaw Blackbead
Rhynchosia minima (L.) DC., Least Snoutbean
Sophora tomentosa L., Yellow Necklacepod
Stylosanthes hamata (L.) Taub., Cheesytoes
Tamarindus indica L., Tamarind; **X**
Trifolium repens L., White Clover; Dutch Clover; **X**
Vigna luteola (Jacq.) Benth., Hairypod Cowpea

GENTIANACEAE—Gentian Family
Eustoma exaltatum (L.) Salisb. ex G. Don, Marshgentian; Catchfly; Prairie gentian
Leiphaimos parasitica Schltdl. & Cham., [*Voyria parasitica* (Schltdl. & Cham.) Ruyters. & Maas.] Parasitic Ghostplant; **E**

HALORAGACEAE—Watermilfoil family
Proserpinaca palustris L., Marsh Mermaidweed

HIPPOCRATEACEAE—Hippocratea Family
Hippocratea volubilis L., Medicine Vine

LAMIACEAE—Mint Family
Salvia serotina L., Little Woman

LAURACEAE—Laurel Family
Cassytha filiformis L., Love Vine; Devil's Gut
Ocotea coriacea (Sw.) Britton, Lancewood

LENTIBULARIACEAE—Bladderwort Family
Utricularia foliosa L., Leafy Bladderwort

LOGANIACEAE—Logania Family
Mitreola petiolata (J.F. Gmel.) Torr. & A.Gray, [*Cynoctonum mitreola* (L.) Britton] Lax Hornpod

LYTHRACEAE—Loosestrife Family
Ammannia latifolia L., Pink Redstem, Toothcup

MALVACEAE—Mallow Family
Abutilon permolle (Willd.) Sweet, Coasta Indian Mallow
Herissantia crispa (L.) Brizicky, Bladdermallow
Hibiscus rosa-sinensis L. var. *rosa-sinensis*, Rosemallow; Shoe-Back-Plant; **X**
Hibiscus tiliaceus L., Sea Hibiscus; Mahoe; **X**
Malvastrum corchorifolium (Desr.) Britton ex Small, False Mallow
Sida abutifolia P. Mill, Spreading Fanpetals
Sida acuta Burm. f., Common Wireweed; Common Fanpetals
Sida ciliaris L., Bracted Fanpetals; Fringed Fanpetals
Sida rhombifolia L., Cuban Jute; Indian Hemp
Thespesia populnea (L.) Sol. ex Correa, Portia Tree; **X**

MELIACEAE—Mahogany Family
Swietenia mahagoni (L.) Jacq., West Indian Mahaogany; **E**

MORACEAE—Mulberry Family
Ficus altissima Blume, Counsil Tree; **X**
Ficus aurea Nutt., Strangler Fig; Golden Fig
Ficus citrifolia Mill., Wild Banyan Tree

MYRSINACEAE—Myrsine Family

Ardisia escallonioides Schiede & Deppe ex Schldl. & Cham., Marlberry

MYRTACEAE—Myrtle Family
Calyptranthes pallens Griseb., Pale Lidflower; Spicewood
Eugenia axillaris (Sw.) Willd., White stopper
Eugenia confusa DC., Redberry Stopper
Eugenia foetida Pers., Spanish Stopper; Boxleaf Stopper
Eugenia rhombea Krug & Urb. ex Urb., Red Stopper
Eugenia uniflora L., Surinam Cherry; **X**

NYCTAGINACEAE—Four O'Clock Family
Boerhavia diffusa L., Red Spiderling; Wineflower
Boerhavia erecta L., Erect Spiderling
Bougainvillea glabra Choisy Paper Flower; **X**
Guapira discolor (Spreng.) Little, Beeftree
Pisonia aculeata L., Devilsclaws; Pullback

OLACACEAE—Ximenia Family
Ximenia americana L., Tallow Wood; Hog Plum

OLEACEAE—Olive Family
Jasminum sambac (L.) Aiton, Arabian Jasmin; C

ONAGRACEAE—Evening Primrose Family
Gaura angustifolia Michx., Southern Beeblossom
Ludwigia bonariensis (M. Micheli) H. Hara, Carolina Primrose-Willow
Ludwigia octovalvis (Jacq.) Raven, Mexican Primrose-Willow

OXALIDACEAE—Woodsorrel Family
Oxalis corniculata L., Common Yellow Woodsorrel; Creeping Woodsorrel

PAPAVERACEAE—Poppy Family
Argemone mexicana L., Mexican Prickly-Poppy

PASSIFLORACEAE- Passion-Flower Family
Passiflora multiflora L., Whiteflower Passion-Flower; **E**
Passiflora suberosa L., Corkystem Passion-Flower

PHYTOLACCACEAE—Pokeweed Family
Rivina humilis L., Rougeplant

PLUMBAGINACEAE—Leadwort Family
Limonium carolinianum (Walter) Britton, Carolina Sealavender

POLYGONACEAE—Buckwheat Family
Coccoloba diversifolia Jacq., Tietongue; Pigeon Plum
Coccoloba uvifera (L.) L., Seagrape. Protected by Florida Law 370.041

PORTULACACEAE—Purslane Family
Portulaca oleracea L., Little Hogweed; **X**
Portulaca pilosa L., Pink Purselane; Kiss-Me-Not

PRIMULACEAE—Primrose Family
Samolus ebracteatus Kunth, Water Pimpernal
Samolus valerandi L. subsp. *parviflorus* (Raf.) Hultèn, Pineland Pimpernel; Seaside Brookweed

RHAMNACEAE—Buckthorn Family
Colubrina arborescens (Mill.) Sarg., Greenhart; **E**
Colubrina asiatica (L.) Brongn., Leatherleaf; Asian Nakedwood; **X**
Colubrina elliptica (Sw.) Briziky. & W.L. Stern, Soldierwood; **E**
Gouania lupuloides (L.) Urb., Chewstick; Whiteroot
Krugiodendron ferreum, (Vahl) Urb., Black Ironwood; Leadwood
Reynosia septentrionalis Urb., Darlingplum; **T**

RHIZOPHORACEAE—Mangrove Family
Rhizophora mangle L., Red Mangrove

RUBIACEAE—Madder Family
Chiococca alba (L.) Hitchc., [*C. parvifolia* Wullschl. ex Griseb.] Snowberry; Milkberry
Exostema caribaeum (Jacq.) Schult., Carribean Princewood; **E**
Gardenia angusta (L.) Merr., Gardenia; **C**
Genipa clusiifolia (Jacq.) Griseb., [*Casasia clusiifolia* (Jacq.) Urb.] Sevenyear Apple
Guettarda elliptica Sw., Hammock Velvetseed
Guettarda scabra (L.) Vent., Rough Velvetseed
Hedyotis corymbosa (L.) Lam., [*Oldenlandia corymbosa* L.] Flattop Mille Graines
Morinda royoc L., Redgal
Psychotria nervosa Sw., Wild Coffee
Randia aculeata L., White Indigoberry
Richardia grandiflora (Cham.& Schltdl.) Schult. & Schult. f., Largeflower Mexican Clover

Spermacoce floridana Urb., Florida False Buttonweed

Spermacoce verticillata L., Shrubby False Buttonweed; **X**

RUTACEAE—Citrus Family

Amyris elemifera L., Sea Torchwood

Citrus aurantifolia (Christm.) Swingle, Key Lime; **X**

Citrus aurantium L., Sour Orange; C

Citrus limon (L.) Burm. f., Lemon; C

Citrus reticulata Blanco, Tangerine; C

Zanthoxylum fagara (L.) Sarg., Wild Lime; Lime Pricklyash

SAPINDACEAE—Soapberry Family

Cardiospermum halicacabum L., Love-in-a-Puff; **X**

Exothea paniculata (Juss.) Radlk. ex Durand, Butterbough

Melicoccus bijugatus Jacq., Spanish Lime; **X**

Sapindus saponaria L., Soapberry

SAPOTACEAE—Sapodilla Family

Chrysophyllum oliviforme L., Satinleaf; T

Manilkara jaimiqui (C.Wright ex Griseb.) Dubard ssp. *emarginata* (L.) Cronquist, Wild Dilly

Manilkara zapota (L.) P. Royen, Sapodilla; **X**

Pouteria campechiana (Kunth.) Baehni, Egg Fruit; Canistel; **X**

Pouteria domingensis (Gaertn. f.) Baehni; **X**

Sideroxylon celastrinum (Kunth) T.D. Penn., Saffron Plum

Sideroxylon foetidissimum Jacq., False Mastic

Sideroxylon salicifolium (L.) Lam., Willow Bustic; White Bully

SCROPHULARIACEAE—Figwort Family

Bacopa monnieri (L.) Pennell, Herb-of-Grace

Capraria biflora L., Goatweed

Linaria canadensis L. Chaz., [*Nuttallanthus canadensis* (L.) D.A. Sutton] Canada Toadflax

SIMAROUBACEAE—Quassia Family

Simarouba glauca DC., Paradisetree

SOLANACEAE—Nightshade Family

Capsicum annuum L. var. *glabriusculum* (Dunal) Heiser & Pickersgill, Bird Pepper; Cayenne Pepper

Lycium carolinianum Walter, Christmasberry; Carolina Desertthorn

Solanum americanum P. Mill., American Black Nightshade

Solanum bahamense L., Bahama Nightshade

Solanum chenopodioides Lam., [*S. nigrescens* Martens & *Galeotti* misapplied], Black Nightshade

Solanum erianthum D. Don, Potatotree

STERCULIACEAE—Cacao Family (Includes Byttneriaceae)

Waltheria indica L., Sleepy Morning

SURIANACEAE—Bay-Cedar Family

Suriana maritima L., Bay Cedar

THEOPHRASTACEAE—Theophrasta Family

Jacquinia keyensis Mez, Joewood; T

ULMACEAE—Elm Family

Trema lamarckianum (Schult.) Blume, Pain-in-the-Back; West Indian Trema

URTICACEAE—Nettle Family

Parietaria floridana Nutt., Florida Pellitory

Pilea microphylla (L.) Liebm., Artillery Plant; Rockweed

VERBENACEAE—Vervain Family

Citharexylum spinosum L., [*C. fruticosum* L.] Florida Fiddlewood

Lantana camara L., Lantana; Shrub Verbena; **X**

Lantana involucrata L., Buttonsage

Phyla nodiflora (L.) Greene, Capeweed; Turkey Tangle Fogfruit

Stachytarpheta jamaicensis (L.) Vahl, Blue Porterweed; Joee

VITACEAE—Grape Family

Vitis rotundifolia Michx., Muscadine

ZYGOPHYLLACEAE—Caltrop Family

Guajacum sanctum L., Holywood Lignumvitae; **E**

MAGNOLIOPHYTA-LILIOPSIDA

AGAVACEAE—Agave Family

Agave decipiens Baker, False Sisal

Agave sisalana Perrine, Sisal Hemp; **X**

Aloe vera L., Aloe; **X**

Sansevieria hyacinthoides (L.) Druce, Bowstring Hemp; Mother-in-Law-Tongue; African Bowstring; **X**

Sansevieria trifasciata Prain cv. *'Laurentii'*, Bowstring Hemp; **X**

Yucca aloifolia L., Spanish Bayonet; Aloe

Yucca; **X**

ALISMATACEAE—Water-plantain family

Sagittaria graminea Michx. var. *weatherbiana* (Fernald) Bogin, Weatherby's Arrowhead

Sagittaria lancifolia L., Bull Tongue Arrowhead

AMARYLLIDACEAE—Amaryllis family

Hymenocallis latifolia (Mill.) M. Roem., Mangrove Spiderlily; Perfumed Spiderlily

ARACEAE—Arum Family

Epipremnum pinnatum (L.) Engl., Golden Pothos; **X**

ARECACEAE—Palm Family

Coccothrinax argentata (Jacq.) L.H. Bailey, Florida Silver Palm; **T**

Cocos nucifera L., Coconut Palm; **X**

Phoenix dactylifera L., Date Palm; Date Fruit; **X**

Phoenix reclinata Jacq., Senegal Date Palm; **X**

Pseudophoenix sargentii H. Wendl. ex Sarg., Sargent's Cherry Palm

Sabal palmetto (Walter) Lodd. ex Schult. & Schult. f., Cabbage palm

Thrinax morrisii H. Wendl., Brittle Thatch Palm; Key Thatch Palm; **E**

Thrinax radiata Lodd. ex Schult. & Schult. f., [*T. parviflora* auct. non Sw.] Florida Thatch Palm; **E**

Veitchia merrilli (Becc.) H.E. Moore, Manila Palm; **X**

BROMELIACEAE—Pineapple Family

Tillandsia balbisiana Schult. & Schult. f., Northern Needleleaf; **T**

Tillandsia fasciculata Sw., Cardinal Airplant; **E**

Tillandsia flexuosa Sw., Twisted Airplant; **E**

Tillandsia paucifolia Baker, Potbelly Airplant

Tillandsia recurvata (L.) L., Ballmoss

Tillandsia usneoides (L.) L., Spanish Moss

Tillandsia utriculata L., Giant Airplant; **E**

COMMELINACEAE—Spiderwort Family

Commelina diffusa Burm. f., Dayflower

Tradescantia pallida (Rose) D.R. Hunt, Purplequeen; **X**

Tradescantia spathacea Sw., [*Rhoeo spathacea* (Sw.) Stearn] Moses-in-the-Cradle; Oyster-Plant; **X**

CYMODOCEACEAE—Manateegrass Family

Halodule wrightii Ashe, [*H. beaudettei* (den Hartog) den Hartog] Shoalweed

Syringodium filiforme Kutz., [*Cymodocea filiformis* (Kutz.) Correll] Manateegrass

CYPERACEAE—Sedge Family

Cladium jamaicense Crantz, [*C. mariscus* (L.) Pohl subsp. *jamaicense* (Crantz) Kuk.] Jamaica Swamp Sawgrass

Cyperus esculentus L., Yellow Nutgrass; Chufa Flatsedge; **X**

Cyperus involucratus Rottb., Umbrella Plant; **X**

Cyperus ligularis L., Swamp Flatsedge

Cyperus planifolius L.C. Rich., Flatleaf Flatsedge

Cyperus polystachyos Rottb., Manyspike Flatsegde

Eleocharis equisetoides (Elliott) Torr., Jointed Spikerush

Rhynchospora colorata (L.) H. Pfeiff., Starrush Whitetop

HYDROCHARITACEAE—Frog's Bit Family

Halophila decipiens Ostenf., Carribean Seagrass

Thalassia testudinum Banks & Sol. ex. J. Koenig, Turtlegrass

LILIACEAE—Lily Family, See Agavaceae and Amaryllidaceae

MUSACEAE—Banana Family

Musa acuminata Colla, 'Dwarf Cavendish' Dwarf Banana; **C**

ORCHIDACEAE—Orchid Family

Bletia purpurea (Lam.) DC. [*Oletis purpurea* (Lam.) A. de Candolle] Pine Pink; **X**

Encyclia boothiana (Lindl.) Dressler, Dollar Orchid; **E**

Encyclia tampensis (Lindl.) Small, Florida Butterfly Orchid; **CE**

Oeceoclades maculata (Lindl.) Lindl., Monk Orchid; **X**

Spiranthes polyantha Rchb. f., Florida Keys Ladies Tresses; Gray Ladiestresses. Historically reported from Elliott Key; **H, E**

POACEAE—Grass Family

Andropogon glomeratus (Walter) Britton, Sterns, & Poggenb., Bushy Bluestem

Andropogon perforatus Trin. ex Fourn., Beardgrass

Andropogon virginicus L., Brownsedge Bluestem
Bothriochloa barbinodis (Lag.) Herter, Beardgrass; **X**
Bothriochloa pertusa (L.) A. Camus, {*Andropogon pertusus* (L.) Willd.} Pitted Beardgrass; **X**
Cenchrus brownii Roem. & Schult., Slimbristle Sandbur
Cenchrus echinatus L., Southern Sandbur
Cenchrus incertus M.A. Curtis, [*C. carolinianus* Walt.] Coastal Sandbur
Cynodon dactylon (L.) Pers., Bermudagrass; **X**
Dactyloctenium aegyptium (L.) Willd. ex Asch. & Schweinf., Durban Crowfootgrass; **X**
Digitaria bicornis (Lam.) Roem. & Schult. ex. Loudon, Asia Crabgrass; **X**
Digitaria ciliaris (Retz.) Koeler, Southern Crabgrass
Digitaria filiformis (L.) Koeler var. *dolichophylla* (Henrard) Wipff, Carribean Crabgrass
Distichlis spicata (L.) Greene, Saltgrass
Eleusine indica (L.) Gaertn., Indian Goosegrass; **X**
Eragrostis amabilis (L.) Wight & Arn., [*E. tenella* (L.) P. Beauv. ex Roem. & Schult.] Feather Lovegrass; **X**
Eragrostis ciliaris (L.) R. Br., Gophertail Lovegrass; **X**
Eragrostis elliottii S. Watson, [*E. campestris* Trin.] Elliott's Lovegrass
Eustachys petraea (Sw.) Desv., [*Chloris petraea* Sw.] Pinewoods Fingergrass
Lasiacis divaricata (L.) Hitchc., Smallcane; Florida Tibisee
Monanthochloe littoralis Engelm., Shoregrass; Keygrass
Neyraudia reynaudiana (Kunth) Keng ex Hitchc., Burmareed; Silkreed; **X**
Panicum amarum Elliott, Bitter Panicgrass
Panicum repens L., Torpedograss; **X**
Panicum virgatum L., Switchgrass
Paspalum blodgettii Chapm., Coral Paspalum; Blodgett's Crowngrass
Paspalum distichum L., Knotgrass
Paspalum notatum Fluegge, Bahiagrass; **X**
Paspalum setaceum Michx., Thin Paspalum
Paspalum vaginatum Sw., Seashore Paspalum
Pennisetum polystachion (L.) Schult., [*Pennisetum setosum* (Sw.) Rich] West Indian Pennisetum; Missiongrass
Rhynchelytrum repens (Willd.) C.E. Hubb., Rose Natalgrass; **X**
Schizachyrium sanguineum (Retz.) Alston. [*S. semiberbe* Nees] Crimson Bluestem
Schizachyrium scoparium (Michx.) Nash, Little Blustem
Setaria palmifolia (J. Konig) Stapf, Palmgrass, **X**
Setaria parviflora (Poir.) Kerguelen, [*S. geniculata* (Poir.) P. Beauv.] Yellow Bristlegrass; Knotroot Foxtail
Spartina patens (Aiton) Muhl., Marshhay Cordgrass; Saltmeadow Cordgrass
Sporobolus domingensis (Trin.) Kunth, Coral Dropseed
Sporobolus indicus (L.) R. Br., [*S. poirettii* (Roem.& Schult.) Hitchc.] Smutgrass
Sporobolus pyramidatis (Lam.) Hitchc., Whorled Dropseed
Sporobolus virginicus (L.) Kunth, Seashore Dropseed
Stenotaphrum secundatum (Walter) Kuntze, St. Augustinegrass
Urochloa adspersa (Trin.) R.D. Webster, [*Brachiaria adspersa* (Trin.) Parodi] Dominican Signalgrass
Urochloa mutica (Forssk.) Nguyen, [*Brachiaria mutica* (Forssk.) Stapf.], Paragrass; **X**
Urochloa subquadripara (Trin.) R.D. Webster, [*Brachiaria subquadripara* (Trin.) Hitchc.] Tropical Signalgrass; **X**
Zoysia japonica Steud., Korean Templegrass; Japanese Lawngrass; **X**
Zoysia matrella (L.) Merr., Manila Templegrass; **X**

SMILACACEAE—Smilax Family
Smilax auriculata Walter, Earleaf Greenbrier
Smilax havanensis Jacq., Everglades Greenbrier

TYPHACEAE—Cattail Family
Typha domingensis Pers., Southern Cattail

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REFERENCES

Anonymous. 1995. Biscayne Bay surface water improvement and management supporting document. South Florida Water Mangement District, Planning Department, West Palm Beach. Nov. 1995.

Anonymous 1974. Climates of the United States. Vols. 1 and 2. Water Information Center, Port Washington, N.Y.

Austin, D.F., A.F. Cholewa, R.B. Lasiter, and B.F. Hansen. 1987. The Florida of John Kunkel Small: His species and types, collecting localities, bibliography and selected reprinted works. Contr. New York Bot. Gard. 18.

Avery, G.N. 1978. Biscayne National Monument plant distribution and frequency list. An unpublished list of vascular plants at Biscayne National Park.

Correll, B.C. and H.B. Correll. 1982. Flora of the Bahama Archipelago. Lubrect and Cramer, Forestburg, New York.

Cronquist, A. 1988. The evolution and classification of flowering plants. 2nd ed. New York Botanical Garden, Bronx.

Davis, J.H., 1942. The ecology of the vegetation and topography of the sands keys of Florida. Pap. Tortugas Lab. Carnegie Inst. Wash. 33:115–195.

Fernald, E.A. and E.D. Purdum. 1992. Atlas of Florida. University of Flotida Press, Gainesville.

Forsgren, T. and L. Kephant. 1978. Conservation and management of tropical hardwood hammocks in the Florida Keys. In: R.R. Lewis and D.P. Cole, eds. Proc. Fifth Ann. Conf. on the restoration of coastal vegetation in Florida. Hillsborough Community College, Tampa, FL. Pp. 177–192.

Guala II, G.F. 1993. The flora of Chicken Key, Dade County, Florida: Before and after Hurricane Andrew. Sida 15:519–526.

Hammer, R.L. and K. Bradley. 1997. Checklist of vascular plants Biscayne National Park, Miami-Dade and Monroe County, Florida. An unpublished species list, Miami-Dade Park and Recreation Department, Natural Area Management, 222 Southwest 137 Avenue, Miami, FL 33170.

Harper, R.M. 1927. Natural resources of southern Florida.

Howard, R.A. and L. Schokman. 1995. Recovery responses of tropical trees after Hurricane Andrew. Harvard Pap. Bot. 6:37–74.

Jordan, C.L. 1985. Florida's weather and climate: implications for water. In: Patton, E.A. and D.J. Patton, eds. Water resources atlas of Florida. Institute of Science and Public Affairs, Florida State University, Tallahassee.

KARTESZ, J.T. 1994. A synonymized checklist of the vascular flora of the United States. Canada, and Greenland. 2nd ed. Volume 1-Checklist. Timber Press, Inc. Portland, OR.

LEYNES, J.B. and D. CULLISON. 1998. Biscayne National Park historic resource study. National Park Servive Southeast Region Atlanta, Georgia.

LOCKWOOD, B., B. DUSEK, K. BATTLE, and A. MOULDING. 1997. A preliminary inventory of the flora and fauna of Biscayne National Park. In house publication.

LOOPE, L.L. 1980. Phenology of flowering and fruiting in plant communities of Everglades National Park and Biscayne National Monument Florida. South Florida Research Center Report T-593. National Park Service, Everglades National Park, Homestead, FL.

MADDEN, M., D. JONES, and L. VILCHEK. 1999. Photointerpretation key for the Everglades vegetation classification system. Photogrammatic Engineering & Remote Sensing 65:171–177.

MCGUIRE, R.J. and L.N. BROWN. 1974. A phytosociological analysis of two subtropical hammocks on Elliot Key, Dade County, Florida. J. Elisha Mitchell Sci. Soc. 90:125–131.

MURPHEY, P. G. and A.E. LUGO. 1986. Structure and biomass of a subtropical dry forest in Puerto Rico. Biotropica 18:89–96.

MYERS, R.L. and J.J. EWELL (eds.). 1990. Ecosystems of Florida. University of Central Florida Press, Orlando, FL.

NIEMEC, P. 1992. The Sweeting homestead; pioneering on the Florida Keys, 1882-1930. Elliot Key, Florida. Biscayne National Park Resource Management Office Division. 1992.

ROBERTSON, W. B. JR. 1955. An analysis of the breeding-bird populations of tropical Florida in relation to the vegitation. Ph. D. Thesis, Univ. Illinois, Urbana.

STALTER, R. 1993. Dry coastal ecosystems of the Gulf Coast of the United States. In: E. van der Maarel, ed. Ecosystems of the World. Elsevier. Pp 375–387.

THORHAUG, A. 1976. The vascular plants of Biscayne Bay. In: A. Thorbaug and A. Volker, eds. Biscayne Bay. Past present and future. University of Miami: Sea Grant Special Publication No. 5:95–102.

TOMLINSON P.B. 1986. The botany of mangroves. Cambridge University Press, London.

WINSBERG, M.D. 1990. Florida weather. University of Central Florida Press, Orlando.

WINSBERG, M.D. 1992. Weather and climate. In: Fernald, E.A. and E.D. Purdum, eds. Atlas of Florida. University Press of Florida, Gainsville.

WUNDERLIN, R.P. 1998. Guide to the vascular plants of Florida. University Press of Florida. Gainsville.

A CHECKLIST FOR THE VASCULAR PLANTS OF PADRE ISLAND NATIONAL SEASHORE

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ABSTRACT

The flowering plants of Padre Island National Seashore (PINS) were sampled over a two year period in three different regions of the island. Specimens from our investigation and plants reported for PINS from the literature were compiled into a checklist. The flora contains both *Flaveria brownii* and *Sporobolus tharpii* which are endemics of the western Gulf of Mexico barrier islands. *Lycium carolinianum* var. *quadrifidum*, reported only along bayshores in Texas, was found in the tidal flat community. Two hundred and fifty-nine genera and 456 species of flowering plants were identified as part of the PINS flora. These occur in 77 families with the Poaceae (95 spp.), Asteraceae (57 spp.), Fabaceae (44 spp.) and Cyperaceae (29 spp.) most common.

RESUMEN

Se han tomado muestras de las angiospermas del parque nacional "Padre Island National Seashore" (PINS) durante un período de dos años, en tres áreas diferentes de la isla. Se hizo un catálogo de los "especímenes" de nuestra investigación y de las plantas citadas a PINS procedentes de una serie de artículos. La flora contiene tanto *Flaveria brownii* como *Sporobolus tharpii* que son endémicas de las islas de barrera del Oeste en el Golfo de México. Se ha encontrado en la comunidad de la zona mareal plana *Lycium carolinianum* var. *quadrifidum* que antes solamente se había citado a lo largo de las bahías de Texas. 259 géneros y 456 especies de angiospermas fueron identificados en la flora de PINS. Las plantas mencionadas pertenecen a 77 familias siendo las familias Poaceae (95 especies), Asteraceae (57 esp.), Fabaceae (44 esp.), y Cyperaceae (29 esp.) las más abundantes.

INTRODUCTION

The Texas Coast is framed by sandy barrier islands which are floristically similar to other barrier islands of the Gulf of Mexico and Atlantic Coast. However, upland sites on Texas barrier islands often grade into extensive

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grassland areas (Duncan & Duncan 1987). Padre Island National Seashore (PINS) encompasses most of the barrier island often referred to as northern Padre Island (Figure 1) and contains extensive grassland areas between its foredune ridges on the eastern gulf side and tidal flats bordering the western Laguna Madre. Southern Padre Island has been considered separately from northern Padre Island in terms of floristic analysis (Judd et al. 1977; Lonard et al. 1978; Lonard & Judd 1980) and is physically separated by the Mansfield Ship Channel. In contrast, Corpus Christi Pass once separated Padre Island from Mustang Island but this pass is now filled and the two islands are joined (Weise & White 1980). There have been a number of investigations involving the vegetation of upland and wetland habitats on northern Padre Island. Most recently, Nelson et al. (1997, 1999) examined four communities in regard to vegetational ecology and floristics near Big Ball Hill on PINS (Fig. 1). Drawe and Ortega (1996) examined effects of seismic survey vehicles on vegetation from five different communities on the northern one-third of the island during October 1988 as well as April and September, 1989. Also, Brown et al. (1989) compiled a vegetative history of the island summarizing early historical accounts and scientific works. Carls et al. (1991) assessed the impact of oil industry activities on three plant communities on the northern one-third of the island, and McAtee and Drawe (1975, 1980, 1981) examined the impacts of vehicular and pedestrian traffic patterns on the northern one-third of the island. However, the most comprehensive ecological treatment of PINS vegetation was done by Baccus and Horton (1979) and Baccus et al. (1977). They examined vegetation along the entire length of PINS and focused on areas with differing amounts of vehicular and pedestrian traffic. Drawe et al. (1981) and Kattner (1973) conducted comprehensive vegetation studies of five habitats about 13 km south of the PINS Ranger Station during each of six seasons from winter 1972 to spring 1973. Higginbotham (1972) analyzed vegetation data from four habitats in the northern one-third of the National Seashore, and Otteni et al. (1972) investigated dune vegetation near the PINS Ranger Headquarters.

PINS was established in 1963 and since that time a considerable number of ecological investigations have been conducted, whereas only four floristic studies have been completed. Rabalais (1975) produced a list of the flora of PINS using work by Jones et al. (1961), Jones (1966), and Rechenthin and Passey (1967). A checklist incorporating data from the aforementioned ecological and floristic studies has never been published. The purpose of this investigation was to produce a checklist for PINS using data from the literature as well as our own field studies of the island. A checklist can aid researchers in identifying plants, provide data for the development of a flora or manual, and allow for biogeographic comparisons with other islands (Nelson Goetze & Lucksinger, unpublished data).

METHODS AND MATERIALS

Areas known as Big Ball Hill, Ranger Road, and Bird Island Basin were sampled during the investigation (Fig. 1). In the Big Ball Hill region, floristic surveys were conducted in May and August through November of 1996, as well as January through March and May of 1997. The Ranger Road and Bird Island Basin regions were sampled from January through April of 1998. Sampling was done by establishing approximately 500m belt transects in each community type with the aid of a Magellan GIS navigator. Communities identified for sampling included coppice dunes, foredunes, barrier flats and secondary dunes, tidal flats (Nelson et al. 1998), and disturbed areas such as roadside ditches. Transects in each community were walked and plants in flower within sight of the transect were sampled. In a few instances, woody vegetation was sampled that was not in flower. Plants collected along the transects were identified by using Jones (1982), Correll and Johnston (1970), Gould (1975), and Gould and Box (1965). Species nomenclature was updated to Jones et al. (1997). Common names were taken from Correll and Johnston (1970) taking into account nomenclatural changes based on Jones et al. (1997). Vouchers were deposited in the herbarium at Texas A&M University-Kingsville (TAIC) and Tarleton State University (TAC) in Stephenville, Texas. In addition to our field data, information from the investigations summarized in the introducrion were used in compiling the checklist. Rechenthin and Passey (1967) reported several specimens only as genera; these records were not included in our checklist. These include *Allium*, *Abutilon*, *Callirhoe*, *Desmodium*, *Penstemon*, *Polygonum*, *Rumex*, and *Tragia*. The checklist is arranged alphabetically by and within family and includes the scientific name, authoriry, common names (if available), herbarium, collector (if available), and collection number. Acronyms used for Texas herbaria include: C.C. Museum (Corpus Christi Museum), PINS (Padre Island National Seashore, Corpus Christi), TAC, and TAIC. When collection data are not available, the abbreviation NSA (No specimen available) is used and investigations where this species was reported are listed. Following the collection data are annotations on habit, endemism, and habitat. Plants that are woody are listed as such; plants without this designation are herbaceous in habit. When known, habitat designations of coppice dunes (CD), foredunes (FD), barrier flar (BF), and tidal flat (TF) (Nelson et al. 1997, 1999) are used.

RESULTS AND DISCUSSION

Seventy-seven families, 259 genera, and 456 species are repoted from PINS. The five most common families are Poaceae (20.8%), Asteraceae (12.5%), Fabaceae (9.6%), Cyperaceae (6.4%), and the Euphorbiaceae (4.2%). The flora of PINS primarily represents a subset of the flora of the South Texas

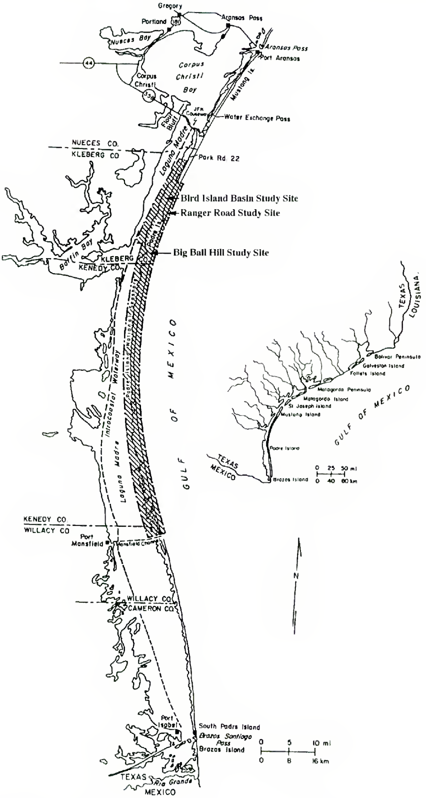

FIG. 1. Map (Weise & White 1980) indicating the location of the study sites. Hatched lines indicate the boundaries of Padre Island National Seashore. Inset shows location of Padre Island National Seashore in Texas.

mainland with the exception of *Flaveria brownii* and *Sporobolus tharpii*, which are reported as possible endemics on Padre Island and the Tamaulipan barrier islands of northern Mexico (Britton & Morton 1989). *Lycium carolinianum* var. *quadrifidum*, reported only along bayshores in Texas (Britton & Morton 1989), was found in the tidal flat community of PINS.

The lack of woody vegetation is a striking feature in regard to the PINS flora. Less than 10% of the species from PINS are considered subshrubs, shrubs, or trees. When one considers the populations of these species in comparison to the total vegetative community of the island, it is estimated that less than 1.0% of the vegetation is woody. Based on historical accounts prior to the early nineteenth century, it appears that woody forms of vegetation have always been scarce on the island (Brown et al. 1989). Britton and Morton (1989) point out that this is not typical of all barrier islands as those of the eastern Gulf and Atlantic shores often support oak- or pine- dominated woodlands. Arid climate is a likely factor in the lack of woody vegetation but is not the only factor as a number of northern Mexico barrier islands have dense stands of thorn-scrub woodland (Britton & Morton 1989). Northern Padre Island may have supported some scattered oak mottes that have declined through time (Britton & Morton 1989; Brown 1989) but is primarily a grassland ecosystem. Therefore, central and southern Texas barrier islands are unique in having a herb-dominated flora and PINS is an excellent example of this type of ecosystem. PINS also has the richest flora of the four barrier island ecosystems that have been studied in Texas (Nelson, unpublished data). A forthcoming investigation will use data from this checklist to elucidate a common flora for four South Texas barrier islands, examine community similarities among the islands, and discuss unique floral components for Matagorda Island, Mustang Island, northern Padre Island, and southern Padre Island (Nelson, unpublished data).

CHECKLIST OF THE VASCULAR FLORA OF PADRE ISLAND NATIONAL SEASHORE

Plants that are woody are listed as such; plants without this designation are herbaceous in habit. Habitat designations: coppice dunes (CD), foredunes (FD), barrier flat (BF), and tidal flat (TF) (Nelson et al. 1997, 1999).

ACANTHACEAE

Ruellia corzoi Tharp & Barkl., PINS, *Lee 2532*.

AGAVACEAE

Yucca constricta Buckley, Beargrass, Spanish bayonet. PINS, *Jones 756*. Shrub. BF and FD.

Yucca treculeana Carr., Spanish dagger, Palma pita. NSA; Jones (1966), Rabalais (1975). Shrub. BF and FD.

AIZOACEAE

Mollugo verticillata L., Indian chick weed. PINS, *Jones 499*.

Sesuvium maritimum (Walt.) Britton, Sterns, & Poggenb., Sea purslane. NSA; Rechenthin and Passey (1967).

Sesuvium portulacastrum (L.) L., Cenicilla. TAIC, *Nelson and Odvody N293*. CD.

Sesuvium trianthemoides Correll, Sea purslane.

TAC, *Nelson, Macke, and Wilburn N697*. BF.

Sesuvium verrucosum Raf., Sea purslane. PINS, *Jones 6400*.

Trianthema portulacastrum L., Horse purslane. PINS, *Jones 498*.

ALISMATACEAE

Echinodorus beteroi (Spreng.) Fassett, Burhead. PINS, *1153*.

AMARANTHACEAE

Amaranthus arenicola I. M. Johnst., Sandhills amaranth. PINS, *6662*.

Amaranthus blitum L., NSA; Rabalais (1975).

Amaranthus greggii S. Watson, Pigweed, Amaranth. TAIC, *Nelson N514*. CD.

Amaranthus polygonoides L., Tropical amaranth. PINS, *500*.

Blutaparon vermiculare (L.) Mears, Silver head. TAIC, *Nelson and Hornsby N398*. TF.

Celosia nitida Vahl, PINS, *Whistler 2470*.

Froelichia drummondii Moq., Snake cotton, Cottonweed. NSA; Jones (1966).

Froelichia floridana (Nutt.) Moq. var. *floridana*, Snake cotton, Cottonweed. PINS, *6689*.

Tidestromia lanuginosa (Nutt.) Standl. var. *lanuginosa*, Espanta vaqueros. TAIC, *Nelson N417*. BF.

APIACEAE

Centella asiatica (L.) Urb., PINS, *Jones 893*.

Hydrocotyle bonariensis Commers. ex Lam., Sombrerillo. TAIC, *Nelson and Perez-Johnson N318*. FD and BF.

Hydrocotyle umbellata L., Ombligo de Venus. PINS, *Jones 1390*.

ASCLEPIDACEAE

Asclepias emoryi (Greene) Vail, Milkweed, Silkweed. NSA; Jones (1966).

Asclepias oenotheroides Cham. & Schlrdl., Hierba de zizotes. TAIC, *Nelson N328*. FD.

Asclepias viridiflora Raf., Milkweed, Silkweed. NSA; Rechenthin and Passey (1967).

Cynanchum angustifolium Pers., PINS, *924*.

ASTERACEAE

Ambrosia artemisiifolia L., Short ragweed, Altamisa. NSA; Baccus and Horton (1979), Higginbotham (1972), Rabalais (1975).

Ambrosia psilostachya DC., Western ragweed. TAIC, *Nelson and McKeller N352*. FD, BF, and TF.

Amphiachyris dracunculoides (DC.) Nutt., Broomweed, Snakeweed. NSA, Rabalais (1975).

Aphanostephus skirrhobasis (DC.) Trel. var. *thalassius* Shinners, Lazy daisy. TAIC, *Nelson and Guerra N375*. BF.

Baccharis neglecta Britton, Roosevelt weed, New Deal weed, Jara dulce. PINS, *M. I. 7227*. Shrub.

Baccharis salicina Torr. & A. Gray, Seep willow, Jara, Water-wally. NSA; Rechenthin and Passey (1967). Shrub.

Borrichia frutescens (L.) DC., Sea ox-eye daisy. TAIC, *Nelson and Goodridge N365*. Subshrub to shrub. BF and TF.

Centaurea americana Nutt., Basketflower, Thornless thistle, Cardo del valle. NSA; Rechenthin and Passey (1967).

Chrysopsis pilosa Nutt., Golden aster, Camphor weed. C.C. Museum, *Jones 6265*.

Cirsium horridulum Michx. var. *elliottii* Torr. & A. Gray, Bull thistle, Yellow thistle. TAC, *Nelson, Macke, and Wilburn N717*. BF.

Cirsium texanum Buckley, Thistle, Plumed thistle. NSA; Rabalais (1975).

Conoclinium betonicifolium (Mill.) King & Rob., TAIC, *Nelson and Martinez N383*. FD, BF, and TF.

Conyza canadensis (L.) Cronquist, Horseweed. PINS, *7925*.

Conyza ramosissima Cronquist, NSA; McAtee (1975).

Coreopsis tinctoria Nutt., Coreopsis, Tickseed. TAC, *Nelson, Macke, and Wilburn N655*. TF.

Croptilon divaricatum (Nutt.) Raf., Scratch-daisy. TAIC, *CSP 44*.

Croptilon rigidifolium (E. B. Sm.) E. B. Sm., Scratch-daisy. TAC, *Nelson, Macke, and Wilburn N636*. FD.

Dyssodia pentachaeta (DC.) Robins. var. *pentachaeta*, Parralena. TAC, *Nelson, Macke, and Wilburn N648*. BF.

Dyssodia tenuiloba (DC.) Robins., Dogweed, Fetid marigold. TAIC, *Perkins 4*.

Eclipta prostrata (L.) L., C.C. Museum, *Jones 6913*.

Erigeron procumbens (Houst. ex Mill.) Nesom, Fleabane. TAIC, *Nelson N624*. BF and FD.

Eupatorium compositifolium Walter, Yankee weed. PINS, *Jones 5871*.

Euthamia leptocephala (Torr. & A. Gray) Greene, PINS, *6264*.

Evax verna Raf., Rabbit-tobacco, Cotton-rose. PINS, *Jones and Baker 6407*.

Flaveria brownii Powell, Longleaf flaveria. TAIC, *Nelson N495*. Endemic. BF.

Gaillardia pulchella Foug., Indian blanket, Firewheel. TAIC, *Nelson and Soto N361*. FD, BF, and TF.

Gamochaeta falcata (Lam.) Cabrera, Cudweed, Everlasting. PINS, *Jones and Baker 6409*.

Gamochaeta pensilvanica (Willd.) Cabrera, Cudweed, Everlasting. NSA; Jones (1966).

Helenium amarum (Raf.) H. Rock var. *amarum*, C.C. Museum, *Jones 7927*.

Helianthus annuus L., Common sunflower, Mirasol. PINS, *548*.

Helianthus argophyllus Torr. & A. Gray, Silverleaf sunflower. PINS, *2516*.

Helianthus debilis Nutt. subsp. *cucumerifolius* (Torr. & A. Gray) Heiser, Cucumberleaf sunflower. TAC, *Nelson, Macke, and Wilburn N684*. TF.

Helianthus praecox Engelm. & A. Gray subsp. *runyonii* (Heiser) Heiser, Sunflower PINS, *2364*.

Heterotheca subaxillaris (Lam.) Britton & Rusby, Camphorweed. TAIC, *Nelson and Resendez N307*. CD and FD.

Iva annua L., Sumpweed, Marsh-elder, Pelocote. NSA; Rechenthin and Passey (1967).

Iva imbricata Walter, Sumpweed, Marsh elder. NSA; Jones (1966), Rabalais (1975).

Iva texensis R. R. Johnson, Sump-weed, Marsh-elder. TAIC, *Nelson N483*. BF and TF.

Krigia occidentalis Nutt., Dwarf dandelion. NSA; Jones (1966), Rabalais (1975).

Liatris elegans (Walter) Michx. var. *elegans*, Gay-feather, Button-snakeroot, Blazing star. PINS, *1180*.

Machaeranthera phyllocephala (DC.) Shinners, Camphor daisy. TAIC, *Nelson N420*. BF and TF.

Palafoxia hookeriana Torr. & A. Gray, PINS, *1383*.

Palafoxia rosea (Bush) Cory var. *rosea*, NSA; Jones (1966).

Palafoxia texana DC. var. *ambigua* (Shinners) B.L. Turner & M. I. Morris, C.C. Museum, *Jones 6776*.

Pluchea purpurascens (Sw.) DC., Canela. PINS, *2424*.

Ratibida peduncularis (Torr. & A. Gray) Barnh. var. *peduncularis*, Mexican hat. PINS, *530*.

Rudbeckia hirta L. var. *angustifolia* (Moore) Perdue, Brown-eyed Susan, Cone flower. NSA; Jones (1966), Rabalais (1975).

Senecio riddellii Torr. & A. Gray, Groundsel, Ragwort, Squaw-weed. TAIC, *Nelson N502*. FD.

Solidago odora Aiton var. *odorata*, Sweet goldenrod. PINS, *1248*.

Solidago sempervirens L., Seaside goldenrod. PINS, *Jones 1256*.

Sonchus asper (L.) Hill, Achicoria dulce. NSA; Jones (1966).

Sonchus oleraceus L., Sow thistle. TAC, *Nelson, Macke, and Wilburn N653*. BF.

Symphyotrichum divaricatum (Nutt.) Nesom, Hierba del marrano. PINS, *Lee 2471*.

Tetragonotheca repanda (Buckley) Small, Nerve-ray. NSA; Rabalais (1975).

Thelesperma filifolium (Hook.) A. Gray, Green-thread. PINS, *Whistler and Norfleet 1864*.

Thelesperma nuecense B. L. Turner, Green-thread. PINS, *Jones 1348*.

Verbesina encelioides (Cav.) Benth. & Hook. ex A. Gray, Cowpen daisy. C.C. Museum, *Jones 7585*.

Xanthium strumarium L., Abrojo. NSA; Jones (1966), Rabalais (1975).

AVICENNIACEAE

Avicennia germinans (L.) L., Black-mangrove, Mangle blanco. PINS, *6668*. Shrub.

BATACEAE

Batis maritima L., Vidrillos. TAIC, *Nelson and Hornsby N393*. Subshrub. TF.

BORAGINACEAE

Heliotropium convolvulaceum (Nutt.) A. Gray, NSA; Rechenthin and Passey (1967).

Heliotropium curassavicum L. var. *curassavicum*, Seaside heliotrope, Cola del mico. TAC, *Nelson, Macke, and Wilburn N681*. TF.

Heliotropium racemosum Rose & Standl., Turnsole, Heliotrope. PINS, *5958*.

BRASSICACEAE

Cakile geniculata (Robins.) Millsp., Sea rocket. TAIC, *Taylor 398*.

Cakile lanceolata (Willd.) Schulz subsp. *pseudoconstricta* Rodman, TAC, *Nelson, Macke, and Wilburn N635*. TF.

Lepidium lasiocarpum T. Nutt. ex Torr. & A. Gray var. *wrightii* (A. Gray) C.L. Hitchc., Pepperwort, Peppergrass. PINS, *Jones 1378*.

Lepidium virginicum L., Lentejilla. TAC, *Nelson, Macke, and Wilburn N652*. BF.

Rorippa nasturtium-aquaticum (L.) Hayek, Water-cress. NSA; Baccus and Horton (1979).

BUDDLEJACEAE

Polypremum procumbens L., C.C. Museum, Jones *7568*.

CACTACEAE

Opuntia engelmannii Salm-Dyck var. *lindheimeri* (Engelm.) B.D. Parfitt & Pinkava, Prickly pear, Cholla. NSA; Jones (1966), Rabalais (1975), Rechenthin and Passey (1967). Shrub.

Opuntia humifusa (Raf.) Raf. var. *humifusa*, Eastern prickly pear. NSA; Jones (1966), Rabalais (1975). Shrub.

Opuntia macrorhiza Engelm. var. *macrorhiza*, Plains prickly pear. TAIC, *Nelson and McKeller N355*. Shrub. BF.

Opuntia stricta (Haw.) Haw., Prickly pear, Cholla. NSA; Rabalais (1975). Shrub.

CAMPANULACEAE

Triodanis perfoliata (L.) Nieuwl., Venus looking glass. NSA; Jones (1966), Rabalais (1975).

CAPPARIDACEAE

Polanisia erosa (Nutt.) H.H. Iltis subsp. *breviglandulosa* H.H. Iltis, Clammy weed. NSA; Jones (1966).

CARYOPHYLLACEAE

Silene antirrhina L., Sleepy catchfly. NSA; Rabalais (1975).

Spergularia echinosperma (Celak.) Asch. & Graebn., Sand-spurrey. TAC, *Nelson, Macke, and Wilburn N658*. TF.

Spergularia marina (L.) Griseb., Salt-marsh sand-spurrey. C.C. Museum, *Jones 6297*.

CHENOPODIACEAE

Atriplex matamorensis A. Nels., Quelite cenizo. NSA; Rabalais (1975).

Atriplex pentandra (Jacq.) Standl., Saltbush. NSA; Rabalais (1975).

Atriplex texana S. Watson, Saltbush. NSA; Rabalais (1975).

Chenopodium album L., Lamb's-quarters, Pigweed. NSA; Rechenthin and Passey (1967).

Chenopodium ambrosioides L. var. *ambrosioides*, Mexican tea, Wormseed, Epazote. PINS, *513*.

Chenopodium berlandieri Moq., Pitseed goosefoot. C.C. Museum, *Jones 6298*.

Salicornia bigelovii Torr., Glasswort, Saladilla. TAIC, *Nelson and McKeller N353*. TF.

Salicornia virginica L., Glasswort, Saladilla. TAIC, *Nelson and French N367*. TF.

Suaeda conferta (Small) I. M. Johnst., Sea blite, Seepweed. NSA; Rabalais, 1975.

Suaeda linearis (Ell.) Moq., Sea blite, Seepweed. PINS, *7139*.

Suaeda tampicensis (Standl.) Standl., Sea blite, Seepweed. NSA; Rabalais (1975).

CISTACEAE

Helianthemum georgianum Chapm., Rock-rose, Frostweed. PINS, *518*.

Lechea mucronata Raf., Pin-weed. PINS, *6628*.

CLUSIACEAE

Hypericum gentianoides (L.) Britton, Stems, & Poggenb., Orange grass, Pineweed. PINS, *Lee 2430*.

Hypercium hypericoides (L.) Crantz subsp.

hypericoides, St. Andrew's cross. PINS, *Jones 721*.

Hypericum pauciflorum Kunth, St. John's wort. PINS, *O'Brien 2540*.

COMMELINACEAE

Commelina erecta L. var. *angustifolia* (Michx.) Fern., Widow's-tears, day-flower. PINS, *521*.

Commelina erecta L. var. *erecta*, Hierba del pollo. TAIC, *Nelson and Hornsby N303*. FD and BF.

Tradescantia humilis Rose, Spiderwort, spiderlily. PINS, *520*.

CONVOLVULACEAE

Ipomoea cordatotriloba Dennst., Morning glory. PINS, *Lee 2474*.

Ipomoea imperati (Vahl) Griseb., Beach morning glory. TAIC, *Nelson and Goodridge N289*. CD and FD.

Ipomoea pes-caprae (L.) R. Brown subsp. *brasiliensis* (L.) v. Ooststr., Railroad vine, Goatfoot morning glory. NSA; Carls et al. (1991), Drawe et al. (1981), Jones (1966), Kattner (1973), McAtee (1975), McAtee and Drawe (1980), Rabalais (1975).

Ipomoea sagittata Poir., Morning glory. PINS, *Lee 2391*.

CUCURBITACEAE

Citrullus lanatus (Thunb.) Matsum. & Nakai var. *citroides* (L.H. Bailey) Mansf., Watermelon sandia. PINS, *Jones 1382*.

Cucumis melo L. var. *melo*, Muskmelon. NSA; Jones (1966), Rabalais (1975).

Cucurbita foetidissima Kunth, Buffalo-gourd, Calabacilla loca. NSA; Rechenthin and Passey (1967).

Ibervillea lindheimeri (A. Gray) Greene, Globe-berry. NSA; Jones (1966).

Melothria pendula L. var. *pendula*, Meloncito. C.C. Museum, *Jones 7146*.

CUSCUTACEAE

Cuscuta indecora Choisy, Pretty dodder. PINS, *Jones 885*.

Cuscuta pentagona Engelm., Dodder, Lovevine. NSA; Rabalais (1975).

CYMODOCEACEAE

Cymodocea filiformis (Kutz.) Correll, Manatee-grass. NSA; Rabalais (1975).

Halodule beaudettei (den Hartog) den Hartog, PINS, *Pratt 2352*.

CYPERACEAE

Cyperus croceus Vahl, Flatsedge. NSA; Jones (1966), Rabalais (1975).

Cyperus echinatus (L.) A.W. Wood, Flatsedge. NSA; Jones (1966), Rabalais (1975).

Cyperus esculentus L., Yellow nut-grass. TAIC, *Nelson N494*. TF.

Cyperus haspan L., Flatsedge. PINS, *Jones 1381*.

Cyperus polystachyos Rottb., Flatsedge. PINS, *Whistler and Lee 2415*.

Cyperus pseudothyrsiflorus (Kükenth.) R. Carter & S.D. Jones, Flatsedge. NSA; Jones (1966).

Cyperus retroflexus Buckley var. *retroflexus*, C.C. Museum, Jones, *6695*.

Cyperus retrorsus Chapm., Flatsedge. TAIC, *Nelson N627*. FD and BF.

Cyperus rotundus L., Nut-grass, Tulillo. NSA; Carls et al. (1987), Carls et al. (1991).

Cyperus squarrosus L. var. *squarrosus*, Flatsedge. NSA; Jones (1966), Rabalais (1975), Rechenthin and Passey (1967).

Cyperus surinamensis Rottb., Flatsedge. TAC, *Nelson, Macke, and Wilburn N641*. FD and BF.

Eleocharis albida Torr., Spikerush. PINS, *Jones 922*.

Eleocharis atropurpurea (Retz.) J. & C. Presl, Spikerush. PINS, *Jones 7416*.

Eleocharis cellulosa Torr., Spikerush. NSA; Rabalais (1975).

Eleocharis flavescens (Poir.) Urb. var. *flavescens*, Spikerush. TAC, *Nelson, Macke, and Wilburn N645*. BF.

Eleocharis geniculata (L.) J. J. Roem. & Schult., Spikerush. TAC, *Nelson, Macke, and Wilburn N638*. BF.

Eleocharis interstincta (Vahl) Roem. & Schult., Spikerush. PINS, *Lee 2475*.

Eleocharis minima Kunth var. *minima*, Spikerush. C.C. Museum, *Jones 7417*.

Eleocharis montevidensis K. Kunth, Spikerush. TAIC, *Nelson, N348*.

Eleocharis parvula (Roem. & Schult.) Link ex Bluff, Nees & Schauer var. *anachaeta* (Torr.) Svenson, Spikerush. PINS, *Jones 923*.

Fimbristylis caroliniana (Lam.) Fern., TAIC, *Nelson N418*. BF.

Fimbristylis castanea (Michx.) Vahl, TAIC, *Nelson N419*. BF.

Fuirena scirpoidea Michx., C.C. Museum, *Fall 76D457*.

Fuirena simplex Vahl, Umbrella-grass. PINS, *O'Brien 2512*.

Lipocarpha micrantha (Vahl.) G.C. Tucker, PINS, *Jones 891*.

Rhynchospora colorata (L.) H. Pfeiff., White-topped umbrella grass. TAC, *Nelson, Macke, and Wilburn N696*. BF.

Schoenoplectus erectus (Poir.) Palla ex J. Raynal, Bullrush. PINS, *Jones 6834*.

Schoenoplectus pungens (Vahl) Palla var. *longespicatus* (Britton) S.G. Sm., Sword-grass, Three-squared-bullrush. TAC, *Nelson, Macke, and Wilburn N654*. BF.

Schoenoplectus saximontanus (Fern.) J. Raynal, Bullrush. NSA; Jones (1966); Rechenthin and Passey (1967).

DROSERACEAE

Drosera brevifolia Pursh, Sundew. PINS, *Jones 6828*.

ELATINACEAE

Elatine triandra Schkuhr., Waterwort. C.C. Museum, *Jones 6833*.

EUPHORBIACEAE

Acalypha radians Torr., Three-seeded mercury. PINS, *Jones 6560*.

Cnidoscolus texanus (Müll. Arg.) Small, Bull nettle, Mala mujer. C.C. Museum, *Jones 7559*.

Croton argyranthemus Michx., C.C. Museum, *Jones 6541*.

Croton capitatus Michx. var. *lindheimeri* (Engelm. & A. Gray) Müll. Arg., Woolly croton, Hogwort. TAIC, *Nelson, N425*. BF.

Croton coryi Croizat, PINS, *Jones 959*.

Croton glandulosus L. var. *lindheimeri* Müll. Arg., TAIC, *McAtee*.

Croton glandulosus L. var. *pubentissimus* Croizat, PINS, *Lee 2414*.

Croton glandulosus L. var. *septentrionalis* Müll. Arg., PINS, *Lee 2388*.

Croton monanthogynus Croton. Michx., PINS, *Fall 1258*.

Croton parksii Croizat, Croton. C.C. Museum, *Jones 6670*.

Croton punctatus Jacq., Hierba del jabali, Beach-tea. TAIC; *Nelson and Guerra, N285*. Subshrub. CD and FD.

Euphorbia bombensis Jacq., Spurge. PINS, *Baker 1132*.

Euphorbia cordifolia Elliott, Spurge. PINS, *Whistler 2527*.

Euphorbia corollata L., Spurge. NSA; Carls et al. (1987).

Euphorbia innocua Wheeler, Spurge. NSA; Jones (1966), Rabalais (1975).

Euphorbia maculata L., Spurge. PINS, *Jones 1287*.

Euphorbia serpens Kunth, Hierba de la golondrina. C.C. Museum, *Jones 7687*.

Phyllanthus abnormis Baill. var. *abnormis*, Leaf-flower. PINS, *Fall 1250*.

Phyllanthus polygonoides Nutt. ex Spreng., Leaf-flower. PINS, *Jones and Baker 604*.

Phyllanthus pudens Wheeler, Leaf-flower. NSA; Rabalais (1975).

Stillingia sylvatica Garden ex L. subsp. *sylvatica*, Queen's delight. PINS, *Jones 617*.

FABACEAE

Acacia minuata (M. E. Jones) Beauch. subsp. *minuata*, Huisache. NSA; Jones (1966), Rabalais (1975), Rechenthin and Passey (1967). Shrub or tree.

Aeschynomene viscidula Michx., Sticky jointvetch. PINS, *Jones 745*.

Astragalus brazoensis Buckley, Milk-vetch, Loco weed. PINS, *Jones 6795*.

Astragalus leptocarpus Torr. & A. Gray, Milk-vetch, Loco weed. PINS, *Jones 7620*.

Baptisia bracteata Nutt. var. *leucophaea* (Nutt.) Kartesz & Gandhi, Plains wild indigo. NSA; Rabalais (1975).

Baptisia bracteata Muhl. ex Elliott var. *laevicaulis* (A. Gray ex Canby) Isley, Plains wild indigo. TAIC, *Nelson and Negrete N402*. BF.

Canavalia rosea (Sw.) DC., Jackbean. Swordbean. PINS, *Jones 919*.

Centrosema virginianum (L.) Benth., Butterfly pea. PINS, *Jones 747*.

Chamaecrista fasciculata (Michx) Greene, Partridge pea. TAIC, *Nelson N489*. FD and BF.

Clitoria mariana L. PINS, *Lee 2400*.

Crotolaria sagittalis L., Rattlepod. PINS, *Jones 4092*.

Dalea emarginata (Torr.& A. Gray) Shinners, PINS, *Nelson, Macke, and Wilburn N713*. BF.

Dalea lanata Spreng., Woolly dalea. PINS, *Jones and Baker 6562*.

Dalea obovata (Torr. & A. Gray) Shinners, Pussyfoot. PINS, *Jones 738*.

Dalea pogonathera A. Gray, Hierba del corazon, Bearded dalea. NSA; Carls et al. (1987).

Desmanthus virgatus (L.) Willd. var. *depressus* (Humb. & Bonpl. ex Willd.) B.L. Turner, PINS, *Jones 850*.

Erythrina herbacea L., Coral bean, Colorín. PINS, *734*.

Galactia canescens Benth., Hoary milkpea. PINS, *Lee 2420*.

Galactia marginalis Benth., PINS, *Whistler 2524*.

Glottidium vesicaria (Jacq.) R.M. Harper, C.C. Museum, *Jones 7748*.

Indigofera miniata Ortega var. *leptosepala* (Nutt. ex Torr. & A. Gray) B.L. Turner, Scarlet pea. NSA; Drawe et al. (1981), Higginbothan (1972), Jones (1966).

Indigofera miniata Ortega var. *miniata*, Scarlet pea. TAIC, *Nelson and Hornsby N301*. FD and BF.

Indigofera suffruticosa Mill., C.C. Museum, *Jones 6673*. Shrub.

Leucaena leucocephala (Lam.) de Wit, C.C. Museum, *Jones 7924*. Shrub or tree.

Medicago polymorpha L., Bur-clover. PINS, *Jones 751*.

Melilotus albus Medik., White sweet clover, Huban. PINS, *Whistler and Lee 248*.

Melilotus indicus (L.) C. All., Sour clover, Alfalfilla. TAC, *Nelson, Macke, and Wilburn N692*. BF.

Mimosa latidens (Small) B.L. Turner, Sensitive brier. PINS, *Whistler 1837*.

Mimosa strigillosa Torr. & A. Gray, Powderpuff, Vergonzosa. NSA; Jones (1966), Rabalais (1975).

Neptunia lutea (Leavenw.) Benth., Yellowpuff. NSA; Rechenthin and Passey (1967).

Neptunia pubescens Benth. var. *pubescens*, PINS, *Jones and Baker 741*.

Parkinsonia aculeata L., Retama. C.C. Museum, *79D096*. Tree.

Pediomelum rhombifolium (Torr. & A. Gray) Rydb., C.C. Museum, *3563*.

Prosopis glandulosa Torr. var. *glandulosa*, Honey mesquite. PINS, *Jones 912*. Shrub or tree.

Rhynchosia americana (Houst. ex Mill.) Metz, Snoutbean. TAIC, *Nelson and Goodridge N321*. FD and BF.

Rhynchosia minima (L.) DC., Snoutbean. TAIC, *Nelson and Perez-Johnson N306*. FD and BF.

Rhynchosia reniformis (Pursh) DC., Dollarleaf. NSA; Rechenthin and Passey (1967).

Rhynchosia senna Gillies ex Hook. var. *texana*, Snoutbean. TAC, *Nelson, Macke, and Wilburn N704*. BF.

Sesbania drummondii (Rydb.) Cory, Rattlebush, Poison bean, Coffee bean. PINS, *Jones 914*. Shrub.

Sesbania exaltata (Raf.) Rydb. ex A. Hill, Bequilla. PINS, *Tharp 233*. Subshrub.

Sophora tomentosa L. var. *occidentalis* (L.) Isely, Yellow sophora. PINS, *Tharp 40*. Shrub.

Strophostyles helvula (L.) Elliot, Amberique bean. PINS, *Pratt 2358*.

Strophostyles leiosperma (Torr. & A. Gray) Piper, Sleek-seed bean. PINS, *Jones 913*.

Stylosanthes viscosa Sw., Pencil-flower. PINS, *Lee 2383*.

Vigna luteola (Jacq.) Benth., PINS, *Jones 750*.

Zornia bracteata J. F. Gmel., Viperina. PINS, *Whistler and Lee 2401*.

FAGACEAE

Quercus minima (Sarg.) Small., C.C. Museum, *Jones 7922*. Shrub.

Quercus virginiana Mill. var. *fusiformis* (Small) Sarg., Oak. TAIC, *Nelson N562*. Shrub or tree. BF.

Quercus virginiana Mill. var. *virginiana*, Live oak, encino. PINS, *Jones 931*. Tree.

FUMARIACEAE

Corydalis micrantha (Engelm. ex A. Gray) A. Gray subsp. *texensis* G. Ownbey, Scrambled eggs. NSA; Jones (1966), Rabalais (1975).

GENTIANACEAE

Eustoma exaltatum (L.) Salisb. ex G. Don, Catchfly-gentian. PINS, *Jones 883*.

Sabatia arenicola Greenm., Rose-gentian. TAIC, *Nelson N625*. FD and BF.

Sabatia campestris Nutt., Rose-gentian. TAIC, *Nelson N569*. TF.

GOODENIACEAE

Scaevola plumieri (L.) Vahl, PINS, *Tanner 1834*. Subshrub.

HYDROCHARITACEAE

Halophila engelmannii Asch., PINS, *Lee 2448*.

Thalassia testudinum Banks & Soland. ex König, Palmas del mar, Turtle-grass. NSA; Rabalais (1975).

HYDROPHYLLACEAE

Nama hispidum A. Gray, NSA; Jones (1966), Rabalais (1975).

Phacelia patuliflora (Engelm. & A. Gray) A. Gray, NSA; Rabalais (1975).

IRIDACEAE

Sisyrinchium biforme E.P. Bicknell, Blue-eyed grass. TAIC, *Nelson and Martinez N386*. BF.

Sisyrinchium sagittiferum E. P. Bicknell, Blue-eyed grass. PINS, *Jones 724*.

JUNCACEAE

Juncus acuminatus Michx., Rush, Bog-rush. PINS, *Jones 818*.

Juncus brachycarpus Engelm., Rush, Bog-rush. NSA; Jones (1966).

Juncus bufonius L. var. *bufonius*, Toad-rush. C.C. Museum, *Jones 1829*.

Juncus marginatus Rostk., Rush, Bog-rush. PINS, TAC, *Nelson, Macke, and Wilburn N664*. TF.

Juncus megacephalus M. A. Curtis, Rush, Bog-rush. TAC, *Nelson, Macke, and Wilburn N699*. BF.

Juncus roemerianus Scheele, PINS, *Whistler 2484*.

Juncus scirpoides Lam., Neddlepod rush. TAIC, *Nelson N513*. BF.

Juncus validus Coville var. *fascinatus* M.C. Johnst., Rush, Bog-rush. PINS, *Jones 6864*.

LAMIACEAE

Monarda punctata L. var. *lasiodonta* A. Gray, Spotted beebalm, Horsemint. C.C. Museum, *Jones 7699*.

Scutellaria drummondii Benth., Skullcap. NSA; Jones (1966), Rabalais (1975).

Scutellaria muriculata Epl., Skullcap. PINS, *Jones 6566*.

Teucrium cubense Jacq. var. *cubense*, Germander. NSA; Rechenthin and Passey (1967).

LAURACEAE

Persea borbonia (L.) K. Spreng., Red bay. PINS, *Jones 905*. Shrub or tree.

LENTIBULARIACEAE

Utricularia subulata L., Bladderwort. C.C. Museum, *Jones 6827*.

LILIACEAE

Cooperia drummondii Herb., Cebolleta. NSA; Rabalais (1975).

Nothoscordum bivalve (L.) Britton, Crow-poison. NSA; Jones (1966).

LINACEAE

Linum alatum (Small) H.K.A. Winkl., Flax. NSA; Drawe et al. (1981), Jones (1966), Rabalais(1975).

Linum aristatum Engelm., Flax. NSA; Rabalais (1975).

Linum imbricatum (Raf.) Shinners, Tufted flax. NSA; Rabalais (1975).

LOASACEAE

Mentzelia oligosperma Nutt. ex Sims, Stick-leaf, Chicken thief, Pegajosa. NSA; Jones (1966), Rabalais (1975).

LYTHRACEAE

Ammannia latifolia L., C.C. Museum, *Jones 3377*.

Lythrum alatum Pursh var. *lanceolatum* (Elliott) Torr. & A. Gray ex Rothr., Loosestrife. TAIC, *Nelson N424*. TF.

Lythrum californicum Torr. & A. Gray, Hierba del cancer. PINS, *Whistler 2469*.

Rotala ramosior (L.) Koehne, Tooth-cup. PINS, *Jones 6831*.

MALVACEAE

Kosteletzkya virginica (L.) K. Presl ex A. Gray, Salt marsh-mallow. C.C. Museum, *Jones 6912*.

Malvastrum americanum (L.) Torr., Malva loca. PINS, *Jones 916*.

Malvastrum coromandelianum (L.) Garcke, PINS, *Jones 917*.

Sida ciliaris L., Bracted sida. *Whistler and Lee 2417*.

Sida cordifolia L., NSA; Rabalais (1975).

Sida lindheimeri Engelm. & A. Gray, PINS, *Jones 868*.

Sphaeralcea lindheimeri A. Gray, False mallow, Globe mallow. PINS, *Baker 763*.

MYRICACEAE

Morella cerifera (L.) Small, Wax-myrtle, Candle-berry. PINS, *Jones 764*. Shrub.

NAJADACEAE

Najas guadalupensis (Spreng.) Magnus, Common water-nymph. PINS, *Hamby and Jones 1152*.

NYCTAGINACEAE

Boerhavia coccinea Mill., Scarlet spiderling. NSA; Rabalais (1975).

Mirabilis albida (Walter) Heimerl., White four-o'clock. PINS, *Jones 6777*.

ONAGRACEAE

Calylophus berlandieri Spach subsp. *pinifolius* (Engelm. ex A. Gray) Towner, NSA; Jones (1966).

Calylophus serrulatus (Nutt.) P.H. Raven, Yellow evening primrose. TAIC, *Nelson and Perez-Johnson N343*. TF.

Gaura longiflora Spach, NSA; Jones (1966), Rabalais (1975).

Gaura parviflora Douglas ex Lehm., Lizard-tail, Velvet-leaf gaura. NSA; Jones (1966), Rabalais (1975).

Ludwigia glandulosa Walter, Cylindric-fruited ludwigia. NSA; Jones (1966), Rabalais (1975).

Oenothera drummondii Hook. subsp. *drummondii*, Beach evening primrose. TAIC, *Nelson and Perez-Johnson N287*. CD and FD.

Oenothera grandis (Britton) Smyth, Evening primrose. NSA; Jones (1966), Rabalais (1975).

Oenothera laciniata Hill, Cut-leaved evening primrose. TAIC; *Nelson N566*. BF and TF.

Oenothera speciosa Nutt., PINS, *Hambly 1195*.

ORCHIDACEAE

Spiranthes vernalis Engelm. & A. Gray, Spring ladies' tresses. TAIC, *Nelson and Soto N329*. FD and BF.

OROBANCHACEAE

Orobanche ludoviciana Nutt. subsp. *multiflora* (Nutt.) Collins, Broomrape. C.C. Museum, *Jones 2040*.

OXALIDACEAE

Oxalis dillenii Jacq. subsp. *dillenii*, Wood-sorrel, lady's sorrel. NSA; Jones (1966), Rabalais (1975).

Oxalis drummondii A. Gray, Wood-sorrel, lady's sorrel. NSA; Rabalais (1975).

PAPAVERACEAE

Argemone albiflora Hornem. subsp. *texana* G.B. Ownbey, White prickly poppy. NSA; Higginbotham (1972).

Argemone sanguinea Greene, Red poppy. NSA; Jones (1966), Rabalais (1975).

PHYTOLACCACEAE

Phytolacca americana L. var. *americana*, Pokeweed, pokeberry. C.C. Museum, *Jones 7657*.

PLANTAGINACEAE

Plantago heterophylla Nutt., Plantain. PINS, *Jones 6807*.

Plantago hookeriana Fisch. & C.A. Mey., Tallow weed. TAC, *Nelson, Macke, and Wilburn N678*. TF.

Plantago virginica L., Pale-seeded plantain. TAIC, *Nelson N565*. TF.

PLUMBAGINACEAE

Limonium carolinianum (Walter) Britton, Sea-lavender, Marsh-rosemary. TAIC, *Nelson N518*. TF.

POACEAE

Andropogon gerardii Vitman, Big bluestem. PINS, *Whistler 2479*.

Andropogon glomeratus (Walter) Britton, Sterns, & Poggenb., Bushy beardgrass. TAIC, *Nelson and Resendez N381*. TF.

Andropogon ternarius Michaux var. *ternarius*, Splitbeard bluestem. PINS, *Jones 1312*.

Andropogon virginicus L., Broomsedge. PINS, *Jones 903*.

Aristida longespica Poir. var. *geniculata* (Raf.) Fern., Three-awn grass. TAIC, *Nelson N499*. TF.

Aristida oligantha Michx., Prairie three-awn. NSA; Rechenthin and Passey (1967).

Aristida purpurea Nutt. var. *purpurea*, Purple three-awn. NSA; Rechenthin and Passey (1967).

Arundo donax L., Giant reed, Carrizo, Georgia cane. TAC, *Nelson, Macke, and Wilburn N632*. BF.

Avena fatua L., Oats. NSA; Jones (1966), Rabalais (1975).

Bothriochloa barbinodis (Lag.) Herter var. *barbinodis*, Beardgrass. TAIC, *Guerra 00606*.

Bothriochloa ischaemum L. var. *songarica* (Fisch. and C.A. Mey.) Celarier & Harlan, PINS, *Whistler 2462*.

Bothriochloa laguroides (DC.) Herter subsp. *torreyana* (Steud.) Hack., Silver beardgrass, Silver bluestem. PINS, *Jones 7684*.

Bromus catharticus Vahl, Rescue grass. NSA; Jones (1966), Rabalais (1975).

Cenchrus echinatus L., Cadillo. TAC, *Nelson, Macke, and Wilburn N706*. FD and BF.

Cenchrus spinifex Cav., Grassbur, Coast sandbur. TAIC, *Nelson and Odvody N315*. FD and BF.

Chloris andropogonoides Fourn., Fingergrass. PINS, *Jones 6732*.

Chloris canterai Arech. var. *canterai*, Fingergrass. NSA; Jones (1966), Rabalais (1975).

Chloris cucullata Bisch., Hooded fingergrass, Hooded windmill grass. NSA; Jones (1966), Rabalais (1975), Rechenthin and Passey (1967).

Chloris gayana Kunth, Rhodes grass. PINS, *Jones 7147*.

Chloris verticillata Nutt., Windmill fingergrass, Tumble windmill grass. NSA; Rechenthin and Passey (1967).

Cynodon dactylon (L.) Pers. var. *dactylon*, Bermudagrass, Pata de gallo. PINS, *Fall 1242*.

Dactyloctenium aegyptium (L.) Beauv., Crowfoot. NSA; Jones (1966), Rabalais (1975).

Dichanthium annulatum (Forssk.) Stapf var. *annulatum*, PINS, *Whistler 2480*.

Dichanthium aristatum (Poir.) C.E. Hubb., C.C. Museum, *Jones 6733*.

Digitaria arenicola (Swall.) A. Beetle, Crabgrass. TAC, *Nelson, Macke, and Wilburn N713*. FD.

Digitaria bicornis (Lam.) Roem. & Schult., C.C. Museum, *Jones 7902*.

Digitaria cognata (Schult.) Pilg., Crabgrass. PINS, *Fall 1253*.

Digitaria sanguinalis (L.) Scop., Northern crabgrass. NSA; Rechenthin and Passey (1967).

Digitaria texana Hitchc., Crabgrass. PINS, *Fall 1267*.

Distichlis spicata (L.) Greene, Saltgrass. PINS, *Whistler 2478*.

Echinochloa crus-galli (L.) Beauv. var. *crus-galli*, Barnyard grass. NSA; Rechenthin and Passey (1967).

Echinochloa crus-pavonis (Kunth) Schult., NSA; Rechenthin and Passey (1967).

Echinochloa walteri (Pursh.) A. Heller, NSA; Rechenthin and Passey (1967).

Eragrostis barrelieri Daveau, Lovegrass. C.C. Museum, *Jones 7582*.

Eragrostis capillaris (L.) Nees., Lacegrass. NSA; Rabalais (1975).

Eragrostis curtipedicellata Buckley, Gummy lovegrass. NSA; Rechenthin and Passey (1967).

Eragrostis intermedia Hitchc. var. *intermedia*, Lovegrass. NSA; Rechenthin and Passey (1967).

Eragrostis lugens Nees., Lovegrass. TAIC, *Estrello*.

Eragrostis pectinacea (Michx.) Nees., Lovegrass. NSA; Rechenthin and Passey (1967).

Eragrostis secundiflora J. Presl subsp. *oxylepis* (Torr.) S.D. Koch, Red lovegrass. TAC, *Nelson, Macke, and Wilburn N707*. CD, FD, and BF.

Eragrostis sessilispica Buckley, Lovegrass. NSA; Jones (1966), Rabalais (1975), Rechenthin and Passey (1967).

Eragrostis spectabilis (Pursh) Steud., Lovegrass. PINS, *Jones 1386*.

Eustachys petrea (Sw.) Desv., TAC, *Nelson, Macke, and Wilburn N642*. BF.

Hordeum pusillum Nutt., Little barley. TAIC, *Nelson N567*. TF.

Leersia hexandra Sw., PINS, *Whistler 2503*.

Leptochloa dubia (Kunth) Nees., Green sprangletop. NSA; Jones (1966), Rabalais (1975).

Leptochloa fascicularis (Lam.) A. Gray var. *fasicularis*, Sprangletop. NSA; Baccus and Horton (1979), Jones (1966), Rabalais (1975).

Leptochloa mucronata (Michx) Kunth, Red sprangletop. NSA; Rechenthin and Passey (1967).

Lolium perenne L., Ryegrass. NSA; Jones (1966), Rabalais (1975).

Monanthochloe littoralis Engelm., TAC, *Nelson, Macke, and Wilburn N687*. TF.

Muhlenbergia capillaris (Lam.) Trin., Gulf muhly. PINS, *Whistler 2502*.

Nassella leucotricha (Trin. & Rupr.) R. Pohl, Texas speargrass, Texas winter-grass. NSA; Jones (1966).

Panicum aciculare Desv. ex Poir. var. *angustiflium* (Elliot) Wipff and S. D. Jones, PINS, *Jones 7621*.

Panicum acuminatum Sw., Panic grass. PINS, *Jones 3961*.

Panicum amarum Elliot var. *amarulum* (A. Hitchc. & Chase) P. Palmer, Beach panic. TAC, *Nelson N624*. CD and FD.

Panicum amarum Elliot var. *amarum*, Beach panic. TAIC, *Nelson N493*. CD and FD.

Panicum capillarioides Vasey. Panic grass. TAIC, *Nelson and Hornsby, N309*. FD.

Panicum nodatum Hitchc. & Chase, Panic grass. PINS, *Fall 1261*.

Panicum oligosanthes Schult., PINS, *Whistler 2513*.

Panicum portoricense Desv. ex W. Hamilt., Panic grass. TAIC, *Nelson and French N369*. BF.

Panicum sphaerocarpon Elliott, Panic grass. TAIC, *Nelson N560*. BF.

Panicum virgatum L., PINS, *Whistler 2508*.

Parapholis incurva (L.) C.E. Hubb., Sicklegrass. TAIC, *Alaniz*.

Paspalum monostachyum Vasey, Paspalum. TAIC, *Nelson. N486*. FD and BF.

Paspalum plicatulum Michx. var. *plicatum*, Brownseed paspalum. PINS, *Jones 899*.

Paspalum setaceum Michx., Paspalum. TAIC, *Nelson and McKeller N299*. FD and BF.

Paspalum vaginatum Sw., Paspalum. PINS, *Jones 1881*.

Pennisetum ciliare (L.) Link var. *ciliare*, Buffelgrass. TAIC, *Nelson and Hornsby. N297*. FD.

Pennisetum glaucum (L.) R. Br., NSA; Rechenthin and Passey (1967).

Phragmites australis (Cav.) Trin. ex Steud. subsp. *australis*, Common reed. C.C. Museum, *Jones 6768*.

Polypogon monspeliensis (L.) Desf., Rabbitfoot grass. TAC, *Nelson, Macke, and Wilburn N680*. TF.

Schedonnardus paniculatus (Nutt.) W. Trel., Tumblegrass. NSA; Jones (1966), Rabalais (1975).

Schizachyrium scoparium (Michx.) Nash var. *littorale* (Nash) Gould, Seacoast bluestem. TAIC, *Nelson and Cadena N314*. FD and BF.

Setaria leucopila (Scribn. & Merr.) K. Schum., NSA; Jones (1966), Rabalais (1975).

Setaria macrostachya Kunth. NSA; Rechenthin and Passey (1967).

Setaria parviflora (Poir.) Kerguélen, NSA; Jones (1966), Rabalais (1975), Rechenthin and Passey (1967).

Sorghastrum nutans (L.) Nash, PINS, *Whistler 2504*.

Sorghum halepense (L.) R. Br., Johnson grass. NSA; Jones (1966), Rabalais (1975).

Spartina alterniflora Lois. var. *glabra* (Bigel.) Fern., Smooth cordgrass. C.C. Museum, *Jones 6906*.

Spartina patens (Ait.) Muhl., Saltmeadow cordgrass. TAIC, *Nelson N423*. BF.

Spartina spartinae (Trin.) Merr. ex Hitchc., Sacahuista, Gulf cordgrass. C.C. Museum, *Jones 7181*.

Sphenopholis obtusata (Michx) F. Lamson., Prairie wedgescale. NSA; Jones (1966), Rabalais (1975).

Sporobolus airoides (Torr.) Torr. subsp. *airoides*, Alkali sacaton. NSA; Jones (1966), Rabalais (1975), Rechenthin and Passey (1967).

Sporobolus cryptandrus (Torr.) A. Gray, Sand dropseed. NSA; Carls et al. (1987), Jones (1966), Rabalais (1975), Rechenthin and Passey (1967).

Sporobolus pyramidatus (Lam.) Hitchc., Dropseed. PINS, *Pratt 2368*.

Sporobolus tharpii Hitchc., Coastal sacaton. TAIC, *Nelson N688*. Endemic. CD and FD.

Sporobolus virginicus (L.) Kunth, Coastal dropseed. TAIC, *Nelson and Hornsby N302*. FD, BF, and TF.

Trichloris pluriflora Fourn., NSA; Jones (1966), Rabalais (1975).

Trichoneura elegans Swall., Silveus-grass. PINS, *Jones 6719*.

Tridens congestus (L. H. Dewey) Nash, Tridens. TAIC, *Nelson N515*. BF.

Triplasis purpurea (Walter) Chapm. var. *purpurea*, Purple sandgrass. PINS, *Jones 896*.

Uniola paniculata L., Sea oats, Espiga del mar. TAIC, *Nelson and Cadena N291*. CD and FD.

Urochloa ciliastissima (Buckley) R.D. Webster, TAC, *Nelson, Macke, and Wilburn N708*. FD.

Urochloa texana (Buckley) R.D. Webster, PINS, *Whistler 2507*.

Vaseyochloa multinervosa (Vasey) Hitchc., Texas grass. PINS, *Jones 6713*.

Vulpia octoflora (Walter) Rydb., Six-weeks fescue. TAIC, *Kiddy*.

POLEMONIACEAE

Phlox drummondii Hook., Phlox. TAC, *Nelson, Macke, and Wilburn N630*. FD.

Phlox glabriflora (Brand) Whitehouse subsp. *glabriflora*, Rio Grande phlox. C.C. Museum, *Jones 6743*.

Phlox glabriflora (Brand) Whitehouse subsp. *littoralis* (Cory) Wherry, Rio Grande phlox. PINS, *Lee 2411*.

POLYGALACEAE

Polygala alba Nutt., Polygala, Milkwort. TAIC, *Nelson N626*. FD and BF.

Polygala incarnata L., Polygala, Milkwort. TAC, *Nelson, Macke, and Wilburn N637*. BF.

Polygala verticillata L., Polygala, Milkwort. C.C. Museum, *Jones 1980*.

POLYGONACEAE

Eriogonum longifolium Nutt. var. *longifolium*, Wild buckwheat. NSA; McAtee (1975), Rabalais (1975).

Eriogonum multiflorum Benth., Wild buckwheat. TAC, *Nelson, Macke, and Wilburn N628*. FD and BF.

Polygonella polygama (Vent.) Engelm. & A. Gray, October-flower. PINS, *Jones 6698*.

PORTULACACEAE

Portulaca oleracea L. subsp. *oleracea*, Purslane, Verdolaga. PINS, *Jones and Baker 780*.

Portulaca pilosa L., Chisme. C.C. Museum, *Jones 2339-A*.

Talinum parviflorum Nutt., Flame-flower. C.C. Museum, *Jones 2243*.

PRIMULACEAE

Anagallis arvensis L., Pimpernel. TAC, *Nelson, Macke, and Wilburn N651*. BF.

Anagallis minima L., Chaffweed. C.C. Museum, *Jones 6805*.

Samolus ebracteatus Kunth, Water-pimpernel, Brookweed. TAIC, *Nelson and Odvody N350*. BF and TF.

RUBIACEAE

Cephalanthus occidentalis L. var. *californicus* Benth., Common buttonbush, Honey-balls, Globe-flowers. PINS, *Jones 908*. Shrub or small tree.

Diodia teres Walter var. *teres*, Poor Joe, Rough buttonweed. PINS, *Jones 6559*.

Hedyotis nigricans (Lam.) Fosberg, Bluets. TAC, *Nelson, Macke, and Wilburn N685*. BF.

Houstonia subviscosa (C. Wright ex A. Gray) A. Gray, Bluets. TAIC, *Nelson and Martinez N335*. FD.

Oldenlandia boscii (DC.) Chapm., Bluets. PINS, *Jones 892*.

Oldenlandia uniflora L., PINS, *Jones 7441*.

Richardia brasiliensis Gómes, PINS, *Jones 7560*.

RUPPIACEAE

Ruppia maritima L., Widgeon-grass. PINS, *Jones and Baker 6552*.

RUTACEAE

Zanthoxylum clava-herculis L., Pepperbark, Hercules-club, Prickly ash, Tickle-tongue, Toothache tree. PINS, *Jones 7058*. Shrub or small tree.

Zanthoxylum hirsutum Buckley, Tickle-tongue, Toothache tree, Prickly ash. PINS, *Jones 786*. Shrub or small tree.

SALICACEAE

Salix nigra Marshall, Black willow, Saúz. TAIC, *Nelson N563*. Tree. BF.

SAXIFRAGACEAE

Lepuropetalon spathulatum Elliott, C.C. Museum, *Jones 6808*.

SCROPHULARIACEAE

Agalinis fasiculata (Elliott) Raf., C.C. Museum, *Jones 7579*.

Agalinis heterophylla (Nutt.) Small ex Britton, Prairie agalinis. TAIC, *Bogusch and Molby 2402*.

Agalinis maritima (Raf.) Raf. var. *glandiflora* (Benth.) Shinners, Seaside gerardia, Salt marsh gerardia. TAIC, *Nelson and Negrete N411*. BF.

Agalinis strictifolia (Benth.) Pennell, PINS, *Lee and Whistler 2390*.

Bacopa caroliniana (Walter) Robins., Blue hyssop. NSA; Rechenthin and Passey (1967).

Bacopa monnieri (L.) Pennell, Water-hyssop. PINS, *Jones and Hambly 1157*.

Bacopa rotundifolia (Michx.) Wettst., PINS, *Whistler 2467*.

Buchnera americana L., Bluehearts. TAIC, *Nelson N623*. BF.

Castilleja indivisa Engelm., Indian paintbrush, Paintedcup. NSA; Rechenthin and Passey (1967).

Lindernia dubia (L.) Pennell var. *anagallidea* (Michx.) Cooperr., False pimpernel. PINS, *Jones 6806*.

Maurandya antirrhiniflora Humb. & Bonpl. ex Willd. subsp. *antirrhiniflora*, Snapdragon vine. PINS, *Jones and Baker 790*.

Nuttallanthus texanus (Scheele) D.A. Sutton, Texas toad-flax. NSA; Jones (1966), Rabalais (1975).

Stemodia lanata Ses. & Moc. ex Benth., Woolly stemodia. TAIC, *Nelson and Negrete N409*. FD and BF.

SOLANACEAE

Capsicum annuum L. var. *aviculare* (Dierb.) D'Arcy & Eshbaugh, Bird pepper, Chilipequin, Chili pequín. NSA; Rabalais (1975). Subshrub or shrub.

Lycium carolinianum Walter var. *quadrifidum* (Dunal) Hitchc., Carolina wolfberry. TAIC, *Nelson N490*. Shrub. TF.

Nicotiana glauca Grah., Tree tobacco, Mustard tree, Rapé, Gigante, Buena moza. C.C. Museum, *Jones 7584*. Shrub or small tree.

Physalis cinerascens (Dunal) Hitchc. var. *spathulifolia* (Torr.) J. Sullivan, Ground cherry. TAIC, *Nelson and Martinez N296*. CD, FD, and BF.

Solanum americanum Mill., American nightshade, Hierba mora negra. PINS, *Jones 7309*.

Solanum rostratum Dunal, Buffalo bur, Kansas-thistle, Mala mujer. NSA; Rechenthin and Passey (1967).

TAMARICACEAE

Tamarix aphylla (L.) Karst., Tamarisk, Salt cedar. NSA; Rabalais (1975). Tree.

Tamarix canariensis Willd., Tamarisk, Salt cedar. NSA; Rabalais (1975). Shrub or tree.

Tamarix chinensis Lour., Tamarisk, Salt cedar. C.C. Museum, *Jones 8147*. Shrub or smalll tree.

Tamarix gallica L., Tamarisco, Rompevientos. PINS, *Jones 6551*. Shrub or small tree.

Tamarix ramosissima Ledeb., Tamarisk, Salt cedar. PINS, *Whistler and Lee 2395*. Shrub or small tree.

TYPHACEAE

Typha domingensis Pers., Tule. PINS, *Whistler and Lee 2439*.

Typha latifolia L., Common cat-tail, Tule espadilla. NSA; Higginbotham (1972), Rechenthin and Passey (1967).

URTICACEAE

Parietaria floridana Nutt., Pellitory. NSA; McAtee (1975), Rabalais (1975).

Parietaria pensylvanica Muhl. ex Willd. var. *obtusa* (Rydb. ex Small) Shinners, Hammerwort. PINS, *Jones 795*.

Urtica chamaedryoides Pursh, Ortiguilla. NSA; Jones (1966), Rabalais (1975).

VERBENACEAE

Glandularia bipinnatifida (Nutt.) Nutt. var. *bipinnatifida*, PINS, *Jones 1205*.

Lantana camara L., West Indian lantana, Alfombrilla hediona. NSA; Rabalais (1975), Rechenthin and Passey (1966). Shrub.

Lantana urticoides Hayek, Texas lantana, Hierba de cristo, Calico bush. PINS, *Jones 7310*. Shrub.

Phyla lanceolata (Michx.) Greene, Northern frog-fruit. NSA; Rechenthin and Passey (1967).

Phyla nodiflora (L.) Greene, Common frog fruit, Cape-weed, Turkey-tangle, Mat-grass, Hierba de la Vírgen María. TAIC, *Nelson and Soto N320*. FD and BF.

Verbena halei Small, Texas vervain. PINS, *Jones 7063*.

VITACEAE

Cissus incisa Des Moul., Marine-ivy treebine, Cow-itch, Hierba del buey. PINS, *Jones 6771*.

XYRIDACEAE

Xyris jupicai Rich., Yellow-eyed grass. PINS, *Jones 7396*.

ZYGOPHYLLACEAE

Kallstroemia hirsutissima Vail ex Small, Carpetweed. C.C. Museum, *Jones 7583*.

Tribulus terrestris L., Caltrop, Goat head, Puncture weed, Abrojo de flor amarilla, Cadillo. NSA; Rabalais (1975).

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REFERENCES

BACCUS, J.T., J.K. HORTON, and P.D. CARANGELO. 1977. A study of beach and dunes floral and faunal interrelations as influenced by recreational and user impact on Padre Island National Seashore. Final report prepared for the Office of Natural Science, Southwest Region, National Park Service, Santa Fe, New Mexico.

BACCUS, J.T. and J.K. HORTON. 1979. An ecological and sedimentary study of Padre Island National Seashore. San Marcos, TX: Department of Biology, Southwest Texas State University. Report prepared for the Office of Natural Resources, Southwest Region, National Park Service, Santa Fe, New Mexico.

BRITTON, J.C. and B. MORTON. 1989. Shore ecology of the Gulf of Mexico. University of Texas Press, Austin.

BROWER, J., J. ZAR, and C. VON ENDE. 1990. Field and laboratory methods for general ecology, third edition. William C. Brown Publishers, Dubque, IA.

BROWN, D.O., C.L. SHERROD, and K. KENNEDY. 1989. Padre Island National Seashore vegetative history. Report prepared for National Park Service, Padre Island National Seashore, Corpus Christi, TX.

CARLS, G.E., R.I. LONARD, and D.B. FENN. 1991. Notes on the vegetation and flora of North Padre Island, Texas. SouthW. Naturalist 36:121–125.

CORRELL, D.S. and M.C. JOHNSTON. 1970. Manual of the vascular plants of Texas. Texas Research Foundation, Renner.

DRAWE, D.L., K.R. KATTNER, W.H. MCFARLAND, and D.D. NEHER. 1981. Vegetation and soil properties of five habitat types on North Padre Island. Texas J. Sci. 33:145–157.

DRAWE, D.L. and I.M. ORTEGA. 1996. Impacts of geophysical seismic survey vehicles on Padre Island National Seashore vegetation. Texas J. Sci. 48:170–178.

DUNCAN, W.H. and M.B. DUNCAN. 1987. The Smithsonian guide to seaside plants of the Gulf and Atlantic coasts. Smithsonian Institution Press. Washington, D. C.

GOULD, F.W. 1975. The grasses of Texas. Texas A&M University Press, College Station.

GOULD, F.W. and T.W. BOX. 1965. Grasses of the Texas Coastal Bend. Texas A&M University Press, College Station.

HIGGINBOTHAM, I., Jr. 1972. An analysis of the vegetation of the Padre Island National Seashore. Unpublished Report. Texas A&I University, Kingsville. (mimeo).

JONES, F.B. 1982. Flora of the Texas Coastal Bend, 3rd ed. Welder Wildlife Foundation, Sinton.

JONES, F.B. 1966. Checklist of Padre and Mustang Island plants. Data on file at Padre Island National Seashore Headquarters, Flour Bluff, TX. (mimeo).

JONES, F.B., C.M. ROWELL, and M.C. JOHNSTON. 1961. Flowering plants and ferns of the Texas Coastal Bend counties. Welder Ser. B-1, Sinton.

JONES, S.D., J.K. WIPFF, and P.M. MONTGOMERY. 1997. Vascular plants of Texas, A comprehensive checklist including synonymy, bibliography, and index. University of Texas Press, Austin.

JUDD, F.W., R.I. LONARD, and S.L. SIDES. 1977. The vegetation of South Padre Island, Texas, in relation to topography. SouthW. Naturalist 22:31–48.

KATTNER, K.R. 1973. Secondary successional vegetation on Padre Island National Seashore. M.S. Thesis. Texas A&I University. Kingsville.

LONARD, R.I. and F.W. JUDD. 1980. The terrestrial flora of South Padre Island, Texas. Misc. Pap. Texas Mem. Mus. No. 6.

LONARD R.I., F.W. JUDD, and S.L. SIDES. 1978. Annotated checklist of the flowering plants of South Padre Island, Texas. SouthW. Naturalist 23:497–510.

MCATEE, J.W. 1975. Human impact on the vegetation and microclimate on the beach and foredunes of Padre Island National Seashore. M.S. Thesis. Texas A&I University, Kingsville.

MCATEE J.W. and D.L. DRAWE. 1980. Human impact on beach and foredune vegetation of north Padre Island, Texas. Environm. Managem. 4:527–538.

MCATEE J.W. and D.L. DRAWE. 1981. Human impact on beach and foredune microclimate of north Padre Island, Texas. Environm. Managem. 5:121–134.

NELSON, A.D., J. GOETZE, I. NEGRETE, V. FRENCH, and M. PEREZ-JOHNSON. 1997. Vegetational analysis and floristics of four communities in the Big Ball Hill region of Padre Island National Seashore. Report submitted to Padre Island National Seashore.

NELSON, A.D., J.R. GOETZE, I.G. NEGRETE, V.E. FRENCH, M.P. JOHNSON, and L. MACKE. 1999. Vegetational analysis and floristics of four communities in the Big Ball Hill region of Padre Island National Seashore. SouthW. Naturalist (Accepted for publication).

OTTENI, L.C., B.E. DAHL, and R.L. BAKER. 1972. The use of grasses for dune stabilization along the Gulf Coast with initial emphasis on the Texas Coast. Gulf Univ. Res. Consortium, Rep. No. 120. Galveston, Texas.

RABALAIS, N. 1975. The vegetation of Padre Island, Padre Island National Seashore, National Park Service. PAIS Inform. Bull. No. 2.

RECHENTHIN C.A. and H. PASSEY. 1967. The vegetation of Padre Island National Seashore. USDA, SCS. Temple, TX. (mimeo).

SMITH, R.L. 1996. Ecology and field biology, fifth edition. Harper Collins College Publishers. New York, NY.

TINER, R.W. 1993. Field guide to coastal wetland plants of the southeastern United States. The University of Massachusetts Press, Amherst.

WEISE, B. and W.A. WHITE. 1980. Padre Island National Seashore: A guide to the geology, natural environments, and history of a Texas barrier island. University of Texas, Austin.

BOOK NOTICE

ROBERT W. ALLARD. 1999. **Principles of Plant Breeding. Second Edition.** (ISBN 0-471-02309-4, hbk.). John Wiley & Sons, Inc., 605 Third Avenue, New York, NY 10158 (212-850-6336). $69.95. 254 pp.

From the Introduction: "In broadest terms, this second edition of *Principles of Plant Breeding* is concerned with the two distinct components of Darwinian evolution: (1) the facts of evolution ("descent with modification") and (2) selection as the chief agent of evolutionary change. However, the narrower focus of the book is on two quite recent and specialized evolutionary events: first, the evolution of crop plants under cultivation, a process that started about 13,000 to 11,000 years ago with the cultivation and ultimate domestication of many wild plant species in various of the world; and second, the current scientific phase of plant breeding, a process that started early in the twentieth century as Darwinian and Mendelian principles became firmly established as the framework within which evolutionary changes in living organisms occur."

Contents of *Principles of Plant Breeding*: Preface. **Part I. Introductory Topics:** Darwinian Evolution, Origins of Agriculture, Evolution During Domestication, Mating Systems of Plants, Overview of Plant Breeding; **Part II. Biological Foundations of Plant Breeding:** Heredity and Environment, Genetic Consequences of Hybridization, Inheritance of Continuously Varying Characters: Biometrical Genetics, Evolution During Cultivation, Marker-Assisted Analysis of Adaptedness in Nature, Marker-Assisted Dissection of Adaptedness in Cultivation. **Part III. Modern Breeding Plans:** Reproductive Systems and Breeding Plans, Breeding Self-Pollinated Plants, Breeding Hybrid Varieties of Outcrossing Plants, Breeding Clonally Propagated Plants, Breeding Hybrid Varieties of Selfing Plants and Plants that Are Clonally Propagated in Nature, Plant Breeding for Low-Input Agriculture, Glossary, References, and Index.

AN ANNOTATED PRELIMINARY CHECKLIST OF THE DICOTYLEDONOUS LIANAS AND VINES FROM THE LAS CRUCES BIOLOGICAL STATION, COSTA RICA

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ABSTRACT

In order to contribute to our understanding of lianas and vines, as well as to facilitate future research, a preliminary checklist of the dicotyledonous lianas and vines from the Las Cruces Biological Station, Costa Rica is presented. Seventy species in sixty genera and thirty-two families are recorded. The largest climbing families at Las Cruces are Cucurbitaceae (11 spp.), Leguminosae (6 spp.), Sapindaceae (5 spp.), and Bignoniaceae (4 spp.).

RESUMEN

Para contribuir al conocimiento de lianas y enredaderas, así como para facilitar otras investigaciones, se presenta una lista preliminar de las lianas y enredaderas dicotiledóneas de la Estación Biológica Las Cruces, Costa Rica. Se citan 70 especies de 60 géneros y 32 familias. Las familias más grandes de Las Cruces son Cucurbitaceae (11 spp.), Leguminosae (6 spp.), Sapindaceae (5 spp.) y Bignoniaceae (4 spp.).

INTRODUCTION

Lianas are important constituents of tropical forests that have, until recently, been largely neglected in both botanical and ecological studies (Gentry 1991). Arguably the most important physiognomic character differentiating tropical and temperate forests (Croat 1978), lianas are woody vines, beginning life as terrestrial seedlings and capable of growth in mature forests (Gentry 1991). Herbaceous vines also start life as terrestrial seedlings, but are typically found in disturbed habitats and lack significant secondary growth. Ninety percent of the liana species of the world occur in the tropics (Walter 1985). Vegetation studies of Central and South American forests indicate that lianas can occur on 42 to 50 percent of forest trees (Montgomery & Sunquist 1978; Putz 1982, 1984). In the last two decades, various lists covering different aspects of the Costa Rican flora have been published (Janzen & Liesner 1980; Hartshorn & Poveda 1983; Haber 1991; Kappelle et al. 1991), how-

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ever, no list has yet been published treating specifically the liana or vine flora of Costa Rica. In order to contribute to our understanding of lianas and vines, and to facilitate future research, the present study sought to document the dicotyledonous lianas and vines of the Las Cruces Biological Station, Costa Rica—a site not previously subjected to systematic liana collections.

METHODS

Site Description

The forest of the Las Cruces Biological Station is classified as tropical premontane rain forest following the Holdridge Life Zone System (Holdridge 1947; Hartshorn 1983). It is a relatively tall forest (30–35 m) with abundant oaks and an epiphyte load conspicuously less than at similarly classified zones at Monteverde (Hartshorn 1983; Krings, pers. obs.). The vegetation of the site is still incompletely known, especially when compared to the more intensively studied La Selva Biological Station. Hartshorn & Poveda (1983) present a preliminary list of sixty-three tree species known from the site.

The climate of the Station is illustrated in Figure 1 by a Walter climate diagram based on data from the Station's meteorological station for the years 1996 and 1997. The mean annual rainfall at the Station is 4236 mm and the mean annual temperature 20.6° C. Stiles et al. (1989) show weather data from the Instituto Meteorológico de Costa Rica indicating mean annual precipitation and mean annual temperature for the nearby town of San Vito to be 3988 mm and 21.7° C respectively.

As seen in Figure 1, rainfall is somewhat seasonal with two distinct peaks from May–June and October–November broken by a '*veranillo*' from July–August. December is the only month in which mean monthly rainfall may drop below 100 mm.

The temperature at the Station fluctuates relatively little throughout the year. As indicated in Figure 1, the highest mean monthly temperature is 21.8° C and the lowest mean monthly temperature 18.7° C. The highest recorded temperature for the two years is 32.4° C and the lowest 15.2° C.

COLLECTION AND DEPOSIT

The dicotyledonous lianas and vines of the Las Cruces Biological Station were collected from August to October 1996 and in March 1997. The collections were made between 1000 m and 1200 m elevation.

Specimens were collected using expandable clipper poles and, in some cases, by climbing the host tree. Sometimes mountaineering ropes were used to assist climbing by attaching them to a weighted fishing line and then shooting the line over a host tree branch with a slingshot (see Perry 1978; Moffett 1993; Laman 1995). The fishing line was used to pull up parachute chord, which unlike fishing line, will support the weight of mountaineer-

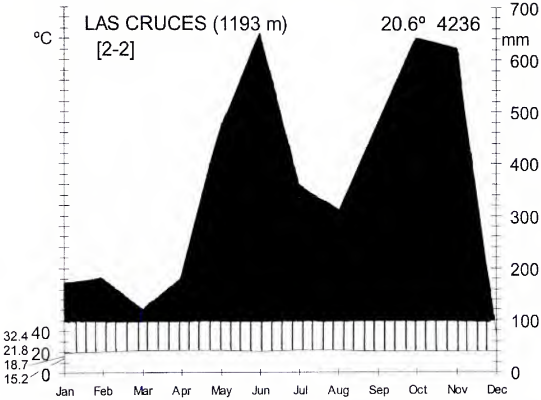

FIG. 1. Climate of the Las Cruces Biological Station, Costa Rica as a Walter climate diagram (based on data from the Station's meteorological station from 1996–1997).

ing rope. Climbing devices, known as ascenders, were then used to climb into the canopy where samples were collected. Voucher specimens were deposited at CR and F.

RESULTS

Seventy species in sixty genera and thirty-two families are recorded. Taxa are arranged alphabetically by family, genus, and species. An asterisk preceding a name indicates that species to be collected from cultivation. Annotations include the relative rarity (Table 1), habit (liana or vine), diameter at breast height (dbh) or height climbed when known, and any distinguishing characteristics. As the relative rarity descriptions are based on casual observation they are not definitive. A complete census of the lianas and vines at

TABLE 1. Relative rarity categories.

Category	Definition
Uncommon	One to five individuals observed
Common	Six or more individuals observed

Las Cruces will most likely change many of these observations. Unless indicated otherwise, notes on distinguishing characteristics come from the author's own study of field and herbarium specimens. For the purposes of the annotations, elevations above 700 m are considered 'montane.'

ACANTHACEAE

Mendoncia brenesii Standl. (*Krings 177*)—Uncommon at Las Cruces. Collection taken from liana climbing to 15 m, 50–60 m from forest edge at an elevation of 1100–1200 m. This opposite-leaved liana is recognized by the subterete, glabrous to strigullose, grooved stems and the ovate bracts. The fruit is bilateral.

Mendoncia tonduzii Turrill (*Krings 213*)—Uncommon at Las Cruces. Collection taken from liana climbing to 11 m at an elevation of 1180–1190 m. Recognized by the 4-angled, hirsute stems and the oblong-elliptic, mucronate bracts, with a rounded apex. The somewhat compressed, purple fruit is asymmetrical near the apex.

AMARANTHACEAE

Chamissoa altissima (Jacq.) Kunth (*Krings 156*)—Uncommon at Las Cruces; only one individual seen. Collection taken from robust liana, 5.7 cm dbh, climbing to 17 m at an elevation of 1120–1200 m. Relatively non-descript, alternate-leaved climber with small flowers subtended by 1–3 bracts in pyramidal terminal inflorescences.

APOCYNACEAE

Mandevilla hirsuta (Rich.) K. Schum. (*Krings 189*)—Uncommon at Las Cruces. Collection taken from vine climbing to only 2 m at an elevation of 1050–1095 m. Distinguished from the other collected Apocynac climber, *Prestonia isthmica*, by the cordate leaf bases and glands on the midrib base above.

Prestonia isthmica Woodson (*Krings 139*)—Uncommon at Las Cruces; only one individual seen. Collection taken at 1015 m elevation, from flexible vine at forest edge with corky, cream-colored older stem and clear, sticky exudate. Young leaves velutinous above and below (see above for other distinguishing characters).

BIGNONIACEAE

Amphilophium pannosum (DC.) Bureau & K. Schum. (*Krings 162*)—Common at Las Cruces. Collection taken from liana 4.3 cm dbh, climbing to 25 m at an elevation of 1075 m. Vegetatively easily recognized by the villous, sharply hexagonal stems with long trichomes (to 2 mm), and trifid tendrils. The compressed, ellipsoid, rugose-tuberculate capsule is also unmistakable. Separated from *Pithecoctenium*, the only other wild Bignon genus in Cosra Rica with hexagonal stems, by the dendroid trichomes of vegetative parts (simple in *Pithecoctenium*).

Arrabidaea verrucosa (Standl.) A.H. Gentry (*Krings 147*)—Common at Las Cruces. Collection taken from liana to 4.4 cm dbh. Distinguished from *A. patellifera* and *A. florida*, the only two other *Arrabidaea* species occurring above 700 m elevation in Costa Rica, by the presence of interpetiolar gland fields, a bilabiate calyx usually greater than 1.5 cm, and a verrucose-tuberculate capsule. Separated from the other tuberculate-fruited Bignon at Las Cruces, *Amphilophium pannosum*, by the linear fruit, to 2.5 cm wide (ellipsoid in *A. pannosum*, to 8 cm wide).

Lundia puberula Pittier (*Krings 258*)—Uncommon at Las Cruces. Collection taken from vine growing over low shrubs at 1075 m elevation. Similar to *Arrabidaea*, but distinguished by the pubescent anthers (glabrous in *Arrabidaea*) and pubescent to velutinous capsules (glabrous, or with scattered trichomes, to tuberculate in *Arrabidaea*).

Martinella obovata (Kunth) Bur. & K. Schum. (*Krings 180*)—Uncommon at Las Cruces; only one individual seen. Collection taken from liana climbing to 15 m, 50–60 m from the forest edge at an elevation of 1100–1200 m. Gentry (1973) suggests good field characters include frequently bending or twisting petiolules, trifid tendrils, and conspicuous interpetiolar swellings. Unrivaled by any other Bignon in Costa Rica, the narrowly linear fruit (to 1.8 cm wide) can exceed 130 cm in length.

BORAGINACEAE

Tournefortia sp. (*Krings 142*)—Uncommon at Las Cruces. Collection taken from liana climbing into canopy at the forest's edge at 1060 m elevation. Somewhat non-descript, but recognized by the scorpiod inflorescences and wintergreen odor to the crushed leaves.

CAMPANULACEAE

Burmeistera cyclostigmata Donn. Sm. (*Krings 179*)—Common at Las Cruces. Collection taken from vine climbing to 4 m, 50–60 m from the forest edge at 1100–1200 m elevation. Recognized by the milky latex, purplish corolla, and serrate-tipped calyx.

Centropogon granulosus C. Presl (*Krings 172*)—Common at Las Cruces. Collection taken from vine climbing to 3 m at 1050 m elevation. Recognized by the bright red corolla with yellow lobes.

COMBRETACEAE

Combretum laxum Jacq. (*Krings 165*)—Uncommon at Las Cruces. Collection taken from liana climbing into the canopy in closed forest at 1200 m elevation. Recognized by the opposite leaves, parallel, tertiary leaf venation, and distinctive four-winged fruit.

COMPOSITAE

Mikania guaco Bonpl. (*Krings 186*)—Uncommon at Las Cruces. Collection taken from liana climbing to 10 m in closed forest at 1050–1095 m elevation. Recognized by the opposite leaves, three-veined from the base, and the glabrate, fistulose stems.

Mikania skutchii S.F. Blake (*Krings 166*)—Uncommon at Las Cruces. Collection taken from liana climbing into canopy of closed forest at 1200 m elevation. Distinguished from *M. guaco* by the densely villous leaves and the villous, never fistulose stems.

Otopappus verbesinoides Benth. (*Krings 197*)—Common at Las Cruces. Collection taken from liana climbing to only 1.5 m at 1075 m elevation. Characterized by asperous stems and opposite leaves (narrower than in the *Mikania* spp. above or the *Sinclairia* sp. below), three-veined from the base. See Hartman & Stuessy (1983) for a revision of the genus.

Sinclairia polyantha (Klatt) Rydb. (*Krings 187*)—Uncommon at Las Cruces. Collection taken from liana climbing to 7 m at 1050–1095 m elevation. Recognized by the serrate, opposite leaves, three-veined from the base, light green above, and glaucous below.

CONNARACEAE

Rourea sp. (*Krings 203*)—Uncommon at Las Cruces. Collection taken from liana climbing to 7 m at 1170 m elevation. Recognized by cylindrical pulvini, pinnately compound leaves, with the basal leaflets alternate to subopposite, and reflexed branchlets aiding in climbing. *Rourea* has 2 carpels (1 in *Connarus*) and imbricate sepals (valvate in *Cnestidium*) (Woodson et al. 1950).

CONVOLVULACEAE

Maripa sp. (*Krings 277*)—Uncommon at Las Cruces. Collection taken from vine climbing to 17 m at the edge of a forest gap at 1030 m elevation. Recognized by the rounded leaf-bases (cordate in *Merremia*), campanulate, whitish-purple flowers, and often impressed venation. Unlike *Merremia*, the fruit is indehiscent.

Merremia sp. (*Krings 211*)—Uncommon at Las Cruces; only seen in one location. Collection taken from seedlings on forested ridge at 1200 m elevation. Recognized by the distinctive large, rounded-squarish seeds and deeply lobed leaves with typical Convolvulaceous venation. Unlike *Maripa*, the fruit is dehiscent.

CUCURBITACEAE

*__Cionoscyos macranthus__ (Pittier) C. Jeffrey (*Krings 280*)—Only known from cultivation at Las Cruces. Collection taken from vine near the Station vegetable garden growing at 1095 m elevation. Recognized by the patelliform glands crowded near the leaf base below and the anthers conduplicate or flexuous. The genus is closely related to *Cayaponia* and essentially only differentiated by the fleshy, peponiform fruit (baccate and fibrous in *Cayaponia*).

***Cucurbita moschata** (Duchesne ex Lam.) Duchesne ex Poir. (*Krings 279*)—Only known from cultivation at Las Cruces. Collection taken from vine growing in Station vegetable garden at 1095 m elevation. Recognized by the 4–5-branched tendrils and somewhat irritating leaf hairs.

Cyclanthera multifoliolata Cogn. (*Krings 269*)—Common at Las Cruces. Collection taken from vigorous vine taking over a large, tree-fall gap at 1190 m elevation. Easily recognized to genus by the anthers in a horizontal ring. Unique among Costa Rican *Cyclanthera* species in the presence of numerous patelliform glands near the leaf base below.

Elateriopsis oerstedii (Cogn.) Pittier (*Krings 175*)—Uncommon at Las Cruces. Collection taken from vine growing outside the Station, on roadside at 1000–1100 m. Easily recognized by the glabrous to puberulous stems, 3-lobate to angulate leaves, whitish-green campanulate flowers with fused filaments and vertically plicate anthers, and smooth, non-echinate, explosively dehiscent fruit.

Fevillea cordifolia L. (*Krings 272*)—Uncommon at Las Cruces; only one individual seen. Collection taken from young liana growing on the edge of a ridge-top gap at 1200 m elevation. One of the few Costa Rican Cucurbits becoming a canopy-reaching liana, it is recognized vegetatively by the bifid tendrils curling above and below the bifurcation. Differentiated from *Sicydium*, the only other montane (i.e., > 700 m) Costa Rican Cucurbits exhibiting tendrils curling above and below the bifurcation, by the woody habit, five stamens, and 3-locular ovary (herbaceous, three stamens, and uni-locular in *Sicydium*).

Gurania makoyana (Lem.) Cogn. (*Krings 276*)—Common at Las Cruces. Collection taken from robust vine climbing to 17 m at the forest edge between 1000 and 1100 m elevation. *Gurania* is one of only two genera recognized by simple tendrils, inflorescences consisting of several flowers, and orange to reddish corollas, but can be distinguished by the orange or reddish calyx lobes (green in *Psiguria*). Separated from other Costa Rican *Gurania* species by the simple leaves, pedicels of staminate flowers 1 to 3 mm long, stem hairs (if present) less than 4 mm long, and the calyx lobes frequently 2 to 3.5 times as long as the calyx tube.

Melothria sp. (*Krings 206*)—Common at Las Cruces. Collection taken from vine climbing to 2 m at 1145 m elevation. Three species of *Melothria* are known from Costa Rica. All are quite similar and cannot be conclusively separated vegetatively. *M. dulcis* is distinguished by a white corolla and yellow to orange fruit. Both *M. scabra* and *M. pendula* exhibit a yellow corolla and are differentiated by the mature fruit (at least 2.5 cm long, light and dark green striped in *M. scabra* versus only to 2 cm long, green to black in *M. pendula*).

Psiguria triphylla (Miq.) C. Jeffrey (*Krings 246*)—Uncommon at Las Cruces. Collection taken from vigorous vine climbing to 15 m at 1000–1100 m elevation. Closely related to *Gurania* (see *G. makoyana* for discussion). Separated from *P. warscewiczii*, the only other *Psiguria* species above 700 m in Costa Rica, by the calyx not green-spotted and the coriaceous leaves (green-spotted calyx and membranaceous leaves in *P. warscewiczii*).

Rytidostylis carthaginensis (Jacq.) Hook. & Arn. (*Krings 250*)—Uncommon at Las Cruces. Collection taken from slender vine growing on a streamside shrub at 1000–1100 m elevation. The only montane Costa Rican Cucurbit displaying an elongate, narrowly cylindrical calyx tube (to 3 cm long).

***Sechium edule** (Jacq.) Sw. (*Krings 278*)—Known only from cultivation at Las Cruces. Collection taken from vine growing in the Station vegetable garden at 1095 m elevation. The genus is recognized by tendrils 3–5-fid and ten floral nectaries at the base of the hypanthium. *S. edule* is recognized by the combination of the nectaries sunken into the base of the hypanthium (but not protruding conspicuously below) and the filaments only partially connate, the anthers free.

Selysia prunifera (Poepp. & Endl.) Cogn.

(*Krings 155*)—Uncommon at Las Cruces. Collection taken from stout liana, 3.2 cm in diameter growing into canopy at 1120–1200 m elevation. The only species of *Selysia* in Costa Rica, it is distinguished from members of *Cayaponia*, *Cionosicys*, *Cyclanthera*, and *Tecunumania*, the only four other Costa Rican genera exhibiting parelliform glands on the abaxial leaf surface, by the glands frequently scattered throughout the abaxial leaf surface (not just crowded near the base), the anthers essentially straight or merely slightly curved at the ends, and the arrow-head shaped seeds.

DICHAPETALACEAE

Dichapetalum nevermannianum Standl. (*Krings 151*)—Uncommon at Las Cruces. Collection taken from liana to 2.5 cm dbh, climbing to 17 m at 1075 m elevation. Distinguished from other Mesoamerican *Dichapetalum* species by the linear-oblong to oblanceolate leaves to only 3 cm wide and the hispid stems and inflorescences (Lundell 1966).

ERICACEAE

Psamissia ramiflora Kl. (*Krings 160*)—Uncommon at Las Cruces. Collection taken from shrubby liana climbing to 17 m at 1120–1200 m elevation. The only lianescent representative of Ericaceae observed at Las Cruces, *P. ramiflora* can be recognized by the alternate, plinerved leaves, with swollen petioles.

EUPHORBIACEAE

Dalechampia cissifolia Poeppig (*Krings 245*)—Uncommon at Las Cruces. Collection taken from vine climbing over low shrubs at 1030 m elevation. Recognized by the serrulate, trifoliolate leaves, much resembling *Cissus*, but lacking tendrils. Only two other *Dalechampia* species in Costa Rica are also trifoliolate. *D. websteri* has 6 female sepals and involucral bracts 10–14 mm long and, though also displaying 7–11 female sepals and involucral bract less than 5 mm long, *D. heteromorpha* has simple and trifoliolate leaves intermixed on the stems (Burger & Huft 1995).

Manihot brachyloba Muell. Arg. (*Krings 173*)—Uncommon at Las Cruces. Collection taken from scrambling liana climbing to 6 m trailside at 1060 m elevation. Distinguished from other Costa Rican *Manihot* species by the climbing habit and the tri-lobed leaves (Burger & Huft 1995).

GESNERIACEAE

Capanea sp. (*Krings 214*)—Uncommon at Las Cruces? Collection taken from lianescent plant climbing to 8 m at 1100–1125 m elevation. Characterized by asymmetric, opposite leaves and campanulate corollas with purple spots.

HIPPOCRATEACEAE

Salacia petenensis Lundell (*Krings 182*)—Uncommon at Las Cruces. Collection taken from robust liana to 7.2 cm dbh, climbing to 20 m at 1060 m elevation. The only liana observed at Las Cruces climbing by stout, leafless, curving branchlets (to 1.5 cm diam.). The large spherical fruits are also distinctive.

HYDRANGEACEAE

Hydrangea peruviana Moric. (*Krings 167*)—Common at Las Cruces. Collection taken from liana climbing with adventitious roots into canopy at 1190 m elevation. Recognized by the opposite, serrulate leaves and the brownish stems with parallel ridges.

LEGUMINOSAE

Caesalpinia urophylla (Donn. Sm.) Standl. (*Krings 164*)—Common at Las Cruces. Collection taken from liana to 3.3 cm dbh, climbing to 15 m at 1190 m elevation. *C. urophylla* is heavily armed with thorns and prickles both along the stems and leaves. Also distinguished from other leguminous climbers at Las Cruces by the large, bi-pinnately compound leaves and the spiny, compressed ellipsoid fruit. Seen in more disturbed areas in the forest.

Canavalia oxyphylla Standl. & L.O. Williams (*Krings 191*)—Common at Las Cruces. Collection taken from vine climbing to 10 m at 1015 m elevation. This trifoliolate vine with pinkish flowers is recognized in fruit by an additional suture displaced from the ones on each valve, often appearing medial on the valve.

Machaerium cobanense Donn. Sm. (*Krings 134*)—Common at Las Cruces. Collection taken from liana growing into canopy along trailside at 1015 m elevation. Recognized by the paired spines of stems and the rounded oblong to elliptic leaflets lacking acuminate tips. Stems may exude a red sap when cut.

Machaerium seemannii Benth. ex Seem. (*Krings 193*)—Uncommon at Las Cruces. Collection taken from liana climbing to 6 m at 1030 m elevation. Recognized by the lanceolate leaflets with acuminate tips and the leading shoots often leafless, but armed with paired spines, and curling much like tendrils.

Mucuna sp. (*Krings 135*)—Common at Las Cruces. Collection taken from vine in forest interior at 1015 m elevation. Generally, unmistakable lianas due to the long pendent flowers and fruits, both often with urticaceous hairs.

Rhynchosia erythrinoides Cham. & Schltdl. (*Krings 149*)—Common at Las Cruces. Collection taken from liana with flattened stem climbing to 15 m at 1075 m elevation. Recognized vegetatively by the somewhat rhombic leaflets of the trifoliolate leaf and the flattened stem (no other liana at Las Cruces has been observed with such a stem).

LOGANIACEAE

Strychnos sp. (*Krings 183*)—Common at Las Cruces. Collection taken from liana climbing to 6 m at 1060 m elevation. Easily distinguished from the only other opposite-leaved, tendrillate liana family in Costa Rica, Bignoniaceae, by the simple, often 3-veined leaves. Tendrils in *Strychnos* also tend to be more hook-like.

MALPIGHIACEAE

Hiraea grandifolia Standl. & L.O. Williams (*Krings 148*)—Uncommon at Las Cruces. Collection taken from liana climbing to 20 m at 1075 m elevation. Recognized by densely ferruginously tomentose stems and samaras with semi-circular lateral wings and reduced dorsal wings. Stipules are often borne above the petiole base.

Tetrapterys sp. (*Krings 170*)—Uncommon at Las Cruces. Collection taken from liana climbing to 25 m at 1060 m elevation. Recognized by samaras with four oblong, elongate lateral wings and reduced dorsal wings.

MARCGRAVIACEAE

Marcgravia sp. (*Krings 273*)—Uncommon at Las Cruces. Collection taken from material off the forest floor on a ridge at 1200 m elevation as the high-climbing liana was unreachable. A very distinct adventitious root climber, recognized when young by the often angular stems growing appressed to the trunk of trees with the leaves pressed flat. The somewhat succulent, alternate, frequently dark-punctate leaves, as well as the whorl of flowers harboring a whorl of saccate nectaries in its center, are also unmistakable.

MENISPERMACEAE

Anomospermum reticulatum (Mart.) Eichler (*Krings 184*)—Uncommon at Las Cruces. Collection taken from robust liana to 5.3 cm dbh, climbing to 4 m at 1030 m elevation. Sometimes mistaken as a curiously unifoliolate legume due to the swollen pulvini, *A. reticulatum* is often more readily recognized when dried by the glossy, reticulate leaf venation.

Cissampelos pareira L. (*Krings 194*)—Common at Las Cruces. Collection taken from vine climbing to 4 m at 1030 m elevation. The genus *Cissampelos* in our area is distinguished from other tropical Menisperm genera, such as *Anomospermum*, *Chondrodendron*, *Hyperbaena*, and *Odontocarya*, by the staminate flowers with only 4 sepals (6–18 in the afore mentioned genera) and the herbaceous habit (Rhodes 1962). *C. pareira* is distinguished from *C. tropaeolifolia* in that the leaves are not peltate.

Cissampelos tropaeolifolia DC. (*Krings 268*)—Uncommon at Las Cruces. Collection taken from vine growing over low shrubs on trailside at 1150 m elevation. A more or less weedy vine, *C. tropaeolifolia* is distinguished from *C. pareira* by the peltate leaves and sericeous indument of the leaves.

NYCTAGINACEAE

Pisonia aculeata L. (*Krings 168*)—Uncommon at Las Cruces. Collection taken from stout liana to 5.2 cm dbh, climbing to 20 m at 1190 m elevation. This opposite-leaved liana is armed with stout, axillary, recurved spines and is recognized in fruit by the stalked glands arranged linearly along the angles of the fruit.

PASSIFLORACEAE

Passiflora costaricensis Killip (*Krings 271*)—Uncommon at Las Cruces. Collection taken from a small liana climbing through trailside thickets at 1170 m elevation. Distinguished from the other two collected *Passiflora* species, by the bilobate leaves, small, subulate stipules, and triangular stems. Distinguished from other bilobate montane *Passiflora* species, by the leaves not peltate, 1 1/2 times as long as wide (or nearly so), and the lateral leaf lobes generally 1/3 the length of the midrib (1/2 or more in *P. capsularis*). The fruit is reddish, ellipsoid, and asymmetrical in cross-section.

Passiflora menispermifolia Kunth (*Krings 150*)—Uncommon at Las Cruces. Collection taken from a small vine climbing to 4 m in the understory at 1075 m elevation. Distinguished from other Costa Rican *Passiflora* species with trilobate leaves by the leaves essentially entire, not peltate, not glandular-ocellate below, villous with straight hairs (puberulent with hooked hairs in *P. lobata*), and petioles with 2 or more gland pairs.

Passiflora oerstedi*i* Mast. (*Krings 215*)—Common at Las Cruces. Collection taken from vine climbing to 4 m in understory between 1100–1125 m elevation. Distinguished from other montane Costa Rican *Passiflora* species with unlobed leaves and cordate leaf bases, by the petioles with 3 or more, linear to filiform, gland pairs, and the stipular venation reticulate (parallel in *P. ligularis*).

PIPERACEAE

Sarcorhachis naranjoana (C. DC.) Trel. (*Krings 144*)—Common at Las Cruces. Collection taken from liana climbing to 6 m at 1060 m elevation. Recognized by alternate, often cordate leaves, swollen nodes, and solitary, axillary, spicate inflorescences (leaf-opposed in *Piper*).

RANUNCULACEAE

Clematis dioica L. (*Krings 195*)—Uncommon at Las Cruces. Collection taken from vine climbing to 5 m at 1030 m elevation. Easily recognized by the opposite, pinnately-compound leaves (3–5 leaflets) and the rachis often curling around objects, much like a tendril, while climbing.

RHAMNACEAE

Gouania sp. (*Krings 138*)—Common at Las Cruces. Collection taken from sterile vine growing in forest edge tangle at 1015 m elevation. Recognized to genus by the tendril axillary to a terminal leaf or inflorescence at apex of short branch and often coiled like a butterfly proboscis. Leaves usually have three basal veins. The collection is probably either *G. polygama* or *G. lupuloides*, the former distinguished by the floral disc somewhat pubescent with relatively long, conspicuous trichomes (glabrous or minutely, appressed puberulent in *G. lupuloides*).

RUBIACEAE

Manettia sp. (*Krings 264*)—Common at Las Cruces. Collection taken from young vine growing over low shrubs in a forest gap at 1070 m elevation. These herbaceous vines are recognized by the opposite leaves with distinct arcuate venation. Corollas are tubular to salverform.

Randia vazquezii Lorence & Dwyer (*Krings 190*)—Uncommon at Las Cruces. Collection taken from liana climbing to 12 m at 1050–1095 m elevation. Recognized by the subterminal, more or less stout, spines in groups of 3 to 4. *Uncaria* spines occur in pairs at the nodes.

SAPINDACEAE

Paullinia alata (Ruiz & Pav.) G. Don (*Krings 140*)—Common at Las Cruces. Collection taken from liana growing into canopy at 1030 m elevation. Distinguished from other pinnately compound-leaved montane *Paullinia* species by the leaves 2-jugate, the leaflets of the lowest pair simple, stipules only to 3 mm long, the unwinged, red fruit to 2 cm long, and the stem cross-section showing 3–6 peripheral vascular cylinders surrounding a central one.

Paullinia bracteosa Radlk. (*Krings 145*)—Common at Las Cruces. Collection taken from stout liana to 4 cm dbh at 1075 m elevation. Easily distinguished from other pinnately compound-leaved montane *Paullinia* species by the large stipules (2–5 cm long) and the stem cross-section showing a single vascular cylinder.

Paullinia grandifolia Benth. ex Radlk. (*Krings 163*)—Common at Las Cruces. Collection taken from liana climbing into canopy at 1180 m elevation. Distinguished from *P. mallophylla* and *P. ingaefolia*, the only other montane *Paullinia* species with the lowest leaflets of the 3–5 jugate leaves trifoliolate or pinnate, by the unwinged fruit (winged in *P. mallophylla*) and narrowly triangular stipules, to 8 mm long (ovate to broadly lanceolate, 1.5 to 4 cm long in *P. ingaefolia*).

Paullinia pterocarpa Triana & Planch. (*Krings 158*)—Uncommon at Las Cruces. Collection taken from liana to 2.6 cm dbh, climbing into canopy at 1120–1200 m elevation. Distinguished from other winged-fruited montane *Paullinia* species, by the pinnately compound leaves with the lowest leaflet pair simple (all others are either trifoliolate or with the lowest leaflet pair trifoliolate).

Serjania valerii Standl. (*Krings 154*)—Uncommon at Las Cruces. Collected from liana to 3.2 cm dbh, climbing to 15 m into canopy at 1120–1200 m elevation. Distinguished from *S. lobulata*, the only other pinnately 5-foliolate montane *Serjania* species, by the densely hirsute stems and petioles (hairs 1–2 mm long) and the conspicuous stipules, to 5 mm long (inconspicuous, to 3 mm in *S. lobulata*).

SOLANACEAE

Solanum sp. (*Krings 176*)—Uncommon at Las Cruces? Collection taken from liana climbing near forest edge at 1100–1200 m elevation. The genus is recognized by calyces with 5 vascular ribs or lobes and anthers dehiscing by terminal pores (D'Arcy 1973).

ULMACEAE

Celtis iguanaea (Jacq.) Sarg. (*Krings 181*)—Uncommon at Las Cruces. Collection taken from robust liana to 4.3 cm dbh, climbing to 10 m at 1025–1075 m elevation. Although the leaves are somewhat reminiscent of *Gouania* (serrulate to serrate at tip, 3-veined from base), *C. iguanaea* is easily recognized by the lack of tendrils, the presence of spines, the more or less asymmetrical leaf bases, and the asperous leaf surfaces.

VITACEAE

Cissus rhombifolia Vahl (*Krings 192*)—Common at Las Cruces. Collection taken from vine climbing to 3 m at 1060 m elevation. Distinguished from other trifoliolate Costa Rican *Cissus* species by the more or less rhombic terminal leaflet, and the small fruits (ca. 1 cm long and wide).

Cissus verticillata (L.) Nicolson & C.E. Jarvis (*Krings 141*)—Common at Las Cruces. Collection taken from liana growing into canopy at 1030 m elevation. Perhaps the most common of the Costa Rican simple-leaved *Cissus* species, *C. verticillata* is distinguished by the leaves not strongly dimorphic (dimorphic in *C. biformifolia*), broadly ovate (narrowly elliptic to lanceolate in *C. brevipes*), and the pedicels glabrous (hirtellous in *C. cacuminis*).

Vitis tiliifolia Humb. & Bonpl. ex Roem. & Schult. (*Krings 210*)—Common at Las Cruces. Collection taken from vigorous liana to 7 cm dbh, climbing to 17 m at 1120 m elevation. The only representative of *Vitis* in Costa Rica, *V. tiliifolia* is distinguished from *Cissus* by the 5-merous flowers, the panicle inflorescence, and the leaves densely floccose-tomentose beneath.

DISCUSSION

This list should be treated as a working checklist. Included are only collections that have been assigned with confidence to either genus or species.

A complete collection list, including unknowns, has been deposited at F.

Nine of the eleven tendrillate climbing families of Costa Rica (see Krings 1997), are represented at Las Cruces, although the Leguminosae are represented by only non-tendrillate species. No climbing, tendrillate Polemoniaceae (*Cobaea*) or Polygonaceae (*Antigonon*, introduced) have been found. This is not surprising as *Cobaea* vines are generally found above 1600 m in Costa Rica, well beyond the upper limits of Las Cruces. Only *C. gracilis* and *C. scandens* are known to have been collected as low as 700–1000 m (Krings 1997).

Although incomplete, I hazard that the list includes the majority of the lianescent taxa of Las Cruces. Currently, the largest climbing families are Cucurbitaceae (11 spp., incl. 3 cultivars), Leguminosae (6 spp.), Sapindaceae (5 spp.), and Bignoniaceae (4 spp.)—together comprising 37.1 % of the recorded species. Most additional species records are likely to come from the following, mostly vining families: Asclepiadaceae, Convolvulaceae, Loganiaceae, and Solanaceae. Among monocotyledons, more work is needed for all taxa, but especially *Smilax* L. and *Dioscorea* L., both of which have been seen on the grounds.

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REFERENCES

BURGER, W. and M. HUFT. 1995. Flora Costaricensis, Family # 113: Euphorbiaceae. Fieldiana 36:1–169.

CROAT, T.B. 1978. Flora of Barro Colorado Island. Stanford University Press, Stanford, California.

D'ARCY, W.G. 1973. Flora of Panama: Solanaceae. Ann. Missouri Bot. Gard. 60:573–780.

GENTRY, A.H. 1973. Flora of Panama: Bignoniaceae. Ann. Missouri Bot. Gard. 60:781–977.

GENTRY, A.H. 1991. Distribution and evolution of climbing plants. In: F.E. Putz and

H.A. Mooney, eds. The biology of vines. Cambridge University Press, New York, NY. Pp. 3–42.

HABER, W.A. 1991. Lista provisional de las plantas de Monteverde, Costa Rica. Brenesia 34:63–120.

HARTMAN, R.L. and T.F. STUESSY. 1983. A revision of *Otopappus* (Compositae, Heliantheae). Syst. Bot. 8:185–210.

HARTSHORN, G.S. 1983. Plants. In: D.H. Janzen, ed. Costa Rican natural history. University of Chicago Press, Chicago, IL. Pp. 141–144.

HARTSHORN, G.S. and L.J. POVEDA. 1983. Checklist of trees. In: D.H. Janzen, ed. Costa Rican natural history, University of Chicago Press, Chicago, Illinois. Pp. 158–183.

HOLDRIDGE, L.R. 1947. Determination of world plant formations from simple climatic data. Science 105:367–368.

JANZEN, D.H. and R. LIESNER. 1980. Annotated checklist of plants of lowland Guanacaste province, Costa Rica, exclusive of grasses and non-vascular cryptogams. Brenesia 18:15–90.

KAPPELLE, M., N. ZAMORA, and T. FLORES. 1991. Flora leñosa de la zona alta (2000–3819 m) de la Cordillera de Talamanca, Costa Rica. Brenesia 34:121–144.

KRINGS, A. 1997. An illustrated guide to the tendrillate lianas and vines from the mountains of Costa Rica. M.S. Thesis, North Carolina State University.

LAMAN, T.G. 1995. Safety recommendations for climbing rainforest trees with 'single rope technique.' Biotropica 27:406–409.

LUNDELL, C.L. 1966. The Mexican and Central American species of *Dichapetalum*. Wrightia 3:173–176.

MOFFETT, M.W. 1993. The high frontier: Exploring the tropical rainforest canopy. Harvard University Press, Cambridge, MA.

PERRY, D.R. 1978. A method of access into the crowns of emergent and canopy trees. Biotropica 10:155–157.

RHODES, D.G. 1962. Flora of Panama: Menispermaceae. Ann. Missouri Bot. Gard. 49:157–172.

STILES, F.G., A.F. SKUTCH, and D. GARDNER. 1989. A Guide to the Birds of Costa Rica. Comstock Publishing Associates, Ithaca, NY. Pp. 18.

WALTER, H. 1985. Vegetation of the earth and ecological systems of the geo-biosphere. Springer Verlag, NY. Pp. 57.

WOODSON, R.E., JR., R.W. SCHERY, and COLLABORATORS. 1950. Flora of Panama: Connaraceae. Ann. Missouri Bot. Gard. 37:164–183.

GAMOCHAETA SIMPLICICAULIS (ASTERACEAE: GNAPHALIEAE) IN FOUR SOUTHEASTERN STATES AND NEW FOR NORTH AMERICA

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ABSTRACT

The presence of the South American native *Gamochaeta simplicicaulis* (Willd. ex Spreng.) Cabrera is documented for North Carolina, South Carolina, Florida, and Alabama, based on specimens in NCU and US. It has not previously been included in accounts of the North American flora. The species apparently is abundant on the coastal plain of the Carolinas, where first collected in 1957, and may be expected to occur with frequency in other regions of the Atlantic and Gulf Coastal plain. A morphological description, illustration, and specimen citations are provided.

RESUMEN

Se documenta la presencia de la planta nativa de Sur América *Gamochaeta simplicicaulis* (Willd. ex Spreng.) Cabrera en Carolina del Norte, Carolina del Sur, Florida, y Alabama, basada en especímenes depositados en NCU y US. No había sido incluida previamente en los informes de la flora norteamericana. La especie es aparentemente abundante en la llanura costera de las Carolinas, donde fue colectada por primera vez en 1957, y puede que se dé con frecuencia en otras regiones de la llanura costera del Atlántico y del Golfo. Se ofrecen una descripción morfológica, una ilustración y citas especímenes.

The South American native *Gamochaeta simplicicaulis* (Willd. ex Spreng.) Cabrera was noted to occur in Florida by Pruski (1997) in his account of the Asteraceae of the Venezuelan Guayana. The distribution of this species, otherwise unreported for North America, is further documented here for North Carolina, South Carolina, and Alabama, based on specimens housed in NCU. It was not included in accounts of *Gamochaeta* (Nesom 1990) for the United States or the southeastern United States (Godfrey 1958; Arriagada 1997). *Gamochaeta simplicicaulis* apparently is relatively widespread on the coastal plain of the Carolinas, where it is known from five coastal and near-coastal counties of North Carolina and every South Carolina county adjacent to the Atlantic Ocean, except one. The localities in Walton Co., Florida (eastern panhandle), and Mobile Co., Alabama, are immediately adjacent to the Gulf coast.

The first collections of *Gamochaeta simplicicaulis* from the United States apparently were made in 1957 from six South Carolina counties in connection with preparation of the Flora of the Carolinas. Judging from the already relatively abundant distribution of the species by the mid 1960s, at least in the Carolinas, it is probable that its current distribution is broader than the present report indicates. The species almost certainly occurs in Georgia and should be sought in Mississippi and Louisiana. It has been collected from one county nearly contiguous with southeastern Virginia (Pasquotank Co., NC).

The native range of *Gamochaeta simplicicaulis* is South America, where it is known from Argentina, Chile, Bolivia, Uruguay, Paraguay, Brazil, Guyana, Venezuela, and Colombia (Cabrera 1961, 1963; Pruski 1997). It also has become naturalized in New Zealand (Drury 1971; Webb 1988).

Gamochaeta simplicicaulis in NCU collections has been identified as *Gamochaeta purpurea* (L.) Cabrera and *Gamochaeta americana* (P. Mill.) Wedd. but is consistently distinguished from both, as in the following key.

1. Upper surface of leaves loosely and lightly but persistently tomentose, dull; involucral bracts lightly villous-tomentose on the lower third; biennial. .... **G. purpurea**

1. Upper surface of leaves completely glabrous, shiny; involucral bracts glabrous from base to apex; annual or biennial. 2

  2. Plants (30–)50–85 cm tall, usually basally and strictly erect; basal and lower cauline leaves on elongate internodes, commonly withered and deciduous at flowering, relatively even-sized to above midstem, the upper cauline linear-lanceolate to linear-oblanceolate and apically long-acute, clusters of small leaves produced in the cauline axils; capitula in small glomerules in an elongate, interrupted capitulescence, sometimes with well-developed lateral branches, the glomerules usually subtended by linear, spreading bracts longer than the glomerules; outer involucral bracts ovate, apically acute-acuminate, hyaline, without color; annual or biennial, flowering mostly July-August. .... **G. simplicicaulis**

  2. Plants 15–35(–50) cm tall, basally decumbent-ascending; basal leaves in a rosette, persistent at flowering, the cauline leaves quickly reduced in size above the basal, the upper mostly oblanceolate and apically rounded, axillary clusters of small leaves absent; capitula in a narrow, elongate, generally compact but sometimes interrupted capitulescence, the bracts few and shorter than the glomerules; outer involucral bracts elliptic-ovate, apically obtuse to rounded, often slightly purplish; biennial, flowering mostly April-June. .... **G. americana**

Gamochaeta simplicaulis (Willd. ex Spreng.) Cabrera, Bol. Soc. Argent. Bot. 9:379. 1961. **(Figs. 1, 2)** *Gnaphalium simplicicaule* Willd. ex Spreng., Syst. Veg. 3:481. 1826. *Gnaphalium purpureum* var. *simplicicaule* (Willd. ex Spreng.) Klatt, Linnaea 42:140. 1878. TYPE: [Venezuela. Edo. Sucra.] Cumaná, *Humboldt 343* (B-Willdenow fiche 15493!, photo-US!).

Annuals or biennials, strictly erect, (30–)50–85 cm tall, fibrous-rooted, the stems commonly simple, strictly erect, and single from the base or with

Fig. 1. Habit and involucre of *Gamochaeta simplicicaulis* (*Ables 32138*).

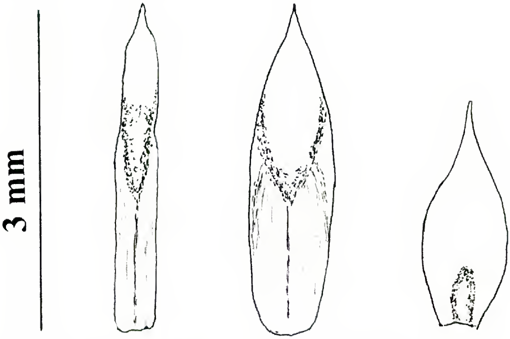

FIG. 2. Involucral bracts of *Gamochaeta simplicicaulis* (*Ables 30684*) inner, middle, and outer (from left to right).

2–5 basally ascending stems, densely and closely white-tomentose. Leaves densely and closely white-felty-matted beneath, completely glabrous and shiny above at maturity, flat, the midrib not depressed, with margins closely undulate and appearing nearly crenulate, the basal and lower cauline leaves oblanceolate to oblanceolate-spatulate, 5–9 cm long, 0.6–1.8 cm wide, on somewhat elongated internodes (not in a rosette), the basal leaves usually withered and deciduous by flowering, gradually becoming smaller above mid-stem, the upper cauline leaves linear-lanceolate to linear-oblanceolate and apically long-acute; clusters of small leaves produced in the axils of mid and upper cauline leaves. Capitula in small glomerules in a narrow, elongate, interrupted capitulescence (8–)16–30 cm long, sometimes with well-developed, ascending, lateral branches, the glomerules usually subtended by linear bracts longer than the glomerules and usually spreading at right angles; involucres cylindric-campanulate, 3–3.5 mm high, the involucral bracts ovate to oblong, scarious and brownish to tan, without red or purple pigments, glabrous from base to tip, apically acuminate-apiculate. Achenes 0.5–0.6 mm long. Flowering (June–)July–August(–October).

Gamochaeta simplicicaulis apparently grows in open sites, as the habitats are described from the southeastern US, but they otherwise are variable (roadsides, fields, open woodlands, dunes), except that a sandy substrate may be constant. Pruski (1997) noted that habitats for the species in the Venezuelan

Guayana are "savannas, roadsides, forest borders, tepui meadows, rock outcrops, 800–2100 m." The late summer to fall flowering of *G. simplicicaulis* also distinguishes it from all other eastern North American *Gamochaeta*, which flower primarily in the spring.

Collections examined. UNITED STATES. **ALABAMA. Mobile Co.:** Dauphin Island, Beauregard St., near Apalache Ave., sunny roadside, 15 July 1965, *R. Deramus D576* (NCU). **FLORIDA. Walton Co.:** edge of pine woods along Laird Drive, 4 mi S of Freeport, 5 Jul 1971, *H.A. Davis 15917* (US fide John Pruski). **NORTH CAROLINA. Brunswick Co.:** along railroad tracks 1/2 mi S of US routes 74 and 76, 25 Jul 1965, *M.N. Sears 1914* (NCU). **New Hanover Co.:** raised land in brackish marsh, causeway to Wrightsville Beach, 29 Jun 1963, *H.E. Ahles* 58631 (NCU); dredge island on Wrightsville Causeway, sand, 29 Jun 1963, *A. McCrary 405* (NCU). **Pasquotank Co.:** vicinity of Weeksville on NC 170, disturbed swamp border, 25 Jun 1958, *H.E. Ahles 44345* (NCU). **Pender Co.:** ca 5 mi N of jct Hwy 210 and Hwy 17 in Hampstead, on Hwy 17 at St. Jude's church, sand field with scattered pines, 19 July 1999, *G. Nesom NC997-5* (BRIT, FLAS, GA, GH, LSU, MISS, NCU, TEX, US, USCH, WILLI – to be distributed). **Wayne Co.:** Cliffs of the Neuse State Park, open area through woodland, 10 Jul 1965, *H.E. Ahles 59659* (NCU). **SOUTH CAROLINA. Berkeley Co.:** 3.5 mi S of jct SC 6 and 311 on dirt road (W of Moncks Corner), thickets, 5 Jul 1957, *H.E. Ahles 30684* (NCU-2 sheets); ca 2 mi W of Honey Hill on SC 45, sandy roadside, 15 Jul 1959, *H.E. Ahles* 52983 (NCU); waste ground around the Santee Wool Combing Mill, Jamestown on SC Rte. 45, 11 Jul 1960, *H.E. Ahles 53783* (NCU). **Charleston Co.:** 3.3 mi from Warrens Cross Roads on county road, 21 Jul 1957, *H.E. Ahles 32138* (NCU). **Dorchester Co.:** 1.5 mi ESE of Bamberg-Dorchester Co. line on County 11, 20 Jul 1957, *H.E. Ahles 31825* (NCU). **Georgetown Co.:** Retreat Beach, Sand Flat, 22 Aug 1957, *A.E. Radford 28509* (NCU); Du Bordieu Island, inner sand dunes, 22 Jul 1961, *H.E. Ahles 54865* (NCU). **Horry Co.:** SSE of Conway at jct 4.3 mi ESE of PeeDee Crossroads, low woods and pinelands, 19 Oct 1957, *C.R. Bell 10930* (NCU). **Jasper Co.:** Savannah, N.W. Refuge, 28 Aug 1959, *E.O. Mellinger s.n.* (NCU). **Orangeburg Co.:** ca 2 mi W of Orangeburg-Dorchester county line on US 178 and 2.3 mi SW of dirt road, sandy upland woods, 19 Jul 1957, *H.E. Ahles 31807* (NCU). **Williamsburg Co.:** 5.6 mi S of Heminway on SC 41, sandy roadside, 15 Jul 1959, *H.E. Ahles 52984* (NCU).

The NCU collections were variously annotated in 1997 as *Gamochaeta purpurea* and *G. americana* by Dr. J.E. Arriagada, as part of the complete NCU collection of southeastern US Inuleae (*sensu lato*) studied for the Generic Flora of the Southeastern United States (Arriagada 1997). His annotations for the entire set, however, without exception, merely repeat the most recent previous identification, except to update the generic name or replace putative synonyms. A discussion of unresolved taxonomic and nomenclatural complexities regarding *G. purpurea* and *G. americana*, as well as other previously unreported species of *Gamochaeta* for the North American flora, is forthcoming (Nesom in prep.).

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REFERENCES

ARRIAGADA, J.E. 1997. The genera of Inuleae (Compositae; Asteraceae) in the southeastern United States. Harvard Pap. Bot. 3:1–48.

CABRERA, A.L. 1961. Observaciones sobre las Inuleae – Gnaphalinae (Compositae) de América del Sur. Bol. Soc. Argent. Bot. 9:359–386.

CABRERA, A.L. 1963. Flora de la Provincia de Buenos Aires. Parte VI. Compuestas. Colección Científica del I.N.T.A. Buenos Aires, Argentina.

DRURY, D.G. 1971. The American spicate cudweeds adventive to New Zealand: (*Gnaphalium* section *Gamochaeta*–Compositae). New Zealand J. Bot. 9:157–185.

GODFREY, R.K. 1958. A synopsis of *Gnaphalium* (Compositae) in the southeastern United States. Quart. J. Florida Acad. Sci. 21:177–184.

NESOM, G.L. 1990. The taxonomic status of *Gamochaeta* (Asteraceae: Inuleae) and the species of the United States. Phytologia 68:186–198.

PRUSKI, J.F. 1997. Asteraceae. Flora of the Venezuelan Guayana 3:177–393.

WEBB, C.J. 1988. *Gnaphalium*. Flora of New Zealand 4:234–249.

VICIA LUTEA (FABACEAE) NEW TO TEXAS

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Vicia lutea L. (yellow vetch) has not been reported for Texas by Correll and Johnston (1970), Hatch et al. (1990), Jones et al. (1997), or Diggs et al. (1999). This species is easily distinguished from the other vetches found in Texas by its axillary sessile flowers, large yellow corollas, unequal calyx lobes, and pustulate-pilose fruits. Isely (1998) provides a key to separate this *Vicia* from others in the United States.

Vicia lutea is a weedy annual native to the Mediterranean region. However, the species is known to occur sporadically in North Carolina and Louisiana, and is seemingly naturalized in California (Hickman 1993). Thomas and Allen (1998) mapped it in nine northern Louisiana parishes. Personal communications with other herbaria have revealed additional collections:

ALABAMA. Lee Co.: 11 May 1961, *Kendrick 83* (AUA). **Sumter Co.:** 1 May 1994, *Thomas & Thomas 135,206* (BRIT). **OREGON. Lane Co.:** 17 Jun 1998, *Koenig s.n.* (OSC).

During field work for a county flora in east central Texas, *Vicia lutea* was collected in Madison County. A single, dense population of *Vicia lutea* was found in full anthesis along seven meters of a dry, sandy slope. The slope was along a roadside, in full sun, and adjacent to a gravel pit. Two weeks later the plants were leafless, yet held a large amount of ripening fruit. Other herbaceous species on the site included *Polygala polygama*, *Coreopsis basalis*, *Lathyrus hirsutus*, *Helianthemum georgianum*, *Schizachyrium scoparium*, and *Paspalum plicatulum*. Woody vegetation along the nearby fenceline was composed of *Quercus marilandica*, *Q. falcata*, and *Pinus taeda*.

The plants at the Madison County site were found at a relatively undisturbed roadside area that is not mowed. The presence of this population may be attributed to traffic associated with a nearby gravel pit, or to cattle and hay transport through this rural area. Upon inspection of previous Madison County collections not yet identified, another specimen of *Vicia lutea* was found. That individual [Madison Co.: 11 April 1998. *A.K. Neill 1458* (TAMU)] was collected at anthesis approximately 27 miles southwest of the voucher specimen, but the reproductive success of that population has not been established.

Vicia lutea may remain a waif in humid, non-Mediterranean climates. One

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visible effect of humidity on the Madison County population was an infection with powdery mildew fungus; the mycelial layer imparted a silvery cast to the leaf surfaces. Additional collections of this species may be expected from Texas and other warm-climate states. Images of the voucher specimen are available at Texas A&M's Bioinformatics Working Group Image Gallery page (http://www.csdl.tamu.edu/FLORA/ imaxxfab.htm).

Voucher specimen: U.S.A. **TEXAS. Madison Co.:** Roadside cut-bank of Chazos loamy sand at entrance to gravel pit, W side of FM 247, 1.8 mi S of TX Hwy 21 jct. (at Midway), Sand Ridge Quadrant, elev. 217 ft, 30°00'N, 95°44'W, 1 May 1999, *A.K.Neill 2618* (TAMU).

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REFERENCES

CORRELL, D.S. and M.C. JOHNSTON. 1970. Manual of the vascular plants of Texas. Texas Research Foundation, Renner.

DIGGS, G.M., B.L. LIPSCOMB, and R.J. O'KENNON. 1999. Shinners and Mahler's illustrated flora of North Central Texas. Sida, Bot. Misc. 16.

HATCH, S.L., K.N. GANDHI, and L.E. BROWN. 1990. Checklist of the vascular plants of Texas. Texas Agric. Exp. Sta. Bull. MP-1655.

HICKMAN, J.C. (Ed.). 1993. The Jepson manual: Higher plants of California. Univ. of California Press, Berkeley.

ISELY, D. 1998. Native and naturalized Leguminosae (Fabaceae) of the United States (exclusive of Alaska and Hawaii). Monte L. Bean Life Science Museum, Brigham Young Univ., Provo, UT.

JONES, S.D., J.K. WIPFF, and P.M. MONTGOMERY. 1997. Vascular plants of Texas, a comprehensive checklist including synonymy, bibliography, and index. Univ. of Texas Press, Austin.

THOMAS, R.D. and C.M. ALLEN. 1998. Atlas of the vascular flora of Louisiana. Vol. III: Dicotyledons: Fabaceae-Zygophyllaceae. Louisiana Dept. of Wildlife and Fisheries, Baton Rouge.

IPOMOEA ASARIFOLIA (CONVOLVULACEAE), ANOTHER POTENTIAL EXOTIC PEST IN THE UNITED STATES

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Known in Brazil as "salsa," *Ipomoea asarifolia* (Desr.) Roem. & Schult. is currently distributed in both the New and Old World but is of uncertain origin; recent research suggests Asia as the most likely native region (Austin, unpubl. data). In 1994, a population of this species was discovered in Broward County, Florida, the first known occurrence in the United States. Based on herbarium specimens collected at the time and identified by the second author, the species was subsequently recorded by Wunderlin (1998). In this note, we wish to formally report details of the discovery and provide additional information on the species' characters and habits, which have raised concerns about its potential as a pest plant in this country.

Following up on a report to the first author from a wetlands botanist inspecting a delineation project, aquatic regional biologist Jackie (Jordan) Smith investigated in October 1994 a suspected population of *Ipomoea aquatica* Forssk., a prohibited species in Florida (Florida Administrative Code, DEP 62C-52). Though the suspect vine was found growing across the surface of a pond, as *I. aquatica* commonly grows, it was not that species and did not match any other *Ipomoea* known for Florida. A small sample was identified in November 1994 by the second author as a species new to the United States. In August 1996, the site, located along a canal maintained by the South Broward Drainage District (SBDD), was revisited, and fresh flowering specimens were collected for verification. The vine was well-established around and in a small pond at a pasture edge and clambered up adjacent shrubs (*Myrica cerifera* L.); it also appeared to have spread farther by runners among the mowed grasses down and along the canal bank.

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The site has been dramatically altered since 1996 by urban development activities. By June 1999, much of the SBDD Canal No. 5 had been filled in and paved over with the opening of the divided, four-laned Dykes Road. A large residential subdivision, Silver Shores, occupies much of the former pastureland just north of the earlier-visited small pond, a remnant of which still exists in the remaining low, wet area, which itself is slated for residential development and has experienced some preliminary bulldozer work. The *I. asarifolia* survived this massive disturbance; in fact, the population has spread considerably along the new roadway and away from the pond area, creeping across bare lime rock, floating across shallow pools of water, and clambering over native and exotic herbs and shrubs. The population extends about 800 m along Dykes Road and as far as 300 m westward from it, between Silver Shores and Miramar Parkway. It does not appear to have been carried east of Dykes Road or south of Miramar Parkway, areas also undergoing considerable earth-moving activity.

Voucher specimens: U.S.A. **FLORIDA. Broward Co.:** W side right-of-way, SBDD Canal No. 5, just NW of I-75 and Miramar Parkway interchange, within Miramar city limits, in mowed area and around small adjacent pond, on sandy soil, 17 Oct 1994, *Jackie Jordan s.n.* (FAU, FSU); 21 August 1996, *Burks 1074* (FAU, FLAS, FSU, USF); along W side of Dykes Rd., in disturbed wet ground, thin muck or sand over limestone or bare limestone, to 300 m W of roadside, between southern boundary of Silver Shores subdivision and jct. of Dykes Rd. and Miramar Parkway, just NW of I-75 and Miramar Parkway interchange, within Miramar city limits, SE 1/4 of NE 1/4 Sec 29, T51S R40E, Lat. 25° 59.158' N, Long. 80° 21.669' W, 25 Jun 1999, *Burks 1159* (FAU, FLAS, FSU, USF).

A vector for this introduction is unknown, but the possibilities are numerous. The site has a long history of disturbance: cattle pasture, canal bank, roadside, housing development; the stand first noted in 1994 may have been overlooked for some time. Seed or stem fragments could have arrived on farm or canal-maintenance equipment; as a contaminant in feed, straw, or grass seed; or in the gut of imported cattle (or migratory birds—little is known about the consumption/dispersal of *I. asarifolia* by animals). Dumping of imported packing material or horticultural material ("yard trash and white goods") was also a common practice in the area. The species is not known in cultivation in the United States, but is cultivated for ornament in Brazil, as "salsa" or "salsa-brava" (Lorenzi & Moreira de Souza 1999). Yet another possibility is introduction for use in traditional herbal remedies (Austin, unpubl. data).

Although *I. asarifolia* may not be New World in origin, it is found widely in Tropical America, from the Carribean to Paraguay (Adams 1972; Austin 1975, 1982a-c, 1997, 1998a-b; Austin & Cavalcante 1982; Austin & Huaman 1996; Austin & Staples 1981; Leon & Alain 1974; McDonald 1994). It is also known in Africa (Heine 1963; Rendle 1905), and in Asia, from Bali, East Java, India, and West Pakistan (Austin & Ghazanfar 1979; Matthew 1995; Ooststroom 1953).

Documented habitats for this perennial species are largely wet sites—marshes, swamps, roadside ditches, and in wet-cultivated crops such as rice (Austin 1982a). While little has been reported in the literature about *I. asarifolia* as a pest plant across its range, it is a recognized agricultural weed in Venezuela and Brazil (Austin 1982c, 1998a; Kissman & Groth 1992; Lorenzi 1991; Moacyr et al. 1995). The plant is sensitive to frost, but grows in a wide range of moist soils and is easily propagated by stem fragments or seeds (Lorenzi & Moreira de Souza 1999). It apparently produces viable seed in Florida; a few seedlings were observed at the Miramar site, along with extensive mats of vines freely rooting at the nodes. Those vines seen in 1999 on drier ground and mixed with other herbaceous vegetation [e.g., *Setaria parviflora* (Poir.) Kerguélen, *Eupatorium capillifolium* (Lam.) Small] often had leaves noticeably damaged by insects, while vines growing on more open, saturated ground showed no damage. A 1996 sample of unrooted vine was floated in a vat of well water in a quarantine greenhouse (Tallahassee, Florida); it sprouted roots at the nodes and sustained itself under those conditions for several months, until it was moved to a frequently watered pot of soil, where it still grows.

The species has been placed taxonomically in the same section of *Ipomoea* [subg. *Eriospermum* (Hall f.) Verdc. ex D.F. Austin sect. *Erpipomoea* Choisy] as *I. aquatica* and *I. pes-caprae* (L.) R. Br., species similarly known for their proclivity to spread vegetatively by long, adventitiously rooting, runners. *I. asarifolia* resembles *I. pes-caprae* in habit, flower color, and general leaf form; however, the former is a species of freshwater habitats whereas the latter is confined to saline conditions near seacoasts. Also, *I. asarifolia* never has the emarginate to bilobed leaf apex characteristic of *I. pes-caprae.*

Diagnostic characters for identifying *I. asarifolia* in the field include its habit of horizontal stems and alternate, smooth, dark-green, cordate leaves, these often with purplish venation and with tips obtuse to mucronulate. The stems, whether clambering or horizontal, may have small, sparse, fleshy trichomes. The plant's showy morning-glory flowers have a campanulate to funnelform corolla of deep rose-lavender with a purple throat (Fig. 1).

Given the spreading habit of this species, its apparent preference for wetlands, its adaptability to disturbance, its recognition as a weed in some locales, and our experience with the Florida population, we view this introduction with alarm and will continue to monitor its occurrence. Steps are immediately being taken to confine any excavated fill to the current site and to plan a control effort.

We gratefully acknowledge John Tobe for noticing the suspect morning

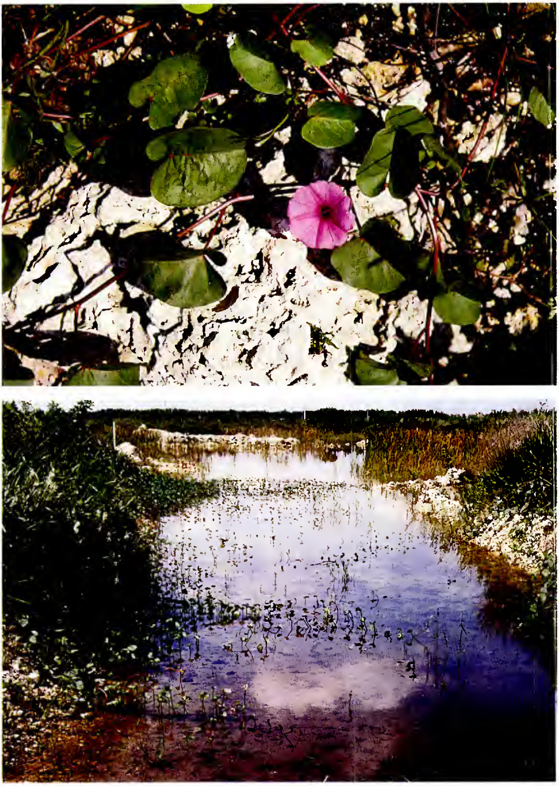

FIG. 1. *Ipomoea asarifolia* in Florida. Top: Flower, leaf form; Bottom: Creeping habit over water, bare ground, other plants.

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REFERENCES

Adams, C.D. 1972. Flowering plants of Jamaica. Univ. of the West Indies, Mona.

Austin, D.F. 1975. Convolvulaceae. In: Flora of Panama. Ann. Missouri Bot. Gard. 62:147–224.

__________. 1982a. Matters of meaning: salsa brasileira. Bull. Fairchild Trop. Gard. 37:24–30.

__________. 1982b. Convolvulaceae, Fam. 165. In: G. Harling and B. Sparre, eds. Flora of Ecuador No. 15. Swedish Research Council,Stockholm.

__________. 1982c. Convolvulaceae. In: Z. Luces de Febres and J.A. Steyermark, eds. Flora de Venezuela. Vol. 8, pt. 3. Ediciones Fundación, Educación Ambiental, Caracas. Pp. 15–226.

__________. 1997. Convolvulaceae. In: Boggan, J., V. Funk, C. Kelloff, M. Hoff, G. Cremers, and C. Feuillet, eds. Checklist of the plants of the Guianas (Guyana, Surinam, French Guiana). 2nd Ed. Publication 30, Biological Diversity of the Guianas Program, Dept. of Botany, National Museum of Natural History, Smithsonian Institution, Washington, DC. Pp. 87–88.

__________. 1998a. Convolvulaceae. In: Steyermark, J. A., P. E. Berry and B. K. Holst, eds. Flora of the Venezuelan Guyana. Volume 4. Caesalpinaceae-Ericaceae. Missouri Bot. Gard. Press, St. Louis. Pp. 377–424.

__________. 1998b. Convolvulaceae. In: Cremers, G. and M. Hoff. Inventaire taxonomique des plantes de la Guyane Francaise VII–Les Dicotyledones. 3ème Partie: Connaraceae a Fabaceae. Muséum National d'Histoire Naturelle, Institut d'Ecologie et de Gestion d la Biodiversité, Ministère de l'Environnement, Paris. Pp. 18–32.

Austin, D.F. and P.B. Cavalcante. 1982. Convolvuláceas de Amazônia. Publ. Avulsas No. 36. Museu Emilio Goeldi, Belém.

Austin, D.F. and S. Ghazanfar. 1979. Convolvulaceae. In: E. Nasir and A.I. Ali, eds. Flora of West Pakistan. Vol. 126. Agricultural Research Council Islamabad. Pp. 1–64.

Austin, D.F. and Z. Huaman. 1996. A synopsis of *Ipomoea* (Convolvulaceae) in the Americas. Taxon 45:3–38.

Austin, D.F. and G.W. Staples. 1981. Convolvulaceae. In: B. Maguire, ed. Botany of the Guayana Highlands. Mem. N.Y. Bot. Gard. 32: 309–323.

Heine, H. (ed.). 1963. Convolvulaceae. In: Hutchinson, J. and Dalziel, J.M. (revised by R.W.J. Keay and F.N. Hepper). Flora of West Tropical Africa. Vol. 2. London, Crown Agents (HMSO). Pp. 337–352.

Kissman, K.G. and D. Groth. 1992. Plantas infestantes e nocivas. Tomo II. BASF Brasileira S.A., São Paulo, Brazil.

Leon, H. and H. Alain. 1974. Flora de Cuba. Vol. 2. Otto Koeltz Science Publishers, Koenigstein.

Lorenzi, H. 1991. Plantas daninhas do Brasil: Terrestres, aquaticas, parasitas, toxicas e medicinais. Weeds of Brazil. 2a ed. Editora Plantarum, Nova Odessa, SP.

Lorenzi, H. and H. Moreira de Souza. 1999. Plantas ornamentais no Brasil–arbustivas, herbaceas e trepadeiras. 2a ed. Instituto Plantarum, Nova Odessa, SP.

Matthew, M.H. 1995. An excursion flora of Central Tamilnadu, India. A.A. Balkema Uitgevers b.v., Rotterdam, The Netherlands.

Moacyr, B.D., J.A. Wise, and T.E. Dawson. 1995. Root and shoot growth in response to soil drying in four Amazonian weed species. Revista Brasileira de Fisiologia Vegetal 7:53–59.

McDONALD, A. 1994. Flora de Veracruz. Convolvulaceae II. Instituto de Ecologia, A.C., Xalapa, Veracruz, and Univ. of California, Riverside.

OOSTSTROOM, S.J. VAN. 1953. Convolvulaceae. Flora Malesiana. Djakarta, Noordhoof-Kolff n.v. Pp. 388–512.

RENDLE, A.B. 1905. Convolvulaceae. In: Thiselton-Dyer, W.T., ed. Flora of tropical Africa. L. Reeve & Co., Kent, England. reprint by Beadley Brothers Ltd., Kent, 1959. Vol. 4(2):62–206.

WUNDERLIN, R.P. 1998. Guide to the vascular plants of Florida. University Press of Florida, Gainesville, FL.

PAEDERIA FOETIDA (RUBIACEAE), NEW TO THE FLORA OF NORTH CAROLINA

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During the summer of 1998, *Paederia foetida* L. (Rubiaceae) (Fig. 1) was discovered growing at the North Carolina Zoological Park, five miles south of Asheboro, North Carolina, in Randolph County. The plant apparently is naturalized in its location from an unidentifiable source. The native vegetation around the collection location, adjacent to a zoological exhibit building, is composed of hardwood, deciduous forest species. The landscape is supplemented with additional plantings of native species to highlight the state's piedmont and mountain geographic regions.

Voucher specimens: **NORTH CAROLINA.** Randolph Co.: North Carolina Zoological Park, Asheboro, 35° 37' 52.37934" N, 79° 45' 36.14607" W, 13 Aug 1998, *Diamond 428* (BRIT, NCU, NC Zoological Park); North Carolina Zoological Park, Asheboro, 35° 37' 52.37934" N, 79° 45' 36.14607" W, 19 Oct 1998, *Diamond 479* (NCU, NC Zoological Park).

While often encountered in horticultural reference materials and select floras as *Paederia scandens* (Lour.) Merr. (Hillier Nurseries 1991; Krüssman 1977; Walker 1976), *P. foetida* L. is currently recognized as the correct scientific name (Kartesz 1999). Synonymous names include *P. chinensis* Hance and *P. tomentosa* Maxim. (Kartesz 1999).

Paederia foetida is a twining, deciduous vine capable of nodal rooting and notable for the rank odor it releases on warm, humid days and when parts of the plant are bruised. In Japan, the plant is referred to as "Flatulent Vine" (Walker 1976), while in the U.S. it has earned the name "Skunk-vine" (Weakley 1998). The genus comprises about 20 species of climbing shrubs native to temperate and tropical Asia and South America. Leaves of *P. foetida* are ovate to broadly ovate, truncate, cordate or subcordate, opposite, the veins on both surfaces with appressed pubescence, the upper surface also bearing short hispid or papillose-hispid hairs. Panicles are axillary; calyx lobes < 1 mm long at flowering; corolla white, tubular, cc. 1 cm long, with deep red throat. Fruit orange, globose, a 2-locular berry.

Documentation of the occurrence of *P. foetida* in North America is limited. Radford et al. (1964) noted it was "collected spreading from its site of cultivation in Darlington, Co., SC," after the manuscript for the *Manual of*

Herbarium of the
North Carolina Zoological Park

Paederia foetida L. RUBIACEAE

Malodorous perennial vine exceeding 4 m Corolla tubular 1 cm long, white, granular throat dark red styles 2 Flowers 5-merous, in axillary cymes Upper leaf surface with strigillose, papillate hairs, and short hairs adpressed along veins Stems twining or scrambling over ground and rooting at nodes, becoming woody

Plant adjacent to elevated walkway at south doorway of north *Streamside* building Asian origin vine, means of arrival at NC Zoological Park Asheboro NC unknown

coll Pete Diamond no 428 13 August 1998

Flora of Randolph County NC

FIG 1. *Paederia foetida*. North Carolina Zoological Park, Asheboro, *Diamond* 479.

the Vascular Flora of the Carolinas had gone to press. There is little documented change in the distribution of *P. foetida* in the Carolinas during the past 30 years. Conferring with Radford, Weakley (1998) reports *P. foetida* is limited to disturbed areas of the South Carolina coastal plain and rarely spreads from plantings. Nelson (personal communication, 1998) notes that *P. foetida* is fairly widespread and naturalized in warmer, Gulf coastal states of the U.S., notably Florida. There also are documented reports of *P. foetida* in Louisiana (Thomas & Allen 1997) and Texas (Brown 1998). The species was first recorded as naturalized from O'ahu, Hawaii, in 1854 (Wagner et al. 1990).

Among three varieties of *P. foetida* recognized by Walker (1976, as *P. scandens*), the North Carolina plants are apparently closest to *P. scandens* var. *mairei* (Lév'l) Hara, based on the leaf shape and vestiture. In var. *mairei*, Walker noted that "lower leaf surfaces are glabrous except for tufts of hairs in vein axils," while in var. *villosa* lower leaf surfaces are villous. Leaves of the North Carolina plants are sparsely hairy but not distinctly villous.

A record of *Paederia foetida* in North Carolina is noteworthy not only to document the spread of this exotic species but also to confirm its ability to tolerate severe winter temperatures. In North Carolina the plant is probably near the limit of its northern hardiness range. This species is reportedly capable of surviving minimum winter temperatures of 0 to 10 degrees Fahrenheit (Huxley 1992), although Krüssman (1977) suggests a cold hardiness of –10 to 0 degrees Fahrenheit.

Paederia foetida has proved hardy in North Carolina, surviving as an herbaceous perennial through the winter of 1998/1999 and, in all likelihood, several previous winters as well. Efforts were made in October 1998 to limit the spread of this species by pulling out or cutting back stems, largely to keep the plant from establishing itself and becoming invasive. Pruned stems, however, were resprouting and leafing out by mid-April 1999.

The single plant discovered at the North Carolina Zoological Park was extensive, climbing through nearby shrubs and low branches of trees and scrambling over the ground up to four meters in length. Because of the propensity for nodal rooting, the main stem is difficult to determine. The most likely point of origin, however, appears near the trunk of a beech tree (*Fagus grandifolia*). This tree was planted during early landscaping around the building in December 1993. Deliveries of 14 balled and burlapped *F. grandifolia* were received at the Park in mid-November from two separate nurseries in the vicinity of McMinnville, Tennessee. While there are currently no reports of *P. foetida* occurring in Tennessee, one possibility is that *Paederia* was already growing in the root ball of one of these trees. The plant may also have sprouted from a seed deposited by migratory birds or, possibly, from purchased commercial birdseed of unknown origin that was scattered in the vicinity. Because the plant was growing at the Park for an undetermined amount of time, any theories relating to its original source are inconclusive.

Several fruits were observed in October 1998, but reproduction appears low. Herbarium specimens collected from the NC Zoological Park indicate that only two berries were produced from more than two dozen panicles, suggesting the occurrence of a low frequency of successful self-pollination. By contrast, fruiting specimens (NCU) collected in Japan in 1985, show heavy berry production.

REFERENCES

BROWN, L. 1998. Personal communication, Houston Community College and Herbarium SBSC, Houston (via Biota of North America Program, NCNB, UNC, Chapel Hill, NC).

HILLIER NURSERIES (COMPILER). 1991. The Hillier manual of trees and shrubs. Sixth edition. David and Charles, Ltd., Newton Abbot, U.K.

KARTESZ, J.T. 1999. A synonymized checklist and atlas with biological attributes for the vascular flora of the United States, Canada, and Greenland. First Edition. In: Kartesz, J.T. and C.A. Meacham. Synthesis of the North American Flora, Version 1.0. North Carolina Botanical Garden, Chapel Hill, NC.

KRUSSMAN, G. 1977. Manual of cultivated broad-leaved trees and shrubs. Volume 2. Timber Press, Portland, OR.

NELSON, J. 1998. Personal communication, Univ. of South Carolina at Columbia herbarium.

HUXLEY, A. (ed. in chief). 1992. New Royal Horticultural Society dictionary of gardening. Volume 3. MacMillan Press Ltd., London.

RADFORD, A.E., H.E. AHLES, and C.R. BELL. 1964. Manual of the vascular flora of the Carolinas. Univ. of North Carolina Press, Chapel Hill.

THOMAS, R.D. and C.M. ALLEN. 1997. Atlas of the vascular flora of Louisiana. Volume 3. Louisiana Department of Wildlife and Fisheries, Natural Heritage Program, Baton Rouge.

WAGNER, W.L., D.R. HERBST, and S.H. SOHMER. 1990. Manual of the flowering plants of Hawaii. Univ. of Hawaii Press, Bishop Museum, Honolulu.

WALKER, E.H. 1976. Flora of Okinawa and the Southern Ryukyu Islands. Smithsonian Institution Press, Washington, D.C.

WEAKLEY, A. 1998. Flora of the Carolinas and Virginia, working draft.

LAPSANA COMMUNIS (ASTERACEAE) NEW FOR TEXAS AND NOTES ON INVASIVE EXOTICS

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Lapsana communis L., nipplewort or succory dock-cress, is a native of Europe (Vuilleumier 1973; Sell 1976; Stebbins 1993) naturalized in a variety of localities in the United States. It is usually described as a weed inhabiting roadsides, disturbed places, and waste areas, often in shady situations. A genus of nine species, *Lapsana* (Asteraceae: Lactuceae) is native to the extratropical regions of Europe, Asia, and northern Africa. The only truly weedy member of the genus, *L. communis* is also adventive in at least Africa, Polynesia, the West Indies, and South America (Vuilleumier 1973). In North America the species is known from Ontario, Quebec, and the northeast U.S. south to North Carolina and west to North Dakota, Missouri and Arkansas; it is also found from British Columbia south to Oregon and California (Robinson & Fernald 1908; Britton & Brown 1898, 1913; Fernald 1950; Gleason 1952; Gleason & Cronquist 1963, 1991; Steyermark 1963; Radford et al. 1968; Strausbaugh & Core 1978; Cronquist 1980; Barkley 1986; Smith 1988; Stebbins 1993). Voss (1996), for example, cited the species for Michigan, indicating it had been found sparingly in the past and largely overlooked until very recently, with it now being very abundant in some localities. *Lapsana communis* was not reported from Oklahoma (Taylor & Taylor 1994); however, it was reported from three western counties of Arkansas (Smith 1988). Despite this proximity, the species has not been previously reported from Texas (Correll & Johnston 1970; Stanford 1976; Hatch et al. 1990; Jones et al. 1997; Diggs et al. 1999).

A collection made in 1999 in Fort Worth (Tarrant County) is apparently the first documented occurrence of this species for Texas. The identification was determined by Theodore M. Barkley of BRIT (formerly, Kansas State University).

Voucher specimens: **TEXAS. Tarrant Co.:** shady area in landscape, 301 Crestwood, Fort Worth, 25 Jun 1999, *O'Kennon 14377* (BRIT, TEX).

At the collection locality a single individual was observed as a landscape weed. The plant was 70 cm tall and 25 cm wide. This yard has incurred a large number of weedy species after a truckload of compost, from a large compost operation run by a local nursery, was dumped and spread in 1997. Seeds of various weedy species, including *Lactuca saligna* (O'Kennon et al. 1998a), *Plantago coronopus* (O'Kennon et al. 1998b), and *Lapsana communis*, were apparently introduced in this manner. Other populations of *Lapsana* have not been found in North Central Texas, and it is unclear whether the species will become more widely established. However, it would not be surprising that the species has been spread to other landscapes by the same method.

The generic name *Lapsana* is derived from Greek, *lapsane* or *lampsane*, a name given by Dioscorides to a vegetable, apparently a species of *Raphanus* (Vuilleumier 1973). According to Vuilleumier (1973), Bentham and Hooker (1873) allied *Lapsana* with *Apogon* Ell. (now included in *Krigia* L.), but Stebbins (1953) considered *Lapsana* (because of its lack of a pappus) to be a specialized offshoot of the *Youngia-Ixeris* line of the Crepidinae. Jeffrey (1966) indicated a similar relationship, putting *Lapsana* in his "*Crepis*-series" with *Crepis*, *Ixeris*, and *Youngia*. Small (1917, cited in Vuilleumier 1973) reported that when stamens of this species are touched, the filament nearest the stimulus contracts and the entire anther tube faces the visitor as the style pushes out the pollen toward it. Vuilleumier (1973) noted that the milky juice of the plant is soothing to sensitive skin, particularly on the nipples of nursing mothers (hence the common name nipplewort).

Lapsana communis (Fig. 1), the flowers of which resemble a *Lactuca*, *Crepis*, *Hieracium*, or *Youngia*, can be recognized by the following description (modified from Cronquist 1980 and Barkley 1986); the absence of a pappus is particularly noteworthy. Erect, branching to single-stemmed annual herb [acting as a biennial in our area], 1.5–10(–15) dm tall, hirsute to glabrescent, with milky juice; leaves alternate, petiolate, thin, ovate to subround, obtuse to rounded, variously dentate, or the lowermost lyrate [somewhat resembling basal leaves of members of the mustard family], 2.5–10 cm long, to 7 cm wide, progressively shorter-petiolate upward, the uppermost blades distinctly narrowed; heads few–numerous in a corymb-like to somewhat elongate panicle-like capitulescence; involucre 5–8 mm tall, cylindric to campanulate-spreading; principal phyllaries ca 8, subequal, uniseriate, subtended by minute calyculate bracts; receptacle naked; florets 8–15 per head, all ligulate and fertile, corollas yellow; achenes 3–5 mm long, ± terete to weakly flattened, curved, glabrous, with numerous nerves (ca. 18–30); pappus none; (n = 6, 7, 8). Jun–Sep. The accompanying illustration is reprinted from Gleason (1952) and Strausbaugh and Core (1978) with the permission of the publishers.

NOTES ON INVASIVE EXOTICS

Lapsana communis is one of a continuing string of introduced species (defined here as those originating outside the United States) introduced into the flora of Texas. These taxa are variously referred to as alien, exotic, or foreign. In a recent floristic study on North Central Texas (Diggs et al. 1999), it was determined that 17.7% (or 394 species) of the flora consisted of such introduced species. This is roughly what would be expected based on data from other parts of the United States. For example, the level of exotic species in the northeastern states has been estimated at 22% (Elias 1977) and 20–30% (Stuckey & Barkley (1993). Comparable figures for introduced species for other states include California (17.5%) (Rejmánek & Randall 1994), Colorado (16%), Iowa (22.3%), Kansas (17.4%), and North Dakota (15%) (Stuckey & Barkley 1993). Considering how recently North Central Texas was settled and converted from almost totally native habitat, the 17.7% figure is quite striking.

Some of these exotics are extremely invasive taxa capable of becoming serious agricultural pests or of destroying native habitats. Particularly problematic are those that aggressively invade native ecosystems, reproduce extensively, and occupy the small remaining areas of natural habitat used by indigenous species. A few of the many problematic species currently spreading in North Central Texas include *Carduus nutans* L. subsp. *macrocephalus* (Desf.) Nyman (musk-thistle or nodding-thistle), *Hydrilla verticillata* (L.f.) Royle (water-thyme), *Pueraria montana* (Lour.) Merr. var. *lobata* (Willd.) Maesen & Almeida (kudzu), and *Scabiosa atropurpurea* L. (pincushions, sweet scabious). *Scabiosa*, for example, is now known from at least seven counties (Collin, Dallas, Fannin, Grayson, Hopkins, Hunt, and Lamar) and will almost surely be found in many more. In Collin County, it lines some roadsides (e.g., Hwy. 75) and virtually forms monocultures. Given the ease with which it moves into adjacent fields, there is real concern that sweet scabious may be able to invade native prairie remnants. Likewise, native habitats (e.g., forests, prairies) are being invaded by a host of other exotics, including *Lonicera japonica* Thunb. (Japanese honeysuckle), *Ligustrum* species (privets), *Sorghum halapense* (L.) Pers. (Johnson grass), and *Festuca arundinacea* Schreb., (tall fescue).

In many areas, a high percentage of the plants encountered will be of introduced species. Given the speed with which exotics have invaded, and the percentage of habitat they now occupy, after habitat destruction, inva-

FIG. 1. Habit of *Lapsana communis* (Britton & Brown 1913, with permission, New York Botanical Garden, and Strausbaugh and Core (1978) with permission Seneca Books, Inc.).

sion by exotics may be the most serious threat facing native plants in North Central Texas (Diggs et al. 1999). Problematically, this is not a short-term concern. According to Cronk and Fuller (1995), the introduction of exotics is "…a lasting threat because when exploitation or pollution stops, ecosystems often begin to recover. However, when the introduction of alien organisms stops the existing aliens do not disappear; in contrast they sometimes continue to spread and consolidate, and so may be called a more pervasive threat." Unfortunately, there is a continuing lack of recognition of the problem. For example, the Federal noxious weed *Salvinia molesta* Mitchell has recently been found in abundance at Toledo Bend Reservoir, on the Texas-Louisiana border (Jacono 1999). This native of Brazil (Forno 1983) can grow rapidly and cover the surface of lakes and streams, and the floating mats shade and crowd out native plants. Additionally, the thick mats reduce oxygen content, degrade water quality, and can cause physical problems including hindering boats and clogging water intakes (Jacono 1998). In Texas, it is considered a "harmful or potentially harmful exotic plant" and it is illegal to release, import, sell, purchase, propagate, or possess this species in the state (Harvey 1998). Nonetheless, likely sources for the introduction are local nurseries found distributing the species as an ornamental water garden plant (Randy Helton, pers. comm., in Jacono 1999).

Another example, *Lythrum salicaria* L. (purple loosestrife), can also be found for sale in Texas nurseries and is even planted on local college campuses. In some parts of the northeastern United States, *L. salicaria* aggressively invades native marshlands eliminating native species. Dense stands covering thousands of acres are sometimes formed with even tenacious natives such as *Typha* (cat-tail) species being excluded. Purple loosestrife is often cited as one of the most detrimental cases of habitat alteration by an exotic species in the U.S. It was introduced in New England in the early 1800s and by 1995 was known in every state but Florida. Because of its potential as a pest, it has been declared a noxious weed in several states with laws banning its distribution and cultivation; this species should not be planted (Stuckey 1980; Graham 1986; Yatskievych & Spellenberg 1993; Flack & Furlow 1996); http://plants.usda.gov/.

A final example for Texas is *Sapium sebiferum* (L.) Roxb., (Chinese tallow tree, vegetable tallow tree). This rapidly growing tree was introduced into the U.S. in South Carolina in the late 1770s and is now widespread; it displaces native vegetation and is considered one of the most serious invasive exotics in the U.S. It apparently releases compounds that modify soil chemistry and affect the establishment of native species (Flack & Furlow 1996). In Texas, it is extremely problematic in invading areas of native coastal prairie and East Texas forest (e.g., Big Thicket National Preserve). While the seriousness of the threat of exotics is still significantly underrealized, at least some increase in awareness is occurring. Examples of recent articles in the popular press on exotics include one in the *Nature Conservancy Magazine* (Flack & Furlow 1996) and a just published report in Scientific American discussing the serious invasion of *Lygodium microphyullum* (Cavanilles) R. Brown (Old World climbing fern) in Florida and the threat it poses to the Everglades (Mirsky 1999).

REFERENCES

Barkley, T.M. 1986. Asteraceae. In: Great Plains Flora Association. Flora of the Great Plains. Univ. Press of Kansas, Lawrence. Pp. 838–1021.

Bentham, G. and J.D. Hooker. 1873. Tribus Chicoriaceae. Gen. Pl. 2:163–533; *Lapsana* 2:509.

Britton, N.L. and A. Brown. 1898. An illustrated flora of the northern United States, Canada and the British possessions. Charles Scribner's Sons, New York.

__________ and __________. 1913. An illustrated flora of the northern United States, Canada and the British possessions. New York Botanical Garden, Bronx.

Correll, D.S. and M.C. Johnston. 1970. Manual of the vascular plants of Texas. Texas Research Foundation, Renner.

Cronk, Q.C.B. and J.L. Fuller. 1995. Plant invaders: the threat to natural ecosystems. Chapman and Hall, New York.

CRONQUIST, A. 1980. Asteraceae. Vascular flora of the southeastern United States 1:1–261. The Univ. of North Carolina Press, Chapel Hill.

DIGGS, G.M. JR., B.L. LIPSCOMB, and R.J. O'KENNON. 1999. Shinners & Mahler's illustrated flora of North Central Texas. Sida, Bot. Misc. 16.

ELIAS, T.S. 1977. Threatened and endangered species problems in North America. An overview. In: G.T. Prance and T.S. Elias, eds. Extinction is forever. New York Botanical Garden, Bronx. Pp. 13–16.

FERNALD, M.L. 1950. Gray's manual of botany, 8th ed. Reprinted 1987. Dioscorides Press, Portland, OR.

FLACK, S. and E. FURLOW. 1996. America's least wanted. Nat. Conservancy Mag. 46(6):17–23.

FORNO, I.W. 1983. Native distribution of the *Salvinia auriculata* complex and keys to species identification. Aquat. Bot. 17:71–83.

GLEASON, H.A. 1952. The new Britton and Brown illustrated flora of the northeastern United States and adjacent Canada, 3 vols. New York Botanical Garden, Bronx.

____________ and A. CRONQUIST. 1963. Manual of the vascular plants of northeastern United States and adjacent Canada. Van Nostrand Reinhold Company, New York.

____________ and ____________. 1991. Manual of the vascular plants of northeastern United States and adjacent Canada, 2nd ed. New York Botanical Garden, Bronx.

GRAHAM, S.A 1986. Lythraceae. In: Great Plains Flora Association. Flora of the Great Plains. Univ. Press of Kansas, Lawrence. Pp. 494–498.

HARVEY, W.D. 1998. Harmful or potentially harmful fish, shellfish, and aquatic plants. In: Texas Administrative Code. Title 31, Part 2 (Texas Parks and Wildlife Department regulations). Chapter 57, subchapter A, section 57.111–112.

HATCH, S.L., K.N. GANDHI, and L.E. BROWN. 1990. Checklist of the vascular plants of Texas Texas Agric. Exp. Sta. Misc. Publ. No. 1655.

JACONO, C. 1998. Have you seen this plant? Texas Parks and Wildlife information sheet.

____________. 1999. *Salvinia molesta* (Salviniaceae), new to Texas and Louisiana. Sida 18:927–928.

JEFFREY, C. 1966. Notes on Compositae: I. The Chicorieae in East Tropical Africa. Kew Bull. 18:427–486.

JONES, S.D., J.K. WIPFF, and P.M. MONTGOMERY. 1997. Vascular plants of Texas: A comprehensive checklist including synonymy, bibliography, and index. Univ. of Texas Press, Austin.

MIRSKY, S. 1999. Floral fiend: The Old World climbing fern speeds its assault on Florida. Sci. Amer. 281:24.

O'KENNON, R.J., G.M. DIGGS, JR., and B.L. LIPSCOMB. 1998a. *Lactuca saligna* L. (Asteraceae) new to Texas. Sida 18:615–619.

O'KENNON, R.J., G.M. DIGGS, JR., and R.K. HOGGARD. 1998b. *Plantago coronopus* (Plantaginaceae) new to Texas. Sida 18:356–358.

RADFORD, A.E., H.E. AHLES, and C.R. BELL. 1968. Manual of the vascular flora of the Carolinas. The Univ. of North Carolina Press, Chapel Hill.

REJMÁNEK, M. and J.M. RANDALL. 1994. Invasive alien plants in California: 1993 summary and comparison with other areas in North America. Madroño 41:161–177.

ROBINSON, B.L. and M.L. FERNALD. 1908. Gray's new manual of botany, 7th ed.: A handbook of the flowering plants and ferns of the central and northeastern United States and adjacent Canada. American Book Company, New York.

SELL, P.D. 1976. *Lapsana*. In: T.G. Tutin, V.H. Heywood, N.A. Burges, D.M. Moore, D.H. Valentine, S.M. Walters, and D.A. Webb, eds. 1976. Flora Europaea, Vol. 4, Plantaginaceae to Compositae. Cambridge Univ. Press, Cambridge, England, U.K. Pp. 344.

SMALL, J. 1917. Irritability of the pollen-presentation mechanism. New Phytol. 16:253-276.

SMITH, E.B. 1988. An atlas and annotated list of the vascular plants of Arkansas, 2nd ed. Published by the author, Fayetteville, AR.

STANFORD, J.W. 1976. Keys to the vascular plants of the Texas Edwards Plateau and adjacent areas. Published by the author, Brownwood, TX.

STEBBINS, G.L. 1953. A new classification of the tribe Cichorieae, family Compositae. Madroño 12:65–81.

__________. 1993. *Lapsana*. In: J.C. Hickman, ed. The Jepson manual: Higher plants of California. Univ. of California Press, Berkeley. Pp. 298.

STEYERMARK, J.A. 1963. Flora of Missouri. The Iowa State Univ. Press, Ames.

STRAUSBAUGH, P.D. and E.L. CORE. 1978. Flora of West Virginia, 2nd ed. Seneca Books, Inc., Grantsville, WV.

STUCKEY, R.L. 1980. Distributional history of *Lythrum salicaria* (purple loosestrife) in North America. Bartonia 47:3–20.

__________ and T.M. BARKLEY. 1993. Weeds. In: Flora of North America Editorial Committee, eds. Fl. North Amer. 1:193–198. Oxford Univ. Press, New York and Oxford.

TAYLOR, R.J. and C.E.S. TAYLOR. 1994. An annotated list of the ferns, fern allies, gymnosperms and flowering plants of Oklahoma, 3rd ed. Southeastern Oklahoma State Univ., Durant.

VUILLEUMIER, B.S., 1973. The genera of Lactuceae (Compositae) in the southeastern United States. J. Arnold. Arbor. 54:42–93.

VOSS, E.G. 1996. Michigan flora. Part III. Dicots (Pyrolaceae–Compositae). Cranbrook Institute of Science Bull. 61 and Univ. of Michigan Herbarium, Ann Arbor.

YATSKIEVYCH, G. and R.W. SPELLENBERG. 1993. Plant conservation. In: Flora of North America Editorial Committee, eds. Fl. North Amer. 1:207–226. Oxford Univ. Press, New York and Oxford.

BOOK REVIEWS

RICHARD P. WUNDERLIN. 1998. **Guide to the Vascular Plants of Florida.** (ISBN 0-8130-1556-1, hbk). University Press of Florida, 15 Northwest 15th Street, Gainesville, FL 32611, U.S.A. $35.00. 806 pp.

This is an identification guide to the marvelous vascular flora of Florida, a state whose plant diversity is surpassed in the U.S. only by California and Texas. Of Florida's 227 families, 1306 genera, and 3834 species, four genera and 155 species are endemic to the state. About 44% of the species are exotics. Genera and species appear alphabetically under each family, but the families are in phylogenetic order. No descriptions or illustrations are given except for a county map of Florida on cover 2 and a drawing of *Tillandsia pruinosa* ("fuzzywuzzy airplant") on the title page. The indexes are three: common names, scientific names, and family names; a family index is on cover 3 and the facing page, a helpful arrangement. The 17 literature citations are largely to major floristic works; no generic revisions are listed. A glossary defines about 600 terms. Data for each species are scientific name, common name, habitat, frequency, brief notes on in-state range, flowering time, and sometimes a limited synonymy. (An "Atlas of Florida Vascular Plants" is available on the Internet at http://www.usf.edu/~isb/projects/hb-atlas.html.) The keys to groups and families occupy 27 pages. I tested them with 17 species; 13 worked well enough, but four were problematical: *Erigenia bulbosa* and *Galium aparine* (sepals obsolete, but Apiaceae and Rubiaceae key out under "calyx and corolla present"); acaulescent violets (Violaceae key out under "leaves alternate"); and *Najas*, with its single-veined leaves (stopped at "leaves with parallel veins"). (This is not the only flora with this problem.) The book is well made and sturdy. Up to now, visitors to Florida have had to take along three guides to the flora (Long & Lakela 1971; Wunderlin 1982; Clewell 1985), but now one will suffice. At $35.00 the book is a bargain. Kudos to Dr. Wunderlin and the University Press of Florida.—*John W. Thieret.*

BOUTELOUA RIGIDISETA (POACEAE) NEW TO LOUISIANA

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A recent grass collection from Fort Polk, in west central Louisiana, is apparently the first record for *Bouteloua rigidiseta* (Steud.) Hitchc. for the state. It is not in Allen (1993) nor Thomas and Allen (1993). In Gould (1975), the distribution is Texas, Oklahoma, and Mexico, while Smith (1994) includes this species in the Arkansas flora. The other two species of *Bouteloua* in Louisiana are rare, with *B. hirsuta* Lag. recorded only from Calcasieu Parish, and *B. curtipendula* (Michx.) Torr. from Caldwell, East Baton Rouge, Natchitoches, and Rapides parishes. The Caldwell and East Baton Rouge collections are recent, but the other three are more than 50 years old.

Voucher specimens: **LOUISIANA. Vernon Parish:** roadside at corner of Entrance Road and Avenue A, ca 1 mi E of La 184 on North Fort section of Fort Polk, ca 5 mi ESE of Leesville, Section 34 T2N R8W, 27 May 1999, *Reid, Allen, and Doffitt 423* (NLU); same locality, 25 Sep 1999, *Allen 18400* (NLU).

REFERENCES

Allen, C.M. 1992. Grasses of Louisiana, second edition. Cajun Prairie Habitat Pres. Soc., Eunice, LA.

Gould, F.W. 1975. The grasses of Texas. Texas A. & M. Univ. Press, College Station, TX.

Smith, E.B. 1994. Keys to the flora of Arkansas. Univ. Of Arkansas Press, Fayetteville, AR.

Thomas, R.D. and C.M. Allen. 1993. Atlas of the vascular flora of Louisiana, Vol. 1: ferns and ferns allies, conifers, and monocotyledons. Louisiana Department of Wildlife and Fisheries, Baton Rouge, LA.

BOOK REVIEWS

SUSANNE M. SCHULTZ, AMY E. DUNHAM, KAREN V. ROOT, SHERYL L. SOUCY, STEVEN D. CARROLL, and LEV R. GINZBURG. 1999. **Conservation Biology with RAMAS Ecolab.** (ISBN 0-87893-768-4, pbk.) Sinaur Associates, Inc., P.O. Box 407, Sunderland, MA 01375-0407 (413-549-4300; 413-549-1118 fax; publish@sinauer.com). $27.95. 216 pp. Illustrated, CD-ROM disk.

Conservation Biology with RAMAS Ecolab is an excellent resource for beginning students of applied ecology or conservation biology. It has been designed to complement most major Conservation Biology texts, as highlighted in a chart that cross-references book chapters with relevant lab activities. The manual and accompanying software are well written and provide a collection of exercises that introduces students to the theories and analytical techniques that are the foundation for these fields. Students begin with the basics of sampling techniques, the use of biological indices, and describing population dynamics. In later chapters they explore techniques for facilitating biological management through sensitivity analyses, determining Maximum Sustainable Yields, reserve design and more.

The RAMAS software that accompanies the manual is very easy to use and is a valuable teaching tool that greatly enhances the learning potential from labs. In each exercise students use computer simulations and models to explore the various topics. Questions and straightforward activiries guide the user through the computer program and help them understand the significance of each of the model parameters. The manual not only provides rhe beginner with training in techniques and model use, but it encourages thoughtful evaluation and analysis of more difficult issues. The background information accompanying each activity exposes students to current dilemmas facing conservation biologists-ranging from the shortcomings of population estimations to the controversy over conservation versus preservation, to the problems associated with reserve size and numbet. The data and dilemmas used for the activities are representative of the diversity of issues and organisms that conservation biologists work with, and will easily spark the interest of students new to the field.

Contents of *Conservation Biology with RAMAS Ecolab*: Biodiversity: The diversity of life, From Bacteria to Blue Whales: Growth without limits, Competition in Osprey, Fish, and Barnacles: Limits to population growth, Wood Storks and Honeyearers: Estimating population characteristics, Grizzly Bears: The problem of small populations, Giant Pandas: Risks faced by endangered species, Hector's Dolphins and the Red-Cockaded Woodpecker: Conserving dwindling populations, African Market Hunting and Tuna Exploitation: Maintaining sustainable levels of harvesting, The African White Rhino: Too many for their own good?, The Wild Ass and the Black-Footed Ferret: Reintroduction of endangered species, Park Size and Species Diversity: Lessons from Islands, Rescuing the Spotted Owl: Conserving species in multiple populations, Biodiversity's Biggest Threat: Human population growth, The Case of Patrick's Marsh Wren: Making decisions to protect species, and Glossary (no index).—*Charlotte Bryant.*

SIDA 18(4): 1286. 1999

ROB BREGMAN. 1996. **The Genus *Matucana*. Biology and Systematics of Fascinating Peruvian Cacti.** (ISBN 90-5410-638-7, hbk). A.A. Balkema, P.O. Box 1675, Rotterdam, Netherlands (Fax: 31-104-413-4947), published in the United States by A.A. Balkema Publishers, Old Post Rd., Brookfield, VT 05036 (Fax: 802-276-3837). $75.00. 116 pp. text, 20 pp. of appendices and index, 80 color plates, 26 SEM photographic plates with diagnostic drawings, 28 line illustrations.

This book is one in a series of horticultural taxonomic works published by A.A. Balkema, of the Netherlands. The genus *Matucana* belongs to the Cactaceae tribe Trichocereae subtribe Borzicactinae, and contains 19 species comprised of 27 taxa, including infraspecific varieties and forms, all endemic to the Western Andean Cordillera in Peru. Differences between the taxonomic philosophies of this work and that of Backeberg from the 1930s to the 1960s, specifically as interpreted by Ritter (1981) are clearly evident throughout the text. This work, specifically oriented toward horticultural as well as taxonomic users, is markedly different from a standard taxonomic revision, owing to the recognition of four informal "species groups" recognized on the basis of seed morphology, the review of pollination and dispersal biology, cultivation information.

The book is divided into 13 chapters, including: 1) taxonomy and systematics, 2) morphology, 3) geography and ecology, 4) reproduction, 5) cultivation, 6) systematics inside *Matucana*-grouping of species, 7) key to all species of *Matucana*, 8) the haynei group, 9) the aurantiaca group, 10) the intertexta group, 11) the paucicostata group, 12) checklist, and finally 13) complete list of field numbers.

The general chapters one through five are carefully done, with a lot of evidence obviously collected from living material in cultivation. In the systematics section, it becomes obvious that the author follows the taxonomic species concept, but unfortunately, no clear discussions are included to justify why a certain species a particular group of synonyms. Statements like (page 50) "To summarize, the differences between all taxa listed here as synonyms of *M. haynei* are too small to treat them as species," are found in discussions after many of the species. While the author gives extensive synonymy lists, type specimens are not listed directly under the basionym, nor for any of the synonyms. The reader is left without knowing if types exist for all the names, if any or all have been lectotypified, etc. Listing of the numerous *nomina nuda* is ill-advised, and I would have left that portion out unless they were actually published. There is no formal generic description, nor citation of a type, although references to *M. haynei* as the oldest name in the group and the discussion of its former monotypic circumscription give us the idea.

While the author has obviously devoted years to the study of this group, I think the systematic value of the monograph is compromised by its very non-standard format. One is not sure if all historical specimens have been re-studied, nor synonyms typified, and the phylogeny portion of each species' discussion gives us no clear picture of the salient features that determines the author's placement of the taxon. It is abundantly clear that seed morphology is employed to delimit the four infrageneric groups, but the illustrations on page 36 lead this reader to think that the groups are difficult to recognize, especially because the seeds must be mature, and all portions of the seed must be intact for one to recognize the characters.

In summary, while this monograph is not a standard systematic treatment, it is an important contribution to a poorly understood, but important group of cacti. It will be a must for all concerned with the Cactaceae, with the Flora of Peru and the dynamics of the vegetation in the Peruvian Western Cordillera. The SEM photos, color photographs, and line drawings are helpful, as are the indices. It should certainly form part of any botanical or horticultural library.—*John J. Pipoly III.*

WALTER S. JUDD, CHRISTOPHER S. CAMPBELL, ELIZABETH A. KELLOGG, and PETER F. STEVENS. 1999. **Plant Systematics: A Phylogenetic Approach.** (ISBN 0-87893-404-9, hbk.). Sinauer Associates, Inc., 23 Plumtree Road, Sunderland, MA 01375-0407, USA. $67.95. 464 pp., numerous figures and CD-ROM with over 650 color photographs and three printable appendices.

Having recently watched again the movie, *Mary Poppins*, I am reminded of a phrase (no, not "supercalifragilisticexpialidoceous") that can be applied to this new text for undergraduate courses in plant systematics—"practically perfect in every way." This is the first such text that is a product of teamwork and is the best to come along since George Lawrence's *Taxonomy of Vascular Plants* of 1951. The authors, all recognized leaders in plant systematics, are former students and associates of Drs. Carroll Wood and Richard Howard. In fact, the book was conceived while most of them were fellow graduate students at Harvard. They wisely and fortuitously waited until they had professionally matured and macromolecular techniques became widely applied before making the idea a reality. The result is a textbook that is easily digested by students who have already mastered basic botany, portrays the vitality and uncertainties of the current state of knowledge in the field, and introduces both the principles of systematics and plants families of worldwide importance. Because the authors are strong advocates of the use of cladistic methods in both research and teaching, phylogenetic concepts are integrated from the introduction to the last family treatment. The goal is not the indoctrination of the conviction that cladistic approaches are better than others. Rather, they hope to make students conversant with the current research paradigm and to understand the rationale used to justify the taxa presented.

I find the sequence of topics follows a logical progression. After a brief introduction of plant systematics in Chapter One, the second chapter provides a thorough primer of cladistic methods and a comparison of cladistic, phenetic, and evolutionary schools. Here, the distinction between grouping, naming, and ranking taxa is lucidly explained. The historical background in Chapter Three is arranged topically and then chronologically, i.e., the development of understanding relationships vs. development of the formation of higher taxa. The next two chapters survey the data synthesized by systematists. Categories of morphological, anatomical, and chemical structures are introduced and important terms are defined. However, jargon is minimal (e.g., leaf shapes are reduced to four with auxiliary modifiers such as "narrowly"), many terms are introduced only in defining diagrams, and others are introduced and defined only in the family treatments (e.g., unique cucurbitoid teeth, which are diagnostic for Cucurbitales). Pollination, dispersal, breeding systems, and chromosomes are discussed with specific examples from the literature to illustrate how these data are used. Professors, especially those not trained in molecular systematics, will appreciate the thorough overview of genome structure, laboratory methods, data types, data analysis, and problems such as species trees versus gene trees. Chapter Six focuses on theoretic aspects of species—the evolution of biodiversity, speciation, and species concepts. Case studies present the problems of applying species concepts to real plant groups. Constituting over half the book, the family treatments are given in the Chapters Seven (nonflowering tracheophytes) and Eight (angiosperms). The text ends with two appendices covering botanical nomenclature and the preparation and identification of specimens.

The book is designed to be "student friendly." The early introduction and integration of cladistics will prepare talented students to launch into the recent literature and attend professional conferences. The simplification of terminology will allow them to concentrate on concepts instead of memorization. The family treatments include not only concise, parallel descriptions (general diagnostic features highlighted in Italics with synapomorphies in bold) but also discussions of geographically and economically important genera and unsolved research problems. Learning family characteristics is aided by the use of floral formulas and full-page diagnostic drawings of representative species taken from the Generic Flora of the Southeastern United States. Only families, orders, and higher taxa are fully recognized that are strongly supported by structural and molecular analyses as monophyletic. Paraphyletic groups or those lacking sufficient study and evidence of monophyly are referred to in quotes, e.g., "Paleoherbs" and "Flacourtiaceae." Students need only learn the characters that unite formerly confusing, closely related family pairs, e.g., Apocynaceae vs. Asclepiadaceae and Brassicaceae vs. Capparaceae. The major families chosen for full treatment include both tropical and temperate ones, preparing the student for fieldwork in the tropics. The extensive color photographs on the CD-ROM provide the serious student opportunities to reinforce an understanding of the family characteristics.

"Practically perfect" of course implies some imperfection. There are some points the authors may want to consider including in subsequent editions. I was surprised to find no mention of punctuated equilibrium and related theoretical problems of higher taxa. Also, the text would have wider appeal in the Desert Southwest (and arid South America) if conspicuous families such as Fouquieriaceae, Frankeniaceae, and Tamaricaceae were mentioned and briefly characterized in the discussions of treated families to which they are related. Among the photos on CD-ROM, I would like to see even greater taxonomic representation and close-up dissections to enhance this already excellent resource.

Families are arranged by the ordinal classification proposed by the Angiosperm Phylogeny Group (APG). Thus, some taxa are supported, though strongly, only by molecular data but cannot be easily characterized. For example, Malpighiales *sensu* APG includes Malpighiaceae, Clusiaceae, Rhizophoraceae, Euphorbiaceae, Chrysobalanaceae, Violaceae, Passifloraceae, and Salicaceae, but not Polygalaceae; only dry stigmas, a fibrous exotegmen, and trilacunar nodes possibly unite the order morphologically. Some instructors may find this disconcerting. However, one should keep in mind that the suprafamilial taxa presented in the book are only those strongly supported such that this classification is likely to change minimally in the future. Although higher taxa in traditional classifications (e.g., those of Cronquist and Thorne, both provided as appendixes on the CD-ROM) can be characterized morphologically, current evidence shows many of the taxa in those classifications to be incorrect. Why teach outdated systems to students, who can surely accommodate uncertainties in the system?

The overall quality of *Plant Systematics* is outstanding. Instructors should eagerly adopt this text (and keep it on their reference shelf). I think that it will lead students to appreciate plant systematics as a field and prepare them for a career in biology better than any other available for a one-semester, undergraduate course.—*Roger W. Sanders, Botanical Research Institute of Texas, 509 Pecan St., Fort Worth, TX 76102-4060, U.S.A.*

GEORGE YATSKIEVYCH. 1999. **Steyermark's Flora of Missouri-Volume 1. Revised Ed.** (ISBN: 1-887247-19-X, hbk). Missouri Department of Conservation, P.O. Box 180, Jefferson City, MO 65201-0180; in co-operation with The Missouri Botanical Garden Press, P.O. Box 299. St. Louis, MO 63166. $38.00. xii + 991 pp., 194 plates of black and white line drawings; 20 figures, including 27 individual black and white photographs; 798 distribution maps.

The long awaited and much anticipated revision of volume one of Julian Steyermark's 1963 classic *Flora of Missouri* (*Flora*) was finally published during the first quarter of 1999. Given the outstanding quality of the Yatskievych's treatment of the monocots in volume one, it was well worth the wait! The book is so well written, organized, researched, illustrated, thorough, and scholarly done, that one must struggle to find fault. In the dedication to Julian Steyermark, the author humbly asks if Steyermark had still been present with us, would he have approved the book's contents? Not only do I believe that Steyermark would have answered with a very enthusiastic and resounding, 'Yes!', but I am confident that he would agree that this will surely be recorded as one of the greatest treatments of monocots ever written!

Volume one of the *Flora* consists of two parts: 1) and introduction, and 2) the *Flora* itself. The first part is so well written and enjoyable to read, that it delivers like a 91-page natural history novel. Printed separately, this part would probably be a number one best seller! The introduction includes: 1) a history of floristic botany in Missouri; 2) an analysis of changes in the state's native and introduced plant taxa since Steyermark's original treatment; 3) a description of the different natural divisions and plant communities within the state; and 4) a discussion on how the evolutionary history, geography, climate, geology, landscape features, and anthropogenic affects of man in Missouri have influenced the distribution and ecology of the state's flora.

The second part, a 900 page *Flora*, is nothing short of a masterpiece that will undoubtedly set a high standard of excellence for similar treatments in the future! Although space would not allow a listing of all the highlights of this section, a few are worth mentioning. The first and most obvious is the thoroughness, accuracy, and comprehensiveness of the treatments of the families, genera, and species discussed. It should be obvious to any reader that several sources of information were used in compilation of the written text. These included: 1) an exhaustive review of the published and unpublished literature (an incredible 694 references cited!) involving the taxonomy, systematics, ecology, distribution, and description of the taxa discussed; 2) an examination of thousands of museum specimens; 3) communication with numerous professional and amateur botanists who actively collect in the state; 4) correspondence and cooperation with leading experts and authorities of the groups covered; and 5) hundreds of hours of field investigations that were necessary to clarify the distribution of numerous species.

I found the keys easy to use and follow, especially those of the larger or more difficult groups (e.g., *Carex*, *Cyperus*, *Eleocharis*, *Eragrostis*, *Panicum*, Poaceae, and Pteridophytes). One plus for the keys is that the author painstakingly covered numerous exceptions found in many groups by lengthening the keys to cover such variations often typical for different monocot taxa.

Another obvious highlight is the exquisite detail displayed in the numerous illustrations, all of which were newly produced for this portion of *The Flora*. The line drawings of each species depicted are some of the most accurate and detailed illustrations I have ever observed. Although the overall quality of the illustrations of the nine different artists used are excellent, I would do this review a great injustice if I did not separately mention the outstanding quality of the drawings provided by Paul Nelson (Acoraceae, Araceae, *Carex*) and Phyllis Bick [Agavaceae, Alismataceae, Cupressaceae, Cyperaceae (in part), ferns & fern allies, Marantaceae, Najadaceae, Orchidaceae, and Poaceae (in part)]. Nelson's illustrations are so accurate and complete that any reader will easily fall victim to modification of a recent commercial, 'bet you can't view just one!'. His line drawings are so stunning in their detail and accuracy that he is one artist who would actually become very successful if he should ever decide 'to quit his day job!'. Likewise, Bick's drawings provide exceptionally accurate depictions of groups many artists have a challenging time correctly illustrating such as difficult species within the Cyperaceae and Poaceae. It is always refreshing to find a recent flora that has been newly illustrated, especially when the drawings are as well done as with this work.

Another high point of the book is that a separate description, county distribution map, and habitat affinities are provided for well over 99% of the taxa discussed. The only exceptions are for those few species that were discovered just as the book was being finalized before going to the printer.

No review of this book's highlights would be complete without a comment on how inexpensive it is, especially for a well bound hard copy with 991 pages. At $38, the book is a steal and easily affordable, even for those on a tight budget.

Although negative points about the book are hard to find, a few should be discussed. The most obvious short coming is that it is difficult to find individual species of *Carex* without knowing ahead of time what Section they are in, or similarly locating genera of grasses without prior knowledge of their tribal affiliation. While this will not be a hindrance to experts working with *Carex* and the Poaceae, it will be problematic for anyone who lacks the necessary expertise for such groups. Although there is an excellent index following the literature cited section, it is very cumbersome to move back and forth through such a heavy book. A simple solution would have been to provide an index to *Carex* species and grass genera at the beginning of each respective treatment.

The author's designations for abundance for some species are hard to comprehend. It is difficult to understand how species that are known from only one or two records in the state (e.g., *Carex atherodes*, *Carex laxiflora*, *Carex reniformis*, *Carex sartwellii*, *Carex straminea*, and *Carex willdenowii*) can be given the same 'uncommon' designation as species known from multiple counties (e.g., *Carex buxbaumii*, *Carex molestiformis*, *Carex vesicaria)* and in some cases, represented by tens of thousands of plants in specific populations (e.g., *Carex arkansana*).

Although overall the illustrations for the Poaceae are extremely accurate, the depiction of only portions of some species prevents a full appreciation of the general habit for certain taxa (e.g., *Poa wolfii*, *Oryzopsis racemosa*, *Elymus riparius*, *Miscanthus* spp., and *Erianthus* spp.).

One noteworthy error is that the last sentence in the discussion of *Bouteloua hirsuta* on page 678 applies to *B. gracilis* as the latter is the rarer of the two in the state that is currently only known from one extant site in Atchison County. Another is associated with the key to the Section Griseae and discovered by the author himself- the second parts of couplet three: "lowermost pistillate scales with the bodies much shorter than the associated perigynia (vs. as long as or longer than the associated perigynia)" should be moved to become the respective second parts of couplet five because *C. oligocarpa* and *C. planispicata* have the bodies of the lowermost pistillate scales shorter than the associated perigynia. As currently written in the key, *C. oligocarpa* and *C. planispicata* would incorrectly key out to *C. fllaccosperma* or *C. glaucodea.* Additionally, it would have been helpful if the artist would have illustrated a lowermost pistillate scale for *C. grisea* and *C. amphibola* (rather than one situated farther up the pistillate spike) so that the illustrations on pages 245 of these two species would correspond with the key on page 247 and the text on pages 247 and 252.

The following items are examples of minor errata: 1) the total introduced taxa on page 83 should read 820 rather than 20, 2) the achene of *Carex oklahomensis* illustrated on page 355 should show two stigmas rather than three, 3) the illustrations for *Bothriochloa laguroides* and *B. bladhii* on page 593 are reversed, 4) the word 'fertile' in the last couplet of the key to *Ophioglossum* on page 140 should be replaced with 'sterile', 5) five or six leaves are listed in the genus description of *Isotria* but only four leaves are depicted in the illustration of *Isotria medeoloides*, 6) Section Intermediae should be listed in the legend of Plate 41 for *Carex sartwellii*, and not Hymenochlaenae, and 7) Section Laxiflorae should be listed in the legend of Plate 41 for *Carex blanda*, and not Hymenochlaenae.

The negative points listed above are so minor and insignificant compared to the overall excellence of this book, that they are nearly not worth mentioning. Given the quality and price of this masterpiece, *Steyermark's The Flora of Missouri- Volume 1*, should be on the shelf of every botanist, naturalist, and plant enthusiast in the Midwest! Additionally, it will be a welcomed reference that will undoubtedly be in high demand throughout botanical circles in North America and abroad. Along with Diggs et al. 1999 excellent *Illustrated Flora of North Central Texas* (see Marshall Johnston's complimentary review in the September 1999 issue of *Sida*), *Steyermark's The Flora of Missouri- Volume 1*, is definitely a "must buy" botanical reference!—*Paul M. McKenzie*

BOOKS RECEIVED

Johnson, Frederic S. 1995. **Wild Trees of Idaho.** (ISBN 0-89301-145-2, pbk.). University of Idaho Press, Moscow, ID 83844-1107, U.S.A. $14.95. xlv + 212 pp.

Michael Kuhns. 1998. **A Guide to the Trees of Utah and the Intermountain West.** (ISBN 0-87421-244-8, pbk.). Utah State University Press, Logan, UT 84322-7800, U.S.A. $14.95. x + 342 pp.

Here are two more tree books for your library. The Idaho volume (8" × 10") treats 88 species plus 19 shrub species not known to reach tree size in Idaho. It has 33 pages of introductory text, including 10 pages of description of the vegetation of the state and a "chronology of Idaho vegetation history" (Triassic to present), useful additions. The "Picture keys to tree leaves" leads to the usual groups of species (e.g., broadleaf trees with alternate, simple leaves), each with a list of common names. (There are no generic keys.) Thus, if the plant in hand has simple, alternate leaves, you are lead to 19 common names. Then you turn to the main part of the book and begin checking these 19 until you find a match for your specimen. Each species is illustrated with black-and-white photocopies of leafy twigs or with drawings from elsewhere. Additionally, 80 color photos—some as small as a square inch—are grouped onto eight full-page plates. Range is shown on maps of northwestern U.S. The book has a glossary and indexes to common names and to scientific names.

Overlapping the Idaho book in the southern third of that state, the Utah volume (4.5" × 8") describes all native and most introduced species, 219 in all. The descriptions of morphology are well made; notes on habitat, uses, and cultivation are given. The black-and-white illustrations are from various sources. Eight plates of color photos show 12 species, half of them introduced. The introductory material considers nativity, common vs. scientific names, tree parts, and tree morphology. A 26-page "selection guide" summarizes data that should be useful for people—both in Utah and in surrounding states—looking for a tree species to plant in their front yard. The key to trees works well. The book closes with a glossary and an index to scientific and common names.

SIDA, CONTRIBUTIONS TO BOTANY AND REVIEWERS FOR VOLUME 18, 1998–1999

The following individuals kindly supported Sida through their time and expertise in reviewing manuscripts published in volume 18, the largest published to date. Your support is deeply appreciated.

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Barrie, F.R., C.E. Jarvis, and J.L. Reveal. 1992a. The need to change Article 8.3 of the Code. Taxon 41:508--512.

Ricketson, J. and J. Pipoly. 1997. A synopsis of the genus *Gentlea* (Myrsinaceae) and a key to the genera of Myrsinaceae in Mesoamerica. Sida 17:697--707.

Crawford, D.J. 1983. Phylogenetic and systematic inferences from electrophoretic studies. In: S.D. Tanksley and T.J. Orton, eds. Isozymes in planr genetics and breeding, Part A. Elsevier, Amsterdam. Pp. 257--287.

Sivinski, R.C. and K. Lightfoot (eds.). 1995. Inventory of rare and endangered plants of New Mexico. New Mexico Forestry and Resources Conservation Division. Energy, Minerals and Natural Resources Departmenr. Misc. Pub. No. 4.

Abbreviations

When the following abbreviations are used the period is omitted. Distance: mm, dm, cm, m, km, ft, mi; directions (in caps): S, N, E, W, months: first 3 letters only, Jan, Feb, etc. Example: Potter Co.: 2 km W of Dot, 5 Jun 1971, <u>Smith 118</u> (SMU).

Documented Plant Chromosome Numbers

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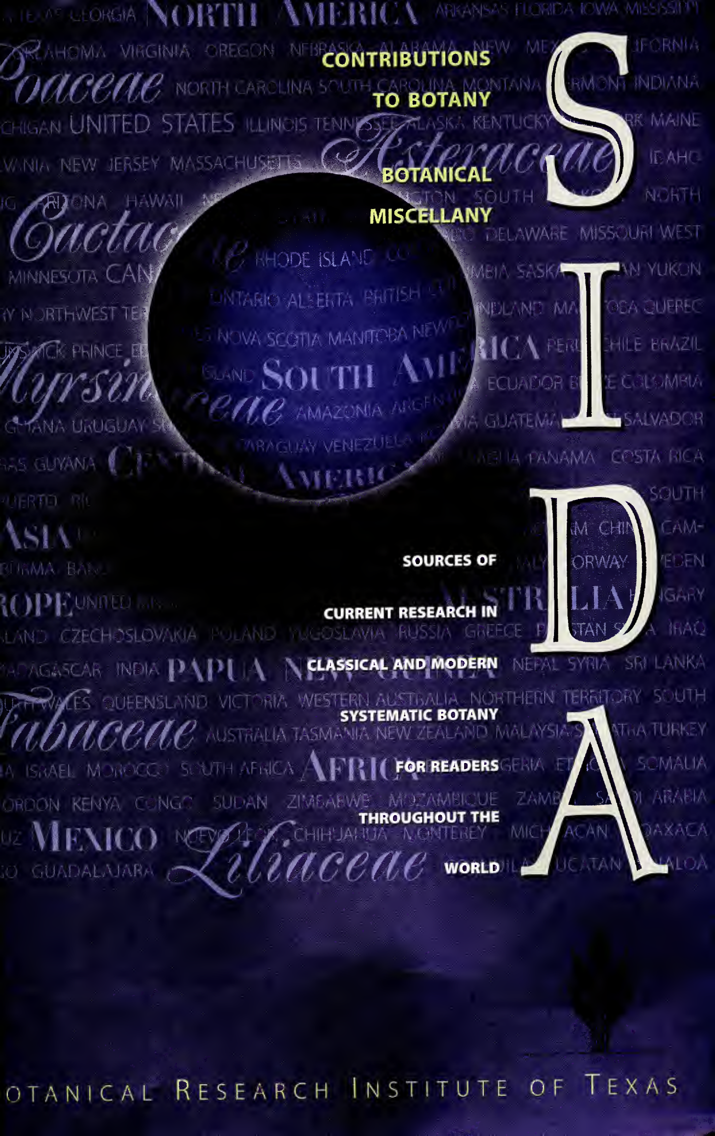

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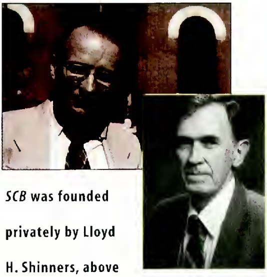

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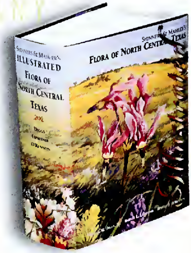

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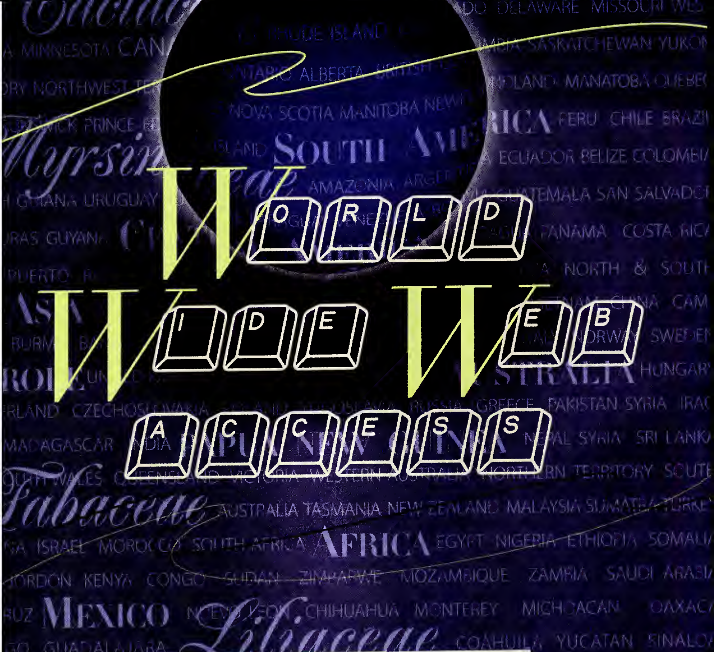

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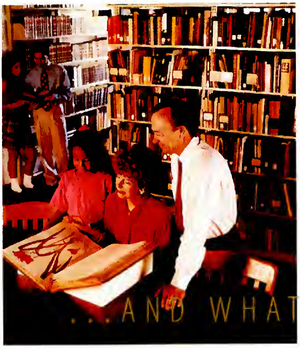

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