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LIFE HISTORY AND DESCRIPTION OF IMMATURE STAGES OF *OXYNA PALPALIS* (COQUILLETT) (DIPTERA: TEPHRITIDAE) ON *ARTEMISIA TRIDENTATA* NUTTALL (ASTERACEAE) IN SOUTHERN CALIFORNIA

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Abstract.—*Oxyna palpalis* (Coquillett) is a univoltine, circumnatal tephritid uniquely reproducing as an inquiline in rosette galls of *Rhopalomyia florella* Gagné (Diptera: Cecidomyiidae) of terminal buds on branches of *Artemisia tridentata* Nuttall. Its larvae also routinely function as facultative predators of *R. florella* larvae, novel behavior for Tephritidae. The egg, first-, second-, and third-instar larvae, and puparia are described and figured for the first time. The egg is distinguished by a pedicel circumscribed by one complete and a partial second ring of irregularly shaped micropyles. All three larval instars of *O. palpalis* are compared to and distinguished from those of *O. aterrima* (Doane), its only other known congener in North America. Oviposition occurs in spring (June) in southern California in nearly fully formed galls of *R. florella* containing young larvae of this cecidomyiid. The young larvae of *O. palpalis* pass the summer (June–September) as first instars singly in small, central, ovoidal cells basad of the cecidomyiid larvae. Second instars occupy their still-small, separate chambers until late fall/early winter (September–October), when some begin to molt to third instars. By mid-winter (February) all larvae are third instars, which continue to overwinter and grow slowly until the resumption of the spring flush of new plant growth (March). At this time, one to six or more third instars enlarge the central gall chamber to accommodate their faster growth and feed gregariously. Cecidomyiid larvae encountered during this third stadium are killed and devoured; surviving immature gall midges usually occupy the periphery of the galls. Pupariation follows in early April, and adults emerge by mid-April. *Eurytoma* sp. (Hymenoptera: Eurytomidae) and *Eupelmus* sp. (Hymenoptera: Eupelmidae) were individually reared from puparia of *O. palpalis* as primary, solitary, probably larval-pupal endoparasitoids. *Lyrcus* sp. (Hymenoptera: Pteromalidae) was reared from individual puparia as a gregarious, primary endoparasitoid.

Key Words: Insecta, *Oxyna,* Asteraceae, *Artemisia,* nonfrugivorous Tephritidae, *Rhopalomyia,* Cecidomyiidae, biology, taxonomy of immature stages, galls, inquiline, circumnatal life cycle, parasitoids, insect predation

Oxyna palpalis (Coquillett) (Diptera: Tephritidae) is one of two species of *Oxyna* now known from North America (Foote et al. 1993, Goeden 2002b). The other species, *O. aterrima* (Doane) was reviewed by Foote et al. (1993) and studied by Goeden (2002b), who synonymized it with *O. utahensis* Quisenberry.

MATERIALS AND METHODS

The present study was based in large part on dissections of samples of galls of the gall midge, *Rhopalomyia florella* Gagné (Diptera: Cecidomyiidae), on *Artemisia tridentata* Nuttall prob. ssp. *parishii* (A. Gray) H. M. Hall and Clements (Asteraceae) collected mainly 0.2 km north of the hamlet of Mile High and just south of the hamlet of Largo Vista; 1580-m elevation; Township 4N, Range 9W, Section 4; Angeles National Forest, Los Angeles Co., during 1996 and 1997. Excised *R. florella* galls, containing eggs and early-instar larvae of *O. palpalis*, and later, overwintered galls containing third instars and puparia of *O. palpalis* were sampled mid-monthly from gall-bearing plants during 1996 and 1997. Samples were transported in cold-chests in an air-conditioned vehicle to the laboratory and stored under refrigeration for subsequent dissection, photography, description, and measurement. Eight eggs, 18 first-, seven second-, and 19 third-instar larvae and nine puparia dissected from galls were preserved in 70% EtOH for scanning electron microscopy (SEM). Additional prepuparia and puparia in excised, opened galls were placed in separate, glass shell vials stoppered with absorbant cotton and held in humidity chambers at room temperature for adult and parasitoid emergence. Specimens for SEM were hydrated to distilled water in a decreasing series of acidulated EtOH. They were osmicated for 24 h, dehydrated through an increasing series of acidulated EtOH and two, 1-h immersions in hexamethyldisilazane (HMDS), mounted on stubs, sputter-coated with a gold-palladium alloy, and studied and photographed with a Philips XL-30 scanning electron microscope in the Central Facility for Advanced Microscopy and Microanalysis, University of California, Riverside.

Most adults reared from isolated prepuparia and puparia were individually caged in 850-ml, clear-plastic, screened-top cages with a cotton wick and basal water reservoir and provisioned with a strip of paper toweling impregnated with yeast hydrolyzate and sucrose. These cages mainly were used for studies of longevity in the insectary of the Department of Entomology, University of California, Riverside, at 25 ± 1°C, and 14/10 (L/D) photoperiod. Two pairs of virgin flies, each consisting of a male and a female obtained from emergence cages also were held in a clear-plastic, petri dish provisioned with a flattened, water-moistened pad of absorbant cotton spotted with honey (Headrick and Goeden 1994) for observations of their courtship and copulation behavior.

Plant names used in this paper follow Hickman (1993) and Bremer (1994); tephritid names and adult terminology follow Foote et al. (1993); cecidomyiid names and gall terminology follow Gagné (1989). Terminology and telegraphic format used to describe the immature stages follow Goeden (2001, 2002a, b), Goeden and Norrbom (2001), Goeden and Teerink (1999), and earlier works cited therein. Means ± SE are used throughout this paper. All remaining voucher specimens and reared parasitoids of this tephritid reside in my research collections. Digital photographs used to construct text figures were processed with Adobe Photoshop® Version 6.

RESULTS AND DISCUSSION

Adult.—*Oxyna palpalis* originally was described as a *Tephritis* by Coquillett in Baker (1904) from a single male specimen from Ormsby County, Nevada. Quisenberry (1949) in his revision of *Oxyna* redescribed this species from three females and two males variously from California, Idaho, and Nevada. Foote and Blanc (1963) and Foote et al. (1993) pictured the right wing.

Immature stages.—The egg, first-, second-, and third-instar larvae, and puparium of *O. palpalis* are described below.

Egg: Thirteen eggs of *O. palpalis* dissected from field-collected galls of *R. florella* galls also bearing cecidomyiid larvae were white, opaque, smooth, ellipsoidal,

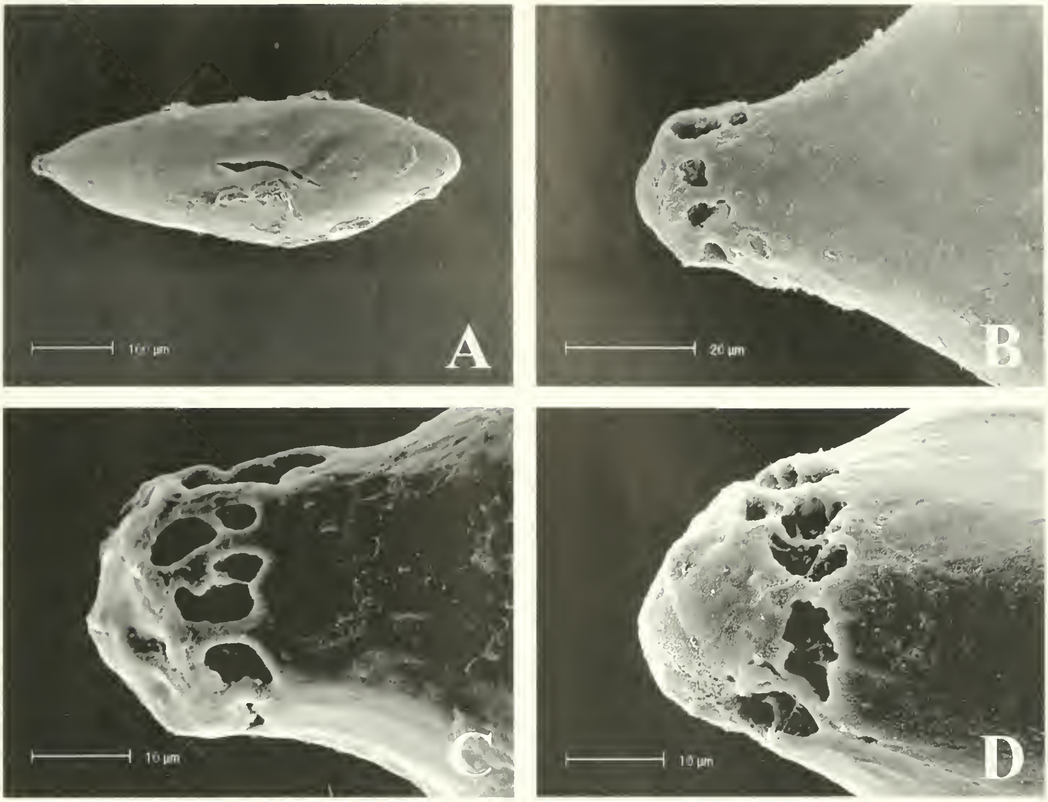

Fig. 1. Egg of *Oxyna palpalis*: (A) habitus, anterior to left; (B) pedicel 1, (C) pedicel 2, (D) pedicel 3. (The three pedicels show variation in size, shape, and placement of micropyles.)

0.65 ± 0.02 (range, 0.62–0.68) mm long, 0.20 ± 0.00 (range, 0.20–0.20) mm wide, smoothly rounded at basal end, with a 0.2-mm, buttonlike pedicel at anterior end (Fig. 1A). The pedicel was circumscribed subapically by one complete and a partial second ring of irregularly shaped micropyles (Fig. 1B, C, D)

This is the first *Oxyna* egg pictured at high magnification (Goeden 2002b). On average, the egg of *O. palpalis* is slightly longer and slightly narrower than that of *O. aterrima* (Goeden 2002b).

First instar larva: White, ellipsoidal, flattened anteriorly and posteriorly (Fig. 2A); body segments with hemispherical or posteriorly-directed, short-spinose, minute acanthae on intersegmental areas of metathorax and abdominal segments A1 through A6 as well as pleura and lateroventrum of A1 through A6; prothorax and gnathocephalon smooth, the latter conical (Fig. 2B), both circumscribed by verruciform sensilla (Figs. 2B-1, -2); dorsal sensory organ, well-defined, flat pad (Fig. 2C-1); anterior sensory lobe (Fig. 2C-2) bears terminal sensory organ (Fig. 2C-3), lateral sensory organ (Fig. 2C-4), supralateral sensory organ (Fig. 2C-5), and pit sensory organ (Fig. 2C-6); stomal sense organ reduced to two verruciform sensilla ventrolaterad of terminal sensory organ (Figs. 2C-7, D-1), not fused with flattened, protrudent, lateral integumental petal (Figs. 2C-8, D-2) above each mouthhook, one medial, papillate, integumental petal (Figs. 2C-9, D-3) between anterior sensory lobes and lateral integumental petals; mouthhook bidentate (Figs. 2B-3, C-10, D-4); median oral lobe laterally compressed, apically rounded (Figs. 2B-4,

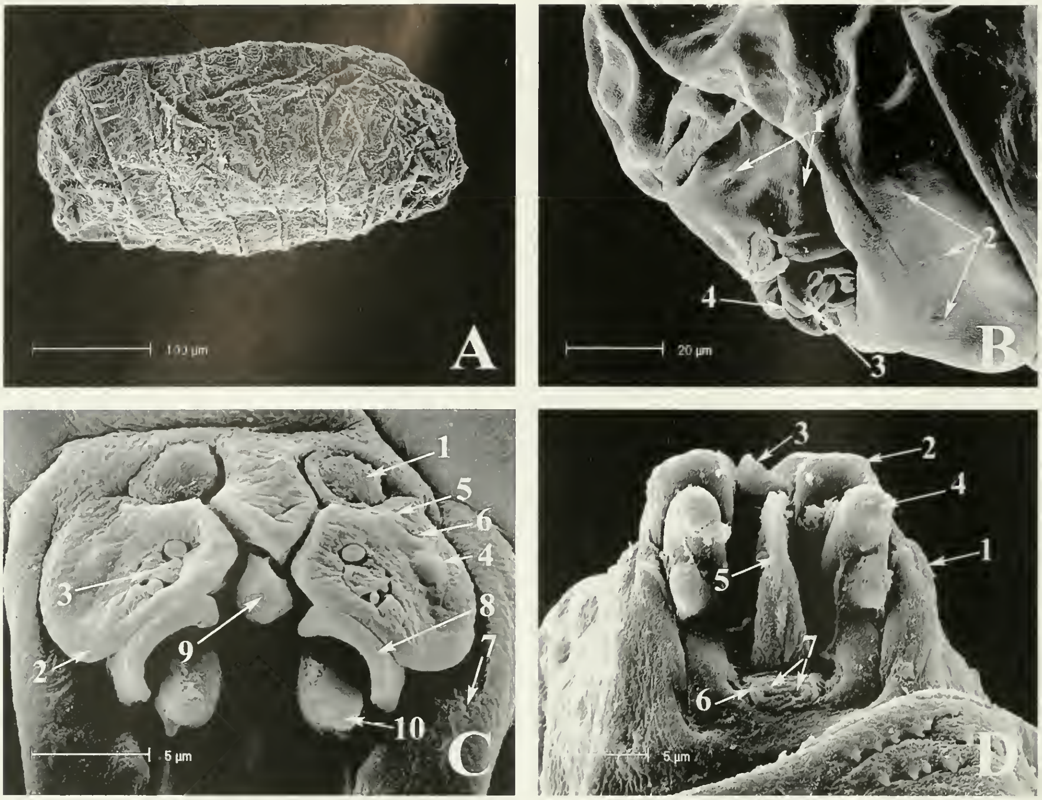

Fig. 2. First instar of *Oxyna palpalis*: (A) habitus, anterior to left, (B) gnathocephalon and prothorax, ventrolateral view, 1—verruciform sensilla on gnathocephalon, 2—verruciform sensilla on prothorax, 3—mouthhook, 4—median oral lobe; (C) gnathocephalon, frontal, close-up view, 1—dorsal sensory organ, 2—anterior sensory lobe, 3—terminal sensory organ, 4—lateral sensory organ, 5—supralateral sensory organ, 6—pit sensory organ, 7—stomal sense organ, 8—lateral integumental petal, 9—medial integumental petal, 10—mouthhook; (D) oral cavity, ventral view, 1—stomal sense organ, 2—lateral integumental petal, 3—medial integumental petal, 4—mouthhook, 5—median oral lobe, 6—labial lobe, 7—pores.

D-5); labial lobe (Fig. 2D-6) broad, separated from median oral lobe, and with two pores ventrally (Fig. 2D-7); anterior spiracle absent; lateral spiracular complexes not seen; caudal segment (Fig. 3A) with a stelex sensillum dorsolaterad (Fig. 3A-1), laterad (Figs 3A-2, B), and ventrolaterad (Figs. 3A-3, C-1) of posterior spiracular plate (Figs. 3A-4, D); posterior spiracular plate bears two rimae (Fig. 3D-1), ca. 0.005 mm long, and four, unbranched or bifurcate, spinose or apically toothed (some bifurcate) interspiracular processes (Fig. 3D-2), the longest process measuring 0.007 mm; intermediate sensory complex (Figs. 3A-5, C-2, D-3) consists of stelex sensillum (Fig. 3C-3) and medusoid sensillum (Fig. 3C-4).

The habitus of the first instar of *O. palpalis* is similar to the first instar of *O. aterrima;* however, as with *Trupanea* spp. (Goeden and Teerink 1999), *Neaspilota* spp. (Goeden 2001), and *Tephritis* spp. (Goeden 2002a), the incidence and patterns of minute acanthae on the thorax and abdomen show interspecific differences. *Oxyna palpalis* has fewer minute acanthae in the intersegmental areas of the thorax and abdominal segments A1 and A2, and unlike *O. aterrima,* none on or between abdominal segments A3 through A6 (Goeden 2002b).

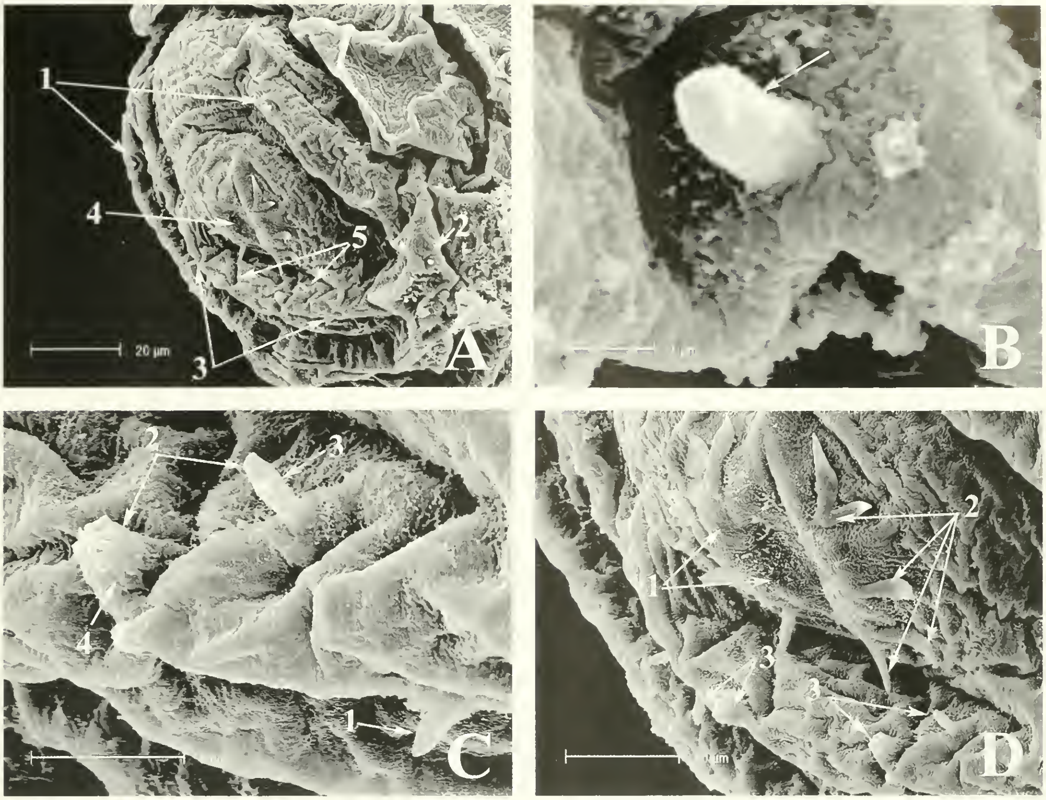

Fig. 3. First instar of *Oxyna palpalis*, continued: (A) caudal segment, 1—dorsolateral stelex sensilla, 2—lateral verruciform sensillum, 3—ventrolateral stelex sensillum, 4—posterior spiracular plate, 5—intermediate sensory complexes; (B) lateral stelex sensillum (arrow); (C) 1—ventrolateral verruciform sensillum, 2—intermediate sensory complex (composed of), 3—stelex sensillum, 4—medusoid sensillum; (D) posterior spiracular plate with 1—two rimae, 2—four interspiracular processes, and 3—two intermediate sensory complexes.

The first instar of *O. aterrima* has two, medial, integumental petals (Goeden 2002b); whereas, *O. palpalis* has only one (Figs. 2C-9, D-3). The single, lateral integumental petal above each mouthhook is fused with the stomal sense organ in *O. aterrima* (Goeden 2002b), but they are not fused in *O. palpalis* (Figs. 2C-8, D-2). The mouthhooks are tridentate in the first instar of *O. aterrima* (Goeden 2002b), but are bidentate in *O. palpalis* (Figs. 2B-3, C-10, D-4). The lateral sensilla surrounding the posterior spiracular plate of *O. aterrima* are verruciform (Goeden 2002b; whereas, these are stelex sensilla in *O. palpalis* (Figs 3A-2, B). The interspiracular processes on the caudal segment of *O. aterrima* are unbranched (Goeden 2002b); whereas, some processes of *O. palpalis* are two-branched (Fig. 3D-2).

Second instar larva: Ovoidal, rounded anteriorly, truncated posteriorly (Fig 4A), body segments with short-spinose, posteriorly-directed, minute acanthae (Fig. 4B-1) circumscribing intersegmental areas of thorax and abdomen; thorax and gnathocephalon smooth (Fig. 4B), the latter conical, the former circumscribed around middle with verruciform sensilla (Fig. 4B-1); dorsal sensory organ, a well-defined, flat pad (Figs. 4C-1, D-1); anterior sensory lobe (Fig. 4C-2) with terminal sensory organ (Fig. 4C-3), lateral sensory organ (Fig. 4C-4), supralateral sensory organ (Fig. 4C-5), and pit sensory organ (Fig. 4C-6); two pairs of foliose, protrudent, lateral integumental

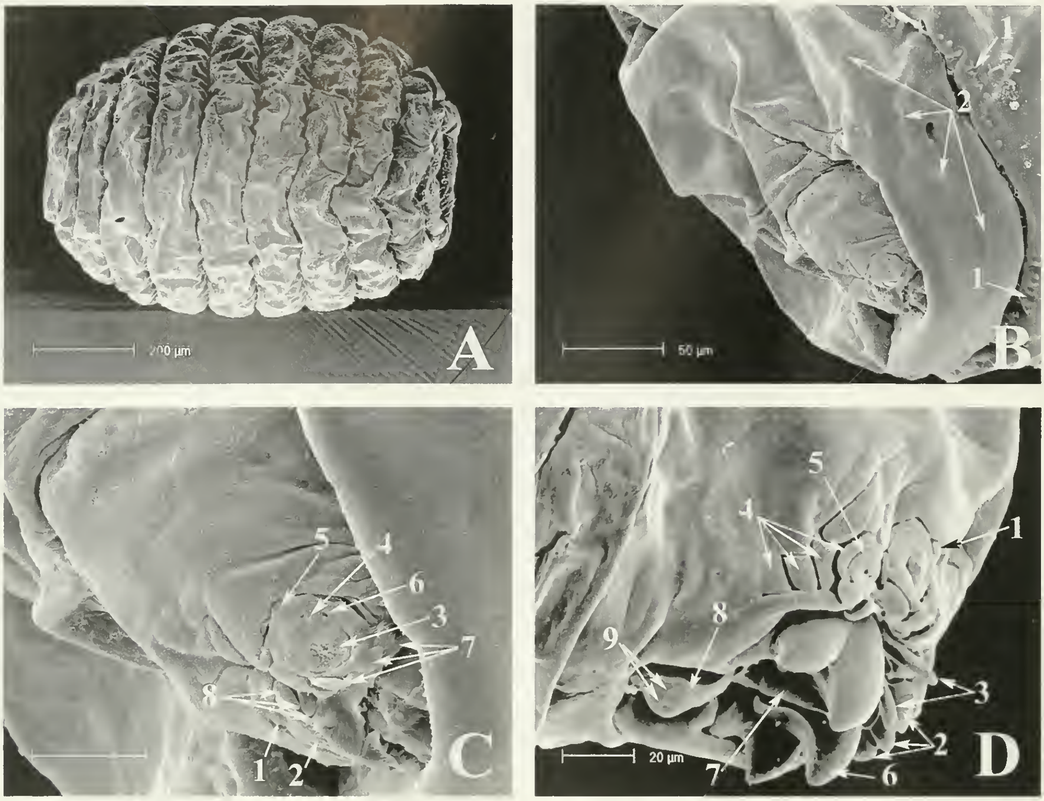

Fig. 4. Second instar of *Oxyna palpalis*: (A) habitus, anterior to left; (B) prothorax and gnathocephalon, frontolateral view, 1—minute acanthae, 2—verruciform sensillum; (C) gnathocephalon, frontolateral view, 1—dorsal sensory organ, 2—anterior sensory lobe, 3—terminal sensory organ, 4—lateral sensory organ, 5—supralateral sensory organ, 6—pit sensory organ, 7—lateral integumental petals, 8—medial integumental petals; (D) gnathocephalon, ventrolateral view, 1—dorsal sensory organ, 2—lateral integumental petals, 3—ventral, medial integumental petals, 4—oral ridges, 5—stomal sense organ, 6—mouthhook, 7—median oral lobe, 8—labial lobe, 9—pores.

petals (Figs 4C-7, D-2) above each mouthhook, two pairs of papillate, medial integumental petals (Fig. 4C-8) between each anterior sensory organ, the ventral pair elongate (Fig. 4D-3); at least four oral ridges (Fig. 4D-4) ventrolaterad of each anterior sensory lobe and stomal sense organ (Fig. 4D-5); mouthhook (Fig. 4D-6) with two teeth; median oral lobe laterally flattened (Fig. 4D-7); labial lobe (Fig. 4D-8) broad, separated from median oral lobe, with two pores ventrally (Fig. 4D-9); anterior thoracic spiracle (Fig. 5A) with five, rounded, wedge-shaped papillae; lateral spiracular complexes not seen; caudal segment (Fig. 5B) with stelex sensillum dorsolaterad (Figs. 5B-1), laterad (Fig 5B-2), and ventrolaterad (Figs. 5B-3, C-1) of posterior spiracular plate (Figs. 5B-4, D); posterior spiracular plate with four, elongate, upright, foliose, interspiracular processes (Fig. 5D-1), the longest process measuring 0.011 mm; intermediate sensory complex (Figs. 5B-5, C-2) consists of stelex sensillum (Fig. 5C-3) and medusoid sensillum (Fig. 5C-4).

One major difference between the second instars of *O. palpalis* and *O. aterrima* is the absence of a black marking on the abdominal ventrum of the former species, where the ventrum and pleura of the latter species are densely covered with knoblike minute acanthae (Goeden 2002b). In *O. palpalis*

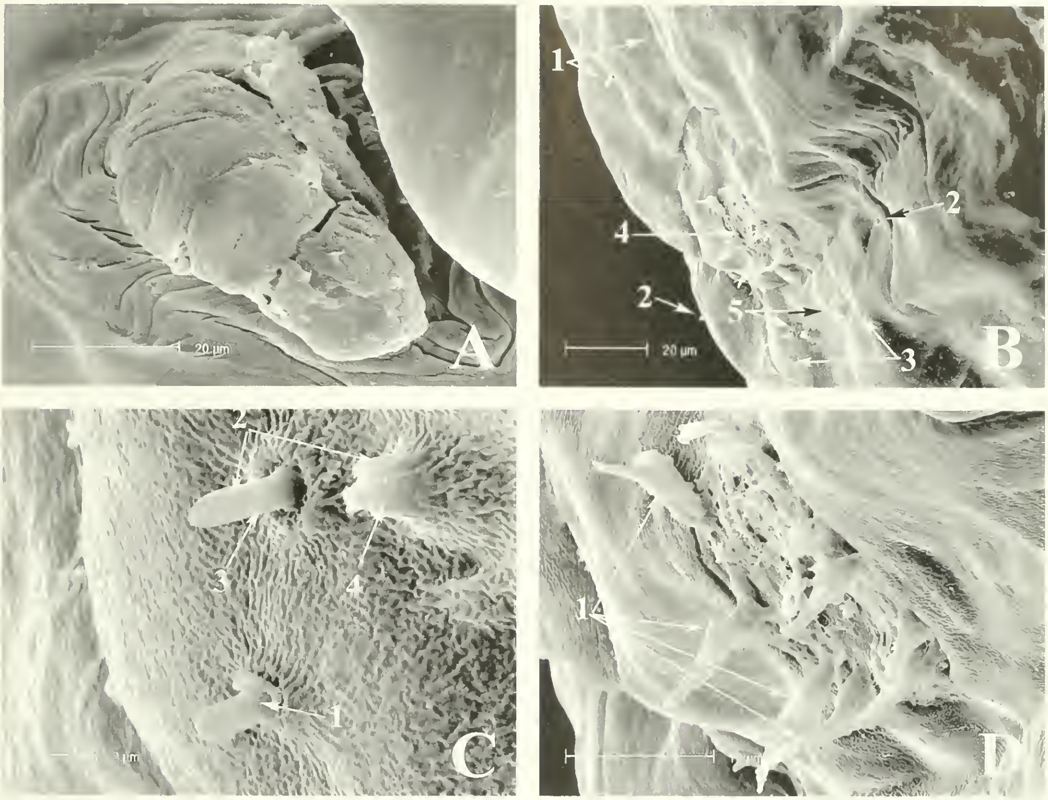

Fig. 5. Second instar of *Oxyna palpalis*, continued: (A) anterior spiracle; (B) caudal segment; caudal segment, 1—dorsolateral stelex sensilla, 2—lateral stelex sensilla, 3—ventrolateral stelex sensilla, 4—posterior spiracular plate, 5—intermediate sensory complexes; (C) 1—ventrolateral stelex sensillum, 2—intermediate sensory complex (composed of), 3—stelex sensillum, 4—medusoid sensillum; (D) posterior spiracular plate, 1—four interspiracular processes.

the minute acanthae are short-spinose and confined mainly to the intersegmental areas of the thorax and abdomen. *Oxyna palpalis* has two pairs of medial integumental petals between each anterior sensory lobe (Fig. 4C-8); whereas, *O. aterrima* has only one such pair (Goeden 2002b). The inner, ventral oral ridge among the four such ridges of *O. aterrima* is ventrally toothed and fused with the stomal sense organ (Goeden 2002b); whereas, none of the four oral ridges of *O. palpalis* is toothed nor fused with the stomal sense organ (Figs. 4D-3, 4).

Third instar larva: Pale yellow or white, ovoidal, tapering anteriorly, truncated posteriorly, distinctly segmented (Fig. 6A), short-spinose, posteriorly-directed, minute acanthae in transverse bands on dorsoposterior fifth of gnathocephalon (Figs. 6A, B-1), minute acanthae also circumscribe anterior fourth of thoracic segments and anterior fourth of abdominal segment A1, dorsum, ventrum and anterior third of pleura of A2-A7, and all but posterior of spiracular plate A-8 (Fig. 7D-1); gnathocephalon smooth, conical (Fig. 6-B); dorsal sensory organ well-defined, hemispherical (Figs. 6B-2, C-1); anterior sensory lobe bears terminal sensory organ (Figs. 6B-3, C-2), lateral sensory organ (Fig. 6C-3), supralateral sensory organ (Fig. 6C-4), and pit sensory organ (Fig. 6C-5); nine or 10 oral ridges (Fig. 6D-1) laterad and ventrolaterad of anterior sensory lobe and stomal sense organ, at least six lobes ventrally toothed and separate from prominent stomal sense organ

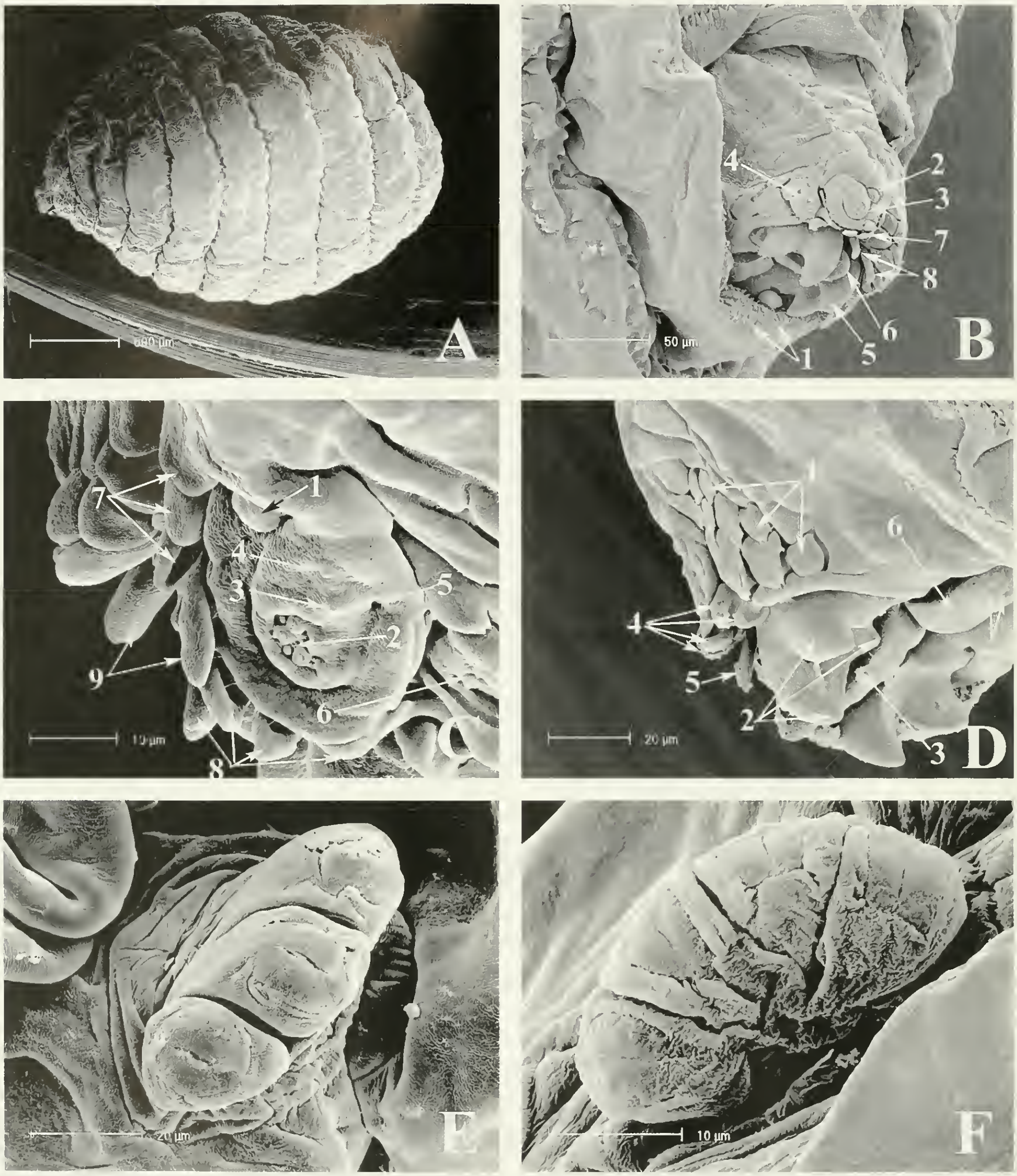

Fig. 6. Third instar of *Oxyna palpalis*: (A) habitus, anterior to left; (B) gnathocephalon, ventrolateral view, 1—minute acanthae, 2—dorsal sensory organ, 3—terminal sensory organ, 4—stomal sense organ, 5—mouthhook, 6—median oral lobe, 7—lateral integumental petal, 8—inner, lateral integumental petals; (C) gnathocephalon, dorsolateral view, 1—dorsal sensory organ, 2—terminal sensory organ, 3—lateral sensory organ, 4—supralateral sensory organ, 5—pit sensory organ, 6—stomal sense organ, 7—medial integumental petals, 8—lateral integumental petals, 9—inner, lateral integumental petals; (D) gnathocephalon and oral cavity, ventrolateral view, 1—oral ridges, 2—three-toothed mouthhook, 3—median oral lobe, 4—lateral integumental petals, 5—inner, lateral integumental petal, 6—labial lobe, 7—pores; (E) anterior spiracle with three papillae; (F) anterior spiracle with four papillae.

(Fig. 6B-4, C-6); mouthhook (Fig. 6B-5, D-2) tridentate (Fig. 5D-2); median oral lobe laterally flattened, apically rounded (Figs. 6B-6, D-3); three pairs of medial integumental petals in vertical row between anterior sensory lobes (Fig. 6C-7); five, lateral integumental petals between each mouthhook and anterior sensory lobe, including four foliose, lateral petals (Fig. 6B-7, C-8, D-4) and single, inner, elongate, papillate, lateral petal (Figs. 6B-8, C-9, D-5); labial lobe (Fig. 6D-6) broad, separated from median oral lobe, and with two pores ventrally (Fig. 6D-8); anterior thoracic spiracle with three (Fig. 6E, 7A-1) or four, rounded, wedge-shaped papillae (Fig. 6F); lateral spiracular complex of mesothorax with closed, relict spiracle (Fig. 7A-2) and six verruciform sensilla (Figs. 7A-3) in vertical row posteriorad of spiracle, additional verruciform sensillum posteriorad of fourth-most-vertical sensillum; lateral spiracular complex of metathorax similarly composed of closed, relict spiracle (Figs. 7A-4, B-1) and four verruciform sensilla (Figs. 7A-5, B-2) similarly positioned; lateral spiracular complex of first abdominal segment composed of closed, presumably relict spiracle (Figs. 7A-6, C-1) and three verruciform sensilla (Figs. 7A-7, C-2) similarly positioned; posterior spiracular plate (Figs. 7D-1, 8A) bears three, broadly elliptical rimae (Fig. 8A-1), ca. 0.03 mm long, and four, unbranched, spiniform, interspiracular processes (Fig. 8A-2), each ca. 0.007 mm long; stelex sensilla dorsolaterad (Figs. 7D-2, 8B), verruciform sensilla laterad (Figs. 7D-3, 8C), and stelex sensilla ventrolaterad (Fig. 7D-4) of posterior spiracular plate; intermediate sensory complexes (Figs. 7D-5, 8D) consist of stelex sensillum (Fig. 8D-1) and medusoid sensillum (Fig. 8D-2).

Fortunately, the third instars of both species of *Oxyna* known from North America have now been described in considerable detail, facilitating comparison between them. For example, the minute acanthae on third instars of *O. aterrima* are fewer in number, occupy fewer body segments, and form different patterns (Goeden 2002b) than the minute acanthae on *O. palpalis. Oxyna palpalis* has at least nine or 10 oral ridges (Fig. 6D-1), six of which have ventrally toothed margins; whereas, *O. aterrima* has only two oral ridges (Goeden 2002b). All five lateral integumental petals of third instar *O. aterrima* are papillate (Goeden 2002b); whereas, only one of the five lateral integumental petals of the third instar of *O. palpalis* is papillate, the rest are foliose (Figs. 6B-7, C-8, D-4). The lateral spiracular complex of the mesothorax of *O. aterrima* has four verruciform sensilla (Goeden 2002b); whereas, this same complex in *O. palpalis* has seven verruciform sensilla (Figs. 7A-3). Similarly, the lateral spiracular complex of the first abdominal segment of *O. aterrima* has four verruciform sensilla, two pairs in separate vertical rows, (Goeden 2002b); whereas, this same complex in *O. palpalis* has three, vertical, verruciform sensilla (Figs. 7A-7, C-2).

The caudal segments of third instars of these congeners also differ considerably. The dorsolateral, lateral, and ventrolateral sensilla surrounding the posterior spiracular plate of *O. aterrima* are all verruciform. The intermediate sensory complex of this species also uniquely consists of two verruciform sensilla, and this composition distinguishes *O. aterrima* from third instars of all other nonfrugivorous tephritids examined by my coworkers and me to date (Goeden 2002b). In *O. palpalis,* the dorsolateral and ventral lateral sensilla are stelex in form (Figs. 7D-2, -4E, 8B), and the intermediate sensory complex is comprised of a stelex sensillum (Fig. 8D-1) and a medusoid sensillum (Fig. 8D-2), like all other third instars described by us to date.

Differences noted between the first and second instars of *O. palpalis* include the usual acquisition of an anterior spiracle in the second instar, the increase in the number of lateral integumental petals from one to three, and the drastic change in shape of the interspiracular processes (Figs. 3D-2, 5D-1). Differences noted between the second

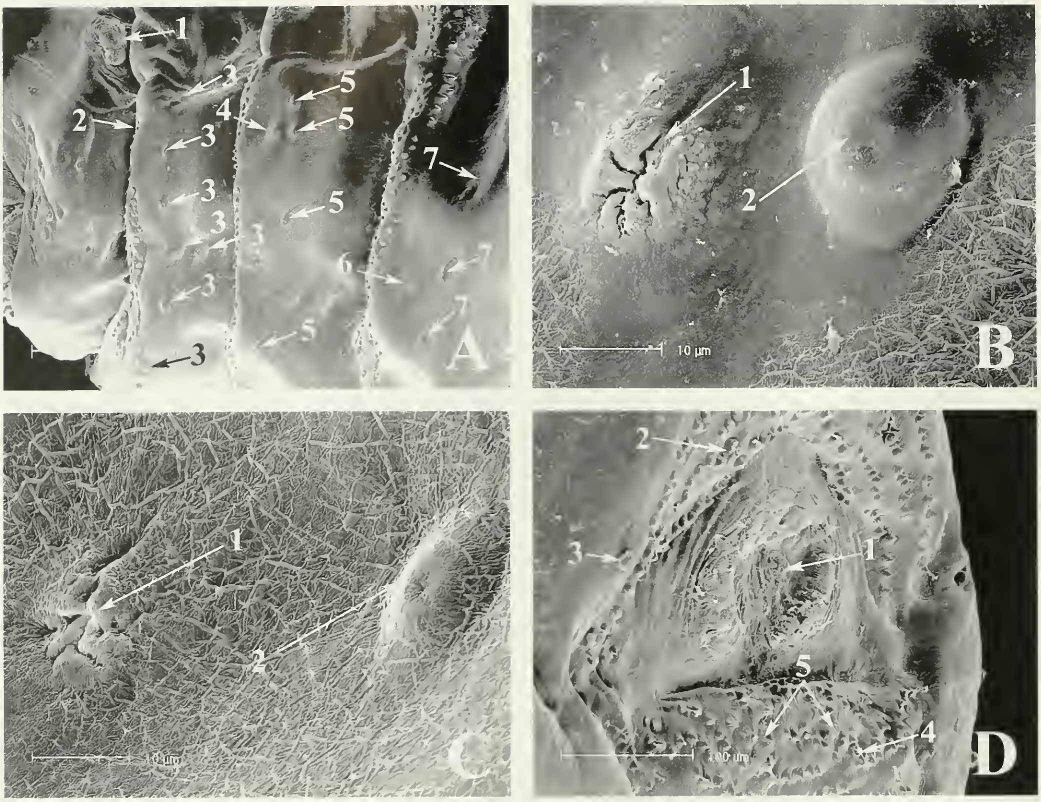

Fig. 7. Third instar of *Oxyna palpalis*, continued: (A) lateral spiracular complexes, 1—anterior spiracle, 2—metathoracic spiracle, 3—verruciform sensillum, 4—mesothoracic spiracle, 5—verruciform sensillum, 6—first abdominal segment spiracle, 7—verruciform sensillum; (B) part of lateral spiracular complex of metathorax, 1—spiracle, 2—verruciform sensillum, (C) part of lateral spiracular complex of metathorax, 1—spiracle, 2—verruciform sensillum; (D) anal segment, 1—posterior spiracular plate, 2—dorsolateral stelex sensillum, 3—lateral verruciform sensillum, 4—ventrolateral stelex sensillum, 5—intermediate sensory complexes.

and third instars include a change in the incidence of the minute acanthae as described above. Other changes include increases from three (Fig. 4C-7) to five (Figs. 6B-7; B-8; C-9; D-4, -5) in the number of lateral integumental petals, which all are foliose in the second instar, but add a central, papillate petal in the third instar. Two pairs of medial integumental petals are present in the second instar (Fig. 4C-8); whereas, three pairs occur in the third instar (Fig. 6C-7). The anterior spiracles with five papillae in the second instar (Fig. 5A) compare with three (Figs. 6E, 7A-1) or four papillae (Fig. 6F) in the third instar. The sensilla surrounding the posterior spiracular plate are the same in number as in the second instar; however, in the second instar the lateral sensilla are stelex (Fig. 5B-2), not verruciform, as in the third instar (Figs. 7D-3, 8C). The interspiracular processes on the posterior spiracular plate of the second instar are larger, foliose, and upright (Fig. 5D-1) compared to the small, resupinate, spiniform processes of the third instar (Fig. 8D-2).

Puparia: Reniform-ellipsoidal, light-, yellow-, or reddish-brown, rarely white (Fig. 9B), anterior end bears the invagination scar and anterior thoracic spiracles; caudal segment bears posterior spiracular plates (Fig. 9C), each with three broadly elliptical, raised rimae (Fig. 9C-1) and four, interspiracular processes (Fig. 9C-2). One hundred and five puparia averaged 3.04 ±

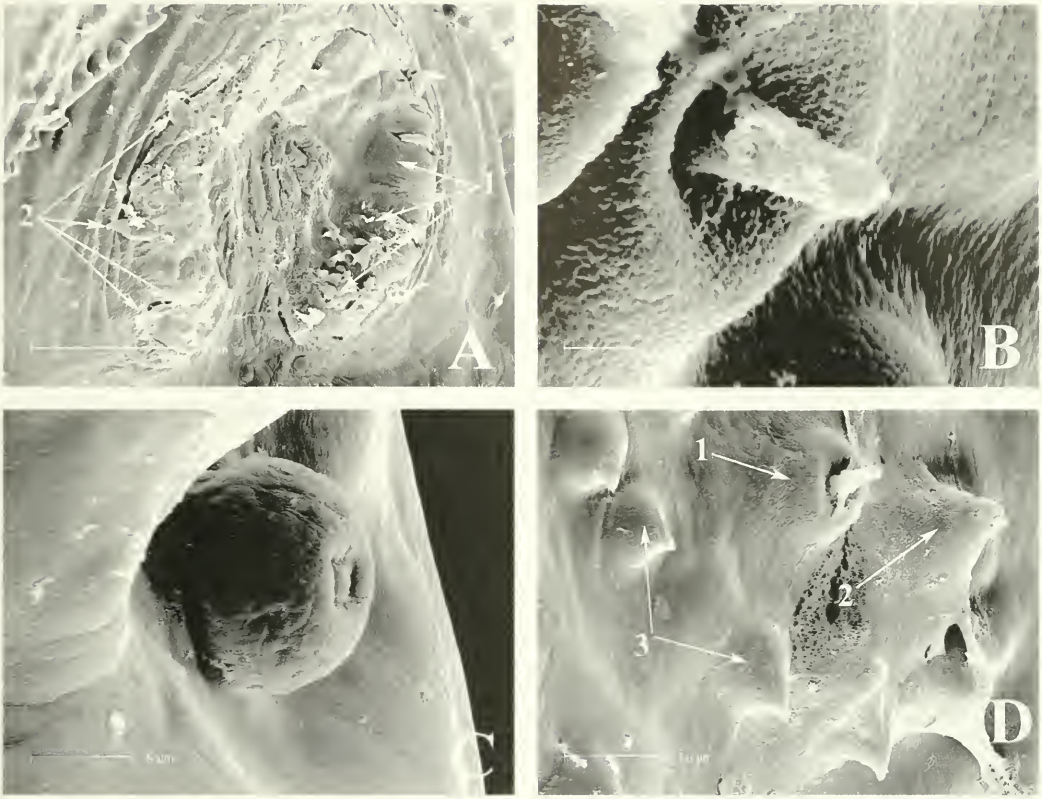

Fig. 8. Third instar of *Oxyna palpalis*, continued: (A) posterior spiracular plate, 1—three rimae, 2—four interspiracular processes, (B) dorsolateral stelex sensillum, (C) lateral verruciform sensillum, (D) intermediate sensory complex, 1—stelex sensillum, 2—medusoid sensillum, 3—minute acanthae.

0.03 (range, 2.13–3.70) mm in length; 1.60 ± 0.016 (range, 1.14–1.99) mm in width.

DISTRIBUTION AND HOSTS

Oxyna palpalis uniquely reproduces as an inquiline in the rosette galls of *Rhopalomyia florella* of terminal buds on branches of *Artemisia tridentata* in southern California. In this capacity it also functions as a facultative predator on the larvae and pupae of *R. florella* (see below), which also renders this tephritid rare and fascinating in the annals of tephritidology. Novak et al. (1967) reported that the larvae form small, succulent, polythalamous galls on small branches of *A. tridentata* in Idaho, but as documented in the next section of this paper, this interpretation was incorrect, as *O. palpalis* is not a gall-former. Foote et al. (1993) mapped the distribution of *O. palpalis* to include California, Idaho, Nevada, Oregon, Utah, Washington, and Wyoming. Thus, like that of *O. aterrima* (Goeden 2001b), the distribution of *O. palpalis* may coincide wholly with *A. tridentata sensu latu*, or in part with one or more of its subspecies (Hickman 1993). This is a shrub that inhabits dry soils, valleys, slopes from 300 to 3000+ m in the western U.S., i.e., north to Washington, the North Central States and south to New Mexico (Hickman 1993). The distribution of *A. tridentata* also extends into southwestern Canada (Barkley 1986).

BIOLOGY

Egg.—In each of 31, nearly fully formed rosette galls of *Rhopalomyia florella* (Gagne 1989) already containing larvae of this cecidomyiid (Fig. 10A), most of 51 eggs of

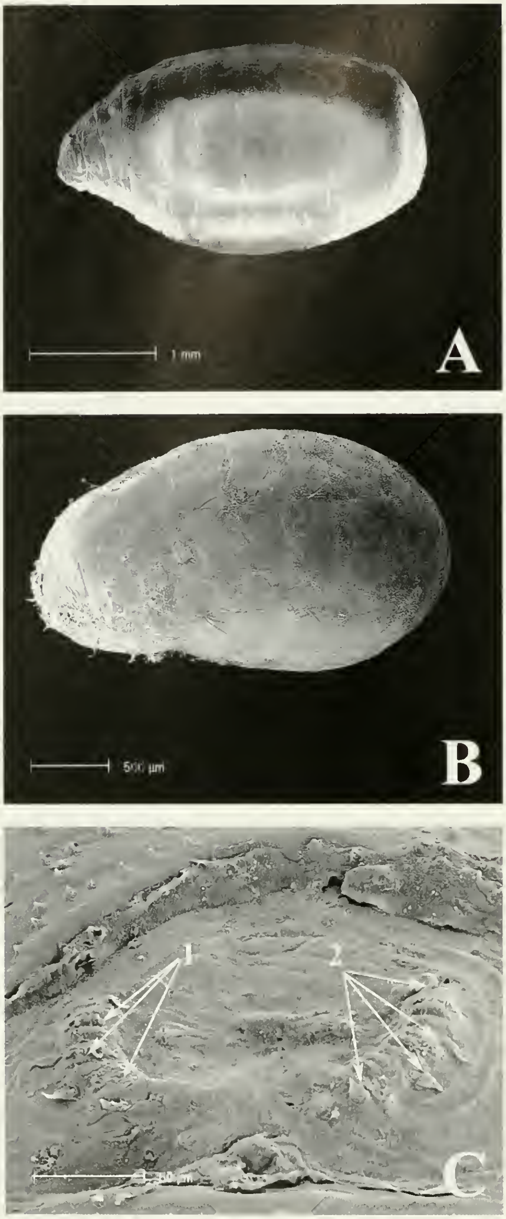

Fig. 9. *Oxyna palpalis*, (A) prepuparium, habitus, anterior to left; (B) puparium, habitus, anterior to left; (C) posterior spiracular plate, 1—three rimae, 2—four interspiracular processes.

O. palpalis were found inserted separately, a few in small clusters, pedicel-last, in leaf bases to depths of half to all of the egg lengths (Fig. 10B). Leaves at the margins or in the centers of the galls received the most oviposition, but a few eggs were layed upon, but not penetrating the tissues between adjacent bases of inner or outer leaves. About half of the eggs lay with their long axes parallel to the long axes of the galls (Fig. 10B); the remainder lay at angles of 5° to 45° to the long axes. Oviposition in galls was scattered throughout a stand of *A. tridentata*, like and sympatric with the galls of *R. florella*, and not confined to certain individual host-plants galled repeatedly over successive years (Headrick and Goeden 1998). This is similar to the pattern of the incidence of galls of *O. aterrima* (Goeden 2002b). Some galls bore tephritid eggs on opposite sides that showed different degrees of embryony, presumably indicative of oviposition by different females at different times. An average of 3.4 ± 0.4 (range, 1–10) eggs was found in these 31 galls. Galls containing eggs of *O. palpalis* (Fig. 10A) averaged 6.3 ± 0.4 (range, 4.3–11.5) mm in length, and 4.0 ± 0.2 (range, 0.6–6.8) mm in width. The linear leaves investing these galls averaged 3.5 ± 0.3 (range, 2.0–8.6) mm in length and 0.9 ± 0.04 (range, 0.6–1.3) mm in width.

Larva.—Upon eclosion, most first instars of *O. palpalis* tunneled into the center of the gall basad of the young, cecidomyiid larvae and leaf bases (Fig. 10C), where each first instar remained for up to 3 months within an individual, ovoidal, open, smooth-walled cell. An average of 2.3 ± 0.2 (range, 1–5) first instars of *O. palpalis* were found in a total of 53 infested galls sampled monthly during the first 3 months following oviposition, during which time the subspheroidal (smaller) (Fig. 10A) to hemispheroidal (larger) galls averaged 6.9 ± 0.3 (range, 3.1–11.5) mm in length and 4.8 ± 0.2 (range, 2.9–7.4) mm in width. The linear leaves laterally surrounding the galls averaged 4.4 ± 0.2 (range, 1.4–8.6) mm in length and 0.9 ± 0.03 (range, 0.6–1.4) mm in width. Seventy-three ovoidal to spheroidal cells containing the first instars of *O. palpalis* averaged 0.78 ± 0.09 (range, 0.28–4.6) mm in length and 0.48 ± 0.18

(range, 0.21–0.99) mm in width. The size of most of these cells containing first instars slowly increased during the first stadium. Unfortunately, the number of cecidomyiid larvae was not recorded in most galls; however, 14 galls containing first instars of *O. palpalis* also were noted to contain an average of 2.2 ± 0.5 (range, 1–8) larvae of *R. florella.* Also, it was subsequently noted that most galls of *R. florella* without *O. palpalis* contained only a single, centrally located larva (Fig. 11D). Thus, some galls containing first instars of *O. palpalis* also contained dead, centrally located, cecidomyiid larva(e) presumably killed after accidental contact with a tephritid larva. Indeed, at least for later instars of *O. palpalis* in those many galls found to be lacking *R. florella* (see below), this relationship may represent nutritionally advantageous, facultative predation.

The larva next molted to the second instar (Fig. 10D), evidenced as the cast cephalopharyngeal skeleton remaining in the cell. This instar may also last about 3 months and is one stage found in overwintering galls in southern California (see below). The external dimensions of 28 galls found to contain second instars measured 6.8 ± 0.3 (range, 3.7–11.4) mm in length by 5.7 ± 0.3 (range, 2.9–8.6) mm in width. The linear leaves investing these galls averaged 4.6 ± 0.3 (range, 1.7–9.1) mm in length and 1.1 ± 0.04 (range, 0.7–1.7) mm in width. These 28 galls each contained an average of 1.8 ± 0.2 (range, 1–6) second instars of *O. palpalis* (Fig. 10D). Two of these galls (7%) contained two and three larvae clustered together in a central, common, open cavity. The remaining 26 galls contained one or more second instars in separate, open, ovoidal cells (Fig. 10D) that averaged 1.3 ± 0.06 (range, 0.6–2.0) mm in length and 0.8 ± 0.04 (range, 0.4–1.1) mm in width. Thus, the galls grew little on average during the second stadium, as did the cells containing individual second instars of *O. palpalis* (Fig. 10D). Ten galls were recorded to contain dead larvae of *R. florella* or none, the latter of which was presumed to reflect complete consumption by *O. palpalis,* but again, cecidomyiid incidence was not recorded in another 10 of these galls, so the incidence of cecidomyiid mortality may actually have been higher.

Oxyna palpalis also overwinters as third instars in southern California (Figs. 10E, F). This is the stage during which the greatest amount of larval growth and attendant increase in gall cavity size takes place (Figs. 10E, F). Seventy-eight galls containing third instars of *O. palpalis* averaged 8.9 ± 0.2 (range, 5.1–13) mm in length by 7.4 ± 0.2 (range, 2.1–4.5) mm. The linear leaves laterally surrounding the galls averaged 5.3 ± 0.2 (range, 2.2–10.8) mm in length and 1.2 ± 0.03 (range, 0.9–1.7) mm in width. Thus, on average, galls increased little, if any, in size during the equally slow growth of the third instars during the winter through early spring, when in response to renewed plant growth following winter rainfall, the cavities that contained the third instars expanded to accomodate the fast-growing, *O. palpalis* larvae. The 65, frass-lined, ovoidal or irregularly shaped, centrally located, open cells that contained single instars of *O. palpalis* within these 78 galls averaged 2.6 ± 0.1 (range, 1.1–5.1) mm in longest measurement by 1.7 ± 0.1 (range, 0.57–2.9) mm in shortest measurement, or about twice as large as cells containing single second instars. Moreover, in galls containing two or more third instars (Figs. 10E, F) these central cavities averaged 3.3 ± 0.2 (range, 1.7–5.1) mm in longest length by 2.6 ± 0.2 (range, 0.85–4.6) mm in shortest width, or, again, more than twice as large on average than cavities containing single second instars, or those with single third instars, sometimes occupying much of the interior of smaller galls. All told, the 78 galls contained an average of 1.7 ± 0.1 (range, 1–5) third instars (Figs. 10E, F). The lateral thickness of the walls of these galls averaged 1.8 ± 0.6 (range, 1.1–2.9) mm, which afforded insufficient spatial protection from parasitoids (see be-

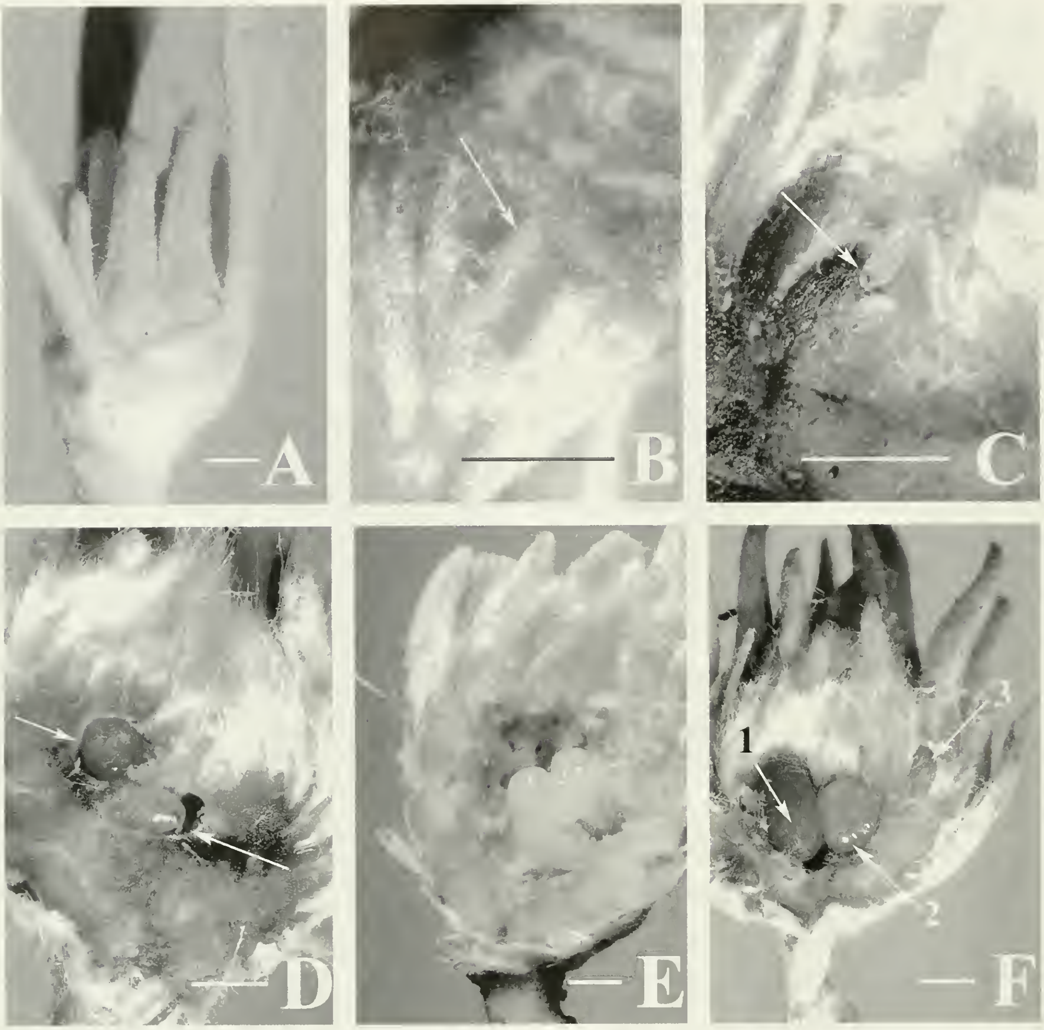

Fig. 10. Life stages of *Oxyna palpalis* in galls of *Rhopalomyia florella*: (A) partly grown gall of *R. florella* that contained egg of *O. palpalis*, (B) egg of *O. palpalis* (arrow) in gall of *R. florella*, (C) newly eclosed, first instar of *O. palpalis* (arrow) tunneling into center of gall, (D) two, overwintering second instars of *O. palpalis* in separate chambers (arrows), (E) four third instars of *O. palpalis* in common, central cell in gall, (F) 1—newly formed puparium and 2—full-sized larva of *O. palpalis*, and 3—pupa of *R. florella* in same gall. Lines = 1 mm.

low) that attacked the third instars and puparia of *O. palpalis*. All told, third instars were found in samples over an 8-month period, 6 months into which, puparia first appeared in monthly gall samples.

Pupa.—Near the end of the third larval stadium, the third instar transformed into a preparium (Fig. 9A), which in *O. palpalis* was of relatively short duration. No window to facilitate future adult egress from the galls was formed in the gall wall, unlike the windows made by *O. aterrima* third instars prior to prepupal formation (Goeden 2002b). The prepuparia of *O. palpalis* (Figs. 9A, 10F-2) transformed into puparia within the larval cells or among the cottony tomentum (Fig. 10F-1), which by then also contained pupae (Fig. 10F-3) or empty pupal exuviae of emerged, surviving *R. florella*, usually found on the periphery of a

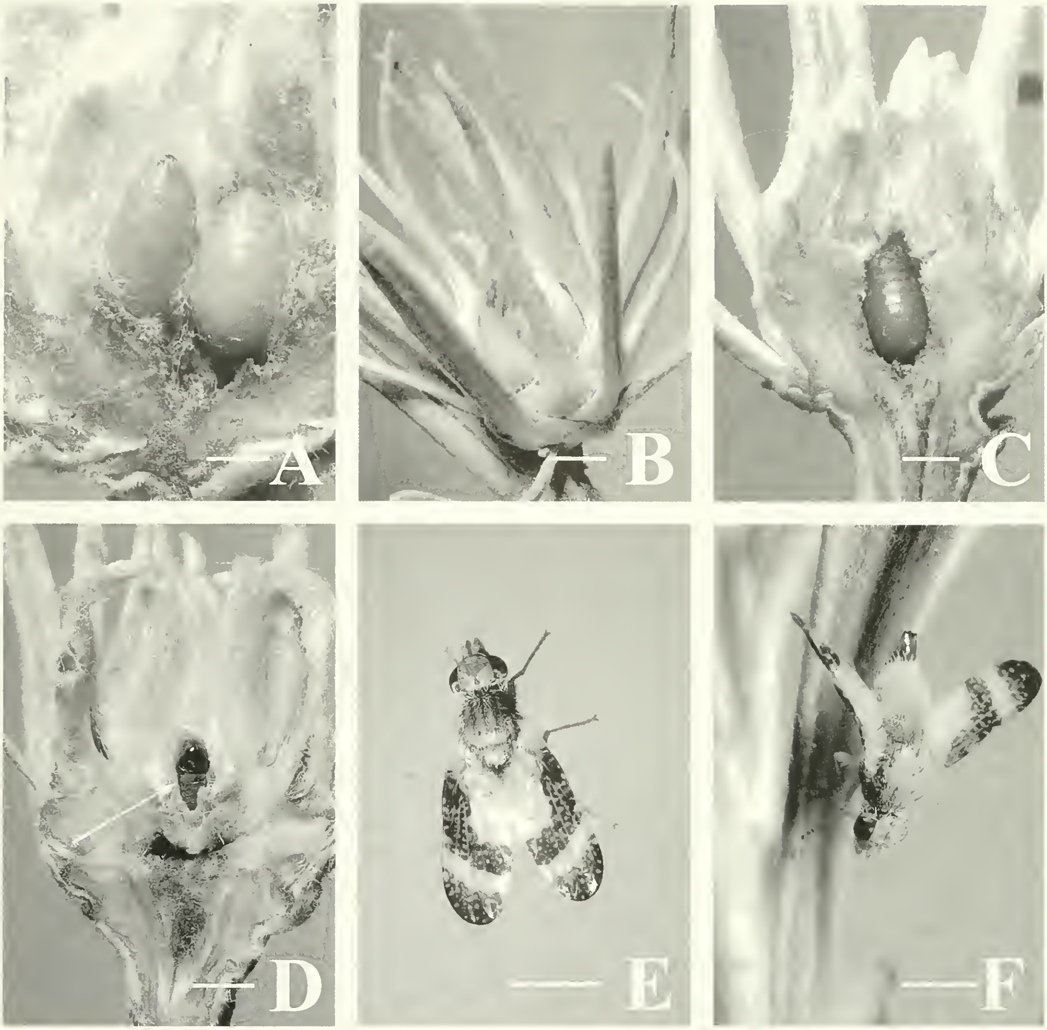

Fig. 11. Life stages of *Oxyna palpalis* in galls of *Rhopalomyia florella*, continued, (A) two puparia of *O. palpalis* in gall, (B) full-size gall that contained puparia of *O. palpalis*, (C) single central puparium of *O. palpalis* in gall, (D) single, central pupa of *R. florella* in gall, (E) male adult of *O. palpalis*, (F) female adult of *O. palpalis*. Lines = 1 mm.

gall (Fig. 10F-3). The anterior end of the puparium of *O. palpalis* usually faced distad, away from the base of the gall (Figs. 10F-1, 11). Eighty-four mature galls (Figs. 11B, C) sampled over a 2-mo period contained an average of 1.5 ± 0.1 (range, 1–5) puparia of *O. palpalis*. These galls externally averaged 9.1 ± 0.2 (range, 5.7–15.0) mm in length by 7.9 ± 0.2 (range, 5.0–11.4) mm in width. The linear leaves laterally surrounding the galls averaged 7.1 ± 0.3 (range, 2.6–16) mm in length and 1.4 ± 0.03 (range, 0.8–2.5) mm in width. Sixty (71%) of the 84 galls each contained a frass-lined, ovoidal or irregularly shaped, central cavity that held a single puparium of *O. palpalis* (Fig. 11C), which averaged 3.4 ± 0.1 (range, 2.3–6.3) mm in longest measurement by 2.0 ± 0.1 (range, 1.1–3.4) mm in shortest measurement. Whereas, in galls containing two or more puparia (Fig. 11A) these central cavities averaged 4.1 ± 0.2 (range, 2.9–5.7) mm in longest length by 3.2 ± 0.1 (range, 2.3–4.6) mm in short-

Table 1. Incidence of *Oxyna palpalis* in galls of *Rhopalomyia florella* on *Artemisia tridentata* on sample dates indicated.

	R. florella Galls Sampled	
Sample Date	No. Without *O. palpalis* (%)	No. With *O. palpalis* (%)
10.iv.1996	49 (84)	9 (16)
1.v. 1996	51 (84)	10 (16)
7.v. 1996	55 (79)	15 (21)
5.vi. 1996	?	15 (?)
18.vi. 1996	12 (38)	20 (62)
16.vii. 1996	15 (56)	12 (44)
13.viii. 1996	25 (71)	10 (29)
16.ix. 1996	76 (87)	11 (13)
16.x. 1996	35 (81)	8 (19)
13.xi.1996	60 (79)	16 (21)
18.xii. 1996	40 (70)	17 (30)
16.i. 1997	20 (71)	8 (29)
12.ii. 1997	34 (63)	20 (37)
13.iii. 1997	65 (81)	25 (19)
9.iv. 1997	76 (76)	24 (24)
16.iv. 1997	69 (78)	19 (22)
30.iv. 1997	45 (80)	11 (20)

est width, again, sometimes occupying much of the interior of smaller galls. The central location of a single pupa of *R. florella* in a gall without *O. palpalis* (Fig. 11D), when compared to a similarly located puparium of *O. palpalis* typical of the 60 galls containing single individuals noted above (Fig. 11C), most of which lacked any sign of *R. florella,* strongly suggests a high incidence of facultative, or at least accidental predation by the tephritid on the cecidomyiid. Table 1 records the incidence of *O. palpalis* in galls of *R. florella* on different sample dates.

Adult.—Adults exited galls presumably by pushing aside, between, and outward through the enfolding, apical, immature leaves and tomentum (Figs. 11A, C). Under insectary conditions, 17 males (Fig. 11E) lived an average of 48 ± 5 (range, 21–84) days, and 12 females (Fig. 11F) an average of 41 ± 6 (range, 12–75) days. These longevities are relatively long in duration for a circumnatal tephritid (Headrick and Goeden 1998). For example, males and females of *O. aterrima* on average respectively lived half as long (Goeden 2002b).

Mating behavior.—The premating, mating, and postmating behaviors of *O. palpalis* were not studied in the field, nor were these behaviors observed in petri dish arenas of the type found to be so useful with many other nonfrugivorous, tephritid species (Headrick and Goeden 1994, Goeden 2002b). In two such arenas, adults exhibited a few behaviors similar to *O. aterrima* (Goeden 2002b) and typical of other circumnatal, gallicolous species, cf., *Procecidochares,* previously studied in southern California, i.e., a lack of courtship behavior, the exhibition of enantion type wing movements by both sexes, and male stalking of females prior to mating (Goeden and Norrbom 2001; Headrick and Goeden 1994, 2000).

Seasonal history.—*Oxyna palpalis* is a univoltine, circumnatal species (Headrick and Goeden 1994, 1998) reproducing in rosette galls of *Rhopalomyia florella* of terminal buds on branches of *A. tridentata* in southern California (Gagné 1989). Eggs are laid in nearly fully formed galls containing young larvae of *R. florella* in early summer (June) and *O. palpalis* passes the summer (June-September) as first instars. These larvae molt to the second instar beginning in mid-September in early fall, and to the third instar beginning in mid-October, initially overwintering as both second and third instars, but solely as third instars by mid-winter (February) of the following year. The third instars complete this instar beginning in early spring (March) at the time of the renewed flush of host-plant growth. Pupariation and adult emergence follow in April and the adults mate and probably oviposit in newly formed galls of *R. florella* on or near the same plants from which both species of flies emerged.

Natural enemies.—Many individual *Eurytoma* sp. (Hymenoptera: Eurytomidae) and six individuals of *Eupelmus* sp. (Hymenoptera: Eupelmidae) were reared separately from individual puparia as primary, solitary, probably larval-pupal endoparasitoids. One, three, three, and seven individuals of *Lyrcus* sp. (Hymenoptera: Pteromalidae) were reared from individual puparia of *O. palpalis* as gregarious, primary endoparasitoids.

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BIOLOGICAL OBSERVATIONS OF *CENTISTES GASSENI* SHAW (HYMENOPTERA: BRACONIDAE), A PARASITOID OF *DIABROTICA* SPP. (COLEOPTERA: CHRYSOMELIDAE)[1]

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Abstract.—In 1992–1993, *Centistes gasseni* Shaw was imported into the United States, and in the laboratory successfully parasitized: southern corn rootworm, *Diabrotica undecimpunctata howardi* Barber; banded cucumber beetle, *D. balteata* LeConte; western corn rootworm, *D. virgifera virgifera* LeConte; and striped cucumber beetle, *Acalymma vittatum* (F.). Males and females of *C. gasseni* lived an average of 15.4 and 12.9 days (with a maximum of 30 and 29 days), respectively. A single female oviposited in 383 host *Diabrotica* over her lifetime, from which 158 cocoons were recovered. Additional observations on the biology and rearing of the parasitoid are presented.

Key Words: *Acalymma vittatum*, biological control, *Centistes gasseni, Diabrotica balteata, Diabrotica barberi, Diabrotica speciosa, Diabrotica undecimpunctata howardi, Diabrotica virgifera virgifera*, host specificity

The northern corn rootworm (NCR), *Diabrotica barberi* Smith and Lawrence, and the western corn rootworm (WCR), *Diabrotica virgifera virgifera* LeConte are the most damaging and costly pests of corn in North America (Sutter and Lance 1991). To achieve effective control of these chrysomelids, soil insecticides routinely have been used on 50–60% of the corn acreage, or 12–16 million ha annually (Metcalf 1986). These insecticides are generally applied prophylactically and are frequently unnecessary (Lance and Sutter 1992). According to Metcalf (1986), the cost from crop loss and treatment due to the corn rootworm (CRW) complex is approximately one billion dollars per year.

In addition, southern corn rootworm (SCR), *Diabrotica undecimpunctata howardi* Barber; striped cucumber beetle, *Acalymma vittatum* (F.); western striped cucumber beetle, *Acalymma trivittatum* (Mannerheim); and banded cucumber beetle, *Diabrotica balteata* LeConte cause 50–100 million dollars in damage to other crops (Cucurbitaceae, Fabaceae) (Metcalf et al. 1962).

Lance and Sutter (1992) cite health risks to growers, livestock and wildlife due to soil insecticides used for CRW control. They also refer to reports of these insecticides being detected in ground and surface water. Therefore, it is evident that there is a need for alternative control measures that are environmentally safe and cost effective.

In 1990, while searching for biocontrol agents of Colorado potato beetle (Coleoptera: Chrysomelidae) in Rio Grande do Sul,

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[1] This article reports the results of research only. Mention of a proprietary product does not constitute an endorsement or a recommendation by the USDA for its use.

Brazil, we learned of the existence of an undescribed braconid parasitoid of the adult Neotropical leaf beetle, *Diabrotica speciosa* Germar (Gassen 1986). It was subsequently described by Shaw (1995) as *Centistes gasseni* Shaw, a solitary endoparasitoid of the adult. As there are no known effective parasitoids of the CRW complex in the United States, we were interested in acquiring and studying *C. gasseni* as a potential new biological control agent. We traveled to Brazil in 1992–93, and, in cooperation with Dirceu Gassen, EMBRAPA-CNPT, collected and imported adults of *D. speciosa* parasitized by the braconid. In this article, we present observations on the biology, rearing, mating behavior and host specificity of *C. gasseni*, obtained during initial attempts to colonize the parasitoid in quarantine.

MATERIALS AND METHODS

Approximately 6,000 *D. speciosa* adults were collected from April 24–26, 1993, at the University of Passo Fundo, Passo Fundo, Rio Grande do Sul, Brazil. Collections were made primarily from potato plants, but some adults were also collected from nearby plots of pepper and sweet potato plants. Parasitoids were also recovered from beetles collected from flowering weeds and wild cucurbit plants, 98 km west of Passo Fundo. Sub-samples of field collected beetles were dissected to determine percent parasitism and the number of parasitoids per host. In subsequent collections, Heineck-Leonel and Salles (1997) recovered *C. gasseni* from *D. speciosa* collected in corn, beans, melon, cucumber, cabbage, broccoli, spinach and lettuce.

Field collected adult beetles were held in 30.5 cm collapsible aluminum screen cages (BioQuip® Products, Gardena, CA). Each cage was inverted and the hinged top served as the bottom. A fitted piece of moistened felt was placed on the bottom as a liner, and covered with a ca 0.5–0.6 cm layer of moistened sand with a 2.5 cm sand-free margin on all sides. The sand and felt served as a substrate in which the parasitoid larvae spun cocoons. Approximately one cm above the bottom of the cage, we fitted a pre-cut piece of number 12 mesh stainless steel screen, that separated the adult *Diabrotica* from emerging *C. gasseni* larvae, which passed through to pupate.

The adult beetles, and 31 parasitoid cocoons recovered prior to departure, were taken to the Maryland Department of Agriculture quarantine facility, Annapolis, MD, and held at 21.1°C, 60% RH, and a 16:8 LD photoperiod. The host beetles were kept in the modified cages which were serviced three times a week. Parasitoid cocoons were carefully removed from the sand and placed in petri dishes, along with a moistened, 3.8 cm cotton roll to maintain humidity.

The containers used for oviposition, and to house the *C. gasseni* adults, were plexiglass tubes (7.6 cm in diameter and 10.2 cm long) modeled after those used by Whistlecraft et al. (1984) in their braconid rearing program. To confirm mating, a single female was confined in an aspirator tube with multiple males until copulation was observed. With *Cotesia melanoscela* (Ratzeburg), Weseloh (1977) found that 20 seconds was necessary to successfully transfer sperm to the female. We therefore considered a successful mating session as one in which copulation was observed for 20 seconds or more. We used several of the methods discussed by Singh (1982) to induce successful mating, including shaking the insects to the bottom of the tube, increasing the number of males per female, and periodically chilling the females prior to exposure to the males.

The following procedures were used in quarantine to conduct studies on the biology, mating behavior, and host preferences of the parasitoid.

Host exposure methods.—*Individual exposure:* To expose host *Diabrotica* adults individually, we placed a parasitoid female into a 35 × 10 mm polystyrene culture dish and introduced a single *Diabrotica* adult. The host beetle was observed until oviposition occurred, then it was removed. Ten to twenty *Diabrotica* were exposed to a female per session. Following each session, the female was held for one hour in a tube or petri dish, and given access to water and honey solution. Each female had no more than two exposure sessions per day. A separate cage (#1–3) was set up for the *Diabrotica* exposed to each of the three, mated *C. gasseni* females used.

Group exposure with immediate removal: Approximately 35 *Diabrotica* beetles were placed in an oviposition tube, into which a *C. gasseni* female was then introduced. As soon as a host beetle was parasitized, it was aspirated out of the tube. As above, following each session females were permitted to rest, and limited to two sessions per day. A separate cage (#4–6) was set up for the *Diabrotica* exposed to each of the three, mated *C. gasseni* females used.

Group exposure for one hour: Six *C. gasseni* females were used to sting a total of 394 BCB over a 7-day span. The females were confirmed mated, and all had emerged in association with other males and females. Beetles were exposed in groups of 15–20 to individual females for one hour, then placed into a single cage (#7).

Group exposure for four hours: Six *C. gasseni* females, selected from a group of females, were used to sting a total of 140 BCB over a 4-day span. All the females had been confined with an equal number of males (17 ♂ & 17 ♀) for 72 hours preceding exposure to *Diabrotica,* but mating was not confirmed. As above, all had emerged in association with other parasitoid males and females. BCB were exposed in groups of 20–25 to single *C. gasseni* females, for four hours duration, then placed into a single cage (#8).

Host species preference.—Adult SCR and BCB were sexed, and three males and three females of each species were placed into an oviposition tube. A *C. gasseni* female reared from BCB host was introduced and exposed to the beetles for one hour, after which time she was removed and held as previously described. Using nine *C. gasseni* females, a total of 792 *Diabrotica* were exposed.

Host sex preference.—To determine if *C. gasseni* exhibited a preference for either male or female hosts, SCR reared parasitoids (n = 10) were exposed individually to six male and six female SCR for one hour. One group of hosts (204 ♀ & ♂, cages 1 & 2, respectively) was exposed to *C. gasseni* females 1–3 days old, another group of hosts (372 ♀ & ♂, cages 3 & 4, respectively) was exposed to *C. gasseni* females, the majority of which were 1–5 days old. Two cages of unexposed male and female *Diabrotica* were maintained as controls.

Host specificity.—Host specificity tests were conducted to determine whether SCR, WCR, BCB, the related SCB and *Cerotoma trifurcata* (F.) were suitable hosts for *C. gasseni.* The criteria for these tests were based on observing the parasitoids' ovipositional behavior for one hour after exposure to the hosts, and then holding parasitoid and hosts together (25–50 per exposure) over night. The female was then removed and the hosts held for parasitoid emergence for 30 days.

Additional non-target insects that may occur in the same habitat, including beneficial and phytophagous coccinellids were also exposed to *C. gasseni* to determine their suitability as hosts. In each test, a single *C. gasseni* female, less than seven days old, was placed in an oviposition tube. Five *Diabrotica* (BCB or SCR), which served as controls, and 25–50 adult host beetles (hosts were obtained from laboratory and field sources) were then introduced. Each tube was observed for one hour to confirm any oviposition that occurred. The *Diabrotica* were removed after they were stung and set up in separate parasitoid emergence containers. After one hour, observations were discontinued, and females were kept with the test beetles for 24 hours. Host beetles were then removed, and held for parasitoid emergence. Thirty days after expo-

Table 1. Emergence, sex ratios and hyperparasitism of *Centistes gasseni* from field collected *Diabrotica speciosa*.

Date	No. Cocoons	No. ♂	No. ♀	Sex Ratio ♂:♀	No. *Mesochorous*	% *Centistes* Emergence
4/92	108	11	19	1:2	12	28
4/93	31	5	6	1:1	2	35
5/93	338	138	64	2:1	3	60
5/94[a]	101	10	13	1:1	5	23
6/94[a]	86	8	8	1:1	14	19

[a] Data from cocoons collected at the ARS, South American Biological Control Laboratory, Buenos Aires, Argentina.

sure, host beetles were dissected to determine if they had been parasitized.

RESULTS

From the 31 cocoons brought back from Brazil, 11 *C. gasseni* and two hyperparasitoids, *Mesochorous* sp. (Hymenoptera: Ichneumonidae) emerged. From the ~ 6000 *D. speciosa* collected in Brazil, we recovered 338 *C. gasseni* cocoons, 66 *C. gasseni* larvae, and 11 puparia of *Celatoria bosqui* Blanchard (Diptera: Tachinidae) (Table 1). As the number of host beetles collected was approximated, we could not accurately determine the percent parasitism. However, in one sub-sample (n = 111) 10.0% were parasitized. In Pelotas, RS, Brazil, Heineck-Leonel and Salles (1997) reported that parasitism, of *D. speciosa* by *C. gasseni*, ranged from 0–18.9% ($\bar{x}$ = 8.7, SD = 7.1) in samples obtained at monthly intervals from May 1994–April 1995.

Mating data were obtained on a sub-sample of P and F generation parasitoid females. Forty-one percent of the P sample (n = 17) successfully mated (Table 2). All *C. gasseni* pupae obtained from *D. speciosa* were set up individually, thus all females that emerged were isolated from other males and females. Of those that mated, 29% did so on the first attempt, 43% on the second, and 28% required three or more attempts to mate. Unsuccessful mating attempts were observed for a minimum of 10 minutes. Seventy-one percent of the F sample (n = 90) successfully mated (Table 2). Of these, 72% occurred on the first attempt, 20% on the second, and 8% required three or more attempts. In the majority of cases, the female would aggressively fight off the advances from any males after she had successfully mated. Nevertheless, 9% of the females did mate a second time, all within 2.1 minutes of the first. When we exposed previously mated females to new males, 8% mated a second time.

Parasitoid female progeny were obtained only from positively mated parental females. When confined with a suitable host, the female mounted the beetle from the side and thrust her ovipositor into the abdomen. The beetle responded to the attack by trying

Table 2. Reproductive behavior of *Centistes gasseni* reared from native and alternative host *Diabrotica*.

Host	Mean % ♀ Mated	Mean ♀ Age (Days)	% Iso.[a] ♀ Mated	% ♀ with ♀ Mated	% ♀ with ♂ Mated	% ♀ with ♀ & ♂ Mated	Mean Expos. (Min)	Mean Length (Sec)	Mean No. ♂ Used	Mean Age ♂ (Days)
Pgen[b]	41	2.1 ± 1.3	41	N/A	N/A	N/A	3.8 ± 3.8	33.6 ± 4.8	5.7 ± 2.0	4.3 ± 3.4
F1-9[c]	71	1.5 ± 0.9	78	86	68	57	3.9 ± 4.1	32.9 ± 11.8	5.8 ± 2.1	2.4 ± 0.4

[a] Isolated from other females and males.

[b] *C. gasseni* reared from *D. speciosa*.

[c] *C. gasseni* reared from North American *Diabrotica*.

Table 3. Parasitism by *Centistes gasseni* using various host exposure methods.

Cage[a]	Days ♀ in Use	♀ Emerged with ♂, ♀	Hosts Exposed	No. Cocoons	% Parasitism	No. ♂ Emerged	No. ♀ Emerged	% Emerged
1	1–5	None	103 SCR[d]	62	60	7	39	74
2	1–2	29♂ 1♀	61 SCR	45	80	37	0	82
3[b]	1–3	29♂ 1♀	47 SCR	28	60	14	1	54
4	2–13	3♂ 3♀	232 SCR	154	73	102	0	66
5	5–9	3♂ 3♀	129 BCB[e]	61	62	57	0	93
6[c]	2–12	1♀	383 BCB	158	52	93	0	59
7	1–9	—	394 BCB	163	52	68	14	50
8	4–6	—	140 BCB	67	64	36	5	61

[a] Cages 1–3, hosts exposed individually, cages 4–6, hosts exposed in groups with immediate removal, cage 7 hosts exposed for one hour, cage 8 hosts exposed for four hours.

[b] Female did not mate until 37 of the 47 hosts had been exposed.

[c] Female mated twice.

[d] Southern corn rootworm, *Diabrotica undecimpunctata howardi* Barber.

[e] Banded cucumber beetle, *D. balteata* LeConte.

to brush the *C. gasseni* from its back, becoming highly active or agitated, or by dropping to the bottom of the container.

Dissections of field collected *D. speciosa* revealed that parasitized beetles contained a single *C. gasseni* larva per host. However, laboratory dissections indicated that superparasitism did occur, with only one larva completing development. At 21.1 ± 0.5°C, the parasitoid would complete its life cycle in 33–41 days ($\bar{x}$ = 34.7 ± 1.7 days). At 23.9 ± 0.5°C, it took 26–32 days ($\bar{x}$ = 27.8 ± 0.7 days). At 21.1 ± 0.5°C, *C. gasseni* females and males lived an average of 12.9 ± 5.0 days and 15.4 ± 2.8 days, respectively.

Host exposure methods.—*Individual exposure:* In the hosts exposed individually (cages 1–3), the mean percent parasitism, based upon the number of hosts exposed and the number of parasitoids (cocoons and/or larvae) recovered, was 66.7% (SD = 11.54), and the mean parasitoid emergence from the resultant cocoons was 70% (SD = 14.4) (Table 3). At 32 ± 5 days post exposure, 89.3% (SD = 5.03) of the host SCR were dead. The female of cage 1, which emerged alone, produced offspring with a sex ratio of 6 ♀:1 ♂, the highest ratio of females to males obtained in this study.

Group exposure with immediate removal: The females of cages 4 and 6 oviposited in 232 SCR and 383 BCB respectively, over a 12 day period (Table 3). These yielded 154 and 158 cocoons, respectively, and 102 males and 93 males, respectively. This was the largest number of hosts stung, and number of cocoons and progeny obtained from individual *C. gasseni* females.

Pre-cocoon mortality was higher in the BCB hosts, averaging 22.0% versus 8.5% in the SCR. Eliminating cage 6 from the computations, since this female was exposed to an excessive number of hosts to determine oviposition limits, percent parasitism using this method of exposure averaged 67.5% (SD = 7.78). The mean parasitoid emergence from the cocoons was 72.6% (SD = 18.0), and at 29 ± 4 days post exposure, 91.5% (SD = 3.5) of the exposed hosts were dead.

Parasitoid females 10–12 days old, were the oldest from which viable progeny were recovered. The oldest age attained by a *C. gasseni* male and female, was 30 and 29 days, respectively. Over the course of the female's life, she was exposed to 114 SCR, both in groups and individually. As she aged, all hosts were exposed individually. On her 24th day, she stung two SCR, this was the oldest age at which we observed attack behavior. A cocoon was recovered from a SCR parasitized by a female 14–24 days old. There was no emergence from the

Table 4. Host specificity of *Centistes gasseni.*

Host Species Tested	Para. Emerge from Host	Para. Dissected from Host	Para. Emerge from Control
Coccinellidae			
Coleomegilla maculata (DeGeer)	–	–	+
Hippodamia variegata (Goeze)	–	–	+
Propylea quatuordecimpunctata (L.)	–	–	+
Epilachna varivestis Mulsant	–	–	+
Cycloneda munda (Say)	–	–	+
Chilocorus stigma (Say)	–	–	+
Hippodamia convergens Guerin	–	–	+
Harmonia axyridis (Pallas)	–	–	+
Chrysomelidae			
Cerotoma trifurcata (F.)	–	–	+
Acalymma vittatum (F.)[a]	+		
Diabrotica balteata LeConte[a]	+		
D. undecimpunctata howardi Barber[a]	+		
D. virgifera virgifera LeConte[a]	+		

[a] The *Acalymma* and *Diabrotica* tested were suitable hosts, dissections and controls were therefore not used.

cocoon, and a male was subsequently dissected out. This proved to be the oldest *C. gasseni* from which both cocoon, and fully formed offspring have been recovered.

Group exposure for one and four hours: The percent parasitism obtained by exposure for one (cage 7) and four (cage 8) hours, was 52% and 64%, respectively (Table 3). From cage 7, 82 parasitoids with a sex ratio of 5 ♂:1 ♀, were recovered. From cage 8, we recovered 41 parasitoids with a 7 ♂:1 ♀ sex ratio. This was the first instance in which parental females that were not confirmed mated, produced female offspring. Pre-cocoon mortality averaged 23% for cages 7 and 8. Parasitoid emergence from the cocoons was 50% and 61% for cages 7 and 8, respectively.

Host species preference.—Although all parental *C. gasseni* used were BCB reared, they did not exhibit a preference for BCB hosts. The percentage parasitism averaged 32% in both the BCB and SCR. Fifty-seven parasitoids, including seven females, were recovered from SCR hosts, and 55 parasitoids, including three females, were recovered from BCB hosts. All *C. gasseni* female offspring were recovered from BCB females and SCR males. Pre-cocoon mortality was 14% for both SCR and BCB. Parasitoid emergence from cocoons was 51% for BCB males and females, 65% for SCR males and 42% for SCR females.

Host sex preference.—In cages 1 and 2, the percent parasitism for female and male hosts was 32% and 23%, respectively. In cages 3 and 4, it was 45% and 38% for the female and male hosts, respectively. Emergence averaged 70% from the cocoons obtained from female hosts, and 78% from cocoons obtained from the males. For both *C. gasseni* age groups, all female offspring were recovered from female SCR hosts.

Beetle mortality appeared to be excessive with this generation: pre-cocoon mortality averaged 46% for cages 1 and 2, and 53% and 60% for cages 3 and 4, respectively. Thus it is uncertain whether the recovery of female parasitoids from female hosts was due to parasitoid preference, or selective mortality.

Host specificity.—The SCR, WCR, BCB and SCB exposed to *C. gasseni* were successfully parasitized, resulting in the recovery of parasitoids from all four hosts. Neither *Cerotoma trifurcata* (F.), nor any of the exposed coccinellids were parasitized (Table 4). In every test, given the choice between the control *Diabrotica* and the test insect, *C. gasseni* always searched for, and attacked the *Diabrotica* first, indicating that the parasitoid was active. The time it took to parasitize all control *Diabrotica* varied from 10–30 minutes. *C. gasseni* females approached the test beetles numerous times during the observation period. Usually, they would rapidly tap their antennae on the beetle, then move on to another host. Occasionally the female would mount the test beetle and probe with the tip of the abdomen at the same location where she would normally oviposit.

DISCUSSION

The survival of *C. gasseni* larvae found during the maintenance of the host cages was extremely low, regardless of whether they were returned to the original cage or set up in petri dishes containing moistened sand. Vance (1932) observed that any *Chelonus annulipes* Wesmael larvae that emerge from the host and completes its final feeding, is unable to construct a cocoon if it is disturbed in any way. Harrison et al. (1993) observed a similar situation with larvae of *Microplitis croceipes* (Cresson). Those larvae died within two hours of exiting the host if they had not spun cocoons by then.

When inducing *C. gasseni* to mate, most of the successful copulations occurred when modified, open-ended aspirator tubes were used, and an air current provided. This seemed to aid the males in orienting to the virgin females (Vinson 1978). This suggests the presence of a sex pheromone in *C. gasseni* (Matthews 1974). In several cases in which females did not mate, or mating occurred after multiple attempts, the males used were ≤24 hours old. Laing and Caltagirone (1969) observed that females of the braconid *Habrobracon lineatellae* (Fischer) will not mate until they are at least 24 hours old, and that insemination is more likely to occur when older males (5–6 days old) are used. As Schlinger and Hall (1960) reported that the sperm supply drops rapidly with each successful mating, whenever possible, we removed each male after it had mated.

The host beetle apparently dies soon after parasitoid emergence; when harvesting *C. gasseni* cocoons we would find almost an equal number of dead beetles. Loan and Holdaway (1961) observed that the curculionid, *Sitona* sp., would stop laying eggs 1–2 days after being stung, and usually die in 3–4 hours following emergence of the endoparasitic braconid larva, *Pygostolus falcatus* (Nees). No female parasitoid progeny were obtained using group exposure of hosts. The large host to parasitoid ratio (Grinberg and Wallner 1991), and rapid rate of oviposition (Flanders 1956) may have been factors. When exposed to hosts in groups, the females would oviposit at a rate of one host per 0.92 ± 0.38 min. When presented with hosts individually, the rate slowed to one host per 2.2 ± 0.78 min.

Centistes gasseni was successfully reared through nine generations. During this period, the sex ratio varied widely, ranging from all males to 6 ♀:1 ♂. An adequate number of females was obtained to conduct experiments and propagate the colony. By the tenth generation, only males were produced. Although our results showed that females contacting each other did not preclude the production of female offspring, it may have affected the sex ratio. With the scelionid *Trissolcus*, contact with other females of the same species (Viktorov 1968), or trace pheromones of other females (Viktorov and Kochetova 1973, Buleza 1975), resulted in production of significantly more male offspring. In addition, the fluorescent lighting utilized in quarantine may have hindered successful mating. Nealis and Fraser (1988), observed that the braconid *Apanteles fumiferanae* (Viereck), mated more frequently under natural rather than artificial light conditions.

The SCR, WCR, BCB, and SCB were readily attacked and parasitized by *C. gasseni*, whereas other phytophagous and beneficial beetles tested proved unsuitable as hosts. Due to the small number of *C. gasseni* females and availability of host beetles, the specificity tests were limited in scope, but generic specificity was evident.

Centistes gasseni has potential for use as a biocontrol agent of the North American CRW complex, and the striped cucumber beetle, *A. vittatum.* The biology, population dynamics and behavior of *C. gasseni* needs to be studied on its native host *D. speciosa* in Brazil.

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A NEW SPECIES OF *EUTARSOPOLIPUS* BERLESE (ACARI: PODAPOLIPIDAE) FROM THE GALAPAGOS ISLANDS, A PARASITE OF *AGONUM CHATHAMI* VAN DYKE (COLEOPTERA: CARABIDAE)

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Abstract.—***Eutarsopolipus brettae*, n. sp.** (Acari: Podapolipidae), is described from *Agonum chathami* Van Dyke (Coleoptera: Carabidae) from the Galapagos Islands and compared with related species of *Eutarsopolipus*. Characters of *E. brettae* do not fit with existing subgroups of *Eutarsopolipus*.

Key Words: beetle, Carabidae, parasitic mites, Acari, Podapolipidae, Galapagos, Ecuador

Mites in the family Podapolipidae (Acari: Heterostigmata) are highly specialized ecto- and endoparasites of the insect orders Blattaria, Orthoptera, Heteroptera, Hymenoptera, and especially Coleoptera. The genus *Eutarsopolipus* Berlese is restricted to hosts in Carabidae (Coleoptera) and occurs worldwide. Along with the type species, *E. lagenaeformis* Berlese 1913, more than 40 others have been discovered, of which 21 were described by Regenfuss (1968, 1974). This is the first record of *Eutarsopolipus* from the Galapagos Islands.

The purpose of this paper is to describe a new species collected from *Agonum chathami* Van Dyke and compare it with other species of *Eutarsopolipus* parasitizing the carabid genus *Agonum*, with *Eutarsopolipus* from Central and South America, and with related *Eutarsopolipus* worldwide.

MATERIALS AND METHODS

Males, larval and adult females, and eggs of *Eutarsopolipus brettae* were collected from *Agonum chathami* Van Dyke borrowed from the California Academy of Sciences, San Francisco, California, U.S.A. The technique for removing mites from museum specimens is described in Husband and Dastych (1998).

Measurements, in micrometers (µm), were taken with the aid of a Zeiss microscope with a stage micrometer and drawing tube. The terminology used follows Lindquist (1986).

Eutarsopolipus brettae Husband, new species
(Figs. 1–3)

Diagnosis.—Adult female *E. brettae* lack stigmata, cheliceral stylets are long, 75–85, and ambulacral II, III claws are well developed (10). The genital capsule of male *E. brettae* has concave lateral margins. Plates C and D are separate in larval female *E. brettae*, cheliceral stylets are long (60–64), setae of the idiosoma and legs are long (Table 1), and the larval female has 3 femur I setae in combination with 1 genu I seta (Table 2).

Adult female (Fig. 1).—*Gnathosoma:* Length 62–69, width 60–67. Palp length 22–25; cheliceral stylet length 75–85 with basal sclerite 12–15, pharynx width 17, walls of pharynx thick, dorsal gnathosomal

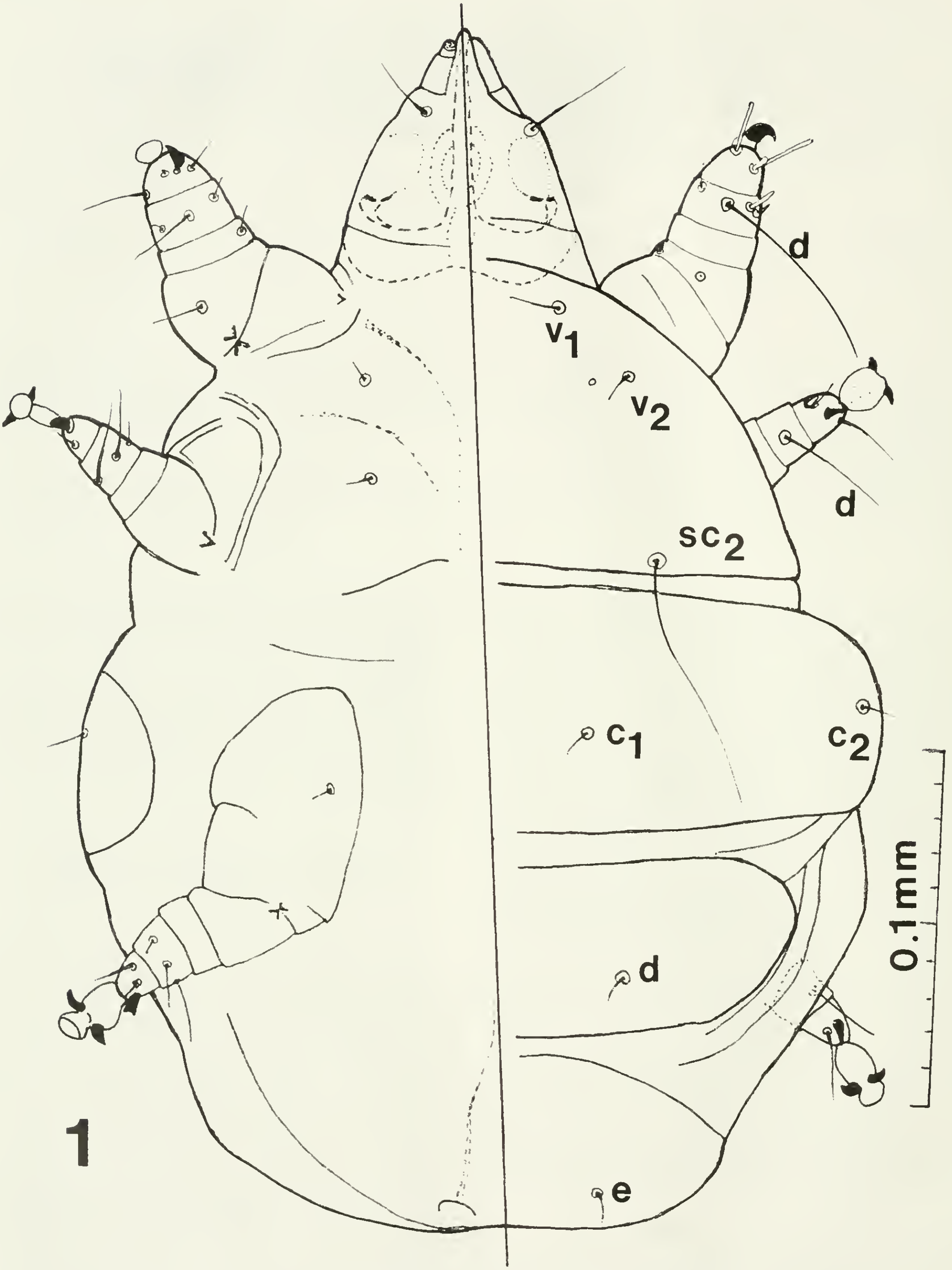

Fig. 1. *Eutarsopolipus brettae,* adult female: left, ventral aspect; right, dorsal aspect.

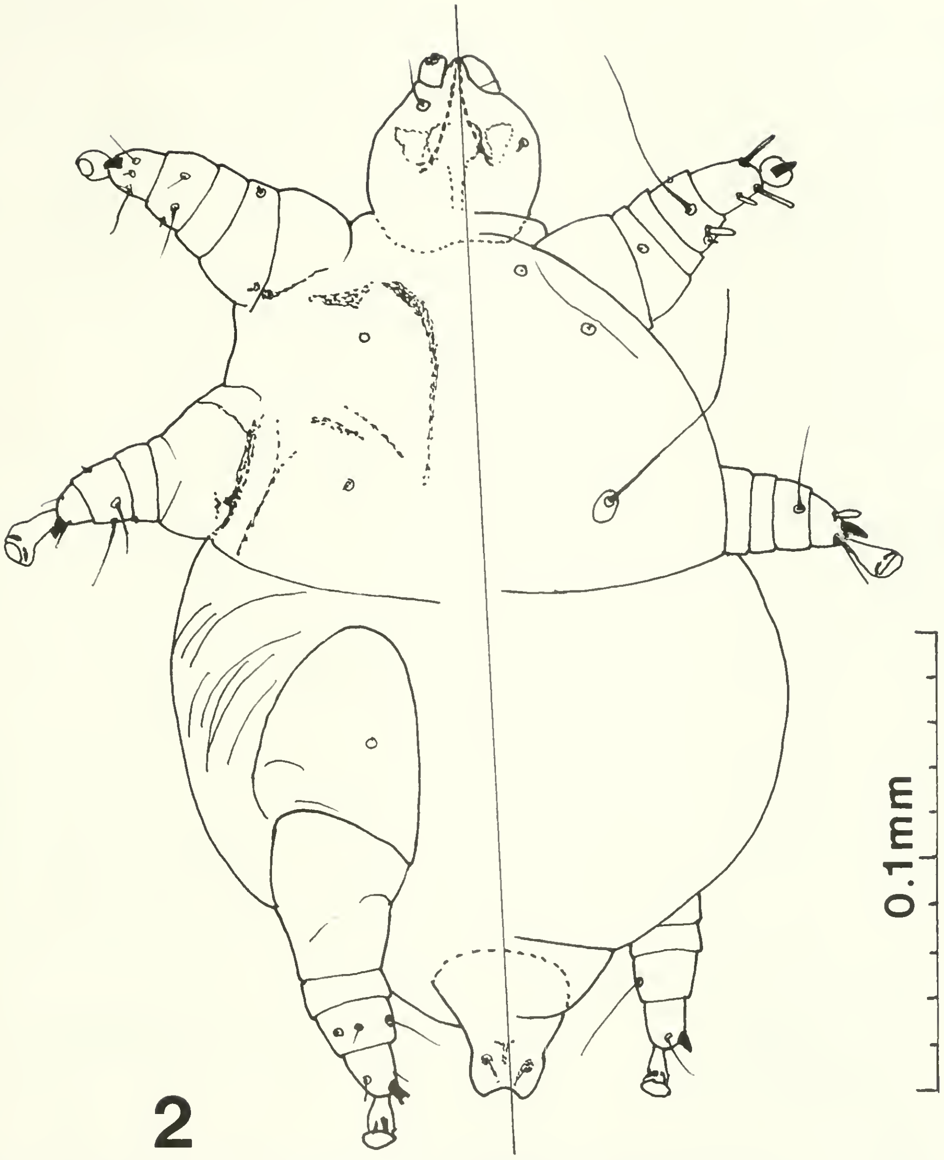

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Fig. 2. *Eutarsopolipus brettae*, adult male: left, ventral aspect; right, dorsal aspect.

setae 32–35, ventral setae 20–25, distance between ventral setae 18–20. No stigmata.

Idiosoma: Length 266–450, width 209–318. Prodorsal plate setae v_1 12–15 v_2 7–8, sc_2 25–30, setae about 10 from posterior margin of prodorsal plate. Distance between setae v_1 55–56; v_2 lateral to line connecting v_1 and sc_2. Plate C midlength 60–70, width 237–265, setae c_1 7–8, c_2 9–10. Plate D length 50–75, width 175–197, setae d 7–8. Plate EF length 40–53, width 130–145, setae e 7–8, no setae h_1, h_2.

Venter: Apodemes 1 and 2 weakly developed, meeting sternal apodeme medially; sternal apodeme not extending beyond junction with apodemes 2. Coxal setae $1a$ 3–4, $2a$ 5–6; setae $1a$ situated equidistant to apodemes 1, 2. Distance between setae $1a$ 37–52. Coxal setae $3a$ not evident, $3b$ 6–7.

3

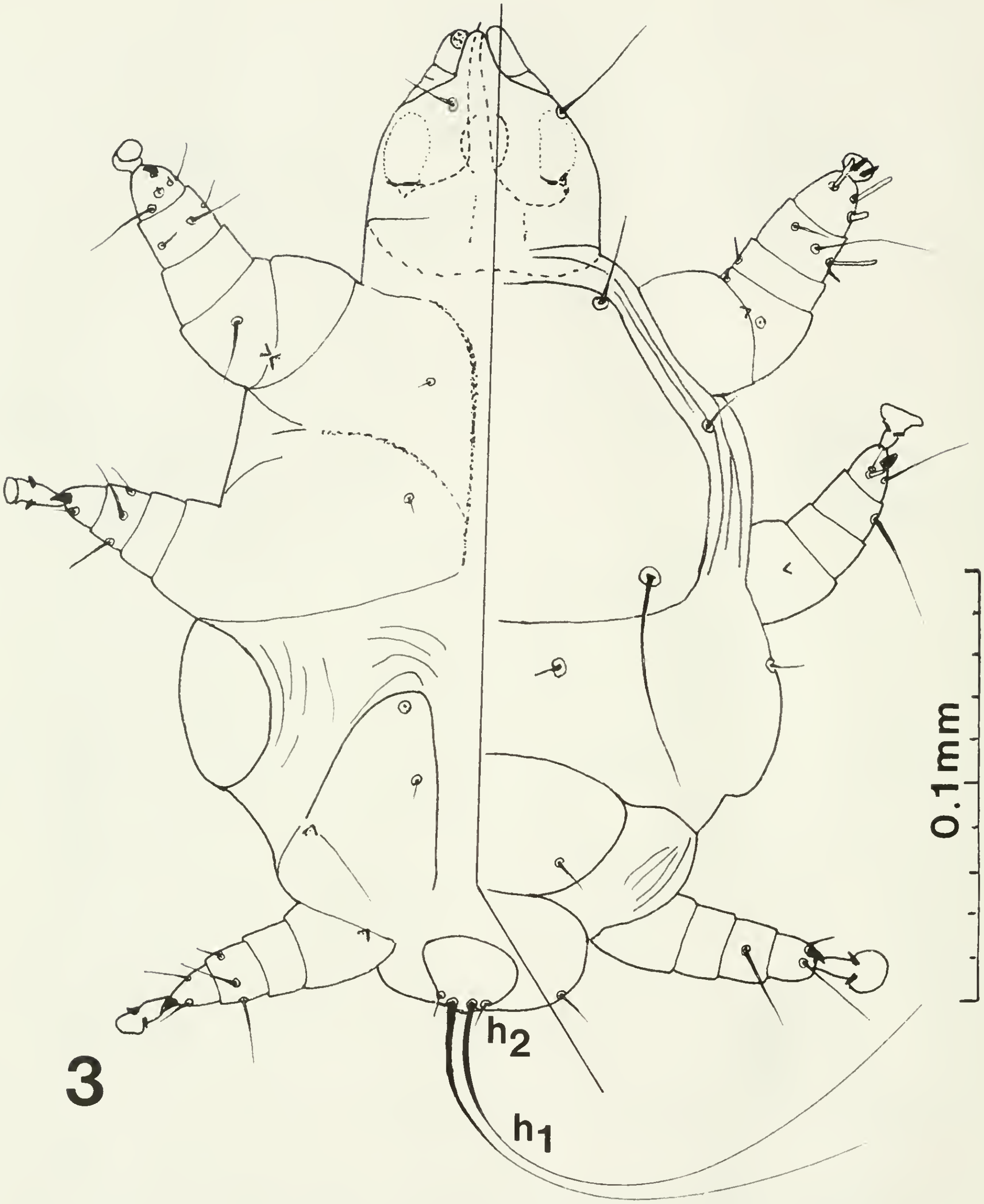

Fig. 3. *Eutarsopolipus brettae*, larval female: left, ventral aspect; right, dorsal aspect.

Legs: Leg setation as in Table 2. Ambulacrum I with a terminal stout claw, ambulacra II, III with 2 strong claws. Tarsus I subunguinal seta spinelike, 2 terminal spines on each of tarsi II, III. Tarsus I solenidion ω 5–6; tarsus II solenidion ω 5. Tibia I solenidion ϕ 8–9, adjacent seta *k* 4–6. Tibial I, II, III setae *d* 45–50, 30–33 and 20–22 respectively.

Male (Fig. 2).—*Gnathosoma:* length 37–40, width 36–37. Palp length 13–17; cheliceral stylet length 25–31, no basal sclerite; pharynx width 10–11, dorsal gnathosomal setae thick 2–4, ventral setae 9–13.

Idiosoma: Length 170–188, width 120–147. Prodorsal setae v_1 m, v_2 m, setae sc_2 53–65. Distance between setae v_1 20–21, distance between setae v_2 52; setae v_2 lateral to line connecting setae v_1 and sc_2. Plates C and D fused, setae c_1, v_2, d, and e vestigial or not present. Genital capsule length 28–30, width 30–35 at base, concave lateral margins.

Venter: Apodemes 1, 2 and sternal apodeme evident; coxae III separated medially. Setae $1a$, $2a$, $3b$ microsetae, $3a$ not evident.

Legs: Leg setation as in Table 2. Ambulacrum I with 1 thick claw, length 4, ambulacra II, III with small claws 3. Tarsus I spinelike seta s 5–6, tarsi II, III spinelike setae tc' and u' 5–7. Tarsus I solenidion ω 5–6, tarsus II solendion ω 4–5; tibia I solendion ϕ 8, adjacent seta k 2–3. Tibiae I, II, III setae d 30–33, 15–22, 19 respectively. Genu III seta v'' evident in only 1 male.

Larval female (Fig. 3).—*Gnathosoma:* length 44–53, width 42–45. Palp length 15–20, cheliceral stylet length 60–64, stylet basal sclerite 7–8, pharynx width 12–13, dorsal gnathosomal setae 31–36, ventral setae 13–14, distance between ventral setae 14–20.

Idiosoma: Length 165–192, width 125–132. Prodorsal plate setae v_1 17–20, v_2 9–16, sc_2 84–85. Distance between setae v_1 34–45; setae v_2 lateral to line connecting setae v_1 and setae sc_2. Plates C and D separate, setae c_1 7–8, c_2 8–10, setae d 7–8: distance between setae d 30–33. Setae c_2 in line with setae c_1. Plate EF oval, setae e 7. Plate H broader at base, setae h_1 80–90, h_2 5–7, distance between setae h_1 2.

Venter: Apodemes 1, 2 and sternal apodeme conspicuous but weakly scerotized. Setae $1a$ 3–4, $2a$ 3–5, $3a$ m and $3b$ 5. Distance between setae $3a$ and $3b$ 18–20, setae $3a$ visible only in larval exoskeleton associated with adult female.

Legs: Leg setation as in Table 1. Ambulacrum I with 2 small, parallel claws. Ambulacra II, III with small, diverging claws. Tarsus I spinelike seta s 5, tarsi II, III spinelike setae tc' and u' 5–7. Tarsus I solenidia ω 3–5, tarsus II solenidion ω 5. Tibia I solenidion ϕ 9–10, seta k 3. Setae tc' 7–9, tc'' 9–10. Tibiae I, II, III setae d 35–40, 18–23 and 17–25 respectively.

Egg.—Length 210–240, width 120–135.

Type, host, and locality data.—Holotype ♀ (RWH010501-1), allotype ♂ and 24 paratypes: from Chatham Island, Galapagos Islands, Ecuador, from under eleytra of *Agonum chathami* Van Dyke (Carabidae) collected by F. S. Williams, 3 October 1905.

Type deposition.—Holotype, allotype, 9 adult ♀ paratypes, 6 ♂ paratypes, 3 larval ♀ paratypes and 2 egg paratypes of *Eutarsopolipus brettae* deposited in the Department of Entomology, California Academy of Sciences, San Francisco, California, U.S.A. One ♂, 2 adult ♀, 1 larval ♀ and 1 vial of paratypes in the collection of the author.

Etymology.—The species is named for Roberta Brett, California Academy of Sciences, San Francisco, California, in recognition of her support of studies of parasitic mites of insects.

DISCUSSION

Before Regenfuss (1968) described 16 new species of *Eutarsopolipus* from Germany, only *E. lagenaeformis* from Italy and *E. desani* Cooreman 1952 from Central Africa were known. Regenfuss (1968) defined 7 subgroups of *Eutarsopolipus.* As new species were described from Pacific Islands, Australia, India, S. Africa, and the Western Hemisphere, characters of existing subgroups of *Eutarsopolipus* no longer worked in placing new species. Husband (1995) created the *ochoai* subgroup and Husband and Macfarlane (1999) created the *catadromi* and *secundus* subgroups. There are now more than 40 species of *Eutarsopolipus* and many more expected from the more than 25,000 known species of Carabidae.

Major characters used to distinguish subgroups of *Eutarsopolipus* include: presence

Table 1. Comparisons of characters and maximum measurements of *Eutarsopolipus brettae* with *Eutarsopolipus* species in the *pterostichi* and *agonum* groups, *E. trichognathi* from South America and *E. ochoai* from Central America.

Character	*E. brettae*	*pterostichi*	*agonum*	*E. trichognathi*	*E. ochoai*
		Adult females			
Stigmata	0	0	+	+	+
Idiosoma	450	510	498	550	580
Amb. II, III claws	10	17	0	0	3, thin
Cheliceral stylets	85	48	40	54	67
Dors. gnath. setae	35	19	20	18	29
Vent. gnath. setae	25	6	5	5	25
Setae v_1	15	6	9	5	23
Setae v_2	8	9	20	5	18
Femur I v''	19	m	0	0	20
Tibia I sol. ϕ	9	10	4	7	9
Tibia II d	33	10	15	8	31
Genu I v'	5	2	0	0	4
		Adult males			
Idiosoma	188	220	196	173	222
Amb. II, III claws	5	minute	0	minute	3, thin
Cheliceral stylets	31	28	22	23	31
Dors. gnath. setae	4, thick	13	7	8	13
Vent. gnath. setae	13	4	m	m	9
Setae sc_2	65	48	37	32	62
Femur I v''	0–12	2	0	0	0
Tibia I d	33	19	13	27	31
		Larval females			
Idiosoma	192	270	230	332	217
Amb. II, III claws	4	minute	0	minute	3, thin
Cheliceral stylets	64	49	29	32	49
Dors. gnath. setae	36	30	16	16	26
Vent. gnath. setae	14	7	5	m	15
Femur I v''	14	m	0	0	10
Tibia I d	40	8	18	10	26
Tarsus II sol. ω	5	2	0	5	5
h_1-h_1 distance	2	7	12	4	0, adj.
h_2	7	22	30	25	m
Genu I v_2	0	0	0	0	5

or absence of stigmata, shape of the male genital capsule, proportions of cheliceral stylets in relation to gnathosoma, presence or absence of idiosomal setae or setae on legs and presence or absence of idiosomal plates. Major characters used to distinguish species include: relative lengths of cheliceral stylets, lengths and widths of other structures, idiosomal plates of adult females divided or not, plates of larval females fused or not, idiosomal shape, structure of setae (thick, thin, with or without microspines), setal position, and relatives lengths and position of setae of the legs and idiosoma.

All *Eutarsopolipus* that are parasites of the carabid genus *Agonum* fit patterns described for the *biunguis* subgroup proposd by Regenfuss (1968). Comparisons of *Eutarsopolipus brettae* with species in the *biunguis* group yielded more than 40 differences. All *biunguis* species have distinct stigmata, no ambulacral I claw, no or minute ambulacra II, III claws, no femur I se-

Table 2. Leg setation of femur, genu, tibia and tarsus for larval female *E. brettae* and related species. Solenidia are included. Two numbers in a column indicate variation in setal numbers.

	Leg I				Leg II				Leg III			
	F	G	Ti	Ta	F	G	Ti	Ta	F	G	Ti	Ta
E. brettae	3	1	7	7	0	1	4	6	0	1	4	5
E. ochoai	3	2	7	9	0	1	4	7	0	1	4	5
E. stammeri	0	2	6	9	0	1	4	6	0	1	4	5
E. trichognathi	2	0	7	8/9	0	0	4	6	0	0	4	5
E. biunguis subgroup from *Agonum*	1/2	0	7	8	0	0	4	5	0	0	4	5
E. lukoschusi	3	0	6	9	0	0	4	6	0	0	4	5
E. pterostichi subgroup	2/3	0/2	5/7	8/9	0	0	4	6/7	0	0	4	5/6

tae v'' and no genu I v'' setae. *Eutarsopolipis brettae* has no stigmata and has the structures which are missing in *biunguis* species. Patterns of characters do not fit patterns for the *biunguis* subgroup, any of the other 6 subgroups proposed by Regenfuss or any of the 3 subgroups added since 1968.

An attempt was made to place *E. brettae* with species which have no stigmata: *E. stammeri* Regenfuss of the *stammeri* subgroup, *E. lukoschusi* Husband 1986 and species in the *pterostichi* subgroup. In contrast to large claws of female *E. brettae*, no claws are present in *E. stammeri*. In *E. lukoschusi* ambulacral claws II, III are minute and ambulacrum I claw is small. Regenfuss (1974) placed *E. inermis* Regenfuss from Georgia, U.S.A., within the *pterostichi* subgroup because it lacked stigmata, the genital capsule of the male was similar to other mites in this group, solenidia were short as was femur I seta *d* and larval females had slightly separated setae h_1. In contrast to other mites in the *pterostichi* subgroup, adult females of *E. inermis* have no genu I setae, all ambulacral claws are reduced and coxal seta 3*a* setae are not present. The holotype of *E. pterostichi* Regenfuss has 3 femur I setae (as does *E. brettae*), 2 genu I setae in contrast to 1 genu I setae in *E. brettae*, and short solenidia ω in contrast to longer solenida ω on tarsi I, II in *E. brettae*. Setae h_1 are nearly adjacent in larval female *E. brettae* and genital capsules of males have concave rather than straight lateral margins. Although adult female *E. brettae* do not appear to have setae 3*a*, ambulacral claws are not reduced as in *E. inermis*. With the exception of *E. inermis* in the *pterostichi* subgroup, cheliceral stylets of all instars of *E. brettae* are distinctly longer (Table 1).

Geographically, the nearest *Eutarsopolipus* species to *E. brettae* are *E. ochoai* Husband 1995 parasite of *Pasimachus* spp. beetles from Costa Rica and *E. trichognathi* Husband and Eidelberg 1996 from *Trichognathus marginipennis* (Latreille) from Brazil. The species *E. trichognathi* occurs in Ecuador, Columbia, Brazil, Paraguay and Bolivia (Husband 1999). In contrast to no stigmata in *E. brettae*, both *E. ochoai* and *E. trichognathi* have stigmata. *Eutarsopolipus trichognathi* shares characters with the *biunguis* subgroup of *Eutarsopolipus*. All instars of *E. ochoai* have small ambulacra II, III claws in contrast to larger claws in *E. brettae*. Genu I of *E. ochoai* has 2 setae in contrast to 1 seta of *E. brettae*. Males of *E. brettae* have short, thick dorsal gnathosomal setae (4) in contrast to longer gnathosomal setae (13) in males of *E. ochoai*. I consider, on the basis of these characters, that *E. brettae* is not closely related to the 2 species of *Eutarsopolipus* from Central and South America.

Until a reassessment of subgroups of *Eutarsopolipus* is completed, *E. brettae* cannot be placed in a subgroup. It has combinations of unique characters of no other *Eutarsopolipus*.

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NEW HOST RECORD, NEW RANGE INFORMATION, AND A NEW PATTERN OF VOLTINISM: POSSIBLE HOST RACES WITHIN THE HOLLY LEAFMINER *PHYTOMYZA GLABRICOLA* KULP (DIPTERA: AGROMYZIDAE)

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Abstract.—The agromyzid leafminer *Phytomyza glabricola* is reported from the holly *Ilex coriacea,* a plant not previously reported to host leafminers. The known geographic range of *P. glabricola* is extended to include Alabama, Florida, Mississippi, North Carolina, and South Carolina. In these areas, it can be found feeding on sympatric populations of its hosts *I. coriacea* and *I. glabra. Phytomyza glabricola* reared from *I. coriacea* are univoltine, having only a single generation a year, while on *I. glabra* this species is multivoltine with at least two generations a year. This suggests that either this leafminer exhibits a high degree of host-associated phenotypic plasticity in life history or that host races are present.

Key Words: host race formation, sympatry, Aquifoliaceae, gallberry, inkberry

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The agromyzid fly *Phytomyza glabricola* Kulp belongs to a complex of closely related leafminers, all of which feed on various species of holly in the genus *Ilex* (Aquifoliaceae) (Kulp 1968, Scheffer and Wiegmann 2000). *Phytomyza glabricola* was first described from the plant species *Ilex glabra* (Linnaeus) Gray by Kulp (1968) in his revision of holly-feeding *Phytomyza* species. On this host, *P. glabricola* makes a linear-blotch mine and is multivoltine (Kulp 1968, Al-Siyabi and Shetlar 1998). In 1996, I reared *P. glabricola* from 26 leafmines found on two bushes of *I. coriacea* (Pursh) Chapman growing in North Carolina. This plant species has not been previously reported to host agromyzid leafminers (Spencer and Steyskal 1986, Spencer 1990).

Ilex glabra and *I. coriacea* are shrubby evergreen hollies that grow sympatrically in the coastal plain of the southeastern U.S. The range of *I. glabra* extends from coastal Nova Scotia to mid Florida to eastern Texas and Missouri and is slightly broader than that of *I. coriacea* which extends only from coastal Virginia to northern Florida to Texas [Galle (1997) includes Mexico in the range, but most other sources do not (Standley 1923, Lundell 1961, Gleason and Cronquist 1963, Radford et al. 1968, Correll and Johnston 1970)]. These two plant species are believed to be very closely related and go by the similar common names gallberry (*I. glabra*) and large gallberry (*I. coriacea*) (Galle 1997).

Phytomyza glabricola has been reported from Connecticut, Massachusetts, New Jersey, New York, Ohio, and Washington, D.C. (Kulp 1968, Spencer and Steyskal 1986), but not from the southeastern U.S. where both *I. glabra* and *I. coriacea* are

Table 1. Collection locations, hosts, and dates for *P. glabricola*.

Location	Host	Date
Alabama		
Covington Co.	*I. glabra*	Jan. 1998
Covington Co.	*I. coriacea*	Jan. 1998
Florida		
Calhoun Co.	*I. glabra*	Oct. 1999
Highlands Co.	*I. glabra*	Jan. 1998, Oct. 1999
Marion Co.	*I. glabra*	Jan. 1999
Wakulla Co.	*I. glabra*	Jan. 1998, Oct. 1999
Wakulla Co.	*I. coriacea*	Jan. 1998
Mississippi		
Forrest Co.	*I. glabra*	Jan. 1998
Forrest Co.	*I. coriacea*	Jan. 1998
North Carolina		
Brunswick Co.	*I. glabra*	Feb. 1997
Brunswick Co.	*I. coriacea*	Feb. 1997
Craven Co.	*I. glabra*	Feb. 2000
Craven Co.	*I. coriacea*	Feb. 2000
Moore Co.	*I. glabra*	Feb. 1996
Moore Co.	*I. coriacea*	Feb. 1996
New Hanover Co.	*I. glabra*	Feb. 1997, Jan. 1998
New Hanover Co.	*I. coriacea*	Feb. 1996, Feb. 1997, Jan. 1998
New York		
Suffolk Co.	*I. glabra*	Aug. 1996
South Carolina		
Berkeley Co.	*I. glabra*	Feb. 1997, Jan. 1998
Berkeley Co.	*I. coriacea*	Feb. 1997, Jan. 1998

common in the pine woods and bays of the coastal plain. The purpose of this study was to investigate the geographic range of *P. glabricola* and to determine whether this species commonly feeds on *I. coriacea*.

MATERIALS AND METHODS

From 1996 to 2000, I periodically traveled within the southeastern U.S. looking for populations of *I. glabra* and *I. coriacea*. Leaves containing well-developed mines were removed from plants, and adult flies were reared from the pupae found within the mines. Species identity of the leafminers reared from *I. glabra* and *I. coriacea* was determined using Kulp (1968) and Spencer and Steyskal (1986).

RESULTS

Adult flies reared from *I. glabra* and *I. coriacea* were readily identified as *P. glabricola*. Flies reared from the two hosts did not noticeably differ from each other in morphological characters. Locations where *P. glabricola* was reared from leafmines on *I. glabra* and/or *I. coriacea* are listed in Table 1. Collection dates for samples are listed in Table 1; eclosion of adults occurred within approximately one month of this date.

Leafmines formed by *P. glabricola* on both *I. glabra* and *I. coriacea* are linear-blotch shaped, although in most cases the extensive feeding during the later instars removes tissue surrounding the initial linear mine so that only a blotch is apparent. Generally, a leaf will contain only one mine with a single larva or pupa present. Occasionally, a leaf will have more than one mine, indicating the presence of several larvae or pupae. This appeared to be more common on the larger-leafed *I. coriacea* than on *I. glabra*. Mines on *I. glabra* have a tendency to be brown with a blistered appearance, while those on *I. coriacea* are more often dark green or reddish-green and do not appear blistered. On both hosts, fly pupation occurs in the mine with the anterior pupal spiracles emerging through an "epidermal window," where just prior to pupation, the larva removes mesophyll adjacent to the lower epidermis of the leaf.

During the course of this study, it became apparent that populations of *P. glabricola* on *I. coriacea* exhibit a univoltine life cycle. Well-developed mines are only found in January and February, and the adults eclose from late January to early March. Observations made at other times indicate that first-instar leafmines are found in the summer, second-instar mines in late fall, and third-instar mines only in the winter prior to adult eclosion. This univoltine life cycle is very similar to that of the native holly leafminer *P. ilicicola* on its host *I. opaca* (Kulp 1968, Potter and Kimmerer 1986), but it is in sharp contrast to the multivoltine life cycle of *P. glabricola* on *I. glabra* (Kulp 1968, Al-Siyabi and Shetlar 1998), where the generation time can be as short as one month (Scheffer, personal observation).

DISCUSSION

These findings confirm that *I. coriacea* is a widely used host for *P. glabricola* in natural settings and extends the known geographic distribution of *P. glabricola* to Alabama, Florida, Mississippi, North Carolina, and South Carolina.

It is unlikely that further study will uncover any additional hosts for *P. glabricola*. Most holly leafminers are strictly monophagous (Kulp 1968, Scheffer and Wiegmann 2000), although in artificial situations (e.g., botanical gardens), additional feeding on non-native *Ilex* species or hybrids may be observed (Scheffer, personal observation; host records listed in Spencer and Steyskal 1986, Griffiths and Piercey-Normore 1995). During the course of this study, *P. glabricola* was reared from *I. glabra* and *I. coriacea* in both natural and ornamental settings, but not from other hollies growing in the same locations, including the evergreen species *I. cassine* Linnaeus, *I. myrtifolia* Walter, *I. opaca* Aiton, and *I. vomitoria* Aiton (Scheffer, unpublished data).

Although holly leafmining species are known to exhibit different patterns of voltinism, no species previously has been reported to exhibit more than one pattern. Many holly leafminers have a multivoltine life cycle with two or more generations a year. In most of these species, the larval feeding period may be as short as a week or two, with a total generation time that of slightly over a month (Scheffer, personal observation; the life cycle of *P. opacae* Kulp is reported to be even shorter (Kulp 1968)). Multivoltine holly leafminers can be found on either evergreen or deciduous hollies and include the species *P. ditmani* Kulp, *P. opacae* Kulp, *P. verticillatae* Kulp, *P. vomitoriae* Kulp, and several undescribed species (Kulp 1968, Spencer and Steyskal 1986, Scheffer, unpublished data). In contrast, univoltine holly leafminers have only one generation a year and a highly extended larval developmental period lasting up to ten months that appears to be unique among the leafmining Agromyzidae (Cameron 1939, Hering 1951, Potter and Kimmerer 1986). Univoltine holly leafminers have been found only on evergreen hollies and include the species *P. ilicicola* Loew, *P. ilicis* Curtis, and an undescribed species on *I. myrtifolia* (Kulp 1968, Spencer and Steyskal 1986, Scheffer, unpublished data).

There are several possible explanations for the observation that *P. glabricola* has a different life history pattern depending on host plant identity. At the two extremes, these hypotheses can be classified as those involving phenotypic plasticity and those involving genetic differences between flies on the two hosts. First, the rate of larval feeding could be a direct physiological result of some unknown quality of host leaf tissue, such that *P. glabricola* larvae in *I. glabra* always develop quickly, while larvae in *I. coriacea* develop very slowly. This situation would be a form of host-mediated phenotypic plasticity and would not require genetic differences in the flies. Consideration of the life history patterns of related holly leafminers suggests that an hypothesis of host-mediated phenotypic plasticity, even if found to be valid in the case of *P. glabricola*, cannot generally explain voltinism differences in the holly leafmining group; *P. ilicicola* and *P. opacae* both oviposit into the soft new leaves of *I. opaca*, but *P. ilicicola* exhibits a univoltine life cycle on this host while *P. opacae* is multivoltine (Kulp 1968, Scheffer and Wiegmann 2000).

An alternative hypothesis is that the flies exhibit different patterns of voltinism because they are genetically different and represent host races or incipient or cryptic species. Under this scenario, the difference in life history on the two hosts could be either a cause of genetic divergence (i.e., the life history differences may be incompatible adaptations to each of the two host plants thereby favoring host race formation) or a result of genetic divergence (i.e., host races diverged for reasons unrelated to voltinism patterns and voltinism patterns have subsequently diverged). Note that even if genetic host races have formed, the difference in voltinism could still be due to phenotypic plasticity, if it exists, such that voltinism would depend on the host, but each host race would exhibit only one pattern because it uses only one host.

Whether *P. glabricola* on *I. glabra* and *I. coriacea* represents a single oligophagous species that feeds on two hosts or a complex of closely related but genetically divergent host races currently is not known. Although the difference in voltinism on the two hosts is suggestive of host races, the voltinism difference by itself does not preclude flies from the two hosts from interbreeding. Adult flies from both hosts emerge in late winter (see dates in Table 1) and can be expected to be present in the same general areas together for several weeks. During this one time each year, interbreeding between flies from the two hosts is at least possible.

Anecdotal evidence from the field indicates that host plant preferences suggestive of host races may be present within *P. glabricola*. When the univoltine leafminers on *I. coriacea*, which are often extremely abundant, emerge en mass in February, adults can be readily observed on *I. coriacea* foliage but not on adjacent *I. glabra* foliage (Scheffer, personal observation), suggesting a possible preference for *I. coriacea*. This is despite the fact that *P. glabricola* from *I. glabra* can be taken into the lab and easily reared to the next generation on *I. glabra* with no apparent hesitancy to oviposit and little or no larval mortality (Scheffer, personal observation).

Results to date of phylogenetic analysis of molecular data are inconclusive with regard to the question of host races wihtin *P. glabricola*. Mitochondrial cytochrome oxidase sequences of flies from *I. glabra* and *I. coriacea* are nearly identical ($< 1\%$ pairwise divergence across more than 2000 bp; Scheffer and Wiegmann 2000), which is typical of sequence variation found within agromyzid species (Scheffer, unpublished data; see also Scheffer 2000). Using this gene region, there is no evidence of host-associated divergence, but given the estimated rate of evolution of insect mitochondrial genes (approx. 2.3% per million years; Brower 1994), mitochondrial sequences would be unlikely to have sufficient variation to track very recent divergence or speciation events.

In conclusion, *P. glabricola* is widely distributed throughout the coastal plain of the eastern United States. It feeds on two holly species, *I. glabra* and *I. coriacea*, which are commonly sympatric throughout much of their ranges. Differences exhibited by *P. glabricola* in patterns of voltinism on these two hosts suggest either host-associated phenotypic plasticity in life history or the presence of genetically differentiated host races. Additional studies of morphological variation, mating and oviposition behaviors, and/or highly variable molecular markers are needed to determine the status of *P. glabricola* leafminers feeding on *I. glabra* and *I. coriacea*.

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LIFE HISTORY AND DESCRIPTION OF IMMATURE STAGES OF *GOEDENIA RUFIPES* (CURRAN) (DIPTERA: TEPHRITIDAE) ON *ISOCOMA ACRADENIA* (E. GREENE) E. GREENE IN SOUTHERN CALIFORNIA

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Abstract.—*Goedenia rufipes* (Curran) is an oligophagous, nonfrugivorous, fruit fly (Diptera: Tephritidae) producing at least two, probably three, annual generations altogether in the flower heads of *Chrysothamnus teretifolius* (Durand and Hilgard) H. M. Hall and *Isocoma acradenia* (E. Greene) E. Greene in southern California. Both of these confirmed hosts are Asteraceae belonging to the subtribe Solidagininae of the tribe Astereae. The egg, second- and third-instar larvae, and puparia are described and figured, and selected characteristics of these stages are compared with those of *G. timberlakei* (Blanc and Foote), the only other well-known species of *Goedenia.* The egg of *G. rufipes* is the first pictured for this genus; it bears a prominent pedicel with semicircular to fusiform micropyles. The second instar is white, but the third instar has a dark brown to black venter on the meso- and metathorax and a similarly darkened caudal segment. The prothorax and gnathocephalon of the second and third instars are smooth, mostly free of the minute acanthae that circumscribe most other body segments. Minute acanthae cover the posterior end of the truncated caudal segment, which also is perforated by scattered, open pores. The third instar lacks oral ridges. The anterior thoracic spiracle of the second instar bears three papillae, which are reduced to two papillae in the third instar. The life cycle is of the aggregative type and overwintering occurs in dead flower heads as prepuparial third instars, as puparia in an open, central cells loosely surrounded by floret fragments and intact undamaged achenes, and as unmated, sexually immature adults. *Eurytoma* sp. (Hymenoptera: Eurytomidae) and *Pteromalus* sp. (Hymenoptera: Pteromalidae) are reported as solitary, larval-pupal endoparasitoids, and *Eupelmus* sp. (Hymenoptera: Eupelmidae) as possible solitary endoparasitoids.

Key Words: Insecta, *Goedenia, Chrysothamnus, Isocoma,* Asteraceae, nonfrugivorous Tephritidae, biology, taxonomy of immature stages, flower-head feeding, aggregative life cycle, seed predation, parasitoids

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Most indigenous, western North American Myopitini (Diptera: Tephritidae: Tephritinae) formerly assigned to the Palearctic genus *Urophora* Robineau-Desvoidy were reclassified in the genus *Goedenia* by Freidberg and Norrbom (1999). To date, the life history and immature stages of only one of the eight known species of *Goedenia* have been described in detail, i.e., *G. timberlakei* (Blanc and Foote), by Goeden et al. (1995). This paper describes the life history and selected immature stages of a second species, *G. rufipes* (Curran).

MATERIALS AND METHODS

The present study utilized specimens of adults reared from 1-liter samples of mature flower heads of *Chrysothamnus teretifolius* (Durand and Hilgard) H. M. Hall and *Isocoma acradenia* (E. Greene) E. Greene (Asteraceae) collected throughout southern California since 1980 (Goeden 1987). The life history study and description of the immature stages of *G. rufipes* were based in large part on dissections of samples of mature and immature flower heads of *I. acradenia* collected east of Ocotillo at Coyote Wells and at 42-m elevation, southwestern Imperial Co., during 1990–1999. One-liter samples of excised, immature and mature flower heads containing the scarce larvae and puparia were transported in cold-chests in an air-conditioned vehicle to the laboratory and stored under refrigeration for subsequent dissection, photography, description, and measurement. Ten ova dissected from a gravid female as well as two second- and 22 third-instar larvae, and nine puparia dissected from flower heads were preserved in 70% EtOH for scanning electron microscopy (SEM). Prepuparia and puparia were placed in separate, glass shell vials stoppered with absorbant cotton and held in humidity chambers at room temperature for adult and parasitoid emergence. Specimens for SEM were hydrated to distilled water in a decreasing series of acidulated EtOH. They were osmicated for 24 h, dehydrated through an increasing series of acidulated EtOH and two, 1-h immersions in hexamethyldisilazane (HMDS), mounted on stubs, sputter-coated with a gold-palladium alloy, studied and digitally photographed with a Philips XL-30 scanning electron microscope in the Institute of Geophysics and Planetary Physics, University of California, Riverside.

Five arenas each consisting of a clear-plastic, petri dish were provisioned with a flattened, water-moistened pad of absorbant cotton spotted with honey (Headrick and Goeden 1994). Each arena contained a virgin male and female obtained from emergence cages that were used for observations of courtship and copulation behavior.

Plant names used in this paper follow Hickman (1993) and Bremer (1994); tephritid names and adult terminology follow Foote et al. (1993). Terminology and telegraphic format used to describe the immature stages follow Goeden (2001a, b, c), Goeden et al. (1993), Goeden and Headrick (1992), Goeden and Norrbom (2001), Goeden and Teerink (1997), Teerink and Goeden (1999), and our earlier works cited therein. Means ± SE are used throughout this paper. Digitized photographs used to construct text figures were processed with Adobe Photoshop® Version 6.

RESULTS AND DISCUSSION

TAXONOMY

ADULT.—*Goedenia rufipes* was described from Arizona as *Aleomyia rufipes* by Curran (1932), who shortly thereafter reclassified it as *Euribia rufipes* (Curran 1934, as cited by Foote et al. 1993). Foote (1965) assigned it to *Urophora,* which Steyskal (1979) adopted in his key to Myopitinae genera and species of *Urophora.* Freidberg and Norrbom (1999) redesignated most of the indigenous, western North American species as *Goedenia,* with *A. rufipes* Curran as the type species.

The wing was figured by Curran (1934, as cited by Foote et al. 1993), Steyskal (1979), and Foote et al. (1993). Freidberg and Norrbom (1999) provided line drawings of the head in lateral and anterolateral view and the hypandrium and phallopodeme in dorsal view.

Immature stages.—The egg, second- and third-instar larvae, and puparium of *G. rufipes* are described below.

Egg: Sixteen ova dissected from a 17-day-old female were white, opaque, smooth, elongate-ellipsoidal, 0.55 ± 0.008 (range, 0.48–0.60) mm long, 0.18 ± 0.005 (range, 0.14–0.20) mm wide, smoothly rounded at tapered basal end (Fig. 1A);

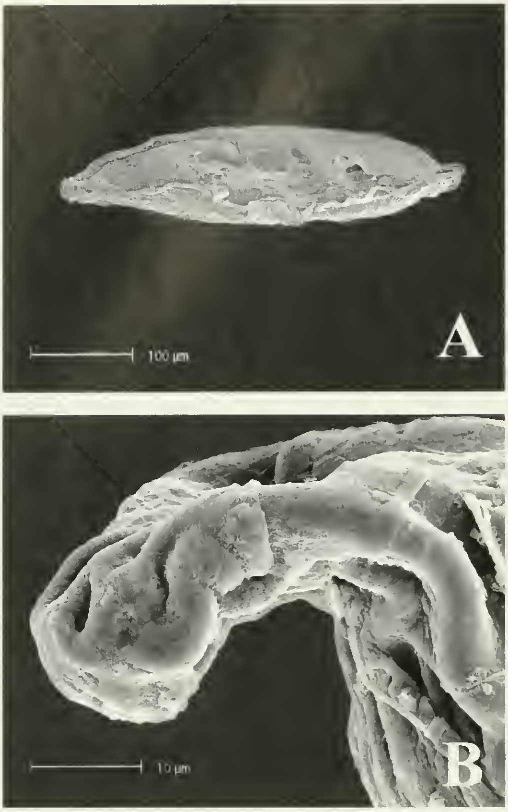

Fig. 1. Egg of *Goedenia rufipes*: (A) habitus, anterior to left; (B) pedicel showing pattern and shapes of aeropyles (probably distorted).

pedicel prominent, 0.03 mm long, circumscribed apically by different-sized, semicircular to fusiform aeropyles arranged singly or in two rows with their long axes parallel to the long axis of the egg (Fig. 1B).

The ova of *G. rufipes* on average equalled in length the ova of *G. timberlakei* and were slightly wider, but otherwise agreed with the description provided by Goeden et al. (1995). Unfortunately, the scanning electron micrograph of a possibly deformed pedicel of *G. rufipes* (Fig. 1B) is the only view of this structure obtained for this genus to date. The eggs and first instars of *Goedenia* spp. are very small, extremely difficult to find and probably are available for only a short period in nature; moreover, their study is further complicated by the tendency of these tephritids to co-occur with other tephritid genera, i.e., *Neaspilota, Procecidochares, Trupanea,* in flower heads of the same host ("symphagy", Goeden 1997), usually in subordinate numbers, as reported by Goeden (1987).

Second instar larva: White, cylindrical, tapered anteriorly, bluntly rounded posteriorly (Fig. 2A); gnathocephalon conical (Fig. 2B), smooth, with few minute acanthae ventrally (Fig. 2B-1), lacking oral ridges (rugose pads); dorsal sensory organ well-defined, round, flattened (Figs. 2B-2, C-1); anterior sensory lobes (Figs. 2B-3, C-2), separated by vertical medial cleft, with terminal sensory organ (Figs. 2B-4, C-3), lateral sensory organ (Fig. 2C-4), supralateral sensory organ (Fig. 2C-5), and pit sensory organ (Fig. 2C-6); stomal sense organ (Figs. 2B-5, C-7) ventrolaterad of anterior sensory lobe and fused (Fig. D-1) with lateralmost of five, foliose, protrudent, lateral integumental petals (Figs. 2C-8, D-2) dorsad of each mouthhook, two vertical pairs of medial integumental petals between anterior sensory lobes (Fig. 2C-9); mouthhook (Figs. 2B-6, D-3) bidentate (Fig. 2D-3); median oral lobe laterally compressed, apically tapered (Fig. 2D-4), separated from labial lobe (Fig. 2D-5); verruciform sensilla circumscribe posterior third of gnathocephalon dorsomedially, dorsolaterally, and laterally (Fig. 2B-7); anterior spiracle with three, subglobose papillae (Fig. 2E); minute acanthae (Fig. 2F) posteriorly directed, spatulate, apically rounded on anterior fourth of meso- and metathorax venters and circumscribing all but posterior three-fourths of first abdominal segment (A1), most of A2 to A6, all but posterior three-fourths of A7, and anterior half of A8. Posterior surface of caudal segment not viewed.

The habitus of the second instar of *G. rufipes* (Fig. 2A) approximates that of *G. timberlakei* (Goeden et al. 1995). Differences noted include five lateral integumental petals in *G. rufipes* (Figs. 2C-8, D-2), not four, as pictured for *G. timberlakei* (Goeden et al. 1995). Moreover, the latter

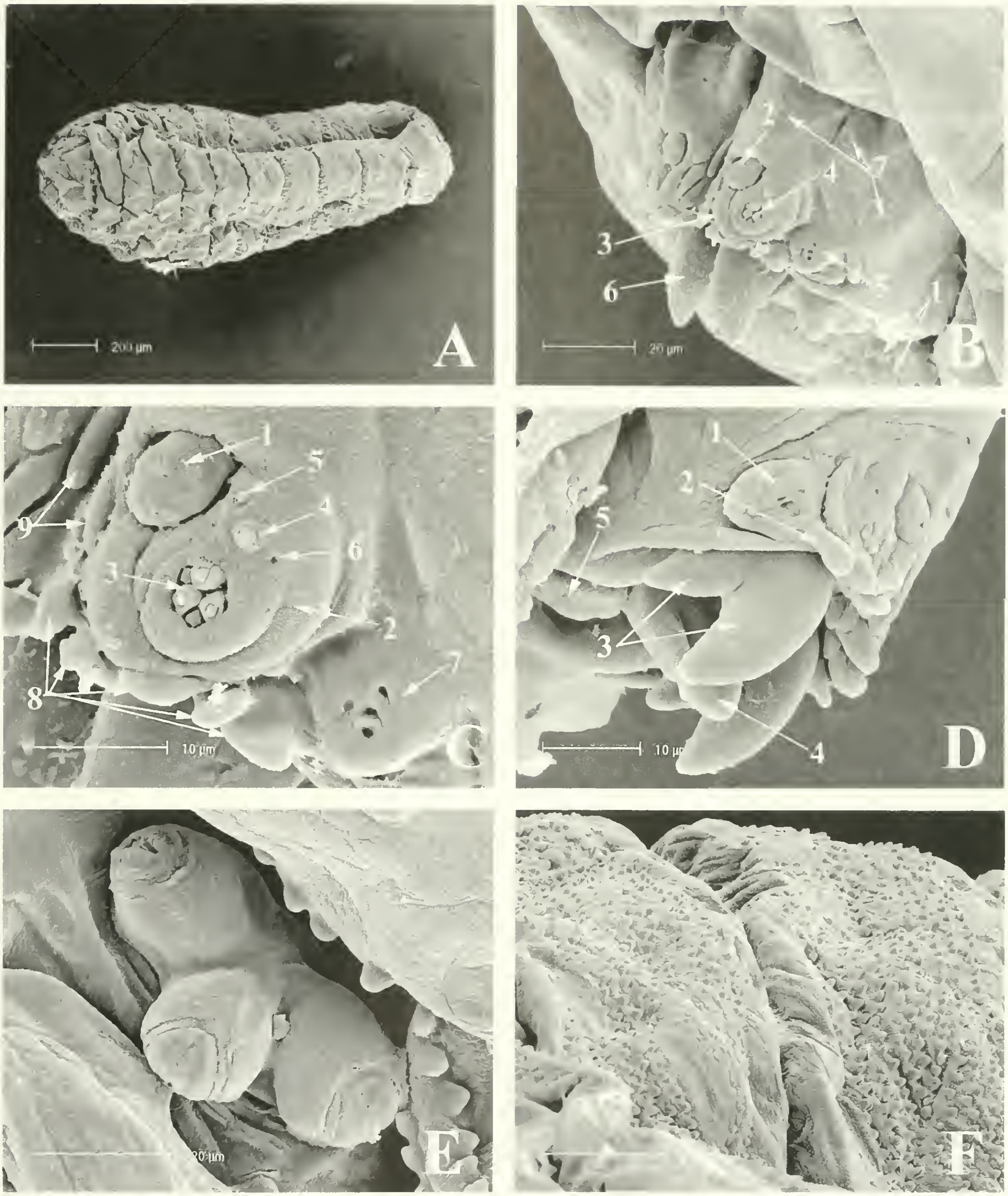

Fig. 2. Second instar of *Goedenia rufipes*: (A) habitus, anterior to right; (B) gnathocephalon, frontolateral view, 1—minute acanthae, 2—dorsal sensory organ, 3—anterior sensory lobe, 4—terminal sensory organ, 5—stomal sense organ; 6—mouthhook, 7—verruciform sensilla; (C) gnathocephalon, close-up, 1—dorsal sensory organ, 2—anterior sensory lobe, 3—terminal sensory organ, 4—lateral sensory organ, 5—supralateral sensory organ, 6—pit sensory organ, 7—stomal sense organ, 8—lateral integumental petals, 9—medial integumental petals, mouthhook; (D) oral cavity of gnathocephalon, ventrolateral view, 1—stomal sense organ, 2—lateralmost integumental petal, 3—mouthhook, 4—median oral lobe, 5—labial lobe; (E) anterior spiracle; (F) minute acanthae on dorsolateral aspect of abdominal segments 1 and 2, anterior to left.

species appears to have only a single pair of medial integumental petals (Goeden et al. 1995), not two pairs, like *G. rufipes* (Fig. 2C-9). The numbers of these integumental petals were not quantified by Goeden et al. (1995), but their presence and general positions were noted and pictured. Another difference is that the anterior spiracle of the second instar of *G. rufipes* bears three papillae (Fig. 2E), not two papillae, like *G. timberlakei* (Goeden et al. 1995).

Third instar larva: Oblong-ellipsoidal, roundly tapered anteriorly, bluntly truncated posteriorly (Fig. 3A), integument white, but venter of meso- and metathorax with dark brown to black infuscation (Fig. 6B); caudal segment dark brown or black (Figs. 6B, C); outwardly or posteriorly directed, conical, bluntly or sharply pointed (Figs. 3B-1, F-1) or hemispheroidal (Figs. 4C-1, E-2, F-2) minute acanthae circumscribe anterior fourth of meso- and metathorax and first abdominal segment (A1) and cover all venters thereof, and circumscribe all but anterior and posterior fifths of A2-A5, all but posterior quarter of A-7, and cover posterior plate of caudal segment (Figs. 4D-2, E-2, F-2); prothorax smooth, lacking minute acanthae (Fig 3B), but circumscribed by verruciform sensilla dorsally, dorsolaterally, laterally, and ventrolaterally (Fig. 3B-2); gnathocephalon conical, anteriorly flattened, and medially divided by vertical cleft (Figs. 3B-3, C), pore dorsoposteriorad of each dorsal sensory organ (Fig. 3C-1); dorsal sensory organ well-defined, hemispherical (Figs. 3C-2, D-1); anterior sensory lobe (Figs. 3C-3, D) bears terminal sensory organ (Figs. 3C-4, D-2), lateral sensory organ (Fig. 3D-3), supralateral sensory organ (Fig. 3D-4), and pit sensory organ (Fig. 3D-5); two medial, papilliform integumental petals (Figs. 3C-5, D-6, E-1), four, lateral, spatulate or papilliform, integumental petals (Figs. 3C-6, D-7, E-2) above each mouthhook (Figs. 3C-7, E-3), lower, lateral petal separate from stomal sense organ (Figs. 3C-8, D-8, E-4) ventrolaterad of anterior sensory lobe; none (Figs. 3C, D), or sometimes one, oral ridge (Fig. 3E-5) laterad of each anterior sensory lobe; mouthhook bidentate, anterior tooth, concave ventrally (Figs. 3E-6); median oral lobe laterally compressed, apically pointed (Figs. 3C-9, E-7); anterior thoracic spiracle on posterior margin of prothorax bears two subglobose papillae (Figs. 3B-4, F-2); mesothoracic, lateral spiracular complex with six verruciform sensilla in vertical series (Fig. 4A-1), mesothoracic spiracle not seen; metathoracic lateral spiracular complex with nearly closed, lateral spiracle (Fig. 4B-1) and four verruciform sensilla (Figs. 4A-2, B-2) in vertical series posterior to spiracle; lateral spiracular complex of first abdominal segment consists of nearly closed spiracle (Figs. 4A-3, C-1) and three verruciform sensilla in vertical series posterior to spiracle (Figs. 4A-4, C-2); caudal segment with pair of posterior spiracular plates (Figs. 4D-1, E-1, F) surrounded by hemispherical minute acanthae (Figs. 4D-2, E-2, F-1) interspersed dorsomedially, medially, and less so, ventromedially with open pores (Figs. 4D-3, E-3); each posterior spiracular plate bears three, smoothly flattened, ovoid rimae (Fig. 4F-2), ca. 0.01 mm in length, and four spinose interspiracular processes, each ca. 0.004 mm long (Fig. 4F-3).

The habitus of the third instar of *G. rufipes* resembles that of *G. timberlakei* (Goeden et al. 1995). In both species, the venter of the thorax and the caudal segment are darkly pigmented (Figs. 6C, Goeden et al. 1995) and minute acanthae circumscribe the meso- and metathorax and abdomen, and especially noteworthy, the posterior surface of the caudal segment, also is dotted prominently with scattered pores (Figs. 4D-3, E-3; Goeden et al. 1995). The prothorax and gnathocephalon of both species are smooth and free of minute acanthae (Fig. 3C, Goeden et al. 1995).

Two medial and four lateral integumental petals are present in *G. rufipes* (Figs. 3C-5, -6, D-6, -7, E-1, -2); whereas, *G. timberlakei* has two medial and six lateral integumental petals (Goeden et al. 1995, un-

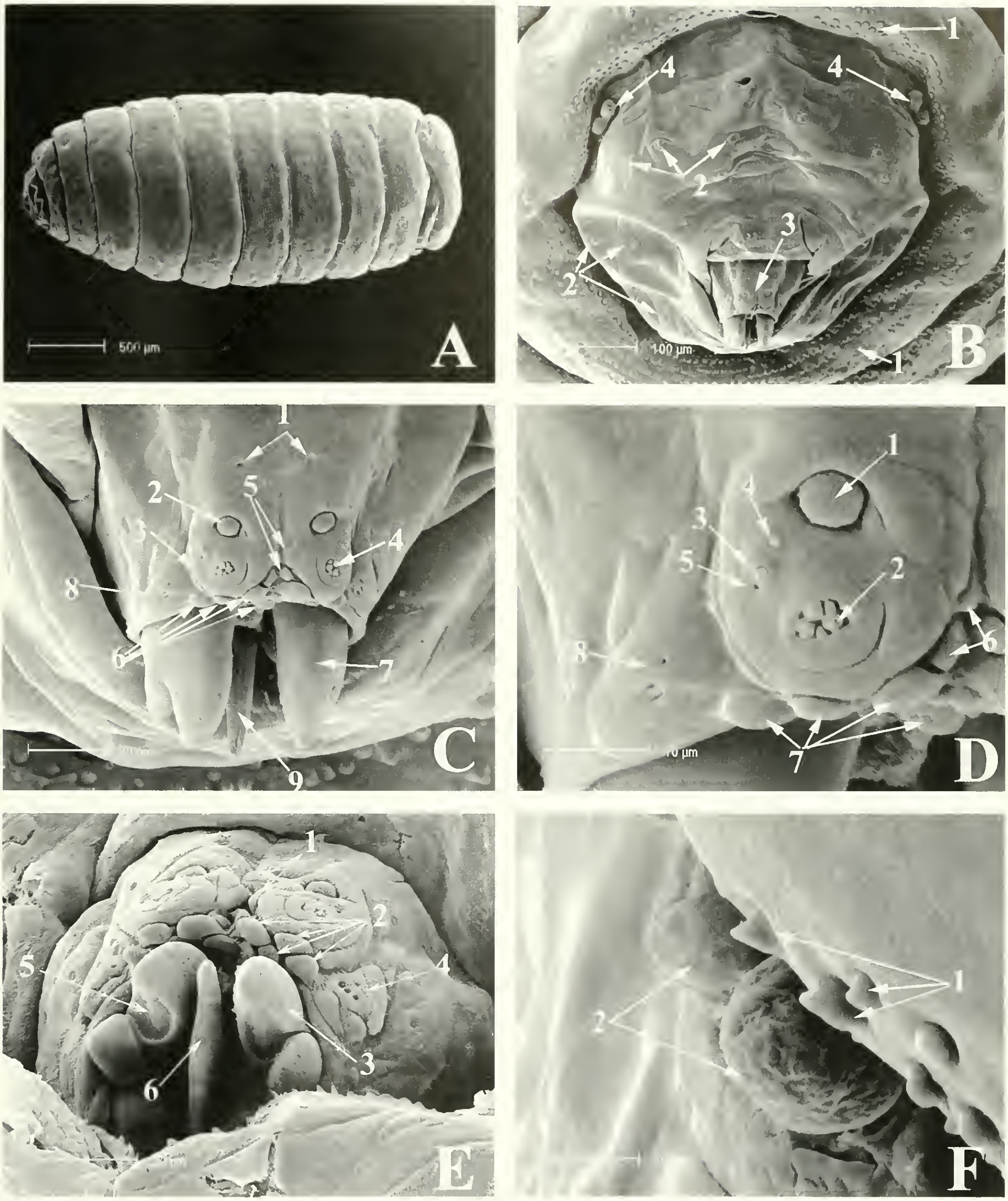

Fig. 3. Third instar of *Goedenia rufipes*: (A) habitus, anterior to left; (B) gnathocephalon and prothorax, frontolateral view, 1—minute acanthae, 2—verruciform sensilla, 3—gnathocephalon, 4—anterior spiracle; (C) gnathocephalon, frontal view, 1—pores, 2—dorsal sensory organ, 3—anterior sensory lobe, 4—terminal sensory organ, 5—medial integumental petals, 6—lateral integumental petals, 7—mouthhook, 8—stomal sense organ, 9—median oral lobe; (D) gnathocephalon, close-up, 1—dorsal sensory organ, 2—terminal sensory organ, 3—lateral sensory organ, 4—supralateral sensory organ, 5—pit sensory organ, 6—medial integumental petals, 7—lateral integumental petals, 8—stomal sense organ; (E) oral cavity of gnathocephalon, ventral view 1—medial integumental petals, 2—lateral integumental petals, 3—mouthhook, 4—stomal sense organ, 5—posterior concavity on anterior tooth of mouthhook, 6—median oral lobe; (F) anterior spiracle, 1—minute acanthae, 2—papillae.

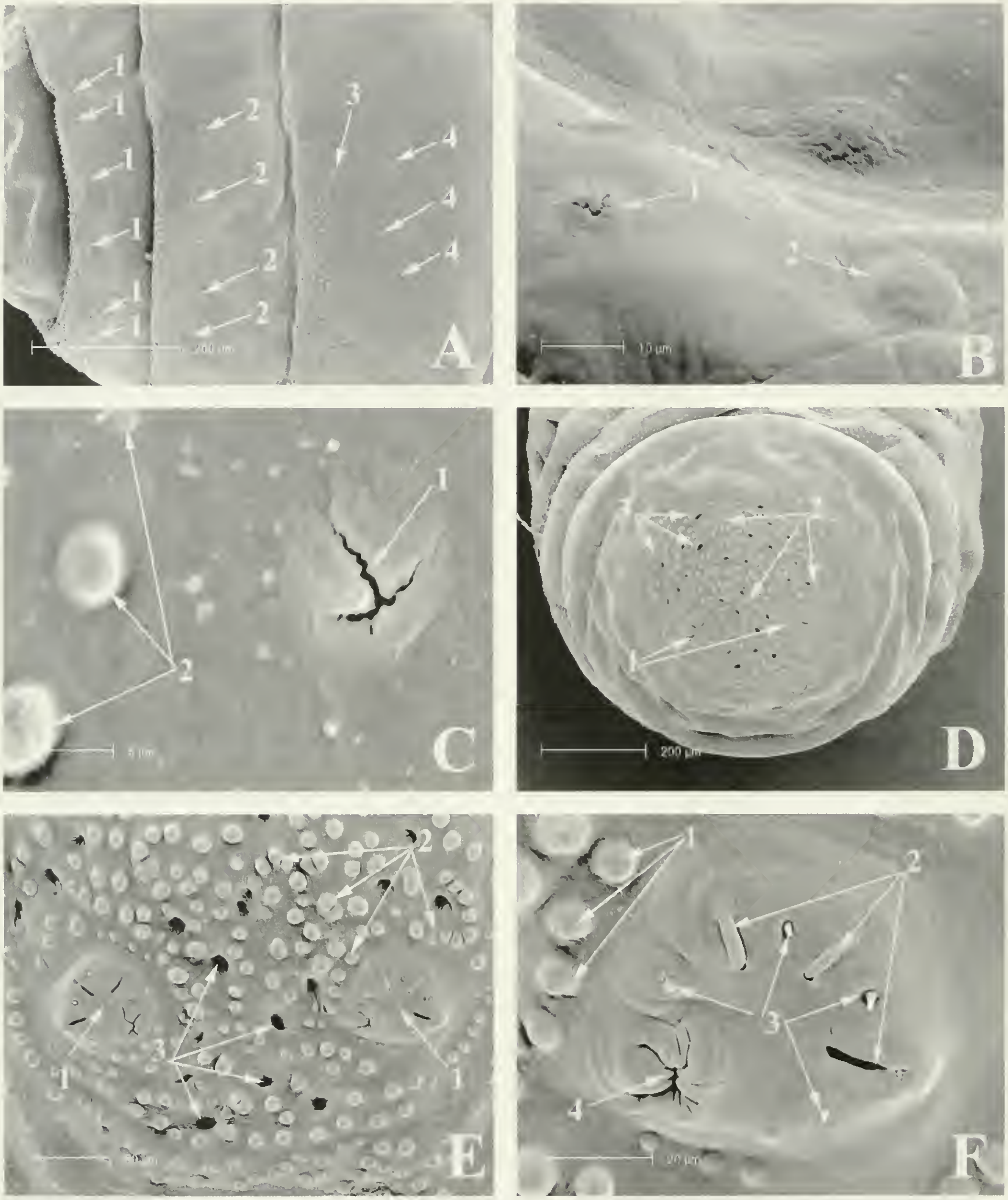

Fig. 4. Third instar of *Goedenia rufipes*, continued, (A) lateral spiracular complexes, 1—verruciform sensilla on mesothorax, 2—verruciform sensilla on metathorax, 3—spiracle on first abdominal segment, 4—verruciform sensilla on first abdominal segment, (B) 1—metathoracic lateral spiracle, 2—verruciform sensillum; (C) 1—lateral spiracle of first abdominal segment, 2—minute acanthae; (D) caudal segment, 1—posterior spiracular plates, 2—minute acanthae, 3—pores; (E) caudal segment, close-up, 1—posterior spiracular plates, 2—minute acanthae, 3—pores; (F) posterior spiracular plate, 1—minute acanthae, 2—rimae, 3—interspiracular processes, 4—ecdysial scar.

published data). The lateralmost integumental petals are separated from the stomal sense organs in both species (Figs. 3C-8, D-8, E-4; Goeden et al. 1995).

Like *G. timberlakei* (Goeden et al. 1995, unpublished data), the third instar of *G. rufipes* lacks oral ridges on either side of the mouth opening, and ventral or ventrolateral to the stomal sense organ (Fig. 3E).

The mouthhooks of the third instars of *G. rufipes* (Fig. 3E-6), like those of *G. timberlakei* (Goeden 2001c), are bidentate; however, the teeth of the latter species were described as "conical", but in the former species the anterior tooth is concave ventrally (Fig. 3E-6). Unfortunately, a vertical view of the oral cavity such as obtained for *G. rufipes* (Fig. 3E), was not obtained for *G. timberlakei* (Goeden et al. 1995, unpublished data).

The anterior spiracle of both species bears only two papillae (Figs. 3B-4, F; Goeden et al. 1995).

The lateral spiracular complex of the mesothorax of *G. rufipes* includes six verruciform sensilla in a vertical series (Fig. 4A-1); whereas, in *G. timberlakei*, this same complex includes only two verruciform sensilla (Goeden et al. 1995). Likewise, the metathoracic lateral spiracular complex of *G. rufipes* includes four verruciform sensilla (Fig. 4A-2), but again, only two such sensilla in *G. timberlakei* (Goeden et al. 1995). Finally, three verruciform sensilla in a vertical series comprise the lateral spiracular complex of the first abdominal segment of *G. rufipes* (Figs. 4A-4, C-2), but only one verruciform sensillum is found on this segment in *G. timberlakei* (Goeden et al. 1995).

Differences noted between the second and third instars of *G. rufipes* include the reduction in the number of papillae on the anterior thoracic spiracle from three (Fig. 2E) to two (Figs. 3B-4, F-2). The number of lateral integumental petals also is reduced from five in the second instar (Figs. 2C-8, D-2) to four in the third instar (Figs. 3C-6, D-7, E-2). The stability of these numbers is questionable, and their separation as medial versus lateral integumental petals is problematic because more precise counts and assessments would require considerably more replication of similar views of gnathocephala than were available to the author.

Puparia: Light (Fig. 6D) to dark (Fig. 6E), reddish brown with dark brown to black, anterior stripe on venter of meso- and metathorax and similarly dark caudal segment, elongate-ellipsoidal, with smoothly rounded anterior end and truncated posterior end (Fig. 5A). Anterior end bears invagination scar and raised, bilobed, anterior thoracic spiracles (not shown). Flattened posterior end of caudal segment studded with smoothly rounded, hemispherical, minute acanthae (Fig. 5B-1) interspersed with open pores (Fig. 5B-2). A pair of raised, oval, posterior spiracular plates (Fig. 5B-3) each bear three oval rimae interspersed with four, peg-like interspiracular processes (not shown, see Fig. 4F and above description of third instar for details). Ten puparia dissected from flower heads of *Isocoma acradenia* averaged 2.73 ± 0.07 (range, 2.50–3.17) mm in length; 1.15 ± 0.04 (range, 1.05–1.31) mm in width.

Distribution and Hosts

To date, *Goedenia rufipes* only is known from southern California and southwestern Arizona north of Mexico (Foote et al. 1993); however, it probably ranges well into Mexico attacking flower heads at least of *Chrysothamnus teretifolius* and *Isocoma acradenia*. The former host is newly reported (Goeden 1987, Foote et al. 1993). Both of these confirmed hosts are Asteraceae belonging to the subtribe Solidagininae of the tribe Astereae (Bremer 1994). Accordingly, *G. rufipes* probably is a narrowly oligophagous tephritid, that to date has not been reared by me from flower heads of several other species of these two, common and widespread, plant genera. *Chrysothamnus teretifolius* occurs on rocky slopes and flats from 600 to 4,000 m in Cal-

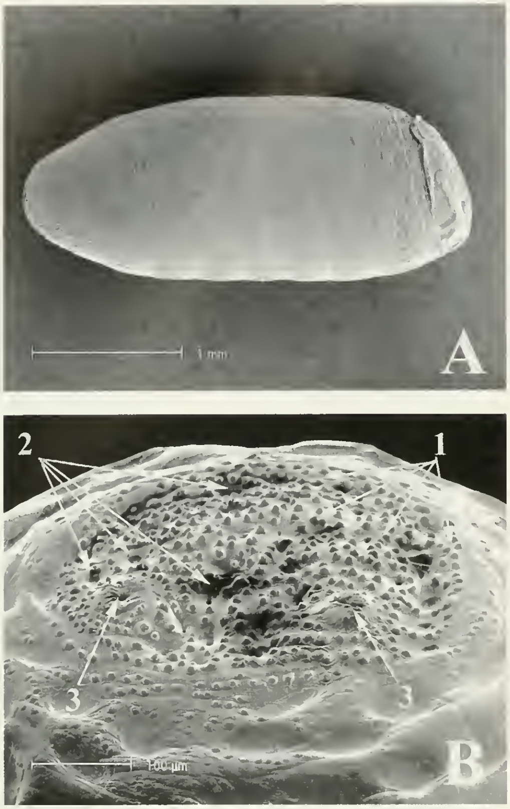

Fig. 5. Puparium of *Goedenia rufipes*: (A) habitus, anterior to left, (B) caudal segment, 1—minute acanthae, 2—pores, 3—posterior spiracular plates.

ifornia to southern Nevada and northwestern Arizona (Hickman 1993), including the higher parts of the Lower Sonoran Zone and arid, lower margins of the Upper Sonoran Zone as delimited by Shreve and Wiggens (1964). *Isocoma acradenia* occurs on sandy or clay soils in alkaline or gypsum flats or slopes below 1,300 m in California, Arizona, Nevada, and Baja California, Mexico (Hickman 1993).

BIOLOGY

Egg.—Eggs of *G. rufipes* are inserted singly, pedicel-last, parallel to the long axes of and between the outer phyllaries of closed, preblossom flower heads of *I. acradenia*.

Larva.—Upon eclosion, the first instar tunneled immediately through the inner bracts and into an ovule of a preblossom flower head. It fed with its body perpendicular to and its mouthparts toward the receptacle within an ovule, which it first excavated, then exited and entered an adjacent ovule. The receptacle was neither abraded or pitted by such feeding.

Second instars (Fig. 6A) mainly continued feeding on ovules in closed, preblossom flower heads, but a few were found feeding on soft achenes in open, blossom or postblossom flower heads (Fig. 6A). They usually fed within the ovules or achenes with their bodies perpendicular to the receptacles, but always above the receptacles. Receptacles of 10 flower heads containing second instars averaged 1.45 ± 0.12 (range, 0.85–1.99) mm in diameter. These 10 flower heads each contained a single larva that had damaged an average of 3.2 ± 0.6 (range, 1–6) ovules/achenes, or about 28% of the average total of 11.6 ± 0.8 (range, 7–14) ovules/achenes per flower head counted within the 10 flower heads. However, more than 600 uninfested flower heads were individually dissected in order to locate these 10 (1.7%) flower heads infested with second instars.

Third instars in flower heads fed with their long axes oriented perpendicular to the receptacles, and with their mouthparts directed towards the receptacles, that they usually scored or pitted deeply (Fig. 6B, C). Fifty flower heads (three, closed preblossom; six, open blossom; 41 postblossom) were dissected that contained an average of 1.3 ± 0.1 (range, 1–4) third instars. These 55 flower heads averaged 1.8 ± 0.05 (range, 1.1–2.9) mm in diameter and contained an average total of 13.9 ± 0.4 (range, 8–20) ovules/achenes, of which on average 7.1 ± 0.5 (range, 1–15) ovules/achenes were damaged or ~51%. However, well over 1,000 flower heads were individually dissected to locate these 55 infested flower heads. Receptacles that consistently were pitted suggested that sap constituted at least part of the diet of third instars of *G. rufipes*. Goeden (1988), Headrick and Goeden

(1990), Goeden and Headrick (1992), Goeden et al. (1993, 1995), Headrick et al. (1996), Goeden and Teerink (1997) first noted, described, and discussed sap feeding by florivorous species of Tephritidae in the genera *Trupanea, Paracantha, Neaspilota, Tephritis, Goedenia* (as *Urophora*), *Dioxyna,* and *Xenochaeta,* respectively. Upon completing feeding, the larvae oriented with their anterior ends away from the receptacles, retracted their mouthparts, and formed puparia (Figs. 6D, E).

Pupa.—The receptacles of nine flower heads that contained an average of 1.3 ± 0.2 (range, 1–2) puparia (Figs. 6D, E) averaged 1.9 ± 0.1 (range, 1.4–2.3) mm in diameter. The receptacles were deeply pitted in all nine flower heads, further confirming that sap constituted part of the diet of third instars. The posterior end of the puparium rested in the smooth cup-like depression and the middle and anterior part of the puparium was surrounded by excavated floret fragments that formed a close, central cell not glued to the puparium.

Adult.—The premating and mating behaviors of *G. rufipes* were not studied in the field, but were observed in petri dish arenas of the type found to be useful with many other nonfrugivorous, tephritid species (Headrick and Goeden 1994). The wings of both sexes were held away from the body at about 45° without supination when at rest (Fig. 6F). Both sexes exhibited wing hamation (Headrick and Goeden 1994) throughout the day concurrent with other behaviors, i.e., grooming, resting, and feeding; this also was the most common wing movement reported for *G. timberlakei* (Goeden et al. 1995). Premating behaviors observed with *G. rufipes* included males and females tracking individuals of the opposite sex, during which males sometimes swayed and usually exhibited abdominal pleural distension (Fig. 6F). The male aggressively mounted a female by jumping upon her, usually from the front, then turning and forcefully grasping her wing bases, thoracic pleura, and aculeus for purchase, while the female usually struggled, resisted his attempts to part her wings, and pushed against the male with her hind legs and tarsi. The males countered by grasping and raising the oviscape with the mid- and hind tarsi, while positioning the apex of the exserted aculeus of a receptive female against his epandrium. Nonreceptive females did not exsert their aculeus or pressed the exserted aculeus against the substrate so as to hinder or prevent proper positioning by males. But if receptive, the female allowed the male to raise her oviscape and extended her aculeus to its full length in reponse to his copulatory induction behavior ("CIB"; Headrick and Goeden 1994, 1999). The CIB mainly consisted of the male rapidly rubbing his hind tarsi, back and forth, along her oviscape. The final mating position commonly had the wings of the male parted at about 20° (Fig. 6H), the wings of the female parted at 60° (Figs. 6G, H), with both pairs of wings centered over the midlines of the flies (Figs. 6G, H). The foretarsi of the male grasped the dorsum of the abdomen of the female laterally at the thoracic juncture, the midtarsi grasped the oviscape at its base, and the hindtarsi crossed under the oviscape or occasionally rested on the substrate (Fig. 6I). The body of the female paralled the substrate with the oviscape raised about 30°, while the extended aculeus pushed the male upward and backward (Fig. 6I). Five pairs were observed to mate once or twice per day for a total of nine matings that lasted an average of 96 (range, 20–285) min. Females became restless before termination of mating by pushing against the males with their hind tarsi, by lofting their wings so as to push them against the males, and by fully extending their aculeus. The male in turn countered this behavior with CIB, rocked from side to side to regain purchase or to avoid the female's pummeling, and sometimes rapidly vibrated his wings, all of which appeared to calm the female and allow coitus to continue. Females sometimes walked about the arenas carrying the males while remaining

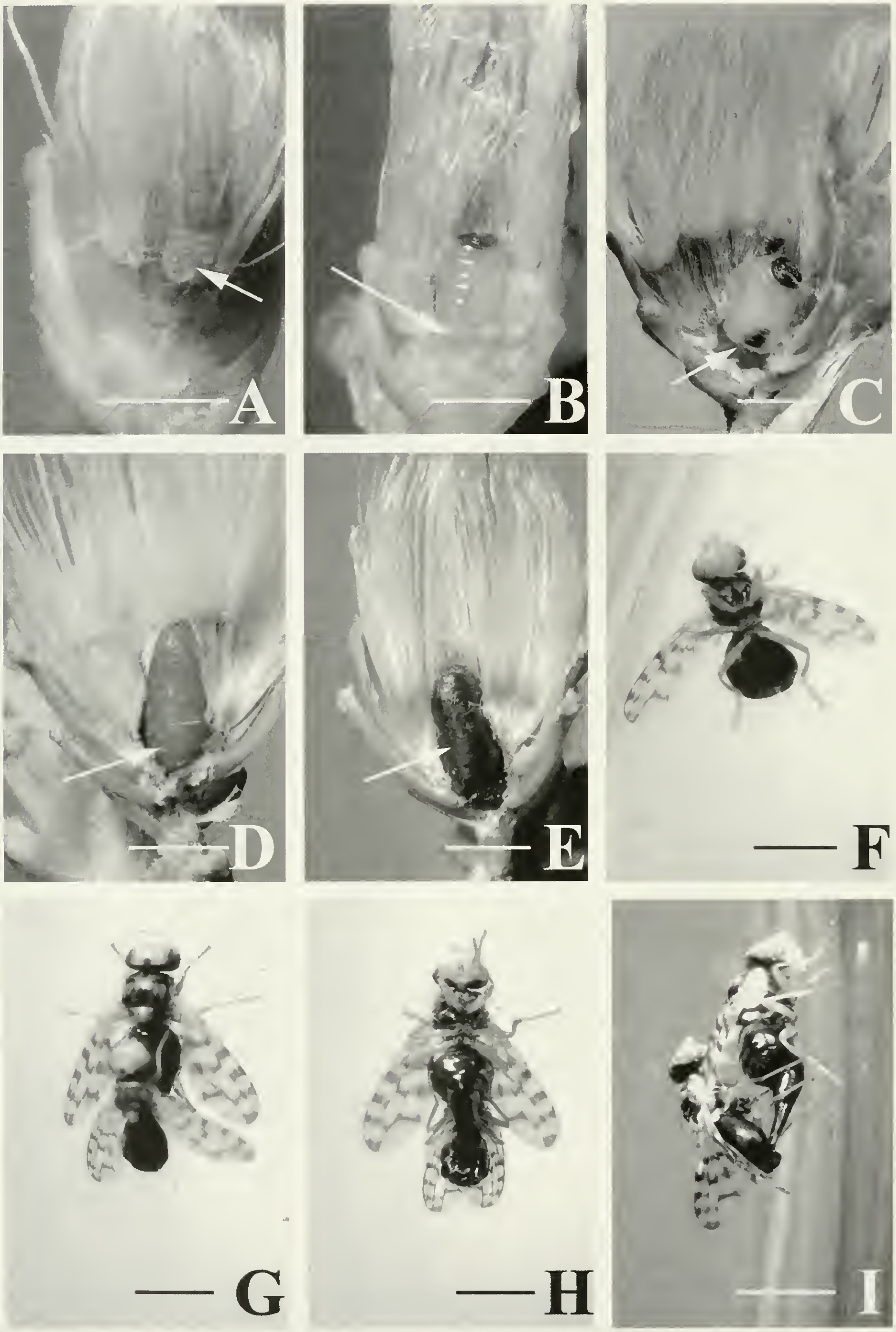

Fig. 6. Life stages of *Goedenia rufipes* (A–E in flower heads of *Isocoma acradenia*): (A) second instar (arrow) feeding on floret; (B) third instar (arrow) feeding deeply in receptacle of flower head; (C) third instar showing dark, ventral infuscation (arrow); (D) newly formed, light brown puparium (arrow); (E) dark overwintered puparium (arrow); (F) ventral view of adult male with wings in resting position with inflated abdominal pleura; (G) mating pair, dorsal view; (H) mating pair, ventral view; (I) mating pair, lateral view. Lines = 1 mm.

in copula. One male was observed to attempt mating with a newly dead female continuously for 5 h. Separations of three other pairs were observed, during which the male initially moved slightly forward while pulling the aculeus vertically upward, then rapidly turned and laterally walked off the female, and quickly posteriorly away from the female, while pulling free his genitalia. The separation of one pair took 15 s.

Seasonal history.—The life cycle of *G. rufipes* in southern California follows an aggregative pattern (Headrick and Goeden 1994, 1998) in which the third instar, puparium, and some adults variously are the overwintering stages. Adults emerge from some of the puparia formed in late-fall, early winter (October–December) and these unmated, sexually immature adults overwinter. The remaining, nonfeeding third instars, prepuparia, and puparia overwinter in dead flower heads remaining on dormant *Chrysothamnus teretifolius* and *Isocoma acradenia.* These overwintered individuals emerge as adults in late winter (February–March) and either aggregate on one or more, as-yet-unknown, spring blooming, alternate hosts to mate and produce an as-yet-undetected spring generation. Or, the overwintered and newly emerged adults continue to pass the following spring and summer (April–August), possibly still as non-reproductive individuals feeding in mountain meadows and riparian habitats bordering the low-elevation, Sonoran Desert. They eventually aggregate on preblossom, fall-blooming, *C. teretifolius* and *I. acradenia,* mate, and subsequently oviposit in the small, newly-formed, closed, preblossom flower heads.

Natural enemies.—Fourteen *Eurytoma* sp. (Hymenoptera: Eurytomidae) and 12 *Pteromalus* sp. (Hymenoptera: Pteromalidae) were reared from separate puparia of *G. rufipes* as solitary, larval-pupal endoparasitoids. Two *Eupelmus* sp. (Hymenoptera: Eupelmídae) also were reared from insectary cagings of mature flower heads as possible solitary endoparasitoids, as reported from *G. timberlakei* by Goeden et al. (1995).

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DESCRIPTION OF *AEGESEUCOELA* BUFFINGTON, NEW NAME, WITH NOTES ON THE STATUS OF *GRONOTOMA* FÖRSTER (HYMENOPTERA: FIGITIDAE: EUCOILINAE)

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Abstract.—***Aegeseucoela* Buffington**, a replacement name for *Moneucoela* Dalla Torre and Kieffer 1910, is described. *Aegeseucoela* contains two previously described species, *Aegeseucoela flavotincta* (Kieffer), **n. comb.**, and *A. grenadensis* (Ashmead), **n. comb.**, both of which are redescribed. The status of *Gronotoma* Förster is discussed, and the synonymy of *Eucoilidea* Ashmead with *Gronotoma* is formally documented. ***Gronotoma nigricornata* Buffington, new name**, is proposed to replace *Eucoilidea nigricornis* Kieffer 1908. Thirty-two **new combinations** in *Gronotoma* are given, and a checklist of the world species of *Gronotoma* is provided. Species in both *Aegeseucoela* and *Gronotoma* are common parasitoids of Agromyzidae (Diptera). *Aegeseucoela* is restricted to the New World tropics and subtropics, and *Gronotoma* is common in the Afrotropics, as well as Asia, Australia, and the Palearctic and Nearctic regions.

Key Words: *Aegeseucoela, Gronotoma,* Eucoilinae, Figitidae, Agromyzidae, Cynipoidea

Eucoiline wasps are endoparasitoids of cyclorrhaphous Diptera inhabiting a variety of habitats. These wasps are generally shiny black to dark reddish brown and range in size from 0.5 mm to 5 mm. The Eucoilinae contain 82 genera and nearly 1000 species, and are by far the most diverse of all figitid subfamilies (Ronquist 1999). Only two major bodies of work have attempted to classify all of the eucoiline genera (Dalla Torre and Kieffer 1910, Weld 1952), and for the most part, eucoiline classification schemes have resulted in a great deal of chaos (discussed in Nordlander 1982b). Presently available identification keys to eucoiline genera (Dalla Torre and Kieffer 1910, Weld 1952) are largely useless due to the reliance on a few key features, none of which are very dependable.

Nordlander (1976, 1978, 1980, 1981, 1982a, 1982b) was the first to treat eucoiline classification from a phylogenetic point of view. Through these works, clear generic and species level definitions were provided for the first time for a number of Palearctic and cosmopolitan taxa. Nordlander (1982b) summarized his findings by proposing informal genus groups defined by explicit morphological criteria, a first step towards a more logical and natural classification scheme.

An investigation into the phylogenetics and classification of one of these informal genus groups, the *Gronotoma* group (Buffington, unpublished data), resulted in the identification of a clade of eucoiline wasps of questionable taxonomic placement. Two previously described species were found to belong in this clade, described here as *Aegeseucoela,* and both species are redescribed. Both species are restricted to the New World tropics and subtropics where they have been reared on numerous occasions from agromyzid flies (O. Lewis, unpublished data).

The first indication of the need for a new eucoiline genus was uncovered during an examination of Kieffer's eucoiline types. The type specimen of *Rhabdeucoela flavotincta* Kieffer did not possess any of the diagnostic features of the genus *Rhabdeucoela* Kieffer, and the species was most likely placed in *Rhabdeucoela* based on the relatively well-developed mesoscutal keel and large scutellar plate (neither of which are universally diagnostic features of *Rhabdeucoela*). Furthermore, *Rhabdeucoela flavotincta* was later moved to two different genera simultaneously by Weld (1952), *Moneucoela* Dalla Torre and Kieffer 1907 and *Tropideucoila* Ashmead 1903. This species is not readily accommodated in any of the three genera in which it was previously placed, and it was therefore coded separately in a phylogenetic analysis (Buffington, unpublished data), the results of which indicate none of the three genera (i.e., *Rhabdeucoela, Moneucoela,* and *Tropideucoila*) will remain monophyletic if this species is included within them. Therefore, *Aegeseucoela* is proposed to accommodate this species and a second species (discussed below).

The second species, *Diranchis grenadensis* Ashmead, also has a confusing taxonomic history. It was one of two species originally included in *Moneucoela* Dalla Torre and Kieffer 1910, which is itself a junior homonym of *Moneucoela* Dalla Torre and Kieffer 1907. Rohwer and Fagan (1917) apparently missed Kieffer's 1907 publication containing the description of *Moneucoela,* and determined that the genus was described as new in Dalla Torre and Kieffer (1910). Further, Rohwer and Fagan (1917) designated *Diranchis grenadensis* Ashmead as the type species of *Moneucoela* Dalla Torre and Kieffer 1910. Weld (1952) considered this a mistake, removed *grenadensis* (Ashmead) from type status of *Moneucoela* Dalla Torre and Kieffer, and designated *tinctipennis* Kieffer (one of two species described in Kieffer 1907) as the type species of *Moneucoela* Dalla Torre and Kieffer 1907. Weld (1952) did not include *grenadensis* within the included species list for *Moneucoela,* resulting in the placement of the species as *incertae sedis.*

In their revision of *Moneucoela* Dalla Torre and Kieffer 1907, Diaz and Gallardo (1998) did not mention *Moneucoela* Dalla Torre and Kieffer 1910, nor the two species that were included in this genus when it was proposed (Dalla Torre and Kieffer 1910). Of the two species originally included in *Moneucoela* Dalla Torre and Kieffer 1910, one is congeneric with *flavotincta* and is redescribed below as *Aegeseucoela.* The second species belongs in *Zaeucoila* Ashmead (Buffington, unpublished data) and will be treated in a subsequent paper. Furthermore, since *grenadensis* Ashmead was designated as the type species for *Moneucoela* Dalla Torre and Kieffer 1910 by Rohwer and Fagan (1917), and *Moneucoela* Dalla Torre and Kieffer 1910 is preoccupied by *Moneucoela* Dalla Torre and Kieffer 1907, *Aegeseucoela* is proposed here as a replacement name for *Moneucoela* Dalla Torre and Kieffer 1910.

The second part of this paper is dedicated to a discussion on the status of the eucoiline genus *Gronotoma* Förster. *Gronotoma* resides within a basal portion of the eucoiline clade (Fontal et al., in preparation), as is the case with *Aegeseucoela* (though these two genera do not form a monophyletic group) (Buffington, unpublished data). Similar to *Aegeseucoela,* species of *Gronotoma* have all been reared from agromyzid flies (Scheffer unpublished data, Davidson 1963, Harding 1965, Viraktamath et al. 1993), mostly found within the genus *Melanagromyza* Hendel (Abe and Konishi 1995; Greathead 1969, 1971). The host preference for agromyzid flies appears to be a plesiomorphic feature within the Eucoilinae (Fontal et al. in preparation).

Gronotoma presently contains 47 described species (including synonymies proposed below), making this genus the most diverse of all eucoiline genera that specialize on agromyzid hosts. Species of *Gronotoma* have a worldwide distribution and the Afrotropics are particularly speciose (Quinlan 1986). Species are also very common in the Oriental (Abe and Konishi 1995), the Palearctic, and the Nearctic regions (Dalla Torre and Kieffer 1910, Weld 1952). Members of this genus are rarely recorded from the Neotropical Region but are frequently collected throughout subtropical Mexico (Buffington, unpublished data). Because of their potential usefulness in the biological control of pest Agromyzidae and the relatively high global diversity of species within the genus, the status of *Gronotoma* is reviewed and includes an important synonymy. Phylogenetic evidence (Buffington, unpublished data) supports the conclusions of Hedicke (1930) and Beardsley (1988) with respect to the synonymy of *Eucoilidea* Ashmead with *Gronotoma*. A world checklist of the species of *Gronotoma* is presented, with nomenclatural notes where applicable.

BMNH	The Natural History Museum, London, UK (S. Lewis).
BPBM	Bernice P. Bishop Museum, Honolulu, HI, USA.
CAS	California Academy of Sciences, San Francisco, CA, USA (W. Pulaski, R. Zuparko).
CNC	Canadian National Collection of Insects, Ottawa, Canada (J. Huber, J. Read, L. Masner).
CUIC	Cornell University Insect Collection, Ithaca, NY, USA (E.R. Hoebeke).
IBPR	Institute of Biology at the Academy of the People's Republic of Romania.
ICIPE	International Centre of Insect Physiology and Ecology, Nairobi, Kenya (R. Copeland).
KPU	Laboratory of Entomology, Kyoto Prefectural University, Kyoto, Japan.
MRAC	Musée Royale de l'Afrique Centrale, Tervuren, Belgium.
USNM	National Museum of Natural History, Smithsonian Institution, Washington, DC, USA (D. Smith).
ZIN	Zoological Institute, Russian Academy of Sciences, St. Petersburg, Russia.
ZMHB	Zoologisches Museum, Humboldt Universität, Berlin, Germany (F. Koch).

Type specimens (holotypes and paratypes) were generously loaned to me by the CAS (containing a large portion of Kieffer's eucoiline types originally housed in Pomona), the USNM (containing many of Ashmead's and Weld's eucoiline types), the BMNH (containing Quinlan's eucoiline types), and the ZMHB (containing many of Förster's eucoiline types).

While sorting unidentified eucoilines in the AEIC in the summer of 2000, I found an extensive series of eucoilines conspecific with the type specimen of *Aegeseucoela flavotincta,* all collected from Costa Rica. Additionally, a long series of *Aegeseucoela flavotincta* and of *A. grenadensis* were sent to me for identification by O. Lewis (Silwood Park, UK); these specimens were of particular importance since host data accompanied each specimen. Unidentified specimens of African *Gronotoma* were generously loaned to me by Dr. Robert Copeland (ICIPE).

Institutions and individuals that donated ethanol preserved specimens for this study were: CNC; TAMU; and Dr. Owen Lewis, Imperial College at Silwood Park, UK. All SEM images utilized in this study were prepared digitally on a JOEL JSM-5600 SEM (operated by James Ehrman, Digital Microscope Facility, Mt. Allison University, Sackville, NB, Canada).

Terminology follows largely that of Weld (1921, 1952), Nordlander (1982b), Ron-

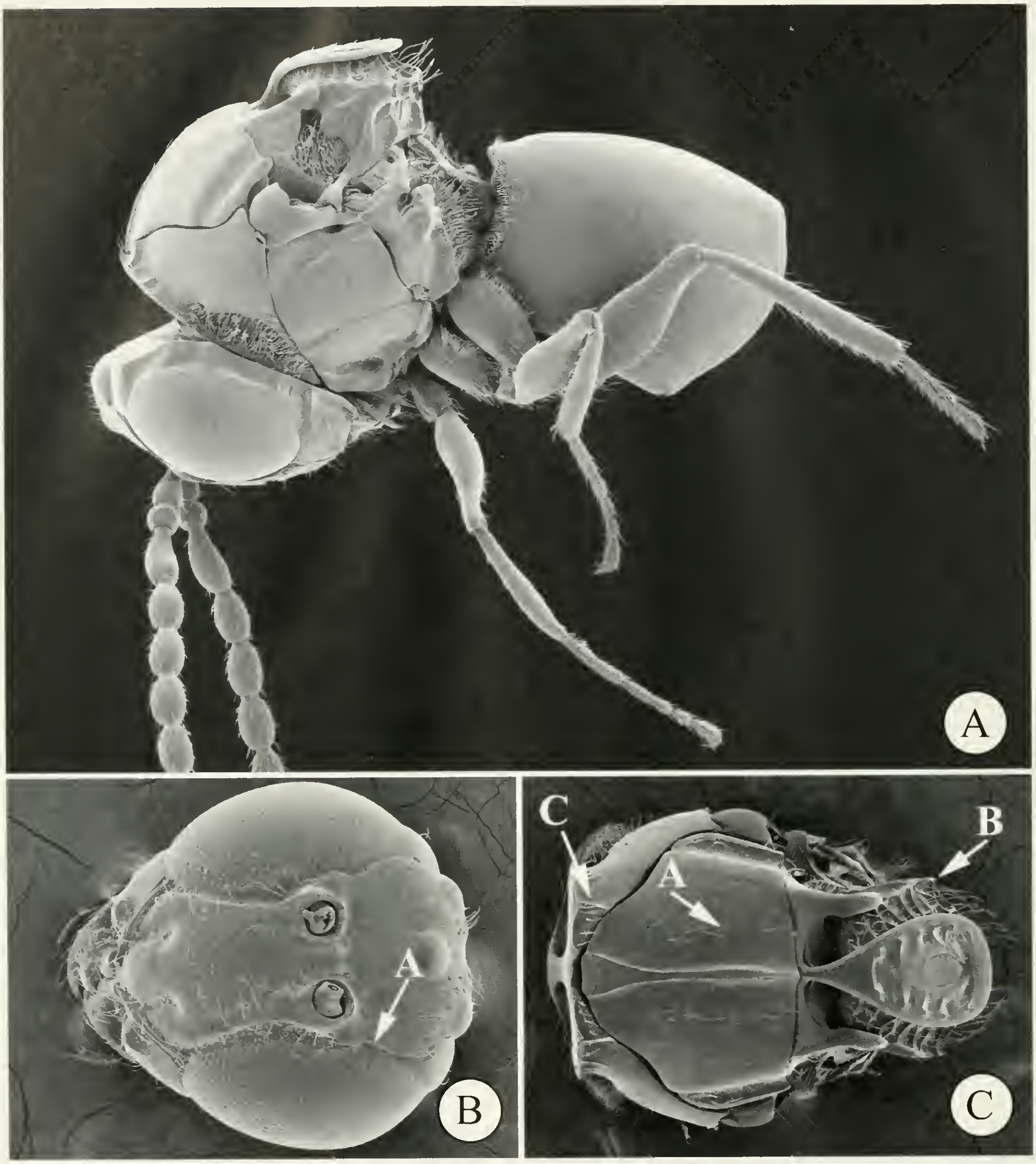

Fig. 1. *Aegeseucoela flavotincta.* A, Side view, habitus. B, Head, anterior view; A = orbital furrow complete to lateral ocellus. C, Mesosoma, dorsal view; A = parapsidal hair line; B = well developed lateraldorsal projections of scutellum; C = pronotal triangle.

quist and Nordlander (1989), and Ronquist (1995), with the following modifications: parapsidal ridges is preferred over parapsidal furrows, as found in Weld (1952); orbital furrows and pronotal triangle are new terms and are defined as such below.

Orbital furrow (Fig. 1B).—A distinct groove originating at either the lateral ocellus or the lateral side of the torulus (depending on the taxon) and lining the inner orbit of the eye, terminating at the clypeal margin after fusing with or paralleling the malar sulcus.

Pronotal triangle (Figs. 1C, 2C).—An

area on the dorsal surface of the pronotum bordered by the lateral pronotal carina, the pronotal plate and the anterior margin of the mesoscutum; found in genera with well developed pronotal ridges.

Aegeseucoela Buffington, new name

Moneucoela Dalla Torre and Kieffer 1910: 103, 888. Type species: *Diranchis grenadensis* Ashmead, designated by Rohwer and Fagan 1917. Preoccupied by *Moneucoela* Dalla Torre and Kieffer 1907.

Diagnosis.—Orbital furrows originating either at lateral ocellus or lateral side of torulus. Genal carina well developed, often flanged posterior to compound eye. Mesoscutal keel present, at least anteriorly. Parapsidal ridges absent. Parapsidal hair lines present. Laterodorsal projections of scutellum present to absent. R1 never tubular or pigmented (radial cell open). Most similar to *Zaeucoila* and *Agrostocynips*, but differs by the presence of the extended orbital furrows (in some species), the presence of parapsidal hair lines and R1 incomplete.

Description.—*Head:* Nearly glabrous, with a few scattered setae along lower face, clypeus, inner orbits of compound eyes, malar space and gena; orbital hair patches present. Ventral ¼ of lower face with admedial clypeal furrows converging towards clypeus. Orbital furrows present, originating at lateral side of torulus or at lateral ocelli (species dependent), terminating at malar sulcus. Malar sulcus simple. Malar space smooth with a single prominent conical protuberance. Genal carina present, extending from malar space to lateral ocelli, often undulating posterior to compound eye.

Antenna: Female, 13 segments, moniliform, semi-clavate; segments 3–13 subequal in length; rhinaria present on segments 3–13. Male, 15 segments, filiform; rhinaria present on segments 3–15; segments 4–15 subequal in length. Segment 3 slightly longer than 4, curved outwardly, excavated laterally.

Pronotum: Pronotal plate wide, with setae along dorsal margin; slightly crested and bifurcate dorsally; pronotal fovea open. Pronotal triangle present (Figs. 1C, 2C). Pronotal impression absent. Lateral aspect of pronotum (below pronotal triangle) smooth and glabrous. Lateral pronotal carina absent.

Mesoscutum: Smooth with some setae. Mesoscutal keel present, reaching posterior margin of mesoscutum; tapering posteriorly. Parapsidal ridges absent. Parapsidal hair lines present (Figs. 1C, 2C). Parascutal impression incomplete, narrow. Notauli absent.

Mesopectus: Upper part and lower part of mesopleuron glabrous and smooth. Dorsal margin of mesopleural triangle well defined, rounded ventrally. Mesopleural carina simple. Lower part of mesopleuron bordered by distinct precoxal carina; anterior surcoxal depression present, reticulate.

Scutellum: Scutellar plate ranging from medium to large; mid pit placed centrally on plate; plate truncated posteriorly; nearly always bearing tubercles and setae on dorsal surface. Dorsal surface of scutellum reticulate; margined laterally and posteriorly. Laterodorsal projections present, present to nearly absent (Figs. 1C, 2B, 2C); posterior projections absent.

Metapectal-propodeal complex: Metapectus nearly glabrous with a few scattered setae posteriorly. Spiracular groove with a well defined dorsal margin and a well defined to rounded ventral margin. Posterior margin of metapectus ridged. Metapleural ridge absent; submetapleural ridge variable from present to absent. Anterior impressions of metepimeron and metepisternum present. Anteroventral cavity semi-circular and setose. Propodeum covered in long setae. Lateral propodeal carinae semi-parallel, bowed at junction with auxiliary propodeal carinae; auxiliary propodeal carinae indistinct. Nucha glabrous, reticulate.

Wings: Hyaline, with base of forewing sometimes darkened; usually setose basally, always setose apically. R1 incomplete, mar-

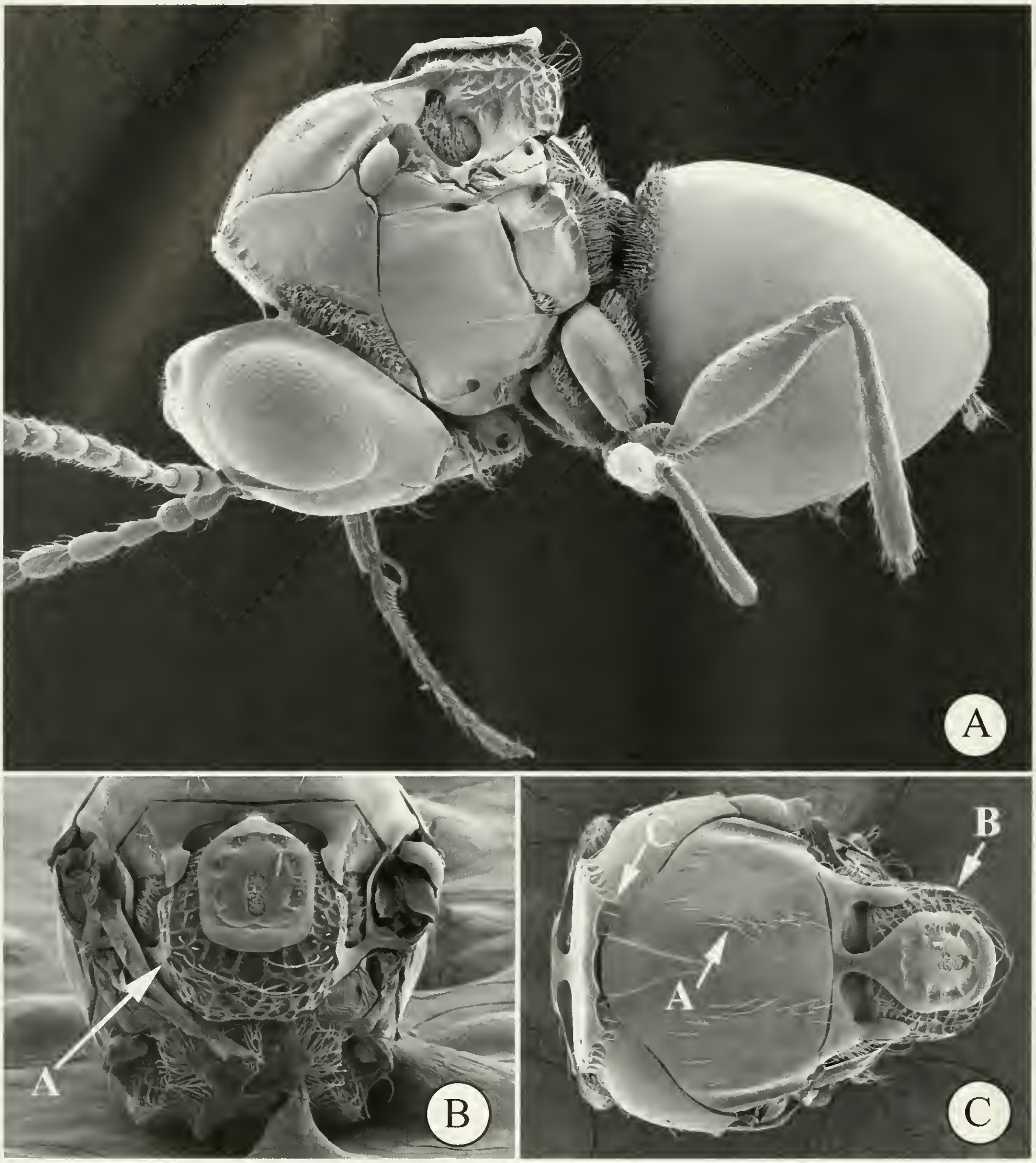

Fig. 2. *Aegeseucoela grenadensis.* A, Side view, habitus. B, Mesosoma, posterolateral view; A = reduced lateral projections of scutellum. C, Mesosoma, dorsal view; A = parapsidal hair line; B = reduced lateraldorsal projection of scutellum; C = pronotal triangle.

ginal cell as long as deep. Apical fringe present, short.

Legs: Fore and mid coxae about the same size, hind coxa about twice size of either fore or mid coxae. Fore coxa variably covered in long setae; mid coxa with anterior and posterior dorsoventral setal bands; hind coxa with a prominent setal band on hind margin. Femora and tibiae sparsely setose; tarsomeres with dense, appressed setae. Length of hind tarsomere 1 equal to 0.5× combined length of remaining hind tarsomeres.

Metasoma: Female: Sub-equal in size to mesosoma. Base of syntergum with a hairy ring present, ranging from complete to dorsally bare, comprised of short, semi-appressed setae and longer erect setae; remainder of metasoma glabrous. Micropunctures present on posterior ¼ of syntergum, and on remaining terga. Terga posterior to syntergum directed posteroventrally, resulting in a 70 degree angle between syntergum and remaining terga. Male: As in female but terga posterior to syntergum abruptly angled ventrally, resulting in a 90 degree angle between syntergum and remaining terga.

Biology.—I have examined specimens reared by O. Lewis from species of agromyzid flies in the genera *Haplopeodes* Steyskal (on Solanaceae) and *Calycomyza* Hendel (on Fabaceae).

Distribution.—Neotropical Region: Costa Rica, Belize, Mexico (Veracruz, Tamaulipas), Panama. Nearctic Region: USA: AZ. Previously only known from Guatemala (*flavotincta*) and Grenada (*grenadensis*).

Etymology.—*Aeges;* from Greek mythology, the name of Athena's dreaded shield, used here to reference the broad, shieldlike pronotal plate present in this genus; *eucoela,* a suffix frequently used by J.J. Kieffer in his treatments of the Neotropical Eucoilinae.

Comments.—Though this genus is closely related to *Zaeucoila* and *Agrostocynips,* phylogenetic evidence (to be found in a forthcoming publication by the author) suggests that neither of these genera will remain monophyletic if the species of *Aegeseucoela* are placed within them. The parapsidal hair lines, extended lateral protuberances on the scutellum and incomplete R1 vein on the forewing are reliable autapomorphies for the genus, and reliable synapomorphies for the species within the genus.

INCLUDED SPECIES

Aegeseucoela flavotincta (Kieffer), **n. comb.** *Rhabdeucoela flavotincta* Kieffer 1908:46, holotype in CAS (#10537). Redescribed below.

Aegeseucoela grenadensis (Ashmead), **n. comb.** *Diranchis grenadensis* Ashmead 1900: 248, holotype in BMNH. Redescribed below.

Aegeseucoela flavotincta (Kieffer), **new combination**
(Fig. 1)

Description.—As in description of genus except as follows: *Head:* Orbital furrows originating at lateral ocelli (Fig. 1B); genal carina continuing to near lateral ocelli, undulating posterior to compound eye (Fig. 1A). *Pronotum:* Pronotal crest prominent, bifurcate; pronotal ridge well developed. *Scutellum:* Scutellar plate large, nearly round; laterodorsal projections of scutellum sometimes well developed (Fig. 1C). *Metapectal-propodeal complex:* Submetapleural ridge usually well developed, connecting ventral margin of spiracular groove with posterior margin of mesopleuron. *Wings:* Base of forewing occasionally darkened; base of forewing ranging from glabrous to setose; forewing always setose apically. *Metasoma:* Hairy ring at base of syntergum often highly reduced (narrow), but always present.

Material examined.—Holotype ♀, Champerico, Guatemala. Coll. Baker. CAS #10537; the type specimen is in good condition, with Kieffer's original determination label (a large red label), the collection data labels, depository label and my determination label (slender white label). Additional material: BELIZE: Las Cuevas, Chiquibul Forest, Cayo District, 550 m, (various dates between Oct. 1997 and Sept. 1998), O.T. Lewis (13 ♀, 5 ♂). BOLIVIA: Yungas, XII.4.84, 2,400 m, Luis Peña (1 ♀); COSTA RICA: S. Rosa Park, Guan., various dates between 27.V.1976 and 10.VIII.1978, D.H. Janzen, Dry Hill (46 ♂, 90 ♀). MEXICO: Veracruz, 2 km SW Fortin, 8°54′N, 97°00′W, 2,700′, 23.VI.1997, J.B. Woolley, screen sweep (1 ♀); Veracruz, El Crucero nr Puente Nacional, 19°20′N, 96°26′W, 13.VI.1997, L.A. Wilson & J.B. Woolley (1 ♀); Tamaulipas, 97 km Ciudad Victoria, Hwy 70, 3.VII.1986, G. Zolnerowich & R. Trevino (1 ♀). PANAMA: Colon Prov., 2 km S Sabanitas, 4–15.VII.1999, 120 m, Gillogly & Woolley, MT 99/033 (1 ♀). U.S.A: Arizona, Portal, 19–23.VIII.1987, H. & M. Townes (4 ♂).

Distribution.—Neotropical and southern Nearctic regions (see above list of localities).

Biology.—I have examined specimens reared from the agromyzid flies *Haplopeodes* sp. on *Solanum erianthum* D. Don (Solanaceae) and *Calycomyza hyptidis* Spencer on *Hyptis capitata* Jacq. and *H. urticoides* Kunth (Lamiaceae) (data from O. Lewis).

Aegeseucoela grenadensis (Ashmead), **new combination**
(Fig. 2)

Description.—As in description of genus except as follows: *Head:* Orbital furrows originating at torulus; genal carina reduced, non-undulating, terminating at dorsal margin of compound eye (Fig. 2A). *Pronotum:* Pronotal crest reduced, sometimes absent; pronotal ridge sometimes absent. *Scutellum:* Scutellar plate ranging from medium to small; laterodorsal projections usually reduced/absent (Figs. 2B, 2C). *Metapectal-propodeal complex:* Submetapleural ridge completely reduced. *Wings:* Base of forewings occasionally darkened; usually entire forewing surface is setose. *Metasoma:* Hairy ring at base of syntergum thick and densely pubescent.

Material examined.—Holotype ♀: Balthazar (windward side), Grenada, West Indies. H.H. Smith (Coll.), BMNH; the type specimen is in poor condition, with the head plus thorax on one end of a pinned card, and the metasoma on the other end. The diagnostic features discussed below for this genus are all visible. Two 'type' labels are present on the specimen, one with a red circle and the second labeled 'BM Type Hym., y. 50'. Under this lies a label with 'paratype' printed on it. Below that is Ashmead's original determination label (in Ashmead's hand). Below that is the collection data, and finally below that, my designation label. Additional material: BELIZE: Las Cuevas, Chiquibul Forest, Cayo District, 550 m, (various dates between Oct. 1997 and Sept. 1998), O.T. Lewis (27 ♀, 20 ♂). MEXICO: Veracruz, 0.7 mi N Jilotepec, 19°36′N, 96°56′W, 3,680′, screen sweep, 14.VI.1997, L.A. Wilson & J.B. Woolley (1 ♀). PANAMA, Prov. Colon, Quebrada Lopez, MT, 2–4.VII.1999, A. Gillogly (1 ♀). VENEZUELA: Merida, Merida City, 8°35′54″N, 71°08′42″W, 1860 m, sweep veg. along trib. to Chama R., 3.V.1981, L. Masner (1 ♀).

Distribution.—Neotropical Region (see above list of localities).

Biology.—I have examined specimens reared from the agromyzid flies *Calycomyza verbenivora* on *Verbena* sp. (Verbenaceae); *Calycomyza* c.f. *cassiae* (Frost) on *Senna cobanensis* (Britton) H.S. Irwin & Barneby (Fabaceae); *Haplopeodes* sp. on *Solanum erianthum* (Solanaceae) (data from O. Lewis).

Comments.—The type specimen of *Diranchis grenadensis* Ashmead, as noted above, is labeled 'paratype.' In the original description of *D. grenadensis,* Ashmead stated "described from 1 female specimen." Since the single specimen, the locality data, and the description all agree, this must be the holotype.

Gronotoma Förster

Gronotoma Förster 1869: 342, 346. Type species: *Gronotoma sculpturata* Förster 1869: 346, by original designation.

Eucoilidea Ashmead 1887: 150, 154. Type species: *Eucoilidea canadensis* Ashmead, by subsequent designation (Ashmead 1903); synonymy by Hedicke (1930) and Beardsley (1988).

Eucoelidea Dalla Torre 1893: 15; Kieffer 1901: 159. Emendation.

Afrostilba Benoit 1956: 544. Type species: *Afrostilba nitida* Benoit, by monotypy. Synonymy by Quinlan (1986).

Ashmead (1887) proposed the genus *Eucoilidea* to accommodate *E. longicornis* and *E. canadensis*, but did not specify a type species. Later, Ashmead (1903) designated *Eucoilidea canadensis* as type species. Dalla Torre (1893) emended the original Ashmead spelling of *Eucoilidea* to *Eucoelidea*, and cites the former in brackets. *Eucoelidea* was recognized in Kieffer (1901), and Kieffer (1907, 1909) described four new species (and two varieties) in '*Eucoelidea* Ashm.' None of Kieffer's treatments of *Eucoelidea* mention the name's emendation from *Eucoilidea*. Based on Article 33.2.1 of the ICZN (1999), *Eucoelidea* is an emendation of *Eucoilidea* and is not available. Burks (1979) reported two apparent misspellings of *Eucoilidea*, namely *Eucoilidia* (Kieffer 1907) and *Eucoelidia* (Kieffer 1909); after consulting the original references, neither of these misspellings were found to exist.

It is apparent from Ashmead's (1887) original description of *Eucoilidea* that he made no comparison with *Gronotoma* before proposing the new genus, and Hedicke (1930) was the first to propose *Eucoilidea* as a synonym of *Gronotoma*. Weld (1952) and Quinlan (1986, 1988), however, subsequently maintained *Eucoilidea* as distinct from *Gronotoma*. Beardsley (1988) again synonymized these two genera. Though the holotype of *E. canadensis* is in poor condition, with great portions of the body obscured by blackish glue, features such as the notauli, the lateral pronotal carinae and the scutellar plate are all clearly visible. Comparing these features with those found in *Gronotoma sculpturata* clearly indicate that indeed, *Eucoilidea* is a junior synonym of *Gronotoma*, supporting the decisions of Beardsley (1988) and Hedicke (1930).

Species of *Gronotoma* can be recognized by the following diagnostic features: lateral pronotal carina present (a distinct ridge, distal to the lateral margins of the pronotal plate, that give species in the this genus the appearance of having a large pronotal plate); notauli present and well-developed in nearly all species; scutellar plate large; hairy ring at base of syntergum absent. Species of *Gronotoma* are most easily confused with *Diglyphosema* Förster, but easily distinguished from that genus by having the scutellum meeting the scutellar plate at an acute angle (meets at a 90 degree angle in *Diglyphosema*), and the scutellar plate not as elongate (though some species of *Gronotoma* tend to have an oval scutellar plate).

Previous works treating the synonymy of *Eucoilidea* with *Gronotoma* focused primarily on the type species; thus, as indicated in the list below, most of the described species have not been formally transferred to *Gronotoma*. Hence, 32 new combinations are proposed, mainly reflecting the taxonomic work on this genus by Weld (1952) and Quinlan (1986). Species for which type material (holotypes and/or paratypes) were examined are indicated by an *. The reader should also note that Kieffer (1901) did indeed treat four species in *Gronotoma* (and not *Eucoilidea*), i.e., *Gronotoma carinata* (Cresson), *G. minor* (Provancher), *G. nigricornis* Kieffer and *G. ovalis* (Thomson) (see in list below).

Included Species

adachiae Beardsley 1988: 39, holotype in BPBM.

advena* (Quinlan), **n. comb. *Eucoilidea advena* Quinlan 1986: 262, 263, holotype in MRAC, paratypes in BMNH.

allotriaeformis (Giraud). *Eucoila allotriaeformis* Giraud 1860: 142. *Gronotoma allotriaeformis:* Förster 1869: 346. Type depository presently unknown.

arcuata* (Kieffer), **n. comb. *Eucoelidea arcuata* Kieffer 1909: 65. Type in CAS.

bakeri* (Kieffer), **n. comb. *Eucoelidea bakeri* Kieffer 1907: 107. Type in CUIC.

bakeri* var. *cupularis* (Kieffer), **n. comb. *Eucoelidea bakeri* var. *cupularis* Kieffer 1907: 108. Type in CAS.

bakeri* var. *flavipes* (Kieffer), **n. comb. *Eucoelidea bakeri* var. *flavipes* Kieffer 1907: 108. Type in CAS.

bucca* (Quinlan), **n. comb. *Eucoilidea* *bucca* Quinlan 1986: 263, holotype in MRAC, paratypes in BMNH.

**canadensis* (Ashmead). *Eucoilidea canadensis* Ashmead 1887: 154. *Gronotoma canadensis:* Hedicke 1930; Beardsley 1988. Holotype in USNM.

carinata (Cresson). *Eucoila ? carinata* Cresson 1865: 6. *Gronotoma carinata:* Kieffer 1901: 159. Type depository presently unknown.

compressa* (Quinlan), **n. comb. *Eucoilidea compressa* Quinlan 1986: 263, 264, holotype in MRAC, paratypes in BMNH.

conversa* (Quinlan), **n. comb. *Eucoilidea conversa* Quinlan 1986: 264, holotype in MRAC, paratypes in BMNH and MRAC.

crenulata* (Kieffer), **n. comb. *Eucoilidea crenulata* Kieffer 1908: 47. Type in CAS.

dilitata* (Kieffer), **n. comb. *Eucoelidea dilitata* Kieffer 1907:108. Type in CAS.

domestica Girault 1932: 3. Type depository presently unknown.

dubia* (Quinlan), **n. comb. *Eucoilidea dubia* Quinlan, 1986: 264, 265, holotype in BMNH, paratypes in BMNH and MRAC.

extraria (Quinlan), **n. comb.** *Eucoilidea extraria* Quinlan 1986: 265, holotype and paratype in MRAC.

fetura* (Quinlan), **n. comb. *Eucoilidea fetura* Quinlan 1986: 265, 266, holotype in MRAC, paratypes in BMNH.

fulvicornis (Hedicke). *Ganaspis fulvicornis* Hedicke 1913: 445. *Gronotoma fulvicornis:* Hedicke 1934: 704. Holotype and four paratypes in ZMHB.

furcula* (Quinlan), **n. comb. *Eucoilidea furcula* Quinlan 1986: 266, holotype in BMNH, paratypes in BMNH and MRAC.

fuscipes* (Kieffer), **n. comb. *Eucoelidea fuscipes* Kieffer 1907: 112. Type in CAS.

gracilicornis Cameron 1889: 15. Type depository presently unknown.

guamensis (Yoshimoto), **n. comb.** *Eucoilidea guamensis* Yoshimoto 1962a: 107, holotype and paratypes in BPBM.

hiranoi Abe and Konishi 1995: 309–311, holotype and paratypes in KPU.

insularis Ashmead 1895: 743, holotype in BMNH.

lacerta (Quinlan), **n. comb.** *Eucoilidea lacerta* Quinlan 1986: 266, 267, holotype and paratype in MRAC.

lana (Quinlan), **n. comb.** *Eucoilidea lana* Quinlan 1986: 267, holotype and paratype in MRAC.

leptis* (Quinlan), **n. comb. *Eucoilidea leptis* Quinlan 1986: 267, 268, holotype in BMNH.

longicornis (Ashmead), **n. comb.** *Eucoilidea longicornis* Ashmead 1887: 154. Type depository presently unknown.

maquilingensis (Kieffer), **n. comb.** *Eucoilidea maquilingensis* Kieffer 1914: 184–185. Type depository presently unknown.

marcellus* (Quinlan), **n. comb. *Eucoilidea marcellus* Quinlan 1986: 268, holotype in BMNH, paratypes in BMNH and MRAC.

mauri* (Quinlan), **n. comb. *Eucoilidea mauri* Quinlan 1986: 268, 269, holotype and paratype in BMNH.

melanagromyzae Beardsley 1988: 40, holotype in BPBM.

micromorpha (Perkins). *Eucoilidea micromorpha* Perkins 1910: 676. *Gronotoma micromorpha:* Beardsley 1988: 38. *Eucoilidea rufula* Yoshimoto 1962b: 845, synonymy by Beardsley (1988), holotype and paratypes in BPBM.

minor (Provancher). *Eucoila minor* Provancher 1888: 398. *Gronotoma minor:* Kieffer 1901: 159. Type depository presently unknown.

nigra Ionescu 1963: 10, holotype in IBPR.

****nigricornata* Buffington, new name.** *Eucoilidea nigricornis* Kieffer 1908: 48. Preoccupied by *Gronotoma nigricornis* Kieffer 1901: 159. Paratypes in CUIC.

nigricornis Kieffer 1901: 159. Type depository presently unknown.

nitida* (Benoit), **n. comb. *Afrostilba nitida* Benoit 1956: 544, holotype in MRAC, paratypes in BMNH. Eucoilidea nitida: Quinlan 1986: 269.

ovalis (Thomson). *Cothonaspis ovalis* Thomson 1877: 817. *Gronotoma ovalis:* Kieffer 1901: 159. Type depository presently unknown.

pallida* (Quinlan), **n. comb. *Eucoilidea* *pallida* Quinlan 1986: 269–270, holotype in BMNH, paratypes in BMNH and MRAC.

parma* (Quinlan), **n. comb. *Eucoilidea parma* Quinlan 1986: 270, holotype in BMNH, paratypes in BMNH and MRAC.

parvula Kieffer 1910: 533. Type depository presently unknown.

perangusta* (Quinlan), **n. comb. *Eucoilidea perangusta* Quinlan 1986: 270, 271, holotype and paratypes in BMNH.

quadrisulcata (Hedicke), **n. comb.** *Eucoilidea quadrisulcata* Hedicke 1922: 229. Two syntypes in ZMHB.

rufipes (Gillette), **n. comb.** *Eucoilidea rufipes* Gillette 1891: 205. Type depository presently unknown.

**sculpturata* (Förster). *Eucoila sculpturata* Förster 1855: 257. *Gronotoma sculpturata:* Förster 1869: 342, 346. Holotype in ZMHB.

**seychellensis* Kieffer 1911: 309. Holotype and paratypes in BMNH.

sugonjaevi Belizin 1973: 22, holotype in ZIN; not examined but characters presented in the original description suggest this species probably belongs in *Nordlanderia.*

trulla* (Quinlan), **n. comb. *Eucoilidea trulla* Quinlan 1986: 271, holotype in BMNH, paratype in MRAC.

tyrus* (Quinlan), **n. comb. *Eucoilidea tyrus* Quinlan 1986: 271, holotype in BMNH.

urundiensis* (Benoit), **n. comb. *Eucoilidea urundiensis* Benoit 1956: 548, holotype in MRAC, paratypes in BMNH and MRAC.

Additional material examined.—Sp. 1: Nearctic Region: Canada (AB, BC, MB, ON, QU, PQ); USA (IL, MD, NY, PA, TX, VA). Neotropical Region: Mexico (Tamaulipas, Chiapas).

Sp. 2: Nearctic Region: Canada (AB, MB); USA (AZ, CA, FL, IN, MO, NC, NM, PA, TN, TX, WA). Neotropical Region: Mexico (Veracruz); Venezuela (Merida).

Sp. 3: Nearctic Region: Canada (ON); USA (NC).

Specimens of other species from: Neotropical Region: Mexico (Oaxaca, Guerrero); Ecuador; Nicaragua. Afrotropical Region: Uganda; Zaire; Kenya.

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ENTOMOBALIA, NEW GENUS, THE FIRST MEMBER OF NYCTELIINI (COLEOPTERA: TENEBRIONIDAE) FROM BRAZIL

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Abstract.—***Entomobalia*, new genus**, (Pimeliinae: Nycteliini) is described from northeastern Brazil and is the first genus of the tribe Nycteliini recorded for that country. This new genus is created on the basis of two previously described species: *Asida platynotos* Perty and *Asida picta* Perty (**new combinations** in *Entomobalia*), formerly placed in the genus *Scotinus* Kirby (Pimeliinae: Asidini). Sixteen different character states among the species of *Scotinus* and the two species assigned to *Entomobalia* are discussed, 11 of which are shared by *Entomobalia* with all or some genera of Nycteliini and not with the remaining species of *Scotinus*. A description for the genus and redescriptions of the two species are provided. Main diagnostic characters for *Entomobalia* are in sexual dimorphism and male and female genitalia. Habitus photographs, illustrations of external morphology, internal skeletal anatomy, genitalic features, and a distribution map are included.

Key Words: Tenebrionidae, Pimeliinae, Asidini, Nycteliini, *Entomobalia*, South America, Brazil

Nycteliini is an endemic Neotropical tribe of Pimeliinae (Doyen 1993), with 285 species distributed in Argentina, Chile, Bolivia, Peru, Paraguay, and Uruguay (Fig. 1) (Flores 1997). The species of Nycteliini are currently arranged in 11 genera, the nine recognized in previous revisions: *Gyriosomus* Guérin-Méneville, *Pilobalia* Burmeister, *Entomoderes* Solier, *Nyctelia* Latreille, *Epipedonota* Solier, *Psectrascelis* Solier, *Scelidospecta* Kulzer, *Auladera* Solier, *Mitragenius* Solier (Kulzer 1954, Flores 1997), the recently described genus *Patagonogenius* (Flores 1999), and the restored genus *Callyntra* Solier (Flores and Vidal 2000).

Our examination of a single specimen collected in Brazil by W. Mann from the Field Museum of Natural History (Chicago, USA) led us to think we had discovered a new species of Nycteliini. More recently we discovered a long series of 80 specimens of this species and another series of 25 specimens of another smaller species, both collected in northeastern Brazil by W. Mann, deposited in the National Museum of Natural History, Smithsonian Institution, (Washington, DC). One specimen of the longer series had been determined by Kulzer as *Scotinus platynotos* (Perty). After requesting a loan of all the species of *Scotinus* present in The Natural History Museum (London, UK), we confirmed that both species had already been described by Perty (1830), the larger as *Asida platynotos* and the smaller as *Asida picta*. Finally, study of the types of Perty from the Zoologische Staatssammlung, Münich (Germany) confirmed the identity of both series of these species.

When Perty (1830) described these two species, he placed them in the genus *Asida* Latreille (Asidini). Laporte (1840) considered that they should be included in the genus *Scotinus* Kirby (Asidini). *Scotinus picta* had not been mentioned in the literature for 160 years, but in 1935, Blair expressed the opinion that *S. platynotos* "is a somewhat aberrant *Pilobalia*". Gebien (1910) listed this species under *Scotinus*, but later he listed it under the nycteliine genus *Pilobalia* (Gebien 1937). This means that both authors believed this species belongs to the tribe Nycteliini rather than the Asidini. However, Kulzer (1954) still accepted this species as a member of the genus *Scotinus*. Through a detailed discussion of the characters, we demonstrate that *Scotinus platynotos* and *S. picta* are not congeneric with the remaining species of *Scotinus*, that they are not Asidini, that they share most of these characters with all or some genera of Nycteliini, and that they deserve recognition as a separate genus, which we have named *Entomobalia*. This new genus exhibits a mosaic of characters present in other genera of Nycteliini, especially *Pilobalia* and *Entomoderes*. The inclusion of these two species in any other known genus of Nycteliini would imply a completely different concept and redefinition of that genus. In addition, the male and female genitalia show unique apomorphies.

Species of Nycteliini inhabit arid and semiarid environments, mainly in the biogeographical provinces Chaco, Monte, Pampa, Central and Arid Puna, Prepuna, Coquimbo, Santiago, Payunia, Western, Central and Fueguinan Patagonia, and San Jorge Gulf (Morrone 2001). The discovery of these two species from northeastern Brazil, at least 3,000 km from the Chaco, the closest point of distribution of a genus of Nycteliini (*Entomoderes*), was unexpected. Thus the range of the tribe is greatly expanded to the Caatinga biogeographical province (Morrone 2001). It is possible that other species of Nycteliini may be found in the Cerrado biogeographical province, which lies between Caatinga and Chaco (Fig. 1).

The objectives of this study are to describe this new genus of Nycteliini, redescribe the two species assigned to the new genus, and compare the distinctive character states of the species of *Scotinus* (Asidini) with the two species assigned to *Entomobalia* (Nycteliini), which had previously been placed in *Scotinus*.

Specimens were obtained from the following institutions: The Natural History Museum, London, UK (BMNH), Field Museum of Natural History, Chicago, IL, USA (FMNH), National Museum of Natural History, Smithsonian Institution, Washington, DC, USA (USNM), and Zoologische Staatssammlung, Münich, Germany (ZSMC). Thanks to the kind generosity of the USNM, we distributed some specimens of both species in the following institutions: California Academy of Sciences, San Francisco, CA, USA (CASC), Field Museum of Natural History, Chicago, IL, USA (FMNH), Instituto Argentino de Investigaciones de las Zonas Áridas, Mendoza, Argentina (IADIZA), Museo Argentino de Ciencias Naturales Bernardino Rivadavia, Buenos Aires, Argentina (MACN), Museu de Zoología da Universidade de São Paulo, São Paulo, Brazil (MZSP), and The Ohio State University, Columbus, OH, USA (OSUC).

Body length was measured dorsally, along the midline, from anterior margin of labrum to elytral apex. For paraproct/coxite length (P/C) we used the ratio proposed by Doyen (1993). For basal lamina of the tegmen/lateral styles length (B/E) and median lobe/tegmen length (L/T) we used the ratios proposed by Flores (1996). Drawings were made with a camera lucida adapted to a stereoscopic microscope.

TAXONOMIC PLACEMENT OF *ENTOMOBALIA*

The two species that we have assigned to the new genus *Entomobalia* (Nycteliini)

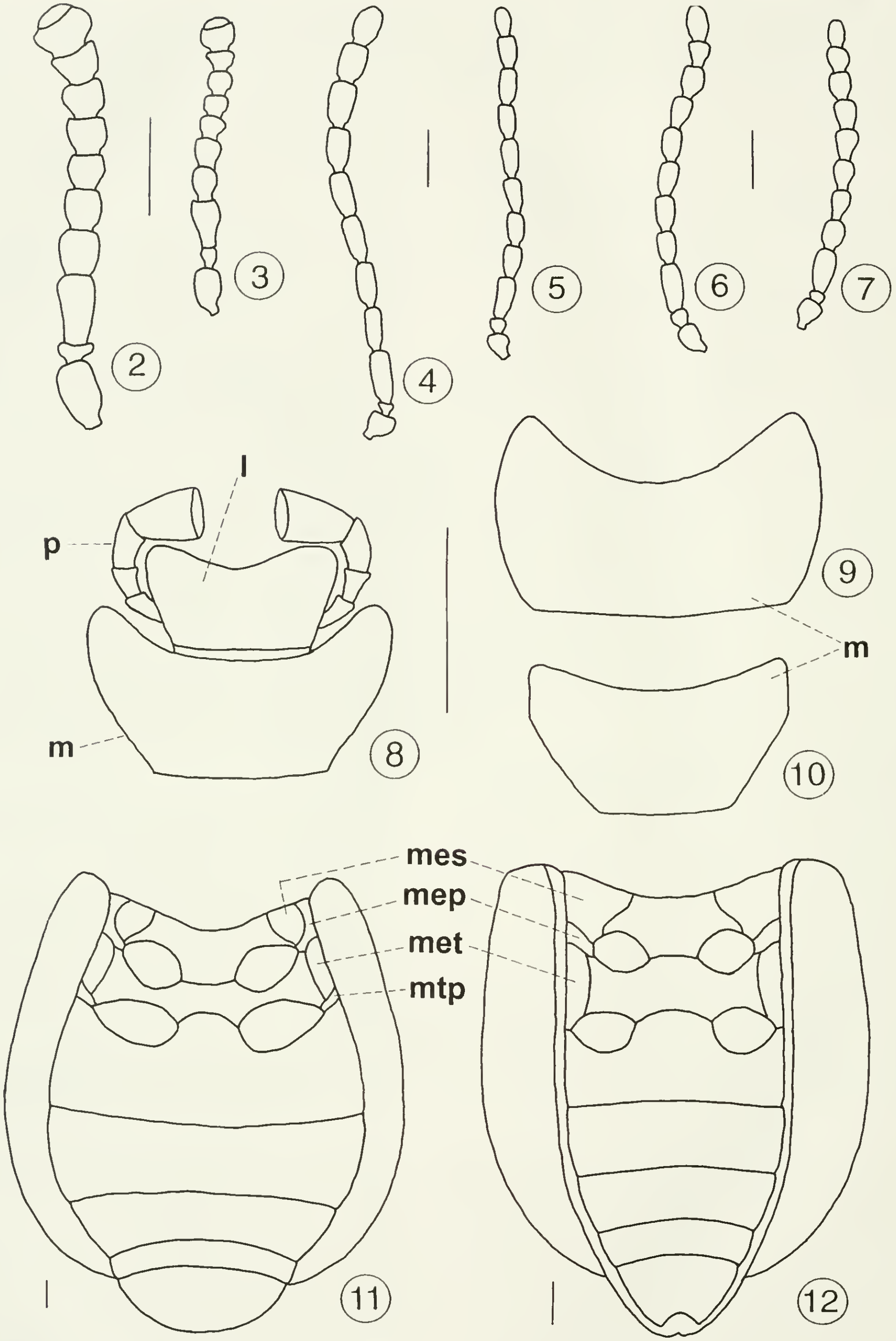
Fig. 1. Known distribution of the genera of Nycteliini (lined area). Black square: distribution records for *Entomobalia platynota*; black circle: distribution records for *E. picta*. 1 and 2: Caatinga and Cerrado biogeographical provinces (*sensu* Morrone 2001).

had previously been placed in the genus *Scotinus,* which belongs to the Asidini, a large tribe of Pimeliinae with more than 1,000 species distributed in North and South America, Africa south of Sahara, Madagascar, and the Mediterranean area (Koch 1955). The species of *Scotinus* are endemic to Brazil (Gebien 1937). We have studied the following characters within the species of *Scotinus,* some of which have been used to study the relationships between the tribes of Pimeliinae (Doyen 1993) and to define the tribe Nycteliini (Flores 1997), finding that *Scotinus platynotos* and *S. picta* share all of these characters with all or some genera of Nycteliini and not with the remaining species of *Scotinus.* The species of *Scotinus* examined from BMNH are the following (T includes type specimens): *S. crenicollis* Kirby (T) (type species), *S. crucifer* Eschscholtz, *S. propius* Wilke, *S. quadricollis* Eschscholtz, *S. quadricollis incisus* Wilke (T), *S. tuberculatus* Eschscholtz, *S. tuberculatus dispar* Wilke (T), *S. chapadensis* Wilke (T), and *S. bajulus* Wilke (T).

1. Size of antennomere 11: Very small, even rudimentary in *Scotinus* (Figs. 2–3); in *Entomobalia* and Nycteliini well developed, sometimes equal to or longer than antennomere 10 (Figs. 4–7).
2. Subgenal process (defined by Doyen 1993: 454): Subadjacent with mentum in *Scotinus* (Solier 1836: plate XIII, Figs. 1–2, Doyen 1993: Figs. 22–25); in *Entomobalia* and Nycteliini it is remote from mentum (Doyen 1993: Fig. 21).
3. Position of ligula: Nearly concealed beneath mentum in *Scotinus* (Solier 1836: plate XIII, Figs. 1–2); in *Entomobalia* it is entirely exposed anterad of mentum (Fig. 8), with the articulating membrane visible. Within Nycteliini, this character state is shared with *Gyriosomus, Pilobalia* and *Entomoderes*.
4. Relative size of ligula: Less than half the size of mentum in *Scotinus* (Solier 1836: plate XIII, Figs. 1–2); in *Entomobalia* it is larger than half of mentum (Fig. 8). Within Nycteliini, this character state is shared with *Gyriosomus, Pilobalia* and *Entomoderes*.
5. Shape of mentum: Cordiform in *Scotinus*, with anterior margin twice as long as posterior margin (Solier 1836: plate XIII, Figs. 1–2). Subtrapezoidal in *Entomobalia*, with anterior margin 1.5 times the length of posterior margin (Fig. 8). Within Nycteliini, this character state is shared only with *Pilobalia* (Fig. 10).
6. Mesepisternum: Small, not reaching the mesocoxal cavities in *Scotinus* (Fig. 11); in *Entomobalia* and Nycteliini it is large, reaching the mesocoxal cavities and closing laterally (Fig. 12).
7. Mesepimeron: Long, reaching the base of elytral epipleuron in *Scotinus* (Fig. 11); in *Entomobalia* and Nycteliini it is short, not reaching the base of elytral epipleuron (Fig. 12).
8. Metepimeron: Transverse in *Scotinus*, widely separating the metacoxal cavities from the elytral epipleuron (Fig. 11); in *Entomobalia* and Nycteliini it is not evident, since the metacoxal cavities are very close to the elytral epipleuron (Fig. 12).
9. Lateral closure of metacoxal cavities: Closed laterally by metepimeron and first visible abdominal sternum in *Scotinus* (Fig. 11); closed laterally by metepisternum in *Entomobalia* (Fig. 12). Within Nycteliini, this character state is shared with *Gyriosomus, Pilobalia* and *Entomoderes*.
10. Distance between meso- and metacoxae: Does not exceed half the metacoxal length in *Scotinus* (Fig. 11); in *Entomobalia* and Nycteliini it exceeds half the metacoxal length (Fig. 12).
11. Abdominal margin of elytral epipleuron: Curved where it contacts meso- and metathorax in *Scotinus* (Fig. 11); in *Entomobalia* and Nycteliini it is straight where it contacts meso- and metathorax (Fig. 12).

Additional character states which differ in *Scotinus* and *Entomobalia*:

1. Antennal length: Short in *Scotinus*, not reaching the middle of the lateral margin of pronotum; longer in *Entomobalia*, extending beyond posterior margin of pronotum.
2. Shape and width of antennomere 10: Oval, wider than long in *Scotinus*, wider than more proximal antennomeres (Figs. 2–3); subrectangular, longer than wide in *Entomobalia*, no wider than more proximal antennomeres (Figs. 4–5).
3. Ventral femoral surface: Covered by sparse setae in *Scotinus*; densely setose on proximal ¾ in *Entomobalia*.
4. Elytral epipleuron: Not evident in *Scotinus* (Fig. 11); evident throughout in *Entomobalia* (Fig. 12). In addition, in *Entomobalia* the elytral epipleuron is equal in width throughout (Fig. 12); within Nycteliini this character state is



Figs. 2–12. External structure. 2–7, Antennae in dorsal view. 2, *Scotinus crenicollis*. 3, *S. crucifer*. 4, *Entomobalia platynota*. 5, *E. picta*. 6, *Pilobalia decorata* (Erichson). 7, *P. oblonga* (Blanchard). 8–10, Labium and mentum in ventral view. 8, Labium of *Entomobalia platynota*. 9, Mentum of *Entomoderes satanicus* Waterhouse. 10, Mentum of *Pilobalia decorata*. 11–12, Mesothorax, metathorax and abdomen in ventral view. 11, *Scotinus quadricollis*. 12, *Entomobalia picta* (female). Abbreviations: l, ligula, m, mentum, p, labial palpus, mes, mesepisternum, mep, mesepimeron, met, metepisternum, mtp, metepimeron. Scale bar = 1 mm.

shared with *Gyriosomus*, *Pilobalia* and *Entomoderes*.

5. Sexual dimorphism: Species of *Scotinus* do not exhibit sexual dimorphism; species of *Entomobalia* exhibit four characters different in male and female (see below).

In his cladistic analysis of Pimeliinae, Doyen (1993) found that all genera of Asidini (from South African, Madagascan, Mediterranean, North and South American regions) constitute a monophyletic group defined by six synapomorphies, five of which are not present in *Entomobalia*: bridge of tentorium absent or incomplete, antennae with ten segments plus the reduced eleventh antennomere, abdominal laterotergites extremely small, apicodorsal lobe of proctiger ending at coxite base, and baculus of proctiger extending proximad, equal to baculus of paraproct. Furthermore Doyen (1993) pointed out that the first two are synapomorphies unique to Asidini within the subfamily Pimeliinae.

Within Pimeliinae, *Entomobalia* must be placed within the Asidine clade (Doyen 1993) by having multiple, long, slender spermathecal tubes which open as a fascicle into the base of the accesory gland duct or into the vagina near the duct (Figs. 17–18). Within the Asidine clade of Doyen (1993), *Entomobalia* belongs to the subclade of South American tribes Nycteliini, Physogasterini and Praocini by having metendosternite arms fused with mesocoxal inflexions. *Entomobalia* is placed in the tribe Nycteliini according to the definition of that tribe by Flores (1996, 1997) and the following change in that tribal concept should be mentioned: in the female genitalia of *Entomobalia* the basal lobe of the coxite is separated vertically from apical lobe (Figs. 17–18), while in the remaining genera of Nycteliini it is separated horizontally from apical lobe (Flores 1996).

The most recent key provided for the genera of Nycteliini is that by Flores (1997), which is modified at couplet 8 to separate out *Pilobalia* and *Entomobalia*:

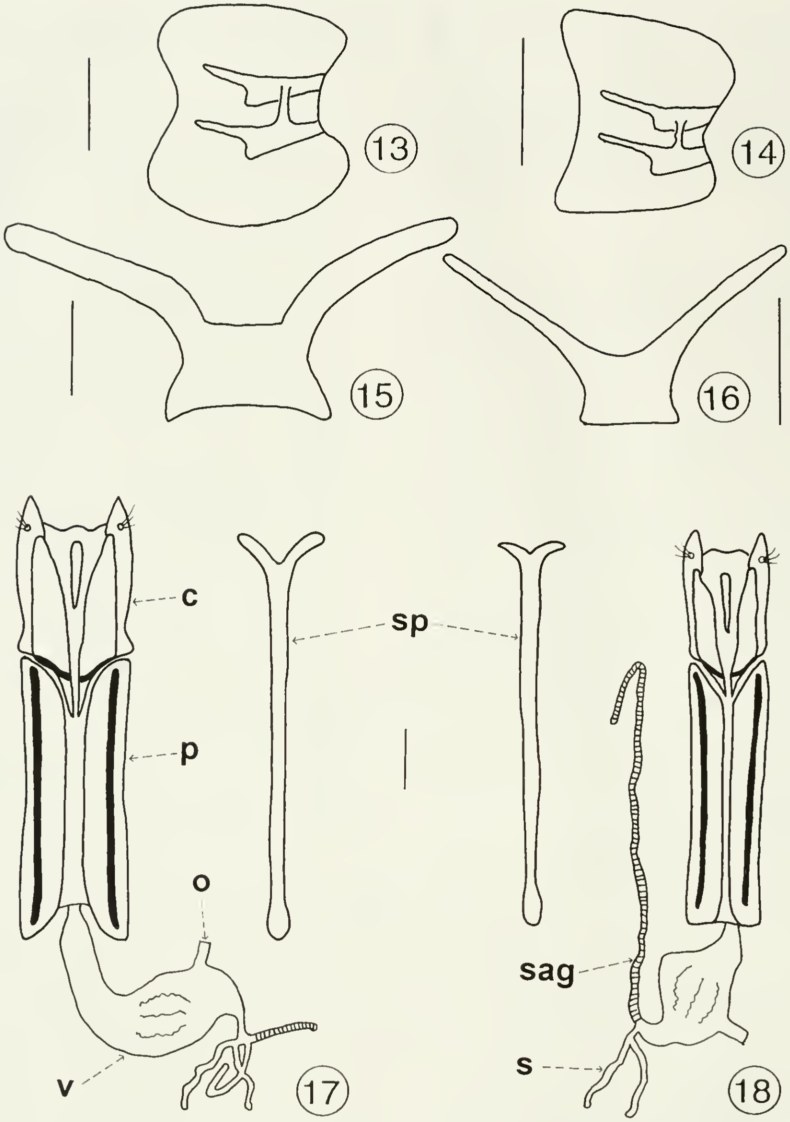
8. Pronotum with a short central-posterior carina and two longer longitudinal carinae, lateral margin with lobe (Flores 1997: Fig. 25); femora with umbilicate setae; mentum transverse (Fig. 9) . . . . *Entomoderes* Solier
– Pronotum lacking carinae, lateral margin concave, lacking lobe; femora with simple setae; mentum subtrapezoidal (Figs. 8, 10) 8a
8a. Mentum impunctate or with very small punctures; antennomere 10 subspherical or pyriform (Figs. 6–7); male with protibiae straight and not expanded apically (Flores 1997: Fig. 26) . . . . *Pilobalia* Burmeister
– Mentum with large punctures; antennomere 10 subrectangular (Figs. 4–5); male with protibiae curved inward and expanded apically (Figs. 19–20) . . . . *Entomobalia*, new genus

Entomobalia Flores and Triplehorn, new genus

Type species.—*Asida platynotos* Perty, present designation.

Diagnosis.—Distinguished from other Nycteliini by the following combination of characters: ligula sclerotized, ventrally exposed, equal to half mentum area; labial palps inserted on posterior half of ligula; mentum subtrapezoidal; pronotum smooth, without punctures, striae or carinae, lateral margin concave, posterior angles acute, overlapping elytral humeri, epipleuron equal in width throughout; metacoxal cavities closed laterally by metepisternum; ventral surface of femora densely setose; median lobe of aedeagus subapically expanded and strongly sclerotized on distal third; sexual dimorphism: male with protibia curved inward and expanded apically, inner surfaces of tibiae densely setose on distal half, and central area of metasternum with setae; female with protibia straight and not expanded apically, inner surfaces of tibiae with normal setae, and central area of metasternum glabrous and shiny.

Description.—Length, 12.1–19.9 mm; width, 6.4–11.3 mm. Body and legs brown to black, with antenna and maxillary palp brown. Pronotum and elytron with two



Figs. 13–18. Internal skeletal anatomy and female genitalia of *Entomobalia* spp. 13–14, Tentoria. 13, *Entomobalia platynota*. 14, *E. picta*. 15–16, Metendosternites in posterior view. 15, *Entomobalia platynota*. 16, *E. picta*. 17–18, Ovipositor (ventral view), spiculum and internal female reproductive tract. 17, *Entomobalia platynota*. 18, *E. picta*. Abbreviations: c, coxite, o, oviduct, p, paraproct, s, spermatheca, sag, spermathecal accessory gland, sp, spiculum, v, vagina. Scale bar = 1 mm.

kinds of short setae, one stout, dark brown, and other finer, golden or light brown.

Head: Epipharynx with anterior margin entirely concealed beneath labrum. Labrum, clypeus and frons with abundant short, golden setae. Clypeus with anterior margin concave. Clypeal suture defined by a deep depression with setae at antennal insertion level. Frons without longitudinal or lateral grooves. Eye reniform. Antenna long, extending beyond posterior margin of pronotum; antennomeres subrectangular, with two different kinds of pubescence: one short and abundant on entire surface, and second consisting of long, scattered setae; unique apical semicircular tomentose sen-

Figs. 19, 20. Habitus in dorsal view. 19, *Entomobalia platynota*, male. 20, *E. picta*, male.

sory patch on antennomere 9. Ligula sclerotized, articulated with mentum by a narrow membrane and exposed ventrally, equal to half mentum area (Fig. 8); labial palpi inserted on posterior half of ligula (Fig. 8). Ligula and mentum with setae arising from large punctures. Mentum subtrapezoidal (Fig. 8). Submentum posteriorly continuous with gula. Tentorium with medial straight bridge (Figs. 13–14).

Thorax: Pronotum short (length: pronotum/elytron ≤ 0.33), pubescent and smooth, without punctures, striae or carinae; disc convex; anterior margin slender and central area not broadened; anterior angles rounded; lateral margin simple, slender, concave, widest behind mid point; posterior angles acute, overlapping elytral humeri; posterior margin biconcave, as wide as base of elytra. Proepisternum with or without grooves and with sparse not umbilicate setae. Prosternum arched, not extended over mesosternum. Mesosternum inclined forward, separated from prosternum. Scutellum visible. Meso- and metepisternum without grooves.

Elytron: Dorsal surface, pseudopleuron and epipleuron impunctate; with one or two carinae, space between external carinae and lateral margin without grooves; lateral margin straight and sharp, epipleuron equal in width throughout, texture similar to that of elytra.

Legs: Procoxal cavity closed posteriorly. Metacoxae separated by one metacoxal width, enclosed laterally by metepisternum. Ventral surfaces of trochanters pubescent, brushlike. Ventral surfaces of femora densely setose on proximal ¾. Ventral surfaces of tarsi bearing abundant decumbent setae.

Sexual dimorphism: Male with protibia curved inward and expanded apically, inner surfaces of tibiae densely setose on distal half, and central area of metasternum with setae. Female with protibia straight and not expanded apically, inner surfaces of tibiae with normal setae, and central area of metasternum glabrous and shiny.

Internal skeletal anatomy: Mesendosternite with a long and slender dorsal arm, longer than horizontal arm. Metendosternite

(Figs. 15–16) with arms long, extending beyond mesocoxal inflections about half distance to tergum, stem equal to metacoxal width, width of stem exceeding length, and stem narrow at middle. Elytral-abdominal fusion accomplished by a ridge in the elytral epipleuron which interlocks in a longitudinal groove of abdominal sterna.

Male genitalia: Rods of sternum IX close at basal third, distance between them not exceeding width of aedeagus. Dorsal membrane of proctiger concave, with two sclerotized areas. Basal lamina of tegmen long (B/E > 1.00). Lateral styles of tegmen distally close, with apex straight and long setae on ventral surface; ventral proximal margin convex in ventral view, projecting dorsally over median lobe. Median lobe long (L/T > 1.00), sheath-shaped, one third the width of lateral styles of tegmen, expanded subapically and strongly sclerotized on distal third, with apex acute and straight.

Female genitalia (Figs. 17–18): Spiculum with arms "V"-shaped. Paraprocts moderate (1,2 ≤ P/C ≤ 2,0), glabrous. Coxites with setae, basal lobe of coxite extended over paraproct and separated vertically from apical lobe, baculi of coxite inclined 45°; midventral sclerite distally broadened. Proctigeral baculus equal to length of paraproct baculus. Vagina saccate; spermathecal tubes shorter than vagina length, all similar in width and branching pattern; spermathecal accesory gland longer than vagina, with duct annulate and thick.

Etymology.—The name of the genus refers to the similarity to the Nycteliine genera *Entomoderes* and *Pilobalia*. Gender feminine.

Distribution and habitat.—Brazil: States of Ceará, Río Grande do Norte, Pernambuco and Bahía, in the Caatinga biogeographical province (Morrone 2001) (Fig. 1). W. Mann, the collector of the large series of both species in Baixa Verde, Río Grande do Norte, stated that "the country was arid, with much scrub and cacti, but little life in evidence" (Mann 1948: 91).

KEY TO THE SPECIES OF *ENTOMOBALIA*

1. Pronotum with lateral margin reflexed; elytron with lateral margin single and protuberances irregularly and sparsely distributed on dorsal surface; length usually greater than 15 mm (Fig. 19) . . . . *E. platynota* (Perty)
– Pronotum with lateral margin not reflexed; elytron with lateral margin double and lacking protuberances; length usually less than 13 mm (Fig. 20) . . . . *E. picta* (Perty)

Entomobalia platynota (Perty), **new combination**

(Figs. 1, 4, 8, 13, 15, 17, 19, 21, 22)

Asida platynotos Perty 1830: 56, plate 12, fig. 2.

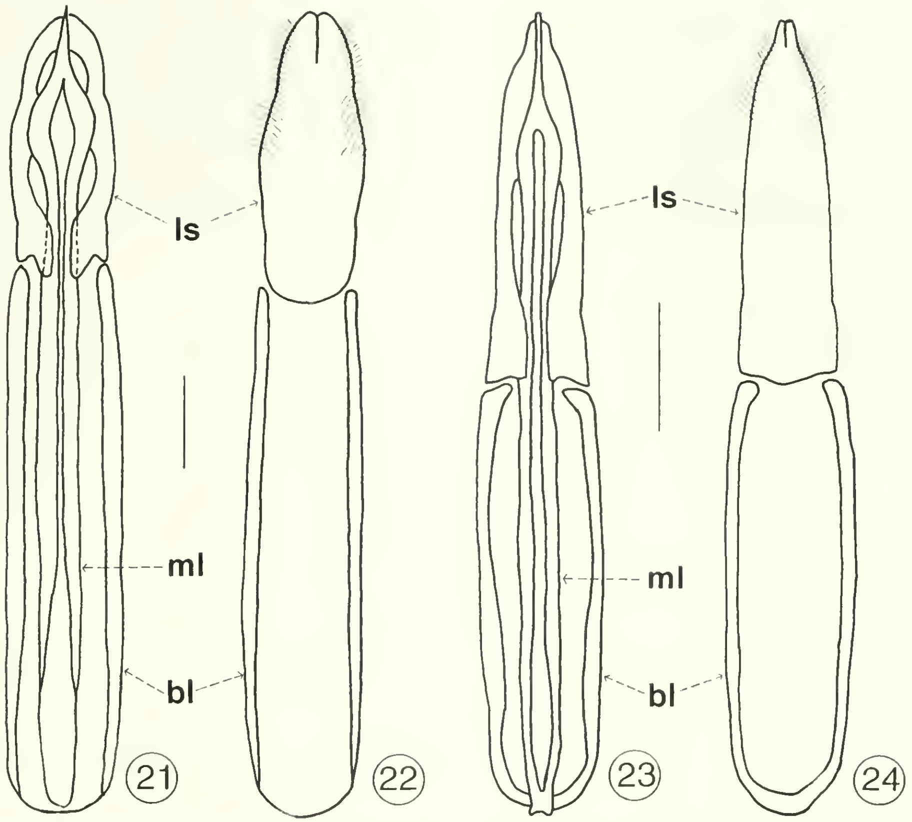
Scotinus platynotos: Laporte 1840: 208; Lacordaire 1859: 165.

Scotinus platynotus: Gemminger and Harold 1870: 1880 (cat.); Gebien 1910: 139 (cat.).

Pilobalia platynota: Blair 1935: 104; Gebien 1937: 753 (cat.); Blackwelder 1945: 519 (cat.); Kulzer 1954: 254 (rev.); Flores 1997: 16 (list).

Scotinus platynotos: Kulzer 1954: 265.

Redescription.—Length, 15.0–19.9 mm; width, 8.0–11.3 mm. Body and femora brown to black, with antenna, tibia and tarsi brown. Stout dark brown setae and golden or light-brown finer setae uniformly and sparsely distributed on pronotum and dorsal surface of elytron, both forming velvet-like patches only on posterior third of elytron. Antenna long, extending three antennomeres beyond posterior margin of pronotum. Pronotum with lateral margin reflexed. Male metasternum with tuft of setae on central area, brush-like. Metepisternum with not umbilicate setae. Elytron with lateral margin single and protuberances irregularly and sparsely distributed on dorsal surface, with one feebly raised complete or incomplete carina, close to lateral margin (Fig. 19); in some specimens with a secondary carina close to suture, consisting of aligned protuberances. Male with protibia expanded apically, but not excavated. Last abdominal segment truncate in males and females. In addition to three characters of sexual di-



Figs. 21–24. Male genitalia of *Entomobalia* spp. in dorsal and ventral views. 21, 22, *Entomobalia platynota*. 23, 24, *E. picta*. Abbreviations: bl, basal lamina of tegmen, ls, lateral styles of tegmen, ml, median lobe. Scale bar = 1 mm.

morphism at generic level, first abdominal sternum with a tuft of brush-like setae on central area in males and glabrous and shiny in females.

Male genitalia.—Lateral styles of tegmen with apex wide, widest at mid point, with long setae on distal half of ventral surface (Fig. 21). Median lobe with apical aperture large, strongly expanded subapically (Fig. 22).

Specimens examined.—Lectotype: [Type] [Brasilia/*Scotinus*/*platynotos*/Perty] (ZSMC). To fix the current interpretation of this name and to ensure stability, we are hereby designating this lectotype: [Lectotypus/*Asida platynotos*/Perty, 1830/Des. G. Flores-/C. Triplehorn 2001]. Non-type specimens. BRAZIL: Río Grande do Norte. Baixa Verde, W. Mann, 75 [55 (USNM), 3 (CASC), 4 (FMNH), 7 (IADIZA), 2 (MACN), 2 (MZSP), 2 (OSUC)]; Ceará-Mirim, W. Mann, 1 (USNM). Pernambuco. Ouricuri, II-1982, J.C.C. Guix (ex *Bufo* stomach), 3 (OSUC). Bahía. Near Queimadas, 11-VI-1915, P.G. Russell, 2 (USNM); S. Salvador, 1918, 2 (USNM); Barra, 1 (BMNH); without more precise data: 2 (BMNH).

Entomobalia picta (Perty), **new combination**

(Figs. 1, 5, 12, 14, 16, 18, 20, 23, 24)

Asida picta Perty 1830: 56, plate 12, fig. 3.

Scotinus picta: Laporte 1840: 208; Lacordaire 1859: 165.

Scotinus pictus: Gemminger and Harold 1870: 1880 (cat.); Gebien 1910: 139

(cat.), 1937: 743 (cat.); Blackwelder 1945: 517 (cat.).

Redescription.—Length, 12.1–15.9 mm; width, 6.4–7.6 mm. Body and femora brown to black, with antenna, tibia and tarsi brown. Stout dark brown setae uniformly and sparsely distributed on pronotum and dorsal surface of elytron, grouped only on outer third of pronotum and elytron. Finer, golden or light brown setae grouped forming velvet-like patches on pronotum and dorsal surface of elytron. Antenna long, extending two antennomeres beyond posterior margin of pronotum. Pronotum with lateral margin not reflexed. Male metasternum with setae on central area, not forming a brushlike tuft. Metepisternum with umbilicate setae. Elytron with lateral margin double and without protuberances, with two low carinae, equidistant between suture and lateral margin (Fig. 20), visible only for the different pattern of setae. Male with protibia expanded apically and excavated inward. First abdominal sternum with short setae in male and female. In addition to three characters of sexual dimorphism at generic level, last abdominal segment truncate in males and emarginate in females (Fig. 12).

Male genitalia.—Lateral styles of tegmen with apex narrow, widest at base, with long setae on distal quarter of ventral surface (Fig. 23). Median lobe with apical aperture small, moderately expanded subapically (Fig. 24).

Specimens examined.—Lectotype and three paralectotypes without label data (ZSMC). One paralectotype: [Brasilia/*Scotinus*/*pictus*/Perty] (ZSMC). To fix the current interpretation of this name and to ensure stability, we are hereby designating this lectotype and four paralectotypes: [Lectotypus/*Asida picta*/Perty, 1830/Des. G. Flores-/C. Triplehorn 2001], the same for the four paralectotypes. Non-type specimens. BRAZIL: Río Grande do Norte. Baixa Verde, W. Mann, 24 [13 (USNM), 2 (CASC), 2 (FMNH), 2 (IADIZA), 1 (MACN), 2 (MZSP), 2 (OSUC)]; Natal, W. Mann, 1 (USNM). Ceará. F. da Rocha coll., 13-III-1940, 1 (USNM); F. da Rocha coll., 2 (USNM). Pernambuco. Pesqueira, V-1935, L. Castro, 4 (USNM). Bahía. Near Queimadas, 10-VI-1915, P.G. Russell, 2 (USNM); without more precise data: 1 (ZSMC).

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A NEW SPECIES AND KEY FOR THE GENUS *ZONOSEMATA* BENJAMIN (DIPTERA: TEPHRITIDAE)

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Abstract.—New taxonomic, host, and distribution data for species of *Zonosemata* are presented. One new species, ***Z. guybushi***, reared from fruit of *Solanum lanceifolium* in Costa Rica, is described, and a revised key to the eight known species of this genus is provided. A neotype is designated for *Z. electa* (Say).

Key Words: *Zonosemata*, fruit flies, taxonomy, host plant, distribution, *Solanum*

This paper includes the first results from a project on the natural history and systematics of the fruit flies (Tephritidae) of Costa Rica. In this project, funded by the Research and Scientific Exchanges Division, Foreign Agricultural Service, USDA, I have collaborated with parataxonomists from the Instituto de Biodiversidad of Costa Rica, who are collecting and rearing fruit flies. Among the many new species and host records resulting from this project was an undescribed species of *Zonosemata* Benjamin reared by Freddy Quesada in Guanacaste. In addition to describing this species, I take this opportunity to provide a revised key to the species of *Zonosemata*, and to report additional taxonomic, host, and geographic data for other species.

Zonosemata includes eight species that are native to the New World (from southeastern Canada to Colombia and northeastern Brazil). The seven previously known species were cataloged by Norrbom et al. (1999: 249), and Smith and Bush (1999: 197) listed their known host plants. All but one of the species have been reared from fruits or at least associated as adults with species of Solanaceae, mainly in the genus *Solanum*. One species, *Z. electa* (Say), has been reared from genera other than *Solanum*, and is considered a pest of pepper and eggplant in the eastern United States and Canada.

Zonosemata belongs to the subtribe Carpomyina of the subfamily Trypetinae (Smith and Bush 1999). Jenkins (1996) questioned whether the apical desclerotized area of the female oviscape (syntergosternite 7), considered a synapomorphy for the Carpomyina by Norrbom (1989), is present in *Zonosemata*. The genitalia of the specimens from the USNM that he dissected are overcleared and this character can no longer be seen in them, but it is apparent in less cleared dissections.

MATERIALS AND METHODS

Morphological terminology follows White et al. (1999). Figure 11 shows the names used for wing bands. Acronyms for institutions housing the examined specimens follow Thompson (1999).

KEY TO SPECIES OF *ZONOSEMATA*

In previous keys for *Zonosemata* (Bush 1966, Hernández-Ortiz 1989), the dark brown (often referred to as "black") markings of the thorax (see Figs. 2 and 3) were important characters in the early couplets. In the following key I have de-emphasized their importance because they appear to vary more than was previously known. For example, the katepisternal spot is consistently present in *Z. vittigera* and *Z. macgregori*, but varies in *Z. scutellata*, *Z. vidrapennis* (present in Central American specimens), and probably *Z. minuta* (present but very small in the examined specimens). It is even rarely present in *Z. electa* (in 4 specimens of the more than 100 examined from the USNM collection). The presutural scutal spot is present in *Z. vittigera*, *Z. macgregori*, and *Z. minuta* (although it is sometimes just a linear mark in the latter), but it is variable in *Z. scutellata*. The postsutural brown markings vary considerably, for example, in *Z. electa* from absent to very large (compare Figs. 2A and B).

1. Wing bands extremely narrow; width of discal, subapical and apical bands less than length of crossvein R-M (Fig. 1H). Most of radial cells and cell dm between discal and subapical bands without microtrichia. Scutum without presutural dark brown mark (Fig. 3C). Mexico, Guatemala, Honduras .... *vidrapennis* Bush
– Wing bands relatively broad; width of discal and subapical bands equal to or greater than length of R-M (Figs. 1A–G, I). Radial cells and cell dm at most with small areas bare of microtrichia between these bands, or if with large bare areas (*Z. vittigera*, *Z. macgregori*), scutum with large presutural, sublateral dark brown mark (Figs. 3B, D) 2
2. Apical band extended basad along vein M, together with subapical band forming P-shaped mark (Fig. 1A). Mexico (Morelos, Guerrero, Chiapas) .... *cocoyoc* Bush
– Apical band not extended along vein M 3
3. Distal 3 abdominal tergites (3–5 in male, 4–6 in female) with dark brown lateral spots, those on last 2 tergites large. Jamaica ... *minuta* Bush
– Dark brown lateral spots present at most on distal 2 tergites, that on penultimate tergite small if present 4
4. Apical band, subapical band anterior to vein R_{4+5}, and accessory costal band faint, much paler than discal band and posterior part of subapical band (Fig. 1G). Accessory costal band often connected to subapical band. Length of first flagellomere of antenna (measured on mesal side) more than 0.7 times height of face (measured to ventral margin of antennal sockets). Colombia, Venezuela, northeastern Brazil .... *scutellata* (Hendel)
– Apical and subapical bands evenly developed, similar to discal band in color (Figs. 1B–E, I). Accessory costal band variable, but not connected to subapical band. Length of first flagellomere less than 0.7 times height of face .. 5
5. Scutum without presutural dark brown marks (Fig. 2). Cells r_{4+5} and dm mostly or entirely microtrichose between discal and subapical bands. Katepisternum rarely with dark brown spot 6
– Scutum with presutural dark brown marks (Figs. 3B, D). Cells r_{4+5} and dm with large bare areas without microtrichia between discal and subapical bands. Katepisternum with dark brown spot 7
6. Discal band (measured along vein M) usually narrower than hyaline area distal to it, at most 1.1 times as broad (Figs. 1B–C). Discal, subapical and apical bands orange brown. Subscutellum and mediotergite usually orange. Southeastern Canada, eastern U.S. ...... *electa* (Say)
– Discal band (measured along vein M) 1.21–1.34 times broader than hyaline area distal to it (Fig. 1D). Discal, subapical and apical bands brown. Subscutellum and most of mediotergite dark brown. Costa Rica .... *guybushi* Norrbom, n. sp.
7. Wing bands relatively narrow, cell r_{2+3} apical to subapical band with large hyaline mark along vein R_{4+5}, at least ⅓ width of cell (Fig. 1I). Vertex usually entirely yellow except for brown ocellar tubercle. Scutum with submedial stripe usually orange anterior to transverse suture (Fig. 3D), occasionally partially to entirely red-brown or dark brown. Accessory costal band distinct. Southwestern U.S. to central Mexico .... *vittigera* (Coquillett)
– Wing bands relatively broad, cell r_{2+3} apical to subapical band entirely infuscated or with narrow hyaline mark along vein R_{4+5}, at most ⅓ width of cell (Fig. 1E). Orbital plate moderate to dark brown, sometimes connected by a band across vertex. Scutum with submedial stripe usually dark brown anterior to transverse suture (Fig. 3B). Accessory costal band sometimes faint. Mexico (Baja California, Sonora) .... *macgregori* Hernández-Ortiz

Zonosemata cocoyoc Bush
(Fig. 1A)

References.—Bush 1966: 319 [description]; Aluja et al. 1987: 324 [Chiapas]; Norrbom 1990: 55 [host].

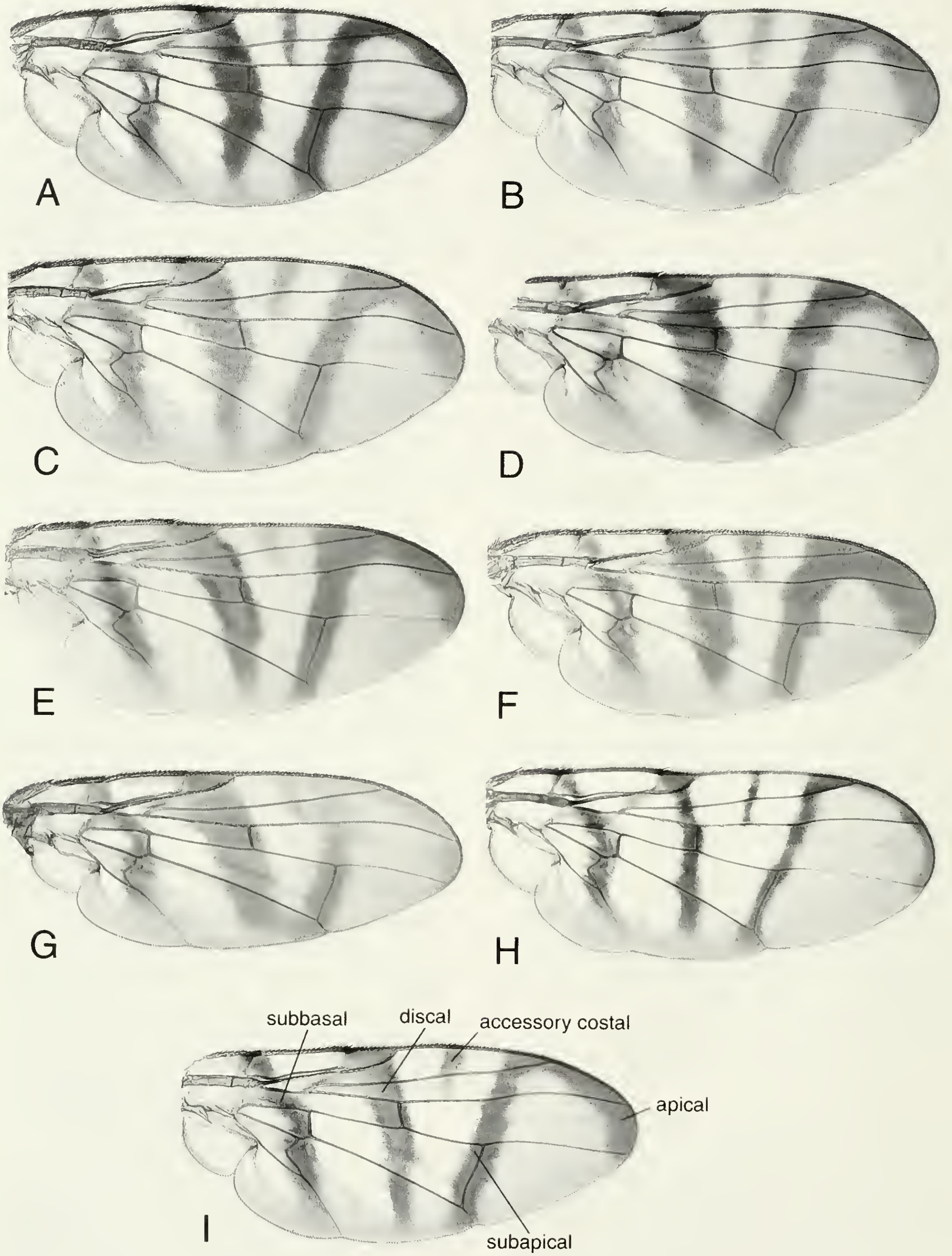

Fig. 1. Wings. A, *Zonosemata cocoyoc.* B–C, *Z. electa.* D, *Z. guybushi.* E, *Z. macgregori.* F, *Z. minuta.* G, *Z. scutellata.* H, *Z. vidrapennis.* I, *Z. vittigera.*

Recognition.—The P-shaped apical and subapical bands distinguish *Z. cocoyoc* from all other species of *Zonosemata*.

Biology.—An undetermined species of *Solanum* was listed by Norrbom (1990) as a host plant.

Distribution.—Known only from Mexico (Chiapas, Guerrero, and Morelos). The following specimen is the first reported from Guerrero.

Specimen data.—MEXICO: Guerrero: Cacahuamilpa, 2.1 mi. NW of, 23 Jul 1981, Bogar, Schaffner & Friedlander, 1 ♀ (TAMU, USNM52777).

Zonosemata electa (Say)

(Figs. 1B–C, 2A–B)

References.—Say 1830: 185 [description]; Bush 1966: 314 [revision]. See Foote et al. (1993: 494) for additional information and references.

Type data.—Say (1830) described this species as *Trypeta electa* based on an unstated number of specimens from Indiana. The syntypes, like the rest of Say's Diptera types, have been lost (Stone 1980: 35). To clarify the concept of this species and prevent its confusion with the similar species *Z. guybushi* (see above key for diagnostic characters, and Benjamin 1934, Bush 1966 and Foote et al. 1993 for descriptions of *Z. electa*), a male in the National Museum of Natural History (USNM) is here designated as neotype. It bears the following labels: "USA: MARYLAND: Montgomery Co., Plummer's Island, 11.VIII.1988, A. L. Norrbom, on *Solanum carolinense* L.", "USNM ENT 00052480", [red] "NEOTYPE ♂ Trypeta electa Say, 1830 desig. Norrbom 2001", and "Zonosemata electa (Say) det. Norrbom 1988".

***Zonosemata guybushi* Norrbom, new species**

(Figs. 1D, 2C)

Recognition.—This species runs to *Z. electa* in the key of Bush (1966). It differs in having broader and darker wing bands (the discal band is broader than the hyaline area between it and the subapical band measured along vein M). Cell cu_1 lacks or has only a very small nonmicrotrichose area, and the subscutellum and at least a broad medial stripe on the mediotergite are dark brown; in *Z. electa* these characters are variable, but the subscutellum and mediotergite are usually entirely orange and there is usually a large nonmicrotrichose area in cell cu_1.

Description.—*Head:* Frons with 3–4 frontal and 2 orbital setae; ocellar seta well developed. First flagellomere 0.53–0.57 mm long, 0.61–0.63 times facial height, with distinct dorsoapical point. Arista with minute pubescense (sparse in holotype). *Thorax:* Mesonotum 3.14–3.20 mm long. Dorsocentral seta aligned with postalar seta. Wing (Fig. 1D): 6.17–6.58 mm long. Pattern, as typical for genus, with following bands: subbasal, discal (covering crossvein R-M), subapical, and anterior apical bands. Bands brown, relatively broad. Discal band (measured on vein M) 1.21–1.34 times as broad as hyaline area distal to it. Discal and subapical bands broadly connected in cell cu_1 although both are fainter in that cell than more anteriorly. Wing mostly microtrichose, with parts of basal and costal cells and most of hyaline areas of cells br and dm between subbasal and discal bands bare; cell cu_1 at most with narrow bare area aligned with that in cu_1. *Abdomen:* Orange. Tergite 6 with large lateral dark brown spot. Oviscape orange, 1.66 mm long. Aculeus 1.96–2.04 mm long, tip similar to other species of *Zonosemata*, slender with minute apical notches.

Type data.—Holotype—♀ (INBio, INBIO002153791), COSTA RICA: Guanacaste: Area Conservacion Guanacaste, San Cristobal, LN 317400 383400, 620 m, emerged 8 Apr 1998 from fruits of *Solanum lanceifolium* Jacq. coll. 10 Sep 1997, 97-F. A. Quesada-134. Paratype, same data except emerged 7 May 1998, 1 ♀ (USNM, INBIO002153688).

Biology.—The type specimens were reared from *Solanum lanceifolium* Jacq.,

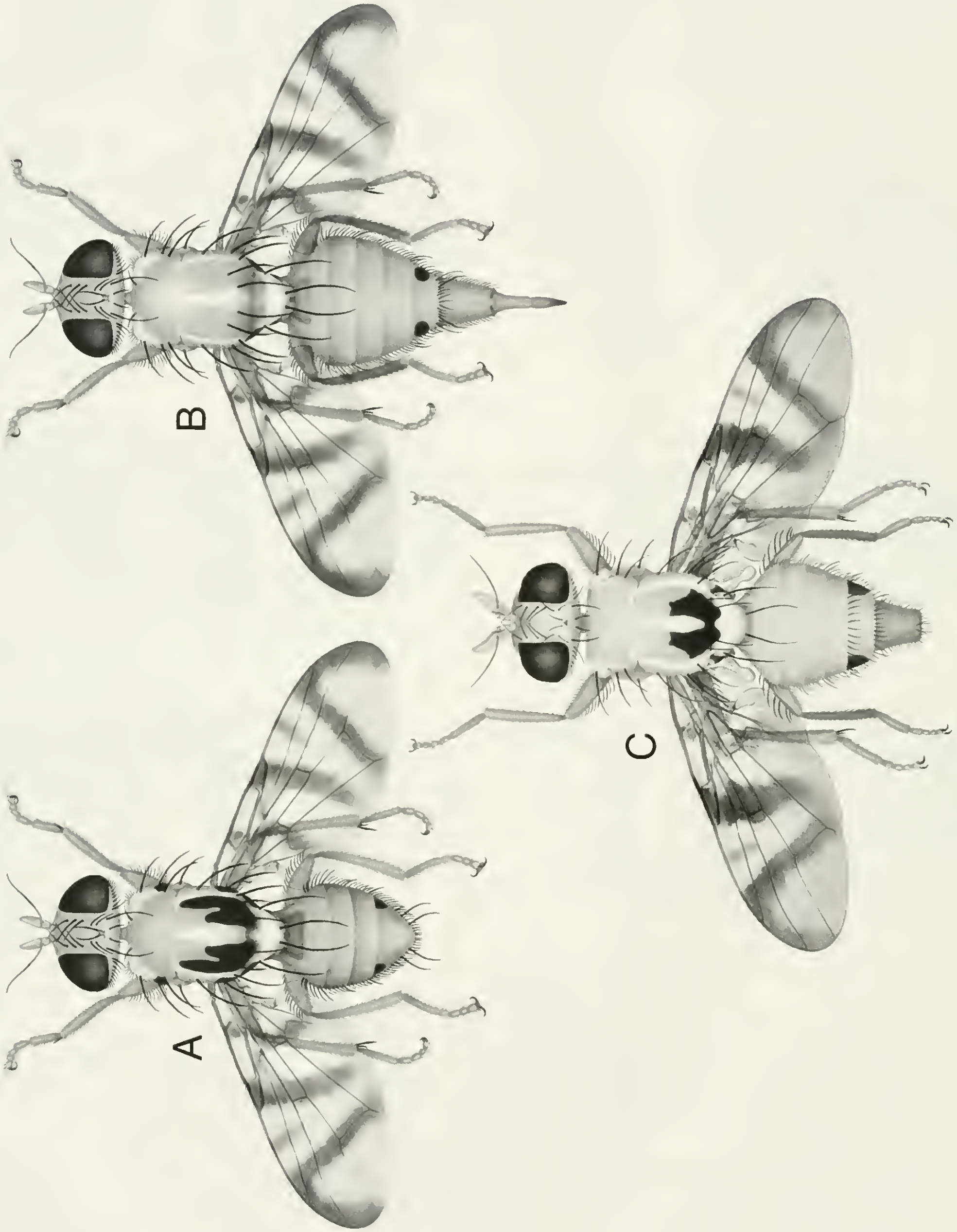

Fig. 2. Dorsal habitus. A–B, *Zonosemata electa,* male and female. C, *Z. guybushi.*

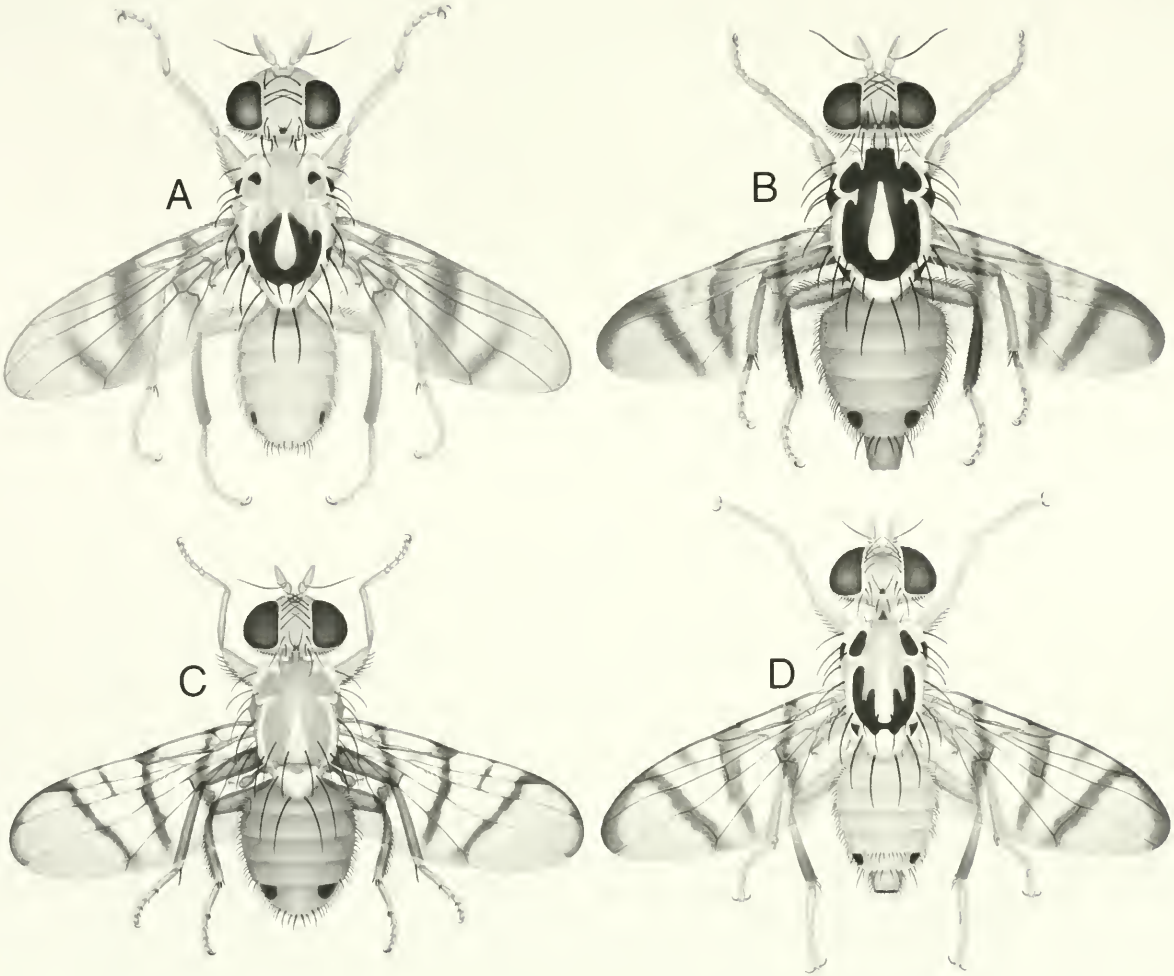

Fig. 3. Dorsal habitus. A, *Zonosemata scutellata.* B, *Z. macgregori.* C, *Z. vidrapennis.* D, *Z. vittigera.*

which occurs in the Greater and Lesser Antilles and from Oaxaca, Mexico to Peru.

Distribution.—Known only from Costa Rica.

Etymology.—This species is named in honor of Guy L. Bush, who produced the latest comprehensive revision of *Zonosemata.*

Zonosemata macgregori Hernández-Ortiz (Figs. 1E, 3B)

References.—Hernández-Ortiz 1989: 206 [description].

Recognition.—In general, *Z. macgregori* has the most extensive dark brown markings of any species of *Zonosemata* (Fig. 3B), although it sometimes cannot be separated from *Z. vittigera* by body color pattern alone. Both of these species have a large dark brown spot on the katepisternum and a large presutural sublateral brown mark on the scutum. In *Z. macgregori,* the submedial stripe is usually dark brown anterior to the suture, whereas it is usually orange in *Z. vittigera,* although there is overlap in this character. The width of the apical band (cell r_{2+3} apical to subapical band entirely infuscated or nearly so) distinguishes *Z. macgregori* from *Z. vittigera.* The orbital plates are moderate to dark brown, sometimes connected by a band across the vertex, whereas the top of the head is usually entirely yellow except for the ocellar tubercle in *Z. vittigera.*

Biology.—No host plant data are known.

Distribution.—Known only from Mexico (Baja California Norte, northern Baja California Sur, and Sonora). The first record from Sonora is reported below, based on a female that was compared with the type series by Vicente Hernández-Ortiz at my request.

Comments.—There is some intergradation in the scutal color pattern with *Z. vittigera.* The submedial band is partly to mostly orange anterior to the transverse suture in 2 of 5 specimens of *Z. macgregori* examined, and in some specimens of *Z. vittigera* from Mexico it is partially or entirely red brown or dark brown. Whether the submedial stripe and presutural lateral spot are connected (considered a diagnostic character for *Z. macgregori* by Hernández-Ortiz) varies in both species, although the connection is orange if present in *Z. vittigera,* whereas it may be brown in *Z. macgregori.* The difference in the width of the wing bands, especially the apical band, seems consistent, although this is based on a rather small sample of *Z. macgregori.* Study of larger samples of specimens or analysis using other methods would be useful to confirm that these populations are not conspecific with those of *Z. vittigera.* Discovery of their host plant would also be helpful in this regard. *Solanum elaeagnifolium* Cav., the only known host plant of *Z. vittigera,* occurs in Sonora and at least the extreme north of Baja California Norte (Wiggins 1980), but I do not know if it occurs in the other areas from which *Z. macgregori* is known.

Specimen data.—MEXICO: Baja California Sur: near Candelaria, 17 Mar 1992, R. Garces & R. Wharton, 1♂ (USNM52781); San Jose Viejo, 20 Mar 1992, R. Wharton & R. Garces, 1♀ (TAMU USNM52783); same, 18 Oct 1991, 1♀ (TAMU USNM52782); Santiago, 16 Mar 1992, R. Garces & R. Wharton, 1♀ (USNM52780). Sonora: San Jose Guaymas, 3 Apr 1989, FRB-13-89, 1♀ (USNM53368).

Zonosemata scutellata (Hendel) (Figs. 1G, 3A)

References.—Hendel 1936: 73 [description, Brazil], Steyskal 1974: 234 [description as *Z. ica,* Colombia]; Norrbom 1990: 53 [synonymy, Venezuela, hosts].

Comments.—This species is known from Colombia, Venezuela, and northeastern Brazil. Its biology is poorly known. Norrbom (1990) listed data for several specimens from Venezuela that were at least associated with a species of *Solanum*; whether on not they were reared is uncertain. The following specimens were clearly reared from a *Solanum* species and provide another data point for the distribution of *Z. scutellata*.

Specimen data.—VENEZUELA: Zulia: Mision del Tokuko (9°42′51″N 72°46′33″W), 300 m., [reared] ex fruto de cojon de gato (*Solanum* sp.), 15 Aug 1995, K. Katiyar & J. Oroño, 2♂ 1♀ (USNM48730–32).

Zonosemata vidrapennis Bush
(Figs. 1H, 3C)

References.—Bush 1966: 321 [description]; Norrbom 1990: 55 [host].

Recognition.—The extremely narrow wing bands distinguish *Z. vidrapennis* from all other species of *Zonosemata* (Fig. 1H). Only it, *Z. vittigera*, and *Z. macgregori* have large nonmicrotrichose areas in the radial cells and cell dm between the discal and subapical bands. Both of the latter species have a dark brown, presutural, sublateral mark on the scutum that is absent in *Z. vidrapennis* (Fig. 3C).

Distribution.—Mexico (Michoacán, Mexico, Puebla, Veracruz, Oaxaca, Chiapas), Guatemala, Honduras.

Biology.—The Honduran specimens were collected on fruits of *Solanum lanceolatum* Cav., which is native from southern Mexico to western Panama and is an introduced weed in California. As this is a likely host plant, *Z. vidrapennis* may be a potential biological control agent for this invasive plant. An undetermined species of *Solanum* was listed by Norrbom (1990) as a host plant in Mexico.

Comments.—The specimens from Guatemala and Honduras differ from Mexican specimens in having a large, U-shaped dark brown mark on the scutum and scutellum, a small dark brown area on the notopleuron, a small brown area on the katepisternum, and a mostly to entirely dark brown subscutellum and mediotergite. These areas are entirely orange in the Mexican specimens, although all of the specimens have large spots on the last abdominal tergite, on the anepimeron, and in males, on the epandrium, so this does not appear to be age-related variation. More detailed study of additional specimens, particularly reared series from both Mexico and Central America, is needed to confirm if this is geographic variation as it is here interpreted.

Specimen data.—GUATEMALA: Escuintla: Escuintla, Grutas de San Pedro Martir, 10 Jul 1965, P.J. Spangler, 1♂ (USNM52409). HONDURAS: Intibucá: Yamaranguila, Las Hortencias, 14°21′11.9″N 88°14′57.5″W, 2150 m, on fruits of *Solanum lanceolatum* Cav., 8 Jun 1998, L. Cañas, 2♂ (USNM52410–1). MEXICO: Chiapas: San Cristobal de las Casas, 35 mi. E, 26 Jul 1957, J.A. Chemsak & B.J. Rennells, 1♀ (UCB). Michoacán: Tzintzuntzan, 7000 ft., 8 Aug 1954, R.E. Ryckman, D. Spencer & C.P. Christianson, 1♀ (USNM52408). Oaxaca: El Punto, 10.8 mi S of, 6100 ft., 19 Jul 1987, R. Wharton, 1♀ (TAMU USNM52779); La Cumbre, 3.2 mi. SW of, 18 Jul 1985, Jones & Schaffner, 1♂ (TAMU USNM52778); Mitla, 5500 ft., 25 Jul 1962, H.E. Milliron, 4♂ (CNC USNM52398–401) 1♂ 1♀ (USNM52403–4); same except 27 Jul 1962, 1♀ (CNC USNM52402); Oaxaca, Monte Alban, 22 Jul 1963, A. Gillogly, 1♀ (UCR). Puebla: Calcaloapan, 19 mi. NW, 30 Jul 1963, J. Doyen, 1♀ (UCB USNM52407).

Zonosemata vittigera (Coquillett)
(Figs. 1I, 3D)

References.—Coquillett 1899: 261 [description]; Cazier 1962: 181 [biology]; Bush 1966: 315 [revision]; Goeden and Ricker 1971: 417 [biology]. See Foote et al. (1993: 496) for additional references.

Recognition.—This species differs from other species of *Zonosemata*, except *Z. vidrapennis* and *Z. macgregori*, by having most of cells r_{4+5} and dm without microtrichia between the discal and subapical bands. It differs from *Z. vidrapennis* in having broader wing bands (particularly the apical band) (Fig. 1I) and a presutural sublateral dark brown spot on the scutum (Fig. 3D) and a dark brown spot on the katepisternum. It differs from *Z. macgregori* in having a narrower apical band (cell r_{2+3}

with a large hyaline spot between the apical band and vein R_{4+5}). The submedial band on the scutum is usually orange anterior to the transverse suture, whereas in *Z. macgregori* it is usually dark brown, but there is overlap in this character in these two species.

Biology.—*Solanum elaeagnifolium* Cav. is the only known host (Cazier 1962, Goeden and Ricker 1971).

Distribution.—Mexico (Chihuahua, Coahuila, Durango, Guanajuato, Michoacán, San Luis Potosí, Sonora, Tamaulipas, Zacatecas; Distrito Federal?) and southwestern United States (southeastern California to Oklahoma and Texas). In Mexico, *Z. vittigera* occurs at least as far south as Guanajuato (Bush 1966). The record from Distrito Federal (Foote 1967) may be an error based on the statement by Bush (1966: 318) that *Z. vittigera* "ranges from just north of Mexico, D.F." The Specimen Data section includes previously unreported records from Mexico.

Comments.—Of 53 specimens from Mexico that I examined, 16 (2 of 5 from Chihuahua, 2 of 7 from Coahuila, and 3 of 8 from Durango, 11 of 31 from Zacatecas) have the submedial stripes at least partially red-brown to dark brown anterior to the transverse suture. One Durango female in the CNC (USNM52414) is unusual in having a pair of submedial and a pair of sublateral dark brown spots on tergite 5 in addition to the normal pair on tergite 6. A female from Coahuila (USNM52435) has the discal and subapical bands broadly connected in cell cu_1.

Specimen data.—MEXICO: Chihuahua: Chihuahua, 17 mi. W, 11 Jul 1964, J. Powell or J.A. Chemsak, 2♀ (UCB USNM53369–70); Ciudad Jiménez, 16 km N, 26 Aug 1991, T. Griswold, 1♀ (USU USNM52434); Mapini dunes, N of, 22 Aug 1991, T. Griswold, 1♀ (USU); Samalayuca, 6 Aug 1950, R.F. Smith, 1♀ (AMNH USNM52433). Coahuila: 20 km. from Saltillo, 26 Jun 1986, Wapshere & Segura, 2♂,1♀ (USNM52435, 53371–2); Nueva Rosita, 29 Aug 1974, G. Bohart & W. Hanson, 1♂ (USNM52436); Saltillo, 12.4 mi. S of, 4 Jul 1985, J. Wooley & G. Zolnerowich, 3♂ (TAMU). Durango: Durango, 5 mi. W, 6500 ft., 14 Jul 1964, J.F. McAlpine, 1♂,1♀ (CNC USNM52412–13); Durango, Hwy. 45, 25 mi. S, 24 Jul 1964, L.A. Kelton, 1♀ (CNC USNM52414); La Zarca, 2 mi. S, 16 Jul 1964, J.A. Chemsak, 1♂ (UCB USNM52438); Pedricena, 5 mi. S of, 29 Jul 1966, P. M. & P. K. Wagner, 1♂ (TAMU USNM52798); Tlahualilo, 4 Sep 1904, A.W. Morrill, 1♀ (USNM52437); Yerbanis, 1 mi. SW of, 12 Aug 1965, H. Burke & J. Meyer, 2♂ (TAMU USNM52796–7). Michoacán: Italia, 28 Apr 1965, A.H. Lewis, 1♀ (USNM52439). San Luis Potosí: San Lorenzo, 1 mi. S of, 25 Jul 1976, Peigler, Gruetzmacher, R. & M. Murray, Schaffner, 1♀ (USNM52784). Tamaulipas: Matamoros, 2 Jul 1955, T. R. Stephens, 1♀ (USNM52443); Reynosa, 10 Jul 1935, F.O. Swan, 1♂ (USNM52444). Zacatecas: Concepcion del Oro, 13 mi. SW of, 9 Jul 1983, Kovarik, Harrison, Schaffner, 1♂,1♀ (TAMU); Concepcion del Oro, 30 mi. SW of, 9 Jul 1983, Kovarik, Harrison, Schaffner, 4♀ (TAMU); Concepcion del Oro, 4 mi. NE of, 4 Jul 1984, Schaffner, Woolley, Carroll, Friedlander, 11♂,2♀ (TAMU) 4♂,1♀ (USNM52790–4); same, J.B. Woolley, 3♂,5♀ (TAMU); Concepcion del Oro, 6 mi. S of, 4 Jul 1984, Carroll, Schaffner, Friedlander, Woolley, 1♂ (USNM52795); Luis Moya, 14 mi. N of, 26 Jul 1959, R.B. Selander & J.C. Schaffner, 1♀ (USNM52442).

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A NEW GENUS AND NEW SPECIES OF CEPHIDAE (HYMENOPTERA) FROM SULAWESI UTARA, INDONESIA

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Abstract.—***Sulawesius grandoculus*, n. gen., n. sp.**, is described from Sulawesi Utara, Indonesia. The genus does not fit into the current classification of the Cephidae, but it is provisionally placed in the Athetocephinae, a subfamily previously known only from Madagascar.

Key Words: *Sulawesius*, Indonesia, Athetocephinae

Most cephids are found in the temperate regions of the Northern Hemisphere. Only a few occur south into subtropical or tropical regions, and very few occur south of the equator. In the New World, the southernmost record is a species of *Hartigia* from the State of Chiapas, Mexico (Smith 1988). In the Old World, however, the tropical fauna is more diverse. The subfamily Athetocephinae, with one genus and two species, occurs in Madagascar (Benson 1935, 1946), *Janus* and *Urosyrista* occur in the tropics in Myanmar and Viet Nam (Naito et al. 1998), and one species of *Janus* is known from western Kalimantan, Indonesia (Smith 1994, 1997). Goulet (1992) reported seeing a species from Australia. It is apparent that more cephids are to be discovered in the Old World tropics, but, unfortunately, only single or a few specimens of several species form the basis of our knowledge. Such is the case with the unusual species we report on here. It is a single specimen from Sulawesi Utara in Indonesia, so unusual that it does not conform to, and, in fact, confounds the existing classification, even at the subfamily level, and unusual in that it is one of the few known cephids that occur in the Southern Hemisphere. It warrants attention and adds another segment of information to our understanding of the family.

PLACEMENT IN CEPHIDAE

The only world classification available is that by Benson (1946) who recognized two subfamilies, Athetocephinae (misspelled Achetocephinae in some literature) and Cephinae. Athetocephinae occur only in Madagascar and Cephinae are Holarctic and Oriental. The subfamily Cephinae includes three tribes, Pachycephini (Mediterranean and Near East), Hartigiini (Holarctic and Oriental), and Cephini (Holarctic).

The genus we describe does not conform to the definition of either of Benson's (1946) subfamilies but shares certain characteristics with each. It shares the following with Athetocephinae: Labial palpus 3-segmented and without a sensory pit, much longer and stouter than the 4-segmented maxillary palpus; lack of a genal carina (although also absent in a few *Pachycephus* and *Janus*); antennae constricted only at the base and thickest in the middle (Fig. 2); left mandible bidentate (though with a different shaped inner tooth, Fig. 3); inner tooth of the tarsal claw longer and stouter than the outer tooth (but a small, rounded basal lobe present); radial crossvein of the forewing meeting the stigma at about its center; and front ocellus separated from each of the hind ocelli by a distance not more than the diameter of a single ocellus. It does not agree with Athetocephinae (characters in parentheses) by the following, most of which would place the new genus in Cephinae, tribe Hartigiini, in Benson's key (1946): Forewing with intercostal area less transparent than the rest of the wing membrane (same transparency); hindwing with 5–7 hamuli (11–15 hamuli); female sawsheath with the main axis almost straight, as in Fig. 4 (sheath strongly directed upward); head in dorsal view strongly narrowing behind eyes, as in Fig. 2 (large and expanded behind eyes); distance between the antennal sockets about equal to the distance between an antennal socket and the nearest anterior tentorial pit, as in Fig. 3 (distance between antennal sockets twice distance between antennal socket and anterior tentorial pit); hindtibia with one preapical spine (no preapical spine); and tarsal claw with indistinct, rounded basal lobe (basal lobe absent).

The new genus has the following unique characters that separate it from Athetocephinae and Cephinae and all the genera therein: Eyes extremely large, covering most of side of head, in lateral view eye close to and parallel with hind margin of head, in dorsal view, head strongly narrowing behind eyes (Figs. 1, 2); left mandible bidentate with inner tooth broad, rounded to truncate (Fig. 3); and tarsal claw with a small, rounded basal lobe.

The labial and maxillary palpi, antennae, position of the radial vein of the forewing, lack of a genal carina, and closeness of the ocelli are similar to *Athetocephus*; the mandibles are similar to *Pachycephus*; the tarsal claws are similar to *Janus, Hartigia,* and *Athetocephus*; and the less transparent intercostal area of the forewing, antennal-antennal to antennal tentorial distance, and sawsheath are similar to the Cephinae. The current subfamilies could be redefined, or a new subfamily or tribe could be justified; however, we prefer to provisionally assign this genus to Athetocephinae because we believe more significant characters, as cited above, are shared with that subfamily than with the Cephinae.

Within the Athetocephinae, the new genus is separated from *Athetocephus* by the large eyes; head strongly narrowing behind the eyes; large, blunt inner tooth of the left mandible; presence of a rounded basal lobe on the tarsal claw; the intercostal area of the forewing less transparent than the rest of the wing membrane; presence of only 5–7 hamuli on the hind wing; and presence of a preapical spur on the hind tibia (though this can be variable in Cephidae). Benson (1935) described *Athetocephus* and again (1946) separated it from other Cephidae, Paulian (1961) gave an illustration of the dorsal habitus of one species, and Chevin (1984) gave some additional notes and described the female of one of the species.

Sulawesius Smith and Shinohara, new genus

Type species.—*Sulawesius grandoculus* Smith and Shinohara, n. sp.

Description.—Antenna constricted to middle of 4th segment, then broadened and slightly tapering at apex, thus somewhat thickened in the middle (Fig. 2); scape 2× longer than broad; pedicel as long as broad; 3rd segment slightly longer that 4th segment; apical 5–6 segments about as long as broad. Labial palpus 3-segmented, without sensory pit. Maxillary palpus apparently 4-segmented (difficult to see in specimen), shorter and more slender than labial palpus. Left mandible bidentate with outer tooth acute and inner tooth broad and rounded to truncate; right mandible with two acute

Fig. 1. *Sulawesius grandoculus*, habitus, lateral view.

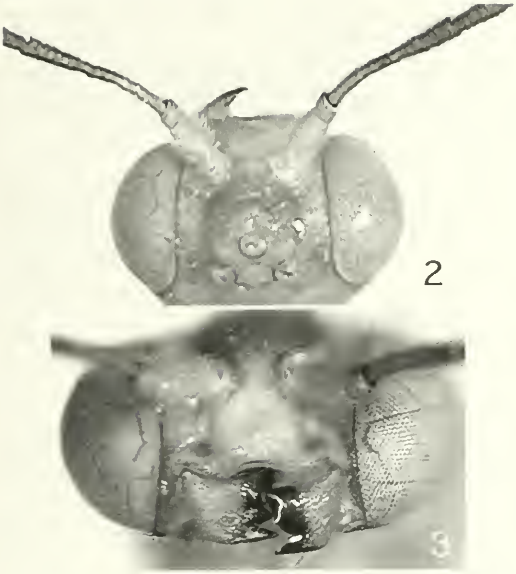
teeth, inner tooth shorter than outer, and with rounded basal region (Fig. 3). Genal carina absent. Eyes extremely large, covering most of side of head, slightly diverging below with lower interocular distance equal to or slightly greater than eye length and upper interocular distance slightly less than eye length; in lateral view, eye close to and parallel with hind margin of head (Figs. 1–3); in dorsal view, head strongly narrowing behind eyes (Fig. 2). Malar space slightly less than diameter of front ocellus (Fig. 3). Front ocellus separated from each hind ocellus by a distance not more than diameter of a single ocellus. Forewing with intercostal area less transparent than rest of wing membrane; radial crossvein (2r) meets stigma at about its center. Hindwing with 5–7 hamuli on front margin; with closed cells M and RS; rest of venation typical of Cephidae. Hindtibia with one preapical spine. Tarsal claws with subapical tooth longer and broader than apical tooth, and with indistinct, rounded basal lobe.

Etymology.—The genus name is based on the Indonesian province in which it was collected. Gender: masculine.

Sulawesius grandoculus Smith and Shinohara, new species

(Figs. 1–5)

Female.—Length, 8.1 mm; forewing length, 9.0 mm. Yellow; apex of mandible reddish brown; antenna with 1st flagellar segment and basal ¼ of 2nd flagellar seg-

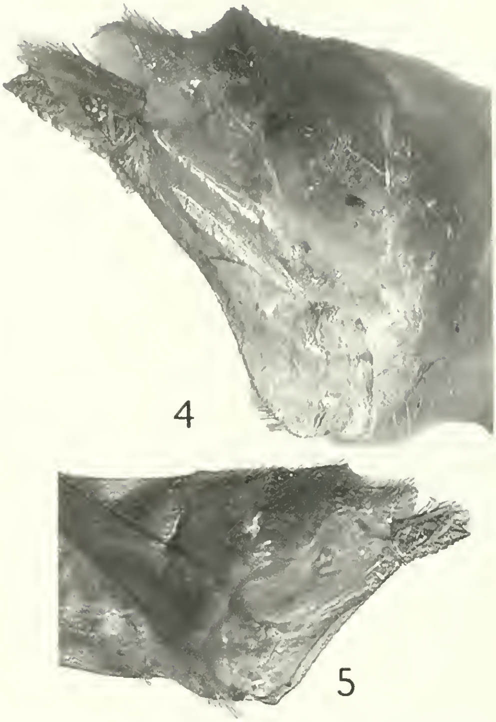


Figs. 2–3. *Sulawesius grandoculus.* 2. Head, dorsal view. 3, Head, front view.

ment reddish brown; apical ¾ of 2nd flagellar segment to apex black; mesopleuron whitish. Wings hyaline, with intercostal area of forewing darkened; veins and stigma black with basal half of costa and subcosta yellow. Head and body shining, impunctate; only mandible with somewhat elongated pits and center of clypeus roughened.

Antenna 22-segmented, length 2.4× head width (Figs. 1, 2). Clypeus with slight central circular emargination (Fig. 3). Distance between antennal sockets only slightly longer than distance from antennal socket to anterior tentorial pit (as 1.2:1.0) (Fig. 3). Distances between eye and lateral ocellus, between hind ocelli, and from hind ocelli to posterior margin of head as 1.1:1.0:1.1; postocellar area about 2× broader than long (Fig. 2). Hind basitarsus slightly shorter than remaining tarsal segments combined (as 1.0:1.1). Cercus length subequal to length of sheath (Fig. 4). Sheath and basal plate in a straight line. Lancet well sclerotized, with truncate serrulae (Fig. 4) (not dissected, partly exerted in holotype).

Male.—Unknown.



Figs. 4–5. *Sulawesius grandoculus,* apex of abdomen and sheath, two aspects.

Holotype.—♀, labeled as follows: "9604021 coll. BMNH," "Indonesia: Sulawesi Utara, Dumoga-Bone N.P., May 1985," "Gunung Mogogonipa, 1000 m, Malaise, J.S. Noyes, J.H. Martin." Deposited in The Natural History Museum, London.

Etymology.—The specific epithet refers to the unusually large eyes of this species.

ACKNOWLEDGMENTS

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LIFE HISTORY AND DESCRIPTION OF IMMATURE STAGES OF *GOEDENIA SETOSA* (FOOTE) (DIPTERA: TEPHRITIDAE) ON *ERICAMERIA BRACHYLEPIS* (A. GRAY) H. M. HALL IN SOUTHERN CALIFORNIA

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Abstract.—*Goedenia setosa* (Foote) is a rare, monophagous or nearly monophagous, univoltine fruit fly (Diptera: Tephritidae) that feeds in the flower heads of *Ericameria brachylepis* (A. Gray) H. M. Hall in southern California. This sole, newly reported host belongs to the family Asteraceae tribe, Astereae, and subtribe Solidagininae, like all other known hosts of *Goedenia* spp. The third-instar larvae and puparia are described and figured, and selected characteristics of these stages are compared with the same stages of two other species of *Goedenia*. The prothorax and gnathocephalon of the second and third instars are smooth and mostly free of the minute acanthae that circumscribe most other body segments. The third instar of *G. setosa* lacks oral ridges, as do the third instars of two other congeners studied to date. The anterior thoracic spiracle bears two papillae in the third instar. Minute acanthae cover the center of the posterior end of the truncated, posteriorly sclerotized, caudal segment, that also is perforated by scattered, open pores, and this central area is ringed by concentric series of shallow, elliptical depressions. The life cycle is of the aggregative type. Overwintering limitedly occurs as sexually immature adults, but more frequently in dead flower heads as prepuparial third instars and puparia in apically open, vasiform cells consisting of floret and achene fragments impregnated and hardened with dried liquid feces and sap. The flattened, sclerotized posterior of the caudal segment of the overwintering prepuparium serves to plug the apical opening of the cell and thus possibly helps to shield it at least from predators. However, *Colotrechnus* sp. (Eulophidae), *Eurytoma* sp. (Eurytomidae), *Eupelmus* sp. (Eupelmidae), *Halticoptera* (Pteromalidae), and *Mesopolobus* sp. (Pteromalidae) are chalcidoid, primary parasitic Hymenoptera commonly reared from the overwintered puparia.

Key Words: Insecta, *Goedenia*, *Ericameria*, Asteraceae, nonfrugivorous Tephritidae, biology, taxonomy of immature stages, flower-head feeding, aggregative life cycle, seed predation, parasitoids

Indigenous, western North American Myopitini (Diptera: Tephritidae: Tephritinae) formerly assigned to the Palearctic genus *Urophora* Robineau-Desvoidy were redesignated as *Goedenia* by Freidberg and Norrbom (1999). To date, the life history and immature stages of two of the eight known species of *Goedenia* have been described in detail, i.e., *G. timberlakei* (Blanc and Foote) and *G. rufipes* (Curran), by Goeden et al. (1995) and Goeden (2002), respectively. This paper describes the life history and selected immature stages of a third species, *G. setosa* (Foote).

Materials and Methods

The present study utilized specimens of adults reared from 1-liter samples of mature flower heads of *Ericameria brachylepis* (A. Gray) H. M. Hall collected at a single location in southern California: South of Banner along Chariot Canyon Road at 980-m elevation in northeastern San Diego County. The life history study and description of the immature stages of *G. setosa* were based in large part on dissections of samples of live, immature and mature, flower heads and dead, overwintered flower heads collected during 1995–1999. One-liter samples of these flower heads containing the scarce larvae and puparia were transported in cold-chests in an air-conditioned vehicle to the laboratory and stored under refrigeration for subsequent dissection, photography, description, and measurement. Sixteen third-instar larvae and nine puparia dissected from flower heads were preserved in 70% EtOH for scanning electron microscopy (SEM). Prepuparia and puparia were placed in separate, glass shell vials stoppered with absorbant cotton and held in humidity chambers at room temperature for adult and parasitoid emergence. Specimens for SEM were hydrated to distilled water in a decreasing series of acidulated EtOH. They were osmicated for 24 h, dehydrated through an increasing series of acidulated EtOH and two, 1-h immersions in hexamethyldisilazane (HMDS), mounted on stubs, sputter-coated with a gold-palladium alloy, studied and digitally photographed with a Philips XL-30 scanning electron microscope in the Institute of Geophysics and Planetary Physics, University of California, Riverside.

A few adults reared from isolated prepuparia and puparia were individually caged in 850-ml, clear-plastic, screened-top cages with a cotton wick and basal water reservoir and provisioned with a strip of paper toweling impregnated with yeast hydrolyzate and sucrose. These cages were used for studies of longevity in the insectary of the Department of Entomology, University of California, Riverside, at 25 ± 1°C and 14/10 (L/D) photoperiod. A virgin male and female obtained from emergence cages were held in a clear-plastic, petri dish provisioned with a flattened, water-moistened pad of absorbant cotton spotted with honey (Headrick and Goeden 1994) for observations of courtship and copulation behavior.

Plant names used in this paper follow Hickman (1993) and Bremer (1994); tephritid names follow Foote et al. (1993). Terminology and telegraphic format used to describe the immature stages follow Goeden (2001a, b, c; 2002), Goeden et al. (1993), Goeden and Headrick (1992), Goeden and Norrbom (2001), Goeden and Teerink (1997), Headrick et al. (1996), Teerink and Goeden (1999), and our earlier works cited therein. Means ± SE are used throughout this paper. Digitized photographs used to construct text figures were processed with Adobe Photoshop® Version 6.

Results and Discussion

Taxonomy

Adult.—*Goedenia setosa* was described by R. H. Foote (in Blanc and Foote 1987) in the genus *Urophora* based on a single male collected from Tar Canyon, Kings County, California. Freidberg and Norrbom (1999) reclassified most of the indigenous, western North American species of *Urophora* as *Goedenia*. A wing photograph of *G. setosa* was provided by Blanc and Foote (1987) and Foote et al. (1993), and the head was figured in dorsal view in Foote et al. (1993).

Foote et al. (1993) noted that "most" *G. setosa* and "most" *G. timberlakei*, along with *Neomyopites* (as *Urophora*) *claripennis* (Foote) are the only U.S. and Canadian *Myopitini* with an entirely black scutellum. Two males (9%) of 22 adults of *G. setosa* reared from flower heads at the study site had the middle third of the scutellum yellow; the scutella of the remaining flies were entirely black. Similarly, 60 (20%) of 302 adults of *G. timberlakei* reared from 11 different hosts (Goeden 1987, unpublished data; Goeden et al. 1995) had the apex of the scutellum ocherous to bright yellow instead of all black.

Immature stages.—*Third instar larva:* Elongate-ellipsoidal, roundly tapered anteriorly, bluntly truncated posteriorly (Fig. 1A), integument white, but venters of meso-, metathorax, and abdominal segments A1–A4 with dark brown to black infuscation; caudal segment, including spiracles, dark brown or black; minute acanthae conical, bluntly or sharply pointed (Figs. 1B-1, E-1), or hemispheroidal (Figs. 2A-1, C-1), and outwardly or posteriorly directed, circumscribe anterior fifth and all of venters of meso- and metathorax, and all but middle half of abdominal segment A1, including all of venters, circumscribe all of A2–A7, and cover dorsal half and posterior part of caudal segment; prothorax smooth, but venter with flattened, pointed, posteriorly directed minute acanthae (Figs. 1B-1, C-1), and circumscribed by verruciform sensilla medially (Fig. 1B-2); gnathocephalon conical and medially divided by a vertical cleft (Fig. 1C-2), pore (Fig. 1D-1) above each dorsal sensory organ; dorsal sensory organ well-defined, hemispherical (Figs. 1D-2); anterior sensory lobe (Figs. 1C-3, D-3) bears terminal sensory organ (Fig. 1D-4), lateral sensory organ (Fig. 1D-5), supralateral sensory organ (Fig. 1D-6), and pit sensory organ (Fig. 1D-7); two medial, papilliform integumental petals (Fig. 1D-8), five, lateral, spatulate or papilliform, integumental petals (Fig. 1D-9) above each mouthhook (Fig. 1C-4), lateralmost integumental petal (Fig. 1D-10) separate from stomal sense organ (Figs. 1C-5, D-11) ventrolaterad of anterior sensory lobe; mouthhook bidentate (Fig. 1C-4); median oral lobe laterally compressed, apically pointed (Fig. 1C-6); verruciform sensilla circumscribe gnathocephalon dorsolaterally, laterally, and ventrolaterally (Figs. 1C-7, D-12); anterior thoracic spiracle on posterior margin of prothorax bears two doliform papillae (Figs. 1B-3, E-2, F-1); mesothoracic, lateral spiracular complex with five verruciform sensilla in vertical series (Fig. 1F-2), mesothoracic spiracle not seen; metathoracic lateral spiracular complex with nearly closed, lateral spiracle (Figs. 1F-3, 2A-2) on posterior margin of anterior, circumnatal band of minute acanthae (Fig. 2A-1); five verruciform sensilla (Figs. 1F-4, 2A-3) in a vertical series posterior to lateral metathoracic spiracle; lateral spiracular complex of abdominal segment A1 consists of a nearly closed spiracle (Figs. 1F-5) and three verruciform sensilla in vertical series posterior to spiracle (Fig. 1F-6); caudal segment with pair of posterior spiracular plates (Fig. 2B-1) surrounded by hemispherical minute acanthae (Figs. 2B-2, C-1) interspersed dorsally, medially, and less so, ventromedially with open pores (Figs. 2B-3, C-2), these structures in turn ringed by two to three, concentric series of shallow, elliptical depressions (Fig. 2B-4), with verruciform sensilla dorsolaterally, laterally, and ventrolaterally outside these depressions (Fig. 2B-5); two, tapered stelex sensilla (Figs. 2B-6, C-3, D) and another verruciform sensillum (Figs. 2B-7, C-4, E) also dorsolateral to each posterior spiracular plate; posterior spiracular plate bears three, smoothly flattened, elliptical rimae (Fig. 2F-1), ca. 0.02 mm in length, and four, spinose, interspiracular processes, each ca. 0.005 mm long (Fig. 2F-2).

The habitus of the third instar of *G. setosa* resembles that of *G. timberlakei* (Goeden et al. 1995) and *G. rufipes* (Goeden 2002). In all three species, the venter of the thorax and the caudal segment are darkly pigmented (Fig. 4B, Goeden et al. 1995, Goeden 2002) and minute acanthae circumscribe the meso- and metathorax and abdomen, and especially noteworthy, the central, posterior surface of the caudal segment, which also is prominently dotted with scattered pores (Figs. 4D-3, E-3; Goeden et al. 1995). However, in *G. setosa* the minute acanthae and pores appear less numerous and more centralized (Figs. 4D-3, E-3) than

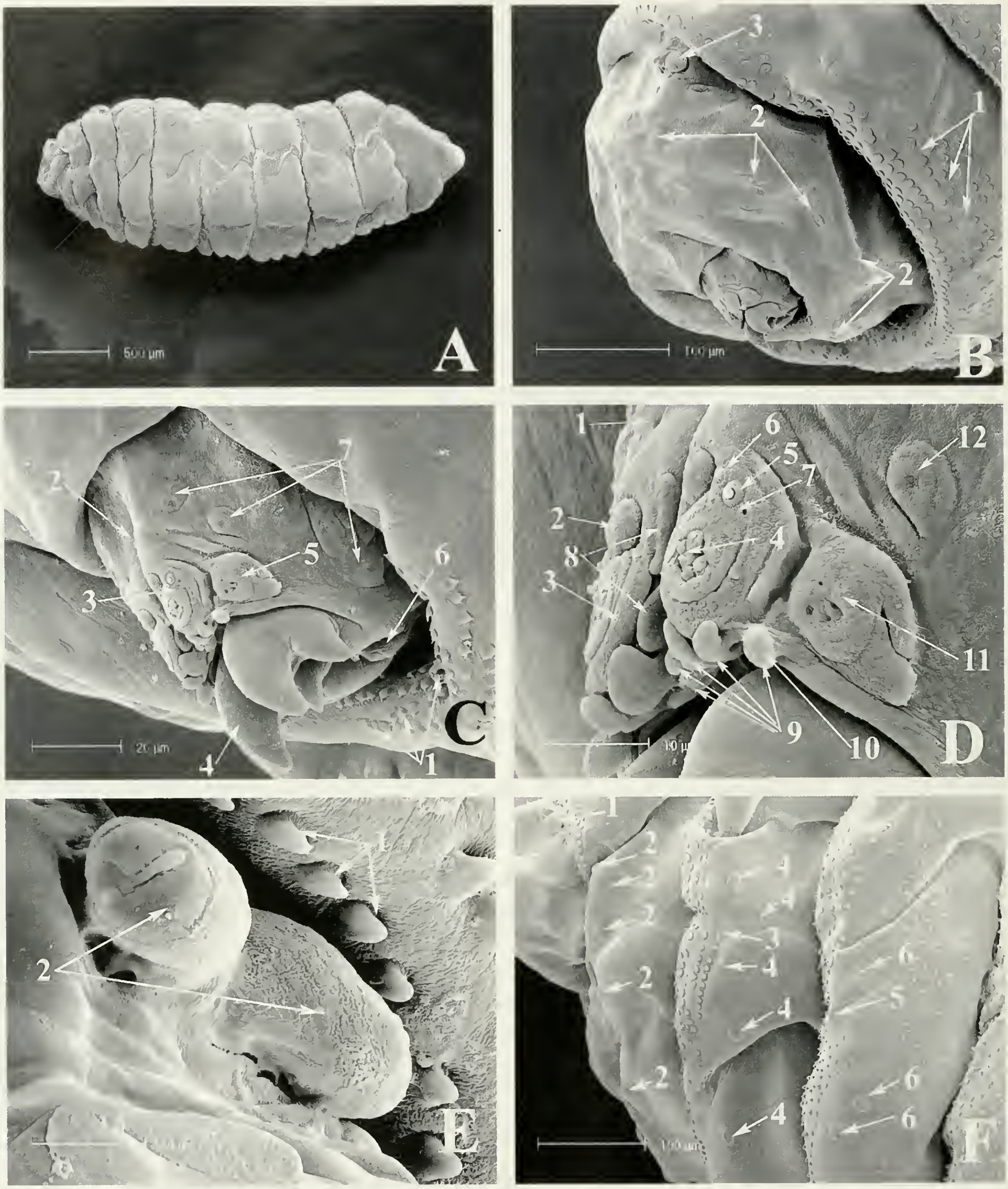

Fig. 1. Third instar of *Goedenia setosa*: (A) habitus, anterior to left; (B) gnathocephalon and prothorax, frontolateral view, 1—minute acanthae, 2—verruciform sensilla, 3—anterior spiracle; (C) gnathocephalon, frontolateral view, 1—minute acanthae, 2—vertical, medial cleft, 3—anterior sensory lobe, 4—mouthhook, 5—stomal sense organ, 6—median oral lobe, 7—verruciform sensilla; (D) gnathocephalon, close-up, 1—pore, 2—dorsal sensory organ, 3—anterior sensory lobe, 4—terminal sensory organ, 5—lateral sensory organ, 6—supralateral sensory organ, 7—pit sensory organ, 8—medial integumental petals, 9—lateral integumental petals, 10—lateralmost integumental petal, 11—stomal sense organ, 12—verruciform sensillum; (E) anterior spiracle, 1—minute acanthae, 2—papillae; (F) lateral spiracular complexes, 1—anterior spiracle, 2—verruciform sensilla on mesothorax, 3—lateral spiracle on mesothorax, 4—verruciform sensilla on metathorax, 5—spiracle on first abdominal segment, 6—verruciform sensilla on first abdominal segment.

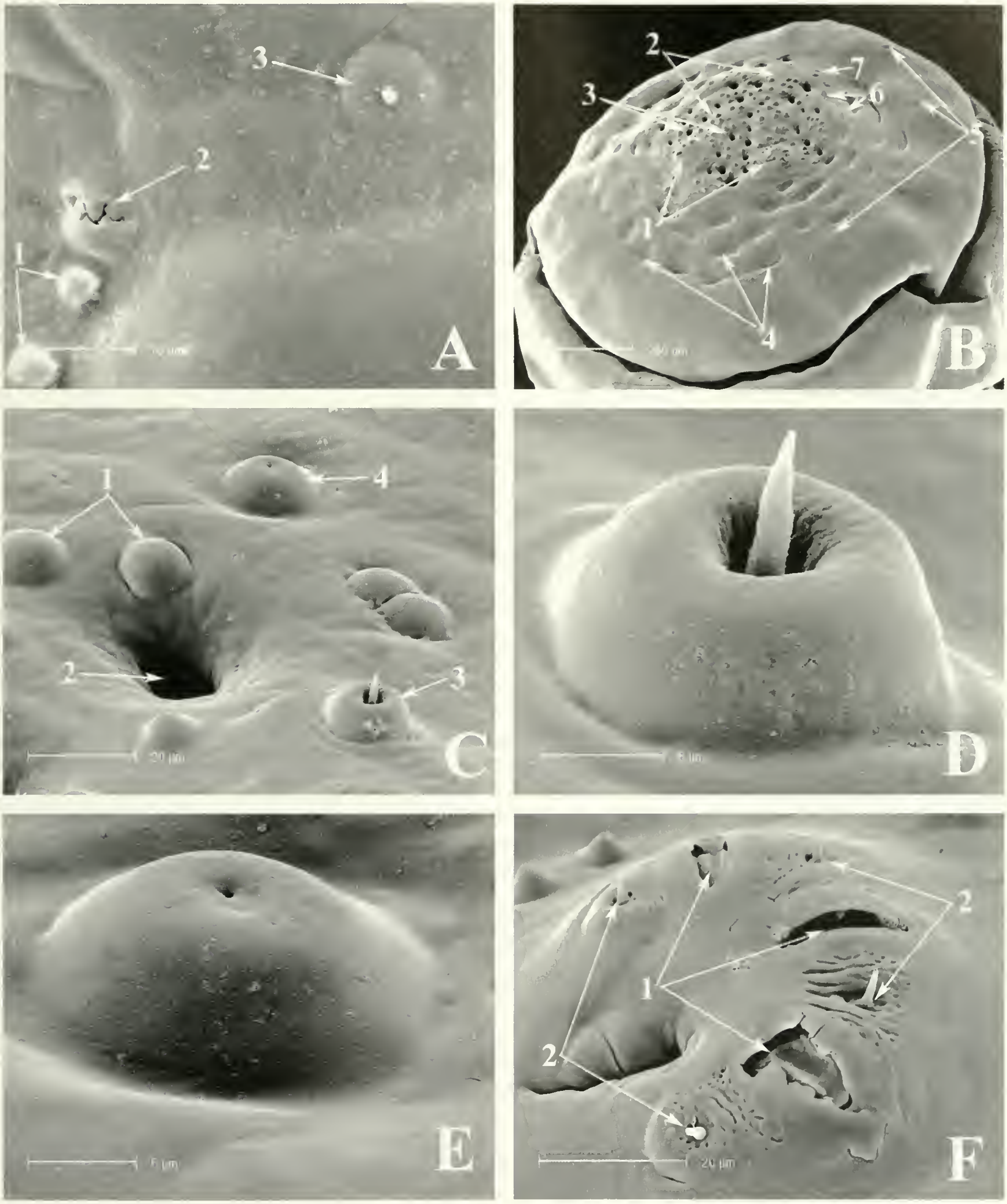

Fig. 2. Third instar of *Goedenia setosa,* continued, (A) close-up of lateral spiracular complex of metathorax, 1—minute acanthae, 2—spiracle, 3—verruciform sensillum; (B) caudal segment, 1—posterior spiracular plates, 2—minute acanthae, 3—pores, 4—shallow, elliptical depressions, 5—verruciform sensilla, 6—stelex sensilla, 7—verruciform sensillum; (C) close-up of caudal segment, 1—minute acanthae, 2—pore, 3—stelex sensillum, 4—verruciform sensillum; (D) stelex sensillum, (E) verruciform sensillum, (F) posterior spiracular plate, 1—rimae, 2—interspiracular processes.

in *G. timberlakei* (Goeden et al. 1995, unpublished data) and *G. rufipes* (Goeden 2002), and in *G. setosa* also are replaced peripherally by concentric series of shallow, elliptical depressions (Fig. 2B-4). Because *G. setosa* also exhibits shallow depressions (Fig. 2B-4) surrounding the center of the caudal segment, what I have termed pores may instead be deep depressions.

The prothorax and gnathocephalon of *G. timberlakei* and *G. rufipes* are smooth and free of minute acanthae (Goeden et al. 1995, Goeden 2002); whereas, the prothoracic venter of *G. setosa* anteriorly bears minute acanthae (Figs. 1B-1, C-1). Two medial and five lateral integumental petals are present in *G. setosa* (Figs 1D-8, -9); whereas, *G. timberlakei* has two medial and six lateral integumental petals (Goeden 2002). The lateralmost of these lateral integumental petals is separated from the stomal sense organ in all three species (Figs. 1C-4, D-10; Goeden et al. 1995, Goeden 2002).

The third instars of the three species of *Goedenia* studied to date lack oral ridges on either side of the mouth opening, and ventral or ventrolateral to the stomal sense organ (Figs. 1C, D; Goeden et al. 1995, 2002a, unpublished data).

The mouthhooks of the third instars of *G. setosa* (Fig. 1C-6), like those of *G. timberlakei* (Goeden et al. 1995) and *G. rufipes* (Goeden 2002), are bidentate; however, a vertical view of the oral cavity like that figured for *G. rufipes* (Goeden 2002) was not obtained for either *G. timberlakei* (Goeden et al. 1995, unpublished data) nor *G. setosa*. Thus, the concave, posterior surface of the anterior tooth described for *G. rufipes* could not be compared with the other two species.

The lateral spiracular complex of the mesothorax of *G. setosa* includes five verruciform sensilla in a vertical series (Fig. 1F-2); whereas, in *G. timberlakei*, this same complex includes only two verruciform sensilla (Goeden et al. 1995), but six such sensilla in *G. rufipes* (Goeden 2002).

The anterior spiracle of all three species bears only two papillae (Figs. 1E-2, F-1; Goeden et al. 1995, Goeden 2002).

The metathoracic lateral spiracular complex of *G. setosa* includes five verruciform sensilla (Fig. 1F-5, 2A-3), but again, only two such sensilla in *G. timberlakei* (Goeden et al. 1995) and four such sensilla in *G. rufipes* (Goeden 2002). Finally, three verruciform sensilla comprise the lateral spiracular complex of the first abdominal segment of *G. setosa* (Fig. 1F-7) and *G. rufipes* (Goeden 2002), but only one verruciform sensillum is found on this segment in *G. timberlakei* (Goeden et al. 1995).

Puparia: Light to dark, reddish brown with dark brown to black, anterior stripe on venter of meso- and metathorax and abdominal segments A1–A4, and similarly dark caudal segment, elongate-ellipsoidal, with smoothly rounded anterior end and truncated posterior end (Fig. 3A). Anterior end bears invagination scar (Fig. 3B-1) and raised, bilobed, anterior thoracic spiracles (Fig. 3B-2). Flattened posterior end of caudal segment studded with smoothly rounded, hemispherical, minute acanthae (Fig 3C-1) interspersed with open pores (Fig. 3C-2). A pair of raised, hemispheroidal, posterior spiracular plates (Fig. 3C-3) each bear three elliptical rimae interspersed with four, peg-like, interspiracular processes. These structures are ringed by shallow, elliptical depressions (Fig. 3C-4). Thirty-two puparia dissected from flower heads of *Ericameria brachylepis* averaged 2.68 ± 0.02 (range, 2.42–2.85) mm in length; 1.10 ± 0.02 (range, 0.94–1.28) mm in width.

DISTRIBUTION AND HOSTS

To date, *Goedenia setosa* only is reported from two locations in southern California (Blanc and Foote 1987), i.e., the type locality and the Chariot Canyon study site, and from its newly reported, sole known host plant, *Ericameria brachylepis*. Like all other known hosts of *Goedenia* spp. (Goeden 1987, Foote et al. 1993), *E. brachylepis* belongs to the family Asteraceae, tribe Astereae, and subtribe Solidagininae (Bremer

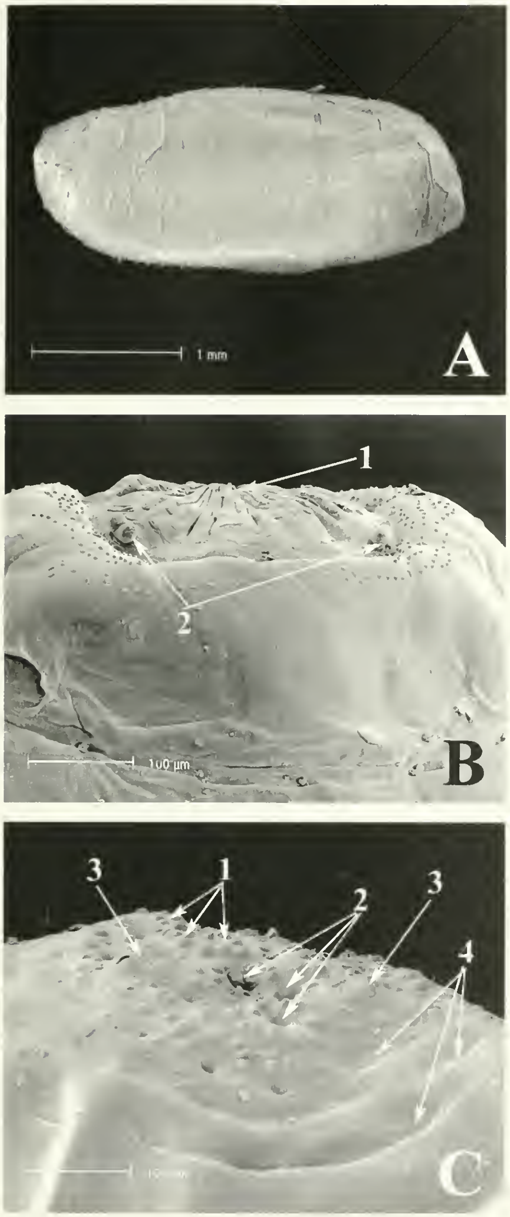

Fig. 3. Puparium of *Goedenia setosa:* (A) habitus, anterior to right, (B) anterior end, 1—invagination scar, 2—anterior spiracles; (C) caudal segment, 1—minute acanthae, 2—pores, 3—posterior spiracular plates, 4—shallow, elliptical depressions.

1994). Accordingly, *G. setosa* apparently is a monophagous, or nearly monophagous, tephritid. The distribution of *E. brachylepis* includes the southern Peninsular Ranges and South Coast of California [regions deliniated in Hickman (1993)] and northern Baja California, Mexico, below 1500 m (Hickman 1993). As the type locality lies outside this distribution, it is possible that another, as-yet-to-be-determined, alternate host plant exists for *G. setosa* in southern California, which if so, probably also belongs to the genus *Ericameria.*

BIOLOGY

Because *G. setosa* co-occurred with *Trupanea wheeleri* Curran and *Neospilota viridescens* Quisenberry in separate flower heads of *E. brachylepis* at the Chariot Canyon study site ("symphagy", Goeden 1997), where *G. setosa* was much less common than the former tephritids, flower heads containing eggs and first instars of *G. setosa* could not be distinguished or described.

Larva.—Upon eclosion, the first instar presumably tunneled immediately through the inner bracts and into an ovule of a preblossom flower head like *G. rufipes* (Goeden 2001a). There, it fed with its body perpendicular to and its mouthparts toward the receptacle within an ovule, which it first excavated, then exited and entered an adjacent ovule. The receptacle was neither abraded or pitted by such feeding.

An average of 1.2 ± 0.2 (range, 1–2) second instars was found feeding on ovules in six, separate, closed, preblossom flower heads (Fig. 4A). They usually fed within an ovule with their bodies perpendicular to, but always above, the receptacles (Fig. 4A). Receptacles of the six flower heads containing second instars averaged 0.95 ± 0.05 (range, 0.85–1.14) mm in diameter. These larvae had damaged an average of 3.7 ± 1.0 (range, 1–7) ovules, or about 46% of the average total of 8.0 ± 0.6 (range, 6–10) ovules counted within each of the six flower heads. However, more than 1,200 flower heads were individually dissected in order to locate these six flower heads infested with second instars.

Third instars fed with their long axes oriented perpendicular to the receptacles, and

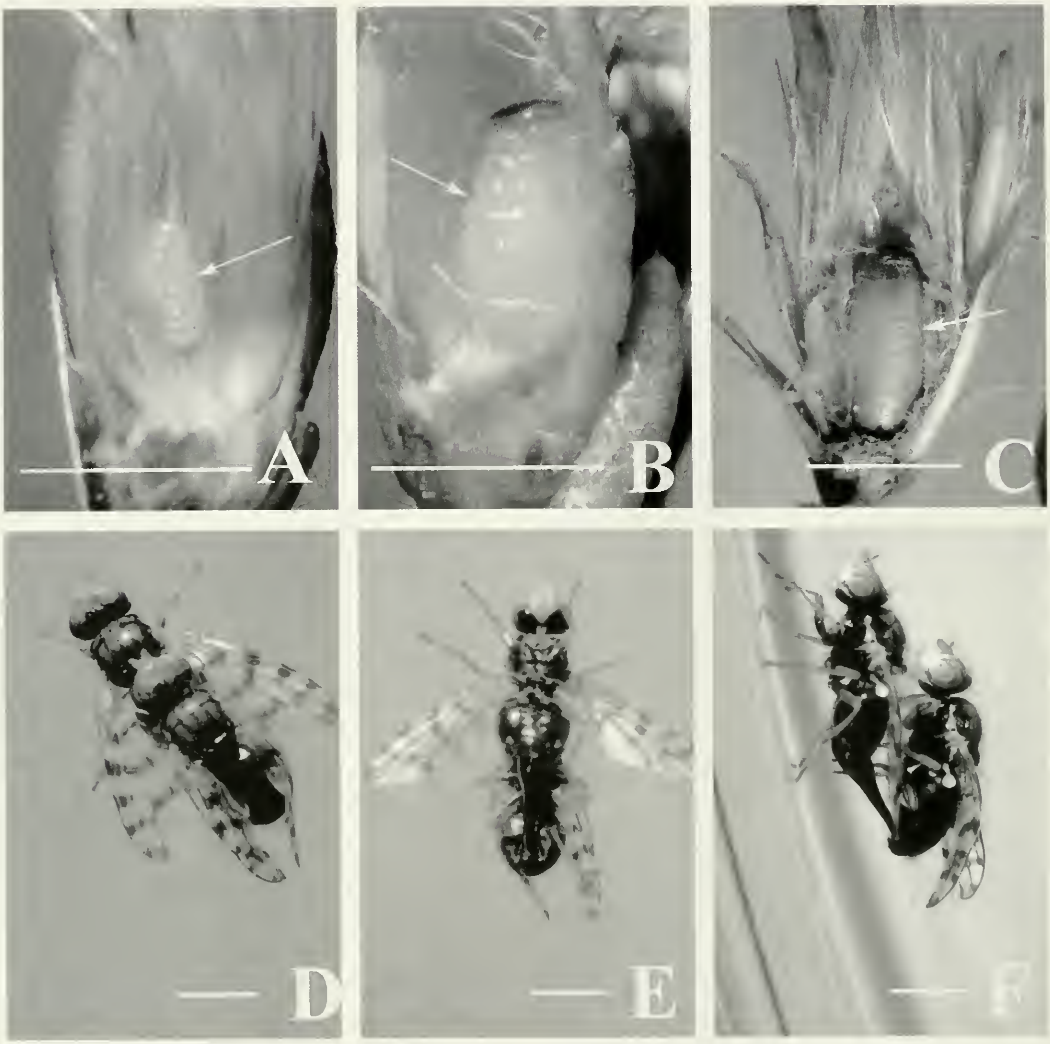

Fig. 4. Life stages of *Goedenia setosa* in flower heads of *Ericameia bachylepis:* (A) second instar (arrow) feeding on floret; (B) third instar (arrow) feeding on soft achenes and receptacle in flower head; (C) puparium in flower head (arrow); (D) mating pair, dorsal view; (E) mating pair, ventral view; (F) mating pair, lateral view. Lines = 1 mm.

with their mouthparts directed towards the receptacles, which they scored or pitted deeply in 11 (44%) of 25 flower heads examined (Fig. 4B). The 25 flower heads (eight, closed preblossom; five, open blossom; 12 postblossom) were dissected and contained an average of 1.0 ± 0.04 (range, 1-2) third instars. These 25 flower heads averaged 1.01 ± 0.03 (range, 0.85–1.42) mm in diameter and contained an average total of 8.6 ± 0.4 (range, 6-10) ovules/achenes, of which on average 6.9 ± 0.8 (range, 2–10) ovules/achenes were damaged or about 80% (Fig. 4B). Again, well over 1,000 flower heads were individually dissected to locate these 25 infested flower heads.

The receptacles that were pitted (Fig. 4B) suggested that sap constituted at least part of the diet of third instars of *G. setosa.* Goeden (1988), Headrick and Goeden (1990), Goeden and Headrick (1992), Goeden et al. (1993, 1995), Headrick et al. (1996), Goeden and Teerink (1997) first noted, described, and discussed sap feeding by florivorous species of Tephritidae in the genera *Trupanea, Paracantha, Neaspilota, Tephritis, Goedenia* (as *Urophora*), *Dioxyna,* and *Xenochaeta,* respectively. Sap could also be transported to the feeding larvae through the corniculae attaching the basal fragments of the ovules/soft achenes to the receptacle. Upon completing feeding, the larva constructed a vasiform cell consisting of ovule/achene/floret fragments impregnated with and hardened by dried, liquid feces and sap. The inside wall of this cell was smooth and ringed by buried pappus fragments, reflecting the turning motions of the larva during the construction of the apically open-mouthed cell. The flattened, sclerotized caudal segment apparently serves as a plug that tightly closes the mouth of the cell, yet allows respiration, and thus also may help to shield the third instar from natural enemies, especially predators. Prior to pupariation the prepupa turns 180° and orients with its anterior end away from the receptacle, retracts its mouthparts, and forms a puparium (Figs. 4C).

Pupa.—The receptacles of 29 flower heads each containing a single puparium (Figs. 4C) averaged 1.12 ± 0.02 (range, 1.10–1.14) mm in diameter. The posterior of the puparium faced the receptacle, rested in the cuplike base of the cell, but free of the inner wall of the cell (Fig. 4C).

Adult.—Under insectary conditions, eight males of *G. setosa* lived an average of 49 ± 3 (range, 36–61) days, and two females lived for 41 and 75 days. These longevities were slightly longer than the mean longevities reported for *G. timberlakei* (Goeden et al. 1995), but fully commensurate with the aggregative type of life histories of both tephritids (Headrick and Goeden 1994, 1998; Goeden et al. 1995).

The premating and mating behaviors of *G. setosa* were not studied in the field, but were observed for a male and female paired when 1-day old in a petri dish arena of the type found to be useful with many other nonfrugivorous, tephritid species (Headrick and Goeden 1994). Both sexes exhibited wing hamation (Headrick and Goeden 1994) throughout the day concurrent with other behaviors, i.e., grooming, resting, and feeding; this also was the most common wing movement reported for *G. timberlakei* (Goeden et al. 1995) and *G. rufipes* (Goeden 2002). Premating behaviors observed with *G. setosa* included males and females tracking individuals of the opposite sex, during which males sometimes swayed and usually exhibited abdominal pleural distension. During mating, the wings of the male were parted at about 20°, the wings of the female were parted at 60–70°, with both pairs of wings centered over the midlines of the files (Figs. 4D, E). The foretarsi of the male grasped the female abdomen dorsolaterally at the thoracic juncture, the midtarsi grasped the oviscape at its base, and the hindtarsi crossed under the oviscape or rested on the substrate (Fig. 4F). During copulation, the body of the female was parallel to the substrate with the oviscape raised about 20°, while the extended aculeus pushed the male upward and backward at an angle of about 20° anteriorly (Fig. 4F). This pair was observed to mate once or twice per day, on several successive days during a 41-day period, for a total of 21 matings that lasted an average of 158 (range, 30–320) min. The female evidenced restlessness before termination of mating by pushing against the male with its hind tarsi, by lofting its wings so as to push them against the male, and by fully extending its aculeus. The male in turn countered this behavior with copulatory induction behavior (CIB), rocked from side to side to regain purchase or to avoid the female's pummeling, and sometimes rapidly vibrated his wings, all of which appeared to calm the female and allow coitus to continue. During separation the male turned and rapidly walked off and away from the female while pulling his genitalia free, a process lasting about 5 s (n = 2).

Seasonal history.—The life cycle of *G.*

setosa in southern California follows an aggregative pattern (Headrick and Goeden 1994, 1998) in which the prepuparia and puparia, and some adults variously are the overwintering stages. Adults emerge from a few puparia formed in late-fall (October–November) and these unmated, sexually immature adults overwinter. The remaining prepuparia, and puparia overwinter in dead flower heads on dormant *Ericameria brachylepis.* These overwintered individuals emerge as adults in late winter (February–March) and pass the following spring and summer (April–August), probably as nonreproductive individuals in riparian habitats. They eventually aggregate on preblossom, fall-blooming, *E. brachylepis,* mate, and subsequently oviposit in the small, newly-formed, closed, preblossom flower heads.

Natural enemies.—Overwintered puparia of *G. setosa* were heavily parasitized and yielded a variety of chalcidoid, primary parasitic Hymenoptera, i.e., *Colotrechnus* sp. (Eulophidae), *Eurytoma* sp. (Eurytomidae), *Eupelmus* sp. (Eupelmidae), *Halticoptera* sp. (Pteromalidae), and *Mesopolobus* sp. (Pteromalidae).

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A NEW SPECIES OF MICROPTEROUS DAMSEL BUG (HETEROPTERA: NABIDAE) FROM NUKU HIVA, MARQUESAS ISLANDS

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Abstract.—A **new species** of micropterous damsel bug, ***Nabis nukuhiva***, is described from the summit area of Nuku Hiva in the Marquesas Islands, and compared to other endemic Marquesan Nabidae. Illustrations of the male paramere, male endosoma, and female dorsal habitus are provided.

Key Words: Heteroptera, Nabidae, Marquesas Islands

As discussed previously (Polhemus 2000), the isolated islands of the Eastern Pacific are notable for their paucity of Reduviidae, and apparently compensatory local radiations of Nabidae. Although the nabid fauna of the Hawaiian Islands has received considerable attention over the last century, with 27 endemic species now described (Polhemus 1999), the similarly interesting nabid biota of the Marquesas Islands has been far less thoroughly investigated. The only previous Heteroptera collections of any significance from these islands were made by the Pacific Entomological Survey in the 1930s, with the Nabidae sent to E. P. Van Duzee in California, who described the four endemic *Nabis* species recorded up to the present time (Van Duzee 1932, 1934). Limited visits were also made by individual researchers from the Bishop Museum in 1977, 1984, and 1988, but these resulted in only limited collections of Heteroptera. More recently, a pair of joint Smithsonian/Bishop Museum expeditions to the Marquesas in 1999 and 2001 reached the islands of Nuku Hiva, Ua Huka, Ua Pou, Hiva Oa, Tahuata, Mohotane, and Fatu Hiva, obtaining extensive Heteroptera collections including a new endemic micropterous *Nabis* species from the cloud forests of upland Nuku Hiva, described herein. Examples of still other new nabid species from both the Marquesas and Society islands are at hand, but many of them are represented by old specimens in such poor condition that it seems best to defer their description in the hope that additional fresh material may accrue from future survey work.

All measurements are given in millimeters; CL numbers following locality citations refer to collection locality numbers used to cross reference specimens, photographs, and field notes. Material depository codons are explained in the Acknowledgments section.

Nabis nukuhiva Polhemus, new species
(Figs. 1, 2, 4)

Description.—*Micropterous male: General coloration* of living specimens pale yellowish brown to orange brown (often fading to tan in dried specimens), with scattered darker brown markings dorsally on head, thorax and abdomen; legs maculate with darker brown; limited markings along

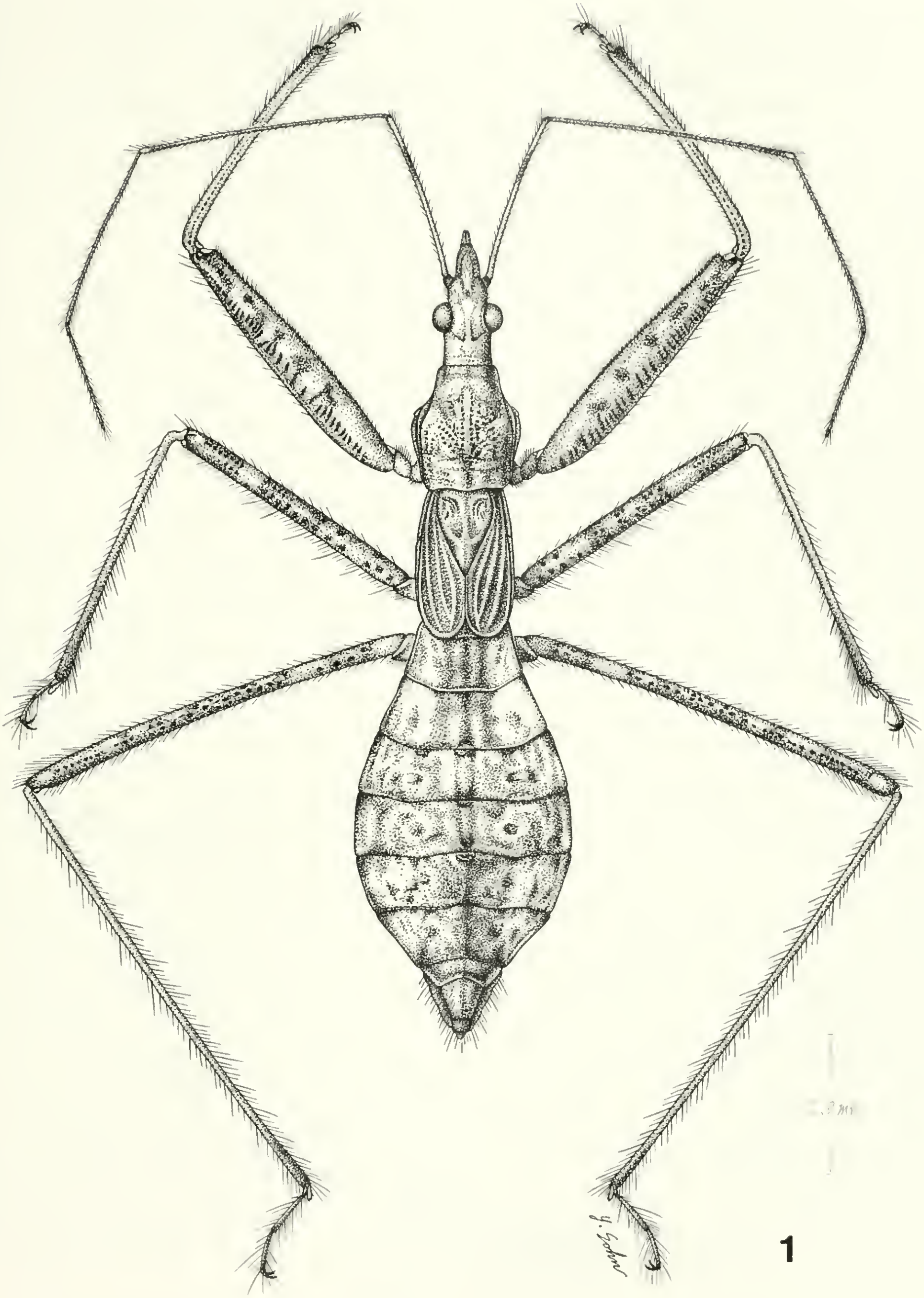

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Fig. 1. *Nabis nukuhiva*, female, dorsal habitus.

central section of abdominal dorsum bright red.

Length 9.95 mm, maximum width (across abdomen) 2.25 mm.

Head elongate, well produced ahead of eyes, length/width = 1.55/0.95, bearing pale, semi-recumbent setae; width of vertex 1.8× the dorsal width of an eye (0.45/0.25); length of preocular portion of head approximately 1.9× the dorsal length of an eye

(0.70/0.37); length of postocular portion of head 1.1× the dorsal length of an eye (0.42/0.37); ocelli absent; length of antennal segments I–IV = 2.35/3.30/2.70/1.50; rostrum length 3.05, reaching to mesocoxae, lengths of segments I–IV = 0.25/1.25/1.10/0.45; coloration of head pale brown, with dark brown patches laterally behind eyes, tylus orange, posteriorly directed V-shaped brown marks present centrally at base of tylus and on frons; antenna dark yellowish brown to orange brown, segment II with a single dark brown annulation near apex, remaining segments unicolorous.

Pronotum narrow, anterior collar elongate, anterior lobe moderately swollen and tumescent, posterior lobe shorter than anterior lobe, with sides weakly convergent posteriorly; length/width = 1.60/1.20, bearing numerous very short, pale, recumbent setae; coloration pale yellowish to reddish brown, central tumescent section sparingly marked with dark brown maculations, anterior collar shallowly punctate, posterior lobe weakly rugulose, both bearing dark brown longitudinal midline stripe, this stripe becoming indistinct on central tumescent section.

Scutellum elongate, roughly triangular, length/width = 1.00/0.70, basal half weakly tumescent, set off from angulate posterior half by incipient ridges extending inward from lateral margins; surfaces of both sections bearing a few very short, pale, recumbent setae; coloration pale yellowish to reddish brown, a pair (1+1) of elongate dark brown patches present on basal half to either side of midline.

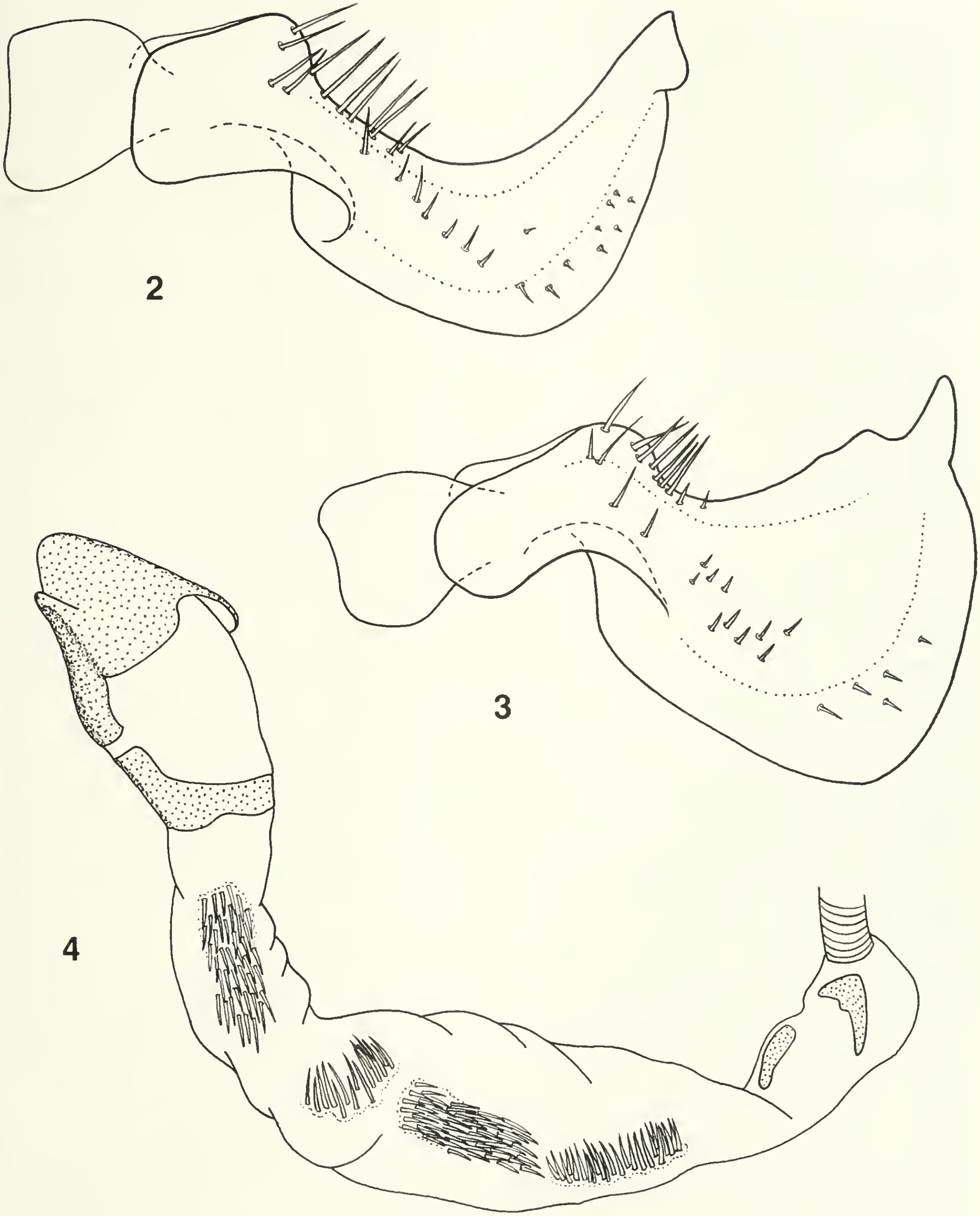
Hemelytra short, micropterous; hemelytron length 1.80, reaching to basal section of abdominal tergite I, bearing short, pale, recumbent setae; clavus evident throughout its length, venation of corium obscure, weakly suggested by remnants of cubital and radial veins, membrane present as tiny rounded flap folded slightly downward toward underlying tergites; coloration pale brown, veins yellowish to pale orange.

Legs elongate, with fore coxa approximately 1.80× as long as thick (0.90/0.50); fore femur fusiform, over 6.60× longer than wide (4.00/0.60), covered with numerous short, pale setae; fore tibia slender, widening at apex, inner margin bearing two parallel rows of about 50 tiny black teeth bordered by pale, erect setae, outer margins bearing semi-erect pale setae, these setae becoming longer distally; middle and hind femora, tibiae and tarsi slender, covered with short, pale, semi-erect setae, middle tibia with inner margin bearing two parallel rows of about 30 tiny black teeth on basal half; coloration of legs yellowish brown to pale orange with complex darker brown maculations on all femora; all tibiae unicolorous, lacking annulations or maculations, becoming slightly infuscated near tips; lengths of leg segments as follows: fore femur/tibia/tarsal 1/tarsal 2/tarsal 3 = 4.00/3.35/0.10/0.15/0.20; middle femur/tibia/tarsal 1/tarsal 2/tarsal 3 = 3.70/4.00/0.10/0.20/0.37; hind femur/tibia/tarsal 1/tarsal 2/tarsal 3 = 5.60/6.50/0.10/0.60/0.55.

Abdomen with segments I–IX exposed, lateral margins broadly arcuate, posteromedial portions of tergites lacking raised tumescences, tergites I–V dorsally concave, with lateral margins curved upward, tergite VI broadly raised centrally, tergites VII–IX narrowed, forming a box-like genital capsule; all tergites covered with scattered short, pale, recumbent setae; ground color of tergites yellowish brown to orange brown, broadly overlain with dark brown maculations and scattered small bright red markings, these markings darker and more dense along midline, anterolateral angles dark brown; lengths of exposed abdominal tergites I–VII = 0.90/0.85/0.75/0.70/0.65/0.75/0.20.

Ventral surface of head and thorax medium brown, paratergites along lateral abdomen dark blackish brown, abdominal ventrites pale yellowish, with irregular dark brown markings present along midline on abdominal ventrites I–VI; entire venter clothed with pale, recumbent setae.

Genitalia with distal section of paramere



Figs. 2–4. Micropterous *Nabis* species endemic to the Marquesas, male genitalic structures. 2, *N. nukuhiva*, paramere. 3, *N. longipes*, paramere. 4, *N. nukuhiva*, endosoma.

sickle-shaped, tip sharp and acute (Fig. 2); endosoma with two small basal sclerites, plus four clusters of long sclerotized spinules in distal section (Fig. 4).

Micropterous female: Similar to micropterous male in general structure and coloration with following exceptions: length 11.20 mm, maximum width (across abdomen) 3.00 mm; overall form slighly more robust than male, with abdomen more broadly expanded (Fig. 1); combined abdominal tergites VIII and IX roughly triangular, longitudinally raised medially to form a tube-like structure over upraised tip of retracted ovipositor; dark markings on dorsum of body and legs similar to those in male; venter with ventrolateral sections of abdominal segment VII not strongly swollen on either side of ovipositor sheath.

Etymology.—The name "nukuhiva" is a noun in apposition, and refers to the island of Nuku Hiva, to which this species is endemic.

Material examined.—Holotype, micropterous ♂: MARQUESAS ISLANDS, Nuku Hiva, cloud forest along crest of Tekau Ridge, E. of new road crossing, 1160–1220 m. (3800–4000 ft.), 8°51′39″S, 140°10′24″W, 21 October 1999, 10:00–15:00 hrs., CL 6007, D. A. and J. T. Polhemus (USNM). Paratypes (all micropterous): MARQUESAS ISLANDS, Nuku Hiva: 10 ♂, 6 ♀, same data as holotype (USNM, BPBM, MHNP); 3 ♂, 1 ♀, same data as holotype except 23–24 August 2001, D. A. and J. T. Polhemus (USNM); 1 ♂, N. side of Tekao Ridge, along old road, 1020 m. (3350 ft.), 8°51′35″S, 140°10′44″W, 24 August 2001, beaten from *Weinmannia parviflora*, D. A. & J. T. Polhemus (USNM); 1 ♀, Tapuaooa, 3000 ft., 1 June 1931, under dead leaves, Le Bronnec and H. Tauraa, Pacific Entomological Survey (BPBM).

Discussion.—Although four endemic species of *Nabis* have been previously described from the Marquesas (Van Duzee 1932, 1934), *Nabis nukuhiva* is only the second micropterous species discovered in the archipelago. The other, *N. longipes* Van Duzee, is also restricted to the cloud forest zone, occurring along the crest of Temetiu Ridge on the island of Hiva Oa; a similar pattern of habitat preference is also exhibited among micropterous *Nabis* species collected by the author in Hawaii and the Society Islands.

Nabis nukuhiva may be separated from *N. longipes* by the following characters: in *N. nukuhiva* the margins of the posterior lobe of the pronotum are slightly convergent posteriorly (Fig. 1), while in *N. longipes* they are divergent posteriorly; the scutellum of *N. nukuhiva* is conspicuously elongate and shows an incipient division into anterior and posterior lobes (Fig. 1), while that of *N. longipes* is more evenly triangular and shows no such incipient transverse division; the ground color of *N. nukuhiva* ranges from straw yellow to pale orange brown, while the general coloration of *N. longipes* is distinctly dark reddish brown, with the reddish color predominating in living specimens; and finally the distal section of the male paramere of *N. nukuhiva* is relatively slender, curving, and sickle-shaped, while that of *N. longipes* is more massive and half-moon shaped (compare Figs. 2 and 3).

To date, three Marquesan *Nabis* species, *N. mumfordi* Van Duzee, *N. ancora* Van Duzee, and *N. nukuhiva*, have been dissected to evaluate the internal characters of the endosoma. All possess comb-like endosomal sclerites, a relatively unusual character state among Nabidae. Such endosomal combs are seen only in a few other groups, including the speciose endemic Hawaiian radiation in the subgenus *Milu* Kirkaldy, the eastern Palearctic subgenus *Reuteronabis* Kerzhner, and a few taxa in Australia and North America. This strongly suggests that such comblike sclerites may be a synapomorphy linking the insular Marquesan and Hawaiian nabid radiations as monophyletic sister clades, although this hypothesis has not yet been tested in the context of a broader-scale cladistic analysis. In *N. nukuhiva*, such endosomal sclerites appear to be highly modified into clusters of long spinules, notably different from the short-spined combs seen in the Hawaiian taxa and certain other Marquesan species; this character state, combined with the narrow pronotum and elongate scutellum, suggests that *N. nukuhiva* may represent a more divergent lineage within this putative clade.

The type series of *N. nukuhiva* was taken amid dense, low-stature cloud forest along the summit of Tekau Ridge, a high, narrow, elongate ridgeline that forms the crest of Nuku Hiva, representing a remnant section of the island's old outer caldera rim. Specimens were collected primarily by light pyrethrin fogging of moss mats growing on the trunks and branches of intertwined trees and shrubs along the extreme crest of the ridge; a few were also taken by beating vegetation. If *N. nukuhiva* is indeed confined to cloud forest environments, then its total range comprises a very limited strip of such vegetation remaining along the Tekau ridgeline. Adamson (1936) noted of this area "The high mountains above Aakapa are one of the richest regions for collecting in the Marquesas. Unfortunately it is one of the least accessible, being a day's journey on horseback from Taiohae, and nearly as much from Hakaui. So far as I know, these mountains cannot be ascended from the north." This situation has now changed greatly with the construction of several new roads subsequent to the 1930s, but ironically these same roads that have provided access to this rich area for biologists have also brought increasing impact from human use, weeds, and feral ungulates, all of which threaten the integrity of this fragile ecosystem.

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PAUESIA COLUMBIANA, N. SP. (HYMENOPTERA: BRACONIDAE: APHIDIINAE) ON JUNIPER APHIDS, AND A KEY TO RELATED SPECIES

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Abstract.—***Pauesia columbiana*** **Pike and Starý, n. sp.**, reared from *Cinara burrilli* (Wilson) on *Juniperus occidentalis* in Oregon is described. The North American species of *Pauesia* are reviewed in relation to a newly introduced grouping of the genus, and a key is provided for species of one of the two groups.

Key Words: aphid, parasitoid, *Cinara, Pauesia*

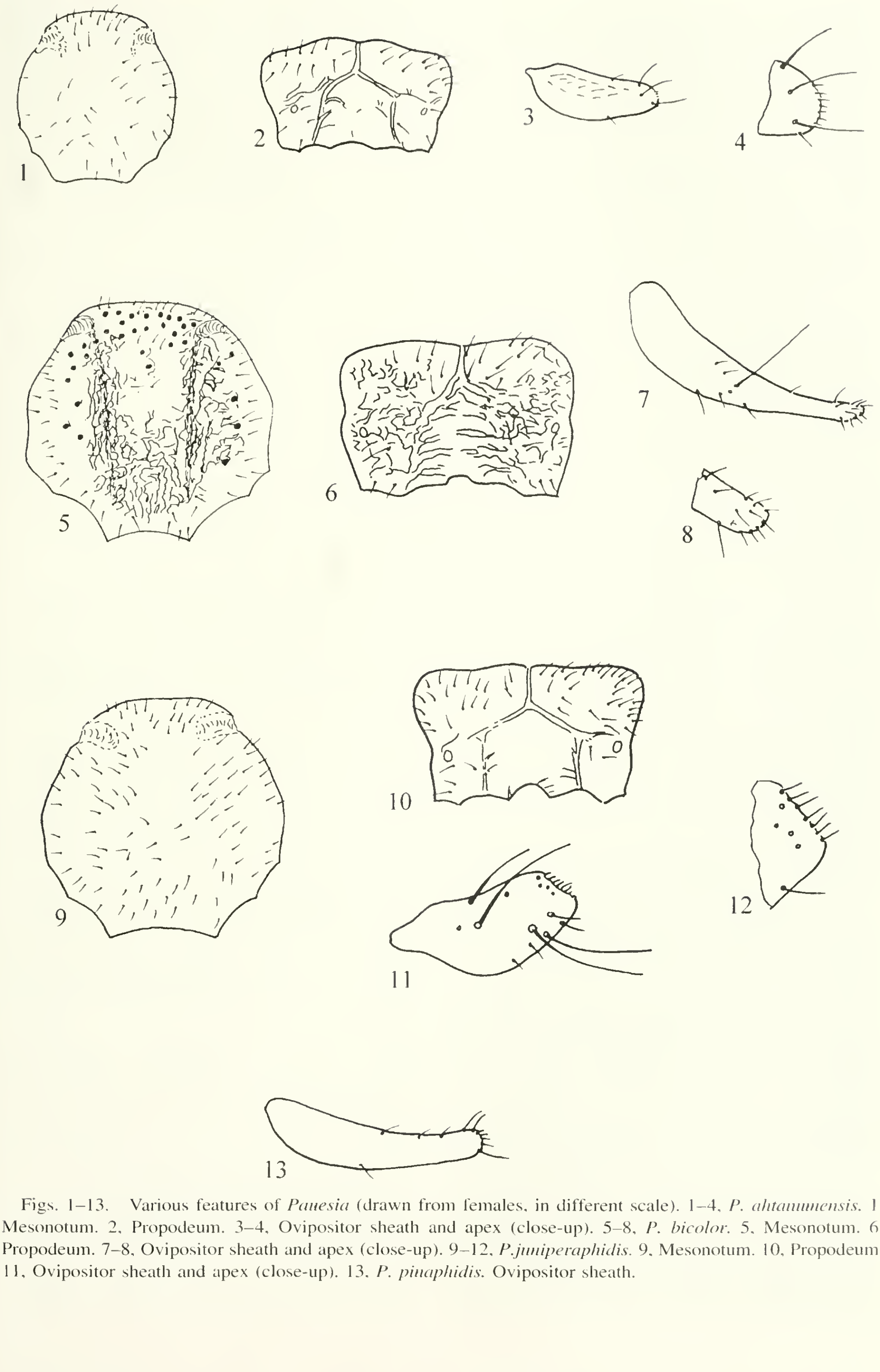
Research on aphidiine parasitoids in the Pacific Northwest has led to the discovery of numerous new species and aphid host relationships (Pike et al. 2000). The genus *Pauesia* Quilis is one of more than a dozen different aphidiine genera in western North America. Its members are restricted to utilizing conifer-feeding aphids in the subfamily Lachninae, the most common being in the genus *Cinara* Curtis. In the present work, a new species of *Pauesia* reared from *Cinara burrilli* (Wilson) feeding on *Juniperus occidentalis* Hook in Oregon is described, a finding which has prompted a closer study of the genus. The North American *Pauesia* are reviewed, a new diagnostic character involving apical setae on the ovipositor sheath is presented to distinguish new groupings, and a key is provided for species of one of two groups. Group 1 is keyed; Group 2 is not keyed because of a lack of available quality material to study.

MATERIAL AND METHODS

Material evaluated.—Museum specimens afforded fundamental material for comparative morphological evaluation and review. Included was an examination of separate body parts preserved in glycerine-containing glass capsules obtained from the late C. F. Smith, North Carolina State University, Raleigh. A large part of the study included *Pauesia* reared from authors' collections of determined aphids taken from a range of Pacific Northwest habitats (Pike and Starý 1996, Pike et al. 1996). In some cases, it was necessary to dissect and slide mount specimens for more detailed view. In such cases, specimens were boiled in 10% KOH for 20–60 seconds, washed in distilled water, and then mounted in DeSwann medium.

References.—References used to understand original descriptions, and for comparison with type material, taxonomic lists, and description of new species included Gahan (1911), Smith (1944), Mackauer (1968), Mackauer and Starý (1967), Marsh (1979, 1991), Starý and Remaudière (1982), Pike and Starý (1996), and Pike et al. (1996, 2000).

Diagnostic characters.—Morphological nomenclature followed prevalently Huber



Figs. 1–13. Various features of *Pauesia* (drawn from females, in different scale). 1–4, *P. ahtanumensis*. 1, Mesonotum. 2, Propodeum. 3–4, Ovipositor sheath and apex (close-up). 5–8, *P. bicolor*. 5, Mesonotum. 6, Propodeum. 7–8, Ovipositor sheath and apex (close-up). 9–12, *P.juniperaphidis*. 9, Mesonotum. 10, Propodeum. 11, Ovipositor sheath and apex (close-up). 13, *P. pinaphidis*. Ovipositor sheath.

and Sharkey (1993). Sculpturing of the mesonotum and propodeum are characters generally used to define the species (Gahan 1911, Smith 1944). We have found it advisable to make observations of both dry material and slide-mounted material. In slide form, setae, circular pits, and rugosities, are often more readily distinguished. The circular pits on the mesonotum referred to by Gahan (1911) and Smith (1944) may occur more or less on all lobes (Fig. 22), merely at the base (Fig. 16), or in concert with conspicuous rugosities (Fig. 5). Other characters of the mesonotum include granulation or feeble rugosities. Similarly, the propodeum also possesses useful characters. The central areola may be well-defined, almost smooth, with few cross-carinae (Figs. 2, 10), or coarsely rugose with numerous cross-carinae (Figs. 6, 17). In some species, the longitudinal carinae may be significantly reduced to absent.

Here we introduce the shape of the setae at the apex of the ovipositor sheaths as a new diagnostic character. These setae are of two types: (1) their base is either simple (Figs. 4, 8, 12, 15, 19) or (2) tubiform (Figs. 21, 23). The character is best viewed when specimens are dissected, slide-mounted, and observed at a minimum of 200× magnification.

Sedlag (1971) emphasised the apparent importance of different types of ovipositor sheaths and accessory prongs in *Pauesia* and related genera. He distinguished four morphological types. The differences were presumed to be due to such factors as strong ant attendance, high mobility of host aphids and their occurrence between conifer needles. In a broader sense, Starý (1976) supported this approach, by distinguishing two basic types of ovipositor sheaths in *Pauesia*, and raising two groups to subgeneric level (*Pauesia* Quilis s. str., type species: *Pauesia albuferensis* Quilis, 1931, = *unilachni* Gahan 1927; and *Paraphidius* Starý 1958, type species: *Aphidius californicus* Ashmead 1889). Later, Sedlag and Starý (1980) described another subgenus, *Pauesiella* from Central Europe, which manifests a spatulate-shaped ovipositor sheath with a strongly narrowed apical portion and bearing a group of strong, long setae in its dorso-apical fifth. Kiriac (1993) reviewed and keyed the Palaearctic species of *Pauesia* which manifest acutely narrowed ovipositor sheaths, compared to the prevailing broad oval shape. However, he did not take into consideration the differences in the shape of the apical setae.

Regarding setae on the apical portion of the sheaths, the tubiform type appeared initially to be associated with the broadly oval-shaped sheaths (Fig. 20), and the simple type to be associated with the narrowed arcuate shape (Figs. 7, 14), but some species such as *P. juniperaphidis* (Fig. 11), *P. xanthothera* (Fig. 18), *P. salignae* (Fig. 23), and others, varied from this association.

Abbreviations.—The following are used in the text for collections: USNM = National Museum of Natural History, Smithsonian Institution, Washington, DC; CFS = C. F. Smith collection, Raleigh, NC; WSU = Washington State University collection, Prosser, WA.

REVIEW OF NORTH AMERICAN *PAUESIA* SPECIES, INCLUDING SPECIES FROM MEXICO

The list below includes all new, and previous classified species (Marsh 1979, 1991; Pike and Starý 1996; Pike et al. 2000; Starý and Remaudière 1982). The generic classification by Marsh (1979) is followed, except that the species are arranged in two groups based on the apical setae of the ovipositor sheath.

Group 1. Setae at ovipositor sheath apex with simple base:

P. ahtanumensis Pike and Starý (Figs. 1–4)
P. bicolor (Ashmead) (Figs. 5–8)
P. columbiana sp.n. (Figs. 24–32)
P. juniperaphidis (Gahan) (Figs. 9–12)
P. pinaphidis (Ashmead) (Fig. 13)
P. scorpinica (Smith) (Figs. 14–15)
P. xanthothera (Smith) (Figs. 16–19)

Group 2. Setae at ovipositor sheath apex with tubiform base:

P. californica (Ashmead)
P. cinaravora Marsh
P. gillettei (Gahan)
P. macrogaster (Ashmead)
P. nigrovaria (Provancher)
P. pahtonis Pike and Starý
P. ponderosae Pike and Starý (Figs. 20–21)
P. ponderosaecola Pike and Starý
? *P. procephali* (Ashmead)
P. pseudotsugae Pike and Starý
P. rufithorax Starý and Remaudière (Mexico)
P. rugosa Starý and Remaudière (Mexico) (Fig. 22)
P. salignae (Watanabe) (Fig. 23)
P. takomaensis (Smith)
P. varigata (Smith)

GROUP 1—ANNOTATED LISTING OF MATERIAL EXAMINED

P. ahtanumensis Pike and Starý. WSU—ex *Cinara ponderosae* (Wilson) on *Pinus ponderosa* and *Pinus* sp. [material examined from Idaho, Montana, and Washington (see: Pike and Starý 1996; Pike et al. 1996, 2000)].

P. bicolor (Ashmead). USNM—1/Maryland, Montgomery Co., Takoma Park [parasitoids labelled as *Aphidius bicolor* Ashm, det. Gahan; *Aphidius bicolor* Ashm, det. C. F. Smith, C. N. Ainslie collection]. 2/Wisconsin, Oneida Co., Amer. Legion St. For., 16 & 24-VII-1957, ex aphids on *Pinus banksiana* [parasitoids labelled as *Aphidius (P.) bicolor* Ashm, det. Mues, coll. P. A. Jones] [Figs. 5–8 drawn from this material]. CFS—Ohio, Kocking Co., 26-VII-1938, ex *Cinara strobi* (Fitch)? [parasitoids labelled as 468 and 471, *Aphidius bicolor* Ashmead, det. C. F. Smith]. WSU—Idaho, Boundary Co., Bonners Ferry, 29-VII-1996, ex *Cinara* sp. on *Pinus contorta*.

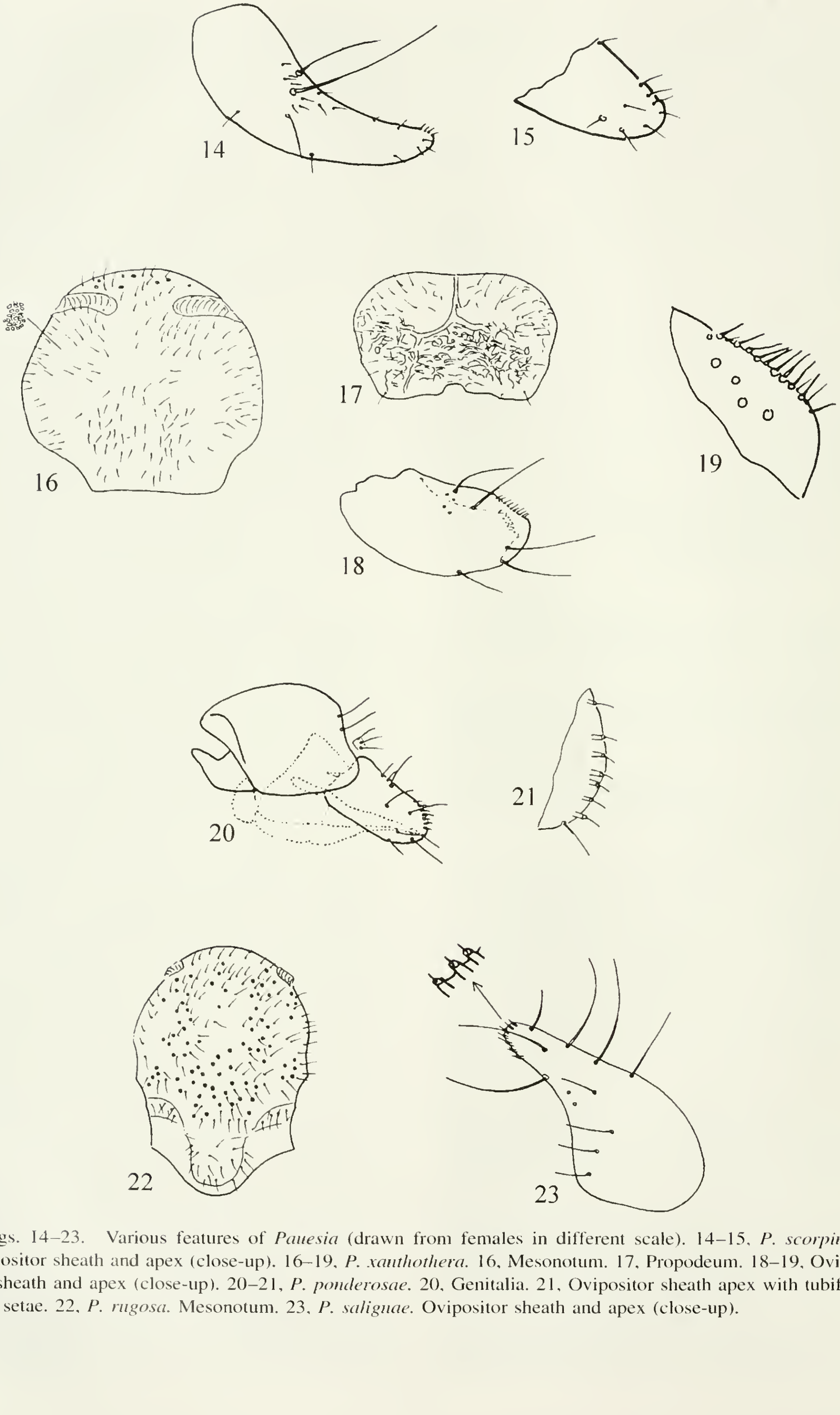
P. columbiana, n.sp. See description below.

P. juniperaphidis (Gahan). USNM—Colorado, Boulder Co., Boulder [parasitoids labelled as 61600, 944, antenna 22 segments, type, USNM 14361, *Aphidius juniperaphidis*; allo-lectotype]. CFS—Colorado, Boulder Co., Boulder, 6-VI-1908 [parasitoids labelled as Type 944, paratype no. 14361 USNM, *A. juniperaphidis*]. WSU—Washington, Yakima Co., Yakima Arboretum, 3-VI-94, ex *Cinara pilcornis* (Hartig) on *Picea pungens*.

P. pinaphidis (Ashmead). USNM—1/Florida, Duval Co., Jacksonville [parasitoid labelled as type, *Aphidius, Aphidius (pinaphidis) = bicolor* det. C. F. Smith, coll. Ashmead]. 2/Louisiana, Orleans Parish, New Orleans, 10 & 25-IV, *Pinus palustris* [parasitoids labelled as *Aphidius pinaphidis* Ashm., det. Gahan, No. 24504, coll. H. K. Plank]. 3/Florida, Alachua Co., Gainesville, ex *Lachnus pini* [parasitoid labelled as *Aphidius pinaphidis* Ashm. det. Gahan. coll. A. C. Mason].

P. scorpinica (Smith). USNM—1/Virginia, Fairfax Co., Vienna, 18-IV-1915, on pine [parasitoids labelled as *Aphidius scorpinicus* det. C.F. Smith; allotype, *Aphidius scorpinicus*. coll. R. A. Cushman]. 2/Virginia, Fairfax Co., Vienna, 19-IV-1912, on pine, coll. J. C. Bridgwell. CFS—Virginia, Fairfax Co., Vienna, 27-III-1914, on pine, coll. R. A. Cushman [parasitoid labelled as female paratype, *Aphidius scorpinicus* sp. n. det. C.F. Smith].

P. xanthothera (Smith). USNM—1/North Carolina, Wake Co., Raleigh, 20-VII-1940, ex black pine aphid [parasitoid labelled as Allotype *Aphidius xanthotherus* sp. n. det. C.F.Smith, coll. S.C. Schnell]. 2/Virginia, Norfolk City Co., Norfolk, 14-V-1931, ex *Dilachnus strobi* Fitch [parasitoid labelled as 6805, paratype *Aphidius xanthotherus* Smith, coll. G.E. Gould] [Figs. 16–19 drawn from this material]. CFS—North Carolina, Raleigh, 20-VII-1940, ex black pine aphid [parasitoid labelled as paratype, *Aphidius xanthotherus* Smith, coll. S. C. Schnell].



Figs. 14–23. Various features of *Pauesia* (drawn from females in different scale). 14–15, *P. scorpiuica*. Ovipositor sheath and apex (close-up). 16–19, *P. xanthothera*. 16, Mesonotum. 17, Propodeum. 18–19, Ovipositor sheath and apex (close-up). 20–21, *P. ponderosae*. 20, Genitalia. 21, Ovipositor sheath apex with tubiform base setae. 22, *P. rugosa*. Mesonotum. 23, *P. salignae*. Ovipositor sheath and apex (close-up).

DESCRIPTION

Pauesia columbiana Pike and Starý, new species
(Figs. 24–32)

Diagnosis.—The new species is similar to *P. juniperaphidis* (Gahan), which is also associated with *Cinara* aphids on *Juniperus*. It is easily distinguished from the latter species by the prevalent yellow coloration of the body, by the sculpture of the propodeum and, less distinctly, by the mean number of antennal segments.

Etymology.—Named after the Columbia River.

Female description.—Eye medium sized, with sparse setae. Malar space 0.4 of eye length. Tentorio-ocular line 0.8 to equal to intertentorial line. Antenna 18–19 (17, 20) segmented, not thickened to apex, and length about as long as head, mesosoma, and half of metasoma. Flagellomere 1 (F1) (Fig. 27) twice as long as broad, with 2–3 longitudinal placodes; F2 (Fig. 27) equal to F1, with 3 placodes. Middle flagellomeres (Fig. 28) as broad as basal segments.

Mesosoma: Mesonotum (Fig. 24) with notaulices distinct anteriorly, effaced on disc, with sparse setae, feebly rugose (Fig. 25). Propodeum (Fig. 29) areolated, areola inside with irregular carinae to rugosities, lateral longitudinal carinae irregular to rugose.

Forewing (Fig. 30): Stigma length about 2.5 to 3.0 times width; distal abscissa of R1 (= metacarpus) somewhat shorter than length of stigma; rs vein somewhat shorter than width of stigma, subequal to 3/Rs vein; 2/Rs vein shorter than rs.

Metasoma: Petiole (Fig. 26) length 2.5 to 3.0 width at spiracles, with sparse long setae in the apical portion, rugose, about 0.6 wider at apex than at spiracles.

Genitalia (Fig. 31): Apical setae of ovipositor sheath with simple bases (Fig. 32).

Coloration: Head brownish, frontal part yellowish, palpi yellow, mandible with brownish apices, antenna brown, scape lighter. Mesosoma yellow, lower part of mesopleuron with brown spot, metanotum with darker patterns. Wing venation brown, stigma brown. Legs yellow, pretarsi brown. Metasoma yellow, ovipositor sheaths dark brown.

Length of body: About 2.2 to 2.3 mm.

Male description.—Antenna 20–21 (+19) segmented. Coloration: Head brown with yellowish face and inner orbits. Antenna light brown, palpi yellow. Mesosoma yellow brown, base of the central lobe of mesonotum, lower part of mesopleura, metanotum, and propodeum brown or merely with brownish patterns. Scutellum yellow brown. Wing venation brown. Legs yellow, apices of tarsi infuscated. Metasoma yellow brown, darkened to apex, petiole yellow.

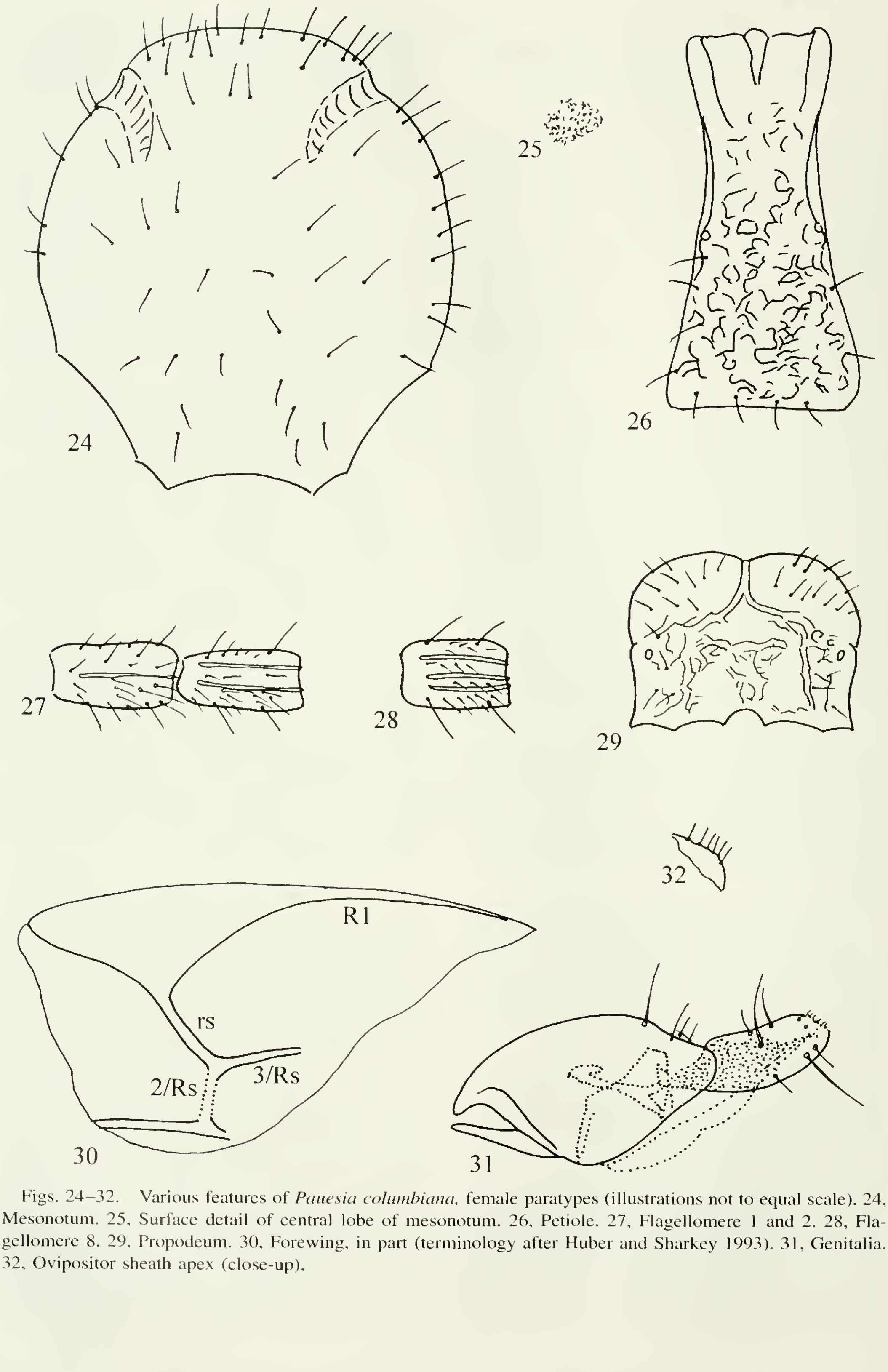
Material.—Holotype (♀) ex *Cinara burrilli* (Wilson)—USA, Oregon, Grant County, Hwy 7, 6 miles West of Whitney, 27-VII-2000, on *Juniperus occidentalis*, WSU Sample AOG582, coll. George and Della Graf. Deposited in USNM.

Paratypes: 11 ♀, 10 ♂ (sample AOG582), same data as holotype. Deposited in part in WSU and collection of P. Starý, České Budějovice, Czech Republic. 1 ♀ (sample 99K068) ex *Cinara burrilli* (Wilson)—USA, Oregon, Wasco County, Cow Canyon, 2 miles N of Antelope Junction, 24-IX-99, on *Juniperus occidentalis*, coll. K. Pike and G. Graf. Deposited in WSU.

STATUS AND SEPARATION OF *PAUESIA SCORPINICA* (SMITH) AND RELATED SPECIES

Smith (1944) redescribed *P. bicolor* (Ashmead), and distinguished another species, *P. scorpinica* as a new species, while suppressing *P. pinaphidis* (Gahan) as a new synonym of *bicolor*. Mackauer (Mackauer and Starý 1967, Mackauer 1968) reclassified *pinaphidis* as a valid species, but placed *scorpinica* as a new synonym of *bicolor*. This classification was followed later by Marsh (1979).

In the present study, we recognize all of the aforementioned taxa (*bicolor*, *pinaphidis*, and *scorpinica*) as distinct, valid species. They are comparable in overall col-



Figs. 24–32. Various features of *Pauesia columbiana*, female paratypes (illustrations not to equal scale). 24, Mesonotum. 25, Surface detail of central lobe of mesonotum. 26, Petiole. 27, Flagellomere 1 and 2. 28, Flagellomere 8. 29, Propodeum. 30, Forewing, in part (terminology after Huber and Sharkey 1993). 31, Genitalia. 32, Ovipositor sheath apex (close-up).

oration and in the more or less large circular pits on the mesonotum. *Pauesia bicolor* and *P. scorpinica* agree in the number of antennal segments (female, 21–22), but the shape and the distribution of the setae on the ovipositor sheaths are different, as correctly described and figured by Smith (1944). *Pauesia pinaphidis* manifests ovipositor sheaths similar to *P. bicolor*, but the dense circular pits on the mesonotum are distinct from *P. bicolor*. Also, the 18–19 segmented antenna (female) of *P. scorpinica* is an indication that the species is different from *P. bicolor* and *P. pinaphidis* (Gahan 1911). The variation of "19–22" antennal segments in the redescription of *bicolor* by Smith (1944) is due to an apparent confusion of the two species. In the USNM material, even the series of "*bicolor* Ashmead" and *(pinaphidis)* = *bicolor*, det. C. F. Smith, with an earlier label *pinaphidis*, det. Gahan are separated and correspond to distinct species. In general, the material available on *pinaphidis* is relatively poor, and may need to be reexamined when new material becomes available.

Key to North American Species of *Pauesia*, Group 1 (Females)

[Group character: Setae with simple base at apex of ovipositor sheaths]

1. Ovipositor sheath slender and rather narrowed to apex (Figs. 7, 13) to claw-shaped (Fig. 14) 2

– Ovipositor sheaths broader, suboval, not conspicuously narrowed to the apex (Figs. 3, 11, 18) 4

2(1). Ovipositor sheath slender and rather narrowed to apex, with 1 (to 0?) long setae in middle (Figs. 7, 13). Antenna 18–19 or 21–22 segmented. Mesonotum with dispersed or dense large circular pits (Figs. 5, 16) . . 3

– Ovipositor sheaths slender, claw-shaped, with several long setae in middle (Fig. 14). Antenna 21–22 segmented. Mesonotum with dispersed large circular pits . . ***scorpinica***

3(2). Antenna 18–19 segmented. Mesonotum coarsely rugose with dense large circular pits, the distance between them approximately equal to pit diameter . . . . . ***pinaphidis***

– Antenna 21–22 segmented. Mesonotum with dispersed large circular pits (distance between pits variable) and coarse rugosities in the distal half (Fig. 5) . . . . ***bicolor***

4(1). Antenna 16–17 segmented. Propodeum with distinct areola which has a few cross-carinae inside, otherwise almost smooth (Fig. 2) . . . . ***ahtanumensis***

– Antenna with 18 or more segments. Propodeum with the areola bearing a few cross-carinae, or cross-carinated and rugose (Figs. 10, 17) 5

5(4). Antenna 18–19 or 19–20 segmented. Mesonotum uniformly feebly rugose, without pits (Figs. 24, 25). Propodeum with areola smooth inside and lateral carinae distinct (Fig. 10), or with irregular carinae to rugosities inside and with lateral carinae irregular (Fig. 29). Ovipositor sheath oval (Fig. 31) or broadly oval (Fig. 11) 6

– Antenna 22–23 segmented. Mesonotum finely granulate-rugose, with a few circular pits (Fig. 16). Propodeum with areola with coarse rugosities and numerous cross-carinae inside, sometimes longitudinal carinae less distinct (Fig. 17). Ovipositor sheath broadly oval, curved on lower side (Fig. 18) . . . . ***xanthothera***

6(5). Body coloration generally dark brown to black, with yellowish patterns on mesosoma. Metasoma ferrugineous. Propodeum (Fig. 10) with distinct, well-determined complete areola, almost smooth inside. Antenna 19–20 segmented . . . . . . ***juniperaphidis***

– Body coloration prevalently yellow, with brownish patterns on mesopleura and metanotum. Propodeum (Fig. 29) with the areola complete, with irregular carinae to rugosities inside, lateral longitudinal carinae irregular to rugose. Antenna 18–19 (17, 20) segmented . . . . ***columbiana***

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MOSQUITOES (DIPTERA: CULICIDAE) COLLECTED NEAR THE GREAT DISMAL SWAMP: NEW STATE RECORDS, NOTES ON CERTAIN SPECIES, AND A REVISED CHECKLIST FOR VIRGINIA

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Abstract.—This paper provides lists of the mosquitoes collected around the North Carolina and Virginia sides of the Great Dismal Swamp National Wildlife Refuge in 1998; the first collection records for *Ochlerotatus aurifer* and *Oc. j. japonicus* in Virginia; notes on *Aedes albopictus, Oc. grossbecki, Oc. infirmatus, Oc. thibaulti, Oc. trivittatus,* and *Wyeomyia smithii*; an up-dating of recent publications that affect the Virginia faunal list; and a revised checklist of the mosquitoes of Virginia. The record of *Oc. flavescens* is deleted from the Virginia checklist.

Key Words: new records, mosquitoes, Virginia, North Carolina, checklist

During 1998 mosquito-borne virus and mosquito faunal surveys were conducted in the vicinity of the Great Dismal Swamp (GDS) in southeastern Virginia and northeastern North Carolina. The Great Dismal Swamp National Wildlife Refuge (GDSNWR) currently consists of 107,000 acres of forested wetlands. Additional areas of the swamp occur outside the refuge. The entire swamp area in the refuge is in a regrowth phase, as all areas have been lumbered at least once. Most areas outside the GDSNWR are under agriculture or housing development. The refuge contains one of the most southern large stands of Atlantic white cedar, *Chamaecyparis thyoides* (L.) BSP. The GDS also serves as a major refuge for many mammal, bird, reptile, amphibian, and plant species. The presence of large numbers of potential bird and mammal hosts for viruses and the recent rapid encroachment of humans around the periphery of the swamp was a primary reason for selecting the GDS as a study site.

Primary goals of the project included: (1) an assessment of mosquito-borne viruses in the area (which will not be addressed in this paper); (2) a survey of mosquito species that occur in the area; (3) up-dating a checklist of the mosquitoes of Virginia; and (4) training and capacity strengthening for all the collaborating participants.

MATERIALS AND METHODS

The basic design for this study was to collect adult female mosquitoes in mosquito light traps (Centers for Disease Control) set in diverse habitats around the periphery of the swamp, with eight trap sites in North Carolina and eight trap sites in Virginia. The trap line was 104 miles long and involved sites in Camden, Gates, and Pasquotank counties in North Carolina and Suffolk and Chesapeake cities in Virginia. Five, two-night collection periods were planned between late April and early October; however, the arrival of Hurricane Bonnie in late August canceled one collection period. Traps, supplemented with CO_2 (dry ice), were set out between 4:30–5:30 PM and picked up the following morning between 7:30–8:30 AM. Female mosquitoes retrieved from the traps were returned to the laboratory in Chesapeake, Virginia, anesthetized with triethylamine (Kramer et al. 1990), identified to species (Darsie and Ward 1981, Slaff and Apperson 1989), sorted into pools of up to 50 specimens, and frozen on dry ice for shipment to the Centers for Disease Control and Prevention (CDC, Fort Collins) for virus isolation. Specimens were processed the same day they were captured and removed from the traps. Uncommon species or unusual specimens were preserved as voucher specimens along with collection data. Species collected in each state during the study are noted in the checklist (Table 1).

Use of the genus *Ochlerotatus* Lynch Arribalzaga and the abbreviation, *Oc.*, follows Reinert (2000). Both *Oc. atlanticus* (Dyar and Knab) and *Oc. tormentor* (Dyar and Knab) are documented from Virginia and North Carolina based on larval characters. However, adult females of these two species cannot be separated morphologically with certainty in the mid-Atlantic Region (Harrison et al. 1998). Therefore we arbitrarily chose to report only the former during this study. Likewise, only *Culex pipiens* L. is reported even though adult females are indistinguishable from *Cx. quinquefasciatus* Say, and hybrids, all of which might have been encountered.

RESULTS AND DISCUSSION

A total of 72,638 mosquito specimens were collected in 110 trap-nights during four two-night collection periods in April, June, July, and October. Of that total, 96.2% of the specimens (69,880) were collected during the first two periods and *Ochlerotatus c. canadensis* (Theobald) made up 97.9% of those specimens. After June, rainfall was extremely sparse and specimen numbers declined dramatically to only 1,634 in July and 1,124 in October. The paucity of rainfall affected temporary pool species, which probably explains the limited number of *Aedes* Meigen, *Ochlerotatus,* and *Psorophora* Robineau-Desvoidy that were collected. The lack of rainfall also affected the pH of the water in the swamp in October (as low as 3.2 to 3.6 in some areas), which may have influenced the presence of certain species. A total of 24 species were collected in both states, of which 21 species came from North Carolina and 23 species came from Virginia (Table 1). *Ochlerotatus aurifer* (Coquillett), *Oc. grossbecki* (Dyar and Knab) and *Oc. trivittatus* (Coquillett) were not collected by us in North Carolina. Neither *Oc. aurifer* nor *Oc. grossbecki* have ever been collected in North Carolina even though they were found in Virginia 3.9 and 17.7 km, respectively, from the state line. *Psorophora columbiae* (Dyar and Knab) was not collected on the Virginia side of the GDS during this study, but is commonly collected by local mosquito control personnel in Chesapeake City. Notes for the new state records and other species are below.

NEW STATE RECORDS

Ochlerotatus aurifer (Coquillett)

Ochlerotatus aurifer females were collected in two sites in Suffolk, Virginia. Twenty specimens were collected beside

Jericho Lane at GDS site VA-5, on the edge of the Great Dismal Swamp National Wildlife Refuge (GDSNWR) on: 28 April (4 ♀); 29 April (12 ♀); and 19 May (4 ♀). This trap site was in a mature deciduous forest with a pasture on one side and a road with a ditch filled with clear water on the other, and is approximately 17.7 km from North Carolina. An additional two females were collected in wet deciduous forest next to Desert Road site VA-8 on 29 April (1 ♀) and 3 June (1 ♀), and only 3.9 km from North Carolina. Seven specimens collected at VA-5 on 28 and 29 April 1998 are deposited in the National Museum of Natural History (NMNH), Smithsonian Institution, Washington, DC, and the remaining specimens are deposited in the Public Health Pest Management (PHPM) collection in Winston-Salem, NC.

Certain characters on these specimens differ from the description of this species provided by Carpenter and LaCasse (1955). Those authors described: (1) the sides of the scutum and most of the prescutellar space with pale golden scales; (2) the posterior pronotum with curved brown scales dorsally, becoming pale golden ventrally; (3) the first abdominal tergum dark with a few intermixed pale scales; and (4) the femora with dark and pale scales intermixed, darker toward the apices, pale on the posterior surface. Our specimens have: (1) the sides of the scutum with bronzy-brown scales anteriorly, becoming slightly lighter posteriorly over the wing root, and the scales around the prescutellar bare spot bronzy-brown anteriorly, slightly paler posteriorly; (2) the posterior pronotum covered in curved bronzy-brown scales; (3) the first abdominal tergum with a distinct median posterior patch of creamy scales; and (4) the femora (particularly the forefemur) almost entirely cream colored, except a few very sparse scattered dark scales that become more common and form a dark area near the apices. Other than these differences, the specimens fit the keys listed above and that of Carpenter and LaCasse (1955). Dr. R. C. Wilkerson, Walter Reed Biosystematics Unit, Walter Reed Army Institute of Research, kindly examined specimens of *Oc. aurifer* in the NMNH mosquito collection and found many had bronzy-brown scales on the sides of the scutum like our specimens, instead of pale golden scales as listed by Carpenter and LaCasse (1955). The senior author (BAH) collected specimens of *Oc. aurifer* in 1967 in the Walter Reed Army Institute of Research field study site in the Pocomoke Cypress Swamp in Worchester County, Maryland, only 2.4 km from Virginia. Those specimens had the sides of the scutum pale golden, as described by Carpenter and LaCasse (1955). The differences noted on the GDS specimens should be considered variations.

Map number 14 (p. 239) in Darsie and Ward (1981) depicts the distribution of *Oc. aurifer* across the northern part of Virginia. However, there are no previous published collection records of this species in Virginia. Apparently these authors based that map distribution on a 1945 record of *Oc. aurifer* collected in Charles County, MD, across the Potomac River from the northern part of Virginia, and a 1937 record collected in the Pocomoke Cypress Swamp in Worchester County, MD, adjacent to Virginia on the eastern shore (Bickley 1957). Accordingly, the above 22 specimens collected during this study represent the first documented evidence of this species in Virginia. These collections of *Oc. aurifer* just north of the state boundary suggest that it probably occurs in northeastern North Carolina.

Ochlerotatus japonicus japonicus (Theobald)

Ochlerotatus j. japonicus was first recognized in the United States in 1998 and reported from New Jersey and New York (Peyton et al. 1999). Since then it has spread into other states and districts as far south as Virginia. It was first detected in Virginia when three males and one female were collected as larvae in Occoquan, Prince William County, Virginia, on July

21, 2000. The reared adults were shipped to the senior author for identification and confirmed as this species. The larvae were collected in stone flower pots and birdbaths by Jim Herendeen and Karrie Trumble under the supervision of Benjamin F. McLaurin, Jr., Gypsy Moth and Mosquito Control Program, Prince William, Prince William County, VA. These specimens represent the first collection of *Oc. j. japonicus* in Virginia. Two males and one female are deposited in PHPM.

COMMENTS ON CERTAIN SPECIES

Aedes albopictus (Skuse)

Aedes albopictus was first detected in Virginia in 1991 in Virginia Beach and reported by Dreda McCreary in the non-refereed Virginia Mosquito Control Association Newsletter, (Skeeter, Vol. 52, 1992). Since then it has become a major cause for mosquito complaints in many areas of the state. In North Carolina this species is distributed throughout every county and is the primary cause of mosquito complaints, sometimes even in areas with salt marsh. During this study 16 specimens of *Ae. albopictus* were collected in CDC light traps in five of the eight Virginia trap sites around the GDS in Chesapeake and Suffolk cities between 2 June and 7 October. In North Carolina, seven specimens were collected in four of the eight traps in Camden, Gates and Pasquotank counties between 2 June and 7 October. Positive sites were those that were closest to human habitation or near discarded tires and containers.

Ochlerotatus flavescens (Mueller)

Darsie and Ward (1981) recorded *Oc. flavescens* in Virginia based on one sentence in the non-refereed newsletter distributed by the Virginia Mosquito Control Association (Skeeter, Vol. 23, 1978). This sentence, "Chuck Burr caught a rare mosquito this year, *Aedes flavescens.*" is the only indication for this species in Virginia, as the identification was not confirmed and the specimen was not preserved. *Ochlerotatus flavescens* is considered a Holarctic species that prefers deep temporary pools in meadows and marshes on the open plains, and is most abundant in the early spring (Carpenter and LaCasse 1955). The nearest published records of this species to Virginia are in New Jersey (Crans 1970), while Means (1979) lists only three collections from New York. Considering the circumstances surrounding this record and the total absence of specimens collected in Virginia (or even near Virginia) before and since that time, we feel the specimen was probably misidentified. Accordingly, *Oc. flavescens* is deleted from the checklist of Virginia mosquitoes.

Ochlerotatus grossbecki (Dyar and Knab)

Gladney and Turner (1969) reported records of this species in Grassymead and Pittsylvania County, Virginia. We have been unable to locate "Grassymead", which apparently came from Dyar (1922). The senior author (BAH) collected specimens of this species in a large freshwater (clear) pool on Assateague Island, Accomack County, Virginia, in March, 1967. Seven females of this species were collected at two sites in Suffolk City and one site in Chesapeake City during the summer of 1998. Three specimens were collected beside Jericho Lane at GDS site VA-5, on the edge of the Great Dismal Swamp National Wildlife Refuge on 28 April (1 ♀) and 29 April (2 ♀). The description of this site is given under *Oc. aurifer* (above). Two additional females were collected at the same site on 19 May in a focused attempt to collect this species. Two larvae were collected in Emerald Greens, Chesapeake City on 21 May and reared to adults. These last two specimens were collected in a ditch with clear water. In the mid-Atlantic and southern states *Oc. grossbecki* is a late winter-early spring mosquito that is rarely collected, primarily because adults hatch and die before most mosquito collection efforts start. The Jericho Lane site on the edge of the GDSNWR in Suffolk is only 17.7 km from North Carolina. Collections of *Oc. grossbecki* from that site suggest that it almost certainly occurs in North Carolina, where it previously has not been documented (Harrison et al. 1998). A specimen of *Oc. grossbecki* from trap site VA-5 collected on 29 April, has been deposited in NMNH, the remaining six specimens are deposited in PHPM.

Ochlerotatus infirmatus (Dyar and Knab)

The only previous record of *Oc. infirmatus* from Virginia is that of three females from Assateague Island reported by Arnell (1976). Nine females of this species were collected at five sites in Virginia during this study. One specimen was collected at GDS site VA-1 on 15 July. This site was in wet deciduous forest beside U.S. highway 17 in Chesapeake City, about 1 km from North Carolina. Four specimens were collected at GDS trap site VA-2 on 14 July (2 ♀) and 6 October (2 ♀). This site was also in wet deciduous forest beside U.S. highway 17 in Chesapeake City, about 4.8 km from North Carolina. One specimen was collected at GDS site VA-6 on 6 October. This site was in mature deciduous forest beside Washington Ditch lane in the GDSNWR in Suffolk. One specimen was collected at GDS site VA-7 on 7 October in a mature pine forest beside Railroad Ditch lane and behind the GDSNWR headquarters. Two specimens were collected at GDS site VA-8 (see site description above under *Oc. aurifer*) on: 6 October (1 ♀) and 7 October (1 ♀). One voucher specimen from Virginia (Chesapeake, highway U.S. 17, VA-1, 15 July 1998) is deposited in PHPM. The remaining specimens were pooled for virus isolation attempts. *Ochlerotatus infirmatus* can be very common in the coastal regions of North Carolina and specimens were collected during the project in Camden and Gates counties.

Ochlerotatus thibaulti (Dyar and Knab)

Gladney and Turner (1969) reported only two previous collections of *Oc.thibaulti* in Virginia (Giles County and Virginia Beach). During this study one female of *Oc. thibaulti* was collected in Suffolk, Virginia at GDS site VA-8 (see the site description under *Oc. aurifer*) on 14 July. Three additional specimens were identified during the study period from collections in Virginia Beach (courtesy, Dreda McCreary). Specimens of this species were also collected at two sites in North Carolina. One female was collected in Camden County at GDS site NC-2 on 2 June at the North Carolina Welcome Center next to the Dismal Swamp Canal on U.S. highway 17 about 4.8 km from Virginia. The trap site was in mature deciduous forest next to a cultivated field. The second collection (5 ♀, 4 ♂), on 30 April, was in Merchant's Mill Pond State Park, Gates County, just southwest of the GDSNWR. One specimen was captured while biting, while the others were aspirated from resting sites in hollow trees and stumps. The nine specimens from Gates County are deposited in PHPM. These two additional records, plus those of Harrison et al. (1998), suggest that this species is probably scattered throughout the coastal plain of North Carolina, wherever there is suitable old swamp habitat.

Ochlerotatus trivittatus (Coquillett)

Only three previous Virginia collections of *Oc. trivittatus*, in Franklin, Pittsylvania and Roanoke counties in the western piedmont and mountains, have been published (Gladney and Turner 1969). One female of this species was collected in Virginia at GDS site VA-3 on 15 July. This site is located off George Washington highway in Chesapeake in deciduous forest near a housing development. This record represents the most eastern collection of this species in Virginia. In North Carolina, *Oc. trivittatus* is considered a locally common piedmont and mountain species (Harrison et al. 1998), and has only been collected in one coastal plain county (Robeson).

Table 1. Revised checklist of mosquito species in Virginia.[1]

1. *Aedes aegypti* (L.)
2. *Aedes albopictus* (Skuse)—NV
3. *Aedes cinereus* Meigen
4. *Aedes vexans* (Meigen)—NV
5. *Anopheles atropos* Dyar and Knab
6. *Anopheles barberi* Coquillett
7. *Anopheles bradleyi* King
8. *Anopheles crucians* Wiedemann—NV
9. *Anopheles punctipennis* (Say)—NV
10. *Anopheles quadrimaculatus* Say
11. *Anopheles smaragdinus* Reinert
12. *Anopheles walkeri* Theobald
13. *Coquillettidia perturbans* (Walker)—NV
14. *Culex erraticus* (Dyar and Knab)—NV
15. *Culex peccator* Dyar and Knab
16. *Culex pipiens* L.—NV
17. *Culex quinquefasciatus* Say
18. *Culex restuans* Theobald—NV
19. *Culex salinarius* Coquillett—NV
20. *Culex territans* Walker—NV
21. *Culiseta inornata* (Williston)
22. *Culiseta melanura* (Coquillett)—NV
23. *Ochlerotatus atlanticus* (Dyar and Knab)—NV
24. *Ochlerotatus atropalpus* (Coquillett)
25. *Ochlerotatus aurifer* (Coquillett)—V
26. *Ochlerotatus c. canadensis* (Theobald)—NV
27. *Ochlerotatus cantator* (Coquillett)
28. *Ochlerotatus dupreei* (Coquillett)
29. *Ochlerotatus fulvus pallens* (Ross)
30. *Ochlerotatus grossbecki* (Dyar and Knab)—V
31. *Ochlerotatus hendersoni* (Cockerell)
32. *Ochlerotatus infirmatus* (Dyar and Knab)—NV
33. *Ochlerotatus j. japonicus* (Theobald)
34. *Ochlerotatus mitchellae* (Dyar)
35. *Ochlerotatus sollicitans* (Walker)
36. *Ochlerotatus sticticus* (Meigen)
37. *Ochlerotatus stimulans* (Walker)
38. *Ochlerotatus taeniorhynchus* (Wiedemann)
39. *Ochlerotatus thibaulti* (Dyar and Knab)—NV
40. *Ochlerotatus tormentor* (Dyar and Knab)
41. *Ochlerotatus triseriatus* (Say)—NV
42. *Ochlerotatus trivittatus* (Coquillett)—V
43. *Orthopodomyia alba* Baker
44. *Orthopodomyia signifera* (Coquillett)—NV
45. *Psorophora ciliata* (Fabricius)
46. *Psorophora columbiae* (Dyar and Knab)—N
47. *Psorophora cyanescens* (Coquillett)
48. *Psorophora discolor* (Coquillett)
49. *Psorophora ferox* (von Humboldt)—NV
50. *Psorophora horrida* (Dyar and Knab)
51. *Psorophora howardii* (Coquillett)
52. *Psorophora mathesoni* Belkin and Heinemann
53. *Toxorhynchites rutilus septentrionalis* (Dyar and Knab)
54. *Uranotaenia sapphirina* (Osten Sacken)—NV
55. *Wyeomyia smithii* (Coquillett)

[1] Species with a "N" (= North Carolina) or a "V" (= Virginia) following the author(s) name(s) are species that were collected around the periphery of the Great Dismal Swamp in 1998.

Wyeomyia smithii (Coquillett)

Coyne and Hagmann (1970) determined that the species in Virginia was *Wyeomyia haynei* Dodge, rather than the more northern *Wy. smithii,* and this was reported in Darsie and Ward (1981). Bradshaw and Lounibos (1977), however, found that these names represent variations of a single species. Based on the work of Bradshaw and Lounibos (1977), Darsie and Morris (1998) sunk *Wy. haynei* as a junior synonym of *Wy. smithii.*

Revised Checklist of Mosquito Species in Virginia

The last publications to specifically address the mosquito fauna of Virginia were Bickley (1957) and Gladney and Turner (1969), who, using the data provided by Dorer et al. (1944) and later collection records, documented 47 species occurring in the state. In subsequent studies an additional four species were recognized in Virginia and added to a list of the mosquitoes of Virginia published in Darsie and Ward (1981): *Wyeomyia haynei* Dodge (Coyne and Hagmann 1970); *Ochlerotatus hendersoni* (Cockerell) (Zavortink 1972): *Ochlerotatus infirmatus* (Arnell 1976); and *Ochlerotatus flavescens* (Skeeter 1978, non-refereed newsletter of the Virginia Mosquito Control Association). Since 1981 additional species have been documented in Virginia. *Aedes albopictus* was recognized in the state by McCreary (Skeeter 1992, non-refereed newsletter of VMCA). Following the recognition of five sibling species in the Quadrimaculatus Complex (Reinert et al.

1997), Strickman et al. (2000) confirmed the presence of *Anopheles quadrimaculatus* Say, *sensu stricto,* and *Anopheles smaragdinus* Reinert, in Virginia. Also, Powell and Harrison (2001) provided the first documentation of *Oc. tormentor* in Virginia. In this study we have documented the occurrence of *Oc. aurifer* and *Oc. j. japonicus* in Virginia.

Considering the above additions, our deletion of *Oc. flavescens* from the Virginia Checklist, and the recognition of *Wy. haynei* as a junior synonym of *Wy. smithii* (Darsie and Morris 1998), these actions result in 55 species and subspecies recognized in the checklist of the mosquito species in Virginia (Table 1).

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MACROPSYLLA NOVAEHOLLANDIAE (SIPHONAPTERA: HYSTRICHOPSYLLIDAE), A NEW SPECIES OF FLEA FROM TASMANIA

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Abstract.—A **new species** of flea of the family Hystrichopsyllidae, ***Macropsylla novaehollandiae*** **Hastriter**, collected from *Pseudomys novaehollandiae* Waterhouse near Coles Bay, Tasmania, is described. The familial placement of the genus *Macropsylla* Rothschild and *Stephanopsylla* Rothschild are discussed.

Key Words: flea, Hystrichopsyllidae, *Macropsylla*, *Stephanopsylla*, Tasmania

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Fleas recently collected from small mammals in northeastern Tasmania were initially thought to represent *Macropsylla hercules* Rothschild. Further study revealed that they represent an undescribed species. Rather common in eastern Australia, the nominate species, *M. hercules,* was described from two females, individually collected from *Mus velutinus* = *Rattus lutreolus* (J. E. Gray) and an unidentified species of *Mus* from Launceston, Tasmania. Hopkins and Rothschild (1956) later illustrated the male head and genitalia of *M. hercules* from Emerald, Victoria, Australia and provided a brief description. The purpose of this paper is to describe a new species of *Macropsylla* and provide supportive evidence for the familial placement of this unique genus.

MATERIALS AND METHODS

The overall body dimensions of males and females were measured from the foremost portion of the frons to the apex of the st. VIII in males and to the posterior border of the sensilium in females. Illustrations were prepared from digitized images prepared with a Zeiss Stemi SV 11 dissecting microscope and Dage-MTI digital camera. Terminology of morphological structures follows those of Rothschild and Traub (1971).

Macropsylla hercules Rothschild 1905
(Figs. 4, 5, 8–12, 14, 16, 17)

Material examined.—AUSTRALIA, New South Wales: ex *Rattus assimilis* = *Rattus fuscipes* (Waterhouse), 24 ♂, 32 ♀; ex *Rattus rattus* (L.), 3 ♂, 3 ♀; ex *R. fuscipes,* 2 ♂, 2 ♀; ex *R. lutreolus,* 3 ♂, 2 ♀, and ex *Melomys* sp., 1 ♀. Northern Territory: ex *Melomys littoralis* = *Melomys burtoni* (Ramsay), 1 ♀. Queensland: ex *R. fuscipes,* 12 ♂, 24 ♀; ex *R. assimilis,* 1 ♂, 2 ♀; ex *Parameles nasuta* E. Geoffroy, 3 ♀; ex *Rattus* sp., 2 ♂, 1 ♀, and *Melomys* sp., 1 ♀. South Australia (Kangaroo Island): ex *R. fuscipes,* 8 ♂, 6 ♀. South Australia (mainland): *R. fuscipes,* 1 ♂. Tasmania: ex *R. lutreolus,* 20 ♂, 21 ♀; *Pseudomys higginsi* (Trouessart), 1 ♂, 4 ♀; ex *Rattus lutreolus velutinus* = *R. lutreolus,* 1 ♂; ex *Mus velutinus* = *R. lutreolus,* 1 ♀ (lectotype), and ex *Mus* sp., 1 ♀ (paralectotype). West Head (location unknown): ex *R. fus-*

cipes, 1 ♂. Victoria: ex *R. assimilis*, 11 ♂, 4 ♀; ex *Mus assimilis* = *R. fuscipes*, 8 ♂, 5 ♀; ex *R. lutreolus* or *R. assimilis*, 9 ♀; and ex *R. lutreolus*, 1 ♀.

Remarks.—Rothschild (1905) indicated in his original description of *M. hercules* (based on two females) that the row of marginal spinelets on t. V is interrupted dorsally. Examination of the lectotype reveals that the dorsal spinelets are not interrupted, but broken off (Figs. 6, 12, black arrows), although those of the paralectotype are interrupted (Fig. 9, black arrow). A dorsal interruption in the row of marginal spinelets among the 223 specimens (98 ♂, 125 ♀) examined was present in only a few specimens from three collection localities. Three females from Kosciusko National Park, New South Wales possessed a broad interruption in rows on t. III–V. No males were examined from that locality. A slight dorsal interruption was also present on t. V of a single male from the Kuipto Forest, just south of Adelaide, South Australia. This male also possesses four deformed setae (much longer than normal spinelets, or combs), two each on one side arising from the base of t. VI and t. VII, respectively. The entire series (8 ♂, 6 ♀) from Kangaroo Island (just south of the locality of the specimen from Kuipto Forest) possess a dorsally interrupted row on t. V in addition to an interrupted row on t. VI (numbering 5–10 spinelets per side). Excluding the new species herein described, the rows of marginal spinelets on t-II-V of all specimens examined from Tasmania (22 ♂, 27 ♀) were complete, and supernumary setae were not present on t.-VI. Considerable variation exists in the number of marginal spinelets in each row; however, the number of spinelets occurring at, or below the level of the spiracle on t. V is consistent, ranging from 4–8 in males and females of *M. hercules* and 0–1 in the new species (Figs. 6–11, white arrows denote position of spiracles).

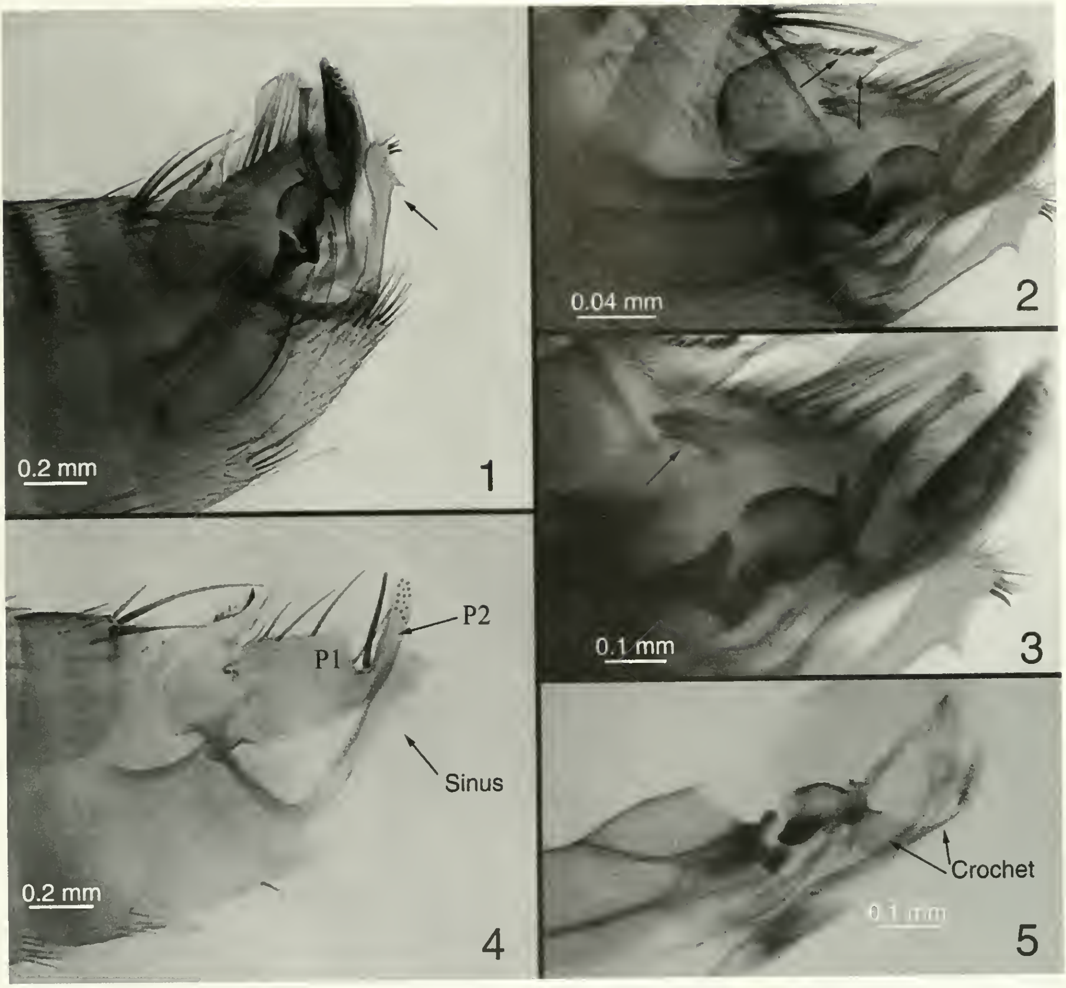
A new unpublished record of *M. hercules* was examined (National Museum of Natural History, Smithsonian Institution, Washington, DC) from *M. littoralis* = *M. burtoni*, Arnhem, Smith Point, Caberg Peninsula, Northern Territory, 25 June 1978, leg. P.R. Bavorstock, extending the northern limits of the species to the north central coast of Australia. *Rattus fuscipes* and *R. lutreolus* are the usual hosts of this flea, but neither is normally found on the northern coastal areas of Australia [Wilson and Reeder (1993)]. Perhaps these commensal rodents have been introduced by commerce along the coast of the Arnhem region, transporting the flea with them. The occurrence of *M. hercules* on *M. burtoni* is probably an accidental association with *R. fuscipes* or *R. lutreolus*.

Macropsylla novaehollandiae Hastriter, new species

(Figs. 1–3, 6, 7, 13, 15)

Type material.—AUSTRALIA. ♂ holotype, ♀ allotype, 2 ♀ paratypes, ex: *Pseudomys novaehollandiae* Waterhouse, Coles Bay, Tasmania, 25 November 1998, B. Lazenby; and 1 ♀ paratype, ex: *P. novaehollandiae*, Flinder's Island, Tasmania, 5 January 1999, B. Lazenby. Holotype, allotype and two paratypes deposited in the National Museum of Natural History, Smithsonian Institution, Washington, DC, and one paratype in the collection of the senior author.

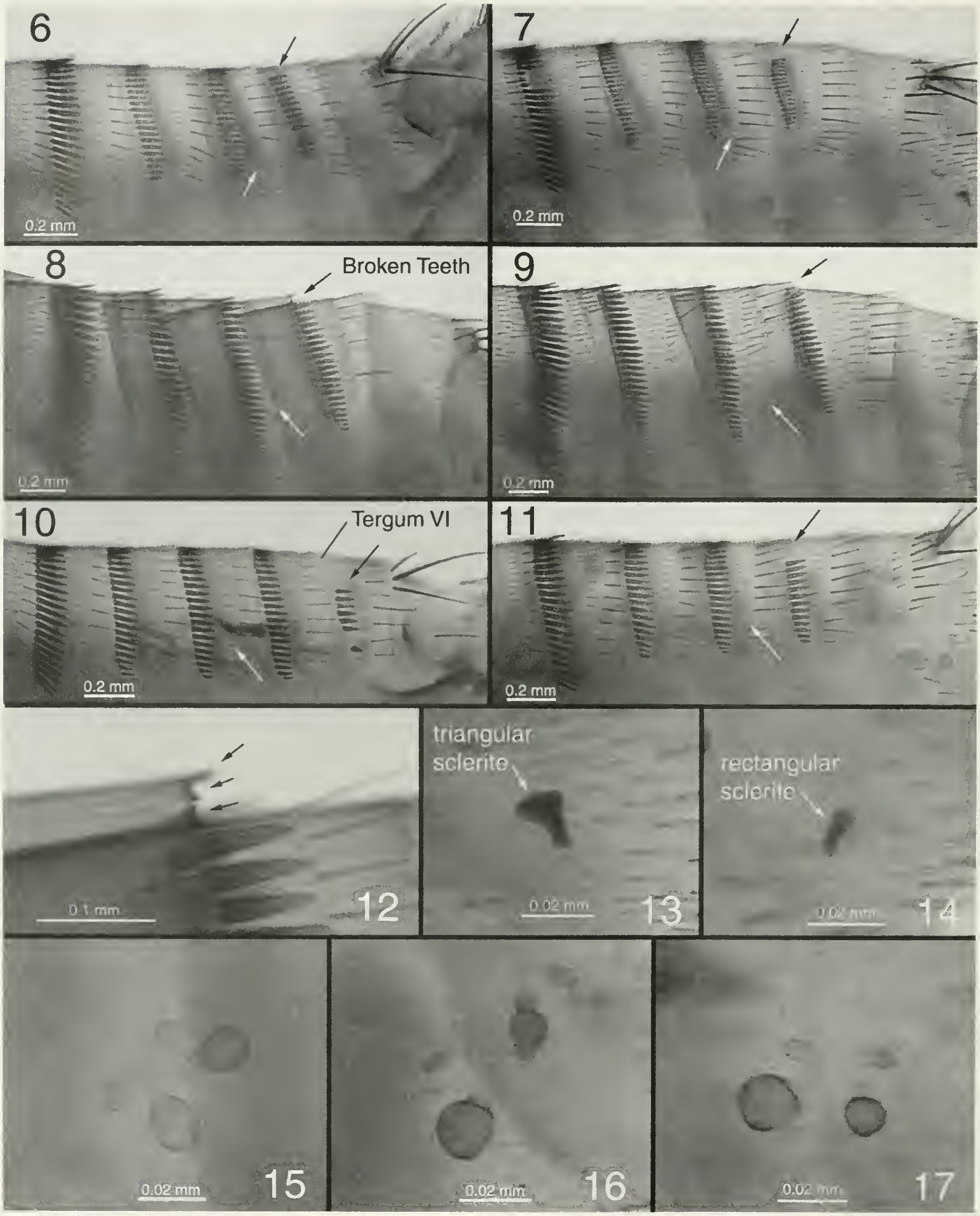
Diagnosis.—Males may be distinguished from *M. hercules* by the length of the sclerotized inner tube that is obviously longer and wider than the spatulate spiniform of the basimere (Fig. 1), the apico-lateral surface of P2 is adorned with 9–10 blunt spiniform setae (14–19 in *M. hercules*) (Fig. 4), spinelets of t. V interrupted dorsally (Fig. 6, black arrow), no more than 1–2 marginal spinelets below level of spiracle on t. V (Fig. 6, white arrow), and st. IX is without a distinct sinus in the caudal margin beneath a caudally pointed acute lobe (compare Fig. 1 and 4). Females are very similar to *M. hercules*, but may be separated by a combination of the following characters: 1) a much weaker lobe along the posterior margin of st. VII, 2) anterior row of setae



Figs. 1–5. 1–3, *Macropsylla novaehollandiae* (male), Coles Bay, Tasmania. 1, Terminal segments (arrow denotes lack of sinus on sternum IX). 2, Aedeagus (arrows denote dorsal and ventral anal lobes). 3, Apex of aedeagus (note relative size of sclerotized inner tube and spatulate spiniform on basimere). 4–5, *M. hercules* (male), Pearl Beach, New South Wales. 4 Terminal segments with right side and aedeagus removed (P1/P2 = processes 1 and 2 of basimere; sinus on caudal margin of sternum IX). 5, Terminal aspect of aedeagus (note relative size of sclerotized inner tubes of Figs. 3 and 5).

on t. VII much finer and curving strongly caudad below level of spiracle (Fig. 7), 3) dorsal antesensilial bristle ¾ or more the length of the middle bristle (only ½ in *M. hercules*), 4) sclerite in dorsal wall of oviduct larger and expanded dorsally (triangular vs. rectangular) (Figs. 13–14), and 5) a combination of marginal spinelets on t. V interrupted dorsally with no more than one spinelet extending below level of spiracle (Fig. 7, white arrow).

Description.—*Head:* Clear marginal band running parallel with frons and diverging dorsad, without setation. Narrow pale marginal band parallel with frons. Six large setae and patch of smaller setae adorn preantennal area in a random pattern in addition to numerous minute scattered setae. Eye well developed, notched ventrally, situated dorsad of angled row of 9 broad spatulate genal ctenidia. Anterior arm of tentorium visible well below eye and anterior



Figs. 6–17. 6–7, *Macrosylla novaehollandiae* (male holotype, female allotype, respectively, Coles Bay, Tasmania). 8–9, *M. hercules* (female lectotype, female paralectotype, Launceston, Tasmania). 10–11, *M. hercules* (females), Kangaroo Island, Australia. 12, *M. hercules*, enlargement of broken teeth noted in Fig. 8. 13, *M. novaehollandiae* (allotype), sclerite of bursa copulatrix. 14, *M. hercules*, sclerite of bursa copulatrix. 15, *M. novaehollandiae* (allotype), spermathecae. 16–17, *M. hercules*. 16, Spermathecae (lectotype). 17, Spermathecae (Kangaroo Island).

to genal ctenidia, central internal oral tuber arising from oral angle. Antenna of male extending onto prosternum, some setae on pedicel extending about half length of antenna. Female antenna not extending to prosternum and longer setae of pedicel extending nearly to apex of antenna. Postantennal region with two defined rows of setae, with anterior setae somewhat scattered. Row of 10–13 slender setae along dorsal margin of antennal fossa. Distinct suture separating preantennal and postantennal areas. Internal occipital tuber present. Maxillary palpus 5-segmented in both sexes, labial palpus 8-segmented in male and 9-segmented in female extending just short of apex of coxae. Maxillary lobe sharply acute at apex. Internal apodeme connecting head to thorax extending deep into prothorax. *Thorax:* Three rows of setae on prothorax and pronotal comb of 15–16 teeth per side in both sexes. Proepisternum with dorsal depression on male to accommodate clavus of antenna, less pronounced in female. Meso- and metanota with 5 rows of setae, each row diminishing in size cephalad. Mesepimeron and mesepisternum with many scattered setae, pleural rod stout and bifurcate dorsally. Lateral metanotal area with 7 scattered setae in male and 3 vertical rows (2, 4, 3–4 setae, anterior to posterior) in female. Pleural arch well-developed, dorsal portion heavily sclerotized. Metepisternum bearing 2 moderate setae dorsally, metepisternum fusing with that of other side and protruding downward between coxae. Metepimeron with 3 vertical rows of setae, posterior stoutest and most dorsal seta below level of spiracle. *Legs:* Lateral surface of forecoxa heavily setose, mesal surface reticulated without setae. Mid- and hindcoxae with sparse small setae along anterior lateral and mesal margins. Oblique sulcus of midcoxa complete. Two femoral pit guard hairs on each femur, each about equal in size on mid- and hindfemora, medial smaller on forefemur (see Remarks). Numerous lateral setae found on all femora and only 2–3 setae on mesal surface of each. Each femur with coarse surface reticulations. Lateral bristles guarding femoral-tibial joints longest of pair on forefemur and shortest on mid- and hindfemora. Dorsal margin of foretibia adorned with many heavy long spines (one nearly reaching apex of second tarsal segment) resembling a false comb; mid- and hindtibiae with 7 and 8 dorsal notches, respectively, with additional setae interspersed between notches. Mesal surface of mid- and hindtibiae sculptured with triangular scalelike reticulations. Hindtibia with apical tooth. Segment I of hindtarsus about as long as hindtibia and segment II longer than segments III and IV combined. Fifth tarsal segment of each leg adorned with a complex set of lateral plantar bristles; first pair set onto plantar surface positioned between second pair, third and fourth pairs each with two bristles per side. Each plantar surface with many minute setae and 2–4 (variable) preapical plantar bristles (some spiniform). *Unmodified abdominal segments:* Chaetotaxy of t. I–VII variable. Only posterior main rows with intercalary setae. Tergites I–VI of male bears 3, 4, 4, 4, 4, and 3 rows, respectively and t. VII with a single defined row and numerous smaller setae scattered anteriorly. Female with similar pattern, but anterior rows less defined. Both sexes with marginal spinelets on t. II–V with row of spinelets interrupted dorsally on t. V. These total 46, 44, 36, and 30 (male), and 49, 44, 44–45, and 28–31 (female), respectively. Number of spinelets below level of spiracle on t. II–IV 7, 3, and 3 (male) and 6–8, 1–5, and 0–2 (female). Those situated below level of spiracle on t. V range from 0 to 2 in both sexes. Both sexes with 3 antesensilial bristles, ventral pair of equal length, and dorsal bristle ¾ as long as others. Abdominal st. II with a lateral patch of small setae (more numerous in female), and a single ventral seta per side; male with 5–7 stout setae per side in main rows and numerous scattered setae anterior to main row on st. III–VII, female same for st. III–VI. *Modified abdominal segments (male):* Tergum VIII reduced, covering little of terminal segments and bearing patch of fine setae across dorsum. Atrium of eighth spiracle greatly expanded, reminiscent of some species of *Megabothris* Jordan 1933. Basimere with two lobes (P1 and P2). P2 is highly modified immovable apical process (anatomically in usual position of the telomere) which bears 9–10 blunt spiniforms on mesal surface and single unique spatulate spiniform arising from sinus between the P1 and P2 (Figs. 1, 4). Located just below sensilium on basimere, 2 structures, which appear as vestigial telomeres, each with several slender setae apically (Fig. 3, arrow). Anterior portion of basimere heavily sclerotized. Sternum VIII with group of 9–10 stout setae per side near caudal margin with numerous smaller setae scattered over surface. Distal arm of st. IX uniquely fused into single structure (paired in most other genera of fleas) bifurcating at base into usual proximal arms. Apex of fused distal arms adorned with 6 spiniform setae and numerous stout setae. Caudal margin with beak-like process with margin below entire without indication of sinus (Fig. 1, arrow). Dorsal anal lobe studded with blunt spiniforn setae, ventral anal lobe bearing 2 long slender setae (Fig. 2, arrows). Many portions of aedeagus more highly sclerotized than those of other fleas, particularly sclerotized inner tube, crescent sclerite, crochet, and medial and lateral lobes of fulcrum. *Modified abdominal segments (female):* Three antesensilial bristles, dorsal bristle about ¾ length of middle bristle. Tergum VIII greatly expanded ventrally so as to envelop vestigial (membranous) st. VIII, covered with many setae, and those towards caudal margin more robust than those more anterior. Caudal margin forming angular lobe. Sensilial plate projecting anterior to caudal margin of t. VII, interrupting dorsal portion of t. VIII. Dorsal anal lobe much larger than inconspicuous reduced ventral anal lobe. Anal stylet nearly three times as long as wide, bearing single minute seta at base of long apical seta. Sternum VII without lobes or sinuses and st. VIII vestigial. Paired spermathecae similar in size and much like those of *M. hercules* (Figs. 15–17). Hyperdeveloped trianglular sclerite in bursae copulatrix, rectangular in *M. hercules* (Figs. 13–14).

Size: Slide mounted specimens: male, 4.1 mm (n = 1), female, 4.5 mm (n = 2). Alcohol specimens: female, 3.3 mm (n = 2).

Etymology.—This species is named after the specific name of the host species, *Pseudomys novaehollandiae,* as a noun in apposition.

Remarks.—Nowak and Paradiso (1983) indicated that the New Holland mouse, *P. novaehollandiae* was limited to a few collections early in the 1900s from New South Wales to Mornington Peninsula of southern Victoria and from subfossil remains found in Tasmania until 1976 when Hocking (1980) reported a population on the northeastern coast of Tasmania. *Macropsylla hercules* is commonly found throughout eastern Australia from Queensland to South Australia and Tasmania on a variety of murid hosts, none of which include *P. novaehollandiae.* The rarity of collecting *P. novaehollandiae* (to include its ectoparasites) probably accounts for the failure to previously find this new species of flea. Additonal collection of this endangered host species on mainland Australia will predictably yield additional specimens of *M. novaehollandiae.*

A pit located on the ventral anterior margin of the femora of each leg has previously not been reported. Although the function of this pit is not known, it appears to be present on most, if not all species of fleas. Dorsad to the "pit" are two stout setae that project downward over the "pit" so as to shield the underlying "pit" structure. The size and arrangement of these setae are variable from species to species and may be consistent among different families. The details and significance of this new observation will be published elsewhere.

DISCUSSION

Oudemans (1909) placed *Macropsylla* in a separate subfamily (Macropsyllinae) and family (Macropsyllidae) based on the presence of an internal occipital tuber and Hopkins and Rothschild (1956), ignoring the subfamily, followed the same scheme and included a second monotypic genus, *Stephanopsylla* Rothschild, in this family. Smit (1982) astutely did not recognize this arrangement and placed Macropsyllinae in the family Hystrichopsyllidae (it is presumed that he also included *Stephanopsylla,* since there was mention of six genera in his family discussion). Lewis (1993, 1998) also followed this arrangement. Several observations substantiate the current systematic arrangement. Characters commonly shared by *Macropsylla* and other genera of the Hystrichopsyllidae include: 1) nearly a complete fusion of the distal arms of st. IX from base to apex; 2) presence of dual spermathecae; 3) combs or spinelets on one or more abdominal tergites; 4) anterior branch of tentorium visible; 5) apical tibial spur present; 6) mesopleural rod bifid (only slightly in *Typhloceras* Wagner); and 7) common pattern of femoral-tibial joint bristles (protibia, outer long, inner short, and meso- and metatibia, outer short, inner long). Smit (1982) indicated the absence of the anterior arm of the tentorium as a character to distinguish genera of the subfamily Macropsyllinae from those of Hystrichopsyllinae. Although the tentorium does not extend as far anteriorly in *Macropsylla* as it does in *Atyphloceras* Jordan and Rothschild, *Ctenoparia* Rothschild, *Hystrichopsylla* Taschenberg, and *Typhloceras,* it is visible. Specimens of *Stephanopsylla thomasi* (Rothschild) were not examined; however, illustrations of this monotypic genus appear morphologically similar to *Macropsylla* except for extreme modifications in the structure of the head. These similarities include an angular genal comb, mouth parts placed well behind the oral angle (lesser in *Macropsylla*), presence of abdominal combs on t. II–V (*Macropsylla*) and t. I–VI (*Stephanopsylla*), presence of a dorsal occipital tuber, and a frons composed of a narrow frontal ridge separated by a narrow band (in lateral view) with a uniform row of minute setae along its posterior margin. These characters distinguish members of the Macropsyllinae from those of Hystrichopsyllinae.

Much emphasis has been placed on the importance of the occipital tuber (Oudemans 1909, Hopkins and Rothschild 1956). In addition to taxa belonging to Macropsyllinae, this structure is present in all genera of Stephanocircidae (minimally so in *Barreropsylla* Jordan). Wagner (1934) amply (and accurately) described the occipital tuber and other structures within the head capsule, using the stephanocircine *Plocopsylla enderleini* Wagner as a model. The nature of the occipital tuber can only be understood when viewed from a frontal or dorsal view (dissected specimens). The conventional lateral view of this structure might suggest that the apodeme is projecting centrally into the middle of the head, which is not the case. The structure is comprised of a heavily sclerotized ridge which follows the contour of the occiput adding rigidity and strength to the head capsule. The term occipital bridge might be more descriptive than occipital tuber. It is not surprising that sephanocircids possess it, since the structure of the head is highly modified to accommodate the helmet found in no other fleas [except the unrelated *Smitella thambetosa* (Pygiopsyllidae)]. Traub (1968) explained this convergent evolutionary condition in detail. Some members of Ischnopsyllidae also possess highly modified incrassations on the occipital areas of the head. One can only speculate why the occipital tuber occurs in relatively unrelated genera whose basic head structures are quite different. The peculiar shape of the frons in Macropsyllinae is reminiscent of some members of the family Ishnopsyllidae, but this feature is likely an independently convergent development. Hopkins and Rothschild (1956) suggested the Ischnopsyllidae (and Stephanocircidae) might well have been descendents of "Macropsyllidae." Phylogenetic analysis of DNA sequence data does not support a close relationship between the Ischnopsyllidae and Macropsyllinae. These observations will be discussed in a future paper.

Both genera in the subfamily Macropsyllinae are restricted to the Australian subregion of the Australian Region. The isolated evolution of hystrichopsyllids (*Macropsylla* and *Stephanopsylla*) in Australia is puzzling considering the disjunct distribution of other hystrichopsyllids (*Atyphloceras, Ctenoparia, Hystrichopsylla* and *Typhloceras*). With exception of *Ctenoparia*, other genera of Hystrichopsyllidae are boreal inhabitants occurring in the Holarctic Region (*Hystrichopsylla, Atyphloceras*) and in the Palaearctic Region (*Typhloceras*). Although *Ctenoparia* and the two Australian genera share familial characteristics and early common geographical connections (Gonwanaland), they are quite dissimilar. It is evident that they were isolated very early or they were introduced by commensal murid rodents via human oceanic travels.

Jordan (1921) suggested that the difference in sizes of the two spermathecae of *Macropsylla* might be an evolutionary intermediate link between those genera possessing dual spermathecae and those with only one. Illustrations (Dunnet and Mardon 1974) of the female of *Stephanopsylla thomasi* and all specimens of *Macropsylla* that we examined demonstrate significant disparity in the shape and size of the paired spermathecae, whereas those of other genera (excluded from Australia) are consistently similar. Traub (1980) provided evidence that the Australian Hystrichopsyllidae (*Macropsylla* and *Stephanopsylla*) are the most ancient genera in the family. If this proves to be the case, one would expect the more primitive genera of the Hystrichopsyllidae (*Macropsylla* and *Stephanopsylla*) to possibly manifest greater morphological variability than more recently evolved taxa (*Atyphloceras, Ctenoparia, Hystrichopsylla,* and *Typhloceras*). Other than exteme modification of the head, *Stephanopsylla* is more similar to other hystrichopsyllids than *Macropsylla*. These similaries are noted particularly in the general features of t. IX, st. VIII, and the aedeagus. The extreme modification of the head of *Stephanopsylla* may be an evolutionary adaptation to its marsupial host species (Dasyuridae Goldfuss and Potoroidae Gray). *Stephanopsylla thomasi* has a peculiar disjunct distribution in Australia with a rather small number of specimens recorded from Western Australia and from Victoria, Australia. Additional collections are needed to elucidate the geographical distribution of *Stephanopsylla thomasi*.

The apparent preference of *Macropsylla* for murid rodents (*R. fuscipes* and *R. lutreolus*) is yet another indication of the systematic relationship to the Hystrichopsyllidae, as other genera in this family all share murid rodents as their preferred hosts. Dunnet and Mardon (1974) reported Australian fleas from 48 different genera of marsupials and only 12 genera of murid rodents. Records of *Macropsylla* occurring on marsupials are undoubtedly accidental associations. Divergence of the ancestral hystrichopsyllid likely occurred after introduction into Australia on murid rodents, some evolving after a successful transition to marsupial hosts (*Stephanopsylla*) while others continued evolving on murids (*Macropsylla*).

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DESCRIPTION OF FEMALES OF *STETHOPHOTOPSIS* PITTS AND *SPHAEROPTHALMA* (*PHOTOPSIOIDES* SCHUSTER) (HYMENOPTERA: MUTILLIDAE)

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Abstract.—The female of *Stethophotopsis maculata* Pitts, ***Stethophotopsis cremauranti*, n. sp.**, and *Sphaeropthalma* (*Photopsioides*) *uro* (Blake) are described. These represent the first descriptions of the females of *Stethophotopsis* Pitts and *Photopsioides* Schuster.

Key Words: Insecta, Sphaeropthaminae, wasp, velvet ant, new species

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Nocturnal mutillids of the southwestern United States have a high diversity, with about 206 known species. Anyone black lighting in the Southwest during the summer is awed by the number of male mutillids that are attracted to the lights. Females of these nocturnal species, however, are rarely collected. The females of many of the nocturnal southwestern Mutillidae species remain unknown. Only five species have been described from both male and female specimens. There are an additional 22 species that are known solely from the females. This leaves 176 species described from males. Some genera and subgenera, such as *Acanthophotopsis* Schuster, *Acrophotopsis* Schuster, and *Odontophotopsis* Viereck, lack a single female association and remain known only from the male. Female associations of these taxa would provide valuable data for generating a phylogenetic hypothesis of the sphaeropthalmine mutillids. This paper adds to our knowledge of the females of some of these nocturnal species.

A pair of *Stethophotopsis maculata* Pitts collected *in copula* was found among the undetermined mutillids in the University of Arizona Collection of Arthropods. The female represents the first female known for this genus. A second male was found doubling the known number of male specimens. It was noted that a congeneric species of female also existed. Examination of both species greatly helped in determining female characters of generic level importance. These two species are described, illustrated, and discussed below.

During a subsequent collecting trip near Portal, Arizona, a pair of mutillids was collected *in copula* at a black light. The male was identified as *Sphaeropthalma* (*Photopsioides*) *uro* (Blake). This paper provides the first description of a female of this subgenus. The female of *Photopsioides* Schuster is described, illustrated and discussed below.

MATERIALS AND METHODS

We follow Schuster's (1958) classification of the sphaeropthalmine genera. Currently, there is no phylogenetic hypothesis available for the subtribe Sphaeropthalmina. It is apparent that *Sphaeropthalma* is not monophyletic (pers. obs.), but reclassification of this group should not be done until more females are known. As the genus now stands, the subgenus *Photopsis* Blake includes females that differ in characters that are considered to be of generic importance, such as a defined pygidium and a petiolate abdomen.

The following acronyms are used for collections that were involved in this study: Canadian National Collection of Insects, Ottawa, Canada (CNCI); Department of Entomology Collection, University of Arizona, Tucson (UAIC); James P. Pitts collection (JPPC).

After Ferguson (1967), we are adopting the following notation for punctation in the order of decreasing coarseness: reticulate, coarse, moderate, small, fine and micropunctate. Micropunctate refers to punctures that are extremely shallow and do not have vertical walls or sharp margins. We have used the term simple pubescence for hairs that are smooth and do not have barbed surfaces. Brachyplumose pubescence refers to hairs with barbs that are less than or equal to the diameter of the shaft at the attachment of the barb. Plumose pubescence is used for hairs that have longer barbs. T2, T3, etc., are used to denote the second, third, etc., metasomal tergites while S2, S3, etc., denote the second, third, etc., metasomal sternites.

Stethophotopsis Pitts
(Figs. 1, 4, 7, 9, 10)

Type species.—*Stethophotopsis maculata* Pitts. Orig. desig.

Female.—*Head:* Narrower than thorax. Eyes projecting, subcircular, clearly faceted. Clypeus anterior edge truncate, base swollen medially. Dorsal carina of antenna present but inconspicuous or absent. Antennal tubercles well developed and subcontiguous. Antenna 12-segmented. Pedicel and first flagellomere subequal in length (Fig. 1). Mandible with internal tooth on distal one-third (Fig. 4). Ventral margin of mandible weakly emarginate at basal one-third (Fig. 4). Genal carina absent. Proboscidal furrow triangular, broad, reaching base of mandibles and margined by carinae. Maxillary palpus 6-segmented, labial palpus 4-segmented.

Mesosoma: Pyriform, slightly longer than wide (Fig. 7). Mesosoma gradually widening from humerus to anterior spiracular tubercles, widest at anterior spiracular tubercles, gradually narrowing from anterior spiracular tubercles posteriorly (Fig. 7). Scutellular scale absent (Fig. 7). Propodeum with separation between dorsal and lateral regions (Fig. 9). Lateral face of pronotum narrow, punctate, with anterior depression. Anterior half of mesopleuron glabrous. Metapleuron glabrous. Spurs of all tibiae pectinate.

Metasoma: First segment distinctly petiolate with respect to second (Fig. 10). T1 attached ventrally to midline of T2 in lateral view such that T2 bulges above attachment (Fig. 10). T2 with lateral felt lines (Fig. 10). S2 strongly convex and without lateral felt lines. T6 with pygidial area undefined. Plumose pubescence present on apical margin of T2. Coarsely punctate and raised integumental maculations present on T2.

Distribution.—Southern Arizona, USA; Sonora, Mexico.

Comments.—Females of *Stethophotopsis* can be distinguished from females of other sphaeropthalmine genera by the combination of presence of plumose pubescence on the metasoma, absence of dorsal carinae on the antennal scrobes, first antennal flagellomere as broad as long, absence of genal carinae, first metasomal segment petiolate, condition of the petiolar attachment, presence of coarsely punctate and raised integumental maculations on the second metasomal segment, and absence of lateral carinae defining pygidium.

Stethophotopsis is a distinct genus in the Sphaeropthalmini (subtribe: Sphaeropthalmina). For males, the unique sternal processes and the condition of the cuspis of the genitalia, being dilated, slightly spatulate, and elongated (attaining the length of the parameres), are apparently autapomorphic for the genus. It remains unclear at this point what characters, if any, are autapomorphic for females of this genus. *Stethophotopsis* males and females will key to subfamily Sphaeropthalminae without difficulty in existing keys by Brothers (1993, 1995). In Schuster's (1958) key to the sphaeropthalmine males of the North American Southwest, *Stethophotopsis* terminates at couplet I, where it can be distinguished by the autapomorphies listed above. Currently, there is no key for the sphaeropthalmine females.

Stethophotopsis maculata Pitts
(Figs. 1, 4, 7, 9, 10)

Female.—*Length:* 7.5 mm.

Head: Head brownish yellow, clothed with sparse erect and dense decumbent white simple pubescence. Malar space 0.6× maximum eye width. First flagellomere 1.1× length of pedicel (Fig. 1). Second flagellomere slightly longer than first, 1.4× length of pedicel (Fig. 1). Scape and pedicel concolorous with head. Flagellum dark brown. Front with confluent punctation. Vertex narrowly reticulate. Mandible brown distally.

Mesosoma: Mesosoma and legs brownish yellow, except femora and tibiae dark brown. Pronotum and mesonotum with decumbent and short erect dark brown pubescence. Metanotum with decumbent white brachyplumose pubescence. Propodeum with white pubescence, somewhat darkened anteriorly, and with long erect and short plumose pubescence posteriorly. Legs with white brachyplumose pubescence. Humeri angulate. Lateral face of pronotum punctate with decumbent white pubescence. Mesopleuron with posterior half punctate with erect white pubescence; anterior half glabrous. Propodeum glabrous laterally; reticulate on lateral margins. Dorsum of mesosoma reticulated.

Metasoma: Yellowish brown. T1 with sparse long erect white brachyplumose and short plumose pubescence. T1 with apical fringe of white plumose pubescence. T2 with two round black integumental maculations on anterior fourth with deep punctation, reticulate surface, raised above surrounding disk, with thick black simple pubescence. T2 felt line 0.2× length of T2. T2–T5 with golden brachyplumose pubescence except black in areas of tergal maculations. T2 with golden-white plumose apical fringe. Sternites with white brachyplumose pubescence. S2 with median longitudinal tumid region on anterior fifth.

Material examined.—Mexico, Sonora, 5 mi east of Alamos, 1 ♀ 1 ♂, 11.VIII.1973, coll. K. Stephan and D. S. Chandler (UAIC); 1 ♂, Mexico, Sonora, 5 mi east of Alamos, 11.VIII.1973, coll. K. Stephan and D. S. Chandler (UAIC).

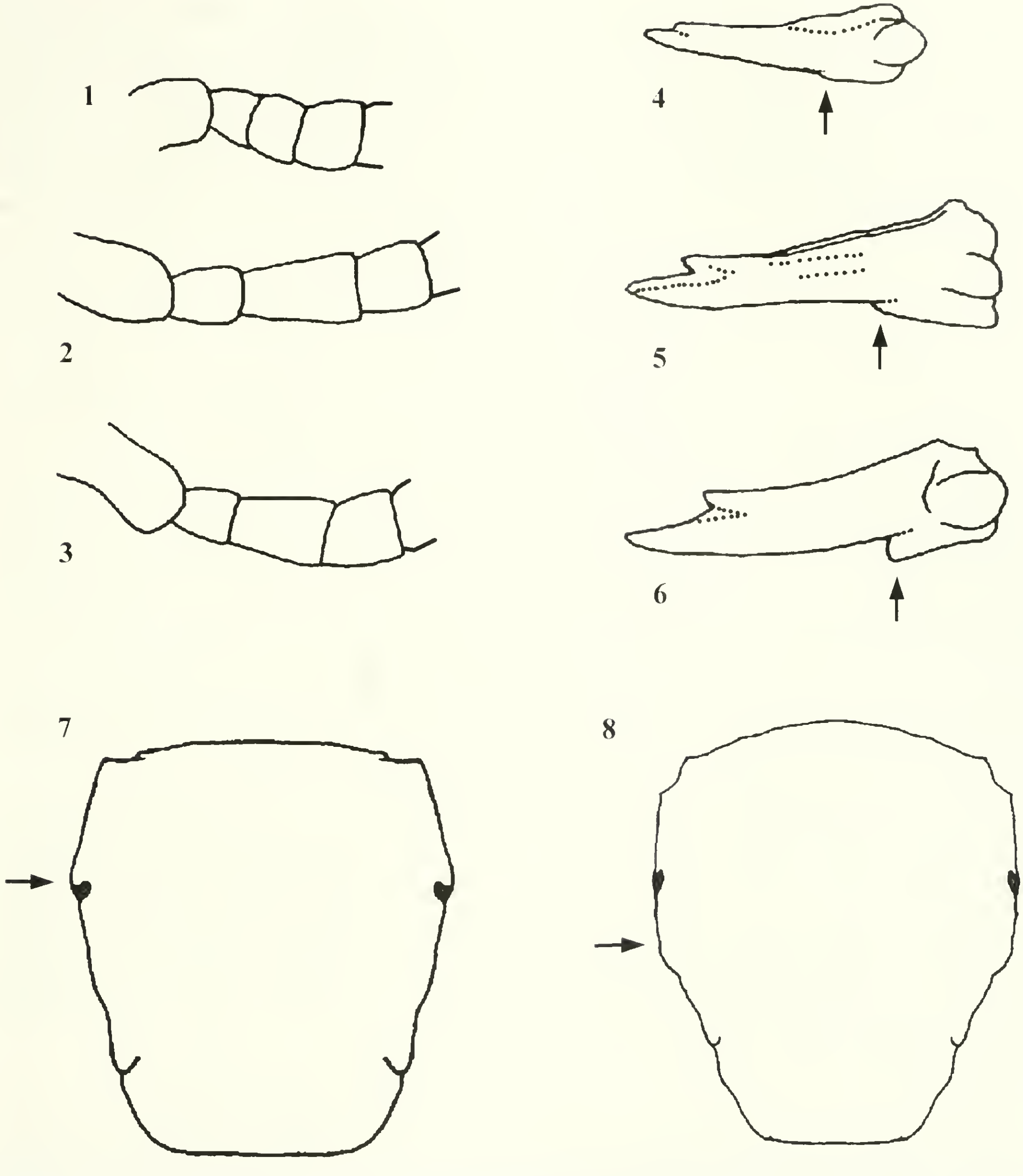
Comments.—One of the males and the female are mounted on the same pin and have an attached label stating that the pair was collected *in copula.* The two males differ from the holotype and paratype by being smaller (5 mm versus 7 mm) and having the integument around the ocelli darkened.

***Stethophotopsis cremauranti* Pitts and Manley, new species**

Female.—*Length:* 9 mm.

Head: Head orangish brown, clothed with sparse erect and decumbent pale golden brachyplumose pubescence. Malar space 0.7× maximum eye width. First flagellomere 1.2× length of pedicel. Second flagellomere slightly shorter than first, 1.1× length of pedicel. Antenna dark brown. Antennal scrobe inconspicuously carinate dorsally. Front and vertex densely punctate. Mandible brown distally.

Mesosoma: Mesosoma, trochanters, and coxae orangish brown. Other segments of legs dark brown. Pubescence of pronotum, mesonotum, and propodeum anteriorly pale golden brown; erect pubescence simple; decumbent pubescence brachyplumose. Pubescence of propodeum anteriorly pale golden and posteriorly white. Pubescence of legs white. Lateral face of prontoum punctate with sparse erect pale golden pubescence. Mesopleuron posterior half punctate with erect pale golden pubescence. Propodeum with posterior lateral half punctate;



Figs. 1–8. 1–3, Apical end of scape and first three flagellomeres of female antenna. 4–6, Mandible of female, dorsal view; arrow indicate ventral emargination. Figs. 7–8, Thorax, dorsal view; arrow indicate widest point. 1, 4, 7, *Stethophotopsis maculata*. 2, 5, 8, *Sphaeropthalma* (*Photopsioides*) *uro*. 3, 6, *Sphaeropthalma* (*Sphaeropthalma*) *pensylvanica*.

anterior half glabrous. Dorsum of mesosoma with coarse punctation.

Metasoma: Dark brown. T1 with long erect white brachyplumose and short plumose pubescence. T1 with apical fringe of white plumose pubescence. T2 felt line 0.3× length of T2. T2 with two round black integumental maculations on anterior fourth with larger and deeper punctation, appearing slightly raised above surrounding disk. Maculations with decumbent and erect brachyplumose pubescence. T2–T5 with white brachyplumose pubescence except dark brown in areas of tergal maculations. T2–

T3 with sparse white plumose apical fringe. Sternites with white brachyplumose pubescence. S2–S3 with sparse white plumose pubescence on lateral apical margin, pubescence simple on median three fourths. S2 with median longitudinal tumid region on anterior fifth.

Material examined.—Holotype ♀, Mexico, Chihuahua, 3 mi east of Parral, 5800′, 30.IV.1953, coll. Creighton (CNCI). Paratype, 1 ♀, Mexico, Chihuahua, 21 mi south of Parral, 5600′, 30.IV.1953, coll. Creighton (CNCI).

Etymology.—From the Latin *cremo* meaning "to burn to ashes" and *auranti* meaning "orange" in reference to the color of the head and thorax.

Comments.—The paratype is only 7.5 mm in length, but the coloration and punctation of both specimens are similar. *Stethophotopsis cremauranti* differs from *S. maculata* in being slightly larger in size. The coloration of the two species is very different. The head and mesosoma of *S. cremauranti* are slightly darker orange than the head and mesosoma of *S. maculata. Stethophotopsis cremauranti,* however, has the metasoma completely dark brown. The metasoma of *S. maculata* is dark brown only in the areas of the tergal maculations. Furthermore, *S. cremauranti* has an inconspicuous carina dorsally on the antennal scrobe, which is totally lacking in specimens of *S. maculata.* Also, the T2 maculations are well developed in *S. maculata* due not only to the fact that there are deep, raised punctures making the maculations appear raised above the surrounding area, but also because there is very thick, black, decumbent pubescence present. In specimens of *S. cremauranti,* neither deep, raised punctation nor thickened pubescence is present.

Sphaeropthalma (*Photopsioides* Schuster)
(Figs. 2, 5, 8, 11, 12)

Type species.—*Agama uro* Blake. Orig. desig.

Female.—*Head:* As wide as thorax. Eyes projecting, subcircular, clearly faceted. Clypeus anterior edge truncate, base tuberculate medially. Antennal scrobes carinate dorsally. Antennal tubercles well developed and subcontiguous. Antenna 12-segmented. First flagellomere length 1.8× length of pedicel (Fig. 2). Mandible with strong internal tooth on distal one-third (Fig. 5). Ventral margin of mandible strongly emarginate at basal one-third (Fig. 5). Gena well developed, without genal carina. Proboscidal furrow triangular, broad, margined by carinae, becoming weak near base of mandibles. Maxillary palpus 6-segmented, labial palpus 4-segmented.

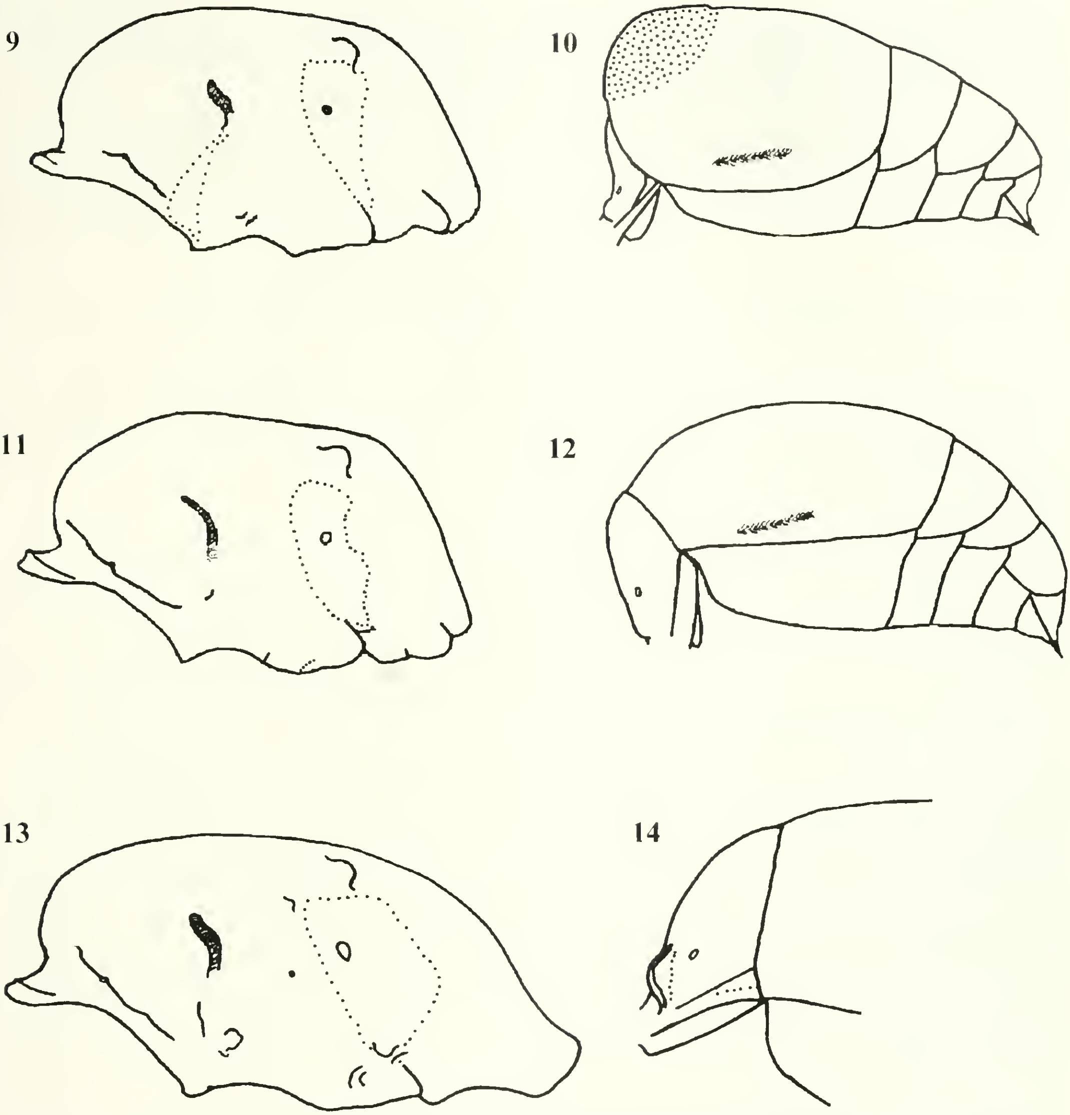
Mesosoma: Pyriform, slightly longer than wide (Fig. 8). Mesosoma widest anteriorly, gradually narrowing just posterior to anterior spiracular tubercles (Fig. 8). Scutellular scale absent (Fig. 8). Propodeum with distinct dorsal and lateral regions (Fig. 11). Lateral face of pronotum narrow and punctate. Mesopleuron punctate. Metapleuron glabrous. Metapleuron separated from mesopleuron by depression. Tibial spurs pectinate.

Metasoma: First segment subsessile with respect to second (Fig. 12). T2 with lateral felt lines (Fig. 12). S2 strongly convex, base prominently raised medially. S2 without lateral felt lines (Fig. 12). T6 with pygidial area undefined. Plumose pubescence present on apical margins of metasomal segments.

Distribution.—Southern Arizona, USA.

Comments.—Since only one species is known, it is difficult to diagnose the generic level characters. Some characters such as the presence or absence of a dorsal carina on the antennal scrobe may not be valid.

Photopsioides is similar to the subgenus *Sphaeropthalma* by the following: presence of plumose pubescence, presence of dorsal carinae on antennal scrobes, first antennal flagellomere 1.8× as long as pedicel (Figs. 2, 3), and absence of lateral carinae that define the pygidium. The females of *Photopsioides* can be distinguished from *Sphaeropthalma* by having a slight tooth on the ventral base of the mandible (Fig. 5) (not



Figs. 9–14. 9–10, *Stethophotopsis maculata*. 11–12, *Sphaeropthalma* (*Photopsioides*) *uro*. 13–14, *Sphaeropthalma* (*Sphaeropthalma*) *pensylvanica*. 9, 11, 13, Thorax, lateral, dotted line indicates impunctate area within. 10, 12, Metasoma, lateral. 14, First metasomal tergite and basal portion of second metasomal tergite, lateral.

strongly developed as in *Sphaeropthalma s.s.* (Fig. 6)), by the length of the propodeum in lateral view being subequal in length to 0.5× the maximum height (Fig. 11) (not ~1× as in *Sphaeropthalma s.s.* (Fig. 13)), having a petiolar attachment that is more clearly petiolate (Fig. 12) than *Sphaeropthalma s.s.* (Fig. 14), and having sparse plumose pubescence on the apical margins of metasomal segments (not having only a median band of dense appressed plumose pubescence on the apical margin of metasomal segment one (for *Sphaeropthalma pensylvanica* (Lepeletier)) or segments one and two and a median propodeal stripe (for *Sphaeropthalma auripilis* (Blake)).

Males of *Photosioides* are similar to those of the subgenus *Sphaeropthalma*. Both have the pygidium and hypopygium short and truncated, lack sternal felt lines, and the cuspis of the genitalia is dilated and covered with plumose tipped setae (Schuster 1958). Males of *Photopsioides* differ from those of the subgenus *Sphaeropthalma* by being nocturnal, weakly sculptured, and having sparse pubescence on the ventral margin of the parameres (Schuster 1958).

Sphaeropthalma (*Photopsioides*) *uro* (Blake)

(Figs. 2, 5, 8, 11, 12)

Female.—*Length:* 9–10 mm.

Head: Head orangish brown, clothed with sparse erect pale white brachyplumose pubescence. Malar space 0.6× maximum eye width. First flagellomere 1.8× length of pedicel (Fig. 2). Second flagellomere length equal to length of pedicel (Fig. 2). Antenna orangish brown. Front and vertex with small dense punctures. Mandible reddish black apically.

Mesosoma: Mesosoma orangish brown. Legs slightly darker than mesosoma. Pubescence of pronotum, mesonotum and metanotum pale golden brown. Propodeum with white brachyplumose pubescence, plumose posteriorly. Humeri angulate. Lateral face of prontum punctate with sparse erect pale white pubescence. Mesopleuron punctate with erect pale white pubescence. Metapleuron glabrous. Propodeum punctate laterally. Dorsum of mesosoma coarsely punctate. Propodeum surface narrowly reticulate posteriorly.

Metasoma: Orangish brown. T3–T6 slightly darker than T1 and T2. T1 with erect brachyplumose pubescence and shorter erect white plumose pubescence. T1 with apical fringe of white plumose pubescence. T2 felt line 0.3× length of T2. T2 with brown erect subplumose pubescence, white on apical margin. T3–T5 with white pubescence. T2–T4 and S2–S5 with dense white plumose apical fringe. S2–S5 with simple white pubescence. T2 surface reticulate anteriorly, coarsely punctate posteriorly. T3–T6 finely punctate. S1 coarsely punctate with white plumose pubescence. S2 with median longitudinal tumid region on anterior fifth, coarsely punctate. S3–S6 finely punctate.

Material examined.—Arizona, Cochise Co., 3 mi north of Portal, 1 ♂ 1 ♀, 3.VIII.1999, coll. J.P. Pitts (JPPC); Cochise Co., 2 mi north of Portal, San Simon Road, 1 ♀, 1.VIII.2000, coll. J.P. Pitts (JPPC); Cochise Co., Portal, 1 ♀, 23.VI.1969, Coll. V. D. Roth (UAIC); Pima County, 8 mi north of Vail, 1 ♀, 30.VIII.1962, coll. F. Werner (UAIC).

Comments.—The specimens differ in size slightly. One specimen is darker beneath the felt lines.

ACKNOWLEDGMENTS

We are indebted to Carl Olsen (UAIC) and John Huber (CNCI) for loan of material. The following institutions are hereby acknowledged for funding (JPP): the CNCI for a CanaColl grant allowing JPP to travel to the CNCI, Ottawa, Canada, in 1999 and the American Museum of Natural History for the Theodore Roosevelt Memorial Fund for travel to the Southwestern Research Station, Portal, Arizona, during 2000. We thank Wade Sherbrooke of the Southwestern Research Station for use of their facilities. We thank Joseph McHugh (University of Georgia), Cecil Smith (University of Georgia), and Theresa Pitts-Singer (University of Georgia) for critically reviewing the manuscript.

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REDESCRIPTION OF TWO SPECIES OF *OMMATIUS* WIEDEMANN, WITH LECTOTYPE AND PARALECTOTYPE DESIGNATIONS FOR *OMMATIUS TENELLUS* VAN DER WULP AND RANGE EXTENSION, AND A REPLACEMENT NAME FOR *OMMATIUS TIBIALIS* RICARDO (DIPTERA: ASILIDAE)

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Abstract.—The type series of *Ommatius tenellus* van der Wulp and *O. tibialis* Ricardo were examined and redescriptions are given for both species. A lectotype and paralectotypes are designated for *O. tenellus,* new records extend the range of the species across northern Africa, and illustrations of the terminalia are presented. ***Ommatius abdelkuriensis* Scarbrough (new name)** is proposed as a replacement name for *O. tibialis.*

Key Words: Diptera, Asilidae, Afrotropical, *Ommatius,* redescriptions

As a part of my revisionary studies of the African species of the tribe Ommatiini (Scarbrough and Marascia 1996, 2000), this paper clarifies and stabilizes the identities of *Ommatius tenellus* van der Wuilp (1899) and *O. tibialis* Ricardo (1903). Both species were originally reported from present day Yemen, *O. tenellus* from two sites on the mainland and *O. tibialis* from the island of Socotra. Yet specimens labeled incorrectly as *O. tenellus* are frequently found in museums. Furthermore, the species was reported from southern India (Joseph and Parui 1998) and was listed in the recent Oriental and Afrotropical catalogues (Oldroyd 1975). Until recently these reports have not been verified (Scarbrough and Hill 2000). Material examined herein extends the range of *O. tenellus* westward from Yemen and Israel across the Sahara desert to Senegal. However, *O. tenellus* is not yet found east of Yemen. A new name for *Ommatius tibialis,* a junior homoym of *O. tibialis* Say (1823), is proposed.

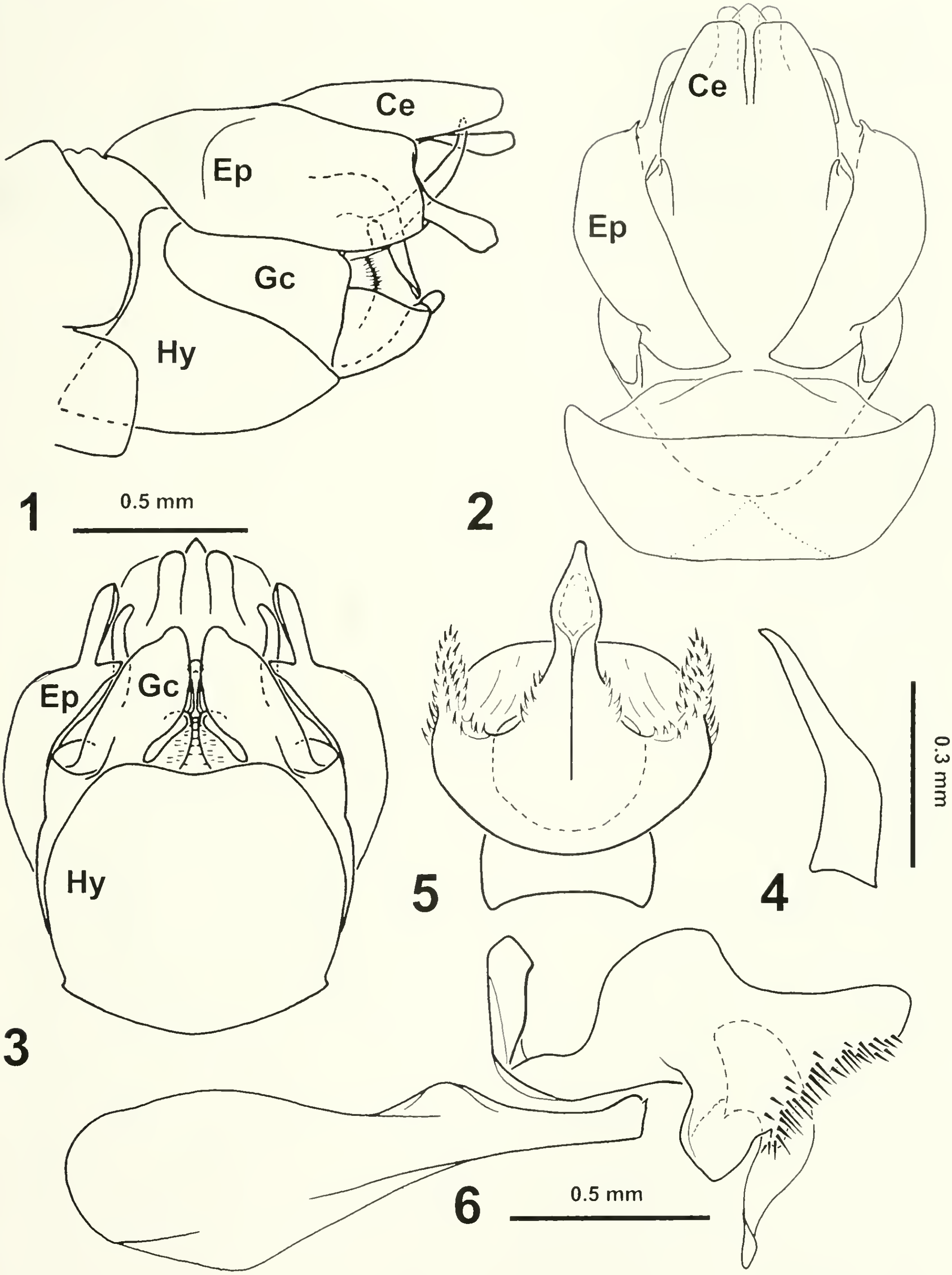
METHODS

Terminology, measurements, and ratios follow that of previous work (Scarbrough and Marascia 1996, 2000; Scarbrough and Hill 2000). Museum acronyms follow Arnett et al. (1993). Data labels associated with each syntype are numbered (1), (2), (3), etc., indicating the sequence of labels on the pin from top to bottom. Brackets provide further information not present on type labels.

Ommatius tenellus van der Wulp
(Figs. 1–10)

Ommatius tenellus Wulp 1899: 97. Type locality: Arabia [= Yemen], Leiji & Haithalhim; 6 syntypes OXUM, BMNH; Oldroyd 1975: 135 (catalogue); 1980: 348 (catalogue).

Redescription.—*Male:* Black body, gray to yellowish-gray tomentose, pale yellow to whitish vestiture and yellow legs. Length, body 7.0–8.0 mm; wing 5.3–5.7 mm. *Head:* Face scattered short setae dorsally,



Figs. 1–6. *Ommatius tenellus*, male terminalia. 1–3, Lateral, dorsal, and ventral views. 4, Gonostylus. 5–6, Aedeagus, dorsal and lateral views. Abbreviations: Ce = cercus, Ep = epandrium, Gc = gonocoxite, Hy = hypandrium.

abundant, longer setae ventrally; 2–4 thick, ventromedial bristles and 2 rows of long, thin bristles present; FHWR 1.0:6.5–1.0: 6.6. Flagellum slightly longer than scape; FWLR 1.0:1.1. Occiput with 10–12 short, thick, postocular bristles extending to midlateral margin of eye, none proclinate.

Thorax: Pronotum gray tomentose, white setose; bristles white. Mesonotum mostly dense tomentose, glabrous median stripe, often divided anteriorly with narrow line of tomentum, and 2 lateral spots present; setae sparse dorsally, 2 dorsocentral bristles present, about as thick and as long as scutellar bristles; anterior notopleural bristle black. Scutellum without a subapical groove, 2 marginal bristles and sparse thin, setae present. Anepimeral bristle present. Halter yellow.

Wing: Hyaline, surface slightly corrugated. Dense microtrichia present narrowly along apical margin. Cell r1 long, ending just before costal vein, petiole extremely short. Cell r4 with base just beyond apex of cell d, sides beyond base narrow, parallel. Crossvein r-m just before to just beyond middle of cell d, slightly shorter than basal petiole of cell m3. Base of cell m_1 wide, WR 1.0:2.0:1.9. Cell m3 with apex near base of cell m1.

Leg: Fore and middle coxae with stout bristles. Fore and middle trochanters yellowish brown, hind trochanter brown. Femora largely yellow, brown variable anteriorly, ranging from light brownish yellow basally, light to brown streaks, to extensively brown, narrow apex of middle and hind femora brown in type series only; bristles yellow. Fore femur with 1 stout, ventrobasal bristle; middle femur with 1 anteroventral and 3–4 posteroventral bristles. Hind femur with 5, wide spaced, anteroventral bristles; 5 posteroventral bristles present on basal third only; HFWLR 1.0:5.5. Tibiae yellow, narrow apex of middle tibia usually and hind tibia always brown. Basal tarsomere of all tarsi largely yellow, narrow apex and remaining tarsomeres of each tarsus brown; all tarsi with few to several yellow bristles.

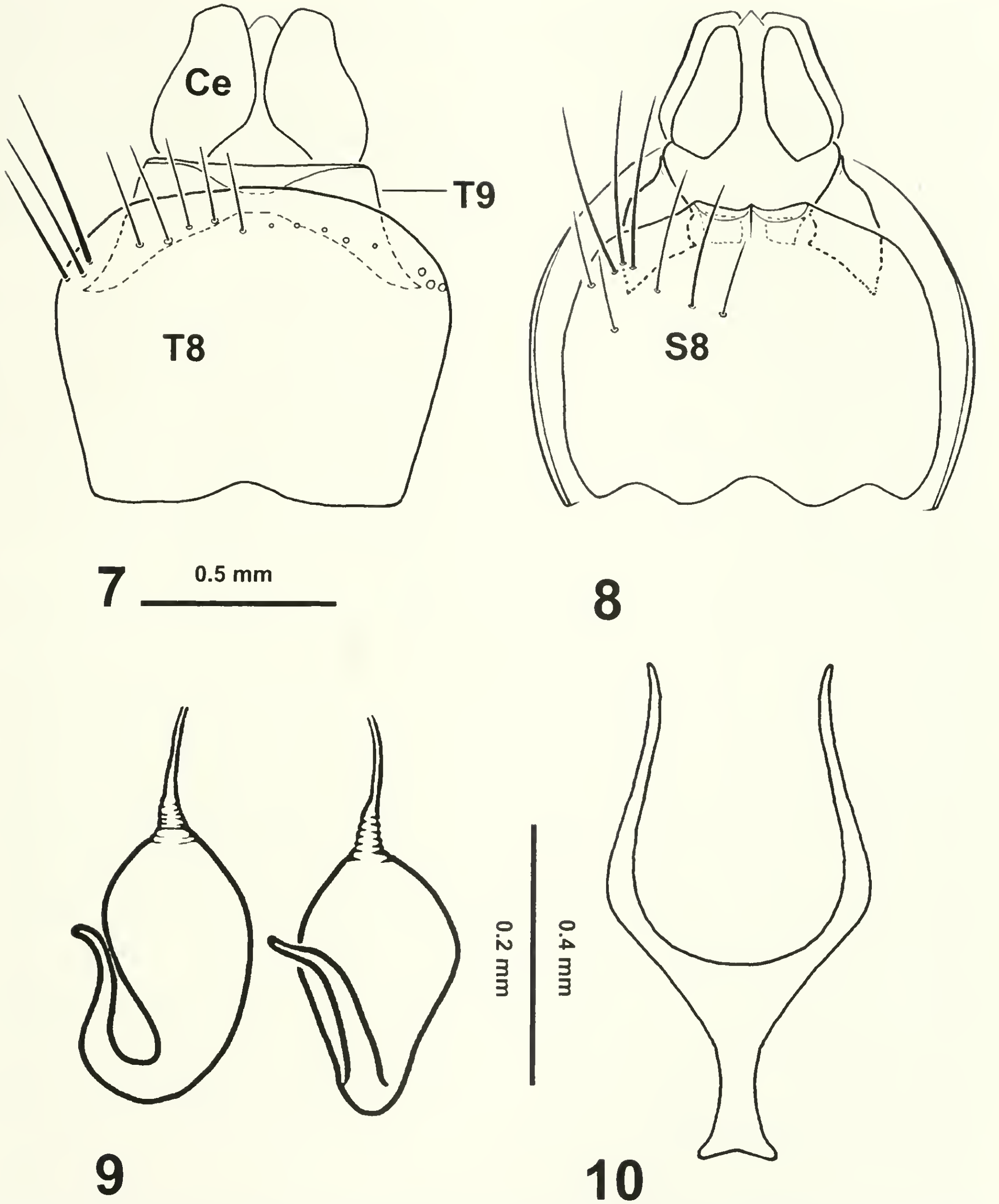
Abdomen: Slightly clavate apically. Ground color mostly black to dark brown, apical margin of most segments lighter, apical 1 to 2 segments lighter, grading to red or yellow; tomentum mostly gray, light brownish-yellow to reddish-brown spot with brown setae on most tergites dorsally; setae mostly yellow.

Terminalia: Brownish yellow to yellow. Epandrium wide basally, abruptly narrowed and digitate apically. Aedeagus with sheath concave in lateral view, apically with abundant setae, thin in lateral view, thicker in dorsal view. Gonocoxal process, unusually long and wide, triangular. Hypandrium about as long as wide, slightly emarginated apically.

Female: Differs from male as follows. Body 8.3 mm; wing 7.7 mm; FHWR 1.0: 5.7; FWLR 1.0:1.0; m1WR 1.0:2.5:2.5; HFWLR 1.0:49. *Thorax:* Glabrous stripes and/or spots, narrow/small, sometimes absent. *Leg:* Hind femur with only long, thin posteroventral setae on basal third. *Abdomen:* Apical 2–3 segments reddish yellow to yellow. Tergite 9 long laterally, broadly emarginate posteriorly. Spermatheca wide basally, strongly narrowed and recurved apically. Genital fork slender.

Specimens examined.—ALGERIA: 1 ♂, Hoggar Tit Oued Anded, 21.VIII.1987, Tanurix A. Pauly Réc., (MRAC). CHAD: 3 ♀, Korrom, 800 m, 30 Aout 1959, TIBESTI, Piedmont, SW Romeau de Mire, (MNHN); 1 ♂, Tchad: N'Gouri, distr. De Kanem VIII-1958, P. Renaud, (MRAC). ISRAEL: 1 ♀, W. Watir, 5.III.1975, A. Freidberg, (TAUI); 1 ♀, Eliot, 6.IX.1974, A. Freidberg, (TAUI). SUDAN: 1 ♀, Khartoun, (NMSA); 1 ♂, Soudan Kartoun, 21–26.VII.1927, W. Wismeijer, (RMNH). SENEGAL: 2 ♂, 2 ♀, 25–25 km Sud de Richard Toll piege malaise, 14.8.1989, Leg H. v. d. Volk c.s. (NMSA). YEMEN: Syntypes, 1 ♂, 4 ♀, 1 sex ?, (OXUM); syntype, 1 ♂, (BMNH).

Distribution.—North Africa, Israel, and



Figs. 7–10. *Ommatius tenellus*, female terminalia. 7–8, Dorsal and ventral views. 9, Spermatheca. 10, Genital fork. Abbreviations: Ce = cercus, T8 = tergite 8, T9 = tergite 9, S8 = sternite 8.

Yemen. Active in March and July through September.

Remarks.—This desert species is recognized by its small size (7–8 mm); black body with gray tomentum and white to yellowish vestiture; clavate abdomen; presence of ventral bristles on the femora and coxae; black glabrous stripe and two lateral spots per side on the mesonotum; and characters of the terminalia (Figs. 1–10). Superficially, it is similar to *O. aegyptius* (Scarbrough and Marascia 2000) but differs in the much smaller size, presence of marginal scutellar bristles, a row of anteroventral bristles below the hind femur, and the combined characters of the wing and terminalia.

Van der Wulp (1899) lists only a male and female following the species name but additional comments following the description suggest other specimens were in his type series; that is 'Fairly common. Several specimens from Haithalhim and Lahej.' A search of collections in the Netherlands and England produced 6 specimens with Wulp's labels [see below]. As a holotype was not designated, all of the specimens must be considered syntypes. To fix the current interpretation of this name and to ensure stability, I here designate the male in OXUM lectotype and the five remaining specimens in OXUM and BMNH as paralectotypes. Label data and condition of the lectotype and paralectotypes follow. Lectotype ♂, by present designation, (1) [red lined label with the word] 'Type' (2) [a note with] 'v. d. Wulp, Trans. ENT. Soc. 1899, pages 97–8, pl. iii, figs. 14–15,' (3) [data label with] S. W. Arabia/19 m. Fr. Aden/Haithalhim/capt. Mar. 25.95/pres. 1899 by J. W. Yerbury; (4) [data label with] 1899 [above] 7751, (5) Hope Ent. Type # 280 4/6, (OXUM) [excellent condition]. Paralectotypes, by present designation, 1 ♂, (1) [data label] 'Type', (2) Ommatius tenellus v. d. Wulp, (30 Lahej, Arabia/9.5.95, [good condition], (BMNH); 4 ♀, 1 (sex?), same labels as lectotype except: (4) 1899 [above] 7753, (5) Hope Ent. Type # 280 1/6 [excellent condition]; 1899 [above] 7750, Hope Ent. Type # 280 2/6 [poor condition with abdomen glued to round label, entire fore tarsus and apical tarsomeres of remaining tarsi absent; (4) 1899 [above] 7755, (5) Hope Ent. Type # 280 3/6 [excellent condition]; (4) 1899 [above] 7751, (5) Hope Ent. Type # 280 5/6 [excellent condition]; (4) 1899 [above] 7754, (5) Hope Ent.Type # 280 6/6) [poor condition; abdomen, wings and left hind leg absent], (OXUM).

Ommatius abdelkuriensis Scarbrough, new name

Ommatius tibialis Ricardo 1903: 375. Type locality: Sokotra, Ab-dul-Kuri; plate xxii, figs. 10, 10a (primary homonym of *Ommatius tibialis* Say 1823: 49); ♀ holotype, BMNH; Oldroyd, 1980: 348 (catalogue).

Redescription.—*Female:* Blackish. Body 9.7 mm; wing, 7.3 mm. *Head:* Gray tomentose with mostly yellow setae. Face evenly contoured, slightly protruding beginning just below antenna; setae, sparse dorsally, more abundant, longer ventrally; 2 vertical rows of 4 black bristles present; FHWR 1.0: 5.0. Frons with 5–6 short, thin, white setae laterally. Antenna yellowish-brown tomentose, blackish setose, pedicel ventrally with 1 long, thick seta, at least twice as long as remaining setae; FWLR 1.0:1.3. Ocellar tubercle with 2 long, black setae posteriorly, 2–3 short, yellow setae anteriorly. Occiput whitish setose, postocular bristles mostly yellow, 4–5 dorsal bristles thin and brown, longest strongly proclinate.

Thorax: Mesonotum dorsally subshiny with sparse grayish tomentum, tomentum dense laterally and posteriorly; setae sparse, whitish; 4 lateral bristles black; dorsocentral setae thin, mostly short, 4 longer setae posteriorly, about two-thirds as long as postalar bristle, 1 black seta present. Scutellum grayish tomentose, with numerous, long setae, setae about half as long as 2 marginal bristles; marginal bristles yellow, about as long as and thick as posterior dorsocentral setae; preapical groove absent. Pleuron grayish tomentose, white setose; anepimeral bristle absent. Halter base yellow, knob reddish.

Wing: Hyaline, dense microtrichia present apically. Crossvein r-m at apical third of cell d. Base of cell r4 beyond apex of cell d; base of vein M_1 strongly angled forward, cell m1 wide apically; m1WR 1.0: 3.4:2.8.

Leg: Fore and middle coxae grayish tomentose, whitish setose; hind coxa mostly brownish tomentose. Femora shiny black, mostly or all whitish setose, ventral setae long. Fore femur with a row of long, thin setae, basal 3–4 setae about 1.5 times as long as greatest width of fore femur. Middle femur with anterior bristles black; anteroventral bristles absent, setae short, posteroventral setae twice as long as anteroventral setae. Hind femur anteriorly with 1 black and 1 yellowish bristle; all ventral vestiture yellowish, anteroventral setae mostly short and thin, 2–3 medially contrastingly thicker than most; posteroventral setae much longer and thinner than anteroventral setae, medially 3–4 thickest and longest; HFWLR 1.0: 6.2. Tibiae yellow with narrow apex brown; vestiture mostly blackish, each tibia with 2–3 thin yellow bristles; apical third of hind tibia anteriorly brown to brownish yellow. Tarsi brown except basal tarsomere of fore and middle tarsi lighter, reddish brown; bristles black.

Abdomen: Black, mostly gray tomentose, pale yellow setose; tergites 1–6 dorsally reddish-brown tomentose, apical 3–4 tergites with black setae; apex of most tergites with black, thin setae medially, thicker, longer, pale yellowish bristles laterally; tergites 7 and 8 sparse gray tomentose, apical bristles thicker than preceding tergites; sternite 6 with a black bristle in apical corner, sternite 7 with 6–7 bristles. Sternite 8 flat, apical margin broadly produced medially; 4 prominent black bristles and a long, low, median carina present, carina extends posteriorly from apical margin to posterior most bristle. Cercus narrow, twice as long as wide.

Type material.—Holotype ♀, Sokotra/Abd-el-Kuri/22.2.1899/W. R. O. Grant/1916–1975; Holotype [round label]; Ommatius tibialis Ricardo/det J. E. Chainey, 1986, [BMNH].

Distribution.—Known only from the Island of Socotra, Yemen. Active in February.

Remarks.—This species is recognized by the blackish body; shiny black femora, and gray tomentum and mostly light vestiture of the body; thinly tomentose mesonotum; abundant long setae on the scutellum and below the femora; and strongly produced apical margin and four prominent bristles on sternite 8. It is further characterized by the presence of thin dorsocentral setae and scutellar bristles, both yellow, and in the absence of an anepimeral bristle.

Unknown to Ricardo, the binominal, *Ommatius tibialis*, had been used earlier for a North American species (Say 1823, Bullington and Lavigne 1984). Here I propose a replacement name, *Ommatius abdelkuriensis* Scarbrough, in reference to the type locality.

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LEPTOYPHA ELLIPTICA MCATEE AND *L. ILICIS* DRAKE (HEMIPTERA: TINGIDAE): NEW DISTRIBUTION RECORDS OF SELDOM-COLLECTED LACE BUGS, WITH CLARIFICATION OF HOST-PLANT RELATIONSHIPS

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Abstract.—Previously published information on the host plant of *Leptoypha elliptica* McAtee and *L. ilicis* Drake—holly, *Ilex* sp. (Aquifoliaceae)—is based on misidentification of the actual host. Both lace bugs specialize on shrubs of the genus *Forestiera* (Oleaceae) and, thus, develop on oleaceous plants like nearly all other species of *Leptoypha.* In addition to a clarification of host associations for these little-known tingids, new distribution records and biological notes are provided.

Key Words: insect distribution, *Forestiera* spp., host-plant relationships

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Holly, *Ilex* sp. (Aquifoliaceae), is the only recorded host plant of the lace bug *Leptoypha ilicis* Drake; the specific epithet reflects this tingid's collection on a shrub presumed to be a species of *Ilex.* A second lace bug, *L. elliptica* McAtee, also was taken on "*Ilex*" sp. at the type locality of *L. ilicis* in Georgia (Drake 1919, McAtee 1919). My 1985 collection of both species on "holly" in Tennessee supported an aberrant host association in a genus that otherwise develops on members of the Oleaceae.

My eventual discovery that the host plant in Tennessee was not a holly but an oleaceous shrub, glade privet (*Forestiera ligustrina* [Michaux] Poiret), suggested that the "*Ilex*" in Georgia had been similarly misidentified in 1917 when *L. ilicis* was first collected. A 1991 trip to Stone Mountain, Ga., the type locality of *L. ilicis,* plus additional fieldwork, confirmed my hypothesis that *L. ilicis,* and the often syntopic *L. elliptica,* develop on species of *Forestiera.*

Here, in addition to clarifying host relationships for both tingids, I provide new distribution records and biological notes. Voucher material has been deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C.

Leptoypha elliptica McAtee
(Fig. 1)

Described from "Texas" without host-plant data by McAtee (1917), this tingid has since been reported from Florida and Georgia (Drake 1918), Indiana (Blatchley 1926), Missouri (Froeschner 1944), and Tennessee (Drake and Ruhoff 1965). It was included in a list of the Tingidae of Oklahoma (Drew and Arnold 1977) because the recorded distribution suggested its eventual collection in that state. Drake's (1919) record of holly as the host on Stone Mountain, Ga., was based on the miridologist H.H. Knight's apparent misidentification of *F. ligustrina.* The Texas record from "swamp bush" (Drake 1918) almost certainly refers to swamp privet (*F. acuminata;* see Discussion).

New collection records (* = new state

Figs. 1–2. 1, *Leptophya elliptica*. 2, *L. ilicis*.

record).—GEORGIA: DeKalb Co., Stone Mountain, southwestern slope ca. 400 m, 3 May 1991. *ILLINOIS: Johnson Co., Belknap-Karnak Rd., SW. of Belknap, 8 June 1991. INDIANA: Knox Co., co. rd. 1300-S nr. Swan Pond, 13 km NW. of Decker, 7 June 1991. *KENTUCKY: Ballard Co., Rt. 51 NE. of Wickcliffe, 9 June 1991. MISSOURI: Mississippi Co., Birds Point, 9 June 1991 (nymphal exuviae only); New Madrid Co., New Madrid, 9 June 1991. *SOUTH CAROLINA: Aiken Co., Savannah River Bluffs Heritage Preserve, ca. 5 km NW. of North Augusta, 18 April 1992 (nymphs only, reared to adulthood), 12 May 2001. TENNESSEE: Davidson Co., Couchville Glade, NNE. of LaVergne, 10 June 1997; Long Hunter State Recreation Area, 29 May 1985, 19 April 1991; Mt. View Rd. Cedar Glade, NNW. of LaVergne, 12 June 1997, 13 May 2000; Dyer Co., Rt. 78, 1 km N. of Obion River, 1.5 km S. of Bogota, 2 June 1985, 9 June 1991; Rutherford Co., Flat Rock Cedar Glades & Barrens State Natural Area, 8.5 km NNE. of Murfreesboro, 11 June 1997, 14 May 2000; Sunnybell Glade, SW. of Mona, 12 June 1997; Wilson Co., Lane Farm Glade, NNW. of Silver Hill, 10 June 1997.

Host plants.—*Forestiera ligustrina* was the host for collections in Georgia and South Carolina, plus Davidson, Rutherford, and Wilson counties in Tennessee. In other cases the host was *F. acuminata* (Michaux) Poiret.

Leptoypha ilicis Drake
(Fig. 2)

Drake (1919) described *L. ilicis* from Stone Mountain, Ga., mentioning its similarity to *L. mutica* (Say). The type series was collected in June 1917 on "holly" but, as noted above, this supposed host association is erroneous. Additional records of this species have been few: Florida (Blatchley 1926, 1928), Oklahoma, and Texas (Hurd 1946). Hurd's (1946) New Hampshire record, which Bailey (1951) said required verification, has been excluded from subsequent catalogs of the family (Drake and Ruhoff 1965, Froeschner 1988).

New collection records (* = new state record; unless cited completely, dates and specific localities are the same as those provided for *L. elliptica*).—GEORGIA: Columbia Co., Heggies Rock, E. of Appling, 5 April 1997; DeKalb Co., Pleasant Hill outcrop, N. of Lithonia, 7 July 1996, and Stone Mountain. *ILLINOIS: Johnson Co. *INDIANA: Knox Co. *KENTUCKY: Ballard Co. *MISSOURI: Mississippi and New Madrid counties. *SOUTH CAROLINA: Aiken Co. (12 May 2001 only). *TENNESSEE: Davidson, Dyer, Rutherford, and Wilson counties.

Host plants.—Because this species generally co-occurred with *L. elliptica*, its hosts are the same as listed under that species: *F. ligustrina* (Georgia and South Carolina, plus Davidson, Rutherford, and Wilson counties in Tennessee) and *F. acuminata* (all other localities).

DISCUSSION

Froeschner (1944) reported adults and nymphs of *L. elliptica* from Missouri but did not mention a host plant. The actual host relationships have gone unrecorded for both *L. elliptica* and *L. ilicis* since the original descriptions of these lace bugs appeared more than 80 years ago. My recent fieldwork now demonstrates that the specific epithet *L. ilicis* is a misnomer based on misidentification of the oleaceous shrub *F. ligustrina* at the type locality. Even this lace bug's other known host, *F. acuminata*, can be confused with holly (Stephens 1973). Both *L. elliptica* and *L. ilicis* specialize on species of *Forestiera*, and they often are syntopic. The two species are easily distinguished; the adults of *L. elliptica* are broadly elliptical, whereas those of *L. ilicis* are narrowly oblong and subparallel (see Figs. 1, 2). The collection of *L. ilicis* from *Vaccinium* sp. (Blatchley 1928) and in "palm jungle sweepings" (Hurd 1946) should be considered accidental occurrences.

All records of these lace bugs fall within the known distributions of their principal hosts, *F. acuminata* and *F. ligustrina*. Although these plants do not range throughout the eastern United States (they do not occur north or east of central Kentucky and Tennessee and southern South Carolina), they are the most widely distributed members of this small New World genus [ca. 15 spp. (Everett 1981)]. That most entomologists are unfamiliar with these inconspicuous plants likely has contributed to the scarcity of both lace bugs in collections. Neither tingid was taken during surveys of the lace bugs of Georgia (Beshear et al. 1976, Beshear 1981) and Oklahoma (Drew and Arnold 1977), despite historical records of both species from Georgia and of *L. ilicis* from Oklahoma (Drake and Ruhoff 1965).

Forestiera acuminata occurs sporadically along stream and river banks and in bottomland swamps and sloughs from southern Indiana and central Illinois, west to southeastern Kansas, eastern Oklahoma, and Texas, and eastward to southern South Carolina, Georgia, and Florida (Little 1977, 1980; Godfrey 1988; Gleason and Cronquist 1991). This weak, leaning, straggly, and shade-tolerant shrub or small tree often grows under larger trees (Deam 1932, Brown and Kirkman 1990). Most abundant in Arkansas, Missouri, and Texas, swamp privet generally attains its largest size in Louisiana (Sargent 1922). This likely was the plant on which Froeschner (1944) found nymphs of *L. elliptica* in Missouri.

Forestiera ligustrina, a deciduous shrub of limestone outcrops and sandy or rocky soil, has a more restricted range than *F. acuminata*. Glade privet is found irregularly from central Kentucky and Tennessee to eastern Texas, southern South Carolina, southwestern Georgia, southern Alabama, and northern Florida (Godfrey 1988, Gleason and Cronquist 1991). It is a characteristic plant of shrub thickets adjacent to most eastern limestone (cedar) glades (e.g., Meyer 1937, Quarterman et al. 1993, Baskin et al. 1995, Baskin and Baskin 1999).

Both lace bugs, like other members of

the genus, are mesophyll feeders; they colonize lower leaf surfaces of *Forestiera* species and cause chlorosis on upper surfaces. Foliar chlorosis usually is light and patchily distributed on host plants. Assuming that adults overwinter, which is typical of other *Leptoypha* species (Mead 1975, Sheeley and Yonke 1977), they become active in early spring. In the present study, late instars of *L. elliptica* were observed in mid-April in Tennessee and South Carolina. The collection of fifth instars of *L. elliptica* in Tennessee in late May and of *L. ilicis* in Georgia in early July likely represented a second generation. Other *Leptoypha* species, such as *L. mutica* and *L. costata* Parshley, are bivoltine or trivoltine (Dickerson and Weiss 1916, Sheeley and Yonke 1977).

In addition to the need to clarify details of their life histories, other biological aspects of these lace bugs warrant attention. Do *L. elliptica* and *L. ilicis* use other *Forestiera* species as hosts? Does the ash-feeding *L. mutica* include *F. acuminata* in its host range, as suggested by its collection on this plant in Texas (Drake 1918), or was the presence of adults on swamp privet strictly accidental? Two apparent problems that were suggested by Mead (1975)—the taxonomic status of *L. ilicis* and puzzling degree of intraspecific variation in *L. mutica*—will be addressed in a forthcoming review of *Leptoypha* by Thomas J. Henry.

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TAXONOMIC NOTES ON STRONGYLOGASTERINI (HYMENOPTERA: TENTHREDINIDAE)

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Abstract.—The western Palaearctic members of the *Strongylogaster multifasciata* group, *S. multifasciata* (Geoffroy 1785) and *S. xanthocera* (Stephens 1835), are keyed, and the status of the included nominal taxa is discussed in view of taxonomical and zoogeographical aspects. Lectotypes are designated for *Strongylogaster desbrochersi* Konow 1892 and *S. desbrochersi* var. *lepticus* Konow 1902, which are **new synonyms** of *S. xanthocera* (Stephens 1835). *Strongylogaster lineata cypria* Benson 1954 is a **new synonym** of *S. multifasciata.* The striking morphological variability among West Palaearctic *S. xanthocera* is caused by the polycentric, both Mediterranean and Eurosiberian, origin of the population. *Hemitaxonus* Ashmead 1898 is proposed as a **new synonym** of *Thrinax* Konow 1885, and 22 of 23 species involved are **new combinations** with *Thrinax.*

Key Words: *Strongylogaster, Hemitaxonus, Thrinax,* Selandriinae

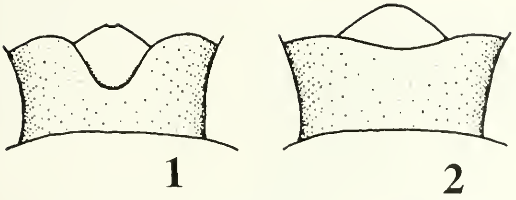
Strongylogaster, a genus of Selandriinae (Tenthredinidae), is represented in the Holarctic region by some 40 species. The larvae are external feeders on ferns. The members of the *S. multifasciata*-group share the distally widened and elongate valvulae 3 of the ovipositor sheath as an apomorphy. Naito (1996) considered six species of this group, two of which, *S. multifasciata* (Geoffroy) and *S. xanthocera* (Stephens), are distributed also in the western Palaearctic. In Europe and northern Africa, adults and larvae of these species sometimes occur numerously on the fronds of the fern named bracken (*Pteridium aquilinum* (L.) Kuhn). This fern, a cosmopolitan pest of pastures, is poisonous to grazers and often harmful to the autochthonous plant cover. It is one, in the Mediterranean possibly the main, larval host of *S. multifasciata* and *S. xanthocera* (see Taeger et al. 1998 for list of hosts).

Throughout the Mediterranean area *S. multifasciata* and *S. xanthocera* seem to produce local forms, and several of them have been named in the past. The present taxonomic results partly contradict Naito's (1996) concept. A key for the *S. multifasciata*-group in the West Palaearctic realm is presented because the published keys (Naito 1996, Blank 1998) are not appropriate for the identification of males and of North African specimens. Zoogeographical aspects are discussed to construe morphological variability.

The second part of this work treats the proper use of the name *Thrinax,* which was so far applied either for a subdivision of *Strongylogaster* or for a separate genus close to *Strongylogaster.*

MATERIAL AND METHODS

The following abbreviations are used for museum collections: DEI = Deutsches Entomologisches Institut, Eberswalde, Germany; MCSN = Museo Civico de Storia



Figs. 1–2. Female hypopygium. 1, *Strongylogaster multifasciata*. 2, *S. xanthocera*.

Naturale "Giacomo Doria", Genoa, Italy; MZLU = Museum of Zoology, Lund University, Sweden; NHM = The Natural History Museum, London, Great Britain; ZSM = Zoologische Staatssammlung, München, Germany.

Before dissection, the male genitalia were treated with 3% potassium hydroxide solution for 6–8 hours at ca 50°C to dissolve tissue from chitinous structures, and then rinsed with water. The dissected penis valve was mounted in glycerine for photographing. Digital photographs were taken with a Olympus C-3030 camera and processed with PhotoImpact 4.2 and CorelDRAW 9. In the list of *Thrinax* species, the occurrence of each species in a zoogeographical region is indicated by [WP] for West Palaearctic, [EP] for East Palaearctic, [N] for Nearctic, and [O] for Oriental.

KEY TO WESTERN PALAEARCTIC SPECIES OF THE *STRONGYLOGASTER MULTIFASCIATA* GROUP

1. Female 2
– Male 3
2(1). Appendix of hypopygium hardly protruding beyond distal margin of hypopygium, basally with a deep depression confined by a distinct raised edge (Fig. 1). Pterostigma usually dark brown anteriorly and pale brown posteriorly. Antenna black, usually scape, pedicel and ventral side of antennomere 3 red .... *Strongylogaster multifasciata* (Geoffroy 1785)
– Appendix of hypopygium distinctly protruding beyond distal margin of hypopygium, without basal depression or distinct edge (Fig. 2). In European specimens, usually antennomeres 1–4(–9) red and pterostigma unicolorous pale, in North African specimens antenna mostly black and pterostigma dark brown .... *Strongylogaster xanthocera* (Stephens 1835)
3(1). Valviceps 1.85–2.05 times longer than wide, dorsal and ventral edge almost straight, distally with an almost straight dorso-distal and ventro-distal outline, medial sclerotization clearly extending up to distal edge of valviceps (Figs. 3–4). Pterostigma usually anteriorly dark brown and posteriorly pale brown. Fore and hind coxae pale except for a narrow line along base. Abdominal segments 3–9 (always?) without black pattern .... *Strongylogaster multifasciata* (Geoffroy 1785)
– Valviceps 1.55–1.70 times longer than wide, ventral edge sinuate, distal edge evenly rounded, medial sclerotization distally fading and not clearly extending up to distal edge of valviceps (Figs. 5–8). Pterostigma unicolorous brown to piceous, seldom bicolorous. Fore coxa with black line along base about as wide as ocellar diameter, hind coxa predominantly black at least laterally. Abdominal segments 4–9 red, in central and northern European specimens, anteriorly more or less black on segments 4–9 .... *Strongylogaster xanthocera* (Stephens 1835)

Strongylogaster Dahlbom 1835

Strongylogaster Dahlbom 1835: 4, 13. Type species: *Tenthredo multifasciata* Geoffroy 1785, subsequent designation under the plenary power (ICZN 2000: Opinion 1953; see Blank et al. 1999)

Pseudotaxonus A. Costa 1894: 157. Type species: *Tenthredo* (*Allantus*) *filicis* Klug 1817, by monotypy. Synonymy by Ross (1937)

Polystichophagus Ashmead 1898: 310. Type species: *Tenthredo* (*Allantus*) *filicis* Klug 1817, by monotypy. Synonymy by Enslin (1913)

Prototaxonus Rohwer 1910c: 49. Type species: *Prototaxonus typicus* Rohwer 1910 [= *Strongylogaster tibialis* Cresson 1880], by original designation. Synonymy by Ross (1937)

Thrinax auct. nec Konow 1885; = *Strongylogaster* subgen. *Thrinax* auct.

Strongylogaster multifasciata (Geoffroy 1785)

(Figs. 1, 3, 4)

Tenthredo spec. Geoffroy 1762: 278, Nr. 14, ♀.

Tenthredo multi-fasciata [recte: *multifas-*

ciata] Geoffroy *in* Fourcroy 1785: 368, Nr. 14, ♀, type locality: France, Paris.

Tenthredo lineata Christ 1791: 450, ♀, type locality: ?; = *Strongylogaster lineata* (Christ 1791). Synonymy by Blank (1998).

Tenthredo alternans Serville 1823: 17, ♀, type locality: France, environs of Paris. Synonymy by Dalla Torre (1894).

Tenthredo alternans Lepeletier 1823: 73, ♀, type locality: France, environs of Paris. Synonymy by Dalla Torre (1894).

Tenthredo (*Allantus*) *linearis* Klug 1817: 217–218, ♂, type locality: Austria, Carinthia, preoccupied in *Tenthredo* by Schrank 1781: 343. Synonymy by Hartig (1837) and Dalla Torre (1894).

Strongylogaster cretensis Konow, 1887: 26, ♀ ♂, type locality: Greece, Crete. Synonymy by Naito (1996).

Strongylogaster lineata cypria Benson 1954: 276, ♀, type locality: Cyprus, near Platania Forest Station. **New synonym.**

Tenthredo cingulata auct. nec Fabricius 1793. See Blank et al. (1999).

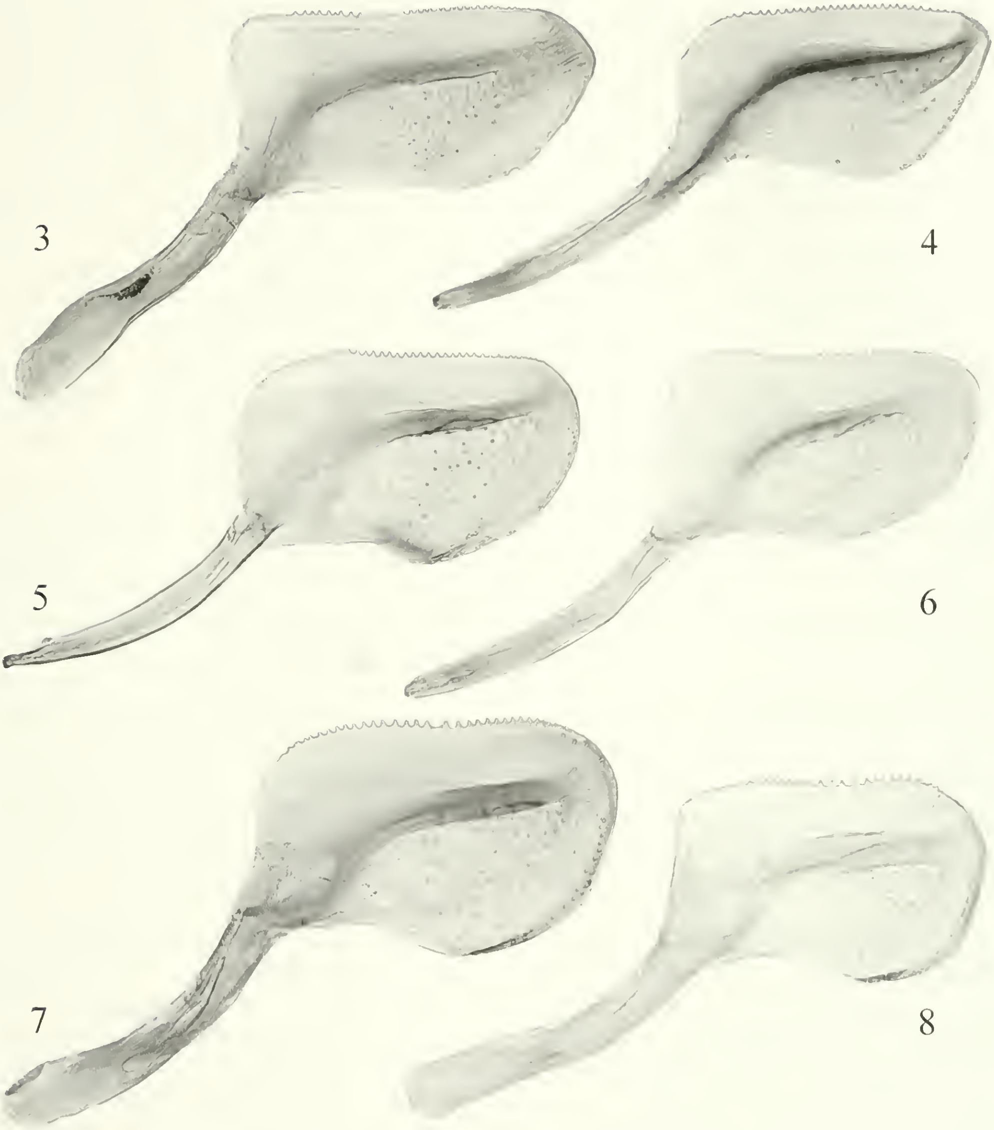
Type material.—*Strongylogaster cretensis.* Lectotype ♂ (designated by Schedl 1981): "Creta"; "Coll. Konow"; [red:] "Typus"; [label with red margin:] "Lectotypus *Strongylogaster cretensis* Konow ♀"; "*Strongylogaster multifasciata* (Geoffroy, 1785) det. S. M. Blank 2001". Both antennal flagella and parts of the left fore wing and of the legs missing. Paralectotype: 1 ♂ from Crete, in poor condition. DEI.

Strongylogaster lineata cypria. Holotype ♀: [round label with red edge:] "Type"; "Cyprus Nr. Platania Forest Stn. 2,500–4,000′ 7.v.1945 G. A. Mavomoustakis"; "near Platania Forest Station 3,500–4,000 ft 7.5.45"; "Holotype *Strongylogaster lineata cypria* subsp. n. det. ♀ R.B. Benson 1953"; "B.M. Type Hym. 1.677"; "*Strongylogaster multifasciata* (Geoffroy, 1785) det. S. M. Blank 2001". In perfect condition. Paratypes: 5 ♀, only 1 ♀ checked from "Lebanon, Falouka, 17.v.1953", leg. Mavromoustakis. NHM.

Remarks.—The typical form of *S. multifasciata* is widely distributed throughout the western Palaearctic Region. According to Naito (1996) the same species also occurs in the eastern Palaearctic (Sibiria, China, Korea, Japan, Taiwan). At least in Central Europe males are comparatively rare, and possibly part of the population reproduces parthenogenetically. *Strongylogaster cretensis* is a valid species according to Schedl (1981), who checked the types and designated a lectotype. Naito (1996) synonymized *S. cretensis* with *S. lineata* (= *S. multifasciata*). The hypopygium of the female lectotype agrees with *S. multifasciata.* In both males and females the abdomen is red except for tergum 1 and more or less tergum 2, and the legs are predominantly red. Such specimens are only known from western Crete (Schedl 1981, 1993) and form an allopatric local population of *S. multifasciata* (see Naito 1996).

The form *S. lineata cypria* described by Benson (1954) for material from Cyprus and Lebanon has entirely pale hind femora and completely black basal antennal segments. It agrees well with the concept of *S. multifasciata* in the shape of the hypopygium and the bicolorous pterostigma. The name Falonka given by Benson is a type error for the Lebanese collecting locality Falouka (= Falugha, Falougha). Naito (1996) omitted *cypria,* which is hereby treated as a synonym with *multifasciata.*

The subapical claw is usually larger in *S. xanthocera* than in *S. multifasciata,* but this character underlies considerable variability. The following characters, which were applied by former authors (see e.g., Muche 1969, Naito 1996), are according to my experience not diagnostic for the separation of the two species: front lobe of mesonotum with/without coarse punctures, density of macro- and microsculpture on other parts of the thorax; relative length of antennal segments; shape of underside of sawsheath near base. The geographic variability of further characters will be discussed under *S. xanthocera* below.



Figs. 3–8. Geographic variability of penis valve. 3, *Strongylogaster multifasciata* from Germany, Lower Bavaria, Bärmannsried. 4, *S. multifasciata* from Greece, Crete, Khaniá. 5, *S. xanthocera* from Germany, Berlin-Friedrichshagen. 6, *S. xanthocera* from Japan, Honshu, Sasayama. 7, *S. xanthocera* from Algeria, Theniet el Had. 8, *S. xanthocera* from Tunisia, Nafzah.

Strongylogaster xanthocera
(Stephens 1835)
(Figs. 2, 5–8)

Tenthredo xanthocera Stephens 1835: 337, ♀ ♂, type locality: England, environs of London.

Strongylogaster geniculata C. G. Thomson 1871: 243, ♀, type locality: Sweden, Ångermanland and Skåne. Synonymy by Konow (1905).

Strongylogaster desbrochersi Konow 1892: 214–214, ♀ ♂, type locality: Algeria, Theniet el Had. **New synonym.**

Strongylogaster desbrochersi var. *lepticus* Konow 1902: 390, ♀ ♂, type locality: Tunisia, Aïn Draham; *Strongylogaster* *desbrochersi* var. *lepidus*: Forsius (1930), type error. **New synonym.**

Type material.—*Strongylogaster desbrochersi.* Lectotype ♀ (here designated in order to ensure the name's proper and consistent application): "Alger."; "Coll. Konow"; [red:] "Type"; [cabinet label:] "*Strongylogaster Desbrochersi* Knw. Alger."; [red:] "Lectotypus ♀ *Strongylogaster desbrochersi* Konow, 1892 des. S. M. Blank 1998"; "*Strongylogaster multifasciata* (Geoffroy, 1785) det. S. M. Blank 2001". Head and front legs missing. Paralectotypes: 1 ♂ "Teniet-el-Hâad [leg.] Desbrochers 1889"; 1 ♂ "Teniet el Haad Algeria"; 1 ♂ "Algeria". DEI.

Strongylogaster desbrochersi var. *lepticus.* Lectotype ♂ (here designated in order to ensure the name's proper and consistent application): "Tunisie Aïn Draham, 4.5.[18]98 [leg.] de Gaulle"; "Coll. Konow"; [red:] "Lectotypus ♂ *Strongylogaster desbrochersi* var. *lepticus* Konow, 1902 des. S. M. Blank 1998"; "*Strongylogaster multifasciata* (Geoffroy, 1785) det. S. M. Blank 2001". In perfect condition. Paralectotypes: 2 ♂ "Tunisie Aïn Draham, 9.5.98 de Gaulle". DEI.

Remarks.—Konow (1892) described *S. desbrochersi* from several males and females collected in Algeria, which he characterized by the predominantly red abdomen and the body length ranging between 7.5 and 10.0 mm. The only available female of the syntype series is hereby designated as the lectotype. Naito (1996) synonymized *S. desbrochersi* and *S. lineata* (= *S. multifasciata*). This is incorrect because the hypopygium of the *S. desbrochersi* lectotype is similar to *S. xanthocera* (Fig. 2) and not to *S. multifasciata.*

Konow (1902) described *Strongylogaster desbrochersi* var. *lepticus* from Tunisia due to the more or less darkened abdomen and legs. Naito (1996) omitted *lepticus*, but Lacourt (1999) listed it in synonymy with *S. multifasciata.* The female syntype(s), mentioned in the original description, are lost. One of the available males is hereby designated as the lectotype. Konow's original name is deemed to be of subspecific rank, because he stated "Tunis" (= Tunisia) as the particular geographical area where the material was collected.

Strongylogaster xanthocera is widely distributed throughout the Palaearctic, and in the East it occurs among others in the Russian Far East and in Japan (Zhelochovtsev 1988, Naito 1996). The most southern European records are from the southern parts of the Balkans and Sicily (Hellén 1967, Zombori 1994, Blank 1993). From Tunisia and Algeria two taxa, *lepticus* (= *lepidus*, type error) and *desbrochersi*, have been described which shall occur there sympatrically. It is impossible to reconfirm this opinion which is based on Forsius' (1930) checklist of the North African sawflies, as this lacks original data for his statement, and the whereabouts of concerning material is unknown. The North African populations are geographically isolated from the European and particularly those from Tunisia differ strikingly from the Central and North European. The following character variability is perceptible among West Palaearctic *S. xanthocera*:

1. The serrulae on the dorsal edge of the valviceps are little larger in males from the southern Mediterranean (Tunisia and Algeria; Figs. 7–8) and Greece than in males from Central Europe (Fig. 5), Corsica and Japan (Honshu, Sasayama, 3.5.1963, leg. T. Naito, Fig. 6; DEI).
2. Tunisian specimens (♀ 6.5–7.5 mm, ♂ 5.5–7.0 mm) are smaller than Algerian (♀ ca 9.0 mm, ♂ 7.5–8.5 mm), specimens from Bulgaria, Corsica, Greece, Sicily, Central and North Europe, and Japan are the largest (♀ 9.5–11.5 mm, ♂ 7.5–10 mm).
3. Southern Mediterranean specimens tend to have a dark pterostigma, whereas the pterostigma is pale in northern Mediterranean, Central and North European and Japanese specimens.
4. The amount of pale color on the fe-

male antenna increases in northern direction: in the females from Tunisia and Algeria the antenna is black and rarely little pale on scape and pedicel; a female from Sicily with scape and pedicel distally little pale (Messina, leg. F. Vitale, MCSN; reported by Zombori [1984] as *S. desbrochersi*); a Bulgarian female has the scape distally, the pedicel completely and antennomere 3 basally red (southern Pirin mountains, Popina Laka, 1,000 m, 14.6.1989, leg. Zerche & Behne, DEI); females from Greece, Corsica and Central Europe have antennomeres 1–4 red; in many females from northeastern Germany the distal antennomeres are brown instead of black (Berlin-Friedrichshagen; DEI); three females from southern Finland have completely pale antennae (Karislojo; DEI).

5. Females with completely red abdominal segments 4–10 were observed in the southern Mediterranean realm, where they may occur syntopically (Tunisia; Blank 2002) or at least sympatrically with the predominantly dark form (red form *S. desbrochersi*, type locality: Teniet el Hâad [= Theniet el Had] ca 135 km SW Algiers; dark form: Algeria, Massif des Mouzaïa [= Djebel Mouzaïa ca 50 km SW Algiers], 14.5.1936, leg. Peyerimhoff, MCSN, see Zombori 1984). The red form is unknown from the northern Mediterranean realm and from Central and North Europe.

6. The abdominal segments 4–9 are red in males from the Mediterranean realm, but the anterior portions of segments 4–9 are extensively darkened towards the abdominal tip in Central European and Japanese males.

The geographic pattern of these characters matches a polycentric species, which had its refugia in the Mediterranean and in eastern Asia during the glacial times. The strains characterized above do not cover the feature of *lepticus*, *desbrochersi* and *xanthocera* as recognized prior to Naito (1996). The abdominal coloration in males and the size of the dorsal serrulae of the valviceps roughly distinguishes the populations with Mediterranean and Eurosiberian origin (zoogeographic terminology in accordance with de Latin 1967). I shall abstain from ranking any of them at subspecific level, because males from Corse cannot be classified to either of these groups. They have the abdominal segments 4–9 completely red like other Mediterranean males, but their valviceps bears only small serrulae like in Central European males. Among the Mediterranean material those specimens from North Africa are characterized by their dark pterostigma and smaller body size. The other characters seem either to follow a (climatic?) gradient (antennal color in females) or to occur arbitrarily (females with red abdomen within local populations of the Mediterranean region).

NOMENCLATURAL NOTES ON *HEMITAXONUS* AND *THRINAX*

The species of this genus chiefly occur in East Asia and in North America (Naito 1971). The only representative of the Western Palaearctic, *T. contigua*, is rare in Europe and usually misinterpreted in the European faunistic literature. Konow (1885) described *T.* "*contigua* m. (= *mixta* [sensu] Thoms.)" and repeated part of the characters, which Thomson (1871) listed for *T. mixta* (i.e., length of body and antennae, shape of ovipositor sheath). Accordingly, it is apparent that Konow had no material of his own on hand, but he interpreted Thomson's description and named the taxon. Type material is not present in Konow's collection (coll. DEI). The specimen, which Malaise (1933) cited as "Thomson's type", is the lectotype of *T. contigua* (type locality: northern Sweden; cf. Blank 1998). Malaise (1933) identified this specimen as "*struthiopteridis* Fors." [= *Sahlbergia struthiopteridis* Forsius, 1910]. *S. struthiopteridis* has widely been accepted as a member of *Hemitaxonus* (e.g., Enslin 1914, Zhelochovtsev 1951, Naito 1971). Consequently, the name *Thrinax* is a senior synonym of *Hemitaxonus* and not available for a subdivision of *Strongylogaster* s.l. as it was understood by most authors so far. It should be pointed out that Zhelochovtsev (1988) has already combined the name *Thrinax* with *struthiopteridis* Forsius, but without giving an explanation. The change of generic name involves the following taxa:

Thrinax Konow 1885

Thrinax Konow 1885: 19, 22–23. Type species: *Thrinax contigua* Konow 1885 [= *Sahlbergia struthiopteridis* Forsius 1910], subsequent designation by MacGillivray (1908), = *Strongylogaster* (*Thrinax*)

= *Hemitaxonus* Ashmead 1898: 311. Type species: *Taxonus dubitatus* Norton 1868, by original designation. **New synonym.**

= *Epitaxonus* MacGillivray 1908: 365–366. Type species: *Taxonus albidopictus* Norton 1869, by original designation. Synonymy by Rohwer (1911)

= *Sahlbergia* Forsius 1910: 49–50. Type species: *Sahlbergia struthiopteridis* Forsius 1910, designation by monotypy. = *Sahlberghia,* type error. Synonymy by Enslin (1913)

= *Canonarea* Malaise 1947: 37–38. Type species: *Canonarea alboorалis* Malaise 1947, by original designation. Synonymy by Naito (1990)

= *Trearea* Malaise 1947: 2, 35–36. Type species: *Trearea compressicornis* Malaise 1947, by original designation. Synonymy by Naito (1990)

Thrinax albidopicta (Norton 1868), **n. comb.** [N]; = *Taxonus albido-pictus* Norton 1868 [nec 1869]; = *Taxonus amicus* Norton 1868 [nec 1869]; = *Hemitaxonus rufopectus* Rohwer 1910b: 204

Thrinax alboorалis (Malaise 1947), **n. comb.** [O]; = *Canonarea alboorалis* Malaise 1947: 38

Thrinax angustata (Zhelochovtsev 1951), **n. comb.** [EP]; = *Hemitaxonus angustatus* Zhelochovtsev 1951: 145–146

Thrinax athyrii (Naito 1971), **n. comb.** [EP]; = *Hemitaxonus athyrii* Naito 1971: 20–21, 26–27

Thrinax compressicornis (Malaise 1947), **n. comb.** [O]; = *Trearea compressicornis* Malaise 1947: 36

Thrinax contigua Konow 1885 [WP, EP]; = *Hemitaxonus contigua* (Konow 1885); = *Sahlbergia struthiopteridis* Forsius 1910: 50–51

Thrinax dubitata (Norton 1862), **n. comb.** [N]; = *Taxonus dubitatus* Norton 1862: 119

Thrinax flexa (Lee & Ryu 1996), **n. comb.** [EP]; = *Hemitaxonus flexus* Lee & Ryu 1996

Thrinax formosana (Takeuchi 1928), **n. comb.** [EP]; = *Hemitaxonus formosanus* Takeuchi 1928: 43

Thrinax goniata (Wei 1997), **n. comb.** [EP or O]; = *Hemitaxonus goniatus* Wei 1997: 1575–1576, 1606–1607

Thrinax japonica (Rohwer 1910), **n. comb.** [EP]; = *Hemitaxonus japonicus* Rohwer 1910a: 112

Thrinax kamtchatica (Malaise 1931), **n. comb.** [EP]; = *Hemitaxonus kamtchaticus* Malaise 1931: 22

Thrinax melanogyne (Naito 1971), **n. comb.** [EP]; = *Hemitaxonus melanogyne* Naito 1971: 20, 22–23

Thrinax minomensis (Takeuchi 1929), **n. comb.** [EP]; = *Hemitaxonus minomensis* Takeuchi 1929: 511–512

Thrinax multicincta (Hall 1918), **n. comb.** [N]; = *Hemitaxonus multicinctus* Hall 1918 [nec Rohwer, nec 1917]: 28

Thrinax nigrooralis (Malaise 1947), **n. comb.** [O]; = *Canonarea nigrooralis* Malaise 1947: 39

Thrinax paucipunctata (Malaise 1931), **n. comb.** [EP]; = *Hemitaxonus paucipunctatus* Malaise 1931: 139–140

Thrinax primaria (D. R. Smith 1966), **n. comb.** [N]; = *Hemitaxonus primarius* D. R. Smith 1966: 114, 119–120

Thrinax rufoclypeus (Wei 1998), **n. comb.** [EP]; = *Hemitaxonus rufoclypeus* Wei *in* Nie & Wei 1998: 126

Thrinax sasayamensis (Okutani 1954), **n. comb.** [EP]; = *Hemitaxonus sasayamensis* Okutani 1954: 76–77

Thrinax takeuchii (Naito 1971), **n. comb.** [EP]; *Hemitaxonus takeuchii* Naito,1971: 20–21, 27–28

Thrinax tokunagai (Takeuchi 1941), **n. comb.** [EP]; *Hemitaxonus tokunagai* Takeuchi 1941: 248–249

Thrinax weni (Wei 1998), **n. comb.** [EP]; = *Canonarea weni* Wei *in* Nie & Wei 1998: 125–126

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LIFE HISTORY AND DESCRIPTION OF ADULTS AND IMMATURE STAGES OF *GOEDENIA STENOPARIA* (STEYSKAL) (DIPTERA: TEPHRITIDAE) ON *GUTIERREZIA CALIFORNICA* (DE CANDOLLE) TORREY AND A. GRAY AND *SOLIDAGO CALIFORNICA* NUTTALL (ASTERACEAE) IN SOUTHERN CALIFORNIA

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Abstract.—*Goedenia stenoparia* (Steyskal) is an oligophagous, multivoltine fruit fly (Diptera: Tephritidae) that feeds in the flower heads of hosts belonging to the family Asteraceae, tribe Astereae, and subtribe Solidagininae, like all other known hosts of *Goedenia* spp. Newly reported hosts are *Ericameria parishii* (E. Greene) H. M. Hall, *Gutierrezia californica* (de Candolle) Torrey and A. Gray, *Hazardia squarrosa* (Hooker and Arnott) E. Greene, *Lessingia glandulifera* A. Gray, and *Solidago californica* Nuttall. Variations in taxonomic characters of adults are described. The third-instar larvae and puparia are described and figured, and selected characteristics of these stages are compared with the same stages of three other species of *Goedenia.* The prothorax and gnathocephalon of the third instar is smooth and mostly free of the minute acanthae that circumscribe most other body segments. The third instar of *G. stenoparia* lacks oral ridges, as do the third instars of three other congeners studied to date. The anterior thoracic spiracle bears two papillae. Minute acanthae cover the center of the truncated, posteriorly sclerotized, caudal segment, that also is perforated by scattered pores, and this central area is ringed by concentric, incomplete series of shallow, elliptical depressions. The life cycle is of the aggregative type. Overwintering limitedly occurs as sexually immature adults, but mainly in dead flower heads as prepuparial third instars and puparia in apically open, vasiform cells consisting of floret and achene fragments glued together with dried liquid feces and sap. Overwintered puparia of *G. stenoparia* were parasitized by chalcidoid Hymenoptera in the genera *Eurytoma* (Eurytomidae), *Pteromalus* (Pteromalidae), and *Torymus* (Torymidae) as probable, primary, solitary, larval-pupal endoparasitoids.

Key Words: Insecta, *Ericameria, Goedenia, Gutierrezia, Hazardia, Lessingia, Solidago,* Asteraceae, nonfrugivorous Tephritidae, biology, taxonomy of adults and immature stages, flower-head feeding, aggregative life cycle, seed predation, parasitoids

Most indigenous, western North American Myopitini (Diptera: Tephritidae: Tephritinae) formerly assigned to the Palearctic genus *Urophora* Robineau-Desvoidy were redesignated as *Goedenia* by Freidberg and Norrbom (1999). To date, the life history and immature stages of three of the eight known species of *Goedenia* have been described in detail, i.e., *G. timberlakei* (Blanc and Foote), *G. rufipes* (Curran) and *G. setosa* (Foote) by Goeden et al. (1995) and Goeden (2002a, b), respectively. This paper describes the life history and selected immature stages of a fourth species, *G. stenoparia* (Steyskal).

MATERIALS AND METHODS

The present study utilized specimens of adults reared from 1-liter samples of mature flower heads of *Gutierrezia californica* (de Candolle) Torrey and A. Gray collected south of Banner along Chariot Canyon Road at 940 m elevation and *Solidago californica* Nuttall at Banner at 820 m elevation in northeastern San Diego County, California. The life history study and description of the immature stages of *Goedenia stenoparia* were based in large part on dissections of samples of live mature and dead overwintered flower heads of both hosts collected during 1994–1997. One-liter samples of flower heads containing the larvae and puparia were transported in cold-chests in an air-conditioned vehicle to the laboratory and stored under refrigeration for subsequent dissection, photography, description, and measurement. Twenty-six, third-instar larvae and four puparia dissected from flower heads of *S. californica* were preserved in 70% EtOH for scanning electron microscopy (SEM). Prepuparia and puparia were placed in separate, glass shell vials stoppered with absorbant cotton and held in humidity chambers at room temperature for adult and parasitoid emergence. Specimens for SEM were hydrated to distilled water in a decreasing series of acidulated EtOH. They were osmicated for 24 h, dehydrated through an increasing series of acidulated EtOH and two, 1-h immersions in hexamethyldisilazane (HMDS), mounted on stubs, sputter-coated with a gold-palladium alloy, studied and digitally photographed with a Philips XL-30 scanning electron microscope in the Institute of Geophysics and Planetary Physics, University of California, Riverside.

Adults reared from isolated prepuparia and puparia were individually caged in 850-ml, clear-plastic, screened-top cages with a cotton wick and basal water reservoir and provisioned with a strip of paper toweling impregnated with yeast hydrolyzate and sucrose. These cages were used for studies of longevity in the insectary of the Department of Entomology, University of California, Riverside, at 25 ± 1°C and 14/10 (L/D) photoperiod. Five pairs of virgin males and females obtained from *G. californica* and 10 pairs obtained from *S. californica* in emergence cages were held in each of 15, clear-plastic, petri dishes each provisioned with a flattened, water-moistened pad of absorbant cotton spotted with honey (Headrick and Goeden 1994) for observations of courtship and copulation behavior.

Plant names used in this paper follow Hickman (1993) and Bremer (1994); tephritid names follow Foote et al. (1993). Terminology and telegraphic format used to describe the immature stages follow Goeden (2001a, b, c; 2002a, b), Goeden et al. (1993), Goeden and Headrick (1992), Goeden and Norrbom (2001), Goeden and Teerink (1997), Headrick et al. (1996), Teerink and Goeden (1999), and our earlier works cited therein. Means ± SE are used throughout this paper. Digitized photographs used to construct text figures were processed with Adobe Photoshop® Version 6.

RESULTS AND DISCUSSION

TAXONOMY

Adult.—*Goedenia stenoparia* was described in the genus *Urophora* by Steyskal (1979) from a single male collected by E. I. Schlinger from Glendale in Los Angeles, California, on 30.vii.1955. Freidberg and Norrbom (1999) reclassified it along with most other indigenous, western North American species formerly placed in *Urophora* as *Goedenia*. Steyskal (1979) provided a drawing of the wing and Foote et al. (1993) figured the wing pattern and the head and thorax in lateral view.

A total of 211 specimens of adults reared from five hosts, i.e., 72 from *Gutierrezia californica* (de Candolle) Torrey and A.

Gray, four from *G. microcephala* (de Candolle) A. Gray, 16 from *G. sarothrae* (Pursh) Britton and Rusby, 93 from *Hazardia squarrosa* (Hooker and Arnott) E. Greene, and 26 from *Solidago californica*, were examined to estimate variation in the main characters used to distinguish *Goedenia stenoparia*. Foote et al. (1993) stated that "From all native *Urophora* [i.e., *Goedenia*] species with a distinctively banded wing pattern and primarily yellow scutellum, *stenoparia* is distinguished by the narrow wing bands, the failure of the discal band to attain the hind margin of the wing . . . , and the nearly complete break in the subapical band along vein M . . . ."

One third of the 211 specimens examined had a black scutellum; the central third or half of the scutellum of the remaining flies were yellow or tawny yellow. The discal band attained the hind margin in 78 (37%) of the 211 flies, but the part posterior to vein Cu_1 is faint posteriorly in all but 15 (5%) of the 211 flies, i.e., seven males and eight females. It is noteworthy that the discal band was broken in cell dm in 71 (34%) flies, i.e., 57 males and 14 females, and was narrow and/or faint in cell dm in an additional 38 (18%) flies, including 20 males and 18 females. In addition, the discal band in 13 of the 71 flies, i.e., nine males and four females, also was broken in cell r_{2+3} or was faint and/or narrow in r_{2+3} in seven more flies. Finally, one male and two females (0.1%) had the discal band intact in cell dm, but broken in cell r_{2+3}.

The presence of a nearly complete break in the subapical band along vein M as a diagnostic character also showed variation. Only 74 (36 %) of 207 adults, i.e., 43 males and 31 females, examined for this character showed a complete or "nearly complete" break.

Another distinguishing character ascribed to *G. stenoparia* by Steyskal (1979) and Foote et al. (1993) is the notopleuron yellow or tawny at the base of the posterior notopleural seta. This character was emphasized in Figure 507 in Foote et al. (1993). In 64 (30%) of the 211 flies, i.e., 31 males and 33 females, the area at the base of this seta was dark brown or black.

Foote et al. (1993) described the legs as yellowish, with only the hind femur slightly darkened basally. The legs of all but one of 210 flies examined for this character would better be described as tawny; moreover, 45 (21%) of these flies, i.e., 34 males and 11 females, had a more extensively darkened hind femur, including some with a substantial basal darkening of all femora, and two males with a dark basal part of the tibia.

Finally, only 31 (15%) of the 209 flies examined had the gena not more than 1/5 as high as the eye as suggested by Foote et al. (1993), the remaining flies showing ratios of 0.20–0.27 times the height of eye. Thus, this character definitely is too variable to use to distinguish *G. stenoparia*.

Although adults of *G. stenoparia* show considerable variation, they usually can be separated from *G. caurina* by a combination of the reduced and fragmented wing pattern and the extensively darkened legs. Likewise, specimens of *G. formosa* are readily distinguished by their wider and complete discal and subapical bands that extend to the hind wing margin. A hyaline spot often present in the apical band in cell r_{4+5} also distinguishes many specimens of *G. formosa* (my unpublished data). Furthermore, the host plants of *G. caurina* and *G. formosa* in southern California differ from those of *G. stenoparia*, as reported below.

Immature stages.—*Egg:* Twenty-nine eggs dissected from immature inflorescences of *Solidago californica* (Figs. 4A, B) were white, smooth, elongate-ellipsoidal, 0.56 ± 0.03 (range, 0.52–0.58) mm in length and 0.16 ± 0.01 (range: 0.14–0.16) mm in width, with a 0.02-mm, peglike pedicel at tapered, anterior end. Anterior end smoothly rounded.

The eggs of *G. stenoparia* on average were slightly longer and wider than the ova of *G. timberlakei* (Goeden et al. 1993) and only slightly longer and narrower than those of *G. rufipes* (Goeden 2002a), but otherwise generally agreed with published descriptions of those species.

Third instar larva: Elongate-ellipsoidal, roundly tapered anteriorly, bluntly truncated posteriorly (Fig. 1A), integument white, but venters of meso-, metathorax, and abdominal segments A1–A4 with dark brown to black infuscation (Fig. 4C); caudal segment dark brown or black; minute acanthae, apically pointed or rounded, conical and posteriorly directed (Figs. 1B-1 D-2; 2A-2) or hemispheroidal (Figs. 1B-2, 2D-1, 3B-1, C-2, D-2), circumscribe anterior fifth of meso- and metathorax, all but pleura and posterior fifth of abdominal segment A-1, posterior four-fifths of abdominal segments A2-A7, excluding pleura of A7, and cover all eight venters thereof, and posterior, truncated surface of caudal segment (Fig. 4A-1); prothorax smooth, but venter with flattened, posteriorly directed minute acanthae (Fig. 1D-1), and circumscribed by inner, medial ring of verruciform sensilla (Fig. 1C-1) and outer, incomplete ring of unpaired, verruciform sensilla (Fig. 1C-2); gnathocephalon (Figs. 1C-3, 1D) conical and medially divided by vertical cleft (Fig. 1D-2), dorsal sensory organ well-defined, hemispherical (Figs. 1D-3, E-1); pores above and dorsolateral of each dorsal sensory organ (Fig. 1D-4), anterior sensory lobe (Figs. 1D-5, E-2) bears terminal sensory organ (Figs. 1D-6, E-3); lateral sensory organ (Fig. 1E-4), supralateral sensory organ (Fig. 1E-5), and pit sensory organ (Fig. 1E-6); two medial, integumental petals (Fig. E-7); four, papilliform, lateral integumental petals (Figs. 1E-8, F-1) above each mouthhook (Figs. 1D-7, F-2), stomal sense organ (Figs. 1D-8, F-3) ventrolaterad of anterior sensory lobe; mouthhook bidentate (Figs. 1D-7, F-2), anterior tooth concave posteriorly (Fig. 1F-4); median oral lobe laterally compressed, apically pointed (Figs. 1D-10, F-5), separated from labial lobe (Fig. 1F-6); anterior thoracic spiracle on posterior margin of prothorax bears two doliform papillae (Figs. 1C-4, 2A-1, B-1); mesothoracic, lateral spiracular complex with six verruciform sensilla in vertical series (Fig. 2B-2), mesothoracic spiracle not seen; metathoracic lateral spiracular complex with nearly closed, lateral spiracle (Figs. 2B-3, C-1) and four verruciform sensilla in vertical series (Fig. 2B-4); lateral spiracular complex of first abdominal segment with partially closed spiracle (Figs. 2B-5, D-1) and five verruciform sensilla in vertical series (Fig. 2B-6); caudal segment with pair of posterior spiracular plates (Figs. 3A-1, B) surrounded by hemispherical minute acanthae (Figs. 3A-2, B-1, C-2, D-2) interspersed dorsally and medially with open pores (Fig. 3A-3, B-4), these structures ringed by two incomplete, concentric series of shallow, elliptical depressions (Fig. 3A-4), with two tapered stelex sensilla (Figs. 3A-5, C-1) and a verruciform sensillum (Figs. 3A-6, D-1); dorsolateral to each posterior spiracular plate; posterior spiracular plate (Figs. 3A-1, B) bears three smoothly flattened rimae (Fig. 3B-2), ca. 0.01 mm in length, and four spinose, interspiracular processes, each ca. 0.005 mm long (Fig. 3B-3).

The habitus of the third instar of *G. stenoparia* (Fig. 1A) resembles those of *G. timberlakei* (Goeden et al. 1995), *G. rufipes* (Goeden 2002a) and *G. setosa* (Goeden 2002b). In all four species, the venters of the thorax, anterior abdominal segments, and the caudal segment are darkly pigmented (Figs. 5D, E; Goeden et al. 1995; Goeden 2002a, b) and minute acanthae circumscribe the meso- and metathorax and abdomen, and especially noteworthy, the central, posterior surface of the caudal segment, which also is dotted with scattered pores (Figs. 3A-2, B-4; Goeden et al. 1995; Goeden 2002b). This central area is ringed by concentric series of shallow, elliptical depressions in all four species (Figs. 3A-2, B-4; Goeden et al. 1995; Goeden 2002b). The prothorax and gnathocephalon of *G. timberlakei* and *G. rufipes* are smooth and free of minute acanthae; whereas, the prothoracic venters of *G. setosa* (Goeden

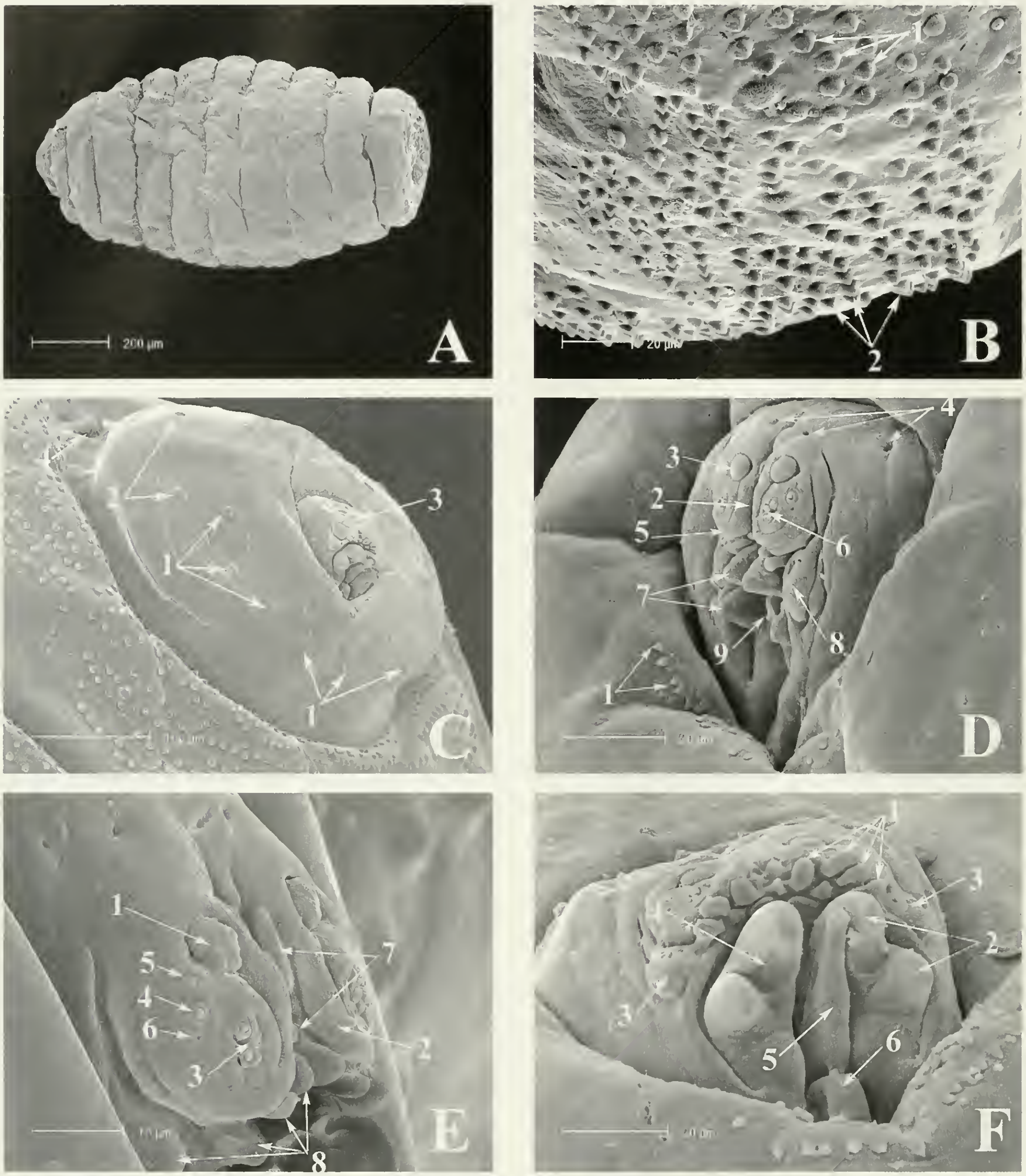


Fig. 1. Third instar of *Goedenia stenoparia*: (A) habitus, anterior to left; (B) minute acanthae on venter of abdominal segment A6, anterior to left; (C) gnathocephalon and prothorax, frontal view, 1—verruciform sensilla of inner ring, 2—verruciform sensilla of incomplete, outer ring, 3—gnathocephalon, 4—anterior spiracle; (D) gnathocephalon, frontolateral view, 1—minute acanthae, 2—vertical, medial cleft, 3—dorsal sensory organ, 4—pores, 5—anterior sensory lobe, 6—terminal sensory organ, 7—mouthhooks, 8—stomal sense organ, 9—median oral lobe; (E) 1—dorsal sensory organ, 2—anterior sensory lobe, 3—terminal sensory organ, 4—lateral sensory organ, 5—supralateral sensory organ, 6—pit sensory organ, 7—medial integumental petals, 8—lateral integumental petals; (F) oral cavity, ventral view, anterior at top, 1—lateral integumental petals, 2—mouthhook, 3—stomal sense organ, 4—posterior concavity on anterior tooth of mouthhook, 5—median oral lobe, 6—labial lobe.

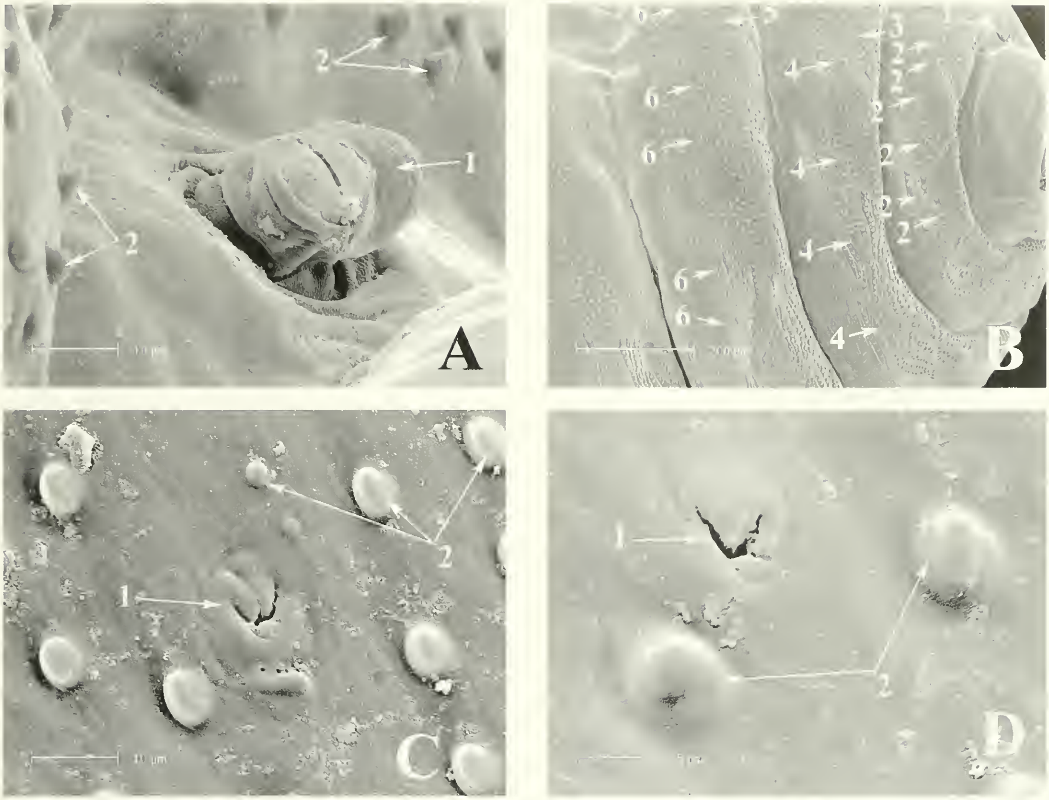


Fig. 2. Third instar of *Goedenia stenoparia*, continued: (A) 1—anterior spiracle, 2—minute acanthae, (B) lateral spiracular complexes, anterior to right, 1—anterior spiracle, 2—verruciform sensilla on mesothorax, 3—lateral spiracle on metathorax, 4—verruciform sensilla on metathorax, 5—lateral spiracle on first abdominal segment, 6— verruciform sensilla on first abdominal segment; (C) close-up of lateral spiracle on metathorax, 1—spiracle, 2—minute acanthae; (D) close-up of lateral spiracle on first abdominal segment, 1—spiracle, 2—minute acanthae.

2002b) and *G. stenoparia* anteriorly bear a few minute acanthae (Figs. 1D-1). Two medial and four lateral integumental petals are present in *G. stenoparia* (Figs. 1E-7, 8, F-1), as in *G. rufipes* (Goeden 2002a); whereas, *G. timberlakei* has six lateral integumental petals (Goeden et al. 1995, unpublished data) and *G. setosa* has five (Goeden 2002b). The lateral-most integumental petal is separated from the stomal sense organ in all four species (Fig. 1F-3; Goeden et al. 1995; Goeden 2002a, b).

The third instars of all four species of *Goedenia* studied to date lack oral ridges on either side of the mouth opening, and ventral or ventrolateral to the stomal sense organ (Figs. 1D, E, F; Goeden et al. 1995; Goeden 2002a, b, and unpublished data).

The mouthhooks of the third instars of *G. stenoparia* (Figs. 1D-7, F-2), like those of *G. timberlakei* (Goeden et al. 1995), *G. rufipes* (Goeden 2002a) and *G. setosa* (Goeden 2002b), are bidentate. Moreover, a ventral view of the oral cavity (Fig. 1F), like that figured and described for *G. rufipes* (Goeden 2002a), but not obtained for either *G. timberlakei* (Goeden et al. 1995, unpublished data) nor *G. setosa* (Goeden 2002b), showed the concavely scalloped, posterior surface of the anterior tooth (Fig. 1F-4).

The anterior spiracle of all four *Goedenia*

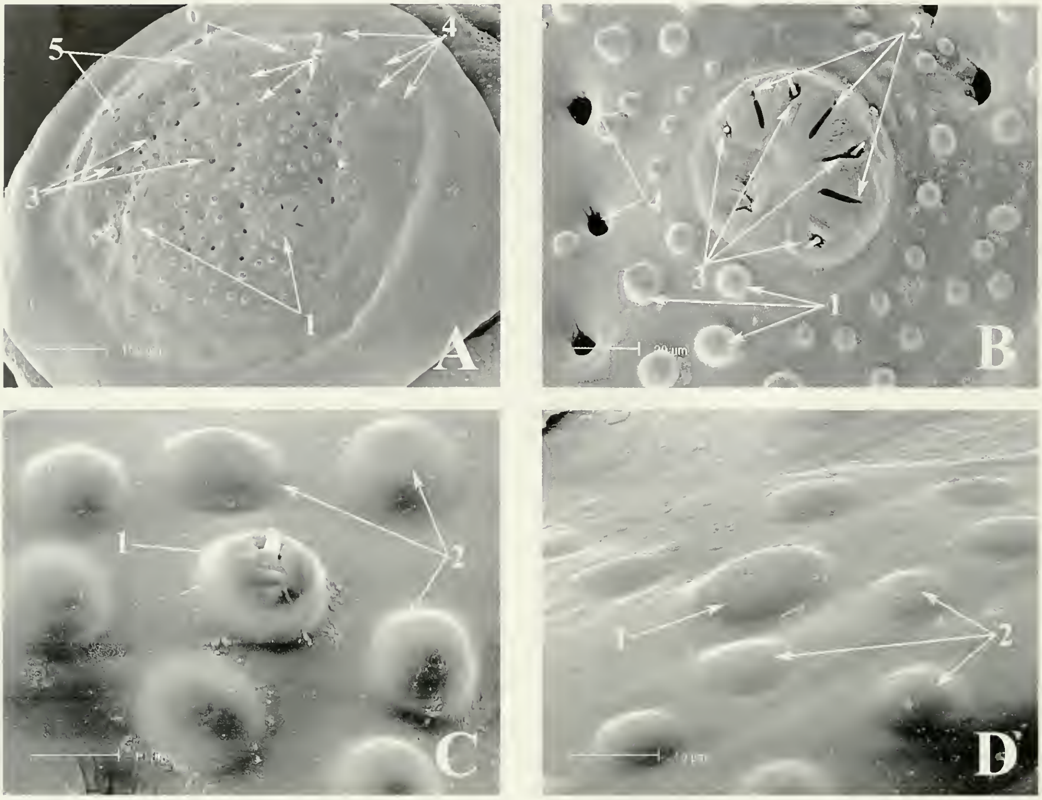


Fig. 3. Third instar of *Goedenia stenoparia*, continued: (A) caudal segment, 1—posterior spiracular plates, 2—minute acanthae, 3—pores, 4—shallow, elliptical depressions, 5—stelex sensilla, 6— verruciform sensillum; (B) posterior spiracular plate, 1—minute acanthae, 2—rimae, 3—interspiracular processes, 4—pores; (C) 1—stelex sensillum, 2—minute acanthae; (D) 1—verruciform sensillum, 2—minute acanthae.

species bears only two papillae (Figs. 1C-4, 2A-1; Goeden et al. 1995, Goeden 2002a, b).

The lateral spiracular complex of the mesothorax of *G. stenoparia* includes six verruciform sensilla in a vertical series (Fig. 2B-2) like that of *G. rufipes* (Goeden 2002a); whereas, in *G. timberlakei*, this same complex includes only two verruciform sensilla (Goeden et al. 1995). Likewise, the metathoracic lateral spiracular complex of *G. stenoparia rufipes* includes four verruciform sensilla (Fig. 2B-4), again like *G. rufipes* (Goeden 2002a); whereas, only two such sensilla occur in *G. timberlakei* (Goeden et al. 1995). Finally, five verruciform sensilla in a vertical series comprise the lateral spiracular complex of the first abdominal segment of *G. stenoparia* (Fig. 2B-6), three such sensilla occur in *G. rufipes* (Goeden 2002a), but only one verruciform sensillum is found on this segment in *G. timberlakei* (Goeden et al. 1995).

Puparium: Light to dark, reddish brown with dark brown to black, anterior stripe or series of spots on venters of meso- and metathorax and abdominal segments A-1 to A-4 (Fig. 5E), and similarly dark, caudal segment, elongate-ellipsoidal, with smoothly rounded anterior end, and truncated posterior end (Fig. 4A). Anterior end bears invagination scar (Fig. 4B-1) and raised, bilobed, anterior thoracic spiracles (Fig. 4B-2). Flattened posterior end of caudal segment studded with smoothly rounded, hemispherical, minute acanthae (Figs. 4C-1, D-1) interspersed with open pores (Figs. 4C-2, D-2). A pair of raised, hemispheroidal, posterior spiracular plates (Fig. 4C-3) each bear three elliptical rimae interspersed with four peg-like, interspiracular processes. These structures are ringed by shallow, elliptical depressions (Fig. 4C-4). Twenty-three puparia dissected from flower heads of *Gutierrezia californica* and *Solidago californica* averaged 2.66 ± 0.07 (range, 1.92–3.27) mm in length; 1.16 ± 0.02 (range, 0.99–1.42) mm in width.

DISTRIBUTION AND HOSTS

Foote et al. (1993) mapped the distribution of *Goedenia stenoparia* as southwestern California along with one location in southwestern Utah, which suggests a widespread distribution for this tephritid in western North America north of Mexico. The collective distributions of the host plants listed below also would indicate such a wide distribution for *G. stenoparia,* which probably also encompasses northern Mexico (Hickman 1993).

Goedenia stenoparia was reported as reared from *G. microcephala, Gutierrezia sarothrae* and *Ericameria cuneata* (as *Haplopappus cuneatus*) (A. Gray) McClatchie by Goeden (1987). Foote et al. (1993) reported these rearing records along with a sweep record from *Hymenoclea salsola* Torrey and Gray, a non-host (Goeden and Ricker 1986), which Goeden (1987) used to illustrate the often misleading or useless nature of sweep records—no matter how accurately the plant and tephritid are identified! *Gutierrezia californica* and *Solidago californica* were newly reported in this paper as hosts, as are *E. parishii* (E. Greene) H. M. Hall, *Hazardia squarrosa,* and *Lessingia glandulifera* A. Gray. All of these new host records for *Goedenia stenoparia* are from southern California. All of the aforementioned hosts belong to the family Asteraceae, tribe Astereae, subtribe Solidagininae (Bremer 1994), as do all other reported and confirmed hosts of *Goedenia* spp. (Goeden 1987, Freidberg and Norrbom 1999). Accordingly, *G. stenoparia* is classed as narrowly oligophagous (on eight species of one host subtribe in the Asteraceae) (Goeden 1987, Headrick and Goeden 1998).

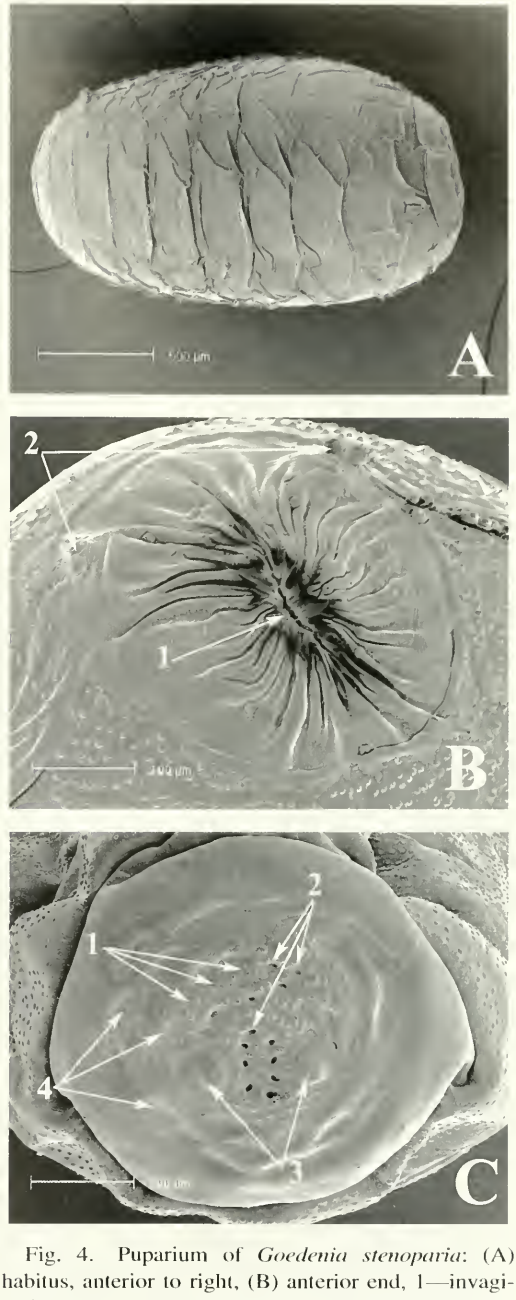
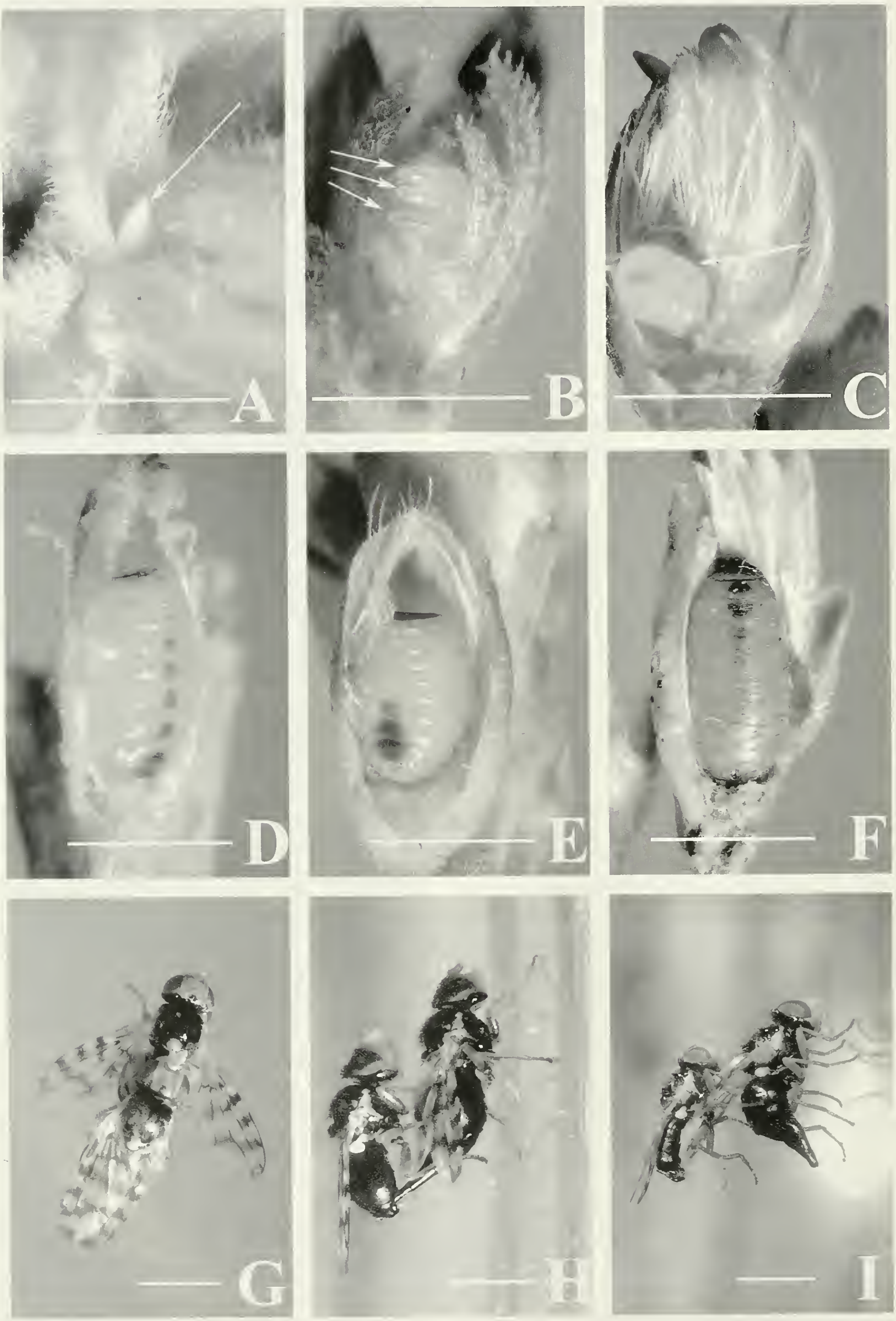


Fig. 4. Puparium of *Goedenia stenoparia*: (A) habitus, anterior to right, (B) anterior end, 1—invagination scar, 2—anterior spiracles; (C) caudal segment, 1—minute acanthae, 2—pores, 3—posterior spiracular plates, 4—shallow, elliptical depressions.

As noted above, their host plants also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serve to distinguish *Goedenia formosa* and *G. caurina* from *G. stenoparia*, at least in southern California. My current opinion is that *G. formosa* is now known only from *Isocoma menziesii* (Hooker and Arnott) G. Nesom, formerly treated by Munz (1974) as two varieties of *Haplopappus venetus* (von Humboldt) Blake, and reported as such as hosts by Goeden (1987). Additional hosts for *G. formosa* reported by Wasbauer (1972) and Goeden (1987) should refer to either *G. stenoparia*, as noted above, to *G. caurina*, or to an undescribed *Goedenia* from *Grindelia* spp. (my unpublished data). Consequently, *G. caurina* currently is recognized by me as reared from *Chrysothamnus parryi* (A. Gray) E. Greene, *C. viscidiflorus* (Hooker) Nuttall, *Ericameria ericoides* (Lessing) Jepson, and *E. palmeri* (A. Gray) H. M. Hall (Goeden 1987, unpublished data). Unfortunately, my coworkers and I did not study *G. caurina* or *G. formosa* in the aforementioned hosts, as their taxonomic distinction from *G. stenoparia* was only recently better clarified, as reported above.

BIOLOGY

Egg.—No flower head of *Gutierrezia californica* containing an egg of *Goedenia stenoparia* was sampled; however, it is assumed that a single egg is inserted into each young preblossom flower head based upon dissections of flower heads each containing a single larva as reported below. The few, solitary eggs observed in very young, closed preblossom heads of *Solidago californica* supported this assumption (Fig. 5A); however, a cluster of three eggs found within the apical leaves covering a young, compound, terminal infloresence of *S. californica*, also containing very small, preblossom flower heads (buds) (Fig. 5B) indicated an alternative mode of oviposition for this tephritid. None of these eggs were inserted within plant tissues, observations supported by empty chorions found adjacent to newly eclosed first instars observed within a few other stem terminals.

Larva.—Upon eclosion from the egg, each first instar commenced to feed separately within a fast-developing, preblossom flower head on the florets therein. The receptacle was neither abraded or pitted by such feeding.

Single second instars were found feeding on ovules in eight, separate, closed, preblossom flower heads of *Gutierrezia californica* (Fig. 5C). They usually fed within an ovule with their bodies perpendicular to, but always above, the receptacles (Fig. 4A). Receptacles of the eight flower heads containing second instars averaged 0.62 ± 0.03 (range, 0.57–0.71) mm in diameter. These larvae had damaged an average of 3.0 ± 0.7 (range, 2–4) ovules, or about 46% of the average total of 6.5 ± 0.4 (range, 5–8) ovules counted within each of the eight flower heads. However, 516 flower heads were individually dissected in order to locate these eight flower heads infested with second instars (Fig. 5C).

Likewise, single second instars were found feeding on ovules in 11 separate, closed, preblossom flower heads of *S. californica* (Fig. 5C). All were found within adjacent flower heads on several compound infloresences, again indicative of oviposition of eggs in clusters. They, too, usually fed on ovules with their bodies perpendicular to, but always above, the receptacles (Fig. 5C). Receptacles of the 11 flower

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Fig. 5. Life stages of *Goedenia stenoparia* in flower heads of *Gutierrezia californica* and *Solidago californica*: (A) single egg (arrow) in *S. californica*; (B) three eggs (arrows) in *S. californica*; (C) second instar (arrow) in *S. californica*; (D) third instar feeding in receptacle having consumed other contents of flower head of *G. californica* (note dark infuscation on venter); (E) third instar in *S. californica*; (F) puparium in flower head of *G. californica*; (G) mating pair, dorsal view; (H) mating pair, lateral view; (I) unreceptive female depressing oviscape to avoid coitus. Lines = 1 mm.

heads containing second instars averaged 1.00 ± 0.04 (range, 0.85–1.14) mm in diameter. These larvae had damaged an average of 2.1 ± 0.3 (range, 1–4) ovules, or about 46% of the average total of 10.6 ± 1.3 (range, 8–15) ovules counted within each of the 11 flower heads.

Third instars fed with their long axes oriented perpendicular to the receptacles, and with their mouthparts directed towards the receptacles, which they scored or pitted, lightly when young to deeply when fully grown, in all of 38 infested flower heads examined of *G. californica* (Fig. 5D). The 38 flower heads (10 closed preblossom; 28 dead, overwintered) each contained a single third instar (Fig. 5D). These 38 flower heads averaged 0.75 ± 0.03 (range, 0.85–1.42) mm in diameter and contained an average of 8.9 ± 0.2 (range, 4–11) ovules/achenes, all of which were damaged or completely destroyed by the time of prepupariation (Fig. 5D).

Similarly, third instars fed as above in all of 50 infested flower heads examined of *S. californica* (Fig. 5E). The 50 flower heads (7 closed preblossom or 43 at least partly open, postblossom and senescent or dead and overwintered) each contained a single third instar. These 50 flower heads averaged 1.14 ± 0.02 (range, 0.42–0.85) mm in diameter and contained an average of 17.2 ± 0.5 (range, 12–22) ovules/achenes, all of which were damaged or completely destroyed by the time of prepupariation (Fig. 5E).

Pitted receptacles in both of the above host species (Figs. 5D, E) suggest that sap constitutes at least part of the diet of third instars of *G. stenoparia,* as reported also for *G. timberlakei* (Goeden et al. 1995), *G. rufipes* (Goeden 2002a), and *G. setosa* (Goeden 2002b). Goeden (1988), Headrick and Goeden (1990), Goeden and Headrick (1992), Goeden et al. (1995), Headrick et al. (1996), and Goeden and Teerink (1997) also first noted, described, and discussed sap feeding by florivorous species of Tephritidae in the genera *Trupanea, Paracantha, Neaspilota, Tephritis, Dioxyna,* and *Xenochaeta,* respectively. Upon completing feeding in flower heads of *Gutierrezia californica,* the larva constructed a vasiform cell consisting of ovule/achene/floret fragments impregnated with and hardened by dried, liquid feces and sap. The wall of these cells in *S. californica* was noticably thinner than in *G. californica.* The flattened, sclerotized caudal segment of the third instar nicely serves as a plug that tightly closes the mouth of the cell, yet allows respiration, and thus apparently also may serve to shield the larva from arthropod predators (but certainly not parasitoids, see below) during overwintering (Goeden 2002b). Prior to pupariation the prepupa turns 180° and orients with its anterior end away from the receptacle, retracts its mouthparts, and forms a puparium (Figs. 5F).

Pupa.—Infested, overwintered flower heads each contained a single puparium (Figs. 5F). The posterior of the puparium faced the receptacle, rested in the cuplike base of the cell, and all but the anterior part of the puparium tightly adhered to the inner wall of the cell in *G. californica* (Fig. 5F). However, puparia in *S. californica* flowerheads were only loosely confined.

Adult.—Under insectary conditions, 45 males of *G. stenoparia* lived an average of 28 ± 2.5 (range, 7–77) days, and 31 females lived an average of 25 ± 2.6 (range, 6–53). These longevities were less than the mean longevities reported for *G. timberlakei* (Goeden et al. 1995) and *G. setosa* (Goeden 2002b), but still are commensurate with the aggregative type of life histories possessed by all three of these tephritids (Headrick and Goeden 1994, 1998; Goeden et al. 1995).

The premating and mating behaviors of *G. stenoparia* were not studied in the field, but were observed for five pairs (one male and one female each) reared from *Gutierrezia californica* and 10 pairs from *S. californica* in separate petri dish arenas. These arenas were of the type found to be useful in studying mating behaviors of many other nonfrugivorous, tephritid species (Headrick and Goeden 1994). Both sexes exhibited wing hamation (Headrick and Goeden 1994) throughout the day concurrent with other behaviors, i.e., grooming, resting, and feeding; this also was the most common wing movement reported for *G. timberlakei* (Goeden et al. 1995), *G. rufipes* (Goeden 2002a), and *G. setosa* (Goeden 2002b). Premating behaviors observed with *G. stenoparia* included males and females tracking individuals of the opposite sex, during which males sometimes swayed and usually exhibited abdominal pleural distension. During mating, the wings of the male were overlapped (Fig. 5G) or parted at 10–60°, the wings of the female were parted at 60–90° (Fig. 5G), with both pairs of parted wings centered over the midline of each fly (Figs. 5G). The foretarsi of the male grasped the dorsum of the abdomen of the female laterally at the thoracic juncture, the midtarsi grasped the abdomen laterally or the oviscape at its base, and the hindtarsi crossed under the oviscape (Fig. 5H). The bodies of both flies paralleled the substrate with the oviscape elevated about 45° (Fig. 5H). In arenas, the flies mated at least once on successive days at different times during daylight; six pairs were observed to mate twice in one day. Another especially active pair was observed mating 28 times on 21 consecutive days, after which, the female died. A total of nine matings were observed that lasted an average of 128 (range, 38–312) min. Mating females were observed to walk about the arenas, to groom, drink, and form droplets (Headrick and Goeden 1994, 1998). Females became restless before termination of mating and pushed against the males with their hind tarsi, they also lofted their wings so as to push against the males and fully extended their aculei. The male in turn countered this agonistic behavior with copulatory induction behavior (CIB), i.e., rubbed his hind tarsi along the oviscape, grasped the female tightly, rocked from side to side to regain purchase or to avoid the female's pummeling, and sometimes rapidly vibrated his wings, all of which appeared to calm the female and allow coitus to continue. During postcoital separation, the male turned and rapidly walked off and away from the female while pulling his genitalia free, a process lasting just 5 and 8 s in two cases. Nonreceptive females avoided matings by decamping, by deflexing their oviscapes to the substrate (Fig. 5I) or otherwise by physically preventing males from gaining purchase by means of agonistic behaviors described above.

Seasonal history.—The life cycle of *Goedenia stenoparia* in southern California follows an aggregative pattern (Headrick and Goeden 1994, 1998) in which the prepuparia, puparia, and a few adults variously are the overwintering stages. Some adults emerged from a few puparia formed in late-fall (October–November) and these unmated, sexually immature adults overwinter. The remaining prepuparia and puparia overwinter in cells in dead flower heads that remain attached to dead inflorescences of *Gutierrezia californica, S. californica,* and presumably the other hosts of *Goedenia stenoparia.* These overwintered individuals emerge as adults in spring (April–May) and pass the following summer (June–September), probably as non-reproductive individuals in riparian habitats. They eventually aggregate on preblossom, fall-blooming, host plants, to mate, and subsequently to oviposit in or alongside of the small, newly-formed, closed, preblossom flower heads.

Natural enemies.—Overwintered puparia of *G. stenoparia* were parasitized by chalcidoid Hymenoptera in the genera *Eurytoma* (Eurytomidae), *Pteromalus* (Pteromalidae), and *Torymus* (Torymidae) as probable primary, solitary, larval-pupal endoparasitoids.

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RANGE EXTENSIONS OF NEW WORLD TORTOISE BEETLES (COLEOPTERA: CHRYSOMELIDAE: CASSIDINAE)

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Abstract.—New country records with localities are provided for 63 species of New World Cassidinae. Data are based on specimens in the National Museum of Natural History, Smithsonian Instituion, Washington, D.C., U.S.A. Host plant data from specimen labels, including several new records, are reported for some species.

Resumen.—Se sumistran nuevos registros para algunos países con localidades para 63 especies de escarabajos cassidines americanos. Los datos estan basados en la colección del Museo Nacional de Historia Natural (E.U.). Se sumistran datos de plantas hospedadoras a partir de etiquetas de algunos especímenes, incluyendo nuevos registros.

Key Words: Chrysomelidae, Cassidinae, distribution, host plants

The subfamily Cassidinae was recently catalogued by Borowiec (1999). By updating taxonomic names and providing known host records, distributional data, and a bibliography, Borowiec established a baseline for further research on the Cassidinae. The large collection of Cassidinae at the National Museum of Natural History, Smithsonian Institution, Washington, DC, was not personally examined by Borowiec in the preparation of the catalogue. The strength of this collection is in its representation of New World material. Based on my examination of specimens, I here provide data that extend the distributions of 63 New World species in 15 genera and give available associated host plant information.

METHODS

Names follow Borowiec (1999) with genera and species listed in alphabetical order. Data are given as on labels, with the month of collection in roman numerals and the number of specimens in parentheses. Plant data from specimen labels are indicated and discussed. Data are limited to species which I could identify. Dissections or type examinations were not done to confirm names.

New Range Extensions in the Subfamily Cassidinae

Agroiconota propinqua (Boheman).—Known distribution: Colombia, Costa Rica, Cuba, Nicaragua, Panama. New records: Dominican Republic: San Cristobal, 26.VII.1917, coll. H. Morisson (2); N. of San Cristobal, at Blanton Mine, 26.VII.1917, coll. H. Morisson (54); Santo Domingo, 10.VI.1934, coll. S.T. Danforth (2); La Toma, N. of San Cristobal, 9-10.VI.1969, colls. Flint & Gomez (1); S. Domingo, Guaiamati, VII.1925, coll. H.E. Box (2); Haiti: Pt. Au Prince, coll. R.J. Crew (12); Pt. Au Prince, VIII.1920, coll. G.N. Wolcott. Jamaica: Chapinand, 13.VIII.1935, coll. Blackwelder (20); Kingston, IV.1906, coll. V. Duzee (2); Green Hills, 28.XI.1961, coll. A.B. Gurney (1); Cockpit City, 13-20.XII.1966, coll. J. Maldonado (2); Spanish Town, on prison farm, ex sweet potato [Convolvulaceae], 5.VI.1917 (1). USA: Puerto Rico: Peñuelas, IX.1960, coll. M. Santiago (4). Venezuela: El Limon, AR 450 m, 18.VIII.1951, coll. F. Fernandez (1).

Agroiconota subtriangularis Spaeth.—Known distribution: Peru. New record: Bolivia: Coroico (1).

Agroiconota tristriata (Fabricius).—Known distribution: Argentina, Brazil, French Guiana, Paraguay, Peru, Suriname. New records: Venezuela: Suapure, Caura, 21.XII.1899, coll. E.A. Klages (1); Orinoco, Caura River, coll. S.M. Klages (1).

Charidotella (Xenocassis) puella (Boheman).—Known distribution: Belize, Colombia, Costa Rica, Ecuador, Mexico, Nicaragua. New records: Peru: Omaguas, coll. F. Knab (16). Honduras: Tela, coll. W.M. Mann (1), in banana thrash, 10.X.1935, coll. R.L. Trigg (1); La Ceiba, 22.XI.1915, coll. F.J. Dyer (1); La Ceiba, 19.IV.1911, coll. F.J. Dyer (1); Tegucigalpa, 3.IV.1917 (1); Tegucigalpa, 5.IV.1917, coll. F.J. Dyer (2); Tela, ex sweet potato [Convolvulaceae], coll. W.M. Mann.

Discomorpha (Discomorpha) biplagiata (Guérin).—Known distribution: Brazil, Colombia, Mexico. The record from Mexico is questionable (Borowiec 1999). New records: Ecuador: coll. F. Campos (13); on floor of banana hold, 16.IV.1936, coll. Scott (1); Chiquinita (2); El Salado, coll. F. Campos (10); Guayaquil, coll. F. Campos (2). Venezuela: Suapure, Caura River, 1.VII.1899, coll. E.A. Klages (10); Suapure, Caura River, 12.V.1900, coll. E.A. Klages (1).

Discomorpha (Discomorpha) metallica (Guérin).—Known distribution: Bolivia, Brazil. New record: Peru: Satipo, IV.1944 (1).

Discomorpha (Discomorpha) miniata (Boheman).—Known distribution: Colombia. New record: Trinidad: coll. Wells (1); Siparia, I.1936 (4).

Discomorpha (Discomorpha) variegata (Linnaeus).—Known distribution: Caribbean, French Guiana, Suriname. New records: Guyana: Georgetown (1); Blairmont Plantation, coll. H.E. Box (3).

Discomorpha (Vulpia) fryi (Spaeth). Known distribution: Peru. New record: Bolivia: [no additional data] (1).

Dorynota (Akantaka) bivittipennis (Boheman).—Known distribution: Brazil. New records: Peru: Huanuco, X.19?? (pin obscures data), coll. A. Miller (1); Tarapato, V-VIII.1886, coll. M. de Mathan (1).

Dorynota (Akantaka) distincta (Baly).—Known distribution: Ecuador. New records: Bolivia: Chapare, coll. Zischka (1); Santa Cruz, Buena Vista, Tax, 10.III.1951, coll. A. Martinez (1).

Dorynota (Akantaka) viridisignata (Boheman).—Known distribution: Argentina, Bolivia, Brazil. New record: Paraguay: Alto Paraguay, Emboscada (1).

Dorynota (Dorynota) nodosa (Boheman).—Known distribution: Colombia, Panama. New records: Venezuela: Suapure, Caura River, 18.I.1900, coll. E.A. Klages (1); Cua, Estado Miranda, coll. C.H. Ballou (2).

Dorynota (Dorynota) pubescens Blake.—Known distribution: Dominican Republic. New records: Haiti: 3.III.1950, coll. G.N. Wolcott (11); Constanza, 3–4000 ft, VIII.1938 (1).

Echoma (Echoma) bonfilsii (Boheman).—Known distribution: Ecuador, Peru. New record: Brazil: [no additional data] (1).

Echoma (Echoma) clypeata (Panzer).—Known distribution: Bolivia, Brazil, Ecuador, French Guiana, Guyana, Paraguay, Peru. New records: Venezuela: Suapure, Caura River, 4.VIII.1899, coll. E.A. Klages (1); Suapure, Caura River, 22.IX.1899, coll. E.A. Klages (1); Suapure, Caura River, 6-12.IX.1899, coll. E.A. Klages (1); Cojedes, San Carlos DEFORSA, 150 m, 7.X.1997, colls. C.J. Rosales, S. Kiefer & J. Segovia (3); Cojedes, San Carlos DEFORSA, 150 m, 9.X.1997, coll. C.J. Rosales (3).

Echoma (Echoma) quadristillata (Boheman).—Known distribution: Costa Rica.

Nicaragua. New record: Guatemala: Puerto Barrios, 24.II.1905 (4).

Eutheria piperata (Burmeister).—Known distribution: Uruguay. New record: Argentina: Buenos Aires, Biolujan Tigre, coll. Martinez (1).

Gratiana insculpta (Boheman).—Known distribution: Mexico. New records: Panama: Canal Zone, coll. G. Irenao (1); Canal Zone, rd to Corozal, IX.1912, coll. H.G. Ireneo (2).

Metrionella angularis (Champion).—Known distribution: Costa Rica, Nicaragua. New records: Panama: Bocas del Toro, 3.VII.1908, ex *Ipomoea* sp. [Convolvulacaeae], coll. W. Robinson (1). This is the first host plant record for this genus of 12 species.

Microctenochira aberrata (Weise).—Known distribution: Costa Rica, Guatemala, Nicaragua. New records: Honduras: La Ceiba, Rio Congrejal, south, 3.IX.1979, coll. G.V. Manley (1); La Ceiba, Rio Congrejal, south, 11.IX.1979, coll. G.V. Manley (1).

Microctenochira aciculata (Boheman).—Known distribution: Brazil. New records: Argentina: Misiones, San Ignacio, coll. Baden (1). Paraguay: Caagualu, Paso Yabai, 15.XI.1951, coll. Foerster (1).

Microctenochira aspersa (Champion).—Known distribution: Costa Rica, Panama. New records: Colombia: Nicanse, in banana debris, 7.XII.1936, coll. T. Charles (1). Guatemala: Quirigua, 7.V.1926, coll. J.M. Aldrich. Mexico: in banana debris, 8.XII.1936, coll. G.C. Martin (2); Oax. Tuxtepex, IV.1934 (6); San Antonio, 5.III.1968, ex palm fronds [Aracaceae], coll. D. Johnson. Palms are probably an unreliable host plant record since records for 10 of the 104 *Microctenochira* indicate only dicotyledonous host plants. Also, the tribe Cassidini is not known to be a palm-feeding group.

Microctenochira bonvouloiri (Boheman).—Known distribution: Guatemala, Mexico. New records: USA: Texas, Brownsville, coll. Townsville (1); coll. Wickham (3); Esper. Rch. (1); 24.VI.1938 (15).

Microctenochira diffinis (Boheman).—Known distribution: Bolivia, Colombia, Ecuador, French Guiana, Peru. New records: Guyana: Demerara, coll. R.J. Crew (1). Suriname: Kwakoegron, Saramacca R., 13.VI.1927 (1); Brokopondo District: Brownsberg Naturpark, Mazaroni Plateau, 4–500 m, 19-25.VIII.1982, Malaise trap, coll. W.E. Steiner (1).

Microctenochira faimairei (Boheman).—Known distribution: Bolivia, Colombia, Ecuador, Panama, Peru. New record: Brazil: Prov. Mato Grosso, 1866, coll. P. Germain (1).

Microctenochira plebeja (Boheman).—Known distribution: Nicaragua, Mexico. New record: Guatemala: with *Dracaena* cuttings, det. at Miami, 26.VIII.1969, coll. A.S. Mills (1).

Omaspides (Omaspides) clathrata (Linnaeus).—Known distribution: French Guyana, Guyana, Suriname. New record: Brazil: Para, Cachimbo, IX.1954, coll. M.A. Ivarenga (1).

Omaspides (Omaspides) ellipsigera Spaeth.—Known distribution: Brazil. New record: Peru: Achinamiza, 10.VII.1925 (1).

Omaspides (Omaspides) specularis Erichson.—Known distribution: Colombia, Ecuador, Peru. New record: Brazil: Hyutanahan, Rio Purus, coll. S.M. Klages (1).

Omocerus (Nebroma) scabrosus (Boheman).—Known distribution: Argentina, Brazil. New record: Bolivia: Isiamus, XII, coll. W.M. Mann (1).

Omocerus (Omocerus) aeruginosus (Boheman).—Known distribution: Brazil, Suriname, Venezuela. New records: Bolivia: Caranavi, coll. Denier (1); Nueva Moka, Gutierrez, XI.1951, coll. Prosen (2). Guyana: Blairmont Plantation, coll. H.E. Box (3).

Omocerus (Omocerus) bicornis (Linnaeus).—Known distribution: Brazil, French Guyana, Suriname. New record: Venezuela: Suapure, Caura River, 24.VI.1900, coll. E.A. Klages (1).

Omocerus (Omocerus) relucens (Spaeth).—Known distribution: Colombia. New record: Guyana: Blairmont Plantation, coll. H.E. Box (2).

Omocerus (Omocerus) taurus (Boheman).—Known distribution: Colombia, Cuba, Brazil, French Guiana, Guyana, Trinidad, Venezuela. New record: Jamaica: [no additional data] (1).

Omocerus (Paratauroma) casta (Boheman).—Known distribution: Costa Rica, Ecuador, Nicaragua, Panama, Venezuela. New record: Colombia: [no additional data] (1).

Omocerus (Paratauroma) caeruleopunctatus (Boheman).—Known distribution: Nicaragua. New record: Panama: [no additional data] (2).

Omocerus (Paratauroma) smaragdinus (Boheman).—Known distribution: Brazil. New records: Bolivia: Rurrenabaque, Beni, VII.1925, coll. G.L. Harrington (1); Rurrenabaque, Beni, X, coll. W.M. Mann (1). Colombia: Villavincencio, Meta, 18.VII.1938 (1).

Omocerus (Platytauroma) truncatus (Boheman).—Known distribution: Argentina, Bolivia, Brazil, Colombia, Paraguay. New record: French Guiana: Cayenne (1).

Orexita dolorosa Spaeth.—Known distribution: Amazonas. New record: Peru: Satipo, II.1944 (2).

Orexita picta (Boheman).—Known distribution: Brazil. New records: Argentina: Misiones, 1947, coll. Heritier (1). Paraguay: Caaguazu, Paso Yabai, 15.XI.1951, coll. J. Foerster (4); Caaguazu, Paso Yabai, 26.XI.1951, coll. J. Foerster (1); Hogenau, X.1940, coll. Schade (1).

Orexita sp. New record: Guyana: [no additional data] (2). This is the first record of the genus in Guyana.

Spaethiella miniata (Boheman).—Known distribution: Colombia. New record: Panama: Barro Colorado Is., Canal Zone, 29.XII.1928 (1).

Spaethiella costipennis (Boheman).—Known distribution: Brazil, Ecuador, Peru. New record: Bolivia: Santa Cruz, Buena Vista, Tacú, 10.III.1951, ex Marantaceae, coll. A. Martinez (1). This is probably a valid host plant since other *Spaethiella* species and closely related tribes are monocot feeders. Host data is known for only 3 of the 33 *Spaethiella* species and these are in the Arecaceae.

Spaethiella erhardti (Boheman).—Known distribution: French Guiana, Suriname. New record: Peru: Amazon Center for Education and Environmental Research, 28.III.1999, colls. M. Lawson & D. Krabill (1).

Spaethiella laevicollis (Spaeth).—Known distribution: Colombia. New record: Venezuela: Caracas Valley, 20.IV.1922 (2).

Stolas acuta (Boheman).—Known distribution: Brazil. New record: Paraguay: 1900, coll. Cosset (1).

Stolas aenea (Olivier).—Known distribution: Brazil, French Guiana. New records: Paraguay: Sapucay, coll. W.T. Foster (2); San Bernardino, coll. K. Fiebrig (1).

Stolas consanguinea (Kirsch).—Known distribution: Peru. New record: Ecuador: Chiquinola (1).

Stolas conspersa (Germar).—Known distribution: Brazil. New records: Paraguay: Bernardino, coll. K. Fiebrig (6); Villarica, II.1922, coll. P. Jørgensen (1).

Stolas festiva (Klug).—Known distribution: Argentina, Bolivia, Brazil, Uruguay. New records: Paraguay: Col. Independencia, 23.III.1951, coll. Foerster (2); Caaguazu, Paso Yabai, 15.XI.1951, coll. J. Foerster (2); S. Estanislao, coll. Schade (1, USNM); Hohenau, III.1953, coll. F. Walz (3); Hohenau, coll. Schade (2): Hohenau, coll. Podtiaguin (2); P. Lopez, coll. Podtiaguin (5); Colonia, San Lazaro, Rio Apa, coll. Podtiaguin (1).

Stolas ignita (Boheman).—Known distribution: Brazil. New record: Argentina: Misiones, IX.1947, colls. S. Javier, P. Londero & Monrós (1).

Stolas implexa (Boheman).—Known distribution: Brazil. New record: Uruguay: Cerro Largo, Frail Muer. to Flossdorf (1).

Stolas inaequalis (Linnaeus).—Known

distribution: Brazil, Suriname. New records: Guyana: Georgetown (1). Venezuela: El Dorado Bo, 100 m, 25.VIII.1954, coll. C.J. Rosales (2).

Stolas isthmica (Champion).—First host plant data: ex *Ipomoea* sp. (3); ex *Ipomoea purga* (1) (Convolvulaceae); and ex *Xanthosoma sagittifolium* (L.) Schott and Endl. (Araceae) (3). *Ipomoea* is probably a valid host since it is a common one for many cassidines. Among the 170 *Stolas* species, host data is known for only 14 species and 8 of these are recorded from *Ipomoea* spp. On the other hand, *Xanthosoma* is probably not a valid host record since derived cassidine genera like *Stolas* tend to feed on dicotyledonous host plants. The Araceae have not been recorded as a host for any cassidines.

Stolas lacordairei (Boheman).—Known distribution: Argentina, Brazil, Paraguay, Uruguay. New record: Chile: Sta. Lucia, San José, 1935, coll. E.P. Reed (7).

Stolas quatuordecimsignata (Boheman).—Known distribution: Bolivia. New record: Peru: Sta. Rosa Convencion, 1936, coll. J. Soukoup (6).

Stolas subcaudata (Spaeth).—Known distribution: Paraguay. New records: Argentina: Salta, II.1941, colls. Oran, Tabillas & Martinez (1). Bolivia: Trinidad, Rio Ibare, 3.I.1948, coll. Kuschel (1).

Stolas submetallica (Weise).—Known distribution: Peru. New record: Bolivia: Chapare, 400 m, coll. Zitschka (1).

Stolas punicea (Boheman).—Known distribution: Belize, Guatemala, Mexico, Nicaragua. New records: Honduras: Loncotilla, 31.I.1928, coll. P.C. Standley (1); La Ceiba, 23-30.V.1978, coll. G.V. Stanley (4); La Ceiba, 10.VI.1978, coll. G.V. Stanley (5); La Ceiba, 1916, coll. F.J. Dyer (1).

Stolas tristigma (Boheman).—Known distribution: Belize, Brazil, Guatemala, Honduras, Mexico, Nicaragua. New records: Argentina: Chaco, Resistencia, coll. Monros (1). Paraguay: [no additional data] (1); Chaco Dpto., Boquerón, 18.XII.1959, coll. Foerster (2); Hohenau, Col. Independencia, 23.IV.1951, coll. Foerster (2); Puerto Pinosco, coll. Podtiaguin (2); Caaguazu, Paso Yobai, 13.X.1951, coll. Foerster (1).

Syngambria andreae (Boheman).—Known distribution: Bolivia, Brazil. New record: Paraguay: Hohenau, X.1940, coll. Schade (4).

Tapinaspis wesmaeli (Boheman).—Known distribution: Colombia, Costa Rica, Guatemala, Mexico. New record: El Salvador: Lake Coatepeque; 19.VII, colls. G.F. & S. Hevel (1).

DISCUSSION

The records reported here document extended distributions of these species. Borowiec's (1999) catalogue is an invaluable reference and serves as a basis for further systematic and biological work on the Cassidinae. Additional range extensions and other biological data are expected for cassidines as existing collections are examined and new collections are made.

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THE NEW WORLD TRIBES AND GENERA OF HISPINES (COLEOPTERA: CHRYSOMELIDAE: CASSIDINAE)

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Abstract.—The tribes and genera of New World hispines are revised and a key to the 98 genera is presented. The traditional division of hispines and cassidines is rejected as inadequate. The name of the subfamily is Cassidinae. The tribe Imatidiini Hincks 1952 is synonymized with Cephaloleiini Chapuis 1875 (**new synonym**). Oediopalpini Monrós and Viana 1947 is synonymized with Spilophorini Chapuis 1875 (**new synonym**). The tribes Delocrariini Hincks 1952 and Hemisphaerotini Hincks 1952 are treated since they are often confused with hispines. *Ocnosispa* Weise 1910 and *Pseudispa* Chapuis 1875 are elevated to full generic status. *Plicatopalpa* Pic is synonymized with *Uroplata* Chevrolat (**new synonym**). ***Serratispa quadricosta*, n. gen., n. sp.** from Brazil is described and placed in the tribe Sceloenoplini.

Key Words: Cassidinae, hispines, genera

Hispines (Coleoptera: Chrysomelidae: Cassidinae) are a group of approximately 3,000 species worldwide (Uhmann 1957b, 1958, 1964; Seeno and Wilcox 1982). Currently they are placed in 170 genera and 24 tribes (Seeno and Wilcox 1982). According to the present classification, there are no tribes or genera indigenous in both the Old and New Worlds.

Weise (1911) published the most recent key to the New World genera, covering the 49 genera described by that date. He (Weise 1910, 1911) also proposed the tribal classification that is still in use. There has been little change in the higher classification since then. In proposing his tribal classification Weise latinized the names proposed by Chapuis (1875) but did not attribute the names to Chapuis. Subsequent authors have attributed the tribal names to Weise (1910, 1911) but the author is Chapuis [ICZN Article 11(f) (1999)]. Uhmann (1957b, 1964) compiled the most recent catalog, containing 82 genera and 1,391 species. Seeno and Wilcox (1982) recorded 83 genera from the New World.

There have been several regional revisions of New World hispines. The most comprehensive of these are Monrós and Viana (1947) for Argentina and Staines (1996b) for Nicaragua. Other works are Blaisdell (1939), Butte (1968a, b, c, 1969), Clark (1983) and Riley (1985) on certain genera in America north of Mexico; Sanderson (1967) on the West Indies hispines; Uhmann (1930a, b, 1934, 1935c, 1937c) on Costa Rican species; Ramos (1998) on Brazilian *Oxychalepus*, and Staines (1996a) the Central American and West Indian *Cephaloleia*. Fourteen genera have been treated for the entire New World: Fischer (1935) revised *Coraliomela*, *Mecistomela*, *Alurnus*, and *Pseudocalaspidea*; Spaeth (1938) revised *Imatidium* (now divided into *Aslam-*

idium, Imatidium, Parimatidium, and *Rhodimatidium*); Staines revised *Brachycoryna* (1986), *Acritispa* (1988), *Octotoma* (1989b, 1994a), *Anisostena* (1993a, 1994b, c, d), and *Physocoryna* (1999); and Ramos (1996) revised *Clinocarispa.*

History of Higher Classification

There is some difficulty in clearly defining hispines. While there are a combination of characters to separate them from cassidines, various intermediate genera connect the two groups. The line dividing them have been differently placed by different systematists. For example, the genus *Imatidium* Fabricius has been placed in both groups at one time or another. Weise (1910) suggested that the tribes Oediopalpini and Cephaloleiini may belong in the cassidines rather than the hispines, based on life history studies. Barber (1946) described *Cubispa* and placed it in the Hispinae; Monrós (1954) argued that it was a Eumolpinae.

While the intent of this article is to provide a workable key to the tribes and genera normally placed in the hispines, a short review of the literature on the higher classification of the Hispinae-Cassidinae is in order. Latreille (1802, 1803, 1807, 1829) proposed Hispe as part of the tribe Cassidaires in the family Cycliques. Gyllenhal (1813) proposed the group Cassideae for the genus *Cassida* Linnaeus and Hispoideae for the genus *Hispa* Linnaeus. Stephens (1829) proposed the family Hispidae. Westwood (1839) placed the group in the Cassididae in the subsection Phytophaga. Lacordaire (1845–1848) proposed the Hispides in Tribe 4. Chapuis and Candeze (1853) placed the group as the tribe Hispides in Division III. Chapuis (1875) placed the Hispinae and Cassidinae in Section IV—Cryptostomes. Jacoby (1908) followed the same system making Cryptostoma Division V. Jacoby's basic system has been followed by subsequent workers, some using family designations for the two groups and others leaving them as subfamilies. Chen (1940) created the family Cassididae with Hispinae and Cassidinae as subfamilies, but most workers have not followed this system. Crowson (1955) included the Cassidinae as part of the Hispinae. Monrós (1959) proposed the group Cassidiformes with the two subfamilies. Chen (1964) then proposed the family Hispidae with the subfamilies Anisoderinae, Hispinae, and Cassidinae. Chen (1973) also proposed the new superfamily Cassidoidea with four families:

1. Cassididae (= Cassidinae of the older system).

2. Anisoderidae consisting of the tribes Anisoderini, Cryptonychini, Eurispini, Prosopodontini, Alurnini, Pharangispini, Coelaenomenoderini, Promecothecini, Cephaloleiini, Arescini, Hysbosispini, and Gonophorini.

3. Hispidae consisting of the tribes Exothispini, Chaeridionini, Oncocephalini, Hispini, Sceloenoplini, Hispoleptini, Chalepini, and Uroplatini.

4. Callispidae consisting of the tribes Callispini, Leptispini, and Oediopalpini.

The tribes Hemisphaerotini, Spilophorini, Delocranini, and Imatidiini were not placed in a family by Chen (1973).

Suzuki (1985, 1988, 1994) considered the subfamily Cassidinae with two tribes Hispini and Cassidini. Chen et al. (1986) further refined the 1973 classification. Borowiec (1995) considered the subfamily Hispinae and proposed a tribal classification of the genera normally considered Cassidinae; one of the proposed changes was the synonymization of the Cassidinae tribe Imatidiini with the hispine tribe Cephaloleiini.

Reid (1995) looked at chrysomelid subfamilies using cladistic methods. He combined hispines and cassidines into the subfamily Hispinae before he did his analysis. This treatment avoided addressing the question of monophyly and relative rank of the taxa. Reid stated that there is not enough data available for a resolution of relationships without considerable massage of the data; his system is to be considered tentative.

Lawrence and Newton (1995) considered

hispines and cassidines as the subfamily Hispinae. Verma (1996) treated Hispinae and Cassidinae as separate subfamilies based on the male genital system. Suzuki (1996) proposed a classification of the subfamily Cassidinae with the tribes Hispini and Cassidini. Farrell (1998) treated Cassidinae and Hispinae as separate subfamilies based on DNA analysis. Hsiao and Windsor (1999) found that there was a complete separation of cassoid and hispoid groups based on DNA analysis of 48 species. This work however did not include three tribes of hispines (Arescini, Hispoleptini, and Sceloenoplini) so the results may be modified by future work.

It is obvious from the preceding summary that there is uncertainty over the rank and status of the Hispinae and Cassidinae. From a systematic point of view merely changing the rank or name of a taxon does not solve the problem of its relationship to other taxa. I agree with Schmitt (1996) that listing intermediate forms as *incertae sedis* would clearly signal unsolved problems while lumping two taxa (including the intermediate forms) would only gloss over our lack of knowledge and not remedy it.

Morphologically and biologically there is no valid reason for retaining Hispinae and Cassidinae as separate subfamilies. The presence of intermediate forms (the tribes Basiprionotini, Cephaloleiini, Delocranini, Epistictinini, Hemisphaerotini, Imatidiini, Notosacanthini, Oediopalpini, and Spilophorini) effectively bridge the subfamilies which were erected based on Palearctic, Nearctic, and a few tropical genera. The most obvious characters mentioned to separate the subfamilies is that cassidines have the margins of the pronotum and elytra expanded, the head often covered by the pronotum, and the free living larvae possessing paired caudal appendages on the last abdominal segment while hispines do not have the expanded elytral and pronotal margins and the larvae are leaf miners and lack caudal appendages. However, these characters break down and are possessed by genera placed in different subfamilies. The adult of *Notosacantha* looks like a typical cassidine but the larvae are leaf miners and have a caudal fork (Medvedev and Eroshkina 1988, Rane et al. 2000). The adult of *Oediopalpa* looks like a typical hispine but the larvae are free living and have a caudal fork (Bruch 1905). The larvae of *Delocrania* and some *Hemisphaerota* (both cassidines and not leaf miners) have the caudal fork reduced or absent (Bondar 1922). The larvae of *Imatidium* (cassidine) is waterpenny-like and lacks caudal appendages (Bondar 1940). The larvae of *Prosopodonta* (hispine) are leaf miners and have the ninth abdominal segment modified into appendage-like structures (Maulik 1931) as do the larvae of *Brontispa* (Maulik 1938). Adults of *Pseudocalaspidea* and some *Sceloenopla* (hispines) have the elytral margins expanded; *Adalurnus* and *Demotispa* (hispines) have both the elytral and pronotal margins expanded.

Workers who have proposed the merger of the two groups, with which I agree, usually call the combined subfamily the Hispinae. However, since Gyllenhal (1813) proposed both Cassidinae and Hispinae in the same publication the valid name is Cassidinae since it appeared on p. 434 while Hispinae appeared on p. 448 [ICZN Article 23.1 (1999)]. The name would still be Cassidinae if one applied the determination of the first reviser [ICZN Article 24.2 (1999)] (Chen 1940).

Chen (1940), Suzuki (1985, 1988, 1994, 1996), Reid (1995), and Lawrence and Newton (1995) combined hispines and cassidines as a subfamily but retained the division between them at the tribal level. Since hispines and cassidines are not clearly distinct at the subfamily level, merely reducing the taxonomic rank does not solve the problem. Either a third tribe would need to be erected to accomodate the intermediate forms which is not acceptable or the entire idea of hispines and cassidines as separate taxonomic units needs to be rejected. I reject the traditional cassidine-hispine division as inadequate because of the intermediate forms linking the groups and am treating them as the subfamily Cassidinae and going directly to the 42 current tribes.

TAXONOMIC TREATMENT

The tribe Chalepini was proposed for genera with 11-segmented antennae while the tribe Uroplatini was proposed for genera with 8- or less segments (Weise 1910). Since 1910 the genera *Charistena, Decatelia* (in part), *Sternostenoides,* and *Sternoplispa* with 10-segmented antennae have been placed in Chalepini. The remaining species of *Decatelia* have 9-segmented antennae. The genera *Cnetispa* and *Nonispa* have 9-segmented antennae and are placed in Uroplatini. These genera totally obscure Weise's tribal divisions, therefore I am combining the two tribes under the name Chalepini.

Bruch (1905) described all life stages of *Oediopalpa negligens* (Weise) and found the larva and pupa to be cassid-like. Weise (1910) suggested the tribe may belong in the Cassidinae based on the general biology and the larvae having a caudal fork. Monrós and Viana (1947) mentioned the different biology of the group but retained it in the Hispinae where it has remained. Borowiec (1995) did not discuss the Oediopalpini.

The cassidine tribes Delocraniini, Hemisphaerotini, and Spilophorini are often confused with hispines. In fact, Spilophorini shares the same morphological characteristics as Oediopalpini (a seta present in each pronotal angle and the prosternum projecting forward to partly cover the mouth) and the two tribes are synonymized as Spiliphorini. Delocraniini and Hemisphaerotini are included in the key for the convenience of workers.

I agree with Borowiec (1995) that the cassidine tribe Imatidiini is a synonym of the hispine tribe Cephaloleiini. Reasons not mentioned by Borowiec is that *Demotispa* (Cephaloleiini) has the same type species as *Pseudimatidium* (Imatidiini) and the described larvae of the two groups share the same morphology (see Maulik 1931 and Bondar 1940). Hsiao and Windsor (1999) based on DNA analysis found that *Imatidium, Aslamidium,* and *Rhodimatidium* formed a distinct group with *Cephaloleia.* The genera *Imatidium, Parimatidium, Aslamidium, Rhodimatidium, Calliaspis, Stilpnaspis, Pseudostilpnaspis,* and *Spaethaspis* are included in this paper.

The genus *Cubispa* is an anomaly. Some characters are hispine-like but an equal number are eumolpine-like. The genus needs extensive study to determine its proper placement but it is not a hispine due to the absence of setae in any of the pronotal angles, the structure of the mouthparts, the lack of bifid tarsal setae, and lack of a pars stridens (Staines 2000). R. W. Flowers also considers *Cubispa* to be an eumolpine (personal. communication.).

Seeno and Wilcox (1982) list the genus *Cladophora* Dejean 1837: 390 as *incertae sedis.* Dejean (1837) listed this name and included the species *flabellata* Dejean. Neither name had a description associated with it, so they do not fulfill the requirements of Article 12.1 (ICZN 1999) and are *nomina nuda.*

Description.—*Head:* Opisthognathous, prominent, visible from above, at least to behind eyes; frons prominent, exposed or rarely retracted; antenna not retractable, closely inserted between eyes. *Pronotum:* Narrower than elytra; more or less quadrangular or trapezoidal, with definite anterior angle which may have small tubercle. *Scutellum:* Always visible. *Elytra:* Without lateral expansions or with reduced and discontinuous expansions; margins usually denticulate or with spines. *Larvae:* Either leafminers or free living; eight pairs of abdominal spiracles well developed and dorsally placed; eighth abdominal segment terminal, with free hind margin.

Ecologically, New World hispines fall into three feeding groups: external feeders; sheath, appressed or rolled-leaf feeders; and leaf miners. In the Old World some species have been reported as stem borers in her-

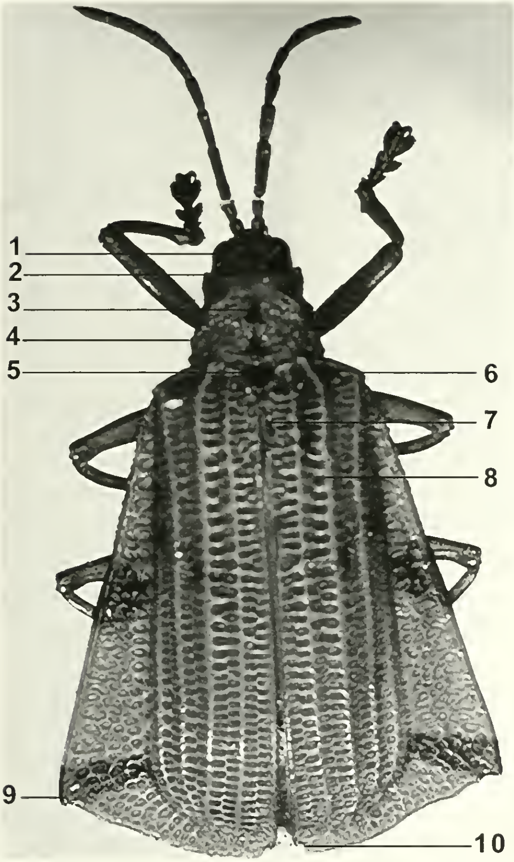


Fig. 1. Dorsal morphology of Hispinae. 1 = vertex of head; 2 = anterior angle of pronotum; 3 = pronotal disc; 4 = lateral margin of pronotum; 5 = scutellum; 6 = humerus; 7 = scutellar puncture row; 8 = elytral costa; 9 = exterior apical angle of elytron; 10 = sutural angle of elytron.

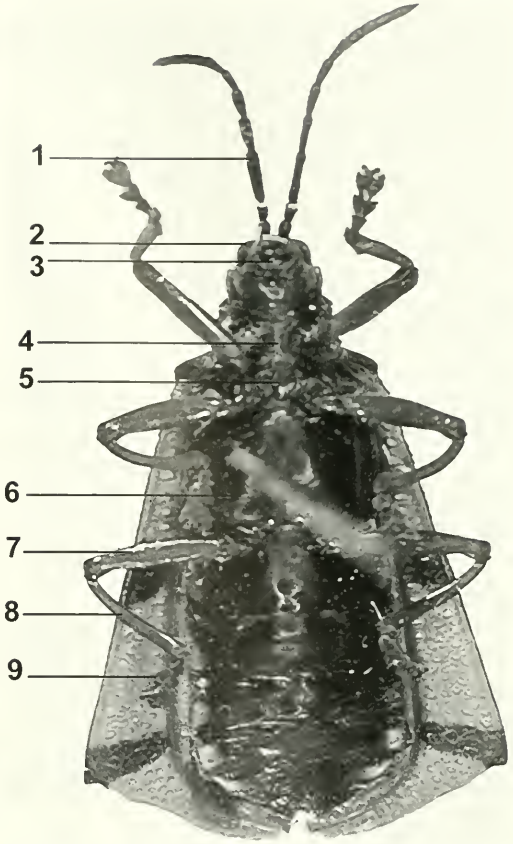


Fig. 2. Ventral morphology of Hispinae. 1 = antenna; 2 = eye; 3 = oral cavity; 4 = prosternum; 5 = mesosternum; 6 = metasternum; 7 = femur; 8 = tibia; 9 = tarsus.

baceous or semi-ligneous plants, but this has not been reported from the New World. The biology of few species has been studied; most species are not associated with a host plant or plant family.

ADULT MORPHOLOGY

From the literature on hispines, there is no uniform nomenclature for the various body parts. In order to aid in the use of this key, the following terms are defined as they are used throughout the manuscript. They are shown on Figs. 1 and 2.

Occiput: Region surrounding occipital and postoccipital sutures and in live adults mostly covered by pronotum.

Vertex: Separated from occiput by occipital suture, occupies post-ocular region.

Eye: Elongate, following dorso-ventral axis, slightly prominent, multifaceted, slightly kidney-shaped.

Frons: Upper anterior portion of head capsule between front and clypeus.

Clypeus: Quadrangular, elongate, united to labrum.

Labrum: Triangular, united to clypeus and oral orifice.

Oral orifice: Subelliptical cavity which occupies middle part of head.

Antenna: 3- to 11-segments, inserted in antennal pit in front of eyes.

Pronotum: Occupies all of dorsal part of prothorax, laterally margined. In anterior angles or posterior angles sometimes a small tubercle with a seta.

Scutellum: Sclerotized portion of mesonotum, visible between elytral bases. More or less triangular or quadrate.

Elytron: Strongly sclerotized mesothoracic wings, remaining open during flight. When closed, they cover to last abdominal segment. Elongate and quadrangular form and flat surface, convex at sides. Sculptured with large punctures usually in regular rows; some species carinate. Most species with costae. Sutural margin somewhat raised; lateral and apical margins dentate or not.

Prosternum: Contains two anterior coxal cavities.

Mesosternum: Narrow between middle coxae, separated from metasternum by a transverse suture. Forms anterior part of middle coxal cavities.

Metasternum: Large, with median longitudinal suture. Forms posterior border of hind coxal cavities.

Episternum: Anterior and larger lateral thoracic sclerite between sternum and notum.

Parapleura: Lateral sclerite between dorsal and sternal parts of thorax.

Coxa: Located in coxal cavity, spherical.

Trochanter: Small, united to base of femur.

Femur: Largest part of leg; more or less cylindrical, united at base to trochanter and at apex to tibia.

Tibia: Variable in length; joins femur and tarsus.

Tarsus: Each with five tarsomeres, penultimate degenerated. Last tarsomere with claws. Basal tarsomere small, triangular; second bilobed, larger than first; third larger than second, with two pronounced lobes; last tarsomere more or less conical, with one or two curved claws at distal end; segments 1 to 3 flattened, with dense pubescence on lower surface.

Abdomen: With five visible sternites; sternites 1 and 2 mores strongly united that others.

KEY TO NEW WORLD TRIBES

1\. Elytron without costae or costae are vestigial; rows of punctures little impressed; antenna 10- or 11-segmented 2
– Elytron costate; rows of punctures strongly impressed; antenna 3- to 11-segmented . . 9
2(1). Pronotum without seta in any angle (or along anterior margin) (Fig. 3) 3
– Pronotum with seta present in 2 or 4 angles (or along anterior margin) 4
3(2). Pronotum with prominent, anteriorly projected lobes, rounded in front . . Delocraniini
– Pronotum without prominent, anteriorly projected lobes . . . . Hybosispini
4(3). Pronotum with a tuft of setae present in each angle; very large (more than 25 mm.) species; elytral punctures random or with only vestiges of order . . . . Alurnini
– Pronotum with a single seta present in 2 or 4 angles (or along anterior margin); elytral punctures more or less in rows; smaller species (less than 20 mm.) 5
5(4). Anterior margin of prosternum expanded forward, partially covering mouth (Fig. 5); pronotum with a seta present in all four angles . . . . Spilophorini
– Anterior margin of prosternum not expanded forward; pronotum with a seta present in each anterior or posterior angle (or along anterior margin) 6
6(5). Pronotum with a seta present in each posterior angle . . . . Prosopodontini
– Pronotum with a seta present in each anterior angle (or along anterior margin) . . 7
7(6). Antennae not separated by a longitudinal keel; pro- and mesocoxae very large . . . . Arescini
– Antennae separated by a longitudinal keel; coxae normal 8
8(7). Mesosternum deeply emarginate, emargination deepened for reception of prosternal process . . . . Hemisphaerotini
– Mesosternum not deeply emarginate . . . . Cephaloleiini
9(1). Antenna thickened at apex . . . . . . Chalepini
– Antenna not thickened at apex 10
10(9). Apical 4 antennal segments different from others (either longer or shorter, thinner or thicker, more pubescent, different in color); clypeus clearly visible . . . . Sceloenoplini
– Apical 4 antennal segments similar to others; clypeus obscure . . . . Hispoleptini

Tribe Spilophorini Chapuis 1875: 364

Amplipalpini Weise 1910: 69.
Oediopalpini Monrós and Viana 1947: 140. **New synonymy.**

Type genus.—*Spilophora* Boheman.

Description.—*Head:* Second and third palpomeres of maxillary and labial palps enlarged, longer and wider than others; clypeus transverse, with upper margin curved, emarginate, overlapping antennal base; antenna 11-segmented. *Pronotum:* Pit containing a seta present in each angle, posterior setae on cones, anterior ones on disc or edge of lateral margin. *Elytron:* With 10 regular rows of shallow punctures; scutellar row absent; intervals not costate. *Venter:* Prosternum with front margin elongate, transverse, raised, partially concealing mouth; abdomen with suture between sterna 1 and 2 obsolete in middle. *Legs:* Apical tarsomere triangular, flattened before claws; claws short.

Key to Genera

1. Elytra (at base) much wider than base of pronotum, rounded (Figs. 5, 7) 2
– Elytra (at base) not much wider than base of pronotum, parallel-sided (Fig. 6) . . . *Oediopalpa*
2. Antennomere III longer than IV and V combined, III–VI with internal angle with an acute spine . . . . *Spilophora*
– Antennomere III shorter than IV and V combined, III–VI internal angle without acute spine . . . . *Calyptocephala*

Calyptocephala Chevrolat
(Fig. 5)

Calyptocephala Chevrolat 1837: 391. Type species: *Cassida nigricornis* Germar (by monotypy).

Description.—*Head:* Rounded, visible dorsally; front subconvex; labrum large, slightly wider than long, apical margin truncate, with medial longitudinal carina; maxillary palp with apical palpomere oblong, longer than preceding; eye oval, slightly convex. *Antenna:* Filiform; ½ length of body; 11-segmented; antennomere I oblong, obconic; II thinner and shorter than I; III 2× as long as II; remainder gradually decreasing in length. *Pronotum:* 2× as wide as long, at base narrower than base of elytra, convex; anterior margin slightly emarginate, angles of emargination obtuse; anterior angle rounded, with a seta in each angle; lateral margin curved, convergent anteriorly; posterior margin almost straight. *Scutellum:* Elliptical. *Elytron:* Subtriangular or suboval, wide basally, narrowed and rounded apically, convex; humerus prominent, subacute. *Venter:* Prosternum with apex notched, narrowed between coxae, dilated apically, truncate basally. *Legs:* Tibiae rounded, notched on apical ⅓, exterior margin subangulate; tarsi wide, tarsomere 1 narrower than rest, 4 little longer than lobes of 3; claws simple, divericate.

Host plants.—*Arecastrum, Astrocaryum, Chamaedorea, Elaeis* (Arecaceae); *Dioscorea* (Dioscoreaceae); *Chusquea* (Poaceae) (Jolivet and Hawkeswood 1995).

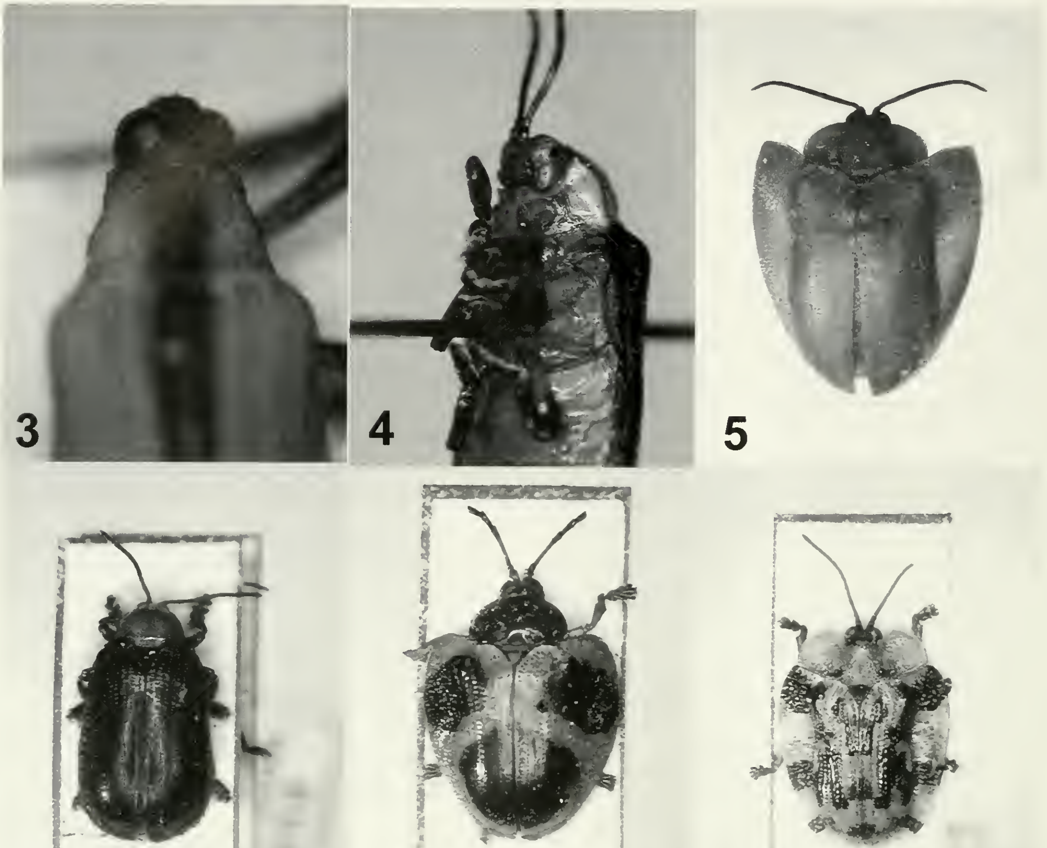
Described species.—11. Key to species: Wagener (1881) covered 6 species.

Range.—Mexico to Argentina.

Oediopalpa Baly
(Figs. 4, 6)

Oediopalpa Baly 1858: 16. Type species: *Hispa cyanipennis* Fabricius (designated by Monrós and Viana 1947).
Amplipala Harold 1875: 185 [invalid replacement name for *Oediopalpa*].
Charispa Baly 1875: 73 [invalid replacement name for *Oediopalpa*].

Description.—Body more or less elongate, moderately convex. *Head:* Small; vertex flat or weakly depressed; eye oblong to oval, finely faceted; mouth small, exposed area covered by palps; mandible dentate. *Antenna:* 11-segmented; thick; antennomere III longest. *Pronotum:* Transverse, apex narrowed; regularly convex, may be impressed in each angle; sometimes with lateral impressions; disc with deep punctures. *Scutellum:* Quadrangular or pentagonal; rounded at apex. *Elytron:* Little wider than pronotum; slightly constricted behind pron-



Figs. 3–11. 3, Setae in anterior angle of pronotum. 4, *Oediopalpa* sp., prosternum. 5–11, Dorsal habitus. 5, *Calyptocephala nigricornis* (Germar). 6, *Oediopalpa cyanipennis* (Fab.). 7, *Spilophora trigemina* (Guérin). 8, *Aslamidium* (s. str.) *caprense* (Herbst). 9, *Aslamidium* (*Neoaslamidium*) *strandi* (Uhmann). 10, *Callasapis cinnabarina* Boheman. 11, *Cephaloleia nitida* Uhmann.

otum, then subparallel; apex conjointly rounded; lateral and apical margins finely serrate or smooth. *Legs:* Short, thick, femora widest, inner margin serrate or not. *Venter:* Prosternum almost flat (Fig. 4). Some species orange or reddish-yellow brown; others may be metallic dark blue, green to black.

Host plants.—*Arundo, Bambusa, Oryza, Panicum, Poa, Saccharum, Zea* (Poaceae) (Jolivet and Hawkeswood 1995).

Described species.—37. Key to species: Weise (1910) covered twenty species; Monrós and Viana (1947), Argentina.

Range.—Mexico to Argentina.

Spilophora Boheman
(Fig. 7)

Spilophora Boheman 1850: 107. Type species: *Calyptocephala trigemina* Guérin-Méneville (designated by Monrós and Viana 1947).

Description.—*Head:* Rounded, visible dorsally; front concave; labrum large, quadrate, apical margin triangularly emarginate, convex, subcarinate medially; maxillary palp with palpomere 4 oblong, subtruncate at apex; eye oval, convex. *Antenna:* ½ length of body, filiform, 11-segmented; antennomere I short, thick, obconic; II shorter and narrower than I; III very long, narrow, as long as IV to VI combined; III–VI with internal angle with an acute spine; VII–XI cylindrical, shorter and narrower than preceding. *Pronotum:* Transverse, at widest ½ width of elytra, convex; anterior margin regularly rounded or slightly sinuate in middle; anterior angle obsolete; posterior angle rectangular; posterior margin sinuate. *Scutellum:* Triangular. *Elytron:* Convex; humerus rounded; lateral margin slightly dilated. *Venter:* Prosternum sinuate in middle, slightly narrowed between coxae, flat, base dilated, subtruncate. *Legs:* Short, robust; femora fusiform; tibiae straight, sometimes subarcuate basally, obliquely truncate apically; tarsi robust, dilated, tarsomere 1 nearly as wide as others, 4 dilated from base to apex, slightly exceeding lobes of 3; claws simple, divaricate.

Host plants.—Unknown.

Described species.—16. Key to species: Wagener (1881) covered 7 species.

Range.—Colombia to Ecuador and Peru.

TRIBE CEPHALOLEIINI CHAPUIS 1875: 277

Callispites Chapuis 1875: 269.
Himatidiites Chapuis 1875: 361 (in part).
Himatidiitae Spaeth 1929: 113.
Imatidiini Hincks 1952: 328. **New synonym.**

Type genus.—*Cephaloleia* Chevrolat.

Description.—Body shape approximately parallel or slightly narrowed behind or oval; explanate margin of pronotum and elytra narrow to moderately broad. *Head:* Suture present at union of oral cavity and antennal bases; without frontal plate; clypeus very short; labrum without carina; neck very short, ledge-shaped. *Antenna:* 10- or 11-segmented. *Pronotum:* Wide; a seta present in anterior angle or along anterior margin. *Elytron:* Noncostate; puncture rows shallow. *Venter:* Metepisternum fused with metepimeron.

KEY TO GENERA

1. Antenna 10-segmented .... *Calliaspis*
– Antenna 11-segmented 2
2(1). Mouthparts projecting forward and visible from above; labrum large, joining head at an oblique angle; anterior margin of pronotum crenate in middle 3
– Mouthparts not projecting forward; anterior margin of pronotum not crenate ... 4
3(2). Antennomere II longest; elytral margins smooth .... *Homalispa* (*Xanthispa*)
– Antennomere III longest; elytral margins serrate .... *Homalispa* (*Homalispa*)
4(2). Elytron rounded, broadly oval or widened apically 5
– Elytron parallel-sided 14
5(4). Antenna pectinate or with antennomeres modified 6
– Antenna filiform 7
6(5). Male antenna pectinate on antennomeres IV to X; female antenna with projections on antennomeres IV to X; pronotum without transverse sulcus ...... *Octocladiscus*
– Antennomeres I to X of both sexes with

projection; pronotum with transverse sulcus . . . . *Cladispa*

7(5). Interantennal carina distinct 8

– Interantennal carina not distinct 10

8(7). Antennomere I longer and thicker than II; pronotum with notch external to setiferous tubercle on anterior emargination; tibiae obliquely and abruptly emarginate appearing pointed externally 9

– Antennomeres I to II subequal in length; anterior margin of pronotum without notches; tibiae not pointed externally . . . . *Demotispa*

9(8). Body elongate, parallel-sided; pronotum rectangular; elytra slightly to moderately wider than pronotum; prosternal process with deep groove along sides . . . . *Asladmidium* (*Neoaslamidium*)

– Body broad, sides rounded; pronotum almost semicircular; elytra much wider than pronotum; prosternal process with several shallow, short grooves at apex . . . . *Aslamidium* (s. str.)

10(7). Posterior part of elytral margin serrate; posterior angle of pronotum sharp and projecting behind; elytra finely dentate externally toward apex; metepisternum separated from metasternum by a distinct suture . . . . *Parimatidium*

– Posterior part of elytral margin smooth; posterior angle of pronotum not as above; elytra not dentate; metepisternum more or less fused posteriorly with metasternum 11

11(10). Antennomeres I and II globular . . . . *Pseudostilpnaspis*

– Antennomeres I and II elongate 12

12(11). Antennomere I subequal in length to II . . . . *Imatidium*

– Antennomere I ½ the length of II 13

13(12). Pronotum with sides almost parallel . . . . *Spaethaspis*

– Pronotum with sides convergent from base to apex . . . . *Stilpnaspis*

14(4). Elytra at base slightly wider than pronotum 15

– Elytra at base much wider than pronotum 16

15(14). Elytra widens apically . . . . *Euxema*

– Elytra parallel-sided . . . . *Stenispa*

16(14). Pronotum longer than wide; base of elytron with carina to humerus; last three abdominal sterna hirsute . . . . *Solenispa*

– Pronotum as wide or wider than long; base of elytron without carina; last three abdominal sterna not hirsute 17

17(16). Pygidium for most part visible from above; maxillary palp with palpomeres 2 and 3 smaller than 1 . . . . *Cephaloleia*

– Pygidium not visible from above; maxillary palp with palpomere 3 longer than 1 and 2 combined . . . . *Melanispa*

Aslamidium Borowiec
(Fig. 8)

Aslamidium Borowiec 1984: 412. Replacement name for *Imatidium:* Aslam (1965: 689) a misapplication of *Imatidium* Fabricius 1801. Type species: *Cassida capense* Herbst (by original designation).

Description.—*Head:* Frons concave posteriorly; eye projecting; interocular space equal to maximum width of an eye; antenna inserted equidistant between eyes and interantennal carina; interantennal carina sharp and united to a transverse carina which encloses oral cavity behind and around labrum; labrum very short and transverse; maxillary palp with palpomere 4 thicker and slightly longer than 3. *Antenna:* 11-segmented, narrowed apically; antennomere I thicker and longer than II; III at least 2× length of II; IV to X decreasing in length; XI laterally compressed and longer than X. *Pronotum:* Small notch on external side of setiferous tubercle within apical emargination; deeply impressed on either side at base; sparsely punctate; lateral margin convergent from base to apex, recurved; anterior angle rounded. *Scutellum:* Broadly triangular. *Elytron:* Lateral margin laminate, lamina reticulate; lateral and apical margin smooth; slightly indented behind humerus; with 10 rows of moderately impressed punctures plus scutellar row. *Venter:* Metepisternum fused posteriorly with metasternum; hypomera beside anterior coxal cavities with transverse impression; 4 visible abdominal sterna. *Legs:* Tibia obliquely and abruptly emarginate, appearing pointed externally.

Host plants.—*Calathea* (Marantaceae) (Jolivet and Hawkeswood 1995).

Described species.—9. Key to species: Group 3 in Spaeth (1938).

Range.—Guatemala to Ecuador.

Aslamidium (*Neoaslamidium* Borowiec)
(Fig. 9)

Aslamidium (*Neoaslamidium*) Borowiec 1998: 371. Type species: *Imatidium formosum* Spaeth (by original designation).

Description.—As in *Aslamidium* except: Body elongate, parallel-sided. *Pronotum:* Rectangular. *Elytron:* Slightly to moderately wider than pronotum; lateral margin impunctate; lateral and apical margins narrow, in widest part narrower than ½ width of elytral disc. *Venter:* Prosternal process with deep groove along margins.

Host plants.—Unknown.

Described species.—3.

Range.—Costa Rica to Ecuador.

Calliaspis Dejean
(Fig. 10)

Calliaspis Dejean 1837: 391. Type species: *Cassida rubra* Olivier (by monotypy).

Calliapis Boheman 1850: 81 (*lapsus calami*).

Cyanaspis Weise 1904: 433. Type species: *Cyanaspis testaceicornis* Weise (by monotypy). Spaeth 1905 (synonymy).

Description.—Convex; rounded. *Head:* Deeply inserted into pronotum; depressed between eyes; medial sulcus present. *Antenna:* 10-segmented; antennomeres VII to X hirsute; I to VI glabrous. *Pronotum:* At base nearly as wide as base of elytra; sparsely punctate; lateral margin strongly curved and convergent toward apex. *Scutellum:* Broadly triangular. *Elytron:* Lateral margin laminate, recurved; indented behind humerus; apex conjointly rounded; lateral and apical margins smooth; with 10 rows of punctures plus scutellar row; interspaces wide. *Venter:* 4 visible abdominal sterna; sternite 4 with medial notch on apical margin; metasternum punctate laterally, smooth in middle.

Host plants.—Unknown.

Described species.—18. Key to species: Wagener (1881) covered 10 species.

Range.—French Guyana to Peru.

Cephaloleia Chevrolat
(Fig. 11)

Cephaloleia Chevrolat 1837: 30. Type species: *Hispa nigricornis* Fabricius (designated by Staines 1991).

Cephalolia Blanchard 1845: 162 *nec* Weise 1910 (*lapsus calami*).

Uhmannispa Monrós and Viana 1947: 172. Type species: *Uhmannispa maculata* Monrós and Viana (by monotypy); Uhmann 1957b (synonymy).

Description.—Body elongate, rather parallel (rarely oval); flat or moderately convex. *Head:* Small; eye finely faceted, slightly prominent. *Antenna:* 11-segmented, as long as head and pronotum combined, filiform; antennomere I thicker and longer than II; slightly thickened at apex. *Pronotum:* Quadrangular, usually wider than long, frequently widest behind anterior angle; weakly convex; lateral margin gradually converge toward base. *Scutellum:* Short; pentagonal or elongate triangle. *Elytron:* Varying in form and contour; lateral margin widened behind humerus or humerus insignificant; one segment of pygidium exposed; with 10 rows of punctures plus scutellar row.

Host plants.—*Alpinia, Renealmia* (Zingiberaceae); *Heliconia* (Heliconiaceae); *Calathea, Ischnosiphon, Maranta* (Marantaceae); *Cyclanthus* (Cyclanthaceae); *Costus* (Costaceae); *Cocos, Diplothemium, Elaeis, Geonoma* (Arecaceae); *Cordyline* (Agavaceae); *Panicum, Pharus, Saccharum* (Poaceae); *Canna* (Cannaceae); *Musa* (Musaceae); *Ananas* (Bromeliaceae); Cyperaceae (Jolivet and Hawkeswood 1995).

Described species.—202 ±. Key to species: Uhmann (1936b) covered 29 species in his collection; Monrós and Viana (1947), Argentina; Staines (1996a), Central America and the West Indies.

Range.—Mexico to Argentina.

Cladispa Baly

Cladispa Baly 1858: 22. Type species: *Cladispa quadrimaculata* Baly (by monotypy).

Description.—Body broadly oval; flattened. *Head:* Short; vertex punctate; frons vertical; eye oval; maxillary palp with palpomere 2 almost as long as other three combined; clypeus with margin evenly arcuate. *Antenna:* 11-segmented, ½ body length; antennomeres II to V wider than I; each antennomere with pointed, oblique angle on inner apical margin; antennomere I thicker than II or III, cylindrical; II and III compressed laterally; apical 6 antennomeres slender and short, gradually decreasing in thickness. *Pronotum:* At midline wider than long, convex; disc impunctate; lateral margin parallel for basal ¾s, then sharply convergent, punctate, and margined laterally; basal margin bisinuate; basal impression present, defined by a transverse sulcus; anterior margin slightly emarginate. *Scutellum:* Short, almost pentagonal; impunctate. *Elytron:* Slightly wider than pronotum; with 10 rows of shallow punctures; margined laterally. *Venter:* Smooth; with 4 visible abdominal sterna. *Legs:* Tibiae emarginate on outer surface, concave enough to cover tarsi; tarsomere 4 not projecting beyond lobes of 3.

Host plant.—*Cyrtopodium* (Orchidaceae) (Jolivet and Hawkeswood 1995).

Described species.—1.

Range.—Brazil.

Demotispa Baly
(Fig. 12)

Demotispa Baly 1858: 65. Type species: *Demotispa pallida* Baly (designated by Monrós and Viana 1947).

Xenispa Baly 1858: 63. Type species: *Xenispa pulchella* Baly (by monotypy); Weise 1910 (synonmy).

Demothispa Gemminger and Harold 1876: 3599 (*lapsus calami*).

Pseudimatidium Aslam 1965: 691. Type species: *Demotispa pallida* Baly (by original designation); Borowiec 2000 (synonymy).

Description.—Body elonagte to elongate-oval, flattened. *Head:* Small; frons vertical; antennal base with keel or may be broadly separated; interantennal carina distinct; eye slightly protruding; maxillary palp with palpomeres 2 to 4 subequal in length. *Antenna:* 11-segmented, long, filiform; antennomeres I–II short, subglobular; III longest, IV to XI subequal in length. *Pronotum:* Slightly narrower than base of elytra, transverse; lateral margin curved, narrowly laminate. *Scutellum:* Pentagonal, cuspidate behind. *Elytron:* Oblong-oval, wider than pronotum, convex, indented behind humerus; lateral margin often expanded, smooth; with 10 rows of punctures plus scutellar row. *Venter:* Prosternum narrow; mesosternum transverse; 4 visible abdominal sterna. *Legs:* Short; claws divaricate.

Host plants.—Unknown.

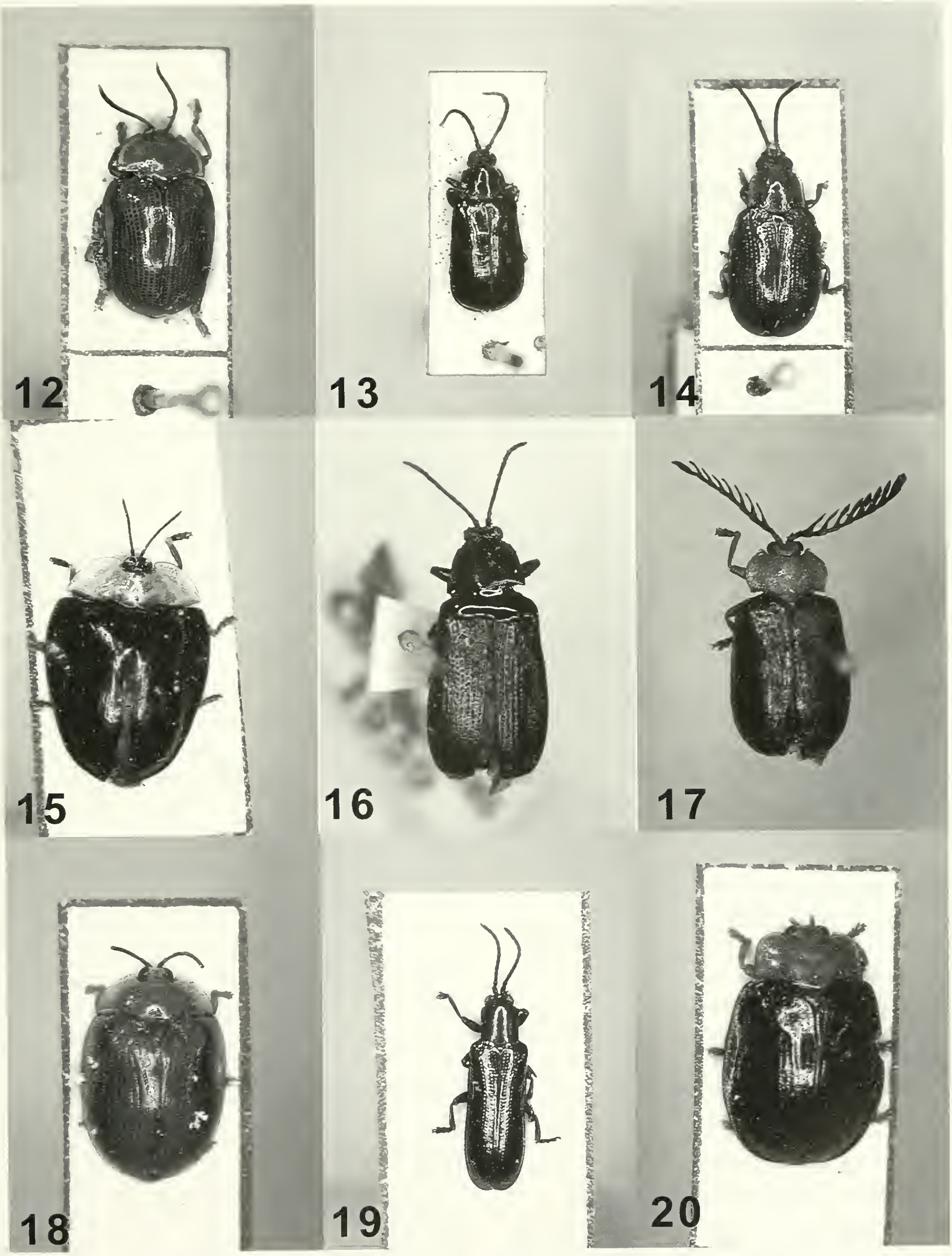
Described species.—48. Key to species: Uhmann (1937a, 1948) covered 23 species; Sanderson (1967), West Indies; group 4 in Spaeth (1938).

Range.—Mexico to Argentina.

Euxema Baly
(Fig. 13)

Euxema Baly 1885: 3. Type species: *Euxema insignis* Baly (by monotypy).

Description.—Body attenuate, moderately convex, gradually widening behind. *Head:* Medial sulcus absent; vertex impunctate. *Antenna:* 11-segmented, filiform, barely ½ body length; antennomere I thicker than others; II short; III longest, 3× length of II; IV to XI uniform in width and length. *Pronotum:* Transverse, slightly narrowed behind, highly convex; apical margin prolonged into lobe which projects over head; margined laterally; basal impression present; lateral impression present in posterior angle; impunctate except for impressions which have large, dense punctures. *Scutellum:* Pentagonal. *Elytron:* Convex; margined laterally; lateral margin smooth;



Figs. 12–20. Dorsal habitus. 12, *Demotispa pallida* Baly. 13, *Euxema insignis* Baly. 14, *Homalispa* sp. 15, *Imatidium thoracicum* (F.). 16, *Melanispa truncata* Baly. 17, *Octocladiscus fasciatus* (Guérin). 18, *Parimatidium rubrum* (Boheman). 19, *Solenispa leptomorpha* (Baly). 20, *Spaethaspis peruviana* Borowiec.

apical margin finely dentate; with 10 rows of lightly impressed punctures.

Host plants.—Unknown.

Described species.—2.

Range.—Panama to Venezuela.

Homalispa Baly
(Fig. 14)

Homalispa Baly 1858: 33. Type species: *Homalispa batesii* Baly (by original designation).

Description.—Body oval or oblong-oval, rather flat. *Head:* Small; eye elongate; frons depressed, obliquely directed forward; labrum large, visible from above; mandible long, bidentate; labium large, almost as long as wide; clypeus short, with one narrow cross striation which is ledge-shaped and bent upwards; mouthparts projecting forward. *Antenna:* 11-segmented, thin, filiform, inserted in a frontal depression, not separated by a keel; antennomere III not longest. *Pronotum:* Transverse; lateral margin convergent apically; anterior margin angularly pointed; narrower than elytra. *Scutellum:* Pentagonal, cuspidate behind. *Elytron:* Wider than pronotum, indented behind humerus; humerus impunctate; lateral and apical margins smooth; with 10 rows of punctures plus scutellar row.

Host plants.—*Lasiacis, Olyra* (Poaceae); *Scleria* (Cyperaceae) (Jolivet and Hawkeswood 1995).

Described species.—26.

Range.—Nicaragua to Argentina.

Homalispa (*Xanthispa* Baly)

Homalispa (*Xanthispa*) Baly 1858: 31. Type species: *Cephaloleia cimicoides* Guérin-Méneville (by monotypy).

Description.—As in *Homalispa* except: Antennomere III longest; lateral and apical margins of elytra serrate.

Host plants.—Unknown.

Described species.—1.

Range.—Brazil.

Imatidium Fabricius
(Fig. 15)

Imatidium Fabricius 1801: 345. Type species: *Imatidium thoracicum* Fabricius (designated by Latreille 1810).

Himatidium Latreille 1804: 131 [unjustified emendation].

Himatidella Aslam 1965: 690. Type species: *Imatidium thoracicum* Fabricius (by original designation); Borowiec 1984 (synonymy).

Description.—*Head:* Posterior half of frons flattened; eye not projecting; interocular width less than width of an eye; distance between antenna not less than 2× distance between antenna and an eye; interantennal carina not raised, transverse carina behind labrum absent; labrum distinct. *Antenna:* 11-segmented, not thickened apically; antennomere I equal in length to II; II more than ½ length of III; IV to X decreasing in length; XI not laterally compressed and shorter than X; IV to XI setose. *Pronotum:* Without notch external to anterior setae; sparsely punctate; no depressions present; lateral margin convergent from base to apex. *Scutellum:* Broadly triangular. *Elytron:* Lateral and apical margins laminate; slightly indented behind humerus; with 10 rows of moderately impressed punctures plus scutellar row. *Venter:* Hypomera with transverse impression beside anterior coxal cavity; 4 visible abdominal sterna. *Legs:* Tibiae not pointed externally though excavated subapically.

Host plants.—*Areca, Astrocaryum, Arecastrum, Bactris, Cocos, Desmoncus, Elaeis, Geonoma, Licuala, Livistona, Phoenix, Pritchardia* (Arecaceae); *Heliconia* (Heliconiaceae) (Jolivet and Hawkeswood 1995).

Described species.—14. Key to species: Group 2 in Spaeth (1938).

Range.—Mexico to Peru.

Melanispa Baly
(Fig. 16)

Melanispa Baly 1858: 30. Type species: *Melanispa truncata* Baly (by monotypy).

Description.—*Head:* Moderately slender, flat; triangular depression present on vertex; punctate between eyes; palpomere 3 of labial palp clavate, longer and wider than preceding. *Antenna:* 11-segmented, slender, filiform, ½ length of body; antennomere I thickened; III longest; I to V shiny, others dull. *Pronotum:* Transverse, slightly narrower than elytra; disc depressed; sparsely punctate; lateral margin convergent from base to apex; margined laterally; basal margin bisinuate. *Scutellum:* Large, triangular. *Elytron:* Lateral and apical margins smooth; humerus not produced; parallel-sided; truncate at apex; pygidium not exposed; with 10 rows of lightly impressed punctures plus scutellar row. *Venter:* Pro-, meso-, and metasterna smooth medially, punctate laterally; with 5 visible abdominal sterna.

Host plant.—Unknown.

Described species.—1.

Range.—Guadeloupe.

Octocladiscus Thomson
(Fig. 17)

Octocladiscus Thomson 1856: 480. Replacement name for *Cladophora* Guérin-Méneville 1844: 284 [name preoccupied by *Cladophora* Guérin-Méneville (Coleoptea: Lycidae)]. Type species: *Cladophora fasciatus* Guérin-Méneville (by monotypy).

Description.—Body broadly oval, flattened. *Head:* Vertex punctate; eye finely faceted. *Antenna:* 11-segmented, ½ length of body; antennomeres II and III short, following antennomeres longer; male pectinate from antennomeres IV to X; female filiform, with projection on antennomeres IV to X. *Pronotum:* At midline 2× as wide as long; lateral marign strongly rounded, narrowing anteriorly; disc impunctate; large shallow punctures present laterally and basally. *Scutellum:* Elongate triangle. *Elytron:* Oblong-oval, wider than pronotum; margined laterally; pygidium visible from above; with 10 rows of punctures plus scutellar row. *Venter:* 5 visible abdominal sterna.

Host plant.—Unknown.

Described species.—1.

Range.—French Guyana.

Parimatidium Spaeth
(Fig. 18)

Parimatidium Spaeth 1938: 307. Type species: *Imatidium rubrum* Boheman (by original designation).

Description.—*Head:* Posterior frons flattened and anterior part depressed; interocular space less than the width of an eye; eye large; interantennal carina and transverse carina behind labrum absent; labrum distinct; maxillary palp with palpomere 4 longer than 3. *Antenna:* 11-segmented, not thickened apically; antennomere III longer than II; XI longer than X. *Pronotum:* Emargination on anterior margin shallow, without notch external to anterior seta; lateral margin strongly convergent from base to apex; lateral impressions absent; posterior angle sharp and acute. *Scutellum:* Broadly triangular. *Elytron:* Lateral margin laminate, dentate externally toward apex, slightly indented behind humerus; with 10 rows of punctures plus scutellar row. *Venter:* Metepisternum distinct posteriorly; hypomera with transverse impression external to anterior coxal cavities. *Legs:* Tibiae not pointed externally, excavated subapically.

Host plant.—*Elaeis* (Arecaceae) (Jolivet and Hawkeswood 1995).

Described species.—5. Key to species: Spaeth (1938) treated as a subgenus of *Imatidium.*

Range.—Venezuela to Paraguay.

Pseudostilpnaspis Boroweic

Pseudostilpnaspis Boroweic 2000: 162. Type species: *Stilpnaspis columbica* Weise (by original designation).

Description.—Body elongate, almost parallel-sided or slightly narrowed posteriorly. *Head:* Interantennal area narrow (not wider than first antennal antennomere), flat or slightly convex, not carinate. *Antenna:* 11-segmented; antennomeres I–II short, subglobular; III distinctly longer that II; I–II sparsely pubescent and glabrous, III–XI densely pubescent, dull. *Pronotum:* Widest at base, slightly narrower than base of elytra; sides on basal ⅓ parallel or slightly converging anteriorly; explanate sides very narrow, not wider than width of antennomeres. *Elytron:* With 10 rows of lightly impressed punctures plus short scutellar row; explanate margin narrow, at widest not wider than two elytral intervals combined.

Host plant.—Unknown.

Described species.—3.

Range.—Costa Rica to Colombia.

Solenispa Weise
(Fig. 19)

Solenispa Weise 1905a: 53. Type species: *Solenispa impressicollis* Weise (designated by Uhmann 1957b).

Description.—Body long, narrow. *Head:* Vertex deeply concave, descending to margin of eye; eye protruding; clypeus with medial carina extending between antennal bases. *Antenna:* 11-segmented; antennomeres I, III, and XI longer than others. *Pronotum:* Longer than wide, completely margined, convex; parallel-sided; basal impression present; punctate flattened area present near midpoint on each side. *Scutellum:* Elongate, triangular. *Elytron:* Lateral and apical margins smooth; apex conjointly rounded; basal margin carinate to humerus; with 10 rows of shallow punctures plus scutellar row. *Venter:* Epipleura visible from oblique angle; pro- and mesocoxae large, globular; prosternum narrow; 5 visible abdominal sterna, first two punctate laterally, last three hirsute.

Host plants.—Unknown.

Described species.—9.

Range.—Costa Rica to Ecuador.

Spaethaspis Hincks
(Fig. 20)

Spaethaspis Hincks 1952: 343. Type species: *Spaethaspis lloydi* Hincks (by monotypy).

Description.—Body elongate; pronotum rectangular with sides almost parallel. *Head:* Vertex finely and sparsely punctate, deeply impressed; interocular space broad, flat; interantennal carina absent; clypeus very short, nearly 4× as wide as long; maxillary palp with palpomere 4 subequal in length to 3. *Antenna:* 11-segmented; basal two antennomeres glabrous; remaining antennomeres feebly pubescent; antennomere II ½ length of I or III; IV subequal in length to III. *Pronotum:* Transverse; anterior margin deeply emarginate in middle; lateral margin straight for basal ⅔s, then slightly converging towards apex; anterior angle broadly rounded; basal margin prominent and more or less truncate adjacent to scutellum, slightly oblique on either side to rectangular posterior angle; posterior angle with shallow depression; sparsely, finely punctate on disc, strongly, distinctly punctate at sides. *Scutellum:* Broadly triangular. *Elytron:* Moderately wide, almost 2× as long as wide; transverse impression behind humerus; lateral margin expanded, somewhat concave with polished margin, slightly widened behind, broadly rounded at apex; with 10 rows of fine punctures plus scutellar row; striae wide. *Venter:* Prosternum broad, strongly expanded behind with deep longitudinal striae, middle stria longest and widest; abdominal sternites flat, very finely punctate, apical segment more or less truncate, without apical emargination. *Legs:* Tarsal claws with large basal tooth.

Host plants.—Unknown.

Described species.—2.

Range.—Ecuador and Peru.

Stenispa Baly
(Fig. 21)

Stenispa Baly 1858: 13. Type species: *Hispa metallica* Fabricius (by original designation).

Description.—Body cylindrical or flattened; parallel-sided or narrowing posteriorly. *Head:* Small, rounded; frons concave;

maxillary palp with palpomere 1 small, 2 and 3 obconical, subequal in length and width, 4 oval, acuminate; antenna inserted close to eye in shallow pits, divided by longitudinal keel; eye oval, finely faceted, slightly prominent. *Antenna:* 11-segmented; antennomeres I to II subglobose; III to X cylindrical, III longer than IV; XI subacute, slightly dilated toward apex. *Pronotum:* Quadrate; slightly narrower than elytra; anterior margin rounded; lateral margin parallel. *Scutellum:* Pentagonal or subcylindrical. *Elytron:* Elongate; slightly convex; narrowing apically; lateral and apical margins finely dentate; with 10 rows of punctures plus scutellar row. *Legs:* Short; robust; femora stout; tibiae not arcuate, slightly flattened; tarsomeres dilated, densely pubescent beneath, tarsomere 4 with nearly half its length projecting beyond 3; claws stout, moderately arcuate, divaricate. *Venter:* Metepisternum very narrow at middle; prosternum narrow, longitudinally furrowed; abdominal sternites 1 and 2 with suture obsolete in middle.

Host plants.—*Carex, Cyperus, Scirpus* (Cyperaceae); *Paspalum, Spartina* (Poaceae); Juncaceae (Jolivet and Hawkeswood 1995).

Described species.—21. Key to species: Horn (1883), North America; Monrós and Viana (1947), Argentina.

Range.—United States to Argentina.

Stilpnaspis Weise
(Fig. 22)

Stilpnaspis Weise 1905b: 298. Type species: *Stilpnaspis marginata* Weise (by monotypy).

Rhodimatidium Aslam 1965: 690. Type species: *Himatidium coccinatum* Boheman (by original designation); Borowiec 2000 (synonymy).

Description.—Body oval to broadly oval; pronotum semicircular in outline, widest just before base, broadly explanate; explanate margin of elytra broad, at widest distinctly wider than elytral intervals 9 and 10 combined. *Head:* Posterior ½ of frons flattened, eye level with it; interocular space less than width of eye; distance between antennal insertion more than 2× the distance between antenna and eye; interantennal carina absent, area between antennal bases broad and flat; labrum long, somewhat narrowed, thickened at sides, without posterior transverse carina; maxillary palp with palpomere 4 longer than 3. *Antenna:* 11-segmented, antennomeres narrow, elongate; antennomere I thickest, robust, longer than wide; II longer than I; III longer than II. *Pronotum:* Transverse, convex, narrower at base than elytra at humeri; with emargination external to anterior seta; lateral margin convergent from base to apex, slightly recurved; without basal depressions; disc impunctate; sparsely punctate laterally. *Scutellum:* Broadly triangular. *Elytron:* Moderately convex; at base as wide as base of pronotum, slightly indented behind humerus, slightly widened before middle; lateral margin laminate, smooth; with 10 rows of lightly impressed punctures plus scutellar row; striae wide. *Venter:* Prosternum with transverse impression beside anterior coxal cavity; 4 visible abdominal sterna. *Legs:* Tibiae excavated subapically, not pointed externally.

Host plants.—Unknown.

Described species.—17. Key to species: Group 1 in Spaeth (1938).

Range.—Costa Rica to Argentina.

TRIBE DELOCRANIINI SPAETH 1929: 113

Hoplionotites Chapuis 1875: 357 (in part).

Type genus.—*Delocrania* Guérin-Méneville.

Description.—*Antenna:* Very long; apical antennomeres wider than long. *Pronotum:* Without anterior angle. *Venter:* Prosternum moderately wide between procoxae; prosternal process wide, truncate apically; mesosternum truncate in front, touching prosternum, not margined behind.

Delocrania Guérin-Méneville
(Fig. 23)

Delocrania Guérin-Méneville 1844: 141. Type species: *Delocrania cossyphoides* Guérin-Méneville (by monotypy).

Description.—*Head:* Barely visible dorsally; labrum transverse, subemarginate on apical margin, small oblique carina in middle; eye oval. *Antenna:* Placed on two tubercles; 11-segmented, filiform, extends just beyond base of pronotum; antennomere I thick; II cylindrical, shorter than I; remainder thinner, subequal in length. *Pronotum:* Wider than long, convex; anterior margin deeply emarginate behind head, emargination quadrate; anterior angle dilate-foliate, rounded; lateral margin slightly curved, sinuate at base; depressed laterally; posterior angle rectangular. *Scutellum:* Quadrate, rounded apically. *Elytron:* At base as wide as base of pronotum, convex; lateral margin dilated, flat; exterior apical angle rounded; with 10 rows of regular punctures, plus scutellar row; one costa present. *Legs:* Short; tibiae obliquely notched apically on external margin; tarsi wide, first three tarsomeres equal in width, tarsomere 4 as long as lobes of 3; claws divaricate.

Host plants.—*Attalea, Cocos, Diplothemium, Elaeis* (Arecaceae) (Jolivet and Hawkeswood 1995).

Described species.—3.

Range.—Costa Rica to Ecuador.

TRIBE HEMISPHAEROTINI MONRÓS AND VIANA 1951: 368

Himatidiites Chapuis 1875: 361 (in part).
Porphyraspitae Spaeth 1929: 113.

Type genus.—*Hemisphaerota* Chevrolat.

Description.—Small species (less than 10 mm); more or less oblong or oval, convex. *Head:* Partially visible dorsally. *Antenna:* 11-segmented, short, not extending beyond base of pronotum; apical antennomeres shorter than wide, thickened. *Pronotum:* Anterior angle prominent, with seta. *Elytron:* With lateral margin expanded. *Venter:* Prosternum short, wide between procoxae, not widened behind, truncate on anterior margin; mesosternum notched in front, depressed, posterior margin doubled; abdominal sternites 1 and 2 not fused. *Legs:* Short; robust; tibiae dilated; tarsi very wide.

KEY TO GENERA

1. Apical tarsomere with two claws; epipleural keel present . . . . *Spaethiella*
– Apical tarsomere with one claw (interior claw degenerate); epipleural keel absent . . . . *Hemisphaerota*

Hemisphaerota Chevrolat
(Fig. 24)

Hemisphaerota Chevrolat 1837: 391. Type species: *Cassida erythrocera* Germar (= *Imatidium cyanea* Say) (by monotypy).

Emperochela Spaeth 1901: 333. Type species: *Porphyraspis palmarum* Boheman (by original designation); Spaeth 1905 (synonymy).

Porphyraspis Hope 1840: 152. Type species: *Cassida erythrocera* Germar (by original designation); Guérin-Méneville 1844 (synonymy).

Description.—Body more or less hemispherical; elytra not strongly sculptured. *Head:* Visible dorsally; medial sulcus present; vertex punctate; clypeus transverse. *Antenna:* 11-segmented; antennomere I long, thick; II shorter than I, subequal in width; III–VII short, transverse; VIII–XI wider than preceding. *Pronotum:* Transverse; convex; anterior margin emarginate behind head; lateral margin curved; posterior angle rounded; depression present in anterior angle. *Scutellum:* Trapezoidal; acute at apex. *Elytron:* Convex, at base little wider than base of pronotum; lateral margin curved; apex conjointly rounded; epipluron without transverse carina; excavation behind epipluron for apex of femur; with 10 rows of regular punctures plus scutellar row. *Venter:* Prosternum wide, anterior margin curved, posterior margin with deep metasternal notch; metasternum large, posterior margin almost straight, anterior

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Figs. 21–29. Dorsal habitus. 21, *Stenispa metallica* (F.). 22, *Stilpnaspis rubiginosus* (Boheman). 23, *Delocrania panamensis* Champion. 24, *Hemisphaerota cyanea* (Say). 25, *Spaethiella circumdata* (Boheman). 26, *Hybosispa melanura* Weise. 27, *Arescus labiatus* Perty prosternum. 28, *Arescus labiatus*. 29, *Chelobasis bicolor* Gray, prosternum.

margin with notch for prosternal process. *Legs:* Short, robust; femora thick, triangular in cross-section; tibiae shorter than femora, triangular in cross-section, excavation on outer surface for reception of tarsi; tarsomeres very wide, flat, tarsomere 1 triangular, 2 larger than 1, transverse, bilobed, 3 deeply bilobed, larger than 2, 4 slightly exceeds lobes of 3; internal claws degenerate.

Host plants.—*Acoelorrhaphe, Arecastrum, Attalea, Chamaerops, Cocos, Sabal, Serenoa, Thrinax, Washingtonia* (Arecaceae) (Jolivet and Hawkeswood 1995).

Described species.—9. Key to species: Wagener (1881).

Range.—Southern United States to Brazil.

Spaethiella Barber and Bridwell
(Fig. 25)

Spaethiella Barber and Bridwell 1940: 11. Replacement name for *Hemisphaerota:* Spaeth 1905 not Chevrolat 1837. Type species: *Imatidium sanguineum* Fabricius (by original designation).

Description.—Body more or less hemispherical; elytra strongly sculptured. *Head:* Visible dorsally; medial sulcus present; vertex irregularly punctate; clypeus transverse, depressed. *Antenna:* 11-segmented; antennomere I long, thick; II subequal in length and width to I; III ½ length of II; VII–XI thicker than preceding. *Pronotum:* Transverse, convex, circular depression present on each side of disc; anterior margin emarginate behind head, with a pair of setae located on small promience on either side of head; lateral margin curved, expanded; posterior angle rounded. *Scutellum:* Trapezoidal; subtruncate at apex. *Elytron:* Convex, at base little wider than base of pronotum; lateral margin more or less parallel or slightly curved; apex conjointly rounded; epiplurae with transverse carina which is obsolete before margin; excavation behind for apex of femur; with 10 rows of regular punctures plus scutellar row. *Venter:* Prosternum wide, anterior margin curved, posterior margin with pointed projection; metasternum large, posterior margin almost straight, anterior margin with notch for prosternal process; suture separating abdominal sterna 1 and 2 distinct. *Legs:* Short, robust; femora thick, triangular in cross-section; tibiae shorter than femora, triangular in cross-section, excavation on outer surface for reception of tarsi; tarsi very wide, flat, tarsomere 1 triangular, 2 larger than 1, transverse, bilobed, 3 deeply bilobed, larger than 2, 4 slightly exceeds lobes of 3; claws short, equal, with small rectangular lamina between.

Host plants.—*Arecastrum, Astrocaryum, Bactris, Cocos, Copernicia, Elaeis, Phoenix, Pritchardia, Washingtonia* (Arecaceae); *Heliconia* (Heliconiceae) (Jolivet and Hawkeswood 1995).

Described species.—33. Key to species: Wagener (1881).

Range.—Guatemala to Peru.

TRIBE HYBOSISPINI WEISE 1910: 69

Type genus.—*Hybosispa* Weise.

Description.—*Head:* Frons with excavation divided by longitudinal keel from antennal base to clypeal margin; clypeus triangular; maxillary palp with palpomeres 2–3 short, 4 oval, as long as 2–3 combined; antenna inserted into pits at side of eye. *Antenna:* 11-segmented; filiform. *Pronotum:* Without setae in any angle. *Elytron:* Truncate posteriorly, part of pygidium exposed; 10 rows of punctures plus scutellar row.

Hybosispa Weise
(Fig. 26)

Hybosispa Weise 1910: 96. Type species: *Hybosispa melanura* Weise (by monotypy).

Description.—Body subcylindrical, attenuate, slightly convex. *Head:* Moderately large; eye large, wider above than below, finely faceted; frons with triangular excavation divided by a longitudinal keel from antennal base to clypeal margin; clypeus triangular; maxillary palp with palpomeres

2 and 3 short, 4 oval, as long as 2 and 3 combined; antenna inserted into pit at side of eye. *Pronotum:* Quadrate, ¼ wider than long; parallel-sided; finely margined on anterior margin; depression present on either side of middle near side margin; seta absent in all angles. *Scutellum:* As long as wide; pentagonal; cuspidate behind. *Elytron:* Wider than pronotum at humeri, gradually narrowing apically, truncate posteriorly, part of pygidium exposed; with 10 rows of punctures plus scutellar row. *Venter:* Mesosternum more elevated than prosternum.

Host plants.—Unknown.

Described species.—5.

Range.—Brazil to Bolivia.

TRIBE ARESCINI CHAPUIS 1875: 298

Type genus.—*Arescus* Perty.

Description.—Body attenuate, moderately convex; color red or yellow with black or blackish-blue markings. *Head:* Short; frontal horn usually present. *Antenna:* Inserted near clypeus, longer than head and pronotum combined; 11-segmented; antennomere I robust; II small; III attenuate, narrow; rest shorter and slightly thicker. *Pronotum:* Quadrate, wider than long; almost parallel-sided, converging suddenly at apex, slightly sinuate behind middle. *Scutellum:* Triangular; longer than wide. *Elytron:* Wider than pronotum at humeri; lateral margin subparallel; apex conjointly rounded; with 10 rows of punctures plus scutellar row, punctures often confused at sides and beyond middle. *Venter:* Pro- and mesosterna narrow; pro- and mesocoxae large, globular; suture between abdominal sternites 1 and 2 obscure in middle. Sexual dimorphism apparent in some genera.

KEY TO GENERA

1\. Prosternum not produced between mesocoxae (Fig. 27) 2

– Prosternum produced between mesocoxae (Fig. 29) 3

2(1). Pronotum with seta present in anterior angle; first antennomere simple, without prolongation; frontal horn long, cuspidate; sexes different . . . . *Xenarescus*

– Pronotum with seta present in all angles; first antennomere with spoon-shaped prolongation; frontal horn short, broadly truncate at apex; sexes similar . . . . *Arescus*

3(1). Pronotum with seta present in anterior angle; mesocoxae separated by diameter of a coxa (Fig. 30) . . . . *Chelobasis*

– Pronotum with seta present in all four angles; mesocoxae separated by less than diameter of a coxa (Fig. 32) . . . . *Nympharescus*

Arescus Perty
(Figs. 27–28)

Arescus Perty 1834: 100. Type species: *Arescus labiatus* Perty (by monotypy).

Description.—Body elongate, parallel; color usually yellow or red with variable black or bluish-black markings, markings may be absent on some specimens. *Head:* Frontal horn variable in length, truncate in front, female process a short triangle in some species; vertex depressed between eyes. *Antenna:* Antennomere 1 lengthened into an ventral process as long as antennomeres II and III combined. *Pronotum:* Quadrangular; basal margin bisinuate, deeply lobed; seta present in all four angles. *Scutellum:* Elongate, triangular. *Elytron:* Similar in both sexes; male without apical appendage; three species with longitudinal carina behind middle. *Venter:* Mesocoxae almost touching; prosternal process not projecting between mesocoxae.

Host plants.—*Heliconia* (Heliconiaceae) (Jolivet and Hawkeswood 1995).

Described species.—6.

Range.—Colombia to Peru.

Chelobasis Gray
(Figs. 29–31)

Chelobasis Gray 1832: 143. Type species: *Chelobasis bicolor* Gray (by monotypy).

Description.—*Head:* Frontal horn truncate at apex; vertex impunctate, depressed between eyes. *Antenna:* Antennomere I lengthened into an ventral process as long as antennomeres II and III combined. *Pronotum:* Quadrate; anterior margin bisinuate, not deeply bilobed; seta present in anterior angle; punctate laterally and basally. *Scutellum:* Elongate, triangular. *Elytron:* Margined laterally; apex conjointly rounded; with 10 rows of punctures; non-costate; male without apical appendage. *Venter:* Mesocoxae separated by the diameter of a coxa; prosternal process projecting between mesocoxae; pro- and mesotibiae expanded at apex.

Host plants.—*Heliconia* (Heliconiaceae); *Calathea, Ischnosiphon* (Marantaceae) (Jolivet and Hawkeswood 1995).

Described species.—4.

Range.—Guatemala to Peru.

Nympharescus Weise
(Figs. 32–33)

Nympharescus Weise 1905a: 320. Type species: *Arescus separatus* Baly (designated by Uhmann 1957b).

Description.—*Head:* Frontal horn truncate at apex; vertex convex between eyes, impunctate. *Antenna:* Antennomere I with ventral process as long as II; III longest. *Pronotum:* Quadrate, flattened; parallel-sided; seta present in all four angles; basal margin bisinuate; tooth present in anterior angle; posterior angle acute. *Scutellum:* Elongate, triangular. *Elytron:* Lateral margin with smooth raised edge or rim; tooth present in sutural angle; with 10 rows of punctures; no costae. *Venter:* Mesocoxae almost touching; prosternal process not projecting between mesocoxae. *Legs:* Exterior apical edges of tibiae expanded backwards.

Host plants.—*Heliconia* (Heliconiaceae) (Jolivet and Hawkeswood 1995).

Described species.—6.

Range.—Colombia to Peru.

Xenarescus Weise
(Fig. 34)

Xenarescus Weise 1905a: 320. Type species: *Hispa monoceros* Olivier (by monotypy).

Description.—Body elongate, parallel-sided. *Head:* Vertex concave; frontal horn long, cuspidate, curved; area behind horn depressed. *Antenna:* Antennomere I simple in female or with a pointed ventral process. *Pronotum:* Quadrangular, longer than wide, weakly convex; punctured pit before middle on each side (deepens in male); seta present in anterior angle; posterior margin with transverse sulcus; female with disc almost symmetrical. *Scutellum:* Triangular. *Elytron:* Costae united, first and second separate behind middle; male with tooth-like tubercle and carina at humerus; apex emarginate at suture, male with spoon-like appendage on exterior apical angle. *Venter:* Prosternum forms small carina sloping back to mesocoxae.

Host plants.—*Heliconia* (Heliconiaceae); *Stromanthe* (Marantaceae); Musaceae (Jolivet and Hawkeswood 1995).

Described species.—1, with 16 subspecies. Key to subspecies: Pic (1927a).

Range.—Colombia and Venezuela.

TRIBE ALURINI CHAPUIS 1875: 292

Sphaeropalpites Chapuis 1875: 359.

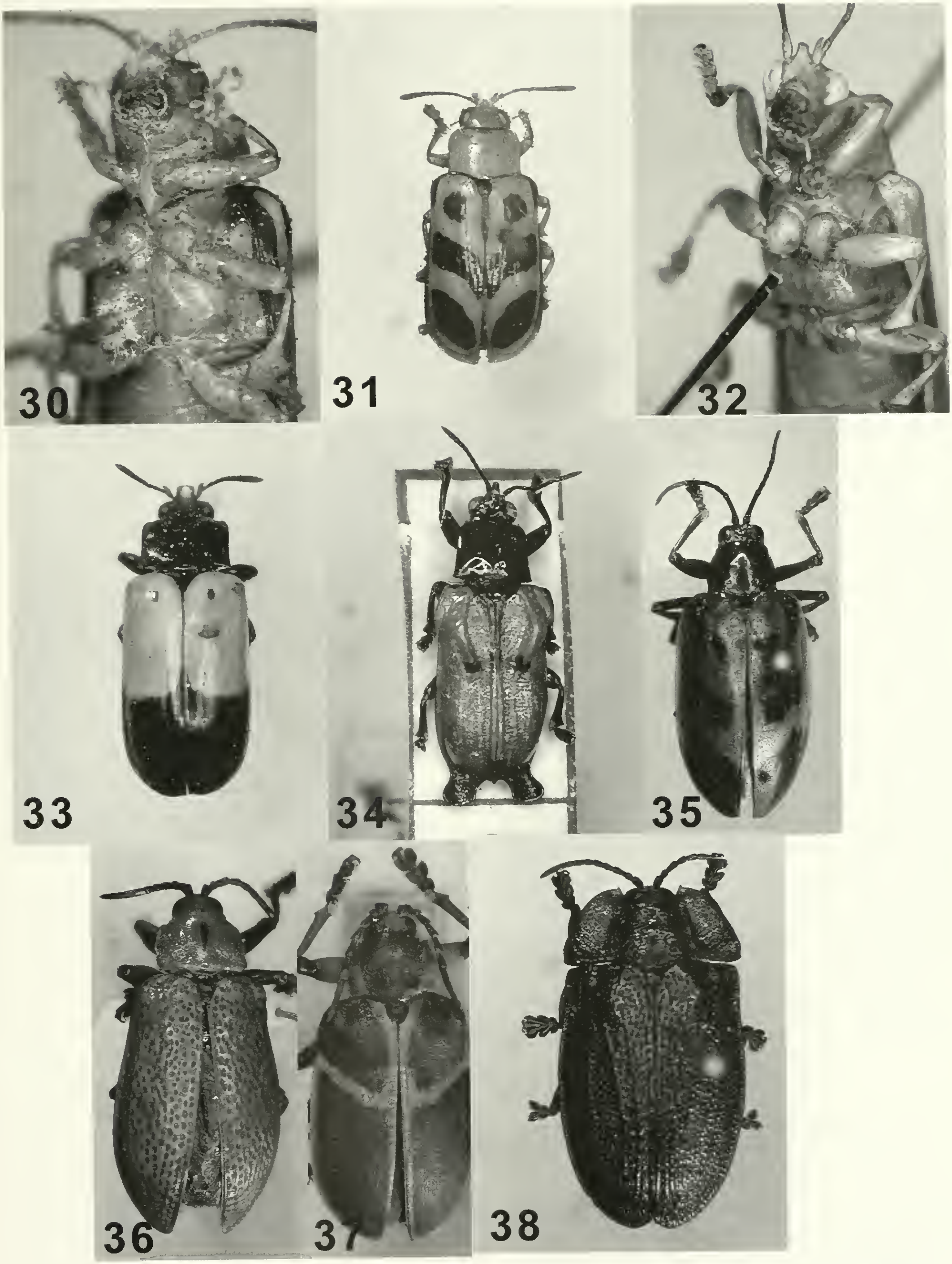
Type genus.—*Alurnus* Fabricius.

Description.—Body large, elongate, elliptical, subparallel, flattened. *Antenna:* 11-segmented, not reaching middle of elytra. *Pronotum:* Tufts of setae present in each angle. *Elytron:* Punctation disordered, not forming rows; costae absent; apex rounded.

Remarks.—This tribe contains the largest species of hispines.

KEY TO GENERA

1. Pronotum nearly as wide as base of elytra (Fig. 38) 2
– Pronotum much narrower than base of elytra (Figs. 35–37, 39) 3
2(1). Body almost oval . . . . *Adalurnus*
– Body elongate . . . . *Platyauchenia*
3(1). Elytra subcordiform (Fig. 39); antennomere III as long as IV to VI combined . . . . *Pseudocalaspidea*
– Elytra subparallel (Figs. 35–37); antennomere III not as long as IV to VI combined 4
4(3). Antenna filiform; antennomere III as long as IV to V combined; epipleura of elytra posteriorly setose; labrum anteriorly impressed . . . . *Alurnus*
– Antenna subserrate; antennomere III not as



Figs. 30–38. Dorsal habitus. 30, *Chelobasis bicolor* mesocoxae. 31, *Chelobasis bicolor*. 32, *Nympharescus separatus* (Baly), mesocoxae. 33, *Nympharescus separatus*. 34, *Xenarescus monoceros* (Olivier). 35, *Alurnus salvini* Baly. 36, *Coraliomela brunnea* (Thunberg). 37, *Mecistomela marginata* (Thunberg). 38, *Platyaucheria latreilleri* (Castelnau).

long as IV to V combined; epipleura of elytra not setose; labrum not impressed 5

5(4). Antennomere IV distinctly shorter than III; elytra with fine punctures densely grouped . . . . *Coraliomela*

– Antennomere IV almost as long as III; punctures of elytra large, rugose . . . . *Mecistomela*

Adalurnus Maulik

Adalurnus Maulik 1936: 392. Type species: *Adalurnus rotundatus* Maulik (by monotypy).

Description.—Body broad, nearly as wide as long, convex, in side view, highest point just behind middle. *Head:* Concave between eyes; mandible large, convex. *Pronotum:* Almost as wide as base of elytra, more shiny than elytra; finely and sparsely punctate. *Scutellum:* Pentagonal; smooth. *Elytron:* Smooth, duller than pronotum; confusedly and moderately punctate, punctures closely spaced; lateral and apical margins smooth, expanded. *Venter:* Almost glabrous; shining; prosternum with front convex, expanded to conceal lower mouthparts; 5 visible abdominal sterna. *Legs:* Fairly robust; sparsely covered with fine hairs; generally not visible from above; femora widest in middle; tibiae wider at apex, setose at apex; tarsi large, broad, thick setae beneath; tarsomeres 1 small; 2 bilobed; 3 longer than 2; 4 long but not projecting past 3; claws simple, strong.

Host plant.—Unknown.

Described species.—1.

Range.—Brazil.

Alurnus Fabricius
(Fig. 35)

Alurnus Fabricius 1775: 94. Type species: *Alurnus grossus* Fabricius (by monotypy).

Poecilalurnis Jacobson 1899: 247. Type species: *Alurnus bipunctatus* Olivier (by original designation); Fischer 1935 (synonymy).

Description.—*Head:* Frons slightly concave. *Antenna:* Filiform, extending to humeri; antennomere I short, thick; II smaller, wider than long; III as long as IV to V combined; VI to XI decreasing in length, thinner than preceding. *Pronotum:* Highly convex, more so anteriorly; wider than long, narrowing posteriorly; glabrous or finely pubescent; margined or not. *Scutellum:* Cordate or triangular. *Elytron:* Oblong-oval, convex; margined; sparsely pubescent. *Venter:* Pubescent.

Host plants.—*Heliconia* (Heliconiaceae); *Cocos, Elaeis* (Arecaceae) (Jolivet and Hawkeswood 1995).

Described species.—21. Key to species: Fischer (1935).

Range.—Costa Rica to Ecuador.

Coraliomela Jacobson
(Fig. 36)

Coraliomela Jacobson 1899: 253. Type species: *Alurnus brunnea* Thunberg (= *Alurnus corallina* Vigors) (designated by Fischer 1935).

Psilurnus Weise 1900: 218. Type species: *Psilurnus consanguineus* Weise (by original designation); Fischer 1935 (synonymy).

Silurnus Weise 1900: 218 [*lapsus calami*].

Description.—Body large, elongate ellipse; color generally red or black; similar in appearance to *Mecistomela*. *Head:* Flat or slightly convex between eyes; frons with small depressions on anterior margin; interantennal keel absent; sulci near eye faint; punctation dense and irregular. *Antenna:* Short, barely reaching base of pronotum; antennomere III not as long as IV to V combined; IV shorter than III. *Pronotum:* Less transverse than in *Mecistomela*; otherwise similar. *Scutellum:* Triangular. *Elytron:* Wider than pronotum; punctation impressed; vestige of irregular costae visible; margined laterally. *Venter:* Rugose.

Host plants.—*Copernicia, Cocos, Diplothemium, Elaeis, Orbignya, Phoenix* (Arecaceae) (Jolivet and Hawkeswood 1995).

Described species.—4. Key to species: Fischer (1935).

Range.—Brazil to Argentina.

Mecistomela Jacobson
(Fig. 37)

Mecistomela Jacobson 1899: 246. Type species: *Alurnus marginata* Thunberg (by monotypy).

Description.—Body large, elongate ellipse. *Head:* Flat or slightly convex between eyes; frons with small depressions on anterior margin; interantennal keel absent; sulci near eye faint; punctation dense and irregular. *Antenna:* Antennomeres short, sparsely pubescent, each antennomere with ventral asymmetrical apical expansion which diminishes in size from base to apex; antennomere IV almost as long as III. *Pronotum:* Transverse, slightly narrowing anteriorly; lateral margins almost parallel; densely punctate; slight basal impression present on each side of middle. *Scutellum:* Triangular. *Elytron:* Wider than pronotum; finely, densely punctate; sides margined. *Legs:* Trochanters with tufts of setae. Pronotum and elytra with orange markings.

Host plants.—*Alagoptera, Copernicia, Cocos, Diplothemium, Elaeis, Lantania, Livistona, Phoenix* (Arecaceae) (Macedo et al. 1994).

Described species.—1. Key to subspecies: Fischer (1935).

Range.—Brazil to Argentina.

Platyauchenia Sturm
(Fig. 38)

Platyauchenia Sturm 1843: 358. Type species: *Cassida latreilleri* Castelnau (by monotypy).

Description.—*Head:* Clypeus transverse, deeply sulcate; maxillary palp with 4 palpomeres, palpomeres 1 to 3 short, equal in length and width, cylindrical, 4 large, rounded, truncate. *Antenna:* Filiform, apical antennomere widest. *Pronotum:* Nearly as wide as base of elytra, widest at base, narrowing anteriorly; lateral margin evenly arcuate from base to apex; disc highly convex; depressed laterally on each side of disc; basal and anterior margins bisinuate. *Scutellum:* Triangular, rounded at apex. *Elytron:* Convex; punctate; widest in middle, narrowing anteriorly and posteriorly; margined laterally; basal and sutural margins yellowish.

Host plants.—*Cocos, Diplothemium* (Arecaceae) (Jolivet and Hawkeswood 1995).

Described species.—2.

Range.—Brazil.

Pseudocalaspidea Jacobson
(Fig. 39)

Pseudocalaspidea Jacobson 1899: 245. Type species: *Alurnus cassidea* Westwood (by monotypy).

Description.—*Head:* Pubescent; medial sulcus present; frons punctate. *Antenna:* Antennomere III as long as IV to VI combined. *Pronotum:* Much narrower than elytra, convex; widest at base, narrowing anteriorly; pubescent, more dense on anterior and lateral margins; finely punctate; anterior angle rounded; basal margin bisinuate. *Scutellum:* Elongate, triangular. *Elytron:* Subcordiform, posteriorly straightened, highly convex; humeral angle produced; laminate laterally. *Venter:* Pro-, meso-, and metasterna with setae; abdominal sterna pubescent; sterna 2 to 4 with pale pustule laterally; sternum 5 with sides and apex pale and pustulate.

Host plant.—Unknown.

Described species.—1. Key to subspecies: Fischer (1935).

Range.—Brazil and Ecuador.

TRIBE PROSOPODONTINI WEISE 1910: 69

Type genus.—*Prosopodonta* Baly.

Description.—*Head:* Nearly attenuate, almost cylindrical, egg-shaped, small; clypeus prolonged to a ridge between the antennal bases. *Antenna:* 11-segmented, filiform, antennomere III longest; apical 5 antennomeres slightly thickened. *Pronotum:* Setae present in posterior angle. *Scutellum:* Longer than wide; rounded behind. *Elytron:*

Nearly ¼ wider than pronotum; 10 rows of punctures plus scutellar row.

Prosopodonta Baly
(Fig. 40)

Prosopodonta Baly 1858: 68. Type species: *Prosopodonta limbata* Baly (by original designation).

Cheirispa Baly 1858: 71. Type species: *Cheirispa suturalis* Baly (by original designation); Weise 1910 (synonymy).

Chirispa Gemminger and Harold 1876: 3604 [*lapsus calami*].

Description.—*Head:* Nearly attenuate, almost cylindrical, egg-shaped, small; medaal sulcus absent; clypeus prolonged into a carina between antennal bases; antenna separated by a sharp keel. *Antenna:* 11-segmented, filiform; antennomeres I and II subequal in length, thick; III longest, cylindrical, as long as I and II combined; IV to VI shorter, oblong, decreasing in length; VII to XI short, slightly dilated; 5 apical antennomeres slightly thickened. *Pronotum:* Transverse; margined laterally and basally; scattered coarse punctures posteriorly on lateral margin; seta present in posterior angle. *Scutellum:* Cuspidate; longer than wide; rounded at apex. *Elytron:* Oblong; nearly ¼ wider than pronotum; margined laterally; apex rounded; punctures little impressed, no costae; with 10 rows of punctures plus scutellar row. *Legs:* Profemur toothed or not.

Host plants.—*Heliconia* (Heliconiaceae); Arecaceae (Jolivet and Hawkeswood 1995).

Described species.—26.

Range.—Nicaragua to Ecuador.

TRIBE SCELOENOPLINI UHMANN 1930a: 238

Cephalodontites Chapuis 1875: 313 (in part).

Cephalodontini Weise 1910: 69.

Type genus.—*Sceloenopla* Chevrolat.

Description.—*Antenna:* Antennomeres III to VII long, cylindrical or laterally compressed; apical 4 differing from the others (either longer or shorter, thinner or thicker, cylindrical, very pubescent, or a different color). *Pronotum:* A seta present in anterior angle. *Scutellum:* Longer than wide; rounded at apex. *Elytron:* With 10 rows of punctures plus scutellar row; humeral rows may have 1 or 2 secondary rows; secondary rows also appear between other rows.

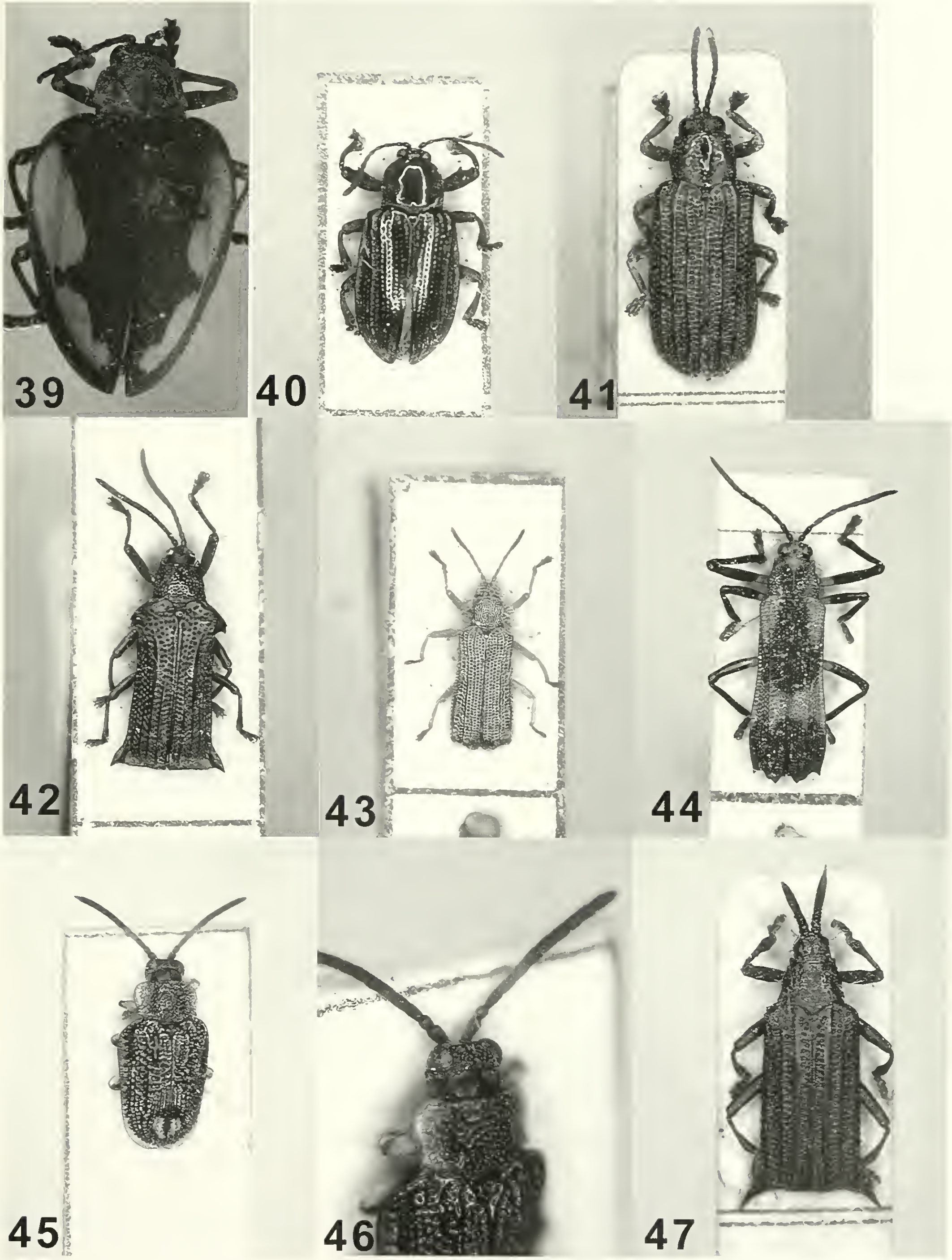
KEY TO GENERA

1. Body more or less flattened (Figs. 42–44); legs slender, the anterior pair longer than rest, frequently armed with a tooth in male 3
– Body moderately convex (Figs. 41, 45); legs in both sexes simple, short and strong . . . 2
2(1). Lateral margin of elytra rounded (Fig. 45) . . . . *Serratispa*
– Lateral margin of elytra parallel (Fig. 41) . . . . *Acentroptera*
3(1). Apical 4 antennomeres shorter than preceding 4 . . . . *Ocnosispa*
– Apical 4 antennomeres longer than preceding 4 4
4(3). Sides of elytron not almost vertical from costa 3 (Fig. 44) . . . . *Sceloenopla*
– Sides of elytron almost vertical from costa 3 (Fig. 43) . . . . *Pseudispa*

Acentroptera Baly
(Fig. 41)

Acentroptera Baly 1858: 121. Type species: *Hispa pulchella* Guérin-Méneville (by original designation).

Description.—Body elongate, slightly convex. *Head:* Vertex depressed; medial sulcus present. *Antenna:* 11-segmented; antennomere I transverse; II subcylindrical, as long as I; III to IV cylindrical, subequal in length, each longer than II; V subcylindrical; VI to X transverse; XI pointed at apex; VII to XI hirsute. *Pronotum:* Longer than wide, widest at base, convex; lateral margin bisinuate; basal impression present; tooth present in anterior angle. *Scutellum:* Quadrate. *Elytron:* Humerus slightly produced; margined laterally; apex with slight lamina; with 10 rows of punctures plus scutellar row; 4 well produced costae, costa 4 may be obsolete in middle. *Venter:* With 5 visible abdominal sterna. *Legs:* Short robust; anterior pair not prolonged.



Figs. 39–47. Dorsal habitus. 39, *Pseudocalaspidea cassidea* (Westwood). 40, *Prospodonata distincta* Baly. 41, *Acentroptera* sp. 42, *Ocnosispa pectoralis* Uhmann. 43, *Pseudispa* sp. 44, *Sceloenopla carinata* (F.). 45, *Serratispa quadricostata* Staines. 46, *Serratispa quadricostata* head. 47, *Acanthodes donckieri* Weise.

Host plant.—*Ananas* (Bromeliaceae) (Jolivet and Hawkeswood 1995).

Described species.—13.

Range.—Costa Rica to Argentina.

Ocnosispa Weise, **new status**
(Fig. 42)

Ocnosispa Weise 1910: 113 (as a subgenus of *Sceloenopla*). Type species: *Chalepus cardinalis* Guérin-Méneville (designated by Uhmann 1957b).

Description.—Varying in form. *Head:* Medial sulcus present. *Antenna:* 11-segmented, apical 4 antennomeres shorter than preceding 4; antennomere I globular, small; II subcylindrical, twice length of I; III to VI cylindrical, IV longest. *Pronotum:* Longer than wide, flattened; margined laterally; basal impression absent; tooth present or absent in anterior angle. *Scutellum:* Cuspidate. *Elytron:* Humerus produced; exterior apical angle toothed or not; with 10 rows of punctures plus scutellar row; 4 costae, costa 2 highly carinate. *Legs:* Elongate, especially anterior pair.

Host plants.—Unknown.

Described species.—19.

Range.—Mexico to Peru.

Pseudispa Chapuis, **new status**
(Fig. 43)

Pseudispa Chapuis 1875: 328. Type species: *Cephalodonta marginata* Guérin-Méneville (by original designation).

Description.—Body elongate, slightly convex. *Head:* Small; medial sulcus present. *Antenna:* 11-segmented; antennomere I short; II elongate; III to VII obconical, decreasing in length; VIII to XI shorter than preceding, cylindrical, thickened. *Pronotum:* Subparallel; basal impression present; longitudinal medial sulcus present. *Elytron:* Oblong, parallel-sided, almost vertical from costa 3; lateral and apical margins smooth; humerus not pronounced; apex almost vertical, truncate; secondary rows of punctures present between intervals 2 and 4.

Host plants.—Unknown.

Described species.—12. Key to species: Monrós and Viana (1947), Argentina.

Range.—Mexico to Argentina.

Sceloenopla Chevrolat
(Fig. 44)

Sceloenopla Chevrolat 1837: 388. Type species: *Hispa maculata* Olivier (= *Hispa spinipes* Fabricius) (by monotypy).

Cephalodonta Chevrolat 1837: 388. *Nomen nudum.*

Cephalodonta Chevrolat 1843: 350. Type species: *Hispa goniapterus* Perty (by monotypy); Uhmann 1930a (synonymy).

Chalepotatus (*Macrochalepus*) Pic 1929b: 4. Type species: *Chalepotatus antennalis* Weise (by monotypy); Monrós and Viana 1947 (synonmy).

Microdonta Chevrolat 1837: 388 not Hope 1837 [misapplied name]. Type species: *Hispa serraticornis* Fabricius (by monotypy); Uhmann 1930a (synonymy).

Description.—Varying in form. *Head:* Small, slightly convex; medial sulcus present; eye slightly prominent. *Antenna:* 11-segmented; apical 4 antennomeres longer than preceding 4; antennomere III longest. *Pronotum:* Trapezoidal, slightly convex; basal impression present; densely punctate; anterior angle prominent, directed forward; posterior angle directed obliquely backwards. *Scutellum:* Quadrate. *Elytron:* Lateral margin smooth; apical margin dentate or not; external apical angle may have lamina or tooth; humerus produced; secondary punctures between intervals 2 and 4 absent.

Host plants.—*Persea* (Lauraceae); *Chrysophyllum* (Sapotaceae); *Anthurium, Philodendrum* (Araceae); *Cocos* (Arecaceae); *Lonchocarpus* (Fabaceae); *Rapanea* (Myrsinaceae); *Esembeckia* (Rutaceae); *Cercopia, Pourouma* (Cercopiaceae); Rubiaceae; Cyclanthaceae (Jolivet and Hawkeswood 1995); *Cupania* (Sapindaceae); *Clusia* (Clusiaceae); *Davilla* (Dilleniaceae); *Sterculia* (Sterculiaceae) (Hespenheide and Dang 1999).

Described species.—154. Key to species:

Uhmann (1937a), species groups; Staines (1996b), Nicaragua.

Range.—Mexico to Argentina.

Serratispa Staines, new genus
(Figs. 45–46)

Type species.—*Serratispa quadricosta* Staines, new species.

Description.—*Head:* Vertex depressed, coarsely punctate. *Antenna:* 11-segmented; filiform; reaching beyond humeri. *Pronotum:* Trapizodial; lateral margin serrate; disc convex; punctate; basal impression present. *Elytron:* Lateral margin sparsely dentate near humerus; exterior apical angle and apical margin sparsely dentate; with 10 rows of punctures plus scutellar row; 4 costae; horizontal plicae present on disc.

Serratispa quadricosta Staines, new species

Holotype.—[Brazil] São Paulo d'Olivença, M. de Mathen, Juin Juillet/F. Monros Collection 1959/Holotype Serratispa quadricosta, des. C. L. Staines 2001 (red label). Deposited in the National Museum of Natural History, Smithsonian Institution.

Description.—Ovid, castanaceous with paler yellowish markings; legs yellowish. *Head:* Vertex depressed, coarsely punctate with a seta arising from each puncture; medial carina present; interantennal carina present; frons not projecting. *Antenna:* Antennomere I cylindrical, longer than II; II transverse; III–V cylindrical, each shorter than I; VI–X transverse; XI pointed at apex; I–III punctate; IV–V with few pale setae; VI–XI darkly setose. *Pronotum:* Anterior angle rounded; lateral margin straight and convergent for basal ½, then rounded and convergent; posterior angle acute; pair of setae present on anterior margin behind head; pronotal length 0.9 mm; pronotal width 1.6 mm. *Scutellum:* Cordate with diamond-shaped sulci on lateral margin; micropunctate. *Elytron:* Narrowing to apex; exterior apical angle rounded, sparsely dentate; humerus rounded; with 11 rows of punctures at base, 10 on rest; punctures in rows 4–10 larger than rest; highly sculptured, with 4 horizontal plicae on disc not reaching suture; interspaces 2 and 3 carinate on basal ¼, carinae unite just behind humerus; shallow depression present on interspaces 4–9 behind humerus; interspaces 1–3 carinate on apical ¼; interspace 4 carinate along edge of depression; elytral length 3.0 mm; elytral width 2.1 mm. Total length: 4.3 mm.

Etymology.—From *serratus* (Latin) = saw plus ispa for the Hispinae; referring to the sawlike lateral margin of the pronotum. *Quadra* (Latin) = four plus *costa* = ridge; for the four lateral plicae on the elytra. The name is a noun in apposition.

Comparative notes.—*Serratispa* differs from all other hispine genera by the following combination of characters: Antenna 11-segmented, filiform; head with vertex depressed, coarsely punctate; pronotum with a pair of setae on anterior margin behind head, lateral margin serrate; elytra costate with lateral plicae, with 11 rows of punctures at base.

Host plant.—Unknown.

TRIBE CHALEPINI WEISE 1910: 69

Octotomites Chapuis 1875: 310.

Cephalodontites Chapuis 1875: 313 (in part).

Uroplatini Weise 1910: 69.

Type genus.—*Chalepus* Thunberg.

Description.—Species of medium to small size; generally elongate, slightly convex. *Head:* Clypeus more or less long; labrum reduced. *Antenna:* 3- to 11-segmented. *Pronotum:* A seta present on a small tubercle on anterior margin near angle. *Elytron:* Denticulate laterally and posteriorly; with 7 to 10 rows of punctures at base, scutellar row present or absent; usually with punctures in double rows separated by a costa, some with irregular puncture rows and tuberculate costae.

KEY TO GENERA

1. Antenna 3- to 7-segmented 2
– Antenna 8- to 11-segmented 11

2(1). Elytral costae irregular, tuberculate (Fig. 88) . . . *Physocoryna*
– Elytral costae regular . . . 3
3(2). Prosternum expands anteriorly to partly cover mouth (Fig. 95) . . . *Sternocthispa*
– Prosternum does not expand anteriorly, not covering mouth . . . 4
4(3). Elytron with 8 or 10 rows of punctures at base . . . 5
– Elytron with 9 rows of punctures at base (Fig. 72) . . . *Heptachispa*
5(4). Elytron with 8 rows of punctures at base . . . 6
– Elytron with 10 rows of punctures at base . . . 10
6(5). Elytron with 10 rows of punctures on apical ½ (Fig. 73) . . . *Heptatomispa*
– Elytron with 8 rows of punctures for entire length . . . 7
7(6). Antenna short or very short, clavate (Fig. 59) . . . *Bruchia*
– Antenna long, filiform . . . 8
8(7). Antenna 3- to 7-segmented; last antennomere acutely pointed at apex (Fig. 47) . . . *Acanthodes*
– Antenna 7-segmented; last antennomere not acutely pointed at apex . . . 9
9(8). Penultimate antennomere longer than ultimate (Fig. 74) . . . *Heptispa*
– Penultimate antennomere shorter than ultimate (Fig. 78) . . . *Nanocthispa*
10(5). Apical four antennomeres combined shorter than three preceding combined (Fig. 66) . . . *Corynispa*
– Apical four antennomeres combined longer than three preceding combined (Fig. 58) . . . *Brachycoryna* (in part)
11(1). Antenna 8-segmented . . . 12
– Antenna 9- to 11-segmented . . . 34
12(11). Antenna short or very short (barely reaching anterior margin of pronotum), clavate . . . 13
– Antenna long (reaching beyond base of pronotum), filiform or clavate . . . 19
13(12). Elytral costae irregular, tuberculate (Figs. 48, 81) . . . 14
– Elytral costae regular . . . 15
14(13). Antennomeres VII and VIII almost fused, antennomeres I to VI thick (Fig. 48) . . . *Acritispa*
– Antennomeres VII and VIII distinct, antennomeres I to VI normal (Fig. 81) . . . *Octotoma* (in part)
15(13). Third tarsomere not bilobed (Figs. 93–94) . . . *Stenopodius*
– Third tarsomere bilobed . . . 16
16(15). Elytron on apical ⅓ with 8 rows of punctures . . . 17
– Elytron on apical ⅓ with 10 rows of punctures . . . 18
17(16). Antennomere VII as wide as VIII (Fig. 81) . . . *Octotoma* (in part)
– Antennomere VII narrower than VIII . . . *Parvispa*
18(16). Elytron with 10 rows of punctures at base (Fig. 58) . . . *Brachycoryna* (in part)
– Elytron with 8 rows of punctures at base (Fig. 70) . . . *Fossispa*
19(12). Elytron with 10 rows of punctures and four costae . . . 20
– Elytron with 8 rows of punctures and three costae . . . 23
20(19). First and fourth elytral costae united at apex; profemur with two teeth (Fig. 90) . . . *Probaenia*
– First and fourth elytral costae not united at apex; profemur with one tooth or unarmed . . . 21
21(20). First elytral costa strongly elevated; 2nd elevated on apical ½; 3rd elevated on basal ½; 4th complete, only finely elevated; puncture rows complete (Fig. 75) . . . *Heterispa*
– Elytra not as above . . . 22
22(21). Antennomeres laterally compressed, triangular; vertex of head without longitudinal sulcus (Fig. 86) . . . *Oxyroplata*
– Antennomeres not laterally compressed, cylindrical; vertex of head with longitudinal sulcus (Fig. 104) . . . *Uroplata*
23(19). Vertex of head without sulcus . . . 24
– Vertex of head with 1 to 5 sulci . . . 25
24(23). Frons not projecting (Fig. 82) . . . *Octuroplata*
– Frons projecting . . . *Mimoethispa*
25(23). Elytron with 10 rows of punctures (Fig. 92) . . . *Spaethispa*
– Elytron with 8 rows of punctures . . . 26
26(25). Elytron with tubercles (Fig. 69) *Euprinota*
– Elytron without tubercles . . . 27
27(26). Vertex of head with medial sulcus . . . 28
– Vertex of head with 3 to 5 sulci . . . 31
28(27). Sulcus present on outer margin of eye (Fig. 80) . . . *Octhispa*
– Sulcus absent on outer margin of eye . . . 29
29(28). Sulcus present on inner margin of eye (Fig. 103) . . . *Temnocthispa*
– Sulcus absent on inner margin of eye . . . 30
30(29). Frons projecting; lateral and apical margins of elytra serrate (Fig. 57) . . *Bothrispa*
– Frons not projecting; lateral and apical margins of elytra smooth (Fig. 77) . . . *Microrhopala*
31(27). Pronotum with basal impression . . . 32
– Pronotum without basal impression . . . 33

32(31). Antennomeres III to V cylindrical (Fig. 60) . . . . *Carinispa*

– Antennomere III cylindrical, IV and V transverse (Fig. 87) . . . . *Pentispa*

33(31). Antennomere III with tooth-like projection on outer apical margin (Fig. 89) . . . . *Platocthispa*

– Antennomere III without tooth-like projection on outer apical margin (Fig. 71) . . . . *Glyphuroplata*

34(11). Antenna 9-segmented 35

– Antenna 10- or 11-segmented 37

35(34). Elytron with 10 rows of punctures at base (Fig. 68) . . . . *Decatelia* (in part)

– Elytron with 8 rows of punctures at base 36

36(35). Exterior apical angles of elytra expanded (Fig. 65) . . . . *Cnetispa*

– Exterior apical angles of elytra not expanded (Fig. 79) . . . . *Nonispa*

37(34). Antenna 10-segmented 38

– Antenna 11-segmented 41

38(37). Elytron with 10 complete rows of punctures (Fig. 68) . . . . *Decatelia* (in part)

– Elytron with 8 complete rows of punctures 39

39(38). Prosternum projecting forward, with two blunt teeth on anterior margin (Fig. 97) . . . . *Sternoplispa*

– Prosternum not projecting forward, without teeth on anterior margin 40

40(39). Mesofemur with tooth (Fig. 99) . . . . *Sternostenoides*

– Mesofemur without tooth . . . . . *Charistena*

41(37). Lateral margin of pronotum with two teeth (Fig. 83) . . . . *Odontispa*

– Lateral margin of pronotum without teeth 42

42(41). Pronotum conspicuously margined laterally (Fig. 67) . . . . *Crasepodonispa*

– Pronotum finely or not margined laterally 43

43(42). Elytron at base with 3 costae and 8 rows of punctures (in some species additional rows present either behind middle or at base), scutellar row present or absent 44

– Elytron at base with 4 costae and 10 rows of punctures (sometimes reduced to 8 or 9 rows in middle), scutellar row present or absent 50

44(43). Anterior margin of prosternum projecting toward mouth (Fig. 98) . . . . . . *Sternostena*

– Anterior margin of prosternum not projecting toward mouth 45

45(44). Femora with a large, ventral tooth at midline (Fig. 50) . . . . *Agathispa*

– Femora without a large, ventral tooth at midline (may have small denticules) . . 46

46(45). Body slender, almost cylindrical, eye not projecting (Fig. 52); mesotibia strongly curved 47

– Body broader, especially at humeri (Fig. 101); eye slightly projecting; mesotibia not strongly curved . . . . *Sumitrosis*

47(46). Costae on elytral intervals 2 and 6 unite on apical fifth (Fig. 53) *Anisostena* (s. str.)

– Costae on elytral intervals 2 and 6 do not unite on apical fifth 48

48(47). Apical five antennomeres wider than preceding (Fig. 54) . . . *Anisostena* (*Apostena*)

– Apical five antennomeres not wider than preceding (Fig. 55) . . . . *Anisostena* (*Neostena*)

49(43). An outward pointing spine produced at humeral angle; exterior apical angle of elytra forms a strong, sharp tooth (Fig. 100) . . . . *Stethispa*

– Humeral angle with incurved tooth or humeral angle angular, without a spine; exterior apical angle of elytra rounded or ends in a broad, flat tooth 50

50(49). Humerus with recurved tooth . . . . *Chalepispa*

– Humerus angular 51

51(50). Anterior margin of prosternum expanded toward mouth . . . . *Chalepotatus*

– Anterior margin of prosternum not expanded toward mouth 52

52(51). Form elongate; elytron with 10 rows of punctures at base 53

– Form oval or cuniform; elytron with 11 rows of punctures at base 55

53(52). Apical tarsomere with one claw . . . . *Anisochalepus*

– Apical tarsomere with two claws 54

54(53). Antennomere III twice as long as II or IV . . . . *Goyachalepus*

– Antennomere III subequal in length to II or IV . . . . *Chalepus*

55(52). Abdominal sterna 1 and 3 with medial sulcus (Fig. 76) . . . . *Metaxycera*

– Abdominal sterna 1 and 3 without medial sulcus 56

56(55). Apices of elytra regularly rounded, sutural angle rectangulate 57

– Apices of elytra conjointly rounded, sutural angle emarginate 59

57(56). Elytral costa 3 complete (Fig. 84) . . . . *Odontota*

– Elytral costa 3 interrupted in middle or absent 58

58(57). Head constricted behind eyes (Fig. 102) . . . . *Temnochalepus*

– Head not constricted behind eyes (Fig. 56) . . . . *Baliosus*

59(56). Apical antennomere pointed at apex (Fig. 85) . . . . *Oxychalepus*

– Apical antennomere rounded at apex . . 60

60(59). Elytron with costae 1 and 4 complete, costae 2 and 3 almost completely obsolete; costa 1 carinate, 4 less elevated (Fig. 105) . . . . *Xenochalepus* (s. str.)

– Elytron with costae 1, 2, and 4 complete, 3 only visible at base and apex (Fig. 106) . . . . *Xenochalepus* (*Neochalepus*)

Acanthodes Baly
(Fig. 47)

Acanthodes Baly 1864: 262. Type species: *Acanthodes generosa* Baly (by original designation).

Acanthispa Chapuis 1875: 323 [*lapsus calami*].

Description.—Body wedged-shaped. *Head:* Long, flattened; projection present between eyes. *Antenna:* Rigid, 3- to 7-segmented; apical antennomere acutely pointed. *Pronotum:* Slighty narrower than elytra, transverse; medially depressed; basal margin with excavation present on each side. *Scutellum:* Transverse, apex obtuse. *Elytron:* Parallel-sided, slightly enlarged apically; spine-like tooth in exterior apical angle; with 8 rows of punctures; extra punctures present, especially between rows 5 and 7.

Host plants.—*Quetzalia* (Celastraceae) (Jolivet and Hawkeswood 1995).

Described species.—15. Key to species groups: Spaeth (1937).

Range.—Colombia to Argentina.

Acritispa Uhmann
(Figs. 48–49)

Acritispa Uhmann 1940b: 143. Type species: *Acritispa dilatata* Uhmann (by monotypy).

Description.—*Head:* Medial sulcus present; vertex micropunctate. *Antenna:* 8-segmented; antennomeres I and II subequal in length; III widened apically; VII as wide as VIII, difficult to distinguish; VIII hirsute club. *Pronotum:* Wider than long; tooth present in anterior angle; lateral margin evenly convergent from base to apex; two tooth-like projections present on lateral margin; densely coarsely punctate. *Elytron:* Greatly expanded at apex; lateral and apical margins dentate; with lateral and transverse plicae; translucent at exterior apical angle. *Legs:* Profemur expanded apically.

Host plants.—Unknown.

Described species.—2. Key to species: Staines (1988).

Range.—Panama to Bolivia.

Agathispa Weise
(Figs. 50–51)

Agathispa Weise 1905a: 64. Type species: *Hispa dimidiata* Olivier (by monotypy).

Description.—Moderately attenuate. *Head:* Clypeus triangular. *Antenna:* 11-segmented; antennomeres I to VI short; VII to XI longer and wider. *Pronotum:* Transverse, narrower in front, obtusely angulate in middle. *Scutellum:* Quadrate. *Elytron:* Rectangular; with 8 rows of punctures, rows 1–5 regular at base, irregular after middle; scutellar row absent; first costa complete, curves outward at apex. *Legs:* Long; femora with a tooth; tibiae slightly curved.

Host plant.—Unknown.

Described species.—1.

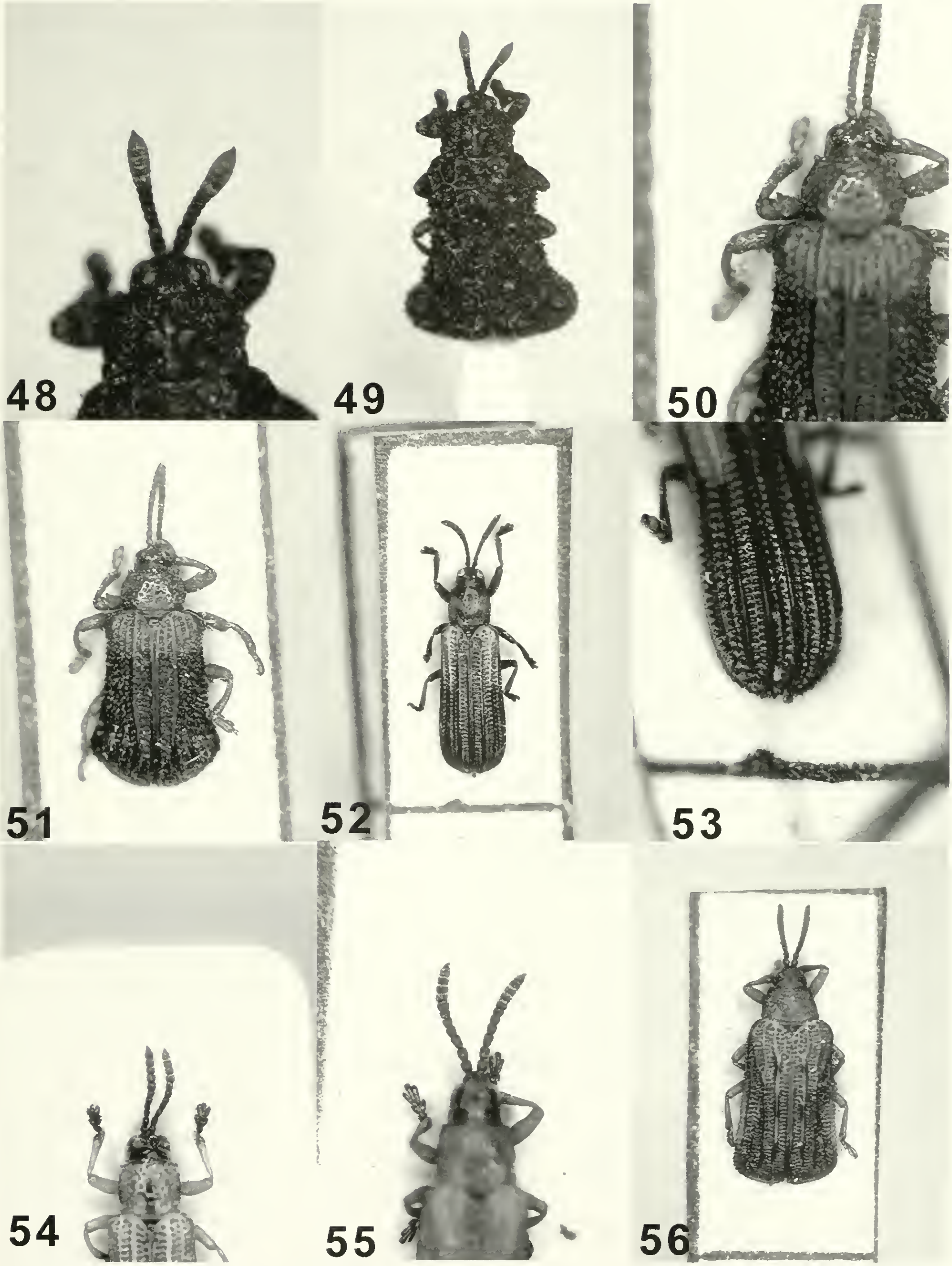
Range.—Dominican Republic.

Anisochalepus Uhmann

Anisochalepus Spaeth 1937: 154 (unavailable name, no type species designated).

Anisochalepus Uhmann 1957a: 109. Type species: *Anisochalepus reimoseri* Uhmann (by monotypy).

Description.—Narrow, elongate, cylindrical. *Head:* Vertex twice as long as wide, flat, depressed between eyes; medial sulcus present; row of punctures present behind eye; clypeus very narrow; frons cristate, deeply punctate. *Antenna:* 11-segmented; antennomere III elongate, 2× as long as II, nearly quadrate; IV to VI combined as long



Figs. 48–56. Dorsal habitus. 48, *Acritispa dilatata* Uhmann antenna. 49, *Acritispa dilatata*. 50, *Agathispa dimidiata* (Olivier), femur. 51, *Agathispa dimidiata*. 52, *Anisostena* (s. str.) sp. 53, *Anisostena* (s. str.) sp., apex of elytra. 54, *Anisostena* (*Apostena*) sp., antenna. 55, *Anisostena* (*Neostena*) *missionensis* Monrós and Viana, antenna. 56, *Baliosus nervosus* (Panzer).

as III. *Pronotum:* Scarcely wider than long; lateral margin weakly convergent, margined behind middle; coarsely punctate; disc with transverse carina present; tooth present in anterior angle; basal impression present. *Scutellum:* Cordate. *Elytron:* Lateral margin finely dentate; apical margin strongly dentate; with 10 rows of punctures plus scutellar row, rows 5 to 8 reduced to two rows behind middle; 4 costae; costa 1 strongly elevated, 2 and 4 weakly elevated, 3 nearly obsolete; sutural margin weakly carinate. *Legs:* Femora and tibiae unarmed; mesotibia weakly curved; femora punctate; apical tarsomeres with one claw.

Host plant.—Unknown.

Described species.—1.

Range.—Paraguay.

Anisostena Weise
(Fig. 52, 53)

Anisostena Weise 1910: 120. Type species: *Charistena elegantula* Baly.

Description.—Body elongate, coarsely punctate. *Head:* Frons medially impressed; vertex with medial sulcus present or absent; eye little swollen. *Antenna:* 11-segmented; antennomere I subglobose; II cylindrical, as wide as I; III to VI gradually widening; VII to XI forming a club. *Elytron:* With 8 rows of punctures plus scutellar row; tricostate. *Legs:* Mesotibia strongly curved.

Host plants.—*Bothrichloa, Panicum, Paspalum, Schizachrium, Tripsacum, Valota* (Poaceae) (Staines 1994b, c, d).

Described species.—23. Key to species: Monrós and Viana (1947), Argentina; Staines (1994b, c, d).

Range.—Canada to Argentina.

Anisostena (*Apostena* Staines)
(Fig. 54)

Anisostena (*Apostena*) Staines 1993a: 186. Type species: *Anisostena angustata* Pic (by original designation).

Description.—As in *Anisostena* (s. str.) expect: *Head:* Medial sulcus present; apical 5 antennomeres wider than preceding. *Pronotum:* Basal impression present; tooth present in anterior angle. *Elytron:* Costate elytral intervals 2, 4, and 6 do not unite near apex.

Host plants.—Poaceae (Monrós and Viana 1947).

Described species.—2. Key to species: Staines (1993a).

Range.—Argentina.

Anisostena (*Neostena* Monrós and Viana)
(Fig. 55)

Anisostena (*Neostena*) Monrós and Viana 1947: 201. Type species: *Anisostena bicolorceps* Pic (by monotypy).

Description.—As in *Anisostena* (s. str.) except: *Head:* Cylindrical; medial sulcus present; apical 5 antennomeres not wider than preceding. *Pronotum:* Basal margin bisinuate. *Scutellum:* Rounded at apex. *Elytron:* Costate elytral intervals 2, 4, and 6 do not unite near apex.

Host plants.—*Olyra, Panicum* (Poaceae) (Staines 1993a).

Described species.—3. Key to species: Staines (1993a).

Range.—Brazil to Argentina.

Baliosus Weise
(Fig. 56)

Baliosus Weise 1905a: 64. Type species: *Hispa nervosa* Panzer (= *Hispa rubra* Weber) (by original designation).

Parabaliosus Monrós and Viana 1947: 254. Type species: *Parabaliosus ogloblini* Monrós and Viana 1947 (by monotypy); Uhmann 1957b (synonymy).

Description.—Wedge-shaped, somewhat flattened. *Head:* Vertex smooth or slightly punctate. *Antenna:* 11-segmented; apical 5 antennomeres somewhat dilated. *Elytron:* Much wider at apex; apex obtuse or approaching truncate; with 10 rows of punctures plus scutellar row; 4 costae, costa 3 feebly interrupted in middle, oblique from umbone to 2nd or 3rd interval for a short distance forward. *Legs:* Short to moderately long; mesotibia not curved.

Host plants.—*Ceanothus* (Rhamnaceae); *Hippocratea* (Celastraceae); *Arrabidea* (Bignoniaceae); *Jatropha* (Euphorbiaceae); *Acer* (Aceraceae); *Ulmus* (Ulmaceae); *Tilia* (Tiliaceae); *Desmodium, Dioclea, Meibomia, Robinia* (Fabaceae); *Bauhinia* (Caesalpiniaceae); *Veronia* (Asteraceae); *Cordia* (Ehretiaceae); *Urtica* (Urticaceae); *Olyra* (Poaceae); *Lippia* (Verbenaceae); *Castanea, Quercus* (Fagaceae); *Salix* (Salicaceae); *Alnus, Betula* (Betulaceae); *Carpinus* (Carpinaceae); *Corylus* (Corylaceae); *Amelanchier, Malus, Prunus, Pyrus, Rubus* (Rosaceae); *Banisteria* (Malpighiaceae); *Citrus* (Rutaceae); *Guazuma* (Sterculiaceae); *Guaiacum* (Zygophyllaceae); *Basanacantha* (Rubiaceae) (Jolivet and Hawkeswood 1995); *Urera* (Urticaceae); *Odontonema* (Acanthaceae); Bignoniaceae (Hespenheide and Dang 1999).

Described species.—44. Key to species: Monrós and Viana (1947), Argentina; Staines (1996b), Nicaragua.

Range.—Canada to Argentina.

Bothrispa Uhmann
(Fig. 57)

Bothrispa Uhmann 1940b: 143. Type species: *Uroplata depressa* Chapuis (by monotypy).

Description.—*Head:* Vertex with depression between eyes, surface alutaceous; medial sulcus absent; frons projecting. *Antenna:* 8-segmented; antennomere I flattened laterally; II as wide as long, cylindrical; III longer than I or II; IV to VII transverse; VIII hirsute, pointed club. *Pronotum:* Wider than long, convex; densely punctate, except for small portion of disc; margined laterally; tooth present in anterior angle; basal impression present. *Scutellum:* Cuspidate. *Elytron:* Lateral and apical margins strongly dentate; with 8 rows of punctures at base, expands to 10 beyond middle; sutural margin carinate; tricostate, none united. *Legs:* Profemur expanded to apex.

Host plant.—Unknown.

Described species.—1.

Range.—Brazil.

Brachycoryna Guérin-Méneville
(Fig. 58)

Brachycoryna Guérin-Méneville 1844: 280. Type species: *Brachycoryna pumila* Guérin-Méneville (by monotypy).

Physocoryna: Baly 1885: 90 not Guérin-Méneville 1844 [misapplied name].

Description.—*Head:* Small; vertex not prominent, with longitudinal sulcus; eye not prominent, separated by more than width of an eye; area around eye, except along pit, rugose; antenna inserted into pit on front of head; pit divided by shallow, central keel. *Antenna:* Short; 7- or 8-segmented; basal antennomeres more or less similar, penultimate slightly expanded, ultimate forming a hirsute, oval club. *Pronotum:* Wider than long, narrower than elytra, convex; punctures distributed over entire surface except along apical margin; medial callus usually present on disc. *Scutellum:* Small; quadrate. *Elytron:* Oblong-oval, longer than wide, parallel-sided; apex broadly, evenly rounded; lateral and apical margins serrate; humeral angle rounded; with 10 rows of punctures, punctures usually distinct, arranged in pairs, but sometimes becoming confused, plus scutellar row; even intervals elevated and often costate. *Legs:* Short; tibiae and femora subequal in length; trochanters slightly angular; tibiae gradually widening to apex with tuft of setae at apex; femora widest at middle. *Venter:* Pro- and mesosternum punctate in middle, alutaceous.

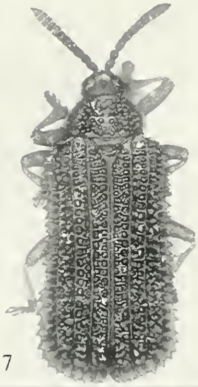
Host plants.—*Abutilon, Sida, Sphaeralcea* (Malvaceae); *Waltheria* (Sterculiaceae); *Artemisia* (Asteraceae) (Staines 1986).

Described species.—7. Key to species: Staines (1986).

Range.—Southern United States to Argentina.

Bruchia Weise
(Fig. 59)

Bruchia Weise 1906a: 227. Type species: *Bruchia sparsa* Weise (by monotypy).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Figs. 57–65. Dorsal habitus. 57, *Bothrispa depressa* (Chapuis). 58, *Brachycoryna pumila* Guérin. 59, *Bruchia sparsa* Weise. 60, *Carnispa nevermanni* Uhmann. 61, *Chalepotatus coarctatus* (Chapuis). 62, *Chalepus sanguinicollis* (L.). 63, *Charistena ruficollis* (F.). 64, *Clinocarispa fasciata* Weise. 65, *Cnetispa darwini* Maulik.

Bruchiella Weise 1916: 39 (invalid replacement name for *Bruchia*).

Description.—*Head:* Medial sulcus present. *Antenna:* 7-segmented; antennomeres I to V very sharp, gradually widening after III, apical two antennomeres less separated; I to III short, transverse; IV to V very short, strongly transverse; VI as long and wider than preceding two combined, as wide as VII; VII subovate, pointed at apex. *Pronotum:* Narrow, width at base and apex equal; lateral margin deflexed, nearly parallel-sided; disc convex, regularly subseriate-punctate; medial line finely impressed. *Scutellum:* Small, quadrate. *Elytron:* 3× as long as pronotum, slightly convex; apex conjointly rounded; with 8 rows of punctures; lightly bicostate, costae interrupted, transversely united before apex.

Host plants.—Unknown.

Described species.—2.

Range.—Costa Rica to Argentina.

Carinispa Uhmann
(Fig. 60)

Carinispa Uhmann 1930a: 255. Type species: *Carinispa nevermanni* Uhmann (by monotypy).

Description.—*Head:* Vertex trisulcate, impunctate; frons projecting. *Antenna:* 8-segmented; antennomere I subglobular; II transverse; III to V cylindrical; VI to VII transverse; VIII pointed at apex. *Pronotum:* Wider than long, widest at base, convex, densely punctate; basal impression present; tooth present in anterior angle. *Scutellum:* Quadrate. *Elytron:* Lateral margin sparsely dentate; apical margin dentate; with 8 regular rows of punctures; tricostate, costae weakly carinate.

Host plants.—*Bunchosia, Malpighia* (Malpighiaceae) (Jolivet and Hawkeswood 1995).

Described species.—1.

Range.—Costa Rica.

Chalepotatus Weise
(Fig. 61)

Chalepotatus Weise 1910: 133. Type species: *Odontota coarctatus* Chapuis (designated by Monrós and Viana 1947).

Description.—Body elongate, moderately flattened. *Head:* Clypeus smooth or setose, with medial carina ending in a tooth before antennal base. *Antenna:* 11-segmented. *Pronotum:* Lateral margin rounded; disc smooth, shiny. *Elytron:* At humeri little wider than pronotum, sides moderately parallel; apex conjointly rounded; with 10 rows of punctures plus scutellar row, puncture rows 5 to 8 narrowed to two rows on basal ½; 4 costae, costa 3 united with 4 for ¼th its length. *Venter:* Prosternum with mid-anterior projection. *Legs:* Short.

Host plants.—Unknown.

Described species.—3. Key to species: Monrós and Viana (1947), Argentina.

Range.—Mexico to Argentina.

Chalepsipa Uhmann

Chalepsipa Uhmann 1955: 3. Type species: *Chalepsipa ignorata* Uhmann (by monotypy).

Description.—*Head:* Vertex extremely smooth, alutaceous; medial sulcus present; frons cuspidate, raised in profile; constricted at base. *Antenna* (only two basal antennomeres present in holotype): Antennomere I globose, punctate; II transverse, punctate. *Pronotum:* Widest at base, weakly transverse; lateral margin parallel to weakly convergent; disc densely punctate; basal impression present; tooth present in anterior angle. *Scutellum:* Ligulate. *Elytron:* Parallel-sided, lateral margin smooth; apical margin with 5 teeth; humerus raised into backward pointed tooth; with 10 rows of punctures plus scutellar row; three complete costae (1, 2, 4), 3 visible at humerus and apex; costae 1 and 2 strongly elevated. *Legs:* Femora densely punctate; apical tarsomere with two claws.

Host plant.—Unknown.

Described species.—1.

Range.—French Guyana.

Chalepus Thunberg
(Fig. 62)

Chalepus Thunberg 1805: 282. Type species: *Hispa sanguinicollis* Linnaeus (designated by Weise 1905a).

Anoplitis Kirby 1837: 227. Type species: *Hispa bicolor* Olivier (by monotypy); Butte 1968b (synonymy).

Parachalepus Baly 1885: 47. Type species: *Parachalepus brevicornis* Baly (by monotypy); Staines 1993b (synonymy).

Description.—*Head:* Wider than long; vertex sulcate or micropunctate; frontal carina feebly developed, elongate or diamond-shaped, extending between antenna and joining clypeal base; clypeus large and usually longer than wide, triangularly elevated, apex feebly arcuate, surface finely punctate or coarsely granularly tuberculate with long white setae. *Antenna:* 11-segmented; basal antennomere incrassate. *Pronotum:* Transverse; convex; slight basal depression with ante-scutellar transverse carina; lateral margin angulate in middle. *Elytron:* Subelongate, parallel, slightly indented at sides; apex regularly rounded, finely serrulate; with 10 rows of punctures at base and apex, may be reduced after middle, scutellar row absent. *Venter:* Sparsely, irregularly micropunctate; abdominal sternite 5 apically truncate.

Host plants.—*Theobroma* (Sterculiaceae); *Bambusa, Brachiaria, Chusquea,* Elymus, *Hystrix, Lasiacis, Olyra, Panicum, Paspalum, Valota, Zea* (Poaceae); *Apios, Benthamantha, Calopogonium, Canavalia, Crotalaria, Cymbosema, Desmodium, Dioclea, Dolichos, Falcata, Glycine, Lathyrus, Meibomia, Mucuna, Phaseolus, Pueraria, Robinia, Vicia* (Fabaceae); *Bauhinia, Cassia* (Caesalpiniaceae); *Prosopis* (Mimosaceae); *Aloysia, Vitex* (Verbenaceae); *Paullinia* (Sapindaceae); *Philodendron* (Araceae); *Cyanus, Eupatorium, Verbesina, Veronia, Wedelia* (Asteraceae); *Cordia* (Ehretiaceae); *Quercus* (Fabaceae); *Cerasus, Crataegus, Malus, Pyrus* (Rosaceae); *Ipomoea* (Convolvulaceae); *Commelina* (Commelinaceae); *Acer* (Aceraceae); *Betula* (Betulaceae); *Terminalia* (Combretaceae); *Bromelia* (Bromeliaceae); *Aristolochia* (Aristolochiaceae); *Arrabidea* (Bignoniaceae); *Actinostomon* (Euphorbiaceae); *Celastrus* (Celastraceae); Sapindaceae (Jolivet and Howkeswood 1995); Tilaceae (Hespenheide and Dang 1999).

Described species.—92±. Key to species: Uhmann (1936a), covered 48 species; Monrós and Viana (1947), Argentina; Butte (1968b), North America; Staines (1996b), Nicaragua.

Range.—Canada to Argentina.

Charistena Baly
(Fig. 63)

Charistena Baly 1864: 251. Type species: *Hispa ruficollis* Fabricius (by original designation).

Description.—*Head:* Small; frons not prominent; eye finely granulate. *Antenna:* 10-segmented; antennomere I stout, oval; II longer than I; III longer than II; IV to VI gradually shorter; VII to X distinct, shorter than others. *Pronotum:* Subcylindrical, not clearly margined. *Elytron:* Elongate, parallel-sided; apex rounded; with 8 rows of coarse punctures; tricostate. *Legs:* Mesotibia strongly arcuate, inner apical angle acute, slightly prolonged; tarsomeres dilated, densely pubescent beneath; tarsomere 1 triangular, rather small; 2 reniform; 3 deeply bilobed; 4 slightly longer than lobes of 3; claws feebly curved, divergent.

Host plants.—*Panicum, Paspalum, Zea* (Poaceae) (Jolivet and Hawkeswood 1995).

Described species.—6.

Range.—Colombia to Argentina.

Clinocarispa Uhmann
(Fig. 64)

Clinocarispa Uhmann 1935b: 227 (unavailable name, type species not designated).

Clinocarispa Uhmann 1940b: 143. Type

species: *Odontota sauveuri* Chapuis (by original designation).

Description.—*Head:* Medial sulcus present; rounded depression present on vertex; clypeus smooth, sparsely setose. *Antenna:* 11-segmented, fusiform, not thickened at apex, slightly compressed laterally, striate; antennomere I subglobular; II transverse; III to V cylindrical, III longest; VI to X transverse; XI pointed at apex; VII to XI pubescent. *Pronotum:* Longer than wide, convex, uniformly punctate; basal impression present; longitudinal medial carina present. *Scutellum:* Subquadrate. *Elytron:* Subparallel, slightly divergent posteriorly; lateral margin smooth; apical margin dentate; with 8 rows of punctures plus scutellar row, with some additional puncture rows on humerus; tricostate. *Legs:* Tarsal claws with two teeth. *Venter:* Prosternum elevated between front coxae, depressed toward mouth, not projecting forward.

Host plants.—*Bambusa, Olyra* (Poaceae) (Ramos 1996).

Described species.—7. Key to species: Ramos (1996).

Range.—Colombia to Peru.

Cnetispa Maulik
(Fig. 65)

Cnetispa Maulik 1930: 49. Type species: *Cnetispa darwini* Maulik (by original designation).

Description.—Small. *Antenna:* 9-segmented; short, barely reaching to base of pronotum, not produced into acute point at apex; antennomeres I and II distinct; III to IX forming elongate, slightly flattened club, III longest; IX broadest at apex. *Pronotum:* Subcylindrical, narrowed apically; light prescutellar impression present. *Scutellum:* Rectangular. *Elytron:* Lateral margin serrate; external apical angle expanding but not spine-like; with 8 rows of punctures plus scutellar row.

Host plants.—*Centrosema, Cymbosema, Desmodium* (Fabaceae) (Jolivet and Hawkeswood 1995).

Described species.—4.

Range.—Costa Rica to Argentina.

Corynispa Uhmann
(Fig. 66)

Corynispa Uhmann 1940b: 143. Type species: *Uroplata clavicornis* Uhmann (by monotypy).

Description.—*Head:* Medial sulcus absent; vertex alutaceous, with depression between eyes; carina present from depression to antennal base. *Antenna:* 7-segmented; antennomere I subglobose, II transverse, III cylindrical; IV to VI transverse, VII 2× as wide as the preceding. *Pronotum:* Longer than wide, parallel-sided; with scattered large punctures; two areas on either side of disc with dense punctures. *Elytron:* Lateral and apical margins dentate; dilated at apex; with 10 rows of punctures; costae carinate, especially on basal 1/5; costa 2 highly carinate at humerus, continues on basal ½, more elevated at apex. *Legs:* Thickened; tarsal claws with tooth at base.

Host plant.—*Stigmatophyllum* (Malpighiaceae) (Jolivet and Hawkeswood 1995).

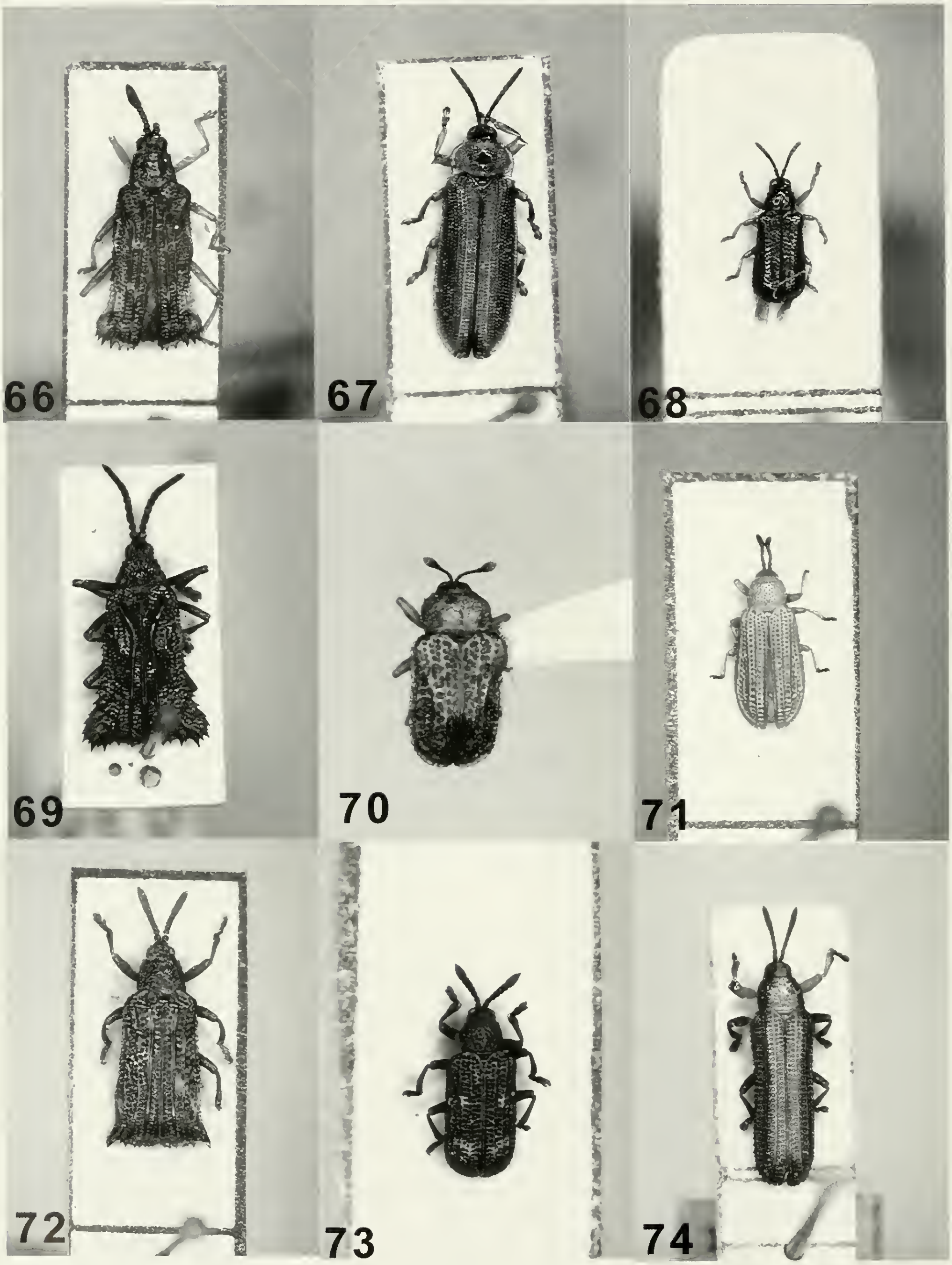
Described species.—1.

Range.—Brazil.

Craspedonispa Weise
(Fig. 67)

Craspedonispa Weise 1910: 125. Type species: *Craspedonispa modesta* Weise (by monotypy).

Description.—Body moderately elongate, almost parallel, slightly convex. *Head:* Clypeus triangular. *Antenna:* 11-segmented, moderately short, filiform; apical 5 antennomeres thickened. *Pronotum:* 2× as wide as long, narrowing basally; lateral margin rounded, broadly and conspicuously margined. *Scutellum:* Wider than long; narrowing behind; apex rounded. *Elytron:* Wider than pronotum; parallel-sided; lateral margin with tooth; apex narrowed, conjointly rounded; with 10 rows of punctures plus scutellar row, punctures close together; punctures of row 10 transverse and reach to



Figs. 66–74. Dorsal habitus. 66, *Corynispa clavicornis* Uhmann. 67, *Craspodonispa* sp. 68, *Dectalia lema* Weise. 69, *Euprinota aterrima* (Guérin). 70, *Fossispa lutena* Staines. 71, *Glyphuroplata uniformis* (Smith). 72, *Heptachispa texta* Uhmann. 73, *Heptatomispa kesseli* Uhmann. 74, *Heptispa solarii* Weise.

lateral margin; unicostate. *Venter:* Prosternum narrowed between coxae. *Legs:* Moderately short.

Host plant.—*Saccharum* (Poaceae) (Jolivet and Hawkeswood 1995).

Described species.—2.

Range.—Trinidad to Brazil.

Decatelia Weise
(Fig. 68)

Decatelia Weise 1904: 435. Type species: *Decatelia lema* Weise (by monotypy).

Paradecatelia Uhmann 1940b: 144. Type species: *Paradecatelia viridis* Uhmann (by monotypy); Monrós and Viana 1947 (synonmy).

Description.—Body small; rounded in front; eye large. *Head:* Clypeus triangular, overlapping labrum. *Antenna:* Reaching humeri, filiform, 9- or 10-segmented; antennomere II longer than I; III not significantly longer than II; apical 5 antennomeres thicker and wider. *Pronotum:* Slightly wider than long, cylindrical; transverse sulcus present before base; lateral margin constricted before base. *Scutellum:* Transverse, quadrate. *Elytron:* Wider than pronotum at humeri, almost parallel-sided; apex widely conjointly rounded; truncate at base; with 10 rows of punctures plus scutellar row; rows 5 to 8 in a longitudinal cavity with angular sides; rows before cavity confused or reduced to 2 or 3 rows. *Venter:* Abdominal sterna 1 and 2 separated by deep suture; prosternum simple, truncate behind. *Legs:* Mesotibia curved; tarsal claws moderately divergent.

Host plants.—Unknown.

Described species.—7. Key to species: Monrós and Viana (1947), Argentina.

Range.—Colombia to Argentina.

Euprionota Guérin-Méneville
(Fig. 69)

Euprionota Guérin-Méneville 1844: 278. Type species: *Euprionota aterrima* Guérin-Méneville (by monotypy).

Description.—*Head:* Vertex with 3 to 5 longitudinal sulci. *Antenna:* 8-segmented; reaching to middle of elytra; antennomeres I to VII short, slightly compressed laterally; VIII wider, compressed laterally. *Scutellum:* Quadrate. *Pronotum:* Transverse; lateral margin sinuate, narrowing anteriorly; basal margin as wide as base of elytra. *Elytron:* Expanding apically; lateral and apical margins strongly denticulate, teeth alternately large and small on apex; exterior apical angle with strong, laminate tooth; tricostate, costa 1 strong, entire, more elevated at base.

Host plant.—*Vernonia* (Asteraceae) (Jolivet and Hawkeswood 1995).

Described species.—5.

Range.—Mexico to Colombia.

Fossispa Staines
(Fig. 70)

Fossispa Staines 1989a: 343. Type species: *Fossispa lutena* Staines (by monotypy).

Description.—*Head:* Surface micropunctate; medial sulcus present; 3 short lateral sulci present near eye; antenna inserted into quadrate pit; pit divided by keel; carina present around eye. *Antenna:* 8-segmented, clavate. *Pronotum:* Wider than long; completely margined laterally; raised areas between punctures micropunctate. *Scutellum:* Quadrate; micropunctate. *Elytron:* With 4 discal costae, costa 3 short and weak, costae 1, 2, and 4 united apically; punctures in double rows, with 8 rows of punctures basally, 10 apically, basal rows 5 and 6 in longitudinal medial depression, latter rows briefly expand to 4 rows behind middle; a short, weak costa between apical rows 6 and 7; costae and raised areas between punctures micropunctate. *Venter:* Rugose at sides.

Host plant.—Unknown.

Described species.—1.

Range.—Guatemala, Jamaica, and Mexico.

Glyphuroplata Uhmann
(Fig. 71)

Glyphuroplata Uhmann 1940b: 143. Type species: *Hispa pluto* Newman (= *Hispa* *porcata* Melsheimer) (by original designation).

Glyphuroplata Uhmann 1937b: 453 (unavailable name, type species not designated).

Description.—Small, coarsely punctate. *Head:* Vertex trisulcate. *Antenna:* 8-segmented, gradually broadening apically. *Elytron:* With 8 or 9 rows of punctures at base, at apical ⅓ may be 10 rows; punctures between rows 4 and 6 may be confused or expanded to 3 or 4 short rows; tricostate. *Legs:* Mesotibia with blunt inward projecting tooth at apex; no distinct tooth before each tarsal claw.

Host plants.—*Digitaria, Eriochloa, Panicum, Valota* (Poaceae) (Riley 1985).

Described species.—4. Key to species: Riley (1985), North America.

Range.—United States to Costa Rica.

Goyachalepus Pic

Goyachalepus Pic 1929a: 26. Type species: *Goyachalepus donckieri* Pic (by monotypy).

Description.—*Head:* Elongate; vertex micropunctate with scattered large punctures; medial sulcus present, becomes keel before base of antenna; two lateral sulci present near top of eye; frons projecting. *Antenna:* 11-segmented, robust, laterally compressed; antennomere I globose; II transverse; III largest, 2.5× length of II or IV; IV to X transverse; XI appendiculate. *Pronotum:* Wider than long; with large, deep punctures; lateral margin sinuate; tooth present in anterior angle; basal impression present. *Scutellum:* Quadrate; alutaceous. *Elytron:* Elongate; lateral margin serrate; apical margin dentate, laminate; with 8 rows of punctures at base plus scutellar row; on apical 1/5 puncture rows 5 and 6 expand to two additional rows divided by a small costa; suture carinate; tricostate, none united; costae 1 and 3 straight, 2 sinuate on apical 1/5. *Venter:* 5 visible abdominal sterna. *Legs:* Apical tarsomeres with two claws.

Host plant.—Unknown.

Described species.—1.

Range.—Brazil.

Heptachispa Uhmann
(Fig. 72)

Heptachispa Uhmann 1953: 876. Replacement name for *Heptatoma* Weise 1921: 187 [preoccupied by *Heptatoma* Meigen (Diptera)]. Type species: *Uroplata crassicornis* Chapuis.

Description.—*Head:* Vertex alutaceous; medial sulcus deep, wide; antennal base on a projection from head. *Antenna:* 7-segmented, thick; antennomeres I to VI transverse, I to IV strongly so; VII longest, a rounded, flattened club. *Pronotum:* Completely margined; basal margin bisinuate; with deep punctures. *Scutellum:* Quadrate. *Elytron:* Exterior apical angle expanding into tooth-like lamina; with 9 rows of punctures at base, rows 5 to 8 expand to an additional row after middle; tricostate. *Legs:* Tarsal claws with a tooth near base.

Host plants.—Unknown.

Described species.—5.

Range.—Brazil to Paraguay.

Heptatomispa Uhmann
(Fig. 73)

Heptatomispa Uhmann 1940b: 143. Type species: *Heptatomispa kesseli* Uhmann (by monotypy).

Description.—Small, parallel-sided. *Head:* Medial sulcus absent; vertex with depression behind eye; surface micropunctate. *Antenna:* 7-segmented, large; antennomeres I to VI transverse, punctate; VII thick, oval; VI not as long as preceding two combined, transverse. *Pronotum:* Convex; alutaceous; with large punctures, along base arranged in two rows. *Elytron:* With 8 rows of punctures at base, expands to 10 on apical ⅓; 4 costae, 1, 2, and 4 entire; alutaceous.

Host plant.—Unknown.

Described species.—1.

Range.—Brazil.

Heptispa Weise
(Fig. 74)

Heptispa Weise 1906b: 241. Type species: *Heptispa solarii* Weise (by monotypy).

Description.—Body strongly flattened. *Head:* Medial sulcus present; sulcus present on inner margin of eye; vertex with few scattered punctures. *Antenna:* 7-segmented; antennomeres I and II transverse, subequal in length; III longer, cylindrical; IV to VI transverse, decreasing in length; VII longest, hirsute, slightly pointed at apex. *Pronotum:* Transverse, completely margined; with large punctures; tooth present in anterior angle; prebasal impression present. *Scutellum:* Transverse, rounded at apex. *Elytron:* Parallel-sided; lateral and apical margins dentate; with 7 entire rows of punctures plus a short row at the humerus, scutellar row absent; tricostate, costae 1 and 2 entire, 3 begins at humerus, all united at apex. *Venter:* Metasternum punctate at sides; last abdominal sternite punctate in middle.

Host plants.—*Cassia* (Caesalpiniaceae); *Inga* (Mimosaceae); *Machaerium* (Fabaceae); *Serjania* (Sapindaceae) (Jolivet and Hawkeswood 1995); *Mimosa* (Mimosaceae) (Hespenheide and Dang 1999).

Described species.—6. Key to species: Staines (1996b), Nicaragua.

Range.—Mexico to Brazil.

Heterispa Chapuis
(Fig. 75)

Heterispa Chapuis 1875: 321. Type species: *Heterispa infuscata* Chapuis (by original designation).

Description.—*Head:* Small, globose; vertex with medial sulcus; conical projection forward to between eyes; antenna with conical projection at base; eye large, convex. *Antenna:* 8-segmented, extends beyond base of pronotum; club with whorls of setae. *Pronotum:* Quadrangular or slightly transverse, narrower than elytra; narrowing from base to apex; light prescutellar impression present. *Scutellum:* Longer than wide. *Elytron:* Oblong or elongate, subparallel; obtuse projection present in exterior apical angle; lateral margin finely serrate; apical margin with many strong, sharp, unequal spines; with 10 rows of large, regular punctures plus scutellar row; elytral interval 2 strongly costate; 4 costate at humerus and apex; 6 visible only at base; 8 entire, less elevated. *Venter:* Mesosternum swollen anteriorly. *Legs:* Long, slender.

Host plants.—*Althaea, Malvastrum, Sida, Sphaeralcea* (Malvaceae); *Triumfetta* (Tiliaceae); *Guazuma* (Sterculiaceae); *Panicum, Stenotaphrum* (Poaceae) (Jolivet and Hawkeswood 1995); *Apeiba* (Tilaceae) (Hespenheide and Dang 1999).

Described species.—5.

Range.—Mexico to Argentina.

Metaxycera Baly
(Fig. 76)

Metaxycera Baly 1864: 255. Type species: *Cephalodonta purpurata* Guérin-Méneville (by original designation).

Description.—Body wedge-shaped, flat. *Head:* Clypeus transverse-triangular, extending to base of antenna. *Antenna:* 11-segmented, strongly filiform, apical 5 antennomeres thickened. *Pronotum:* Almost 2× as wide as long; lateral margin weakly rounded, slightly margined. *Scutellum:* Wider than long, apex rounded. *Elytron:* At humeri wider than pronotum, gradually narrowing to apex; apex widely conjointly rounded; with 10 rows of punctures plus scutellar row; 4 costae. *Venter:* Abdominal sterna 1 and 3 with deep sulcus in middle.

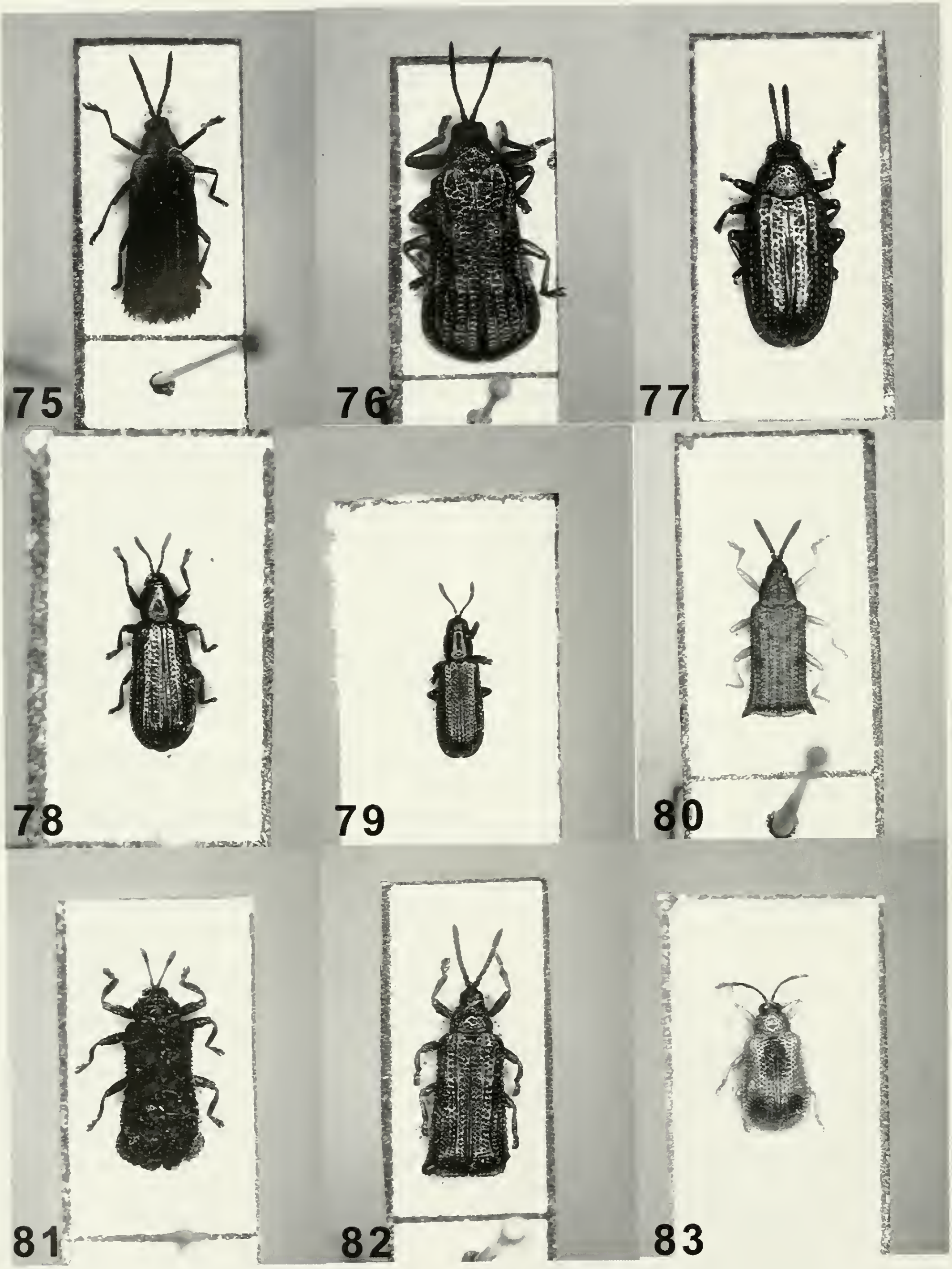
Host plants.—*Cecropia* (Cecropiaceae) (Jolivet and Hawkeswood 1995).

Described species.—12.

Range.—Colombia to Uruguay.

Microrhopala Chevrolat
(Fig. 77)

Microrhopala Chevrolat 1837: 339. Type species: *Hispa vittata* Fabricius (designated by Baly 1864).



Figs. 75–83. Dorsal habitus. 75, *Heterispa vinula* (Erichson). 76, *Metaxycera sexpustulata* Baly. 77, *Microrhopala vittata* (F.). 78, *Nanocthispa atra* (Weise). 79, *Nonispa carlosbruchi* Maulik. 80, *Octhispa* sp. 81, *Octotoma scabripennis* Guérin. 82, *Octuroplata octopustulata* (Baly). 83, *Odontispa bimaculata* Uhmann.

Description.—*Head:* Subglobular; vertex mesally impressed, impression bordered on each side by longitudinal row of punctures; longitudinal sulcus present between antenna; area surrounding eye punctate. *Antenna:* Reaching beyond base of pronotum; antennomeres VII and VIII wider and more pubescent than preceding. *Pronotum:* Longer than wide, widest posteriorly, often narrowed anteriorly, narrower than elytra at humeri; convex; anterior margin straight, lateral margin straight, arcuate, sinuate or bisinuate, posterior margin bisinuate; punctation usually dense; a slender, usually slightly elevated strip lacking coarse punctures present in front of scutellum. *Elytron:* Longer than wide; usually slightly narrowed behind humerus; with 8 rows of punctures plus a scutellar row; rows 1 and 2 extending to apex, 8 and 9 separate or sometimes confused apically, extending to near suture where they unite with 1 and 2; intervals 1 and 9 and also 3 and 7 uniting apically; interval 9 strongly elevated. *Venter:* Prosternum margined anteriorly by row of short setae; abdomen sparsely punctate and pubescent, apical sternite more coarsely punctate and often more pubescent than preceding sterna.

Host plants.—*Ambrosia, Aster, Boltonia, Brickellia, Chrysopsis, Encelia, Franseria, Helianthus, Silphium, Sericocarpus, Solidago* (Asteraceae); *Salvia* (Lamiaceae) (Jolivet and Hawkeswood 1995).

Described species.—19. Key to species: Clark (1983), North America; Staines (1996b), Nicaragua.

Range.—Canada to Colombia.

Mimoethispa Pic

Mimoethispa Pic 1927b: 10. Type species: *Mimoethispa irregularis* Pic (by monotypy).

Description.—Oblong-elongate, somewhat dilated apically, shining. *Head:* Vertex micropunctate; medial sulcus absent; frons with projection at base of antenna; clypeal margin evenly arcuate. *Antenna:* 8-segmented, antennomeres I to VI small; VII elongate, as long as IV to VI combined; VIII largest, 3× length of VII, apex somewhat attenuate. *Pronotum:* Widest at base, narrowing anteriorly; disc impunctate; basal impression present, with scattered punctures; laterally with dense, large punctures. *Scutellum:* Triangular; micropunctate. *Elytron:* Lateral and apical margins dentate; flattened lamina present from exterior apical angle to suture; humerus pronounced; with 8 rows of punctures at base, expanded to 9 rows posteriorly, additional row present between costae 2 and 3; tricostate, costa 3 as wide as a puncture.

Host plant.—Unknown.

Described species.—1.

Range.—Brazil.

Nanocthispa Monrós and Viana
(Fig. 78)

Nanocthispa Monrós and Viana 1947: 312. Type species: *Octhispa atra* Weise (by monotypy).

Description.—*Head:* Finely punctate; opaque; with very fine pubescence; frons depressed, concave, with some sulci; clypeus large, flat, less densely punctate than rest of head, subquadrate; eye small, with carina behind. *Antenna:* Short, 7-segmented; antennomere II 1.5× the length of I. *Pronotum:* Subcylindrical; transversely convex. *Scutellum:* Small, quadrangular; angle rounded. *Elytron:* Parallel-sided; apex conjointly rounded, with 2 small teeth; with 8 rows of punctures plus scutellar row; tricostate, all unite at apex.

Host plant.—Unknown.

Described species.—1.

Range.—Argentina.

Nonispa Maulik
(Fig. 79)

Nonispa Maulik 1933: 606. Type species: *Nonispa carlosbruchi* Maulik (by monotypy).

Enneachalepus Spaeth 1934: 207. Type species: *Enneachalepus aeruginosus*

Spaeth (by monotypy); Uhmann 1957b (synonymy).

Description.—Body oblong, slightly narrowed in front, widest at apex. *Head:* Wide, convex, smooth; eye small, not convex, carina absent on inner margin; clypeus wider than long, punctate. *Antenna:* 9-segmented. *Pronotum:* Longer than wide, scarcely punctate; slight basal impression present. *Scutellum:* Quadrate, rounded at apex. *Elytron:* Parallel-sided; lateral margin smooth; upper surface smooth, without elevations, depressions or roughness; apex rounded, small emargination at apical sutural angle; with 8 rows of punctures, scutellar row absent; tricostate, costae more elevated toward apex. *Venter:* Smooth. *Legs:* Slender, unarmed.

Host plant.—Unknown.

Described species.—1.

Range.—Bolivia to Argentina.

Octhispa Chapuis
(Fig. 80)

Octhispa Chapuis 1877: 23. Type species: *Octhispa fossulata* Chapuis (designated by Monrós and Viana 1947).
Oethispa Pic 1927b: 12 (*lapsus calami*).

Description.—Body moderately attenuate or very narrow. *Head:* Small; eye slightly prominent; vertex with medial sulcus; clypeus prominent, punctate. *Antenna:* Moderately long or short, 8-segmented, more or less clavate; apical antennomere rounded, middle antennomeres compressed laterally. *Pronotum:* Narrowed anteriorly; basal impression present; punctate. *Scutellum:* Quadrangular, angle rounded. *Elytron:* Humerus may have large tooth; lateral and apical margins dentate; with 8 rows of punctures plus scutellar row; tricostate; apex rounded, emarginate or truncate.

Host plants.—*Dioclea, Machaerium* (Fabaceae); *Inga* (Mimosaceae); *Cassia* (Caesalpiniaceae); *Basanacantha* (Rubiaceae); *Adenocalymna, Paullinia, Serjania* (Ehretiaceae); *Coccoloba* (Polygonaceae); *Byrsonima, Malpighia* (Malpighiaceae) (Jolivet and Hawkeswood 1995); *Stigmatophyllum* (Malphigiaceae); *Colubrina* (Rhamnaceae); *Ochroma* (Bombaceae) (Hespenheide and Dang 1999).

Described speices.—102. Key to species: Staines (1996b), Nicaragua.

Range.—Mexico to Argentina.

Octotoma Chevrolat
(Fig. 81)

Octotoma Chevrolat 1837: 390. Type species: *Hispa plicatula* Fabricius (by monotypy).

Description.—Body wedged-shaped. *Head:* Medial sulcus present or absent. *Antenna:* 8-segmented; reaching to base of pronotum; antennomere I subglobose; VII as wide as VIII; VIII oval, subacute at tip. *Pronotum:* Transverse; tooth present in anterior angle; margined laterally; four depressions present, two before and two after midline. *Elytron:* With 8 or 10 rows of punctures plus scutellar row; costae may be developed; some species with transverse and lateral carinae, these species having asymmetrical sculpture. *Legs:* Femora distinctly sinuate beneath near apex; tibiae curved at base, protibia more dilated than others and with outer edge sinuate; tarsomeres dilated, densely pubescent beneath, tarsomeres 1 small, twice as long as wide, 3 longer than 2 and deeply bilobed, 4 little longer than lobes of 3; claws divergent.

Host plants.—*Clerdendrum, Lantana, Tectona, Verbena* (Verbebaceae); *Mentha, Monarda, Origanum, Salvia* (Lamiaceae); *Campsis, Tecoma* (Bignoniaceae); *Canavalia, Cymbosema, Dioclea, Lespedeza* (Fabaceae); *Fraxinus* (Oleaceae); *Sesamum* (Pedaliaceae); *Eupatorium* (Asteraceae); *Quercus* (Fagaceae); *Xanthorrhoea* (Xanthorrhoeaceae); *Stigmatophyllum* (Malpighiaceae) (Jolivet and Hawkeswood 1995).

Described species.—10. Key to species: Staines (1989b, 1994a).

Range.—United States to Brazil.

Octuroplata Uhmann
(Fig. 82)

Octuroplata Uhmann 1937b: 454 (unavailable name, type species not designated).
Octuroplata Uhmann 1940b: 143. Type species: *Uroplata octopustulata* Baly (by original designation).

Description.—*Head:* Oblong, rounded anteriorly; vertex without sulci; interocular impression present which becomes keel anteriorly; eye slightly prominent; clypeus smooth, flat. *Antenna:* 8-segmented; apical antennomere pointed. *Pronotum:* Transverse; laterally rounded; punctate. *Scutellum:* Oblong. *Elytron:* With 8 rows of punctures plus scutellar row; tricostate (1, 2, 4) in anterior center, becomes 2 lines of sunken punctures and vestige of costa 3 on apical ½. *Legs:* Short; tarsal claws with tooth at base.

Host plant.—*Senna* (Fabaceae) (Teixeira et al. 1999).

Described species.—9.

Range.—French Guyana to Argentina.

Odontispa Uhmann
(Fig. 83)

Odontispa Uhmann 1940a: 120. Type species: *Prospodonta latipennis* Pic (by monotypy).

Description.—Elytra much wider than pronotum. *Head:* Vertex smooth; frons elongate, projecting between antennal bases; antennal insertion below midpoint of eye. *Antenna:* 11-segmented; antennomere III longest; apical 5 antennomeres thickened. *Pronotum:* Strongly transverse, 2× as wide as long, convex; lateral margin bisinuate, tooth present in middle of lateral margin; disc smooth, strongly punctate laterally; basal impression present. *Scutellum:* Quadrate. *Elytron:* Much wider than pronotum; short-oval; lateral margin indented behind humerus; lateral and apical margins flattened, finely, sparsely dentate; humerus prominent; punctures large, shallow; interval 8 costate on apical ½; suture elevated. *Legs:* Small tooth present before each tarsal claw.

Host plants.—Unknown.

Described species.—2.

Range.—Brazil.

Odontota Chevrolat
(Fig. 84)

Odontota Chevrolat 1837: 388. Type species: *Hispa scapularis* Olivier (designated by Butte 1968c).

Description.—Wedged-shaped or oblong. *Head:* Slightly wider than long; vertex trisulcate, area between ocular and medial sulci finely rugopunctate; frontal ridge cristulate, either elongate or diamond-shaped; clypeus strongly transverse, prominently raised, base subangulate. *Antenna:* 11-segmented; basal antennomere incrassate. *Pronotum:* Transverse, generally widest medially; lateral margin angulate in middle, bisinuate; dorsum transversely convex, basal depression present or absent. *Elytron:* Oblong, gradually but slightly dilated from base to apex; apex regularly rounded; exterior apical angle rectangulate; lateral margin serrulate or not; with 10 rows of punctures plus scutellar row. *Venter:* Abdominal sternite 5 generally truncate, female with small irregular patch of setae on center elevation.

Host plants.—*Amorpha, Amphicarpaea, Apios, Glycine, Meibomia, Pueraria, Robinia, Sophora, Tephrosia* (Fabaceae) (Jolivet and Hawkeswood 1995).

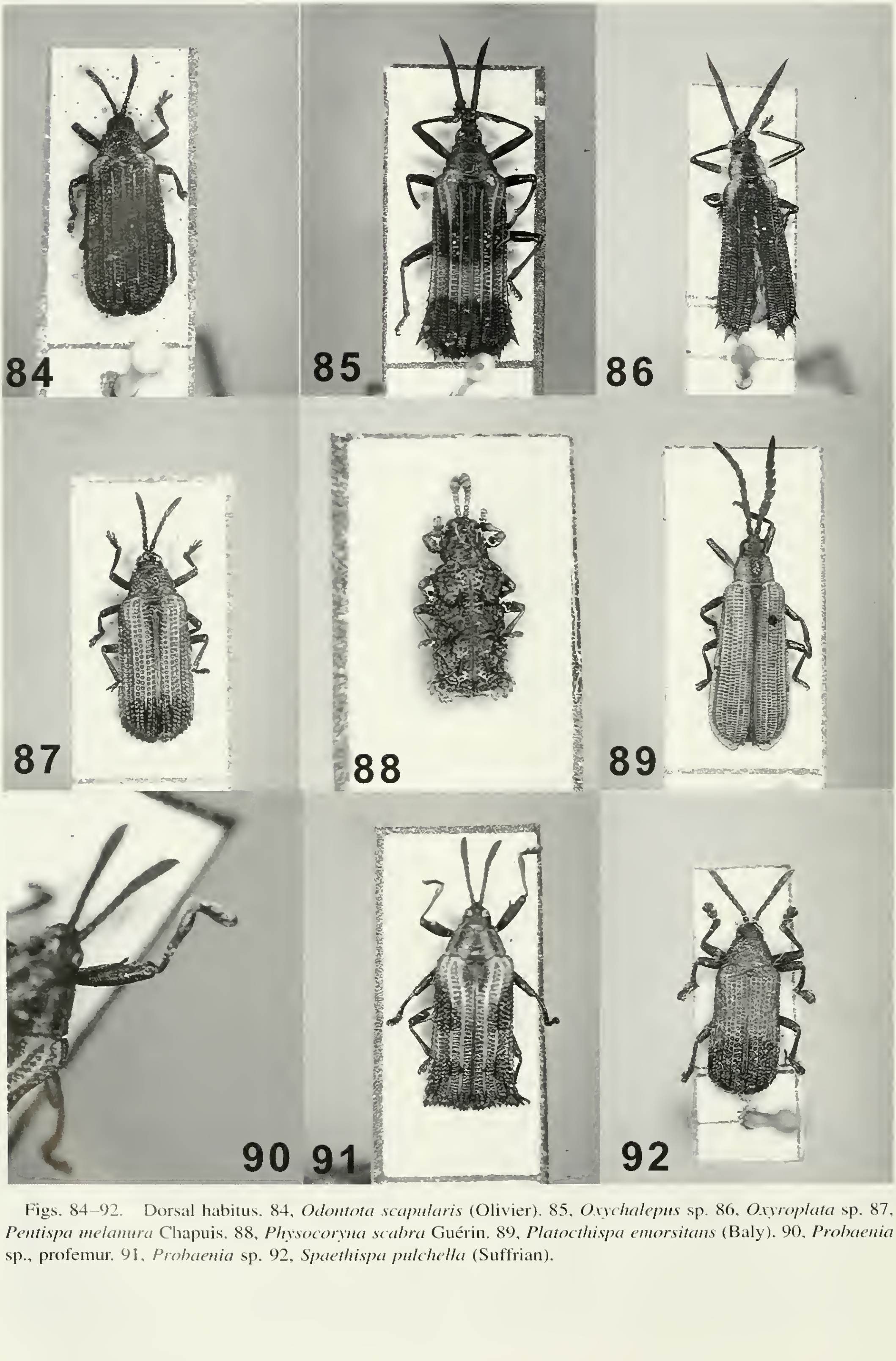
Described species.—7. Key to species: Butte (1968c), North America.

Range.—Canada to United States.

Oxychalepus Uhmann
(Fig. 85)

Oxychalepus Uhmann 1938a: 438. Type species: *Odontota proxima* Guérin-Méneville (by original designation).

Description.—*Head:* Deep medial sulcus present; slightly constricted behind eyes; projection present at base of antenna. *Antenna:* 11-segmented; antennomere XI



Figs. 84–92. Dorsal habitus. 84, *Odontota scapularis* (Olivier). 85, *Oxychalepus* sp. 86, *Oxyroplata* sp. 87, *Pentispa melanura* Chapuis. 88, *Physocoryna scabra* Guérin. 89, *Platocthispa emorsitans* (Baly). 90, *Probaenia* sp., profemur. 91, *Probaenia* sp. 92, *Spaethispa pulchella* (Suffrian).

sharply pointed at apex; III to XI laterally compressed; suture between antennomeres VII to XI very weak. *Pronotum:* Trapezoidal, widest at base; transverse basal impression present. *Elytron:* Lateral margin dentate; apical margin strongly dentate; with 10 rows of punctures plus scutellar row; 4 costae, 1, 2, and 4 complete, 3 visible at humerus and apex.

Host plants.—*Canavalia, Cymbosema, Dioclea, Mucuna, Phaseolus* (Fabaceae); *Inga* (Mimosaceae); *Cassia* (Caesalpiniaceae); *Solanum* (Solanaceae); *Heliconia* (Heliconiaceae); *Flagellaria* (Flagellariaceae); *Cocos* (Arecaceae); *Freycinetia, Pandanus* (Pandanaceae); *Pleomele* (Agavaceae) (Jolivet and Hawkeswood 1995).

Described species.—12. Key to species: Staines (1996b), Nicaragua; Ramos (1998), Brazil.

Range.—Mexico to Argentina.

Oxyroplata Uhmann
(Fig. 86)

Oxyroplata Uhmann 1937b: 454 (unavailable name, type species not designated).

Oxyroplata Uhmann 1940b: 143. Type species: *Uroplata bellicosa* Baly (by original designation).

Description.—*Head:* Medial sulcus present; frons strongly projecting. *Antenna:* 8-segmented, compressed, antennomeres sharply pointed; antennomere I subglobular, slightly compressed laterally; II transverse, shortest; III large, laterally compressed, almost as long as IV and V combined; IV to VII transverse, decreasing in width and length; VIII elongate, acutely pointed at apex. *Pronotum:* Longer than wide; widest at base; tooth present in anterior angle; basal impression present. *Scutellum:* Quadrate. *Elytron:* Lateral margin dentate, margined; apical margin laminate, strongly dentate, subcordate-emarginate; with 10 rows of punctures; 4 costae, 2 and 4 strongly elevated, 1 complete, 3 visible at base and apex.

Host plants.—Unknown.

Described species.—4.

Range.—Costa Rica to Peru.

Parvispa Uhmann

Parvispa Uhmann 1940b: 143. Type species: *Parvispa marmorata* Uhmann (by monotypy).

Description.—*Head:* Medial sulcus deep, long; longitudinal carina present on each side of medial sulcus; vertex alutaceous; row of deep punctures present around eye. *Antenna:* 7-segmented; antennomeres I and II subglobular; III transverse; IV to VI as long as wide; VII hirsute club. *Pronotum:* As wide as long; margined on all sides; lateral margin bisinuate; longitudinal callus present; transverse basal depression present; large deep punctures present over entire surface. *Scutellum:* Quadrate, alutaceous. *Elytron:* Apex conjointly rounded; with 8 rows of punctures plus scutellar row; tricostate; costae 1 and 2 united on apical fifth; costa 2 not reaching union of 1 and 3; costae carinate, uniform in height, no depressions or interruptions; sutural margin elevated. *Legs:* Tarsomeres 3 deeply bilobed; 4 barely projecting beyond lobes of 3.

Host plant.—Unknown.

Described species.—1.

Range.—Bolivia.

Pentispa Chapuis
(Fig. 87)

Pentispa Chapuis 1875: 322. Type species: *Uroplata melanura* Chapuis (designated by Uhmann 1957b).

Penthispa Weise 1911: 52 [unjustified emendation].

Description.—*Head:* Small, globose; with 3 to 5 longitudinal sulci on vertex; eye slightly convex, large. *Antenna:* Short, robust, 8-segmented, apical 2 antennomeres thickened; antennomere I transverse, large; II transverse, smaller than I; III cylindrical, pitted; IV transverse, pitted; V to VII transverse, with setae; VIII elongate, setose, pointed at apex. *Pronotum:* Wider than long, widest at base, slightly constricted in middle; basal impression present; densely punctate. *Scutellum:* Subquadrate, transverse or square. *Elytron:* Oblong, slightly expanding apically; exterior apical angle rounded; lateral margin dentate; apical margin strongly dentate; with 8 rows of punctures, scutellar row present or absent; tricostate. *Venter:* Metasternum rounded anteriorly, slightly convex. *Legs:* Short, robust.

Host plants.—*Colea, Pithecoctenium* (Bignoniaceae); *Paullinia, Serjania* (Sapindaceae); *Baccharis, Clibadium, Elephantopus, Eupatorium, Verbesina, Vernonia* (Asteraceae); *Malpighia* (Malpighiaceae); *Chusquea* (Poaceae) (Jolivet and Hawkeswood 1995).

Described species.—26. Key to species: Staines (1996b), Nicaragua.

Range.—Southern United States to Peru.

Physocoryna Guérin-Méneville
(Fig. 88)

Physocoryna Guérin-Méneville 1844: 279. Type species: *Physocoryna scabra* Guérin-Méneville (by monotypy).

Description.—Body elongate, attenuate. *Head:* Small, medial sulcus absent; vertex with triangular depression. *Antenna:* Very short, 7-segmented; antennomeres I to III moderate, similar in size, as wide as long or III slightly longer than I or II; IV–VI transverse; VII much wider, oval, with whorls of bristles, hirsute. *Pronotum:* Transverse; tooth present in anterior angle; tooth present on lateral margin; with irregular pits. *Elytron:* Parallel-sided, enlarged in exterior apical angle; lateral and apical margins serrate; apex almost truncate; surface with strong, confused punctures; puncture row 1 visible on basal ½, interrupted by tubercles; elytral sculpturing symmetrical. *Venter:* Prosternum broad. *Legs:* Short; tarsi wide, tarsomeres 1 short, 2 twice as large as 1, 3 as long as 1 and 2 combined, 4 slightly exceeds lobes of 3.

Host plants.—*Canavalia, Cymbosema, Dioclea, Phaseolus* (Fabaceae); *Stimatophyllum* (Malpighiaceae) (Staines 1999).

Described species.—3. Key to species: Staines (1999).

Range.—Nicaragua to Argentina.

Platocthispa Uhmann
(Fig. 89)

Platocthispa Uhmann 1939: 332 (unavailable name, type species not designated).
Platocthispa Uhmann 1940b: 144. Type species: *Odontota gregorii* Chapuis (by original designation).

Description.—Body flattened. *Head:* 3 parallel sulci between eyes; frons projecting. *Antenna:* 8-segmented, antennomeres transverse, apical antennomeres thickened, reaches to middle of elytra; antennomere I slightly compressed laterally; II shorter and narrower than I; III longer than IV and V, compressed laterally, tooth-like projection on outer apical margin; IV to VI compressed laterally, IV with small tooth; VII compressed laterally; VIII elongate, as long as V to VII combined. *Pronotum:* Wider than long; lateral margin evenly convergent from base to apex, margined laterally; tooth present in anterior angle; basal impression present; basal margin bisinuate; longitudinal sulcus present on disc. *Scutellum:* Quadrate. *Elytron:* Lateral margin dentate; apical margin more dentate, laminate; apex subcordate-emarginate; exterior apical angle rounded; with 8 rows of punctures, scutellar row absent; tricostate, costa 1 most elevated, 3 extends from humerus to middle of elytra. *Venter:* With 5 visible abdominal sterna.

Host plants.—*Cassia* (Caesalpiniaceae) (Jolivet and Hawkeswood 1995); *Piper* (Piperaceae); *Costus* (Zingiberaceae); *Calathea* (Marantaceae); *Ochroma* (Bombaceae) (Hespenheide and Dang 1999).

Described species.—7.

Range.—Southern United States to Peru.

Probaenia Weise
(Figs. 90–91)

Probaenia Weise 1904: 447. Type species: *Odontota crenata* Blanchard (designated by Monrós and Viana 1947).

Description.—Body elongate, rectangular. *Head:* Eye not prominent; clypeus triangular, smooth, edges margined, medial carina present. *Antenna:* 8-segmented. *Pronotum:* Trapezoidal, at base as wide as or slightly narrower than elytra, strongly narrowed behind anterior margin, conical. *Elytron:* Apical and lateral margins dentate; flat triangular lamina present in exterior apical angle; with 10 rows of punctures plus scutellar row; 4 costae; costae 3 and 4 united at apex. *Legs:* Profemur with 1 to 3 teeth on inner margin.

Host plants.—*Verbena* (Verbenaceae); *Igna* (Mimosaceae); *Rolandra, Verbesina, Vernonia* (Asteraceae) (Jolivet and Hawkeswood 1995); *Mikania, Piptocarpha* (Asteraceae); *Arrabidaea* (Bignoniaceae) (Hespenheide and Dang 1999).

Described species.—45.

Range.—Nicaragua to Argentina.

Spaethispa Uhmann
(Fig. 92)

Spaethispa Uhmann 1939: 333. Type species: *Uroplata pulchella* Suffrian (by monotypy).

Description.—*Head:* Vertex with 3 longitudinal sulci; clypeus transverse, with longitudinal lines. *Antenna:* 8-segmented; antennomere I subglobose; II transverse; III cylindrical; IV to VII transverse, wider than preceding; VII elongate, truncate at apex. *Pronotum:* Wider than long; margined laterally; tooth present in anterior angle; densely, coarsely punctate. *Scutellum:* Triangular. *Elytron:* Lateral margin dentate; apical margin more dentate; with 10 rows of punctures, additional puncture row present between interspace 3 and 4 behind middle; tricostate, costae weakly produced, sutural margin carinate.

Host plant.—Unknown.

Described species.—1.

Range.—Cuba.

Stenopodius Horn
(Figs. 93–94)

Stenopodius Horn 1883: 301. Type species: *Stenopodius flavidus* Horn (by monotypy).

Description.—*Head:* Small; vertex not prominent; frons vertical; eye large, oval, facets numerous. *Antenna:* Clavate, short, extends a short way beyond apical margin of pronotum, 8-segmented; antennomere VIII oval, pointed at apex. *Pronotum:* Wider than long; in most species apex more or less prolonged (lobed) at middle and sinuate at each side; base wider than apex, broadly lobed, sinuate laterally, overlapping base of elytron, except in middle. *Scutellum:* Subquadrate; apex truncate, feebly arcuate or slightly emarginate. *Elytron:* Oblong-oval; about ½ longer than wide; parallel-sided and broadly rounded in apical ¼; lateral and apical margins more or less serrulate; 8 or 10 rows of large, circular punctures. *Legs:* Glabrous; metafemur slightly longer than tibia; tarsomeres not dilated, with pale setae beneath, first 3 tarsomeres subequal, 3 emarginate above, 4 as long as 1 to 3 combined; claws feebly arcuate.

Host plants.—*Althaea, Malva, Sphaeralcea* (Malvaceae) (Jolivet and Hawkeswood 1995).

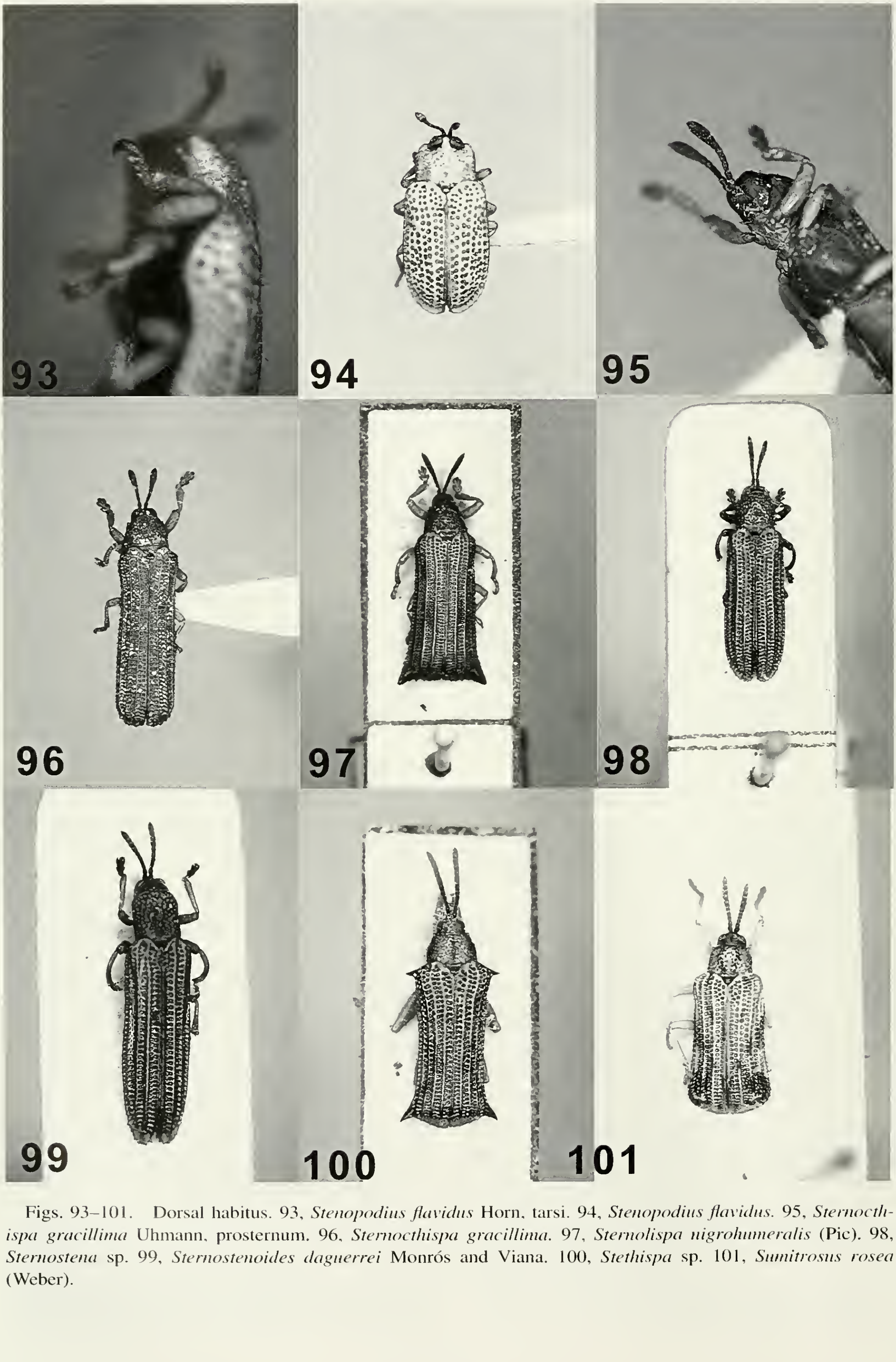
Described species.—7. Key to species: Blaisdell (1939), North America.

Range.—Canada to Mexico.

Sternocthispa Uhmann
(Figs. 95–96)

Sternocthispa Uhmann 1938b: 113. Type species: *Sternocthispa gracillima* Uhmann (by monotypy).

Description.—*Head:* Trisulcate; micropunctate. *Antenna:* 7-segmented; antennomere I transverse; II and III cylindrical, subequal in length; IV to VI transverse; VII



Figs. 93–101. Dorsal habitus. 93, *Stenopodius flavidus* Horn, tarsi. 94, *Stenopodius flavidus*. 95, *Sternocthispa gracillima* Uhmann, prosternum. 96, *Sternocthispa gracillima*. 97, *Sternolispa nigrohumeralis* (Pic). 98, *Sternostena* sp. 99, *Sternostenoides daguerrei* Monrós and Viana. 100, *Stethispa* sp. 101, *Sumitrosus rosea* (Weber).

enlarged, hirsute club, nearly as long as I to VI combined, pointed at apex. *Pronotum:* As wide as long, convex; lateral margin sinuate; tooth present in anterior angle; medial carina present; with large, shallow punctures; surface distinctly micropunctate; basal impression present. *Scutellum:* Quadrate; micropunctate. *Elytron:* At base much wider than pronotum, elongate, parallel-sided; lateral margin serrate; apical margin dentate, laminate; exterior apical angle rounded; with 8 rows of punctures plus scutellar row; tricostate; costa 1 more elevated on apical ½; 2 and 3 elevated for entire length. *Legs:* Apical tarsomeres with two claws; small tooth present at base of each tarsal claw; femora punctate. *Venter:* Prosternum produced, partially concealing mouth; 5 visible abdominal sterna.

Host plant.—Unknown.

Described species.—1.

Range.—Brazil.

Sternoplispa Uhmann
(Fig. 97)

Sternoplispa Uhmann 1935d: 237 (unavailable name, type species not designated).
Sternoplispa Uhmann 1940b: 144. Type species: *Sternoplispa triformis* Uhmann (by original designation).

Description.—*Head:* Vertex with small triangular depression, impunctate; medial sulcus present. *Antenna:* 10-segmented; antennomere I subglobose; II and III cylindrical; IV to VI transverse, narrower than preceding; VII to IX transverse, wider than preceding; X pointed at apex. *Pronotum:* Longer than wide, convex; basal impression present. *Scutellum:* Rounded at apex. *Elytron:* Lateral margin dentate; triangular tooth present on external apical angle; with 8 rows of punctures plus scutellar row; tricostate. *Venter:* Prosternum projecting forward, with two blunt teeth present on anterior margin.

Host plants.—Unknown.

Described species.—7. Key to species: Uhmann (1948).

Range.—Brazil to Argentina.

Sternostena Weise
(Fig. 98)

Sternostena Weise 1910: 120. Type species: *Charistena basalis* Baly (designated by Monrós and Viana 1947).

Description.—Body elongate, almost cylindrical. *Head:* Small, elongate; interocular area with some markings; antenna inserted into anterior of head. *Antenna:* 11-segmented; antennomere I robust, longer than wide; II longer, more slender than I; III longest, more slender than II; IV to VI similar, shorter than II; VII to XI somewhat thickened, more closely united than others. *Pronotum:* Slightly longer than wide; lateral margin curved. *Scutellum:* Quadrate, angle rounded. *Elytron:* Elongate, subparallel; apical denticulation irregular; with 8 rows of punctures plus scutellar row; tricostate. *Legs:* Short, relatively robust; mesotibia curved. *Venter:* Prosternum projecting forward, covering part of mouth.

Host plant.—*Paspalum* (Poaceae) (Jolivet and Hawkeswood 1995).

Described species.—7. Key to species: Monrós and Viana (1947), Argentina.

Range.—Costa Rica to Argentina.

Sternostenoides Monrós and Viana
(Fig. 99)

Sternostenoides Monrós and Viana 1947: 267. Type species: *Sternostenoides daguerrei* Monrós and Viana (by monotypy).

Description.—Body elongate, subcylindrical. *Head:* Medial sulcus faint; frons punctate; clypeus finely punctate, with longitudinal carina. *Antenna:* 10-segmented; antennomeres I and II similar, wider than the next three; III to V lengthened; VI shorter and wider than V; VII to X thicker than rest, forming a poorly defined club. *Pronotum:* Narrower than elytra, cylindrical; parallel-sided, slightly elongate; irregularly punctate. *Scutellum:* Quadrangular. *Elytron:* Lateral and apical margins finely dentate; apex conjointly rounded; with 8 rows of punctures plus scutellar row; tricostate, united on apical 1/5. *Legs:* Mesotibia strongly curved; mesofemur with short spine. *Venter:* Prosternum with short median plate on anterior margin.

Host plant.—Unknown.

Described species.—1.

Range.—Argentina.

Stethispa Baly
(Fig. 100)

Stethispa Baly 1864: 265. Type species: *Stethispa bonvouloirii* Baly (by original designation).

Description.—Body elongate. *Head:* Clypeus transverse, rarely triangular, frequently expanding to base of antenna. *Antenna:* Short, 11-segmented, filiform; apical 5 antennomeres thickened, longer than preceding. *Pronotum:* Conical or rounded laterally; narrowing anteriorly. *Scutellum:* Transverse, narrowing behind, rounded at apex. *Elytron:* Elongate, rectangular; humerus with outward directed spine; strongly pointed tooth present on exterior apical angle; with 10 rows of punctures, scutellar row present or absent; 4 costae. *Venter:* Suture between first 2 abdominal sterna obscure in middle. *Legs:* Tarsal claws divergent.

Host plants.—*Coccoloba, Ruprechtia* (Polygonaceae); *Aristolochia* (Aristolochiaceae) (Jolivet and Hawkeswood 1995).

Described species.—18. Key to species: Monrós and Viana (1947), Argentina.

Range.—Costa Rica to Argentina.

Sumitrosis Butte
(Fig. 101)

Sumitrosis Butte 1969: 13. Replacement name for *Anoplitis* Chapuis 1875: 316 (preoccupied by *Anoplitis* Kirby 1837). Type species: *Hispa rosea* Weber (by original designation).

Description.—*Head:* Slightly wider than long; vertex finely granulose with deep medial sulcus; frontal carina feeble, joining clypeal base; clypeus feebly transverse. *Antenna:* 11-segmented. *Pronotum:* transverse; lateral margin obtusely subangulate at middle and feebly narrowing towards apex and obliquely more or less so towards base; transversely convex; basal impression present or absent. *Elytron:* Elongate-ovate; lateral margin serrulate or not; apex conjointly, distinctly rounded; with 8 rows of punctures plus scutellar row; tricostate.

Host plants.—*Amorpha, Amphicarpaea, Cajanus, Canavalia, Desmodium, Dolichos, Glycine, Lespedeza, Meibomia, Phaseolus, Pueraria, Robinia, Strophostyles* (Fabaceae); *Potentilla* (Rosaceae); *Cassia* (Caesalpiniaceae); *Celastrus* (Celastraceae); *Aster, Eupatorium, Helianthus, Rudbeckia, Solidago, Veronia, Wedelia* (Asteraceae); *Cyrilla* (Cyrillaceae); *Laportea* (Urticaceae); *Chenopodium* (Chenopodiaceae); *Bambusa, Chusquea, Lasiacis* (Poaceae); *Quercus* (Fagaceae) (Jolivet and Hawkeswood 1995); *Heliconia* (Musaceae) (Hespenheide and Dang 1999).

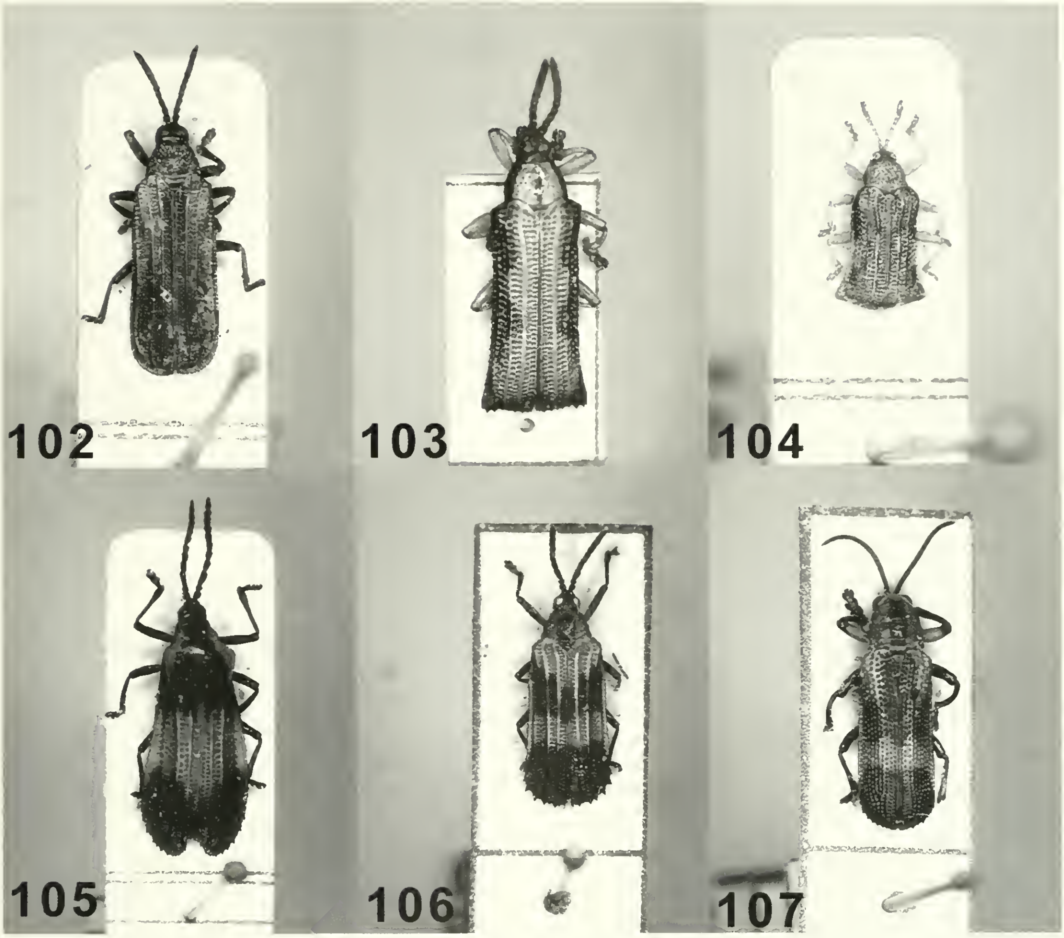
Described species.—58. Key to species: Butte (1969), North America; Staines (1990), Argentina; Staines (1996b), Nicaragua.

Range.—Canada to Argentina.

Temnochalepus Uhmann
(Fig. 102)

Temnochalepus Uhmann 1935a: 56. Type species: *Odontota lugubris* Chapuis (by original designation).

Description.—*Head:* Clypeus hardly granulose, with medial carina which is prolonged into a deep interocular sulcus; sharp postocular constriction present; projection present at base of antenna. *Antenna:* 11-segmented; antennomeres I to II cylindrical, II shorter and narrower than I; III longer than I or II; IV to VI transverse, decreasing in length; VII to X transverse, slightly compressed laterally; XI rounded at apex. *Pronotum:* Wider than long, widest at base; small tooth present in anterior angle; transverse basal impression present; densely



Figs. 102–107. Dorsal habitus. 102, *Temnochalepus imitans* Uhmann. 103, *Temnocthispa truncata* (F.). 104, *Uroplata* sp. 105, *Xenochalepus* (*s. str.*) sp. 106, *Xenochalepus* (*Neochalepus*) *medius* (Chapuis). 107, *Hispoleptis diluta* (Guérin).

punctate. *Elytron:* Lateral margin smooth; apical margin scarcely denticulate; with 10 rows of punctures plus scutellar row; 4 costae, 1, 2, and 4 well developed; costa 3 visible at humerus and apex or totally absent.

Host plants.—*Panicum, Pharus* (Poaceae); *Commelina* (Commelinaceae) (Jolivet and Hawkeswood 1995).

Described species.—4. Key to species: Monrós and Viana (1947), Argentina.

Range.—Brazil to Argentina.

Temnocthispa Uhmann
(Fig. 103)

Temnocthispa Uhmann 1939: 331 (unavailable name, type species not designated). *Temnocthispa* Uhmann 1940b: 144. Type species: *Hispa truncata* Fabricius (by original designation).

Description.—*Head:* Medial sulcus present; sulcus present on inner margin of eye. *Antenna:* Antennomere I subglobose, slightly compressed laterally; II to VII transverse, III longer than II; VIII elongate club, pointed at apex. *Pronotum:* Much narrower than base of elytra; slightly constricted behind head; tooth present in anterior angle; lateral margin curved. *Scutellum:* Quadrate. *Elytron:* Lateral and apical margins dentate; with 8 regular puncture rows plus scutellar row; additional puncture row present on apical ½; tricostate, costae 1 and 2 more elevated than 3. *Legs:* Femora or pro- and mesofemora toothed; tarsal claws without tooth.

Host plants.—Unknown.

Described species.—3.

Range.—French Guyana to Ecuador.

Uroplata Chevrolat
(Fig. 104)

Uroplata Chevrolat 1837: 389. Type species: *Uroplata mucronata* Olivier (designated by White 1988).

Codiohispa Maulik 1930: 48. Type species: *Codiohispa anonicola* Maulik (by monotypy); Uhmann 1957b (synonymy).

Mimuroplata Pic 1933: 389. Type species: *Mimuroplata irregularis* Pic (by monotypy); Monrós and Viana 1947 (synonymy).

Plicatopalpa Pic 1932: 29. Type species: *Plicatopalpa irregularis* Pic (by monotypy). **New synonomy.**

Description.—*Head:* Oblong, rounded; vertex smooth or with no sulci. *Antenna:* 8-segmented; antennomeres VII and VIII with whorls of golden setae. *Pronotum:* Varying in form, at base narrower than elytra; lateral margin more or less rounded; disc frequently with 3 longitudinal vittae. *Scutellum:* Transverse. *Elytron:* With 10 rows of punctures, scutellar row present or absent; 4 costae, 3 and 4 united on apex; 3 interrupted. *Legs:* Moderately long; protibia occasionally with a tooth; empodium present between tarsal claws.

Host plants.—*Annona, Rollinia* (Annonaceae); *Baccharis, Clibadium, Elephantopus, Eupatorium, Rolandra, Vernonia, Wedelia* (Asteraceae); *Banisteria, Malpighia* (Malpighiaceae); *Lantana, Lippa, Verbena* (Verbenaceae); *Caesarea* (Vivianaceae); *Arrabidaea, Bignonia, Colea, Pithecoctenium* (Bignoniaceae); *Calopogonium* (Fabaceae); *Aristolochia* (Aristolochiaceae); *Althaea, Sida* (Malvaceae); *Ocotea* (Lauraceae); *Panicum* (Poaceae); Acanthaceae (Jolivet and Hawkeswood 1995); *Inga* (Mimosaceae); *Gouania* (Rhamnaceae) (Hespenheide and Dang 1999).

Described species.—88. Key to species: Staines (1996b), Nicaragua.

Range.—Mexico to Argentina.

Xenochalepus Weise
(Fig. 105)

Xenochalepus Weise 1910: 136. Type species: *Odontota omogera* Crotch (designated by Butte 1968a).

Hemichalepus Spaeth 1937: 147 (unavailable name, type species not designated).

Hemichalepus Uhmann 1957b: 94. Type species: *Odontota haroldi* Chapuis (by original designation); Staines and Riley 1994 (synonymy).

Description.—*Head:* Slightly wider than long; vertex sulcate; longitudinal carina between antenna reaching base of clypeus; clypeus large; labrum prominent, wider than long; outer margin of mandible rather broadly and evenly arcuate; eye convex, elongate-oval. *Antenna:* 11-segmented; antennomere I incrassate. *Pronotum:* Wider than long; lateral margin bisinuate, angulate at middle; transversely convex; slight basal impression with transverse carina present. *Elytron:* Elongate-oval; apex conjointly rounded, deeply subquadrate-emarginate at suture; lateral and apical margins serrulate; with 10 rows of punctures plus scutellar row. *Legs:* Last tarsomeres produced between bases of claws into a narrow triangular, truncate process. *Venter:* Abdomen sparsely micropunctate; apex of sternite 5 slightly emarginate; generally sternite 5 of female with small irregular patch of setae on both sides of central elevation, in male patch of setae scarcely perceptible.

Host plants.—*Theobroma* (Sterculiaceae); *Bambusa, Panicum, Saccharum, Zea* (Poaceae); *Canavalia, Cymbosema, Dioclea, Dolichos, Faba, Glycine, Lathyrus, Mucuna, Nissolia, Phaseolus, Vigna* (Fabaceae); *Inga* (Mimosaceae); *Urera* (Urticaceae); *Schubertia* (Malvaceae); *Prunus* (Rosaceae); *Celtis* (Ulmaceae) (Jolivet and

Hawkeswood 1995); *Cecropia, Coussapoa, Pourouma* (Cecropiaceae); *Anthurium* (Araceae) (Hespenheide and Dang 1999).

Described species.—26. Key to species: Uhmann (1938a), key to species groups; Monrós and Viana (1947), Argentina; Butte (1968a), North America; Staines (1996b), Nicaragua.

Range.—Southern United States to Argentina.

Xenochalepus (*Neochalepus* Staines and Riley)
(Fig. 106)

Xenochalepus (*Neochalepus*) Staines and Riley 1994: 219. Type species: *Odontota medius* Chapuis (by original designation).

Description.—As in *Xenochalepus* (s. str.) except differing in development of elytral intervals and shape of mesosternum as follows: Elytron with intervals 2, 4, and 8 costate, other intervals not developed or, in some species, interval 6 raised near base and again apically; mesosternum between mesocoxae clearly transverse.

Host plants.—*Olyra, Oryza* (Poaceae); *Lathyrus, Mucuna, Nissolia, Phaseolus, Robinia, Wisteria* (Fabaceae); *Inga* (Mimosaceae); *Bauhinia* (Caesalpiniaceae); *Ipomoea* (Convolvulaceae) (Uhmann 1938a, Monrós and Viana 1947).

Described species.—64. Key to species: Spaeth (1937).

Range.—Southern United States to Argentina.

TRIBE HISPOLEPTINI CHAPUIS 1875: 283

Type genus.—*Hispoleptis* Baly.

Description.—*Head:* Clypeus obscure. *Antenna:* 11-segmented; filiform, apical 4 antennomeres similar to preceding; at least apical portion compressed laterally. *Pronotum:* Nearly quadrate, narrowing apically. *Elytron:* Elongate, subparallel; puncture rows strongly impressed.

Hispoleptis Baly
(Fig. 107)

Hispoleptis Baly 1864: 262. Type species: *Promecotheca diluta* Guérin-Méneville (by original designation).

Description.—Moderately elongate, with patterns of black and yellow or reddish. *Head:* Vertex impunctate; interantennal carina distinct, bluntly pointed; eye transverse, narrowed behind. *Antenna:* Filiform, more or less compressed apically; antennomere I subglobular; II very small; III longest; IV to X progressively decreasing in length; XI longer than X; III to XI with fine longitudinal carinae; apical 4 antennomeres with deep longitudinal depression on outer side. *Pronotum:* Almost as long as wide, more or less narrowing apically; at base almost straight, margined and transversely impressed; margined laterally. *Scutellum:* Impunctate. *Elytron:* At humeri wider than pronotum, elongate, subparallel; deeply punctate; dentate apically; no costae. *Legs:* Procoxae closer together than meso- or metacoxae; mesotrochanter with sharp projection; femora progressively less incrassate from anterior to posterior; protibia with interior tuft of setae; mesotibia curved, with inner apical tooth; pro- and metatibiae straight, without teeth; first tarsomere of prolegs asymmetrical and much wider than on other tarsi; tarsomeres 2 and 3 with longitudinal medial depression on all legs. *Venter:* Prosternum projecting in front in middle, transversely concave between coxae; abdominal sterna 1 and 2 connate, suture distinct; all sterna with impressions laterally.

Host plants.—*Cocos, Elaeis* (Arecaceae) (Jolivet and Hawkeswood 1995).

Described species.—4. Key to species: Aslam (1965).

Range.—French Guyana to Brazil.

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LIFE HISTORY AND DESCRIPTION OF ADULTS AND IMMATURE STAGES OF *GOEDENIA STEYSKALI*, N. SP. (DIPTERA: TEPHRITIDAE) ON *GRINDELIA HIRSUTULA* HOOKER AND ARNOTT VAR. *HALLI* (STEYERMARK) M. A. LANE (ASTERACEAE) IN SOUTHERN CALIFORNIA

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Abstract.—***Goedenia steyskali*, n. sp.**, is a nearly monophagous, univoltine fruit fly (Diptera: Tephritidae) reared from and studied in the flower heads of *Grindelia hirsutula* Hooker and Arnott var. *halli* (Steyermark) M. A. Lane belonging to the family Asteraceae, tribe Astereae, and subtribe Solidagininae, like all other known hosts of *Goedenia* spp. This tephritid also has been reared from *Grindelia camporum* E. Greene. A key to *Goedenia* spp. in North America North of Mexico is provided that incorporates this new species. This new species is distinguished from all other North American congeners by the combination of its extensively darkened legs, an uninterrupted discal wing band that rarely attains the posterior wing margin, and the prominent, central, tawny or yellow area on the scutellum. The second- and third-instar larvae and puparium also are partially described and figured, and selected characteristics of these stages are compared with the same stages of other species of *Goedenia*. The anterior thoracic spiracle bears four papillae in the second instar and three papillae in the third instar. The third instar of *G. steyskali* lacks oral ridges, as do the third instars of four other congeners studied to date. Among these same congeners, the third instar of *G. steyskali* has the fewest minute acanthae and pores in the center of the truncated, posteriorly sclerotized, caudal segment. In turn, these structures and a pair of posterior spiracular plates are ringed by two to three, concentric, incomplete series of shallow, elliptical depressions. The life cycle is of the aggregative type. The first and second instars feed on ovules and soft achenes, but the latter instar after or near final molt begins to feed like the third instar in the receptacle, which may be mined extensively, and on sap. Overwintering occurs as sexually immature adults, or mainly as prepuparial third instars and puparia in flower heads on dead plants in apically open, thin-walled, vasiform cells consisting of floret and achene fragments glued together with dried liquid feces and sticky sap. The flattened, dark, sclerotized caudal segment of the third instar serves as a plug that tightly closes the mouth of the cell, yet allows repiration, and thus apparently also may serve to shield the larva from arthropod predators during overwintering. Overwintered puparia of *G. steyskali* were parasitized by chalcidoid Hymenoptera in the genera *Eurytoma* (Eurytomidae), *Pteromalus* (Pteromalidae), and *Torymus* (Torymidae) as probable, primary, solitary, larval-pupal endoparasitoids.

Key Words: Insecta, *Goedenia*, *Grindelia*, Asteraceae, nonfrugivorous Tephritidae, biology, taxonomy of adults and immature stages, flower-head feeding, aggregative life cycle, phragmosis, seed predation, parasitoids

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Most indigenous, western North American Myopitini (Diptera: Tephritidae: Tephritinae) formerly assigned to the Palearctic genus *Urophora* Robineau-Desvoidy were transferred to *Goedenia* by Freidberg and Norrbom (1999). To date, the life history and immature stages of four of the eight known species of *Goedenia* have been described in detail, i.e., *G. timberlakei* (Blanc and Foote) by Goeden et al. (1995), *G. rufipes* (Curran) by Goeden (2002a), *G. setosa* (Foote) by Goeden (2002b), and *G. stenoparia* Steyskal by Goeden (2002c). This paper describes the life history and selected immature stages of a fifth, heretofore undescribed species, *G. steyskali*.

MATERIALS AND METHODS

The present study utilized specimens of adults reared from flower heads of *Grindelia hirsutula* Hooker and Arnott var. *halli* (Steyermark) M. A. Lane collected in the vicinity of Lake Cuyamaca, Cleveland National Forest at about 1370 m elevation in northeastern San Diego County, California. The life history study and description of the immature stages of *Goedenia steyskali* were based in large part on dissections of samples of live mature and dead overwintered flower heads collected during 1992–1999. One or two-liter samples of the large, resinous, flower heads containing the larvae and puparia were transported in cold-chests in an air-conditioned vehicle to the laboratory and stored under refrigeration for subsequent dissection, photography, description, and measurement. Two second-instar and 19 third-instar larvae and 10 puparia dissected from flower heads of *Grindelia hirsutula* were preserved in 70% EtOH for scanning electron microscopy (SEM). Prepuparia and puparia were placed in separate, glass shell vials stoppered with absorbant cotton and held in humidity chambers at room temperature for adult and parasitoid emergence. Specimens for SEM were hydrated to distilled water in a decreasing series of acidulated EtOH. They were osmicated for 24 h, dehydrated through an increasing series of acidulated EtOH and two, 1-h immersions in hexamethyldisilazane (HMDS), mounted on stubs, sputter-coated with a gold-palladium alloy, studied and digitally photographed with a Philips XL-30 scanning electron microscope in the Institute of Geophysics and Planetary Physics, University of California, Riverside.

Adults reared from isolated prepuparia and puparia were individually caged in 850-ml, clear-plastic, screened-top cages with a cotton wick and basal water reservoir and provisioned with a strip of paper toweling impregnated with yeast hydrolyzate and sucrose. These cages were used for studies of longevity in the insectary of the Department of Entomology, University of California, Riverside, at 25 ± 1°C and 14/10 (L/D) photoperiod. Six pairs of virgin males and females obtained from *G. hirsutula* in emergence cages were held in separate, clear-plastic, petri dishes provisioned with a flattened, water-moistened pad of absorbant cotton spotted with honey (Headrick and Goeden 1994) for observations of courtship and copulation behavior.

Plant names used in this paper follow Hickman (1993) and Bremer (1994); tephritid names follow Foote et al. (1993). Format used to describe the adults follows Steyskal (1979), Foote et al. (1993), and Goeden and Norrbom (2001). Terminology and telegraphic format used to describe the immature stages follow Goeden (2001a, b, c; 2002a, b, c), Goeden et al. (1993), Goeden and Headrick (1992), Goeden and Norrbom (2001), Goeden and Teerink (1997), Headrick et al. (1996), Teerink and Goeden (1999), and our earlier works cited therein. Means ± SE are used throughout this paper. Digitized photographs used to construct text figures were processed with Adobe Photoshop® Version 6. The holotype, allotype and 18 paratypes of each sex of *Goedenia steyskali* are deposited in the National Museum of Natural History, Smithsonian Institution, Washington, DC (USNM); the remaining eight paratypes reside in my research collection.

RESULTS AND DISCUSSION

TAXONOMY

Adult.—In accordance with revisionary changes made by Freidberg and Norrbom (1999), the following key to *Goedenia* based on Foote et al. (1993) incorporates the new species described below as well as the single species of *Neomyopites* known from America north of Mexico. It thus includes the only other indigenous, U.S. or Canadian species of Myopitini likely to be confused with *Goedenia*, but not *Rhynencina* nor introduced, Palearctic *Urophora* spp. now present in North America [three-digit figure numbers refer to figures in Foote et al. (1993), not to the present publication].

KEY TO SPECIES OF GOEDENIA

1. Wing without dark bands or spots except sometimes in pterostigma or, very rarely, in cell r_1 (figs. 488, 489) 2
– Wing with dark bands or spots in addition to that in pterostigma 3
2. At least basal ¾ of all femora black; pleuron and scutellum shining black, scutellum sometimes with yellow apex; wing pattern as in fig. 488 . . . . *timberlakei* (Blanc and Foote)
– Legs entirely yellow; pleuron and scutellum black but distinctly tomentose; wing pattern as in fig. 489 . . . . . *Neomyopites claripennis* Foote
3. Scutellum wholly black 4
– Scutellum yellowish, at least in center (fig. 503, a) 5
4. Dark marks on wing consisting largely of isolated spots (fig. 490); frons entirely yellow or orange; scutal setulae all small, brownish, none strongly projecting . . . . . *grindeliae* (Coquillett)
– Dark marks on wing consisting of transverse bands as well as spots (Fig. 491); posterior half of frons dark brown (fig. 504); scutal setulae sparse, black, erect, some distinctly projecting . . . . *setosa* (Foote)
5. Thorax partly shining reddish yellow, including anterior pleura and part of scutum; wing pattern as in fig. 492 . . . . *rufipes* (Curran)
– Thorax largely black, including entire scutum 6
6. Legs with femora at least basal third black . . 7
– Legs with femora mostly or entirely yellow, with at most basal fourth black 8
7. Wing pattern reduced and usually fragmented (fig. 495) . . . . *caurina* (Doane)
– Wing pattern with discal and subapical bands of wing usually largely intact; discal band usually does not attain hind margin of wing, or if so, faint and narrow posteriorly (Fig. 1) . . . . *steyskali* Goeden, n. sp.
8. Discal and subapical bands of wing narrow, i.e., half or less as wide as adjacent hyaline areas between them in cells r_1 and r_{2+3}; discal band usually failing to attain hind margin of wing, or faint and narrow posteriorly when does; discal band commonly broken in cell dm, less so also in cell R_{2+3}; notopleuron usually yellow or tawny at base of posterior notopleural seta (fig. 507, a); wing pattern as in fig. 493 . . . . *stenoparia* (Steyskal)
– Discal and subapical bands usually entire and wider, i.e., about as wide as adjacent hyaline areas between them in cells r_1 and r_{2+3}; discal band usually attains hind margin of wing (fig. 494); scutellum entirely or mostly microtrichose . . . . *formosa* (Coquillett)

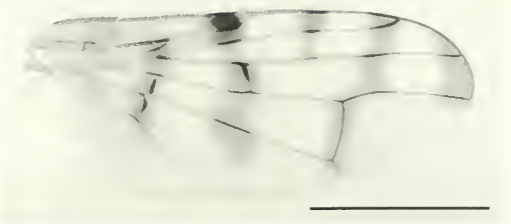

Fig. 1. Right wing of female *Goedenia steyskali*. Line = 1 mm.

Goedenia steyskali Goeden, new species
(Figs. 1, 6D, E, F)

Female (Holotype).—*Head:* Generally tawny, sometimes reddish brown or with dark brown areas on frons, except occiput and often ocellar tubercle black. In profile, 1.0–1.3 times as high as long, face distinctly protruding below antenna, face and frons meeting at an angle of ca. 120°; parafacial 0.6–1.0 as wide as first flagellomere; face white or paler than frons, strongly concave, facial ridges distinct; eye 0.7–1.0 times as wide as high; gena below eye 0.2–0.4 times eye height; frons 0.5 to 0.7-mm wide at vertex, narrowing very slightly at antennal bases; antenna short, tawny, microtrichose, arista black; two frontal setae, one orbital seta, one ocellar seta, one inner and one outer vertical setae, all shiny black, like most microtricha on head; proboscis geniculate, labella length 0.6–0.9 times as long as head height, 0.7–1.0 times as long as head length.

Thorax: Scutum microtrichose over shiny black ground-color, except for one bare, narrow, shiny, medial stripe and pair of shiny, stripes aligned with dorsocentral setae, with intra-alar setae between them; many, short, black, upright setulae investing scutum; central third to half of scutellum generally tawny, rarely yellow; thoracic setae all black; dorsocentral seta distinctly posterior to supra-alar seta, one-third the distance from supra-alar to acrostichal seta; anepisternum, anepimeron, and katepisternum mostly shiny and bare, tawny or yellow stripe from postpronotal lobe across dorsal part of anepisternum; scutellum strongly convex, free of setulae and microtrichia centrally, scutellar setulae sparse and lateral, two pairs of scutellar setae; halter tawny or yellow. Legs tawny with basal thirds to entire femora black, middle femur usually least darkened, posteroventral setae prominent on front femur, hind femur without outstanding anteroventral seta, leg setulae dark brown or black. Wing 2.0–2.9 mm long, wing pattern *Myopites*-type as in Fig. 1, with well-developed discal and subapical bands, the latter usually not attaining the posterior wing margin, these bands two-thirds to just as wide as adjacent hyaline areas between them in cells r_1 and r_{2+3}; discal band rarely broken in cell dm; subapical band sometimes nearly interrupted along vein M.

Abdomen: Tergum microtrichose, except anterior and posterior ends shiny black, covered with brown or black, upright setulae inserted much closer to each other than their average length, becoming longer laterally and posteriorly; single row of long, black setae along posterior margin of last abdominal tergite; oviscape funnel-shaped, 0.75–1.35 mm long ventrally, black, covered with black setulae which are shortest posteriorly.

Male (allotype).—*Thorax:* Like ♀, but ♂ with head in profile, 1.0–1.4 times as high as long, parafacial 0.6–0.9 as wide as first flagellomere, eye 0.8–0.9 times as wide as high, gena below eye 0.3–0.5 times eye height, frons 0.5 to 0.8 mm wide at vertex, narrowing to 0.4 to 0.5 mm at antennal bases, labella length 0.6–0.8 times as long as head height, 0.7–0.9 times as long as head length. Wing 2.0 to 2.6 mm long. Subapical band usually narrowed or interrupted along vein M.

Variation.—In only one ♀ paratype (4%) among the holotype and 25 ♀ paratypes of *G. steyskali* are none of the femora darkened; i.e., entirely tawny. In nine (35%) of these 26 ♀ types, the discal wing band very faintly and narrowly attained the posterior wing margin. Similarly, the subapical band was narrowed along vein M in 10 (38%) of these 26 ♀ types.

Likewise, in only one (5%) of 22 ♂ types, the discal wing band distinctly attained the posterior wing margin; whereas, in an additional six (27%) of these 22 ♂ types, the discal wing band only faintly and narrowly attained the posterior wing margin. The subapical band was narrowed along vein M in 16 (73%) of these 22 ♂ types.

Diagnosis.—The main morphological characters distinguishing the adults of *G. steyskali* from most other species of *Goedenia* are the combination of the usually extensively dark legs, the discal wing band that rarely attains the posterior wing margin, and the prominent centrally tawny or yellow scutellum. This species is readily distinguished from *G. caurina* (Doane) with its reduced and fragmented wing pattern, and from *G. stenoparia* which usually has legs mostly yellow (Goeden 2002c). *Goedenia formosa* (Coquillett) has a discal wing band that always attains, often broadly, the posterior wing margin, and is the only species that sometimes has a hyaline spot in the apical wing band in cell r_{4+5} (Goeden 2002c).

As discussed below, *G. steyskali* apparently is nearly monophagous. So far as known, it breeds in only two *Grindelia* spp., one or more species of which have also been reported (for *Urophora* spp.) as host plants for *Goedenia caurina* (Wasbauer 1972, Steyskal 1979, Foote et al. 1993), *G. formosa* (Wasbauer 1972, Goeden 1987, Steyskal 1979, Foote et al. 1993), and *G. grindeliae* (Coquillett) [fly spp. reported as *Urophora* spp. by Wasbauer (1972) and Foote et al. (1993)]. Since my discussion of the host relations of North American *Goedenia* (as *Urophora*) (Goeden 1987), I have identified a single ♀ reared from a mature flower head of *Grindelia camporum* E. Greene collected 1.6 km east of Tehachapi, Kern County, 16.ix.1988, as *G. formosa*, which confirms the record for this host in Wasbauer (1972). However, my recent analysis (Goeden 2002c), questions the records for *Grindelia* as a host plant for *Goeden caurina* in Steyskal (1979) and Foote et al. (1993). I also never have recorded *Goedenia grindeliae* from *Grindelia*, only a single ♂ reared from a flower head of *Heterotheca villosa* (Pursh) Shinners collected by D. H. Headrick in Whitewater Canyon, Riverside County, on 15.x.1987. Future taxonomy and life history studies of *Goedenia caurina, G. formosa*, and *G. grindeliae*, which my associates and I had not found time to research in detail, may further clarify the host-plant relations of these species relative to *Grindelia*.

Types.—Holotype, ♀; Cuyamaca Rancho State Park along State Highway 74 at 1,180 m (3,830 ft); Cleveland National Forest, San Diego County, CA; 3.iii.1995; R. D. Goeden, coll. (hereafter RDG, coll.)/J. A. Teerink, coll. (hereafter JAT, coll.)(all dates are flower head collection dates); reared from flower head of *Grindelia hirsutula* var. *halli;* allotype, ♂, along State Highway 79 on north shore of Lake Cuyamaca at 1,356 m (4,450 ft), Cleveland National Forest, San Diego County, CA; 25.ii.1997; RDG/JAT, coll. (USNM). Paratypes: CALIFORNIA: 7 ♂, 8 ♀ (6 ♂, 3 ♀ to USNM); same data as holotype (USNM). 5 ♂, 7 ♀ (5 ♂, 6 ♀ to USNM); same data as allotype (USNM). 1 ♂; same data as holotype, except 24.viii.1995. 1 ♀; southwest of Lake Cuyamaca at 1350 m (4,430 ft), 7.ix.1995, otherwise same data as holotype and allotype. 1 ♂, 6 ♀; same data as holotype, except 20.iii.1996 (USNM). 7 ♂, 3 ♀ (6 ♂, 3 ♀ to USNM); same data as allotype, except 20.iii.1996 (USNM). 1 ♀; Mulholland Drive just west of San Diego Freeway at 466 m (1,530 ft), Santa Monica Mountains, Los Angeles Co., CA; 28.ix.1990; reared from flower head of *Grindelia camporum* E. Greene (USNM).

Etymology.—This tephritid is named for George C. Steyskal, who first identified my specimens as a new species of *Urophora* (Goeden 1987), a genus that he had earlier revised (Steyskal 1979), and who contributed much to the taxonomy of Diptera.

Immature stages.—The second- and third-instar larvae and puparium are partially described to the best extent that specimen preparation allowed for use of scanning electron microscopy.

Second instar larva: White, cylindrical, tapered anteriorly, bluntly rounded posteriorly (Fig. 2A); gnathocephalon conical (Fig. 2B-1, C), smooth, with few minute acanthae ventrally (Fig. 2B-2); dorsal sensory organ well-defined, round, flattened (Figs. 2C-1, D-1, E-1), pore above each dorsal sensory organ (Fig. 2C-2); anterior sensory lobes (Figs. 2C-3, D-2), separated by vertical medial cleft, each bear terminal sensory organ (Figs. 2D-3, E-2), lateral sensory organ (Fig. 2E-3), supralateral sensory organ (Fig. 2E-4), and pit sensory organ (Fig. 2E-5); stomal sense organ (Figs. 2C-4, D-4, E-6) ventrolaterad of anterior sensory lobe and fused with lateral-most (Figs. 2C-5, D-5, E-7) of five, foliose, protrudent, lateral integumental petals (Figs. 2C-6, E-8) dorsad of each mouthhook, three vertical pairs of medial integumental petals between anterior sensory lobes (Fig. 2C-7); mouthhook (Figs. 2B-2, C-8, D-6) bidentate; median oral lobe laterally compressed, apically tapered (Figs. 2C-9, D-7); verruciform sen-

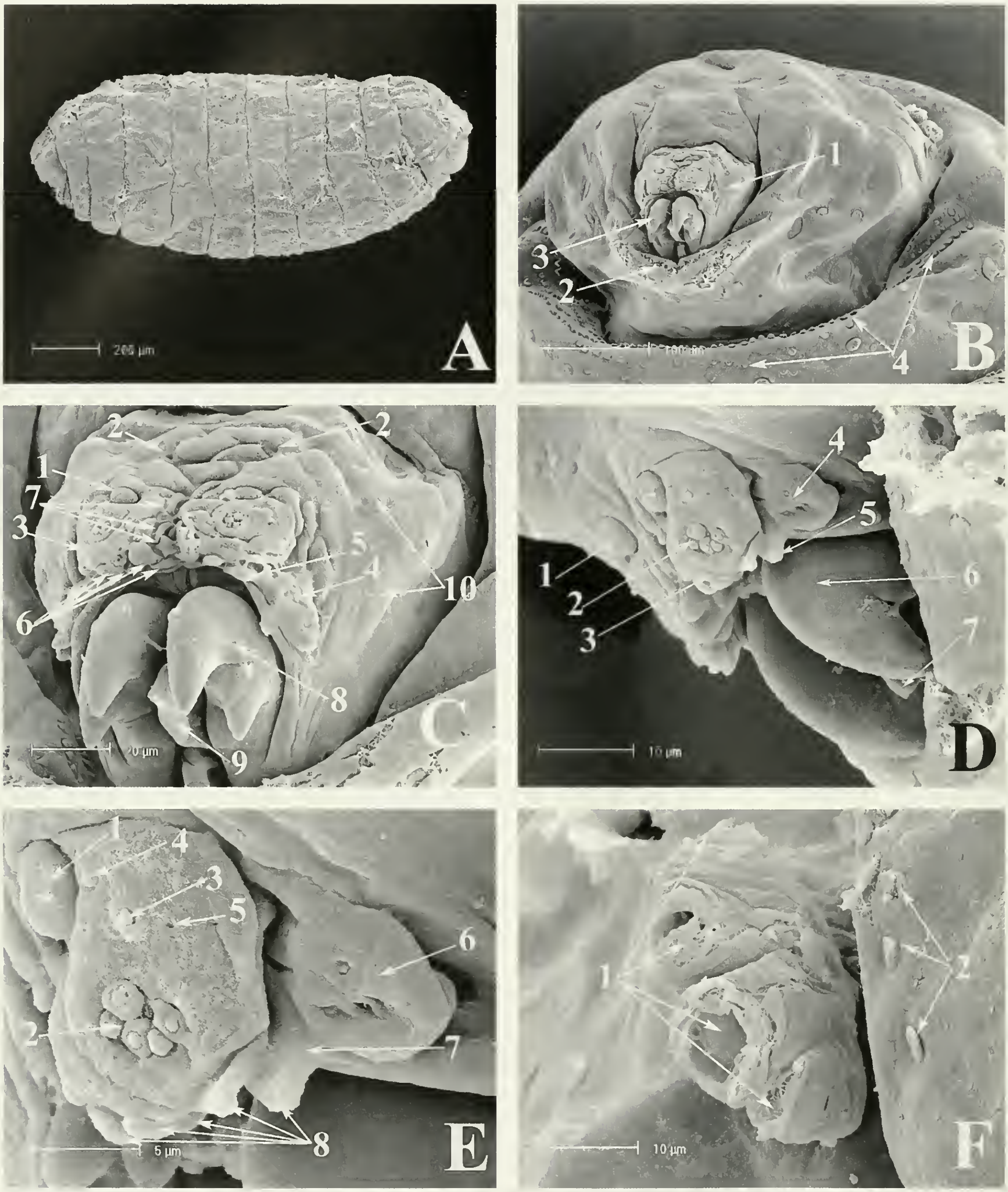

Fig. 2. Second instar of *Goedenia steyskali*: (A) habitus, anterior to left; (B) gnathocephalon and prothorax, frontoventral view, 1—gnathocephalon, 2—mouthhook, 3—minute acanthae; (C) gnathocephalon, frontolateral view, 1—dorsal sensory organ, 2—pores, 3—anterior sensory lobe, 4—stomal sense organ, 5—lateralmost lateral integumental petal, 6—lateral integumental petals, 7—medial integumental petals, 8—mouthhook, 9—median oral lobe; (D) gnathocephalon, lateral view, 1—dorsal sensory organ, 2—terminal sensory organ, 3—anterior sensory lobe, 4—stomal sense organ, 5—lateralmost lateral integumental petal, 6—mouthhook, 7—median oral lobe; (E) 1—dorsal sensory organ, 2—terminal sensory organ, 3—lateral sensory organ, 4—supralateral sensory organ, 5—pit sensory organ, 6—latermost lateral integumental petal, 8—lateral integumental petals; (F) 1—three-papillae of anterior spiracle, 2—minute acanthae.

silla circumscribe posterior third of gnathocephalon dorsolaterally and laterally (Fig. 2C-10); anterior spiracle with four, subglobose papillae (Fig. 2F-1); posteriorly directed, spatulate, apically rounded, minute acanthae (Figs. 2B-3, F-2) circumscribe anterior fourth of mesothorax (Fig. 2B-4) and metathorax, anterior and posterior fourth of first abdominal segment (A-1), anterior and posterior third of A-2, most of A-3 to A-6, all but middle third of A-7, and anterior third of A-8. Posterior surface of caudal segment not examined.

The habitus of the second instar of *G. Steyskali* (Fig. 2A) approximates those of *G. timberlakei* (Goeden et al. 1995) and *G. rufipes* (Goeden 2002a). Differences noted include five lateral integumental petals in *G. steyskali* (Figs. 2C-5, E-8), like *G. rufipes* (Goeden 2002a), not four, as pictured for *G. timberlakei* (Goeden et al. 1995). Moreover, the latter species appears to have only a single pair of medial integumental petals (Goeden et al. 1995), not two pairs, like *G. rufipes* (Goeden 2002a), or three pairs like *G. steyskali* (Fig. 2C-6). The numbers of these integumental petals were not quantified for *G. timberlakei* by Goeden et al. (1995), but their presence and general positions were noted and illustrated. Another difference is that the anterior spiracle of the second instars of *G. steyskali* and *G. rufipes* bear four papillae (Fig. 2E), not two papillae, like *G. timberlakei* (Goeden et al. 1995), or three papillae like *G. rufipes* (Goeden 2002a).

Third instar larva: Elongate-ellipsoidal, roundly tapered anteriorly, bluntly truncated posteriorly (Fig. 3A), integument white, ventral aspect of metathorax, and abdominal segments A1 and A2 with dark brown to black infuscation; caudal segment dark brown or black (Fig. 6B); minute acanthae, apically pointed or rounded, conical and posteriorly directed (Figs. 3B, 4B-1) or hemispheroidal (Fig. 4C-1), circumscribe anterior fourth of meso- and metathorax, and abdominal segment A1, all but middle third of A2, anterior half of A3, posterior four-fifths of abdominal segments A4 to A6, and posterior half of A7; prothorax smooth (Fig. 4A-1); gnathocephalon (Figs. 3C, 4A-2) conical and medially divided by vertical cleft (Fig. 3C-1), dorsal sensory organ well-defined, hemispherical (Fig. 3C-2); anterior sensory lobe (Fig. 3C-3) bears terminal sensory organ (Fig. 3C-4); lateral sensory organ (Fig. 3C-5), supralateral sensory organ (Fig. 3C-6), and pit sensory organ (Fig. 3C-7); two medial, integumental petals (Fig. 3C-8); four, papilliform, lateral integumental petals (Figs. 3C-9, D-1) above each mouthhook (Figs. 3C-10, D-2), stomal sense organ (Figs. 3C-11, D-3) ventrolaterad of anterior sensory lobe; mouthhook bidentate (Figs. 3C-10, D-2), anterior tooth concave posteriorly (Fig. 3D-4); median oral lobe laterally compressed, apically pointed (Figs. 3C-12, D-5), separated from labial lobe (Fig. 3D-6) with two ventral pores (Fig. 3D-7); anterior thoracic spiracle on posterior margin of prothorax (Fig. 4A-3) bears three doliform papillae (Fig. 3E); mesothoracic, lateral spiracular complex with at least four, verruciform sensilla in vertical series (Fig. 4A-4), mesothoracic spiracle not seen; metathoracic, lateral spiracular complex with nearly closed, lateral spiracle (Figs. 4A-5, B-2) and five, verruciform sensilla in vertical series (Figs. 4A-6, B-3); lateral spiracular complex of first abdominal segment consists of nearly closed spiracle (Figs. 4A-7, C-2) and four, verruciform sensilla in vertical series (Figs. 4A-8, C-3); caudal segment with paired posterior spiracular plates (Figs. 4D-1, E) separated by bare area with interspersed hemispherical minute acanthae medially (Fig 4D-2) and open pores dorsally (Fig. 4D-3), these structures in turn ringed by two to three incomplete, concentric series of shallow, elliptical depressions (Fig. 4D-4), with three, tapered, stelex sensilla (Fig. 4F) dorsal and dorsolateral to each posterior spiracular plate; posterior spiracular plate (Fig. 4E) bears three rimae (Fig. 4E-1), ca. 0.003 mm in length, and four, spinose, in-

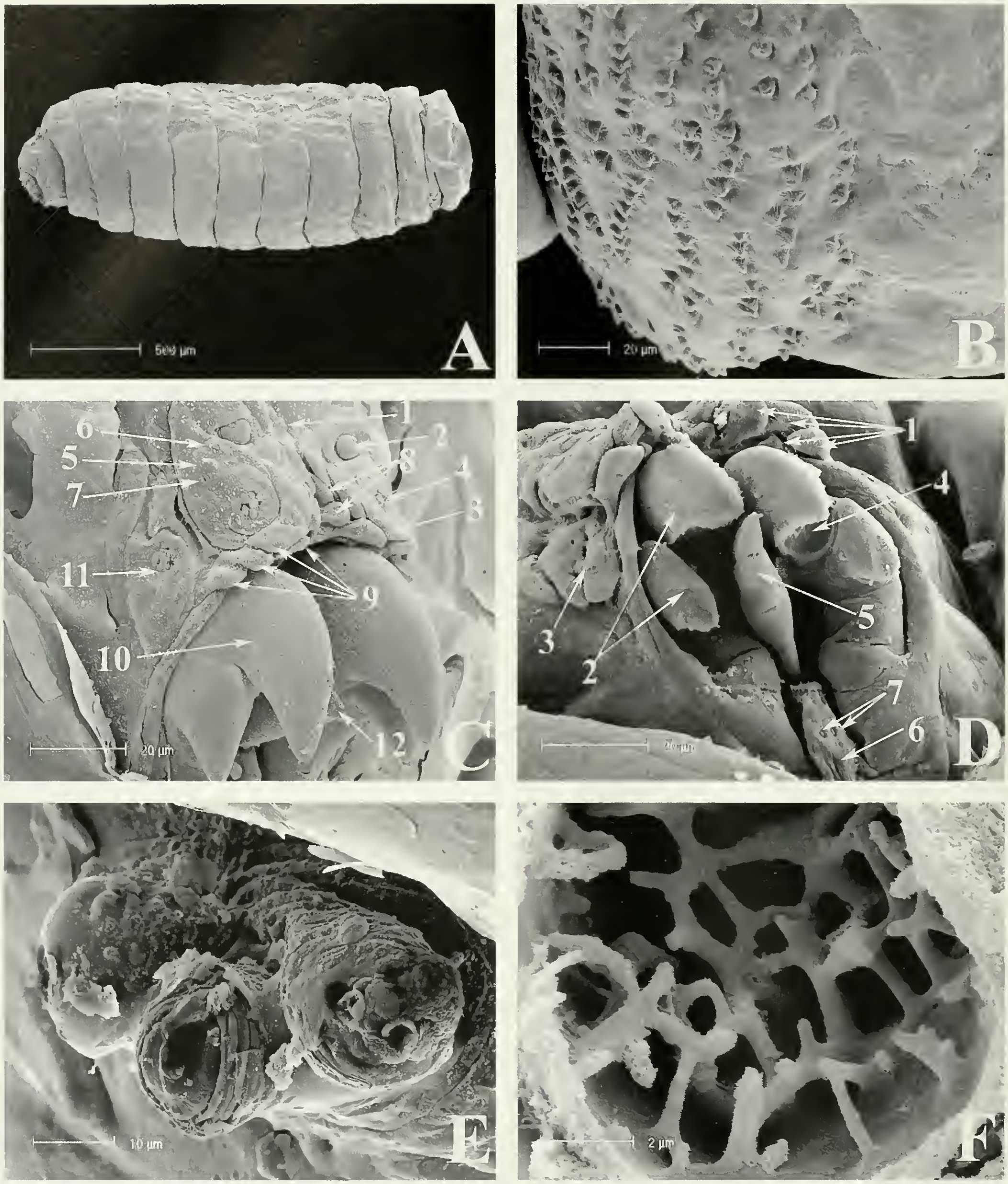

Fig. 3. Third instar of *Goedenia steyskali*: (A) habitus, anterior to left; (B) lateral view of venter of second abdominal segment showing minute acanthae; (C) gnathocephalon in frontolateral view, 1—vertical cleft, 2—dorsal sensory organ, 3—anterior sensory lobe, 4—terminal sensory organ, 5—lateral sensory organ, 6—supralateral sensory organ, 7—pit sensory organ, 8—medial integumental petals, 9—lateral integumental petals, 10—mouthhook, 11—stomal sense organ, 12—median oral lobe; (D) oral cavity, ventral view, 1—lateral integumental petals, 2—teeth of mouthhook 3—stomal sense organ, 4—posterior concavity on anterior tooth of mouthhook, 5—median oral lobe, 6—labial lobe, 7—pores; (E) anterior spiracle; (F) latticed interior of papillum of anterior spiracle.

terspiracular processes, each ca. 0.003 mm long (Fig. 4E-2).

The habitus of the third instar of *G. steyskali* (Fig. 3A) resembles that of *G. timberlakei* (Goeden et al. 1995), *G. rufipes* (Goeden 2002a), *G. setosa* (Goeden 2002b), and *G. stenoparia* (Goeden 2002c). In all five species, the venters of the thorax, anterior abdominal segments, and the caudal segment are darkly pigmented (Fig. 6B; Goeden et al. 1995; Goeden 2002a, b, c) and minute acanthae circumscribe the meso- and metathorax and abdomen, and especially noteworthy, the central, posterior surface of the caudal segment is dotted with scattered pores (Fig. 4D-2, 3; Goeden et al. 1995; Goeden 2002b, c). This central area is ringed by concentric series of shallow, elliptical depressions in all five species (Figs. 3A-2, B-4; Goeden et al. 1995; Goeden 2002a, b, c) The prothorax and gnathocephalon of *G. timberlakei* and *G. rufipes* are smooth and free of minute acanthae; whereas, the prothoracic venters of *G. steyskali* (not shown), *G. setosa* (Goeden 2002b) and *G. stenoparia* anteriorly each bear a few minute acanthae (Goeden 2002c).

The third instars of all five species of *Goedenia* studied to date lack oral ridges on either side of the mouth opening, and ventral or ventrolateral to the stomal sense organ (Fig. 3C, Goeden et al. 1995; Goeden 2002a, b, c, and unpublished data).

Two medial and four lateral integumental petals are present in *G. stenoparia* (Goeden 2002c), as in *G. rufipes* (Goeden 2002a); whereas, *G. timberlakei* has six lateral integumental petals (Goeden et al. 1995, unpublished data), *G. setosa* has five (Goeden 2002b), and *G. steyskali* has four (Figs. 3C-9, D-1). The lateral-most integumental petal apparently is fused with the stomal sense organ in *G. steyskali* (Fig. 3D-1, 3), but this petal is separated from the stomal sense organ in the other four species (Goeden et al. 1995; Goeden 2002a, b, c).

The mouthhooks of the third instar of *G. steyskali* (Figs. 3C-10, D-2), like those of *G. timberlakei* (Goeden et al. 1995), *G. rufipes* (Goeden 2002a), *G. setosa* (Goeden 2002b), and *G. stenoparia* (Goeden 2002c), are bidentate. Moreover, a ventral view of the oral cavity (Fig. 3D), like that also figured and described for *G. rufipes* (Goeden 2002a) and *G. stenoparia* (Goeden 2002c), but not obtained for either *G. timberlakei* (Goeden et al. 1995, unpublished data) or *G. setosa* (Goeden 2002b), shows the concavely scalloped, posterior surface of the anterior tooth (Fig. 3D-3).

The anterior spiracle of the third instar of *G. steyskali* bears three papillae (Fig. 3E) differing from the other four *Goedenia* species studied, in which this spiracle bears only two papillae (Goeden et al. 1995, Goeden 2002a, b, c). The latticed interior of one of the papillae of *G. steyskali* is shown in Fig. 3F.

The lateral spiracular complex of the mesothorax of *G. steyskali* (Fig. 4A-4) contains at least five verruciform sensilla in a vertical series. In *G. rufipes* (Goeden 2002a) and *G. stenoparia* (Goeden 2002c), this complex contains six verruciform sensilla, but in *G. timberlakei,* it includes only two verruciform sensilla (Goeden et al. 1995). Likewise, the metathoracic lateral spiracular complex of *G. steyskali* (Figs. 4A-5, 6) contains five verruciform sensilla in a vertical series. Those of *G. rufipes* and *G. steyskali* include four verruciform sensilla (Goeden 2002a), again like *G. stenoparia* (Goeden 2002c); whereas, only two such sensilla occur in *G. timberlakei* (Goeden et al. 1995). Finally, four verruciform sensilla in a vertical series comprise the lateral spiracular complex of the first abdominal segment of *G. steyskali* (Figs. 4A-7, 8), but five such sensilla comprise this complex in *G. stenoparia* (Goeden 2002c), three such sensilla occur in *G. rufipes* (Goeden 2002a), and only one verruciform sensillum is found on this segment in *G. timberlakei* (Goeden et al. 1995).

The number of minute acanthae and pores dorsomediad of and between the posterior spiracular plates (Figs. 4D-1, 2, 3) are

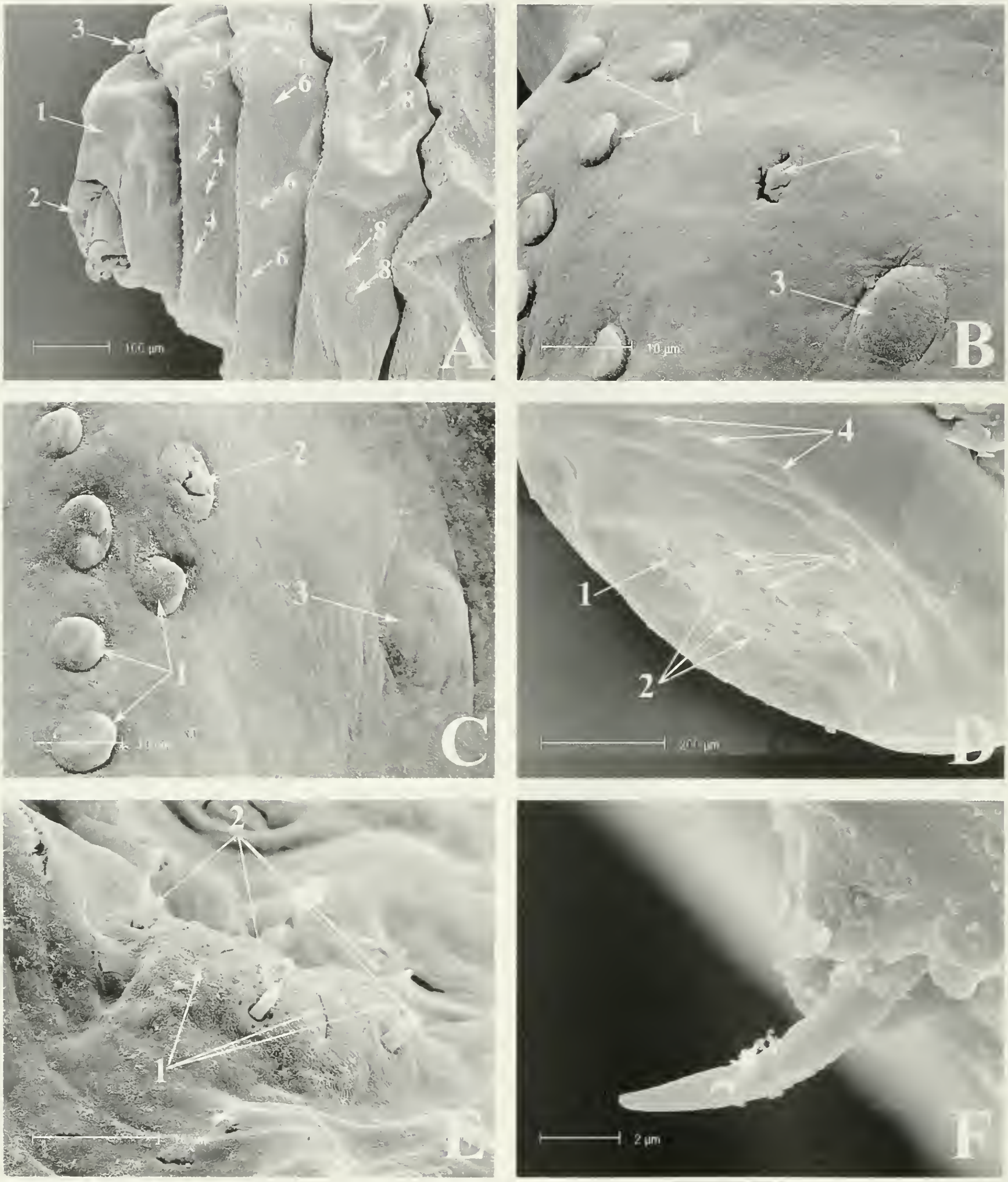

Fig. 4. Third instar of *Goedenia steyskali*, continued: (A) anterior spiracular complexes, anterior to left, 1—prothorax, 2—gnathocephalon; 3—anterior spiracle, 4—verruciform sensilla on mesothorax, 5—lateral spiracle on metathorax, 6—verruciform sensilla on metathorax, 7—lateral spiracle on first abdominal segment, 8—verruciform sensilla on first abdominal segment; (B) close-up of lateral spiracle on metathorax, 1—minute acanthae, 2—spiracle, 3—verruciform sensillum; (C) close-up of lateral spiracle on first abdominal segment, 1—minute acanthae, 2—spiracle, 3—verruciform sensillum; (D) caudal segment, 1—posterior spiracular plates, 2—minute acanthae, 3—pores, 4—elliptical depressions; (E) posterior spiracular plate, 1—rimae, 2—interspiracular processes, (F) stelex sensillum.

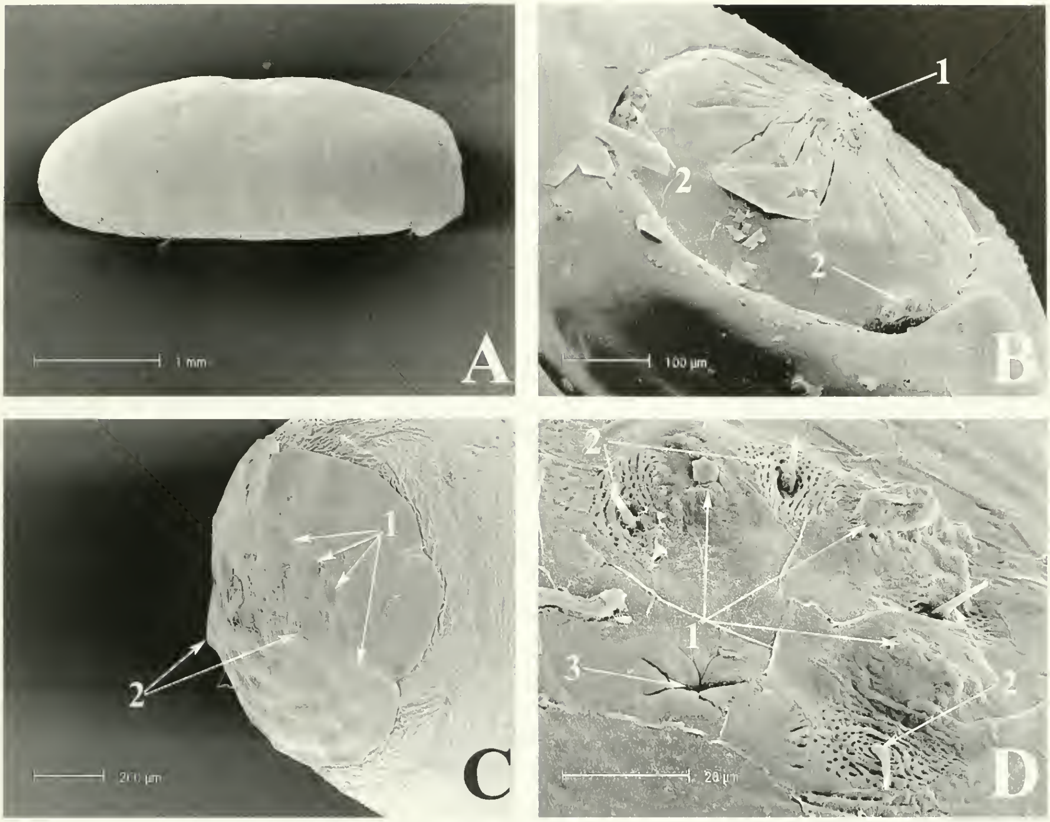

Fig. 5. Puparium of *Goedenia steyskali*: (A) habitus, anterior to right, (B) anterior end, 1—invagination scar, 2—anterior spiracles; (C) caudal segment, 1—shallow elliptical depressions, 2—posterior spiracular plates.

the least of those found on the five congeners studied to date (Goeden et al. 1995, Goeden 2002a, b, c).

Puparium: Light to dark, reddish brown with dark brown to black, anterior stripe or series of spots on venters of meso- and metathorax and abdominal segments A-1 to A-2, and similarly dark, caudal segment. Elongate-ellipsoidal, with smoothly rounded anterior end, and truncated posterior end (Fig. 5A). Anterior end bears invagination scar (Fig. 5B-1) and raised, trilobed, anterior thoracic spiracles (Fig. 5B-2). Posterior end of caudal segment studded with a few, smoothly rounded, hemispherical, minute acanthae interspersed with a few open pores surrounded by shallow elliptical depressions (Fig. 5C-1). A pair of raised, hemispheroidal, posterior spiracular plates (Fig. 5C-2, D) each bearing three elliptical rimae (Fig. 5D-1) interspersed with four, peg-like, interspiracular processes (Fig. 5D-2). Eleven puparia dissected from flower heads averaged 3.40 ± 0.10 (range, 2.70–3.99) mm in length; 1.48 ± 0.55 (range, 1.44–1.79) mm in width.

DISTRIBUTION AND HOSTS

Goedenia steyskali was studied on *Grindelia hirsutula* var. *halli* which is locally common but localized, in meadows, dry slopes, and open pine/oak woodlands in southern San Diego County, where it is listed as a rare species by Hickman (1993). The only other host that I have reared *Goedenia steyskali* from is *Grindelia camporum*, possibly var. *camporum* Greene (Hickman 1993), that is more widespread in southern and central California; however, my record for the single specimen that I reared from this plant species requires confirmation and additional collection records in order to define the distribution of this tephritid. Both host plants of *Goedenia steyskali* belong to the family Asteraceae, tribe Astereae, subtribe Solidagininae (Bremer 1994), as do all other, reported and confirmed hosts of *Goedenia* spp. (Goeden 1987, Freidberg and Norrbom 1999). Accordingly, *G. steyskali* is classed as narrowly oligophagous (on two spp. in one host subtribe in the Asteraceae) (Goeden 1987, Headrick and Goeden 1998).

Biology

Egg.—No flower head of *Grindelia hirsutula* var. *halli* containing an egg of *Goedenia steyskali* was sampled; however, it is assumed that one or more eggs are inserted individually into a young preblossom flower head based upon dissections of flower heads. Moreover, individual flower heads containing separate second and third instars, third instars in different stages of development, or larvae and puparia suggest oviposition by more than one female in the same flower heads.

Larva.—Upon eclosion, the first instars commence to feed on the ovules. The receptacle was neither abraded nor pitted by such feeding.

An average of 1.4 ± 0.2 (range, 1–2) second instars were found feeding on ovules in five, separate flower heads (three preblossom, two postblossom) (Fig. 6A). They usually fed individually on a sucession of ovules or soft achenes with their bodies perpendicular to, but always above, the receptacles (Fig. 6A). These larvae destroyed an average of 12 ± 5 (range, 17–22) ovules/soft achenes in these flower heads, the receptacles of which averaged 5.9 ± 1.0 (range, 4.0–10.0) mm in diameter. These larvae had damaged about 25% of the average total of 48 ± 6 (range, 24–80) ovules counted within a total of nine pre- and postblossom, flower heads. The flower heads are extremely sticky with sap, thus difficult to handle and dissect when fresh. Shortly before or after the molt to the third instar, the larvae began to feed with their long axes oriented perpendicular to the receptacles, and with their mouthparts directed towards the receptacles, in which they begin to tunnel (Fig. 6B).

Similarly, third instars fed on receptacles as above in all but two (96%) of 48 infested flower heads examined. The 48 flower heads (9 closed preblossom, 16 live and postblossom, and 23 dead and overwintered) each contained an average of 1.5 ± 0.2 (range, 1–7) third instars. These 48 flower heads averaged 6.03 ± 0.22 (range, 4.56-8-62) mm in diameter, and as noted above, nine contained an average total of 48 ovules/achenes. The receptacles were pitted by the third instars in all 48 flower heads, indeed, some individuals tunneled deeply into the receptacle and buried themselves completely (Fig. 6C-1), horizontally beneath the receptacle surface. A few larvae tunneled through the receptacle into the peduncle of the flower head. Such deeply pitted receptacles indicated that sap constituted at least part of the diet of third instars of *G. steyskali*, as also reported for *G. timberlakei* (Goeden et al. 1995), *G. rufipes* (Goeden 2002a), *G. setosa* (Goeden 2002b), and *G. stenoparia* (Goeden 2002c). Goeden (1988), Headrick and Goeden (1990), Goeden and Headrick (1992), Goeden et al. (1995), Headrick et al. (1996), Goeden and Teerink (1997) also first noted, described, and discussed sap feeding by florivorous species of Tephritidae in the genera *Trupanea, Paracantha, Neaspilota, Tephritis, Dioxyna,* and *Xenochaeta,* respectively. Upon completing feeding in flower heads, the larva constructed a thin-walled, vasiform cell consisting of ovule/achene/floret fragments impregnated with and hardened by dried, liquid feces and sap and basally extending into the receptacle. As noted elsewhere, the flattened, sclerotized caudal segment of the third instar, nicely serves as a plug that tightly closes the mouth of the cell, yet allows respiration, and thus apparently also may serve to shield the larva

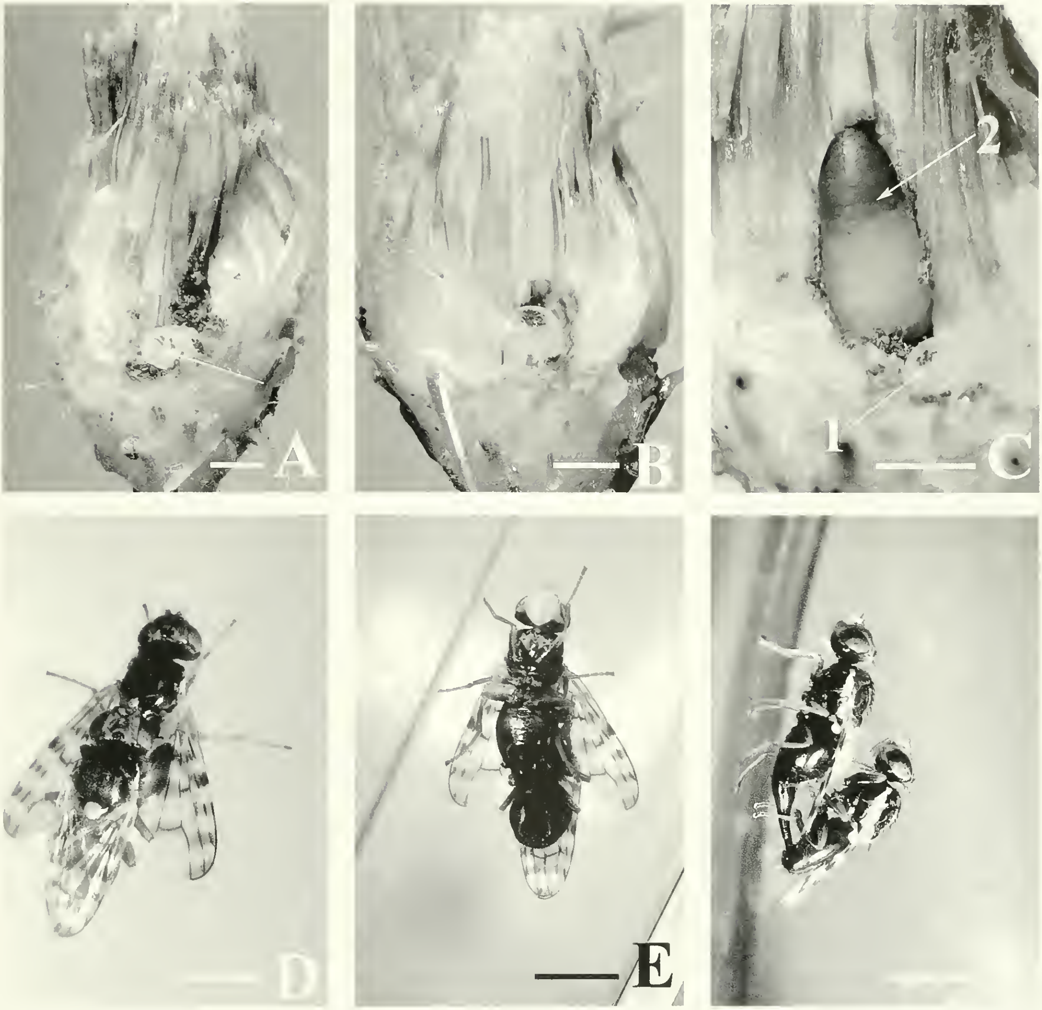

Fig. 6. Life stages of *Goedenia steyskali* in flower heads of *Grindelia hirsutula*: (A) second instar (arrow), (B) third instar (arrow) feeding in receptacle (note dark infuscation on caudal plate); (C) 1—third instar and 2—puparium in flower head, (D) mating pair, dorsal view; (E) mating pair, ventral view; (F) mating pair, lateral view. Lines = 1 mm.

from arthropod predators during overwintering (= phragmosis; Goeden 2002b, c). Prior to pupariation the prepupa turns 180° and orients with its anterior end away from the receptacle, retracts its mouthparts, and forms a puparium (Figs. 6C-2).

Pupa.—Postblossom, mature flower heads of the F_1 generation and overwintered, dead flower heads still attached to plants usually each contained a single puparium, but as many as four. The posterior of the puparium faced the receptacle, rested in the cuplike base of the cell (Fig. 6C-2).

Adult.—Under insectary conditions, 14 males of *G. steyskali* lived an average of 52 ± 5 (range, 17–77) days, and 21 females lived an average of 49 ± 3 (range, 22–78) days. These longevities were more than the mean longevities of 39 and 31 days reported for *G. timberlakei* (Goeden et al. 1995) and 28 and 25 days for *G. stenoparia* (Goeden 2002c), but comparable to 49 and 58 days for *G. setosa* (Goeden 2002b), respectively. These adult longevities are commensurate with the aggregative type of life histories possessed by all four of these tephritids (Headrick and Goeden 1994, 1998; Goeden et al. 1995).

The premating and mating behaviors of *G. steyskali* were not studied in the field, but were observed for six pairs (one male and one female each) in separate petri dish arenas. These arenas were of the type found to be useful in studying mating behaviors of many other nonfrugivorous, tephritid species (Headrick and Goeden 1994). Both sexes exhibited wing hamation (Headrick and Goeden 1994) throughout the day concurrent with other behaviors, i.e., grooming, resting, and feeding; this also was the most common wing movement reported for *G. timberlakei* (Goeden et al. 1995), *G. rufipes* (Goeden 2002a), *G. setosa* (Goeden 2002b), and *G. stenoparia* (Goeden 2002c). Premating behaviors observed with *G. stenoparia* included males and females tracking individuals of the opposite sex, during which males sometimes swayed and usually exhibited abdominal pleural distension. During mating, the wings of the male were overlapped (Figs. 6D, E) or parted at 10–20°, the wings of the female were parted at 60–80° (Figs. 6D, E), with both pairs of parted wings centered over the midlines of the flies (Figs. 6D, E). The foretarsi of the male grasped the dorsum of the abdomen of the female laterally at the thoracic juncture, the midtarsi grasped the abdomen laterally or the oviscape at its base, and the hindtarsi touched the substrate or crossed under the oviscape (Fig. 6F). The bodies of both flies paralleled the substrate with the oviscape elevated about 30° (Fig. 6F). In arenas, the flies mated at least once on successive days at different times during daylight and were observed eight times to mate twice in one day. Another pair was observed mating three times during one day. A total of 15 matings were observed that lasted an average of 147 (range, 50–280) min. Females *in copula* were observed to walk about the arenas. Females became restless before termination of mating and pushed against the males with their hind tarsi, they also lofted their wings so as to push against the males and fully extended their aculei. The male in turn countered this agonistic behavior with copulatory induction behavior (CIB), i.e., rubbed his hind tarsi along the oviscape, grasped the female tightly, or rocked from side to side to regain purchase or to avoid the female's pummeling, all of which appeared to calm the female and allow coitus to continue. During postcoital separation, the male turned and rapidly walked off and away from the female while pulling his genitalia free, a process lasting just 6 and 10 s in two cases.

Seasonal history.—The life cycle of *Goedenia steyskali* in southern California follows an aggregative pattern (Headrick and Goeden 1994, 1998) in which the prepuparia, puparia, and adults variously are the overwintering stages. *Grindelia hirsutula* has a long bloom period, with young, immature through fully mature flower heads found on single plants. Overwintered adults and adults emerged from overwintered puparia in spring (March–May) aggregate the following summer (June–July) on their preblossom host plants, to mate, and subsequently to begin to oviposit in the small, newly-formed flower heads. The new generation emerges from puparia formed in late summer (August) through late-fall (October–November), whereas, later-formed larvae overwinter as prepuparia as noted above.

Natural enemies.—Overwintered puparia of *G. stenoparia* were parasitized by chalcidoid Hymenoptera in the genera *Eurytoma* (Eurytomidae), *Pteromalus* (Pteromalidae), and *Torymus* (Torymidae) as probable primary, solitary, larval-pupal endoparasitoids.

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TWO NEW SPECIES OF NORTH AMERICAN *PROTOCALLIPHORA* HOUGH (DIPTERA: CALLIPHORIDAE) FROM BIRD NESTS

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Abstract.—***Protocalliphora bennetti*, n. sp.**, and ***P. rugosa*, n. sp.** (Diptera: Calliphoridae) infesting bird nests are described from North America. *Protocalliphora bennetti* is primarily eastern but extends northwest to Alaska, British Columbia, and northern Idaho, and *P. rugosa* is western ranging from British Columbia south to Wyoming, Utah, and Oregon. Bird hosts of each species are listed. The puparia of these species are more readily identified than are adults. Adults of *P. bennetti* are intermediate between *P. sialia* and *P. shannoni,* while adults of *P. rugosa* are almost identical to *P. hirundo.* A key is presented to the males and puparia of *Protocalliphora* species with white calypteres and digitate surstyli.

Key Words: new species, *Protocalliphora,* Diptera, Calliphoridae, bird nests, North America

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Members of the genus *Protocalliphora* Hough are commonly known as bird blow flies because of their habit of parasitizing nestling birds. The taxonomy of this genus in North America was poorly understood until Sabrosky et al. (1989) redescribed the 11 known species and described 15 new species. Sabrosky began studying *Protocalliphora* in 1950 and soon realized that, despite Hall's then recent revision (1948), much work was still needed. Bennett (1957) completed a doctoral dissertation on the eastern species of *Protocalliphora* while Whitworth completed a masters thesis (1971) and doctoral dissertation (1977) on western species. Both Bennett and Whitworth reared many *Protocalliphora* from bird nests thereby associating males, females, and immatures. This made it possible to clarify new species relationships.

I have tested the adult and puparial keys provided in Sabrosky et al. (1989) on numerous specimens submitted for identification. The key, which utilizes male, female, and puparial characters, is very reliable for specimens in good condition. The key to single males is usually reliable, but the key for single females is good for only the ten most distinctive species. The puparial keys have serious restraints because most puparial descriptions were based on specimens from a single area without accounting for geographical variation. Many of the characters used to distinguish species using puparia proved to be variable when specimens from different areas were studied.

Problems with existing puparial keys led to misidentifications in Dawson et al. (1999). A single puparium from a kestrel nest identified as *P. avium* Shannon and Dobroscky in that work, is now recognized as *P. sialia* Shannon and Dobroscky. Also, a series of two males, five females, and numerous puparia identified as *P. shannoni* Sabrosky et al. in Dawson et al. (1999) are now regarded as a new species described as

P. bennetti. Because of problems with the puparial keys, a study of *Protocalliphora* puparia was begun in 1997. The on-going study of puparia has revealed two previously undescribed species with distinctive puparia, but with adults that are almost indistinguishable from known species. These species are described here, with their distribustions and hosts, and separated from related species.

MATERIALS AND METHODS

Protocalliphora are rarely collected using conventional techniques and are mostly taken directly from bird nests. To collect adults, nests must be examined within 10–15 days after nestlings fledge; after that, only empty puparia will be found. As most bird nests are found after leaf drop in the fall or when birders are cleaning out nest boxes after the nesting season, the development of a good key to empty puparia will be of great value in expanding our knowledge of this genus.

Initially, local bird nests in western Washington State were collected. Subsequently, requests for bird nests were made via the Internet and ornithological publications, and nests were acquired from all over the lower United States, Canada, and Alaska. Since 1993, 3884 nests have been examined, mostly from bird nest boxes; 38.6% of these nests were infested with 17 species of *Protocalliphora*. A detailed key to North American *Protocalliphora* puparia is being developed and will be published in the near future.

Nests were examined for puparia by dissecting them on a large sheet of white paper. Most nests received for study were in sealed Ziploc® bags and, if infested, contained empty puparia. Some nests had emerged adults, and a few, collected right after nestlings fledged, had viable pupae from which adults were reared. Puparia were picked out of nest material, counted, and viable pupae were often sorted into individual vials so adults could be matched with their puparia.

Empty puparia were screened and sorted to species with a stereo microscope equipped with a brightfield/darkfield stand with zoom capabilities to 70×. For specimens that could not be positively identified with a stereo scope, species identification was verified by preparing slide mounts and viewing with a compound scope at up to 400×. Puparia were boiled for 1–5 minutes in a 10% potassium hydroxide solution to soften and clear the cuticle. After rinsing in distilled water, puparia were sectioned with small scissors. The dorsal, ventral, stigmatal, and prothoracic fringe areas were cut away (Figs. 1–3) and soaked in specimen clearing fluid for 1–3 days. Once sections were sufficiently clear, they were dehydrated in 95% then 100% ethanol and mounted in Euparol mounting medium. All slide-making materials were purchased from Bioquip® Products, Gardena, California. Slides were then dried in an oven at about 70°C for 1–2 weeks, until the medium hardened. It is very important that the medium is completely dry or specimens will drift when slides are placed on edge.

Most terminology regarding puparia and adults follow Sabrosky et al. (1989). However, measurements of the prothoracic fringe are total diameter, rather than a measurement of individual spines. Prothoracic spine lengths cannot be measured accurately in puparia, only in larvae. Also, cuticular spine lengths are based on the longest spines in an area, rather than the average spine length since average spine lengths tended to mask differences between species. All measurements have been performed on 25 specimens, unless indicated otherwise. Adult and puparial specimens collected from nests are identified by nest lot numbers. Individuals from a given lot may be distinguished by Lot #-1, -2, etc.

Protocalliphora (Protocalliphora) bennetti Whitworth, new species

(Figs. 1, 4)

Protocalliphora shannoni: Dawson et al. 1999 (misidentification).

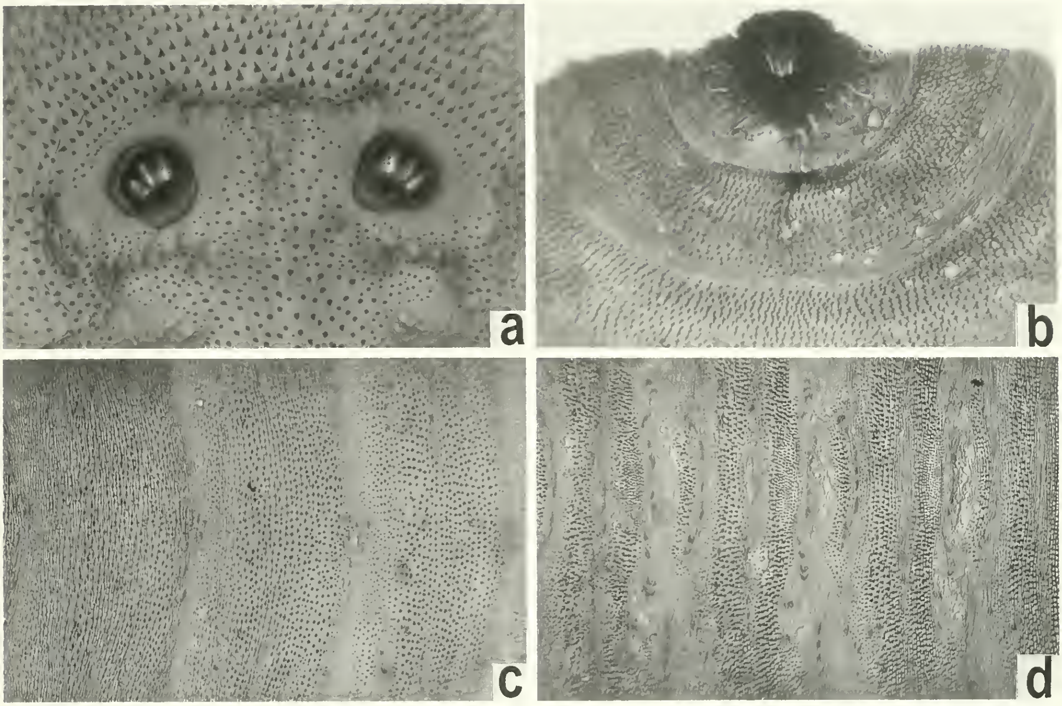
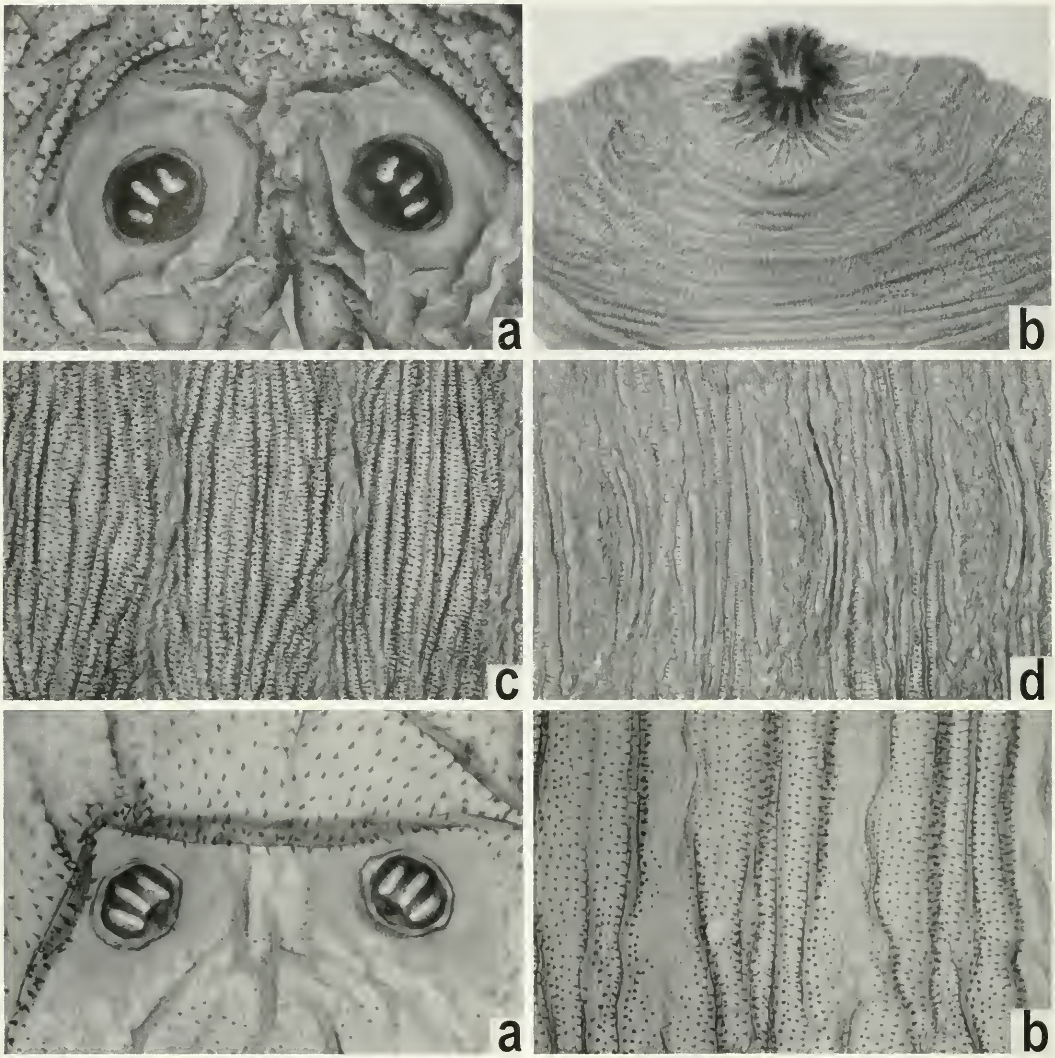


Fig. 1. Puparium of *Protocalliphora bennetti:* a, stigmatal view; b, prothoracic fringe; c, dorsum; d, venter.

Diagnosis.—Sexes concolorous, monochromatic, shining metallic blue to bluish purple, adults very similar to *P. sialia* frons width intermediate between *P. sialia* and *P. shannoni* (see Figs 4–6); surstyli digitate. Prothoracic fringe of puparia about 350μ, much shorter than *P. sialia*, dorsal cuticular folds faint compared to pronounced in *P. sialia*.

Male.—Head ground color black, parafrontal and parafacial silvery microtomentose, preocellar area triangular (Fig. 4) and polished shining to subshining black. Thorax shining metallic dark blue to bluish purple, dorsum thinly microtomentose, viewed from behind microtomentum with three shining undusted stripes, central stripe broad but stops short of anterior edge of pronotum, lateral stripes narrower, sometimes indistinct and extending to anterior edge of pronotum. Abdomen concolorous with thorax, with sparse white microtomentum when viewed from behind at a low angle. Calypter white with faintly yellow rims.

Frons narrow 0.075 times head width (0.065–0.08), some Alaska specimens to 0.09 and 1.10 times ocellar span (0.88–1.38); frons width about equal to 3rd antennal segment 1.04 (0.72–1.29); frontal vitta narrow above, widening below, at narrowest 3 to 4 times width of an adjacent parafrontal, parafrontal greatly narrowed above, silvery microtomentose ending below ocellar triangle, to a thin black line above; preocellar area with small, black, polished area varying from a tiny area just below median ocellus to a long polished streak (Fig. 4). Parafrontal with a few tiny hairs starting midway to 2 or 3 rows below and merging with numerous hairs on broader parafacial. Parafacial, at widest, 1.6 times 3rd antennal segment (1.13–1.80) and 1.64 times width of frons (1.26–2.17), 1.73 times width of ocellar span (1.39–2.08), and 0.79 times vibrissal interval (0.625–0.964), cheek height



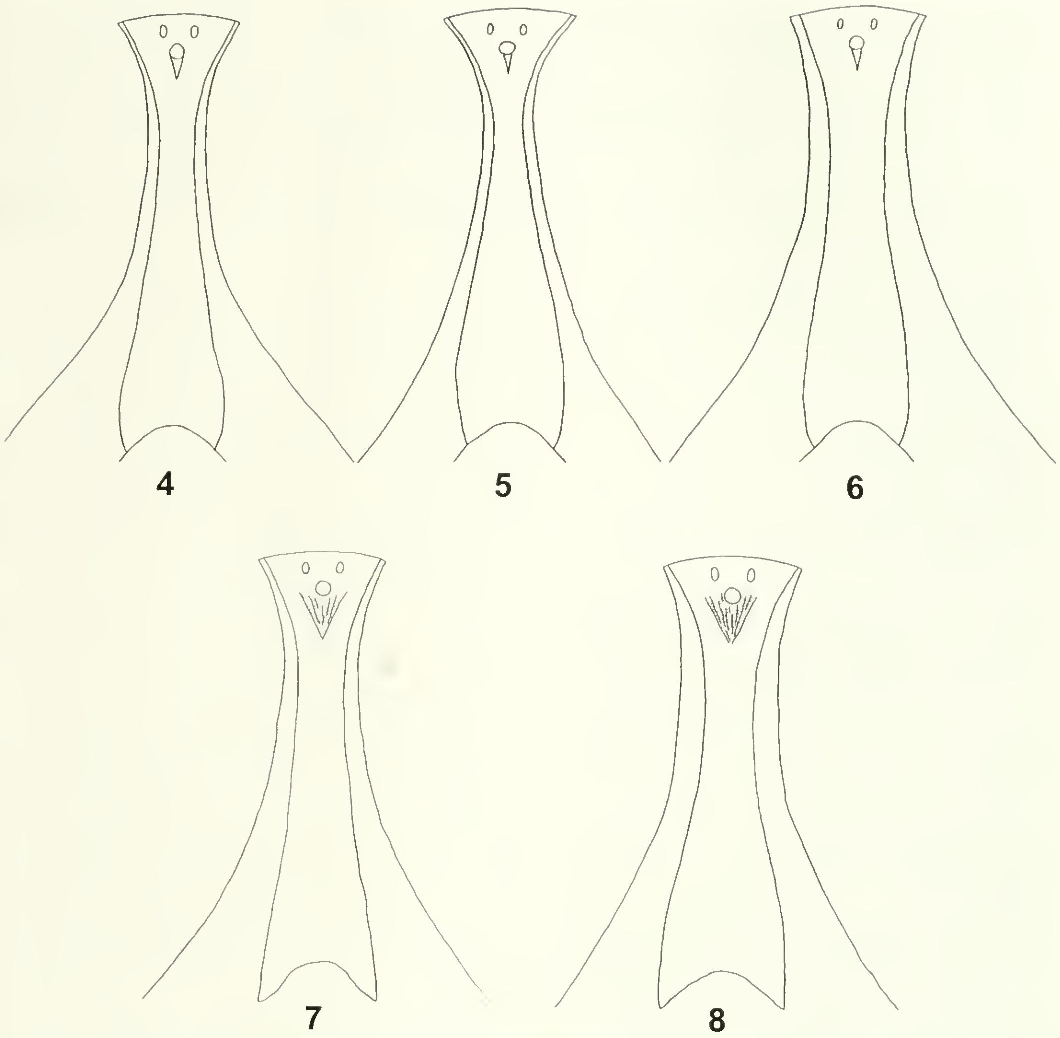
Figs. 2–3. Puparia. 2, *Protocalliphora rugosa* (top four figures): a, stigmatal view; b, prothoracic fringe; c, dorsum; d, venter. 3, *P. hirundo* (bottom two figures): a, stigmatal view; b, dorsum.

0.38 times maximum eye height (0.290–0.414).

Thorax without accessory notopleural bristles or hairs on tympanic membrane, only a few hairs occasionally on postalar wall. Foretibia normally with one median posterior bristle, although some specimens with 2 on one or both sides. In 23 specimens from type series, nest lot #3351, holotype with 2 posterior bristles on left tibia, two males with 2 posterior bristles on both sides, and 2 males with 2 posterior bristles on right side.

Terminalia with cerci distally acuminate, narrow and parallel, surstyli digitate and broadly rounded at distal end, aedeagus as usual in genus (Sabrosky et al. 1989).

Female.—Same color as male; head with microtomentum of parafrontal and parafacial light brown to golden brown, commonly with a spot of changeable reflection on upper surface of parafacial opposite lunule,



Figs. 4–8. Frons comparisons in adult male *Protocalliphora*. 4, *P. bennetti*. 5, *P. shannoni*. 6, *P. sialia*. 7, *P. rugosa*. 8, *P. hirundo*.

viewed from above spot dark brown against light brown, or from below golden on charcoal background. Preocellar area large, irregular polished black, usually contrasting with rest of frons. Frons at vertex 0.25 times width of head (0.24–0.28), to 0.30 in Alaska specimens, and 3.10 times ocellar span (2.78–3.67); frontal vitta parallel sided, with few or no bristles mesad of row of frontal bristles; parafacial relatively broad, width 0.51 times that of frons (0.482–0.596), 1.62 times ocellar span (1.47–1.82), and 0.81 times vibrissal interval (0.714–0.967); cheek height 0.37 times maximum eye length (0.321–0.414).

Puparium.—Length, 7.5 mm (6–8.5 mm); width 3.25 mm (2.6–4.0 mm); medium thick-walled, dull dark brown cuticle. *Posterior region* (Fig. 1a): Stigmatal plates 170μ (145–198μ)/76 in diameter; distance between buttons 503μ (400–600μ)/75; and across stigmatal plates 1007μ (820–1250μ)/75; stigmatal ratio 0.50 (0.41–0.60)/74. Upper mesostigmatal spines as tubercles, lower spines up to 15μ below, folds absent, plaques faint; hyperstigmatal spines numerous, longest spines 27µ (20–35µ)/76; hypostigmatal area longest spines 12.5µ (7.5–17.5µ)/76; circumstigmatal folds weak to absent. *Dorsal cuticle* (Fig. 1c): Numerous spines to 35µ (30–40µ)/76, cuticular ridges weak or absent. *Ventral cuticle* (Fig. 1d): Ventral band ratio 0.72 (0.54–89); anterior band pronounced, several rows of small spines to rear; medial band pronounced, numerous rows of small spines toward rear making medial band unusually broad; posterior band average width, no reduction to rear. Diameter of prothoracic fringe 350µ (300–425µ).

Types.—Holotype male, allotype, and 21 paratypes (11 ♂, 10 ♀) from Virginia, Roanoke Co., Roanoke, May 15, 2000, Carolina chickadee nest 3351. Holotype and allotype in the National Museum of Natural History, Smithsonian Institution, Washington, DC; additional paratypes there and at the Museum of Comparative Zoology, Harvard University, Spencer Entomological Museum, University of British Columbia, and my collection.

Additional paratypes: CANADA, BRITISH COLUMBIA (34 ♂, 31 ♀, numerous puparia): 12 ♂, 7 ♀, most with puparia, Lumby, black-capped chickadee nest, Sept. 24, 1957, J. Grant; 22 ♂, 24 ♀ and numerous puparia, Prince George, black-capped chickadee, nest #4064, July 2001, R.D. Dawson. ONTARIO: 14 puparial slides prepared by G.F. Bennett, labeled 52-60W, which, according to Bennett's coding, is Algonquin Park, house wren, nest #60, summer 1952. Some slides were labeled *P. cooki*, the name was never published. There also was a reference to associated adults examined by Sabrosky, which were not located. SASKATCHEWAN (2 ♂, 5 ♀, 75 puparia): 1 ♂, 5 ♀, 15 puparia, Saskatoon area, tree swallow, nest #2546; 1 ♂ and 60 puparia, house wren, nest 2547, summer 1996, Russ Dawson.

UNITED STATES: ALASKA (688 adults, numerous puparia): Fairbanks, Creamers' Field, 4 tree swallow nests, July 1994, D.D. Roby; 7 ♂, 11 ♀, 44 puparia, mixed with 23 *P. braueri* (Hendel), nest #20; 4 ♂, 34 puparia mixed with 27 *P. braueri* and 12 *P. sialia* puparia, nest #41; 4 puparia, mixed with 30 *P. braueri,* and 1 *P. sialia,* nest #42; 5 puparia, nest #4; 2 puparia, 61°41′N, 144°51′W, Wrangell National Park, pine grosbeak, Nest LRS008, June 26, 1998, S. Matsuoka; 666 adults and numerous puparia, collected near Anchorage, around 61°10′N, 150°22′W, 35 black-capped and boreal chickadee nests, June and July 2000, by S. Matsuoka. IDAHO (11 puparia): Kootenai County, Mica Bay, Lake Coeur d'Alene, 8 puparia, tree swallow nest #4057, July 6, 2001; 3 puparia, house wren nest #4266, July 20, 2001. MAINE (30 puparia): Waldo county, Thorndike, Webb Road, black-capped chickadee, nest #4645, summer 2000. MASSACHUSETTS (4 ♂, 8 ♀, 110 puparia): From 20 infested tree swallow nests, Birkshire County, 3 locations near Pittsfield, from my series #3006–3033, 3788–3846, 3892–3947, nests contributed by Dr. Christine M. Custer, USGS, upper Midwest Environmental Sciences Center, La Crosse, WI. In 1999, 13 nests had a total of 63 *P. bennetti* puparia, of these, 7 nests involved mixed infestations where a total of 33 *P. bennetti* puparia were mixed with 150 *P. sialia* puparia; from the same sites in 2000 there were 7 infested tree swallow nests with 3 ♂, 9 ♀ and 47 puparia, 4 nests involved mixed infestations with *P. sialia.* MINNESOTA (10 puparia): Marshall County, Agassiz National Wildlife Refuge, 3 tree swallow nests #3042, #3052, and #3053, summer 1999, Dr. Christine Custer. NEW YORK (9 ♂, 12 ♀, 162 puparia): Cattaraugus County, Franklinville, July 15, 1999, 3 nests; 6 ♂, 10 puparia, starling nest #2744; 7 ♂ 11 ♀, 26 puparia, house wren nest #2748; 23 puparia mixed with 2 *P. sialia* puparia, house wren nest #2749; 12 puparia, Oswego County, Mexico, tree swallow nest #2765, summer 1999; Cattaraugus County, Franklinville, late July 2000, 6 nests; 16 puparia, house wren nest #2934; 5 ♂, 1 ♀, 12 puparia, tree swallow nest #4067; 1 ♂, 3 puparia, house wren nest

Fig. 9. Distribution of *Protocalliphora bennetti* (solid dots) and *P. rugosa* (circles).

#4070; 36 puparia, tree swallow nest #4071; 19 puparia mixed with 7 *P. sialia* puparia, tree swallow nest #4072; 5 puparia mixed with 70 *P. sialia* puparia, tree swallow nest #4073. VIRGINIA (8 ♂, 5 ♀, 20 puparia): Roanoke County, Salem, Carolina chickadee nest #3307, May 18, 2000; 23 puparia Roanoke County, Roanoke, house wren nest #3625, late June, 2000. WEST VIRGINIA (125 adults, numerous puparia, mixed with 20 adult *P. deceptor*): Marion County, Fairview, Carolina chickadee nest #3390, early June 2000. WISCONSIN (7 puparia): Rusk County, Sheldon, eastern bluebird nest #5560, August 2001. All specimens collected by author from nests contributed by Cornell Birdhouse Network contributors, Cornell University, unless stated otherwise.

Specimens examined.—101 ♂, 92 ♀, plus 688 adults from Alaska and 125 adults from West Virginia not counted by sex, also numerous puparia.

Distribution.—USA: Alaska, Idaho, Maine, Massachusetts, Minnesota, New York, Virginia, West Virginia, Wisconsin. Canada: British Columbia, Ontario, Saskatchewan (Fig. 9).

Basis for description of puparia.—Alaska slides - #20, 1–14 & 16, plus 21 slides from the Anchorage areas from material provided by S. Matsuoka. Massachusetts slides-#3013, 1–3. New York, #2744, 1–4; #2748, 1–4; #2749, 1–7; #2934, 1–3. Ontario slides-52-60w, 1–12. Saskatchewan slides-#2546, 1–3; #2547, A&D, 1–4. Collection data for these nest numbers can be found under type series information.

Hosts.—Eastern bluebird, Boreal, black-capped, Carolina chickadees, pine grosbeak, European starling, tree swallow, and house wren.

Ecology and biology.—This species seems to be the eastern counterpart of *P. parorum* Sabrosky, Bennett, and Whitworth, which is found in the west. Both species are frequently found in chickadee and house wren nests. *Protocalliphora bennetti,* like *P. parorum* is found in cavity nests of wrens and chickadees, but *P. bennetti* is also found in tree swallow nests, while *P. parorum* is not. In tree swallow nests, it is often, mixed with *P. sialia,* the unusual tree swallow parasite. This suggests that chickadees and wrens are the favored hosts while tree swallows are not. *Protocalliphora bennetti* extends west across Canada, and northwest from the East Coast to Alaska as does *P. avium.* To-date, I have found *P. parorum* as far north as southern British Columbia while northern Idaho appears to be the southern most range of *P. bennetti* in the west (Fig. 9).

Variation.—Male specimens from northeastern U.S. tend to have lower frons to head ratios (0.06–0.08). Specimens from British Columbia and Alaska tend to have higher ratios, 0.08–0.09, and occasionally to 0.10. Alaskan puparia tend to have higher ventral band ratios, an average of 0.81, versus an average of 0.69 for those from northeastern United States. Despite this variation, adults and puparia show many characters in common and appear to be the same species.

Etymology.—I am pleased to dedicate this species to the late Dr. Gordon F. Bennett of the Memorial University of Newfoundland who was a mentor and co-author. His early work inspired me, and his pioneering research on immature *Protocalliphora* laid the foundation for my current studies.

***Protocalliphora* (*Protocalliphora*) *rugosa* Whitworth, new species**

(Figs. 2, 7)

Protocalliphora hirundo: Sabrosky et al. 1989, (in part). Specimens identified as *P. hirundo* from nests of purple martins, tree swallows, and violet-green swallows almost certainly are *P. rugosa.* Identification of Utah specimens has been verified. The photographs identified as *P. hirundo* in figures 53b and 53c of Sabrosky et al. 1989 appear to be *P. rugosa,* figures 53a and 53d appear to be *P. hirundo.*

Diagnosis.—Sexes concolorous monochromatic, shining metallic blue, adults very similar to *P. hirundo.* Parafrontal greatly narrowed above in males, much narrower than *P. hirundo* (Figs. 7, 8). Frons to head ratio slightly smaller in males 0.08 (0.07–0.09) vs 0.10 (0.09–0.11) in *P. hirundo.* Cuticular ridges of puparia prominent in stigmatal area, ridges on venter and dorsum closer together, usually smaller, and more regular than *P. hirundo* (Figs. 2, 3).

Male.—Head ground color black; parafrontal and parafacial silvery microtomentose when viewed from above; parafacial dark red or dark brown, color of parafacial extends through genal groove under eye. Thorax shining, metallic dark blue or bluish purple, dorsum faint gray microtomentose, when viewed from rear, with 3 broad, weak shining stripes. Abdomen concolorous with thorax. Calypteres opaque white, outer rims tinged with pale yellow.

Frons at narrowest 0.08 times head width (0.07–0.09) and slightly wider than ocellar span (1.19 ×; 1.0–1.40); preocellar area dull gray microtomentose elongate triangle. Lower parafrontal broad, narrowing greatly in prevertical area, microtomentose area ending just short of ocellar triangle (Fig. 7). Parafacial 1.82 times width of 3rd antennal segment (1.5–2.25) and 1.42 times width of frons (1.17–2.00); 1.65 times ocellar span (1.36–2.22); and 0.85 times vibrissal interval (0.68–1.11); cheek not half maximum length of eye 0.42 (0.37–0.48).

Thorax without accessory notopleural bristles and without hairs on tympanic membrane, with only an occasional seta on postalar wall. Foretibia with only a single median posterior bristle.

Terminalia like *P. hirundo* (Sabrosky et al. 1989), cerci distally acuminate, parallel, surstyli relatively short and broad, broader at base, slightly curved inward to distal end, parallel-sided; aedeagus as usual in genus.

Female.—Same color as male, but head with parafrontal silvery tan with a yellow tinge when viewed from above. Most specimens with a changeable spot in parafacial opposite lunule; dorsum of thorax duller than in male with heavy gray microtomentose very similar to female *P. hirundo*. Abdomen as in male. Frons at vertex 0.28 times head width (0.26–0.30) and 3.62 times ocellar span (3.09–4.11), frontal vitta with a few scattered weak hairs; preocellar area with a dull black, or tan, triangular or rounded area; parafacial broad throughout but narrowing steadily to prevertical area above. Parafacial, 2.26 times width of 3rd antennal segment (1.67–2.86), 0.52 times width of frons (0.43–0.59), 1.89 times ocellar span (1.55–2.22), and almost equal to vibrissal interval (1.06 ×; 0.89–1.26); check 0.46 times maximum eye length (0.37–0.47).

Length of normal adults 9.5 mm (9–10 mm).

Puparium.—Length 8.5 mm (8–9 mm); width 3.5 mm (3–4 mm); thick-walled, dark brown cuticle. *Posterior region* (Fig. 2a): Stigmatal plates 195μ (158–213μ) in diameter; distance between buttons 534μ (420–740μ); and across stigmatal plates 1204μ (940–1460μ); stigmatal ratio 0.44 (0.39–0.53). Upper mesostigmatal spines as knoblike tubercles or short spines, lower spines to 15μ, folds moderate to pronounced; hyperstigmatal area longest spines 30μ (25–40μ)/54 folds pronounced; hypostigmatal area longest spines to 15μ (10–20μ)/54, pronounced irregular folds; circumstigmatal folds concentric, and moderate to pronounced. *Dorsal cuticle* (Fig. 2c): Dense spines to 35μ (30–40μ)/36; cuticular ridges pronounced, dense, and parallel, ridges broad, 35–50μ in width. *Ventral cuticle* (Fig. 2d): Ventral band ratio 0.72(0.54–0.85)/54, ratios difficult to measure because of ridges; anterior band and patch pronounced, medial band pronounced, posterior band reduced to a few rows of short spines. Diameter of prothoracic fringe 350μ (300–400μ).

Types.—Holotype male, allotype and 24 paratypes (12 ♂, 12 ♀), from Utah: Cache Co, Logan Canyon, July 18, 1970, tree swallow nest #358. Holotype and allotype in the National Museum of Natural History, Smithsonian Institution, additional paratypes there and in University of British Columbia, Spencer Entomological Museum, Utah State University, Washington State University, and Whitworth Collections.

Additional paratypes: CANADA, BRITISH COLUMBIA (9 ♂, 10 ♀, 31 puparia): 22 puparia, Osoyoos, tree swallow nest #3713, 7/1/2000; 9 ♂, 10 ♀, 6 puparia, Haney, bank swallow nest, July 25, 1955, Mrs. Boye (Spencer Museum); 3 puparia, near Kamloops, Lac du Bois, tree swallow, August 10, 1954, G.J. Spencer. IDAHO (2 puparia mixed with 13 *P. sialia* puparia): Athol, Bonner Co., tree swallow nest #4044, July 15, 2000. MONTANA (4 puparial slides): Ravalli County, "swallow species", no date, G.F. Bennett Collection. OREGON (4 ♀ and 138 puparia): Springfield area, Lane County; 3 puparia, violet-green swallow nest #3741, July 8, 2000; all the following from tree swallow nests; 9 puparia mixed with 2 *P. sialia* puparia, nest #4194, July 8, 2000; 19 puparia mixed with 4 *P. hirundo* puparia, nest #4202, July 13, 2000; 11 puparia mixed with 3 *P. sialia* puparia, nest #4203, July 10, 2000; 62 puparia nest

#4204, July 12, 2000; 1 adult ♀, 15 puparia mixed with 5 *P. sialia* puparia, nest #4205, July 15, 2000; 2 puparia mixed with 5 *P. sialia* puparia, nest #4501, July 8, 2000; 7 puparia, nest #4502, July 24, 2000; 9 puparia, nest #4506, July 26, 2000; 3 ♀, 3 puparia, nest #4508, June 6, 2000; 1 puparium mixed with 3 *P. braueri* puparia, nest #4511, June 15, 2000. UTAH (94 ♂ and 107 ♀, many puparia): Logan Canyon, Cache Co. tree swallow nests; 10 ♂, 11 ♀, nest #359, July 18, 1970; 2 ♂, 2 ♀, nest #497, August 7, 1970; 19 ♂, 13 ♀, nest #498, August 7, 1970; the following nests were collected July 17, 1971; 9 ♂, 17 ♀, nest #1196; 7 ♂, 5 ♀, nest #1197; 9 ♂, 7 ♀, nest #1198; 2 ♂, nest #1199; 5 ♂, 8 ♀, nest #1200; 3 ♂, 3 ♀, nest #1202; 2 ♀, purple martin nest #1215, July 23, 1971; 1 ♂, 1 ♀, tree swallow nest #1216, July 23, 1971; 11 ♂, 12 ♀, Monte Cristo, Rich Co., purple martin nest #519, August 10, 1970; 5 ♂, 4 ♀, mixed with *P. sialia,* Walton Canyon, Rich Co., cliff swallow nest #418; 1 ♂, 3 ♀, mixed with *P. halli* Sabrosky, Bennett, and Whitworth. Logan, Cache Co., barn swallow nest #1290, August 14, 1971; 7 ♂, 6 ♀, Box Elder Co., violet-green swallow nest August 2, 1966, collector Ken Capelle. WASHINGTON (19 ♂, 81 ♀, many puparia): Tacoma area, Pierce Co.; 3 ♂ mixed with 65 *P. braueri,* house sparrow nest #1955, July 6, 1978; 3 ♂, 4 ♀, tree swallow nest #1966 June 15, 1979; 8 males, 15 ♀, tree swallow nest #2025, June 23, 1990; 6 ♂, 12 ♀, purple martin nest #2164, July 30, 1990; 22 ♀, purple martin nest #2165, July 30, 1990; 15 ♀, purple martin nest #2229, August 5, 1991; 7 puparia, tree swallow nest #2384, August 15, 1993; 85 puparia, purple martin nest #2539, summer 1996; 1 puparium, tree swallow nest #2557, July 13, 1997; 2 ♂, 3 ♀, Snohomish, Snohomish Co., tree swallow nest #2566, August 1, 1997; 5 ♀, Bellingham, Whatcom Co., violet-green swallow nest #3751, July 10, 2000; 1 ♀, Bellingham, Whatcom Co., tree swallow nest #4166, August 2, 2000; 2 ♀, Bellingham, Whatcom Co., tree swallow nest #4171, July 30, 2000; 20 ♀, tree swallow, nest #4172, July 30, 2000. WYOMING (2 ♂, 3 ♀): Gros Ventre River, Jackson, violet-green swallow nest #448, 7/29/70.

Specimens examined.—145 ♂, 228 ♀, numerous puparia.

Distribution.—USA: Idaho, Montana, Oregon, Utah, Washington, Wyoming, Canada: British Columbia (Fig. 9).

Basis for description of puparia.—Utah slides - 359-2 & 3; 447; 519-A & C; 1198-1, 2, & 3; Washington slides - 2384, 1–2; 2539, 1–5, 7–10; 2557; 3751, 1–2; 4172, 1–2; Oregon slides - 3741, 1; 4194, 2; 4202, 1 & 3; 4204, 2; Idaho slides - 4044, 1–2. Collection data for these nest numbers can be found under type series information.

Hosts.—Purple martin, house sparrow, and many swallow species including: bank, barn, cliff, tree and violet-green.

Ecology and biology.—*Protocalliphora rugosa* was the primary species in the nests of purple martins in northwestern United States and also often found in tree and violet-green swallow nests. It rarely occurred in barn swallow, bank swallow, or cliff swallow nests where *P. halli, P. chrysorrhoea* (Meigen) and *P. hirundo* respectively were the primary parasites. Puparia were usually found wrapped in feathers like *P. sialia* and *P. parorum.* Adult specimens of *P. rugosa* reared from nests in Washington were disproportionately females. Three nests, lot numbers 2165, 2229, and 4172, produced 57 adults, all females, with no males. However, in Utah the sex of adults was about equally male and female (94 males, 107 females). Similar sex ratio distortion has been observed in other insects due to the presence of son-killing or male-killing bacteria like *Wolbachia,* which kills male hosts of diploid insects early in development. I have not observed this sex ratio distortion in other species of *Protocalliphora,* but *Wolbachia* has been found in all species of *Protocalliphora* examined to date (E. Baudry, personal communication) [information obtained in writing].

Etymology.—The specific name is derived from the Latin *rugosus*, which means wrinkled or folded and describes the heavy folds characteristic of the puparia of the species.

KEY TO SPECIES

The following key will serve to separate males and associated puparia of closely related species with white calypteres and digitate surstyli.

1. Frons of male as wide or wider than breadth of 3rd antennal segment. Hyperstigmatal spines of puparia 25μ or more, posterior ventral spine bands not reduced to rear. 2
– Frons of male obviously narrower than breadth of 3rd antennal segment. Hyperstigmatal spines of puparia short, usually 20μ or less, posterior ventral spine bands significantly reduced to rear. . . . . *shannoni*
2. Preocellar area of male with polished black triangle or streak (Figs. 4–6). Dorsal cuticle of puparia with ridges weak or absent, or if pronounced, prothoracic fringe 500μ or more. . . 3
– Preocellar area of male with dull gray triangle or streak (Figs. 7, 8). Dorsal cuticle with pronounced ridges, diameter of prothoracic fringe 400μ or less. 4
3. Puparium with prothoracic fringe diameter of 500μ or more, dorsum heavily ridged, frons in male averaging about 1.4 times breadth of 3rd antennal segment (Fig. 6). . . . . *sialia*
– Puparium with prothoracic fringe about 375μ (Fig. 1b), dorsal ridges usually weak (Fig. 1c), frons in male about equal to the breadth of the 3rd antennal segment (Fig. 4). . . . *bennetti*, n. sp.
4. Stigmatal region of puparium with a few broad, irregular folds (Fig. 3a), dorsum with broad, irregular folds (Fig. 3b). Upper portion of parafrontal in male not significantly narrowed (Fig. 8). . . . . *hirundo*
– Stigmatal region of puparium with narrower, concentric folds (Fig. 2a), dorsum with narrow, regular folds (Fig. 2c). Upper portion of parafrontal in male narrows significantly (Fig. 7). . . . . *rugosa*, n. sp.

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NOTE

First Records of the Sugarcane Pest, *Blastobasis graminea* Adamski (Lepidoptera: Coleophoridae: Blastobasinae), from Mexico and Central America

Although described only recently (Adamski 1999), *Blastobasis graminea* Adamski has been known as a pest of sugarcane (*Saccharum officinarum* Linnaeus; Poaceae) in Colombia and Venezuela for nearly 50 years (e.g., Box 1953, Guagliumi 1962). Cárdenas and Hernández (1988) described the biology of *B. graminea* in Colombia, and Adamski (1999) presented details of its morphology, along with illustrations of the adult, genitalia, larval chaetotaxy, and damage. Martorell (1976) reported two species of Blastobasinae feeding in flower heads of sorghum (*Sorghum aethiopicum* Hackel Ruprecht ex Stapf.; Poaceae) in the Virgin Islands, and it is possible that one of them represents *B. graminea*. Unfortunately, these specimens are presumably lost.

During a survey of sugarcane fields in central Mexico in February 2001, specimens of *B. graminea* were collected in the states of Veracruz and Jalisco. In Jalisco (Autlán and Casimiro Castillo), larvae of *B. graminea* were collected from young stalks of sugarcane at ground level, while in Veracruz (La Gloria), adults were collected using light-traps and blacklight. We assume that both of these collections represent resident pest populations in the sugarcane fields from which they were collected. Coincidentally, specimens of *B. graminea* (larvae and adults) recently were sent to the Systematic Entomology Laboratory for identification from Costa Rica, where they had been reared from sugarcane. These new records (from Mexico and Costa Rica) significantly broaden the known geographic range of *B. graminea* (Fig. 1).

At present, it is unknown whether the records from Costa Rica and Mexico represent a recent invasion of this species into Central America, an old, previously undetected invasion, or a host switch by native *B. graminea* populations onto cultivated sugarcane. The fact that *B. graminea* has been reared from corn (*Zea mays* Linnaeus; Poaceae) and sorghum suggests that it has the potential to become a widespread pest throughout the lowlands of northern South America and Central America where these crops are cultivated. However, it seems that adequate time for this scenario to come to fruition has elapsed without the potential result. The fact that *B. graminea* also has been recorded from *Coix lacryma-jobi* Linnaeus (Poaceae) and *Setaria paniculifera* Fournier (Poaceae), two widespread native grasses, suggests that it already may have a broad native distribution in the region and has switched over to cultivated plants opportunistically in certain parts of its range. Regardless, the potential of *B. graminea* to become a more widespread and economically important pest of sugarcane seems high in light of the information presented herein. Furthermore, we recommend that future survey work be conducted for this insect in sugarcane producing areas of northern Mexico and southeastern United States where *B. graminea* is not known to occur at present.

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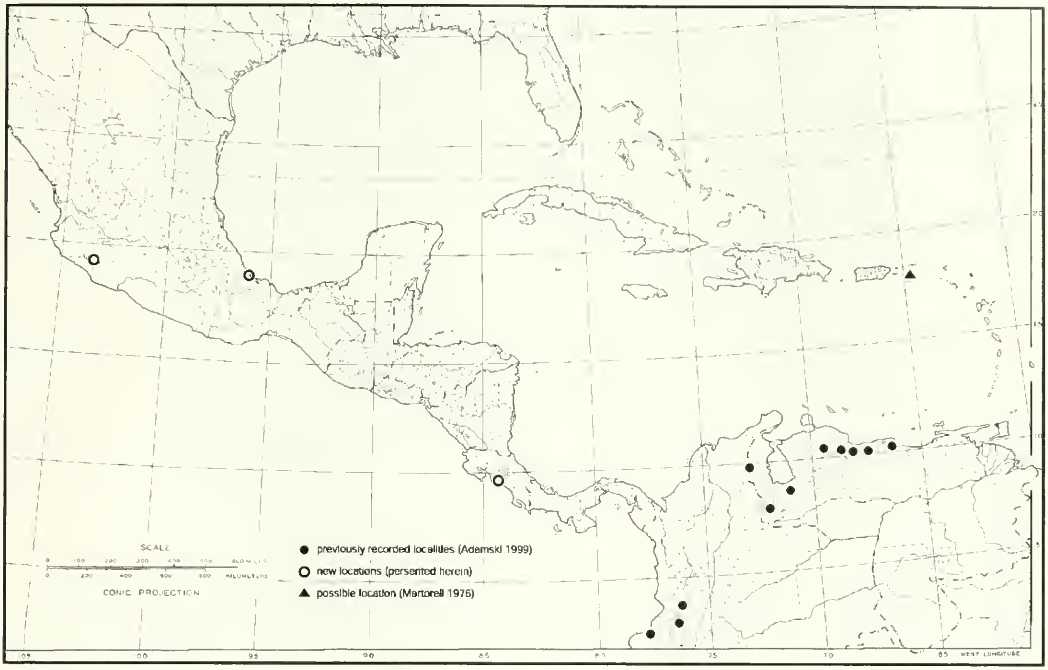

Fig. 1. Known distribution of *B. graminea*. Closed circles are previously reported locations (Adamski 1999); open circles are new locations (presented herein); triangle is possible location (Martorell 1976).

Independencia, Veracruz; and Leopoldo Montero, La Gloria Sugar Mill, La Gloria, Veracruz. We thank Pedro Esteban Diaz, Instituto Nacional de Ecologia, SEMARNAP, Mexico, for providing Adamski with a collecting permit. César Guillén Sánchez and Kenji Nishida, Universidad de Costa Rica, San Pedro, and Eugenie Phillips Rodriguez, Instituto Nacional de Biodiversidad, Santo Domingo, Heredia, Costa Rica, forwarded to us specimens of *B. graminea* from Costa Rica. Vitor Becker, Planaltina, Brazil, David Smith, Systematic Entomology Laboratory, USDA, Washington, DC, and an anonymous reviewer provided helpful comments on the manuscript.

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NOTE

Tapinoma sessile (Say) (Hymenoptera: Formicidae) Nest in Association with the Northern Pitcher Plant, *Sarracenia purpurea* L. (Sarraceniaceae)

Tapinoma sessile (Say), the odorous house ant, is a native species found throughout the United Sates and Canada and is considered a house pest (Wang and Brook 1970). This species is extremely flexible in selecting nesting sites. Nests are excavated in the soil, with or without a covering object such as stones. Nests are also constructed under bark and have been reported in a variety of preformed cavities (Creighton 1950). When colonies nest in the soil, the nests are shallow and temporary. In studying nest relocation in four species of ants, Smallwood reported that *T. sessile* moved its nest approximately every twenty-six days (Smallwood 1982). Nests of *T. sessile* have been reported in boggy areas as well as swamps (Smith 1928).

While *T. sessile* is a diminutive species, its colonies can consist of several thousand workers and are reported to be polygynous. New colonies can be formed by a queen and a group of workers leaving the parent colony (budding) or by a single founding queen.

Workers of *T. sessile* visit plants to collect honeydew from plant-feeding insects including mealybugs, aphids and plant hoppers, as well as to collect floral and extrafloral nectars. They also are reported to feed on both living and dead insects.

An elevated soil nest of *T. sessile* was observed against a leaf of *Sarracenia purpurea* L., the northern pitcher plant (Fig. 1), in Suitland Bog, Prince Georges' Co., Maryland. Suitland Bog is a hillside fen. The ant nest and associated pitcher plant were monitored for several weeks. During the observation period one to six worker ants were observed on the hood (B) and lip (A) of the leaf closest to the ant colony (Fig. 1). Ants were sporadically observed on other leaves of the same plant cluster. As one ant would leave the leaf closest to the nest, others would arrive. Yet, the numbers of ants on the leaf at any one time remained between 1–6 workers. An ant nest at that location was surprising because the ground was saturated with water. It was assumed that the nest did not extend below the surface. Worker ants were active for much of the day (period between 9:00 AM and 4:00 PM).

At the end of the observation period, one side of the nest was partially opened. Mature larvae and pupae were readily apparent. Since the nest was minimally disturbed, only a small fraction of the colony was visible. By the time the site was revisited again in September, the ants had abandoned the nest. It is assumed that they moved to higher and drier ground to prepare for over-wintering.

Sarracenia purpurea has dermal glands in the leaves that release extrafloral nectar (Joel 1986). The greatest density of these glands is on the lip of the leaf (Fig. 1A). The total carbohydrate content of the extrafloral nectar of *S. purpurea* has been studied by Cipollini (Cipollini et al. 1994). Nectar production is correlated with the age of the leaf. Older leaves do not produce detectable quantities of carbohydrates. Dress (Dress et al. 1997) reported measurable amounts of amino acids in *S. purpurea* extrafloral nectar samples.

The discovery of extrafloral nectar sources can prompt several different responses in ants. When foraging worker ants encounter a rich nectar source, the ants will consume the sugar source until they are replete. Others will feed and mark a trail back to the parent nest to recruit other workers. Koptur (1992) states that worker ants will treat ex-

Fig. 1. *Sarracenia purpurea* plant with *Tapinoma sessile* nest to the right of the labeled leaf. A = lip of the leaf, B = hood of the leaf.

trafloral nectaries in the same manner as they treat honeydew-producing insects. They will actually defend and protect the sugar source.

We believe *Tapinoma sessile* has taken this strategy one step further. Upon locating and evaluating the extrafloral nectar source of *S. purpurea,* the ants built a nest next to the pitcher plant. Brood production for the ant appeared to coincide with extrafloral nectar flow from the new leaves.

The northern pitcher plant is rather localized in its distribution being restricted to bogs, fens and hillside seeps in the eastern United States and Canada. The observation reported here demonstrates the flexibility of *T. sessile* to adapt to a specific set of conditions. Since there was a second *T. sessile* nest near a separate plant in a different part of Suitland Bog, this was not an isolated observation. The ants appeared to be taking advantage of a particular food source in the most efficient manner to maximize their brood production.

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NOTE

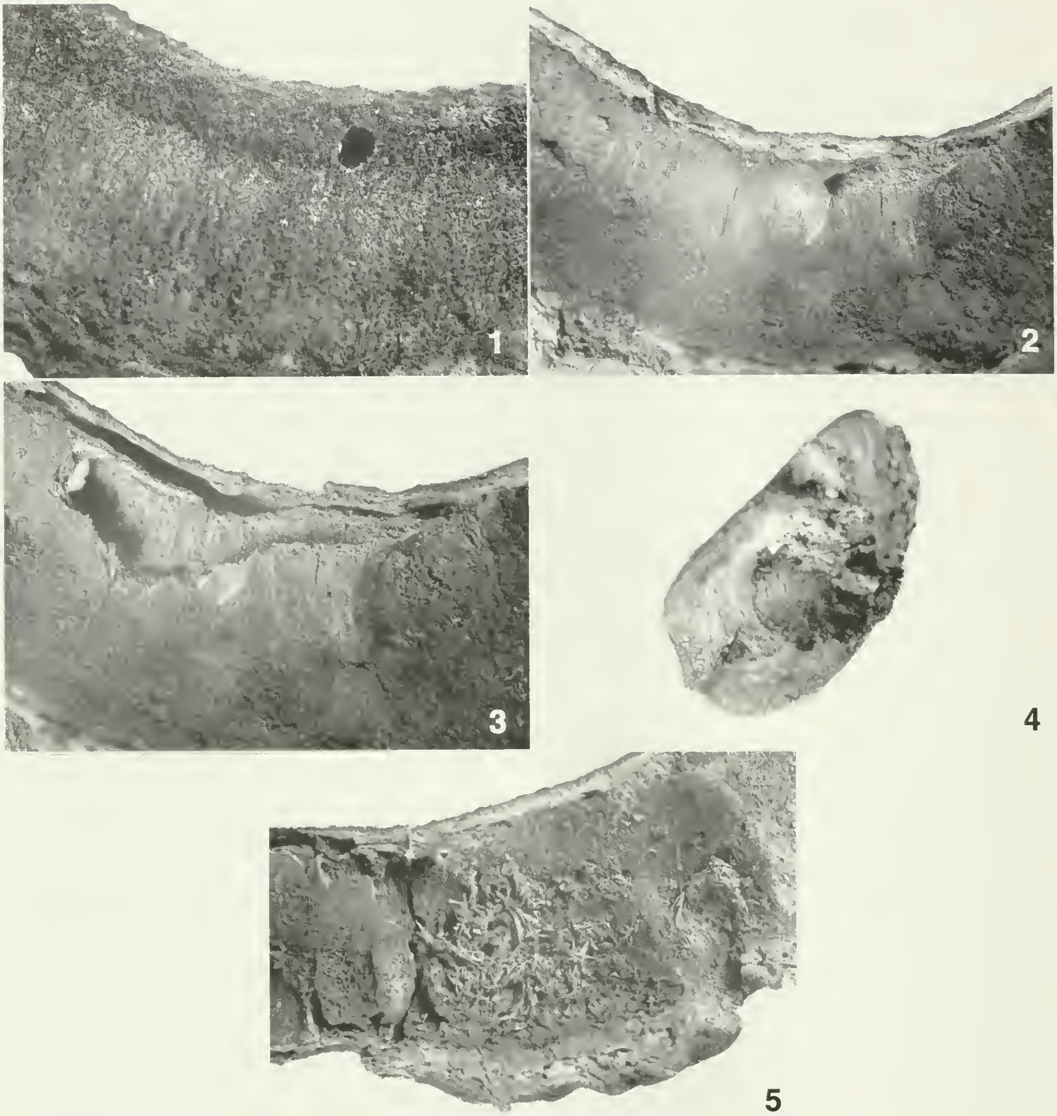
Feeding Habits of *Nyssodrysina lignaria* (Bates) (Coleoptera: Cerambycidae: Lamiinae)

Cerambycidae are essentially xylophagous, with few species utilizing other kinds of food (Duffy 1953; Duffy 1960; Linsley 1961; Martins 1997; Marinoni et al. 2001; Monné 2001a, b). A few species feed on seeds: *Ataxia sulcata* Fallén (Pteropliini), *Leptostylus terraecolor* Horn, *Lophopoeum timbouvae* Lameere, and *Nyssodrysina lignaria* (Bates) (Acanthocinini) (Marinoni et al. 2001). Studies indicate that adults of *Nyssodrysina lignaria* have been obtained from pods of legumes, such as *Inga lushnathiana* Benth. (Leguminosae) (Bosq 1943) and from the fruit of *Theobroma cacao* (Linnaeus) (Sterculiaceae) (Bondar 1939). The only reports describing seed-living larvae are Lima (1955) who cited species of *Inga* as host plants, and Biezanko and Bosq (1956) who noted the presence of larvae boring seeds of *Inga uruguensis* Hooker and Arnott and *Inga virescens* Benth.

Three adults that developed in the pods of *Inga sessilis* (Vell.), collected in Curitiba, during the month of November (1998), allowed insight into the feeding habits of *Nyssodrysina lignaria.* Lorenzi (1998) defined the fruit of *Inga sessilis* (ingá-macaco; ingá-ferradura; ingá-carneiro) as being a "woody legume, tomentous-velvety, flattened and curved like a horseshoe, containing few seeds covered by a thick layer of sweet aril." The pod in which the insects were reared had a length of 14 cm on the convex side and a width of approximately 2.5 cm at the widest part. The seeds had a length of about 1.5 cm and a width a little less than 1 cm. Studies of pods and characteristics of the feeding behavior of *N. lignaria* were conducted after the emergence of adults, which occurred in September (two individuals) and November (one individual) of 1999. It was shown that in one of the pod valves, the adults made two emergence holes (Fig. 1 depicts one of these openings). There was no hole on the internal wall (endocarp), indicating a passage of the larva to the internal cavity of the pod, which would make feeding on the seeds possible. These findings indicate that the two insects developed by feeding exclusively on mesocarp. Oviposition must have been next to the suture of the pod valves. The larva, penetrating into the exocarp, produces a gallery parallel to the suture (Fig. 3), where the remains (excrement, particles and fibrous strips) are compacted inside. As the larva develops, it bores into the mesocarp toward the middle of the pod. The gallery takes the shape of a wide pupal chamber next to the exit hole (Fig. 3). The chamber appears as a simple cavity without any delimiting artifact.

The third specimen reached the internal cavity of the pod, which was evident by the presence of an oval opening in the internal wall (endocarp) of the valve (Fig. 2). It fed on part of the seed (Fig. 4), and the amount consumed was small, indicating that a large part of larval alimentary needs had been supplied by the ingestion of cellulose from the valve. The larva still produced long strips from the woody tissue that constituted the endocarp of the pod (Fig. 5). These strips were dispersed in the internal cavity, uncharacteristic of the formation of a bird nest type pupal chamber, as occurs in various genera of Cerambycidae (Duffy 1953, 1960).

The behavior of these three individuals indicates that the spermophagous nature of this species must be circumstantial. The ingestion of pod walls should be the basic source of food. This behavior (carpophagy) can be considered as transitory in the process of adaptation to a strictly spermophagous habit. Even though the spermophagous behavior of *Nyssodrysina lignaria* may be viewed as circumstantial, it should



Figs. 1–5. Pods of *Inga sessilis* with *Nyssodrysina lignaria*. 1, Adult emergence hole. 2, Internal view of one valve showing hole made by larvae. 3, Internal view of one valve showing gallery and pupal camera produced by larva (residues in gallery removed). 4, Seed partially consumed by larva. 5, Internal view of one valve showing fibrous stripes of endocarp produced by larva.

be noted that two other species of the same tribe Acanthocinini (described above) have been reported to be seed consumers.

Costa and Link (1988) and Marinoni and Ganho (in press) point out other findings on the behavior of these beetles. The first authors collected 1162 specimens of *N. lignaria*, during a one-year period (August, 1986 to July, 1987), utilizing impact traps with alcohol as an attractant in six tree planting fields (eucalyptus, pine, "acacia negra," "ipê amarelo"). This number corresponds to about twice (591 individuals) that collected by the project "Levantamento da Fauna Entomológica no Estado do Paraná (PROFAUPAR)" in eight sites, utilizing Malaise traps (384) and light traps (207) carried out during the same period (August, 1986 to July, 1987) when this species was the most abundant among all the Cerambycidae from a total of 2000 specimens (Marinoni and Ganho, in press).

These findings allow us to point out two important aspects. The first is the large difference between collections using traps with and without alcohol as an attractant. The second is the abundance of the species (591 specimens) in the collections by PROFAUPAR, which was greater than that of all other species. The second most abundant species was *Compsa albopicta* (Perty), with only 166 specimens.

The reason for the large abundance of *N. lignaria* must be related to the utilization of fruit for food by larvae. The feeding habit of this species, although not essentially spermophagous, is associated with fruit and not wood (trunk, limbs and roots). The fruit of these host species, having an annual cycle, can provide a larger quantity of food compared to wood which the majority of Cerambycidae species utilize only after dying or falling (due to wind, lightning, senility, etc.).

The greater abundance by collections using traps containing alcohol as an attractant is likely connected with the search for fruit for reproduction. The seeds of *Inga sessilis,* such as those of *Inga edulis* Mart., are covered by a thick layer of aril. The aril becomes sweet when the fruit ripens. This favors the development of a fermentation process resulting in the production of alcohol (Duke 1983), which must be the substance that attracts *Nyssodrysina lignaria.*

We are grateful to George L. Venable for help in producing the plate, to Albino M. Sakakibara for the photos, and to Steven W. Lingafelter and Wayne N. Mathis for reviewing a draft of this paper. We are also grateful to FUNPAR, CNPq and CAPES for the support.

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NOTE

Replacement Names in the Eumaeini (Lepidoptera: Lycaenidae: Theclinae)

In preparing the Eumaeini (Lepidoptera: Lycaenidae: Theclinae) part of the Atlas of Neotropical Lepidoptera Checklist ("Atlas Checklist" hereafter, Robbins, in press), I discovered two generic and two specific homonyms that need to be replaced. The purpose of this note is to publish them in advance of the Atlas Checklist.

GENERIC NAMES

Eucharia Boisduval 1870 (type species *Papilio ganimedes* Cramer) is a junior homonym of *Eucharia* Hübner [1820] (Lepidoptera: Arctiidae). D'Abrera and Bálint (in D'Abrera 2001) proposed the generic name *Annamaria* with type species *Thecla draudti* Lathy, a congener of *P. ganimedes*, but *Annamaria* D'Abrera and Bálint is unavailable under ICZN Article 13.1.1 (1999) because this genus was not "accompanied by a description or definition that states in words characters that are purported to differentiate the taxon." Consequently, the **new name *Lamasina* Robbins** is proposed as a replacement name for *Eucharia* Boisduval. *Lamasina* contains four species in the Atlas Checklist: *Lamasina ganimedes* (Cramer 1775) **new combination**, *Lamasina draudti* (Lathy 1926) **new combination**, *Lamasina rhaptissima* (K. Johnson 1991) **new combination**, and *Lamasina saphonota* (Constantino, Salazar, and K. Johnson 1993) **new combination**. *Lamasina* is masculine and named for Gerardo Lamas, with deep appreciation for his prodigious contributions to the Atlas Checklist and to our knowledge of Neotropical butterflies in general.

D'Abrera and Bálint (in D'Abrera 2001) proposed the generic name *Gulliveria* for type species *Thecla gigantea* Hewitson. However, this name is preoccupied by *Gulliveria* Castelnau 1878 (Pisces). The **new name *Megathecla* Robbins** is proposed as a replacement name. *Megathecla* is feminine and is another way of drawing attention to the size of the type species. This genus consists of two species in the Atlas Checklist: *Megathecla gigantea* (Hewitson 1867) **new combination** and *Megathecla cupentus* (Stoll 1781) **new combination.**

SPECIFIC NAMES

Thecla aurorina Draudt 1921 is transferred to *Theclopsis* Godman & Salvin 1887 in the Atlas Checklist, but is preoccupied by the earlier name *Thecla aurorina* Oberthür 1880. The **new name *Theclopsis aurina* Robbins** is proposed to replace *Thecla aurorina* Draudt 1921. *Theclopsis aurina* is an indeclinable, non-latinized name that is intended to be euphonious and reminiscent of *T. aurorina.*

Serratofalca callilegua K. Johnson & Sourakov 1993 and *Gigantofalca calilegua* K. Johnson 1995 are transferred to *Calycopis* Scudder 1876 in the Atlas Checklist. As a consequence, they are secondary homonyms under ICZN Article 58.7 (1999), despite different spellings, because they both refer to the name of the same geographical locality (Calilegua). The **new name *Calycopis mirna* Robbins & Duarte** is proposed as a replacement for the junior homonym, *Gigantofalca calilegua* K. Johnson 1995. *Calycopis mirna* was described from Argentina, but we know it as a widespread species in southern Brazil and name it as a noun in apposition for Mirna Casagrande in recognition of her many contributions to our knowledge of Neotropical butterflies, including extensive collecting in southern Brazil.

Acknowledgments.—I am most grateful to Gerardo Lamas (Lima, Peru) for superb advice on nomenclatural matters. Marcelo

Duarte (Curitiba, Brazil) first realized that the species that we knew from southern Brazil was the same as *Calycopis calilegua* from Argentina, which is why he is the co-author of the replacement name for this taxon.

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NEW PUBLICATION

Revision of the Oriental Species of Aphthona *Chevrolat (Coleoptera: Chrysomelidae)*

by Alexander S. Konstantinov and Steven W. Lingafelter

This hardcover book of over 340 pages presents a revision of the large flea beetle genus *Aphthona* for the Oriental Region. This is the second monographic treatment of this genus (the senior author revised the Palearctic fauna in 1998). In the work, 93 species are treated, with 37 being described as new. Numerous new synonyms and combinations are recognized and are presented. Full descriptions and diagnoses are included along with dichotomous identification keys. Hundreds of illustrations, including four full color habitus drawings, are provided to facilitate identification. Of primary significance are the large, detailed aedeagal and spermathecal illustrations for every species. Distribution maps are also included.

Available from the Entomological Society of Washington (see inside back cover).

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NOTE

Ornithodoros kohlsi Guglielmone and Keirans (Acari: Ixodida: Argasidae), a new name for *Ornithodoros boliviensis* Kohls and Clifford 1964

Kohls and Clifford (1964) described all post-embryonic stages of *Ornithodoros boliviensis* from ticks found on bats and in houses in northeastern Bolivia. However, the name *O. boliviensis* is preoccupied by *Ornithodoros boliviensis* Bacherer Gutiérrez 1931. He described the last nymphal stage of *Otobius megnini* (Dugès 1883) as *Ornithodoros boliviensis,* from ticks frequently found in the ears of humans in the vicinity of Sucre, Bolivia (Bacherer Gutiérrez 1931). Therefore, *Ornithodoros boliviensis* Bacherer Gutiérrez constitutes a junior subjective synonym of *Otobius megnini* (Dugès 1883) (**new synonymy**), and we propose the name ***Ornithodoros kohlsi*** **Guglielmone and Keirans** (**new name**) for *Ornithodoros boliviensis* Kohls and Clifford 1964.

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BOOK REVIEW

Fauna of New Zealand No. 42. Aphodiinae (Insecta: Coleoptera: Scarabaeidae). By Z. T. Stebnicka. 2001. Manaaki Whenua Press, Lincoln, New Zealand. 64 pp. ISBN 0-478-09341-1. Price $29.50 (includes shipping). Order from Manaaki Whenua Press, P.O. Box 40, Lincoln 8152, New Zealand or http://www.landcare.cri.nz/mwpress.

The Scarabaeidae are a large family of beetles, numbering about 35,000 species. The Aphodiinae are one of the larger subfamilies and account for about 3,500 species. This is the first comprehensive review of the Aphodiinae in New Zealand by one of the world's leading authorities on aphodiines, Zdzislawa Stebnicka from Poland. While this fauna is small (only 20 species), this work presents them accurately and in detail.

Although the Aphodiinae are a large, diverse, and cosmopolitan group, little was known about them in New Zealand prior to this study. They are commonly referred to as "dung beetles," but not all species are associated with dung. Aphodiines feed and breed in the soil on various kinds of excrement and/or in vegetable debris. Two species in New Zealand are actually minor pests of cultivated plants. The monograph begins with a popular summary (in English and Maori) and a checklist of taxa. A brief section on "Systematics" includes an overview of the classification of the subfamily. The next section on "Morphology" discusses and illustrates the characters used to delineate aphodiines, including the diagnostic characters for tribes found in New Zealand. A section on "Biology" includes information on life history and feeding preferences. An important section on "Biogeography" follows where Stebnicka discusses the nine indigenous species and the 11 species that have been accidentally introduced (six from Australia, 2 from America, 1 from Africa, 2 from Europe). One species is found only on South Island while seven are found only on North Island (including one also found on the Kermadec Islands). One species is indigenous to the Three Kings Islands, one to the Chatham Islands, and one to the Kermadec Islands. The New Zealand fauna of Aphodiinae is similar to that of Australia (as might be expected) but with a much smaller number of taxa. Stebnicka concludes that the distribution of the nine indigenous species and their systematic relationships suggests a Gondwonan origin.

A key to the 20 species in four tribes and nine genera is presented, and this is followed by descriptions, geographic distributions (with 20 locality record maps), seasonality, and biological associations. Two new species are described and two new synonymies are proposed. Two habitus drawings are provided as well as 41 line drawings and 16 scanning electron micrographs. The work concludes with an extensive references section.

The information included in this work is easily accessible and well-presented in a traditional systematic treatment. The taxonomy is sound and the descriptions accurate. The key is easy to use. Although the focus is only on New Zealand, this work is nevertheless comprehensive and an excellent presentation. This seems to be a hallmark of Stebnicka's work.

The primary users of this work will be systematists, ecologists, resource managers, and students in New Zealand wishing to know more about their entomofauna. It will also be useful to scarab taxonomists, curators and collection managers organizing their holdings, biogeographers studying southern hemisphere distribution patterns, and a fairly large set of amateur beetle collectors. Lastly, the *form* of this treatment could easily serve as a template for others to follow when writing future faunistic studies because it is so clear, comprehensive, and functional.

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New Publication

Revision of the Genus Anoplophora *(Coleoptera: Cerambycidae)*

by Steven W. Lingafelter and E. Richard Hoebeke

This hardcover book of 236 pages is the first comprehensive taxonomic treatment for *Anoplophora* woodboring beetles. This genus included the notorious Asian longhorned beetle that was introduced recently into New York City and Chicago. Using a thorough examination of primary types scattered throughout Asia and Europe as a foundation, this work proposed over 20 new synonyms and dozens of new combinations. Full color illustrations of adults of both sexes, detailed diagnoses and descriptions, distribution maps, an identification key, and hundreds of additional figures of characters used in *Anoplophora* identification are included. Over 50 pages of professionally prepared full color plates also are included. Thhis work is the only comprehensive resource that will enable identifications of this important group of beetles.

Available from the Entomological Society of Washington (see inside back cover).

PUBLICATIONS FOR SALE BY THE ENTOMOLOGICAL SOCIETY OF WASHINGTON

Miscellaneous Publications

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INVASIVE SPECIES OF MEALYBUGS (HEMIPTERA: PSEUDOCOCCIDAE) AND THEIR THREAT TO U.S. AGRICULTURE

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Abstract.—We provide a compilation of 158 species of mealybugs that are either a pest or threat to United States agriculture. Included for each species, where applicable, is reference to: the United States origin and date of introduction; whether it is established in the United States; its pest or threat status in the United States along with a validation citation; its principle hosts; and its biogeographical region of origin.

Key Words: Pseudococcidae, mealybugs, invasive species, biological control, agriculture

Mealybugs (Pseudococcidae) are major agricultural pests and pose serious problems when introduced into new areas of the world without natural enemies. In recent years, it has become increasingly obvious that introduced species have a major economic and esthetic impact on plants. Public concern stimulated Congress to develop a report on the subject (Office of Technology Assessment 1993) and a Presidential initiative (Executive Order 13112) to seek a solution to this problem is currently underway. Scale insects are notorious invaders because they are small, often live in concealed habitats, and frequently are transported on commodities that are common in international commerce. Mealybugs are a group of scale insects that are of special interest because of the recent introduction of four pest species in the United States. They are: the pink hibiscus mealybug, *Maconellicoccus hirsutus* (Green) (California 1999), the papaya mealybug, *Paracoccus marginatus* Williams and Granara de Willink (Florida 1998), the vine mealybug *Planococcus ficus* (Signoret) (California 1994), and the banana mealybug *Pseudococcus elisae* Borchsenius (Florida 1995). The origin of recent California infestations of *P. ficus* is not clear. This species was collected in several localities in the southeastern United States beginning in 1924, but was always found on fig trees (*Ficus carica* L.). It has not been recollected since 1959 and was never collected east of Texas. The infestation in California is only on grapes and has not been found on figs. It is likely that the California infestation is from an overseas source and not from the eastern United States.

Since invasive species are a major issue in U.S. agriculture, and with several recent introductions of pest mealybug species, we decided to investigate several parameters concerning invasive mealybug species. Our objectives were: 1) to develop a preliminary list of the pest mealybug species of the world; 2) to provide a list of introduced and pest mealybugs of the United States; 3) to ascertain which of the species in the previous two objectives are introduced or native to the United States; 4) to examine data provided by the United States Department of Agriculture, Animal and Plant Health Inspection Service—Plant Protection and Quarantine (USDA, APHIS-PPQ) concerning the most commonly intercepted mealybug species at the United States ports-of-entry; and 5) using this information, to try to understand which mealybugs are most likely to invade the United States in the future.

Materials and Methods

Executive Order 13112 established the National Invasive Species Council and provided a definition of an invasive species as: ". . . a species that is 1) non-native (or alien) to the ecosystem under consideration **and** 2) whose introduction causes or is likely to cause economic or environmental harm or harm to human health." This definition not only includes alien species to the United States but also encompasses native species. The definition also has an economic or potential economic component. Using this definition, the grape mealybug, *Pseudococcus maritimus* (Ehrhorn) would be an example of an invasive species in the United States even though it likely is native. The definition that we use is a bit more simplistic. We consider invasive species to be those that are not native to the United States (alien or adventive) regardless of economic harm.

To make a table of pest mealybugs of the world, we have used a broad definition of the term "pest." Essentially, if a species is described in the literature as a pest, or as causing damage, or being controlled, or of economic importance, we have included it in the list. Our perspective for this paper has focused on the impact or potential impact of a pest mealybug in the United States. For example, *Antonina pretiosa* Ferris is known only from bamboo, and therefore, is considered to have relatively minor pest potential in the United States; it may be far more important in areas of the world where bamboo is a predominant component of the natural or ornamental vegetation. Conversely, *Pseudococcus cryptus* Hempel occurs on an array of agricultural crops that are important to the United States economy and is considered a major threat. The term "threat" is used for species that are considered pests but do not occur in the United States. For adventive species, we have approximated the United States date of introduction by searching the literature for the earliest collection record or have examined specimens in the National Entomological Collection of the National Museum of Natural History, in Beltsville, Maryland for the earliest record. Obviously, these dates are only estimates of when the species first invaded the United States. It is difficult to determine the zoogeographic area of origin for some species. It is clear that they are from the old or new world, but it is not always evident from which area. In some cases, we have simply made an educated guess based on the current distribution of the species, the distribution of what appears to be its closest relatives, and the natural distribution of its primary host plants. We have used the same criteria to determine if a particular species is native to the United States. In several instances, it is not clear, e.g., *Phenacoccus gossypii* Townsend and Cockerell or *P. dearnesii* King.

Results

Table 1 provides information on 158 mealybug species. Since the table includes six species that have been introduced into the United States but are not considered pests, we estimate that there are 152 mealybugs that represent either a pest or threat to the United States agriculture. In the United States, there are 66 pest mealybug species, 19 are considered to be native. Therefore, 47 mealybug pests in the country are invasive species. Based on information presented in ScaleNet on the Pseudococcidae by Ben-Dov and German (2001), there are

Table 1. Pest or threat mealybug species to United States agriculture. Abbreviation for origin are: Afrotropical Region (AF); Australasian Region (AU); Nearctic (NE); Neotropical Region (NT); Oriental Region (OR); Palearctic Region (PA).

Pest or Threat species	U.S. Origin and Date of Introduction	Established in U.S.	Pest or Threat Status in U.S.	Reference to Threat or Pest Status	Principle Hosts	Origin
Antonina crawi Cockerell	CA, 1900	yes	minor pest	Sasscer 1918	bamboo	PA
Antonina graminis (Maskell)	TX, 1942	yes	pest	Ben-Dov 1994	grass	OR
Antonina pretiosa Ferris	CA, 1925	yes	minor pest	Ferris 1953	bamboo	PA
Atrococcus bejbienkoi Kozár and Danzig		no	minor threat	Kosztarab and Kozár 1988	raspberry	PA
Balanococcus diminutus (Leonardi)	CA, 1906	yes	pest	Saakyan-Baranova 1954	Phormium	AU
Balanococcus poae (Maskell)		no	major threat	Cox 1987	rye grass	AU
Birendracoccus saccharifolii (Green)		no	threat	Ali 1962	sugar cane	OR
Brevennia rehi (Lindinger)	CA, AZ, 1967	yes	pest	Ben-Dov 1994	grass	OR
Cataenococcus hispidus (Morrison)		no	major threat	Azhar 1983	many tropical hosts	OR
Chaetococcus bambusae (Maskell)	MD, 1952	yes	not a pest		bamboo	PA
Chaetococcus phragmitis (Marchal)	NJ, 1975	yes	not a pest		phragmites	PA
Crisicoccus azaleae (Tinsley)	CA, 1898	yes	pest	Fox-Wilson 1939	azalea	PA
Crisicoccus matsumotoi (Siraiwa)		no	threat	Park and Hong 1992	fruit trees	PA
Crisicoccus pini (Kuwana)	CA, 1918	yes	not a pest		pine	PA
Coccura suwakoensis (Kuwana and Toyoda)		no	threat	Danzig 1986	fruit and ornamentals	PA
Coccidohystrix insolita (Green)		no	threat	Krishnamoorhy and Mani 1996	egg plant	PA
Delottococcus euphorbiae (Ezzat and McConnell)		no	threat	Marotta and Pagano 1997	succulents	AF?
Dysmicoccus angustus (Ezzat and McConnell)	?, 1912	yes	not a pest?		bamboo	OR
Dysmicoccus boninsis (Kuwana)	FL, 1895	yes	minor pest	Ben-Dov 1994	sugar cane	PA
Dysmicoccus bispinosus Beardsley		no	minor threat	García 1995	tropical hosts	NE
Dysmicoccus brevipes (Cockerell)	FL, 1880	yes	minor pest	Ben-Dov 1994	polyphagous	NT
Dysmicoccus carens Williams		no	threat	Razak et al. 1994	sugarcane	OR
Dysmicoccus cocotis (Maskell)		no	threat	Williams and Watson 1988	palms	OR
Dysmicoccus rassii (Leonardi)	FL, 1966	yes	pest	Williams and Granara de Willink 1992	polyphagous	NT
Dysmicoccus neobrevipes Beardsley		no	threat	Williams and Watson 1988	polyphagous	NT
Dysmicoccus vaccinii Miller and Polavarapu	native	yes	pest	Miller and Polavarapu 1997	blueberry	NE
Dysmicoccus wistariae (Green)	NJ, 1915	yes	pest	Hamilton 1942	taxus	PA
Ehrhornia cupressi (Ehrhorn)	native	yes	pest	Brown and Eads 1967	cypress	NE
Ferrisia malvastra (McDaniel)	FL, 1918	yes	pest	Williams 1996	polyphagous	NT(?)
Ferrisia virgata (Cockerell)	NM, 1896	yes	pest	Ben-Dov 1994	polyphagous	NT(?)
Geococcus citrinus Kuwana		no	threat	Huang 1987	citrus	OR

Table 1. Continued.

Pest or Threat species	U.S. Origin and Date of Introduction	Established in U.S.	Pest or Threat Status in U.S.	Reference to Threat or Pest Status	Principle Hosts	Origin
Geococcus coffeae Green	1958	no	threat	Williams and Granara de Willink 1992	polyphagous, including coffee	OR
Heliococcus bohemicus *Šulc*		no	major threat	Kosztarab and Kozár 1988	grape	PA
Heliococcus summervillei Brookes		no	minor threat	Summerville 1928	grass, including sugar cane	AU
Heterococcus nigeriensis Williams		no	threat	Harris 1961	sorghum	AF
Heterococcus nudus (Green)	NH, 1921	yes	pest	McKenzie 1967	grass	PA
Heterococcus tritici (Kiritshenko)		no	threat	Kiritchenko 1932	wheat	PA
Hypogeococcus festerianus (Lizer and Trelles)		no	minor threat	Marotta and Garonna 1992	cactus	NT
Hypogeococcus spinosus Ferris	CA, 1951	yes	minor pest	Ben-Dov 1994	cactus	NE
Idiococcus bambusae Takahashi and Kanda	NJ, 1916	yes	not a pest		bamboo	PA
Kiritshenkella sacchari (Green)		no	minor threat	Williams 1970	sugar cane	OR
Maconellicoccus australiensis (Green and Lidgett)		no	minor threat	Brookes 1972	acacia	AU
Maconellicoccus hirsutus (Green)	CA, 1999	yes	major pest	Ben-Dov 1994	polyphagous	OR
Maculicoccus malaitensis (Cockerell)		no	threat	Cockerell 1929	tropical plants	AU
Melanococcus albizziae (Maskell)		no	threat	Williams 1985a	acacia	AU
Miscanthicoccus miscanthi (Takahashi)	MD, VA, 1989	yes	minor pest	Stimmel 1996	miscanthus	OR(?)
Mizococcus sacchari Takahashi		no	minor threat	Takahashi 1928	sugar cane	OR
Neochavesia caldasiae (Balachowsky)		no	minor threat	Balachowsky 1957	coffee	NT
Nipaecoccus aurilanatus (Maskell)	CA, 1912	yes	minor pest	Brown and Eads 1967	auracaria	AU
Nipaecoccus nipae (Maskell)	CA, 1897	yes	pest	Ben-Dov 1994	polyphagous	NT
Nipaecoccus viridis (Newstead)		no	major threat	Sharaf and Meyerdirk 1987	polyphagous	OR(?)
Oracella acuta (Lobdell)	native	yes	minor pest	Gu and Chen 1996	pine	NE
Palmicultor browni (Williams)	FL, 1995		not a pest			PA
Palmicultor palmarum (Ehrhorn)	FL, 1999	yes	minor pest	Hara et al. 1996	palm	OR(?)
Paracoccus burnerae (Brain)		no	threat	Hattingh 1993	citrus	AF
Paracoccus juniperi (Ehrhorn)	native	yes	minor pest	Calkins 1946	juniper	NE
Paracoccus marginatus Williams and Granara de Willink	FL, 1998	yes	pest	Williams and Granara de Willink 1992	polyphagous	NE
Paraputo leveri (Green)		no	minor threat	Williams 1987a	coffee	AF
Paraputo taraktogeni Rao		no	threat	Rao 1950	chaulmoogra tree and tea	OR
Peliococcus perfidiosus Borchsenius		no	threat	Kosztarab and Kozáár 1988	tobacco, potato	PA
Phenacoccus acericola King	native	yes	pest	Johnson and Lyon 1991	sugar maple	NE
Phenacoccus aceris (Signoret)	ME, 1933	yes	pest	Ben-Dov 1994	polyphagous (trees)	PA
Phenacoccus avenae Borchsenius		no	major threat	Williams and Miller 1985	???bulbs????	PA

Table 1. Continued.

Pest or Threat species	U.S. Origin and Date of Introduction	Established in U.S.	Pest or Threat Status in U.S.	Reference to Threat or Pest Status	Principle Hosts	Origin
Phenacoccus azaleae Kuwana		no	major threat	Xie et al. 1998	azalea	PA
Phenacoccus dearnessi King	IL, 1894	yes	pest	Cranshaw et al. 1998	fruit trees	PA(?)
Phenacoccus defectus Ferris	native	yes	pest	Malumphy 1997	succulents	NE
Phenacoccus emansor Williams and Kozarzhevskaya		no	threat	Pijls et al. 1998	iris bulbs	PA
Phenacoccus gossypii Townsend and Cockerell	native?	yes	pest	McKenzie 1967	polyphagous	NE
Phenacoccus graminicola Leonardi	CA, 1953	yes	pest	Ward 1966	apples	PA
Phenacoccus herreni Cox and Williams		no	threat	Castillo and Bellotti 1990	cassava	NT
Phenacoccus hordei (Lindeman)		no	minor threat	Kosztarab and Kozár 1988	grass	PA
Phenacoccus madeirensis Green	native?	yes	pest	Castillo and Bellotti 1990	polyphagous	NT
Phenacoccus manihoti Matile-Ferrero		no	minor threat	Ben-Dov 1994	cassava	NT
Phenacoccus minimus Tinsley	native	yes	pest	Doane et al. 1936	spruce	NE
Phenacoccus parvus Morrison	FL, 1983	yes	pest	Williams and Watson 1988	polyphagous	NT
Phenacoccus piceae (Low)		no	minor threat	Kosztarab and Kozár 1988	*Picea*	PA
Phenacoccus pumilus Kiritshenko		no	threat	Kosztarab and Kozár 1988	pine	PA
Phenacoccus solani Ferris	native	yes	pest	Dudley et al. 1952	polyphagous	NE
Phenacoccus solenopsis Tinsley	native	yes	minor pest	Fuchs et al. 1991	cotton	NE
Phenacoccus tegrigorianae Borchsenius		no	threat	Ter-Grigorian 1956	cereals	PA
Planococcoides njalensis (Laing)		no	minor threat	Dufour 1991	cacao	AF
Planococcus citri (Risso)	FL, 1880	yes	pest	Ben-Dov 1994	polyphagous	OR
Planococcus dioscoreae Williams		no	minor threat	Williams 1960	yams	AU(?)
Planococcus ficus (Signoret)	LA, 1924 CA, 1994	yes	pest	Ben-Dov 1994	polyphagous	PA
Planococcus fungicola Watson and Cox		no	minor threat	Watson and Cox 1990	coffee	AF
Planococcus halli Ezzat and McConnell		no	minor threat	Cox 1989	yams	AF
Planococcus japonicus Cox	MD, 1978	yes	pest	Cox 1989	azalea	PA
Planococcus kenyae (Le Pelley)		no	minor threat	Le Pelley 1943	coffee	AF
Planococcus kraunhiae (Kuwana)	CA, 1915	yes	pest	Park and Hon 1992	polyphagous	PA
Planococcus lilacinus (Cockerell)		no	major threat	Ben-Dov 1994	polyphagous	AF(?)
Planococcus litchi Cox		no	minor threat	Cox 1989	lychee	PA(?)
Planococcus mali Ezzat and McConnell		no	minor threat	Cox 1989	currants	PA(?)
Planococcus minor (Maskell)		no	major threat	Ben-Dov 1994	polyphagous	OR
Planococcus musae Matile-Ferrero and Williams		no	threat	Matile-Ferrero and Williams 1995	plantain	AF

Table 1. Continued.

Pest or Threat species	U.S. Origin and Date of Introduction	Established in U.S.	Pest or Threat Status in U.S.	Reference to Threat or Pest Status	Principle Hosts	Origin
Planococcus radicum Watson and Cox		no	threat	Watson and Cox 1990	coffee	OR
Planococcus vovae (Nasonov)		no	threat	Williams 1984	cypress	PA
Polystomophora ostiaplurima (Kiritchenko)		no	threat	Kosztarab and Kozár 1988	trees	PA
Pseudococcus apomicrocirculus Gimpel and Miller		no	threat	Gimpel and Miller 1996	orchids	NE
Pseudococcus calceolariae (Maskell)	CA, 1915	yes	pest	Ben-Dov 1994	polyphagous, including citrus	AU(?)
Pseudococcus comstocki (Kuwana)	DC, 1906	yes	pest	Ben-Dov 1994	fruit trees and ornamental plants	PA
Pseudococcus cryptus Hempel		no	major threat	Ben-Dov 1994	citrus	NT(?)
Pseudococcus dendrobiorum Williams		no	threat	Williams 1985a	orchids	AU
Pseudococcus dolichomelos Gimpel and Miller	native	yes	pest	Gimpel and Miller 1996	polyphagous	NE
Pseudococcus elisae Borchsenius	FL, 1995	yes	pest	Gimpel and Miller 1996	polyphagous	NT
Pseudococcus importatus McKenzie	NJ, MD, 1941	yes	minor pest	Johnston 1964	orchids	NT
Pseudococcus jackbeardsleyi Gimpel and Miller	FL, 1921	yes	pest	Gimpel and Miller 1996	polyphagous	NT
Pseudococcus landoi (Balachowsky)		no	threat	Williams and Granara de Willink 1992	polyphagous	NT
Pseudococcus longispinus (Targioni Tozzetti)	DC, 1881	yes	major pest	Ben-Dov 1994	polyphagous	AU
Pseudococcus mandio Williams		no	minor threat	Gimpel and Miller 1996	cassava	NT
Pseudococcus maritimus (Ehrhorn)	native	yes	pest	Ben-Dov 1994	grape and fruit trees	NE
Pseudococcus microadonidum Beardsley		no	minor threat	Williams 1981	coconut	AU
Pseudococcus microcirculus McKenzie	CA, 1954	yes	minor pest	McKenzie 1967	orchids	NT
Pseudococcus nakaharai Gimpel and Miller	DC, 1890	yes	minor pest	Gimpel and Miller 1996	cactus	NE
Pseudococcus odermatti Miller and Williams	FL, 1973	yes	pest	Miller and Williams 197	citrus	OR
Pseudococcus peregrinabundus Borchsenius		no	minor threat	Gimpel and Miller 1996	banana	NT
Pseudococcus saccharicola Takahashi		no	threat	Williams 1970	sugar cane	PA
Pseudococcus solenedyos Gimpel and Miller		no	threat	Gimpel and Miller 1996	tropical fruit	NE
Pseudococcus sorghiellus (Forbes)	native	yes	pest	Gimpel and Miller 1996	beans, clover	NE
Pseudococcus spanocera Gimpel and Miller	native	yes	pest	Gimpel and Miller 1996	soybeans	NE
Pseudococcus viburni (Signoret)	native	yes	pest	Ben-Dov 1994	polyphagous	NE
Pseudoripersia turgipes (Maskell)		no	threat	Williams 1985a	casuarina	AU
Puto barberi (Cockerell)		no	major threat	Williams and Granara de Willink 1992	polyphagous	NT
Puto pilosellae (Šule)		no	minor threat	Kosztarab and Kozlár 1988	strawberries	PA
Rastrococcus iceryoides (Green)		no	major threat	Le Pelley 1968	coffee and mango	AF(?)
Rastrococcus invadens Williams		no	major threat	Williams 1986	mango	AF(?)

Table 1. Continued.

Pest or Threat species	U.S. Origin and Date of Introduction	Established in U.S	Pest or Threat Status in U.S.	Reference to Threat or Pest Status	Principle Hosts	Origin
Rastrococcus spinosus (Robinson)		no	minor threat	Le Pelley 1968	coffee	AF(?)
Rastrococcus truncatispinus Williams		no	threat	Williams 1985a	citrus	AU
Rastrococcus vicorum Williams and Watson		no	threat	Williams and Watson 1988	citrus	AU(?)
Rhicoecus albidus Goux		no	minor threat	Williams 1962	grasses	PA
Rhizoecus americanus (Hambleton)	FL, 1959	yes	pest	Hambleton 1976	polyphagous	NT
Rhizoecus andensis (Hambleton)		no	threat	Watson and Cox 1990	coffee	AF
Rhizoecus cacticans (Hambleton)	native ?	yes	pest	Dziedzicka 1990	polyphagous	NE(?)
Rhizoecus cobelopus Williams		no	threat	Williams 1987b	polyphagous	AU
Rhizoecus cocois Williams		no	minor threat	Williams 1985b	coconut	AU
Rhizoecus dianthi Green	CA, 1954	yes	pest	Snetsinger 1966	polyphagous	PA(?)
Rhizoecus epicopus (Williams)		no	threat	Williams and Granara de Willink 1992	sugar cane	NT
Rhizoecus falcifer Kunckel d'Herculais	CA, 1917	yes	pest	Cox 1987	polyphagous	PA
Rhizoecus hibisci Kawai and Takagi	FL, 1978	yes	pest	Kawai and Takagi 1971	polyphagous	PA
Rhizoecus kondonis Kuwana	CA, 1921	yes	pest	Godfrey and Pickel 1998	alfalfa	PA
Rhizoecus nemoralis (Hambleton)		no	minor threat	Watson and Cox 1990	coffee	NT
Rhizoecus rumicis (Maskel)		no	threat	Williams 1985a	grass	AU(?)
Rhizoecus saintpauliae Williams		no	threat	Williams 1985c	African violets	OR
Rhodania porifera Goux		no	minor threat	Ter-Grigorian 1973	Festuca	PA
Saccharicoccus sacchari (Cockerell)	FL, 1944	yes	minor pest	Ben-Dov 1994	sugar cane	NT(?)
Spilococcus andersoni (Coleman)	native	yes	pest	Brown and Eads 1967	Monterey cypress	NE
Spilococcus mamillariae (Bouche)	CA, 1938	yes	pest	Maniehote and Middlekauff 1967	cactus	NE
Tridiscus sporoboli (Cockerell)	native	yes	pest	Baxendale et al. 1994	buffalograss turf	NE
Trionymus haancheni McKenzie	native	yes	pest	Osborn 1952	barley	NE
Trionymus multivorus (Kiritchenko)		no	minor threat	Myartseva and Kharchenko 1987	grass and lettuce	PA
Trionymus polyporus Hall		no	threat	Willcocks 1925	grains	PA
Trionymus radicicola (Morrison)		no	threat	Stahl 1927	sugar cane	OR
Trionymus violascens Cockerell	native	yes	pest	Cockerell and Robinson 1915	grass	NE
Bryburgia amaryllidis (Bouche)	CA, 1960	yes	minor pest	Ben-Dov 194	lillies	AF
Vryburgia brevicruris (McKenzie)	CA, 1935	yes	pest	McKenzie 1967	polyphagous	AF
Vryburgia rimariae Tranfaglia		no	threat	Marotta and Garonna 1992	succulents	AF
Vryburgia transvaalensis (Brain)		no	threat	Brain 1929	ornamentals	AF
Vryburgia trionymoides (De Lotto)	CA, 1994	yes	minor pest	Gill, in press	*Caralluma*	AF
Xenococcus acropygae Williams		no	threat	Williams 1998	grape	OR

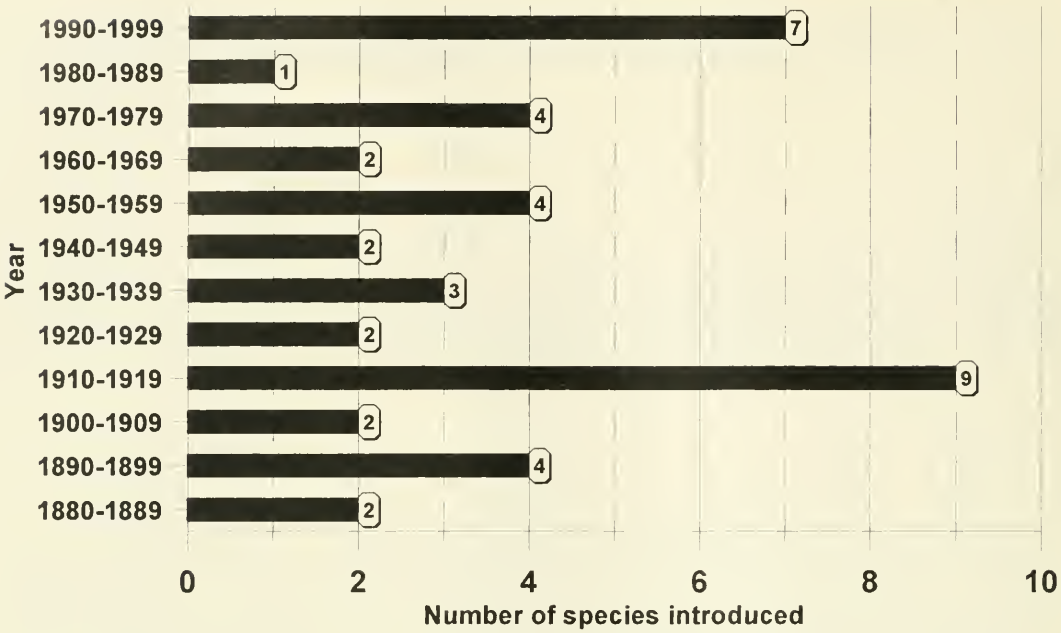

Fig. 1. Introduction of mealybug pests into the United States from 1880–1999.

350 species of mealybugs in the United States; thus, the adventive component of the mealybug fauna in the United States is approximately 13%. With the exception of the 1980's, every decade since the 1880's has seen the introduction of at least 2 species of mealybug pests (Fig. 1). Two periods, the 1910's and the 1990's, witnessed the greatest number of introduced mealybug pests (9 and 7 species, respectively).

A summary of the area of origin of all invasive species in the United States is as follows: Palearctic Region—17 U.S. invaders, 4 of which are considered non-pest adventives; Neotropical Region—12 U.S. invaders, none are considered non-pest adventives; Oriental Region—7 U.S. invaders, one is considered a non-pest adventive; Australasian Region—4 U.S. invaders, one is considered a non-pest adventive; Afrotropical Region—3 U.S. invaders, none are considered non-pest adventives; and Nearctic Region outside of the U.S.–4 U.S. invaders, none are considered non-pest adventives.

Examination of the origin of pest mealybugs worldwide provides the following totals: from the Palearctic Region, 46; Nearctic Region, 27; Neotropical Region, 25; Oriental Region 23; Afrotropical Region, 19; and from the Australasian Region, 18. Host characteristics of these pests include: 22% polyphagous; 20% on grasses; 16% on citrus/tropical fruits; 6% on coffee; and the remainder are not polyphagous and occur on various other hosts. Based on the characteristics of the highest pest mealybug distributions and greatest frequency of host plants, a list of 10 species most likely to invade the United States has been determined. These species include: *Cataenococcus hispidus* (Morrison), *Dysmicoccus neobrevipes* Beardsley, *Heliococcus bohemicus* Šulc, *Nipaecoccus viridis* (Newstead), *Phenacoccus avenae* Borchsenius, *Phenacoccus azaleae* Kuwana, *Planococcus lilacinus* (Cockerell), *Planococcus minor* (Maskell), *Pseudococcus cryptus* Hempel, and *Rastrococcus iceryoides* (Green).

Interception records from the past five years from the USDA, APHIS-PPQ also were searched. A list of the 10 species intercepted most frequently at U.S. ports-of-entry are: *Cataenococcus hispidus* (Morrison); *Dysmicoccus bispinosus* Beardsley; *Dysmicoccus mackenziei* Beardsley; *Dysmicoccus neobrevipes* Beardsley; *Maconellicoccus hirsutus* (Green); *Palmicultor palmarum* (Ehrhorn); *Paracoccus marginatus* Williams and Granara de Willink; *Planococcus kraunhiae* (Kuwana); *Planococcus lilacinus* (Cockerell); and *Planococcus minor* (Maskell). Comparison of the two lists reveals four species that are common to both. They are: *Cataenococcus hispidus*; *Dysmicoccus neobrevipes*; *Planococcus lilacinus*; and *Planococcus minor*. We suggest that these species are most likely to be the next invasive mealybugs into the United States.

DISCUSSION

Our data indicate that the decades starting in 1910 and 1990 had the largest number of mealybug introductions. We speculate that the first peak occurred because of implementation of the Plant Quarantine Act in 1912. At this time, new inspection procedures were started causing the detection of many insect contaminants in import commodities at U.S. ports-of-entry. Increased detection caused the development of strategies to reduce the risk of introduction of the potential invasive species. We suspect that the recent increase in world trade and the difficulty of inspecting large volumes of containerized imports may explain the larger number of mealybug establishments in the 1990's.

Our findings provide predictions about the most likely mealybug species to be introduced into the United States in the future and give procedures that may help others make predictions about the next invasive mealybug in other countries. Another criterion for predicting invasive species problems that was not considered here might include examination of all polyphagous species that have several agricultural hosts. A final observation: although invasive species are not always economic before they invade a new area, examination of the list of U.S. invaders reveals that most were considered to be at least minor pests before they were invasive in the U.S.

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THE *CERACANTHIA* COMPLEX (LEPIDOPTERA: PYRALIDAE: PHYCITINAE) IN COSTA RICA. I. *CERACANTHIA* RAGONOT

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Abstract.—The mostly Neotropical *Ceracanthia* complex (*Ceracanthia* Ragonot, *Megarthria* Ragonot, *Drescoma* Dyar, *Lascelina* Heinrich) is defined. The genus *Ceracanthia* is redescribed and *Drescomopsis* Dyar is **newly synonymized** with *Ceracanthia.* Ten species of *Ceracanthia* are recognized in Costa Rica, five of which are described as new: ***Ceracanthia alturasiana*, *Ceracanthia cornuta*, *Ceracanthia eugenieae*, *Ceracanthia pseudopeterseni*,** and ***Ceracanthia squamimagna*.** Three of the remaining species are transferred from *Megarthria* and given the **new combinations**: *Ceracanthia frustrator* (Heinrich), *Ceracanthia schausi* (Heinrich), and *Ceracanthia squamifera* (Heinrich), and one species is referred from *Drescomopsis* to form the **new combination** *Ceracanthia soraella* (Druce). Keys are provided to separate the genera belonging to the *Ceracanthia* complex and for males of the species belonging to *Ceracanthia.* Habitus photographs of male adults, and line drawings of male antennae and male genitalia, of all species are included. Also figured are the female genitalia of six of the ten species and the costal scale cluster or scale ridge of the forewings of *Ceracanthia soraella* and *Ceracanthia frustrator.*

Key Words: Phycitinae, taxonomy, Neotropical

The subfamily Phycitinae is the largest of the five subfamilies currently in the Pyralidae. Many included species are morphologically hyperdiverse, particularly with regard to the male antennae and male genitalia. Recent extensive collecting of phycitines, particularly by personnel at the Instituto Nacional de Biodiversidad (INBio), Santo Domingo, Costa Rica, has prompted an in-depth study of the Phycitinae in Costa Rica. One group belonging to the subfamily that has been frequently collected belongs to a complex consisting of the genera *Ceracanthia* Ragonot, *Megarthria* Ragonot, *Drescoma* Dyar, and *Lascelina* Heinrich. The characteristic forewing, of most species of the complex, is mainly pale on its anterior (costal) half and chiefly dark on its posterior (inner) half (Figs. 2–9). Many have the male antenna with a basal sinus bearing an upper and lower spine or protuberance (Figs. 11–20). All have the eighth abdominal sternite of the male developed as a digitate pocket. The male genitalia have a strong fusion of the gnathos and scaphium, large, broad valvae, and usually a long vinculum. Almost all have very obvious, long setal tufts extending from the base of the sacculus (Figs. 21, 23, 25, 27, 29, 31, 33, 37, 39). The female genitalia are simple; the only feature of any significance is a signum in the corpus bursae that consists of a scobinate, partly-sclerotized patch with, or without, a small, to large spine (Figs. 43–48).

Unaware that such a complex of many similar appearing species existed, early lepidopterists, Zeller (1881), Ragonot (1893), and Druce (1899), who in their studies of South American and Mexican species relied chiefly on forewing habitus, grouped species together and recognized only three. Later, Dyar (1914, 1919) named a few additional species from Cuba and Central America. Heinrich, in 1956, was the first to include genitalia in his study and thereby provided a more accurate, expanded account of the group, particularly in Costa Rica. Neunzig and Dow (1993) reviewed the species occurring in Belize, and Neunzig described species from Mexico (1994) and the Dominican Republic (1996).

This paper provides more information on the genus *Ceracanthia* in Costa Rica. A subsequent contribution (*Ceracanthia* complex. II) will cover species in Costa Rica that belong to the other three genera. Most of the specimens studied were borrowed from the collection of INBio. Additional Costa Rican material has been seen that has recently accumulated in the National Museum of Natural History (USNM), Smithsonian Institution, Washington, DC, U.S.A., the Essig Museum, University of California (UCB), Berkeley, CA, U.S.A., and in the collection of Vitor O. Becker (VOB) Brasilia, Brazil.

All types of previously described species belonging to the complex were examined, including those of *Megarthria* (*Myelois*) *peterseni* (Zeller) and *Ceracanthia* (*Homoeosoma*) *soraella* (Druce) in The Natural History Museum (BMNH) London, England. Holotypes of new species have been deposited in the insect collections of INBio and UCB. Paratypes can be found at INBio, USNM, UCB, in the collection of VOB and at North Carolina State University (NCSU) Raleigh, NC, U.S.A.

It has not been possible to associate females with males with all species because of striking similarities in color and maculation of most species in the complex. Therefore, caution needs to be exercised using females in the key to genera, and in referring to the descriptions of genera.

The appearance of the immature stages of all species belonging to the complex in Costa Rica remain unknown. Heinrich (1956) included *Maytenus phyllanthoides* Bentham (Celastraceae) as the host of a North American species in the genus *Lascelina*.

KEY TO GENERA OF THE *CERACANTHIA* COMPLEX

1. Scape of male antenna broad (about 3× as wide as width of base of shaft); shaft of male antenna with basal sinus, but distal part of sinus simple, without mesially protruding spine or other element; male genitalia with gnathos having a very weakly developed, highly sclerotized, tubular apical element, a sacculus with more than two kinds of scale tufts attached to its base (most scales strongly coiled), and a distinctly broad vinculum (disproportionately so, particularly relative to size of uncus); female genitalia with ductus bursae long and distinctly twisted (about 2× as long as corpus bursae) . . . . *Megarthria* Ragonot

– Scape of male antenna more slender (cylindrical) (Figs. 11–20); shaft of male antenna with *or* without basal sinus (if sinus is present, a spine or protuberance usually occurs at the distal end of the sinus) (Figs. 11–20); male genitalia with apex of gnathos formed into well developed, sclerotized, slender element (Figs. 21, 23, 25, 27, 29, 31, 33, 35, 37, 39) *or* without rodlike grasping element, a sacculus with one or two kind(s) of scale tufts attached to its base (all scales straight to slightly curved), and vinculum not overly broad relative to rest of genitalia; female genitalia (Figs. 43–48) with ductus bursae shorter than, or about same length as, corpus bursae 2

2. Apical part of gnathos developed into a hook or rod, only partially fused to scaphium (Figs. 21, 23, 25, 27, 29, 31, 33, 35, 37, 39); aedoeagus without basal supplemental appendage (Figs. 22, 24, 26, 28, 30, 32, 34, 36, 38, 40); scobinate patch of signum of corpus bursae simple (Figs. 44–47), *or* with small, short spine (Fig. 43) *or* with large, mostly laterally oriented, hooked spine (Fig. 48) 3

– Apical part of gnathos not developed into a slender rodlike element or hook (gnathos completely fused to wall of scaphium); aedoeagus with supplemental, basal appendage; scobinate patch of corpus bursae with large, mostly anteriorly oriented, hooked spine . . . . *Lascelina* Heinrich

3. Base of shaft of male antenna simple; hindwing with distinct notch in costa, just beyond base; transtilla present, in form of a "U" (central part straplike); valva with uniformly tapered, pointed projection near apex of sacculus; scobinate patch of corpus bursae with large, hooked spine (length of spine equal to about ½ width of corpus bursae) . . . . *Drescoma* Dyar

– Base of shaft of male antenna with shallow to deep sinus, and usually a pair of spines (in some species scale tuft also present) (Figs. 11–20); hindwing without notched costa; transtilla usually absent; clasperlike projection near apex of sacculus usually distinctly swollen (Figs. 21, 23, 27, 29, 31, 33, 35, 37); scobinate patch of signum of corpus bursae simple (Figs. 44–47), *or* with small short spine (Fig. 43), *or* with large, hooked spine (length of spine equal to about ⅓ width of corpus bursae) (Fig. 48) . . . . *Ceracanthia* Ragonot

Ceracanthia Ragonot

Ceracanthia Ragonot 1893:230. Type species: *Ceracanthia vepreculella* Ragonot 1893. Monotypy

Procandiope Dyar 1919:50. Type species: *Procandiope mamella* Dyar 1919. Monotypy

Drescomopsis Dyar 1919:61. **New synonymy.** Type species: *Drescomopsis subelisa* Dyar 1919. Original designation. *Drescomopsis subelisa* is considered to be a junior synonym of *Homoeosoma soraella* Druce 1899.

Note.—We have synonymized *Drescomopsis* with *Ceracanthia* because the type species of the two genera have similar male antennae and similar genitalia. Heinrich (1956) kept *subelisa* in Dyar's *Drescomopsis* because of a reduced number of veins in the hindwing of *subelisa*, a feature that we consider to be of minor taxonomic significance.

Description.—Male antenna with scape cylindrical, slightly swollen apically; shaft usually with distinct sinus at base (sinus shallow in *pseudopeterseni* and *soraella*); basal and distal end of sinus usually with spine, or protuberance; inner surface usually covered with appressed scales (*mamella, pseudopeterseni* and *soraella* with erect papillae); sinus with or without brush or tuft of scales attached to posterior base of sinus; sensilla trichodea (cilia) of antenna about ⅓ as long as width of shaft at mid-sinus. Antenna of female simple. Labial palpus of male upturned, reaching above vertex; 3rd segment about as long as 2nd segment (about ½ as long as 2nd segment on *squamimagna*). Maxillary palpus of both sexes small, short scaled. Haustellum well developed. Ocelli present. Forewing of male simple, or with raised costal scale cluster or scale ridge (*soraella, frustrator*), or with slight costal concavity or fold (*pseudopeterseni, squamimagna*), underside simple or with subcostal streak of contrastingly-colored scales. Forewing of both sexes smooth, with 11 veins; R_{3+4} and R_5 stalked for about ½, or slightly over ½, their lengths; M_1 straight to slightly bowed; M_2 and M_3 separate or connate at base; CuA_1 from lower angle of cell; CuA_2 arising from well before lower angle of cell. Hindwing with seven to eight veins (1A, 2A, and 3A treated as one vein); $Sc + R_1$ and Rs fused for less than ½ their lengths beyond cell; M_1 straight to slightly curved; M_2 and M_3 usually fused for less than ½ their lengths (M_2 and M_3 completely fused in *soraella*); CuA_1 briefly fused with stalk of M_2 and M_3 (or fused to single vein $M_2 + M_3$); CuA_2 from before, but near lower angle of cell or from lower angle of cell; cell slightly more, to slightly less, than ⅓ length of wing. Male abdominal segment with one, or more, pair(s) of scale tufts originating from within a pocket of 8th abdominal sternite (pocket present in *mamella*, but without scale tufts); scales forming tufts simple, sometimes slightly broadened distally, not overly long, curved somewhat medially. Male genitalia with uncus broadly rounded apically; gnathos with apical part developed into hook or rod (center part of hook or rod weakly formed, fused with scaphium); transtilla usually absent (present in *soraella, cornuta, schausi, eugenicae, alturasiana*); juxta a plate with short, setiferous, lateral arms; valva broad, covered on inner surface of distal half with broadened, spinelike setae (basal half with usual setae); outer surface of valva of most species with long, black, weakly attached scales that curl under usually obscuring some features of inner part of valva; sacculus with apex usually distinctly swollen, not pointed; base of sacculus with large (primary) and, usually, small (secondary) tuft of scales (*eugenieae* without tufts); aedoeagus slender to somewhat robust; vesica usually with two groups of microspines or with larger spines (*mamella* with just one group of microspines and *alturasiana* with group of microspines and group of medium-sized spines). Female genitalia with ductus bursae shorter than corpus bursae; corpus bursae with signum; signum usually consisting of patch of scobinations with inner members forming patch more strongly developed and situated on an invaginated, teardrop-shaped, highly sclerotized plate (*pseudopeterseni, soraella, squamifera, squamimagna*) (signum in *mamella* similar, but one scobination developed into a small short spine and plate rectangular; *alturasiana* with large, curved, pointed hook associated with patch of scobinations); ductus seminalis attached to corpus bursae near junction of ductus bursae and corpus bursae.

Key to Species of Male *Ceracanthia*

(A key including females is not possible because the sexes of some species cannot be associated with certainty at this time.)

1. Forewing mostly pale on anterior half and dark on posterior half, with dark bands extending diagonally from about ⅓ out on costa, and from apex of wing, to dark posterior half, dividing most of pale costal area into three mainly white patches (most distal white patch small and indistinct in most species) (Figs. 2–9) 3

– Forewing not as above (Figs. 1, 10) 2

2. Forewing dull, yellowish ochre along costa; postmedial line of forewing indistinct (Fig. 1); antenna with inner surface of sinus covered with erect papillae, and without brush of scales attached to posterior base of sinus . . . . *mamella* (Dyar)

– Forewing mostly dark along costa; postmedial line of forewing distinct (Fig. 10); antenna with inner surface of sinus covered with appressed scales and with small, short brush of scales attached to posterior base of sinus . . . . *alturasiana* Neunzig and Solis, n.sp.

3. Forewing with long group of protruding scales extending over ½ length of costa (Figs. 4, 42) . . . . *frustrator* (Heinrich)

– Forewing without long group of protruding scales extending over ½ length of costa 4

4. Forewing with small raised scale cluster at base of costa (Figs. 3, 41); hindwing with M_2 and M_3 completely fused . . . . *soraella* (Druce)

– Forewing without small raised scale cluster at base of costa; hindwing with M_2 and M_3 only partially fused 5

5. Antenna with inner surface of sinus covered with erect papillae (Fig. 13) . . . . *pseudopeterseni* Neunzig and Solis, n.sp.

– Antenna with inner surface of sinus covered with appressed scales 6

6. Antenna with distal end of sinus strongly produced mesially into a smoothly-scaled, conical, hooked element (Fig. 20) . . . . *cornuta* Neunzig and Solis, n.sp.

– Antenna with distal end of sinus not strongly produced into a smoothly-scaled, conical, hooked element 7

7. Antenna with large tuft of scales attached to posterior base of sinus (tuft extends well beyond sinus; some scales forming tuft obovate) (Fig. 15) *squamimagna* Neunzig and Solis, n.sp.

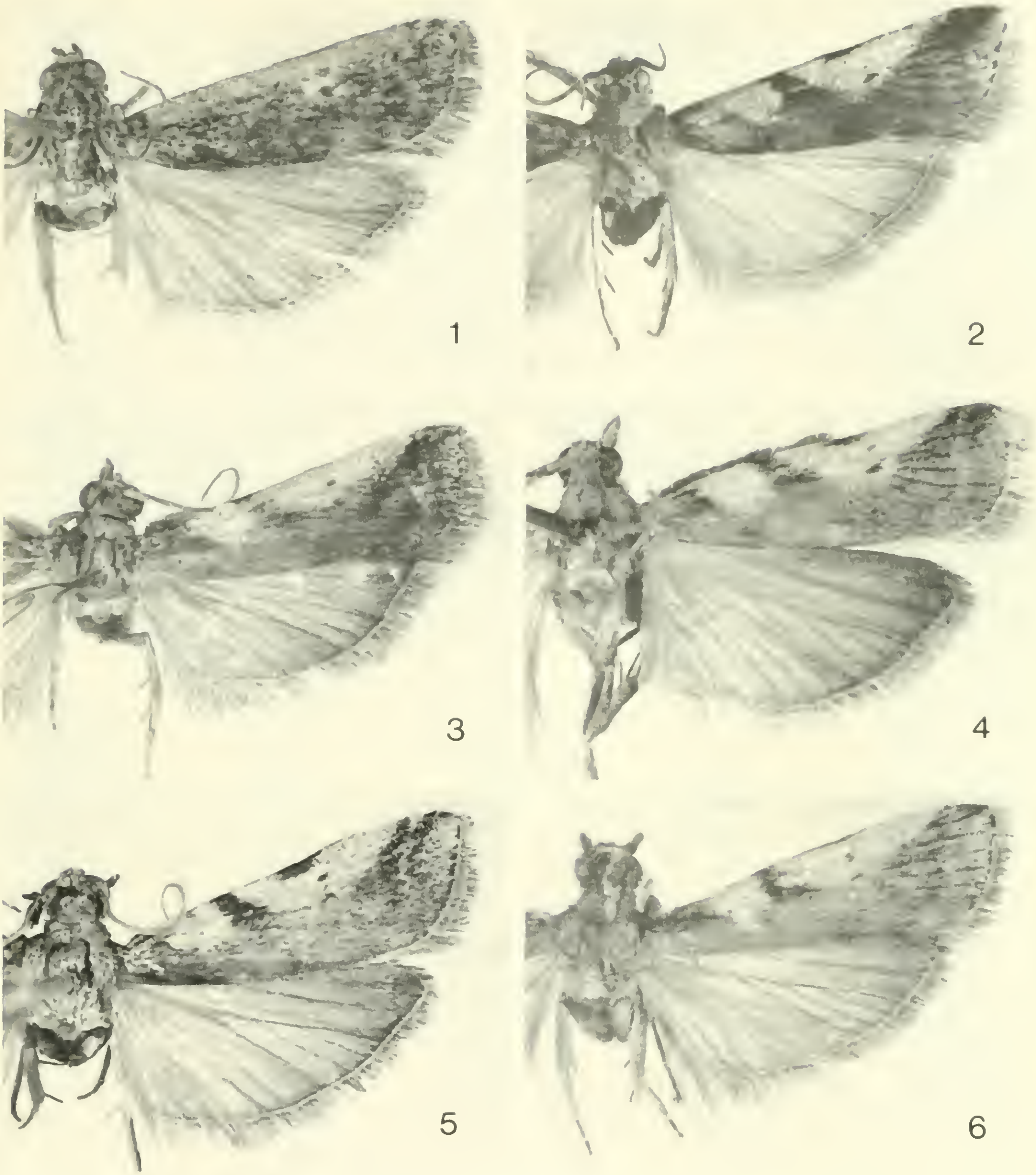
– Antenna with tuft of scales attached to posterior base of sinus smaller (tuft does not extend beyond sinus, or only slightly beyond sinus) (Figs. 16–18) 8

8. Genitalia with inner basal lobe of valva strongly projecting mesially (lobe from each valva touching, or almost touching, each other); and with well developed transtilla (Figs. 35, 37) 9

– Genitalia with inner basal lobe of valva weakly developed, and without transtilla (Fig. 31) . . . . *squamifera* (Heinrich)

9. Genitalia without scale tuft on sacculus, and with vinculum narrow (Fig. 35) . . . . *eugenieae* Neunzig and Solis, n.sp.

– Genitalia with well developed scale tuft on sacculus and with vinculum broad (Fig. 37) . . . . *schausi* (Heinrich)



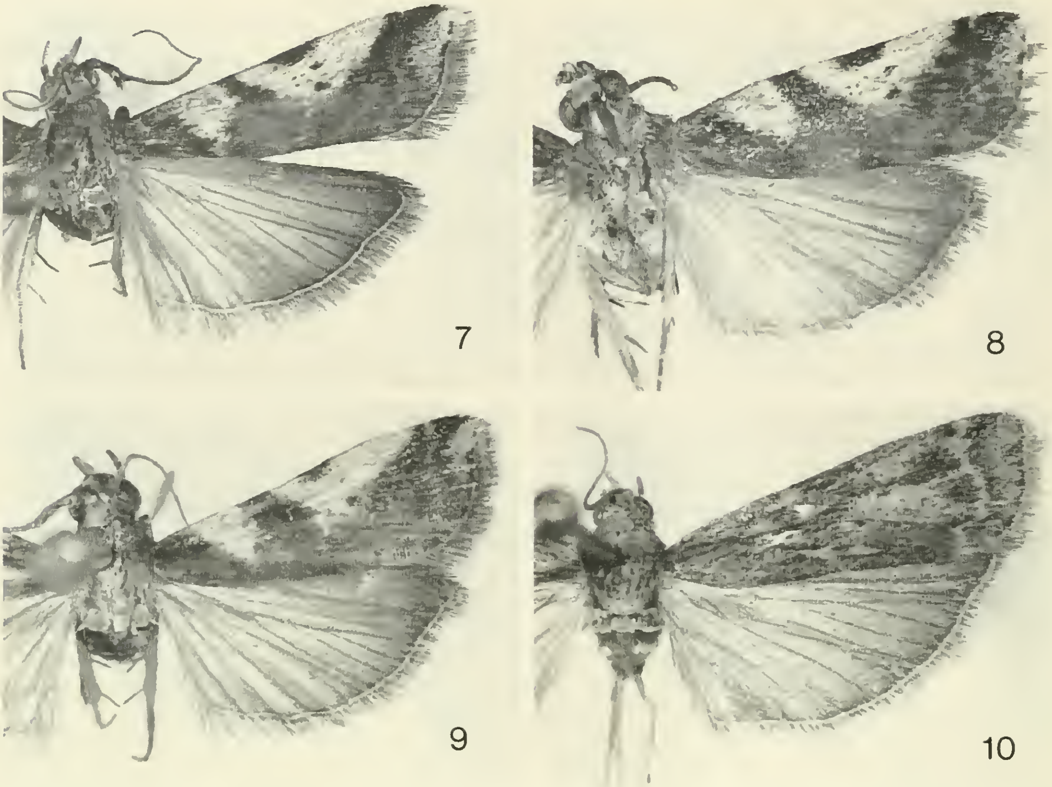
Figs. 1–6. Male. 1, *Ceracanthia mamella*. 2, *C. pseudopeterseni*, holotype. 3, *C. soraella*. 4, *C. frustrator*. 5, *C. squamifera*. 6, *C. squamimagna*, holotype.

Ceracanthia mamella (Dyar)
(Figs. 1, 11, 21–22, 43)

Procandiopa mamella Dyar 1919:51.

Ceracanthia mamella can be recognized by the appearance of the forewing (Fig. 1). A broad, dull, yellowish ochre costal band extends the length of the forewing. The rest of the forewing is mostly a mixture of pale brown, red and black scales (appearing purple without magnification). The antemedial line is very weakly formed, and the postmedial line only slightly more apparent.

The male antenna (Fig. 11) has a well developed sinus in the base of the shaft, with a strong, mesially directed spine near



Figs. 7–10. Male. 7, *Ceracanthia cornuta*, holotype. 8, *C. schausi*. 9, *C. eugenieae*, holotype. 10, *C. alturasiana*, holotype.

its base and another at its distal end. The inner surface of the sinus is covered with erect papillae (a feature found only in a few other *Ceracanthia* (*pseudopeterseni*, *soraella*)).

The male genitalia (Figs. 21–22) have the costa of the distal half of the valva with a slightly inwardly produced distension, and the primary tuft of the sacculus distinctly longer than the length of the valva. The female genitalia (Fig. 43) possess a scobinate, sclerotized, rectangular patch, bearing a short spine, in the corpus bursae. The ductus bursae is shorter than the corpus bursae.

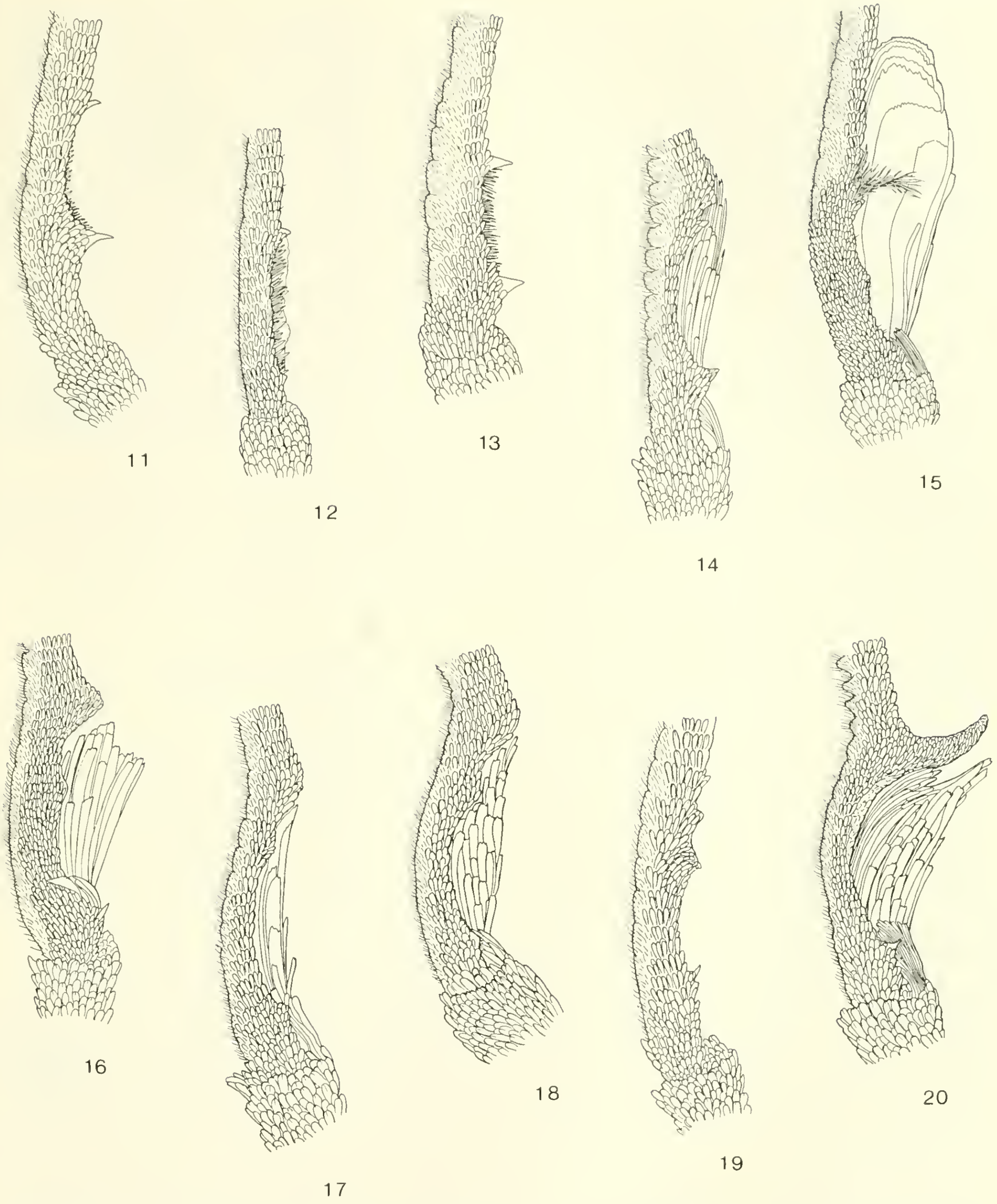
Costa Rican material examined.—Turrialba, Provincia Cartago, 17–21, 22–28 February 1965, S. S. & W. D. Duckworth (1 ♂, 2 ♀); Rio San Lorenzo, Tierras Morenas, 1,050 m., Provincia Guanacaste, September, 1993, G. Rodriguez, INBio CRI002131584 (1 ♂); Parque Nacional Santa Rosa, Provincia Guanacaste, 12 December 1978–10 January 1979, D. H. Janzen, INBio CRI00204312 (1 ♂).

Other material examined.—Guatemala, Cayuga, May, (no year on label), W. Schaus & W. Barnes (1 ♂, 1 ♀); Panamá, Rio Trinidad, March, May, 1912, A. Busck (1 ♂, 1 ♀; syntypes of *P. mamella* in USNM).

Ceracanthia pseudopeterseni Neunzig and Solis, new species

(Figs. 2, 13, 23–24, 44)

Diagnosis.—The combination of the following features will separate male *Ceracanthia pseudopeterseni* from other male *Ceracanthia*: forewing length about 11.0 mm. and with its anterior or costal half mostly pale and its posterior half dark (a dark diagonal band at about ⅓ out on costa



Figs. 11–20. Male, basal part of right antenna, frontal view. 11, *Ceracanthia mamella*. 12, *C. soraella*. 13, *C. pseudopeterseni*. 14, *C. frustrator*. 15, *C. squamimagna*. 16, *C. squamifera*. 17, *C. schausi*. 18, *C. eugenieae*. 19, *C. alturasiana*. 20, *C. cornuta*.

divides most of the pale costal half into three strongly contrasting, chiefly white patches) and antenna with a sinus whose inner surface is covered with erect papillae (Fig. 13).

Description.—Forewing length 10.0–12.0 mm. Head: frons white; vertex a mixture of black and brownish red scales; labial palpus outwardly mostly white, sprinkled with brownish red scales and with patch of brown near eye and at distal ⅓ of last segment; maxillary palpus simple in both sexes, pale basally, a mixture of black and brownish red distally; antenna of male with basal and distal ends of sinus of shaft only slightly produced mesially (sinus shallow); distal and subbasal end of sinus with distinct spines; inner surface of sinus with erect papillae; short tuft of ochre scales attached to posterior base of sinus (tuft extends about ½ length of sinus). Forewing of male with long, costal fold and with underside possessing subcostal streak of brownish red scales along most of outer half of wing; wing above mostly white on anterior half and chiefly brown on posterior half; base mostly dark brown to black; a pair of black, diagonally-converging bands extend from costa to fuse with brown of posterior half; bands divide costal half of wing into three contrasting, mostly white patches; middle white patch with small, isolated, elongate, black streak at about mid-costa, and with a single black discal spot; a sprinkling of brownish red scales chiefly on white patches. Hindwing simple in both sexes, pale brown, darker along margins. Male genitalia (Figs. 23–24) with uncus subtriangular, rounded apically; apical process of gnathos a slender, tapered, hooked rod; transtilla absent; juxta a thin plate with short triangularly-shaped, setiferous, lateral lobes; valva broad with distal half evenly rounded along costa, and with broadened, spinelike setae on inner surface; inner basal lobe of valva weakly developed; sacculus with apex distinctly lobed and with large, and small, tuft of very thin scales at base (large tuft slightly longer than length of valva); vesica of aedoeagus with group of very small spines and group of slightly larger, more strongly sclerotized spines; vinculum distinctly longer than greatest width, and medially constricted. Female genitalia (Fig. 44) with signum developed as scobinate patch (part of patch sclerotized, teardrop shaped and with pronounced scobinations); ductus bursae shorter than corpus bursae.

Types.—Holotype: ♂. Monte Verde, Punt. Prov., Costa Rica, 15–16 May, 1980, D. H. Janzen & W. Hallwachs, INBio CRI002044009, genitalia slide 4542 HHN (INBio). Paratypes: same collection data as holotype, except 8–10 Dec. 1978, D. H. Janzen, INBio CRI002044008, genitalia slide 4543 HHN (INBio) (1 ♂); C. R. Puntarenas Pr., Monteverde, 1,400 m., III-29-31-92, UL & MV lights, S. McCarty & J. Powell, genitalia slides 4877, 4878 HHN (UCB) (1 ♂, 1 ♀); Volcan Sta. Maria, Guat., July, (no year on label), Schaus and Barnes Coll. (USNM) (1 ♂); Oconeque, Carbaya, S. E. Peru, 7,000 ft., G. Okenden, genitalia slide 3596 CH (102, 128 USNM) (USNM) (1 ♂).

Etymology.—The name *pseudopeterseni* refers to the misidentification of this species by Heinrich (1956) and subsequently by others as *Megarthria peterseni* (Zeller).

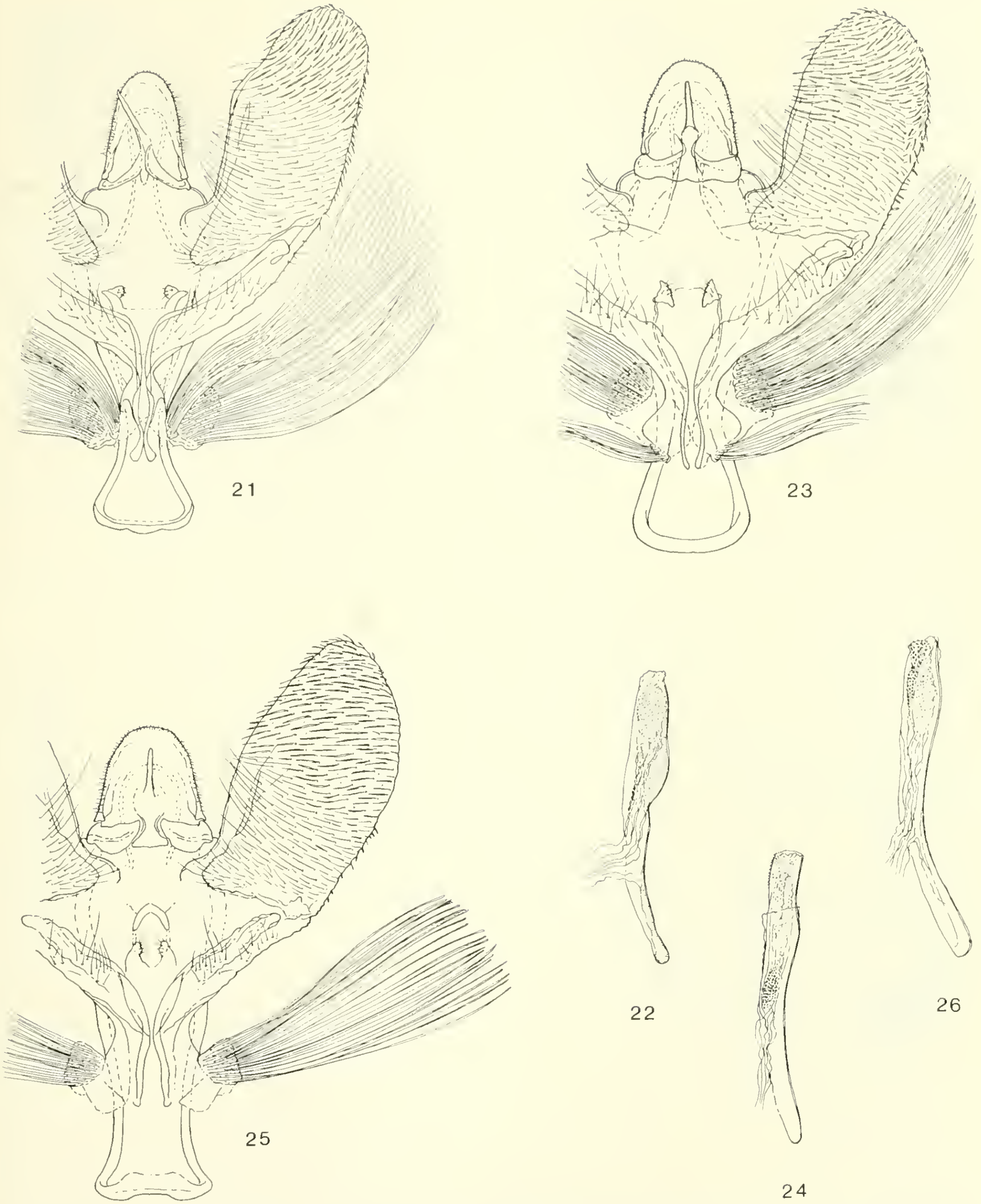
Ceracanthia soraella (Druce), **new combination**

(Figs. 3, 12, 25–26, 41, 45)

Homoeosoma soraella Druce 1899:565.
Drescoma drucella Dyar 1914:328.
Drescomopsis subelisa Dyar 1919:62.

Note.—The rationale for transferring *soraella* from *Drescomopsis* to *Ceracanthia* was given following the list of synonyms of the genus *Ceracanthia*.

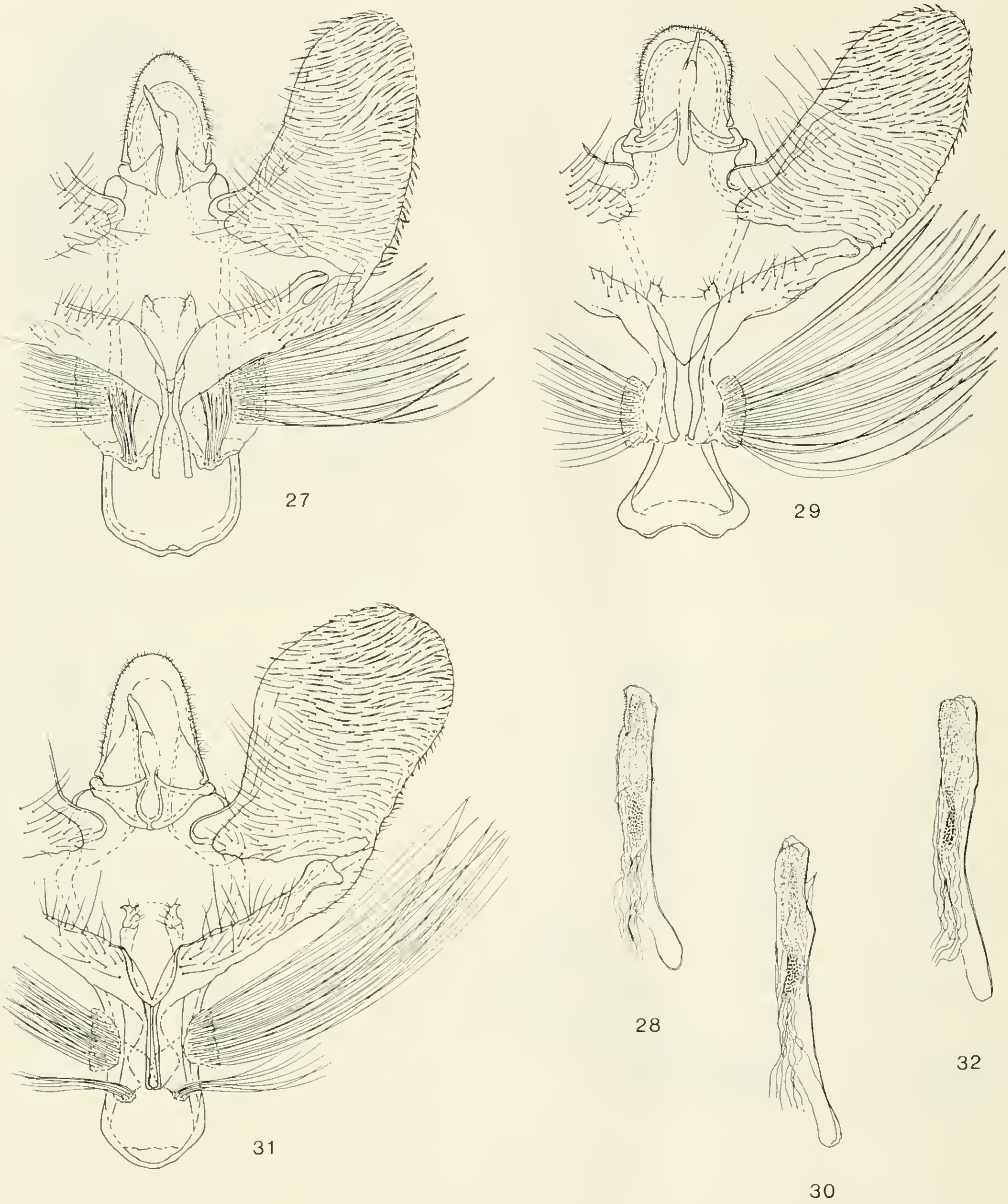
Ceracanthia soraella superficially resembles a small version of *Ceracanthia pseudopeterseni*. The color and maculation of the forewing of both species are similar, and the inner surface of the male antenna of both possess erect papillae. However, *Ceracanthia soraella* has many diagnostic features that separate it from *Ceracanthia pseudopeterseni*, as well as from all other *Ceracanthia*. For example, the male and female of the former has M_2 and M_3 completely fused in the hindwing, and the forewing of the male with a small, flared cluster of scales at the base of costa (Figs. 3, 41), and on the underside, between the discal cell and vein 1A, an elongate pocket enclosing a scale tuft and a mass of modified



Figs. 21–26. Male genitalia, ventral view. 21, *Ceracanthia mamella* (aedoeagus omitted). 22, *C. mamella*, aedoeagus. 23, *C. pseudopeterseni* (aedoeagus omitted). 24, *C. pseudopeterseni*, aedoeagus. 25, *C. soraella* (aedoeagus omitted). 26, *C. soraella*, aedoeagus.

scales. Other *Ceracanthia* have M_2 and M_3 stalked and have males that lack the small costal cluster and the pocket with its tuft and scales.

The male antenna has a very shallow, easily overlooked, sinus. Heinrich (1956) wrote "shaft of male slightly swollen at base, otherwise simple." However, a close



Figs. 27–32. Male genitalia, ventral view. 27, *Ceracanthia frustrator* (aedoeagus omitted). 28, *C. frustrator*, aedoeagus. 29, *C. squamimagna* (aedoeagus omitted). 30, *C. squamimagna*, aedoeagus. 31, *C. squamifera* (aedoeagus omitted). 32, *C. squamifera* aedoeagus.

look shows a slight depression enclosing a group of papillae, and a small spine at the distal end of the sinus (Fig. 12). Unlike most of its congeners, the sinus of *Ceracanthia soraella* lacks an associated brush or tuft of scales.

The most diagnostic feature of the male genitalia (Fig. 25) is the straplike transtilla with a pair of anteriorly directed arms. The corpus bursae of the female genitalia has a signum with a teardrop-shaped patch of scobinations (Fig. 45).

Costa Rican material examined.—Juan Viñas, June, November, (no year on label), W. Schaus & W. Barnes (1 ♂); Sitio, June, (no year on label), (1 ♀); Quepos, Parque Nacional Manuel Antonio, 120 m., Provincia Puntarenas, November, 1990, G. Varela & R. Zuniga, INBio CRI000180596 (1 ♂); Cerro Tortuguero, 0–120 m., Parque Nacional Tortuguero, Provincia Limon, March, 1992, May 1991, R. Delgado, INBio CRI000853321, J. Solano, INBio CRI001398889, CR INBio I001398587, INBio I000358990 (4 ♂).

Other material examined.—Mexico, Jalapa, (no date on label), M. Trujillo (3 ♀; syntypes of *H. soraella* in BMNH), Cordoba, May, 1908, F. K. Knab (1 ♀); Belize, San Ignacio, April, 1989, L. C. Dow (1 ♀), Mountain Pine Ridge, May, 1990, L. C. Dow (1 ♂, 1 ♀); Guatemala, Cayuga, April, June (2 ♀; syntypes of *D. subelisa* in USNM); Panamá, Paraíso, May, 1923, R. C. Shannon (1 ♂), Porto Bello, March, October (1 ♂, 1 ♀; syntypes of *D. drucella* in USNM), Rio Trinidad, March, 1912, A. Busck (1 ♀); Ecuador, Zaruma, 1916, F. W. Rohwer (1 ♂); French Guiana, St. Jean de Maroni, no date (1 ♂); Brazil, Isla Sant. Catarina, June, 1935, F. Hoppman (1 ♀), Linhares, January, 1998, V. O. Becker (1 ♂), Cacaulândia, November, 1991, V. O. Becker (1 ♂), Ibateguara, March, 1994, V. O. Becker (1 ♂). Amsel (1956, 1957), probably correctly, reported this species from Maracay, Venezuela, but we have been unable to verify his identification.

Ceracanthia frustrator (Heinrich), **new combination**
(Figs. 4, 14, 27–28, 42)

Megarthria frustrator Heinrich 1956:87.

The color and maculation of the forewing of *Ceracanthia frustrator* greatly resembles the appearance of the forewing of most other *Ceracanthia*. The male of *Ceracanthia frustrator*, however, has a feature not seen on males of other species belonging to the genus (or in the subfamily!): a group of scales protrudes beyond the costa for over ½ the length of the forewing (Figs. 4, 42).

The male antenna (Fig. 14) has a well developed basal sinus with a triangular cluster of scales (possibly enclosing a spine) protruding from its base and a low spine associated with its distal end. The inner surface of the sinus is covered with appressed scales, and a brush of scales is present, attached to the posterior base of the sinus (the brush, composed of narrow scales extends slightly beyond the length of the sinus).

The male genitalia (Figs. 27–28) lack a transtilla, and have a large scale tuft, and a small secondary scale tuft, attached to the base of the sacculus (the large tuft is slightly shorter than the length of the valva). The vinculum is broad and not constricted medially.

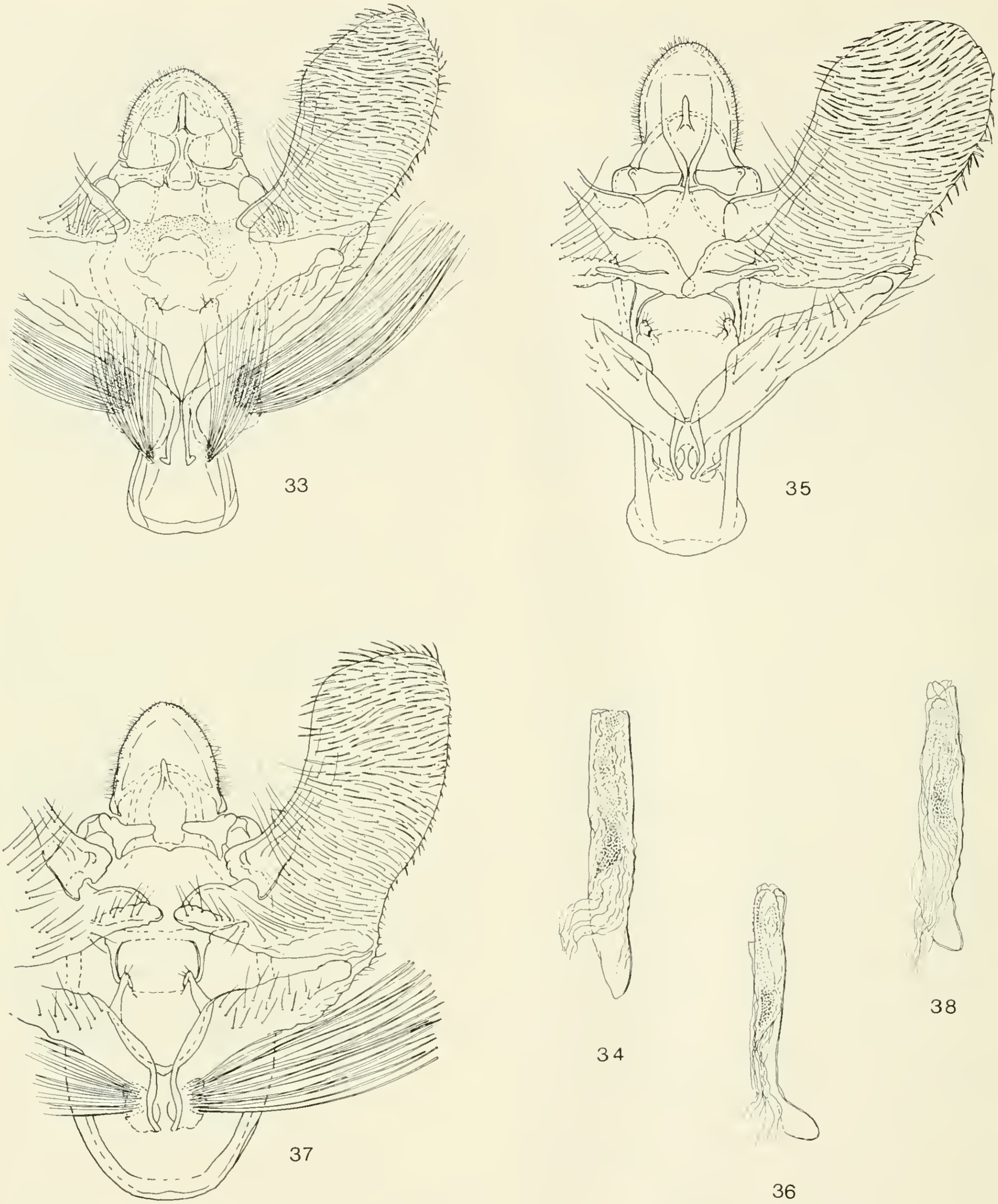
We have not been able to associate with certainty females with males, and, therefore, the appearance of the female genitalia is unknown.

Costa Rican material examined.—Juan Viñas, February, (no year on label), W. Schaus & W. Barnes (1 ♂; holotype of *M. frustrator* in USNM); 8 km. N. Vara Blanca, 1,400 m., Provincia Alejuela, 25 March, 1992, McCarty & Powell (1 ♂, 2 ♀).

Ceracanthia squamifera (Heinrich), **new combination**
(Figs. 5, 16, 31–32, 46)

Megarthria squamifera Heinrich 1956:87.

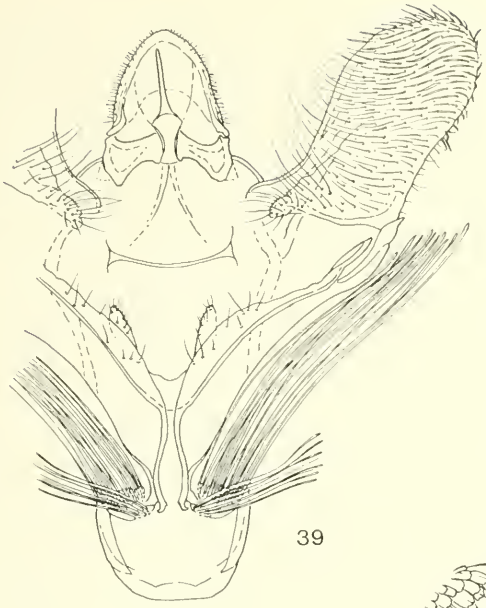
Ceracanthia squamifera is best recognized by examining the antenna of the male (Fig. 16). A strong sinus is present at the base of the shaft, and there is a well developed brush of dark scales attached to the posterior base of the sinus and lying within the sinus. The brush extends almost the entire length of the sinus.



Figs. 33–38. Male genitalia, ventral view. 33, *Ceracanthia cornuta* (aedoeagus omitted). 34, *C. cornuta*, aedoeagus. 35, *C. eugenieae* (aedoeagus omitted). 36, *C. eugenieae*, aedoeagus. 37, *C. schausi* (aedoeagus omitted). 38, *C. schausi*, aedoeagus.

The male genitalia (Fig. 31) have a particularly broad valva with the costa of its distal half noticeably distended. The large brush of the sacculus is longer than the length of the valva. The corpus bursae of the female genitalia has a signum with a teardrop-shaped patch of scobinations (Fig. 46).

Costa Rican material examined.—Mount Poás, May, (no year on label), W. Schaus



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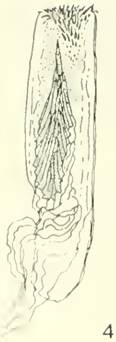

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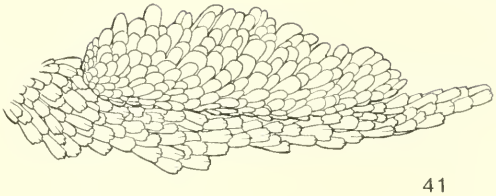

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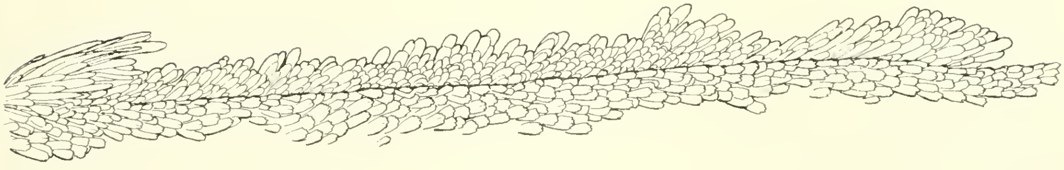

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Figs. 39–42. Male genitalia, ventral view, and scale cluster or scale ridge on costa of male right wing, dorsal view. 39, *Ceracanthia alturasiana* (aedoeagus omitted). 40, *C. alturasiana*, aedoeagus. 41, *C. soraella*. 42, *C. frustrator*.

& W. Barnes (1 ♂; holotype of *M. squamifera* in USNM); 9 km. S. Sta. Cecilia, Estacion Pitilla, 700 m., Provincia Guanacaste, July, 1991, 4–18 December, 1991, January 1995, C. Moraga, INBio CRI1000527303, INBio CRI000599235, CR INBio I002001987, INBio CRI001627819 (4 ♂) ; Monteverde, Provincia Puntarenas, 10–11 December, 1979, D. H. Janzen, INBio CRI002044007, INBio CRI002044011 (2 ♂).

Ceracanthia squamimagna Neunzig and Solis, new species

(Figs. 6, 15, 29–30, 47)

Diagnosis.—The male of *Ceracanthia squamimagna* is among the more easily recognized members of the genus. A large, pale tuft of scales is associated with the sinus at the base of the shaft of the antenna (Fig. 15). Some of the scales forming the tuft are very broad (obovate), and the tuft extends about as far beyond the end of the sinus as the length of the sinus. The distal end of the sinus is also peculiar, in that it is strongly produced and pointed mesially, and is roughly covered with many slender setae.

Description.—Forewing length 7.5–8.0 mm. Head: frons white washed with brownish red; vertex mostly brownish red, suffused with black anteriorly and white posteriorly; labial palpus outwardly white with patches of brownish red; maxillary palpus simple in both sexes, same color as labial palpus; antenna of male (Fig. 15) with well developed sinus at base of shaft; distal end of sinus strongly produced and pointed mesially, and roughly covered with many slender setae; inner surface of sinus with appressed scales; large, pale, scale tuft attached to posterior base of sinus (tuft extends distally about as far beyond end of sinus as length of sinus; some scales forming tuft obovate). Forewing: with concavity in basal ½ of costa; underside with basal subcostal patch of reddish brown; wing above mostly white on anterior half and chiefly brown on posterior half; base mostly dark brown to black; a pair of diagonally converging black bands extend from costa to fuse with brown of posterior half; bands divide costal half of wing into three contrasting, mostly white patches (most distal patch small, obscure in some specimens); middle white patch with small isolated, elongate, mostly red patch at about midcosta, and with pair of black discal spots; a sprinkling of red to brownish red scales chiefly on white patches. Hindwing: underside with basal, ochre, subcostal patch; wing above pale brown, darker along margins. Male genitalia (Figs. 29–30) with uncus broadly rounded at apex; apical process of gnathos a slender, tapered, slightly hooked rod; transtilla absent; juxta a thin, triangular plate with short, setiferous, lateral lobes; valva broad, with distal ½ evenly rounded along costa, and with broadened, spinelike setae on inner surface; inner basal lobe of valva moderately well developed; sacculus with apex distinctly lobed and with large, dark tuft of thin scales at base; no small secondary tuft at base of sacculus; vesica of aedoeagus with group of very small spines and group of slightly larger, more strongly sclerotized spines; vinculum longer than greatest width, and medially constricted. Female genitalia (Fig. 47) with signum developed as scobinate patch (part of patch sclerotized, teardrop-shaped, and with pronounced scobinations); ductus bursae shorter than corpus bursae.

Types.—Holotype: ♂. Quepos, 120 m., P. N. Manuel Antonio, Prov. Punt., Costa Rica, G. Varela & R. Zuniga, Nov. 1990, L-S-370900, 449800, INBio CRI000228018, genitalia slide 4540 HHN (INBio). Paratypes: Cerro Tortuguero, P. N. Tortuguero, 0–100 m., Prov. Limon, Costa Rica, J. Solano, Abr. 1991, L-S-285000, 588000, INBio CRI000444314, INBio CRI000444053, genitalia 444314 MC, 444053 MC (INBio) (1 ♂, 1 ♀); Cerro Tortuguero, 0–120 m., P. N. Tortuguero, Prov. Limon, Costa Rica, Abr., May 1991, J. Solano, L-S-285000, 588000, INBio CRI001375039, INBio CRI001398885, INBio CRI001398904, genitalia slides 4525 HHN, 4526 HHN, 4538 HHN (USNM, NCSU) (1 ♂, 2 ♀).

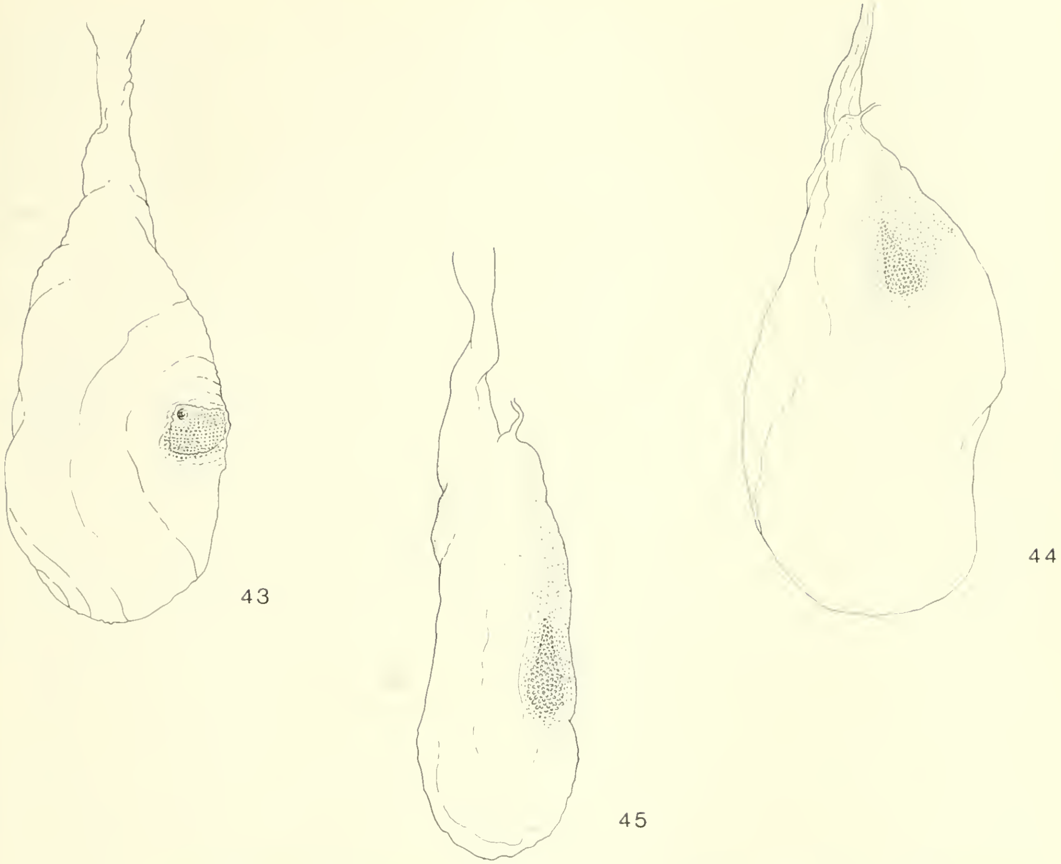
Etymology.—The name *squamimagna* is a combination of the Latin *squama* (scale) and the Latin *magna* (large) in reference to the large tuft of scales associated with the sinus of the male antenna.

Ceracanthia cornuta Neunzig and Solis, new species

(Figs. 7, 20, 33-34)

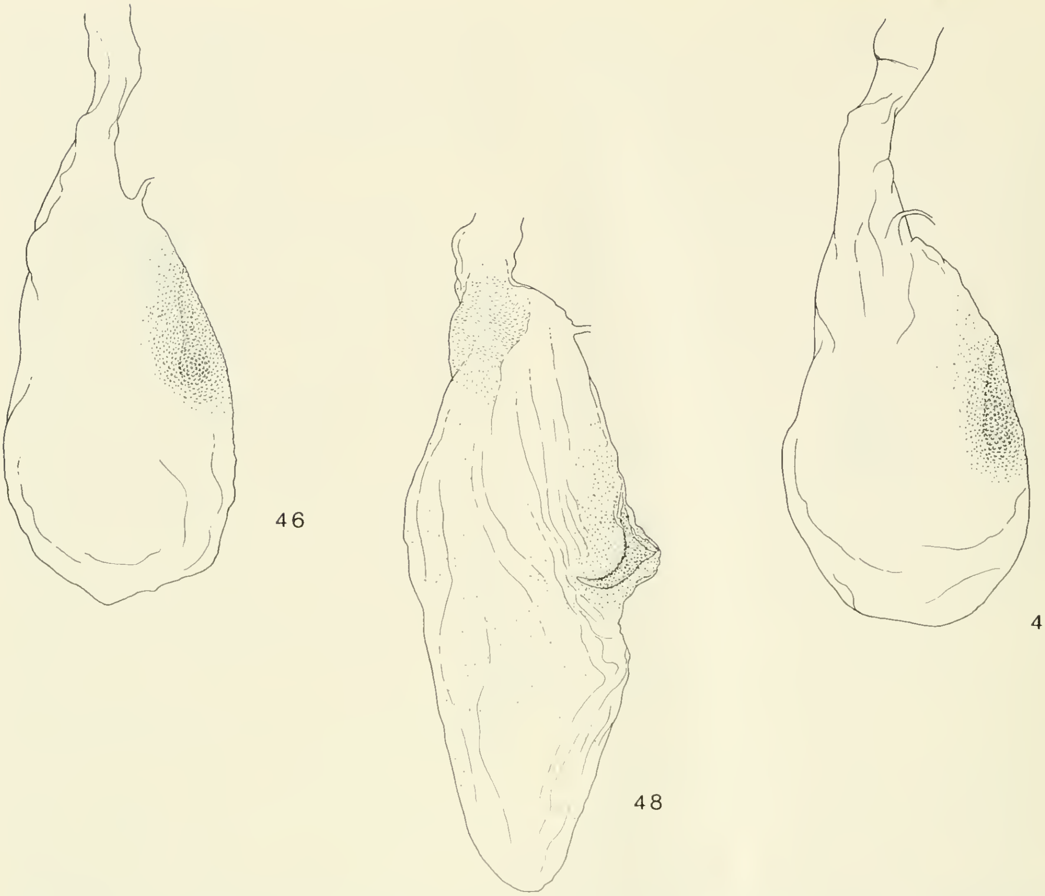
Diagnosis.—As with many *Ceracanthia*, the best diagnostic feature of *Ceracanthia cornuta* is found on the male antenna. The distal end of the well developed sinus, at the base of the shaft, is produced mesially into a large, smoothly-scaled, conical, slightly-hooked element (Fig. 20).

Description.—Forewing length 11.0–11.5 mm. Head: frons ochreous white; ver-



Figs. 43–45. Female genitalia, anterior part, ventral view. 43, *Ceracanthia mamella*. 44, *C. pseudopeterseni*. 45, *C. soraella*.

tex a mixture of pale brown, brown and dark brown scales; pale brown between antennae; labial palpus outwardly with segments mostly white at base and chiefly pale brown and pale reddish brown distally; maxillary palpus simple in male, white and pale brown; antenna of male with sinus in base of shaft, and with basal and distal ends of sinus distinctly produced mesially (distal end enlarged into a conical slightly-hooked process); inner surface of sinus of antenna with appressed scales; brown tuft of scales attached to posterior base of sinus (tuft extends almost to tip of hooked, conical process); part of outer margin of antenna serrate, particularly just above sinus. Forewing of male simple, without costal fold, costal concavity or sex-scaling; wing above mostly white on anterior half and mainly brown and black on posterior half; base mostly black; pair of black diagonally converging bands extend from costa to fuse with brown of posterior half; bands divide costal half of wing into three contrasting, mostly white patches; middle white patch with small, isolated, elongate, black and brownish red patch at about mid-costa, and with pair of black and brownish red discal spots; a sprinkling of brownish red scales, chiefly on white patches. Hindwing of male simple, pale brown, darker along margins. Male genitalia (Figs. 33–34) with uncus broad at base; apical process of gnathos a slender, tapered rod; transtilla present, consisting of a transverse, arched, spined band; juxta a thin plate with short, rounded lateral, seti-



Figs. 46–48. Female genitalia, anterior part, ventral view, 46, *Ceracanthia squamifera*. 47, *C. squamimagna*. 48, *C. alturasiana*.

ferous lobes; valva broad, with distal half of costa enlarged; inner basal lobe of valva with low, adjunct, eliptical protuberance; sacculus with apex distinctly lobed, and with large and small, pale tufts of very thin scales at base (large tuft slightly longer than length of valva); vesica of aedoeagus with elongate cluster of microspines, and a second group of slightly larger, more sclerotized spines; vinculum longer than greatest width, with medial constriction. Female unknown.

Types.—Holotype: ♂. Fila Orosilito, Est. Pitilla, 9 km. S. Santa Cecilia, Prov. Guana., Costa Rica, 800–1,000 m., Abr. 1995, C. Moraga, LN 328650, 378600 #4828, INBio CR1002204210 genitalia slide 4516 HHN (INBio). Paratype: Est. La Casona, 1,520 m., Res. Biol. Monteverde, Prov. Puntarenas, Costa Rica, Jul. 1991, N. Obando, L-N 253250, 449700, INBio CR1000948482, genitalia slide 948482 MC (INBio) (1 ♂).

Etymology.—The large, slightly-hooked, conelike protuberance at the distal end of the sinus of the male antenna is responsible for the specific epithet *cornuta*.

Ceracanthia schausi (Heinrich), **new combination**

(Figs. 8, 17, 37–38)

Megarthria schausi Heinrich 1956:87.

Heinrich (1956) separated *Ceracanthia schausi* (as *Megarthria schausi*) from other similar species by its unusual transtilla consisting of a sclerotized plate with thin, short arms projecting from its lower (anterior) corners. Our study has discovered another *Ceracanthia* with a similar transtilla (see next species), so a combination of features now needs to be used to identify *Ceracanthia schausi*. In addition to the transtilla, *Ceracanthia schausi* has a broad, rounded vinculum and a strong tuft of scales at the base of the sacculus.

The male antenna (Fig. 17) has a well developed sinus at the base of its shaft. The sinus has a basal spine, and its inner surface is covered with pale, appressed scales. A tuft of mostly dark brown, to black scales, is present, extending the length of the sinus.

We have been unable to associate with certainty females of *Ceracanthia schausi* with males, and, therefore, the appearance of the female genitalia is unknown.

Costa Rican material examined.—Juan Viñas, January, (no year on label), W. Schaus (1 ♂; holotype of *M. schausi* in USNM); 9 km. S. Sta. Cecilia, 700 m., Estacion Pitilla, Provincia Guanacaste, 2–15 May, 1992, C. Moraga, INBio CRI000405603, INBio CRI000599224 (1 ♂, 1 ♀); Estacion La Casona, 1,520 m., Reserva Biologica Monteverde, Provincia Puntarenas, October, 1992, N. Obando, CR INBio I000818108 (1 ♂); Monteverde, 4,400′, Provincia Puntarenas, 2 September 1988, C. V. Covell, Jr. (1 ♂).

Other material examined.—Belize, 1,000 Foot Falls, Mountain Pine Ridge, May, 1990, L. C. Dow (1 ♂, 1 ♀), Butler Line, Mountain Pine Ridge, May, 1990, L. C. Dow (1 ♂), San Ignacio, June, 1990, L. C. Dow (1 ♂).

Ceracanthia eugenieae Neunzig and Solis, new species

(Figs. 9, 18, 35–36)

Diagnosis.—Based on the male genitalia, *Ceracanthia eugenieae* is closely related to *Ceracanthia schausi*. Both have peculiar lobes that protrude inwardly from the base of the valva, and both have a transtilla consisting of a plate with a pair of curved lower (anterior) arms. But, *Ceracanthia eugenieae*, most noticeably, differs from *Ceracanthia schausi*, and all other *Ceracanthia*, in lacking a tuft of scales at the base of the sacculus (Fig. 35).

Description.—Forewing length 8.0–8.5 mm. Head: frons brownish white; vertex reddish brown, dark brown near eye; labial palpus outwardly with basal 2/3 of each segment mostly white, or brownish white, and with distal part white, or brownish white, red, or brownish red, and brown, or black; maxillary palpus simple, white, or brownish white; antenna of male (Fig. 18) with strongly developed sinus; basal and distal ends of sinus without spines (basal end with small, black mound of very short? sensilla); inner surface of sinus covered with appressed setae; tuft or brush of scales attached to posterior base of sinus (tuft or brush extends length of sinus). Forewing of male with long costal fold; underside with subcostal streak (dark with pale center basally becoming brownish red near distal part of costal fold); wing above mostly white on anterior half and chiefly brown on posterior half; base mostly dark reddish brown and black; a pair of black (or dark brown), diagonally-converging bands extend from costa to fuse with brown of posterior half; bands divide costal half into three contrasting, mostly white patches; distal patch small; middle patch with small, isolated, elongate brownish red and black patch at about mid-costa, and with two brownish red and black discal spots; a sprinkling of red or brownish red scales chiefly on white patches. Hindwing simple, pale brown, darker along margins. Male genitalia (Figs. 35–36) with uncus subtriangular, rounded apically; apical process of gnathos a short, slender, tapered, slightly-hooked rod; transtilla a square plate with pair of curved arms extending from its lower (anterior) corners; juxta a thin plate with short, setiferous lateral arms; valva broad with distal half slightly produced inwardly, and with broadened, spinelike setae on inner surface; inner basal lobe of valva strongly developed (as in *Ceracanthia schausi,* but with tips overlapping); vesica of aedoeagus with elongate cluster of microspines and a second cluster of slightly larger, more heavily sclerotized spines; sacculus with apex lobed; base of sacculus without large tuft of setae or scales (also without small secondary tuft present on some *Ceracanthia*); vinculum longer than greatest width, without medial constriction, with base laterally lobed. Female unknown.

Types.—Holotype: ♂. Estación Pitilla, 9 km. S. de Santa Cecilia, Prov. Guana., Costa Rica, 700 m., AGO 1995, C. Moraga, Luz, L-N-329950 380450, #6207, CR INBio I002309873, genitalia slide 4539 HHN (INBio). Paratype: Turrialba, Costa Rica, 600 m., 10.1.1972, V. O. Becker, genitalia slide 4922 HHN (VOB) (1 ♂).

Etymology.—We are pleased to name this species in honor of Eugenie Phillips-Rodríguez at INBio. Her enthusiasm in providing specimens, and assisting in many other ways, greatly added to the success of our study.

Ceracanthia alturasiana Neunzig and Solis, new species

(Figs. 10, 19, 39–40, 48)

Diagnosis.—Like *Ceracanthia mamella,* the forewing of *Ceracanthia alturasiana* does not resemble the forewings of other species in the genus. However, the latter species cannot be confused with the former because the color and maculation of the forewings of the two species are very different. An obvious feature is a strong postmedial line on the wing of *Ceracanthia alturasiana* (Fig. 10); this distinct line is absent from *Ceracanthia mamella,* as well as from all other Costa Rican *Ceracanthia.*

Description.—Forewing length 8.0–8.5 mm. Head: frons ochre; vertex pale reddish ochre; labial palpus outwardly with basal segment white and pale ochre, other two segments ochre with brown distally; maxillary palpus simple in both sexes, ochre; antenna of male with basal sinus with small spine at basal end of sinus and small spine at distal end of sinus (two additional spines beyond distal end of sinus); inner surface of sinus with appressed scales; small, short weakly-formed tuft of scales attached to base of sinus (tuft extends about ½ length of sinus). Forewing: simple, without costal concavity, costal fold, or other modifications or embellishments; wing above basally and subbasally dark brown to black, sprinkled with brownish red, and with dusting of ochre, particularly along costa; antemedial line fragmented, bur rather distinct, ochre; postmedial line well developed, white and ochre; medial area with ground color dark brown to black, with dusting of brownish red scales, and with distinct patch of ochre surrounding discal spots; discal spots dark brown to black and brownish red. Hindwing simple in both sexes, mostly pale brown, darker along margins. Male genitalia (Figs. 39–40): with uncus subtriangular, rounded apically; apical process of gnathos a slender, long, slightly-tapered, hooked rod; transtilla present, represented by a thin, sclerotized, medial band; juxta a thin plate with short, setiferous, lateral lobes; valva broad with distal half slightly produced along costa, and with broadened, spinelike setae on inner surface; inner basal lobe of valva weakly developed; sacculus with apex narrowly lobed, and with yellowish, basal tuft of thin scales (tuft slightly longer than length of valva); vesica of aedoeagus with cluster of microspines and a well developed group of medium-sized spines; vinculum longer than greatest width, and not medially constricted. Female genitalia (Fig. 48) with ductus bursae shorter than corpus bursae; corpus bursae with patch of many, small spines posteriorly that extends a short distance into ductus bursae, and with a more anterior sclerotized, scobinate patch on its right side (when viewed ventrally) bearing an imbricate, hooked spine that extends mostly laterally; ductus seminalis attached to corpus bursae near junction of ductus bursae and corpus bursae.

Types.—Holotype: ♂. C. R.: Estac. Biol. Las Alturas, 1,550 m., 12 air km. NE San Vito, Punt. Prov., I-22/24-1993, J. Powell, at blacklight, genitalia slide 4857 HHN (UCB). Paratypes: same collection data as holotype, genitalia slide 4858 HHN (UCB, NCSU) (3 ♀); C. R.: Puntarenas Pr., Monteverde, 1,400 m., III-30-1992, Powell (UCB) (1 ♀).

Etymology.—The specific epithet is derived from the type locality (Las Alturas), and the Latin suffix *-ana* (meaning "belonging to").

ACKNOWLEDGMENTS

We thank the many parataxonomists at INBio for collecting, spreading and labeling most of the specimens we studied. Also, at the same institution, Mario Comacho prepared slides of genitalia, and Eugenie Phillips arranged for the loan of material. Other study specimens were provided by Jerry A. Powell, UCB, and Vitor O. Becker, Brasilia, Brazil. Robert L. Blinn, NCSU, made the habitus photographs.

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A REVIEW OF *PTOUS* CHAMPION (COLEOPTERA: CURCULIONIDAE: CRYPTORHYNCHINAE)

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Abstract.—Three new species are described in the genus *Ptous*, ***P. cecropiae*, n. sp.**, ***P. woldai*, n. sp.**, and ***P. liebermanorum*, n. sp.**, and *P. otidocephalinus* Champion is redescribed. These species and at least three other undescribed forms can be separated into two groups. The species are illustrated and a key is provided. Two species have been reared from members of the plant genus *Cecropia* (Cecropiaceae), and a third has been collected on *Cecropia* as adults. Members of the genus *Ptous* are hypothesized to be part of a mimicry complex possibly based on the weevil genus *Myrmex* as Mullerian models.

Key Words: *Cecropia*, mimicry, *Myrmex*

The genus *Ptous* was described by Champion in 1906 for a single specimen from Nicaragua. In recent years collecting, ecological sampling, and rearing have yielded a number of additional specimens of at least seven different species. The present paper describes four of these as part of a more general study of insects associated with the plant genus *Cecropia* by one of us (L. M. LaPierre, in preparation).

The following collection acronyms are used throughout the text: BMNH: The Natural History Museum, London, England; CHAH: Henry A. Hespenheide, University of California, Los Angeles, CA, U.S.A.; CMNC: Canadian Museum of Nature, Ottawa, Canada; CWOB: Charles W. O'Brien, Tallahassee, FL, U.S.A.; INBC: Instituto Nacional de Biodiversidad, Santo Domingo de Heredia, Costa Rica; STRI: Smithsonian Tropical Research Institute, Ancon, Panamá; USNM: National Museum of Natural History, Smithsonian Institution, Washington, DC, U.S.A.

Ptous Champion 1906: 632.

Type species.—*Ptous otidocephalinus* Champion, by monotypy.

Champion separated the genus *Ptous* on a combination of characters that make it very distinctive in the Cryptorhynchinae but which produce a strong superficial resemblance to members of the genus *Myrmex* (= *Otidocephalus*) in the Myrmecinae, a resemblance that is probably mimetic (see below). Species are relatively slender, narrowly obovate or ovate, and more or less strongly shining black and glabrous above with a relatively inconspicuous pattern of stripes and fasciae of white setae on the elytra. The third elytral interval is usually raised and denticulate near the base of the elytra, and the first (sutural), fifth and seventh intervals also may be raised or faintly carinate. The eyes are relatively large and narrowly separated along the middle, as in the Zygopinae, and the ocular lobes on the pronotum are poorly developed. The legs are relatively long and slender. Champion placed *Ptous* between the genera *Trachalus* and *Cryptorrhynchus* but did not discuss its relationships with either. It is interesting that there are similarities of *Ptous* with *Cophes gibbus* Champion, which also has been reared from *Cecropia.*

Characters.—Species in the genus fall into two groups based on elytral pattern and form of the posterior tibiae. One group of species possesses an elytral pattern of a more or less complete lateral stripe on the sixth interval and a more or less well developed transverse subapical fascia, has the apical half of the first (sutural) interval raised and denticulate, and has the posterior tibiae terete and straight. The other group of species has an elytral pattern of broad oblique fasciae from the base of fifth elytral interval to the suture of the elytra, without a subapical fascia and with or without a submarginal stripe, and posterior tibiae that are flattened and weakly arcuate on their posterior margins. Species within these two groups differ in details of the setal patterns, the nature of the surface sculpture, and male genitalia.

KEY TO SPECIES OF *PTOUS*

1\. Elytral pattern of oblique fasciae from base of fifth interval to suture at middle of elytron and then continuing parallel to suture, with lateral stripe, no subapical fascia; first (sutural) interval not raised or denticulate; posterior tibia flattened and weakly arcuate on posterior margin; Costa Rica . . . . *P. liebermanorum,* n. sp.

– Elytral pattern of more or less complete stripe of setae on sixth interval parallel to lateral margin and transverse subapical fascia; apical half of the first (sutural) interval raised and denticulate; posterior tibia mostly terete and straight, laterally compressed only at base 2

2\. Posterior ⅕ of elytra almost completely covered by setae; sides of pronotum with setae to top of ocular lobes; tooth on anterior femora < 0.1 mm long, acute; Panamá . . . . *P. woldai,* n. sp.

– Elytra with posterior transverse subapical fascia but with large glabrous area; sides of pronotum with setae only below ocular lobes; tooth on anterior femora > 0.1 mm long, acuminate 3

3\. Stripe of setae on sixth elytral interval incomplete; first (sutural) interval with setae only at apex and at posterior transverse fascia; fifth and seventh intervals not raised; Panamá . . . . *P. cecropiae,* n. sp.

– Stripe of setae on sixth elytral interval complete; apical half of first (sutural) interval with stripe of setae; fifth and seventh intervals raised, faintly carinate; Nicaragua to Panamá . . . . *P. otidocephalinus* Champion

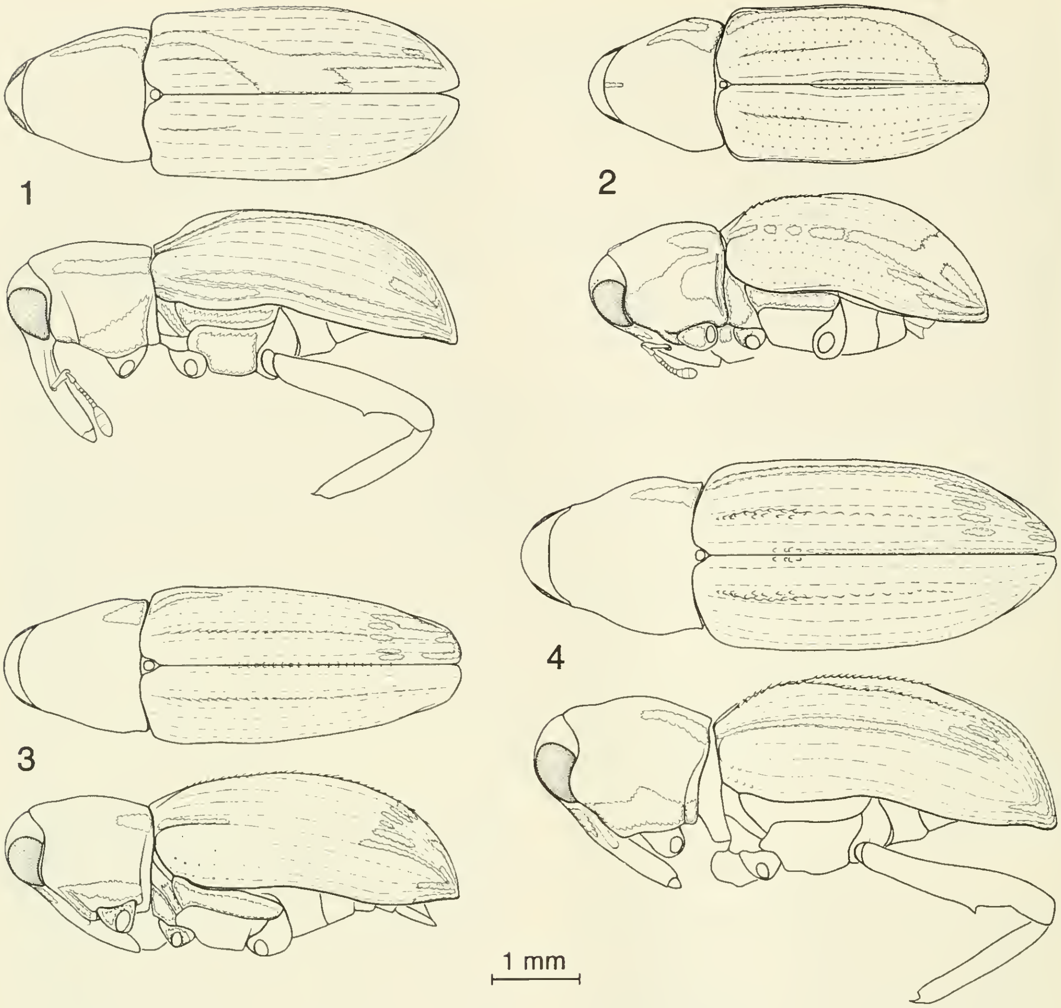
Ptous liebermanorum Hespenheide and LaPierre, new species

(Figs. 1, 5)

Holotype male.—Black, moderately shining, relatively slender, slightly obovate; above glabrous except oblique stripe of small white setae from base of fifth elytral interval to third interval at about basal ⅓, continuing to apex, on first and second elytral intervals for middle ⅓, for entire length of ninth interval, basal ½ of tenth, apical ⅖ of eighth, and apical ⅙ of seventh interval; stripes of white setae on pronotum anterior to base of elytral stripes parallel to lateral margin reaching almost to apex; beneath and at base of rostrum with moderately dense white setae, somewhat condensed above anterior coxae, but glabrous above base of ocular lobes; legs with very small white setae, denser on dorsal and ventral surfaces; 5.0 mm long, 1.9 mm wide.

Head finely, densely punctate above, with eyes large, rather narrowly separated, rostrum 1.3 mm long, antennae inserted just above middle of rostrum. Pronotum 1.4 mm long slightly wider than long, widest just before base, sides weakly arcuate, weakly convex in cross section, nearly flat in lateral view, moderately densely, finely punctate. Elytron 3.2 mm long; somewhat matte, regularly convex, more weakly so in lateral view, basal ⅕ of third interval somewhat raised and minutely denticulate. Metasternum and first abdominal sternite very shallowly, broadly concave. Legs long, anterior femur with acute triangular tooth, posterior femur with tiny acute tooth, Aedeagus as in Fig. 5.

Allotype female.—As holotype, except metasternum and base of first abdominal sternite weakly convex, 6.8 mm long.



Figs. 1–4. Dorsal and lateral habitus and posterior tibia of species of *Ptous:* 1, *P. liebermanorum.* 2, *P. woldai.* 3, *P. cecropiae.* 4, *P. otidocephalinus.*

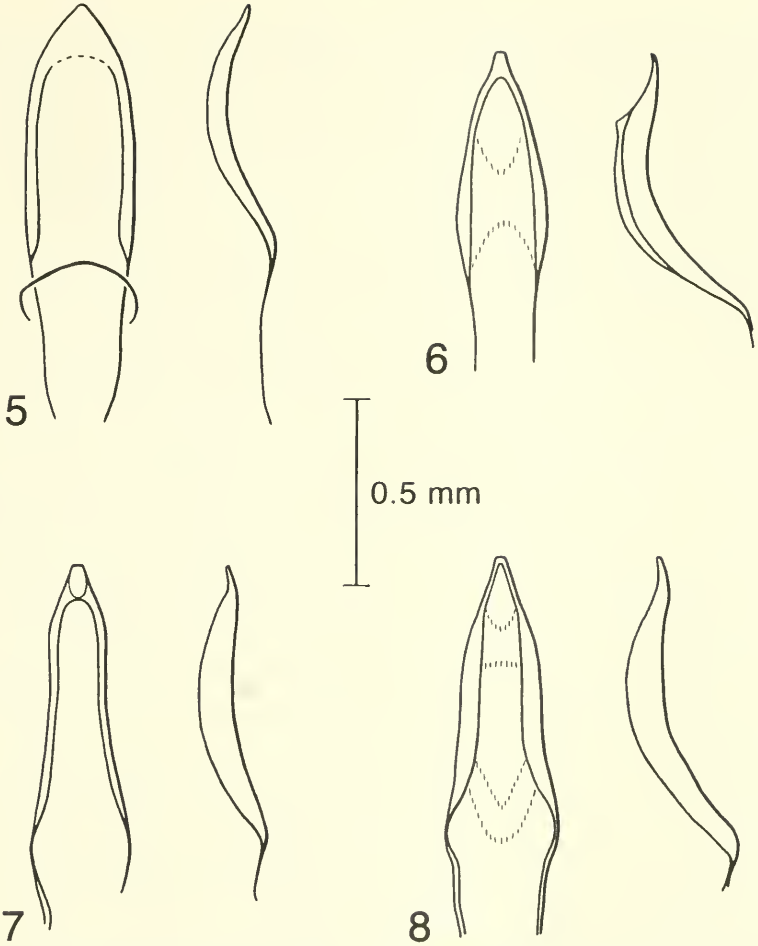
Holotype.—COSTA RICA: Heredia Pr., Est. Biol. La Selva, 50–150 m, 10°26′N 84°01′W, 09.11.1998, L.M. LaPierre, #98.277 (INBC).

Allotype.—Same data as holotype, except #98.277-1 (INBC).

Paratypes.—COSTA RICA: Alajuela Pr., 20 km S Upala, 01-20.11.1990, F.D. Parker (1, CWOB); Heredia Pr., same data as holotype, except #98.278.1; 24.01, 14.02, 03.2000, L.M. LaPierre, #00.649, 650, 651, reared from *Cecropia obtusifolia* wood (8, BMNH, CHAH, CWOB, USNM).

Discussion.—Specimens vary in size from 4.1–6.8 mm in length (mean = 5.52 mm, N = 12). In addition to this species, material has been seen that appears to represent three additional species of *Ptous* in the group with oblique elytral fasciae. Two of these species are from Panamá, one is from Bolivia. Each is represented by only a single female specimen, all in the collection of Charles W. O'Brien. We prefer to defer description of these until more material, including males, becomes available.

This species is dedicated to Drs. Milton and Diana Lieberman in warm appreciation of their generosity and advice to LML



Figs. 5–8. Male aedeagus of species of *Ptous*. 5, *P. liebermanorum*. 6, *P. woldai*. 7, *P. cecropiae*. 8, *P. otidocephalinus*.

while he worked at San Luis Biological Station.

Ptous woldai Hespenheide and LaPierre, new species
(Figs. 2, 6)

Holotype male.—Black, moderately shining, relatively slender, slightly obovate; above glabrous except stripe of white setae on sixth elytral interval from base to apex and on apical ¼ of all other intervals; somewhat broad and irregular stripes of white setae on pronotum interior to base of elytral stripes, parallel to lateral margin reaching almost to apex and few white setae along mideline of pronotum at apex; white setae at base of rostrum and along midline of head above eyes; moderately dense white setae on sides of pronotum to top of ocular lobes, and on meso- and metasterna; abdominal sternites glabrous; legs with uniform white setae, denser on femora; 4.4 mm long, 1.7 mm wide.

Head finely, densely punctate above, with eyes large, rather narrowly separated, rostrum 1.0 mm long, antennae inserted just above middle of rostrum. Pronotum 1.25 mm long slightly wider than long, widest at basal ⅓, sides arcuate, weakly convex in cross section and in lateral view, moderately densely, finely punctate. Elytron 2.8 mm long; rather strongly shining, evenly convex in lateral view, basal ¼ of third interval and apical ½ of first (sutural) interval raised and denticulate, fifth and seventh intervals raised, fifth more strongly so; coarsely punctate. Metasternum and base of first abdominal sternite very weakly, broadly concave. Legs moderately long, anterior femur with small acute triangular tooth, posterior femur with tiny acute tooth; posterior tibia terete, basally somewhat arcuate. Aedeagus as in Fig. 6.

Allotype female.—As holotype, except metasternum and base of first abdominal sternite weakly convex, 5.1 mm long.

Holotype.—PANAMÁ, Barro Colorado Is., UV trap 1 (3 m high), 09.07.1977, H. Wolda (CWOB).

Allotype.—Same data as holotype, except 13.04.1977 (CWOB).

Paratypes.—Same data as holotype, except 18, 22.10.1976, 13.04, 18, 27.05, 05.07.1977, 12.08.1978, 27.09.1981, 08.08.1983 (8, CWOB); same data as holotype, except UV trap 3 (26 m high), 21, 28.06, 14.07, 2, 3, 15, 16.08, 20.09, 6,20.09.1976, 20.03, 18, 23, 29.06, 19, 20.06, 07.07, 02, 17.11.1977, 24.04, 07, 23.05, 25.06, 04, 11.07, 23.11.1978, 10.091979, 04–05, 09.11.1980 (31, BMNH, CHAH, CWOB, STRI, USNM).

Discussion.—Specimens vary in size from 3.6–5.0 mm in length (mean = 4.22 mm, N = 40).

This species is named for Henk Wolda whose extensive sampling of insects on Barro Colorado Island (Wolda et al. 1998) and elsewhere in Panamá has been an important early step in the understanding of the biodiversity and seasonal phenology of Neotropical insects.

Ptous cecropiae Hespenheide and LaPierre, new species

(Figs. 3, 7)

Holotype male: Black, strongly shining, relatively slender, narrowly ovate; above glabrous except stripe of white setae on basal ⅕ of sixth elytral interval and apical ¼ of second and fifth interval, and oblique transverse fascia at apical ⅕; small patches of white setae on pronotum just anterior to base of elytral stripes; beneath and at base of rostrum with moderately dense white setae, somewhat more condensed on sides, but glabrous above base of ocular lobes and on abdominal sternites; legs with very small white setae on tibiae and dorsal portions of middle and posterior femora; 5.0 mm long, 1.9 mm wide.

Head finely, densely punctate above, with eyes large, rather narrowly separated, rostrum 1.3 mm long, antennae inserted just above middle of rostrum. Pronotum 1.35 mm long slightly wider than long, widest at basal ⅓, sides rounded-angulate, weakly convex in cross section, nearly flat in lateral view, sparsely, finely punctate. Elytron 3.35 mm long; evenly convex, more weakly so in lateral view, basal ¼ of third interval and apical ¾ of first (sutural) interval raised and denticulate, fifth interval slightly raised. Metasternum and first abdominal sternite deeply, longitudinally concave. Legs long, anterior femur with long, acuminate tooth, posterior femur with shorter acuminate tooth; posterior tibia terete, basally somewhat laterally compressed. Aedeagus as in Fig. 7.

Allotype female.—As holotype, except metasternum flat and base of first abdominal sternite weakly convex, 6.8 mm long.

Holotype.—PANAMÁ, Chiriqui, Fortuna (08°44′N 82°15′W) 1,050 m, UV trap, 19.10.1976 (CWOB).

Allotype.—Same data as holotype, except 31.10.1977 (CWOB).

Paratypes.—PANAMÁ, Cocle Prov., Cerro Goital, 10-12.06.1985, E.G.Riley & D. Rider (1, CWOB); Panamá Prov., Cerro Campana, 05.07.1974, C.W. & L. O'Brien & Marshall (1, CWOB), Cerro Campana, 850 m, 08°40′N 79°56′W, 29.05.1970, H.A. Hespenheide, on *Cecropia* (1, CHAH), 29.04.1973, H.A. Hespenheide (1, BMNH), 08.02.1972, W. Bivin (1, CMNC).

Discussion.—Specimens vary in size from 3.9–6.3 mm in length (mean = 5.18 mm, N = 7).

The specific refers to the adult and putative larval host of this and other *Ptous*, species of plant genus *Cecropia*.

Ptous otidocephalinus Champion 1906: 633.
(Figs. 4, 8)

Diagnosis.—Female: Black, strongly shining, relatively slender, narrowly ovate; above glabrous except complete stripe of white setae on sixth elytral interval, on bases of fourth and fifth intervals, and along apical ⅔ of suture, and broad oblique transverse fasciae at apex and apical ⅕; narrow lines of white setae on pronotum anterior to base of elytral stripes; beneath and at base of rostrum with moderately dense white setae, somewhat more condensed on sides, but glabrous posterior to ocular lobes and on abdominal sternites; legs with very small white setae on tibiae and dorsal portions of femora; 5.4 mm long, 2.1 mm wide.

Head finely, densely punctate above, with eyes large, rather narrowly separated, rostrum 1.5 mm long, antennae inserted just above middle of rostrum. Pronotum 1.4 mm long slightly wider than long, widest at basal ¼, sides rounded-angulate, weakly convex in cross section, nearly flat in lateral view, sparsely, finely punctate. Elytra 3.7 mm long; evenly convex, more weakly so in lateral view, basal ⅕ of third interval and apical ¾ of first (sutural) interval raised and denticulate. Metasternum and first abdominal sternite weakly convex. Legs long, anterior femur with acute tooth, posterior femur with very small acute tooth; posterior tibia terete, basal ½ somewhat laterally compressed.

Male.—As female, except metasternum and base of first abdominal sternite deeply, longitudinally concave. Aedeagus as in Fig. 8.

Specimens examined.—COSTA RICA: Puntarenas Pr., San Luis de Monteverde & vic., 1,000–1,200 m, 10°17′N 84°49′W, 19.08.1998, L.M. LaPierre, #San97.93-01-20 (CHAH, USNM, INBC), 1,100–1,400 m, 21-25.07, 02-09.08.1996, L.M.La Pierre, *Cecropia* (CHAH); Heredia Pr., Est. Biol. La Selva, 50–150 m, 10°26′N 84°01′W, 09.11.1998, L.M. LaPierre, #98.278.2; 24.01, 14.02, 02, 03, 09.05.2000, L.M. LaPierre, #00.649, reared from *Cecropia obtusifolia* wood (8, BMNH, CHAH). NICARAGUA, Granada, Sallé (holotype, BMNH). PANAMÁ: Chiriqui, 1300 m., Alto Lino nr. Boquete, UV trap, 25.05.1977, 19.04.1978, H. Wolda (CWOB).

Discussion.—*Ptous otidocephalinus* is very similar to *P. cecropiae*, but can be separated by differences in the male genitalia and the characters given in the key. Specimens vary in size from 4.2–5.9 mm in length (mean = 5.05 mm, N = 36). The holotype is a female.

ECOLOGY OF *PTOUS*

Species of *Ptous* were reared by LaPierre as part of a general survey of wood-boring and other insects feeding on members of the Cecropiaceae at La Selva Biological Station and at San Luis de Monteverde, both in Costa Rica. Branches with maximum basal diameter of about 15 cm were clipped from mature trees of *Cecropia obtusifolia* Bertoloni (La Selva and San Luis) and *C. insignis* Liebmann, *Coussapoa villosa* Poeppig and Endlicher, and *Pourouma bicolor scobina* (Benoist) C.C. Berg and van Heusden (all at La Selva only) and left below the trees from which they were cut. After two months sections of the branches were removed and placed in rearing containers; sections were 30–40 cm in length and represented a range of diameters from 4–15 cm.

Ptous liebermanorum and *P. otidocephalinus* were reared from branches of *Cecropia obtusifolia* and *C. insignis* at La Selva, and *P. otidocephalinus* from *C. obtusifolia* at San Luis. Concurrent rearings from the other genera of the Cecropiaceae at La Selva (*Coussapoa, Pourouma*) did not produce any *Ptous* although other species of Coleoptera were shared among the samples. Based on these rearing data and hand collections of adults, it appears that *Ptous* is a specialist on senescing wood of *Cecropia* species.

Virtually all specimens of *Ptous* we have seen for which there is collection data have been either reared from or collected on *Cecropia* or have been collected in UV light traps. It is interesting that no specimens of *Ptous* have been collected by the general sampling methods (Malaise traps, canopy foggings, UV light traps) of the Arthropods of La Selva (ALAS) Project. Although species of *Cecropia* have not been among the species fogged, other samples have been taken over a range of habitats at La Selva, and *Cecropia* species are widely distributed among these habitats. *Cecropia* specialists in other weevil genera (*Lechriops, Lissoderes, Pseudolechriops*) have been collected in standardized samples, however.

Other cryptorhynchine weevils reared from *Cecropia* by LaPierre include *Coelosternus variisquamis* (Champion) and *Cophes gibbus* Champion. A complete summary of the results of these rearings will appear elsewhere (LaPierre, in preparation).

PTOUS AND MIMICRY

Champion (1906) named *Ptous otidocephalinus* for its striking resemblance to species of *Otidocephalus* (= *Myrmex*). The senior author has suggested elsewhere (Hespenheide 1987, 1995) that this resemblance is a case of mimicry and that it involves a number of other taxa, including other species in several subfamilies of the Curculionidae, Buprestidae, Cleridae, and Rhynchitidae. It is possible that species of *Myrmex* are in fact the distasteful models for this system, in view of their species richness and relative commonness, but no experimental feeding trials have been made to support this hypothesis. It is interesting that both *Ptous* and the zygopine weevil *Lissoderes* share this habitus (Hespenheide 1987) and that both use *Cecropia* species as hosts. Just as restriction of a species' activity affects its ability to be sampled by generalized sampling methods (see above), microhabitat is also important to the effectiveness of mimicry (Hespenheide 1996).

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Chris Lyall and Sharon Shute assisted during a visit to The Natural History Museum, London. Charles W. O'Brien shared expertise and generously loaned material from his personal collection. LML is grateful to Kirsten Querbach for the help she affably provided in monitoring rearing containers at San Luis and to Pamela Wright for comments on the manuscript. Fieldwork by LaPierre at La Selva and San Luis was supported by a fellowship from the Department of Organismic Biology, Ecology and Evolution, UCLA. Hespenheide has been supported through the ALAS Project at La Selva (National Science Foundation grants BSR 9025024, DEB 9401069, DEB 9706976, and DEB-0072702) and grants from the UCLA Academic Senate. Both authors also were supported by personal funds. Margaret Kowalczyk prepared the figures.

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TWO NEW SPECIES OF THE CHEWING LOUSE GENUS *GLIRICOLA* MJÖBERG (PHTHIRAPTERA: GYROPIDAE) FROM PERUVIAN RODENTS

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Abstract.—Two new species of chewing lice (Phthiraptera: Gyropidae) from high-elevation Peruvian rodents are described and illustrated: ***Gliricola cutkompi*** from *Cuscomys ashaninka* Emmons (Abrocomidae) and ***G. brooksae*** from *Dactylomys peruanus* (J. A. Allen) (Echimyidae). The specimen of *Cuscomys ashaninka* that yielded the series of *G. cutkompi* also was the source of the type series of the previously described *Abrocomophaga emmonsae* Price and Timm. This finding reconfirms that single individual caviomorph rodents may harbor two different genera of lice of the family Gyropidae.

Resumen.—Se describen y se ilustran dos especies nuevas de piojos suramericanos (Phthiraptera: Gyropidae) de roedores peruanas de alta montaña: ***Gliricola cutkompi*** parásito de *Cuscomys ashaninka* Emmons (Abrocomidae) y ***G. brooksae*** parásito de *Dactylomys peruanus* (J. A. Allen) (Echimyidae). La serie típica de *G. cutkompi* fue colectada del mismo especimen de *Cuscomys ashaninka* del cual se colectó la serie típica de *Abrocomophaga emmonsae* Price y Timm, anteriormente descrita por nosotros. Tal descubrimiento reconfirma que un solo individuo de roedor caviomorfo puede hospedar a dos generos distintos de la familia Gyropidae.

Key Words: chewing lice, *Gliricola*, Gyropidae, Phthiraptera, Rodentia

The chewing louse genus *Gliricola* Mjöberg (Phthiraptera: Gyropidae) contains 38 recognized species, with 29 of these in the nominate subgenus and 9 in the subgenus *Hutiaphilus* Price and Timm. The members of the subgenus *Gliricola* are known from the Central and South American caviomorph rodent families Caviidae and Echimyidae. Members of *Hutiaphilus* are restricted to the caviomorph family Capromyidae, the West Indian hutias that are found on the islands of the Greater and Lesser Antilles and the Bahamas. In our description of the subgenus *Hutiaphilus*, we provide a discussion of the features of the genus *Gliricola* as well as both subgenera (Price and Timm 1997). Detailed characterization of members of the family Gyropidae and subfamily Gliricolinae have been presented by Clay (1970) and Price and Timm (2000). For brevity, these will not be repeated here.

We recently obtained two series of *Gliricola* from two poorly known high-elevation caviomorph rodents from Peru—the recently described abrocomid *Cuscomys ashaninka* Emmons (Abrocomidae) and the montane bamboo rat *Dactylomys peruanus*

(J. A. Allen) (Echimyidae). Each of these series represents a species new to science in the nominate subgenus. Furthermore, these hosts represent new generic records for *Gliricola,* and one, *Cuscomys ashaninka,* represents a new family record, the Abrocomidae. It is our intent to describe and illustrate these new species here.

In the following descriptions, all measurements are in millimeters. The holotypes and some paratypes of both new species will be deposited in the Museo de Historia Natural, Universidad Nacional de San Marcos, Lima, Peru; other paratypes will be distributed to the National Museum of Natural History, Smithsonian Institution (Washington, D.C.), the K. C. Emerson Entomology Museum, Oklahoma State University (Stillwater, Oklahoma), and the University of Minnesota (St. Paul, Minnesota). The hosts are deposited in the Museo de Historia Natural, Universidad Nacional de San Marcos (MUSM) and the National Museum of Natural History, Washington (USNM). Abbreviations used for dimensions are given in the first description. For split drawings with a median vertical line, dorsal is to the left and ventral to the right.

Gliricola (*Gliricola*) *cutkompi* Price and Timm, new species

(Figs. 1–3)

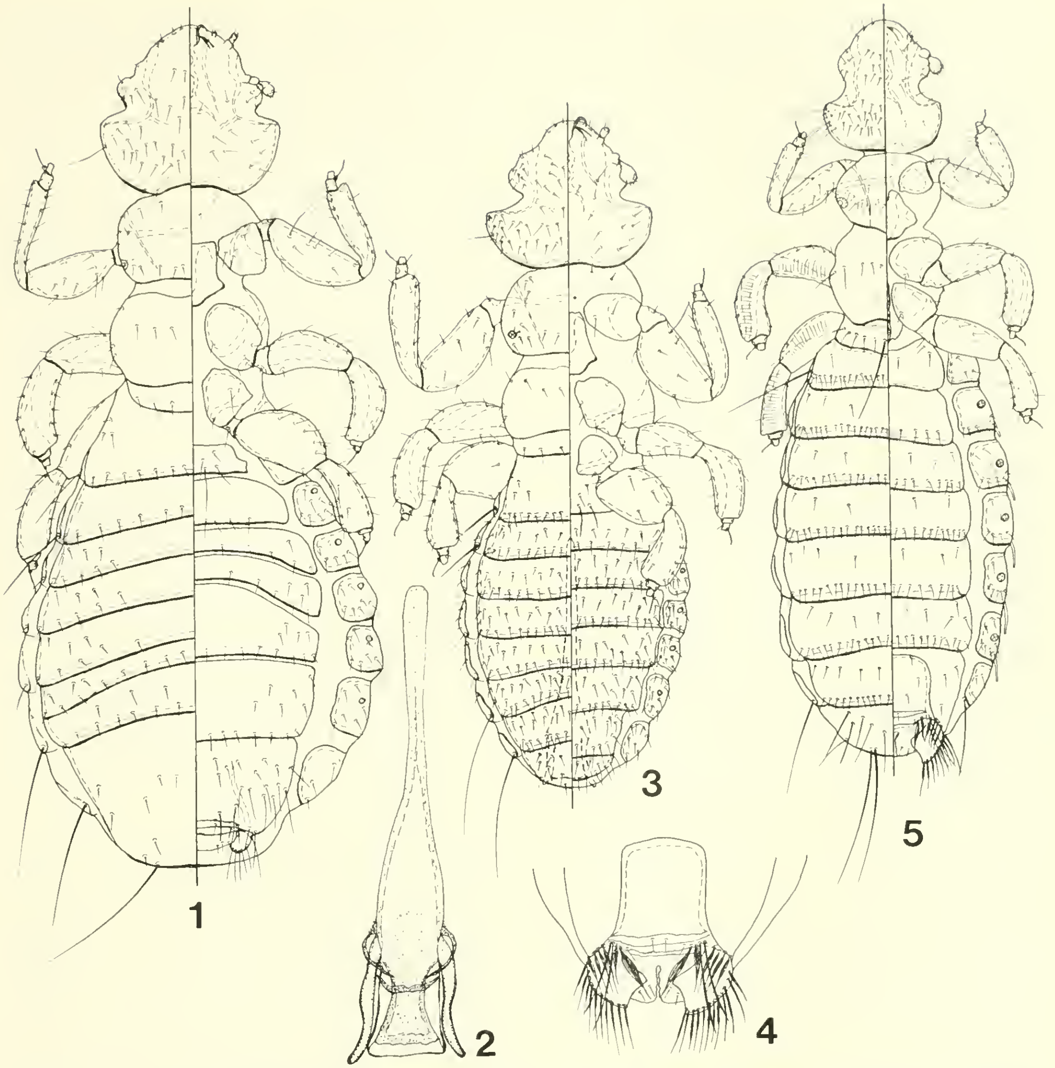
Type host.—*Cuscomys ashaninka* Emmons.

Female.—As in Fig. 1. Abdomen broad, with sparse chaetotaxy. Marginal tergal setae: I, 5–6; II–VIII, 10–17. Anterior tergal setae: I, 0; II–III, 2–7; IV–VIII, 4–14. Pleural setae: II–VII, 10–14; VIII, 7–9; each side of pleura II–III with long seta, VII–VIII with very long seta. Sternum II with 6–8 total setae. Marginal sternal setae: III, 8; IV–V, 9–13; VI–VII, 15–17. Anterior sternal setae mostly lateral: III, 0–3; IV–V, 2–5; VI, 4–7; VII, 7–10. Tergum VII shortened, terminal tergum large. Sterna IV–V short, VI medially enlarged, and VII enlarged, subrectangular. Each gonapophysis with 10–11 slender marginal setae. Dimensions: temple width (TW), 0.27–0.29; head length (HL), 0.24–0.27; prothorax width (PW), 0.22–0.23; metathorax width (MW), 0.24–0.27; abdomen width at segment V (AWV), 0.49–0.56; total length (TL), 1.17–1.30.

Male.—As in Fig. 3. Head and thorax near those of female. Abdomen with denser chaetotaxy and terga and sterna all of approximately same length. Marginal tergal setae: I, 4–6; II–VII, 15–22; VIII, 13–16. Anterior tergal setae: I, 0; II, 4–8; III–VIII, 13–23. Pleural setae: II–III, 11–15; IV–VII, 11–17; VIII, 10–14. Sternum II with 6–7 total setae. Marginal sternal setae: III, 8–10; IV–VII, 13–19. Anterior sternal setae evenly across segment: III, 4–8; IV, 9–13; V, 11–15; VI, 14–19; VII, 17–22. Genitalia as in Fig. 2. Dimensions: TW, 0.25–0.27; HL, 0.22–0.23; PW, 0.20–0.22; MW, 0.22–0.23; AWV, 0.37–0.39; TL, 1.01–1.06; genitalia width at paramere base, 0.06–0.07; genitalia paramere length, 0.09–0.10; genitalia length, 0.38–0.41.

Type material.—Holotype female, ex *Cuscomys ashaninka,* Perú: Cuzco, Cordillera Vilcabamba (11°39′36″S, 73°38′31″W), el. 3,350 m, 15 June 1997, coll. Louise H. Emmons #1359; in collection of the Museo de Historia Natural, Universidad Nacional de San Marcos, Lima, Perú, MUSM 12715 ♀ (also see Emmons 1999). Paratypes: 4 ♀, 5 ♂, same data as holotype.

Diagnosis.—The wide female head and abdomen, with the gross modifications in sizes of certain abdominal terga and sterna, set this species apart from all other known *Gliricola.* Additionally, the female gonapophysis setae do not include any broad flattened setae, a condition that virtually all other species show. The male genitalia of *G. cutkompi* are unique, but show a general overall similarity to those of five other species—*G. decurtatus* (Neumann) from *Kannabateomys amblyonyx* (Wagner), *G. fonsecai* Werneck from *Echimys dasythrix* (Hensel), *G. maculatus* Werneck from *Proechimys iheringi* Thomas, *G. humilis* Werneck from *Proechimys albispinus* (I.



Figs. 1–5. 1–3, *Gliricola cutkompi*. 1, Female, dorsoventral. 2, Male genitalia. 3, Male, dorsoventral. 4–5, *G. brooksae*. 4, Female ventral terminalia. 5, Female, dorsoventral.

Geoffroy), and *G. paraensis* Werneck from *Echimys grandis* (Wagner). However, there are distinct differences in genitalic details and the females of all five species are quite different from those of *G. cutkompi*.

We are uncertain about our interpretation of the unique segmentation of the female dorsal terminalia. There is the possibility that what we present in the female description as a shortened tergum VII and much enlarged terminal tergum may actually be a situation in which tergum VII is transversely divided into two parts. If that is the case, then what we here consider terga VII and VIII may actually be a case in which both parts originate with tergum VII and tergum VIII may be fused with IX to form the enlarged terminal tergum. The location of the pleura and sterna seem to support the latter interpretation. Whichever may be correct, the details illustrated in Fig. 1 clearly impart the essentials necessary for the correct application of the data in the description.

Etymology.—This species is named for

Laurence K. Cutkomp, Department of Entomology, University of Minnesota, in recognition of his lengthy and productive career in teaching and research on insect toxicology and the over 45 years he has been a close friend and colleague of the senior author.

Gliricola (*Gliricola*) *brooksae* Price and Timm, new species

(Figs. 4–5)

Type host.—*Dactylomys peruanus* (J. A. Allen).

Female.—As in Fig. 5. Abdomen narrow, without modifications of tergal and sternal sizes, and with many marginal tergal and sternal setae. Total tergal setae on I, 11–14. Marginal tergal setae: II–V, 25–34; VI–VII, 24–29; VIII, 20–25. Anterior tergal setae: II, 0–1; III–VI, 4–8; VII–VIII, 5–11. Pleural setae: II–VII, 7–14; VIII, 3–9; each of spiracle-bearing pleura III–VII with slender lateroposterior process; each side of pleuron II with 1 very long lateral seta and VIII with 2 such setae. Sternum II with 4–8 total setae. Marginal sternal setae: III, 8–10; IV, 13–18; V–VII, 17–21. Anterior sternal setae: III, 0; IV, 0–5; V–VI, 3–7; VII, 7–11. Each gonapophysis (Fig. 4) with 17–21 prominent marginal setae. Dimensions: TW, 0.19–0.20; HL, 0.20–0.21; PW, 0.15–0.16; MW, 0.19–0.21; AWV, 0.37–0.43; TL, 1.17–1.29.

Male.—Unknown.

Type material.—Holotype female, ex *Dactylomys peruanus*, Perú: Junin, Cordillera Vilcabamba (11°31′35″S, 73°38′31″W), el. 2,015 m, 23 June 1997, coll. Louise H. Emmons #1374; in collection of the Museo de Historia Natural, Universidad Nacional de San Marcos, Lima, Perú, MUSM ♀. Paratypes: 2 ♀, same data as holotype; 5 ♀, same except (11°33′35″S, 73°38′28″W), el. 2,050 m, 2 July 1997, Louise H. Emmons #1398, USNM 582148 ♀.

Diagnosis.—The female is unique among all known species of *Gliricola* in having the slender lateroposterior process on each of pleura III–VII and the large number of marginal setae surrounding each gonapophysis. No females of the other taxa have any suggestion of such a pleural process or of gonapophysis chaetotaxy approaching that of *G. brooksae*.

Etymology.—This species is named for Marion A. Brooks, Department of Entomology, University of Minnesota, in recognition of her lengthy and productive career in teaching and research on insect microbiology and the over 45 years she has been a close friend and colleague of the senior author.

DISCUSSION

The specimen of *Cuscomys ashaninka* that yielded the series of lice used here in the description of the new species *Gliricola cutkompi* also was the source of the series of *Abrocomophaga* used by Price and Timm (2000) as the basis for the new species description of *A. emmonsae*. Thus, this single individual was the host for lice of two different genera in the family Gyropidae.

Where accurate records are available, we find gyropid lice to be extremely host-specific ectoparasites, with speciation of lice closely paralleling speciation of their mammalian hosts (Price and Timm 1997, 2000). Where we have a solid understanding of both host and louse species, only a single species of louse in the subgenus *Gliricola* occurs on a single host individual, whereas two (or in one case three) species of lice in the subgenus *Hutiaphilus* may be present on an individual host (Price and Timm 1997, 2000). As species of *Gliricola* are known to occur on a host species throughout its range, we suspect that *G. cutkompi* will be found on *Cuscomys ashaninka* and *G. brooksae* on *Dactylomys peruanus* throughout their respective ranges.

Members of the genus *Gliricola* are now known from the Central and South American caviomorph rodent families Caviidae (5 *Gliricola* known) and Echimyidae (25 *Gliricola* known), the endemic South American family Abrocomidae (1 *Gliricola* known), and the endemic West Indian family Capromyidae (9 *Hutiaphilus* known). Because of the diverse radiation of the caviomorph rodents in these families (Abrocomidae, 5 species; Capromyidae, 13 species; Caviidae, 14 species; and Echimyidae, 70+ species), the host specificity of *Gliricola*, and the paucity of gyropid lice currently available from these rodents, we strongly suspect that numerous new species of *Gliricola* have yet to be discovered. Clearly, species of *Gliricola* are widely distributed on the caviomorph rodents and are host specific, attesting to an ancient host–parasite association. Much remains to be learned about the systematics and host relationships in this extremely diverse and speciose genus of chewing lice.

ACKNOWLEDGMENTS

We thank Linda Gordon and Louise Emmons, National Museum of Natural History, Washington, D.C., and Victor Pacheco, Museo de Historia Natural, Universidad Nacional de San Marcos, Lima, for allowing us to remove specimens of lice from mammal specimens housed in their respective collections, thereby making the discovery of these two new species possible. Rob Anderson translated our Abstract into Spanish for the Resumen included herein. This work was partially sponsored by the Agricultural Experiment Station, University of Minnesota.

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ENIGMATIC TREEHOPPER GENERA (HEMIPTERA: MEMBRACIDAE): *DEIRODERES* RAMOS, *HOLDGATIELLA* EVANS, AND *TOGOTOLANIA*, NEW GENUS

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Abstract—Two poorly known Neotropical treehopper genera, *Deiroderes* Ramos and *Holdgatiella* Evans, are revised and redescribed based on adult morphology. The Caribbean genus *Deiroderes* (unplaced within the subfamily Stegaspidinae) has three valid species including ***D. inornatus*, new species** (Jamaica). The Neotropical genus *Holdgatiella* (currently unplaced within Membracidae) has two valid species including ***H. stria*, new species** (Venezuela). In addition, a previously unknown Caribbean genus is here described, ***Togotolania*, new genus,** with two species: ***T. longicorna*, new species** (Dominican Republic) and ***T. brachycorna*, new species** (Guadeloupe). All species included in these three genera are illustrated, and keys are given for the identification of adults.

Key Words: Membracidae, *Deiroderes, Holdgatiella, Togotolania,* Caribbean, taxonomy

Treehoppers (Hemiptera: Membracidae) are traditionally recognized by the enlarged pronotum, which in many species is conspicuously ornamented with stalks, spikes, or bulbs. In most genera, there is at least a posterior pronotal process extending over (or even concealing) the scutellum. However, the pronota of the Neotropical treehopper genera *Deiroderes* Ramos and *Holdgatiella* Evans are remarkably unremarkable. A third genus, *Togotolania,* described here as new, also has a simple pronotum, adorned only with a median horn. These three genera are probably not closely related, indicating that enlarged pronotal ornamentation was likely gained or lost multiple times in Membracidae. Other treehopper genera lacking a posterior pronotal process occur in the subfamilies Nicomiinae, Endoiastinae, Centrotinae, and Stegaspidinae (fossils), though these may be cases of secondary loss.

Following the most recent reclassifications of Membracidae (Deitz and Dietrich 1993a, Dietrich et al. 2001a), *Deiroderes* and *Holdgatiella* were among several genera that remained unplaced within the taxonomic framework. Although these two genera were originally described in the subfamily Centrotinae (Ramos 1957a, Evans 1962a), emerging morphological (Dietrich et al. 2001a, Cryan et al. in press) and molecular (Cryan et al. 2000a, Cryan, unpublished data) evidence is revealing support for new phylogenetic placements within Membracidae, as discussed below.

MATERIALS AND METHODS

Protocols used during this work follow the materials and methods described by Cryan and Deitz (1999a). The following codens are used to refer to the collections in which relevant specimens are located or have been deposited. Arnett et al. (1993a) listed the full postal addresses for most of the institutions; those not found in that publication are indicated by a dagger (†) following the coden.

CIRAD†: Labo Entotrop (Faunistique-Taxonomie), Montpellier, France.
CNCI: Canadian National Collection of Insects, Agriculture and Agri-Food Canada, Ottawa, Canada.
JARC†: J.A. Ramos Collection, University of Puerto Rico, Mayagüez, Puerto Rico.
JWEC†: J.W. Evans Collection, c/o Australian Museum, Sydney, Australia.
MNHN: National Collection of Insects, Muséum National D'Histoire Naturelle, Paris, France.
NCSU: North Carolina State University Insect Collection, Department of Entomology, North Carolina State University, Raleigh, North Carolina, USA.
SHMC†: S.H. McKamey Collection; current address: Systematic Entomology Laboratory, USDA, ℅ National Museum of Natural History, Smithsonian Institution, Washington, D.C., 20560-0168, USA.
USNM: National Museum of Natural History, Smithsonian Institution, Washington, D.C., USA.

Genus *Deiroderes* Ramos 1957

Deiroderes Ramos 1957a: 96. Type species: *Deiroderes inermis* Ramos 1957a: 96, by original designation.

Diagnosis.—The genus *Deiroderes* includes small stegaspidine treehoppers with simple pronota (lacking well-developed suprahumeral horns and posterior pronotal process) and dark tubercles along the veins of the forewings.

Adult.—*Dimensions* (mm): total length (from head to apex of forewings at rest) 3.2–3.9. *Structure: Head* (Figs. 1–2, 8–9, 14–15): broad, wider than long, with fine pubescence; ocelli not raised, above centroocular line; foliate lobes small, rounded or quadrate; postclypeus weakly or strongly trilobed. *Thorax: Pronotum* (Figs. 2, 9, 15): simple, convex; either low or elevated; suprahumeral horns represented by low carinae, or absent; posterior pronotal process absent. *Pronotal surface sculpturing*: finely punctate, each pit associated with one short seta; setae clubbed, normal, or flattened. *Scutellum* (Figs. 2, 9, 15): short, acuminate; anterior half slightly raised; posterior half flattened, with slight median depression. *Legs* (Figs. 3, 10): metathoracic femur with or without dorsal row of cucullate setae; metathoracic tibia with enlarged setal rows I, II, and III, all with cucullate setae; metathoracic tarsomere I with 1 apical cucullate seta. *Forewing* (Figs. 4, 11, 16): punctate, coriaceous basally; venation simple; 1 [rarely, 2] r-m and 1 m-cu crossvein present; dark tubercles, each bearing one stout seta, spaced irregularly along veins and crossveins. *Hindwing*: venation essentially identical to *Microcentrus* hindwing venation as illustrated by Deitz (1975a, fig. 37c) and Dietrich et al. (2001a, fig. 2B). *Genitalia:* ♀ 2nd valvulae (Figs. 5, 17) narrow throughout, with distinct dorsal serrations; ♂ lateral plates (Figs. 6, 12) free, without hook; aedeagus and styles (Figs. 7, 13) variable; aedeagus with anterior face of posterior arm not denticulate.

Range.—Caribbean, from Virgin Islands to Cuba.

Remarks.—Ramos (1957a) originally described *Deiroderes* as a member of the subfamily Centrotinae, indicating the genus was closely related to *Lophyraspis* Stål (now in Aetalionidae: Biturritiinae: Biturritiini) and *Tolania* Stål (now in Membracidae: Nicomiinae: Tolaniini). *Deiroderes* was later removed from Centrotinae and considered unplaced within Membracidae (Deitz and Dietrich 1993a). Dietrich et al. (2001a) found that *Deiroderes* was included within a monophyletic Stegaspidinae in some of the most-parsimonious cladograms resulting from a more detailed morphology-based phylogenetic analysis of the family Membracidae. Nevertheless, evidence for placement of *Deiroderes* remained equivocal, and therefore the genus remained unplaced in Membracidae.

In a phylogenetic analysis of basal treehopper groups, Cryan et al. (in press) found that *Deiroderes* groups with the genus *Antillotolania* Ramos at the base of Stegaspidinae. Morphological features that placed the genus within Stegaspidinae included the forewing's distal m-cu crossvein (fused basad of the fork of vein M) and hooklike apex of the male styles.

Within Stegaspidinae, some features—forewing with one r-m and one m-cu crossvein; vein R_{2+3} fused basally with R_1; and male lateral plates free, lacking posteroapical hooks—suggest that *Deiroderes* is more closely related to the tribe Stegaspidini (reviewed in Cryan and Deitz 1999a, b, 2000a). Nevertheless, phylogenetic analyses based on morphological (Dietrich et al. 2001a, Cryan et al. in press) and molecular (Cryan et al. 2000a, Cryan, unpublished data) evidence suggest either that *Deiroderes* might be more closely related to Microcentrini or that placement is equivocal. Therefore, pending more definitive resolution, we refer *Deiroderes* to Stegaspidinae but propose that the genus remains unplaced to tribe.

When creating a generic name that refers to a feature of the prothorax, it is customary to modify the Greek noun "*dere*" to "*deres*," thereby making the name masculine (G. Kuschel, personal communication). The first part of the compound name, "*deiro-*," means to behead something, or to cut the neck; thus, "*Deiroderes*" best translates as the "beheaded" treehopper, probably referring to either the lack of pronotal horns or the relatively flat head.

KEY TO THE SPECIES OF ADULT *DEIRODERES*

1. Forewing vein M branching at, or immediately distad of, crossvein r-m, M_{3+4} extending posteriorly at right angle to M (Fig. 4); metathoracic femur with dorsal and ventral rows of cucullate setae (Fig. 3) . . . . *D. inermis* Ramos
– Forewing vein M branching distinctly distad of crossvein r-m, M_{3+4} extending obliquely to wing margin (Figs. 11, 16); metathoracic femur without rows of cucullate setae (Fig. 10) . . . 2
2. Pronotal metopidium produced dorsally, with well-developed median carina; pronotum with suprahumeral carinae (Fig. 15) . . . . *D. punctatus* (Metcalf and Bruner)
– Pronotal metopidium low, dorsal median carina not well developed; pronotum without suprahumeral carinae or horns (Fig. 9) . . . . *D. inornatus*, new species

Deiroderes inermis Ramos
(Figs. 1–7)

Deiroderes inermis Ramos 1957a: 96.

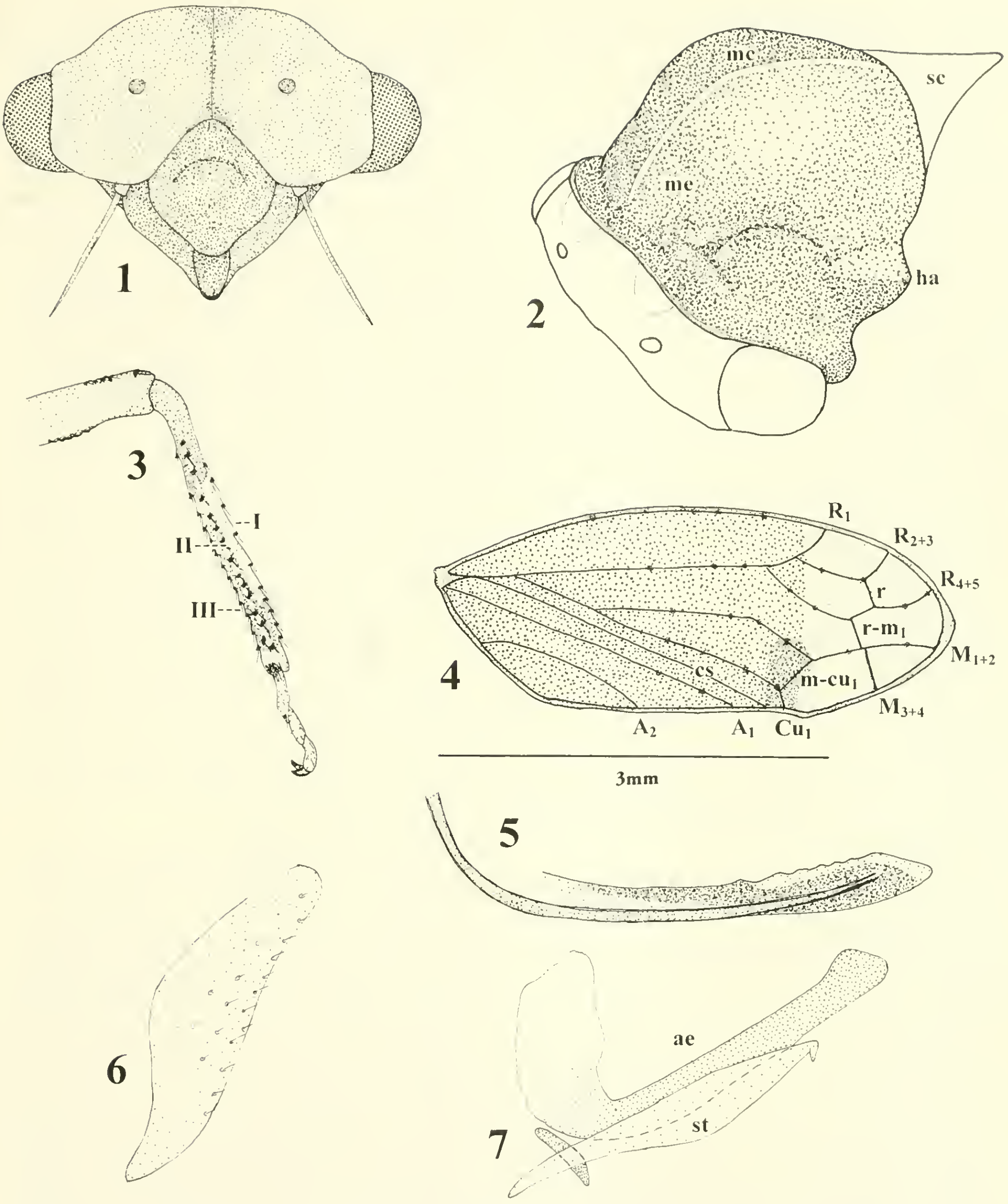
Type locality.—Guánica, Puerto Rico.

Diagnosis.—*Deiroderes inermis* has the forewing with vein M branching immediately distad of the r-m crossvein, M_{3+4} extending directly to the posterior margin of wing (nearly forming a right angle with M).

Adult.—*Dimensions* (mm): total length ♀ 3.2–3.5, ♂ 3.5; width between humeral angles ♀ 1.2–1.4; ♂ 1.3; pronotal length ♀ 0.8–1.0, ♂ 0.9; wing length ♀ 2.6–2.8, ♂ 2.4; width of head including eyes ♀ 1.1–1.3, ♂ 1.2. *Coloration:* body tan to dark brown; forewing dark basally, dark coloration sometimes extending ⅔ of wing length, with dark spot at distal end of vein Cu. *Structure: Head:* dorsal projections (Fig. 1) indistinct. *Thorax: Pronotum* (Fig. 2): metopidium low; humeral angles short, blunt; middorsal crest weakly produced; suprahumeral horns and carinae absent. *Legs* (Fig. 3): metathoracic femur with dorsal and ventral rows of cucullate setae; metathoracic tibiae with cucullate setae row I less robust than setae in II or III. *Forewing* (Fig. 4): M branching immediately distal to r-m crossvein, M_{3+4} extending to posterior edge of wing, at right angle to M. *Genitalia:* ♀: 2nd valvulae (Fig. 5) narrow throughout, apical ⅓ with distinct dorsal serrations. ♂: lateral plates (Fig. 6) free, lacking hooks, sparsely setose; styles (Fig. 7) with small hook apically; aedeagus (Fig. 7) with posterior arm straight.

Nymph.—Unknown.

Distribution.—British Virgin Islands: Guana Island [NCSU], Virgin Gorda



Figs. 1–7. *Deiroderes inermis.* Structures of the holotype (male genitalia illustrated from a non-type specimen). 1, Head, anterior aspect (face). 2, Head, pronotum, and scutellum, anterolateral aspect. 3, Left metathoracic femur, tibia, and tarsus, ablateral aspect. 4, Right forewing. 5, Female second valvulae, lateral aspect. 6, Male left lateral plate, lateral aspect. 7, Male aedeagus and left style, lateral aspect (illustrated with connective tissue). Abbreviations: $A_{\#}$, anal vein(s); ae, aedeagus; $Cu_{\#}$, cubital vein(s); cs, claval suture; ha, humeral angles; m-$cu_{\#}$, medial-cubital crossvein(s); $M_{\#}$, medial vein(s); mc, median carina; me, metopidium; sc, scutellum; st, style; r, radial crossvein; r-$m_{\#}$, radial-medial crossvein(s); $R_{\#}$, radial vein(s); I, II, III, enlarged setal rows.

[NCSU], Tortola [NCSU]; U.S. Virgin Islands: St. John [JARC]; Puerto Rico [NCSU].

Material examined.—Holotype [♀] [NCSU, deposited on indefinite loan to USNM] with labels: "Insular Forest/Guanica P.R./3-Aug. 1945./On Capparis nitida.," "J.A. Ramos/Collector," "Holotype," "Deiroderes/inermis Ramos/145." Paratype [♀; forewings missing] [NCSU] with labels: "Cambalache/P.R. 11-7-47," "Caldwell &/Martorell/Collectors," "Paratype," "Deitz Research/83-227e ♀," "JARC," and "PARATYPE/Deiroderes/inermis/Ramos." Other specimens: 1 ♀ (Deitz Research #83-227f ♀) from JARC; 2 ♂ (Cryan Research #94-286a ♂ and Cryan Research #94-273b ♂) from NCSU; 1 ♀ from USNM.

Remarks.—The holotype of *D. inermis* was collected on *Capparis* sp. (Capparaceae), though there is a discrepancy concerning the host species. In the original description of *D. inermis* (Ramos 1957a), the holotype is listed as "on *Capparis indica* (L.) Fawc and Rendle"; however, the holotype label information indicates the host as *C. nitida* (*C. indica* and *C. nitida* are not synonyms). This insect's Latin specific epithet translates directly to "unarmed" or "weaponless," presumably referring to the complete absence of pronotal projections (suprahumeral horns and posterior process).

A specimen of *D. inermis* from the British Virgin Islands was included in a molecular systematic investigation of membracid relationships (Cryan et al. 2000a). Results based on parsimony and maximum likelihood analyses of DNA nucleotide sequence data from two nuclear genes (EF-1α and 28S rDNA) indicated that *Deiroderes* was a member of a clade that also included *Antillotolania* Ramos and *Microcentrus* Stål.

Deiroderes inornatus Cryan and Deitz, new species

(Figs. 8–13)

Type locality.—Jamaica.

Diagnosis.—*Deiroderes inornatus* has a simple, unadorned pronotum, strongly deflected postclypeus and beak, and sinuate aedeagus.

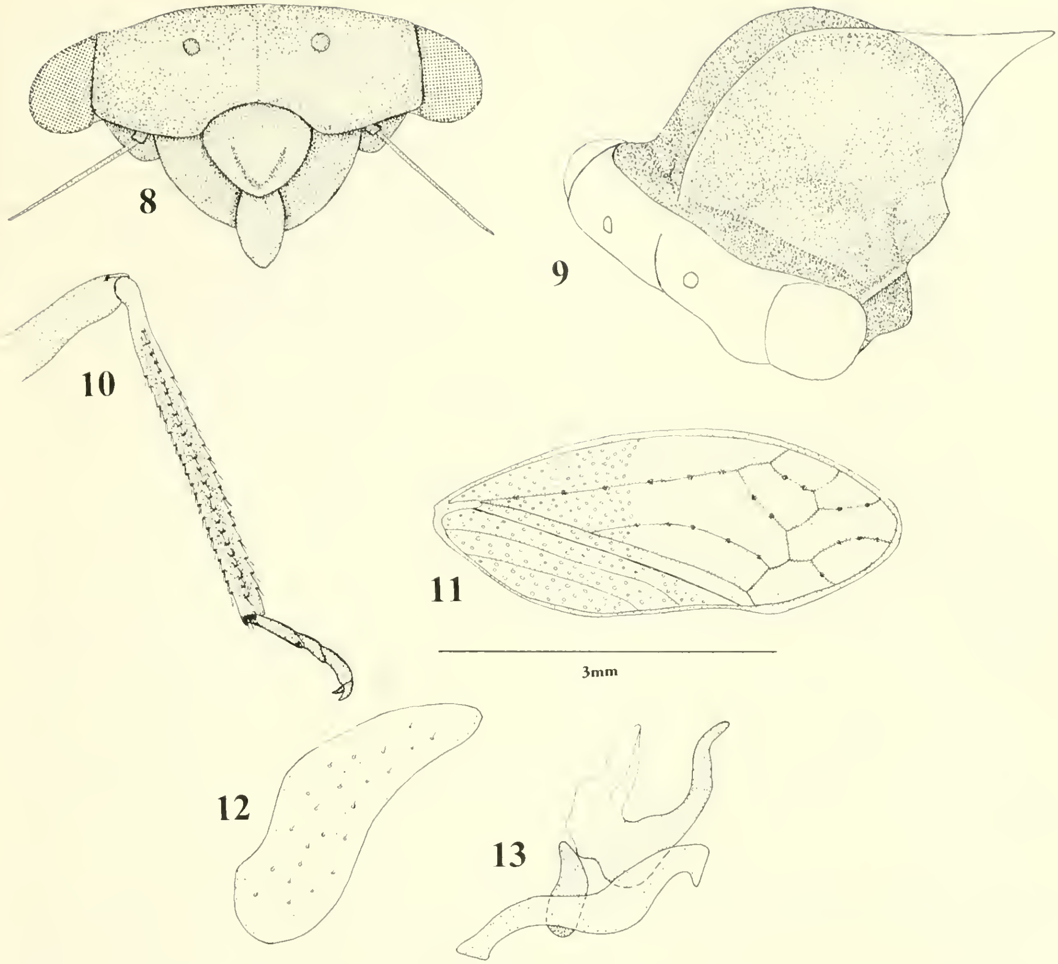
Adult ♂.—*Dimensions* (mm): total length 5.1–6.0; width between humeral angles 1.9–2.1; pronotal length 1.4–1.5; wing length 4.0–4.9; width of head including eyes 2.1–2.3. *Coloration:* body tan to dark brown; forewing tan or dark brown basally, light brown apically. *Structure: Head:* dorsal projections (Fig. 8) small or indistinct; postclypeus and anteclypeus strongly deflected under thorax. *Thorax: Pronotum* (Fig. 9): metopidium low; humeral angles weakly produced; mid-dorsal crest weakly produced; suprahumeral carinae and horns absent. *Legs* (Fig. 10): metathoracic femur without rows of cucullate setae. *Forewing* (Fig. 11): vein M branching well after r-m crossvein; M_{3+4} extending obliquely to posterior margin of wing; some specimens with 2 r-m crossveins on one or both forewings. *Genitalia:* lateral plates (Fig. 12) free, without hooks; styles (Fig. 13) sinuate, hooked apically; aedeagus (Fig. 13) with posterior arm sinuate, narrowing apically. ♀: unknown.

Nymph.—Unknown.

Distribution.—Jamaica [USNM, CNCI].

Material examined.—Holotype [♂] [USNM] with labels: "Jamaica/19-VII-35," "Sta 16/Chapin and/Blackwelder," "Voucher Specimen/Cuticular Hydrocarbon/Analysis Study/Jason R. Cryan, 1995," and "HOLOTYPE ♂/*Deiroderes*/*inornatus*/Cryan & Deitz." Paratype [♂] [CNCI] with labels: "JAMAICA, 4000′/Hardwar Gap/VII-23-1966/Howden & Becker," "Specimen data/captured—NMNH/Biota (Colwell) file," and "PARATYPE ♂/*Deiroderes*/*inornatus*/Cryan & Deitz." Paratype [♂, dissected; head and pronotum missing] [USNM] with labels: "Jamaica/19-VII-35," "Sta 16/Chapin and/Blackwelder," "CRYAN RESEARCH/#94-273a ♂," and "PARATYPE ♂/*Deiroderes*/*inornatus*/Cryan & Deitz." Other specimens: 1 ♂ from CNCI; 1 ♂ from USNM.

Remarks.—*Deiroderes inornatus* is de-



Figs. 8–13. *Deiroderes inornatus*. Structures of the holotype. 8, Head, anterior aspect (face). 9, Head, pronotum, and scutellum, anterolateral aspect. 10, Left metathoracic femur, tibia, and tarsus, ablateral aspect. 11, Right forewing. 12, Male left lateral plate, lateral aspect. 13, Male aedeagus and left style, lateral aspect (illustrated with connective tissue).

scribed from five males; females are unknown. Minor color variation is evident among males, and while some specimens have 2 r-m crossveins in one or both forewings, no other substantial variation in morphology of males is apparent. Further, although some species in the subfamily Stegaspidinae exhibit sexual di- or polymorphism (Cryan et al. in press), both sexes of *D. inermis* are morphologically similar. This fact, combined with the apparent allopatric distribution of *Deiroderes* species, makes it unlikely that *D. inornatus* is actually the male of *D. punctatus* (for which males are unknown).

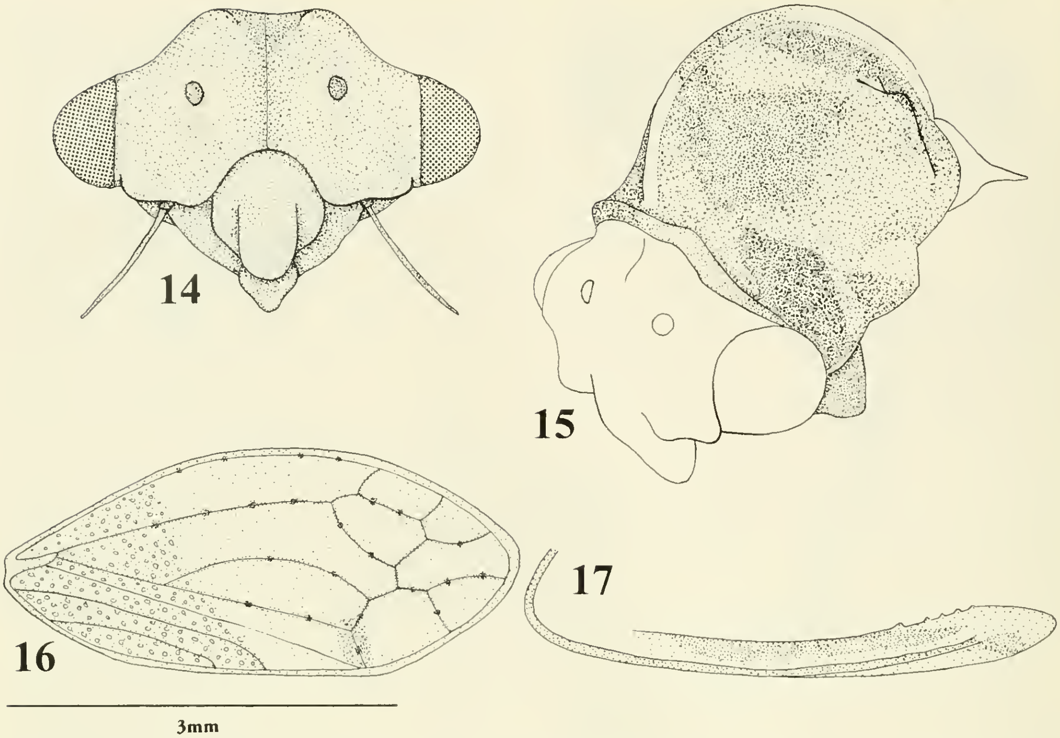
The specific name "*inornatus*" is Latin for "unadorned," referring to the lack of suprahumeral horns and posterior pronotal process in this species.

Deiroderes punctatus (Metcalf and Bruner)

(Figs. 14–17)

Tolania punctata Metcalf and Bruner 1925b: 213.

Eustollia punctata: Goding 1926a: 105.



Figs. 14–17. *Deiroderes punctatus.* Structures of a female paratype. 14, Head, anterior aspect (face). 15, Head, pronotum, and scutellum, anterolateral aspect. 16, Right forewing. 17, Female second valvulae, lateral aspect.

Deiroderes punctatus: Ramos 1957a: 96.
Microcentrus punctata: Hamilton 1971b: 235.

Type locality.—Camagüey, Cuba.

Diagnosis.—*Deiroderes punctatus* has an elevated pronotum with an expanded middorsal carina and suprahumeral ridges.

Adult ♀.—*Dimensions* (mm): total length 3.6–3.8; width between humeral angles 1.3–1.4; pronotal length 0.9–1.1; wing length 3.0–3.1; width of head including eyes 1.3–1.4. *Coloration:* body light brown; pronotum with dark brown patches; forewing brown in basal ⅓, with dark spot at distal end of vein Cu. *Structure: Head:* dorsal projections (Fig. 14) distinct, partially hidden by anterior pronotal shelf; postclypeus prominent, trilobed. *Thorax: Pronotum* (Fig. 15): metopidium elevated; suprahumeral carinae present; middorsal carina strongly elevated; supraocular callosities evident. *Legs:* metathoracic femur without rows of cucullate setae. *Forewing* (Fig. 16): vein M branching well beyond r-m crossvein; M_{3+4} extending obliquely to posterior margin of wing. *Genitalia:* ♀: 2nd valvulae (Fig. 17) narrow throughout, distal ⅓ with distinct dorsal serrations. ♂: unknown.

Nymph.—Unknown.

Distribution.—Cuba [NCSU].

Material examined.—Paratype [♀, dissected] [NCSU] with labels: "Camaguey, Cuba/Col. J. Acuna/Julie 15, 1923.," "On/"Guaitajan," "190b," "CUBA/5," "Paratype," "Deitz Research/73-107c ♀," "Tolania/punctata/Metc. & Brun./det. Z.P.M.," and "Deiroderes/punctata/(Metcalf &/Bruner)/det. L.L. Deitz 1983." Paratype [♀] [NCSU] with labels: "9061," "Camaguey, Cuba/Col., J. Acuna/Julie 15, 1923.," "Paratype," and "Tolania/punctata/Metc. & Brun./det. Z.P.M."

Remarks.—Although included in four different genera by four different authors, the overall morphology of *D. punctatus* (especially of the forewing) places it in the genus *Deiroderes.* The specific epithet is an adjective and must agree in gender with *Deiroderes* (masculine); thus the correct spelling is *D. punctatus.* Other than the cryptic reference of one specimen being found "on Guaitajan" (see Material Examined, above; we found no reference to this in any botanical literature consulted), no information is available concerning the life history, ecology, or behavior of this species.

Genus *Holdgatiella* Evans 1962

Holdgatiella Evans 1962a: 515. Type species: *Holdgatiella chepuensis* Evans 1962a: 516, by original designation.

Diagnosis.—The forewing of *Holdgatiella* has vein M 3-branched; the male aedeagus is tentaculate.

Adult.—*Dimensions* (mm): total length (from head to apex of forewings at rest) 6.1–7.9. *Structure: Head* (Figs. 18, 25): dorsal projections weakly developed. *Thorax: Pronotum* (Figs. 19, 26): suprahumeral horns and posterior process absent; metopidium steeply declivous. *Pronotal surface sculpturing:* finely punctate, each pit associated with one short seta. *Scutellum* (Figs. 19, 26): swollen basally, flattening to acuminate apex. *Legs* (Figs. 20, 27): metathoracic tibiae with cucullate setae in rows I, II, and III; metathoracic tarsomere I with 1 apical cucullate seta. *Forewing* (Figs. 21, 28): apical limbus broadened proximally along costal margin, vein M with 3 branches, 1 r-m crossvein present (distad of first branch of vein M). *Hindwing:* venation essentially identical to *Microcentrus* hindwing venation as illustrated by Deitz (1975a, fig. 37c) and Dietrich et al. (2001, fig. 2B); apex with arcuate chaetoids (Dietrich and Deitz 1993a, Dietrich et al. 2001a). *Genitalia:* ♀ 2nd valvulae (Figs. 22, 29) slightly broadened at or beyond midpoint, with distinct dorsal serrations; ♂ lateral plates (Figs. 23) fused to pygofer; apex of aedeagus tentaculate (Fig. 24).

Range.—Chile, Venezuela.

Remarks.—As Evans (1961a) observed, *Holdgatiella* superficially resembles *Deiroderes,* differing chiefly in wing venation and morphology of the male and female genitalia. Evans placed *Holdgatiella* in the subfamily Centrotinae, while noting that the genus is closely related to the complex comprising Aetalionidae, Nicomiidae (now Membracidae: Nicomiinae), Biturritidae (now Aetalionidae: Biturritiinae), and the leafhopper subfamilies Ulopinae and Macropsinae. Linnavuori and DeLong (1978a) wrote, "*Holdgatiella,* an undoubted Mesozoic relic, evidently belongs to Membracidae as suggested by Evans, although it apparently has rather an isolated position within this family. Its relations to the other Membracidae remain open until a modern revision of the neotropical representatives of the family has been done." Indeed, this genus was among seven membracid genera unplaced to subfamily in Deitz and Dietrich's (1993a) reclassification of Membracoidea. The morphology-based phylogenetic analyses of Dietrich et al. (2001a) suggest that *Holdgatiella* is the sister group to Nicomiinae, and the authors noted that an expanded concept of Nicomiinae (to include *Holdgatiella* and other groups) might be warranted. In those analyses, *Holdgatiella* is closely allied with *Nicomia* and *Tolania,* based primarily on forewing venation: vein M with three branches and vein R with four branches (only in *H. stria,* new species, but apparently the plesiomorphic condition). The tentaculate male aedeagus of *Holdgatiella,* however, sets it distinctly apart from these genera. Results from a separate morphology-based phylogenetic investigation of basal treehopper groups (Cryan et al. in press) agreed with the alliance of *Holdgatiella* with Nicomiinae. A more detailed analysis of relationships within Nicomiinae and related groups is underway (Albertson and Dietrich, personal communication).

KEY TO THE SPECIES OF ADULT *HOLDGATIELLA*

1. Scutellum (Fig. 19) without mid-dorsal groove; metathoracic femur (Fig. 20) with ventral row of cucullate setae; forewing (Fig. 21) with 2 or 3 m-cu crossveins; frons with foliate lobes weakly developed (Fig. 18) . . . . *H. chepuensis* Evans

– Scutellum (Fig. 26) with mid-dorsal groove; metathoracic femur (Fig. 27) without ventral cucullate setae; forewing (Fig. 28) with only 1 m-cu crossvein; frons with foliate lobes well developed (Fig. 25) . . . . . *H. stria*, new species

Holdgatiella chepuensis Evans
(Figs. 18–24)

Holdgatiella chepuensis Evans 1962a: 516.

Type locality.—Chepu, Chile.

Diagnosis.—*Holdgatiella chepuensis* has a ventral row of cucullate setae on the metathoracic femur.

Adult.—*Dimensions* (mm): total length ♀ 6.5–7.0, ♂ 6.1–6.4; width between humeral angles ♀ 2.2–2.4, ♂ 2.1–2.2; pronotal length ♀ 1.2–1.4, ♂ 1.3–1.4; wing length ♀ 5.5–5.9, ♂ 5.2–5.4; width of head including eyes ♀ 2.4–2.6, ♂ 2.3–2.4. *Coloration:* ♀: face and body tan with dark brown markings, legs tan, forewing tan basally, hyaline apically; ♂: face and body fuscous with black markings, abdominal sternites yellow, abdominal tergites yellow with brown transverse stripes, legs fuscous dorsally, tan ventrally, forewing brown basally, anterior half of membranous area hyaline, posterior half brown. *Structure: Head:* face (Fig. 18) with weakly developed foliate lobes; postclypeus ovoid. *Thorax: Pronotum* (Fig. 19): humeral angles produced, blunt; median dorsal carina weak; posterior margin without triangular projections. *Pronotal surface sculpturing:* punctate; pits shallow, associated with a single short, apically curved seta. *Scutellum* (Fig. 19): slightly swollen basally, flattening to acuminate apex. *Legs* (Fig. 20): metathoracic femur with dorsal and ventral rows of cucullate setae (20–26 and 15–18 setae, respectively). *Forewing* (Fig. 21): basal ⅓–½ coriaceous; branching pattern of vein R variable; 2 or 3 m-cu crossveins present, distal m-cu crossvein distad of first branch of vein M. *Genitalia:* ♀: 2nd valvulae (Fig. 22) abruptly broadened in distal ⅓; dorsal ridge of broadened area weakly serrate. ♂: lateral plate (Fig. 23) fused to pygofer; styles (Fig. 24) elongate, ventrally curved to axe-like apical lobe; aedeagus (Fig. 24) L-shaped, anterior arm irregularly shaped, posterior arm slender; anterior face of posterior arm apically tentaculate (5 pairs of short, tentacle-like appendages).

Nymph.—Unknown.

Distribution.—Chile: Aucar [JWEC]; Cautin [JARC]; Chepu [NCSU]; Llanquihue [JARC]; Osorno [JARC].

Material examined.—Holotype not examined. Other specimens: 2 ♀ and 4 ♂ from JARC, 1 ♂ from JWEC, and 1 ♂ from NCSU.

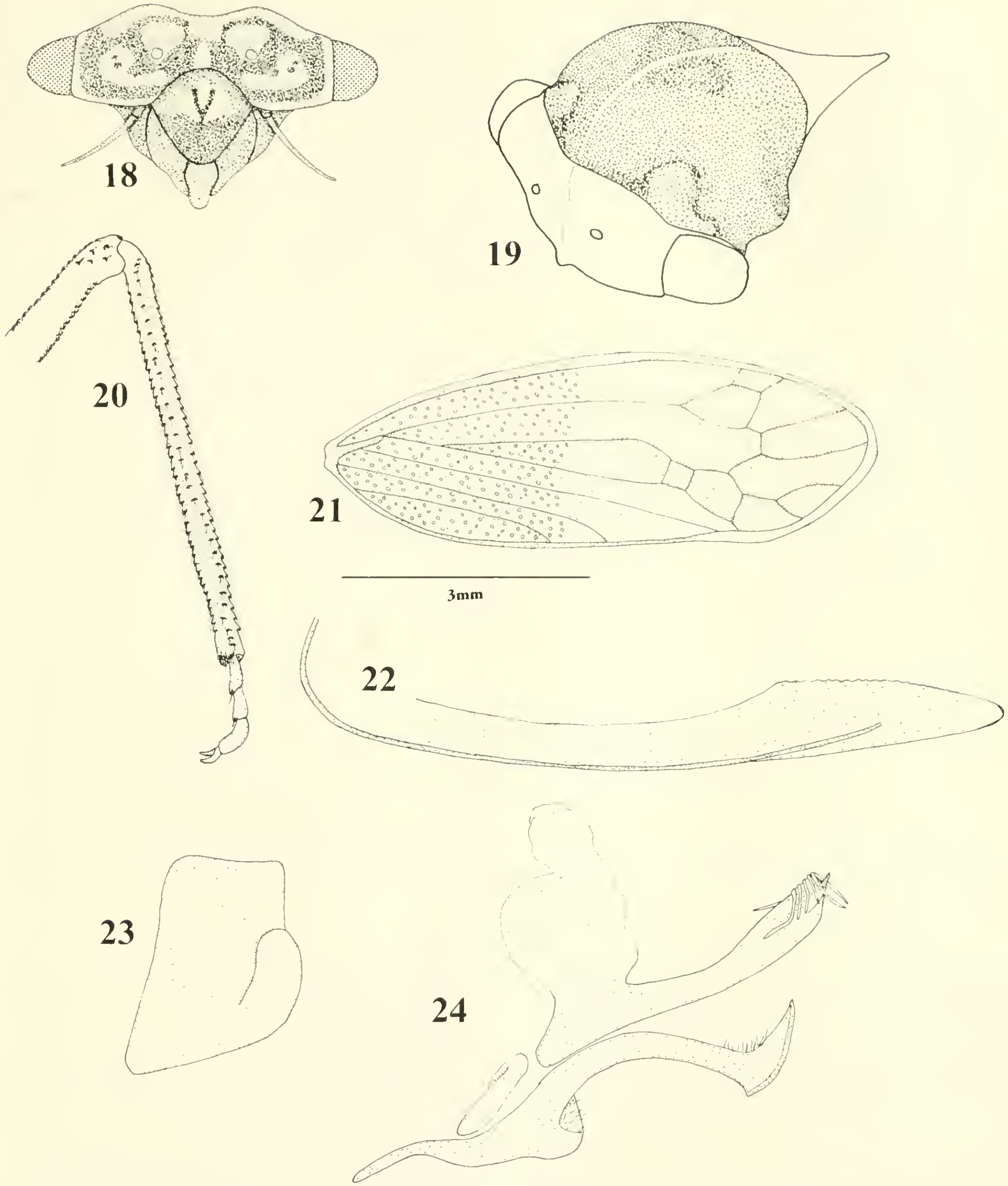
Remarks.—The aedeagal structure of this species differs greatly from that of other treehoppers. Not only are the apical lobes of the styles uniquely shaped, but also the presence of five pairs of apical appendages on the aedeagal corona sets *H. chepuensis* apart. Linnavuori and DeLong (1978a) illustrated various anatomical structures of *H. chepuensis*, including the hindwing, which appears nearly identical in venation to *Microcentrus* hindwings (Deitz 1975a, fig. 37c; Dietrich et al. 2001a, fig. 2B). The specific name "*chepuensis*" refers to the type locality, Chepu, Chile.

***Holdgatiella stria* Cryan and Deitz, new species**
(Figs. 25–29)

Type locality.—20 km SE of Azulita, Mérida, Venezuela.

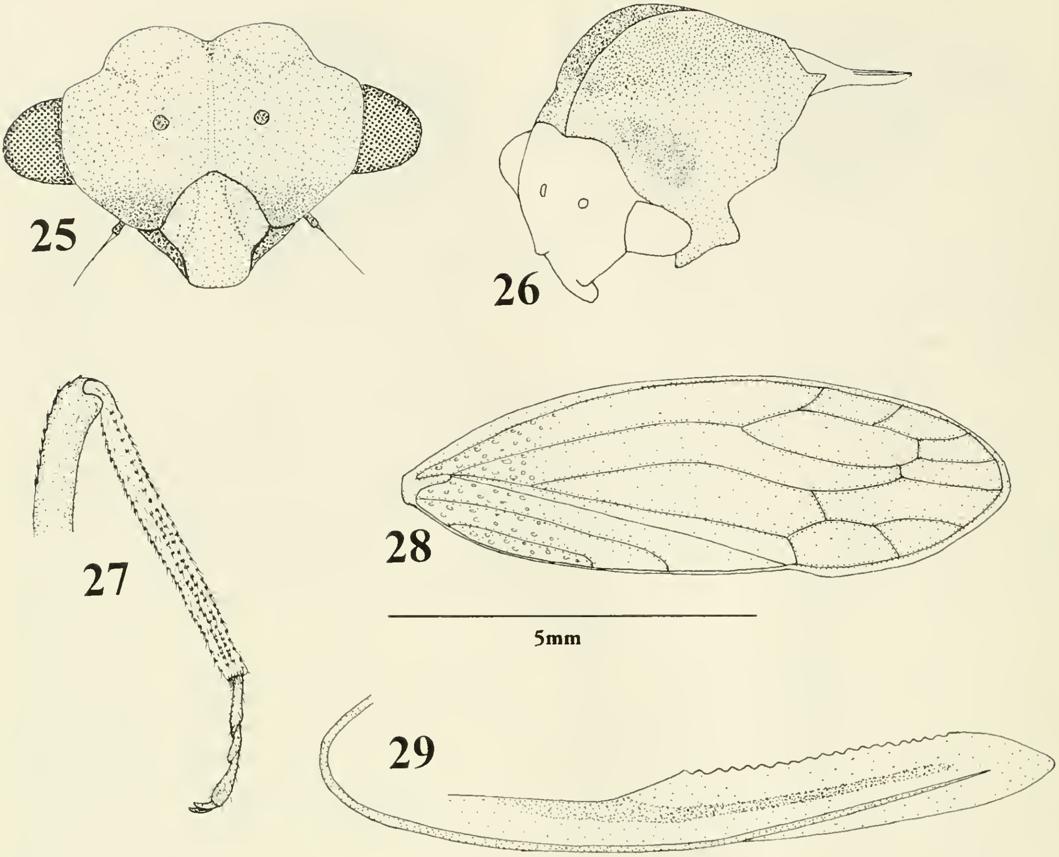
Diagnosis.—*Holdgatiella stria* has the pronotum with posterolateral processes, the scutellum with a median dorsal groove, and the forewing with 1 m-cu crossvein.

Adult ♀.—*Dimensions* (mm): total length 7.9; width between humeral angles 2.6; pronotal length 2.1; wing length 7.0; width of head including eyes 2.5. *Coloration:* face tan with fuscous punctures and



Figs. 18–24. *Holdgatiella chepuensis.* 18, Head, anterior aspect (face). 19, Head, pronotum, and scutellum, anterolateral aspect. 20, Left metathoracic femur, tibia, and tarsus, ablateral aspect. 21, Right forewing. 22, Female second valvulae, lateral aspect. 23, Male left lateral plate and pygofer, lateral aspect. 24, Male aedeagus and left style, lateral aspect (illustrated with connective tissue).

foliate lobes, body tan with dark markings, pronotum tan with brown metopidial crown, legs tan, forewing tan basally, hyaline apically. *Structure: Head:* face (Fig. 25) with well-developed foliate lobes; postclypeus weakly trilobed. *Thorax: Pronotum* (Fig. 26): humeral angles short, stout; median dorsal carina well developed; posterior margin with triangular projections on either side of scutellum. *Scutellum* (Fig.



Figs. 25–29. *Holdgatiella stria.* Structures of the holotype. 25, Head, anterior aspect (face). 26, Head, pronotum, and scutellum, anterolateral aspect. 27, Left metathoracic femur, tibia, and tarsus, ablateral aspect. 28, Right forewing. 29, Female second valvulae, lateral aspect.

26): slightly produced basally, flattening to acuminate apex, with median dorsal groove. *Legs* (Fig. 27): metathoracic femur with dorsal row of 15–18 cucullate setae; metathoracic tibia with paired cucullate setae in distal ½ of row II. *Forewing* (Fig. 28): basal ¼ coriaceous; vein R with 4 branches (R_1, R_2, R_3, R_{4+5}); 1 m-cu crossvein present, distad of first branch of vein M. *Genitalia:* 2nd valvulae (Fig. 29) slightly broadened midway; dorsal ridge of distal ½ serrate. ♂: unknown.

Nymph.—Unknown.

Distribution.—Venezuela: Mérida [SHMC/USNM].

Material examined.—Holotype [♀] [SHMC, deposited on indefinite loan to USNM], with labels "VEN: Merida, 20 km/SE Azulita, La/Carbonera 27.VII-/3.VIII.89 S&J Peck," "♀," "*Holdgatiella* sp./det. S. McKamey 1991," and "HOLOTYPE/*Holdgatiella*/*stria*/Cryan & Deitz."

Remarks.—Although the scutellum is not emarginate apically, the presence of a median dorsal groove suggests that the ancestors of *H. stria* had a posterior pronotal process that was secondarily lost. The specific name "*stria*" is Latin for "furrow" or "groove," referring to the median dorsal groove of the scutellum.

Genus *Togotolania* Cryan and Deitz, new genus

Type species.—*Togotolania longicorna,* new species.

Diagnosis.—*Togotolania* has the following unique combination of characters: head with large dorsal projections, pronotum with a median horn, and forewings each with 3 r-m and 1 m-cu crossveins.

Adult.—*Dimensions* (mm): total length (from head to apex of forewings at rest) 6.4–7.2. *Structure: Head:* dorsal cranial projections large, either pyramiform (Fig. 30) or emarginate (Fig. 35); ocelli on or above centro-ocular line. *Thorax: Pronotum* (Figs. 31, 36): metopidium elevated; supraocular callosities indistinct; posterior process lacking, suprahumeral horns absent or represented by low carinae at base of median dorsal horn. *Scutellum* (Figs. 31, 36): short with swollen base, flattening to acuminate apex. *Legs* (Fig. 32): metathoracic tibia with enlarged setal rows I, II, and III, all with reduced cucullate setae. *Forewing* (Figs. 33, 37): 3 r-m crossveins present; vein R_{4+5} fused to R basad of fork of R_1 and R_{2+3}; 1 m-cu crossvein present, distad of fork of vein M. *Hindwing:* venation essentially identical to *Microcentrus* hindwing venation as illustrated by Deitz (1975a, fig. 37c) and Dietrich et al. (2001, fig. 2B). *Genitalia:* ♀ 2nd valvulae (Fig. 34) broadened at midpoint; ♂ lateral plates (Fig. 38) free, lacking apical hook; styles (Fig. 39) slender, with apical hook; aedeagus (Fig. 39) U-shaped, with posterior arm tapering sharply at apex.

Range.—Dominican Republic, Guadeloupe.

Remarks.—Included in the phylogenetic analysis of Dietrich et al. (2001a) as "New Genus T", *Togotolania* was placed in a largely unresolved lineage basal to the clade comprising Nicomiinae + Centrodontinae + Centronodinae. Results of a separate morphology-based analysis (Cryan et al. in press) were concordant, with *Togotolania* placed at the base of a lineage comprising *Holdgatiella, Tolania,* and Centronodini. Although we here leave *Togotolania* unplaced in the family Membracidae, we acknowledge that this genus is probably allied with Nicomiinae. The generic name "*Togotolania*" translates as "cloaked *Tolania*" and refers to the hoodlike pronotal structure. It is formed from "*toga*" [Latin] and "*tolania*" [origin unknown], joined by the vowel "o" for euphony (Brown 1956).

Key to the Species of Adult *Togotolania*

1. Median pronotal horn (Fig. 31) large, laterally compressed; head (Figs. 30–31) with pyramiform dorsal projections; forewing (Fig. 33) with crossvein r-m_2 distad of fork of vein M . . . . *T. longicorna,* new species
– Median pronotal horn (Fig. 36) small, not laterally compressed; head (Figs. 35–36) with emarginate dorsal projections; forewing (Fig. 37) with crossvein r-m_2 basad of fork of vein M . . . . *T. brachycorna,* new species

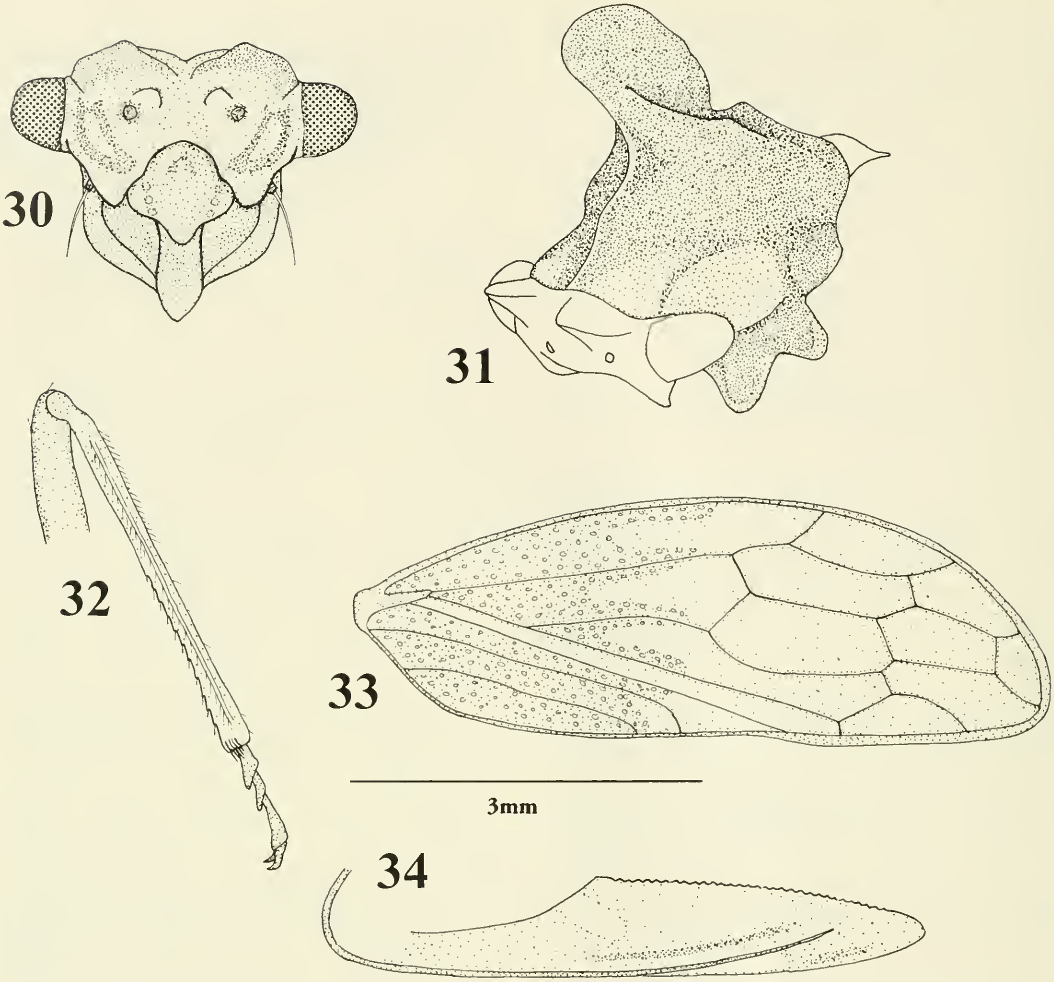
***Togotolania longicorna* Cryan and Deitz, new species**

(Figs. 30–34)

Type locality.—2 km east of Boca Chica, Dominican Republic.

Diagnosis.—*Togotolania longicorna* is easily recognized by its large, median, anterior pronotal horn; the pronotum is uniformly black.

Adult ♀.—*Dimensions* (mm): total length 6.4; width between humeral angles 1.9; pronotal length 1.6; wing length 5.1; width of head including eyes 1.9. *Coloration:* face tan with dark brown ovate markings; body fuscous with pronotum black; forewing brown with dark venation; legs brown. *Structure: Head:* face (Fig. 30) strongly sulcate between pyramiform dorsal projections; postclypeus weakly trilobed, each lateral lobe with 3 small callosities; foliate lobes strongly developed. *Thorax: Pronotum* (Fig. 31): humeral angles well developed, blunt; median dorsal horn laterally compressed; suprahumeral horns reduced to low carinae at base of median horn. *Scutellum* (Fig. 31): apex acuminate, lacking median dorsal groove. *Legs* (Fig. 32): metathoracic femur with 1 dorsal cucullate seta; metathoracic tibia with weakly cucullate setae in rows I, II, and III. *Forewing* (Fig. 33): r-m_2 and r-m_3 distad of fork of vein M. *Genitalia:* 2nd valvulae (Fig. 34) broadened at midpoint, tapering to apex;



Figs. 30–34. *Togotolania longicorna.* Structures of the holotype. 30, Head, anterior aspect (face). 31, Head, pronotum, and scutellum, anterolateral aspect. 32, Left metathoracic femur, tibia, and tarsus, ablateral aspect. 33, Right forewing. 34, Female second valvulae, lateral aspect.

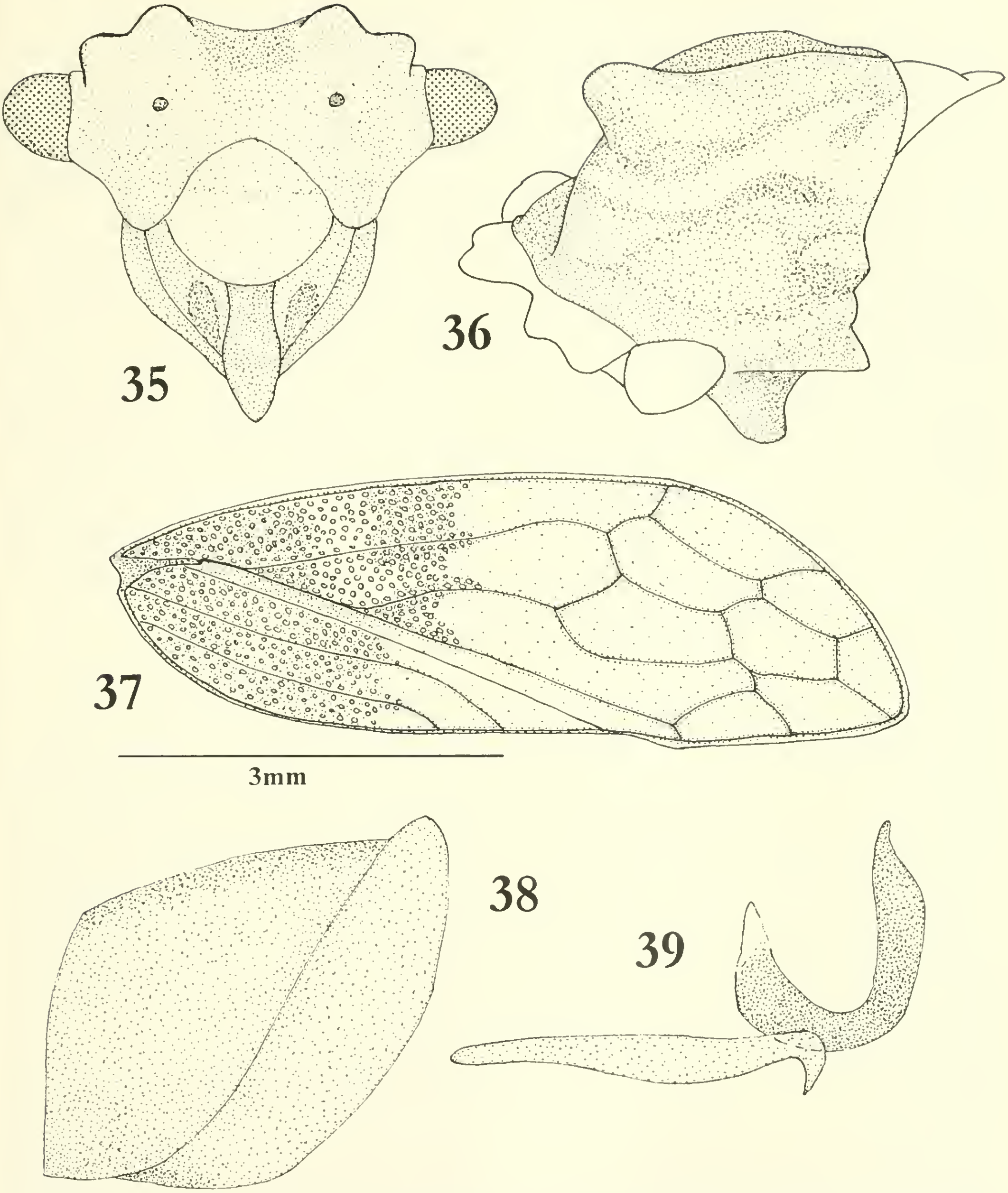
dorsal ridge of broadened area serrate. ♂: unknown.

Nymph.—Unknown.

Distribution.—Dominican Republic [SHMC/USNM].

Material examined.—Holotype [♀, dissected] [SHMC, on indefinite loan to USNM] with labels "DOM. REP., Dis. Nac.,/2 km. E. Boca Chica/August 11, 1979/C.W. O'Brien," "VOUCHER SPECIMEN/Cuticular Hydrocarbon/Analysis Study/Jason R. Cryan, 1995," "HOLOTYPE/*Togotolania*/*longicorna*/Cryan & Deitz," and "SHM."

Remarks.—*Togotolania longicorna,* described from a single female specimen, is unique in its large, median dorsal horn on the crest of the pronotal metopidium. The suprahumeral carinae are located at the base of this horn; in some other treehopper groups with a dorsal pronotal elongation, the suprahumeral horns or carinae are at or near the apex (for example, the genus *Lycoderes* Germar; see Cryan and Deitz 1999b: fig. 2). The Latin specific name "*longicorna*" translates as "long horned," referring to the median anterior pronotal horn.



Figs. 35–39. *Togotolania brachycorna.* Structures of the holotype. 35, Head, anterior aspect (face). 36, Head, pronotum, and scutellum, anterolateral aspect. 37, Right forewing. 38, Male left lateral plate and pygofer, lateral aspect. 39, Male aedeagus and left style, lateral aspect.

Togotolania brachycorna **Cryan and Deitz, new species**

(Figs. 35–39)

Type locality.—Riv. Corossol, Guadeloupe.

Diagnosis.—The median, anterior pronotal horn of *Togotolania brachycorna* is short and weakly developed; the pronotum is mottled brown and tan, with a pale stripe encircling the median horn.

Adult ♂.—*Dimensions* (mm): total length 7.2; width between humeral angles 2.3; pronotal length 1.9; wing length 5.6; width of head including eyes 2.2. *Coloration:* face, body, pronotum, and legs mottled brown and tan; pronotum with pale strip encircling median horn; basal ⅓ and venation of forewing dark brown. *Structure: Head:* face (Figs. 35–36) strongly sulcate between large, emarginate dorsal projections; postclypeus unilobed; foliate lobes rounded. *Thorax: Pronotum* (Fig. 36): humeral angles well developed, blunt; median dorsal horn weakly developed; suprahumeral horns absent. *Scutellum* (Fig. 36): apex acuminate, lacking median dorsal groove. *Legs:* metathoracic femur with 1 dorsal cucullate seta; metathoracic tibia with minute cucullate setae in rows I, II, and III. *Forewing* (Fig. 37): r-m_1 and r-m_2 basad of fork of vein M. *Genitalia:* lateral plates (Fig. 38) large, free, lacking apical hook; styles (Fig. 39) slender, hooked apically; aedeagus (Fig. 39) strongly U-shaped, with posterior arm tapered and lacking denticles on anterior face. ♀: unknown.

Nymph.—Unknown.

Distribution.—Guadeloupe [CIRAD/MNHN].

Material examined.—Holotype [♂, dissected, with hindwings and 1 leg mounted beneath specimen] [CIRAD, deposited at MNHN] with labels "GUADELOUPE/Forêt, PETIT-BOURG/Riv. Corossol/20-X-1962/J. Bonfils," "3," and "HOLOTYPE/*Togotolania/brachycorna*/Cryan & Deitz."

Remarks.—*Togotolania brachycorna*, described from a single male specimen, has a much shorter median pronotal horn relative to its congener (described above). The suprahumeral horns are lacking, and the pronotal coloration differs greatly from that of *T. longicorna*. Based on morphological variation and geographical separation, we believe the possibility is remote that *T. brachycorna* is the male of *T. longicorna*. The Latin specific name "*brachycorna*" translates as "short horned," referring to the median anterior pronotal horn.

Discussion and Summary

The genus *Deiroderes* (with three species) is potentially allied to *Antillotolania* within the subfamily Stegaspidinae, although tribal association is unclear. Despite some similarities with the genera *Melizoderes* and *Llanquihuea* (family Melizoderidae; Linnavuori and DeLong 1978a, Deitz and Dietrich 1993a), *Holdgatiella* and *Togotolania* (each with two species) are apparently among the basal lineages within Membracidae, probably allied with the subfamily Nicomiinae (Dietrich et al. 2001a; Cryan et al. in press). Further studies may confirm that one or two new family group taxa are needed to accommodate these treehoppers.

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THE SAWFLY GENUS *KAMBAITINA* MALAISE (HYMENOPTERA: TENTHREDINIDAE) IN INDIA

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Abstract.—The southeastern Asian genus *Kambaitana* is reviewed. Five **new species** from India are described: ***K. clypeata, K. lineata, K. impunctata, K. pup,*** and ***K. cardiaca.*** *Kambaitana fulvipicta* Malaise from Myanmar and India is redescribed. Males of the genus are characterized for the first time. A key for all seven known species, including *K. albipicta* Malaise from Myanmar, is provided.

Key Words: *Kambaitina,* India, Myanmar, Tenthredinidae, Allantinae

The genus *Kambaitina* is known only from Myanmar and India. It was described by Malaise (1961) who included two new species, *K. fulvipicta* and *K. albipicta,* both from Myanmar. Saini and Deep (1994) first recorded the genus and *K. albipicta* from India. The genus belongs in the subfamily Allantinae as defined by Smith (1979), and in which it was subsequently included by Abe and Smith (1991). Here we describe five additional species from India, describe the males of the genus for the first time, and give a key to all seven species.

Host plants are not known for the genus. Species may be associated with rosaceous plants such as *Rubus* spp. or *Fragaria* spp. as are many related allantines in the Northern Hemisphere.

Types of new species are deposited in Pusa National Collections, Division of Entomology, Indian Agricultural Research Institute, New Delhi. Paratypes are in Punjabi University, Patiala, India (PUP) and the National Museum of Natural History, Smithsonian Institution, Washington, DC (USNM).

Abbreviations used in text are: EL = eye length; IATS = inner apical tibial spur; ICD = intercenchri distance; IDMO = interocular distance at level of median ocellus; ITD = intertegular distance; LID = lower interocular distance; MB = metabasitarsus; OATS = outer apical tibial spur; OCL = oculooccipital distance; OOL = oculoocellar distance, POL = postocellar distance.

Kambaitana Malaise

Kambaitina Malaise 1961: 253–255; Malaise 1963: 192 (in key); Abe and Smith 1991: 41, 103. Type species: *Kambaitina fulvipicta* Malaise, by original designation.

Description.—Antenna long, 2.7–3.2× head width, hardly tapering towards apex; third segment equal to or shorter than fourth segment; scape longer than its apical width; pedicel almost as long as broad. Inner margins of eyes subparallel, scarcely converging below; lower interocular distance greater than eye length (Fig. 2). Clypeus deeply, roundly incised ⅓ to ½ its medial length, with blunt lateral lobes (Fig. 2); frontal area

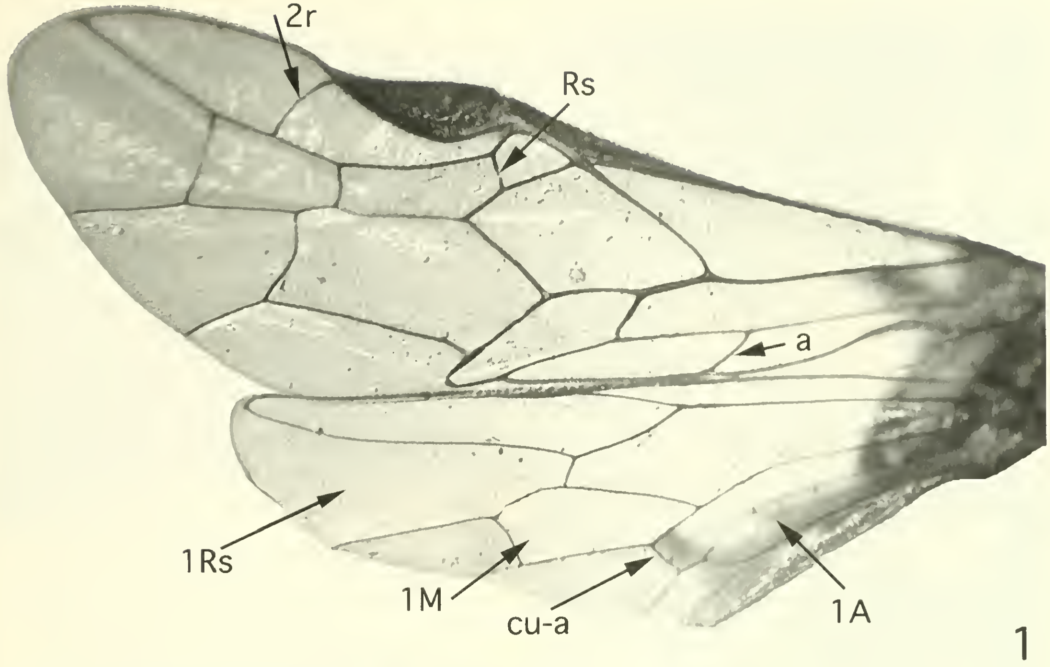


Fig. 1. Forewing and hindwing of *Kambaitina cardiaca.*

roundly elevated above a tangent touching both eyes; postocellar area subconvex, broader than long (Fig. 3). Malar space about equal to diameter of front ocellus. Genal carina developed only near base of mandible. Mandibles asymmetrical, right mandible with a large subapical tooth, left mandible with minute subapical tooth, almost simple. Metabasitarsus shorter than following segments combined; tarsal claws with long subapical tooth, slightly shorter than outer tooth; basal lobe absent. Forewing (Fig. 1) with crossvein 2r present; Rs present, therefore with 4 cubital cells; anal cross vein (a) oblique (70°). Hindwing (Fig. 1) with cell 1M closed, cell 1Rs open; anal cell (1A) petiolate, petiole shorter than cell width; cu-a meeting petiole of anal cell at a slightly oblique angle. Ovipositor well sclerotized, long and slender (Fig. 4).

Discussion.—*Kambaitana* belongs to the group of genera Malaise (1961) called the *Monostegidea* group, which includes *Empronus* Malaise, *Monostegidea* Rohwer, and *Kambaitia*. All are eastern Asian and Oriental. This group is characterized by the asymmetric mandibles, the right mandible with a large subapical tooth and the left mandible with only a minute tooth, almost simple (in other genera of Allantinae with asymmetric mandibles the left mandible has a large tooth and the right mandible is simple); the long malar space; the closed cell M in the hindwing; the short metabasitarsus; and the long antennae with a short third segment. Malaise (1961) gave a key to these four genera and defined *Kambaitina* by roundly incised clypeus with blunt lateral teeth; the hind orbits carinate only near the base of the mandibles; the scape and pedicel both longer than broad; the tarsal claw with inner tooth about as long as outer one and without a basal lobe; the subconvex mesoscutellum situated on the same level as all three mesonotal lobes; the hindleg with the tibia longer than the tarsus; and the lateral furrows of the head reaching the back of the head. The latter four characters distinguish *Kambaitana* from *Kambatia,* the genus to which it is most similar.

Figs. 2–3. *Kambaitina cardiaca.* 2, Head, front view. 3, Head, dorsal view.

Based on the tarsal claw character given by Malaise (1961), the placement of *K. albipicta* from Myanmar is not clear. He stated that *K. albipicta* has "claw without basal lobe, with a very small one, then with a bristle." Because species of *Kambaitina* lack a basal lobe, we believe *K. albipicta* may belong in *Kambatia.* Although this decision will require study of the type, we include *K. albipicta* in the following key to species.

Malaise (1961) did not have males of either of the two species he described. Because we have available males of most species, we feel that the generic character "scape and pedicel distinctly longer than they are broad at apex," should be changed to "scape distinctly longer than broad at apex." In all males, the pedicel is almost as long as broad at its apex.

KEY TO SPECIES OF *KAMBAITINA*

1\. Antenna entirely black 2

– Antenna with a white band, segments 6 to 7 or more whitish yellow 4

2\. Clypeus roundly, narrowly, and deeply incised (Fig. 8); median fovea broad, deep and ditchlike; antennal segments 5–9 compressed (male genitalia as in Figs. 28, 34) . . *K. clypeata,* n. sp.

– Clypeus broadly, roundly, or subsquarely incised (Figs. 9–10); median fovea shallow, in form of narrow streak; antennal segments 4–9 compressed 3

3\. Postocellar area broader than long as 3:2, with a distinct medial longitudinal furrow on its anterior ¾; clypeus subsquarely incised, with crenulate anterior margin (Fig. 10); labrum with rounded anterior margin (Fig. 10); inner half of tegula and lateral deflexed parts of tergite 2 whitish yellow; all sternites black; frons minutely, densely punctured (male genitalia as in Figs. 29, 36) . . . . *K. lineata,* n. sp.

– Postocellar area broader than long as 2:1, without median furrow; clypeus roundly incised, with smooth anterior margin (Fig. 9); labrum with pointed anterior tip (Fig. 9); tegula entirely black, lateral deflexed sides of tergites 2–4 and sternites 2–5 entirely whitish yellow; frons impunctate (female lancet as in Fig. 24; male genitalia as in Figs. 30, 35) . . . . *K. impunctata,* n. sp.

4\. Propodeum entirely black; antennal segments 6 and 7 whitish yellow, segments 8 and 9 compressed; clypeus roundly incised up to ⅓ of its medial length (Fig. 7) (female lancet as in Fig. 22; male genitalia as in Figs. 27, 33) . . . . *K. pup,* n. sp.

– Posterior margin of propodeum whitish yellow; antennal segments with at least 6–8 whitish yellow, segments 6–9 compressed; clypeus roundly or subsquarely incised up to ½ of its medial length (Figs. 5–6) 5

5\. Postocellar area broader than long as 2:1; lateral furrows not reaching hind margin of head; clypeus subsquarely incised (Fig. 6); only inner half of tegula whitish yellow; antennal segments 3 and 4 equal (female lancet as in Fig. 23; male genitalia as in Figs. 26, 32) . . . . *K. cardiaca,* n. sp.

– Postocellar area broader than long as 5:4; lateral furrows reaching hind margin of head; clypeus roundly incised (Fig. 5); tegula whitish yellow; antennal segments 3 and 4 as 5:6 . . . 6

6\. Narrow posterior margins of tergites 2, 6–8 and broad posterior margin of tergite 9, antennal segments from middle of 5 to 8, and spot on temple whitish yellow; wing hyaline, tarsi 2–4 uniformly fuscoferruginous; tarsal claw with-

Fig. 4. Apex of abdomen, sawsheath, and ovipositor of *Kambaitina fulvipicta.*

out basal lobe (female lancet as in Fig. 24; male genitalia as in Figs. 25, 31) . . . . *K. fulvipicta* Malaise

– Broad posterior margins of all tergites and antennal segments from middle of 4 to 8 whitish yellow; spot on temple fuscous; wings faintly yellowish; metatarsi 2–4 black with a white longitudinal stripe on posterior surface; tarsal claw with indistinct basal lobe . . . . *K. albipicta* Malaise

Kambaitina clypeata Saini, Smith, and Vasu, new species

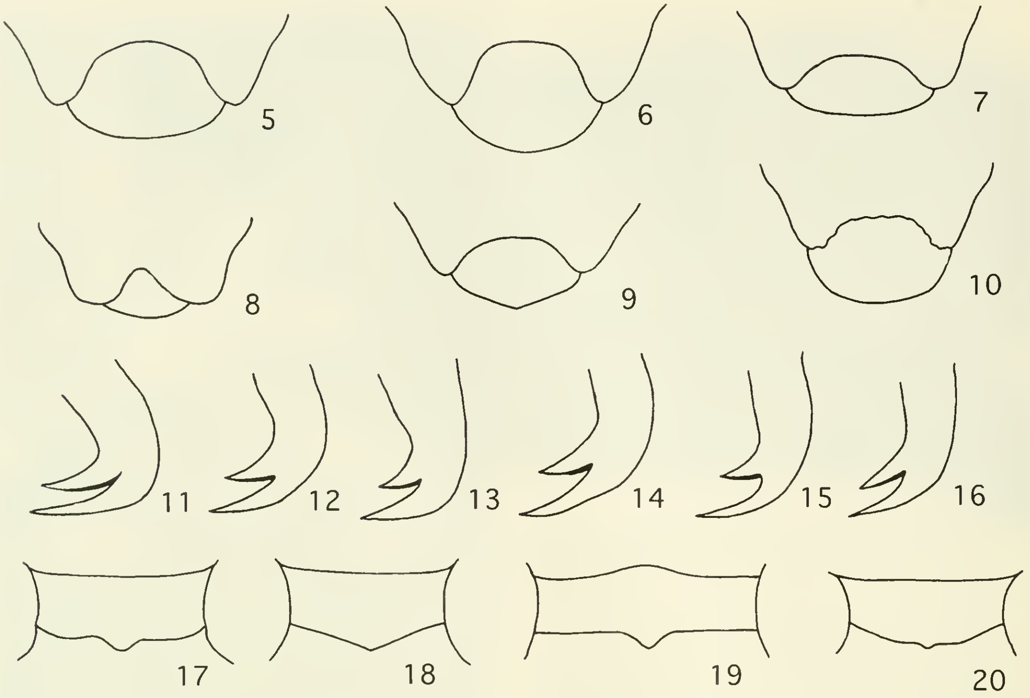
(Figs. 8, 11, 28, 34)

Female.—Unknown.

Male.—*Color:* Black with labrum, clypeus except extreme base, lower orbits, extreme posterodorsal and posterolateral margins of pronotum, extreme apices of coxae, and trochanters whitish yellow; spot on mesoscutellum, femora, tibiae, protarsus, mesotibia and mesotarsus fuscoferruginous. Wings hyaline; venation including costa, subcosta, and stigma piceous.

Structure: Length 7.0 mm. Antennal length 3× head width, antennal segments 3 and 4 equal, apical 4 segments gradually decreasing in length as 8:7:6:4, segments 5–9 compressed. Clypeus (Fig. 8) narrowly and roundly incised up to ⅓ its medial length with broadly rounded lateral teeth; labrum (Fig. 8) with deflexed rounded anterior margin, broader than long as 3:2. Supraclypeal area triangularly raised with a sharp longitudinal carina; malar space 0.75× diameter of median ocellus; lower margin of eye at level of lower rim of antennal socket; LID:IDMO:EL = 3:3:2. Supraclypeal and supraantennal pits well marked; supraantennal tubercles well developed and confluent with similarly elevated frontal ridges; median fovea in form of prominent, broad groove, clearly reaching median ocellus; post-, inter-, and circumocellar furrows sharp and distinct; lateral postocellar furrows deep, parallel, and abruptly ending just before hind margin of head; postocellar area broader than long as 4:3; head slightly widened behind eyes; 00L:POL:OCL = 3:2:3. Mesoscutellum subconvex, without carina, its appendage without carina; ICD:ITD = 1:2. Tarsal claw (Fig. 11); metabasitarsus subequal to following segments combined as 6:7; IATS:MB:OATS = 4:12:3. Genitalia: Penis valve (Fig. 28), genital capsule (Fig. 34).

Sculpture and pubescence: Head shining with few, sparse, fine, inconspicuous wrinkles confined to frontal area. Thorax with minute scattered punctures except posterior



Figs. 5–20. 5–10, Clypeus and labrum. 5, *Kambaitina fulvipicta.* 6, *K. cardiaca.* 7, *K. pup.* 8, *K. clypeata.* 9, *K. impunctata.* 10, *K. lineata.* 11–16, Tarsal claw. 11, *K. clypeata.* 12, *K. fulvipicta.* 13, *K. impunctata.* 14, *K. cardiaca.* 15, *K. pup.* 16, *K. lineata.* 17–20, Hypopygium. 17, *K. fulvipicta.* 18, *K. impunctata.* 19, *K. cardiaca.* 20, *K. pup.*

slope of mesoscutellum bearing numerous large, shallow punctures, surface shining. Abdomen impunctate, surface subshining. Body covered with blackish pubescence.

Type.—Holotype ♂, India, Manipur, Ukhrul, 1,800 m, 23.ix.1992.

Distribution.—India: Manipur.

Remarks.—The black antennae and characteristic shape of the clypeus which is roundly, narrowly, and deeply incised separates this species from other species of this genus.

Etymology.—The species name reflects the characteristic shape of the clypeus.

Kambaitina lineata Saini, Smith, and Vasu, new species

(Figs. 10, 16, 29, 36)

Female.—Unknown.

Male.—*Color:* Body black with labrum, clypeus, a square spot on supraclypeal area, inner orbit, lower hind orbit, spot on temple close to hind margin of head, broad posterodorsal and posteroventral margins of pronotum, most of tegula except an outer spot, posterior triangular apex of mesonotal middle lobe, top of mesoscutellum, parapterum, broad spot in middle of mesepisternum, spot on metepisternum, deflexed lateral margin of tergite 2, procoxa except extreme base, apical ½ of mesocoxa, outer stripe and apical ⅓ of metacoxa, and all trochanters and adjacent parts of femora whitish yellow; femora and tibiae and tarsi of all legs fuscoferruginous. Wings hyaline; venation including costa, subcosta, and stigma piceous.

Structure: Average length 6.5mm. Antennal length 3.2× head width, antennal segments 3 and 4 subequal as 8:9, apical 4 segments subequal as 6:5:4:4, segments 4–9 compressed. Clypeus (Fig. 10) subrectangularly incised up to ⅓ its medial length with crenulate anterior margin and blunt lateral teeth. Labrum (Fig. 10) with deflexed, rounded anterior margin, broader than long as 5:3. Supraclypeal area triangularly raised with a faint longitudinal blunt carina; malar space 0.75× diameter of front ocellus; lower margin of eye below level of antennal socket; LID:IDMO:EL = 3:3:2. Supraclypeal and supraantennal pits deep and well marked; supraantennal tubercles moderately raised and confluent with similarly raised frontal ridges; median fovea in form of shallow ditch with a very fine streak in middle, posteriorly not extending to median ocellus; post-, inter-, and circumocellar furrows sharp and distinct; lateral furrows deep, bulging medially and reaching hind margin of head, postocellar area subconvex, with shallow but distinct median longitudinal furrow on anterior ¾, broader than long as 3:2. Head parallel behind eyes; OOL:POL:OCL = 3:2:3. Mesoscutellum subconvex, ecarinate, its appendage ecarinate; ICD:ITD = 1:2. Tarsal claw (Fig. 16); metabasitarsus shorter than following segments combined as 2:3; IATS: MB:OATS = 5:16:4. Genitalia: Penis valve (Fig. 29), genital capsule (Fig. 36).

Sculpture and pubescence: Frontal area with minute irregular, scattered punctures, rest of head shining with dense, minute punctures. Thorax almost impunctate except few shallow punctures on posterior slope of mesoscutellum, surface shining with general oily lustre. Abdomen impunctate, shining. Body covered with brownish black pubescence.

Types.—Holotype ♂ India, Nagaland, Pfutsero, 2,000 m, 20.v. 1993. Paratypes: 1 ♂, India, Nagaland, Vizho-Razho, 1,800 m, 11.v.1993; 2 ♂, same data as holotype.

Distribution.—India: Nagaland.

Remarks.—A combination of the following characters separate *K. lineata* from other species of the genus: antenna and sternites entirely black; postocellar area with a distinct medial longitudinal furrow on anterior ¾, clypeus subsquarely incised; inner half of tegulae whitish yellow; and antennal segments 4–9 distinctly compressed.

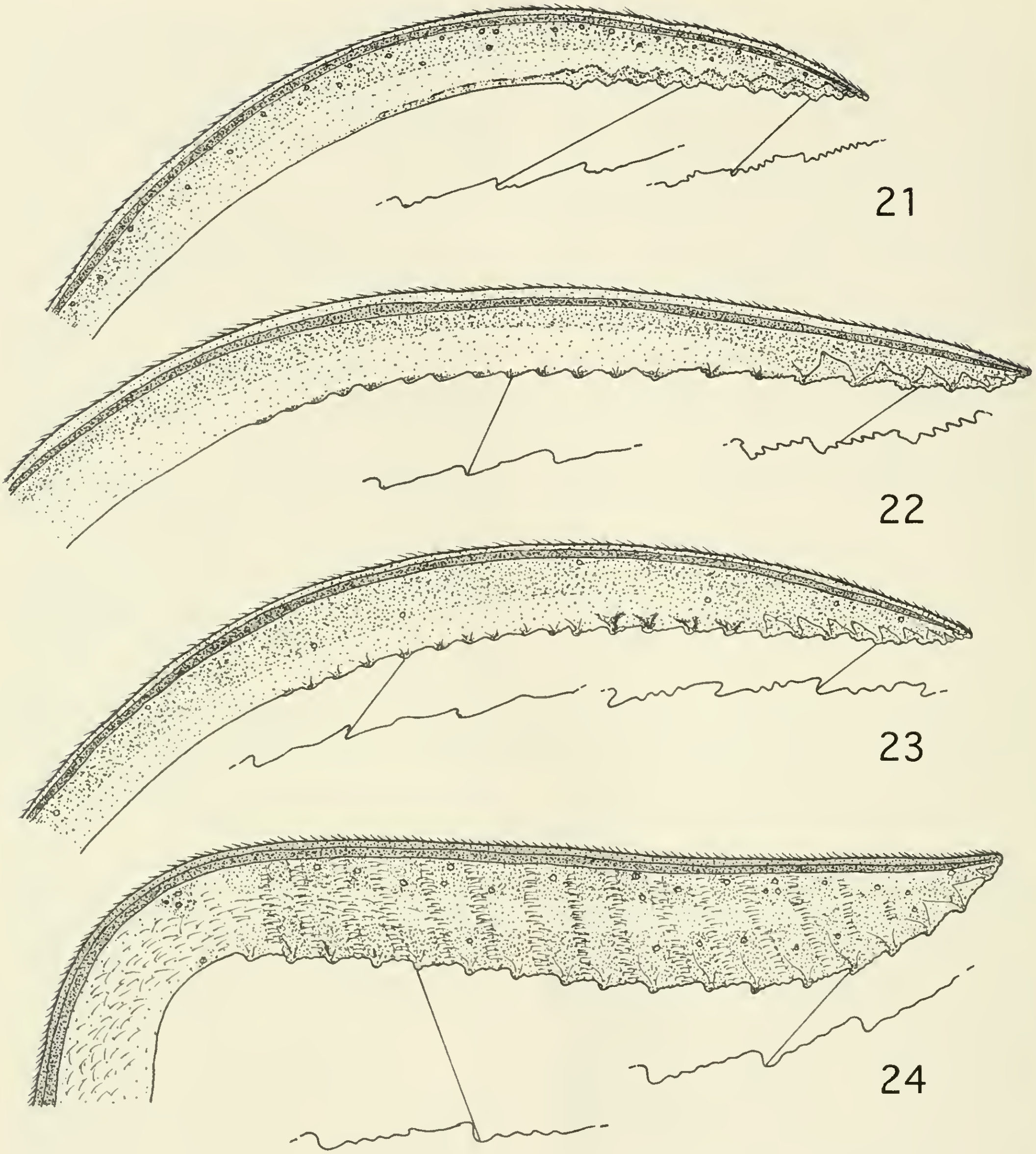
Etymology.—The species name is based on the presence of a distinct medial longitudinal furrow on the anterior ¾ of postocellar area.

Kambaitina impunctata Saini, Smith, and Vasu, new species

(Figs. 9, 13, 18, 24, 30, 35)

Female.—*Color:* Black with labrum, clypeus, triangular spot on supraclypeal area, basal ½ of mandible, narrow inner orbit, spot on mesonotal lateral lobe before mesoscutellum, spot on mesoscutellum, broad transverse stripe on lower half of mesepisternum narrowly extending to coxal rim, lateral deflexed sides of tergites 2–4, sternites 2–5, and coxae and trochanters whitish yellow; femora, tibiae, and tarsi fulvous. Wings hyaline; venation including costa, subcosta, and stigma piceous.

Structure: Length 7.0 mm. Antennal length 3.2× head width, segments 3 and 4 subequal as 5:6, length of apical four segments gradually decreasing as 8:7:6:5, flagellar segments 4–9 faintly compressed. Clypeus (Fig. 9) roundly incised up to ⅓ its medial length with blunt lateral teeth. Labrum (Fig. 9) with deflexed pointed anterior tip, broader than long as 3:2. Supraclypeal area protuberant; malar space 0.75× diameter of front ocellus; lower margin of eye below level of antennal socket; LID:IDMO: EL = 3:3:2. Supraclypeal and supraantennal pits deep and well marked, supraantennal tubercles moderately raised and confluent with similarly roundly raised frontal ridges; median fovea in form of deep, narrow, streak extending to median ocellus, post-, inter-, and circumocellar furrows sharp; lateral furrows deep and ending abruptly just before hind margin of head; postocellar area broader than long as 2:1. Head parallel behind eyes; 00L:POL:OCL = 3:2:3. Mesoscutellum subconvex, ecarinate, its appendage ecarinate; ICD:ITD = 2:5. Tarsal claw (Fig. 13); metabasitarsus equal to following joints combined; IATS:



Figs 21–24. Lancet. 21, *Kambaitina fulvipicta.* 22, *K. pup.* 23, *K. cardiaca.* 24, *K. impunctata.*

MB:OATS = 5:14:4. Lancet (Fig. 24) broad, with 18 serrulae, annular hairs distinct full width of lancet. Hypopygium as in Fig. 18.

Sculpture and pubescence: Head, thorax and abdomen impunctate and shining with general oily lustre. Body covered with brownish pubescence.

Male.—Length 6.5 mm. Similar to female except ventral surface of scape, lower orbits, ventral half of hind orbits, parapterum, broad transverse band extending from anterior to posterior margin along convexity of mesepisternum whitish yellow. Lateral deflexed sides of tergite 4 and all sternites entirely black. Genitalia: Penis valve (Fig. 30), genital capsule (Fig. 35).

Types.—Holotype ♀, India, West Bengal, Darjeeling, 2,280 m, 7.v.1993. Paratype: 1 ♂ same data as holotype, deposited in PUP.

Distribution.—India: West Bengal.

Remarks.—*Kambaitina impunctata* is separated from other species by the following combination of characters: antenna black; clypeus roundly incised; labrum with pointed anterior tip; tegulae black; lateral deflexed parts of tergites 2–4 and sternites 2–5 entirely whitish yellow; and body impunctate. The female lancet also is distinct from other known females of the genus; it is broader and has distinct annular hairs extending its full width (Fig. 24). Females of the other species with black antennae are unknown, but it is possible this type of lancet is characteristic of species of this group, whereas the lancets of the species with white-banded antennae are much more slender and lack annular hairs.

Etymology.—The species name pertains to the impunctate body.

Kambaitina pup Saini, Smith, and Vasu, new species

(Figs. 7, 15, 20, 22, 27, 33)

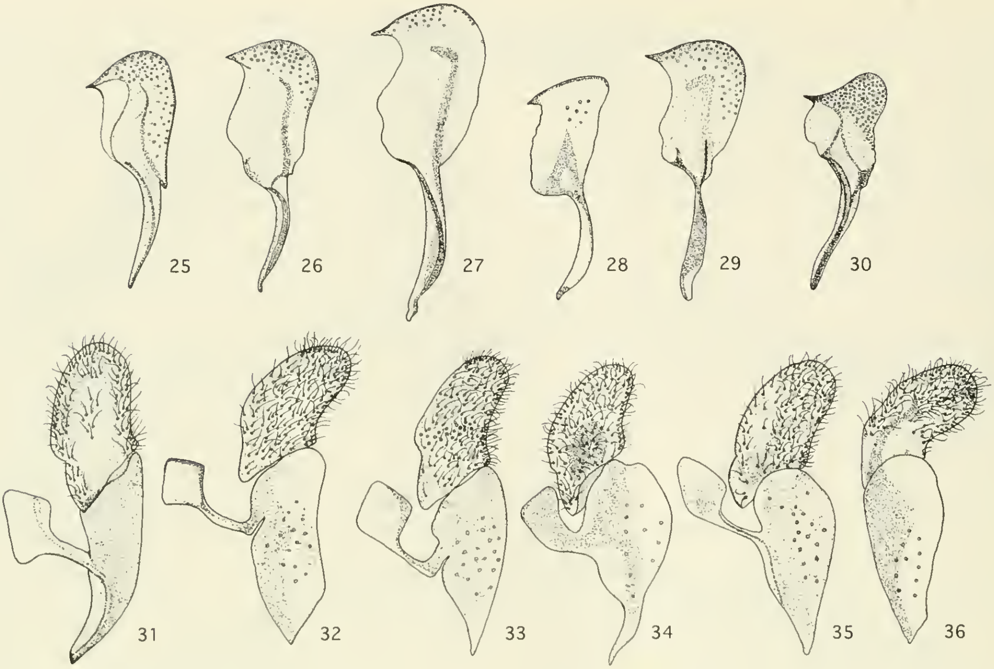
Female.—*Color:* Black, with antennal segments 6 and 7, labrum, clypeus, small square spot on supraclypeal area, broad lower and narrow upper orbits discontinuous in middle, broad spot on lower hind orbits, spot on hind margin of head behind temple, broad posterodorsal and posterolateral margins of pronotum, tegula, apex of mesonotal middle lobe, anterior mesoscutellum, parapterum, broad spot in middle of mesepisternum, spot on posteroventral tip of mesepimeron, spot on metepisternum, deflexed lateral sides of all tergites, posterior margin of last sternite, procoxa except extreme base, apical ½ of meso- and metacoxae, and all trochanters and adjacent parts of all femora whitish yellow; femora, tibiae and tarsi fuscoferruginous. Wings hyaline; venation including costa, subcosta, and stigma piceous.

Structure: Average length 6.5 mm. Antennal length 2.7× head width; segments 3 and 4 equal, apical four segments subequal as 8:7:6:5, segments 8 and 9 compressed. Clypeus (Fig. 7) roundly incised up to ⅓ of medial length with blunt lateral lobes. Labrum (Fig. 7) with deflexed rounded anterior margin, broader than long as 3:2. Supraclypeal area protuberant; malar space equal to diameter of median ocellus; lower margin of eye below level of antennal socket; LID:IDMO:EL = 6:6:3. Supraclypeal and supraantennal pits deep and well marked; supraantennal tubercles moderate and confluent with similarly roundly raised frontal ridges; median fovea in form of broad and shallow groove marked by longitudinal fine streak in its middle, posteriorly shallowly reaching front ocellus; post-, inter-, and circumocellar furrows sharp and distinct; lateral furrows deep, protuberant, sunken and ending just before hind margin of head; postocellar area broader than long as 3:2. Head parallel behind eyes; OOL:POL:OCL = 3:2:2. Mesoscutellum subconvex, ecarinate, its appendage ecarinate. Tarsal claw (Fig. 15); metabasitarsus shorter than following joints combined as 4:5; IATS:MB:OATS = 3:8:2. Lancet (Fig. 22) with 22 serrulae on about apical half of lancet; without annular hairs. Hypopygium as in Fig. 20.

Sculpture and pubescence: Frontal area with dense, minute, irregular punctures intermingled with network of irregular grooves and ridges, rest of head with fine, shallow punctures, surface shining. Thorax impunctate except posterior slope of mesoscutellum bearing few minute shallow punctures, surface shining with general oily lustre. Abdomen impunctate, subshining. Body covered with brownish pubescence.

Male.—Average length 6.5 mm. Similar to female except broad front and hind orbits whitish yellow and continuous with temple spot. Deflexed lateral sides of tergites 2–4 fuscous. Genitalia: Penis valve (Fig. 27), genital capsule (Fig. 33).

Types.—Holotype ♀, India, Manipur, Ukhrul 1,700 m, 23.v.1993. Paratypes: 1 ♀, Manipur, Zunheboto, 1,800 m, 14.V.1993;



Figs. 25–36. Male genitalia. 25–30, Penis valve. 25, *Kambaitana fulvipicta*. 26, *K. cardiaca*. 27, *K. pup*. 28, *K. clypeata*. 29, *K. lineata*. 30, *K. impunctata*. 31–36. Gonoforceps. 31, *K. fulvipicta*. 32, *K. cardiaca*. 33, *K. pup*. 34, *K. clypeata*. 35, *K. impunctata*. 36, *K. lineata*.

1 ♀, 16.v.1993; 1 ♂, Nagaland, Vinzho-Razho, 1,800 m, 11.v.1993; 1 ♂, Satakha, 1,500 m, 15.v.1993, 1 ♀, 2 ♂, Pfutser, 2,100 m, 20.v.1993.

Distribution.—India: Manipur, Nagaland.

Variation.—The extreme base of antennal segment 6 and extreme tip of segment 7 may be fuscous; the deflexed lateral sides of tergites 2–4 in the male may be fuscous, and the outer margins of the tegulae may be piceous.

Remarks.—*Kambaitana pup* is distinguished from other species of the genus by the following: Antennal segments 6 and 7 whitish yellow; clypeus roundly incised for one-third its medial length; propodeum entirely black; and antennal segments 8 and 9 distinctly compressed.

Etymology.—The species name is derived from the acronym of Punjabi University, Patiala (PUP), where revisionary work on the taxonomy of sawflies is being carried out. It is used as a noun in apposition.

Kambaitina cardiaca Saini, Smith, and Vasu, new species

(Figs. 1–3, 6, 14, 19, 23, 26, 32)

Female.—*Color*: Black with antennal segments 6–8, labrum, clypeus, square spot on supraclypeal area; broad inner orbit, triangular spot on hind margin of head behind temple, broad posterodorsal and posterolateral margins of pronotum; inner half of tegula, apex of mesonotal middle lobe, top of mesoscutellum, broad spot on metascutellum, parapterum, broad spot on lower ⅔ of mesepisternum, spot on posterior tip of mesepimeron, paired spot on each metepisternum and metepimeron, spot on metasternum, extreme posterior margin of propodeum and tergites 2, 8 and 9, deflexed lateral sides of all tergites, broad medial spot on sternites 2–6, sternite 7 more or less, pro- and mesocoxae except extreme bases, outer surface and apical ½ of metacoxa, and all trochanters and adjacent parts of all femora whitish yellow; femora, tibiae, and tarsal segments fuscoferruginous. Wings hyaline; venation including costa, subcosta and stigma piceous.

Structure: Average length 9.5 mm. Antenna 2.7× head width, segments 3 and 4 equal in length, apical 4 segments subequal as 8:7:6:5, segments 6–9 compressed. Clypeus (Figs. 2, 6) subsquarely incised up to ½ its medial length with blunt lateral teeth. Labrum (Figs. 2, 6) with deflexed rounded anterior margin, broader than long as 3:2. Supraclypeal area protuberant with faint longitudinal carina; malar space equal to diameter of median ocellus, lower margin of eye below level of antennal socket; LID: IDMO:EL = 6:6:3. Supraclypeal and supraantennal pits well marked; supraantennal tubercles moderately raised and confluent with similarly raised frontal ridges; frontal anterior to front ocellus broadly and roundly heart shaped, gradually and only very faintly depressed towards center, with median fovea in form of narrow streak shallowly reaching median ocellus; postocellar furrows sunken; inter- and circumocellar furrows sharp and distinct; lateral furrows deep and abruptly ending well before hind margin of head; postocellar area broader than long. Head parallel behind eyes; 00L: POL:OCL = 3:2:3. Mesoscutellum subconvex, ecarinate, its appendage ecarinate; ICD:ITD = 2:5. Tarsal claw (Fig. 14); metabasitarsus subequal to following segments combined as 8:9; IATS:MB:OATS = 3:8:2. Lancet (Fig. 23) with 23 serrulae on about apical half of lancet; annular hairs absent. Hypopygium as in Fig. 19.

Sculpture and pubescence: Frontal area with dense, minute, irregular punctures, rest of head with sparse, fine, punctures, surface shining. Thorax impunctate except posterior slope of mesoscutellum bearing few minute punctures, surface shining with general oily lustre. Abdomen impunctate, dull. Body covered with fuscous pubescence.

Male.—Average length 7.5 mm. Similar to female except deflexed lateral margin of tergites 5–9 black. Genitalia: Penis valve (Fig. 26); genital capsule (Fig. 32).

Types.—Holotype: ♀, India, Manipur, Ukhrul, 1,700 m, 21.v.1993. Paratypes: 4 ♀, 6 ♂, Manipur, Ukhrul, 1,700 m, 21.v: 1993; 1 ♀, 2 ♂, Nagaland, Vizho-Razho, 1,800 m, 11.v.1993; 1 ♂, Zunheboto, 1,800 m, 14.v.1993; 6 ♀, 2 ♂, Satakha, 1,500 m, 15.v.1993; 3 ♀, 2 ♂, Pfutsero, 2,000 m, 19.v.1993, 15, 4 ♀, 3 ♂, 20.v.1993.

Distribution.—India: Manipur, Nagaland.

Variation.—Antennal segments 7 and 8 may be more or less fuscoferruginous.

Remarks.—*Kambaitana cardiaca* is distinguished from other species of the genus by antennal segments 6–8, the inner half of the tegulae, the posterior margins of tergites 2, 8 and 9, and the medial spot on sternites 2–6 whitish yellow; the subsquarely incised clypeus with the emargination half its medial length; and the lateral furrows ending before the hind margin of the head.

Etymology.—The species name is derived from the peculiar shape of the frontal area.

Kambaitina fulvipicta Malaise
(Figs. 4, 5, 12, 17, 21, 25, 31)

Kambaitina fulvipicta Malaise 1961: 254–255; Saini and Deep 1994: 49.

Female.—*Color:* Black with antennal segments 6–8, labrum, clypeus, square spot on supraclypeal area, basal ½ of mandible, inner orbits, lower half of hind orbit, spot on temple, broad posterodorsal and posterolateral margins of pronotum, tegula, apex of mesonotal middle lobe, top of mesoscutellum, broad spot on metascutellum, parapterum, broad transverse spot on lower half of mesepisternum, posterior margin of propodeum, extreme posterior margins of tergites 2 and 6–8 and broad posterior margin of tergite 9, deflexed lateral sides of all tergites, sternites 2–7 more or less, pro- and mesocoxae and trochanters, apical ½ of metacoxa, and metatrochanter whitish yellow; femora, tibiae, and tarsi fuscoferruginous.

Wings hyaline; venation including costa, subcosta, and stigma piceous.

Structure: Average length 8.0 mm. Antennal length 3.2× head width; segments 3 and 4 subequal as 5:6, length of apical four segments gradually decreasing as 8:7:6:5, apical segments 6–9 faintly compressed. Clypeus (Fig. 5) roundly incised for ½ its medial length with blunt lateral lobes. Labrum (Fig. 5) with deflexed rounded anterior margin, broader than long as 3:2. Supraclypeal area protuberant; malar space 1.25× diameter of front ocellus; lower margin of eye below level of eye; LID: IDMO: EL 3:3:2. Supraclypeal and supraantennal pits well marked; supraantennal tubercles moderately raised and confluent with similarly roundly raised frontal ridges; median fovea in form of narrow depressed area with a pit on its anterior half and posteriorly only shallowly reaching front ocellus; post-, inter-, and circumocellar furrows distinct; lateral furrows deep, bulging medially and reaching hind margin of head; postocellar area broader than long as 5:4. Head parallel behind eyes; 00L:POL:OCL = 6:4:7. Mesoscutellum almost flat, ecarinate, its appendage ecarinate; ICD:ITD = 1:3. Tarsal claw (Fig. 12); metabasitarsus shorter than following segments combined as 3:4; IATS: MB:OATS = 8:20:7. Lancet (Figs. 4, 21) with 10 serrulae on only apical half; annular hairs absent. Hypopygium as in Fig. 17.

Sculpture and pubescence: Frontal area opaque with dense and minute punctures, rest of head shining with scattered minute punctures. Thorax and abdomen shining, impunctate with general oily lustre. Body covered with blackish pubescence.

Male.—Average length 7.5 mm. Similar to female except antennal segment 6 and 7 fuscoferruginous. *Genitalia:* Penis valve (Fig. 25), genital capsule (Fig. 31).

Types.—♀ (holotype), 1 ♀ (paratype) at Naturhistoriska Riksmuseet, Stockholm.

Specimens examined.—2 ♀, 1 ♂, India, Himachal Pradesh, Kasol, 1,600 m, 29.v.1984; 2 ♀, West Bengal, Darjeeling, 2,280 m, 2.v.1986; 1 ♂, Uttar Pradesh, Ghangria, 3,000 m, 27.vi.1987; 1 ♀, Chopta, 3,000 m, 25.vi.1992; 1 ♀, Arunachal Pradesh, Nine mile, 2,000 m, 24.5.1993.

Distribution.—Myanmar; India: Himachal Pradesh, West Bengal, Uttar Pradesh, Arunachal Pradesh.

Variation.—The apical half of antennal segment 5, the pronotum almost entirely, and the mesoscutellar appendage more or less may be whitish yellow. The apical half of antennal segment 8 may be black.

Remarks.—This species is characterized by the whitish yellow antennal segments 6–8, tegulae, narrow posterior margins of tergites 2 and 6–8, broad posterior margin of tergite 9, and sternites 2–7; roundly incised clypeus which is incised for half its medial length; subquadrate postocellar area; and lateral furrows reaching the hind margin of head. The female lancet is distinct from other known females by having only ten serrulae and only on the apical half rather than on most of its length (Fig. 21).

The specimens studied go to *Kambaitana* in Malaise's keys (1961, 1963) and agree with the original description (1961). The male is associated with the female for the first time.

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SYSTEMATIC STUDIES ON THE *ANTONINA CRAWI* COCKERELL (HEMIPTERA: COCCOIDEA: PSEUDOCOCCIDAE) COMPLEX OF PEST MEALYBUGS

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Abstract.–Careful analysis of specimens identified as *Antonina crawi* Cockerell has shown that three very similar species are involved, i.e., *A. crawi*, ***A. nakaharai* Williams and Miller, new species**, and *A. socialis* Newstead (**reinstated status**). A key is provided for 11 species reported on bamboos and a description is given for a bamboo-infesting species from Taiwan, i.e., ***A. maai* Williams and Miller, new species**. *Antonina crawi* is reported from China, Japan, and the U.S. (California) but is suspected to have disappeared from the latter country.

Key Words: Coccoidea, Pseudococcidae, new species, *Antonina maai*, *Antonina nakaharai*, redescribed species, *Antonina crawi* Cockerell, *Antonina socialis* Newstead, bamboo, key

As part of a study on the mealybugs of southern Asia, the first author noted an unusually large amount of morphological variation in *Antonina* specimens determined as *A. crawi* Cockerell. After careful analysis of these specimens it is evident that what had originally been considered a single taxon is actually three different species. Because mealybugs in the Crawi complex are primarily bamboo feeders and because bamboos are frequently used as ornamentals, we examined as many *Antonina* specimens as possible from that host and provide a key to all of the species that occur on bamboo.

Antonina includes 17 valid species, all of which are native to the Old World (Ben-Dov et al. 2001), particularly Asia. They are: *A. australis* Froggatt (Australia), *A. bambusae* Khalid and Shafee (India), *A. crawi* Cockerell (probably native to Japan and China), *A. elongata* Tang (China), *A. graminis* (Maskell) (possibly native to India), *A. maritima* Ramakrishna Ayyar (India and Sri Lanka), *A. meghalayaensis* Khalid and Shafee (India), *A. natalensis* Brain (possibly Africa), *A. pretiosa* Ferris (Asia), *A. purpurea* Signoret (Europe), *A. tesquorum* Danzig (northeastern Asia), *A. thaiensis* Takahashi (Malaysia and Thailand), *A. transcaucasica* (Borchsenius) (Armenia and Azerbaijan), *A. transvaalensis* Brain (South Africa), *A. vera* Borchsenius (northeastern Asia), and *A. zonata* Green (southern Asia). *Antonina indica panica* Hall recently has been considered a valid species (Williams 2001), i.e., *A. panica*.

Several species have become invasive pests in various parts of the world, particularly *A. crawi* (actually *A. nakaharai* Williams and Miller, n. sp. and *A. socialis* Newstead), *A. graminis*, and *A. pretiosa*

(Miller et al. 2002). A comprehensive book was written by Hendricks and Kosztarab (1999) on the legless mealybugs including detailed morphological treatments and a key for the adult females of all but 4 species of *Antonina.* They were unable to locate specimens of *A. bambusae, A. elongata, A. meghalayaensis,* and *A. transcaucasica.* The immature stages of several species were treated by Yang and Kosztarab (1967), and adult males were described by Afifi and Kosztarab (1967) and Beardsley (1965).

We have found 11 species that occur on bamboo including: *A. bambusae* (*Bambusa*), *A. crawi* (see later description for list of bamboo hosts), *A. graminis* (*Bambusa* sp.), *A. maai* Williams and Miller, n. sp. (see later description for list of bamboo hosts), *A. meghalayaensis* (*Bambusa* sp.), *A. nakaharai* Williams and Miller, n. sp. (see later description for list of bamboo hosts), *A. pretiosa* (*Arundinaria, Bambusa, Phyllostachys, Pleioblastus, Sasa,* and *Yushania*), *A. purpurea* (*Phyllostachys*), *A. socialis* (see later description for list of bamboo hosts and corrected status), *A. thaiensis* (*Bambusa*), *A. zonata* (*Bambusa, Indocalamus, Semiarundinaria, Teinostachyum*). It is interesting that 9 of these species are specific to bamboos and only 2 species are incidental on bamboo. The latter 2 species (*A. graminis* and *A. purpurea*) are more general feeders occurring on a wide range of grass hosts.

The three species encompassing the Crawi complex are here determined as *A. crawi, A. nakaharai,* and *A. socialis.* These species are considered a complex because they have so frequently been confused. There are no characters unique to this group that do not also occur in other species of *Antonina.* Although *Antonina maai* is similar to species in the Crawi complex, it is most similar to *A. pretiosa.*

MATERIALS AND METHODS

Depositories of specimens are: The Natural History Museum, London (BMNH); California Department of Food and Agriculture, Sacramento (CDFA); Florida State Collection of Arthropods, Gainesville (FSCA); Muséum National d'Histoire Naturelle, Paris (MNHN); Taiwan Agricultural Research Institute, Entomology Collection, Taichung, Taiwan (TARI); National Museum of Natural History, Beltsville, MD (USNM); R. M. Bohart Museum, University of California, Davis, CA (UCD).

Abbreviations used in the Specimens Examined sections are: ad. = adult; imm. = immature; sl. = slide.

Measurements of the labium are the longest dimension of the anterior to the posterior edges of the structure as it appears on slide-mounted specimens. In some instances the labium is oriented with the apex pointing directly at the microscope slide (ventrally) rather than pointing posteriorly, as is the case for most mealybugs. Thus, the measurement in these instances is not always taken of the lateral profile of the labium but instead is of the largest diameter of the structure. Measurements of the anal tube are taken on the dorsal surface from the anterior end of the anal ring to the opening of the anal tube nearest to the anal ring; this measurement is the shortest length. Also note that there is a band of pores and tubular ducts internally near the entrance of the anal tube. These structures are not shown in the illustrations.

Inclusion of *Antonina bambusae* and *A. meghalayaensis* in the key to *Antonina* species that occur on bamboo is based on examination of the original descriptions only; we have been unable to locate specimens of these species. Hendricks and Kosztarab (1999) questioned the validity of some of the statements made by Khalid and Shafee (1988) in their descriptions of these species, including the presence of a circulus in *A. bambusae.*

RESULTS

Antonina crawi Cockerell
(Fig. 1)

Antonina crawi Cockerell 1900:70.

Antonina crawii: Ferris 1918:77 (misspelling).

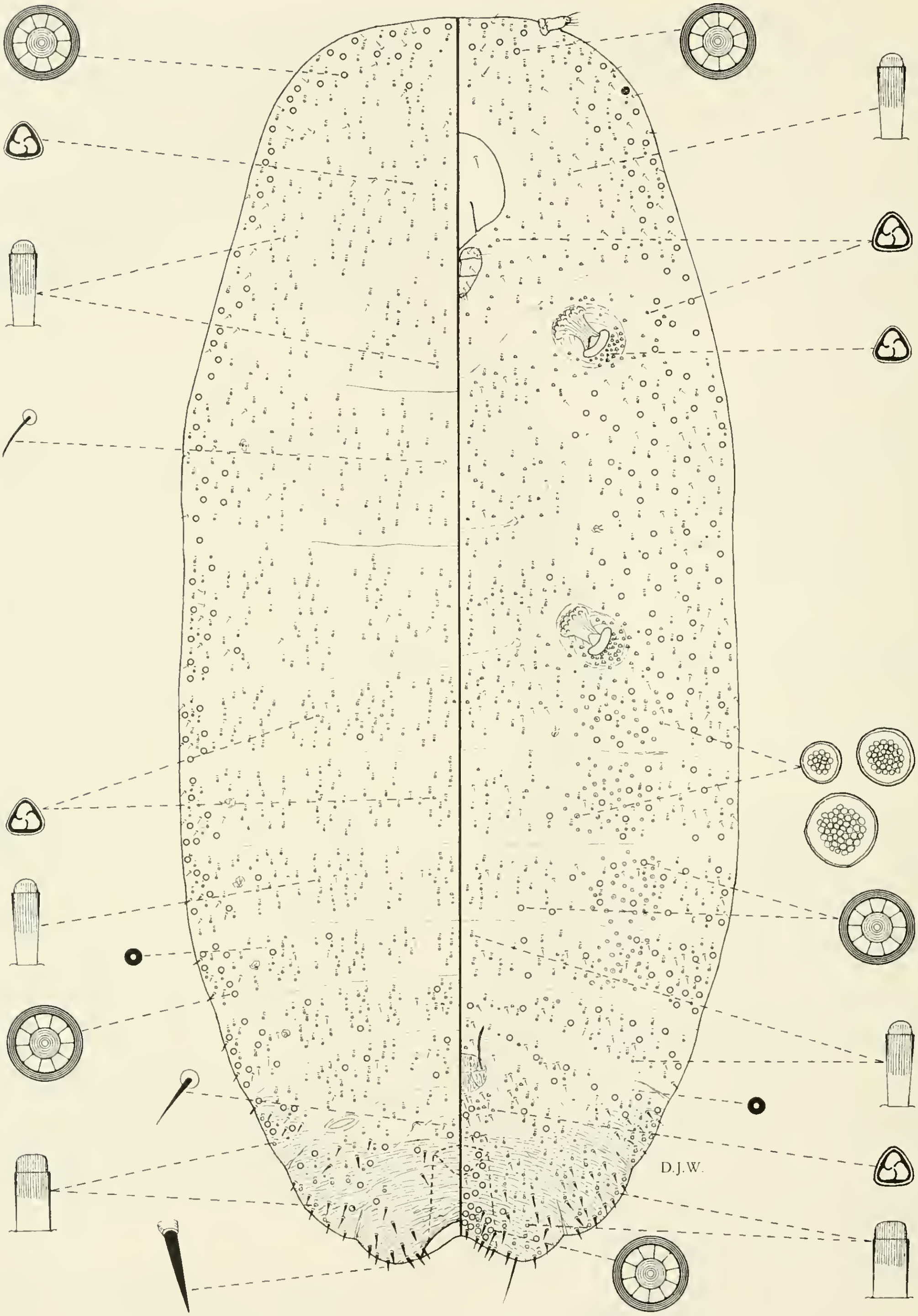

Fig. 1. *Antonina crawi.* Specimen from Japan, near Tokyo, on *Arundinaria fastuosa.*

Antonina bambusae: Borchsenius 1934:13 (misidentification).

Type material.–Lectotype adult female single specimen on slide labeled as follows: left label "Antonina/crawi Ckll/TYPE/Bamboo/Japan (Craw) 1900/Ckll. Coll.:" right label "*LECTOTYPE*/Desig. H. Hendricks/1992/Antonina crawi Ckll./Remounted: Balsam." In addition there is an additional slide containing 2 adult female paralectotypes (all in USNM). The lectotype was designated by Hendricks and Kosztarab (1999).

Description.—*Adult female* on microscope slide, elongate oval, 1.4–4.5(3.2) mm long, 0.7–2.9(1.8) mm wide; posterior apex of last 2 or 3 abdominal segments sclerotized (more mature paratypes sometimes with more sclerotization); lateral margins of abdominal segments VII–VIII convex, rarely segment VI slightly convex, others straight sided. Antenna 2- or 3-segmented, 45–62(54) μ long. Legs usually represented by inconspicuous sclerotized area or small dermal pocket, sometimes absent. Labium 55–90(80) μ long, between 2 and 3 times shorter than clypeolabral shield. Ostioles present on abdomen only. Circulus absent. Spiracles with 2 sizes of trilocular pores in sclerotized area surrounding atrium. Cerarii absent, but posterior abdominal setae enlarged, subconical. Anal ring invaginated in anal tube, 145–175(162) μ long; ring diameter 88–130(105) μ; anal tube internally with ring of multilocular pores and tubular ducts. With 28–66(42) multilocular pores on each side of body in area delimited by posterior edges of each anterior and posterior spiracle.

Dorsal surface with short setae, decreasing in length and width anteriorly; longest seta on posterior apex 32–40(36) μ long. Trilocular pores of 1 size, absent from posterior 3 or 4 segments, absent along body margin except near spiracles, scattered over remainder of surface. Discoidal pores of same distribution pattern as triloculars, less abundant. Multilocular pores forming longitudinal band along body margin; with 0–7(3) pores on segment VII near intersegmental line between VII and VIII. Oral-collar tubular ducts of 1 variable size, absent or rare on segment VIII except in anal tube, abundant over remainder of surface.

Ventral surface with setae similar to those on dorsum. Multilocular disc pores present in band along body margin, with 6–24(14) pores on abdominal segment IV within area delimited by lateral margin of disc-like pore clusters on each side of segment; with multilocular pores on segment VIII often spanning space between vulva and posterior apex of body, occasionally restricted to half or three-fourths of distance between vulva and posterior apex of body; dermal surface surrounding opening of anal tube with cluster of multilocular pores and oral-collar tubular ducts. Disc-like pores present in mediolateral areas from metathorax to segments IV, V, or rarely VI. Trilocular pores of 2 or 3 sizes, smaller size in plate outside of spiracular atrium; larger size scattered around mouthparts, medium size scattered over remainder of surface except absent or rare on posterior 3 or 4 segments, most abundant near body margin. Oral-collar tubular ducts present over surface. Vulvar area with 1 pair of lateral apophyses and 1 pair of weakly indicated posterior apophyses.

Notes.—This species is similar to *Antonina nakaharai* and *A. socialis* but differs by having: 6–24(14) multilocular pores on abdominal segment IV within the area delimited by the lateral margins of disc-like pore clusters on each side of the segment; disc-like pores present from abdominal segment II to segments IV, V, or VI; the row of dorsal multilocular pores on segment VII, adjacent to the intersegmental line between segments VII and VIII, with 0–7(3) pores on each side of body. *Antonina nakaharai* has: 0–4(1) multilocular pores on abdominal segment IV within the area delimited by lateral margins of disc-like pore clusters on each side of the segment; disc-like pores present from abdominal segment II to segments IV, V, or VI; the row of dorsal multilocular pores on segment VII, adjacent to the intersegmental line between segments VII and VIII, with 0–3(0) pores on each side of body. *Antonina socialis* has: 0–7(2) multilocular pores on abdominal segment IV within the area delimited by the lateral margins of disc-like pore clusters on each side of the segment; disc-like pores present from abdominal segment II to VII or VIII; the row of dorsal multilocular pores on segment VII, adjacent to the intersegmental line between segments VII and VIII, usually with 1–12(6) pores on each side of body.

Although this species previously was reported to be widespread (Ben-Dov 1994), the species concept presented here limits its distribution to China, Japan, and the U. S. (California). The latter record is based on a single adult female that was collected in San Jose, California, in 1900; it has not been collected in the U. S. since and is assumed to have disappeared in the intervening period.

Specimens examined.—CHINA: Bamboo gardens, Lingnan University, Canton, on *Phyllostachys nigra*, date ?, F. A. McClure (1 ad. ♀, 2 imm. on 1 sl.) (USNM). JAPAN: Kagoshima, on *Phyllostachys* sp., I-11-1923, B. M. Broadbent (1 ad. ♀) (USNM); Kuro, Chiku, Hotel Chiku, on *Bambusa* sp.,? -?-1889, collector ? (2 ad. ♀ on 1 sl.) (USNM); Shinohana-machi, Kohoku-ku, Kanagawa-ken, Yokohama, on *Sasa* sp., X-19-1941, K. Sato (9 ad. ♀ on 2 sl.) (USNM); Near Tokyo, on *Arundinaria fastuosa* cultivar Hasimoto, III-18-1917, collector ? (1 ad.♀) (USNM); locality ?, on bamboo, XI-?-1909, E. M. Ehrhorn (1 ad. ♀) (USNM); locality ?, on bamboo, ?-?-1900, Craw (1 lectotype ad. ♀, 2 lectotype ad. ♀ on 2 sl.) (USNM); [Authors' note: An additional slide containing 1 ad. ♀ from E. E. Green's collection may also be from the type series, but associated information only indicates, Japan, from bamboo (BMNH)]. UNITED STATES: CALIFORNIA: San Jose, Japanese Nursery, on bamboo, II-?-1900, collector ? (1 ad. ♀, 12 first instars on 2 sl.) (USNM).

Antonina maai Williams and Miller,
new species
(Fig. 2)

Antonina pretiosa: Hendricks and Kosztarab 1999:115 (misidentification, in part)

Type material.–Holotype adult female mounted alone on a slide labeled as follows: left label "Taiwan/Hsinkien, Taipeh/Hsien/Ex Bambusa/Oct 9, 1951/T Maa/Ferris No M331" right label "*Antonina maai*/Williams & Miller/HOLOTYPE, UCD." In addition there are 55 paratypes deposited in the following museums: BMNH, CDFA, FSCA, MNHN, TARI, UCD, USNM.

Description.—*Adult female* holotype on microscope slide, elongate oval, 1.5 mm long (paratypes 1.0–2.7(1.6) mm), 0.8 mm wide (paratypes 0.7–1.8(1.1) mm); posterior apex of last 3 abdominal segments sclerotized, lateral margins of all abdominal segments sclerotized (more mature female paratypes sclerotized completely); without convex lateral margins of abdominal segments; sometimes margin of segment VIII convex in very mature adults. Antenna 2-segmented, basal segment small, with 3 setae, apical segment larger with 5 sensory setae and 2 or 3 thinner setae, antenna 62 μ long (paratypes 52–70(61) μ). Legs absent. Labium profile 70 μ long (paratypes 48–75(66) μ), about 3 times shorter than clypeolabral shield. Ostioles present on abdomen only. Circulus absent. Spiracles only with smaller size of trilocular pore in atrium. Cerarii absent, but posterior abdominal setae slightly enlarged. Anal ring invaginated in anal tube, 142 μ long (paratypes 135–168(150) μ); ring diameter 88 μ long (paratypes 85–100(92) μ); anal tube internally with ring of small trilocular pores near entrance. With 5 multilocular pores on each side of body in area delimited by posterior edges of each anterior and posterior spiracle (paratypes 0–10(4) pores).

Dorsal surface with short setae, decreas-

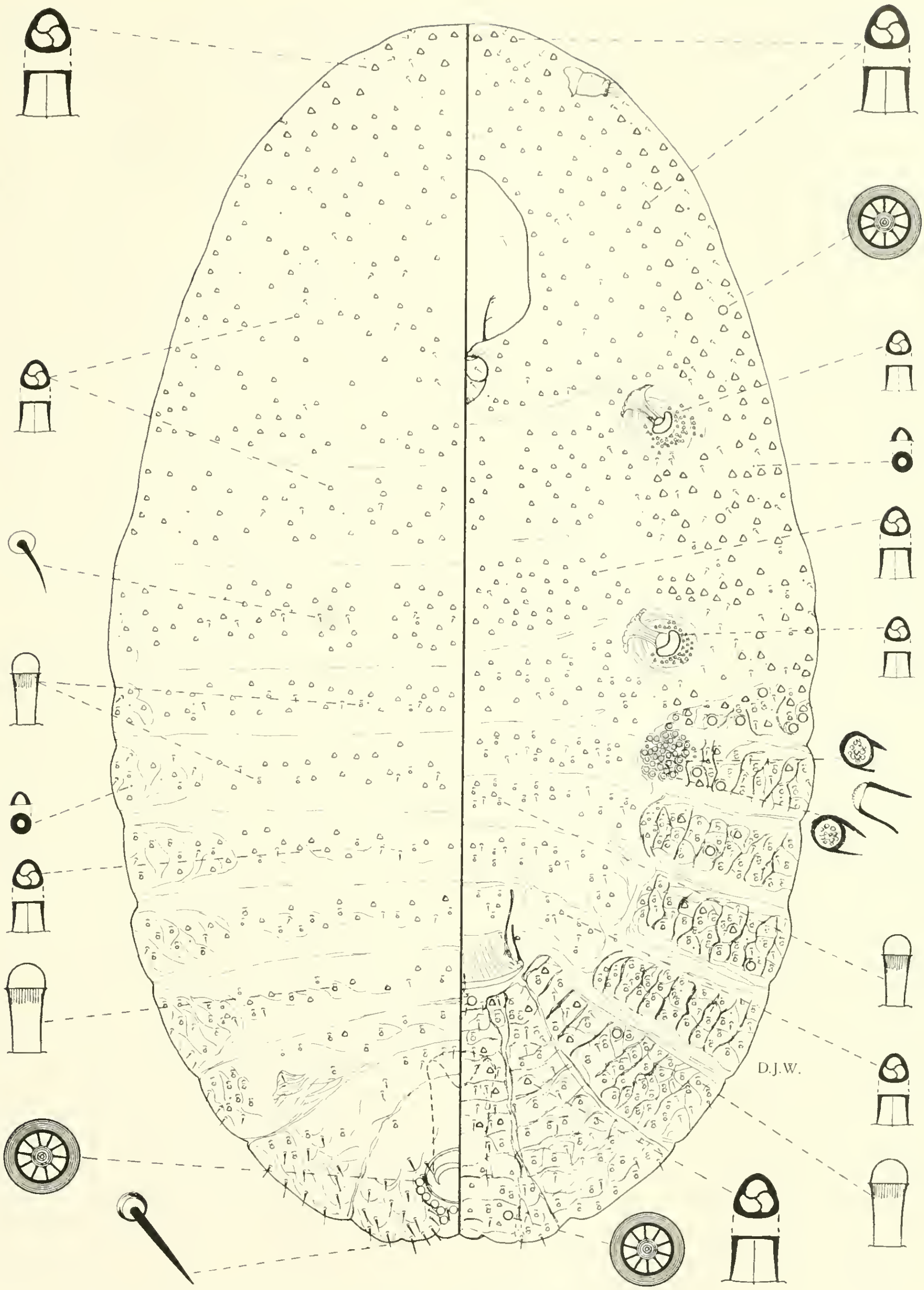

Fig. 2. *Antonina maai.* Specimen from Taiwan, Taipeh, Hsien, on *Bambusa* sp.

ing in length and width anteriorly; longest seta on posterior apex 28 μ long (paratypes 25–31(28) μ). Trilocular pores of 2 sizes, smaller size scattered over most of surface, increasingly abundant anteriorly, absent on posterior 2 or 3 abdominal segments; larger size restricted to marginal areas of anterior thorax and head. Discoidal pores of same distribution pattern as triloculars, less abundant. Multilocular pores present in cluster near entrance of opening to anal tube, multilocular pores absent elsewhere on holotype, variable on paratypes from relatively abundant near body margin of abdominal segments, thorax, and head to only 1 or 2 along any area of body margin; without pores on segment VII near intersegmental line between VII and VIII (paratypes 0–1(0) pores). Oral-collar tubular ducts of 2 sizes, larger size restricted to marginal areas of abdomen, usually absent from segment VIII, smaller size in medial and mediolateral areas of abdomen and posterior thorax, absent from head (most paratypes with some small ducts along body margin of thorax and head).

Ventral surface with setae similar to those on dorsum. Multilocular disc pores present in diffuse band along body margin, without pores in medial and mediolateral areas of segment IV; usually without multilocular pores on segment VIII, rarely with 1 or 2; dermal surface near anal tube surrounded by cluster of multilocular pores. Disc-like pores restricted to mediolateral cluster on abdominal segments I and II; often tubular in structure. Trilocular pores scattered over surface, most abundant anteriorly. Oral-collar tubular ducts of 2 sizes, larger size present laterally from metathorax or abdominal segment I to abdominal apex, smaller size in medial and mediolateral area, sometimes present laterally on head and thorax. Vulvar area with 1 pair lateral apophyses, 1 pair lateral apodemes, and 1 medial apophysis.

First-instar (based on numerous embryos from Taiwan and 1 first instar from Canton, China) are not in sufficient condition to allow a complete description, but some diagnostic characters are as follows. Antenna 6-segmented. Mesosternal apophysis absent. Small round circulus present on intersegmental line between segments III and IV. Ostioles restricted to posterior pair. Trilocular pores of 3 sizes: larger size present around body margin, usually with 17 on each side of body (1 on lateral margin of each abdominal segment, 2 on lateral margin of each thoracic segment, and 3 on lateral margin of head); medium-sized triloculars usually associated with ventral mediolateral setae on each side of segment VII and with 1 or 2 near mouthparts, about 1/3 of specimens with 4 such pores forming longitudinal line associated with ventral mediolateral setae of abdominal segments IV–VII; small-sized triloculars forming marginal line around body, associated with larger marginal triloculars, also with 2 in each sclerotized area associated with spiracular atrium, 1 associated with each leg, 1 associated with each ostiole, and sometimes with 1 or 2 in ventral mediolateral areas of segments II and III. Discoidal pores associated with ventral sublateral setae, with 1 on each side of each body segment. Cerarii present on lateral margins of segments V or VI to VIII, those on segment V and VI with 1 conical seta, those on segments VII and VIII with 2 conical setae. Dorsal setae arranged in 4 longitudinal lines on each side of body (1 submedial, 1 mediolateral, and 2 lateral) with 1 seta in each position on each body segment except without mediolateral setae on segments II and III; ventral setae arranged in 3 longitudinal lines on each side of body (1 submedial, 1 mediolateral, and sublateral) with 1 seta in each position on each abdominal segment. Posterior abdominal segments with slight lobe laterally. Posterior seta 56–65(65) μ long.

Notes.—Adult females of this species are most similar to the adult females of *Antonina pretiosa* in possessing abdominal segments which are plate-like and sclerotized. *Antonina maai* differs by having disc-like pores confined to a single submedian group behind each posterior spiracle and having a few multilocular pores scattered along body margin including near opening to anal tube; *A. pretiosa* has disc-like pores forming a band from abdominal segment II posteriorly around entire abdomen and lacks pores along the body margin except near opening to anal tube.

Based on the descriptions and key presented by Yang and Kosztarab (1967) the first instar of this species also seems to be most similar to *A. pretiosa.* However, we discovered a discrepancy in their description that merits correction. All specimens of *A. pretiosa,* including those examined by Yang and Kosztarab contain a very small, but definite circulus. *Antonina maai* and *A. pretiosa* share the following characters: 3 sizes of trilocular pores; no longitudinal lines of triloculars on dorsum; cerarii with conical setae; body margin of posterior abdominal segments lobed; a small circulus. *Antonina maai* differs by having: line of small-sized trilocular pores around body margin and trilocular pore associated with each ostiole. *Antonina pretiosa* has: no line of small-sized trilocular pores around body margin and no trilocular pore associated with ostioles.

Etymology.—This species is named after Tsing-chao Maa, the collector, formerly of the Agricultural Research Institute, Taipeh, Taiwan, who also collected many scale insects in China and other areas in South East Asia. His help during G. F. Ferris' expedition to China in 1948–1949 was much appreciated by Ferris (see Ferris 1950).

Other specimens examined (not paratypes).—CHINA: Foochow (= Fuzhou), on, ?-?-1976, M. S. Yang (8 ad. ♀, on 3 sl.) (BMNH); Lingnan University, Canton, on *Bambusa multiplex,* IX-18-1948 (Ferris Collection # 97) (11 ad. ♀, 1 first instar, on 6 sl.) (UCD).

Antonina nakaharai Williams and Miller, new species

(Fig. 3)

Type material.–Holotype adult female center specimen on slide with 2 adult female paratypes labeled as follows: left label "Glendale, MD/V-18-77 on/*Phyllostachys* sp./leaf sheath by S./Nakahara 6-77-3/" right label "*Antonina nakaharai*/Williams & Miller/HOLOTYPE/PARATYPE" the right label also gives a map of the position of the holotype. In addition there are 111 adult female paratypes, 7 immature paratypes (excluding first instars), and 155 first instar paratypes.

Description.—*Adult female* holotype on microscope slide, elongate oval, 1.7 mm long (paratypes 1.4–3.7(2.6) mm), 0.7 mm wide (paratypes 0.4–1.8(1.1) mm); posterior apex of last 3 abdominal segments sclerotized (more mature paratypes sometimes with more sclerotization); lateral margins of abdominal segments VI–VIII convex, others straight sided. Antenna 2-segmented (paratypes with 2 or 3 segments), 65 μ long (paratypes 52–85(62) μ). Legs usually represented by inconspicuous sclerotized area, sometimes with associated seta. Labium 60 μ long (paratypes 70–100(80) μ), 2–3 times shorter than clypeolabral shield. Ostioles present on abdomen only. Circulus absent. Spiracles with 2 sizes of trilocular pores in atrium. Cerarii absent, but posterior abdominal setae enlarged, subconical. Anal ring invaginated in anal tube, 150 μ long (paratypes 120–170(139) μ); ring diameter 85 μ long (paratypes 88–100(95) μ); anal tube internally with ring of small multilocular pores and tubular ducts. With 14 & 19 multilocular pores on each side of body in area delimited by posterior edges of each anterior and posterior spiracle (paratypes 10–50(25) pores).

Dorsal surface with short setae, decreasing in length and width anteriorly; longest seta on posterior apex 42 μ long (paratypes 30–52(40) μ). Trilocular pores of 1 size, absent from posterior 2 or 3 segments, scattered over remainder of surface, least abundant posteriorly. Discoidal pores of same distribution pattern as triloculars, less abundant. Multilocular pores forming longitudinal band along body margin; without pores on segment VII near intersegmental

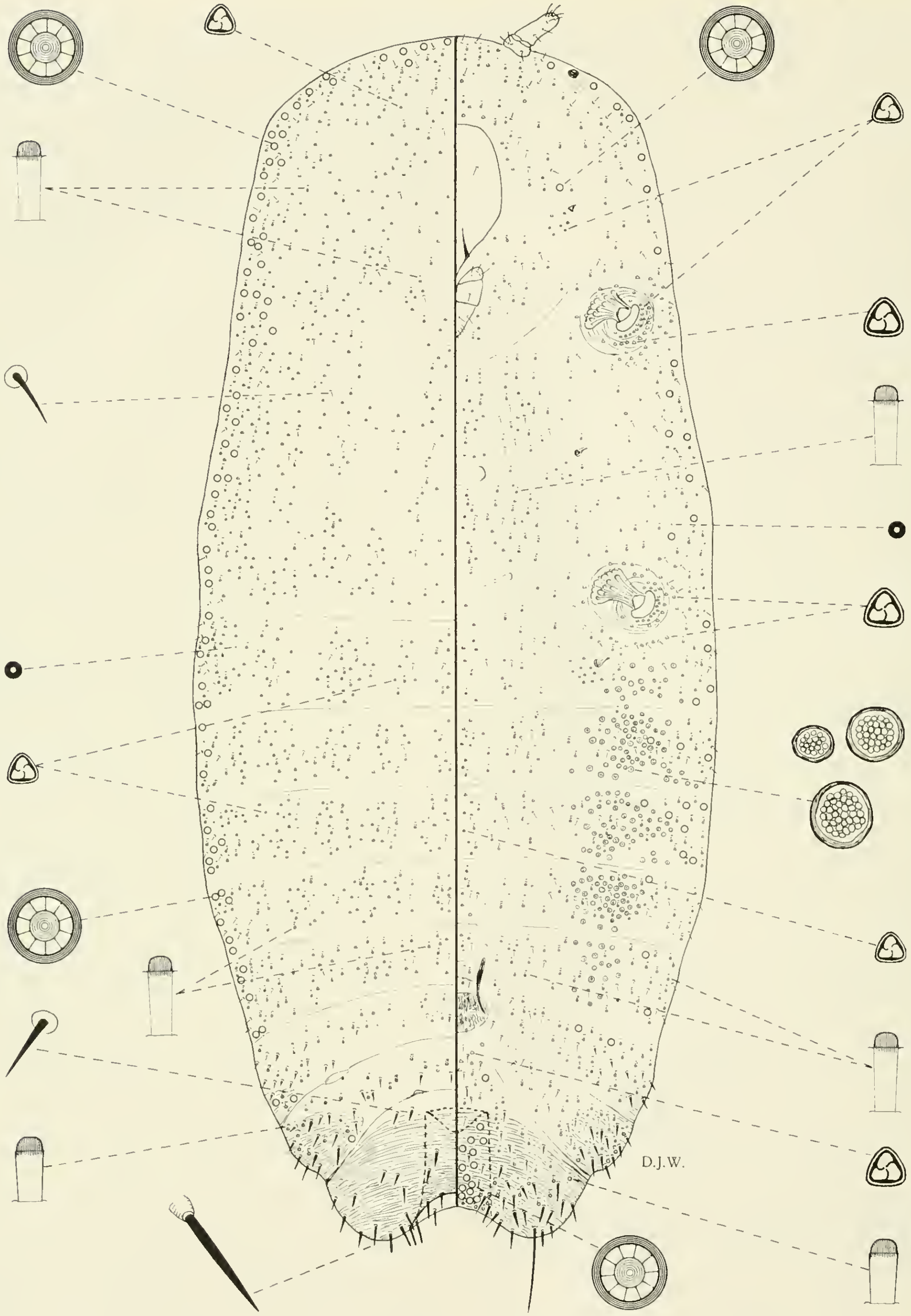

Fig. 3. *Antonina nakaharai*. Specimen from U.S., Maryland, Glendale, on *Phyllostachys* sp.

line between VII and VIII (paratypes 0–3(0) pores). Oral-collar tubular ducts of 1 size, absent from segment VIII except in anal tube, abundant over remainder of surface.

Ventral surface with setae similar to those on dorsum. Multilocular disc pores present in band along body margin, with 1 pore on abdominal segment IV within area delimited by lateral margin of disc-like pore clusters on each side of segment (paratypes with 0–4(1) pores); with multilocular pores on segment VIII restricted to posterior half or third of distance between vulva and posterior apex of body; dermal surface surrounding opening of anal tube with cluster of multilocular pores. Disc-like pores present in mediolateral areas from metathorax to segment VI (paratypes from metathorax to segments IV, V, or VI). Trilocular pores of 2 or 3 sizes, smaller size in plate outside of spiracular atrium and near leg areas; larger size scattered around mouthparts and spiracles, medium size scattered over remainder of surface except absent or rare on posterior 3 or 4 segments, most abundant near body margin. Oral-collar tubular ducts present over surface. Vulvar area with 1 pair of lateral apophyses and 1 pair of weakly indicated posterior apophyses.

Notes.—For a comparison of this species with *A. crawi* and *A. socialis* see the "Notes" section of the former species.

Etymology.—We have named this species after Sueo (Steve) Nakahara who collected some fine specimens of this species in the U.S. He has been an important colleague of both authors for many years.

Specimens examined.—CHINA: Hong Kong, on *Sinobambusa tootsii,* I-30-41, W. B. Wood (2 ad. ♀ on 2 sl.) (USNM) (not part of paratype series); Hong Kong, Botanical Gardens, on *Ixora stricta* (?), VIII-1-1936, R. H. LePelley (1 ad. ♀) (USNM); Koolongue, Fukien, on *Phyllostachys aurea* VII-26-1930, F. A. McClure (2 ad.♀ on 1 slide) (USNM); locality ?, on *Sinobambusa laeta,* Gouldman (1 ad. ♀) (USNM) (not part of paratype series); locality ?, on *Bambusa* sp., IX-1-1936, F. C. Chen (4 ad. ♀ on 4 sl.) (BMNH). RUSSIA: Szoesi (= Sochi), on *Bambusa* sp., IX-5-1985 F. Kozár (1 ad. ♀) (BMNH). JAPAN: Kuro, Chiku, Hotel Chiku, on bamboo, ?-?-1889 (2 ad. ♀, 3 first instars on 2 sl.) (USNM); Mt. Hicko, on bamboo, date and collector ? (1 ad. ♀) (USNM); Sunza Village, on bamboo, XI-6-1980, E. L. Paddock (5 ad. ♀, 1 imm. on 3 sl.) (CDFA); Tokyo on bamboo, date and collector ? (3 ad. ♀ on 1 sl.) (UCD); Yokohama, on bamboo "seeds," I-?-1908, (12 ad. ♀, 7 first instars on 4 sl.) (USNM); Yokohama, on *Arundinaria variegata pygmaea,* VII-11-1911, collector ? (1 ad. ♀) (USNM); Imperial Plant Quarantine Station, Yokohama, on bamboo, date ?, S. I. Kuwana (1 ad. ♀) (UCD); locality ?, on bamboo, XI-?-1909, E. M. Ehrhorn (1 ad.♀) (USNM) (not part of paratype series); locality, host ?, II-?-1912, collector ? (3 ad. ♀ on 1 sl.) (UCD); locality ?, on *Arundinaria japonica,* VIII-14-1933, W. H. Wheeler (1 ad. ♀) (USNM); locality ?, on bamboo stems and leaves, VII-29-1934, W. J. Ehinger (5 ad. ♀, 1 imm. on 2 sl) (USNM); locality ?, on bamboo stems, VIII-2-1934, H. G. Taylor (3 ad. ♀) (USNM); locality ?, on bamboo, I-3-1935, C. V. Scott (1 ad. ♀) (USNM); locality ?, on bamboo, XI-11-1936, O. A. Hardy (2 ad. ♀ on 1 sl) (USNM); locality ?, on bamboo, I-29-1937, A. B. Wells (3 ad. ♀ on 1 sl) (USNM); locality ?, on *Bambusa* sp., X-4-1938, R. F. Wilbur (2 ad. ♀ on 1 sl) (USNM); in quarantine at Seattle, WA, on bamboo, I-17-1946, Young and Smith (1 ad. ♀) (USNM); in quarantine at Encinitas, San Diego Co., CA, on *Sasa kurihensis chabomanba,* III-28-1991, K. Sims (5 ad. ♀ on 3 sl.) (CDFA). TAIWAN: Lo-linshan, 2,660 m. elevation, near Arisan, on pygmy bamboo, IX-29-1949, T. Maa (6 ad. ♀ on 3 sl.) (UCD). UNITED STATES: HAWAII: Honolulu, on bamboo, VIII-3-1959, S. Miyake (5 ad.♀ on 1 sl.) (USNM); Honolulu, on bamboo, date and collector ? (1 ad. ♀, 3 first instars on 2 sl.) (USNM); Kawaihae, on bamboo, XII-29-1994, S. Nakahara (5 ad.♀, 1 imm. on 1 sl.) (USNM) Oahu, on bamboo, IV-4-1961, J. W. Beardsley (4 ad.♀ on 2 sl.) (USNM). LOUISIANA: New Orleans, on bamboo, IX-29-1924, H. K. Plank (6 ad. ♀ on 1 sl.) (USNM). MARYLAND: Prince George's Co., Glendale, on *Phyllostachys* sp., leaf sheaths, V-18-1977, S. Nakahara (8 ad. ♀, 2 imm. on 3 sl.) (BMNH, USNM). NEW JERSEY: Riverton, on *Bambusa* sp., VII-15-1915, H. B. Weiss (9 ad. ♀, 2 imm. >100 first instars on 7 sl.) (USNM). SOUTH CAROLINA: Aiken, on bamboo, III-8-1911, A. Euctris (2 ad. ♀ on 2 sl.) (USNM). TEXAS: Houston, on bamboo, date ?, N. B. Zuber (5 ad. ♀, 1 imm. on 1 sl.) (USNM); Houston, on bamboo, VIII-?-1918, E. Teas (2 ad. ♀, 4 first instars on 2 sl.) (USNM).

Antonina socialis Newstead, **reinstated status**

(Figs. 4–5)

This species was described by Newstead (1901) but was subsequently treated as a junior synonym of *Antonina crawi* by Williams (1962) based on the illustration of Ferris (1953). Ben-Dov (1994) and Ben-Dov et al. (2001) concurred with Williams' synonymy.

Type material.—Lectotype adult female right specimen on slide with 2 additional adult female paralectotypes labeled as follows: left label "Broxbourne,/Herts; on Arun-/dinaria japonica/Ex Ed. Gard. Chron./26.i.99./E.M.M. vol. XII.p.85"; right label "Antonina/socialis nsp/123 News/Cotype females/3 = lectotype/316" (BMNH). The lectotype was designated by Williams (1985).

Description.—*Adult female* on microscope slide, elongate oval, 1.3–5.0(3.3) mm long, 0.7–2.2(1.7) mm wide; posterior apex of last 2 abdominal segments sclerotized (more mature paratypes sometimes with more sclerotization); lateral margins of abdominal segments VII-VIII convex, others straight sided. Antenna 2- or 3-segmented, 75–105(103) μ long. Legs usually represented by inconspicuous sclerotized area or small dermal pocket, sometimes absent. Labium 88–112(99) μ long, between 2 and 3 times shorter than clypeolabral shield. Ostioles present on abdomen only. Circulus absent. Spiracles with 2 sizes of trilocular pores in sclerotized area surrounding atrium. Cerarii absent, but posterior abdominal setae enlarged, subconical. Anal ring invaginated in anal tube, 127–200(167) μ long; ring diameter 85–132(120) μ); anal tube internally with ring multilocular pores and tubular ducts. With 14–96(50) multilocular pores on each side of body in area delimited by posterior edges of each anterior and posterior spiracle.

Dorsal surface with short setae, decreasing in length and width anteriorly; longest seta on posterior apex 32–47(40) μ long. Trilocular pores of 1 size, absent from posterior 3 or 4 segments, absent along body margin except near spiracles, scattered over remainder of surface. Discoidal pores of same distribution pattern as triloculars, less abundant. Multilocular pores forming longitudinal band along body margin; with 1–12(6) pores on segment VII near intersegmental line between VII and VIII. Oral-collar tubular ducts of 1 variable size, absent or rare on segment VIII except in anal tube, abundant over remainder of surface.

Ventral surface with setae similar to those on dorsum. Multilocular disc pores present in band along body margin, with 0–7(2) pores on abdominal segment IV within area delimited by lateral margin of disc-like pore clusters on each side of segment; with multilocular pores on segment VIII restricted to posterior half or quarter of distance between vulva and posterior apex of body, occasionally with 1 to 3 such pores just posterior to vulva; dermal surface surrounding opening of anal tube with cluster of multilocular pores and oral-collar tubular ducts. Disc-like pores present in mediolateral areas from metathorax to segments VII or VIII. Trilocular pores of 2 or 3 sizes, smaller size in plate outside of spiracular atrium; larger size scattered around mouth-

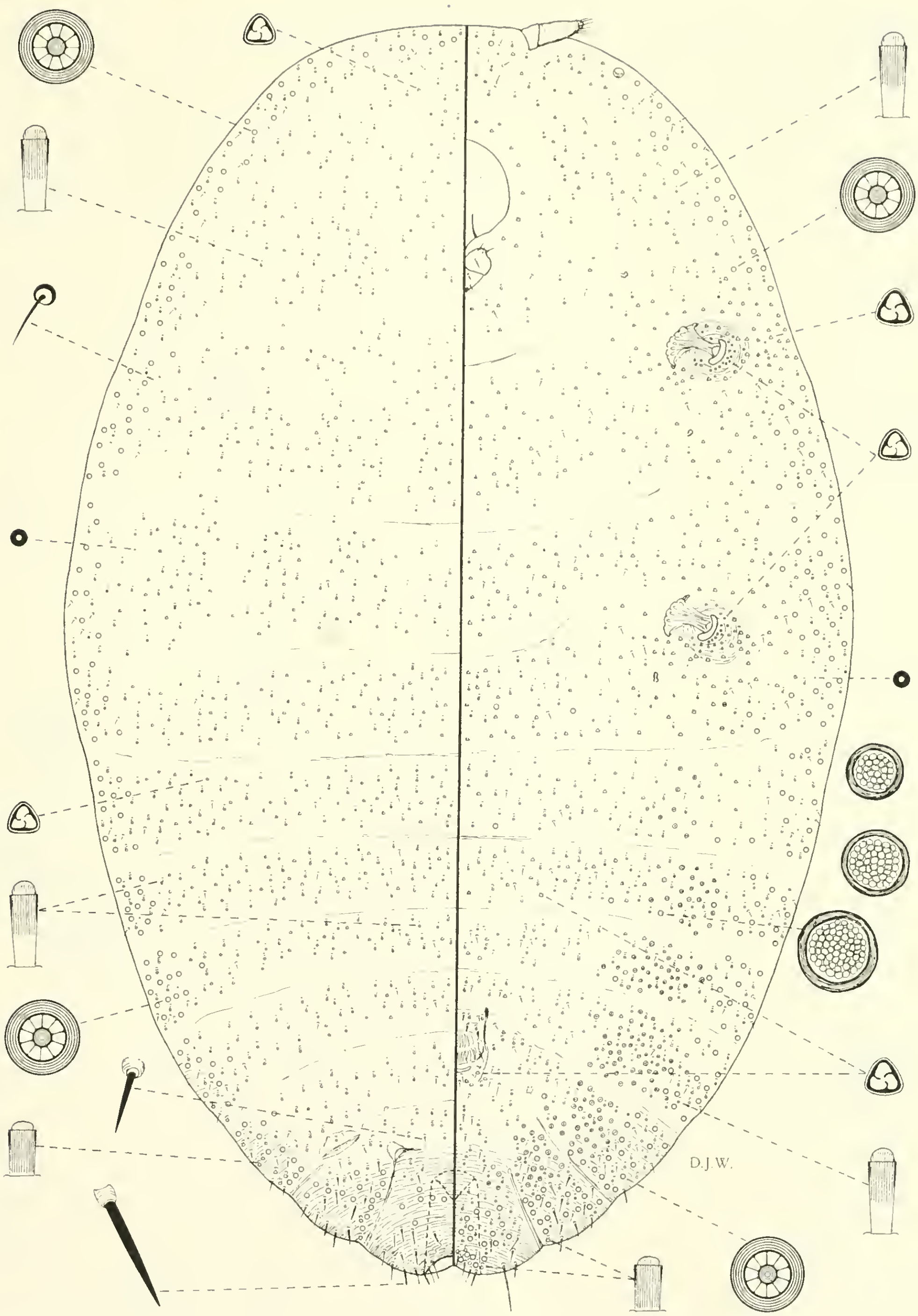

Fig. 4. *Antonina socialis.* Specimen from U.S., Louisiana, New Orleans, on bamboo.

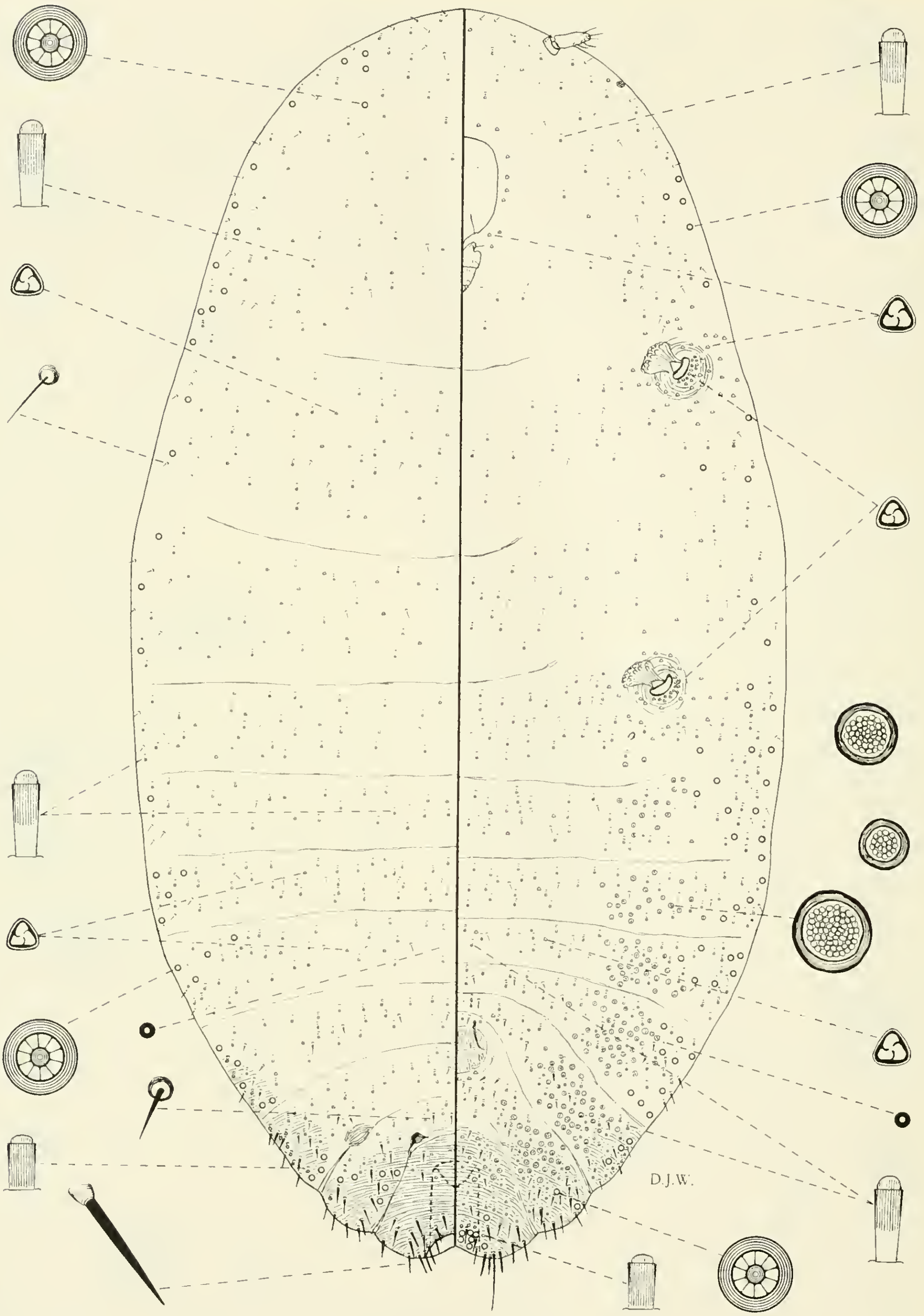

Fig. 5. *Antonina socialis*. Specimen from Bermuda, on bamboo.

parts, medium size scattered over remainder of surface except absent or rare on posterior 3 or 4 segments, most abundant near body margin. Oral-collar tubular ducts present over surface. Vulvar area with 1 pair of lateral apophyses and 1 pair of weakly indicated posterior apophyses.

Notes.—For a comparison of this species with *A. crawi* and *A. nakaharai* see the "Notes" section of the former species.

Original material of this species is not satisfactory for illustrating. Fig. 4 is reasonably similar in appearance to the type series. Fig. 5 shows a variant that has fewer multilocular pores.

Specimens examined.—BERMUDA: locality ?, on bamboo, date and collector ? (6 ad ♀ on 4 sl.) (BMNH); locality ?, on *Arundinaria* sp., V-7-1955, F. J. Simmonds (4 ad. ♀ on 1 sl.) (USNM). CHINA: Hong Kong, on *Bambusa* sp., X-21-1921, A. S. Hitchcock (1 ad. ♀, 1 imm. on 1 sl.) (USNM); locality ?, on *Indocalamus nanicus*, I-30-1941, Gouldman (2 ad. ♀, 4 first instars on 2 sl.) (USNM); Lingnan University, Canton, on small bamboo, XI-7-1948, G. F. Ferris (1 ad. ♀ on 1 sl.) (UCD). JAPAN: Kagoshima, on bamboo, V-12-1901, C. L. Marlatt (2 ad. ♀ on 1 sl.) (USNM); Yokohama, on *Arundinaria hindsii*, VII-12-1921, A. S. Hitchcock (1 ad ♀, 5 first instar on 1 sl.) (USNM); Yokohama, on bamboo, date ?, Kuwana (1 ad. ♀) (UCD); Locality ?, on bamboo, date and collector? (CDFA); locality ?, on *A. hindsii*, VIII-2-1921, A. S. Hitchcock (2 ad. ♀ on 2 sl.) (USNM). TAIWAN: Taihoku, on bamboo, XI-20-1914, M. Mumi (4 ad. ♀ 2 imm. on 2 sl.) (UCD); locality ?, on *A. kansan*, I-30-1941, Gouldman (3 ad. ♀ on 1 sl.) (USNM). UNITED KINGDOM: ENGLAND: Hertfordshire, Broxbourne, on *A. japonica*, I-26-1899, editor of Gardener's Chronicle (3 ad. ♀ on 1 sl) (BMNH); Hertfordshire, Broxbourne, on *A. japonica*, date and collector ? (1 ad. ♀) (BMNH). SCOTLAND: East Lothian, Prestonkirk, on freshly imported bamboo from Japan, VII-?-1905, A. Hepburn (4 ad. ♀ on 1 sl.) (BMNH). UNITED STATES: CALIFORNIA: Sacramento, on ?, II-24-1913, E. O. Essig (3 ad ♀, 1 first instar on 4 sl.) (USNM); Ventura, on bamboo, XI-1-1910, collector ? (5 ad ♀ on 3 sl.) (USNM); Ventura, on bamboo, I-10-1911, E. O. Essig (1 ad ♀) (USNM); Ventura, on bamboo, I-12-1913, S. H. Essig (5 ad ♀, 6 imm., 1 first instar on 5 sl.) (UCD, USNM). HAWAII: Honolulu, host and date ?, E. M. Ehrhorn (7 ad. ♀ on 3 sl.) (UCD, BMNH); Moanalua Gardens, Honolulu, on bamboo, X-3-1908, Kotinsky (2 ad. ♀ on 2 sl.) (USNM); Moanalua Gardens, Honolulu, on bamboo, III-10-1910, E. M. Ehrhorn (7 ad. ♀ on 1 sl.) (USNM); Moanalua Gardens, Honolulu, on bamboo, IV-22-1914, collector ? (2 ad. ♀ on 1 sl.) (USNM). LOUISIANA: Metaire Ridge Nurseries, New Orleans, on bamboo, IV-5-1921, F. Foster (1 ad. ♀); New Orleans, IV-2-1921, on bamboo, W. Bradley (2 ad. ♀ on 1 sl.) (UCD); New Orleans, on *Pseudosasa japonica*, *Sasa japonica*, and *Arundinaria japonica*, II-11-1943, R. A. Young (3 ad. ♀, 1 imm. on 2 sl.) (USNM); New Orleans, on bamboo, II-17-1945, G. Rau (4 ad. fem on 2 sl.) (USNM).

KEY TO ADULT FEMALES OF *ANTONINA* SPECIES OCCURRING ON BAMBOO

1. Anal ring not on dermal surface but present in internal tube; without a circulus 2

– Anal ring on dermal surface, not in internal tube; apparently with a circulus .... *bambusae* Khalid and Shafee

2(1). Disc-like pores not confined to segments V or VI to VIII 3

– Disc-like pores confined to segments V or VI to VIII .... *meghalayaensis* Khalid and Shafee

3(2). Abdominal segments plate-like and sclerotized from body margin to medial or sublateral areas of segments III or IV to VIII 4

– Abdominal segments not plate-like and sclerotized from body margin to medial or sublateral areas, or with plate-like areas restricted to segments VI to VIII 5

4(3). Disc-like pores in definite submedial groups, forming a band from abdominal segment II posteriorly around abdomen; multilocular pores absent except near opening of anal tube .... *pretiosa* Ferris

– Disc-like pores confined to single submedial group behind each posterior spiracle on abdominal segment II; multilocular pores present along body margin of venter and near opening of anal tube (Fig. 2) . . . . *maai* Williams and Miller, n. sp.

5(3). Disc-like pores present in large group from metathorax posteriorly to at least segment III 6

– Disc-like pores restricted to small group posterior to each second spiracle between metathorax and abdominal segment II . . . . *zonata* Green

6(5). Multilocular pores absent from crescentic band adjacent to atrium of each spiracle (Fig. 4); crescentic band containing trilocular pores only 7

– Multilocular pores present in crescentic band adjacent to atrium of each spiracle; crescentric band containing multiloculars and triloculars . . . . *purpurea* Signoret

7(6). Multilocular pores present on dorsum . . . 8

– Multilocular pores absent from dorsum . . . . *graminis* (Maskell)

8(7). Multilocular pores not encircling crescentic band of trilocular pores adjacent to anterior spiracles 9

– Multilocular pores encircling crescentic band of trilocular pores adjacent to anterior spiracles . . . . *thaiensis* Takahashi

9(8). Disc-like pores restricted to segments II to IV, V, or VI (rarely with 1 or 2 on VII) 10

– Disc-like pores present on segments II to VII or VIII (Figs. 4–5) . . . *socialis* Newstead

10(9). Ventral abdominal multilocular pores abundant, with 6 or more pores on segment IV in area defined by lateral margins of disc-like pore clusters (Fig. 1) . . . . *crawi* Cockerell

– Ventral abdominal multilocular pores uncommon, with 5 or fewer pores on segment IV in area defined by lateral margins of disc-like pore clusters (Fig. 3) . . . . *nakaharai* Williams and Miller

DISCUSSION

We have examined the first instars of representatives of each species of the Crawi complex and find no consistent morphological differences among them. The illustration and description of the first instar by Yang and Kosztarab (1967) is reasonably accurate, except there is an extra longitudinal line of trilocular pores near the body margin. The species that they treated as *A. crawi* is actually *A. nakaharai.*

Because of confusion about the correct identities of *A. socialis, A. crawi,* and *A. nakaharai,* it is difficult to determine which was the focus of the treatments of most authors. Ferris (1953) presented an illustration of what was labeled as *A. crawi,* but it actually is fairly typical of *A. socialis.* The specimens that he illustrated were either collected in Ventura, California by E. O. Essig or New Orleans, Louisiana by W. Bradley. Ferris' illustration also was used by McKenzie (1967) (he treated specimens of *A. socialis* and *A. crawi*), Williams and Granara de Willink (1992) (they treated only *A. socialis*), and Zimmerman (1948) (probably treated only *A. nakaharai*). We have attempted to associate as many literature citations as possible of *A. crawi* with the correct species from the Crawi complex. This information is as follows: Affifi and Kosztarab (1967) (probably *A. nakaharai*); Beardsley (1965) (probably *A. nakaharai*); Ben-Dov (1994) (all three species); Cockerell (1900) (*A. crawi*); Danzig (1980) (probably *A. nakaharai*); Hendricks and Kosztarab (1999) (all three species); Hodgson and Hilburn (1991 and 1991b) (probably *A. socialis*); Hu et al. (1992) (probably *A. socialis*); McKenzie (1967) (*A. crawi* and *A. socialis*); Newstead (1901) (*A. socialis*); Nur et al. (1987) (probably *A. nakaharai*); Paik (1978) (probably *A. socialis*); Tang (1977) (probably *A. socialis*); Tang (1992) (not part of Crawi complex; similar to *A. tesquorum*); Tereznikova (1975) (possibly *A. nakaharai*); Williams and Granara de Willink (1992) (probably *A. socialis*); Yang and Kosztarab (1967) (first instar probably *A. nakaharai;* second instar ?); Zimmerman (1948) (probably *A. nakaharai*).

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A NEW SPECIES OF *DAIMOTHORACODES* PETROVITZ (COLEOPTERA: SCARABAEOIDEA: HYBOSORIDAE) AND A KEY TO SPECIES OF THE GENUS

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Abstract.—***Daimothoracodes confossus*** **Ocampo and Vaz-de-Mello, new species**, is described from Minas Gerais, Brazil. A key to the three species of the genus is provided in English and Portuguese.

Resumo.—***Daimothoracodes confossus*** **Ocampo e Vaz-de-Mello, sp. nov.**, é descrito com base em exemplares de estado de Minas Gerais, Brasil. Uma chave para as três espécies conhecidas do gênero é fornecida, incluindo uma versão em português.

Key Words: Coleoptera, Hybosoridae, *Daimothoracodes*, Brazil, taxonomy

The genus *Daimothoracodes* Petrovitz 1970 was created for one species, *D. mirabilis* Petrovitz 1970. The original description was based on one female specimen from the State of Goiás, Brazil. Martínez (1994) described and illustrated the male genitalia of *D. mirabilis* and recorded the species from the states of Minas Gerais and São Paulo in Brazil and Misiones Province in Argentina. He also described a second species, *D. magnificus* Martínez 1994, from Ichilo Province, Bolivia.

In this paper we describe *Daimothoracodes confossus*, from Minas Gerais State, Brazil. We also provide a key to species of *Daimothoracodes* and diagnostic illustrations.

All known specimens of *Daimothoracodes confossus* were collected at light.

Daimothoracodes Petrovitz 1970

Diagnosis.—This genus is distinguished from other genera of Hybosoridae from the New World by the following combination of characters: Shape of the pronotum with the base at middle posteriorly produced; elytron elongate, convex, with epipleuron not developed; meso and metatibiae profoundly, laterally flattened.

Daimothoracodes confossus Ocampo and Vaz-de-Mello, new species

(Figs. 1, 2a, b, 7–8)

Type series.—Holotype male labeled "Brasil: MG, Águas Vermelhas, XII-1998. A. Bello & F. Z. Vaz-de-Mello." Allotype female and 3 paratypes with same data, 5 paratypes with same data except XII-1997, A. Bello. Holotype and allotype deposited at the Museu de Zoologia, Universidade de São Paulo (São Paulo, Brazil); two paratypes at the University of Nebraska State Museum (Lincoln, NE, USA), four paratypes in A. M. Bello personal collection (Rio de Janeiro, Brazil), one paratype in H. F. Howden personal collection (Ottawa,

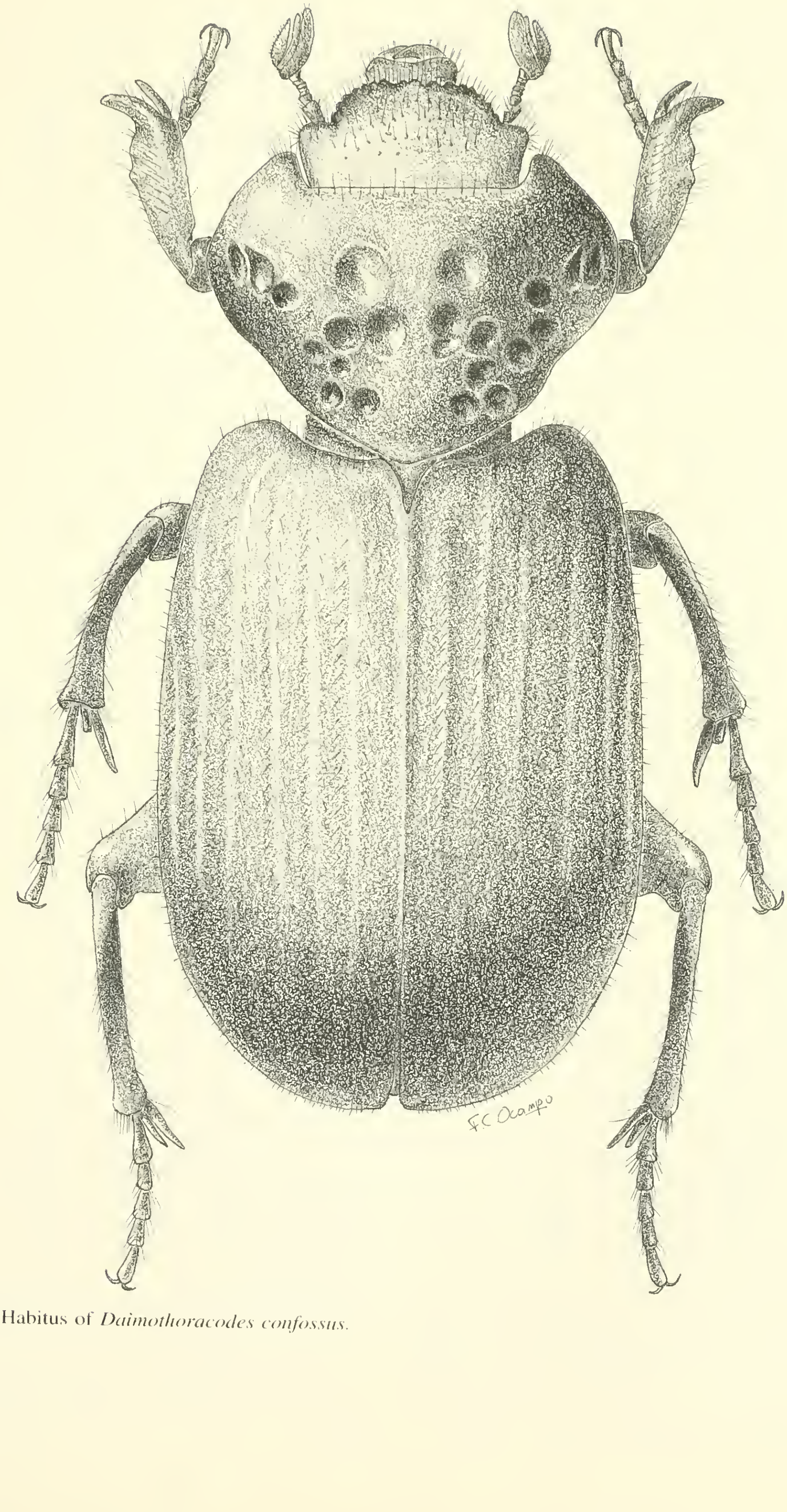
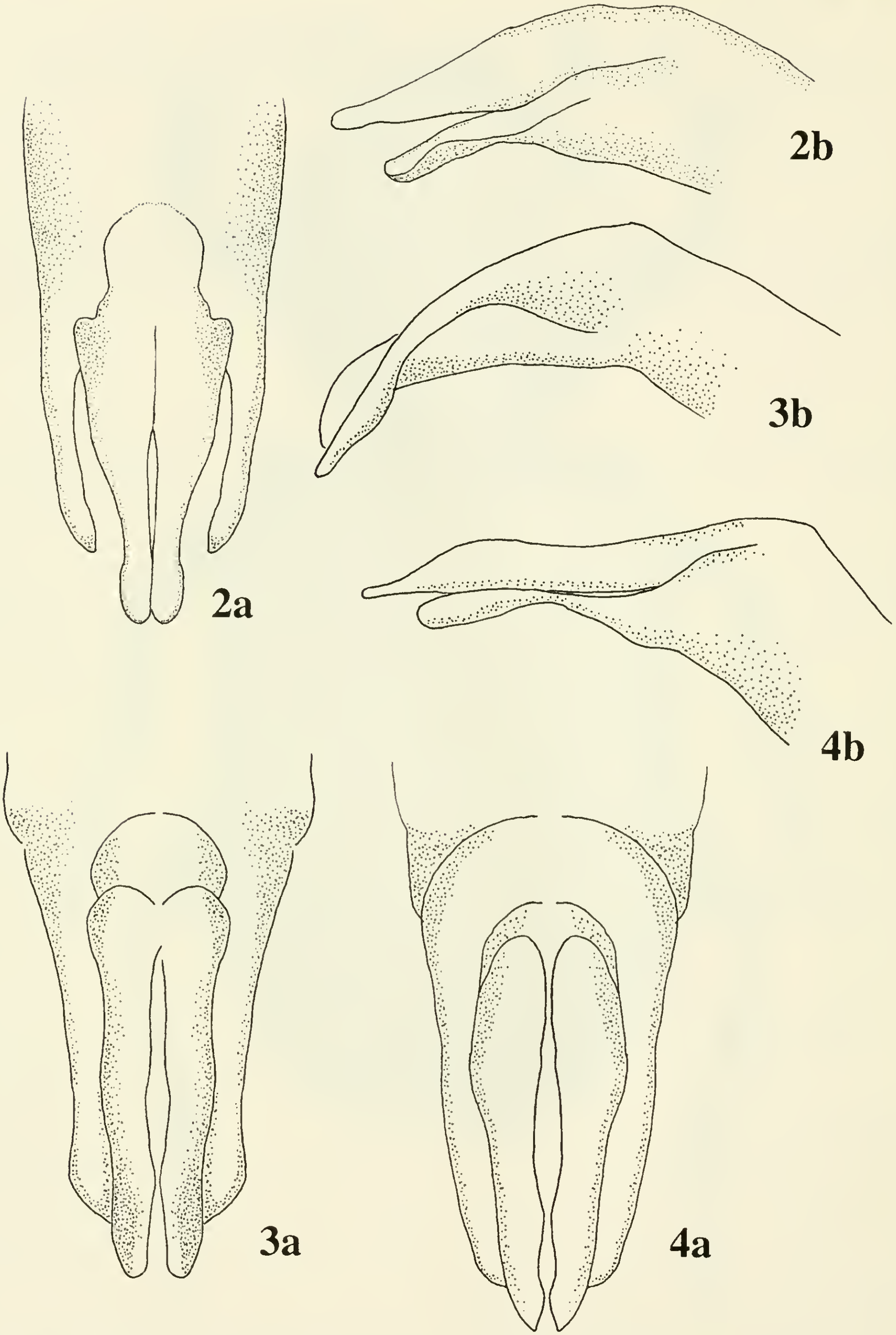
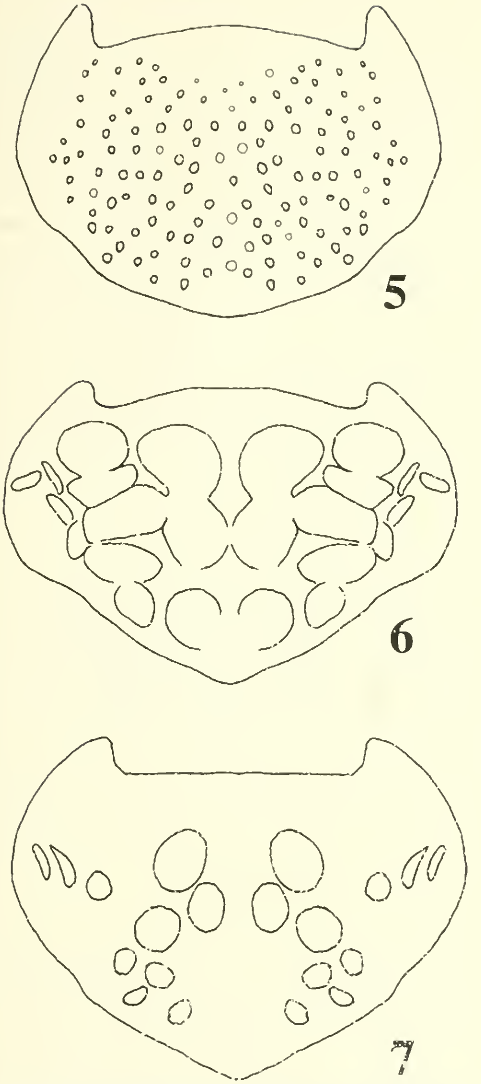


Fig. 1. Habitus of *Daimothoracodes confossus.*



Figs. 2–4. Caudal (a) lateral (b) views of parameres. 2, *Daimothoracodes confossus*. 3, *D. mirabilis*. 4, *D. magnificus*.



Figs. 5–7. Pronotum. 5. *Daimothoracodes magnificus.* 6. *D. mirabilis.* 7. *D. confossus.*

Canada), and one paratype in A. Ballerio personal collection (Brescia, Italy).

Holotype male.—Length 6.14 mm; greatest width 2.90 mm. *Color:* Testaceous. *Head:* Frons subrectangular, surface smooth, slightly rugose toward clypeus, sparsely setose, setae minute. Eye canthus subtriangular. Eyes not visible in dorsal view, totally covered by pronotum when head retracted. Frontoclypeal suture obsolete. Clypeus slightly rugose, sparsely setose; margins rounded, reflexed except in middle, crenulate; vertical face of apex blunt, with sparse, long, slender setae. Labrum reduced, 0.46 times as long as clypeus, 0.55 times as wide as clypeus, mesally indented; lateral margin rounded. Mandibles protruding beyond labrum, external surface smooth; with small, dorsal, preapical tooth and acute apical tooth. Labium with surface of mentum smooth and with 16 long, slender setae; apex rounded. Antenna 10-segmented; scape subequal in length to segments 2–7, strongly notched, with long slender setae on dorsal surface; segment 2 globose; segments 3–7 wider than long; club 3-segmented, rounded, basal segment slightly cupuliform, partially receiving segment 2. *Pronotum:* Convex, 0.94 times as long as wide, surface smooth between fovea, glabrous; anterior margin straight, right-angled behind eye, with short, sparse setae; lateral margin strongly produced at middle; base (each side of middle) emarginate; base at middle posteriorly produced, subtriangular. Disc with 21 deep, large rounded or oval foveae; foveae variable in shape, size, and depth, but deeper, larger and more rounded on disc. Anterior angle acutely rounded. *Scutellum:* Surface smooth, glabrous, subtriangular. *Elytron:* Elongate, convex, 1.45 times as long as wide; sparsely setose, setae arranged in longitudinal series from base to apex; with 8 poorly developed, carinate striae, and 2 laterad of humerus; striae not reaching elytral apex. Epipleuron not developed. *Venter:* Prosternal surface finely rugose, biconcave; with well-developed keel in middle; prosternal shield with posteriomedial process well-developed, pointed. Mesosternal surface smooth, posteriorly depressed; posterior process spinelike. Metasternal surface smooth, sparsely setose. *Legs:* Procoxa large, 0.66 times as long as profemur, anteriorly globose. Trochanters and femora sparsely setose, setae long. Protibial dorsal surface with longitudinal line of setae at middle and at margin (setae long, sparse); ventral surface with long, sparse setae; with 3 teeth in apical half; apical tooth large, 0.4

Fig. 8. Distribution of *Daimothoracodes* species.

times as long as tibia, curved; medial and basal teeth reduced, nearly obsolete; spur long, as long as apical tooth, slightly curved, apex rounded. Protarsus with protarsomere 1 as long as 2–4 combined; protarsomere 2–4 subglobose; 5th protarsomere 1.5 times longer than protarsomere 4. Pro-, meso-, and metatarsal claws shorter than tarsomeres 5, simple, curved. Meso- and metatibiae profoundly, laterally flattened, sparsely setose; setae long, slender. Meso- and metatibial medial spurs longer than tarsomere 1; mesotibial external spur reduced, 0.3 times as long as medial spur, apex rounded; metatibial external spurs longer than tarsomere 1. Spurs semicircular in cross section. Meso- and metatarsomeres 1 longer than 2, meso- and metatarsomeres 2–5 subequal in length. *Parameres:* Figs. 2a, b.

Allotype female.—Length 5.81 mm; greatest width 2.82 mm. Similar to holotype except for 22 pronotal fovea.

Paratypes.—Length 5.5–6.2 mm; greatest width 2.7–2.9 mm. Similar to the holotype except 14–25 pronotal fovea.

Etymology.—From the Latin *confossus,* meaning full of holes; in reference to the presence of numerous deep foveae on the pronotal surface.

Distribution (Fig. 8).—This species is known only from the type locality, Águas Vermelhas, Minas Gerais, Brazil.

Recognition.—This species is distinguished from other species in the genus *Daimothoracodes* by the large, deep foveae on the dorsal surface of the pronotum (Figs. 1, 7), the lack of setae on the pronotal surface, and the form of the male parameres (Figs. 2a, b).

KEY TO SPECIES OF *DAIMOTHORACODES*

1. Pronotal surface with large, deep foveae or deep, irregular depressions (Figs. 6–7), lacking setae, or with (at most) few scattered setae . . 2
– Pronotal surface with deep punctures, sparsely arranged (Fig. 5); surface with dense, short setae. Parameres as Figs. 4a, b . . . . *D. magnificus* Martínez 1994
2. Pronotal disc with deep, large, rounded foveae; foveae variable in number (14–25), shape, and depth, not or rarely coalescent (Fig. 7). Parameres as in Figs. 2a, b . . . . *D. confossus* Ocampo and Vaz-de-Mello, n. sp.
– Pronotal disc with deep, irregular depressions, depressions variable in number and depth, coalescent (Fig. 6). Parameres as in Figs. 3a, b . . . . *D. mirabilis* Petrovitz 1970

CHAVE PARA AS ESPÉCIES DE *DAIMOTHORACODES*

1. Pronoto com depressões grandes e profundas, irregulares ou arredondadas; superfície dorsal com no máximo poucas setas espalhadas e pouco conspícuas (Figs. 6–7) 2
– Pronoto apenas pontuado, sem depressões marcadas; superfície pilosa, coriácea (Fig. 5); parâmeros como nas Figs. 4a, b . . . . *D. magnificus* Martínez 1994
2. Pronoto com fóveas grandes, profundas e arredondadas, em número (14–25), tamanho e profundidade variáveis, raramente coalescendo (Fig. 7); parâmeros como nas Figs 2a, b . . . . *D. confossus* Ocampo and Vaz-de-Mello, new species
– Pronoto com depressões irregulares e profundas, variáveis em profundidade e número, coalescentes (Fig. 6); parâmeros como nas Figs. 3a, b . . . . *D. mirabilis* Petrovitz 1970

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PENTAMYZUS HILLE RIS LAMBERS, A NEOTROPICAL GENUS OF THE TRIBE MACROSIPHINI (HEMIPTERA: APHIDIDAE: APHIDINAE), WITH THE DESCRIPTION OF A NEW SPECIES

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Abstract.—***Pentamyzus fueguinus*, n. sp.**, is described and two little-known South American species of *Pentamyzus*, *P. tenuis* and *P. acaenae*, are studied from aphids caught in Tierra del Fuego (Argentina). Considering that *Pentamyzus* is one of the few genera of Macrosiphini in the Neotropical Region, we present several hypothesis about its evolution in the subcontinent.

Resumen.—A partir de pulgones capturados en Tierra del Fuego (Argentina) se describe ***Pentamyzus fueguinus* n. sp.** y se estudian otras dos especies sudamericanas poco conocidas: *P. tenuis* y *P. acaenae.* Aprovechando que *Pentamyzus* es uno de los pocos géneros de Macrosiphini con representación neotropical se analizan varias hipótesis sobre su historia evolutiva en el subcontinente.

Key Words: *Pentamyzus*, Aphididae, Macrosiphini, aphid evolution, new species, Tierra del Fuego, Argentina

Macrosiphini (Aphidinae) is the richest tribe both in species and genera in the family Aphididae (Remaudière and Remaudière 1997, Eastop 1998) and it is very difficult to subdivide it into subtribes "because speciation in a great scale has taken place during a rather short time rather recently" (Heie 1992). The tribe Macrosiphini is poorly represented in the Neotropical Region and most of its species recorded in this region are allochthonous (Smith and Cermeli 1979, Nieto Nafría et al. 1994). Autochthonous Neotropical species belong to the genera *Microparsus* Patch 1908 (several species), *Uroleucon* Mordvilko 1914 (many species), *Pentamyzus* Hille Ris Lambers 1966 (3 species), *Blanchardaphis* Ortego, Nieto Nafría, and Mier Durante 1998 (2 species) and *Nietonafriella* Ortego 1998 (1 species). *Utamphorophora peruviana* (Essig 1953), *Macrosiphum salviae* Bartholomew 1932, and *Wahlgreniella australis* Delfino 1981 may also be native. *Pentamyzus* is the only genus of these with species living on Poaceae or Rosaceae, which are very important plant families in the speciation of Aphidinae (Heie 1996, von Dohlen and Moran 2000).

Pentamyzus includes four known species: *P. acaenae* (Schouteden 1904) from Tierra del Fuego (Argentina); the type species *P. graminis* Hille Ris Lambers 1966 from California; and *P. falklandicus* Hille Ris Lambers 1974 and *P. tenuis* Brown 1987 both from the Falkland Islands. The last three species live on Poaceae and the first one was described on *Acaena splendens* Hook & Am. (Rosaceae), but this record (Schouteden 1904) was considered doubtful by Hille Ris Lambers (1974) and Brown (1987), due to (1) the known biology of the other species of the genus, and (2) the presence of grass fragments in the specimen tube of the syntypes collected at San Pío Cape, Ushuaia in 1892. The four species are known only by their respective typical series (Schouteden 1904; Hille Ris Lambers 1966, 1974; Brown 1987).

MATERIALS AND METHODS

Supported by project LE20/99 (granted by the Regional Government of *Castilla y León*, Spain), four samples of *Pentamyzus* were collected in Tierra del Fuego (Argentina) by J.M. Nieto Nafría and M.P. Mier Durante:

1) On *Acaena splendens* (Rosaceae), Ushuaia: Tierra Mayor, 9.I.2000 [49 apterous viviparous females, 4 apterous males, and nymphs], see *P. acaenae*;

2) on *Acaena splendens* (Rosaceae), Ushuaia: Glacial Martial, 14.I.2000 [6 apterous viviparous females, 2 apterous oviparous females and nymphs], see *P. acaenae*;

3) on *Alopecurus magellanicus* var. *bracteolatus* (Phil.) M. C. Mariano (Poaceae), Río Grande, 12.I.2000 [288 apterous viviparous females, 4 apterous oviparous females, 26 apterous males, and nymphs]; see *P. tenuis* and the new species; and

4) on *Hordeum comosum* J. & C. Presl (Poaceae), Río Grande: San Pablo Cape, 12.I.2000 [192 apterous viviparous females, 4 apterous oviparous females and nymphs]; see the new species.

Abbreviations used in the text are as follows: ab.seg. = abdominal segment(s); ant.III, ant.IV = antennal segments III, IV; ant.Vb, antVpt = base and processus terminalis of the antennal segment V; BL = body length; BW = body width; c. = cauda; D = basal diameter of ant.III; IAD = inter-antennal distance; h.tb. = hind tibia; h.t.II = second segment of hind tarsus; s. = siphunculus; u.r.s. = ultimate rostral segment.

RESULTS

Three species of *Pentamyzus* have been identified: (a) *P. acaenae* (Schouteden 1904) from samples 1 and 2; (b) *P. tenuis* Brown 1987, one viviparous female, from sample 3; and (c) a new species from samples 3 and 4.

Pentamyzus fueguinus Nieto Nafría, Mier Durante, and Ortego, new species

(Figs. 1, 2B)

Apterous viviparous female (n = 413; 67 measured) (Table 1; Figs. 1A, 2B).—When alive reddish brown to greenish brown, oval in shape, and dorsally little convex and rigidly sclerotized: tergites of ab.seg. I to IV or V form a continuous plate, tergites of thoracic segments and ab.seg.VI, VII and VII free (sometimes separation metathorax-ab.seg.I and ab.seg.IV–V and abd.seg.V–VI not extending to marginal areas). Mounted specimens yellowish with distal ¼–⅓ of antenna, u.r.s., and tarsi brown; well-pigmented specimens with other pigmented areas: parts of antenna, clypeus, third rostral segment, coxae and parts of femora and tibiae, intersegmental sclerites and marginal spots on prothorax to ab.seg.IV, plus slightly pigmented anal plate and siphunculi. Frontal tubercles conspicuous, lateral ones divergent and with 1–2 setae; medial one slightly displaced to ventral part of head. Dorsal cuticle sclerotized and more or less alveolated. Dorsal setae scarce, stiff, short and blunt, as antennal ones; ventral setae pointed, not too stiff, and longer than dorsal ones. Rostrum reaching middle coxae; setae long, pointed and flexible. Legs relatively short; with setae similar to dorsal ones, except: (1) tarsal setae pointed, and (2) ventral setae on femora and distal setae on tibiae pointed and longer than those, especially a group of 4 to 6 external and distal setae on tibiae, normally at most 0.5 times tibial width at this point. Proximal half of h.tb. with 0–4(exceptionally to 9) scent plates placed inside. Abdominal papillae absent. Siphunculius slightly sigmoid and clavate,

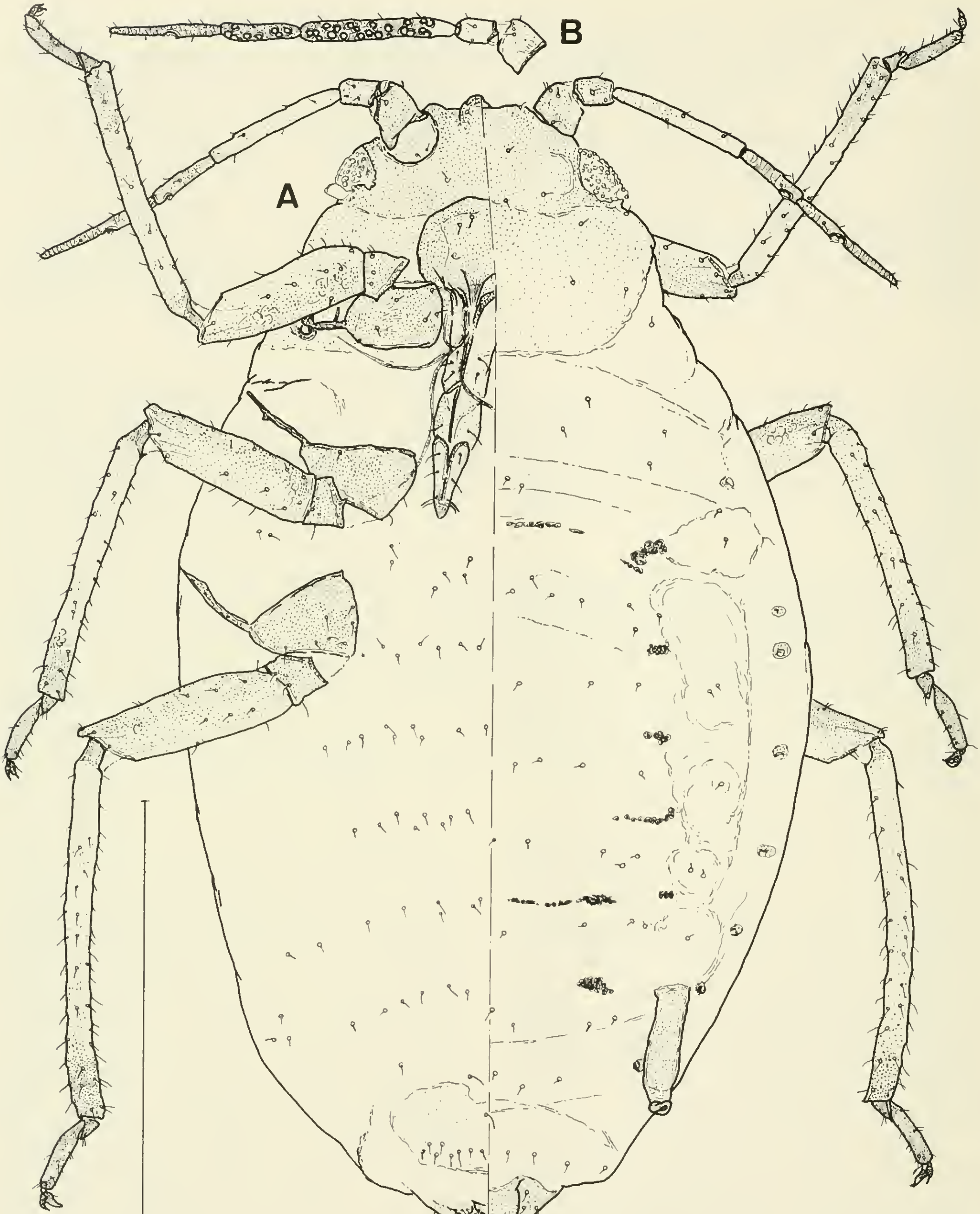

Fig. 1. *Pentamyzus fueguinus.* A, Apteorus viviparous female, habitus, dorsal view to right and ventral view to left. B, Male, antenna. Scale bar = 1 mm. Illustration by M. Enrique Ortega Lorenzo (León, Spain).

with a cylindrical part at end and a well-developed flange; wrinkled at base, smooth on swollen part and striate on cylindrical distal neck. Subgenital setae relatively long and pointed. Gonapophyses conspicuous. Cauda more or less elongated-triangular with convex sides, with long, flexible and pointed setae. Metric and other meristic data in Table 1.

Alatae viviparous female.—Not known and probably does not exist. In material collected, several thousand nymphs and none of them alatoid.

Oviparous female (n = 4; 4 measured) (Table 1).—Very similar to viviparous female. Proximal half of h.tb. lightly swollen and with (exceptionally from 13) 20–44 scent plates, placed inside. Subgenital plate with (8)13–22 and 13–28 discal and posterior setae, respectively.

Apterous male (n = 26; 14 measured) (Table 1; Fig. 1B).—In life darker than female, with legs and antenna brown to black when alive. When mounted, heavily pigmented: ant.III to ant.Vpt, u.r.s., $\frac{1}{6}$ distal part of tibiae and tarsi dark brown, and head, rostrum, legs, intersegmental and stigmatic sclerites, siphunculi, genitalia and cauda smoked; several specimens with light pigmented marginal areas on pre-siphuncular segments and one transversal bar on ab.seg.VIII. Frontomedial tubercle ventral, larger than faint cephalic lateral ones, and nodulose as dorsal cuticle of thorax and abdomen. Similar in shape to male of *P. acaenae*, but with more alveolated and darker cuticle, especially on sclerotized areas. Ant.III and ant.IV with 41–77 and 13–30 (exceptionally ant.Vb with 4) small, round and striated-walled secondary sensoria.

Type material.—Holotype: apterous viviparous female (measured specimen number 2) collected on *Alopecurus magellanicus* var. *bracteolatus* at Río Grande (Tierra del Fuego Province, Argentina), 12.1.2000, in collection Universidad de León, Departamento de Biología Animal. Paratypes: other apterous viviparous females, oviparous females and males of studied material samples 3 and 4, deposited in the authors' collections and in The Natural History Museum (London), Muséum National d'Histoire Naturelle (Paris), and Zoologisk Museum, Københavns Universitet (Copenhagen).

Etymology.—The specific name is from Tierra del Fuego, in masculine to agree with the gender of the genus.

Biology and distribution.—*Pentamyzus fueguinus* is a monoecious species with apterous males. Their biological cycle is short. Males and oviparous females and many male nymphs, which are recognizable by their brown or black appendages, were collected in early austral summer. Aphids form groups of 4 to 12 specimens on the outface of leaves of *Alopecurus magellanicus* var. *bracteolatus* and *Hordeum comosum*, which grow in moist areas near the Grande River and a little river on the beach at San Pablo Cape, respectively (this moist microhabitat is very similar to that reported by Hille Ris Lambers 1966 for *Pentamyzus graminis*). Grasses of dry neighboring environments are not colonized. We looked for the species without success on different grasses in moist and dry environments of the Argentinean Tierra del Fuego and Patagonia.

Pentamyzus acaenae (Schouteden 1904) (Fig. 2A)

Apterous viviparous female (Table 1).—When alive light to green and very convex. Dorsum of body heavily sclerotized, nodulose and unpigmented; tergites of metathorax to ab.seg.VI form a continuous plate, tergites of ab.seg. VII and VIII mutually free. Very few metric differences have been observed with regard to types [Schouteden 1904], the only known specimens; these differences could be due to different collection dates, November and January, but different volume of samples must also be taken into account. Dorsal setae scarce, stiff, short and blunt; setae of antenna and legs similar in shape and in length, except (1) tarsal setae pointed, and (2) ventral setae of

Table 1. Metric and meristic data of *Pentamyzus fueguinus* and *P. acaenae*, apterous vivparous females (apt. viv. f.), oviparous females (apt. ov. f.) and males (apt. mal.). In square brackets in the apterous vivparous females column of *P. acaenae* are data from types.

	Pentamyzus fueguinus			*Pentamyzus acaenae*		
	apt. viv. f.	apt. ov. f.	apt. mal.	apt. viv. f.	apt. ov. f	apt. mal.
BL (mm)	1.87–2.60	1.77–2.53	1.00–1.85	1.00–2.45	1.70–1.73	1.45–1.58
BL/BW	1.61–1.98	1.73–2.02	1.68–2.23	[1.48] 1.54–1.88	1.60–1.70	1.93–2.17
antenna (mm)	0.72–1.13	0.80–1.00	0.82–0.98	0.66–1.21	0.67–0.72	1.05–1.33
antenna/BL	0.32–0.54	0.33–0.53	0.45–0.56	0.35–0.55	0.39–0.42	0.71–0.84
ant.III (mm)	0.26–0.48	0.27–0.39	0.31–0.40	0.24–0.48	0.23–0.24	0.44–0.54
ant.IV (mm)	0.12–0.24	0.14–0.19	0.16–0.21	0.12–0.23	0.11–0.13	0.23–0.32
ant.Vb (mm)	0.10–0.15	0.11–0.15	0.11–0.15	0.09–0.17	0.10–0.12	0.12–0.16
ant.Vpt (mm)	0.09–0.17	0.11–0.17	0.09–0.13	0.07–0.18	0.08–0.11	0.11–0.16
IAD/ant.III+IV	0.28–0.55	0.31–0.50	0.34–0.43	0.29–0.52	0.51–0.52	0.22–0.26
ant.III/ant.IV	1.90–2.36	1.52–2.36	1.70–2.16	1.88–2.35 [2.40]	1.88–2.09	1.68–1.94
ant.III/ant.Vpt	2.03–3.50	2.20–2.79	2.64–3.74	2.66–4.14	2.23–2.83	3.49–4.05
ant.Vpt/ant.Vb	0.69–1.48	0.84–1.17	0.83–1.13	0.68–1.09 [1.30]	0.85–0.88	0.89–0.97
rostrum (mm)	0.35–0.50	0.35–0.50	0.40–0.53	0.35–0.48	0.36–0.40	0.35–0.44
BL/rostrum	2.00–3.47	2.36–2.93	1.76–2.56	2.64–3.20	2.50–2.97	1.71–2.07
u.r.s. (mm)	0.12–0.17	0.12–0.17	1.13–0.16	0.12–0.15	0.12	0.11–0.12
u.r.s/basal width	1.93–2.54	1.71–2.21	1.92–3.22	1.84–2.64	1.84–1.85	2.00–2.40
u.r.s./h.t.II	0.93–1.18	0.86–1.36	0.90–1.07	0.96–1.18	1.09–1.20	0.92–0.96
hind femur (mm)	0.37–0.50	0.37–0.50	0.37–0.45	0.30–0.50	0.30–0.33	0.32–0.43
h.tb. (mm)	0.62–0.93	0.62–0.85	0.62–0.78	0.50–0.98	0.52–0.55	0.70–0.80
h.t.II (mm)	0.11–0.17	0.11–0.16	0.13–0.17	0.10–0.15	0.10–0.11	0.12–0.13
s. (mm)	0.21–0.39	0.25–0.35	0.20–0.25	0.22–0.43	0.25–0.27	0.25–0.28
s./BL	0.09–0.16	0.10–0.19	0.11–0.14	0.12–0.19	0.14–0.16	0.16–0.19
s./ant.III	0.69–0.87	0.78–0.91	0.57–0.71	0.67–1.67	1.04–1.15	0.48–0.56
s./its maximal width	3.12–4.88	3.33–4.67	2.50–4.08	2.75–5.38	3.33–4.16	3.47–4.91
widest/thickest siphuncular width	1.15–1.67	1.08–2.14	1.44–3.00	1.18	1.30–2.50	1.44–1.86
s./c.	1.07–1.45	1.25–1.56	1.53–2.45	1.02–1.59	1.16–1.42	1.62–1.93
c. (mm)	0.11–0.28	0.16–0.23	0.10–0.14	0.19–0.30	0.19–0.22	0.14–0.16
c./its basal width	0.77–1.81	0.86–1.57	0.80–1.30	1.15–2.00	1.46	1.27–1.40
setae on						
vertex (μm)	12–18	7–13	12–18	10–23	10–15	20–25
vertex (times D)	0.6–0.9	0.3–0.7	0.5–0.9	0.5–1.0	0.6–0.7	1.0–1.5
ant.seg.III (μm)	10–18	10–15	10–18	10–18	10	10–15
ant.seg.III(times D)	0.4–0.8	0.4–0.8	0.4–1.0	0.6–1.0	0.5–0.7	1.1–1.3
ab.seg.I-V (μm)	10–15	10–18	10–15	7–18	12–13	12–18
ab.seg.I-V (times D)	0.4–0.9	0.5–0.8	0.5–0.8	0.4–0.9	0.6	0.7–1.2
ab.seg.VII (μm)	10–15	10–13	10–15	10–15	10–15	17–20
ab.seg.VII (timesD)	0.5–0.8	0.5–0.8	0.5–0.7	0.5–1.0	0.6–0.8	0.8–1.2
ab.seg.VIII (μm)	12–23	12–20	12–20	15–28	12–28	20–25
ab.seg.VIII(times D)	0.6–1.3	0.5–1.0	0.6–1.0	0.7–1.7	0.8–1.4	1.1–1.5
setae number on						
head	15–29	17–28	16–34	15–27	20	15–25
ant.III	4–13	6–9	4–10	4–11	5–6	3–7
ant.IV	2–6	2–5	1–4	1–4	2–3	1–3
ant.Vb	0–5	2–4	2–5	(0)1–4	2–3	3–4
u.r.s. (compl.)	2–4(5)	2–4	(1)2–4	2–4	2–4	4
tarsal seg.I	3:3:2-3	3:3:2-3	3:3:2-3	3:3:2	3:3:2	3:3:2
ab.seg.I-V	4–15	4–11	4–10	4–11	7	4–10
ab.seg.VII	4–10	7–14	4–8	4–9(12)	7	4–6
ab.seg.VIII	4–11	4–9	4–8	4–8(12)	6–7	4–6
c.	4–11	5–8	4–7	6–10	5–6	5–9
subgenital plate						
(discal)	2–8(10)	8–22	—	(0)2–4(6)	10–16	—
(posterior)	10–22	13–28	—	7–18	16	—

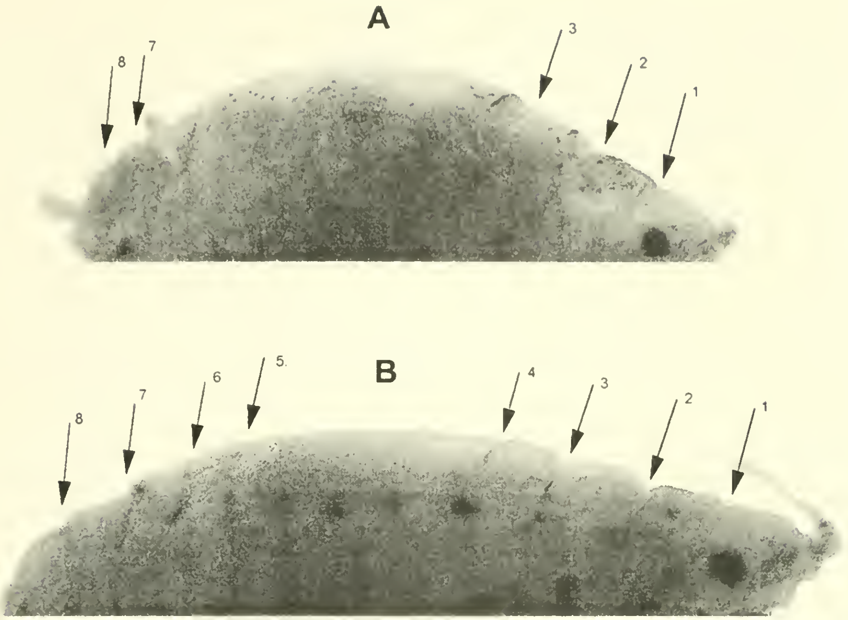

Fig. 2. Apterous viviparous female. A, *Pentamyzus acaenae*. B, *P. fueguinus*. Head-prothorax (1), prothorax-mesothorax (2), mesothorax-metathorax (3), metathorax-ab.seg.I (4), ab.seg.IV-ab.seg.V (5), ab.seg.V-ab.seg.VI (6), ab.seg.VI-ab.seg.VII (7), ab.seg.VII-ab.seg.VIII (8) intersegmental lines.

femora and distal setae of tibiae pointed and longer than those, especially a group of 4 to 8 external and distal on tibiae, normally at least 0.5 times tibial width at this point. Ventral setae pointed and flexible and longer than dorsal ones.

Apterous oviparous female (previously undescribed) (Table 1).—Very similar to viviparous female. With group of 8–16 scent plates on an internal small swollen area at proximal half of h.tb. Subgenital plate with 10–16 discal setae and 16 posterior setae.

Apterous male (previously undescribed) (Table 1).—Green, but darker than female, with smoked head and legs when alive; pigmentation similar to male of *P. fueguinus* when mounted; dorsal cuticle of thorax and abdomen less nodulose as male of *P. fueguinus*. Ant.III, ant.IV and ant.Vb respectively with 61–73, 25–32 and 0–1 secondary sensoria, similar to those new species.

Biology and distribution.—*Pentamyzus acaenae* is a monoecious species, with apterous males. Its life cycle is very short. Sexuales occur in the first month of the austral summer and winged viviparous females possibly do not exist (alatoid nymphs have not been observed). Aphids live on the leaves or shoots of the rosaceous *Acaena splendens*, which is very common in the deciduous forest of the mountainous area of the southern half of Tierra del Fuego; this plant and other species of *Acaena* exist in other areas of Argentinean Tierra del Fuego and Patagonia, but the aphid has not been recorded there.

Pentamyzus tenuis Brown 1987

Pentamyzus tenuis is a very peculiar species (the body is elongated and the front is convex). We collected one female, which is similar in general to the types (two viviparous females and two nymphs), but some differences have been observed (Table 2). The host plant in Tierra del Fuego is not the typical host plant, *Poa alopecurus* Kunth. (Brown 1987). The presence of this aphid in South America, at a locality situated approximately eight degrees to the west and two degrees to the south of the

Table 2. Metric and meristic data of apterous viviparous females of *Pentamyzus tenuis* from Falkland Islands and Tierra del Fuego.

	Falkland I.	T. del Fuego		Falkland I.	T. del Fuego
BL (mm)	2.36–2.56	2.87	h.t.II (mm)	0.09–0.10	0.12
BL/BW (times)	2.5–2.7	3.11	s. (mm)	0.18–0.19	0.20
ant.III (mm)	0.14–0.25	0.19	s./ant.III (times)	1.2–1.3	1.1
ant.IV (mm)	0.06–0.07	0.08	scent plates, number	—	1-2
ant.Vb (mm)	0.09–0.10	0.13	cephalic setae, number	50	56
ant. Vpt (mm)	0.06–0.07	0.10	cephalic setae (µm)	20	33
ant.III/ant.Vpt (times)	2.14–2.33	1.95	ant.III setae/D (times)	1.0–1.3	1.4
h.tb. (mm)	0.30–0.31	0.38	ab.VIII setae (µm)	30–40	43

typical locality, is not surprizing. In all cases, the species must be very scarce with four specimens from the East Falkland Island and only one from Tierra del Fuego, and this one was found in the laboratory together with more than 300 specimens of *Pentamyzus fueguinus*.

Discussion

Taxonomy

Without doubt, *Pentamyzus* belongs to Macrosiphini, although the ratio ’ab.seg.I-ab.seg.II spiracles distance’:‘ab.seg.II-ab.seg.III spiracles distance’ is too great. Our data show 0.39–0.63 times in *P. tenuis* ap.viv.f. (Brown 1987 and our data), 0.40–0.65 times in *P. acaenae* all morphs, and (0.31)0.46–0.58(0.67) times in *P. fueguinus*. According to Hille Ris Lambers (1966), the closest genus to *Pentamyzus* is *Glabromyzus* Richards 1960 which, according to Footit and Richards (1993), also has a sclerotic and alveolated dorsum, moderately sized frontal tubercles, clavate siphunculi, and short and blunt dorsal and antennal setae, but it has six-segmented antennae, longer cauda, and is dioecious (primary host, *Rhus*; secondary host, Cyperaceae, Poaceae, and Juncaceae). The venation of the anterior wings is also different with three medial branches in *Glabromyzus* and two in *P. graminis*, the only species of *Pentamyzus* with known alata.

Pentamyzus fueguinus is a well-characterized species by the presence of apterous males, and it can be separated from other species of *Pentamyzus* using the following key for the apterous viviparous females, which is based on the key by Brown (1987).

1. Body strongly elongated (BL at least 2.5 times BW). Frontal tubercles absent, frons convex. Antenna short (IAD is at least 1.07 times ant.III+ant.IV). Dorsum with polygonal glandular facets on well-pigmented sclerotic dorsal areas. Dorsal setae pointed [On *Poa alopecurus* and *Alopecurus magellanicus*. Falkland Islands; Tierra del Fuego] . . . . *P. tenuis*

– Body oval or oval-elongate (BL at most 2.0 times BW). Medial and lateral frontal tubercles present. Antenna relatively long (IAD at most 0.6 times ant.III+ant.IV). Dorsum with no polygonal glandular facets, largely sclerotic and more or less alveolated or nodulose. Dorsal setae blunt 2

2. Ant.III 1.3–1.6 times ant.IV. U.r.s. at most 0.07 mm and 0.80 times h.t.II and without complementary setae. Siphunculus slightly clavate or cylindrical, without enlarged flange [On unidentified grasses. California] . . . . . . *P. graminis*

– Ant.III 1.8–2.6 times ant.IV. U.r.s. at least 0.12 mm and 0.80 times h.t.II and with 2–4 (exceptionally 1 or 5) complementary setae. Siphunculus clavate, with enlarged flange and opening outside 3

3. Ant.Vpt al least 0.25 mm and 1.50 times Vb. U.r.s. shorter than 0.90 times h.t.II. Siphunculus without narrow cylindrical neck between swelling and bad definite flange, and 1.56 times BL at least. Marginal papillae sometimes present on ab.seg.II to ab.seg.IV [On *Paradiochloa flabellata*. Falkland Islands] . . . . *P. falklandicus*

– Ant.Vpt at most 0.19 mm and 1.52 times Vb. U.r.s. longer than 0.90 times h.t.II. Siphunculus with a narrow cylindrical neck between swell-

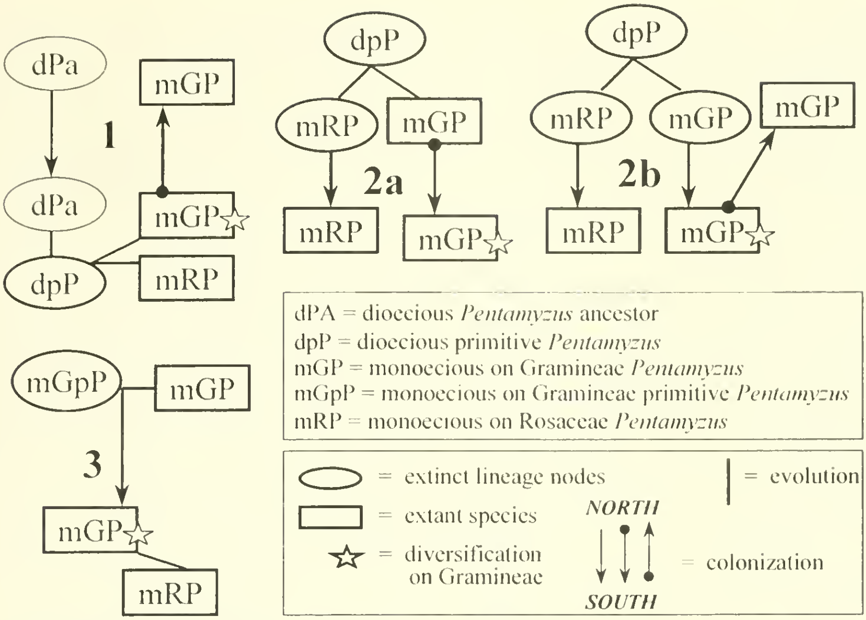

Fig. 3. Hypothesis on the origin and diversification of *Pentamyzus*.

ing and well definite flange, and 1.60 times BL at most. Marginal papillae not present on abdominal segments 4

4. Green and very convex aphids living on rosaceous herbs. Tergites of metathorax to ab.seg.VI form a continuous sclerotized plate, tergites of prothorax, mesothorax and ab.seg.VII and VIII free (Fig. 2A). Distal and external setae of h.tb. normally longer than 0.5 times h.tb. width at seta insertion point [On *Acaena splendens*. Tierra del Fuego, southern slopes of the Andes] . . . . *P. acaenae*

– Brown aphids living on grasses. Tergites of ab.seg.I to IV or V forming a continuous plate, while tergites of thoracic segments and ab.seg.VI to VIII free (Fig. 2B). Distal and external setae of h.tb. normally shorter than 0.5 times h.tb. width at seta insertion point [On *Alopecurus magellanicus* and *Hordeum comosum*. Tierra del Fuego, North of the Andes] . . . . *P. fueguinus*

Pentamyzus tenuis has a body shape very different from the other species of the genus with no developed frontal tubercles, glandular formations, or pointed dorsal setae, but it has the five-segmented antennae, the clavate siphunculi, and lives on grasses which are reasons not to establish a new genus level taxon.

The absence of winged viviparous females in the South American species could be related to the fact that they live in very windy areas.

PHYLOGENY AND BIOGEOGRAPHY

The presence and relative richness of *Pentamyzus* in the "far south" of South America (including the Falkland Islands, as they are situated on the continental platform) is evident. The presence of *P. graminis* in California shows a very enlarged discontinuous distribution of the genus. This known distribution could be unreal because extended areas of South America are not well studied, although we have looked for aphids in Andean areas of several Argentinean provinces and interesting mountain areas of Mexico are well surveyed (Remaudière, personal communication). In our opinion, there are three possibilities (Fig. 3) to explain the origin and diversification of *Pentamyzus*.

(1) *Pentamyzus* appeared in South America as a member of a lineage of Macrosiphini which emigrated from North America and more recently one species (as far as we know) returned to North America,

to California. The primitive *Pentamyzus* may have been dioecious, as its ancestor. Later, it diversified into two monoecious sublineages, one rosaceous-feeding and another grass-feeding. The sublineage on Rosaceae finally established itself on herbaceous ones, because there are no other autochthonous rosaceans species in the far south (this is not surprising in monoecious aphids, for example *Chaetosiphon fragaefolii* (Cockerell 1901), *Amphorophora gei* (Börner 1939), or *Acyrthosiphon boreale* Hille Ris Lambers 1952 [Macrosiphini] living on Rosaceae herbaceous species), and *P. acaenae* belongs to this sublineage. The other known *Pentamyzus* species belong to the other sublinage; in this group the most different species are: (i) *P. tenuis,* which has a elongated body and is South American, and (ii) *P. graminis,* which has several derivative characteristics such as small-clavate siphunculi, lack of complementary u.r.s. setae, and lack of marginal papillae (this last characteristic is also present in other species of the genus) and belongs to the returned lineage.

(2) The primitive dioecious *Pentamyzus* stock was North American, and host diverging originated in North America. Later, two sublineages colonized South America via the Andes. Here we found two possibilities: (2a) The northern species on Rosaceae disappeared, *P. acaenae* belongs to the rosacean sublineage established in the South, *P. graminis* belongs to the old northern grass sublineage, and *P. falklandicus, P. fueguinus,* and *P. tenuis* belong to the southern grasses sublineage; or (2b) all northern species disappeared and *P. graminis* returned from South America, such as in hypothesis 1.

(3) *Pentamyzus* was a North American monoecious and grass-feeding genus. Later it colonized South America, and one sublineage (represented by *P. acaenae*) acquired *Acaena* as a host. As in hypothesis 2, there are two possibilities with regard to *P. graminis*: (i) it belongs to the non-displaced old-lineage (in Fig. 3), or (ii) it is the last species of a lineage which returned from South America.

The three hypotheses are concomitant with the present theory on the colonization of South America by the Aphidinae (the Holarctic origin of this subfamily and its subordinated taxa, such as Macrosiphini, is generally accepted, Heie 1996). South America was invaded in different waves by different lineages of this tribe (so *Microparsus, Pentamyzus* and siphunculi-reticulated aphids, such as *Uroleucon, Nietonafriella,* and *Blanchardaphis,* belong to different generic groups and live on plants of different families, the first one on Fabaceae and last three on Asteraceae).

The three hypotheses may be correct, but we prefer 1 or, to a lesser extent, 3, because they are the most parsimonious when explaining the morphological similarities between *P. fueguinus* and *P. acaenae* and the presence of two "special" grass-feeding species, *P. tenuis* (because of its body appearance) and *P. graminis* (because its derivative characteristics and distribution). In either case, only molecular analysis could allow us to arrive at a conclusion as to which of these hypotheses is correct.

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DESCRIPTION OF FIVE NEW SPECIES OF TABANIDAE (DIPTERA) FROM COSTA RICA AND REVISED KEYS TO SPECIES FOR THE GENERA *FIDENA* WALKER, *SCIONE* WALKER, AND *CHRYSOPS* MEIGEN IN COSTA RICA

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Abstract.—Five new species of Tabanidae from Costa Rica in four genera are described and differentiated from related species in their respective genera occurring in Costa Rica: ***Fidena* (*Fidena*) *griseithorax* Burger, new species, *Scione albopilosus* Burger, new species, *Acanthocera* (*Polistimima*) *vespiformis* Burger, new species, *Chrysops alajuelensis* Burger, new species,** and ***Chrysops costaricensis* Burger, new species**. The immature stages of *Acanthocera* (*Polistimima*) *vespiformis* also are described, the first representative of the genus *Acanthocera* Macquart for which the immature stages have been found. Revised keys to the species of *Fidena* Walker, *Scione* Walker, and *Chrysops* Meigen occurring in Costa Rica are presented.

Key Words: Neotropical, keys, Tabanidae, Costa Rica, new species

Examination of the Tabanidae in the collection of the Instituto Nacional de Biodiversidad (INBio), Santo Domingo de Herédia, Costa Rica, and selected specimens in the Florida State Collection of Arthropods (FSCA) and the Cornell University Insect Collection (CUIC) revealed five undescribed species from Costa Rica, including a striking wasp mimic in the subgenus *Polistimima* Fairchild, genus *Acanthocera* Macquart, the first representative of this genus recorded from Central America. These species are described below, compared with related taxa, and revised keys to species of the genera *Fidena* Walker, *Scione* Walker, and *Chrysops* Meigen occurring in Costa Rica are adapted from Fairchild (1986).

Fidena (*Fidena*) *griseithorax* Burger, new species
(Figs. 1–2)

Diagnosis.—A large grayish and black species with elongate, conical tomented face, snow-white beard, gray dusted mesoscutum, blackish and brown legs, uniformly yellowish brown infuscated wings and shining black abdomen with white lateral hair tufts on tergites 2, 5 and 6.

Female.—*Head:* Front narrow, height 8.75 times width at base, slightly diverging above, gray tomentose below, slightly darkened toward vertex, bearing dense black hairs, callus absent. Subcallus grayish brown tomentose, protuberant. Frontoclypeus conical, elongate, entirely light gray tomentose and bearing abundant black setae dorsally and laterally, setae especially dense anteriorly. Antenna with scape and pedicel grayish brown, flagellum dark brown. Maxillary palp with apical palpomere dark brown, long and slender, length 8.3 times greatest width, about ¼ length of mouthparts, black setose, except for bare area basally on outer surface. Outer sheath of proboscis broken off and missing, stylets nearly twice as long as height of head. Eye densely pale pilose. Beard snow-white.

Thorax: Mesoscutum grayish brown medianly, gray laterally, overlain with hoary gray tomentum, bearing black and scattered white hairs. Notopleural lobe light gray tomentose, bearing mostly long black hairs and scattered white hairs. Area above wing base with dense tuft of white and black hairs. Postalar lobe bearing long white and scattered black hairs. Scutellum light brown with some grayish tones medianly, bearing black hairs. Pleuron light brownish gray, bearing dense white hairs dorsally and posteriorly on the mesanepisternum, posterodorsal area of the katepisternum, the mesanepimeron and the anterior katatergite, and black hairs ventrally on the katepisternum, posteriorly on the katatergite, and scattered black hairs intermixed among white hairs on the mesanepisternum below the wing base. *Legs:* Coxae grayish brown, fore coxa white haired on basal ⅔, black haired on apical ⅓, mid and hind coxae black haired. Femora dark brownish black and wholly black haired. Fore tibia and tarsus brown, mostly black haired, with orange hairs ventrally on apical half of fore tibia and ventrally on all tarsomeres, mid tibia and tarsus dark brown, hind tibia and tarsus black, mid- and hind tibiae and tarsi wholly black haired. *Wing:* Pale yellowish brown tinted, costal cell strongly yellowish, vein R_4 without spur, cell r_5 closed and petiolate.

Abdomen: Shining black and black pilose, except anterior portion of first segment dark brown, tergites and sternites 2, 5 and 6 with lateral patches of white hairs.

Length: 19.2 mm, wing, 16 mm.

Holotype.—Female, COSTA RICA: Estación Esquinas, Peninsula de Osa, Provincia Puntarenas, 200 m, August 1993, J. Quesada (INBIOCRI001157720). Deposited in the Instituto Nacional de Biodiversidad (INBio), Santo Domingo, Herédia, Costa Rica.

Etymology.—This species is named for the hoary grayish tomentum overlying the gray and brownish color of the mesoscutum.

Discussion.—*Fidena griseithorax* shares with *Fidena flavipennis* Kröber in the Costa Rican fauna the narrow front, elongated, tomented face, dark legs, light yellowish brown tinted wings with closed and petiolate cell r_5, and coloration of the abdomen. *Fidena griseithorax* is easily distinguished from *F. flavipennis* by the white beard, white hairs on the pleuron and the gray tomentum and lateral white hairs on the mesoscutum.

Key to Species of *Fidena* Occuring in Costa Rica

1. Legs prominently bicolored, femora black, tibiae and tarsi yellow. Wing black or heavily infuscated basally to ends of cells br and bm . . 2

– Legs not bicolored, all black, brown or yellowish. Wing rarely heavily infuscated basally, usually evenly tinted 3

2. Beard snow white. Sides of mesoscutum with a stripe of white hairs from before transverse suture to posterior margin. Abdomen shiny black, with small tufts of silver-white hairs in middle of tergites 2–5, and at sides of tergites 2, 5 and 6. Sternites 2–4 with white lateral hair tufts; 2 sometimes with white hind marginal band. Face partially denuded and shiny . . . . *eriomeroides* (Lutz)

– Beard black or dark brown. Mesoscutum without contrasting pale hairs. Abdomen shiny black or deep brown, with segments 4 or 5–7 clothed with pale straw yellow, rufous orange, brown or black hairs. Tergite 2 with a patch of white hairs at sides, and sternites 2–4 with small lateral white hair tufts. Rarely tergites 3 and 4 with small white hair tufts . . . . *rhinophora* (Bellardi)

3. Legs pale yellowish brown. Beard, pleuron and abdominal sternites pale yellowish pilose, contrasting with dark dorsal surfaces . . . . *auribarba* (Enderlein)

– Legs dark brown to black 4

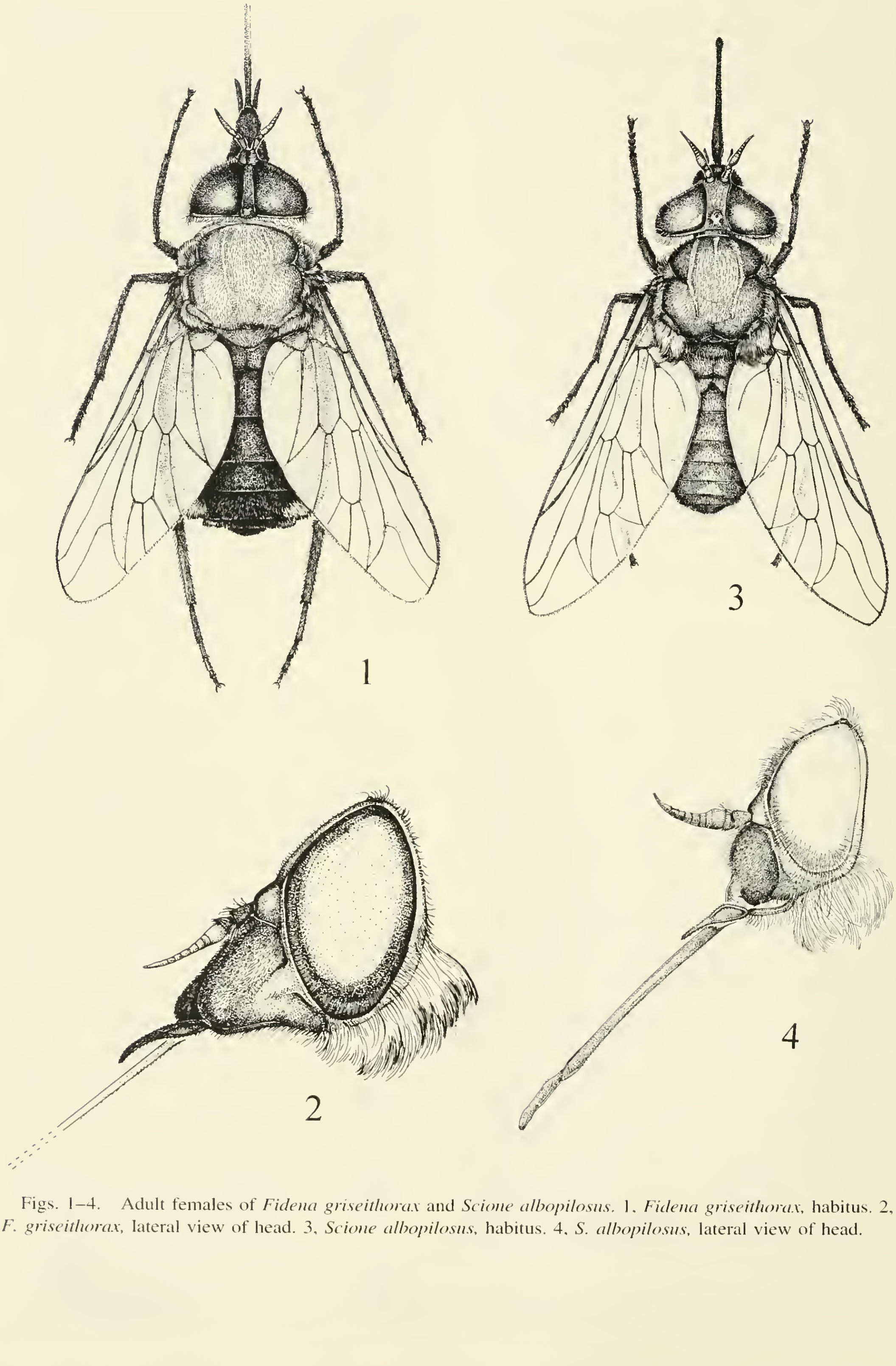
4. Abdomen largely black pilose 5

– Abdomen extensively golden pilose 7

5. Beard snow-white. Pleuron mostly snow-white haired . . . . *griseithorax*, n. sp.

– Beard and pleuron dark brown to black haired 6

6. Large species, generally over 18 mm in wing length. Front narrow, more than 4.5 times as high as wide, convergent below. Antenna brownish black. Face conically produced,



Figs. 1–4. Adult females of *Fidena griseithorax* and *Scione albopilosus*. 1, *Fidena griseithorax*, habitus. 2, *F. griseithorax*, lateral view of head. 3, *Scione albopilosus*, habitus. 4, *S. albopilosus*, lateral view of head.

brown, wholly grayish tomentose. Wing uniformly deep yellowish brown tinted. Abdomen dark brown to black, shiny, sparsely black pilose, with tufts of white hairs at sides of tergites 2, 5 and 6 . . . . *flavipennis* Kröber

– Small species, wing length generally less than 12 mm. Front broader, less than 3 times as high as wide, parallel-sided. Antenna bright yellow. Face less produced, yellow, with extensive bare patches laterally. Wing smoky hyaline, the costal cell blackish and end of cell br darkened. Abdomen black, the second segment sparsely white haired above and below, forming a more or less distinct hind marginal band widened at sides above. Tergites 5–7 sparsely white haired and often with median white triangles on tergites 3–4 . . . . *schildi* (Hine)

7. Abdomen with pale yellow integument and all segments beyond black pilose first segment pale golden pilose . . . . *bicolor* Kröber

– Abdomen with at least some segments beyond first not entirely golden pilose 8

8. Face relatively short, shorter than front and subcallus, largely shiny. Antenna short and unusually broad, basal flagellomeres distinctly wider than long. Thorax black, generally with prominent white hair tufts on each side of the scutellum, rarely reduced to a few white hairs mixed with black. Abdomen largely bright golden pilose, but with first tergite black pilose, second with golden hairs forming a large median triangle and lateral patches, third with only dorsolateral anterior black patches, remainder wholly golden pilose. Wing yellowish tinted, the basal cells and costal cell darker; cell r_5 coarctate, rarely closed . . . . *trapidoi* Fairchild

– Face relatively long, as long as or longer than front and subcallus, gray tomentose above, shiny laterally. Antenna long and slender, basal flagellomeres at least as long as wide. Thorax without white hair tufts beside scutellum. Abdomen bright golden pilose from third to last segments only, but with a small patch of yellow hairs on posterior lateral borders of second tergite. Wing evenly brownish yellow tinted, cell r_5 closed and petiolate . . . . *howardi* Fairchild

Scione albopilosus Burger, new species
(Figs. 3–4)

Diagnosis.—A small, dark blackish brown species with distinct dorsolateral mesoscutal stripes, snow-white haired beard, pleuron and postalar tufts, unicolorous grayish wings and yellowish brown and pale pilose sternum.

Female.—*Head:* Front relatively broad, twice as high as width at base, slightly diverging below, black brown and black pilose, except lighter brown near eye margins. Subcallus and frontoclypeus concolorous with front. Face relatively short, densely black pilose. Antennal scape and pedicel dark brown, scape bearing long black setae, basal four flagellomeres brown, apical four flagellomeres darker brown. Maxillary palpus dark brown, apical palpomere relatively broad and strongly flattened, strongly narrowed in apical half and sharply pointed, length about three times greatest width. Proboscis relatively long and slender, about 1.5 times height of head. Beard snow-white haired. Eye densely light brown pilose.

Thorax: Mesoscutum and scutellum shining dark brown and black pilose except for large tufts of snow-white hairs above wing base and on postalar lobe. Mesoscutum bearing two distinct yellowish gray dorsolateral longitudinal stripes that fade out in posterior third, and a narrower gray median longitudinal stripe extending about half way to scutellum. Pleuron light gray tomentose and white pilose except for scattered black hairs intermixed on mesanepisternum. *Legs:* Fore coxa grayish brown, white pilose basally, black pilose apically. Fore legs dark brown, mid and hind legs black. *Wing:* Wholly grayish hyaline.

Abdomen: Tergites 1–2 brown, remaining tergites darker brown to black-brown, tergites 1–5 with a middorsal row of yellowish white haired spots, and pale haired lateral margins, otherwise black pilose. Sternites pale yellowish brown, white pilose.

Length: 11.0 mm, wing, 10.7 mm.

Holotype.—Female, COSTA RICA: Provincia Carta, M N Guayabo, Turrialba, 1,100 m, 21 June 1994, coll. J. F. Corrales (INBIOCRI001973469). Deposited in the Instituto Nacional de Biodiversidad (INBio) collection, Santo Domingo, Herédia, Costa Rica.

Etymology.—This species is named for the snow-white haired beard, postalar hair tufts and pleuron strongly contrasting with the dark brown body.

Discussion.—This species is closest to *Scione costaricana* Szilády, but differs in having much longer and more slender apical palpomere, the snow-white hairs of the head and thorax, dark brown and black haired scutellum, grayish hyaline wing, less distinct middorsal yellowish spots on the abdominal tergites, and the entirely pale yellowish brown and pale pilose sternum.

Key to the Species of *Scione* Occuring in Costa Rica

1. Wing particolored, yellowish and gray, crossveins with obscure dark clouds. Thorax striped with yellowish gray markings. Abdomen yellowish brown to brown, often with some darker color posteriorly, with a middorsal row of yellow to white pilose triangles or spots on the posterior margin of tergites 1–6 (sometimes obscure to absent in abraded specimens) . . . . *maculipennis* (Schiner)

– Wing hyaline or slightly tinted, not particolored and without clouds on the crossveins . . 2

2. Mesoscutum with distinct grayish or yellowish brown dorsolateral stripes extending at least half way to scutellum. Abdomen with contrasting pale hair tufts 3

– Mesoscutum without strongly contrasting stripes. Abdomen without contrasting pale hair tufts 4

3. Beard, pleural hairs and postalar hair tufts snow-white. Sternum pale yellowish brown, white pilose . . . . *albopilosus* n. sp.

– Beard pale yellow to golden and black haired to mostly black haired. Postalar hair tufts golden. Sternum with the anterior two segments brown, remainder black, black pilose except for white haired hind margins on sternites 2–5 . . . . *costaricana* Szilády

4. Beard, pleuron and sternum white pilose. Apical palpomere extremely short and blunt, only half as long as flagellum . . *aurilans* (Wiedemann)

– Beard, pleuron and sternum black pilose. Apical palpomere sickle shaped, subequal in length to flagellum . . . . . . *fulvosericea* (Kröber)

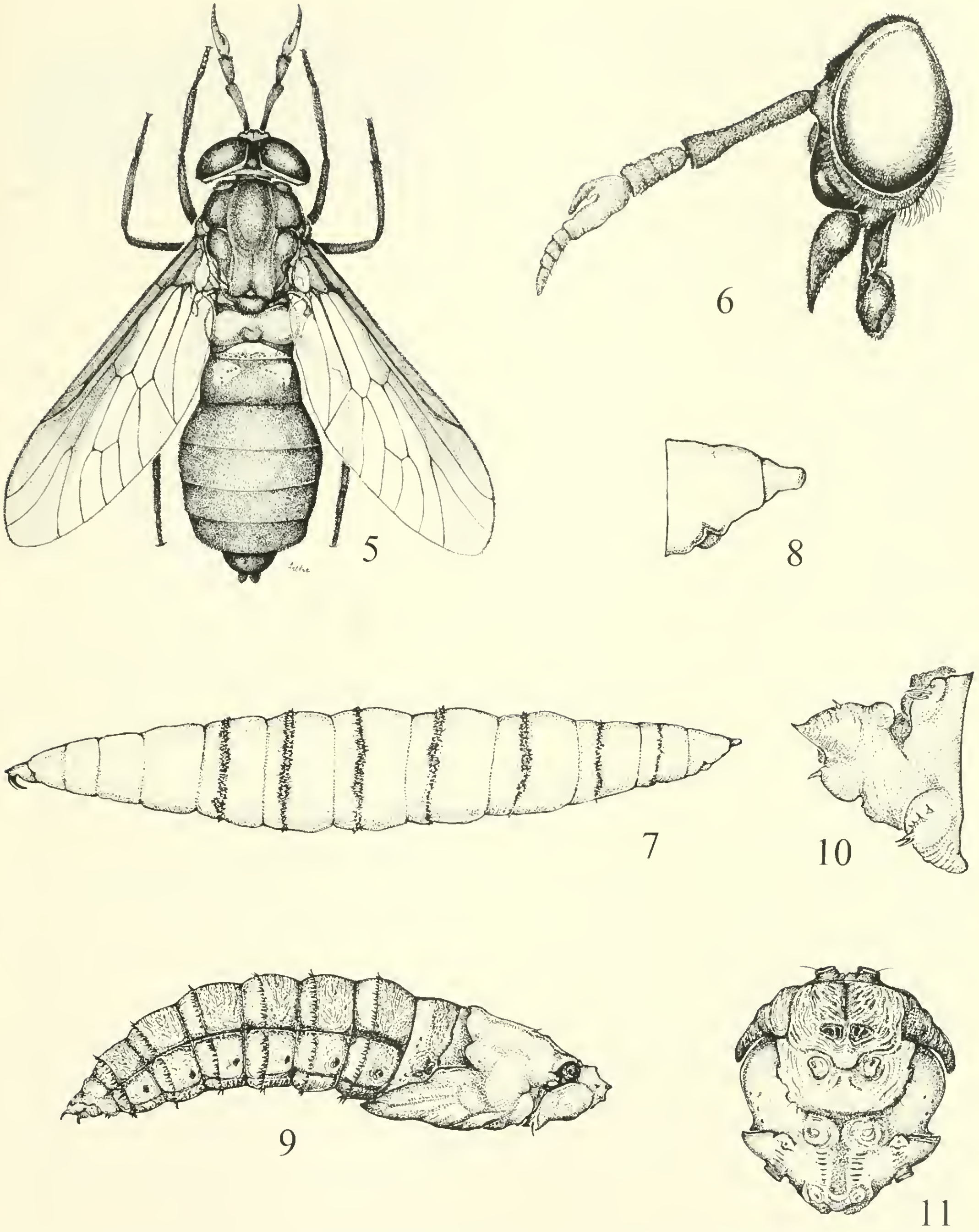
Acanthocera (Polistimima) vespiformis Burger, new species

(Figs. 5–11)

Diagnosis.—A large, wasplike blackish brown and black species with greatly elongated scape and pedicel, basal flagellomere with thumblike dorsal spine, greatly inflated maxillary palpi, wing with anterior third darkened, and abdomen strongly constricted basally.

Female.—*Head:* Front parallel above, slightly divergent below near subcallus, index 1.6, velvety black medianly, blackish brown laterally, bearing dense, very short bristly black hairs, except on callus and near eye margins, callus brown, triangular, rather poorly defined, widely separated from eye margins, with a narrow dorsal extension half way to vertex. Vertex distinctly sunken below level of ocular margin, ocular margin with short orange and black hairs. Subcallus brownish black, with long yellowish and dark hairs dorsolaterally below junction with front. Frontoclypeus shining dark brown, strongly swollen. Gena blackish gray tomentose. Antenna extremely long, equal in length to mesoscutum and scutellum combined, scape and pedicel shining dark brown, flagellum reddish brown, scape cylindrical, greatly elongate, twice length of pedicel and equal in length to flagellum, scape and pedicel together 1.5 times longer than flagellum, basal flagellomere and apical flagellomeres subequal in length, basal flagellomere with thumblike dorsal spine extending ¾ length of basal flagellomere, apical flagellomeres not hirsute, gradually tapered apically, terminal flagellomere sharply pointed. Maxillary palpus subshining dark brown, apical palpomere greatly inflated basally, strongly narrowed distally and sharply pointed apically, bearing short dark hairs. Labellum of proboscis partially sclerotized. Beard sparsely black haired.

Thorax: Mesoscutum black medianly, blackish brown laterally, bearing very short recumbent black hairs and pale yellowish white hairs posterolaterally anterior to scutellum. Scutellum black medianly, brown laterally, with tuft of white hairs on lateral margins. Pleuron blackish above, with dark grayish bloom below, bearing short black and yellowish hairs and small tuft of white hairs on posterodorsal surface of mesane-



Figs. 5–11. *Acanthocera* (*Polistimima*) *vespiformis*. 5, Adult female, habitus. 6, Adult female, lateral view of head. 7, Mature larva, lateral view. 8, Mature larva, lateral view of anal segment. 9, Pupa, lateral view. 10, Pupal aster, lateral view. 11, Frontal plate of pupa.

pisternum anterior to wing base. *Legs:* Coxae and femora blackish, except femora narrowly brown at extreme apices, coxae and fore and mid femora bearing golden hairs, hind femur black haired, fore and mid tibiae blackish brown and golden haired, hind tibia black and black haired, concolorous with hind femur, tarsi brown, golden haired. *Wing:* Anterior third strongly yellowish brown tinted, tinting fading out toward wing apex beyond fork of veins R_4 and R_5, and faint yellowish tint along vein Cu in cell bm, vein R_4 without spur.

Abdomen: Segments 1–2 strongly compressed laterally, abdomen strongly arched dorsally, tergite 1 brown anteriorly, black laterally and posteriorly, tergite 2 black, with 2 brown patches sublaterally in middle of segment, tergites 1–2 with patch of silvery hairs posterolaterally, remaining tergites black and black haired, sternite 2 irregularly brown and black, with complete transverse band of silvery hairs on posterior margin, remaining sternites black and black haired.

Length: 19.2 mm, wing, 16 mm.

Mature larva.—Length 26–28 mm, body creamy white to yellowish white. Head capsule 5.2 mm long, 1.2 mm wide. Respiratory siphon 0.8 mm long, width and length subequal. Anal segment length and width subequal. Body fully striated, cuticular striations most conspicuous on thoracic segments, very indistinct on abdominal segments, especially posteriorly, striations very narrowly spaced. Pseudopodia, if present, inapparent. Anterior third of thoracic segments ornamented with extremely small, dense microspines. Anterior margins of abdominal I-VII with row of elongate, curved microspines entirely encircling each segment, posterior margin of segment VII and anterior margin of anal segment broadly encircled by dense, minute microspines.

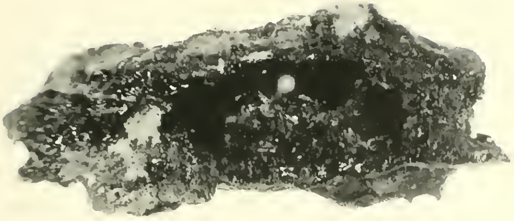
Pupa.—Length 18.4–20.8 mm. Color uniformly light brown. Frontal plate with numerous transverse dark cuticular striations anteriorly and laterally. Antennal ridges very narrowly divided medianly into 2 strongly projecting, shelflike extensions anteriorly, raised about 0.4 mm above surface of frontal plate, strongly rugose. Anterior and posterior orbital setae very short, borne on very small, irregular tubercles. Frontal tubercle absent. Callus tubercles very low and irregular, anterior and posterior margins sinuous, each bearing a single short seta. Antennal sheaths large and conspicuous, extended well beyond cephalothoracic suture, length about 1.4 mm. Thoracic spiracles strongly recurved, earlike. Anterior mesonotal tubercle bearing 2 setae each. Abdominal spinous fringes biseriate dorsally and laterally, uniseriate ventrally, anterior row very short, posterior row mostly short and stout, with scattered longer, more slender spines intermixed, and mostly long, slender spines mid ventrally. Dorsal preanal combs reduced to 3–4 spines borne on very large sublateral lobes and a single short spine on a median lobe. Ventral preanal comb with 5 short, stout spines on each side (♀). Terminal aster with dorsal arms reduced to minute spines, lateral and ventral arms very stout, lateral arms longest, projecting posteriorly, ventral arms about half length of lateral arms, projecting posteroventrally.

Holotype.—Female, COSTA RICA: Puntarenas Province, Península de Osa, Parque Nacional Corcavado, near Cerro Rincón, 700 m., coll. Alejandro Azofeifa Azofeifa, Jan. 1997.

Paratypes.—3 ♀, same data as holotype, except coll. Jan. 1998. All specimens reared from larvae and pupae. Holotype ♀ and 2 ♀ paratypes to be deposited in the Instituto Nacional de Biodiversidad (INBio), Santo Domingo, Herédia, Costa Rica; 1 ♀ paratype in the University of New Hampshire Insect Collection (UNHC).

Etymology.—This remarkable species is named for its striking wasplike appearance.

Discussion.—The paratype females are very similar to the holotype, except 15.2 mm–15.4 mm. This striking wasp mimic was originally considered to belong to a new subgenus of *Acanthocera*, but the elon-



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Figs. 12–13. Larval habitat of *Acanthocera* (*Polistimima*) *vespiformis*. 12, Sap run from Cedro María tree (*Calophyllum brasiliense*) showing central cavity. 13, Pupal exuvia of *A. vespiformis* protruding from a sap run.

gate scape combined with the relatively short flagellum with apical flagellomeres not greatly lengthed suggests that this species should be placed in the subgenus *Polistimima,* erected by Fairchild (1969) for *Acanthocera* (*Polistimima*) *polistiformis* Fairchild, 1961, from Amapá, Brasil. *Acanthocera* (*Polistimima*) *vespiformis* differs from that species in color of the body, legs and wings, the much longer antennal scape and the basal flagellomere with a long thumblike dorsal spine. Unfortunately, the species from Brasil is known only from a single male. Thus, it is uncertain whether some of the differences of *A. vespiformis* may be due to sexual differences.

Larvae and pupae of *A. vespiformis* were found inhabiting tunnels in sap runs (Figs. 12–13) associated with beetle attacks to Cedro María trees (*Calophyllum brasiliense* Cambess) (Clusiaceae). When the larvae are in the sap tunnels, they transform the sap into a sticky, foul-smelling mass that attracts flies and wasps that become trapped in the sticky sap. The larvae prey on the trapped insects. The larvae always were found only in sap tunnels less than two meters from the ground. Prior to adult emergence, the pupa moves partially out of the tunnel (Fig. 13). Emergence occurs during the day. Developing larvae have been observed throughout the year (Zumbado, personal communication). Length of the life cycle is unknown. In addition to the adults listed above, one deformed, shrivelled adult female did not harden properly, and is not included in the series of paratypes. This is the first species of the genus *Acanthocera* for which larvae and pupae have been found and reared, so it is not known if other species of *Acanthocera* live in similar habitats. This also is the first record for the genus *Acanthocera* in Central America., hitherto known only in South America, as far north as Colombia.

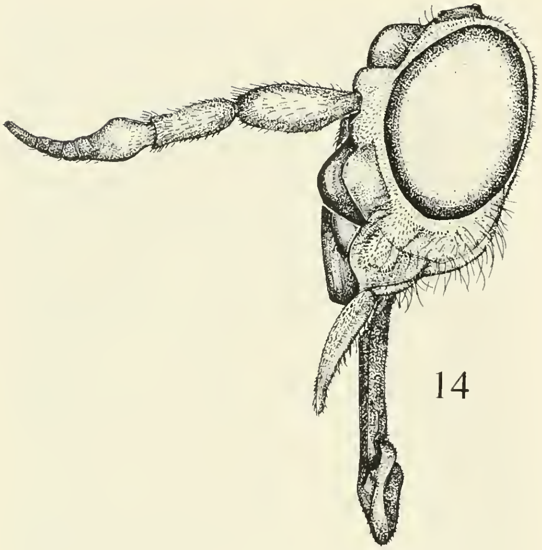
Chrysops alajuelensis Burger, new species

(Figs. 14–16)

Diagnosis.—A yellowish gray and brown species with strongly inflated antennal scapes, blackish gray thorax, reddish to yellowish brown scutellum, wing crossband with irregular outer margin, abdominal tergites with pale yellowish gray median triangles and sublateral spots, leaving a darker bivittate submedian marking and sternites uniformly yellowish brown or faintly spotted.

Female.—*Head:* Front yellowish gray tomentose with a dark subshiny area surrounding ocelli. Frontal callus crescent shaped, narrowed laterally, reddish brown with darker markings laterally on the upper margin. Frontoclypeus reddish brown with narrow yellowish gray tomentose stripe. Antenna with scape, pedicel and base of flagellum brown, remainder of flagellum black, scape and pedicel distinctly inflated. Maxillary palpus light brown.

Thorax: Mesoscutum blackish gray with



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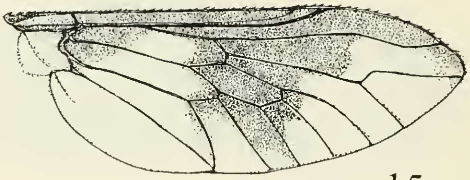

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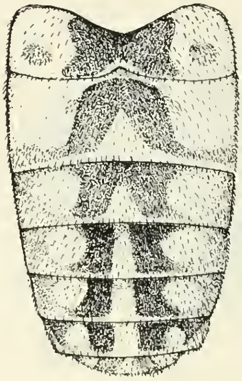

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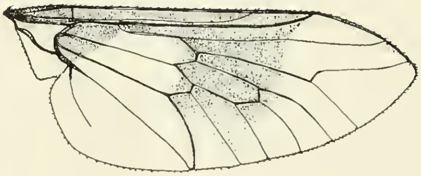

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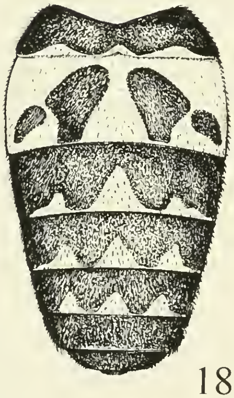

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Figs. 14–18. Adult females of *Chrysops alajuelensis* and *Chrysops costaricensis*. 14, *C. alajuelensis*, lateral view of head. 15, *C alajuelensis*, wing. 16, *C. alajuelensis*, abdomen, dorsal view. 17, *C. costaricensis*, wing. 18, *C. costaricensis*, abdomen, dorsal view.

broad, indistinct submedian grayish longitudinal stripes and lateral margins. Scutellum reddish brown. Pleuron yellowish gray tomentose and yellowish white pilose. *Legs:* Femora reddish brown except extreme apices darker, tibiae and tarsi light brown. *Wing:* Dark pattern distinct, cells br and bm ⅗ and ⅓ infuscated basally, respectively, crossband broad, outer margin irregular, with an extension toward fork of veins R_4 and R_5 along vein R_{4+5} and in cell m_1, cell cua_1 with apical half hyaline, apical spot drop-shaped.

Abdomen: Tergite 1 with a dark submedian marking adjacent to scutellum and pale sublateral spots, tergites 2–6 with pale median triangles and sublateral spots leaving a darker bivittate submedian area. Sternites uniformly yellowish brown and pale whitish pilose.

Length: 9.2 mm, wing, 7.6 mm.

Male.—*Head:* Eyes holoptic, narrowly contiguous at mid-height, upper eye facets distinctly larger than lower facets. Ocellar tubercle subshiny blackish, with long blackish hairs. Frontoclypeus shiny light brown with very narrow yellowish gray tomentose midstripe. Antennal scape and pedicel blackish brown, flagellum black except at extreme base. Maxillary palpus dark brown, apical palpomere short and slender, blunt apically.

Thorax: Mesoscutum and scutellum subshiny blackish, pale stripes on mesoscutum evanescent. Pleuron concolorous with mesoscutum, black pilose. *Legs:* Similar to female. *Wing*: Pattern similar to female except cells br and bm ¾ infuscated basally.

Abdomen: Black, tergites 2–5 with broad yellow sublateral spots and lateral margins of tergites 1–4 yellowish to yellowish brown. Sternites 1–5 yellowish, with broad median longitudinal black stripe and narrower stripes sublaterally, sternites 6–7 black.

Length: 7.2 mm, wing, 6.4 mm.

Holotype.—Female, COSTA RICA: Guanacaste Province, 12 mi. SW of Cañas, II-27–1964, 25 ft., H. E. Evans (FSCA).

Paratypes.—COSTA RICA: San José Province: 3 ♂, 1 ♀, San Antonio-Desamparados, 16–18 June 1964, C. O. Berg (2 ♂, 1 ♀ CUIC, 1 ♂ FSCA); Alajuela Province: 1 ♀, San Josecito de Alajuela, 2 km. from road to Atenas, near. Rio Itiquis, 6 July 1969, Karl Valley, taken sweeping (CUIC); Guanacaste Province: 1 ♀, same data as holotype ♀ (FSCA); 2♀, Estación Pitilla, 9 km. S. Santa Cecilia, GNP Biodiversity Survey, 85°25′40″W, 10°59′26″N, Jan. 1989 (INBIOCRI001047591) and Feb. 1989 (INBIOCRI000105975) (INBio).

Etymology.—Named for Alajuela Province in Costa Rica.

Discussion.—The five paratype females are 8.4–8.8 mm long. All the males are 7.2 mm long. The female paratypes are very similar to the holotype, except the posterior extensions of the crossband do not reach the hind margin of the wing. Two of the male paratypes have very faint, small dark grayish median posterior triangles on tergites 2–4.

Chrysops alajuelensis is closely related to *Chrysops scalaratus* Bellardi, known from Mexico to western Panama, and was initially confused with that species. Females of *C. alajuelensis* differ from those of *C. scalaratus*, as follows: frontal callus relatively slender and reddish brown, antennal scapes distinctly stouter, frontoclypeus with distinct midfacial tomentose stripe, mesoscutum yellowish gray with very indistinct paler stripes, scutellum reddish brown, ground color of abdominal tergites yellowish brown, sublateral spots relatively small, sternites unicolorous yellow brown or with very faint longitudinal stripes. *C. scalaratus* has the frontal callus broader and mostly black, antennal scape only slightly inflated, frontoclypeus bare and shiny, rarely with a short tomentose spur beneath antennae, mesoscutum shiny black with distinct gray longitudinal stripes, scutellum black, abdominal tergites with ground color blackish and sublateral pale spots very large, sternum with distinct median black stripe. Males of *C. alajuelensis* differ from those of *C. scalaratus* as follows: antenna shorter and scape much stouter, mesoscutum with paler stripes evanescent or absent, abdominal tergites with broad black midstripe and large sublateral yellowish brown spots, sternites bearing broad median and narrow sublateral black stripes. *Chrysops scalaratus* males have the antenna distinctly longer and scape less inflated, mesoscutum with distinct longitudinal gray stripes, abdominal midstripe narrow, with distinct median grayish triangles on tergites 2–5 and narrow sublateral dark stripes on tergites 2–6, sternites without distinct sublateral black stripes.

***Chrysops costaricensis* Burger, new species**

(Figs. 17–18)

Diagnosis.—A yellow and black species with blackish thorax, conspicuously yellow spotted pleuron, wholly black femora, narrow apicocostal infuscation on the wing, and black abdomen with distinct rows of median and dorsolateral triangles.

Female.—*Head:* Front yellowish gray tomentose with a large shiny black area surrounding ocelli. Frontal callus crescent shaped, broadest in middle, strongly narrowed near eye margins, brown with black upper margin. Frontoclypeus shining brown, gena strongly inflated. Antennal scape light brown, relatively slender, pedicel darker brown to blackish at apex, flagellum black. Maxillary palpus dark reddish brown.

Thorax: Mesoscutum and scutellum shining black, mesoscutum with two broad yellowish submedian longitudinal stripes anteriorly that fade out about half way to the scutellum, and lateral margins narrowly yellowish. Pleuron shining black, proepisternum, proepimeron, upper area of mesanepisternum, mesanepimeron and meron strongly yellow spotted and pale haired. *Legs:* Femora wholly black, fore and hind tibiae black, mid tibia brown, all basal tarsomeres brown, apical tarsomeres brown basally, black apically. *Wing:* Wing with distinct dark brown pattern and broad crossband, cells br and bm ⅖ and ⅕ infuscated basally, respectively, apices also infuscated, crossband with slightly irregular outer margin, divided posteriorly by hyaline area in cell cua_1 that does not encroach on cell m_3, apicocostal infuscation narrow, filling half of cell r_1 and slightly widened in cell r_4, extending to wing apex.

Abdomen: Tergite 1 with narrow, irregular posterior and lateral margins yellow, tergite 2 yellow with pair of large, black submedian markings narrowly joined to smaller dorsolateral black spots, producing paired geminate markings, middorsal yellow triangle large, extending to anterior margin, tergites 3–5 black with middorsal row and dorsolateral rows of distinct yellow triangles arising from hind margins, tergites 6–7 black. Sternites broadly black medianly and laterally, leaving narrow ventrolateral yellowish brown patches, and hind margins narrowly yellowish.

Length: 7.3 mm, wing, 6.6 mm.

Male.—(Headless). Thorax and abdomen similar to female, but more extensively black. Submedian pale stripes on mesoscutum evanescent. Pleuron almost entirely black except for small gray tomentose spots on proepisternum, mesanepisternum and meron. Wing with cells br and bm entirely infuscated except for small subapical hyaline spots, and infuscation broadly invading cell a_1. Abdominal tergite 2 more extensively black, median yellow triangle small, equilateral, not extending to anterior margin.

Holotype.—Female, COSTA RICA: Província Herédia, Estación Magsasay, Parque Nacional Braulio Carrillo, 200 m., January, 1991, coll. A. Fernandez (INBIOCRI000627622) (INBio).

Paratypes.—COSTA RICA: 1 ♀, Herédia Province: Estación El Ceibo, Parque Nacional Braulio Carrillo, 400–600 m, March 1990, coll. C. Chaves (INBIOCRI000167501) (INBio); ♀, same data, except January 1990 (INBIOCRI000201892) (INBio). Puntarenas Province: ♀, Rancho Quemado, Península de Osa, 200 m., November 1991, coll. F. Quesada (INBICRI000462501) (UNHC); ♀, same data, except December 1992 (INBIOCRI000905966) (INBio); ♂, same data except December 1991 (INBIOCRI000342968) (INBio). San José Province: ♀, F. Cementario de la Máquina, Parque Nacional Chirripó, 2,100–2,500 m., 2 March 1993, coll. M. Zumbado (INBIOCRI001305778) (INBio).

Discussion.—The paratype females are 6.6–7.3 mm long. The black markings on tergite 2 are narrowly or broadly confluent, producing paired geminate dark markings, and the ventrolateral yellowish-brown markings on sternites 3–5 are absent.

Chrysops costaricensis appears to be closest to *Chrysops chiriquensis* Fairchild, 1939, known from Mexico (Chiapas) to Colombia, but differs in the following characteristics: females are somewhat smaller than *C. chiriquensis* females; frontal callus reddish brown with black upper margin, frontoclypeus bare and shiny, pleuron strongly yellow spotted, femora black, wing with apical infuscation narrow, joined to crossband, median yellow triangle on tergite 2 open to anterior margin. Females of *C. chiriquensis* have the frontal callus largely black, frontoclypeus with tomentose midstripe, mesoscutum without yellowish lateral stripe, pleuron dull grayish spotted, femora brownish with black apices, apical infuscation drop shaped, separated from crossband, median triangle on tergite 2 not open to anterior margin. The male of *C. costaricensis* has femora black, wing with apical infuscation joined to crossband, and tergites 2–5 with median and sublateral yellow triangles arising from posterior margin. Males of *C. chiriquensis* have reddish brown femora, apical infuscation separated from crossband and tergites 2–4 with yellow sublateral stripes.

KEY TO THE SPECIES OF *CHRYSOPS* OCCURRING IN COSTA RICA

An asterisk (*) indicates not yet recorded from Costa Rica, but possibly may occur there.

1. Frontoclypeus with a median tomentose stripe 2
– Frontoclypeus entirely bare and shiny (rarely with a short tomentose spur) 3
2. Mesoscutum and scutellum shiny black. Apical infuscation of wing separated from crossband. Abdominal tergites black with pale yellowish markings, tergite 1 entirely black except for extreme apex, tergites 3–5 with median and sublateral yellowish triangles arising from hind margins. Sternum black with yellowish gray sublateral stripes . . . . *chiriquensis* Fairchild
– Mesoscutum grayish brown tomentose. Scutellum yellowish brown. Apical infuscation of wing joined to crossband. Abdominal tergites mostly yellowish brown with yellowish brown median triangles and rounded sublateral spots not arising from hind margins. Sternum uniformly yellowish brown to faintly striped medianly and sublaterally . . . . . *alajuelensis*, n. sp.
3. Discal cell of wing largely hyaline, at least a central spot or hyaline streak 4
– Discal cell of wing wholly infuscated 5
4. Abdomen largely yellow, with two dorsolateral dark stripes from the second to third tergites, generally divided into two stripes on third and succeeding segments. Legs and frontal and facial callosities largely yellow. Thorax yellow to brown, with yellow tomentose stripes. Wing pattern yellowish brown . . . *variegatus* (DeGeer)
Abdomen with prominent gray tomentose transverse bands on posterior margins of all tergites. Wing pattern of two dark bands crossing the wing at the ends of cells br and bm and beyond discal cell. Apical spot a faint, narrow infuscation along fore border. Apices of femora and at least bases of tibiae yellow . . . . *alleni* Fairchild
5. Apical spot of wing a slender band or slightly widened, not extending beyond apex and encroaching into cell r$_4$ only at extreme apex . . 6
– Apical spot of wing extensive, filling most of wing apex and leaving but a narrow and irregular hyaline crescent or series of spots between it and crossband 12
6. Cell cua$_1$ entirely infuscated. Cell m$_3$ usually with a small hyaline spot. Crossband broad and intensely black. Thorax black, without dorsal stripes or lateral spots. Abdomen black, sides of the second tergite with small, dull yellow triangles, and with small, dull yellow median triangles on tergites 2–4 . . . . *leucospilus* Wiedemann*
– Cell cua$_1$ always with at least the apex hyaline, often over half hyaline. Cell m$_3$ with or without a hyaline spot 7
7. Mesoscutum and pleuron blackish, without stripes or spots. Wing with hyaline area in cell cua$_1$ clearly extending into cell m$_3$, but not crossing it. Abdomen black with small dull yellow triangles laterally on tergite 2 and median yellow triangles on tergites 2–5 . . *melaenus* Hine
– Mesoscutum strongly striped or at least weakly striped anteriorly, pleuron striped or spotted . . . 8
8. Abdomen with second tergite largely yellow except for two large, submedian black markings and small dorsolateral spots, yellow median triangle reaching anterior margin. Tergites 3–5 black with prominent median and dorsolateral yellow triangles arising from posterior margin. Sternites 1–4 with large median black patches . . . . *costaricensis*, n. sp.
– Abdomen without prominent yellow dorsolateral triangles on tergites 3–5 9
9. Abdomen with a dorsolateral series of pale dashes, forming a pair of interrupted stripes, as well as a row of pale median triangles on tergites 2–5. Sides of tergites 1–3 or 4 yellowish. Abdomen yellowish ventrally, with a broad, black median longitudinal stripe. Crossband of wing with outer border irregular, with extension toward fork of veins R$_4$ and R$_5$ along vein

R_{4+5}, fading posteriorly and failing to reach hind margin in cell m_3 . . . . . *scalaratus* Bellardi

– Abdomen without dorsolateral interrupted stripes or even ventral stripe. Outer margin of crossband straight or slightly concave, crossband filling apex of cell m_3 10

10. Second tergite black, broadly yellow at the sides, rarely with a small median yellow spot, generally without any median marks. Tergites 3–4 black, with equilateral yellow triangles whose apices may reach anterior borders, tergite 5 with a yellow hind border widened into a low triangle in middle. Wing with a narrower crossband, the hyaline area in posterior margin of crossband large, filling all but base of cell cua_1 and entirely crossing cell m_3 in the middle. Cell r_3 with a small hyaline streak at base . . . . *auroguttatus* Kröber

– Second tergite black with yellow median hourglass-shaped mark extending longitudinal width of tergite, sides broadly yellow. Third to fifth tergites black with yellow hind borders, widened into narrow median triangles which usually reach anterior border of segments. Wing with a broad, dark crossband, without a hyaline fenestra in cell r_3, and with hyaline area in the posterior margin of the crossband confined to cell cua_1 11

11. Apical spot black, extending as a clearly defined narrow costal stripe of even width to wing apex . . . . *varians* var. *tardus* Wiedemann

– Apical spot dilute, poorly defined, spread as a brownish shade over much of wing apex . . . . *varians vargus* Fairchild

12. Hind femur at least one-third black basally 13

– Hind femur red or yellow, at most extreme apex black 14

13. Abdomen black, with the second segment anteriorly narrowly, laterally broadly yellow, and with a broad yellow median triangle which rarely extends through black to join anterior yellow band. Tergites 3–5 or 6 with narrow yellow hind borders, widened into median triangles of variable size on 3 and often 4. Pleuron usually with a spot of yellow pile, rarely lacking. Wing with crossband joined to a cloud on fork of veins R_4 and R_5 by a dark bridge above the vein, leaving a small hyaline spot between cloud and crossband on vein . . . . *calogaster* Schiner

– Abdomen wholly black, or rarely with pattern of *calogaster* faintly indicated in grayish tomentum. Pleuron always entirely black. Cloud on fork of veins R_4 and R_5 never joined by a complete bridge to crossband, rarely almost joined by spurs . . . . *soror* Kröber

14. Cloud on fork of veins R_4 and R_5 joined to crossband by a broad spur of dark color. Mid tibia black or blackish, contrasting with pale femora. Abdomen with second tergite narrowly white to yellow anteriorly, widened to full length of segment at sides and with a broad, small median yellow triangle. Third and fourth tergites rarely with faint vestiges of small, pale median triangles . . ***nexosus*** Fairchild

– Cloud on fork of veins R_4 and R_5 unconnected with crossband. Mid tibia at most slightly brownish, not strongly contrasting with pale femora. Abdomen as above, but pale triangle on second tergite usually taller and narrower, occasionally joined to anterior yellow by a narrow, median yellow stripe. Third tergite usually with a dull yellowish median streak, sometimes lacking, and fourth tergite rarely with a minute paler streak . . *mexicanus* Kröber

Acknowledgments

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A REVISION OF THE NEOTROPICAL BUTTERFLY GENUS *SECO* HALL AND HARVEY (LEPIDOPTERA: RIODINIDAE)

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Abstract.—The South American riodinid genus *Seco* Hall and Harvey is revised. The taxonomy and biology of its species are discussed, locality data and range maps are given, and the adults and male and female genitalia (where known) are illustrated for all species.

Key Words: *Charis*, Neotropics, Riodinini, *Seco*, xeric habitats

A recent phylogenetic review of the Neotropical riodinid genera *Charis* Hübner [1819] and *Calephelis* Grote and Robinson 1869, showed that the heterogeneous *Charis* was paraphyletic with respect to *Calephelis*, prompting the division of *Charis* into three monophyletic genera (Hall and Harvey 2002). One of these genera, *Detritivora* Hall and Harvey 2002 (containing the *cleonus* and *gynaea* groups), has been revised already by Hall and Harvey (2001) and Harvey and Hall (2002). The purpose of this paper is to revise the remaining genus, *Seco* Hall and Harvey 2002, a small group of rare and very poorly known riodinine butterflies that are uniquely restricted to xeric habitats around the periphery of South America. The adults and genital structures of all species (where known) are illustrated, and a distribution map is presented based on an extensive compilation of specimen data.

METHODS

Dissections were made using standard techniques, abdomens being soaked in hot 10% potassium hydroxide solution for approximately five minutes, and subsequently stored in glycerol. Morphological terms for genitalia follow Klots (1956) and Eliot (1973), and the terminology for wing venation follows Comstock and Needham (1918). The protocol for listing material examined follows Hall (1999).

Seco specimens have been examined and their locality data recorded from the following collections:

AME	Allyn Museum of Entomology, Florida Museum of Natural History, Sarasota, FL, USA
AMNH	American Museum of Natural History, New York, NY, USA
BMNH	The Natural History Museum, London, UK
CMNH	Carnegie Museum of Natural History, Pittsburgh, PA, USA
DA	Collection of David Ahrenholz, St. Paul, MN, USA
JHKW	Collection of Jason Hall & Keith Willmott, Washington, DC, USA
MUSM	Museo de Historia Natural, Universidad Nacional Mayor de San Marcos, Lima, Peru
SMF	Senckenberg Museum, Frankfurt, Germany
USNM	National Museum of Natural History, Smithsonian Institution, Washington, DC, USA

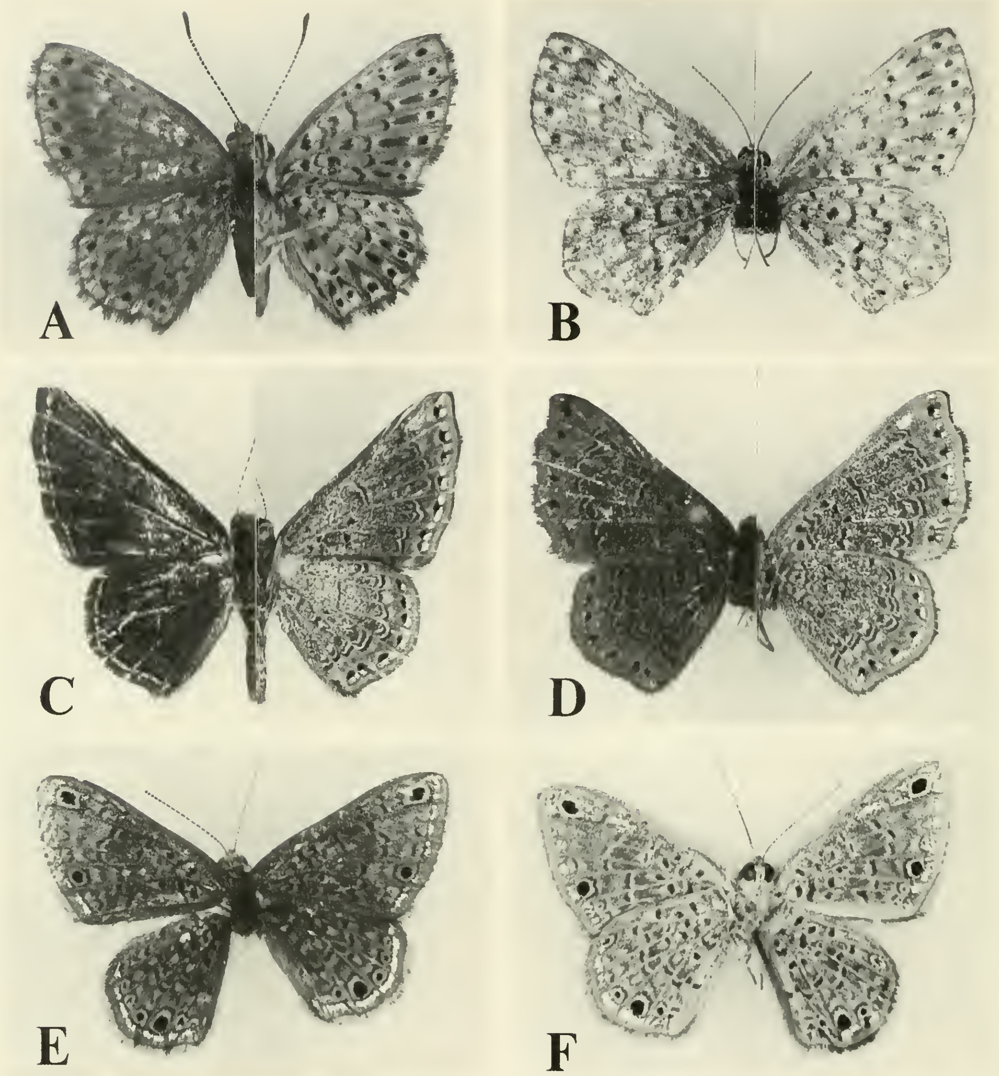

Fig. 1. Adults of *Seco* species (dorsal surface on left, ventral surface on right, unless otherwise stated). A, ♂ *S. aphanis*, Iguazú, Argentina (BMNH). B, ♀ *S. aphanis*, La Soledad, Argentina (BMNH). C, ♂ *S. calagutis*, nr. Macará, Ecuador (JHKW). D, ♀ *S. calagutis*, Salto de Napac, Ecuador (USNM). E, ♂ *S. ocellata*, dorsal surface, Puerto Colombia, Colombia (CMNH). F, ♂ *S. ocellata*, ventral surface.

ZMHU Museum für Naturkunde, Humboldt-Universität zu Berlin, Germany

REVISION OF *SECO*

Seco Hall and Harvey 2002
(Figs. 1–4)

Seco Hall and Harvey 2002: 415–417. Type species by original designation: *Charis calagutis* Hewitson 1871: pl. 46, figs. 11, 12.

Diagnosis and systematic position.—*Seco* species are small riodinids (forewing length 10–12 mm) with compact wing shapes and rounded wings. The sexes are monomorphic. The dorsal surface is brown with prominent discal and postdiscal lines, the latter containing individual spots that are unusual in being outwardly curved, and a single submarginal silver line (rays along veins in *aphanis*). The fringe varies from entirely brown (*ocellata*) to entirely white (*calagutis*). The ventral surface differs only by having additional silver markings in the forewing apex (*calagutis* and *ocellata* only). This arrangement of submarginal silver markings is unique in the family. All members of *Detritivora* and *Charis* have two dorsal submarginal silver lines and lack the elongate silver markings in the ventral forewing apex (Hall and Harvey 2002).

The male genitalia of all *Seco* species possess the deep notch in the anterior margin of the tegumen characteristic of the tribe Riodinini (Harvey 1987). The uncus is rectangular, the falces and tegumen are of average size and shape for the tribe, and the vinculum is evenly narrow and sinuate. The aedeagus is narrow and sigmoidal with a pointed tip that opens broadly; no cornuti are present. The pedicel is highly modified into the posteriorly elongate structure with fine acanthae (acellular projections) restricted to a raised distal area (termed a "vogelkopf" by Stichel 1910–11) that is so common in the Riodinini. The valvae consist of a typically elongate and somewhat membranous lower process and a short upper process that is joined above the aedeagus to form a transtilla. The transtilla is developed into a pair of lateral upwardly curved projections similar to those found in *Chalodeta* Stichel 1910 (Hall 2002), but in *Seco* species the transtilla is short instead of markedly elongate and downwardly curved, and the lateral projections are asymmetrical.

The female genitalia are interspecifically variable. The corpus bursae is elongate, the signa small spine-like invaginations (*calagutis*) or very small sclerotized pads (*aphanis*), the ductus bursae membranous with only the very distal portion sclerotized, the ductus seminalis membranous, the ostium bursae a simple hole either centrally positioned (*calagutis*) or displaced to the right (*aphanis*), and only abdominal sternite eight is sclerotized.

Seco appears to be most closely related to *Detritivora, Charis* and *Calephelis*, but its exact phylogenetic relationship to them and other closely related genera such as *Chalodeta* is not certain. Depending on how certain characters were coded and which outgroup(s) was used in the analysis, Hall and Harvey (2002) found *Seco* to variably be sister to *Detritivora, Charis* and *Calephelis*, sister to *Charis* and *Calephelis* or sister to *Chalodeta* and *Detritivora*. The first of these evolutionary scenarios seems the most plausible (Hall and Harvey 2002).

KEY TO THE SPECIES OF *SECO*

1. Outer silver submarginal line on all wings complete and parallel to outer wing margin (Figs. 1C–F) 2
– Outer silver submarginal line on all wings consists of rays along veins (Figs. 1A, B) . . *aphanis*
2. Postdiscal line displaced distally, submarginal black spots on all wings of even size (Figs. 1C, D) . . . . *calagutis*
– Postdiscal line positioned medially, submarginal black spots on all wings of uneven size (Figs. 1E, F) . . . . *ocellata*

Biology.—*Seco* species are distributed allopatrically in certain lowland xeric regions around the periphery of South America. They occur in western Ecuador and Peru, northern Colombia and Venezuela, and southern Brazil, eastern Argentina and Uruguay. All *Seco* species are rare in collections and hence little is known of their biology. However, at the right time and place they appear to be relatively common. Males are encountered perching in small groups along streamsides or shaded forest paths within several meters of the ground and have been recorded nectaring from asteraceous flowers (Hall and Willmott, unpublished data). The food plants and early stages are unknown.

Seco aphanis (Stichel 1910)
(Figs. 1A, B, 2A, 3A, 4)

Charmona aphanis Stichel 1910: 19–20. Type locality: Uruguay. Syntypes, 2 ♂ and 1 ♀, ZMHU [examined].

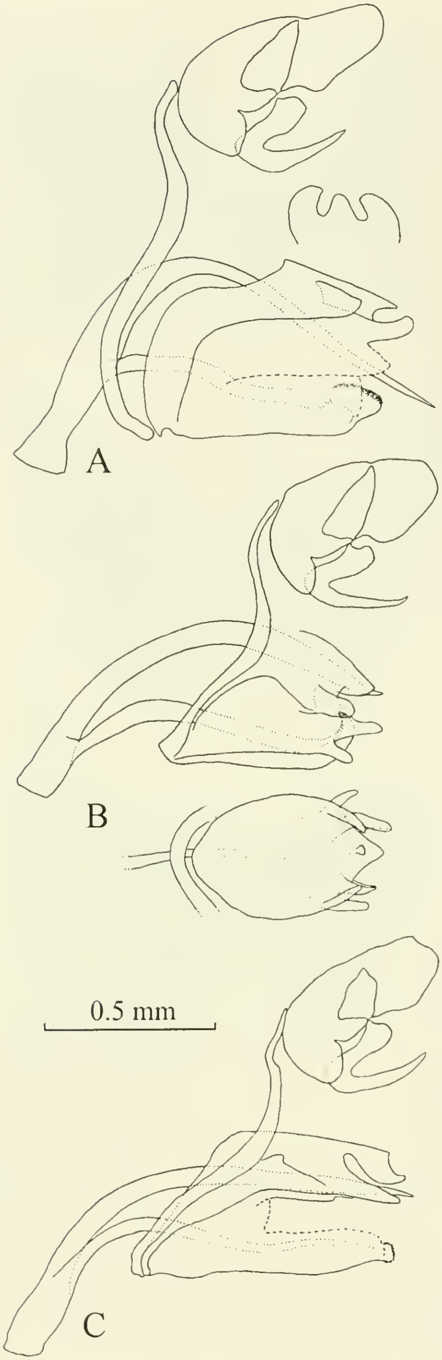

Fig. 2. Male genitalia of *Seco* species in lateral view unless otherwise stated. A, *S. aphanis*, also transtilla tip in ventral view. B, *S. calagutis*, also pedicel and valve complex in ventral view. C, *S. ocellata*.

Identification and taxonomy.—Typical forewing length of both sexes 11 mm. *Seco aphanis* is readily distinguished from its congeners by its possession of an outer silver submarginal line on all wings that consists of rays along veins instead of a continuous line paralleling the distal wing margin, and sparsely setose instead of bare eyes. The male genitalia have a more prominent "vogelkopf" covered with more prominent acanthae, a short triangular upper valve process, an asymmetrical laterally tilted transtilla, and lateral transtilla processes that are broad and dorso-ventrally instead of laterally compressed and inwardly as well as upwardly curved.

This is the most poorly known of all *Seco* species and, perhaps because it is not similar in appearance to other *Charis* species, the genus in which it used to be treated (Stichel 1930, 1931; Bridges 1994; Callaghan and Lamas 2002), specimens in museums are curated under several different genera or, more typically, in "protem" drawers of unsorted material. Even in the BMNH (and hence in d'Abrera 1994), it is incorrectly identified as *Audre zachaeus* (Fabricius 1798).

Biology.—Biezanko et al. (1979) reported that *S. aphanis* is "frequent in the southeast region [of Rio Grande do Sul, Brazil], flying among flowering bushes in April." The known months of capture are October and April, the earliest and latest months of summer.

Distribution.—*Seco aphanis* is currently known from the southeastern Brazilian state of Rio Grande do Sul, eastern Argentina, and Uruguay (see Fig. 4), but it should also occur in southeastern Paraguay and at least as far north as the Brazilian state of Paraná.

Material examined.—ARGENTINA: *Misiones*, Iguazú (Oct) 1 ♂ BMNH; *Entre Ríos*, La Soledad (Apr) 4 ♂, 1 ♀ BMNH. BRAZIL: *Rio Grande do Sul*, Pelotas 1 ♂, 1 ♀ SMF. URUGUAY: "Buschantal" [= forested valley] 1 ♂ SMF; No locality data 2 ♀, 1 ♂ ZMHU.

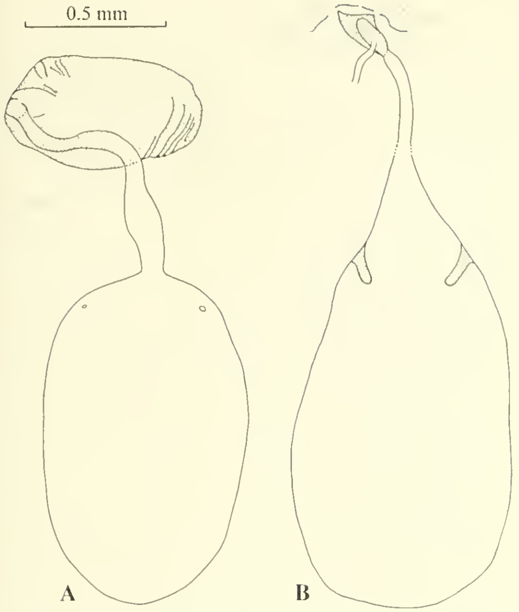

Fig. 3. Female genitalia of *Seco* species in dorsal view. A, *S. aphanis*. B, *S. calagutis*.

Seco calagutis (Hewitson 1871)
(Figs. 1C, D, 2B, 3B, 4)

Charis calagutis Hewitson 1871: pl. 46, figs. 11–12. Type locality: La Chima, W. Ecuador. Syntype ♂ BMNH [examined].

Identification and taxonomy.—Typical forewing length of both sexes 12 mm. *Seco calagutis* is most similar to *S. ocellata* but has a markedly distally displaced postdiscal line on all wings, submarginal black spots on all wings that are of an even size (in *ocellata* they are expanded into "eyespots" in forewing cells Cu1 and R4+5 and hindwing cell Cu1), no additional silver triangle at the base of ventral forewing cell R4+5, and yellow-brown speckling across much of the ventral surface. The male genitalia of *S. calagutis* have a vertically elongate and slightly recurved tip to the pedicel which is not weakly bifurcate as in *S. ocellata*, a more elongate and well sclerotized lower valve process, a considerably shorter and more angular upper valve process, a more posteriorly elongate transtilla, and more elongate and prominently asymmetrical lateral transtilla projections.

Biology.—*Seco calagutis* is the most commonly represented species of the genus in collections. In Ecuador, it becomes increasingly rare towards the northern wetter end of its range, but can be locally common in the dry semi-deciduous woodlands of the southwest (Hall and Willmott, unpublished data). It has been recorded from sea-level to 1,100 m. In Ecuador, it has been collected in March, May, and September, and in Peru during May, June, and October, all months around the beginning and end of the rainy season. Males are encountered perching in small groups along forest edges, trails and streamsides, and more rarely on hilltops, between 1 and 3 m above the ground. They rest with their wings outspread under the tips of leaves and their flight is somewhat weak. Males have been observed visiting flowers of Asteraceae (Hall and Willmott, unpublished data).

Distribution.—*Seco calagutis* is restricted to central and southwestern Ecuador and northwestern Peru (see Fig. 4). The following additional localities were reported by G. Lamas (personal communication, in coll. MUSM) for PERU: *Tumbes*, Matapalo, La Totora; Quebrada Angostura, Hualtaco; Puesto [de Vigilancia] Campo Verde; *Cajamarca*, Hacienda La Viña.

Material examined.—ECUADOR: *Pichincha*, Río Tanti, Tinalandia 1 ♂ JHKW; Salto de Napac 1 ♀ USNM; *Manabí*, Palmarcito, nr. Pedernales 1 ♂ DA; Ayampe 1 ♂ JHKW; *Los Ríos*, Río Palenque 1 ♂ AME; *Bolívar*, La Chima 1 ♂, 1 ♀ BMNH; *Chimborazo*, Dos Puentes 3 ♂ AMNH; Chimbo 2 ♂ BMNH; *Guayas*, Duran [= Eloy Alfaro] 1 ♂ AMNH; *Loja*, Quebrada Curichanga, Río Sabiango, nr. Macará 4 ♂ JHKW. PERU: *Piura*, 3 km. W. of Canchaque 1 ♂, 1 ♀ USNM; Ulunche 3 ♂ USNM; La Tina 2 ♂ USNM.

Seco ocellata (Hewitson 1867)
(Figs. 1E, F, 2C, 4)

Symmachia ocellata Hewitson 1867: pl. 45, fig. 8. Type locality: Venezuela. Syntypes, 2 ♂, BMNH [examined].

Fig. 4. Map of South America illustrating distributions of *Seco* species.

Identification and taxonomy.—Typical forewing length of male 12 mm. *Seco ocellata* is most similar to its sister species *S. calagutis* and is distinguished in that species account. The female is unknown to us.

Biology.—This is the most poorly represented *Seco* species in collections, perhaps only because it is endemic to an infrequently collected region. The label data of a Colombian specimen indicate the habitat of the species to be "dry hills with thick scrub."

Distribution.— *Seco ocellata* is restricted to northern Colombia and presumably the dry regions of northwestern Venezuela (the only Venezuelan specimens examined have no precise data).

Material examined.—COLOMBIA: *Atlántico,* Puerto Colombia (Jul) 1 ♂ CMNH; *Magdalena,* Atanques 3 ♂ BMNH. VENEZUELA: No locality data 2 ♂ BMNH.

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REDISCOVERY OF THE GENUS *PLATYSCELIDRIS* SZABÓ (HYMENOPTERA: SCELIONIDAE) AND DESCRIPTION OF A NEW SPECIES

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Abstract.—*Platyscelidris kittenbergeri* Szabó is redescribed, and a new species, ***P. fossorius***, is described from Madagascar. The genus is remarkably similar in superficial characters to the Australian *Mirobaeoides* Dodd, including the possession of a pair of apical femoral spines in *P. fossorius*. The structure of the antenna and ovipositor place the genus within the Scelionini *sensu* Austin and Field.

Key Words: egg-parasitoid, Afrotropical, Madagascar

Many species of parasitoid wasps of the family Scelionidae display degrees of wing reduction. Some have wings that are merely shortened; others are practically apterous, with the wings so reduced as to be barely visible. This phenomenon is not restricted to any clade within the family, and it may be related, in part, to the need for females to search for host eggs within the litter and soil.

Szabó (1959) described *Platyscelidris* as a new genus of Scelionidae on the basis of a single brachypterous female specimen collected in East Africa in 1905 by the Hungarian big-game hunter Kálmán Kittenberger. Since then, no further specimens have been reported. The original description contains two highly unusual features for a scelionid. The dorsal surface of the mesosoma was said to be made up of only two sclerites, the mesoscutum and the metanotum. Szabó asserted that the scutellum is lacking. Brachyptery is commonly associated with modifications in mesosomatic structure, but the absence of a scutellum is unprecedented. Second, the first metasomatic tergite is reduced: "Petiole very small, present as a semicircular field in the middle of the anterior margin of the second tergite" (our translation). The genus *Baeus* Haliday has T1 hidden in dorsal view, but most species have this sclerite well developed.

Szabó considered the genus to be an intermediate form between the subfamilies Baeinae and Scelioninae, but its precise position within the family was uncertain. Masner (1976) included a brief treatment of *Platyscelidris* in his review of the world Scelionidae and provisionally placed it in the tribe Gryonini (Scelioninae). In his key to genera, *Platyscelidris* falls in the section in which the genera of Baeini (including Idrini) and Gryonini are distinguished, with the main diagnostic character being the reduction in size of the first metasomatic tergite.

We recently sorted a litter sample from Madagascar and discovered specimens of an unusual micropterous species. Our initial impression was that it was a species of *Gryon* Haliday or *Mirobaeoides* Dodd, but closer examination and a review of the literature led us to conclude that we had found a new species of *Platyscelidris*. We here redescribe the genus and its type species, describe a new species, and discuss relationships of the genus within the Scelionidae.

Materials and Methods

Specimens for this study are deposited in the collections of the Ohio State University (OSUC), Canadian National Collection of Insects (CNCI), National Museum of Natural History, Smithsonian Institution, Washington, DC (USNM), and the Hungarian Natural History Museum (HNHM). The figures were prepared using a Spot Insight Color® camera (Diagnostic Instruments, Inc.), Auto-Montage version 3.05(3) (Syncroscopy, Inc.), and Adobe® Photoshop® 6.0.1 software. The OSUC numbers refer to unique identifying bar code labels attached to the specimens.

Platyscelidris Szabó

Platyscelidris Szabó 1959: 45, original description. Type species: *Platyscelidris kittenbergeri* Szabó, by monotypy and original designation. Masner 1976: 60, description; Johnson 1992: 461, catalog of world species.

Description.—Female. Head and compound eyes large, prominent; frons convex throughout, without deep scrobe; lateral ocelli contiguous with inner orbits; vertex separated from occiput by sharp angle or broadly rounded; palpal formula apparently 3-2 (palpi very small and largely hidden); antenna 12-merous, clava 6-merous, claval formula A12-A8/1-2-2-2-1; dorsum of mesosoma flattened; skaphion absent, but mesoscutum strongly angled anteriorly; notauli absent; scutellum unarmed; metanotum, where visible, unarmed, appearing as a simple transverse strip; propodeum hidden mesally; tibial spur formula 1-1-1; wings highly reduced or absent; metasoma with 7 tergites, 6 sternites, T7 extruded with ovipositor; laterotergites incised into sternites, submarginal ridge developed; T1 transverse; T2 distinctly longer than T3. ♂ unknown.

Diagnosis.—The 12-merous antenna will distinguish *Platyscelidris* from the superficially similar Australian genus *Mirobaeoides* and all other Baeini (see below). The hidden propodeum and the narrowing of T1 laterally will adequately separate it from species in the diverse genus *Gryon*.

Discussion.—Masner's (1976: 7) key to world genera of Scelioninae must be adapted to include the new species described below.

24(23). Metasoma apparently sessile, T1 much narrower than T2, appearing as a fusiform or small nail-like sclerite situated medially on front margin of T2; scutellum appearing as a narrow transverse sclerite; propodeum entirely hidden medially; micropterous (male unknown) . . . . *Platyscelidris* Szabó p. 60

– Metasoma variable, T1 normal, almost as wide as T2, transverse; scutellum variable in shape, usually semicircular; propodeum variable, usually entirely visible; wings variable 25

Key to Species of *Platyscelidris*

1. Mesosoma in dorsal view with large mesoscutum followed by single transverse sclerite (scutellum) (Fig. 2); T1 in form of small hemispherical sclerite on anterior margin of T2 (Fig. 2); hind femur without apical spines; hyperoccipital carina absent . . . *P. kittenbergeri* Szabó

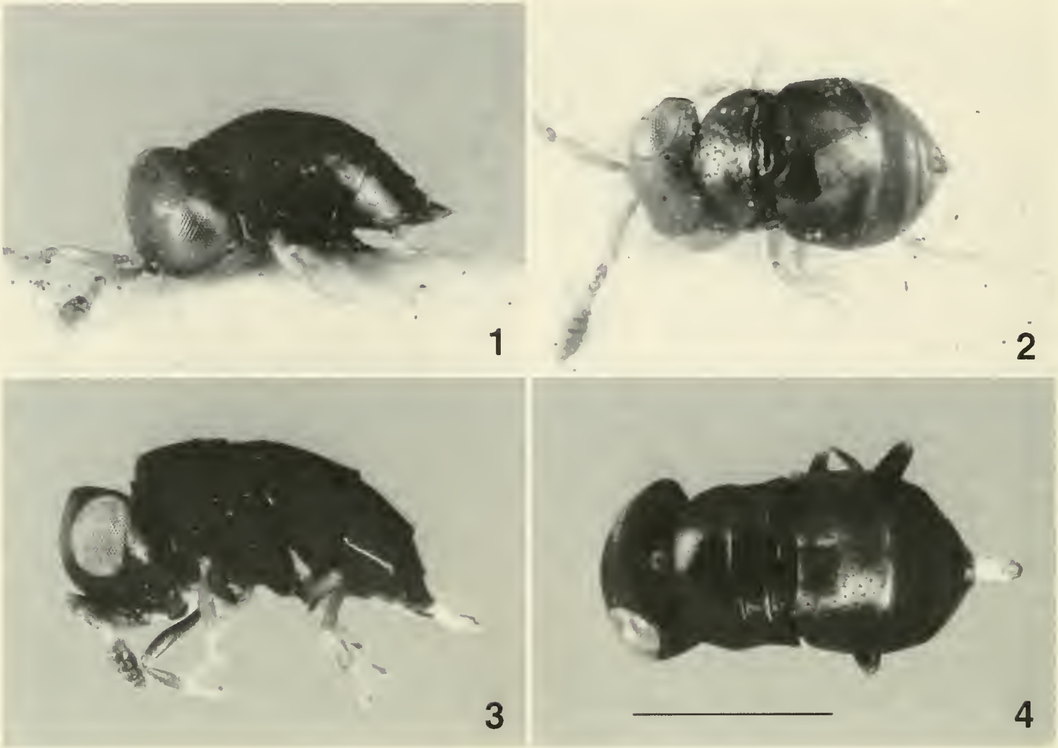
– Mesosoma with mesoscutum followed by two transverse sclerites (scutellum and metanotum) (Fig. 4); T1 forming relatively wide transverse fusiform sclerite (Fig. 4); hind femur with pair of strong apical spines; hyperoccipital carina present . . . . *P. fossorius*, new species

Platyscelidris kittenbergeri Szabó
(Figs. 1–2)

Platyscelidris Kittenbergeri Szabó 1959: 46, original description; Masner 1976: 60, type information.

Female.—Mesosoma, metasoma, A8-A12 brown; head, legs, A1–7 light brown; A1-A7 brown to yellowish brown; length: 0.81 mm.

Head transverse in dorsal view, width 0.41 mm, wider than mesosoma, ratio of head width to mesosoma width 1.15; compound eyes hairless; hyperoccipital carina



Figs. 1–4. 1, *Platyscelidris kittenbergeri*, holotype ♀, lateral view. 2, Same, dorsal view. 3, *Platyscelidris fossorius*, holotype ♀, lateral view. 4, Same, dorsal view. Scale line = 0.50 mm.

absent, vertex broadly rounded onto occiput, aciculate; gena narrowly visible dorsally, with sharp carina parallel to longitudinal axis of body arising from posterior orbit and intersecting occipital carina; compound eyes not bulging, in dorsal view margin in continuous line with frons; occipital carina largely obscured from view; occiput obscured medially by mesoscutum; head in frontal view oval, wider than long, vertex gently arched; ocelli minute; compound eyes relatively small, frons width 0.53 times head width, without distinct frontal depression or central keel; gena appearing convex above anterior mandibular articulation, no surface sculpture visible; lower frons without distinct fanlike striae, with fine aciculate microsculpture, other irregular, asymmetical ridges present, especially ventrally, probably remnants of glue; apex of mandible not visible.

Antenna 12-segmented, clava 6-segmented; claval formula not visible.

Mesosoma slightly narrower than the metasoma, ratio of mesosoma width to metasoma width 0.82; pronotum not visible in dorsal view; mesoscutum semicircular, distinctly overhanging head anteriorly, surface aciculate, with evenly spaced setigerous punctures, associated with fine minute hairs, lateral margins gently raised, punctures absent along posterior margin, notauli absent; wings absent; mesoscutellum strongly transverse, 0.27 times length of mesoscutum, sculptured as mesoscutum; without distinct axillary pits; metanotum, propodeum not visible dorsally; lateral surface of pronotum with deep femoral depression, longitudinally carinate ventrally, with fine aciculate microsculpture above; fore and mid coxae closely approximated, ventral portion of mesepisternum obscured;

mesopleural carina formed by raised ridge, crenulate posteriorly; mesepisternum anterior to mesopleural carina aciculate; mesopleural scrobe very finely sculptured, mesopleural pit present, suture between meso- and metapleuron distinct; antero-ventral corner of metapleuron obscured; metapleuron glabrous, metapleural pit not visible, metapleuron wrinkled, distinctly separated from lateral propodeum by ridge; lateral surface of propodeum smooth, posterior edge of metapleuron and propodeum nearly straight, without lamella; apex of hind femur without apical spines.

Metasoma 1.22 times longer than wide, entirely without longitudinal sculpture, strongly and evenly convex anteriorly; T1 short, length 0.04 mm, longest medially, narrow, not reaching lateral margins of metasoma, aciculate, with very few setigerous punctures; T2 longest segment, length 0.24 mm, transverse, aciculate; T3 length 0.12 mm, punctures absent on posterior border, aciculate to faintly aciculate; T6 without visible setae; T7 hidden; laterotergites smooth, glabrous; S2–S6, where visible, with similar surface sculpture as tergites.

Male.—Unknown.

Host.—Unknown.

Material examined.—Holotype ♀ (examined, HNHM): "Mto-ja-Kifaru, Febr. 905 [on reverse]; Africa or., Katona; *Baeidae* n. gen.; Platyscelidris g.n. Kittenbergeri sp.n. - det. J. B. Szabó; Holotypus! 1958 J. B. Szabó [red label]; Holotypus ♀ Platyscelidris kittenbergeri Szabó 1959 [red margined label]; Hym. Typ. No. 9572 Mus. Budapest." The specimen is in only fair condition, somewhat dirty, and glued on a small card. The second metasomatic tergite is cracked. Much of the surface sculpture of the body is obscured, probably because Szabó seems to have enhanced the magnification of his microscope by immersing the specimen in a drop of water, thus dissolving and spreading some of the adhesive ("Wangen im Wassertropf gesehen . . . ," Szabó 1959: 46). According to Masner (1976), the type locality is in present-day Tanzania. Wheeler (1922) also cited this locality, as "Mto-ya-Kifaru," placed it in German East Africa, and equated it to Arusha-chini, 3°35′S 37°25′E.

Diagnosis.—Distinguished from the new species described below, *P. fossorius*, by the apparent lack of a metanotum, the longitudinal carina on the gena, the rounded vertex without a hyperoccipital carina, and the narrow, semicircular T1.

Platyscelidris fossorius Johnson and Musetti, new species
(Figs. 3–4)

Female.—General coloration dark brown to black; legs, mandible brown; A1–A7 brown to yellowish brown, A8-A12 dark brown; length: 0.90–1.16 mm (mean = 1.08 mm, SD = 0.08 mm).

Head transverse in dorsal view, width 0.48–0.55 mm (mean = 0.52 mm, SD = 0.02 mm), slightly arched around mesosoma, wider than mesosoma, ratio of head width to mesosoma width 1.05–1.15 (mean = 1.10, SD = 0.03); compound eyes hairless; surface sculpture aciculate, with evenly spaced setigerous punctures associated with fine minute hairs; hyperoccipital carina along vertex sharp, angle between vertex and occiput acute; gena not visible dorsally; compound eyes not bulging, margin in continuous line with frons; occipital carina extended ventrally to posterior mandibular articulation, strongly developed laterally, interrupted medially; occiput distinctly concave, aciculate; head in frontal view oval, vertex gently arched; ocelli minute; compound eyes relatively small, frons width 0.46–0.52 times head width (mean = 0.50, SD = 0.02), without distinct frontal depression or central keel; frons and vertex covered with evenly spaced setigerous punctures, with fine minute hairs; gena distinctly reflexed above anterior mandibular articulation, surface aciculate; lower frons finely striate on either side of malar suture, striae radiating from clypeal margin, frons otherwise finely aciculate; mandible tridentate, with lower tooth longest, lower and upper teeth longer than median tooth.

Antenna 12-segmented, clava 6-segmented; claval formula A8-A12 1-2-2-2-1.

Mesosoma slightly narrower than the metasoma, ratio of mesosoma width to metasoma width 0.84–0.90 (mean = 0.87, SD = 0.02); pronotum not visible in dorsal view; mesoscutum distinctly transverse, with anterior corners rounded, surface aciculate, with evenly spaced setigerous punctures, associated with fine minute hairs, lateral margins gently raised, punctures absent and faintly aciculate along posterior margin, notauli absent; mesoscutellum strongly transverse, 0.27–0.41 times length of mesoscutum (mean = 0.34, SD = 0.04), sculptured as mesoscutum; two axillary pits anteriorly on either side of mesoscutellum along transscutal articulation; metanotum clearly visible, very narrow, length 0.46–0.68 times length of mesoscutellum (mean = 0.55, SD = 0.07), length 0.62–1.85 times length T1 (mean = 0.99, SD = 0.41), surface aciculate with 1 row of evenly spaced setigerous punctures; propodeum visible dorsally as triangular sclerites on either side of metanotum, surface imbricate-aciculate; lateral surface of pronotum with femoral depression, with longitudinal wrinkles ventrally, otherwise finely aciculate throughout; fore and mid coxae distinctly separated by mesepisternum ventrally; mesopleural carina formed by simple raised ridge with no crenulations; mesepisternum anterior to mesopleural carina aciculate; mesopleural scrobe very finely sculptured, mesopleural pit present, suture between meso- and metapleuron distinct; antero-ventral corner of metapleuron produced ventrally to narrow sharp point; metapleuron glabrous, with distinct round metapleural pit, longitudinal sulcus extending from pit to posterior edge of propodeum; lower ⅔ of lateral surface of propodeum finely sculptured, smooth above, posterior edge of metapleuron and propodeum expanded into thin lamella; apex of hind femur with a pair of spines flanking base of tibia, posterior spine distinctly longer.

Metasoma 1.25–1.44 times longer than wide (mean = 1.31, SD = 0.06), entirely without longitudinal sculpture, strongly and evenly convex anteriorly; T1 short, length 0.03–0.06 mm (mean = 0.05 mm, SD = 0.01 mm), longest medially, aciculate, with very few setigerous punctures; T2 the longest segment, length 0.23–0.32 mm (mean = 0.29, sd = 0.03 mm) transverse, aciculate, punctures absent on anterior third, punctures also absent posteriorly, sculpture faintly aciculate around border; T3 length 0.17–0.24 mm (mean = 0.21 mm, SD = 0.02 mm), punctures absent on posterior border, aciculate to faintly aciculate; T6 covered with very short setae; T7 with long recurved setae on each side; laterotergites smooth, glabrous; S2– S6 with similar surface sculpture as tergites.

Male.—Unknown.

Host.—Unknown.

Material examined.—Holotype ♀: MADAGASCAR: Tuléar Prov., 18 km NNW Betroka, 825 m, 23°09′48″S 48°58′07″E, 24.xi-14.xii.1994, M. A. Ivie and D. A. Pollock, OSUC 60936 (deposited in OSUC).

Paratypes.—Two ♀ with same data as holotype: OSUC 60919, OSUC 60905 (OSUC). MADAGASCAR: Prov. Toliara; Ifaty; 23°09′, 43°37′E; 17–22 Sept. 1993; pitfall trap in sand, desert scrub forest; collrs. W. E. Steiner, R. Andriamassimanana, 1 ♀: OSUC 90316 (CNCI); PT in desert scrub, W. Steiner, 3 ♀: OSUC 90317, OSUC 90318, OSUC 90319 (USNM).

Diagnosis.—Distinguished from *P. kittenbergeri* by the presence of a third dorsal mesosomatic sclerite (the metanotum), the lack of a longitudinal genal carina, the presence of the hyperoccipital carina, and the wide, fusiform T1.

Discussion.—The specimens of *P. fossorius* strongly resemble the genus *Mirobaeoides*, a group of 14 species known only from mainland Australia, Tasmania, and Lord Howe Island (Austin 1986, Johnson

1992). Most female baeines are easily recognized by their 7-segmented antenna with a large, often globose, clava. *Mirobaeoides* is exceptional in this regard, because the female antenna is 11-merous with four clearly separated apical clavomeres. One of the defining features of *Mirobaeoides*, in both sexes, is the possession of a pair of spines at the apex of the hind femur (Austin 1986). The only similar structure described in scelionids are the genual spines of some species of *Gryon*. These spines, however, are more irregular in distribution among species and are found at the base of the hind tibia. The specimens of *P. fossorius* have well-developed apical femoral spines. Despite the difference in the number of antennomeres, we were initially excited to discover an apparent new species of *Mirobaeoides* on the opposite side of the Indian Ocean.

One of the specimens forced us to reevaluate this conclusion. The apex of the metasoma of this female has a short, cylindrical, membranous tube that bears the seventh metasomatic tergite at its apex (Figs. 3–4). We have not made detailed dissections of the limited material available, but this formation has been described by Field and Austin (1994) and Austin and Field (1997) as a *Scelio*-type ovipositor. This is a set of morphological specializations that produces a long telescoping tube bearing the skeletal elements of the ovipositor at its apex. The length of this tube may be several times the apparent length of the entire metasoma and presumably allows the female much greater range for reaching and parasitizing host eggs. Austin and Field (1997) suggested that the complex of apomorphic features of this ovipositor-type may be used to define a monophyletic group within the subfamily Scelioninae, their Scelionini *sensu lato*, a grouping that dismembers several of the tribes defined by Kozlov (1970) and Masner (1976). All known Baeini have the plesiomorphic appendicular *Ceratobaeus*-type ovipositor. We concluded that the Madagascan specimens could not be assigned to an expanded concept of *Mirobaeoides*, but must somehow fit within the concept of Scelionini outlined by Austin and Field (1997).

The *Scelio*-type ovipositor is a highly complex and integrated set of morphological specializations. We agree with Austin and Field (1997) that joint possession of this set of characters is strong evidence of phylogenetic affinity and can be of help in understanding scelionid relationships. Some groups, e.g., *Opisthacantha* Ashmead, have some species with the *Scelio*-type ovipositor and others with the *Ceratobaeus*-type ovipositor. This may well hint that such a taxon needs to be re-evaluated. We would like to add a note of caution, however. The supposition that the elements of this character set are integrated into an emergent morphological structure implies that the characters themselves may not be independent. Without information on the genetic and developmental mechanisms, it seems plausible to us that any viable character reversal may require reversion of the entire structure to the plesiomorphic *Ceratobaeus*-type condition. The best evidence of the utility of a character set is its compatibility with the totality of other characters and not an *a priori* assumption of its importance.

Szabó (1959) suggested that *Platyscelidris* represents a link between his concepts of Scelioninae and Baeinae. Most authors today consider the Baeinae to be a tribe within Scelioninae, so that hypothesis essentially proposes little other than a vague similarity to baeines. The *Scelio*-type ovipositor allies the genus with the Scelionini *sensu lato*, and not with the Baeini nor Gryonini (as suggested provisionally by Masner 1976). A large part of the difficulty in finding the proper context for this genus arises from the paucity of characters that circumscribe the subfamilies and tribes within Scelionidae. Resolution of the phylogeny of this family would help greatly to resolve such issues as well as provide valuable insights into the mechanisms of host-finding and shifts from one host taxon to another.

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TWO NEW SPECIES OF ORSILLINE LYGAEIDAE (HETEROPTERA) FROM THE HAWAIIAN ISLANDS

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Abstract.—Two new species of orsilline Lygaeidae are described from the Hawaiian Islands: ***Oceanides gruneri***, taken in canopy fogging samples from ohia trees (*Metrosideros polymorpha*) on eastern Molokai; and ***Nesius (Physonysius) poepoe***, collected from understory vegetation in the upper elevations of the West Maui Mountains. Shaded habitus drawings and distribution maps are provided for both new species, the male paramere of *N.* (*Physonysius*) *poepoe* is illustrated, and a revised key to the species in the subgenus *Physonysius* is included.

Key Words: Lygaeidae, Hawaii, *Oceanides, Nesius,* new species, illustrations, key

As interpreted by Ashlock (1967), the tribe Metrargini in the Lygaeidae contains 6 genera endemic to the Hawaiian Islands, which have produced a diverse insular radiation of 80 endemic species and subspecies (Usinger 1942; Usinger and Ashlock 1958; Ashlock 1966, 1983; Nishida 1997). Although most of the species occurring in obvious or easily accessible habitats have now been described, additional new species are discovered on a regular basis in remote localities or unusual microhabitats. The present paper describes two such taxa, taken from upland wet forest habitats on the islands of Maui and Molokai.

In the descriptions below, all measurements are given in millimeters, and represent the dimensions of the holotype specimen. CL numbers in the material examined sections refer to a coding system used to cross reference ecological data and habitat photographs. Collection depository codons are given in the acknowledgments section. English system equivalents of metric elevational data are given in brackets, to provide compatability with USGS topographic maps.

Holotypes of both new species described herein are deposited in the National Museum of Natural History, Smithsonian Institution, Washington, DC (USNM). Paratypes are also deposited in that collection, and in the Bernice P. Bishop Museum in Honolulu (BPBM).

Oceanides gruneri Polhemus, new species

(Figs. 1–2)

Description.—*Macropterous male:* Overall length 4.70; maximum width (across abdomen) 1.85. General coloration dark brown to black, with extensive pale coloration on pronotum and hemelytra.

Head: Length 0.85, width 1.10, general coloration black, tip of tylus dark yellow, eyes and ocelli pale reddish; dorsal surface slightly elevated between eyes, coarsely rugulose, sparingly clothed with recumbent pale pubescence, this pubescence denser in areas behind eyes and laterad to ocelli; an-

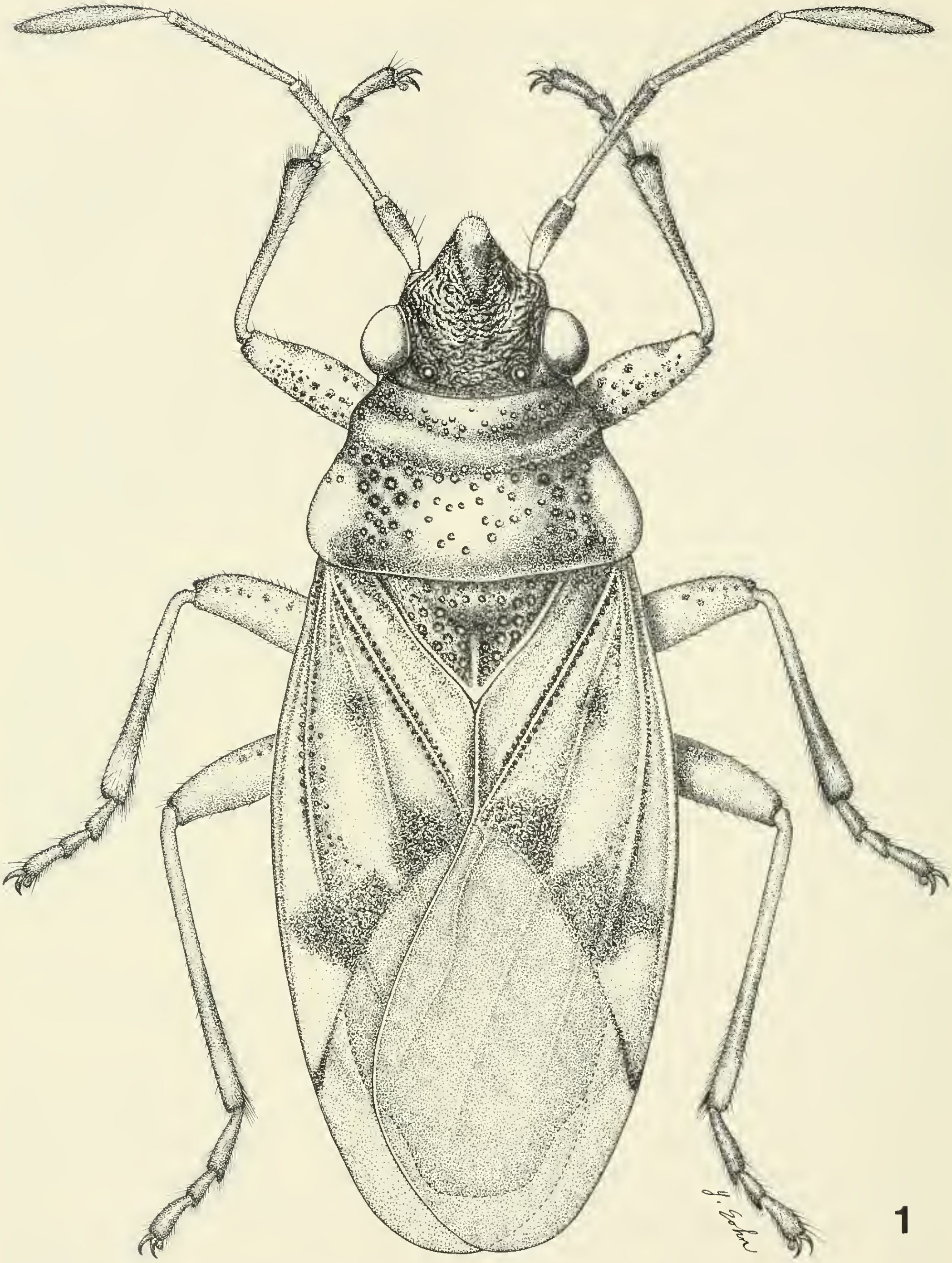

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Fig. 1. *Oceanides gruneri*, male, dorsal habitus.

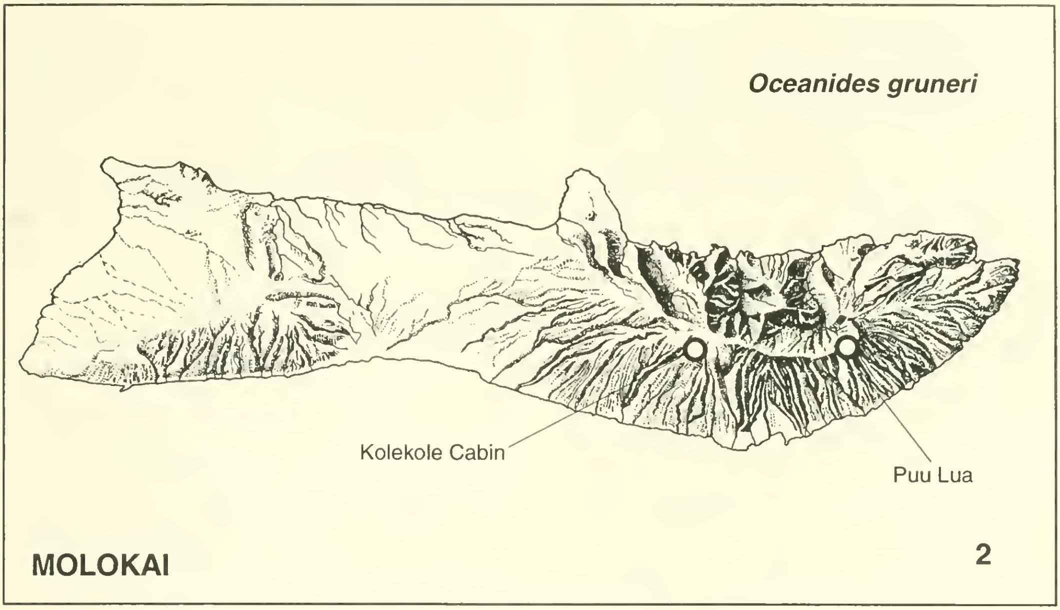

Fig. 2. Distribution of *Oceanides gruneri* on Molokai.

teocular length 0.42, equal to 1.2× dorsal length of an eye; eye length 0.35, width 0.25; interocular space 1.12; ocelli small; buccula low, gradually tapering in height, without abrupt change in width to base of head; rostrum pale brown, apex dark, reaching beyond hind coxae, segment I nearly reaching base of head, segment lengths (from base) 0.75, 0.70, 0.75, 0.65; antennae long, slender, segments I and IV distinctly thicker than II and III, all segments dark brown, extreme base of segment I and extreme distal ends of segments I–III creamy white, all segments bearing short erect pale setae, these setae slightly shorter than the diameters of these segments, segment I with 3 longer setae near base, lengths of segments I–IV = 0.35, 0.65, 0.60, 0.60.

Pronotum: Length 0.55, maximum width 1.55, dark brown to blackish, with yellowish-white markings narrowly along extreme anterior margin, broadly on central portion of posterior lobe, and on posterolateral angles; calli black, shining, margins bearing pale recumbent pubescence, anterior collar and posterior lobe shining, without evident setae, surfaces sparsely set with deep, dark brown punctations; lateral pronotal margins bulging outward at lateral margins of calli.

Scutellum: Length 0.52, maximum width 0.80, black, bearing a narrow, raised, longitudinal medial carina on posterior half, marked by a slender white longitudinal stripe; surface coarsely rugulose, thickly clothed with recumbent pale pubescence.

Hemelytra: Macropterous, extending well beyond end of abdomen, weakly rugose, bearing scattered pale recumbent setae; general coloration yellowish white with scattered dark markings, clavus entirely pale except for narrow dark patch along commisure, and lines of dark brown punctations on either side of claval suture; corium bearing a single roughly circular blackish spot in basal half traversing the cubitus, two additional larger and more irregular blackish patches on distal half adjacent to base of wing membrane, and a small dark mark at extreme posterior angle; membrane uniformly pale translucent brown; costal margins broadly and evenly arcuate.

Legs: Yellowish white, dorsal sufaces of femora spotted with dark brown, dorsal faces of tibiae and tarsi narrowly medium brown; all segments clothed with fine, pale, semi-recumbent setae intermixed with scattered longer erect pale setae; tibiae slightly expanded near distal ends. Lengths of leg segments as follows: fore femur, tibia, tarsal I, tarsal II, tarsal III = 1.12, 1.00, 0.20, 0.10, 0.20; middle femur, tibia, tarsal I, tarsal II, tarsal III = 1.12, 1.00, 0.25, 0.10, 0.20; hind femur, tibia, tarsal I, tarsal II, tarsal III = 1.25, 1.40, 0.35, 0.10, 0.12.

Ventral surface: Black, acetabula and peritreme dark yellow, adbominal ventrites VI–VIII marked with medium brown; ventrolateral portions of head and thorax and all of abdomen bearing numerous pale recumbent setae.

Macropterous female: Length 5.15; maximum width 2.00. Similar to male in general structure and coloration with following exceptions: posteromedial portion of pronotum not so broadly marked with yellowish white; ventromedial portion of abdomen basal to ovipositor sheath broadly marked with dark yellow.

Etymology.—It is my pleasure to name this species in honor of Daniel S. Gruner, a friend and colleague whose canopy fogging study of *Metrosideros polymorpha*, undertaken during his tenure as a graduate student at the University of Hawaii, has greatly increased our understanding of speciation and diversification processes in the Hawaiian insect biota.

Material examined.—Holotype, macropterous ♂: HAWAIIAN ISLANDS, Molokai Is., rain forest at Kolekole Cabin, Kamakou TNCH Preserve, 1,220 m [4,000 ft], 21°06′15″N, 156°53′47″W, 23 October 1997, CL 8071, canopy fogging sample MO97-1+2-Sc, D. A. Polhemus and D. Gruner (USNM). PARATYPES (all macropterous): HAWAIIAN ISLANDS, Molokai Is.: 1 ♂, same data as holotype except canopy fogging sample MO9705-1-1 (USNM); 1 ♀, same data as holotype except canopy fogging sample MO9704-2-1 (USNM); 1 ♀, same data as holotype except taken from bundle of dead *Cibotium* tree fern fronds, 21–25 October 1997, D. A. Polhemus (USNM); 2 ♂, Kamakou Preserve, road between cabin and Puu Kolekole, 1,170 m [3,840 ft], 22 October 1997, Coll. #85, C. P. Ewing, on *Cheirodendron trigynum* (BPBM); 1 ♀, lee side of Puu Lua, nr. rim of Wailau Valley, 2,750–3,000 ft., 15 June 1999, 21°06′28″N, 156°48′48″W, CL 8342, D. A. Polhemus, on *Cheirodendron* sp. (USNM).

Discussion.—*Oceanides gruneri* belongs to a distinctive set of *Oceanides* species with contrasting black and white dorsal markings. It is similar in general appearance to *O. humeralis* Ashlock from Kauai, *O. perkinsi* Usinger and *O. incognitus* Usinger from the Koolau Mountains of Oahu, and *O. oresitrophus* (Kirkaldy) from East Maui, and it seems likely that all of these species will eventually prove to be members of a monophyletic segregate within the *Oceanides* lineage. Both *O. gruneri* and *O. oresitrophus* may be separated from *O. humeralis*, *O. perkinsi*, and *O. incognitus* by the presence of a black spot transgressing the cubital vein in the basal half of the hemelytron. In turn, *O. gruneri* and *O. oresitrophus* may be separated from each other by the length of the anteocular portion of the head, which is 1.2× the dorsal length of an eye in *O. gruneri* but equal to the eye length in *O. oresitrophus*; by the length of antennal segment II, which is 1.8× the length of antennal segment I in *O. gruneri*, versus 2.0× the length of segment I in *O. oresitrophus*; and by the presence of an irregular patch of pale coloration centrally on the posterior pronotum in *O. gruneri*, which is lacking in *O. oresitrophus*. The pale markings on the corium of *O. gruneri* also have a more yellowish overall hue than those of *O. oresitrophus*, which are a clearer, brighter white.

Most captures of *O. gruneri* to date have come from canopy fogging samples taken from ohia trees (*Metrosideros polymorpha*). It is uncertain whether this species occurs in the canopy itself, or on the pads of moss that cover many of the branches; the collection of several additional specimens on *Cheirodendron trigynum* trees suggests the latter. In any case, the lack of previous captures at the relatively well-collected Kolekole Cabin type locality on Molokai by entomologists operating near ground level strongly indicates an arboreal habit for this species.

Nesius (*Physonysius*) *poepoe* Polhemus, new species

(Figs. 3–5)

Description.—*Submacropterous male:* Overall length 3.80; maximum width (across abdomen) 1.75. General coloration uniform shining reddish brown, with a few contrasting paler or darker markings on head and scutellum.

Head: Length 0.55, width 1.00, general coloration reddish brown, tylus, vertex adjoining inner margins of eyes, and posteromedial portion of vertex dark yellow, posterior margin of head dark brown, eyes silvery black, ocelli pale orange brown; dorsal surface slightly elevated between eyes, smooth; dorsal head sparingly clothed with recumbent pale pubescence, this pubescence slightly denser in areas behind eyes and laterad to ocelli, and flanking tylus; anteocular length 0.30, equal to dorsal length of an eye; eye length 0.30, width 0.22; interocular space 0.60; ocelli small; buccula low, barely raised, gradually tapering in height without abrupt change in width to base of head; rostrum pale brown, apex dark, reaching to hind coxae, segment I nearly reaching base of head, segment lengths (from base) 0.50, 0.50, 0.50, 0.45; antennae long, slender, segments I and IV distinctly thicker than segments II and III, segment I pale brown, suffused with dark brown centrally, segment II dark brown, suffused with pale brown centrally, segment III dark brown, segment IV medium brown, extreme base of segment I and extreme distal ends of segments I–III creamy white, all segments bearing short erect pale setae, these setae slightly shorter than the diameters of these segments, segment I with 3 longer setae near base, lengths of segments I–IV = 0.27, 0.55, 0.52; 0.60.

Pronotum: Length 0.70, maximum width 1.37, uniform reddish brown, shining, lacking pubescence; calli weakly raised, margins lacking setae; anterior collar and posterior lobe sparsely set with deep, dark brown punctures; lateral pronotal margins weakly sinuate, not bulging strongly outward at lateral margins of calli.

Scutellum: Length 0.55, maximum width 0.70, shining, lacking pubescence; overall coloration reddish brown, posterior half with a pale posteromedial stripe running along a narrow, raised, longitudinal medial carina; basal section smooth, lateral sections deeply and coarsely punctate.

Hemelytra: Convex and submacropterous, nearly coleopteriform, venation of corium obscure, membrane highly reduced; dorsal surface weakly rugose, shining, bearing scattered short, pale, semi-erect setae; coloration uniformly translucent reddish brown to orange brown, without contrasting markings; membrane of each hemelytron not completely overlapping with that of other when wings are at rest.

Legs: Uniformly orange brown, except for a few small dark brown spots or mottled areas on posterior faces of middle and hind tibiae; all segments clothed with fine, pale, semi-recumbent setae. Lengths of leg segments as follows: fore femur, tibia, tarsal I, tarsal II, tarsal III = 0.90, 0.87, 0.15, 0.07, 0.12; middle femur, tibia, tarsal I, tarsal II, tarsal III = 1.00, 0.90, 0.17, 0.07, 0.12; hind femur, tibia, tarsal I, tarsal II, tarsal III = 1.20, 1.30, 0.25, 0.12, 0.15.

Ventral surface: Dark brown to black, acetabula and peritreme yellowish white, evaporative area surrounding peritreme dull matte grey, adbominal ventrites VI–VIII marked with medium brown, genital segment orange brown; ventrolateral portions of head and thorax and all of abdomen bearing numerous pale recumbent setae.

Male paramere: Stout and set with spine-like setae basally, distal section form-

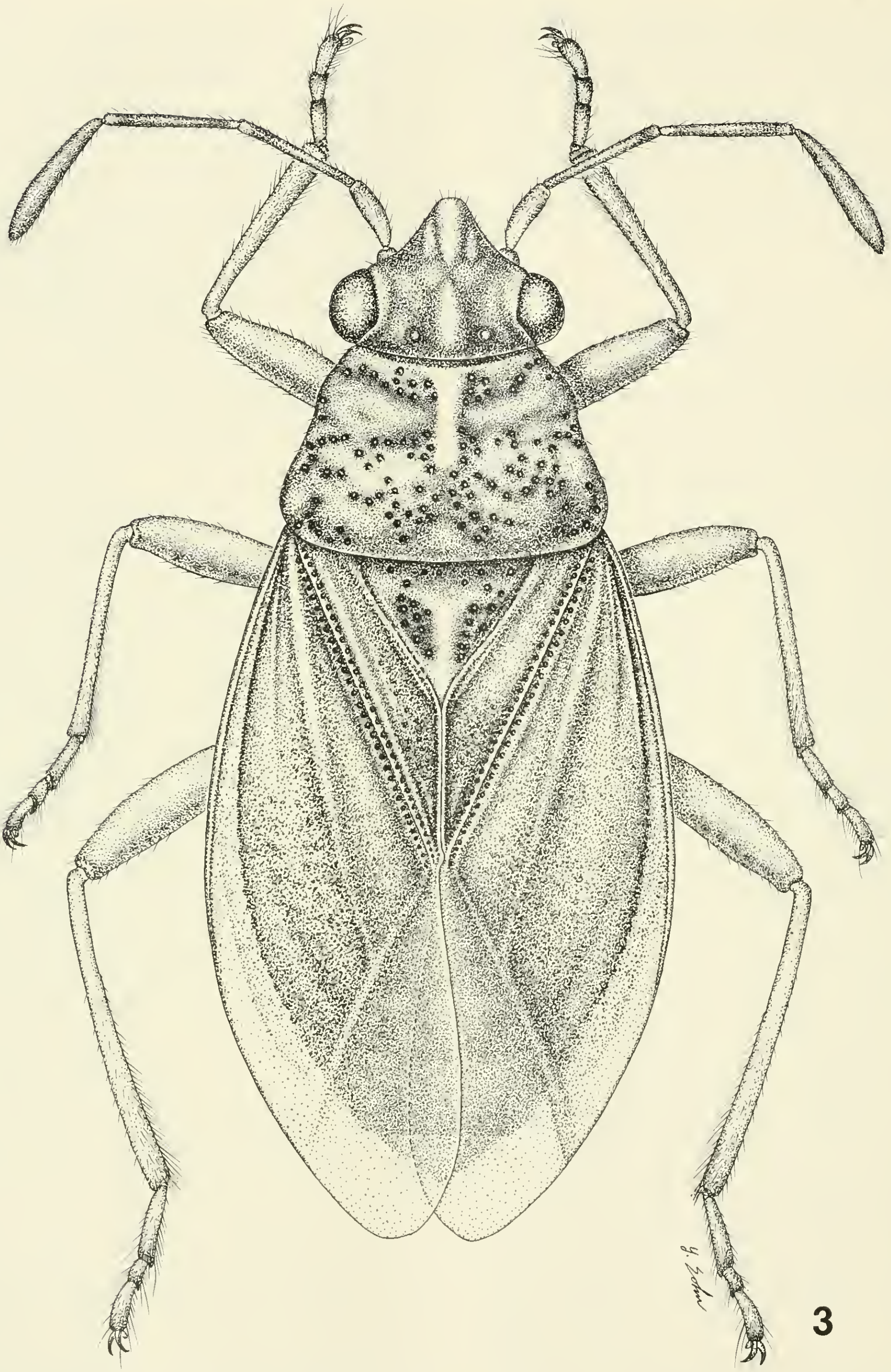

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Fig. 3. *Nesius* (*Physonysius*) *poepoe*, female, dorsal habitus.

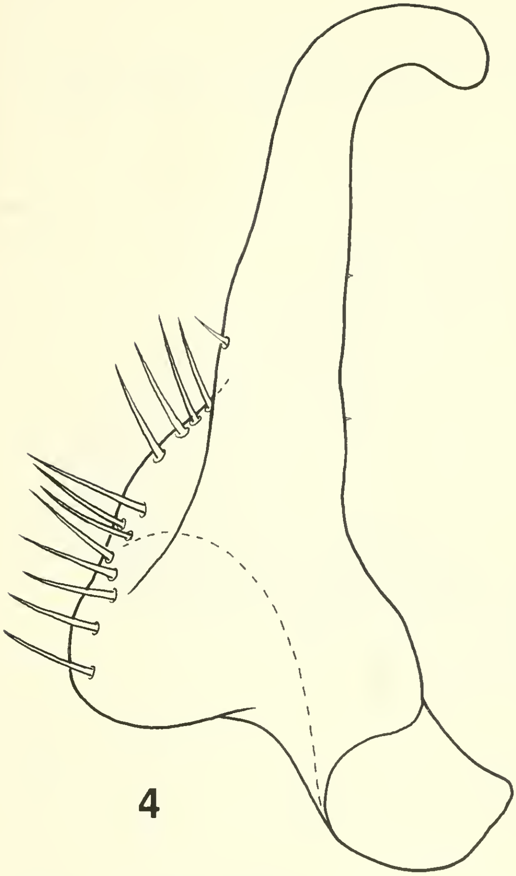

Fig. 4. *Nesius* (*Physonysius*) *poepoe*, male right paramere, dorsal view.

ing a slender, elongate shaft, tip hooked and rounded (Fig. 4).

Brachypterous female: Slightly larger than male, length 4.20; maximum width 2.00. Similar to male in general structure and coloration, but with end of terminal abdomen bright red.

Etymology.—The name "poepoe" comes from the Hawaiian word for "rounded," and refers to the overall body shape of this species.

Material examined.—HOLOTYPE, submacropterous ♀: HAWAIIAN ISLANDS, Maui Is., West Maui Mountains, moss forest nr. Puu Kukui summit, 1,750 m [5,740 ft], 20°53′37″N, 156°35′22″W, 11 May 1992, CL 8109, D. A. Polhemus (USNM). PARATYPES (all submacropterous): HAWAIIAN ISLANDS, Maui Is.: 1 ♂, 1 ♀, West Maui Mountains, valley and ridge S. of Mt. Eke, Eke Natural Area Reserve, 1,310 m [4,297 ft], 20°55′04″N, 156°34′22″W, 23–25 May 1997, CL 8291, D. A. Polhemus (USNM); 1 ♀, West Maui Mountains, Puu Kukui trail between Nakalalua and Violet Lake, 1,340–1,490 m [4,395–4,487 ft], 3 March 1998, R. Takumi (BPBM); 1 ♂, West Maui Mountains, Puu Kukui trail at Nakalalua, 1,350 m [4,430 ft], 20°54′55″N, 156°35′32″W, 22–23 May 1997, CL 8114, D. A. Polhemus (USNM).

Discussion.—Usinger (1942) proposed *Physonysius* as a subgenus of *Nesius* to hold two very distinctive species characterized by their rounded overall form, submacropterous hemelytra, and smooth, shining dorsal surfaces: *Nesius* (*Physonysius*) *molokaiensis* from eastern Molokai, and *Nesius* (*Physonysius*) *ampliatus* from Haleakala, eastern Maui. *Nesius* (*Physonysius*) *poepoe* may be easily separated from these two taxa by its smaller body size, longer rostrum, and shorter hemelytra, as given in the supplemental key provided below (revised from Usinger 1942).

REVISED KEY TO SPECIES OF SUBGENUS *PHYSONYSIUS*

Based on Holotypes

1. Rostrum long, extending to hind coxae; overall body length 4.6 mm or less; ground color distinctly reddish; West Maui . . . . *N.* (*P.*) *poepoe*, n. sp.

– Rostrum shorter, extending only to middle coxae; overall body length exceeding 5.0 mm; ground color dark brown or black; East Maui and Molokai 2

2. General coloration uniform dark brown, without extensive pale markings; head uniformly dark brown dorsally, without a pale stripe along midline; embolium translucent reddish brown along entire length; scutellum with basal angles brown, not contrasting with central portion; East Maui (Haleakala) . . . . *N.* (*P.*) *ampliatus* Usinger

– General coloration dark brown to black with scattered paler markings; head dark brown dorsally but with a dark yellowish longitudinal midline stripe on vertex; embolium pale translucent yellowish on basal two thirds; scutellum

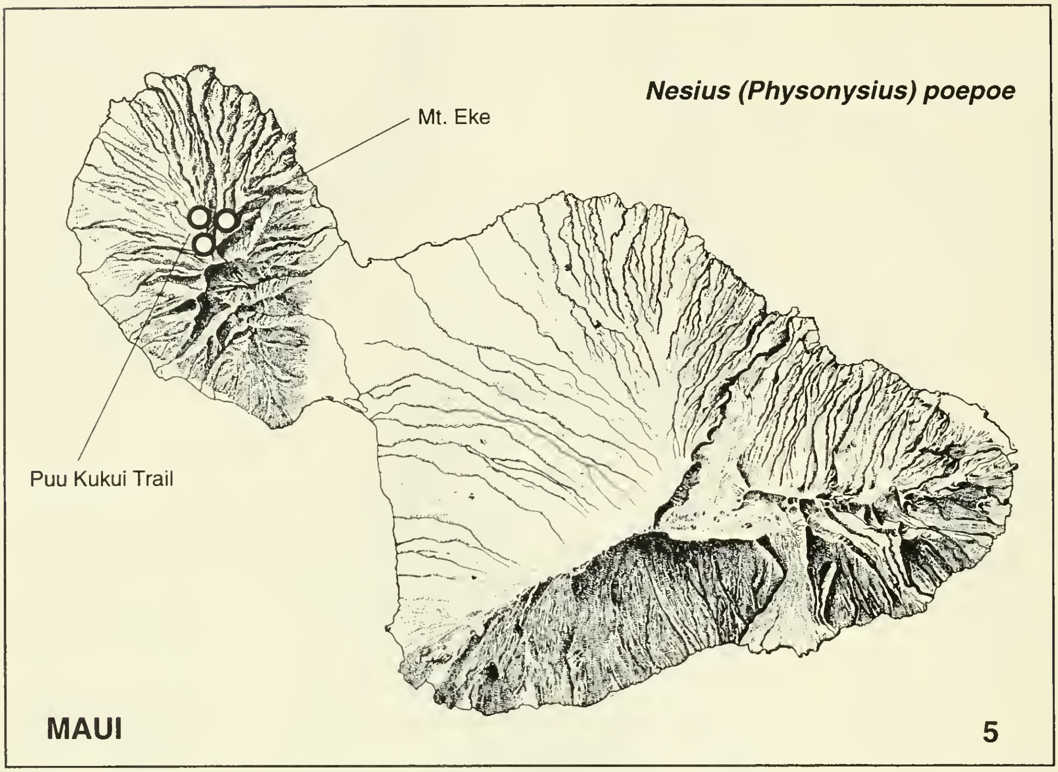

Fig. 5. Distribution of *Nesius* (*Physonysius*) *poepoe* on Maui.

with basal angles pale yellowish, contrasting with dark central portion; Molokai . . . . *N.* (*P.*) *molokaiensis* Usinger

Certain strongly brachypterous individuals of *Nesius* (*Nesius*) *kirkaldyi* (Usinger), endemic to eastern Maui, can also approach *Nesius* (*Physonysius*) *poepoe* in size and shape, but are orange brown rather than reddish brown in overall coloration, have the embolar margin of the hemelytra less strongly expanded and arcuate, and have the overall hemelytral surface finely rugulose, rather than smooth and shining. These brachypterous forms of *N.* (*Nesius*) *kirkaldyi* also retain a more completely developed wing membrane, so that the membranes of both hemelytra completely overlap when the wings are closed, while in *N.* (*Physonysius*) *poepoe* the wing membrane is greatly reduced, creating only a narrow amount of overlap, if any, between the two wing membranes in the closed position (Fig. 3). To date, no fully macropterous individuals of *N.* (*Physonysius*) *poepoe* have been collected, while many such individuals of *N.* (*Nesius*) *kirkaldyi* are present in the Bishop Museum collection.

Physonysius clearly forms a distinct clade within the Hawaiian *Nesius* radiation, and could potentially be raised to full generic status. This decision is complicated, however, by the fact that certain other Hawaiian *Nesius* species exhibit morphologies intermediate between *Physonysius* and other less highly modified *Nesius* species. In particular, the above-mentioned *N.* (*Nesius*) *kirkaldyi* (Usinger), endemic to Maui, and *Nesius* (*Trachynysius*) *whitei* (Blackburn), from Hawaii island, display a range of variation in their wing morphs which in the most extreme states of submacroptery approximate the arcuate-margined, nearly coleopteriform condition seen in *Physonysius*. As a result, Usinger's (1942) placement of

Physonysius as a subgenus of *Nesius* is retained for the present pending a phylogenetic analysis of the entire Hawaiian *Nesius* radiation.

As currently understood, the distribution of *Physonysius* is limited to islands on the Maui Nui platform near the southeastern end of the Hawaiian Archipelago. With the collection of *N. peopoe*, species are now known from three of the four high volcanoes in this island group: Molokai, West Maui and Haleakala. Given this distribution, it is probable that a member of the subgenus will also eventually be discovered on Lanai, the only other volcano on the Maui Nui platform that rises to an elevation sufficient to support wet upland forests favored by *Physonysius*.

AKNOWLEDGMENTS

This revision is based primarily on material collected by the author during field surveys supported by the Smithsonian Institution's Drake Fund (USNM), or held in the collections of the Bernice P. Bishop Museum, Honolulu, Hawaii (BPBM). It could not have been completed without the generous cooperation of the staff in the Department of Natural Sciences at the latter institution, particularly Scott E. Miller (now with the Smithsonian Institution), David Preston, Francis G. Howarth, and Gordon Nishida. I also thank James K. Liebherr of Cornell University and Curtis Ewing, from the University of Hawaii, for companionship and assistance in the field; the staff of Pacific Helicopter Tours, Inc., who provided access to remote field sites on Molokai and in the West Maui Mountains; Randy Bartlett and Hank Oppenheimer of the Maui Land and Pineapple Company, who kindly allowed access to Puu Kukui and surrounding ridge trails; and the Nature Conservancy of Hawaii (TNCH), who permitted collections in their Kamakou Preserve on eastern Molokai. This paper represents contribution 2002-002 to the Hawaii Biological Survey.

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A NEW SPECIES OF *PSEPHENOPS* GROUVELLE (COLEOPTERA: PSEPHENIDAE) FROM MEXICO

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Abstract.—***Psephenops lupita*, new species**, is described from specimens collected in a stream running through a cloud forest at Coatepec (1,200 m), Veracruz State, Mexico. The total number of described species assigned to the genus is now eight.

Resumen.—Se describe e illustra a ***Psephenops lupita*, n. sp.**, con base en especímenes colectados en un arroyo de agua dulce de un bosque nebuloso en Coatepec (1,200 m snm), Veracruz, México, aumentando el numero total de especies descritas de este genero a ocho.

Key Words: Psephenidae, new species, Veracruz State, Mexico

The genus *Psephenops* Grouvelle (= *Xexanchorinus* Grouvelle) is comprised of seven known species, with an apparently fragmentary distribution: *P. smithi* Grouvelle 1898 (Antillean); *P. grouvellei* Champion 1913 (Guatemala); *P. haitianus* Darlington 1936 (Haiti); *P. maculicollis* Darlington 1936 (Colombia and Costa Rica); *P. argentinensis* Delève 1967 (Argentina); *P. prestonae* Spangler 1990 (Costa Rica), and *P. mexicanus* Arce-Pérez and Novelo-Gutiérrez 2000 (Mexico). In this paper a new species is reported from Mexico.

Ten specimens, all males, were collected in a stream located at Coatepec Village (1,200 m altitude), Municipality of Coatepec; an additional specimen was collected in a stream located at Xico Viejo Village (1,800 m altitude), Municipality of Xico, Veracruz State, Mexico. Individuals were initially preserved in ethanol (80%) and some were later pinned; all collected material was examined. Male genitalia were extracted in ethanol, and potassium hydroxide (KOH 5%) was used to clear genitalia to make illustrations. Microphotographs were taken with a scanning electron microscope JEOL, model JSM T20, with magnification of 200×.

Psephenops lupita Arce-Pérez, new species

(Figs. 1–4)

Holotype male.—Body oval, depressed; integument black, with reddish-yellow reflections, completely covered with iridescent, reddish-yellow, short setae; head, antenna, pronotum and scutellum black; elytron dark reddish brown, slightly elevated at humeral region; antennal segments 1–2 yellow; legs with coxae, trochanters, and femora yellow, tibiae and tarsi black; ventrally reddish black, vestiture short, fine, and dense, grayish, with iridescent, yellow reflections; total length 3.80 mm, maximum humeral width 1.65 mm.

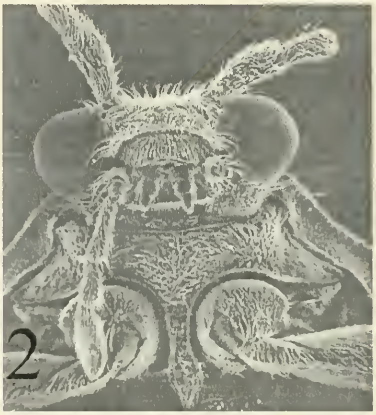
Head: Wider than long, transverse. Clypeus subrectangular, declivous at an angle of less than 90 degrees from plane of frons, distal margin widely emarginate; fronto-clypeal surface with long, robust and stiff setae; vertex minutely punctate, with minute setae and a very shallow longitudinal furrow at middle. Antenna filiform, 11-segmented, scape larger than other segments, pedicel 0.57 length of scape and subglobose; third 0.64 length of scape; 7 flagellar segments small, apical segment acuminate. Eyes lateral, rounded, very prominent, dark reddish brown; postocular area amber yellow (Fig. 1). Labrum similar to clypeus but shorter; maxillary palpus 4-segmented, covered with long setae; segment 1 smallest; segments 2 and 4 largest; relative proportion of segments: 0.30, 0.90, 0.60, 1.0, basal segments 1–3 subconical; segment 4 oval, slightly depressed and ending in an inner subapical ridge. Labial palpus very short, 3-segmented; segments 1–2 rounded and wide, segment 3 smallest, subconical and dark, segment 2 largest, robust (Fig. 2).

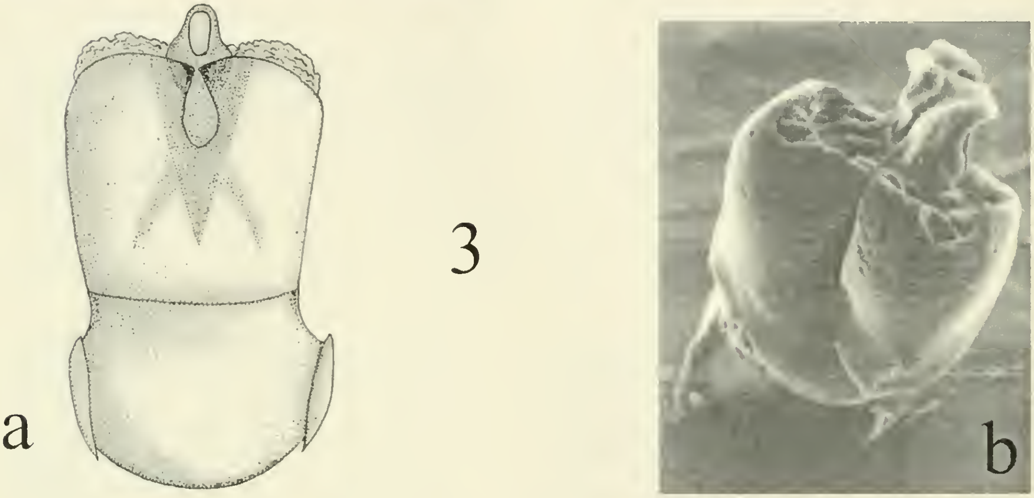
Thorax: Pronotum (Fig. 1) subtrapezoidal (posterior margin 1.5 mm, lateral margin 0.95 mm); anterior margin arcuate; posterior margin bisinuate and almost as wide as elytral base; lateral margins almost straight along anterior half and expanded laterally on posterior half; posterolateral angles subacute; all margins slightly thickened; pronotal disc with middorsal longitudinal carina weakly developed at distal half, and a wide, shallow, long depression at each side of carina; in lateral view, pronotal disc (except for posterolateral expansions) convex; pronotal surface with punctation finer than that of head, and covered with short, cineraceous-yellow setae, and long dark reddish setae, setae shorter than those of head; prosternum (Fig. 2) black, short and slightly carinate; with long, concave, lanceolate, and slightly carinate postcoxal process, which reaches anterior half of mesosternum. Mesonotum with scutellum short and black, with tip broadly round; elytron dark reddish brown, with short yellow setae and long reddish-yellow setae; sides parallel on basal 0.75, then gradually converging posteriorly; base depressed on each side within humeri; surface without striae; length (from base to apex of suture) 2.65 mm; width (across humerus) 1.65 mm. Mesosternum, with wide groove for reception of prosternal process. Metasternum bulky with medium longitudinal groove deep between matacoxae.

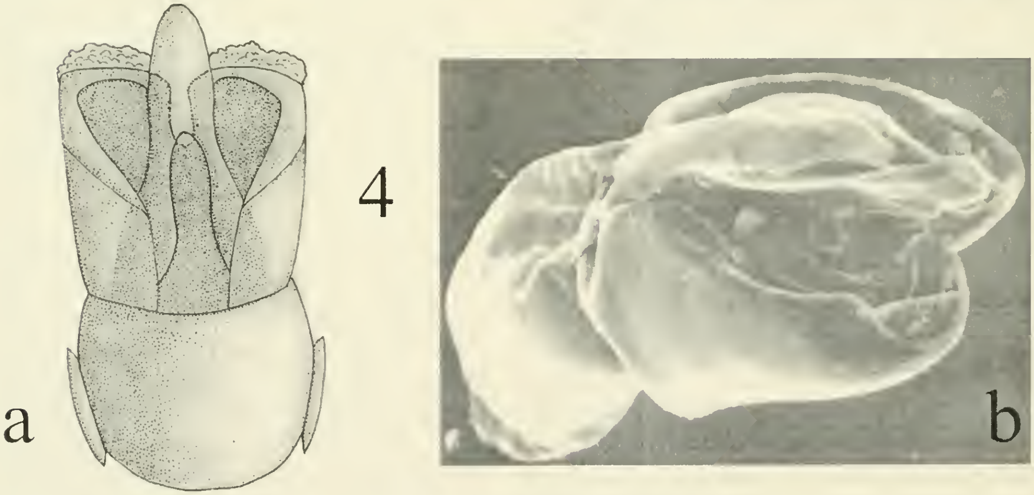
Legs: Procoxa globose, mesocoxa conical, metacoxa transverse; femora robust with dark yellowish setae; tibiae slender; metatibia as long as femur; protibia with distinct apical posterolateral denticle; tarsi, 5-segmented, tarsomeres 1 and 2 lobed ventrally, with thick spongelike vestiture with short setae; lobe of tarsomere 1 extending distally to 0.30 of tarsomere 2; tarsomere 2 longer, extending distally and completely covering area of tarsomeres 3, 4, and 0.20 of tarsomere 5; proportional length of tarsomeres: 0.40, 1.0, 0.25, 0.20, 0.85; a pair of long, curved, and slender apical claws present, each with small basal tooth.

Abdomen: Vestiture short, fine and dense. Seven visible sterna in relaxed specimens; usually segment 6 hidden under segment 5. Sternum 2 largest. Posterior margins of sterna 1 and 2 deeply concave at middle, sinuate at sides. Posterior margins of sterna 3 and 4 straight, that of sternum 5 with a wide and shallow concavity at each side of midline. Sternum 6 very short, posterior margin widely concave. Pygidial plate narrow, oval, as long as sternum 5, and densely covered with long and stiff reddish-yellow setae.

Genitalia (Figs. 3–4): Trilobate, total length 0.50 mm. Parameres very wide and subsquare, with apices truncated (Fig. 3a), in dorsoapical view notched apically (Fig. 3b), broadly emarginate and curved inward in ventrolateral view (Fig. 4b); length 0.26 mm. Penis longer than parameres, in ventral view fingerlike, widened in basal half (Fig. 4a), length 0.30 mm, bearing a longitudinal lance-shaped sclerite along base which measures 0.18 mm in length; dorsal area of phallobase concave (Fig. 3a); ventral por-







Figs. 1–4. *Psephenops lupita.* 1, Details of head and pronotum showing mid-dorsal carina, dorsal view. 2, Detail of venter showing prosternal process. 3–4, Male genitalia. 3a, Dorsal view, showing phallobase and parameres. 3b, Microphotograph, dorsoapical view. 4a, Ventral view, showing long fingerlike penis widened in basal half. 4b, Microphotograph, ventrolateral view.

tion bulky, subcylindrical; length 0.20 mm, width 0.20 mm (Figs. 4a, b).

Female.—Unknown. (Apparently, females of this group larger and bulkier than males, but less frequently collected.)

Variation in paratype series.—Some specimens have reddish-brown elytra and in some the posterior margin of abdominal sternum 5 is not clearly convex at the middle. Measurements (in mm): total length of body, 3.75–3.85; maximum humeral width 1.65–1.80; length of pronotum 0.70–0.95, basal width 1.45–1.55; elytral length 2.60–2.70.

Discussion.—Males of *Psephenops lupita* may be distinguished from males of other species of the genus by the following combination of characters: Antenna filiform, elytra without conspicuous striae (moniliform in *P. mexicanus* and *P. maculicollis*, elytra with striae); pronotum and elytra without tubercles or protuberances (pronotum and elytra with tubercles and protuberances in *P. grouvellei*); tarsomeres 1–2 lobed, protibiae with denticle (tarsomeres 1-2-3 lobed, protibiae without denticle in *P. prestonae*); tarsomeres 1–2 lobed, elytra without conspicuous striae (promesotarsomeres 1–2 lobed, metatarsomere 1 lobed, elytra with striae in *P. haitianus*); antenna filiform 11-segmented, elytra without conspicuous striae, penis fingerlike (antenna 8-segmented, elytra with striae, penis lanceolate in *P. argentinensis*). Apparently, *Psephenops lupita* is most similar to *Psephenops mexicanus*, but the two may be distinguished by the following combination of characteristics (those of *P. mexicanus* in parentheses): Total length 3.75–3.85 mm (3.15–3.55 mm), maximum humeral length 1.65–1.80 mm (1.45–1.70 mm), antennae filiform (moniliform), segments 1–2 yellow (black); legs with coxae, trochanters and femora yellow (black), parameres very wide and subsquare in dorsal view (slender and subtriangular), penis in ventral view fingerlike, widened in basal half (apical half subtriangular, with a small lateral toothlike projection).

Type material.—Holotype ♂ labeled: "MEXICO, Veracruz, Coatepec, Municipality Coatepec, 1,200 m, bosque mesófilo de montaña, río "Huehueyapan", 2-IV-1999, R. Arce col."; Paratypes: same data as holotype (2 ♂); same locality 19-IV-2000 (3 ♂); 26-IV-01 (3 ♂); and Xico Viejo, Municipality of Xico 26-VII-1998 (1 ♂). Holotype and paratypes deposited at Colección Entomológica, Instituto de Ecología, A.C., Xalapa, Veracruz, México.

Etymology.—This species is dedicated to my beloved wife Guadalupe Gómez Mendiola; from spanish Guadalupe, diminutive "Guadalupita, "lupita."

Habitat.—Adult males of *Psephenops lupita* were captured in a stream with rapid water flow, on stones covered with moss and aquatic phanerogams.

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DYSMICOCCUS FERRIS AND SIMILAR GENERA (HEMIPTERA: COCCOIDEA: PSEUDOCOCCIDAE) OF THE GULF STATE REGION INCLUDING A DESCRIPTION OF A NEW SPECIES AND NEW UNITED STATES RECORDS

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Abstract.—A key to the species of *Dysmicoccus*, *Oracella*, and *Paradoxococcus* of the Gulf State Region is presented. ***Dysmicoccus radinovskyi*** **Miller and Miller**, n. sp., is described and illustrated from the adult female, third-instar female, and second-instar female. *Dysmicoccus merrilli* (Ferris) is a **new synonym** of *Dysmicoccus boninsis* (Kuwana). *Dysmicoccus grassii* (Leonardi), *Dysmicoccus mackenziei* Beardsley, and *Dysmicoccus neobrevipes* Beardsley represent new distribution records.

Key Words: mealybugs, Coccoidea, Pseudococcidae, Gulf State Region, new species, *Dysmicoccus*, *Oracella*, *Paradoxococcus*

Ferris (1950) described *Dysmicoccus* with the intention of making *Pseudococcus* a natural group. It appears that characters chosen by Ferris may have been less than successful in this endeavor since some authors (Beardsley 1966, Miller and McKenzie 1971) have questioned the monophyly of *Dysmicoccus*. *Dysmicoccus*, as currently understood, is characterized by having the following combination of characters: lack oral-rim tubular ducts; have 5 or fewer conical setae in the cerarii; have auxiliary setae in cerarii anterior of the anal lobe pair; and have 17 or fewer pairs of cerarii. The genus currently includes 110 species worldwide with 39 species occurring in the Nearctic Region (Ben-Dov and German 2001a, Ben-Dov, et al. 2001). Woody and herbaceous plants serve as hosts, including many grasses (Kosztarab 1996). Keys to species referable to the Nearctic Region have been provided by several authors including: Ferris (1950, 1953), McKenzie (1962, 1964, 1967), Miller and McKenzie (1973),Williams and Granara de Willink (1992), and Kosztarab (1996).

In the United States, five species are of economic concern: *Dysmicoccus boninsis* (Kuwana) on sugar cane, *Dysmicoccus vaccinii* Miller and Polavarapu on blueberries, *Dysmicoccus wistariae* (Green) on yews, and *Dysmicoccus brevipes* (Cockerell) and *Dysmicoccus grassii* (Leonardi) on many hosts including several economic plants.

Oracella is a monotypic genus containing *Oracella acuta* (Lobdell). As with *Dysmicoccus*, Ferris (1950) erected *Oracella* with the intent of making *Pseudococcus* a more natural group. *Oracella*, as currently understood, is characterized by having the following combination of characters: lack of oral-rim tubular ducts, with 2 conical setae in the cerarii, with auxiliary setae in cerarii anterior of the anal lobe pair, with dorsal and ventral multilocular pores, with few oral-collar tubular ducts, and with less than

17 pairs of cerarii. Although, there is some evidence that *Oracella* is congeneric with *Dysmicoccus*, we do not think it wise to consider them synonyms at this time, pending an analysis of the monophyly of the genus. However, we include *Oracella* here because of its similarities to *Dysmicoccus*. Occurring primarily in southeastern United States (Lobdell 1930, Ben-Dov 1994, Kosztarab 1996) on *Pinus* spp., *Oracella acuta* can reach pest levels following repeated pesticide applications (Clarke et al. 1992). *Oracella acuta* has been accidently introduced into China where it is a serious pest (Kosztarab 1996).

Paradoxococcus McKenzie is also a monotypic genus similar to *Dysmicoccus* with *Paradoxococcus mcdanieli* McKenzie (1962) as the type species. *Paradoxococcus* is characterized by having the following combination of characters: lack of oral-rim tubular ducts, with 2 conical setae in the cerarii, with auxiliary setae in cerarii anterior of the anal lobe pair, lack of multilocular pores, presence of large oral-collar tubular ducts, and with less than 10 pairs of cerarii.

The pupose of this paper is to provide a key to species of *Dysmicoccus*, *Oracella*, and *Paradoxococcus* of the Gulf State Region. In addition, a new species description and synonymies are also presented.

MATERIALS AND METHODS

The Gulf State Region, as defined in this paper, encompasses the U.S. states that contact the Gulf of Mexico including: Alabama, Florida, Louisiana, Mississippi, and Texas. Terminology follows that of Williams and Granara de Willink (1992) and Gimpel and Miller (1996) for adult females and immatures. Measurements were made with an ocular micrometer using a Nikon E600 compound microscope. Numbers and measurements of adult females are for 10 specimens and are given as an average followed by the range in parentheses. Holotype measurements and numbers are recorded separately in parentheses. Descriptions of third-instar females and the second-instar female are based on six and one specimens, respectively. Associated enlargements of various structures on the illustrations are not proportional. Depositories of specimens are: The Natural History Museum (BMNH), London, United Kingdom; Florida State Collection of Arthropods (FSCA), Gainesville, Florida; Museum National d'Histoire Naturelle (MNHN), Paris, France; University of California, Davis (UCD); National Museum of Natural History (USNM), Coccoidea Collection, Beltsville, Maryland. Information listed in the Specimens Examined section is verbatim from information recorded on the microscope slides. The abbreviation "ad." refers to adult specimens and "sl." refers to slide(s).

RESULTS

New Synonymy

While examining specimens and descriptions of species to be included in the key, we discovered that *Dysmicoccus merrilli* (Ferris) and *D. boninsis* (Kuwana) were remarkably similar. Each species has: (1) Cerarii that are restricted to the abdomen and have 1 or 2 on the head; (2) translucent pores that are present and abundant on the hind coxa and are absent or few on the tibia; and (3) oral-collar tubular ducts that are present over most of the dorsal surface, but are absent or greatly reduced in number on the first and eighth abdominal segments and on the metathorax. The only difference that we could find or mentioned in the literature was the shape of the circulus which is small and oval in *D. merrilli* and generally larger and more rectangular in many specimens of *D. boninsis*. However, after examining a long series of specimens it became apparent that *D. boninsis* occasionally has a small, oval circulus similar to the one in *D. merrilli*. The variable shape of the circulus on *D. boninsis* was illustrated by Williams and Watson (1988). Therefore, we consider *D. merrilli* (original combination *Trionymus* *merrilli* Ferris 1953) as a junior, subjective synonym of *D. boninsis* (original combination *Dactylopius* (*Pseudococcus*) *boninsis* Kuwana 1909), **new synonymy**.

New United States Records of Invasive Species

Through the courtesy of Avas B. Hamon, FSCA, we examined all *Dysmicoccus* specimens in the FSCA collection. Our examination confirmed Hamon's identifications and revealed two species for the Gulf State Region which are new records of distribution. *Dysmicoccus mackenziei* Beardsley is known from Mexico, Central America, Jamaica, and Italy (Ben-Dov and German 2001c). In the United States, it was previously known only from California on *Tillandsia punctulata* Schlecht. & Cham. (Beardsley 1965), an ornamental flowering plant. The Florida material represents a new eastern United States distribution record. Collection data for *D. mackenziei* is as follows: UNITED STATES: FLORIDA: Miami, 14-II-1985, D. Barger, on *Tillandsia* sp., (5 ad. ♀ on 5 sl.) FSCA; Tampa, Hillsborough, 28-XI-1988, C. Kamelhair, on *Tillandsia utriculata,* (3 ad. ♀ on 3 sl.) FSCA.

Dysmicoccus neobrevipes Beardsley has been recorded from many countries in the Neotropical Region and is known from southern Asia and the Pacific (Ben-Dov and German 2001d). *Dysmicoccus neobrevipes* feeds on many hosts of economic importance including various ornamental plants and food crops (Williams and Granara de Willink 1992). Originally described from Hawaii (Beardsley 1959), it has not been recorded from the continental United States until now. Therefore, this represents the first continental U.S. record. Collection data for *D. neobrevipes* is as follows: UNITED STATES: FLORIDA: Miami-Dade Co., Miami, 2-X-1978, P. Chobrda, on (?) *Furcraea* sp. (nr. *Agave* sp.), (3 ad. ♀ on 3 sl.) FSCA; 22-VIII-1985, L. D. Howerton, on *Yucca elephantipes* [= *Yucca guatemalensis*], (4 ad. ♀ on 4 sl.) FSCA; 9-X-1986, D. Leone et al., on *Agave desmettiana,* (4 ad. ♀ on 4 sl.) FSCA; Orange Co., Apopka, 15-XI-1983, P. Gibson, on *Yucca elephantipes* [= *Yucca guatemalensis*], (2 ad. ♀, 4 third-instar ♀ on 6 sl.) FSCA; 16-II-1984, C. Phelps, on *Yucca* sp., (3 ad. ♀ on 3 sl.) FSCA; 9-IV-1990, A. Capitano, on *Agave angustifolia,* (2 ad. ♀ on 2 sl.) FSCA.

Additionally, specimens identified as *Dysmicoccus grassii* (Leonardi) (= *Dysmicoccus alazon* Williams) were also present in the USNM collection. Previously known from Nigeria, much of the Neotropical Region, Sicily, and the Canary Islands (Ben-Dov and German 2001b), records of *D. grassii* represent new distribution data for the United States. Collection data for *D. grassii* are as follows: UNITED STATES: FLORIDA: Brevard Co., Cocoa Beach, 22-V-1970, J. MacGowan, on *Coccoloba* sp., (1 ad. ♀) USNM; Collier Co., Marco, 30-IV-1975, R. F. Denno, J. A. Davidson, and D. R. Miller, on *Coccoloba* sp., (1 ad. ♀) USNM; Dade Co., Key Biscayne, 12-I-1966, S. Nakahara, on *Coccoloba uvifera,* (1 ad. ♀) USNM; Cape Florida State Park, Crandon Pk., Key Biscayne, 8-XII-1970, S. Nakahara, on *Coccoloba uvifera,* (7 ad. ♀ on 2 sl.) USNM; Key Biscayne, 4-IV-1974, R. F. Denno and D. R. Miller, on *Coccoloba* sp., (6 ad. ♀ on 3 sl.) USNM; Matheson Hammock Pk., 4-IV-1974, R. F. Denno and D. R. Miller, on *Rhizophora* sp., (1 ad. ♀) USNM; Lake just N. of Mahogony Hammock, 9-IV-1974, D. R. Miller and R. F. Denno, on *Persea borbonia,* (1 ad. ♀) USNM; Adams Key, 24-II-1977, D. R. Miller, on *Coccoloba diversifolia,* (1 ad. ♀) USNM; Miami Lakes, 26-IV-1977, M. Corman, on *Callistemon citrinus,* (1 ad. ♀) USNM; Indian River Co., nr. Orchid, 8-V-1975, R. F. Denno, J. A. Davidson, and D. R. Miller, on *Coccoloba uvifera,* (3 ad. ♀ on 2 sl.) USNM; Monroe Co., 19-VI-1969, D. Simberloff, on *Rhizophora mangle,* (3 ad. ♀ on 3 sl.) USNM; Key Largo, 3 mi. N. Jct. Hghy 1 and 905, 5-IV-1974, R. F. Denno and D. R. Miller, on *Ficus* sp., (1 ad. ♀) USNM; Key Largo nr. N. end, 8-IV-1974, R. F. Denno and D. R. Miller, on *Lys-*

iloma latisiliquum, (7 ad. ♀ on 4 sl.) USNM; Sarasota Co., Osprey, 17-V-1971, C. J. Bickner, on *Codiaeum* sp., (1 ad. ♀) USNM.

Material determined as *Dysmicoccus bispinosus* Beardsley is also present in the collections of FSCA and USNM. We suspect that current concepts of this species are too broad and anticipate that Florida specimens will eventually be discovered to be one or more different species. Therefore, this taxon is not treated here.

Key to Species of *Dysmicoccus* *Oracella*, and *Paradoxococcus* of the Gulf States Region (Adult Females)

1 Circulus present 2
– Circulus absent 11
2(1) With 17 pairs of cerarii 3
– With less than 17 pairs of cerarii 8
3(2) Body setae normally not more elongate on dorsomedial area of abdominal segment 8 than on other areas of dorsum 4
– Body setae on dorsomedial area of abdominal 8 conspicuously longer than on other areas of dorsum . . . . *Dysmicoccus brevipes* (Cockerell)
4(3) Dorsal body setae short, longest seta on dorsum of abdominal segment 8 less than ½ width of anal ring 5
– Dorsal body setae long, longest seta on dorsum of abdominal segment 8 more than ½ width of anal ring . . . . *Dysmicoccus morrisoni* (Hollinger) (in part)
5(4) Abdominal cerarii predominantly each with 2 conical setae 6
– Abdominal cerarii predominantly each with more than 2 conical setae 7
6(5) Cluster of oral-collar tubular ducts present laterad of anterior spiracles; ventral abdominal multilocular pores present on segments 4–8 (occasionally absent from segment 4) . . . . *Dysmicoccus grassii* (Leonardi)
– Cluster of oral-collar tubular ducts absent laterad of anterior spiracles; ventral abdominal multilocular pores present on segments 6–8 . . *Dysmicoccus texensis* (Tinsley)
7(5) Hind coxa with translucent pores; opening of largest oral-collar tubular ducts approximately equal to diameter of multilocular pores . . *Dysmicoccus mackenziei* Beardsley
– Hind coxa without translucent pores; opening of largest oral-collar tubular ducts less than diameter of multilocular pores . . . . *Dysmicoccus neobrevipes* Beardsley
8(2) Dorsal oral-collar ducts absent from abdomen and thorax; translucent pores absent from hind coxa 9
– Dorsal oral-collar ducts present on abdomen and thorax; translucent pores present on hind coxa . . . . *Dysmicoccus boninsis* (Kuwana)
9(8) Abdominal cerarii each predominantly with more that 2 conical setae . . . . *Dysmicoccus difficilis* (Lobdell)
– Abdominal cerarii each with 2 or fewer conical setae 10
10(9) Multilocular pores present on dorsum; discoidal pores absent near eyes . . . . *Oracella acuta* (Lobdell)
– Multilocular pores absent from dorsum; discoidal pores present near eyes . . . . *Dysmicoccus morrisoni* (Hollinger) (in part)
11(1) With 17 pairs of cerarii 12
– With fewer than 17 pairs of cerarii . . . 14
12(11) Oral-collar tubular ducts forming continuous ventral row across medial area of abdominal segment 5 13
– Oral-collar tubular ducts on medial area of ventral abdominal segment 5 either entirely absent or not forming continuous row . . . . *Dysmicoccus lasii* (Cockerell)
13(12) Oral-collar tubular ducts forming continuous ventral row across medial area of abdominal segment 6; apical antennal segment either partially or completely divided; oral-collar tubular duct orifices smaller than diameter of trilocular pore . . . . *Dysmicoccus radiuovskyi* Miller and Miller, n. sp.
– Oral-collar tubular ducts on medial area of abdominal segment 6 either entirely absent or not forming continuous row; apical antennal segment undivided; oral-collar tubular duct orifices larger than diameter of trilocular pore . . . . *Dysmicoccus diodium* (McConnell)
14(11) Multilocular pores absent; with less than 8 pairs of cerarii . . . . *Paradoxococcus mcdanieli* McKenzie
– Multilocular pores present; with more than 8 pairs of cerarii 15
15(14) Abdominal cerarii each predominantly with more that 2 conical setae; with 13 or fewer pairs of cerarii . . . . *Dysmicoccus obesus* (Lobdell)
– Abdominal cerarii each predominantly with 2 conical setae; with 15 or more pairs of cerarii . . . *Dysmicoccus milleri* Kosztarab

Dysmicoccus radinovskyi Miller and Miller, new species

(Figs. 1–3)

Suggested Common Name: Dr. Rad's Mealybug

Holotype.—An adult female holotype is hereby designated with left label "HOLOTYPE *Dysmicoccus radinovskyi* Miller & Miller"; right label "Dade Co., Fla. Everglades Nat. Park 18 X 1972 W.H. Pierce on *Psychotria undata*"[= *Psychotria nervosa*] (USNM). All specimens listed in the Specimens Examined section are paratypes except for the holotype.

Etymology.—This species is named in honor and memory of Millersville University of Pennsylvania biology professor, Dr. Syd Radinovsky, better known to his students as "Dr. Rad." In his 34 years at Millersville University, Dr. Rad's enthusiasm for the biological sciences was unparalleled. His support for students was without equal. A field biologist in the true sense, Dr. Rad loved to talk about and visit unique habitats. It is fitting that the type localities of *D. radinovskyi* are from some of Dr. Rad's beloved unique habitats: South Florida, the Everglades, and the Florida Keys.

ADULT FEMALE

(Fig. 1)

Field features.—Body white, covered with mealy wax. Mealybugs adhere to roots of *Psychotria* plants when pulled up; usually found on roots of *Psychotria* growing as understory in hammocks along barrier islands of east central Florida (K. Hibbard, personal communication).

Slide-mounted characters.—Body 1.08 (1.00–1.21) mm long (holotype 1.02 mm), 0.75(0.64–0.92) mm wide (holotype 0.80 mm)

Dorsum with 17 pairs of cerarii (Fig. 1O); cerarii 1–11 and 13–14 with 2 conical setae; cerarii 12, 15, with 3(2–3) conical setae (holotype 3); cerarii 16–17 with 3 (3–4) conical setae (holotype 3–4); all with auxiliary setae and associated trilocular pores. Anal-lobe cerarius (Fig. 1I) with 3(1–4) auxiliary setae (holotype 3) (Fig. 1J), 2 conical setae (holotype 2) (Fig. 1K), 20(18–24) trilocular pores (holotype 18) (Fig. 1L), 2(1–4) discoidal pores (holotype 3) (Fig. 1M). Multilocular pores absent; trilocular pores (Fig. 1N) scattered nearly evenly over surface; discoidal pores present, about μ diameter of trilocular pore. Oral-collar tubular ducts absent. Longest submedial seta on segment VII 18(13–25) μ long (holotype 25 μ); 4 submedial setae on segment VIII, longest seta 19(13–28) μ long (holotype 28 μ).

Anal-ring seta 100(88–113) μ long (holotype 100 μ); 1.5(1.2–1.6) (holotype 1.6) times as long as width of anal ring.

Venter with multilocular pores (Fig. 1G) usually in posterior and anterior bands on segments VI-VII and restricted to posterior band on segment VIII, occasionally with 1 or 2 pores on posterior margin of segments V; occasionally with 1 multilocular pore near base of pro- and mesocoxa. Trilocular pores scattered throughout. Discoidal pores common, of same size as on dorsum. Oral-collar tubular ducts of 1 size (Fig. 1F), orifice smaller than diameter of trilocular pore, present in medial and mediolateral areas of abdominal segments III-VII, few ducts near coxae. Setae as follows: 4 cisanal (Fig. 1H), longest 39(30–45) μ long (holotype 45 μ); longest anal-lobe seta 119(105–130) μ long (holotype 113 μ); longest seta on hind trochanter 82(63–88) μ long (holotype 78 μ).

Circulus absent. Labium 129(113–143) μ long (holotype 133 μ). Antennae 7–8 segmented with apical segment partially or fully subdivided (Fig. 1A), 273(263–288) μ long (holotype 263 μ). Eye with associated discoidal pore (Fig. 1B). Legs with translucent pores restricted to hind femur and tibia, ventral surface (when leg is lying flat as shown in illustration) without pores, dorsal surface of femur (Fig. 1D) with 18(12–22) pores (holotype 12), dorsal surface of tibia (Fig. 1D) with 15(12–18) pores (holotype 12). Hind femur 137(130–142) μ

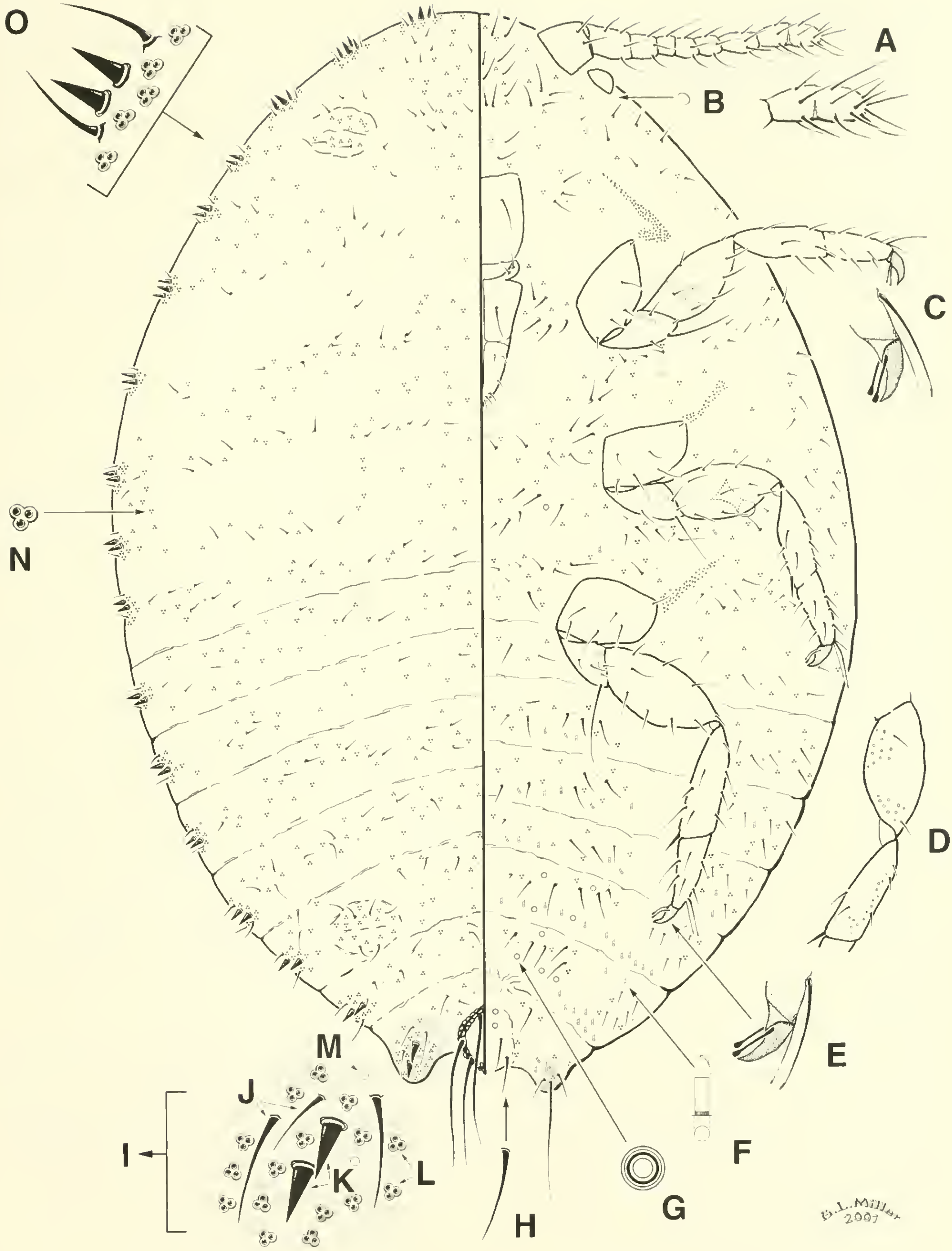

Fig. 1. Adult female of *Dysmicoccus radinovskyi.* A, Antenna and detail of terminal segment; B, Discoidal pore near eye; C, Tarsal claw and digitules of fore leg; D, Dorsal surface translucent pores of femur and tibia; E, Detail of tarsal claw and digitules of hind leg; F, Oral-collar tubular duct; G, Multilocular pore; H, Cisanal seta; I, Anal-lobe cerarius; J, Auxiliary seta; K, Cerarian seta; L, Trilocular pore; M,. Discoidal pore; N, Trilocular pore; O, Cerarius.

long (holotype 130 μ); hind tibia 121(113–138) μ long (holotype 115 μ); hind tarsus 81(75–88) μ long (holotype 80 μ). Tibia/tarsus 1.5(1.3–1.7) (holotype 1.4); femur/tarsus 1.7(1.6–1.8) (holotype 1.6). Length of hind femur divided by greatest width of hind femur 2.4(2.1–2.9) (holotype 2.9). Hind tibia with 14(12–16) setae (holotype 14). Claw digitules on all legs clubbed, approximately same size. Tarsal digitules on hind 2 pairs of legs clubbed, each tarsus with 1 digitule noticeably longer and with club slightly larger than other (Fig. 1E); tarsal digitules on front pair of legs of 2 different sizes and shapes, 1 digitule clubbed and robust, other digitule without club, slender (Fig. 1C).

Notes.—The above description is based on 124 specimens from 17 localities. *Dysmicoccus radinovskyi* is unusual with the terminal antennal segment being either entirely or partially subdivided, the circulus is absent, and the oral-collar tubular ducts are of 1 size. This species is close to *D. diodium* but differs by the diameter of the oral-collar tubular ducts which are smaller than the diameter of trilocular pores (*D. diodium* has oral-collar tubular ducts larger than the diameter of trilocular pores), the oral-collar tubular ducts forming a continuous row across the medial area of ventral abdominal segment 6 (*D. diodium* either lacks oral-collar tubular ducts or only has a few scattered oral-collar tubular ducts in the medial area of ventral abdominal segment 6), and the subdivided terminal antennal segment (*D. diodium* does not have a subdivided terminal antennal segment).

The adult female can be distinguished from the third and second instars by having multilocular pores, translucent pores on hind femur and tibia, and a vulva.

Third-instar Female
(Fig. 2)

Slide-mounted characters.—Body 0.74 (0.69–0.80) mm long, 0.43(0.40–0.48) mm wide.

Dorsum with 17 pairs of cerarii; cerarii 1–11, 13–14, and 16 with 2 conical setae; cerarii 12, 15, 17 with 3(2–3) conical setae; all with auxiliary setae. Anal-lobe cerarius with 1(1–3) auxiliary setae, 2 conical setae, 15(13–17) trilocular pores, 1 discoidal pore. Multilocular pores absent; trilocular pores scattered nearly evenly over surface; discoidal pores present, about ⅓ diameter of trilocular pore. Oral-collar tubular ducts absent. Longest submedial seta on segment VII 13(10–15) μ long; 2 submedial setae on segment VIII, longest seta 13(10–15) μ long.

Anal-ring seta 87(78–100) μ long; 1.6(1.5–1.8) times as long as width of anal ring.

Venter without multilocular pores; trilocular pores scattered throughout. Discoidal pores scarce, of same size as on dorsum. Oral-collar tubular ducts uncommon, one size, present anterior to clypeus and lateral mesothorax. Setae as follows: 4 cisanal, longest 25(15–35) μ long; longest anal-lobe seta 95(92–98) μ long; longest seta on hind trochanter 67(66–70) μ long.

Circulus absent. Labium 108(98–113) μ long. Antennae 6-segmented, 227(213–237) μ long. Legs without translucent pores. Hind femur 111(105–118) μ long; hind tibia 88(83–93) μ long; hind tarsus 77(75–80) μ long. Tibia/tarsus 1.1(1.1–1.2); femur/tarsus 1.4(1.4–1.5). Length of hind femur divided by greatest width of hind femur 2.8(2.6–3.0). Hind tibia with 9(9–10) setae. Claw and tarsal digitules same as adult female.

Notes.—The above description is based on 5 specimens from 3 localities. The third-instar female can be distinguished from all other instars by its 6-segmented antennae, absence of mutilocular pores, and 13–17 trilocular pores on anal-lobe cerarii.

Second-instar Female
(Fig. 3)

Slide-mounted characters.—Body 0.56 mm long, 0.31 mm wide.

Dorsum with 17 pairs of cerarii although some cerariian setae are not distinct from

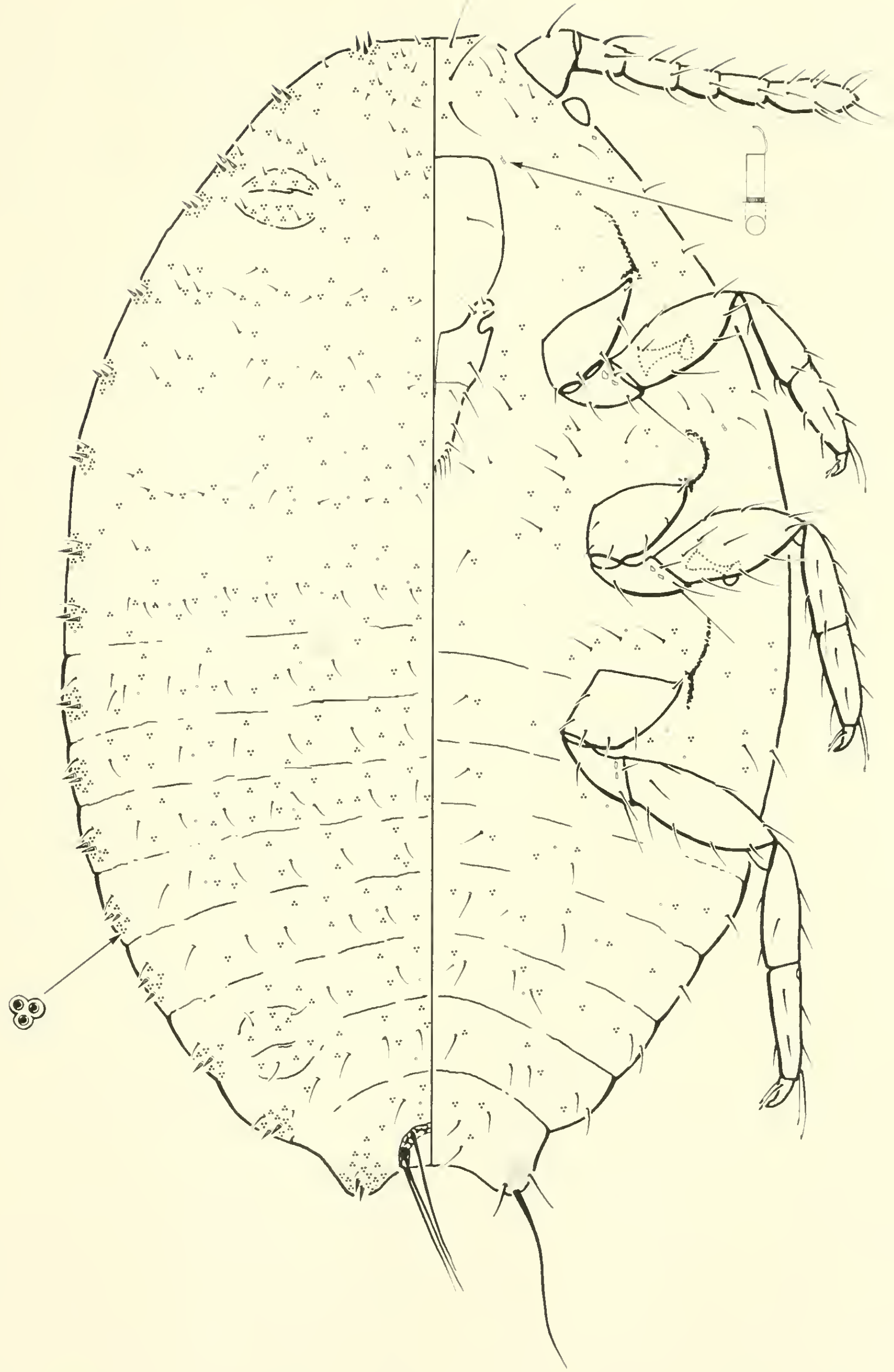

Fig. 2. Third-instar female of *Dysmicoccus radinovskyi.*

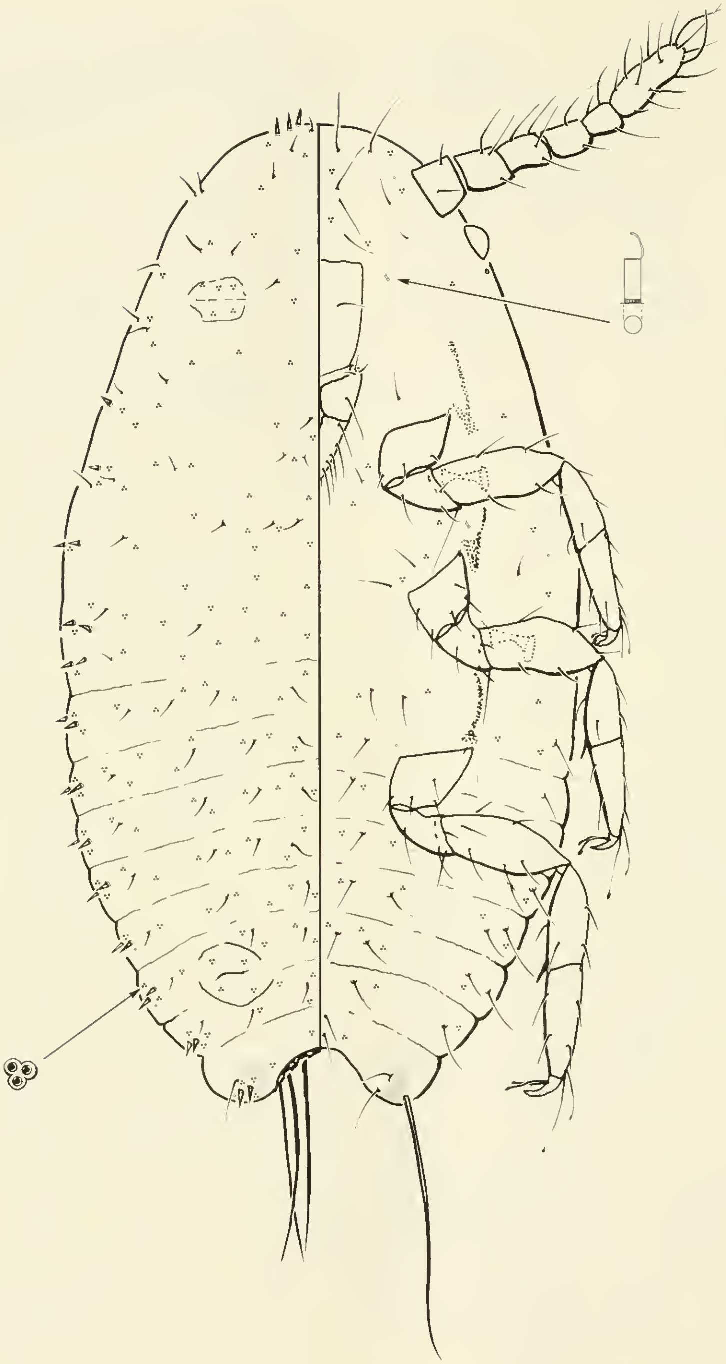

Fig. 3. Second-instar female of *Dysmicoccus radinovskyi*.

auxiliary setae; cerarii 1–7, with 2 distinct conical setae; cerarius 17 with 3 conical setae; all with auxiliary setae. Anal-lobe cerarius with 1 auxiliary seta, 2 conical setae, 7 trilocular pores, 1 discoidal pore. Multilocular pores absent; trilocular pores scattered nearly evenly over surface; discoidal pores about μ diameter of trilocular pore. Oral-collar tubular ducts absent. Longest submedial seta on segment VII 5 μ long; submedial setae absent on segment VIII.

Anal-ring seta 63 μ long; 1.6 times as long as width of anal ring.

Venter without multilocular pores; trilocular pores scattered throughout. Discoidal pores scarce, of same size as on dorsum. Oral-collar tubular ducts uncommon, one size, present lateral to clypeus and lateral mesothorax. Setae as follows: 4 cisanal, longest 23 μ long; longest anal-lobe seta 80 μ long; longest seta on hind trochanter 50 μ long.

Circulus absent. Labium 75 μ long. Antennae 6-segmented, 175 μ long. Legs without translucent pores. Hind femur 80 μ long; hind tibia 63 μ long; hind tarsus 63 μ long. Tibia/tarsus 1.0; femur/tarsus 1.3. Length of hind femur divided by greatest width of hind femur 2.6. Hind tibia with 9 setae. Claw and tarsal digitules same as adult female.

Notes.—The above description is based on 1 specimen from 1 locality. The second-instar female can be distinguished from all other instars by its 6-segmented antennae, absence of multilocular pores, and 5 trilocular pores on anal-lobe cerarii.

SPECIMENS EXAMINED

Paratypes.—UNITED STATES: FLORIDA: Brevard Co.: Florida Beach, S. side of Mullett Creek Rd., 26-II-2001, K. Hibbard, on *Psychotria nervosa* (28 ad. ♀, 1 second-instar ♀ on 6 sl.) BMNH, MNHN, UCD, USNM; Broward Co.: Ft. Lauderdale, 4-X-1982, M. McDonald, on *Psychotria nervosa* (3 ad. ♀ on 3 sl.) FSCA; 3-XI-1987, T. Phillips, on *Psychotria* sp. (2 ad. ♀ on 2 sl.) FSCA; Charlotte Co.: 3 mi. E. Punta Gorda, 21-XI-1980, Z. Smith, on *Psychotria* sp.[?] (3 ad. ♀ on 3 sl.) FSCA; Collier Co.: Collier Seminole State Pk., Juct. of 92 and 41, 11-IV-1974, D. R. Miller and R. F. Denno, on *Psychotria* sp. (6 ad. ♀, 2 3rd ♀ on 4 sl.) FSCA, USNM; Miami-Dade Co.: Miami, 31-VIII-1972, P. Pullara, on *Psychotria nervosa* (1 ad. ♀) FSCA; Everglades Nat. Park, 18-X-1972, W. H. Pierce, on *Psychotria nervosa* (3 ad. ♀, 1 3rd ♀ on 4 sl.) FSCA, USNM; Miami, 29-IX-1972, W. H. Pierce, on *Psychotria nervosa* (2 ad. ♀ on 2 sl.) FSCA,USNM; 31-IX-1972, W. H. Pierce, on *Psychotria nervosa* (1 ad. ♀) FSCA; on coast east of Perrina, 4-IV-1974, R. F. Denno and D. R. Miller, on *Psychotria nervosa* (9 ad. ♀ on 4 sl.) FSCA,USNM; lake just N. of Mahogany Hammock, 9-IV-1974, D. R. Miller and R. F. Denno, on crinkle leaf—*Psychotria* sp. (7 ad. ♀ on 4 sl.) FSCA, USNM; N. Miami Beach, 5-VI-1986, D. Gruber and L. Davis, (3 ad. ♀ on 3 sl.) FSCA; Indian River Co.: nr. Orchid, 8-V-1975, R. F. Denno, J. A. Davidson, and D. R. Miller, on *Psychotria* sp. (4 ad. ♀ on 2 sl.) USNM; Orchid, 1.7 mi. N. of S.R. 510 on N. Jungle Tr., 23-II-2001, K. Hibbard, on *Psychotria nervosa* (42 ad. ♀, 2 3rd ♀ on 7 sl.) USMN; Manatee Co.: Ellenton, 15-I-1980, J. Felty and Z. Smith, on *Psychotria nervosa* (3 ad. ♀ on 3 sl.) FSCA, USNM; Monroe Co.: Key Largo, 8-IV-1974, D. R. Miller and R. F. Denno, on *Psychotria* sp. (8 ad. ♀ on 4 sl.) FSCA,USNM; 25 mi. west of 41 intersection of 94, 10-IV-1974, R. F. Denno and D. R. Miller, on *Psychotria* sp. (3 ad. ♀ on 3 sl.) FSCA,USNM; Palm Beach Co.: West Palm Beach, 16-I-1967, N. Bezona, on *Psychotria nervosa* (2 ad. ♀ on 2 sl.) FSCA; St. Lucie Co.: Port St. Lucie, 25-X-1982, K. Hibbard, on *Psychotria nervosa* (2 ad. ♀ on 2 sl.) FSCA; White City, 7-X-1982, K. Hibbard, on *Psychotria nervosa* (2 ad. ♀ on 2 sl.) FSCA.

CONCLUSIONS

With the description of *D. radinovskyi*, a total of 12 species of the genus are known from the Gulf State Region of the United States. Newly published records of *D. grassii, D. mackenzii* and *D. neobrevipes* alert economic entomologists to the presence of three new pest species either in Florida or the continental United States.

Acknowledgments

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THE *CERACANTHIA* COMPLEX (LEPIDOPTERA: PYRALIDAE: PHYCITINAE) IN COSTA RICA. II. *MEGARTHRIA* RAGONOT, *DRESCOMA* DYAR, AND *LASCELINA* HEINRICH

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Abstract.—The genera *Megarthria* Ragonot, *Drescoma* Dyar, and *Lascelina* Heinrich are redescribed. *Amegarthria* Neunzig and Dow and *Megacerdresa* Neunzig are **newly synonymized** with *Megarthria* and *Lascelina*, respectively. One species of *Megarthria*, two species of *Drescoma*, and three species of *Lascelina* are recognized in Costa Rica. Two species are described as new: ***Lascelina papillina*** and ***Lascelina pitilla***. *Megacerdresa cordobensis* Neunzig is given the **new combination** *Lascelina cordobensis* (Neunzig). *Megarthria cervicalis* Dyar is a **new junior synonym** of *Megarthria peterseni* (Zeller). Keys are provided for males of *Drescoma* and *Lascelina*. Habitus photographs of male adults, line drawings of most male antennae and male genitalia of all species, are included. Also figured are the female genitalia of four of the six species, the forewing and hindwing of *Drescoma cyrdipsa*, and the costa of the forewing of *Megarthria peterseni*.

Key Words: Phycitinae, taxonomy, Neotropical

This second paper treating the *Ceracanthia* complex, a common, mostly Neotropical group within the subfamily Phycitinae in Costa Rica, deals with the genera *Megarthria* Ragonot, *Drescoma* Dyar, and *Lascelina* Heinrich. In Part I (Neunzig and Solis 2002), we revised *Ceracanthia* Ragonot, the largest genus in the complex. Information relative to the contributions of early workers, an overview of the salient diagnostic features of members of the complex, and a key to genera can be found in Part I. Specimens studied for Part II came from the following sources: Instituto Nacional de Biodiversidad, Santo Domingo, Costa Rica (INBio); North Carolina State University Entomology Museum, Raleigh, N. C., U.S.A. (NCSU); National Museum of Natural History, Smithsonian Institution, Washington, D. C., U.S.A. (USNM); The Natural History Museum, London, England (BMNH); and the collection of Vitor O. Becker, Brasilia, Brazil (VOB).

Megarthria Ragonot

Megarthria Ragonot 1893:156. Type species: *Myelois peterseni* Zeller 1881. Original designation.

Amegarthria Neunzig and Dow 1993:42. **New synonymy.** Type species: *Megarthria cervicalis* Dyar 1919, here considered a synonym of *Myelois peterseni* Zeller 1881. Original designation.

Note.—The genus *Amegarthria* was proposed by Neunzig and Dow (1993) because of major differences they found between

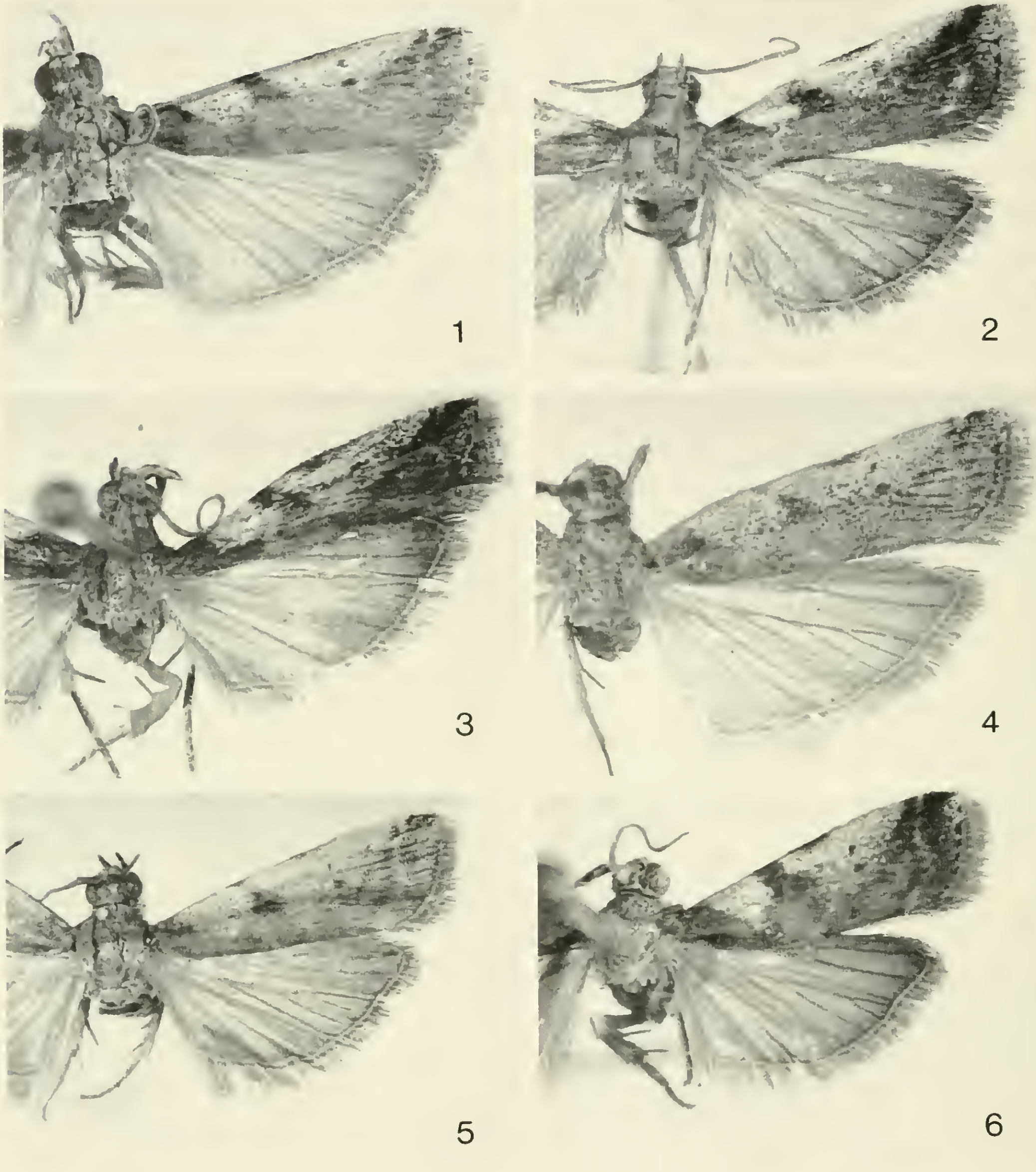
Megarthria cervicalis Dyar and other species placed by Heinrich (1956) in his concept of *Megarthria*. However, our present study, which included an examination of Zeller's types in the BMNH and a more thorough review of the literature, has shown that Heinrich misidentified the type species of Ragonot's *Megarthria*. Heinrich erroneously selected a species belonging to the related genus *Ceracanthia* Ragonot (additional information regarding this *lapsus* by Heinrich is given herein under "Remarks" following the treatment of *Megarthria peterseni*). The actual type species of *Megarthria* is identical to the type species of *Amegarthria*, and, therefore, *Amegarthria* is a junior synonym of *Megarthria*.

Description.—Antenna of male with scape large (about 3× as wide as width of base of shaft); shaft strongly bent outward near its attachment to scape forming a short, strongly curved sinus; sinus without spines marking its basal and upper limits; inner surface of sinus covered with appressed scales; very small triangular tuft of scales attached to posterior base of sinus; sensilla trichodea (cilia) of antenna abundant, about as long as width of shaft at midsinus. Antenna of female simple. Labial palpus of male upturned, extending above vertex; 3rd segment about as long as 2nd segment. Maxillary palpus of both sexes small, short scaled. Haustellum well developed. Ocellus present. Forewing of male with peculiar, small, hood-shaped, basal, costal prominance (Fig. 25), and associated costal fold; underside of wing with subcostal streak of brownish-red scales; forewing of both sexes smooth, with 11 veins; R_{3+4} and R_5 stalked for about ½ their lengths, M_1 straight; M_2 and M_3 separate; CuA_1 arises from lower angle of cell; CuA_2 arising well before lower angle of cell. Hindwing with eight veins (1A, 2A, 3A together treated as one vein); $Sc+R_1$ and Rs fused for less than ½ their lengths beyond cell; CuA_1 short stalked to M_2 and M_3; CuA_2 arises from just before outer angle of cell; cell less than ½ length of wing. Male abdominal segment 8 with small tuft, consisting of broadly flattened and contorted scales (digitate pocket from sternite of segment 8 strongly bent and flattened). Male genitalia with uncus small relative to other genitalic structures; gnathos with weakly developed medial, hooklike element (fused with scaphium except for broadly swollen apex); transtilla present, consisting of a thin rectangular plate; juxta platelike with slender, seta-bearing lateral arms; valva broad, covered on inner surface with slender setae (without broadened spinelike setae on distal half); sacculus with apex a small, slender hooked, fingerlike process lying above a broad squared-off element, base of sacculus with three pair of ventral scale tufts (largest pair consisting of broad, tightly-coiled scales); aedoeagus long and slender, vesica of aedoeagus with small, semi-oval, sclerotized plate and patch of microspines; vinculum broad (about as long as greatest width) and evenly rounded posteriorly. Female genitalia with ductus bursae long, slender, twisted, with microspines within lower ⅓; corpus bursae short, oval, slightly less than ½ as long as ductus bursae; microspines, similar to those in ductus bursae, extending for a short distance into corpus bursae; ductus seminalis attached to corpus bursae near junction of ductus bursae and corpus bursae.

Megarthria peterseni (Zeller)
(Figs. 1, 7, 12–13, 25–26)

Myelois peterseni Zeller 1881:198.
Megarthria cervicalis Dyar 1919:42. **New synonymy.**
Megarthria beta Heinrich 1956:88.

Identifying features can be seen easily in the unusual male antenna (Fig. 7) (in which the shaft is strongly bent outwardly near its attachment to a large, broad scape), the peculiar, small hood-shaped, costal prominence at the base of the forewing (Fig. 25), the coiled scales at the base of the sacculus (Fig. 12), and the twisted, long (about 2× length of corpus bursae) ductus bursae (Fig.

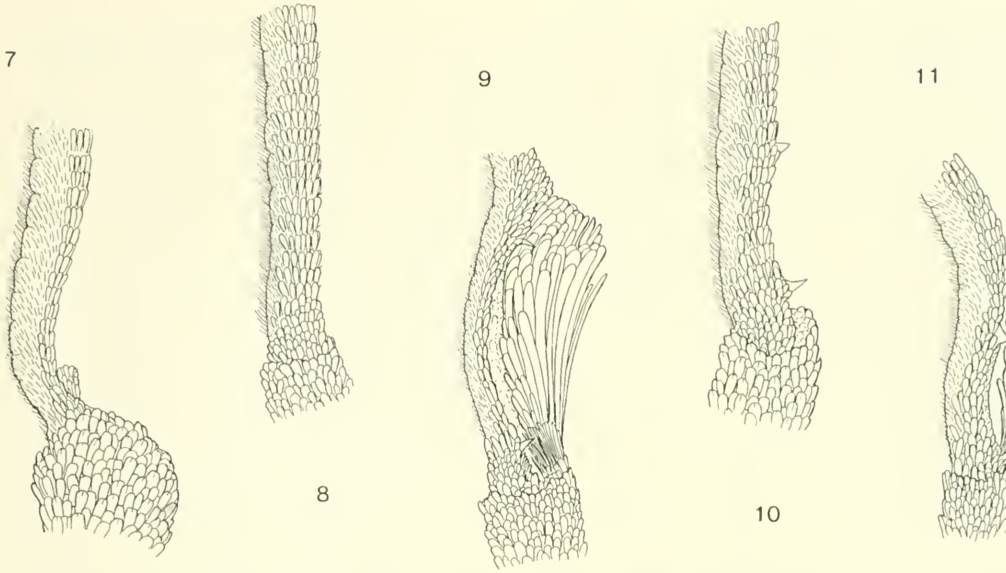


Figs. 1–6. Males, dorsal view. 1, *Megarthria peterseni*. 2, *Drescoma cyrdipsa*. 3, *Drescoma cinilixa*. 4, *Lascelina cordobensis*. 5, *L. pitilla*. 6, *L. papillina*.

26). Additional diagnostic features are included under the description of the genus.

Costa Rican material examined.—San José, (no date on label), H. Schmidt (1 ♀); Rancho Quemado, 200 m., Peninsula de Osa, Provincia Puntarenas, October, 1992, F. Quesada, INBio CR I000945014 (1 ♂).

Other material examined.—Cuba, Tanamo, August (1 ♂; holotype of *Megarthria cervicalis* Dyar in USNM); Mexico, Jalapa, (no date on label), W. Schaus (1 ♀), Orizaba, March (no year on label), R. Muller (1 ♀; holotype of *Megarthria beta* Heinrich in USNM); Belize, 1000 Foot Falls, Mountain Pine Ridge, May, June, 1990, L. C. Dow (4 ♂, 3 ♀); Guatemala, February,



Figs. 7–11. Basal part of right male antenna, frontal view. 7. *Megarthria peterseni*. 8. *Drescoma cyrdipsa*. 9, *Lascelina cordobensis*. 10, *L. pitilla*. 11, *L. papillina*.

May, October, W. Schaus & W. Barnes (1 ♂, 2 ♀); Panama, Porto Bello, May, 1912, A. Busck (2 ♀), Las Cumbres, 1971, M. Daykin (1 ♂); Columbia, Honda, (no date on label), Petersen (1 ♂; lectotype of *Myelois peterseni* Zeller in BMNH); Trinidad, Caparo, (no date on label), F. Birch (1 ♀); Brazil, Rondônia, Porto Velho, April, May, 1989, V. O. Becker (1 ♂, 1 ♀).

Remarks.—Heinrich (1956), apparently, did not look at the syntypes of *Myelois peterseni*. He stated "I have seen no specimens from Colombia" (the type locality). He, also, did not carefully read the description of *peterseni* in Ragonot's 1893 publication. Heinrich's description and figures purported to be *Megarthria peterseni* are of a species described as new in the genus *Ceracanthia* in our Part I (Neunzig and Solis 2002). Particularly unfortunate was Heinrich's erroneous statement in reference to the specimens upon which he based his description and figures, that "the males before me . . . agree in antennal characters with the type of *peterseni* as described by Ragonot." Heinrich described, and his figure 279 illustrated, a male antenna with prominent spines associated with a sinus in the shaft. In actuality, no mention was made by Ragonot (1893) of a spined sinus. Ragonot stated that the distinctive feature of *peterseni* is the large scape that is swollen distally (". . . *l'article basilaire, qui est long, très gros, dilaté au sommet.*" (pp. 156–157)). Indeed, Ragonot based his genus name, *Megarthria* (large-joint) on this feature of the scape.

It also should be pointed out that the original description of *peterseni* by Zeller (1881) did not mention spines on the antenna, although he included similar features in his 1881 descriptions of the antennae of other new species having these structures. In addition, Zeller's fig. 20 of the forewing of *peterseni* agrees more closely with Fig. 1 of the present paper than with fig. 2 in Part I of our study.

HHN has examined Zeller's syntypes of *Myelois peterseni* in the BMNH. There are two males and five females each with a green label on which is written "Myelois peterseni Z. Honda pet." and a white label with "Zell. Coll. 1884." A male that agrees with Zeller's and Ragonot's description is here selected as lectotype in order to fix the identity of *Megarthria peterseni.* A red label with "LECTOTYPE peterseni Zeller, Neunzig and Solis" has been added to this specimen. Zeller's other male syntype in the BMNH is a specimen of *Drescoma cyrdipsa* Dyar.

The holotype of *Megarthria cervicalis* Dyar in the USNM is the same species as the newly designated lectotype of *Myelois peterseni* Zeller, and, therefore, *Megarthria cervicalis* has been made a junior synonym of *Megarthria peterseni. Megarthria beta* Heinrich was synonymized with *cervicalis* by Neunzig and Dow in 1993.

Drescoma Dyar

Drescoma Dyar 1914:328. Type species: *Drescoma cyrdipsa* Dyar 1914. Original designation.

Description.—Antenna of male simple (with slender scape and without sinus, spines, and/or scale tufts); sensilla trichodea (cilia) abundant, about ⅓ as long as width of shaft near base. Antenna of female simple. Labial palpus of male upturned, reaching above vertex, 3rd segment almost as long as 2nd segment. Maxillary palpus small, short-scaled. Haustellum well developed. Ocellus present. Forewing of male with costal concavity in basal half of wing; forewing of both sexes smooth, with 11 veins; R_{3+4} stalked for over ½ their length; M_1 straight; M_2 and M_3 separate; CuA_1 arises from lower angle of cell; CuA_2 arising before lower angle of cell. Hindwing of male with costal concavity in basal ½ of wing; underside with subcostal patches or streaks of contrastingly colored scales and with anal fold and associated scale pencil; hindwing of both sexes with eight veins (1A, 2A, and 3A together treated as one vein); $Sc+R_1$ and Rs fused for less than ½ their lengths beyond cell; M_1 slightly concave; stalk of $Sc+R_1+Rs+M_1$ angularly bent just beyond base; M_2 and M_3 fused for over ½ their lengths beyond cell; CuA_1 short stalked to M_2 and M_3; CuA_2 arises from lower angle of cell; cell about ⅓ length of wing. Male abdominal segment 8 without tuft (digitate pocket from sternite of segment 8 simple). Male genitalia with uncus broadly rounded apically; gnathos with distomedial elements developed into a rodlike structure; transtilla present, consisting of wide, very shallow U-shaped structure; juxta small, platelike with short, setae-bearing arms; valva moderately broad, covered on inner surface with slender setae (*cyrdipsa*), or covered on inner surface, in part, with broadened, spinelike setae and, in part, with slender setae (*cinilixa*); outer surface of valva with long, black, weakly-attached scales that sometimes obscure some features of inner valva; sacculus with apex a pointed process; base of sacculus with an extended lateral arm bearing either a large, long scale tuft (*cyrdipsa*), or bearing a large, long scale tuft and a much smaller, short scale tuft (*cinilixa*); aedoeagus slender; vesica with elongate patch of microspines, and a folded, in part sclerotized, platelike element; vinculum slender, constricted medially, with well-developed, posteriorly directed, lateral arms at anterior end. Female genitalia (of *cyrdipsa*) (Fig. 28) with ductus bursae shorter than corpus bursae and with cluster of small spines at its distal end; corpus bursae with scobinate patch and large hooked spine (spine, in general, laterally directed and extending across about ½ width of corpus bursae).

KEY TO SPECIES OF MALE *DRESCOMA*

(A key including females is not possible because females of *cinilixa* remain unknown.)

1. Underside of hindwing with subcostal, rough patch of pale brown, semi-metallic scales, followed by group of yellow scales and a linear cluster of short, slender, black scales; sacculus of genitalia with apical part rounded (Fig. 14) . . . . *cyrdipsa* Dyar

– Underside of hindwing with subcostal, smooth patch of mostly whitish-yellow scales, followed by streak of black and streak of reddish brown scales; sacculus of genitalia with apical part slender and sharply pointed (Fig. 16) . . . . *cinilixa* Dyar

Drescoma cyrdipsa Dyar
(Figs. 2, 8, 14–15, 24, 28)

Drescoma cinilixa Dyar 1914:329

This is an easily recognized species. Both the forewing and hindwing of the male have obvious costal notches (the vein below the notch in the hindwing is, also, noticeably angled) (Fig. 24). Also, on the underside of the male hindwing there is a pale, rough, brownish, semi-metallic, subcostal patch of scales near the base of the wing, followed by a group of small, yellowish scales and a linear cluster of short, slender, black scales. In addition near these contrasting scales, between the stalk of Sc+R and the stalk of Cu+A is found a well-developed patch of black scales. Furthermore, a pale brown scale pencil, within a short yellowish-white fold, is present on the anal margin of the hindwing.

The male genitalia (Figs. 14–15) have a well-developed transtilla with lateral arms that are distinctly broadened, and the apical part of the sacculus is rounded; the female genitalia (Fig. 28) have a large hooklike spine in the corpus bursae that extends about ½ the distance across the width of the corpus bursae.

Costa Rican material examined.—Estacion Sirena, Parque Nacional Corcovado, Provincia Puntarenas, May–July, 1992, G. Fonseca, INBio CRI001741662, INBio CR I000708220 (1 ♂, 1 ♀); Cerro Tortuguero, 0–120 m. Parque Nacional Tortuguero, Provincia Limon, May, 1991, J. Solano, INBio CRI001398617 (1 ♂).

Other material examined.—Mexico, Chiapas, May, 1915, R. Muller (1 ♀); Belize, San Ignacio, May, 1990, L. C. Dow (1 ♂), 1000 Foot Falls, Mountain Pine Ridge, June 1990, L. C. Dow (1 ♂); Guatemala, Cayuga, January, May, June, August, (no year on label), W. Schaus & W. Barnes (2 ♂, 2 ♀); Panama, Cabima, May, 1911, A. Busck (1 ♂), Corozal, February and November, 1911, A. Busck (1 ♂, 1 ♀), La Chorrera, April and May, 1911, A. Busck (1 ♂, 1 ♀; syntypes of *Drescoma cyrdipsa* in USNM), Rio Trinidad, March 1912, A. Busck (2 ♂, 1 ♀), Taberilla, (no date on label), (1 ♀); French Guiana, St. Jean Maroni, (no date on label), (1 ♀); Brazil, Pipa, March, 1994, V. O. Becker (1 ♂).

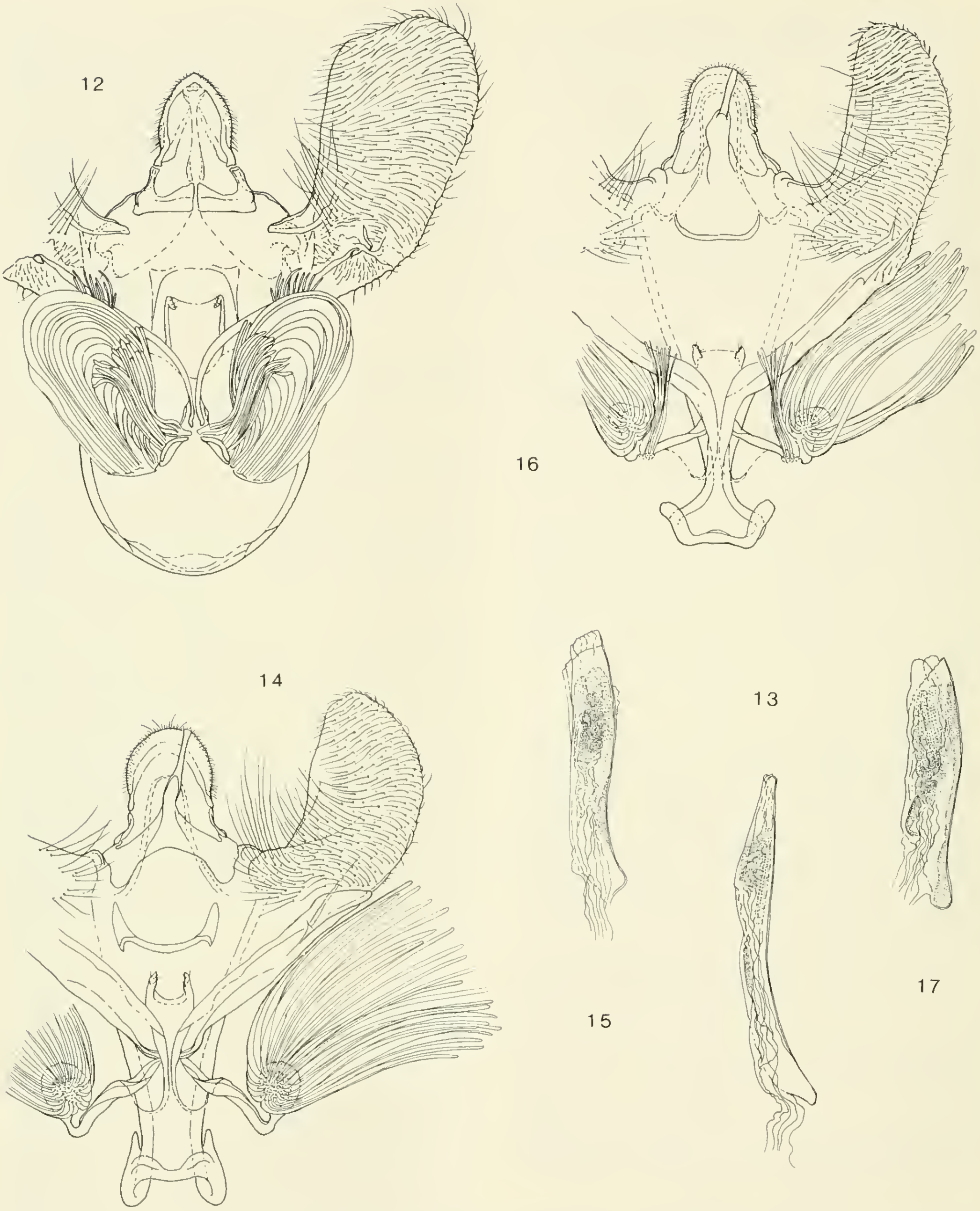
Drescoma cinilixa Dyar
(Figs. 3, 16–17)

Drescoma cinilixa Dyar 1914:329

Drescoma cinilixa is closely related to *Drescoma cyrdipsa.* This relationship is particularly apparent in males of both species, each with the costa of the forewing and hindwing strongly notched. Nevertheless, the two can be distinguished by the underside of the male hindwing. *Drescoma cinilixa* has the wing with a smooth, subcostal, basal patch of mostly whitish-yellow scales (in some specimens the patch has a few brown scales), followed distally by a streak of black and a streak of reddish-brown scales. There is only a small black patch of scales, or no black patch, between the stalk of Sc+R and the stalk of Cu+A. A partially black fold on the anal margin of the hindwing encloses a short, black scale pencil.

The male genitalia (Fig. 16) include a transtilla that is much thinner than that of *Drescoma cyrdipsa.* The sacculus at its apical end is slender and sharply pointed, and at its base bears both a large scaled tuft and a secondary, small tuft of scales. We have not been able to associate the sexes of *Drescoma cinilixa*; consequently, the female genitalia are unknown.

Costa Rican material examined.—Estacion Los Almendros, Provincia Guanacaste, 300 m., 4–12 September, 1994, E. Lopez, INBio CR I002019761 (1 ♂); Acosa, Estacion Sirena, Provincia Puntarenas, 6–12 April, 1995, A. Picardo, INBio CR I002196747 (1 ♂).

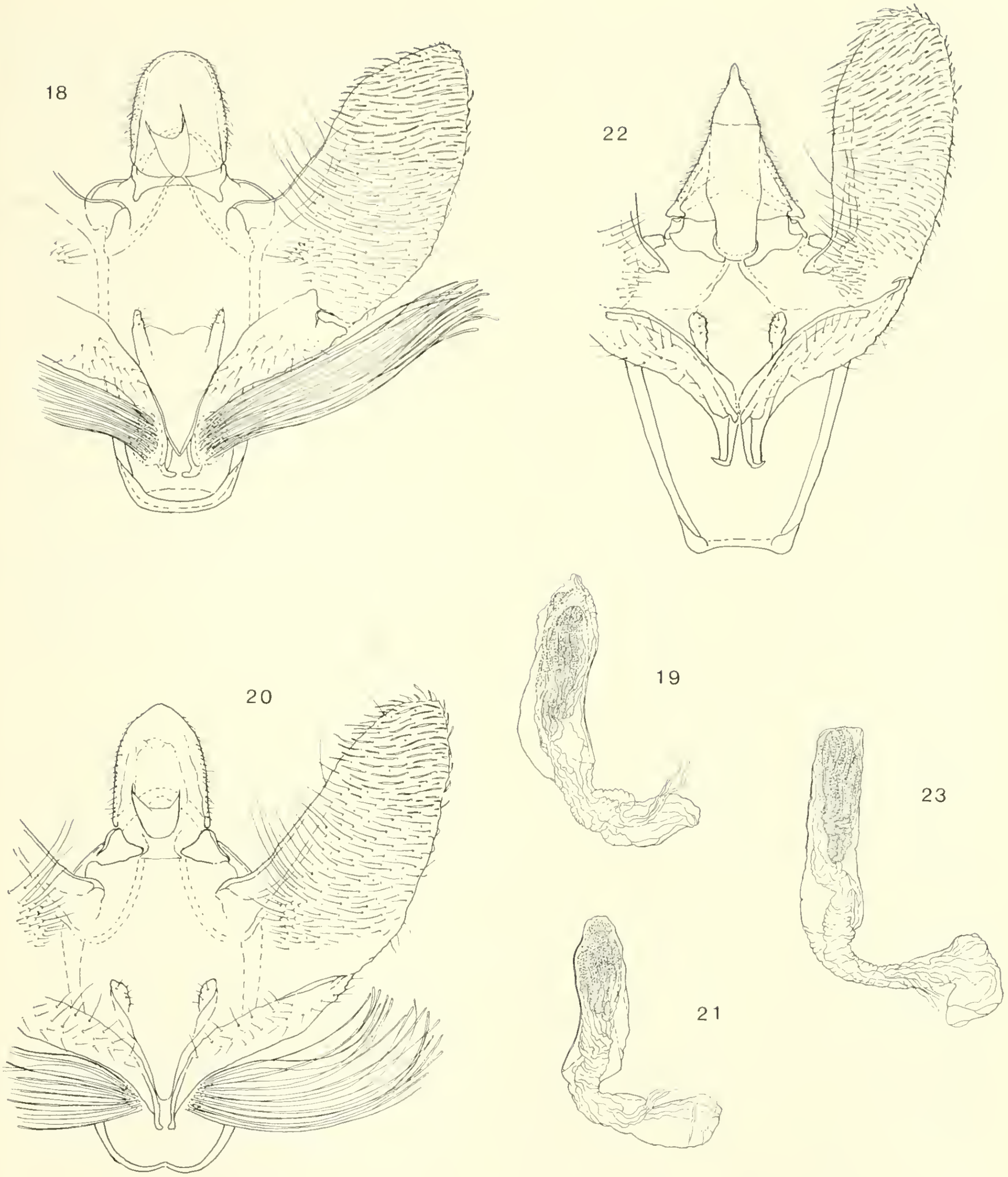


Figs. 12–17. Male genitalia, ventral view. 12, *Megarthria peterseni* (aedoeagus omitted). 13, *M. peterseni*, aedoeagus. 14, *Drescoma cyrdipsa* (aedoeagus omitted). 15, *D. cyrdipsa*, aedoeagus. 16, *D. cinilixa* (aedoeagus omitted). 17, *D. cinilixa*, aedoeagus.

Other material examined.—Guatemala, Cayuga, May (no year on label), W. Shaus & W. Barnes (1 ♂); Panama, La Chorrera, May, 1912, A. Busck (1 ♂; type in USNM).

Lascelina Heinrich

Lascelina Heinrich 1956:264. Type species: *Lascelina canens* Heinrich 1956. Original designation.



Figs. 18–23. Male genitalia, ventral view. 18, *Lascelina cordobensis* (aedoeagus omitted). 19, *L. cordobensis*, aedoeagus. 20, *L. pitilla* (aedoeagus omitted). 21, *L. pitilla* aedoeagus. 22, *L. papillina* (aedoeagus omitted). 23, *L. papillina* aedoeagus.

Megacerdresa Neunzig 1994:360. **New synonymy.** Type species: *Megacerdresa cordobensis* Neunzig 1994. Original designation.

Note.—*Lascelina* was rejected by Neunzig in 1994 as a place to include *cordobensis*, and a new genus, *Megacerdresa*, was proposed, chiefly because Heinrich's concept of the group did not contain species with more than seven veins in the hindwing (*cordobensis* has eight). The study of many recently available members of the complex in Costa Rica and the description by Neunzig (1996) of a new species of *Lascelina* in the Dominican Republic reveals significant similarities in the male genitalia. Thus we synonymize *Megacerdresa* and *Lascelina* despite differences in venation.

Description.—Antenna of male with scape cylindrical, swollen apically; shaft with distinct sinus at base; basal and distal ends of sinus each with a small spine, or low, stout spinelike element; inner surface of sinus covered with appressed setae; sinus with or without brush or tuft of scales attached to posterior base; sensilla trichodea (cilia) of antenna about ⅓ as long as width of shaft at midsinus. Antenna of female simple. Labial palpus of male upturned, reaching above vertex, 3rd segment about as long as 2nd segment. Maxillary palpus of both sexes small, short scaled. Haustellum well developed. Ocellus present. Forewing of male simple, underside with dark subcostal patch or streak in some species. Forewing of both sexes smooth, with 11 veins; R_{3+4} and R_5 stalked for about ½ or slightly over ½ their lengths; M_1 slightly bowed; M_2 and M_3 close, but separated at base, or shortly stalked; CuA_1 arises from lower angle of cell; CuA_2 arising well before lower angle of cell. Hindwing underside, in some species, with dark patch or streak; with seven to eight veins (1A, 2A, 3A together treated as one vein); $Sc+R_1$ and Rs fused for about ½ their lengths beyond cell; M_1 straight; M_2 and M_3 fused for about ½ their lengths or completely fused; CuA_1 briefly fused with stalk of M_2 and M_3, or stalked for about ½ its length with fused M_{2+3}; CuA_2 arises from just before lower angle of cell, or from lower angle of cell; cell distinctly less than ½ length of wing. Male abdominal segment 8 with small tuft, consisting of rather straight, simple short scales (within pocket of sternite of abdominal segment 8). Male genitalia with uncus broadly rounded, truncated, slightly pointed, or nipple-like distally; gnathos apically completely fused to wall of scaphium (without apical hook or rodlike element); transtilla absent; juxta a plate with short, lateral, setiferous arms; valva moderately broad, covered on distal half of inner surface with broadened spinelike setae; sacculus with apex usually with posteriorly projecting lobe; base of sacculus with or without moderately large, ventral scale tuft (all species without small secondary scale tuft); aedoeagus robust, with bent, supplemental, basal appendage; vesica with patch of microspines and two sclerotized plates; vinculum broad, without constriction, about as long as greatest width. Female genitalia (*cordobensis*, *canens*, *pitilla*) with ductus bursae shorter than corpus bursae, slightly twisted, usually with a few scobinations near ostium bursae, and a dense, elongate, medial patch of many microspines and numerous sclerotized, irregular ridges near junction with corpus bursae; corpus bursae membranous, with curved denticulate spine, originating from near wall of corpus and directed mostly anteriorly.

KEY TO SPECIES OF MALE *LASCELINA*

(A key including both sexes is not possible because the female of *papillina* is unknown.)

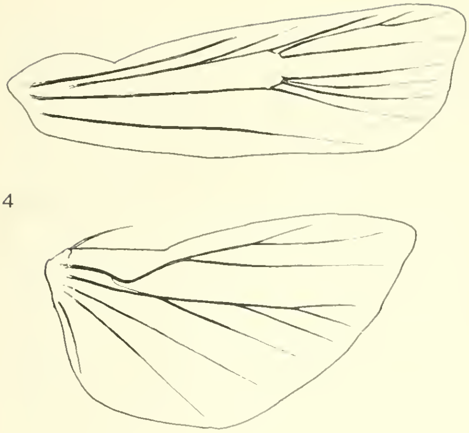
1. Enlarged base of antennal shaft surrounding sinus dark; apex of uncus broadly rounded (Fig. 18) . . . . *cordobensis* (Neunzig)
– Enlarged base of antennal shaft surrounding sinus pale; apex of uncus slightly pointed (Fig. 20) or nipplelike (Fig. 22) 2
2. Antenna without scale tuft associated with sinus (Fig. 10); apex of uncus slightly pointed (Fig. 20) . . . . . . *pitilla* Neunzig and Solis, n. sp.
– Antenna with scale tuft associated with sinus (Fig. 11); apex of uncus nipple-like (Fig. 22) . . . . *papillina* Neunzig and Solis, n. sp.

Lascelina cordobensis (Neunzig), **new combination**

(Figs. 4, 9, 18–19, 27)

Megacerdresa cordobensis Neunzig 1994: 362.

The male of *Lascelina cordobensis* can be identified using a combination of features. These are found mainly in the genitalia and include a broadly rounded apex of



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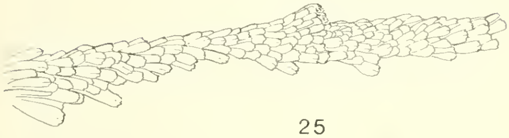

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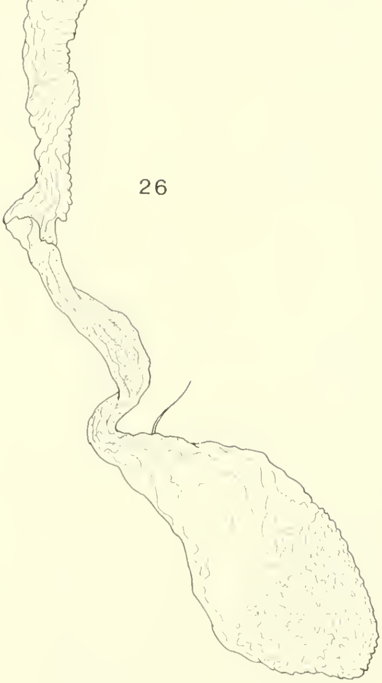

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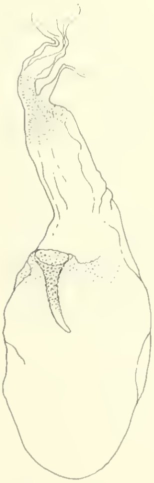

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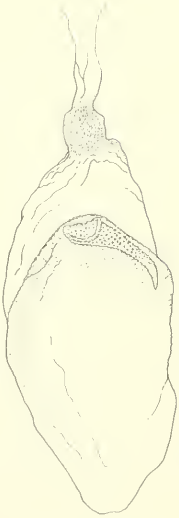

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29

Figs. 24–29. Venation of male right forewing and hindwing, dorsal view, hoodlike prominence on male right wing, dorsal view, and female genitalia, anterior part, ventral view, 24, *Drescoma cyrdipsa.* 25–26 *Megarthria peterseni.* 27, *Lascelina cordobensis.* 28, *Drescoma cyrdipsa.* 29, *L. pitilla.*

the uncus, a complete absence of a rodlike median distal hook on the gnathos, and a valva with its distal margin angulate (Fig. 18). Useful for a tentative identification is the easily seen dark color of the enlarged base of the shaft of the male antenna that surrounds the sinus.

Costa Rican material examined.—Estacion La Casona, 1,520 m. Reserva Biologica Monteverde, Provincia Puntarenas, September, 1992, N. Obando, INBio CR 1000947024 (1 ♂); Cerro Tortuguero, Parque Nacional Tortuguero, 0–100 m., Provincia Limon, March, May, 1991, J. Solano, INBio CR 1001399037, INBio CR 1000197451 (1 ♂, 1 ♀).

Other material examined.—Mexico, Cordoba, August–December, 1966, A. B. Lau (10 ♂, 13 ♀; holotype ♂ in USNM).

Lascelina pitilla Neunzig and Solis, new species

(Figs. 5, 10, 20–21, 29)

Diagnosis.—The external habitus of *pitilla* together with the general appearance of its male genitalia clearly show that *pitilla* belongs to the genus *Lascelina* (Figs. 20–21). The male antenna will distinguish it from its congeners. Other species in the genus have an obvious scale tuft associated with the sinus of the shaft; this feature is absent in *pitilla* (Fig. 10).

Description.—Forewing length 6.0–7.5 mm. Head with frons white medially, pale reddish brown near eyes; vertex pale reddish brown, darker anteriorly; labial palpus outwardly with basal segment mostly white, with some pale reddish brown, 2nd and 3rd segments mostly brown with reddish brown distally; maxillary palpus simple, mostly pale reddish brown with a few dark brown scales basally; antenna of male with sinus in base of shaft; distal and basal end of sinus with small, sharply pointed, medially directed spine; inner surface of sinus covered with appressed scales; no scale brush or tuft attached to posterior base of sinus. Forewing of male simple without costal fold, costal concavity or sex-scaling; wing above mostly white on costal half and pale brown, reddish brown, brown, and red on posterior half; base brown, suffused with red; a pair of mostly red to reddish-brown diagonally converging bands extend from costa to fuse with brown and red of posterior half of wing; bands divide costal half of wing into three contrasting, mostly white patches (band that starts ⅓ from base of costa incomplete; distal band with weak margins); most distal white patch very small; middle white patch with small isolated, elongate red patch at about midcosta, and with pair of red and black discal spots; postmedial line vague, whitish. Hindwing simple, pale brown, darker along margins. Male genitalia (Figs. 20–21), with uncus slightly pointed distally; apical part of gnathos fused to scaphium; transtilla absent; juxta a thin plate with rounded, setiferous, lateral arms; valva slightly pointed apically; inner base of valva with cluster of setae arising from protuberances; sacculus with ventral tuft of thin scales (tuft reaches to about apex of sacculus); aedoeagus robust, with angled basal supplement; vesica with patch of microspines, and two apically rounded, sclerotized plates; vinculum short, not medially constricted. Female genitalia (Fig. 29) with ductus bursae shorter than corpus bursae and with patch of microspines distally; corpus bursae with curved, scobinate spine.

Types.—Holotype: ♂. Est. Pitilla, 700 m., 9 km. S. Sta. Cecilia, P. N. Guanacaste, Prov. Guanacaste, Costa Rica, 27 jul. a 14 ago. 1992, C. Moraga, L-N 330200, 380200, INBio CR 1000393816, genitalia slide 393816 MC (INBio). Paratypes: Same collection label data as holotype except collector P. Rios, INBio CR 1000867296, genitalia slide 4547 HHN (NCSU) (1 ♂); Est. Pitilla, 9 km. S. Sta. Cecilia, Prov. Guana., Costa Rica, 700 m., 18–23 Jul. 1993, P. Rios, L N 330200 380200, INBio CR 1001767419, genitalia slide 4546 HHN (INBio) (1 ♂); Est. Pitilla, 700 m. 9 km. S. Sta. Cecilia, Prov. Guan., Costa Rica, C. Moraga, Apr. 1991, L N 330200 380200, INBio CR 1000617183, genitalia slide 617183 MC (INBio) (1 ♀); Est. Pitilla, 700 m., 9 km. S. Sta. Cecilia, Prov. Guan., Costa Rica, P. Rios, Jul. 1991, L N 330200, 380200, INBio CR 1000346701, genitalia slide 4548 HHN (INBio) (1 ♀).

Etymology.—The specific epithet is based on the type locality, Estacion Pitilla, located in the Guanacaste National Park, Costa Rica.

Lascelina papillina Neunzig and Solis, new species
(Figs. 6, 11, 22–23)

Diagnosis.—The best diagnostic feature of *Lascelina papillina* is the triangularly-shaped uncus with its distal, nipple-like protuberance (Fig. 22). *Lascelina pedernalensis,* which occurs in the Dominican Republic, has a similar uncus, but its distal protuberance is less strongly developed (see fig. 53 of Neunzig 1996).

Description.—Forewing length 7.0 mm. Head with frons and vertex brownish white; labial palpus outwardly with basal segment white, whitish brown, and brown, 2nd and 3rd segments whitish brown, in part suffused with dark brown; maxillary palpus simple, whitish brown; antenna of male with well-developed sinus at base of shaft; basal and distal ends of sinus with low, stout, spinelike elements; inner surface of sinus covered with appressed scales; tuft of pale brown and brown scales attached to posterior base of sinus (tuft extends slightly beyond distal end of sinus). Forewing of male simple (without costal fold, costal notch, or contrastingly colored sex-scales); wing above mostly white on costal half and brown, reddish brown, and red on posterior half; base dark brown; a pair of black diagonally converging bands extend from costa to fuse with brown, reddish brown, and red of posterior half of wing (distal band broad, somewhat diffuse with indistinct margins); black bands divide costal half of wing into three contrasting, mostly white, patches (most distal patch very small); middle patch with small, isolated, elongate black patch at about midcosta, and with two black distal spots; a sprinkling of red scales chiefly on white patches; postmedial line apparent, whitish, but weakly developed. Hindwing simple, pale brown, darker brown along margins. Male genitalia (Figs. 22–23) with uncus distinctly triangular, with a well-developed, nipple-like apex; apical part of gnathos fused to scaphium; transtilla absent; juxta a thin plate with rounded, setiferous, lateral arms; valva rounded apically; inner base of valva with broad, slightly elevated, moundlike, setiferous elements; sacculus with apex rather simple, with small, slender lobe; base of sacculus without ventral tuft of scales; aedoeagus robust, with angled basal supplement; vesica with patch of microspines and two sclerotized plates; vinculum about as long as greatest width, truncated distally. Female genitalia unknown.

Type.—Holotype: ♂. Rancho Quemado, Peninsula de Osa, 200 m., Prov. Puntarenas, Costa Rica, F. Quesada, Dec. 1991, L-S-292500, 511000, INBio CR 1000345866, genitalia slide 345866 MC (INBio).

Etymology.—The specific epithet is derived from *papilla,* Latin for nipple, and refers to the appearance of the distal part of the uncus.

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In large measure this study was possible because of the collecting and curating efforts of numerous parataxonomists at the Instituto Nacional de Biodiversidad, Santo Domingo, Costa Rica. M. Comacho and E. Phillips, at the same institution, prepared genitalic slides and arranged for specimen loans, respectively. V. Becker, Brasilia, Brazil, generously made available additional study specimens. K. Tuck provided access to types in The Natural History Museum, London, England, and R. Blinn, North Carolina State University, Raleigh, North Carolina, U.S.A., made the habitus photographs. We are also grateful to L. Deitz, North Carolina State University; T. Henry, Systematic Entomology Laboratory, U.S. Department of Agriculture, Washington, D. C., U.S.A.; and J. Shaffer, George Mason University, Fairfax, Virginia, U.S.A., for critical reviews of the manuscript.

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THE CHEWING LOUSE GENUS *KAYSIUS* PRICE AND CLAYTON (PHTHIRAPTERA: AMBLYCERA: MENOPONIDAE) FROM THE PASSERIFORMES (AVES)

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Abstract.—The menoponid genus *Kaysius* Price and Clayton, originally described as monotypic for *K. emersoni* Price and Clayton, is redefined and expanded to include two species previously placed in *Machaerilaemus* Harrison: *Menopon tityrus* Carriker and *Machaerilaemus cotingae* Carriker, both **new combinations**. Character states and illustrations are provided for the separation of these three species.

Key Words: chewing lice, *Kaysius*, Menoponidae, Phthiraptera, Passeriformes

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When Price and Clayton (1989) described the menoponid chewing louse genus *Kaysius*, they did so basing it on the single new species, *Kaysius emersoni*, whose type host is *Glyphorynchus spirurus* (Vieillot) from Peru. At that time, it was difficult to decide which features were of generic importance and which should be relegated only to the specific definition. This is virtually always the case in dealing with a monotypic genus such as this. However, when a recent study of the genus *Machaerilaemus* Harrison was undertaken, it was discovered that two of the 25 species placed in that genus to date actually are species belonging to *Kaysius*. With this finding that *Kaysius* is more widespread than initially thought, we have been able to re-examine the definition of *Kaysius* and contribute to the identification of these three species. We suspect that further collecting from additional passerines will broaden the known host range of *Kaysius* even further.

Kaysius Price and Clayton

Kaysius Price and Clayton 1989:29. Type species: *Kaysius emersoni* Price and Clayton, by monotypy.

The following features may be used to characterize species belonging to this genus. Little sexual dimorphism, except that associated with smaller male dimensions, reduced male setal numbers, and terminalia. Head width approximately twice its length; without preocular notch or slit; all temple setae 21–27 present (Fig. 3, numbering laterad from midline), with 24 and 26 very short, 25 and 27 very long; alveoli of temple setae 26 and 27 well separated; antennal fossa not deep, with antenna entirely or mostly exposed, but completely beneath head; gular plate pigmented only along setal bases; without ventral spinous processes; nodi and associated carinae weak; hypopharynx with weakly developed sclerites. Thorax with prosternal plate developed (Fig. 2), rounded posteriorly, usually without central setae, rarely with 1 central seta;

Table 1. Comparison of characters separating *Kaysius* from *Machaerilaemus*.

Character	*Kaysius*	*Machaerilaemus*
1. Alveoli of temple setae 26 & 27.	Well separated	Adjacent
2. Gular pigmentation	Only along setal bases	More extensive
3. Prosternal plate shape	Rounded posteriorly	Pointed posteriorly
4. Prosternal plate central setae	0–1	More than 3
5. Mesosternal plate setae	Only 2	More than 5
6. Sternite I	Distinctly separate	Fused with metasternum
7. Outermost seta on tergite I	Very short	Very long postspiracular
8. Male genitalia	Slight asymmetry with blunt parameres curved same direction	Symmetrical with long pointed outwardly curved parameres
9. Female subgenital plate margin	Straight to gently rounded	Distinct medioposterior convexity

outer central pronotal seta longer than minute inner seta; mesosternal plate with only 2 associated short setae; venter of femur III without ctenidia or well-developed brush; only 2 medioanterior mesonotal setae associated with postnotum. Abdomen with no tergites enlarged, divided, or with anterior setae; tergite I with short seta laterad of postspiracular seta; all postspiracular setae on I-VIII very long; sternite I present as distinct plate, with setae; lateral areas of sternites without ctenidia or brushes; female sternite VII partially fused with VIII; female anus essentially oval, without inner setae; female subgenital plate margin straight to gently rounded, not convex medially; male genitalia with slender parameres flexed in same direction, rounded endomeral plate, sac weakly spined with poorly to well-developed associated sclerite. *Kaysius* is separated from the closely related *Machaerilaemus* by the features given in Table 1. For brevity, generic characters will not be repeated under the species descriptions. Host classification follows that of Howard and Moore (1991).

In the following descriptions, all measurements are in millimeters. Abbreviations for dimensions are TW, head width at temples; HL, head length at midline; PW, prothorax width; MW, metathorax width; AWIV, abdomen width at level of segment IV; TL, total length; ANW, female anus width; GL, male genitalia length from tip of basal apodeme to end of parameres; GW, male genitalia width at paramere base.

Kaysius emersoni Price and Clayton
(Fig. 6)

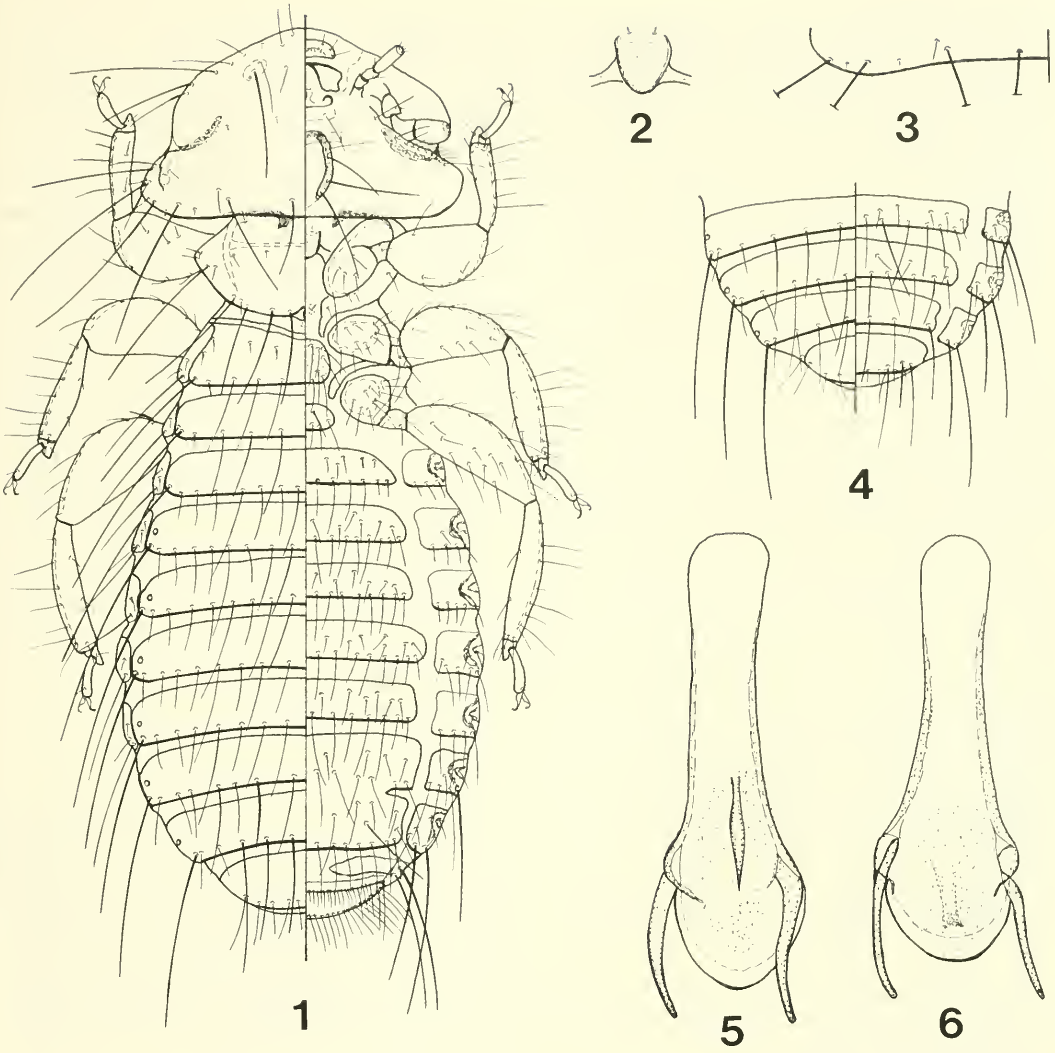
Kaysius emersoni Price and Clayton 1989: 31. Type host: *Glyphorynchus spirurus* (Vieillot).

This species has been very adequately described and illustrated by Price and Clayton (1989) and details will not be repeated here, other than to provide an illustration of the male genitalia (Fig. 6) for comparative purposes with those of the other two species treated here. All material of *K. emersoni* known to date has been collected from *G. spirurus* [Dendrocolaptidae] in Peru.

Kaysius tityrus (Carriker), **n. comb.**
(Figs. 1–4)

Menopon tityrus Carriker 1903:182. Type host: *Tityra personata* = *Tityra semifasciata costaricensis* Ridgway.

Female.—As in Fig. 1. Metanotum with 10–12 marginal setae, 4 short medioanterior setae; metasternal plate with 12–18 setae. Tergal setae on I, 12–15; II-V, 16–20; VI, 17–20; VII, 14–19; VIII, 12–15; IX, 9–14. Prominent pleural thickenings on II-VIII. Sternal setae on I, 6–10; II, 22–26; III, 26–31; IV-VI, 26–35; VII, 19–27. Subgenital plate with 14–21 marginal, 12–17 anterior setae. Anus with 30–39 dorsal, 36–



Figs. 1–6. 1–4, *Kaysius tityrus*. 1, Female, dorsoventral. 2, Female prosternal plate. 3, Female temple setae 21–27, numbering laterad from midline. 4, Male terminalia, dorsoventral. 5, 6, Male genitalia. 5, *K. cotingae*. 6, *K. emersoni*.

41 ventral setae. Dimensions: TW, 0.46–0.48; HL, 0.23–0.28; PW, 0.30–0.32; MW, 0.34–0.37; AWIV, 0.51–0.53; TL, 1.25–1.39; ANW, 0.15–0.18.

Male.—Metanotum with 10–11 marginal setae, 4 short medioanterior setae; metasternal plate with 14–16 setae. Terminalia as in Fig. 4. Tergal setae on I, 11–12; II-V, 14–17; VI, 13–16; VII, 12–14; VIII, 10; IX, 6–8. Prominent pleural thickenings on II-VIII. Sternal setae on I, 6–10; II, 18–23; III, 23–27; IV-VI, 22–29; VII, 13–16; VIII, 8–11. Genitalia as in Fig. 5, with slender sac sclerite 0.09–0.10 long. Dimensions: TW, 0.44; HL, 0.22–0.26; PW, 0.28–0.29; MW, 0.31–0.32; AWIV, 0.43–0.48; TL, 1.07–1.12; GL, 0.34–0.36; GW, 0.10–0.11.

Material.—[Tyrannidae]–Female holotype of *M. tityrus*, ex *T. s. costaricensis*, Costa Rica; 2 ♀, ex *T. s. colombiana* Ridgway, Colombia; 2 ♀, 1 ♂, ex *T. semifasciata* (Spix), Nicaragua; 4 ♀, 3 ♂, ex *T. cayana cayana* (Linnaeus), Trinidad.

Remarks.—*Kaysius tityrus*, by its smaller body dimensions, longer male genitalia with its slender, elongate, well-defined sac sclerite, fewer tergal and sternal setae, and presence of pleural thickenings, is readily separated from *K. emersoni.* The host distribution of *K. tityrus* as presently known involves only two species of *Tityrus* from Costa Rica, Trinidad, Nicaragua, and Colombia.

Carriker (1949), in commenting further on the status of the *Menopon tityrus* that he had described in 1903, admitted that he had been doubtful of the proper generic placement of the species. Only after confirmation from Dr. G. H. E. Hopkins that it belonged to *Machaerilaemus* did Carriker relegate it to that genus. Carriker (1949) still expressed doubt about this generic placement. He felt that some characters placed *M. tityrus,* as well as *Machaerilaemus cotingae* Carriker, apart from the other *Machaerilaemus* and that these two species might ". . . ultimately warrant erection of a special genus for their reception." We agree with his feelings and now remove them from *Machaerilaemus* and place them within *Kaysius.*

Kaysius cotingae (Carriker), **n. comb.**
(Fig. 5)

Machaerilaemus cotingae Carriker 1949: 298. Type host: *Cephalopterus ornatus ornatus* G. St-Hilaire.

Female.—Close to *K. tityrus,* except as follows. Tergal setae on IV-V, 25–28; VI, 23–26; VII, 20–22. Sternal setae on II, 25–30; III, 40–45; IV-VI, 33–48; VII, 28–33. Dimensions: TW, 0.57–0.60; HL, 0.28–0.29; PW, 0.36–0.38; MW, 0.43–0.45; AWIV, 0.66–0.70; TL, 1.50–1.53; ANW, 0.20–0.22.

Male.—Also close to *K. tityrus,* except as follows. Tergal setae on II, 18; III-V, 20–22; VI, 16–21; VII, 16–17. Sternal setae on III, 28–29; IV-VI, 30–37; VII, 16–20. Dimensions: TW, 0.53–0.54; HL, 0.27; PW, 0.33–0.34; MW, 0.39–0.40; AWIV, 0.59–0.60; TL, 1.23–1.25; GL, 0.41–0.43; GW, 0.12–0.13.

Material.—[Cotingidae]–Female holotype, male allotype, 3 ♀, 1 ♂ paratypes of *M. cotingae,* ex *C. ornatus,* Peru.

Remarks.—The specimens of the type series of *K. cotingae* show this species is distinctly separate from the other two by its much broader head and the greater total length and length of the male genitalia. Its male genitalia, on the basis of the well-defined sac sclerite (Fig. 5), and the presence of pleural thickenings easily distinguish this species from *K. emersoni.* The larger number of tergal setae at least on IV-VII and other dimensional differences further separate *K. cotingae* from *K. tityrus.*

On the basis of the similarity of the male genital sac sclerite and the abdominal pleural thickenings, *K. cotingae* and *K. tityrus* are grouped together and apart from *K. emersoni.* The only known host for *K. cotingae* is *C. ornatus* from Peru.

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REVISION OF THE GENUS *INDOSTEGIA* MALAISE (HYMENOPTERA: TENTHREDINIDAE) IN INDIA

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Abstract.—The genus *Indostegia*, known only from India, includes five species, *I. apicicornis* Malaise, ***I. frontata*, n. sp.**, ***I. foveata*, n. sp.**, ***I. vatsi*, n. sp.**, and ***I. ecarinata*, n. sp.** The male of *I. apicicornis* Malaise is described for the first time. A key is provided for the species.

Key Words: revision, *Indostegia* Malaise, India, Hymenoptera, Allantinae

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The genus *Indostegia* was described by Malaise (1934) for a single species, *I. apicicornis* Malaise from India. It belongs in the subfamily Allantinae as defined by Smith (1979) where it was placed by Abe and Smith (1991). The genus has remained monotypic until the recent discovery of additional species in India. Here we include five species, four of which are new, describe the male of *I. apicicornis* Malaise for the first time, and provide a key to species. Thus far, the genus is known only from India. Host plants are not known, but *Indostegia* is similar to the holarctic genus *Taxonus* Hartig, the larvae of which feed on rosaceus plants such as *Rubus* spp. and *Fragaria* spp., and the larvae of *Indostegia* may do the same.

Holotypes of the new species are deposited at the Indian Agriculture Research Institute, Pusa National Collection, Division of Entomology, New Delhi, India. Other specimens are at Punjabi University, Patiala, India (PUP), and the National Museum of Natural History, Smithsonian Institution, Washington, DC (USNM).

Abbreviations used in text are: EL = eye length; IATS = inner apical tibial spur; ICD = intercenchri distance; IDMO = interocular distance at level of median ocellus; ITD = intertegular distance; LID = lower interocular distance; MB = metabasitarsus; OATS = outer apical tibial spur; OCL = oculooccipital distance; OOL = oculoocellar distance; POL = postocellar distance.

Indostegia Malaise

Indostegia Malaise 1934: 468–470; Malaise 1963: 186 (in key); Abe and Smith 1991: 40, 103. Type species: *Indostegia apicicornis* Malaise 1934, by original designation.

Description.—Antenna 3.4–4.0× head width, scape longer than broad, pedicel as long as broad, flagellum more or less strongly compressed and tapering towards apex (instead of flagellum, except for three basal segments, strongly compressed, as stated by Malaise 1934); clypeus (Fig. 3) with transverse convexity, very widely and deeply incised with sharp, depressed, lateral lobes; labrum rounded, broader than long, flat and shining; inner margins of eyes parallel, lower interocular distance greater than

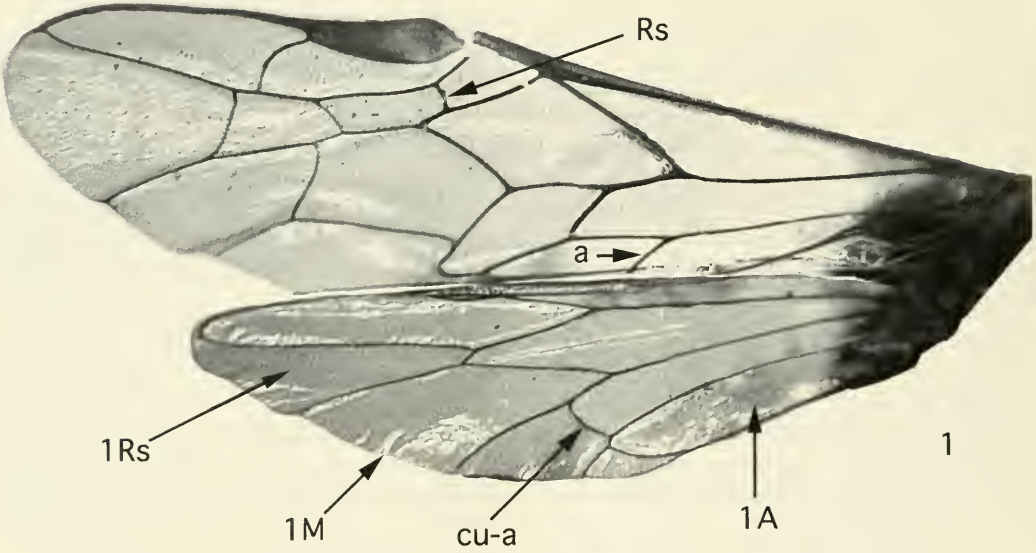


Fig. 1. Forewing and hindwing of *Indostegia frontata*.

eye length (Fig. 3); malar space equal to or broader than diameter of median ocellus (instead of malar space 1.5× diameter of median ocellus, as stated by Malaise 1934); genal carina present except behind postocellar area; lower margin of eye below level of antennal sockets; epicnemium absent; mesoscutellum roundly elevated to subconvex; metabasitarsus subequal or slightly shorter in length to following tarsal segments combined; tarsal claw with subapical tooth slightly shorter than apical one, basal lobe distinct or low and indistinct (instead of basal lobe very minute but distinct, as stated by Malaise 1934). Forewing (Fig. 1) with anal cross vein (a) joining 1A at a 35°–40° angle; 1st cubital crossvein (Rs) present. Hindwing (Fig. 1) without closed middle cells (1Rs and 1M); anal cell (1A) sessile; cu-a meets apex of anal cell at a slightly oblique angle.

Discussion.—Since *Indostegia* was based on one species, represented by only one female, the generic limits were rather narrow. We have slightly broadened the generic concept as noted parenthetically above.

Indostegia is close to the holarctic *Taxonus,* especially the wing venation, cleft tarsal claws with a basal lobe, deeply emarginated form of the clypeus, and similarity of the male genitalia (Smith 1979: figs. 274–285). *Indostegia* can be separated by the laterally flattened flagellar segments, usually segments three to apex, and the exceptional length of the antenna which is more than three times the head width. The flagellar segments of *Taxonus* are rounded and the antennae are not more than twice the head width. In Malaise's (1963) key, *Indostegia* goes to the same couplet as *Parasiobla* Ashmead, currently considered a synonym of *Taxonus* (Smith 1979).

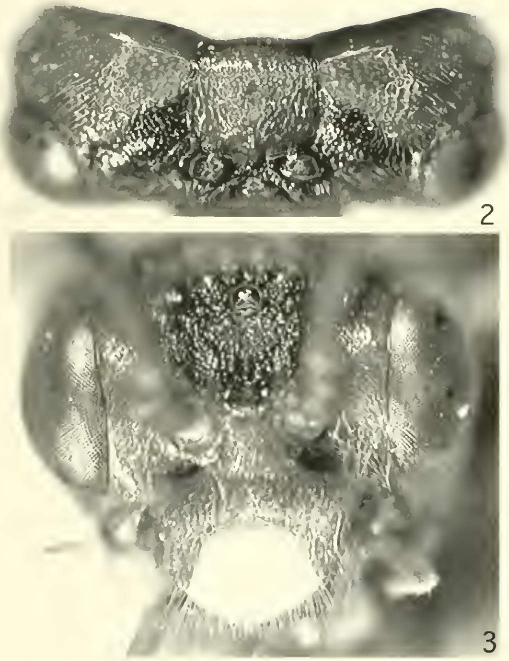
KEY TO SPECIES OF *INDOSTEGIA*

1. Postocellar area quadrate or longer than broad (Fig. 2); median fovea clearly reaching median ocellus; male valve narrow and elongate (Figs. 22–23) 2

– Postocellar area broader than long; median fovea not reaching median ocellus; male valve oval (Figs. 24–26) 3

2. Clypeus roundly incised, anterior margin crenulate (Fig. 4); median fovea with deep pit in anterior half and posteriorly only shallowly reaching median ocellus; postocellar area longer than broad as 5:4; annular hairs on lancet distinct for entire width of lancet (Fig. 18); apex of male valve rounded (Fig. 22) . . . . *I. frontata,* n. sp.

– Clypeus rectangularly incised, anterior margin smooth (Fig. 5); median fovea without a pit,



Figs. 2–3. *Indostegia frontata.* 1, Head, dorsal view. 2, Head, front view.

broad, deep, ditchlike and clearly reaching median ocellus; postocellar area as long as broad; annular hairs on lancet absent to indistinct (Fig. 20); apex of male valve acute (Fig. 23) . . *I. foveata*, n. sp.

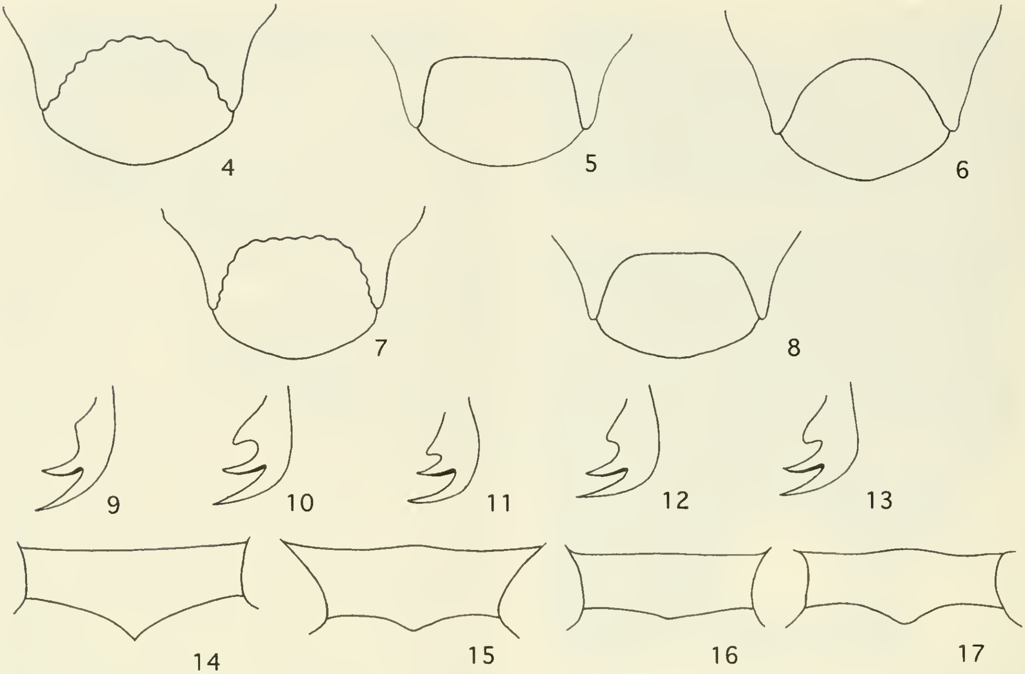
3. Lateral furrows of postocellar area reaching hind margin of head; mesoscutellar appendage ecarinate; clypeus roundly incised (Fig. 6) (lancet as in Fig. 21, serrulae low, serrate) . . . . *I. vatsi*, n. sp.
– Lateral furrows of postocellar area abruptly ending just before hind margin of head; mesoscutellar appendage with median carina; clypeus subsquarely incised (Figs. 7–8) 4
4. Scape length 2× its apical width; antennal segments 3 and 4 as 3:4; flagellum laterally compressed except 2 basal segments; anterior margin of clypeus smooth (Fig. 8); postocellar area without median carina; tarsal claw with large basal lobe (Fig. 11) . . . . *I. ecarinata*, n. sp.
– Scape length 1.25× its apical width; antennal segments 3 and 4 as 8:9; flagellum laterally compressed except 3 basal segments; anterior margin of clypeus crenulate (Fig. 7); ostocellar area with median carina on its anterior ¼; tarsal claw with very minute basal lobe (Fig. 9) (lancet with serrulae narrow, lobelike, Fig. 19) . . . . *I. apicicornis* Malaise

Indostegia frontata Vasu, Saini, and Smith, new species

(Figs 1–4, 12, 14, 18, 22, 27)

Female.—*Color:* Black with antennal segments 7 and 8 except apical tip of 8, labrum, posterodorsal and posterolateral margins of pronotum, top of mesoscutellum, extreme posterior and deflexed lateral margins of tergites 2–4, medial broad spot on sternites 2–5, apical ¼ of coxae, trochanters and adjacent parts of femora, and metatarsus except metabasitarsus whitish yellow; scape, pedicel, antennal segment 3 more or less, mandible base, clypeus, head except frontal spot, lateral margins of mesonotal middle lobe meeting at apex, tegula, posterior and lateral slopes of mesoscutellum, medial spot on tergites 7–9, pro- and mesofemora, outer surface of metafemur, tibiae, pro- and mesotarsi, and metabasitarsus fuscoferruginous. Wings hyaline, basal ⅓ of stigma fulvous, rest of stigma and veins piceous.

Structure: Average length 9.5 mm. Antennal length 3.8× head width, scape length 1.25× its width, antennal segments 3 and 4 subequal in length as 7:8, flagellum strongly compressed and flattened except basal 3 segments. Clypeus (Figs. 3–4) roundly incised with crenulate anterior margin. Malar space equal to diameter of median ocellus; LID:IDMO:EL = 3:3:2. Supraclypeal and supraantennal pits well marked, supraantennal tubercles low and confluent with indistinct frontal ridges; frontal area anterior to median ocellus broadly and roundly heart-shaped, gradually and only very faintly depressed towards center, with median fovea in form of a narrow streak shallowly reaching median ocellus; post-, inter- and circumocellar furrows distinct, lateral furrows deep, distinct and ending abruptly just before hind margin of head; postocellar area convex with a faint median carina at its anterior ¼, longer than broad as 5:4; head slightly widened behind eyes, OOL:POL:OCL = 5:4:6. Mesoscutellum roundly elevated without carina, appendage with faint



Figs 4–17. *Indostegia* species. 4–8, Clypeus and labrum. 4, *Indostegia frontata*. 5, *I. foveata*. 6, *I. vatsi*. 7, *I. apicicornis*. 8, *I. ecarinata*. 9–13, Tarsal claws. 9, *I. apicicornis*. 10, *I. vatsi*. 11, *I. ecarinata*. 12, *I. frontata*. 13, *I. foveata*. 14–17, Female hypopygium. 14, *I. frontata*. 15, *I. foveata*. 16, *I. vatsi*. 17, *I. apicicornis*.

medial longitudinal carina; ICD:ITD = 1:3. Tarsal claw (Fig. 12) with broad basal lobe; metabasitarsus equal to following tarsal joints combined, IATS:MB:OATS = 3:8:2. Lancet (Fig. 18) with 24 serrulae; serrulae serrate; annular hairs extend width of lancet. Hypopygium as in Fig. 14.

Sculpture and pubescence: Frontal area minutely, densely punctured, rest of head with fine punctures, surface shining. Mesonotum punctured like head, posterior and lateral slopes of metascutellum densely covered with large, irregular punctures, appendage with few punctures, surface polished, mesopleuron rugose with dense, large, pit-like confluent punctures on and along its convexity. Mesosternum and mesepimeron minutely punctured. Abdomen impunctate, subshining. Body covered with fuscous pubescence.

Male.—Average length 8.5 mm. Similar to female except for clypeus, medial streak on tergites 2–4, and pro- and mesocoxae except their extreme bases whitish yellow, and medial spots on propodeum fuscoferruginous. Genitalia: Penis valve (Fig. 22), genital capsule (Fig. 27).

Material examined.—Holotype: ♀, India, Manipur, Ukhrul, 1,700 m, 24.v.1993. Paratypes: 5 ♀, 6 ♂, India, Manipur, Ukhrul, 1,700 m, 21.v – 24.v.1993, deposited in PUP and USNM.

Variation.—The apical tips of antennal segments 6, 7, and 8 may be entirely whitish yellow. The frontal black spot may extend laterally to eye margins but not touching them, posteriorly surrounding the lateral sides of postocellar area. Tergites 7–9 may be fuscoferruginous. The medial spots on propodeum in the male may be entirely black.

Distribution.—India: Manipur.

Remarks.—The longer than broad postocellar area, roundly incised clypeus with the anterior margin crenulate, the deep pit at the anterior half of the median fovea, and median fovea only indistinctly reaching the median ocellus will distinguish *I. frontata* from other species discussed here. The only other species with the anterior margin of the clypeus crenulate is *I. apicicornis*. This species shares with *I. foveata* the narrow, elongate penis valve of the male genitalia (Figs. 22, 23).

Etymology.— The species name is based on the peculiar shape of the frontal area.

Indostegia foveata Vasu, Saini, and Smith, new species

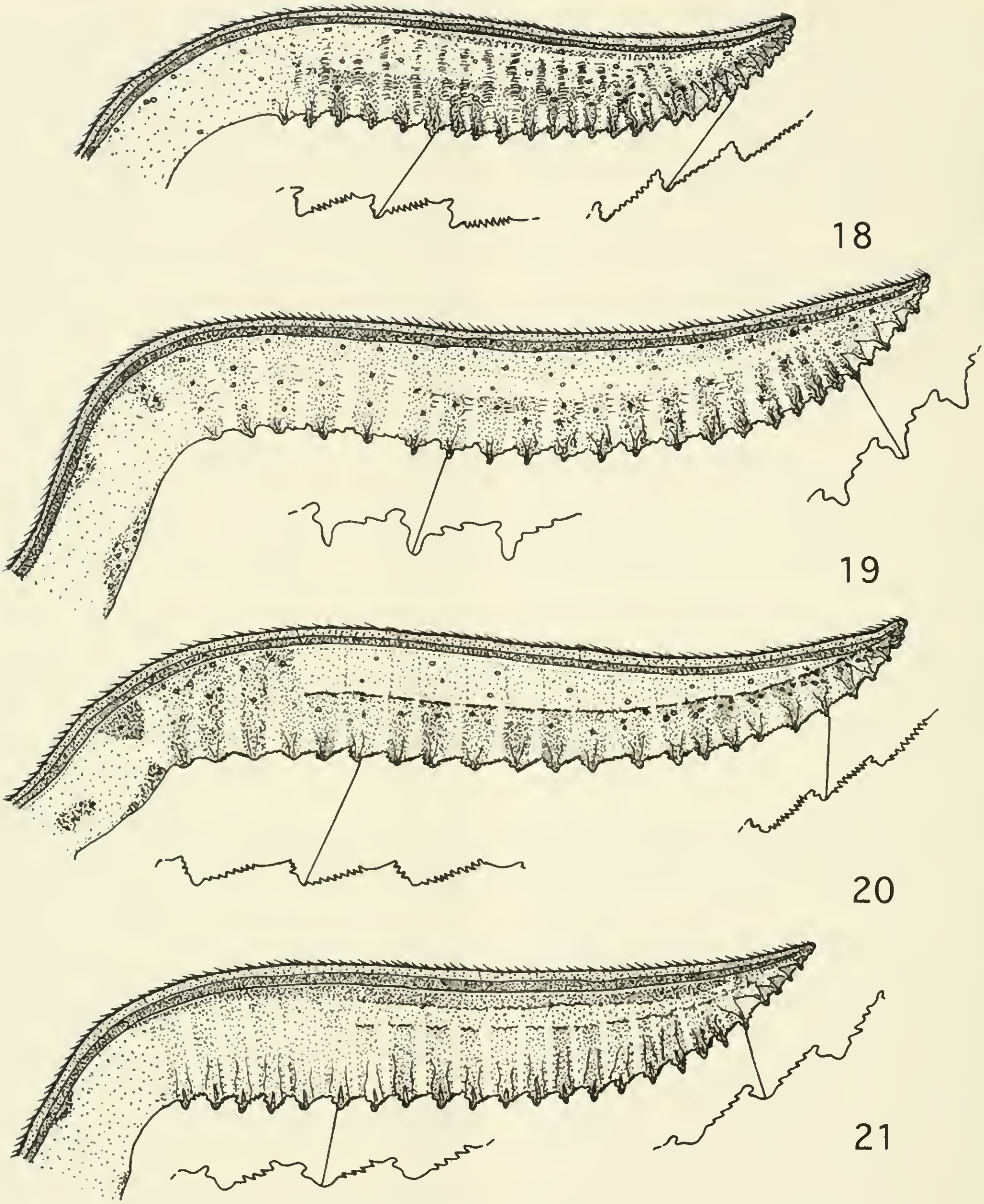
(Figs. 5, 13, 15, 20, 23, 28)

Female.—*Color:* Black with extreme apical tip of antennal segment 6 and segments 7 and 8 entirely, labrum, spot on anterior slope of mesoscutellum, longitudinal streak at center of tergites 2 and 3, extreme posterior margins and deflexed lateral sides of tergites 1–3, continuous medial broad band on sternites 2–5, and extreme apices of coxae, trochanters, and proximal margins of femora whitish yellow; scape, pedicel, antennal segment 3 more or less, dorsal aspect of segment 4, head except an irregular spot covering frontal area, ocellar region laterally not touching eye margins, posteriorly extending to hind margin of head in form of fine stripes lateral to lateral furrows, posterodorsal and posterolateral margins of pronotum, tegula, lateral margins of mesonotal middle lobe meeting at apex, band encircling whitish-yellow spot on mesoscutellum, broad rectangular spot on tergite 7 and abdominal segments 8 and 9 entirely, anterior aspects of coxae, pro- and mesofemora, outer tip of metafemur, tibiae and tarsi fuscoferruginous. Wings hyaline, costa and basal ⅓ of stigma fulvous, apical ⅔ of stigma and veins piceous.

Structure: Length 9.5 mm. Antennal length 3.4× head width, scape length 1.25× its breadth, antennal segments 3 and 4 subequal as 7:8, flagellum strongly compressed and flattened except basal 3 segments. Clypeus rectangularly incised, anterior margin smooth (Fig. 5). Malar space equal to diameter of median ocellus; LID:IDMO:EL = 8:8:5. Frontal area raised to level of eyes, supraclypeal and supraantennal pits well marked, supraantennal tubercles and frontal ridges indistinct, median fovea broad, deep and ditchlike and posteriorly clearly reaching median ocellus, post-, inter- and circumocellar furrows distinct, lateral furrows deep, distinct and ending abruptly slightly before hind margin of head, postocellar area convex, as long as broad, with distinct longitudinal carina on anterior ¼, head considerably prolonged behind eyes OOL:POL:OC:L = 5:4:5. Mesoscutellum roundly elevated with faint medial carina on its posterior slope, its appendage with median carina; ICD:ITD = 1:3. Tarsal claw (Fig. 13) with distinct basal lobe; metabasitarsus shorter than following joints combined as 6:7, IATS:MB:OATS = 5:16:5. Lancet (Fig. 20) with 22 serrulae; serrulae serrate; annular hairs absent to indistinct. Hypopygium as in Fig. 15.

Sculpture and pubescence: Head with dense, minute, irregular punctures, most prominent on frontal region, surface subshining. Mesonotum punctured like head; mesoscutellum with dense, large, shallow punctures, surface subshining; mesoscutellar appendage with few, large punctures, surface polished. Mesopleuron rugose with dense, large, pitlike confluent punctures mostly confined to region on and around its convexity. Mesosternum and mesepimeron with fine punctures, surface shining with general oily lustre. Abdomen impunctate, subshining. Body covered with silvery pubescence.

Male.—Length 8.5 mm. Similar to female except frontal spot laterally touching eye margins and posteriorly covering most of postocellar area; clypeus, posterodorsal angles of pronotum, metatarsus, abdominal segments 2–5 except medial streak, fuscous; lateral spots and a medial spot on anterior part of tergite 5 whitish yellow. Genitalia: Penis valve (Fig. 23), genital capsule (Fig. 28).



Figs. 18–21. Female lancet. 18, *Indostegia frontata*. 19, *I. apicicornis*. 20, *I. foveata*. 21, *I. vatsi*.

Material examined.—Holotype: ♀, India, Manipur, Ukhrul, 1,800 m, 23.ix.1992. Paratype: 1 ♂ with same data as holotype. Paratype at PUP.

Distribution.—India: Manipur.

Remarks.—*Indostegia foveata* is distinguished by the postocellar area as long as broad, the rectangularly incised clypeus with anterior margin smooth, not crenulate, and the median fovea broad, deep, ditch-like, and clearly reaching the median ocellus.

Etymology.—The species name is based on the characteristic shape of median fovea.

Indostegia vatsi Vasu, Saini, and Smith, new species

(Figs. 6, 10, 16, 21, 24, 29)

Female.—*Color:* Black with antennal segments 7 and 8, labrum, posterodorsal and posterolateral margins of pronotum, stripe along posterior margin of propodeum, deflexed lateral and extreme posterior margins of tergites 2–4, medial longitudinal band on sternites 2–6, extreme apices of coxae, trochanters, apical ⅓ of metabasitarsus and following metatarsal joints entirely whitish yellow; scape, pedicel, antennal segment 3 more or less, clypeus, mandible base, head except frontal spot anteriorly extending to antennae, laterally not touching eyes, and posteriorly covering entire interocellar area, posteroventral angle of pronotum, tegula, lateral margins of mesonotal middle lobe meeting at apex, broad irregular spot anterior to mesoscutellum, mesoscutellum, parapterum, nebulous spot along posterior margin of mesosternum, tergite 9, apical ⅔ of profemur, apical ⅓ of mesofemur, stripe along ⅔ of outer aspect of metafemur, tibiae except extreme apex of metatibia, basitarsi except apical ⅓ of metabasitarsus fuscoferruginous. Wings hyaline, costa fuscoferruginous, stigma and remaining veins piceous.

Structure: Average length 9.5 mm. Antennal length 3.8× head width, scape length 1.5× its apical width, antennal segments 3 and 4 subequal as 8:9, flagellum strongly compressed and flattened except 3 basal segments. Clypeus (Fig. 6) with anterior margin smooth. Malar space 1.25× diameter of median ocellus; LID:IDMO:EL = 7:7:4. Frontal area at level of eyes, supraclypeal and supraantennal pits well marked; supraantennal tubercles low, almost flat and posteriorly confluent with similar frontal ridges; median fovea with deep pit on its anterior half and posteriorly not reaching median ocellus, post-, inter-, and circumocellar furrow distinct; lateral furrows deep, distinct and reaching hind margin of head; postocellar area subconvex, with a distinct longitudinal carina in its anterior ¼, broader than long as 5:4, head considerably widened behind eyes; OOL:POL:OCL = 2:2:3. Mesoscutellum subconvex without carina, its appendage ecarinate, ICD:ITD = 2:7. Tarsal claw (Fig. 10) with large basal lobe; metabasitarsus equal to following tarsal joints combined, IATS:MB:OATS = 5:16:4. Lancet (Fig. 21) with 26 serrulae; serrulae serrate. Hypopygium as in Fig. 16.

Sculpture and pubescence: Frontal area with very minute, insignificant punctures, rest of head impunctate, surface shining. Mesonotum shining with fine inconspicuous punctures. Mesopleuron rugose with large, dense, irregular, pitlike confluent punctures along convexity, appendage impunctate, polished. Abdomen impunctate, shining. Body covered with blackish pubescence.

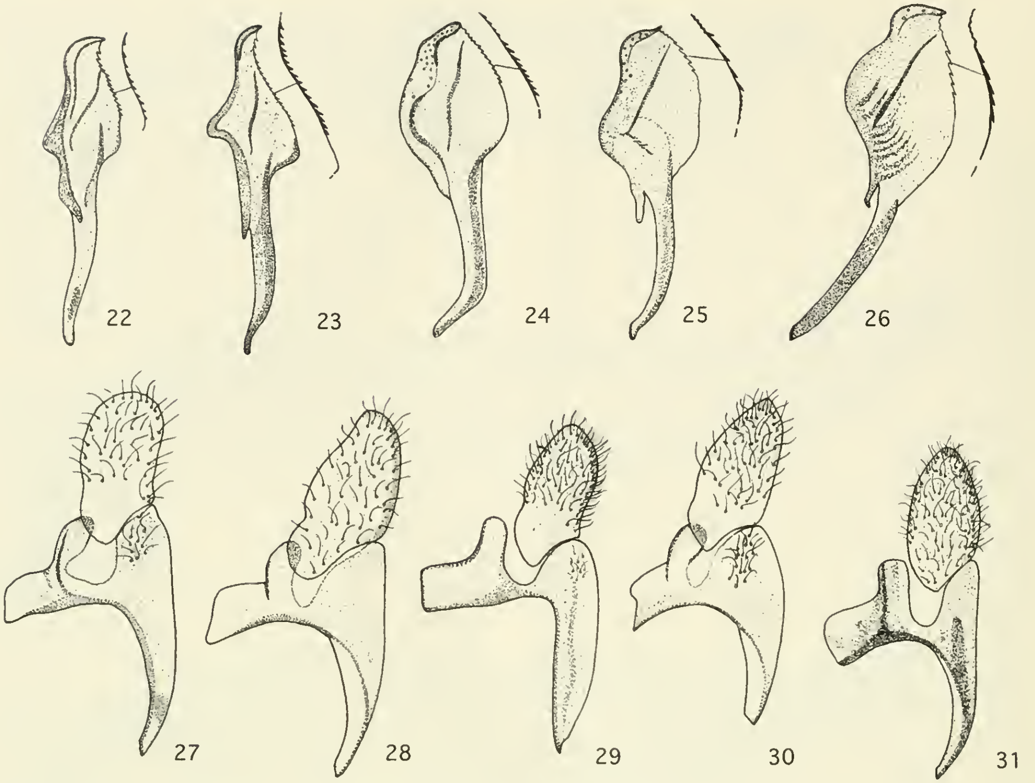
Male.—Length 8.5 mm. Similar to female except antennal segment 3 entirely black, extreme tip of antennal segment 6 whitish yellow. Frontal black spot laterally touching eyes and posteriorly extending to hind margin of head lateral to postocellar area. Fuscoferruginous spot on mesosternum missing. Genitalia: Penis valve (Fig. 24), genital capsule (Fig. 29).

Material examined.—Holotype: ♀, India, Sikkim, Gangtok, 1,700 m, 20.ix.1993. Paratypes: 1 ♀, 4 ♂ with same data as holotype; 4 ♂, India, West Bengal, Darjeeling, 2,280 m, 11.ix.1993. Paratypes at PUP.

Distribution.—India: Sikkim, West Bengal.

Remarks.—*Indostegia vatsi is* separated from other species by the broader than long postocellar area, median fovea not reaching the median ocellus, lateral furrows reaching the hind margin of head, roundly incised clypeus with the anterior margin smooth, and the ecarinate mesoscutellar appendage.

Etymology.—This species is named in memory of Late Prof. L. K. Vats of Kurukshetra University, Kurukshetra, India.



Figs. 22–31. Male genitalia. 22–26. Penis valves, lateral. 22, *I. frontata*. 23, *I. foveata*. 24, *I. vatsi*. 25, *I. ecarinata*. 26, *I. apicicornis*. 27–31, Genital capsule, ventral view of right half. 27, *I. frontata*. 28, *I. foveata*. 29, *I. vatsi*. 30, *I. ecarinata*. 31, *I. apicicornis*.

***Indostegia ecarinata* Vasu, Saini, and Smith, new species**

(Figs. 8, 11, 25, 30)

Female.—Unknown.

Male.—*Color:* Black with antennal segments 7 and 8, labrum, clypeus except medial spot, posterodorsal margin of pronotum, extreme posterior and deflexed lateral margins of tergites 2–4, medial spot on sternites 2–5, extreme apices of coxae, trochanters and adjacent parts of femora, metatarsus except metabasitarsus whitish yellow; scape, pedicel, medial spot on clypeus, head except frontal spot extending anteriorly between antennae, laterally to eyes in its upper part and posteriorly covering interocellar area extending backwards to reach hind margin of head lateral to lateral furrows only, broad medial spot on pronotum, tegula, lateral margins of mesonotal middle lobe meeting at apex, mesoscutellum more or less, tergite 9 entirely, sternite 7, apical ½ of profemur, anterior to apical ½ of mesofemur, extreme apex of anterior to apical ½ of metafemur, tibiae except extreme outer apical tip of metatibia, pro- and mesotarsi fuscoferruginous. Wing hyaline, costa and extreme base of stigma fulvous, remainder of stigma and rest of veins piceous.

Structure: Average length, 8.0 mm. Antennal length 4× head width, scape length 2× its apical width, antennal segments 3 and 4 as 3:4, flagellum strongly compressed and flattened except basal 2 segments. Clypeus rectangularly incised with anterior margin smooth (Fig. 8). Malar space 1.25× diameter of median ocellus; LID:IDMO:EL

= 4:4:3. Frontal area at level of eyes; supraclypeal and supraantennal pits well marked; supraantennal tubercles and frontal ridges indistinct; median fovea in form of deep pit in its anterior half and posteriorly not reaching median ocellus; post-, inter-, and circumocellar furrows very deep; lateral furrows deep, distinct and ending just before hind margin of head; postocellar area subconvex, broader than long as 6:5. Mesoscutellum roundly raised, without carina, its appendage faintly carinate, ICD: ITD = 2:5. Tarsal claw (Fig. 11) with broad basal lobe; metabasitarsus shorter than following joints combined as 6:7, IATS:MB: OATS = 5:16:4. Genitalia: Penis valve (Fig. 25), genital capsule (Fig. 30).

Sculpture and pubescence: Head with dense, minute punctures on frontal area, rest of head almost impunctate, surface shining. Mesonotum with few, sparse, inconspicuous punctures, mesoscutellum with few, large, shallow punctures on its posterior slope, appendage polished, mesopleuron rugose with large, pitlike confluent punctures on and along its convexity. Abdomen impunctate and subshining. Body covered with mixed blackish and silvery pubescence.

Material examined.—Holotype: ♂, India, Sikkim, Damthang, 1,600 m, 17.v.1993. Paratype: 1 ♂, India, Sikkim, Gangtok, 1,700 m, 20.ix.1993. Paratype at PUP.

Distribution.—India: Sikkim.

Remarks.—*Indostegia ecarinata* is distinguished from other species by the scape length twice as long as its apical width, antennal segment 3 shorter than 4, the rectangularly incised clypeus with the anterior margin smooth, and the tarsal claw with a large basal lobe.

Etymology.—The species name refers to the absence of a carina on postocellar area.

Indostegia apicicornis Malaise
(Figs. 7, 9, 17, 19, 26, 31)

Indostegia apicicornis Malaise 1934: 469.

Female.—*Color:* Black with antennal segments 7 and 8, labrum, posterodorsal and posterolateral margins of pronotum, stripe along posterior margin of propodeum, lateral spot on tergites 2–4, medial spot on sternites 2–4, extreme apices of meso- and metacoxae, trochanters, metabasitarsus and following metatarsal joints more or less whitish yellow; scape, pedicel, clypeus, mandible base, head except frontal spot extending anteriorly to antennae, laterally not touching eyes and posteriorly covering interocellar area, posteroventral angle of pronotum, tegula, lateral margins of mesonotal middle lobe meeting at apex, broad irregular spot anterior to mesoscutellum, mesoscutellum, a nebulous spot along posterior margin of mesosternum, apical 2/5 of meso- and metafemora, tibiae, basitarsi and following tarsal segments of pro- and mesolegs fuscoferruginous. Wings hyaline, veins piceous except extreme fulvous apex of subcosta; stigma piceous.

Structure: Average length 10.0 mm. Antennal length 3.4× head width, scape length 1.25× its apical width, antennal segments 3 and 4 subequal as 8:9, flagellum strongly compressed and flattened except 3 basal segments. Clypeus (Fig. 7) subsquarely incised with anterior margin of incision crenulate. Malar space 1.5× diameter of median ocellus; LID:IDMO:EL = 3:3:2. Frontal area at level of eyes; supraclypeal and supraantennal pits well marked; supraantennal tubercles indistinct and confluent with moderately raised frontal ridges; median fovea with broad, shallow pit in its anterior half, not reaching median ocellus; post-, inter-, and circumocellar furrows distinct; lateral furrows deep, distinct and abruptly ending just before hind margin of head; postocellar area subconvex with distinct longitudinal carina on its anterior ¼, broader than long as 5:4. Head parallel behind eyes, OOL: POL:OCL = 2:2:3. Mesoscutellum subconvex without carina, mesoscutellar appendage with distinct median carina; ICD:ITD = 2:7. Tarsal claw (Fig. 9) with minute, indistinct basal lobe; metabasitarsus shorter than following tarsal joints combined as 6: 7, IATS:MB:OATS = 4:10:3. Lancet (Fig.

19) with 24 serrulae; serrulae slender, lobelike. Hypopygium as in Fig. 17.

Sculpture and pubescence: Frontal area wrinkled and with dense, minute punctures, rest of head with fine, sparse punctures, surface shining. Mesonotum with minute, scattered punctures, surface shining, mesoscutellum with transverse row of large, shallow punctures on its posterior slope, surface shining, mesoscutellar appendage polished. Mesopleuron rugose with large, dense, irregular, pitlike confluent punctures on and along its convexity. Abdomen impunctate, shining. Body covered with mixed fuscous and silvery pubescence.

Male.—Average length 8.5 mm. Similar to female except frontal black spot laterally touching eye margins and posteriorly extending to hind margin of head lateral to lateral furrows; whitish yellow lateral spots on tergites 2–4 absent. Genitalia: Penis valve (Fig. 26), genital capsule (Fig. 31).

Holotype.—♀, Indian Museum, Zoological Survey of India, Calcutta; examined. From Darjeeling, Himalayas, alt. 7,000 ft., 2-VI-1917, E. Brunetti.

Specimens examined.—4 ♀, 5 ♂, India, Uttar Pradesh, Mandal, 2,300 m, 15.vi.1987; 2 ♀, 1 ♂, Kalamuni Top, 2,700 m, 26.vi.1991; 1 ♀, Munsyari, 2,290 m, 26.vi.1991; 1 ♀, 1 ♂, Chopta, 3,000 m, 25.vi.1992; 1 ♀, 5 ♂, Mastura, 1,800 m, 25.vi.1992; 1 ♂, Kilbury, 2,190 m, 22.vi.1993; 1 ♂, Meghalaya, Smit, 1,500 m, 3.v.1993; 1 ♂, Nagaland, Pfutsero, 2,100 m, 19.v.1993; 9 ♂, Manipur, Ukhrul, 1,800 m, 21.v.1993.

Variation.—Antennal segment 3 may be fuscoferruginous, and the clypeus and top of the mesoscutellum may be whitish yellow. A whitish yellow medial streak may be present on tergites 2–4, and the remaining tergites may be fulvous to fuscoferruginous. Tergites 7–9 may be whitish yellow to fuscoferruginous. The posterolateral slopes of mesoscutellum may have large, shallow, scattered punctures.

Distribution.—India: Uttar Pradesh, Nagaland, Meghalaya, Manipur.

Remarks.—The specimens we studied run to *Indostegia* in Malaise's key (1963) and comply well with Malaise's (1934) original description and type of *I. apicicornis*. This species is characterized by the subsquarely incised clypeus with the anterior margin crenulate, the malar space longer than the diameter of the median ocellus, the postocellar area broader than long with a distinct carina, the mesoscutellar appendage with a median carina, and the tarsal claw with an indistinct or minute basal lobe. In addition, the narrow, lobelike serrulae of the lancet (Fig. 19) differ from all other species of *Indostegia*.

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THE FAUNA OF TEPHRITIDAE (DIPTERA) FROM CAPITULA OF ASTERACEAE IN BRAZIL

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Abstract.—This is the first comprehensive survey of the fauna of Tephritidae that breed in capitula of Asteraceae in southern and southeastern Brazil, resulting from a sampling program begun in 1985. The Tephritidae is the most diverse and abundant family of endophages of Asteraceae flowerheads in Brazil. From approximately 1,800 samples of capitula from 403 species of Asteraceae, we reared 9,697 Tephritidae individuals belonging to 80 species and 18 genera. Of these, at least 31 species and 3 genera are undescribed, and 30% of the described species were not previously recorded from Brazil. The most diverse tribes of Asteraceae in the Neotropics, Vernonieae and Eupatorieae, have the greatest diversity of associated tephritids, although Vernonieae has a greater number of specialist species. Although the tribe Senecioneae is moderately diversified in the studied area, it is rarely attacked and has no specialist tephritid species, in contrast with other areas of the world. The tephritid fauna in Brazilian Asteraceae flowerheads is dominated by Neotropical genera (e.g., *Tomoplagia*, *Xanthaciura*, *Dictyotrypeta*, *Tetreuaresta*, and *Trypanaresta*) that represent 80% of the obtained species and 90% of the obtained individuals. Most of these tephritid species are restricted to one tribe or some lower taxonomic level of Asteraceae. The main host plants for 75% of them belong to one genus or group of related genera of host plants. Most of our host records for genera and species of tephritids agree with previously published records from other world regions, showing that there is little variation in the set of host plants of tephritid species and genera among areas. The geographic distribution and host plants for each genus are discussed, and a list of host plants and localities is presented, for the identified species, totaling 167 new host records.

Key Words: Tephritidae, Asteraceae, host records, checklist

Tephritidae are well known mainly because of the economic importance of various species of the subfamilies Trypetinae and Dacinae, whose larvae are pests of fleshy fruits (e.g., many species of the genera *Anastrepha*, *Dacus*, *Bactrocera*, *Rhagoletis* and *Ceratitis*). However, Asteraceae is the most important host family for Tephritidae worldwide (Zwölfer 1988, White and Elson-Harris 1992, Foote et al. 1993). The larvae of most species of the large subfamily Tephritinae breed in Asteraceae, forming galls in various parts or feeding in capitula, and some Trypetini (Trypetinae) mine stems or leaves of Asteraceae (Foote et al. 1993, Norrbom et al. 1999a, Han 1999). The association with Asteraceae is ancient and seems to have been a major factor in tephritid diversification (Zwölfer 1988, Straw 1989a, b). The high diversity and cosmopolitan distribution of the Tephritinae suggest the occurrence of a great radiation after the colonization of Asteraceae. Knowledge of Neotropical Tephritidae is still very incomplete, and is more developed for groups with economic relevance, mainly the genus *Anastrepha*. There is little information on the biology of most species, especially the Tephritinae, and even their taxonomy is far from complete (Foote 1980, Foote et al. 1993).

In Brazil, we started an extensive survey of endophagous insects of Asteraceae in 1985 to investigate the factors determining the local and regional richness in phytophagous insect communities (Lewinsohn 1988, 1991). The capitula of Asteraceae concentrate food in a protected place, and, as a result, shelter a rich and diversified fauna of endophagous insects (Zwölfer 1979, 1982, 1988; Lewinsohn 1988, 1991). Females of these insects lay their eggs on or in the capitula, and the larvae develop inside them, eating sap, flowers, ovules and/or fruits (Zwölfer 1979, 1988; Straw 1989a, b; Gielis 1993; Gagné 1994; Almeida 1997). In southern and southeastern Brazil, the main endophages of Asteraceae capitula belong to three Diptera families (Tephritidae, Cecidomyiidae and Agromyzidae) and four Lepidoptera families (Tortricidae, Pterophoridae, Pyralidae, and Gelechiidae), totaling at least 117 species (Lewinsohn 1988, 1991; Lewinsohn and Prado, in press; Lewinsohn et al., unpublished data). In temperate regions, the Tephritidae are always one of the families with greatest species richness and abundance among flower-head feeders (Zwölfer 1982, 1988; Sobhian and Zwölfer 1985, Straw 1989b; Foote et al. 1993).

The organization patterns of endophagous guilds in Brazilian Asteraceae flowerheads have already been partially analyzed (Lewinsohn 1991, Prado and Lewinsohn 1994, 2000), but a complete list of the species and genera that comprise these guilds has not yet been published. Here, we present the compiled records of Tephritidae reared from Asteraceae capitula sampled through 13 years at 48 localities in southern and southeastern Brazil. We characterized this insect fauna according to its composition, distribution and host plant use. We also present lists of the sample localities, and of the host plants of the described species.

METHODS

The data presented in this study were obtained from surveys of endophagous insects in Asteraceae flowerheads we made in southern and southeastern Brazil from 1985 to 1998. The majority of the data are from two surveys: from 1985 to 1988, seventy species of Asteraceae representing the main habitats, extent of geographical distribution, and taxonomic groups were sampled in eight areas of southeastern Brazil (Lewinsohn 1988); and from 1995 to 1997, we carried out a broader survey, expanding sampling for all Asteraceae to 32 localities within the states of Minas Gerais, Santa Catarina and Rio Grande do Sul. Apart from these extensive surveys that included the whole endophagous fauna, we also included data from more restricted samples, including: a one-year intensive survey of tephritids on plants of the tribe Vernonieae in Serra do Cipó (data for the genus *Tomoplagia* were partially compiled by Prado and Lewinsohn, 1994, but are updated here); surveys of capitula endophages of *Praxelis clematidea* (Griseb.) R. King and H. Rob. (Ortiz 1997) and *Trichogoniopsis adenantha* (DC.) R. King and H. Rob. (Almeida

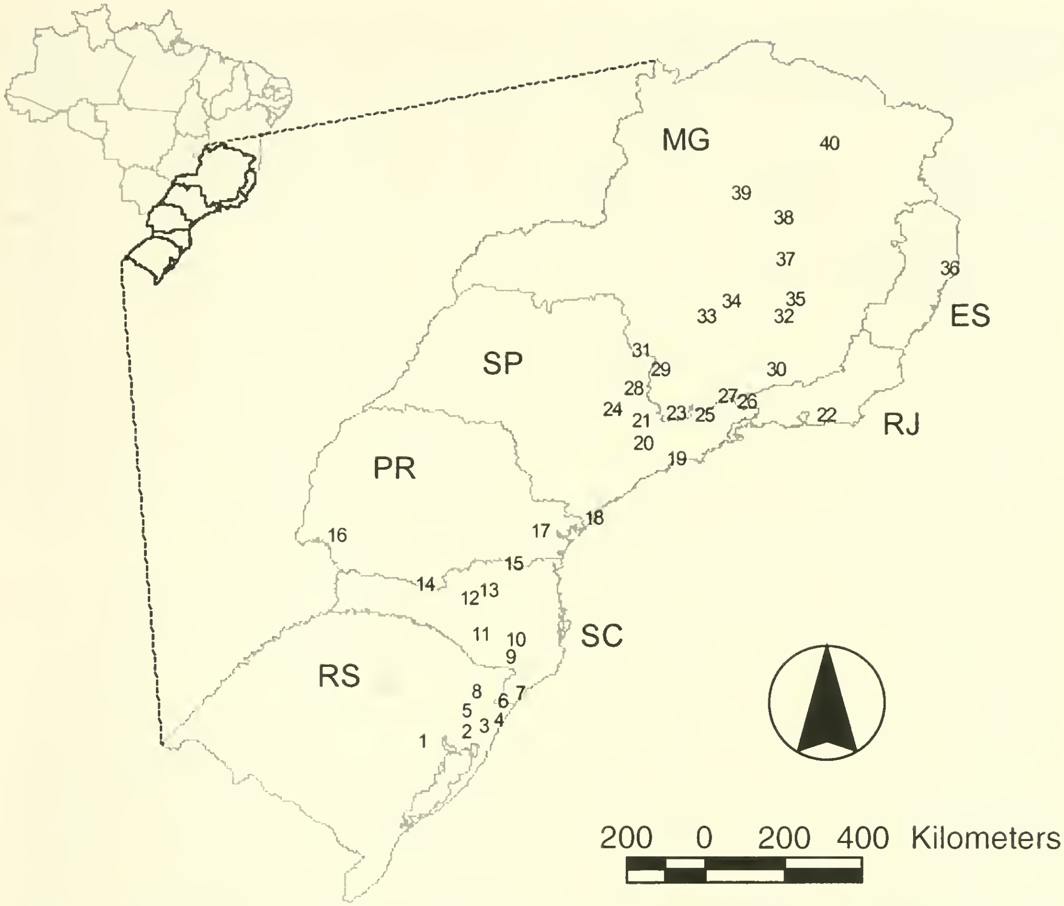

Fig. 1. States of southern and southeastern Brazil, with the localities where flowerheads were sampled. Abreviations of states: ES—Espírito Santo, MG—Minas Gerais, PR—Paraná, RJ—Rio de Janeiro, RS—Rio Grande do Sul, SC—Santa Catarina, SP—São Paulo. Localities and their code numbers are: Arceburgo, 31; Bertioga, 19; Bom Jardim da Serra, 9; Caçador, 13; Camanducaia, 23; Cambará do Sul, 8; Campinas, 21; Campos do Jordão, 25; Capão da Canoa, 3; Capão Novo, 4; Caraça, 35; Curitiba, 17; Diamantina, 38; Divinópolis, 34; Engenheiro Passos, 26; Formiga, 33; Grão Mogol, 40; Gravataí, 2; Guaíba, 1; Ilha do Cardoso, 18; Itatiaia, 26; Joaquim Felício (Serra do Cabral), 39; Jundiaí (Serra do Japi), 20; Lages, 11; Lauro Müller, 9; Lebon Régis, 12; Linhares, 36; Mafra, 15; Maquiné, 5; Maricá, 22; Matos Costa, 14; Mogi Guaçu, 28; Monte Verde, 23; Ouro Branco, 32; Parque Estadual de Ibitipoca, 30; Parque Nacional de Foz do Iguaçu, 16; Passa Quatro, 27; Pericó, 9; Piracicaba, 24; Poços de Caldas, 29; Praia Grande, 7; Santa Cecília, 12; Santo Antônio da Patrulha, 2; São Joaquim, 9; Serra do Cipó, 37; Visconde de Mauá, 26; Torres, 6; Urupema, 10. Some localities have the same number because they are not far enough to be represented as separate points in the map. See also Appendix II.

1997) in Serra do Japi, Jundiaí, São Paulo; and a survey of the endophages of the Tribe Eupatorieae in the Mantiqueira Mountain Range (Minas Gerais, São Paulo, and Rio de Janeiro) by Adriana Almeida and coworkers. Also, records of tephritids from sporadic samples of capitula obtained from 1989 to 1998 were added. Together, the records cover 48 localities from southern and southeastern Brazil (Fig. 1), comprising most of the region's main terrestrial habitats. Samples span all seasons, even though sampling was concentrated in the periods when most of the plant species are flowering, which varies between areas (summer and spring in southern areas, and summer and winter in southeastern areas). For the analysis of patterns of host use, species richness, and geographical distribution, we also used data from Lewinsohn (1991), Foote (1980), Foote et al. (1993), Prado and Lewinsohn (1994) and Norrbom et al. (1999a, b).

In the host use analyses, plant species were recorded as "main hosts" only of tephritid species that were reared from more than one flowerhead sample, or for which more than five flies were reared from a single sample. Plant species from which we reared five or fewer flies from a single sample were conservatively classified as "occasional hosts."

In each locality, we inspected an average of four sites with a minimum distance of 500 m from each other, and sampled capitula in different developmental stages, from those bearing young flowers to those with mature achenes. Capitula in the pre-anthesis stage, very dry, or with dispersing achenes were excluded. Seventy per cent of the localities were visited more than once. The number of sampled capitula varied according to their size and the availability of the plant at each site, ranging from tens to several thousand. Most of the samples were standardized from 500 ml to 1,000 ml of fresh volume, whenever possible. We also sampled at least one voucher for each plant sample, for identification. The capitula were kept in transparent plastic pots of 500 ml or 1,300 ml, covered with a mesh cap, in which the adult insects emerged. In the laboratory, the rearing pots were inspected at regular intervals of one to four days to remove adults. Adults were kept in a refrigerator at 15°C for at least 24 hours so that they would develop their natural color before being preserved. After 15 days with no further insect emergence, rearing was concluded; this usually occurred six to eight weeks after collection.

Except for *Tomoplagia* species, which were largely identified by P. Prado, at least some specimens of all tephritid species were identified by A. L. Norrbom. Additional specimens were identified by keys from the literature or Norrbom manuscripts and comparison with the above specimens. Most Tephritidae specimens listed in this study are deposited in entomological collections of the Museu de História Natural da Universidade Estadual de Campinas and the Laboratório de Interações Insetos-Plantas from the Departamento de Zoologia of Universidade Estadual de Campinas. Selected specimens were also deposited in the Museu de Zoologia de São Paulo, São Paulo, Brazil, and in the National Museum of Natural History, Smithsonian Institution, Washington, DC. Host plant vouchers are deposited in the Herbário da Universidade Estadual de Campinas, and some duplicates in the National Museum of Natural History, Smithsonian Institution.

RESULTS AND DISCUSSION

Characterization of the Fauna

We collected about 1,800 capitula samples from 403 Asteraceae species, comprising about 20% of the total described species for Brazil (Table 1). Taxonomically, this is a fairly unbiased sample of the Asteraceae regional flora—the proportion of sampled plant species did not vary much among tribes, ranging from 18% to 28% of described species of each tribe (Table 1). Endophagous tephritids emerged from 264 species of plants; these flies included a total of 80 tephritid species or morphospecies belonging to 18 genera (Tables 1–2).

Tephritidae is the most important family of endophagous insects feeding in Asteraceae capitula in Brazil. In our extensive survey of capitula endophages, they comprise 66% of the species, 55% of the genera, and 60% of the specimens, of all sampled insects. These results agree with lists of insect faunas from capitula in other world regions, in which tephritids are always among the most diverse and abundant families (Zwölfer 1982, 1988; Sobhian and Zwölfer 1985; Straw 1989a; Foote et al. 1993).

The largest Asteraceae tribes in Brazil also supported the greatest number of associated Tephritidae species (Table 1).

Table 1. Main Asteraceae tribes occurring in Brazil, and their numbers of described species, according to Barroso (1986). Other columns show, for each plant tribe, the number of sampled species in this study, the percentage of species with tephritid occurence, the total tephritid species number, and the number of tephritid species recorded exclusively in the tribe.

Asteraceae Tribe	No. Spp. in Brazil	No. Spp. Sampled	% Spp. with Tephritids	No. Spp. of Tephritidae	No. exclusive Spp. of Tephritidae
Astereae	203	37	46	14	6
Cardueae	17	3	0	0	0
Eupatorieae	616	147	52	28	6
Heliantheae	236	45	80	19	7
Inuleae[1]	56	10	20	3	3
Lactuceae	17	4	0	0	0
Mutisieae[2]	173	35	51	15	4
Senecioneae[3]	83	23	22	4	1
Helenieae	21	4	75	2	0
Vernonieae	442	125	82	40	24
TOTAL[4]	1,900	433	61	81	50

[1] Including the Plucheeae, Gnaphalieae and Inuleae s.s., separated subsequently as Tribes (Bremer 1994).

[2] Including the Barnadesioidea, separated subsequently as a subfamily (Bremer 1994).

[3] The only specimen of *Lamproxynella separata* we obtained was reared from one sample of *Senecio brasiliensis* (Speng.) Less. capitula, and is tentatively considered exclusive for Senecioneae.

[4] The total species for Brazil estimated by Barroso (1986) also includes the tribes Anthemideae, Calenduleae, and Cotuleae, from which we sampled no species.

Nonetheless, there are important differences between the two major tribes of Brazilian Asteraceae, Vernonieae and Eupatorieae. The Vernonieae have greater tephritid species richness and a greater proportion of plant species with these insects, despite the similar numbers of species in Brazil, and of the sampled species in these tribes (Table 1). The proportion of tephritid species exclusive to each tribe is also markedly greater among the Vernonieae, and very low in Eupatorieae (Table 1). Two possible nonexclusive explanations are that the Vernonieae are chemically and morphologically more distinct and/or were colonized by tephritid lineages intrinsically more specialized. The species from the main genera associated with Vernonieae (i.e., *Tomoplagia*, *Dictyotrypeta*, and *Tetreuaresta*), are normally restricted to related genera of host plants, in contrast to *Xanthaciura*, *Cecidochares* and *Trupanea* species, the most important genera associated with the tribe Eupatorieae. Five of the seven *Xanthaciura* species primarily associated with Eupatorieae occasionally use plants from the tribe Heliantheae, its sister group (Bremer 1994), and, more rarely, from the tribes Astereae and Vernonieae. Two of the three *Cecidochares* species have as an occasional host *Moquinia racemosa* (Spreng.) DC., which has a controversial tribal status but is not an Eupatorieae (Robinson 1994). Five of seven sampled *Trupanea* species may occur on Eupatorieae, but only one is exclusive to this tribe.

A notable exception to the general correlation of plant tribal diversity and tephritid diversity in southern Brazil is the virtual absence of endophagous tephritids on Senecioneae. From capitula samples of 22 Senecioneae species, we reared only one individual each of *Dioxyna chilensis* (Macquart), *Trypanaresta coelestina* (Hering), *Lamproxynella separata* (Malloch) (Appendix I), and *Trupanea* sp. The Senecioneae cannot be considered major hosts of any of these species, except perhaps *L. separata*, whose host range needs further investigation (see next section). In the Nearctic Region, capitula of Senecioneae are used by at least ten Tephritidae species in the genera

Table 2. Number of obtained Tephritidae specimens and species (described, undescribed and total), by genus. Total species exceeds the sum of described and undescribed species because it includes morphospecies of unclear taxonomic status (especially *Trupanea*). Also shown, the number of described species for each genus for the Neotropical Region (according to Norrbom et al. 1999a), and the tribes of the main host plants for each genus.

Genus	No. Specim.[1]	Descr. Spp.	Undescr. Spp.	Total Spp.	Neotrop. Spp.	Main Host Tribes
Acinia	37	3	0	3	9	Plucheeae
Acrotaeniini gen. 1	16	0	1	1		Vernonieae
Acrotaeniini gen. 2	31	0	1	1		Vernonieae
Acrotaeniini gen. 3	401	0	1	1		Mutisieae
Cecidochares	223	2	1	3	12	Eupatorieae
Dictyotrypeta	357	1	6	7	4	Vernonieae, Mutisieae, Heliantheae
Dioxyna	155	3	0	3	5	Heliantheae, Helenieae
Dyseuaresta	387	1	0	3	12	Heliantheae
Euarestoides	98	0	1	1	3	Mutisieae
Lamproxynela	1	1	0	1	8	Senecioneae
Neomyopites	105	1	1	2	28	Eupatorieae, Astereae
Paracantha	16	1	0	1	7	Heliantheae
Plaumannimyia	29	1	0	1	2	Astereae
Tetreuaresta	347	0	3	5	19	Vernonieae
Tomoplagia	3,375	12	13	25	45	Vernonieae[2]
Trupanea	713	0	0	8	80	Eupatorieae, Mutisieae
Trypanaresta	112	3	0	5	17	Astereae
Xanthaciura	3,294	6	3	9	17	Eupatorieae, Heliantheae
TOTAL	9,697	35	31	80	259	

[1] In order to show the relative importance of each genus, only specimens from extensive surveys (i.e., able to include all genera) are summed in this column.

[2] *Tomoplagia* is primarily associated with the tribe Vernonieae, but three species are specialists on other tribes: *T. costalimai* and *T. rivittata* (on Mutisieae), and *T. biseriata* (on Heliantheae).

Aciurina, *Stenopa*, *Tephritis*, *Trupanea*, and *Campiglossa* (Foote et al. 1993). Since the latter two genera also occur in the Neotropics, our finding of tephritid absence in Brazilian Senecioneae cannot be ascribed to the lack of colonizing groups. This absence might be attributed to the lower diversity of Senecioneae in Brazil compared to other important tribes (Table 1). However, in two tribes that are smaller and were less sampled than Senecioneae, tephritids are better represented (Table 1). In plants of the tribe Inuleae (genus *Pluchea*), we recorded three *Acinia* species (37 specimens) that are exclusive to this tribe (Table 2, and Appendix I). The only sampled genus of the tribe Helenieae, *Porophyllum*, includes main hosts of *Dioxyna chilensis* (16 specimens in *Porophyllum*, Appendix I) and an unidentified species of *Trupanea* (six specimens in *Porophyllum*). As already pointed out by Lewinsohn (1988), such scarcity of specialized tephritid species in Senecioneae is the first record of this nature for a whole Asteraceae tribe on a large geographical scale.

In Appendix I we list the 35 identified species, their host plants, and sample localities. One third of these species and three of the genera (*Acinia*, *Euarestoides*, and *Paracantha*) were not previously recorded for Brazil (Norrbom et al. 1999b).

The majority of the unidentified morphospecies are undescribed species, and they total a minimum of 31. The other species belong to genera whose species are difficult to identify because they are in need of systematic revision, especially *Trupanea*, *Trypanaresta* and *Dyseuaresta* (Foote et al. 1993). We also obtained three new genera, all belonging to the Tribe Acrotaeniini (Table 2), associated with endemic hosts of highland meadows on rocky outcrops (the Campo Rupestre vegetation, Giulietti and Pirani 1988). Also, the genus *Dictyotrypeta*, as currently recognized, may be polyphyletic (Norrbom and Prado, unpublished data).

More than a third (31 of 80) of the species we obtained are undescribed, and this indicates how little known taxonomically neotropical tephritids still are. It also suggests that tephritid species richness is much higher than currently known. Extrapolating the ratio of 39% of new species we found to the total of tephritid species described for the Neotropical Region (716 spp., Norrbom et al. 1999a), we achieve an estimate of approximately 990 species, similar to the number of species currently recognized in the Afrotropical and Oriental Regions, considered today the areas with the greatest Tephritidae richness (Norrbom et al. 1999a). Although the number of described species in these regions presumably will rise with new occurrence data and new descriptions (e.g., see Freidberg and Norrbom 1999), the Neotropical Region is perhaps the least studied (Foote et al. 1993), and may have a larger portion of its fauna unknown.

The Tephritidae fauna of Asteraceae capitula in Brazil is dominated by the genus *Tomoplagia*, which comprises 31% of the morphospecies and 35% of the reared specimens (Table 2). *Xanthaciura* and *Trupanea* are, respectively, the second and third most important genera, both in species and in specimen numbers (Table 2). The genera *Dictyotrypeta*, *Tetreuaresta* and *Trypanaresta* follow, with five to seven morphospecies and two to four percent of the specimens each (Table 2). For the other 12 genera there are a maximum of three morphospecies each, and together they represent 17% of total specimens (Table 2). This fauna is predominantly Neotropical, except for the genera *Trupanea*, *Dioxyna* (with cosmopolitan distribution), and *Paracantha* (Panamerican). The other genera are Neotropical in origin, totaling 80% of the species and 90% of the obtained specimens. The genus *Acinia*, as currently recognized, includes Palearctic and American species, but according to Korneyev (1999) the latter are not closely related to the former and should be removed, thus this group of species should also be considered of Neotropical origin.

Although our survey is restricted to part of Brazil, we obtained an average of 30% of the number of recorded species of the Neotropics for each genus. For *Tomoplagia*, for example, we obtained 25 morphospecies compared with 45 described neotropical species (55%). Other important genera in our sample show a similar trend, such as *Xanthaciura* (9 morphospecies compared with 17 described ones), *Trypanaresta* (5:17), and *Tetreuaresta* (5:19). For all of these examples, the proportions are high because we obtained not only a representative percentage of the described species, but also many undescribed ones. In the genus *Dictyotrypeta*, for example, we obtained more morphospecies than the number of described ones (7:4). In contrast, the numbers of morphospecies of *Trupanea*, *Paracantha*, *Lamproxynella*, and *Neomyopites* in this study were small in relation to the total species recorded in the Neotropics (7–15%, see Table 2). It is very doubtful that these genera are associated with plant families other than Asteraceae in Brazil, but at least some of the species might develop in plant organs other than the flowerheads. There are few species of these genera recorded for Brazil (Norrbom et al. 1999b), however, and they probably are more diversified in other areas in the Neotropical Region.

The endophagous Tephritidae of capitula in southern Brazil are highly specialized. Sixty percent of the species were obtained from hosts belonging to a particular Asteraceae tribe or lower taxonomic category (Fig. 2). The main hosts for 80% of the species are restricted to a subtribe or lower category, and only 4% of the species have main hosts in more than one tribe. Oligophagy may be a general trend in the Tephritinae, since similar degrees of specialization were observed in the Nearctic and Palearctic Regions (Zwölfer 1982; Sobhian

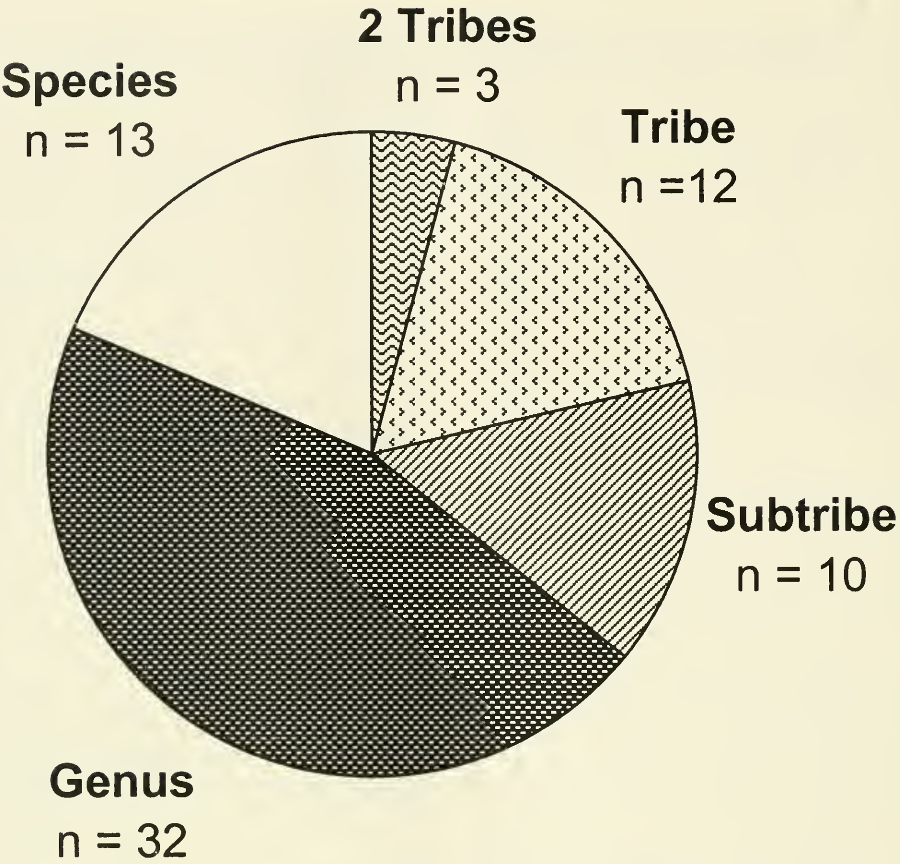

Fig. 2. Pie diagram of main host plant range of the obtained species of Tephritidae. Wedges represent the percentages of tephritid species reared from single host species, a single host genus, subtribe, or tribe, or from 2 tribes. Species reared from a single sample were excluded, because the data were too scarce to ascertain their host ranges.

and Zwölfer 1985; Goeden 1987, 1989, 1992, 1993, 1994, 1997; White and Elson-Harris 1992; Headrick and Goeden 1998). In the Tephritidae, capitula utilization depends on very specialized adaptations to the morphology, chemistry, and phenology of the host plant, which in general hinders the use of very different host plants (Zwölfer 1982, 1987; Straw 1989a, b). The genera of endophagous Tephritidae of capitula also are fairly specialized. Only three of the obtained genera have main host plants in more than two tribes. Two of these, *Tomoplagia* and *Dictyotrypeta*, are associated with three Asteraceae tribes, but are composed mostly of specialized species. *Tomoplagia* is mainly associated with one tribe (Vernonieae), with some species using plants from the tribes Mutisieae or Heliantheae. Among *Dictyotrypeta* species reared, two use plants of the related tribes Vernonieae and Mutisieae, two species are specialists on Heliantheae, and the remaining four species are associated with Vernonieae. Finally, *Trupanea* does in fact include many more generalist species and has been recorded from at least six different tribes of Asteraceae in other regions of the world (Munro 1964, Goeden 1992, White and Elson-Harris 1992, Foote et al. 1993). However, the genus is in dire need of revision, and host ranges of revised species may be smaller than they appear now.

As will be detailed in the next section, host plant taxa for tephritid species and genera agree with the published records from other world regions and the scarce records for the Neotropics (Foote et al. 1993, Norrbom et al. 1999a). The small variation in the host plants used, even in different biogeographic regions, suggests that the set of potential hosts for a particular Tephritidae taxon is under strong phylogenetic restriction, as suggested by Zwölfer (1982, 1987), Straw (1989b), and Lewinsohn and Prado (in press).

NOTES ON THE OBTAINED GENERA

In the following discussion, the genera are arranged alphabetically, except for *Euarestoides* and *Plaumannimyia*, which are discussed with *Trypanaresta.*

The genus *Acinia* has 13 described species, widely distributed in the Americas and Palearctic Region (Norrbom et al. 1999a,b). However, Korneyev (1999) has indicated that the nine American (mainly Neotropical) species should be removed from the genus. We obtained specimens of *A. picturata* (Snow) and *A. ica* Hering from *Pluchea laxiflora* Hook. and Arn. ex. Baker, and of *A. aurata* Aczél from *Pluchea sagitalis* (Lam.) Cabrera (Appendix I). According to these records and those of Aczél (1958), Frías (1992) and Foote et al. (1993), hosts of *Acinia* in the New World are restricted to the tribe Plucheeae (Inuleae s. l.). No *Acinia* species was previously recorded for Brazil (Norrbom et al. 1999a, b), although Foote (1980, Table 1) indicated he had examined Brazilian specimens in a geographical distribution table of Neotropical genera.

Cecidochares is a mainly Neotropical genus, although *C. caliginosa* (Foote) (transferred from *Procecidocharoides* by Norrbom et al. 1999a, b) occurs in the southwestern United States and Mexico. There are 13 described species (Norrbom et al. 1999a, b), and at least 10 undescribed (Norrbom, unpublished). Specimens identified as *C. connexa* (Macquart) are referred to as '*C. connexa* complex' (See Appendix I), because recent biological evidence suggest that they may be a complex of cryptic species (McFadyen et al. pers. com.). The species of *Cecidochares* of known biology are all associated with Eupatorieae, and most are gall makers (Lima 1934, Silva et al. 1968, Cruttwell 1974, Foote et al. 1993). We reared three species of *Cecidochares* from capitula of the Tribe Eupatorieae, most of them without signs of galling. In one sample of *C. connexa* complex (from *Chromolaena laevigata* (Lam.) R. King and H. Rob., Paraná State), however, there were galls within the flower heads.

Dictyotrypeta is an exclusively Neotropical genus with numerous undescribed species (Foote 1980, Norrbom and Prado, unpubl.). Its limits are not well established, and it may be polyphyletic. The species reared in this study may not be congeneric with *D. syssema* Hendel, the type species (Norrbom and Prado, unpublished). The biology of the genus is poorly known; Foote et al. (1993) stated that four species breed in Heliantheae flowers. Of the seven *Dictyotrypeta* morphospecies we recorded, three use Vernonieae hosts (including *D. atacta* (Hendel), see Appendix I), two use Heliantheae, and two species use hosts from the tribes Vernonieae and Mutisieae.

Dioxyna is a broadly distributed genus with 13 described species. In the New World, their hosts are mainly species of the related tribes Heliantheae and Helenieae. The North American and Caribbean species, *D. picciola* (Bigot), is a relative generalist, using plants from the tribes Astereae, Heliantheae and Helenieae, whereas *D. thomae* (Curran) is recorded only from *Bidens bipinnata* L. and *Wedelia* sp. (Heliantheae) (Foote et al. 1993). In our surveys, all of the main hosts for *D. thomae* and *D. peregrina* (Loew) belong to the genus *Bidens.* The third species we obtained, *D. chilensis* (Marcquart), was reared from *Isostigma* sp. (Heliantheae) and *Porophyllum ruderale* (Jacq.) Cass. (Helenieae) (Appendix I).

Dyseuaresta is a little known, American, mainly Neotropical genus (Foote 1980, Foote et al. 1993), with 12 described species (Norrbom et al. 1999a, b). Our data and records of *D. mexicana* (Wiedemann) from *Melanthera* spp. (Wasbauer 1972) suggest that this genus is primarily associated with the tribe Heliantheae. Frías (1992) reported *D. impluviata* (Blanchard) from *Senecio*, but this species may belong to *Lamproxynella*, a genus whose limits with *Dyseuaresta* are not well defined. We obtained *Dyseuaresta adelphica* (Hendel) from capitula of *Aspilia* spp. and from one species of *Calea* (Heliantheae). We reared two undescribed species, one from flowerheads of *Verbesina*, *Calea* and *Aspilia* (all Heliantheae), and the other from *Aspilia*, although both species occasionally used plants of the tribe Eupatorieae.

The genus *Lamproxynella* is exclusively Neotropical and is considered closely related to *Dyseuaresta* (Foote et al. 1993). Of eight described species, only *L. separata* (Malloch) is recorded from Brazil. We reared one specimen of this species from *Senecio brasiliensis* (Spreng.) Less. (Senecioneae) flowerheads (Appendix I). These data, and the rearing of two other species from Senecioneae in Chile (Norrbom, pers. obs.), are the only records of host plants of *Lamproxynella*, and suggest its association with the tribe Senecioneae.

The genus *Neomyopites*, which was recently proposed to include many of the New World species previously placed in *Urophora* (Freidberg and Norrbom 1999), has at least 28 described species, all but two of which are restricted to the Neotropical Region. Their known hosts belong to the tribes Astereae, Eupatorieae, Heliantheae, and Liabeae (Freidberg and Norrbom 1999). Some species induce galls in the capitula, as do many *Urophora* species in the Palearctic Region. We reared *N. paulensis* (Steyskal) from five Eupatorieae genera (Appendix I). This species is the main endophage of the genus *Mikania*, which is characterized by reduced capitula (with a maximum of four flowers), and has a poor endophagous fauna. The other species we obtained, which is probably undescribed, has a completely hyaline wing and was reared from only one sample of *Baccharis articulata* (Lam.) Pers. (Astereae). Both species were reared from normal capitula, with no sign of galling.

Paracantha is a genus restricted to the New World. Although five of its ten species occur in the Nearctic Region and can even reach southern Canada, the most closely related genera are all Neotropical (Foote et al. 1993). Until now, no species had been recorded for Brazil, although Foote (1980) indicated he had examined Brazilian specimens. The previously known hosts for *Paracantha* are from the genus *Cirsium* (tribe Cardueae) and several Heliantheae genera and species (Foote et al. 1993). We obtained individuals of *Paracantha australis* Malloch from five Heliantheae species from Minas Gerais, Rio Grande do Sul, and Santa Catarina (Appendix I). In Brazil, there are no native species of the tribe Cardueae, but three introduced species were sampled in southern Brazil (*Cirsium vulgare* (Savi) Ten., *Arctium minus* Bernh. and *Carduus nutans* L.). Although we collected a great volume of these plants in seven localities from Santa Catarina and Rio Grande do Sul, no *Paracantha* emerged from these samples.

Tetreuaresta is an exclusively Neotropical genus, with a great number of undescribed species (Foote 1980, Norrbom and Prado, unpublished). Its limits are not well established, and it may be polyphyletic. Biologically it is very poorly known, except for *Tetreuaresta obscuriventris* (Loew), introduced to Hawaii and other Pacific islands for control of its only known host plant, *Elephantopus mollis* H.B.K. (Vernonieae) (White and Elson-Harris 1992, Foote et al. 1993). The five *Tetreuaresta* species we obtained are all associated with Vernonieae hosts.

The Neotropical genus *Tomoplagia* has 47 described species (Norrbom et al. 1999a, b) and is primarily associated with the tribe

Vernonieae. Of the two species that occur in the United States, *T. obliqua* (Say) is recorded from at least seven Vernonieae species, and *T. cressoni* Aczél from *Trixis californica* Kellog and *Perezia microcephala* (DC.) A. Gray (Mutisieae) (Goeden and Headrick 1991, Foote et al. 1993). In Brazil, the association with Vernonieae had already been established (Lewinsohn 1988, Prado and Lewinsohn 1994), and *T. rudolphi* (Lutz and Lima) had been recorded making stem galls on *Vernonanthura* spp. (Lima 1934, Silva et al. 1968). The main hosts for all the species of *Tomoplagia* we obtained belong to this tribe, with three exceptions, namely, *T. costalimai* Aczél, which uses *Trixis* spp. (Tribe Mutisieae), *T. trivittata* (Lutz and Lima), which uses *Gochnatia* spp. (Mutisieae), and *T. biseriata* (Loew), which uses *Calea* spp. (Heliantheae) (Appendix 1). Plants of the tribes Mutisieae and Heliantheae are occasionally used by some other *Tomoplagia* species (Appendix 1). Therefore, the occasional use of Heliantheae and Mutisieae by an ancestor may have facilitated the evolution of the species specialized on these tribes.

Most species of *Tomoplagia* are restricted to only one tribe or to a lower taxonomic category of host plants. However, the most polyphagous species, *T. incompleta* (Williston), may occasionally use Mutisieae and Eupatorieae as hosts, apart from its Vernonieae main hosts (Appendix 1, Prado and Lewinsohn 1994). *Tomoplagia* belongs to the mostly Neotropical tribe Acrotaeniini (Norrbom 1987, Foote et al. 1993, but see also Korneyev 1999). The known host plants for other Acrotaeniini (genera *Tetreuaresta* and *Acrotaenia*) belong to the tribes Vernonieae and Heliantheae (Foote et al. 1993, Appendix 1). Among the Vernonieae, the subtribe Lychnophorinae is virtually endemic to montane rocky outcrops, with greatest diversity in the Serra do Espinhaço in Minas Gerais (Robinson et al. 1980, Robinson 1992, Bremer 1994). In this study, we obtained six new *Tomoplagia* species specialized on this subtribe. These species had not been sampled before and are associated with plants with limited distributions, hence they are also probably endemic to rocky outcrops (Prado et al., unpublished). We also obtained two species from two new genera of Acrotaeniini. One of these species uses *Lychnophora* spp., a genus restricted to highland meadows on rocky outcrops (campos rupestres) and adjacent Brazilian savannas (cerrados) from Minas Gerais, Bahia and Goiás (Coile and Jones 1981, Robinson et al. 1980, Robinson 1992). The other species was recorded from species of *Lychnophora* and *Eremanthus*, a genus found in campo rupestre and cerrado vegetation from central and southeastern Brazil (MacLeish 1987). About 400 specimens of a third Acrotaeniini genus were reared from capitula of *Wunderlichia mirabilis* Riedel (Mutisieae), a primitive Asteraceae also restricted to rocky outcrops of central Brazil (Bremer 1994).

Trupanea is one of the largest genera of Tephritinae, with more than 200 described species, including 80 in the Neotropical Region (Norrbom et al. 1999a, b). Species identification in this genus is extremely difficult, and the Neotropical fauna lacks an adequate taxonomic revision (Foote 1980, Foote et al. 1993). In a preliminary examination, we separated our *Trupanea* specimens into eight morphospecies that are mainly associated with the tribes Eupatorieae and Mutisieae. One morphospecies was also reared from *Porophyllum* (tribe Helenieae, formerly placed in the Heliantheae). The known hosts for *Trupanea* in the Nearctic Region belong to these three tribes (Wasbauer 1972; Goeden 1985, 1992; Foote et al. 1993). In Chile, the genus is recorded from the tribes Astereae and Heliantheae (Frías 1985). In the present study, the majority of *Trupanea* morphospecies had broader host ranges than the species of the other tephritid genera. Four morphospecies were recorded from two to five Asteraceae tribes.

Trypanaresta is a genus of Neotropical origin, with 17 described species (Norrbom et al. 1999a, b). The synonymy of *Euarestoides arnaudi* Foote with *E. flavus* (Adams) and its transfer to *Trypanaresta* (Norrbom et al. 1999b) expanded the known distribution of the genus to the Nearctic Region. *Trypanaresta* is closely related to *Plaumannimyia* (which has two described species, restricted to southern Brazil) and *Euarestoides* (three species in Central America, Mexico, and USA) (Norrbom et al. 1999a, b). Species of the tribe Astereae, mainly of the genus *Baccharis*, are recorded in the literature as hosts for the first two genera (Foote et al. 1993), which is in accord with our data. The two more abundant species of *Trypanaresta* in our surveys, *T. coelestina* (Hering) and *T. imitatrix* (Hering), were obtained from various *Baccharis* species (Appendix I), from either male or female flowers. The three remaining species were obtained in small numbers, and from few samples, also from Astereae. One individual of *T. thomsoni* (Hendel) was reared from capitula of *Solidago chilensis* Meyen (Appendix I), two individuals of an unidentified species were reared from *Conyza* spp. and *S. chilensis* capitula, and two individuals of another unidentified species were reared from capitula of *Conyza bonariensis* (L.) Cronquist (all in Astereae). We also obtained ten individuals of *Plaumannimyia pallens* Hering from capitula of *Baccharis* spp. in southern Brazil (Appendix I). In the genus *Euarestoides*, only the hosts of *E. acutangulus* (Thomson) were previously known, and these include species of the tribes Heliantheae, Helenieae and Astereae (Foote et al. 1993). In the present study, we obtained one undescribed species of *Euarestoides* from capitula of four species of *Gochnatia* (Mutisieae) from Minas Gerais and Rio de Janeiro. *Euarestoides* was not previously recorded from Brazil (Norrbom et al. 1999b).

Xanthaciura is a Neotropical and Nearctic genus with 17 described species (Norrbom et al. 1999a, b). It is known from the central, southeastern, southern and northeastern regions of Brazil and is associated with the tribes Heliantheae and Eupatorieae. The few published host plant data refer to three of the four species that reach the United States, *X. connexionis* Benjamin, *X. insecta* (Loew), and *X. tetraspina* (Phillips) (Foote et al. 1993), and their host plant tribes and genera are the same as presented in this study. The fourth species that reaches the United States, *X. chrysura* (Thomson), had no previously reported host plants (Foote et al. 1993). We recorded nine *Xanthaciura* species from Asteraceae capitula, three of them undescribed (Table 2). The most abundant species in our samples were *X. biocellata* (Thomson) and *X. chrysura*, both primarily associated with various genera of Eupatorieae (Appendix I). *Xanthaciura quadrisetosa* (Hendel), *X. mallochi* Aczél, and the three undescribed species are also primarily associated with Eupatorieae. *Xanthaciura insecta* (Loew) is primarily associated with the subtribe Coreopsidinae of the tribe Heliantheae, as shown by our records from *Bidens* spp. (Appendix I), and those of Wasbauer (1972) from *Bidens* spp. in the United States, and of Norrbom (in Foote et al. 1993) from *Bidens squarrosa* Kunth in Venezuela and *Dahlia coccinea* Cav. in Mexico. *Xanthaciura unipuncta* Malloch is also associated with Heliantheae, but also breeds in some species of Eupatorieae (Appendix I).

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Appendix I

Checklist of Described Tephritid Species Reared from Asteraceae Capitula in Southern and Southeastern Brazil

This appendix lists the described species obtained in our survey, their hosts, and sample sites. We also indicate the number of individuals of each species we obtained and the number of samples from which they were reared. Nomenclature and geographical distributions are in accord with Norrbom et al. (1999b). Localities are grouped by states, which are indicated by their abbreviations. Host plants are grouped by tribe. Plant species from which fewer than five tephritid individuals were reared from a single sample were conservatively considered occasional hosts. For a map of localities see Fig. 1, and for a list of them see Appendix II. For full scientific names of host plants, see Appendix III.

Acinia aurata Aczél
2 samples, 2 individuals.
Localities: SP: Bertioga, Campinas.
Previously known distribution: Bolivia, Argentina.
Main host: Inuleae: *Pluchea sagitalis.*

Acinia ica Hering
1 sample, 30 individuals.
Locality: MG: Ouro Branco.
Previously known distribution: Peru.
Main host: Inuleae: *Pluchea laxiflora.*

Acinia picturata (Snow)
1 sample, 5 individuals.
Locality: SC: Matos Costa.
Previously known distribution: USA, S to Guatemala, West Indies, Hawaii (introd.).
Main host: Inuleae: *Pluchea laxiflora.*

Cecidochares connexa (Macquart) complex
15 samples, 45 individuals.
Localities: MG: Camanducaia, Diamantina, Grão Mogol, Joaquim Felício (Serra do Cabral), Parque Estadual de Ibitipoca, Serra do Cipó, RJ: Visconde de Mauá.
Previously known distribution: Venezuela, Argentina, Brazil.
Main hosts: Eupatorieae: *Chromolaena chaseae, Chromolaena cylindrocephala, Chromolaena squalida, Pseudobrickellia brasiliensis.*
Occasional hosts: Eupatorieae: *Chromolaena ascendens, Chromolaena maximilianii, Chromolaena multiflosculosa, Chromolaena sp., Trichogonia salviaefolia, Trichogonia villosa,* Moquinieae: *Moquinia racemosa.*

Cecidochares fluminensis (Lima)
11 samples, 51 individuals.
Localities: MG: Monte Verde, Parque Estadual de Ibitipoca, Passa Quatro, RJ: Itatiaia, Visconde de Mauá, SP: Campinas, Campos do Jordão.
Previously known distribution: Central America, Trinidad, Venezuela, Guyana, Brazil (AM, RO, RJ, SP).
Main hosts: Eupatorieae: *Chromolaena maximilianii, Chromolaena laevigata.*
Occasional hosts: Eupatorieae: *Chromolaena hookeriana*

Dictyotrypeta atacta (Hendel)
8 samples, 192 individuals.
Localities: MG: Diamantina, Joaquim Felício (Serra do Cabral), Serra do Cipó.
Previously known distribution: Brazil, Paraguay.
Main hosts: Vernonieae: *Lessingianthus buddleiifolius, Lessingianthus coriaceus, Lessingianthus roseus, Lessingianthus vepretorum.*
Occasional hosts: Vernonieae: *Proteopsis argentea,* Eupatorieae: *Trichogonia villosa.*

Dioxyna chilensis (Macquart)
7 samples, 77 individuals.
Localities: MG: Diamantina, Joaquim Felício (Serra do Cabral), RS: Guaíba, SP: Campinas.
Previously known distribution: Peru, Bolivia, Chile, Argentina.
Main hosts: Heliantheae: *Isostigma* sp., Helenieae: *Porophyllum ruderale.*
Occasional hosts: Heliantheae: *Calea graminifolia,* Helenieae: *Porophyllum riedelii,* Senecioneae: *Senecio oxyphyllus.*

Dioxyna peregrina (Loew)
7 samples, 26 individuals.
Localities: MG: Passa Quatro, SP: Bertioga, Campinas, Campos do Jordão, Jundiaí (Serra do Japi).
Previously known distribution: Brazil
Main host: Heliantheae: *Bidens pilosa.*
Occasional host: Eupatorieae: *Praxelis clematidea.*

Dioxyna thomae (Curran)
3 samples, 39 individuals.
Localities: MG: Diamantina, Grão Mogol, Joaquim Felício (Serra do Cabral).
Previously known distribution: U.S.A. (Florida), West Indies, Guyana.
Main hosts: Heliantheae: *Bidens* spp. (two species).

Dyseuaresta adelphica (Hendel)
23 samples, 202 individuals.
Localities: MG: Diamantina, Grão Mogol, Joaquim Felício (Serra do Cabral), Ouro Branco, Serra do Cipó.
Previously known distribution: Brazil (MS, PR), Paraguay.
Main hosts: Heliantheae: *Aspilia jolyana, Aspilia cylindrocephala, Aspilia laevissima,* six other undetemined species of *Aspilia.*
Occasional hosts: Heliantheae: *Aspilia foliacea,* two other undetemined species of *Aspilia* spp., *Calea* sp.

Lamproxynella separata (Malloch)
1 sample, 1 individual.
Locality: MG: Poços de Caldas.
Previously known distribution: Brazil (SP), Argentina.
Host: Senecionieae: *Senecio brasiliensis.*

Neomyopites paulensis (Steyskal)
37 samples, 130 individuals.
Localities: MG: Camanducaia, Diamantina, Grão Mogol, Joaquim Felício (Serra do Cabral), Ouro Branco, Parque Estadual de Ibitipoca, Passa Quatro, Ser-

ra do Cipó, RJ: Maricá, Visconde de Mauá, SC: Lages, Mafra, SP: Bertioga, Campinas, Campos do Jordão.

Previously known distribution: Trinidad, Paraguay, Brazil (SP).

Main hosts: Eupatorieae: *Ayapana amigdalina, Chromolaena laevigata, Chromolaena maximilianii, Chromolaena squalida, Grazielia intermedia, Mikania cipoensis, Mikania micrantha, Mikania officinalis, Mikania sessilifolia, Praxelis clematidea, Stomathanthes polycephalus, Symphyopappus decussatus.*

Occasional hosts: Eupatorieae: *Chromolaena chaseae, Chromolaena odorata, Mikania retifolia, Mikania sp., Pseudobrickellia brasiliensis.*

Paracantha australis Malloch
5 samples, 16 individuals.

Localities: MG: Serra do Cipó, Diamantina, RS: Cambará do Sul, SC: Bom Jardim da Serra, Lages.

Previously known distribution: Argentina, Uruguay.

Main hosts: Heliantheae: *Calea* spp. (at least three species).

Occasional hosts: Heliantheae: *Aspilia* sp., *Verbesina subcordata.*

Plaumannimyia pallens Hering
4 samples, 10 individuals.

Localities: RS: Guaíba, SC: Lages, Matos Costa, Pericó.

Previously known distribution: Brazil (SC).

Main hosts: Astereae: *Baccharis dracunculifolia, Baccharis punctulata, Baccharis uncinella, Baccharis* spp. (at least two other species).

Tomoplagia argentiniensis Aczél
39 samples, 300 individuals.

Localities: ES: Linhares, MG: Serra do Cipó, Ouro Branco, RJ: Itatiaia, SP: Campinas, Ilha do Cardoso, Jundiaí (Serra do Japi).

Previously known distribution: Brazil (MG, RJ, SP), Argentina.

Main host: Vernonieae: *Cyrtocymura scorpioides.*

Tomoplagia biseriata (Loew)
4 samples, 29 individuals.

Localities: MG: Diamantina, Grão Mogol, SC: Lages.

Previously known distribution: Ecuador, Brazil.

Main hosts: Heliantheae: *Calea nitida, Calea oxyleps, Calea* spp. (at least two other species).

Tomoplagia costalimai Aczél
16 samples, 83 individuals.

Localities: MG: Diamantina, Grão Mogol, Joaquim Felício (Serra do Cabral), Serra do Cipó, RS: Guaíba, SC: Lages, Matos Costa, SP: Jundiaí (Serra do Japi).

Previously known distribution: Argentina.

Main hosts: Mutisieae: *Trixis mollissima, Trixis praestans, Trixis vauthieri, Trixis verbasciformis.*

Occasional hosts: Mutisieae: *Jungia floribunda.*

Tomoplagia fiebrigi Hendel
5 samples, 46 individuals.

Localities: MG: Joaquim Felício (Serra do Cabral), RS: Guaíba, SC: Lages.

Previously known distribution: Paraguay, Argentina.

Main hosts: Vernonieae: *Vernonanthura aff. lucida, Vernonanthura nudiflora.*

Occasional host: Vernonieae: *Vernonanthura tweedieana.*

Tomoplagia formosa Aczél
13 samples, 45 individuals.

Localities: MG: Caraça, Diamantina, Serra do Cipó, PR: 20 km SE of Curitiba, RJ: Visconde de Mauá, RS: Guaíba, SC: Bom Jardim da Serra, Lages, São Joaquim.

Previously known distribution: Brazil (MG), Argentina.

Main hosts: Vernonieae: *Chrysolaena flexuosa, Chrysolaena platensis, Lepidaploa salzmanii.*

Occasional hosts: Vernonieae: *Chrysolaena herbacea, Lessingianthus (Oligocephalus) desertorum,* Heliantheae: *Verbesina* sp.

Tomoplagia incompleta (Williston)
132 samples, 512 individuals.

Localities: MG: Diamantina, Grão Mogol, Joaquim Felício (Serra do Cabral), Passa Quatro, Ouro Branco, Serra do Cipó, RJ: Itatiaia, RS: Capão Novo, Guaíba, SC: Bom Jardim da Serra, Lages, Mafra, Pericó.

Previously known distribution: West Indies, Paraguay, Brazil (MG), Argentina.

Main hosts: Vernonieae: *Chresta sphaerocephala, Chrysolaena flexuosa, Chrysolaena herbacea, Chrysolaena platensis, Echinochoryne schwenkiaefolia, Lepidaploa lilacina, Lepidaploa spixiana, Lepidaploa salzmanii, Lessingianthus (Oligocephalus) simplex, Lessingianthus carduoides, Lessingianthus linearis, Lessingianthus linearifolius, Lessingianthus psilophyllus, Lessingianthus pumillus, Lessingianthus roseus, Lessingianthus stoechas, Lessingianthus vepretorum.*

Occasional hosts: Eupatorieae: *Chromolaena laevigata, Heterocondylus alatus, Mikania sessilifolia,* Mutisieae: *Gochnatia amplexifolia, Trixis vauthieri,* Vernonieae: *Chresta* sp., *Eremanthus* sp., *Lepidaploa* sp., *Lessingianthus (Oligocephalus) desertorum, Lessingianthus brevipetiolatus, Lessingianthus coriaceus, Lessingianthus glabratus, Lessingianthus laevigatus, Lessingianthus poliphyllus, Lessingianthus rubricaulis, Lessingianthus sellowii, Lessingianthus warmingianus, Minasia* sp., *Vernonia incana, Vernonanthura glanduloso-dentata.*

Tomoplagia minuta Hering
48 samples, 648 individuals.

Localities: MG: Diamantina, Formiga, Grão Mogol, Monte Verde, Ouro Branco, Parque Estadual de Ibitipoca, Serra do Cipó, RJ: Itatiaia, Visconde de

Mauá, RS: Cambará do Sul, SC: Lages, Matos Costa, Mafra.

Previously known distribution: Brazil (MG, SP, SC).

Main hosts: Vernonieae: *Vernonanthura beyrichi, Vernonanthura catharinensis, Vernonanthura chamaedrys, Vernonanthura mariana, Vernonanthura membranacea, Vernonanthura montevidensis, Vernonanthura phaeoneura, Vernonanthura phosphorica, Vernonanthura subverticillata, Vernonanthura westiniana.*

Occasional host: Vernonieae: *Vernonanthura petiolaris, Vernonanthura tweedieana.*

Tomoplagia punctata Aczél

7 samples, 27 individuals.

Localities: MG: Grão Mogol, Joaquim Felício (Serra do Cabral), Ouro Branco, RJ: Itatiaia, Visconde de Mauá, SP: Bertioga.

Previously known distribution: Argentina.

Main host: Vernonieae: *Centratherum punctatum.*

Tomoplagia pseudopenicillata Aczél

14 samples, 55 individuals.

Localities: MG: Ouro Branco, Serra do Cipó, SP: Ilha do Cardoso, Campinas.

Previously known distribution: Brazil (MG, SP).

Main host: Vernonieae: *Cyrtocymura scorpioides.*

Tomoplagia reimoseri Hendel

57 samples, 1093 individuals.

Localities: MG: Diamantina, Formiga, Grão Mogol, Joaquim Felício (Serra do Cabral), Ouro Branco Serra do Cipó.

Previously known distribution: Trinidad, Venezuela, Paraguay, Brazil, Argentina.

Main hosts: Vernonieae: *Vernonanthura glanduloso-dentata, Vernonanthura mariana, Vernonanthura membranacea, Vernonanthura mucronulata, Vernonanthura phosphorica, Vernonanthura subverticillata, Vernonanthura* spp. (at least two other species).

Occasional hosts: Astereae: *Baccharis aphylla,* Vernonieae: *Cyrtocymura scorpioides, Minasia* sp.

Tomoplagia tripunctata Hendel

56 samples, 133 individuals.

Localities: MG: Caraça, Diamantina, Ouro Branco, Parque Estadual de Ibitipoca, Serra do Cipó.

Previously known distribution: Paraguay, Brazil.

Main hosts: Vernonieae: *Lessingianthus brevipetiolatus, Lessingianthus carduoides, Lessingianthus linearifolius, Lessingianthus linearis, Lessingianthus psilophyllus, Lessingianthus roseus, Lessingianthus vepretorum.*

Occasional hosts: Mutisieae: *Trixis vauthieri,* Vernonieae: *Lessingianthus pumillus, Lessingianthus rosmarinifolius, Lessingianthus stoechas, Lessingianthus pycnostachyus.*

Tomoplagia trivittata (Lutz & Lima)

2 samples, 14 individuals.

Localities: MG: Joaquim Felício (Serra do Cabral), SP: Mogi Guaçu.

Previously known distribution: Brazil (MG, SP, MS), Argentina.

Main hosts: Mutisieae: *Gochnatia barrosii, Gochnatia floribunda.*

Trypanaresta coelestina (Hering)

14 samples, 76 individuals.

Localities: MG: Diamantina, Ouro Branco, Passa Quatro, Serra do Cipó, PR: 25 km SE of Curitiba, RS: Cambará do Sul, Santo Antônio da Patrulha, SC: Lages.

Previously known distribution: Brazil (PR, SC).

Main hosts: Astereae: *Baccharis dracunculifolia, Baccharis helichrysoides, Baccharis leucopappa, Baccharis brachylaenoides* var. *ligustrina, Baccharis trinervis.*

Occasional hosts: Astereae: *Baccharis brachylaenoides, Baccharis ramosissima, Baccharis serrulata,* Senecionieae: *Senecio selloi.*

Trypanaresta imitatrix (Hering)

6 samples, 11 individuals.

Localities: MG: Ouro Branco, Serra do Cipó, PR: Parque Nacional de Foz do Iguaçu, RS: Guaíba, SP: Campinas.

Previously known distribution: Brazil (SP to SC), Argentina.

Main hosts: Astereae: *Baccharis dracunculifolia, Baccharis punctulata, Baccharis trinervis, Heterothalamus psiadioides.*

Trypanaresta thomsoni (Hendel)

8 samples, 12 individuals.

Localities: RJ: Maricá, SC: Santa Cecília, SP: Bertioga, Campinas.

Previously known distribution: Bolivia, Argentina.

Main hosts: Astereae: *Conyza canadensis, Conyza bonariensis.*

Occasional hosts: Astereae: *Solidago chilensis,* Inuleae: *Pluchea sagitalis.*

Xanthaciura biocellata (Thomson)

165 samples, 1,506 individuals.

Localities: MG: Diamantina, Grão Mogol, Joaquim Felício (Serra do Cabral), Ouro Branco, Parque Estadual de Ibitipoca, Passa Quatro, Serra do Cipó, RJ: Engenheiro Passos, Itatiaia, Maricá, Visconde de Mauá, RS: Gravataí, SP: Bertioga, Campinas, Campos do Jordão.

Previously known distribution: Peru, Bolivia, Paraguay, Brazil, Uruguay, Argentina.

Main hosts: Eupatorieae: *Ageratum fastigiatum, Ayapana amigdalina, Barrosoa betonicaeformis, Chromolaena barbacensis, Chromolaena chaseae, Chromolaena costatipes, Chromolaena cylindrocephala, Chromolaena decumbens, Chromolaena hookeriana, Chromolaena horminoides, Chromolaena laevigata, Chromolaena maximilianii, Chromolaena minasgeraesensis, Chromolaena pedalis,* *Chromolaena pungens, Chromolaena sagittifera, Chromolaena squalida, Heterocondylus alatus, Heterocondylus amphidictyus, Heterocondylus jaraguensis, Koanophyllon adamantium, Praxelis clematidea, Symphyopappus cuneatus, Symphyopappus decussatus, Trichogonia hirtiflora, Trichogonia salviaefolia, Trichogonia villosa, Trichogoniopsis adenantha.*

Occasional hosts: Eupatorieae: *Acritopappus longifolius, Pseudobrickellia brasiliensis, Campuloclinium campuloclinoides, Campuloclinium chlorolepsis, Campuloclinium macrocephalum, Campuloclinium megacephalum, Chromolaena congesta, Chromolaena matogrossensis, Chromolaena multiflosculosa, Chromolaena myriocephala, Chromolaena odorata, Chromolaena stachyophylla, Symphyopappus reticulatus, Symphyopappus* aff. *reticulatus,* Mutisieae: *Inulopsis scaposa,* Vernonieae: *Lessingianthus (Oligocephalus) virgulatus, Lessingianthus hovaefolius, Lychnophora* sp., *Vernonanthura mariana.*

Xanthaciura chrysura (Thomson)

167 samples, 829 individuals.

Localities: MG: Arceburgo, Camanducaia, Caraça, Diamantina, between Formiga e Divinópolis, Grão Mogol, Joaquim Felício (Serra do Cabral), Monte Verde, Ouro Branco, Parque Estadual de Ibitipoca, Passa Quatro, Serra do Cipó, RJ: Engenheiro Passos, Itatiaia, Visconde de Mauá, RS: Cambará do Sul, Guaíba, Gravataí, SC: Bom Jardim da Serra, Lages, Matos Costa, Mafra, Pericó, SP: Bertioga, Campinas, Campos do Jordão, Ilha do Cardoso, Ilha Comprida, Jundiaí (Serra do Japi).

Previously known distribution: USA (Florida), from Mexico to Argentina.

Main hosts: Eupatorieae: *Adenostemma lavenia, Ageratum conyzoides, Ageratum fastigiatum, Ageratum* sp., *Austroeupatorium inulaefolium, Austroeupatorium paulinum, Austroeupatorium silphiifolium, Barrosoa betonicaeformis, Campovassouria cruciata, Campuloclinium macrocephalum, Campuloclinium purpurascens, Chromolaena chaseae, Chromolaena cylindrocephala, Chromolaena horminoides, Chromolaena laevigata, Chromolaena maximilianii, Chromolaena minasgeraesensis, Chromolaena pungens, Chromolaena squalida, Hatschbachiella tweedieana, Heterocondylus alatus, Heterocondylus grandis, Heterocondylus jaraguensis, Grazielia gaudichaudeana, Grazilellia intermedia, Praxelis clematidea, Trichogonia hirtiflora, Trichogoniopsis adenantha.*

Occasional hosts: *Austroeupatorium picturatum, Chromolaena barbacensis, Chromolaena hookeriana, Chromolaena matogrossensis, Chromolaena multiflosculosa, Chromolaena myriocephala, Chromolaena pedalis, Chromolaena* spp. (at least three other species), *Grazielia* sp., *Koanophyllon thysanolepis, Mikania cipoensis, Mikania cordifolia, Mikania decumbens, Mikania lasiandrae, Mikania micrantha, Mikania officinalis, Mikania sessilifolia, Symphyopappus decussatus, Symphyopappus itatiayensis, Vittetia orbiculata,* Heliantheae: *Aspilia pascalioides,* Vernonieae: *Eremanthus* sp.

Xanthaciura insecta (Loew)

3 samples, 31 individuals.

Localities: MG: Diamantina, Joaquim Felício (Serra do Cabral), Ouro Branco.

Previously known distribution: USA, Mexico to Venezuela, West Indies.

Main hosts: Heliantheae: *Bidens brasiliensis, Bidens* sp.

Xanthaciura mallochi Aczél

3 samples, 10 individuals.

Localities: MG: Parque Estadual de Ibitipoca.

Previously known distribution: Costa Rica, Panama, Colobia, Ecuador, Peru, n. Argentina, s. Brazil.

Main host: Eupatorieae: *Chromolaena maximilianii.*

Xanthaciura quadrisetosa (Hendel)

27 samples, 51 individuals.

Localities: MG: Diamantina, Grão Mogol, Joaquim Felício (Serra do Cabral), Ouro Branco, Parque Estadual de Ibitipoca, Passa Quatro, RS: Capão Novo, SC: Lages, RJ: Visconde de Mauá, SP: Campos do Jordão, Piracicaba.

Previously known distribution: Bolivia, Brazil, Argentina.

Main hosts: Eupatorieae: *Ageratum conyzoides, Ageratum fastigiatum, Campovassouria cruciata, Koanophyllon thysanolepis, Mikania purpurascens.*

Occasional hosts: Eupatorieae: *Austroeupatorium* sp., *Grazielia intermedia, Symphyopappus casarettoi,* Heliantheae: *Bidens* sp., *Calea nitida.*

Xanthaciura unipuncta Malloch

22 samples, 79 individuals.

Localities: MG: Diamantina, Guaíba, Grão Mogol, Joaquim Felício (Serra do Cabral), Ouro Branco, Serra do Cipó, RJ: Engenheiro Passos, Maricá, SC: Lages, Pericá, SC: Lages, Pericó, SP: Bertioga, Campinas.

Previously known distribution: Guatemala to Colombia and Trinidad, Paraguay, Brazil, Argentina.

Main hosts: Eupatorieae: *Campovassouria cruciata,* Heliantheae: *Aspilia cylindrocephala, Aspilia jolyana, Aspilia* spp. (at least four species), *Wedelia paludosa.*

Occasional hosts: Astereae: *Baccharis punctulata,* Eupatorieae: *Barrosoa betonicaeformis, Chromolaena squalida, Mikania purpurascens, Trichogonia villosa,* Heliantheae: *Aspilia montevidensis, Calea elongata, Calea* sp. Vernonieae: *Cyrtocymura scorpioides.*

Appendix II

Gazetteer

This appendix lists the sites sampled in this study and their state (ES—Espírito Santo; MG—Minas Gerais; PR—Paraná; RJ—Rio de Janeiro; RS—Rio Grande do Sul; SC—Santa Catarina; SP—São Paulo), their code number in Fig. 1, and their geographical coordinates. Some localities have the same code number because they are not far enough apart to be represented as separate points in the map in Fig. 1.

Code	Locality	State	Coordinates
1	Guaíba	RS	30°11′S51°51′W
2	Gravataí	RS	29°55′S50°50′W
2	Santo Antônio da Patrulha	RS	29°53′S50°50′W
3	Capão da Canoa	RS	29°42′S50°20′W
4	Capão Novo	RS	29°41′S49°49′W
5	Maquiné	RS	29°30′S50°50′W
6	Torres	RS	29°23′S49°49′W
7	Praia Grande	SC	29°11′S49°49′W
8	Cambará do Sul	RS	29°04′S50°38′W
9	Bom Jardim da Serra	SC	28°18′S49°49′W
9	Lauro Müller	SC	28°26′S49°49′W
9	Pericó	SC	28°16′S49°49′W
9	São Joaquim	SC	28°15′S49°49′W
10	Urupema	SC	27°56′S49°49′W
11	Lages	SC	27°51′S50°36′W
12	Lebon Régis	SC	26°55′S50°50′W
12	Santa Cecília	SC	26°47′S50°50′W
13	Caçador	SC	26°46′S50°23′W
14	Matos Costa	SC	26°28′S51°51′W
15	Mafra	SC	26°08′S49°49′W
16	Parque Nacional do Iguaçu	PR	25°30′S53°48′W
17	Curitiba	PR	25°25′S49°15′W
18	Ilha do Cardoso	SP	25°08′S47°58′W
19	Bertioga	SP	23°51′S46°09′W
20	Jundiaí	SP	23°11′S46°52′W
21	Campinas	SP	22°59′S46°59′W
22	Maricá	RJ	22°55′S42°49′W
23	Camanducaia	MG	22°46′S46°08′W
23	Monte Verde	MG	22°52′S46°03′W
24	Piracicaba	SP	22°42′S47°34′W
25	Campos do Jordão	SP	22°41′S45°30′W
26	Engenheiro Passos	RJ	22°30′S44°41′W
26	Itatiaia	RJ	22°30′S44°34′W
26	Visconde de Mauá	RJ	22°19′S44°35′W
27	Passa Quatro	MG	22°23′S44°58′W
28	Mogi Guaçu	SP	22°15′S47°09′W
29	Poços de Caldas	MG	21°47′S46°34′W
30	Parque Estadual do Ibitipoca	MG	21°43′S43°54′W
31	Arceburgo	MG	21°22′S46°56′W
32	Ouro Branco	MG	20°30′S43°43′W
33	Formiga	MG	20°28′S45°26′W
34	Divinópolis	MG	20°08′S44°53′W
35	Caraça	MG	20°08′S43°30′W
36	Linhares	ES	19°25′S40°04′W
37	Serra do Cipó	MG	19°15′S43°43′W
38	Diamantina	MG	18°13′S43°43′W
39	Joaquim Felício	MG	17°43′S44°44′W
40	Grão Mogol	MG	16°34′S42°42′W

APPENDIX III

Full Scientific Names of Plants Cited in Appendix I

This appendix lists the full scientific names (including authority) of the species of host plants cited in the Appendix I.

Acritopappus longifolius (Gardner) R.M. King & H. Rob.
Adenostemma lavenia (L.) Kuntze
Ageratum conyzoides L.
Ageratum fastigiatum (Gardner) R.M. King and H. Rob.
Aspilia cylindrocephala H. Rob.
Aspilia foliacea Baker
Aspilia jolyana Barroso
Aspilia laevissima Baker
Aspilia pascalioides Griseb.
Austroeupatorium inulaefolium (Kunth) R.M. King & H. Rob.
Austroeupatorium paulinum (DC.) R.M. King & H. Rob.
Austroeupatorium picturatum (Malme) R.M. King & H. Rob.
Austroeupatorium silphiifolium (Mart.) R.M. King & H. Rob.
Ayapana amygdalina (Lam.) R.M. King & H. Rob.
Baccharis aphylla Sch. Bip.
Baccharis brachylaenoides var. ligustrina (DC.) Maguire & Wurdack
Baccharis dracunculifolia DC.
Baccharis helichrysoides DC.
Baccharis leucopappa DC.
Baccharis punctulata DC.
Baccharis ramosissima Gardner
Baccharis serrulata DC.
Baccharis trinervis Pers.
Baccharis uncinella DC.
Barrosoa betonicaeformis (DC.) R.M. King & H. Rob.
Bidens brasiliensis Sherff
Bidens pilosa L.
Calea elongata Baker
Calea graminifolia Sch.-Bip. ex Kraschen.
Calea nitida Less.
Calea oxyleps Baker
Campovassouria cruciata (Vell.) R.M. King & H. Rob.
Campuloclinium campuloclinoides (Baker) R.M. King & H. Rob.
Campuloclinium chlorolepis (Baker) R.M. King & H. Rob.
Campuloclinium macrocephalum (Less.) DC.
Campuloclinium megacephalum (Mart. ex Baker) R.M. King & H. Rob.
Campuloclinium purpurascens (Sch. Bip. ex Baker) R.M. King & H. Rob.
Centratherum punctatum Cass.
Chresta sphaerocephala DC.
Chromolaena ascendens (Sch. Bip. ex Baker) R.M. King & H. Rob.
Chromolaena barbacensis (Hieron.) R.M. King & H. Rob.
Chromolaena chaseae (B.L. Rob.) R.M. King & H. Rob.
Chromolaena congesta (Hook. & Arn.) R.M. King & H. Rob.
Chromolaena costatipes (B.L. Rob.) R.M. King & H. Rob.
Chromolaena cylindrocephala (Sch. Bip. ex Baker) R.M. King & H. Rob.
Chromolaena decumbens Gardner
Chromolaena hockeriana (Griseb.) R.M. King & H. Rob.
Chromolaena horminoides DC.
Chromolaena laevigata (Lam.) R.M. King & H. Rob.
Chromolaena matogrossensis (Hieron.) R.M. King & H. Rob.
Chromolaena maximilianii (Hieron.) R.M. King & H. Rob.
Chromolaena minasgeraesensis (Hieron.) R.M. King & H. Rob.
Chromolaena multiflosculosa (DC.) R.M. King & H. Rob.

APPENDIX III. Continued.

Chromolaena myriocephala (Gardner) R.M. King & H. Rob.
Chromolaena odorata (L.) R.M. King & H. Rob.
Chromolaena pedalis (Sch. Bip. ex Baker) R.M. King & H. Rob.
Chromolaena pungens (Gardner) R.M. King & H. Rob.
Chromolaena sagittifera (B.L. Rob.) R.M. King & H. Rob.
Chromolaena squalida (DC.) R.M. King & H. Rob.
Chromolaena stachyophylla (Spreng.) R.M. King & H. Rob.
Chrysolaena flexuosa (Sims) H. Rob.
Chrysolaena herbacea (Vell.) H. Rob.
Chrysolaena platensis (Spreng.) H. Rob.
Conyza bonariensis (L.) Cronquist
Conyza canadensis (L.) Cronquist
Cyrtocymura scorpioides (Lam.) H. Rob.
Echinocoryne schwenkiaefolia (Mart.) H. Rob.
Gochnatia amplexifolia (Gardner) Cabrera
Gochnatia barrosii Cabrera
Gochnatia floribunda Cabrera
Grazielia gaudichaudeana (DC.) R.M. King & H. Rob.
Grazilelia intermedia (DC.) R.M. King & H. Rob.
Hatschbachiella tweedieana (Hook. & Arn.) R.M. King & H. Rob.
Heterocondylus alatus (Vell.) R.M. King & H. Rob.
Heterocondylus amphidictyus (DC.) R.M. King & H. Rob.
Heterocondylus grandis (Sch. Bip. ex Baker) R.M. King & H. Rob.
Heterocondylus jaraguensis (B.L. Rob.) R.M. King & H. Rob.
Heterothalamus psiadioides Less.
Inulopsis scaposa (Remy) Hoffm.
Jungia floribunda Less.
Koanophyllon adamantium (Gardner) R.M. King & H. Rob.
Koanophyllon thysanolepis (B.L. Rob) R.M. King & H. Rob.
Lepidaploa lilacina (Mart. ex DC.) H. Rob.
Lepidaploa salzmanii (DC.) H. Rob.
Lepidaploa spixiana (Mart. ex DC.) H. Rob.
Lessingianthus (Oligocephalus) desertorum (Mart. ex DC.) H. Rob.
Lessingianthus (Oligocephalus) simplex (Less.) H. Rob.
Lessingianthus (Oligocephalus) virgulatus (Mart. ex DC.) H. Rob.
Lessingianthus brevipetiolatus (Sch. Bip. ex Baker) H. Rob.
Lessingianthus buddleiifolius (Mart. ex DC.) H. Rob.
Lessingianthus carduoides (Baker) H. Rob.
Lessingianthus coriaceus (Less.) H. Rob.
Lessingianthus glabratus (Less.) H. Rob.
Lessingianthus hovaefolius (Gardn.) H. Rob.
Lessingianthus laevigatus (Mart. ex DC.) H. Rob.
Lessingianthus linearifolius (Less.) H. Rob.
Lessingianthus linearis (Spreng.) H. Rob.
Lessingianthus poliphyllus (Sch. Bip. ex Baker) H. Rob.
Lessingianthus psilophyllus (DC.) H. Rob.
Lessingianthus pumillus (Vell.) H. Rob.
Lessingianthus pycnostachyus (DC.) H. Rob.
Lessingianthus roseus (Mart. ex DC.) H. Rob.
Lessingianthus rosmarinifolius (Less.) H. Rob.
Lessingianthus rubricaulis (Humb. & Bonpl.) H. Rob.
Lessingianthus sellowii (Less.) H. Rob.
Lessingianthus stoechas (Mart. ex Baker) H. Rob.
Lessingianthus vepretorum (Mart. ex DC.) H. Rob.
Lessingianthus warmingianus (Baker) H. Rob.
Mikania cipoensis Barroso

Appendix III. Continued.

Mikania cordifolia (L. f.) Willd.
Mikania decumbens Malme
Mikania lasiandrae DC.
Mikansia micrantha H.B.K.
Mikania officinalis Mart.
Mikania purpurascens (Baker) R. King & H. Rob.
Mikania retifolia Sch. Bip. ex Baker
Mikania sessilifolia DC.
Moquinia racemosa (Spreng.) DC.
Pluchea laxiflora Hook. & Arn. ex Baker
Pluchea sagitalis (Lam.) Cabrera
Porophyllum riedelii Baker
Porophyllum ruderale (Jacq.) Cass.
Praxelis clematidea (Griseb.) R. King & H. Rob.
Proteopsis argentea Mart. & Zucc. ex Sch. Bip.
Pseudobrickellia brasiliensis (Spreng.) R. King & H. Rob.
Senecio brasiliensis (Spreng.) Less.
Senecio oxyphyllus DC.
Senecio selloi (Spreng.) DC.
Solidago chilensis Meyen
Stomathanthes polycephalus (Sch. Bip. ex Robinson) H. Rob.
Symphyopappus casarettoi B. Robinson
Symphyopappus cuneatus (DC.) Sch. Bip. ex Baker
Symphyopappus decussatus Turcz.
Symphyopappus itatiayensis (Hieron.) R. King & H. Rob.
Symphyopappus reticulatus Baker
Trichogonia hirtiflora (DC.) Sch. Bip. ex Baker
Trichogonia salviaefolia Gardner
Trichogonia villosa Sch. Bip. ex Baker
Trichogoniopsis adenantha (DC.) R. King & H. Rob.
Trixis mollissima D. Don
Trixis praestans (Vell.) Cabrera
Trixis vauthieri DC.
Trixis verbasciformis Less.
Verbesina subcordata DC.
Vernonanthura beyrichi (Less.) H. Rob.
Vernonanthura catharinensis (Cabrera) H. Rob.
Vernonanthura chamaedrys (Less.) H. Rob.
Vernonanthura glandulosa-dentata (Hieron.) H. Rob. in litt.
Vernonanthura mariana (Mart. ex Baker) H. Rob.
Vernonanthura membranacea (Gardn.) H. Rob.
Vernonanthura montevidensis (Spreng.) H. Rob.
Vernonanthura mucronulata (Less.) H. Rob.
Vernonanthura nudiflora (Less.) H. Rob.
Vernonanthura petiolaris (DC.) H. Rob.
Vernonanthura phaeoneura (Toledo) H. Rob.
Vernonanthura phosphorica (Vell.) H. Rob.
Vernonanthura subverticillata (Sch. Bip. ex Baker) H. Rob.
Vernonanthura tweedieana (Baker) H. Rob.
Vernonanthura westiniana (Less.) H. Rob.
Vernonia incana Less.
Vittetia orbiculata (DC.) R. King & H. Rob.
Wedelia paludosa DC.

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A NEW SPECIES OF *FRUMENTA* BUSCK (LEPIDOPTERA: GELECHIIDAE: GNORIMOSCHEMINI) FROM MÉXICO: A POTENTIAL BIOCONTROL AGENT AGAINST *SOLANUM ELAEAGNIFOLIUM* (SOLANACEAE)

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Abstract.—***Frumenta solanophaga*, new species**, is described from San Luis Potosí, México. It was reared from *Solanum elaeagnifolium* Cavanilles (Solanaceae) as part of a survey for potential biocontrol agents against this introduced weed in southern Africa. *Frumenta* also includes two previously described species from southern United States; the group appears to feed exclusively on *Solanum*. Photographs and illustrations of *F. solanophaga* depict the imago, wing venation, intersegmental abdominal lobes of the female, and male and female genitalia. A key to the species of *Frumenta* is provided.

Key Words: Gelechiidae, *Solanum*, biocontrol

Frumenta was proposed by Busck (1939) to accommodate the single species, *Gelechia nundinella* Zeller, 1873. Hodges (1983) synonymized *Gelechia beneficentella* Murtfeld, 1881, with *Gelechia nundinella* and transferred *Asapharcha nephelomicta* Meyrick, 1930, to *Frumenta*. Since then, the genus has included only the two aforementioned species, which are known only from the United States. The genus belongs to the tribe Gnorimoschemini.

Since its description, *Frumenta nundinella* has been known as a herbivore of the noxious weed, horse-nettle (*Solanum carolinense* Linnaeus; Solanaceae), and the moth has been cited repeatedly as a potential biological control agent against this weed in the United States and Canada (e.g., Murtfeld 1881; Forbes 1923; Foott 1967; Bailey and Kok 1976, 1982; Bailey 1977). Solomon (1980, 1981, 1983) presented details of the life history of *F. nundinella*, including hosts and herbivore relationships and phenology. *Frumenta nephelomicta*, which galls the stems and fruit of *S. elaeagnifolium* Cavanilles, was released for the biological control of this weed in South Africa (Neser et al. 1990).

During recent efforts to discover new potential biological control agents against *Solanum elaeagnifolium*, specimens of a undescribed species of *Frumenta* where reared in San Luis Potosí, México, by personnel associated with the Plant Protection Research Institute, Pretoria, South Africa, and sent to the Systematic Entomology Laboratory, USDA, for identification. The purposes of this paper are to describe this new species and to summarize information on host plant usage in *Frumenta* in general.

Adult vestiture was examined using an incandescent light source (reflected light). Kornerup and Wanscher (1978) was used as a color standard for the description of *Frumenta solanophaga*. Genitalia were dissected as described by Clarke (1941), except

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Fig. 1. Holotype of *Frumenta solanophaga*.

the ventral part of the male genitalia was separated from the dorsal part on one side. The free part then was swung across the tegumen and mounted flat. Mercurochrome and chlorazol black were used as stains. Slide preparations were examined with dissecting and compound microscopes. Terminology for genitalia and wing venation follows that of Polvolný (1991) and Powell and Polvolný (2001).

KEY TO ADULTS OF *FRUMENTA*

1. Forewing white, intermixed with pale-yellow scales, with few small, pale-brown discal and marginal spots . . . . *nephelomicta*
– Forewing pale gray, intermixed with pale-yellow scales, with many large gray discal and marginal spots 2
2. Male 3
– Female 4
3. Valva beyond basal arch long, gnathos about ½ width of base of uncus (Fig. 3) . . . *solanophaga*
– Valva beyond basal arch short, gnathos about ¼ width of base of uncus . . . . *mindinella*
4. Ductus bursae about three times length of apophyses anteriores; apophyses anteriores narrow throughout length . . . . *mindinella*
– Ductus bursae about two times length of apophyses anteriores; apophyses anteriores dilated basally (Fig. 5) . . . . *solanophaga*

Frumenta solanophaga Adamski and Brown, new species

(Figs. 1–5)

Diagnosis.—*Frumenta solanophaga* is superficially most similar to *F. nundinella*, but it is genitally most similar to *F. nephelomicta*. *Frumenta solanophaga* shares with *F. nephelomicta* the following: valva elongate-rectangular beyond the basal arch; gnathos widened in distal junction of arms; and basal half of the apophyses anteriores dilated. *Frumenta solanophaga* differs from *F. nephelomicta* by having a darker forewing pattern, deeper basal arch of valva, distally wider valva, a longer aedeagus, and stouter apophyses anteriores.

Description, adult.—*Head:* Vertex and frontoclypeus pale yellowish brown or pale gray; scape pale gray, intermixed with pale-brown scales, flagellum gray; outer surface of labial palpus pale brown, intermixed with white scales, inner surface white; proboscis white.

Thorax: Tegula and mesonotum pale yellowish brown; legs with gray scales narrowly tipped with pale yellow, tarsomeres banded with pale yellowish-brown scales apically. Forewing (Figs. 1–2): Length 10.0–12.2 mm (mean = 11.6; n = 9). Ground color pale yellowish brown, intermixed with white and few pale-gray scales; darker gray and brown scales, each tipped with pale yellow form small costal spots, 2–3 larger, irregularly shaped discal spots, and large submarginal spots; in some specimens ground color as above with area posterior to CuP gray, or wing gray, intermixed with few pale yellow scales. Venation with R_4– R_5 stalked about ⅔ distance from cell; anterodistal part of cell slightly attenuate; R_5 and medial veins divergent; CuA_1–CuA_2 long, nearly parallel. Undersurface with gray scales, narrowly tipped with pale yellow, intermixed with pale-yellow scales near apex. *Hindwing* (Figs. 1–2): Shiny gray. Venation with Sc + R_1, Rs, and M_1 divergently arched from M_2 and M_3; Sc + R_1 and radial branch connected by a short cross vein near ⅓ length of cell; distal margin of cell concave inwardly; Rs and M_1 originating near anterodistal part of cell, slightly divergent, each juxtaposed to apex; M_2 closer to M_3 at base, arching closer to M_1 from ⅓ length to margin; CuA_1–CuA_2 subparallel.

Abdomen: Pale gray scales, intermixed with white scales; male terga 1–3 with brownish-orange scales; female intersegmental membrane with large lateral lobe anterior to spiracle on seventh segment (Fig. 4). *Male genitalia* (Fig. 3): Uncus trapezoidal, lateral margins slightly curved ventrally, setose submarginally; gnathos elongate, flat, rounded apically; valva short, slightly narrowed submedially, distal lobe sparsely setose, blunt apically; vinculum elongate, acutely curved anterolaterally; aedeagus elongate, bulbous at base, parallel-sided and narrow distally. *Female genitalia* (Fig. 5): Papillae anales with long setae intermixed with short setae; apophyses posteriores slender; eighth sternum and tergum fused forming a sclerotized ring, extended anterolaterally into a pair of broad apophyses anteriores, and extended ventromedially, forming a broadly rounded, shallowly invaginated antrum; ductus bursae elongate, swollen near inception of ductus seminalis; swollen area with a small, internal, semicircular support; corpus bursae elongate, wider anteriorly than posteriorly, with an elongate signum on posterior end.

Holotype.—♂, "MÉXICO, San Luis Potosí, San Luis de la Paz, 21.19N, 100.32W, 10.ix.1999, H. G. Zimmermann, AcSN 2109," "Emerged in quarantine from berries of *Solanum elaeagnifolium* (Solanaceae), Larvae eat seeds and flesh," "National Coll[ection] of Insects, Pretoria, S[outh] Afr[ica]." Holotype not dissected. Deposited in the National Museum of Natural History Museum, Smithsonian Institution, USA [USNM].

Paratypes.—5 ♂, 3 ♀, same label data as holotype, except, "♂ genitalia slide by D Adamski, USNM 81218" [green label], "♂ genitalia slide by D Adamski, USNM 82133" [green label], "♂ wing slide by D Adamski, USNM 82134" [green label], "♀ genitalia slide by D Adamski, USNM 81219" [green label], ♀ genitalia slide by D Adamski, USNM 81220" [green label], "♀ genitalia slide by D Adamski, USNM 82132" [green label]. Five paratypes deposited in USNM; one paratype deposited in the Transvaal Museum, Pretoria, South Africa; one paratype deposited in The South African Museum, Capetown, South Africa.

Etymology.—The specific epithet is derived from the plant genus, *Solanum,* to which the host of *F. solanophaga* belongs, and from the Greek "*phagein,*" meaning, "to eat."

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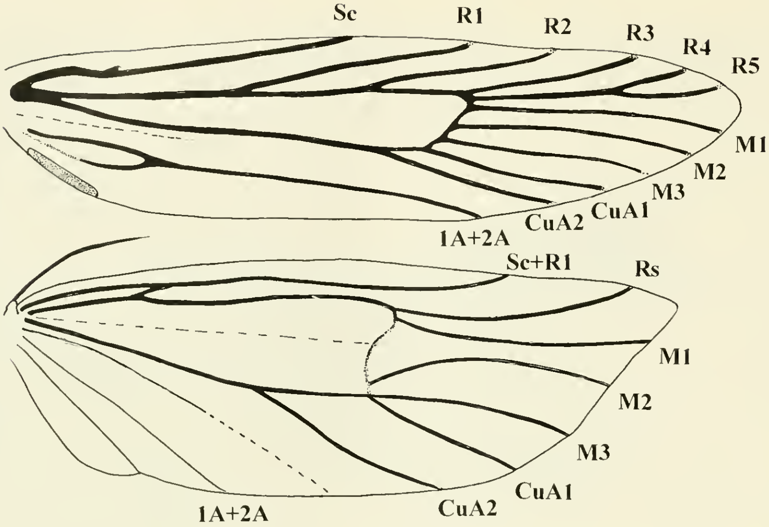

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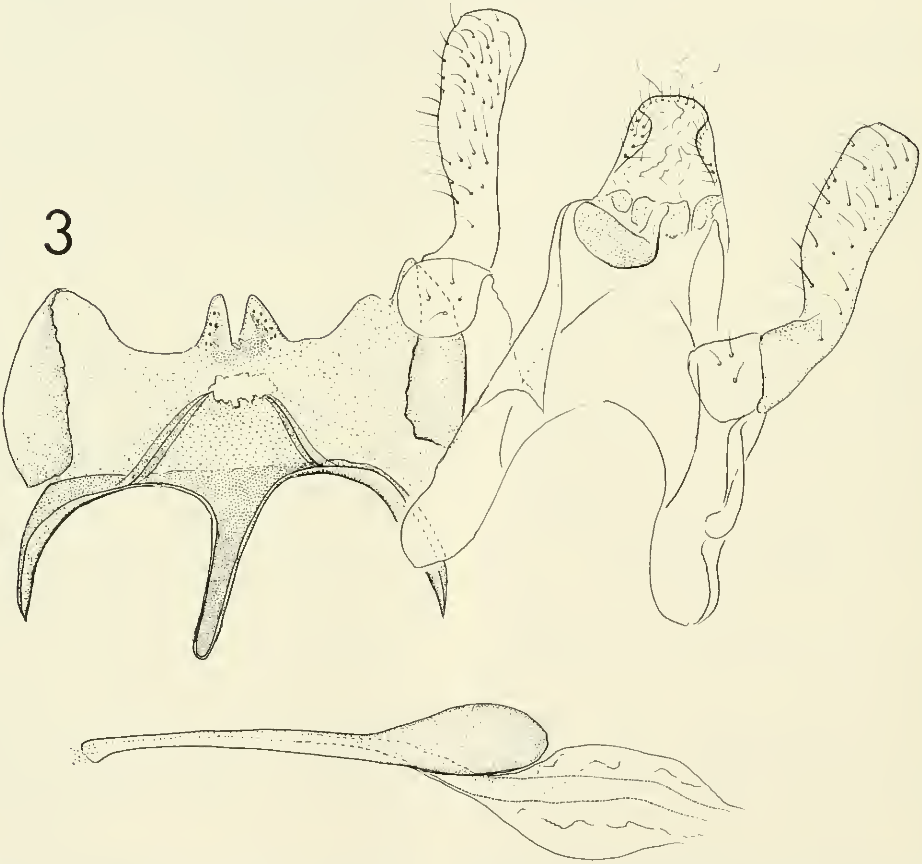

Figs. 2–3. *Frumenta solanophaga.* 2, Wing venation (male). 3, Male genitalia; genital capsule and aedeagus.

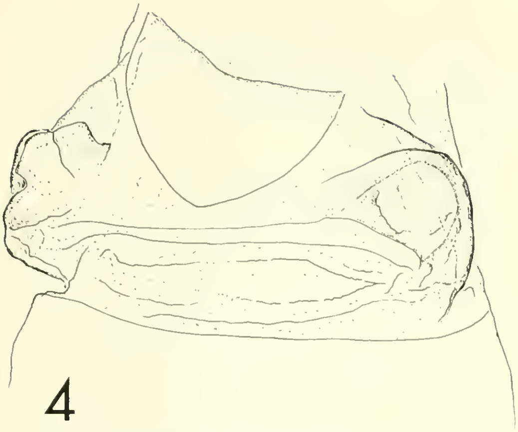

Fig. 4. *Frumenta solanophaga.* Lateral lobes of intersegmental membrane anterior to spiracle of seventh segment (female).

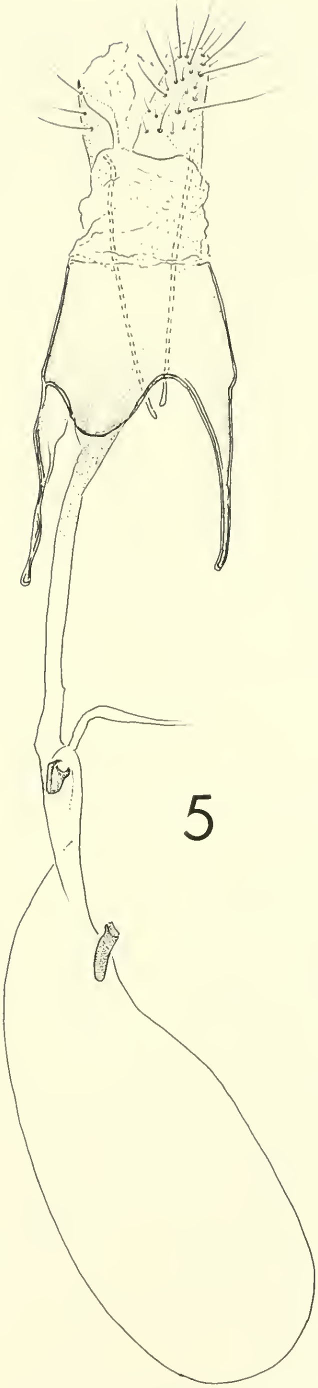

Fig. 5. *Frumenta solanophaga.* Female genitalia.

DISCUSSION

Association with Solanaceae.—The larval use of Solanaceae is common in the gelechiid tribe Gnorimoschemini, where many species are known to be pests of solanaceous crops (Povolný 1973, 1975), e.g., *Scrobipalpa absoluta* (Meyrick) on tomato (*Lycopersicon esculentum* Mill.) in northern South America; *Scobipalpopsis solanivora* Povolný on potato (*Solanum tuberosum* L.) in Central America; *Phthorimaea isochlora* Meyrick on "friegaplato" (*Solanum saponaceum* Duy) in Colombia; *Phthorimaea operculella* Zeller on potato throughout the New World; *Keiferia lycopersicella* (Walsingham) on tomato throughout the New World; *Keiferia colombiana* Povolný on friegaplato in Colombia; and *Symmetrischema tangolias* (Gyen) (= *S. plaesiosema* (Turner)) on *Solanum nigrum* L. in the United States and presumably on *Solanum* in Australia.

Members of *Frumenta* apparently are specialists on the plant genus *Solanum. Frumenta nundinella,* which occurs throughout southern and midwestern United States (i.e., Georgia, Illinois, Indiana, Louisiana, Missouri, Pennsylvania, Texas, and Virginia) is widely recognized as an important herbivore of *Solanum carolinense. Fru-*

menta nephelomicta, which is known from Arizona and New Mexico, has been reared from *Solanum elaeagnifolium* and was introduced into South Africa for the biological control of this weed. An apparently undescribed species of *Frumenta* from Texas and New Mexico also has been reared from *S. elaeagnifolium* (specimen data from USNM). The discovery of *F. solanophaga* as a herbivore of *S. elaeagnifolium* adds further support to the hypothesis that the genus is closely associated with *Solanum.*

The biology of *F. solanophaga* is unknown. According to Bailey and Kok (1976), the larvae of *Frumenta nundinella* attack at least two stages of *Solanum carolinense.* They feed on the tips of the young leaves before formation of fruits and pupate in characteristic leaf chambers in mid-July. After the plants fruit in late July, the larvae are fruit borers; one larva is capable of destroying all the seeds within a berry. The larvae pupate inside the berries, emerging as adults in August and September. In contrast, the larvae of *Frumenta nephelomicta* have been described as gallers of stems and fruit (Neser et al. 1990).

Potential use in biological control.—*Solanum elaeagnifolium* goes by a variety of common names, including bull-nettle, silver horse-nettle, white-horse-nettle, silverleaf nightshade, silver-leaf-nettle, trompillo (Brako et al. 1995), and satansbos (the latter used primarily in South Africa). It is a persistent, prickly, perennial evergreen shrub native to the New World (Goeden 1972) that has been introduced inadvertently into southern Africa and Australia, where it has become an economically important weed (Siebert 1975, Wells et al. 1986). It may poison livestock where it occurs in areas used for grazing (Kingsbury 1964, Parker 1990). In South Africa, several studies have been conducted on potential biological controls for *S. elaeagnifolium* (Siebert 1975; Olckers and Hulley 1989a, b, 1991a, b). The status of the biological control of this weed in South Africa is summarized by Neser et al. (1990).

In the mid 1980s *Frumenta nephelomicta* was introduced into South Africa for control of *S. elaeagnifolium.* According to Julien (1987), the insect failed to establish, apparently owing to severe drought and small releases; however, further releases are intended. The source of the specimens of *F. nephelomicta* released was not indicated, but if it was México (rather than southwestern United States), then "*F. nephelomicta*" was most likely a misidentification of *F. solanophaga.* Because of possible differences in feeding habits among species of *Frumenta,* accurate identification of this potential biocontrol organism is critical.

ACKNOWLEDGMENTS

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DESCRIPTIONS OF THE IMMATURE STAGES OF FIVE MEXICAN SPECIES OF GYMNETINI (COLEOPTERA: SCARABAEIDAE: CETONIINAE)

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Abstract.—The third instar larva of *Amithao haematopus* (Burmeister) from Chiapas, México, is described as the first description of a larva in this genus. The third instar larvae and pupa of *Marmarina maculosa* (Olivier) from Veracruz, México are described. The third instar larvae and pupa of *Hoplopyga liturata* (Olivier) from Veracruz are described, including comments on first and second instar larvae. The third instar larva of *Gymnetis hebraica difficilis* Burmeister from Veracruz, is described. The larva of *Gymnetis flavomarginata sallei* Schaum is redescribed with specimens from Veracruz, including differences with second and first instar larvae and the description of the pupa. All of these species are included in a key to the larvae of New World Gymnetini, which now has 14 species in nine genera.

Resumen.—Se describe la larva de tercer estadio de *Amithao haematopus* (Burmeister) de Chiapas, México, que representa la primera descripción larvaria para el género. Se describen la larva de tercer estadio y la pupa de *Marmarina maculosa* (Olivier) de Veracruz, México. Se describen la larva y la pupa de *Hoplopyga liturata* (Olivier) con ejemplares de Veracruz, incluyendo comentarios sobre las larvas de primero y segundo estadio. Se describe la larva de tercer estadio de *Gymnetis hebraica difficilis* Burmeister de Veracruz. Se redescribe la larva de tercer estadio de *Gymnetis flavomarginata sallei* Schaum, con ejemplares de Veracruz, incluyendo las diferencias con las larvas de primero y segundo estadio, y la descripción de la pupa. Todas estas especies se incluyen en una clave para las larvas de los Gymnetini del Nuevo Mundo, que ahora contiene 14 especies de nueve géneros.

Key Words: *Amithao, Marmarina, Hoplopyga, Gymnetis,* larvae, pupae, taxonomy, key, México

Ritcher (1966) described the third instar larvae of four species of the genera *Cotinis* Burmeister, *Gymnetis* MacLeay and *Gymnetina* Casey from the United States. Monné (1969) described the larvae of two species of *Blaesia* Burmeister and *Marmarina* Kirby from Uruguay. Morón and Ratcliffe (1984) described the larva of one species of *Argyripa* Thomson from México, and a key to the seven then-known species of New Word Gymnetini. Vanin and Costa (1984) described the larva of one species of *Hoplopyga* Thomson from Brazil. Micó et al. (2001) provided descriptions of the larva of one species of *Hologymnetis* Martínez from México and another species of *Hoplopyga* from Brazil, with a key to larvae of the 10 then-known species of Gymnetini from the Americas.

In this paper, we describe for the first time the third instar larvae of one species of the genus *Amithao*; the third instar larvae of three species of *Marmarina, Gymnetis* and *Hoplopyga*; the first and second instar larvae of two species of *Gymnetis* and *Hoplopyga*; and the pupae of three species of *Gymnetis, Marmarina* and *Hoplopyga*. Also, we redescribe the larva of third instar of *Gymnetis flavomarginata sallei* Schaum, and present a new key to the third instar larvae of 14 known species and nine genera of Gymnetini. Technical terms are those of Ritcher (1966), Morón (1993), and Micó et al. (2001). Studied specimens are deposited in the collection of immature stages of the Departamento de Entomología, Instituto de Ecología, Xalapa, México (IEXA).

Relative to the 3100 species of Cetoniinae listed from the world, only 55 larvae representing 30 genera of Cetoniini, Gymnetini, Goliathini and Cremastoceilini are described at present. Consequently, it is difficult to get a set of diagnostic characters that aid in distinguishing the larvae of the tribe Gymnetini from the larvae of other tribes. But as a preliminary introduction, based on Ritcher (1966), Micó et al. (2001), and our own experience, we propose the following combination of characters as diagnostic for larvae of Gymnetini: frons with 1–2 posterofrontal setae at each side; labrum symmetrical, anterior border trilobed; clithra present; plegmata absent; haptomerum with a transverse row of 7–19 heli; maxillary stridulatory area consisting of a row of 3–9 curved teeth with anteriorly projecting points; ocelli clearly defined, vague or absent; last antennal segment with 2–15 dorsal sensory spots; tarsungulus cylindrical, rounded apically, bearing 5–15 setae; raster usually with elliptical monostichous or polystichous palidia, each palidium with 12–38 pali.

Key to the Known Third Stage Larvae of Gymnetini from the Americas. (Modified from Micó et al. 2001.)

1\. Palidia present 2

– Palidia absent . . *Gymnetina cretacea* (LeConte)

2\. Raster with each palidium consisting of 2 or more irregular rows of pali. Last antennal segment with 3–7 dorsal sensory spots. 3

– Raster with palidia monostichous. Last antennal segment with 2–15 dorsal sensory spots 5

3\. Tarsungulus with 7 setae. Maxillary stridulatory area with 5 teeth. Last antennal segment with 3 ventral sensory spots . . . . *Hologymnetis cinerea* (Gory and Percheron)

– Tarsungulus with 10–12 setae. Maxillary stridulatory area with 7–9 teeth. Last segment of antenna with 5–13 ventral sensory spots 4

4\. Raster with inner row of each palidium having 7–10 pali much stouter and larger than those in outer row . . . . *Cotinis mutabilis* (Gory and Percheron)

– Raster with inner row of each palidium having 9–10 pali slightly larger than those in outer row . . . . *Cotinis nitida* (Linné)

5\. Dorsum of abdominal segment VII with 3 annulets. Last antennal segment with 10–15 dorsal sensory spots 6

– Dorsum of abdominal segment VII with 2 annulets. Last antennal segment with 2–5 dorsal sensory spots 7

6\. Ocelli present, well-defined (Fig. 1). Haptomeral region with 14–16 heli in a transverse row (Fig. 2). Each palidium consisting of a row of 17–20 pali (Fig. 12) . . . . *Amithao haematopus* (Burmeister)

– Ocelli absent. Haptomeral region with 10–15 heli in a transverse row. Each palidium consisting of a row of 23–26 pali . . . . *Argyripa lansbergei* (Sallé)

7\. All tarsungulus bearing 5–7 setae 8

– All tarsungulus bearing 8–15 setae 10

8\. With haptomeral cone-like process. Haptomerum with a row of 10–16 short heli, and 7–14 short, stout, spine-like setae (Fig. 16) 9

– Without haptomeral cone-like process. Haptomerum with a row of 16 medium size heli, and 16–17 medium size, stout, spine-like setae . . . . *Blaesia atra* Burmeister

9\. Last antennal segment with 5 dorsal sensory spots. Maxillary stridulatory area with row of 9 acute teeth. Each palidium consisting of an irregular row of 12–13 pali . . . . *Marmarina tigrina* (Gory and Percheron)

– Last antennal segment with 2–3 dorsal sensory spots (Fig. 23). Maxillary stridulatory area with row of 6 acute teeth (Fig. 20). Each palidium consisting of an irregular row of 19–20 pali (Fig. 25) . . . . *Marmarina maculosa* (Olivier)

10. Distance between the 2 lobes of respiratory plate of spiracles much less than the dorsoventral diameter of the bulla (Fig. 48). Last antennal segment with 2–3 dorsal sensory spots 11

– Distance between the 2 lobes of respiratory plate of spiracles slightly less than the dorsoventral diameter of the bulla, or as long as such diameter (Fig. 35). Last antennal segment with 3–4 dorsal sensory spots 12

11. Metatarsungulus bearing 10–12 setae. Each palidium consisting of a row of 12–18 pali. Ocelli absent or vaguely defined. Spiracles with peritrema strongly sclerotized (Fig. 58) . . . . . . *Gymnetis flavomarginata sallei* Schaum

– Metatarsungulus bearing 8 setae. Each palidium consisting of a row of 20–21 pali. Ocelli absent. Spiracles with peritrema weakly sclerotized . . . . *Gymnetis hebraica difficilis* Burmeister

12. Right mandible with 2 scissorial teeth. Haptomeral region with a transverse row of 8–11 heli . . . . *Hoplopyga singularis* (Gory and Percheron)

– Right mandible with 3 scissorial teeth (Fig. 30). Haptomeral region with a transverse row of 12–19 heli 13

13. Metatarsungulus bearing 11–12 setae. Last antennal segment with 3 dorsal sensory spots. Each palidium consisting of a row of 14–18 pali . . . . *Hoplopyga brasiliensis* (Gory and Percheron)

– Metatarsungulus bearing 9–10 setae. Last antennal segment with 4 dorsal sensory spots. Each palidium consisting of a row of 14–15 pali . . . . *Hoplopyga liturata* (Olivier)

LARVAE OF *AMITHAO* THOMSON

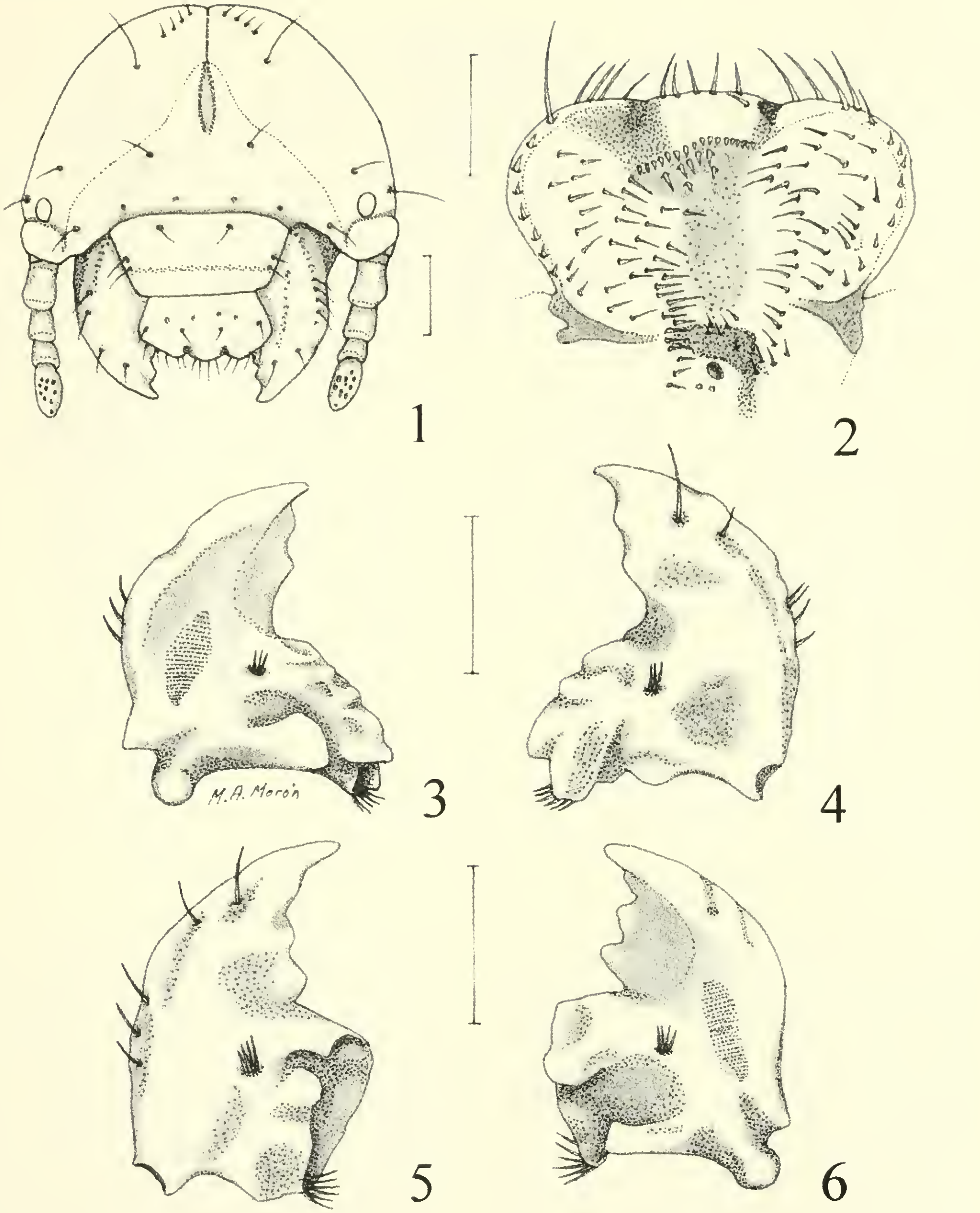
This larval description of *Amithao haematopus* (Burmeister) is the first for the genus. Based on current knowledge of Gymnetini larvae, the larvae of *Amithao* are most similar morphologically to those of *Argyripa* species. The known larvae of *Amithao* have the ocelli well-defined, haptomeral region with 14–16 heli in a transverse row, last antennal segment with 12 dorsal sensory spots, tarsungulus bearing 7–8 setae, and each palidium consisting of a row of 17–20 pali. Larvae of *Argyripa* have the ocelli absent, haptomeral region with 10–15 heli in a transverse row, last antennal segment with 10–15 sensory spots, tarsungulus bearing 8–9 setae, and each palidium consisting of a row of 23–26 pali. Larvae of both genera have the dorsum of abdominal segment VII with 3 annulets.

The genus *Amithao* consist of 15 species that are found from the southeastern Mexico to Brazil, including Jamaica and Hispaniola. The genus is being revised by Brett C. Ratcliffe. Adults of *Amithao* species have been collected with rotting fruit traps and are rarely attracted by lights (Morón et al. 1997). The known larvae feed in organic matter deposited in the axillary folds of leaves of epiphytes.

Amithao haematopus (Burmeister)
(Figs. 1–14)

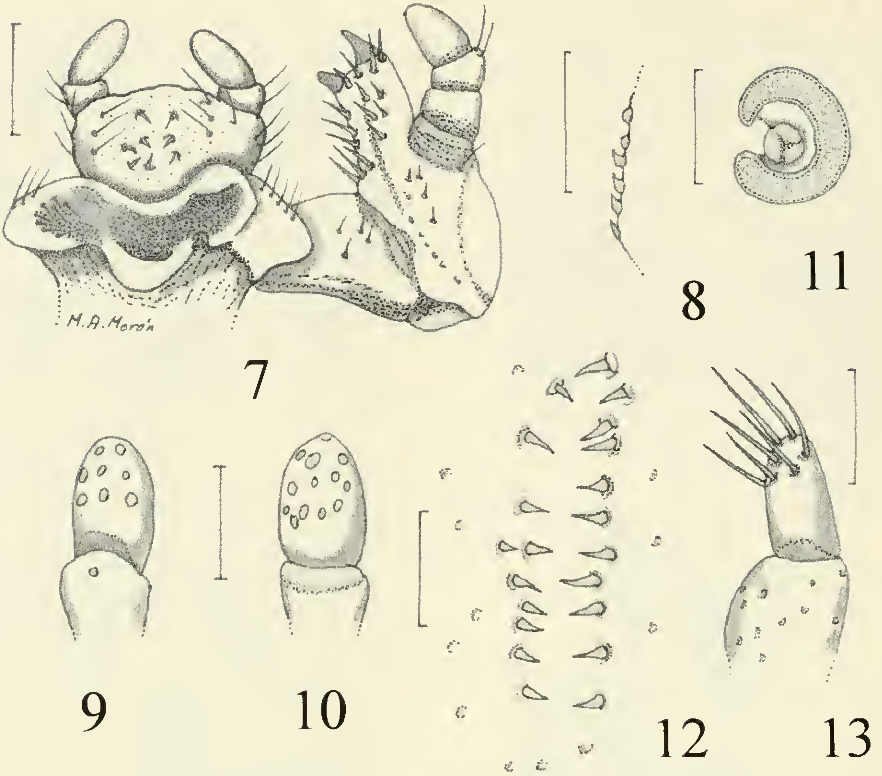
Third instar larva.—This description is based on four third instar larvae associated with dead adult females or their remnants collected from debris found in the axillary folds of leaves of epiphyte *Acmaea* sp. (Bromeliaceae). Locality data: México: State of Chiapas, Ocosingo municipality, Biosphere Reserve "Montes Azules," Boca del Chajul, 2-I-1983, 110 m elevation, C. Fragoso (1 larva) (IEXA); same data except 24-X-1984 (3 larvae) (IEXA).

Head (Fig. 1): Maximum width of head capsule 4.6–4.8 mm. *Cranium* smooth, orange yellowish. Frons with a median, longitudinal depression extending anteriorly from the epicraneal stem, a single posterior frontal seta, single anterior angle seta on each side, and 4 anterior frontal setigerous punctures. Dorsoepicranium with 4 small setae and 1 long seta in a line diverging from center-base of head. Tentorial pits not defined. *Clypeus:* Shape subtrapezoidal with 2 posterior clypeal setae and 2 exterior clypeal setae on each side. Preclypeus weakly sclerotized, without setae. Labrum trilobed, clithra present. *Epipharynx* (Fig. 2): Corypha with 5 stout setae. Haptomeral region with cone-like process, without macroscopic sensilla, behind process a curved



Figs. 1–6. *Amithao haematopus,* third-instar larva. 1, Head, frontal view. 2, Epipharynx. 3, Right mandible, ventral view. 4, Right mandible, dorsal view. 5, Left mandible, dorsal view. 6, Left mandible, ventral view. Scale lines = 1 mm, except fig. 2 = 0.5 mm.

row of 14–16 small heli, 6–7 stout spine-like setae behind row. Acanthoparia with 7–9 short setae. Chaetoparia with 28–36 setae on each side. Dexiotorma wide and long, with moderately developed pternotorma. Laeotorma elongated, with small pternotorma. Nesia with sensorial cone. Haptolachus with 2 sensilla below sensorial cone. *Mandibles:* Right mandible (Figs. 3–4) with 1 scissorial tooth anterior to scissorial notch and 2 scissorial teeth posterior to notch. Stridulatory area elongate-oval, length 2



Figs. 7–13. *Amithao haematopus*, third instar larva. 7, Hypopharynx and right maxilla, dorsal view. 8, Stridulatory area of maxilla. 9, Last antennal segment, ventral view. 10, Last antennal segment, dorsal view. 11, Abdominal spiracle. 12, Palidia. 13, Tarsungulus of posterior leg. Scale lines = 0.5 mm.

times its width. Molar area with 3 lobes. Calx wide. Brustia formed by 6–8 setae. Lateral edge with 3–5 setae. Left mandible (Figs. 5–6) with 1 scissorial tooth anterior to scissorial notch, 1 tooth posterior to notch, and 2 teeth on premolar area. Stridulatory area elongate, length 3 times its width. Molar area with 2 lobes. Acia absent. Brustia formed by 6–8 setae. Lateral edge with 3–4 setae. *Maxilla:* Galea and lacinia fused (Fig. 7), forming mala. Mala with large uncus at apex and 1 subterminal uncus vaguely bifid. Surface with 4 indistinct rows of setae. Stridulatory area (Fig. 8) with row of 5 curved, acute teeth and a distal, truncate process. *Labium* (Fig. 7): Dorsal surface with large, erect, truncate process. Hypopharyngeal sclerome with group of 7 setae on left side; both lateral lobes with 3–5 setae arranged in 1 row. Glossa with 8 setae at middle, and 2 lateral rows formed by 3–4 setae on each side. *Antenna:* First segment as long as following 2 segments together. Surface (Figs. 9–10) of last segment with 12 dorsal and 8 ventral sensory spots. Ocelli clearly defined (Fig. 1). *Thorax:* Thoracic spiracles with C-shaped respiratory plate 0.58 mm high and 0.51 mm wide; plate with 23 holes across diameter at middle; holes irregularly oval. Dorsal surface of each segment with many short setae. *Abdomen* (Fig. 14): Spiracles of abdominal segments I–VII similar in size, those abdominal segment VIII slightly smaller. Distance between 2 lobes of respiratory plate slightly less than dorsoventral diameter of bulla (Fig. 11). Bulla irregularly oval, slightly convex. Dorsal areas of

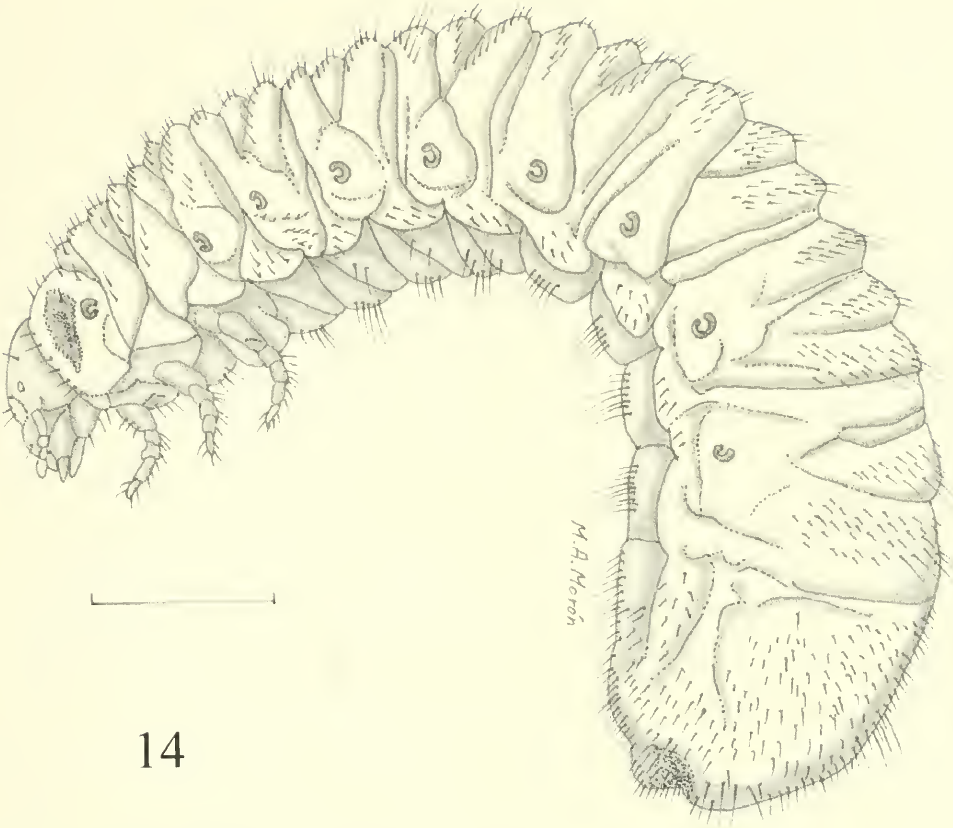


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Fig. 14. *Amithao haematopus*, third instar larva. Scale line = 5 mm.

each segment with many short setae. Prescutum of abdominal segments IV, VI and VII with irregular, transverse rows of long setae. Scutum of abdominal segments III–VII with transverse row of long setae. Scutellum of abdominal segments II–VI with irregular, transverse rows of long setae. Segments IX and X fused, covered with short setae and some sparse, long setae toward posterior borders. Spiracular area and pleural lobes of abdominal segments I–VIII with few, sparse, short setae. Raster with pair of palidia (Fig. 12) each consisting of an irregular row of 17–20 pali, rows joined anteriorly. Septula diffuse. Tegilla composed of scarce short, thick setae and some slender long setae. Lower anal lip with mixture of medium size setae and short setae. *Legs:* Tarsungulus (Fig. 13) cylindrical, apex rounded and bearing 7–8 setae.

LARVAE OF *MARMARINA* KIRBY

The larval description of *Marmarina maculosa* (Olivier) from Mexico is the second for the genus. *Marmarina tigrina* (Gory and Percheron), from Uruguay, was described by Monné (1969). Based on our current knowledge of Gymnetini larvae, the larvae of *Marmarina* are most similar morphologically to those of *Blaesia* species. Larvae of *Marmarina* have a haptomeral cone-like process; with a row of 10–16 short heli, and 7–14 short, stout, spine-like setae behind row, last antennal segment with 2–5 dorsal sensory spots, maxillary stridulatory area with row of 6–9 acute teeth, and each palidium consisting of an irregular row of 12–20 pali. Larvae of *Blaesia* have a slightly convex haptomeral process, with a row of 16 medium size heli, and 16–17 medium size, stout, spine-like setae behind row, maxillary stridulatory area with row of 7 acute teeth, last antennal segment with 4 dorsal sensory spots, and each palidium consisting of an irregular row of 14–16 pali. Larvae of both genera have the dorsum of abdominal segment VII with 2 annulets.

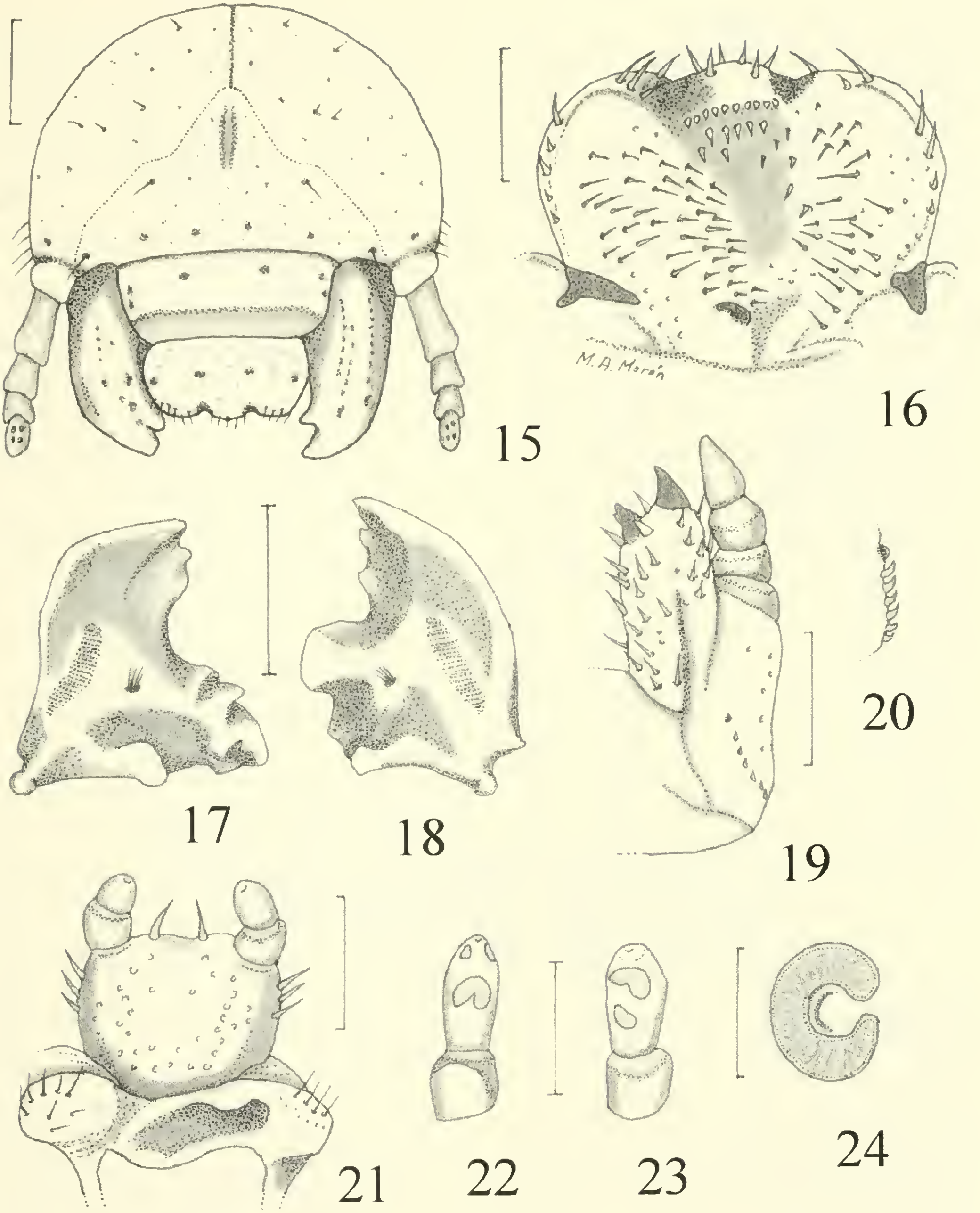
The genus *Marmarina* (= *Maculinetis* Schurhoff) consists of three species, three subspecies and three varieties that are found from the southeastern Mexico to Argentina (Blackwelder 1944). The genus is being revised by Brett C. Ratcliffe. Adults of *Marmarina* species have been collected on mature tropical fruits, rarely with rotting fruit traps, and sifting soil litter (Morón et al. 1997). The known larvae feed in organic matter deposited under rotten logs or in debris of ant nests of *Acromyrmex* sp.

Marmarina maculosa (Olivier)
(Figs. 15–27)

Third instar larva.—This description is based on one exuvium of a third instar larva reared to an adult female, collected under a rotten log from tropical rain forest. Locality data: México: State of Veracruz, Monte Pío municipality, Estación de Biología Tropical "Los Tuxtlas," 6-III-1986, 150 m elevation, M. L. Castillo (1 exuvium) (IEXA).

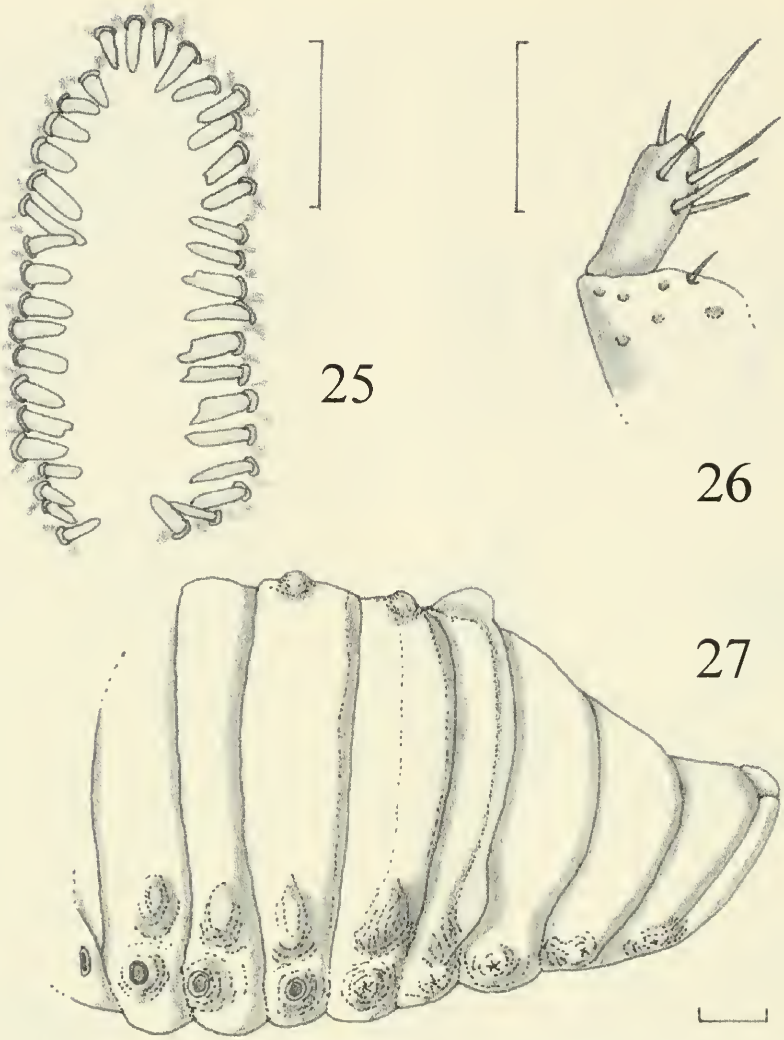
Head (Fig. 15): Maximum width of head capsule 3.8 mm. *Cranium* nearly smooth, with sparse shallow punctures, reddish brown. Frons with median, longitudinal depression extending anteriorly from epicraneal stem, a single posterior frontal seta and single anterior angle seta on each side, and 4 anterior frontal setigerous punctures. Dorsoepicranium with 4 small setae widely separated. Tentorial pits not defined. *Clypeus:* Shape subtrapezoidal, with 2 posterior clypeal setigerous punctures and 2 exterior clypeal setigerous punctures on each side. Preclypeus weakly sclerotized, without setae. Labrum trilobed, clithra present. *Epipharynx* (Fig. 16): Corypha with 6 stout, setae. Haptomeral region with cone-like process, without macroscopic sensillae, behind process a transverse row of 10 small heli, 7 stout spine-like setae behind row. Acanthoparia with 4–5 medium size or short setae. Chaetoparia with 36–47 setae on each side. Dexiotorma wide and long, with moderately developed pternotorma. Laeotorma short, with small pternotorma. Nesia with sensorial cone. Haptolachus without macroscopic sensilla below sensorial cone. *Mandibles:* Right mandible (Fig. 17) with 1 scissorial tooth anterior to scissorial notch and 2 scissorial teeth posterior to notch. Stridulatory area elongate, sinuose, length 4 times its width. Molar area with 3 lobes. Calx short. Brustia absent. Lateral edge without setae. Left mandible (Fig. 18) with 1 scissorial tooth anterior to scissorial notch, 1 tooth posterior to notch, and 1 tooth on premolar area. Stridulatory area elongate, length 4 times its width. Molar area with 2 lobes. Acia absent. Brustia absent. Lateral edge without setae. *Maxilla:* Galea and lacinia fused (Fig. 19), forming mala. Mala with large uncus at apex and 1 subterminal uncus vaguely bifid. Surface with 4–5 indistinct rows of setae. Stridulatory area (Fig. 20) with row of 6 curved, acute teeth and a distal, truncate process. *Labium* (Fig. 21): Dorsal surface with large, curved, truncate process. Hypopharyngeal sclerome without setae on left side; both lateral lobes with 4–8 setae. Glossa with 2 setigerous punctures at middle, 2 transverse rows of setigerous punctures near basal margin, and 2 lateral irregular rows formed by 4–7 setiferous punctures on each side. *Antenna:* First segment slightly longer than the following 2 segments together. Surface (Figs. 22–23) of last segment with 2–3 dorsal and 3–4 ventral sensory spots. Ocelli not defined (Fig. 15). *Thorax:* Thoracic spiracles with C-shaped respiratory plate 0.54 mm high and 0.50 mm wide; plate with 20 holes across diameter at middle; holes irregularly oval. Dorsal surface of each segment with many short setae and some slender, long setae.

Abdomen: Spiracles of abdominal segments I–VIII similar in size. Distance be-



Figs. 15–24. *Marmarina maculosa*, third instar larva. 15, Head, frontal view. 16, Epipharynx. 17, Right mandible, ventral view. 18, Left mandible, ventral view. 19, Right maxilla, dorsal view. 20, Stridulatory area of maxilla. 21, Hypopharynx, dorsal view. 22, Last antennal segment, ventral view. 23, Last antennal segment, dorsal view. 24, Abdominal spiracle. Scale lines = 0.5 mm, except figs. 15, 17–18.

tween 2 lobes of respiratory plate much less than dorsoventral diameter of bulla (Fig. 24). Bulla regularly oval, slightly convex. Dorsal areas of each segment with many short setae. Prescutum of abdominal segments I–VII with irregular, transverse rows of long setae. Scutum of abdominal segments II–VII with transverse row of long



Figs. 25–27. *Marmarina maculosa,* third instar larva. 25, Palidia. 26, Tarsungulus of posterior leg. Pupa. 27, Abdomen, dorsolateral view. Scale lines = 0.5 mm, except fig. 27 = 1 mm.

setae. Scutellum of abdominal segments I–VI with irregular, transverse rows of long setae. Segments IX and X fused, covered with short setae and some sparse, long setae toward posterior borders. Spiracular area and pleural lobes of abdominal segments I–VIII with many short setae. Raster with pair of palidia (Fig. 25), each consisting of a row of 19–20 pali, rows joined anteriorly. Septula elongate. Tegilla composed of many short, thick setae and some slender, long setae. Lower anal lip with many short setae. *Legs:* Tarsungulus (Fig. 26) cylindrical, apex rounded and bearing 6–7 setae.

Pupa. Female.—This description is based on one exuvium of a pupa reared to an adult female, collected under a rotten log from tropical rain forest. Locality data: México: State of Veracruz, Monte Pío municipality, Estación de Biología Tropical "Los Tuxtlas," 6-III-1986, 150 m elevation, M. L. Castillo (1 exuvium) (IEXA).

Form: Body elongate, robust, exarate. Yellowish white. With very fine velvety mierotrichia on last abdominal segments. *Head:* Strongly reflexed downward. Antenna and mouth parts clearly separated. Ocular canthus and compound eyes well-differentiated. Clypeus concave. Labrum tumid. Surface of frons slightly convex. *Thorax:* Pronotal disk with irregular, shallow depressions toward sides; lateral margins not defined. Meso- and metanota differentiated. Meso- and metascutellum narrowed posteriorly, apex acute. Pteroteca widened, with apex rounded, free, compressed around body; hind wing teca nealy as long as the elytron teca. Meso-metasternal process large and rounded, emerging between mesocoxae. Protibia with 3 short process on external border. Meso- and metatibia each with 2 rounded, short, apical spurs. All tarsomeres vaguely defined. *Abdomen* (Fig. 27): Tergites I–IV convex, without dioneiform organs; tergite V with vague transverse carina on posterior border; tergite VI with strong transverse carina on posterior border; tergites VII–VIII convex. Tergo-lateral tubercles II–VI prominent, surrounded by fine rugae. Spiracle I elongate, not prominent, partially protected by posterodorsal fleshy fold. Spiracles II–IV tuberculiform, with ringlike, sclerotized peritreme. Spiracles V–VII closed, slightly prominent, surrounded by fine rugae. Spiracle VIII closed, tuberculiform, surrounded by fine rugae. Sternites II–VII convex, with fine transverse lines. Last tergite with lateral rugae around small tubercle, and wide, fleshy lobes on the posterior border, without urogomphi. Genital ampulla wide, flattened, with fine mesial sulcus.

LARVAE OF *HOPLOPYGA* THOMSON

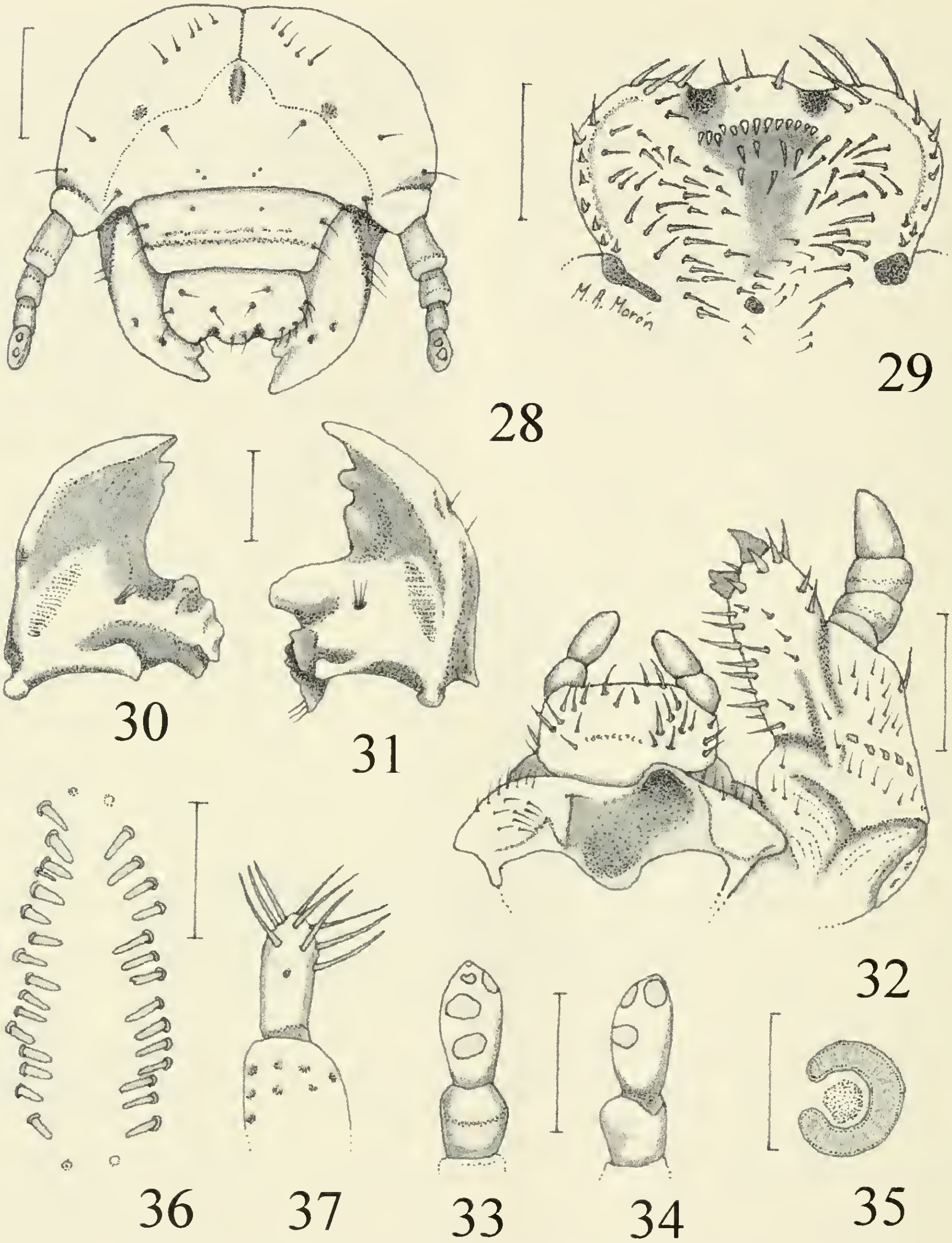
The larval description of *Hoplopyga liturata* (Olivier) from Mexico is the third in the genus. *Hoplopyga brasiliensis* (Gory and Percheron) from Brazil was described by Vanin and Costa (1984), and *Hoplopyga singularis* (Gory and Percheron) from Brazil was described by Micó et al. (2001). Larvae of *Hoplopyga* are most similar morphologically to those of *Gymnetis* species. Larvae of *Hoplopyga* have the haptomeral area with a row of 8–19 heli, maxillary stridulatory area with a row of 3–5 acute teeth, last antennal segment with 3–4 dorsal sensory spots, tarsungulus bearing 9–15 setae, the distance between the 2 lobes of respiratory plate of spiracles slightly less than dorsoventral diameter of bulla, or as long as such diameter, and each palidium consisting of an irregular row of 14–25 pali. Larvae of *Gymnetis* have the haptomeral area with a row of 10–14 heli, maxillary stridulatory area with a row of 3–5 acute teeth, last antennal segment with 2–3 dorsal sensory spots, tarsungulus bearing 8–12 setae, the distance between the 2 lobes of respiratory plate much less than dorsoventral diameter of bulla, and each palidium consisting of an irregular row of 12–21 pali. Larvae of both genera have the dorsum of abdominal segment VII with 2 annulets.

The genus *Hoplopyga* contains about 20 species distributed from Mexico to Argentina, and it is currently being revised by Brett C. Ratcliffe. Adults of *Hoplopyga* species have been collected from rotting fruits, resting on foliage, and in termite nests. The larvae feed on rotting wood and other organic debris (Micó et al. 2001).

Hoplopyga liturata (Olivier)
Figs. 28–38

Third instar larva.—This description is based on three third instar larvae reared from eggs obtained from adult female, fixed 6-X-2000, collected with rotten banana trap in montane cloud forest. Locality data: México: State of Veracruz, Xalapa municipality, Rancho Guadalupe, 12-VIII-1999, 1,350 m elevation, R. Arce (3 larvae) (IEXA).

Head (Fig. 28): Maximum width of head capsule 3.5 mm. *Cranium* nearly smooth, without defined punctures, orange yellowish. Frons with median, longitudinal shallow depression extending anteriorly from epicraneal stem, a single posterior frontal seta and single anterior angle seta on each side, and 4 anterior frontal setigerous punc-



Figs. 28–37. *Hoplopyga liturata*, third instar larva. 28, Head, frontal view. 29, Epipharynx. 30, Right mandible, ventral view. 31, Left mandible, ventral view. 32, Hypopharynx and right maxilla, dorsal view. 33, Last antennal segment, dorsal view. 34, Last antennal segment, ventral view. 35, Abdominal spiracle. 36, Palidia. 37, Tarsungulus of posterior leg. Scale lines = 0.5 mm, except fig. 28 = 1 mm.

tures. Dorsoepicranium with 4 small setae and 1 long seta in a line diverging from center-base of head. Tentorial pits vaguely defined. *Clypeus:* Shape subtrapezoidal with 2 posterior clypeal setigerous punctures and 2 exterior clypeal setigerous punctures on each side. Preclypeus weakly sclerotized, without setae. Labrum trilobed, elithra present. *Epipharynx* (Fig. 29): Corypha with 3 stout setae. Haptomeral region with cone-like process, without macroscopic sensillae, behind process a transverse row of 12 small heli, 6 stout spine-like setae behind row. Acanthoparia with 8 medium size or short setae. Chaetoparia with 18–28 setae on each side. Dexiotorma wide and long, with short pternotorma. Laeotorma short, rounded, with small pternotorma. Nesia with sensorial cone. Haptolachus without macroscopic sensilla below sensorial cone. *Mandibles:* Right mandible (Fig. 30) with 1 scissorial tooth anterior to scissorial notch and 1 scissorial tooth well-developed and 1 vague tooth posterior to notch. Stridulatory area elongate, length 3 times its width. Molar area with 3 lobes. Calx short. Brustia absent. Lateral edge without setae. Left mandible (Fig. 31) with 1 scissorial tooth anterior to scissorial notch, 1 tooth posterior to notch, and 1 tooth on premolar area. Stridulatory area elongate, length 3 times its width. Molar area with 2 lobes. Acia absent. Brustia formed by 4 setae. Lateral edge with 2 setae. *Maxilla:* Galea and lacinia fused (Fig. 32), forming mala. Mala with large uncus at apex and 1 subterminal uncus vaguely bifid. Surface with 3–4 indistinct rows of setae. Stridulatory area with row of 4 curved, acute teeth and a distal, truncate process. *Labium* (Fig. 32): Dorsal surface with large, curved, truncate process. Hypopharyngeal sclerome without setae on left side; both lateral lobes with 8–13 setae. Glossa with transverse row of small sensilla at middle, 6 setae near anterior margin, and 2 lateral irregular rows formed by 3–4 setae on each side. *Antenna:* First segment as long as following 2 segments together. Surface (Figs. 33–34) of last segment with 4 dorsal and 3 ventral sensory spots. Ocelli not defined (Fig. 28). *Thorax:* Thoracic spiracles with C-shaped respiratory plate 0.52 mm high and 0.48 mm wide; plate with 18 holes across diameter at middle; holes irregularly oval. Dorsal surface of each segment with many short setae and some slender, long setae. *Abdomen:* Spiracles of abdominal segments I–VIII similar in size. Distance between 2 lobes of respiratory plate slightly less than dorsoventral diameter of bulla (Fig. 35). Bulla regularly oval, slightly convex. Dorsal areas of each segment with many short setae. Prescutum of abdominal segments I–VII with irregular, transverse rows of long setae. Scutum of abdominal segments II–VII with transverse row of long setae. Scutellum of abdominal segments I–VI with irregular, transverse rows of long setae. Segments IX and X fused, covered with short setae and some sparse, long setae toward posterior borders. Spiracular area and pleural lobes of abdominal segments I–VIII with many short setae. Raster with pair of palidia (Fig. 36), each consisting of an irregular row of 14–15 pali, rows converging anteriorly. Septula irregular, elongate. Tegilla composed of some short, thick setae and some slender, long setae. Lower anal lip with many short setae. *Legs:* Tarsungulus (Fig. 37) cylindrical, apex rounded and bearing 9–10 setae.

Second instar larva.—This description is based on two second instar larvae reared from eggs obtained from an adult female, fixed 6-VII-2000, with data as cited above (2 larvae) (IEXA). Similar to third instar except as follows: maximum width of head capsule: 2.06 mm. Dorsoventral diameter of spiracles 0.32 mm. Each palidium with 12–13 pali.

First instar larva.—This description is based on two first instar larvae reared from eggs obtained from an adult female, fixed 6-VI-2000, with data as cited above (2 larvae) (IEXA). Similar to second instar except as follows: maximum width of head capsule:1.06 mm. Respiratory plates of spiracles kidney shaped; dorso ventral diameter of spiracles: 0–16 mm. With one small, tubercle-like, eclosion spine, bearing preapical thin seta, on each side of metanotum. Palidia not defined.

Pupa, female.—This description is based on one pupa reared from eggs obtained from an adult female, fixed, 5-XII-2000,

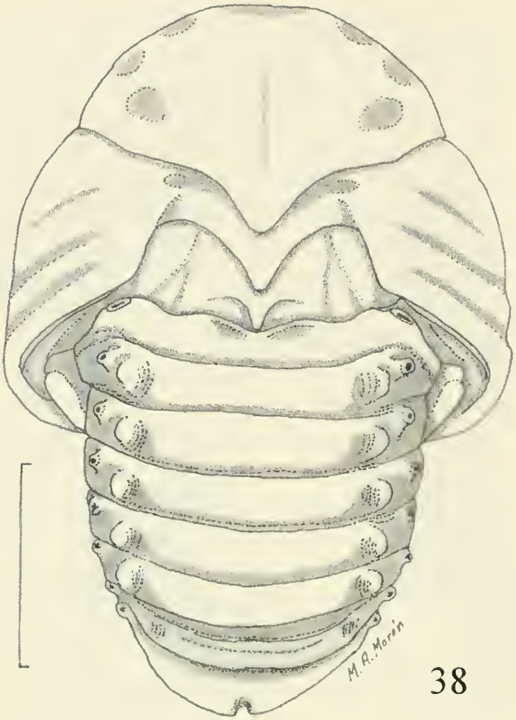


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Fig. 38. *Hoplopyga liturata*, pupa, dorsal view. Scale line = 5 mm.

with data as cited above (1 pupa) (IEXA). *Form:* Body elongate, robust, exarate (Fig. 38). Yellowish white. Without velvety microtrichia on abdominal segments. *Head:* Strongly reflexed downward. Antennae and mouth parts clearly separated. Ocular canthus and compound eyes well-differentiated. Clypeus concave. Labrum tumid. Surface of frons slightly convex. *Thorax:* Pronotal disk with irregular shallow depressions toward sides; lateral margins not defined. Meso- and metanota differentiated. Meso- and metascutellum narrowed posteriorly, apex rounded. Pteroteca widened, with apex rounded, free, compressed around body; hind wing teca nealy as long as the elytron teca. Meso-metasternal process large and rounded, emerging between mesocoxae. Protibia with 3 short process on external border. Meso- and metatibia each with 2 rounded, short, apical spurs. All tarsomeres vaguely defined. *Abdomen:* Tergites I–VIII convex, without dioneiform organs or transverse carina on posterior borders. Tergo-lateral tubercles II–VI prominent, surrounded by fine rugae. Spiracle I elongate, not prominent, partially protected by posterodorsal fleshy fold. Spiracles II–IV tuberculiform, with ring-like, sclerotized peritreme. Spiracles V–VII closed, tuberculiform, prominent, surrounded by fine rugae. Sternites II–VII convex, with fine transverse lines. Last tergite with lateral rugae around small tubercle, and narrow, fleshy lobes on posterior border, without urogomphi. Genital ampulla wide, flattened, with fine mesial sulcus.

LARVAE OF *GYMNETIS* MacLeay

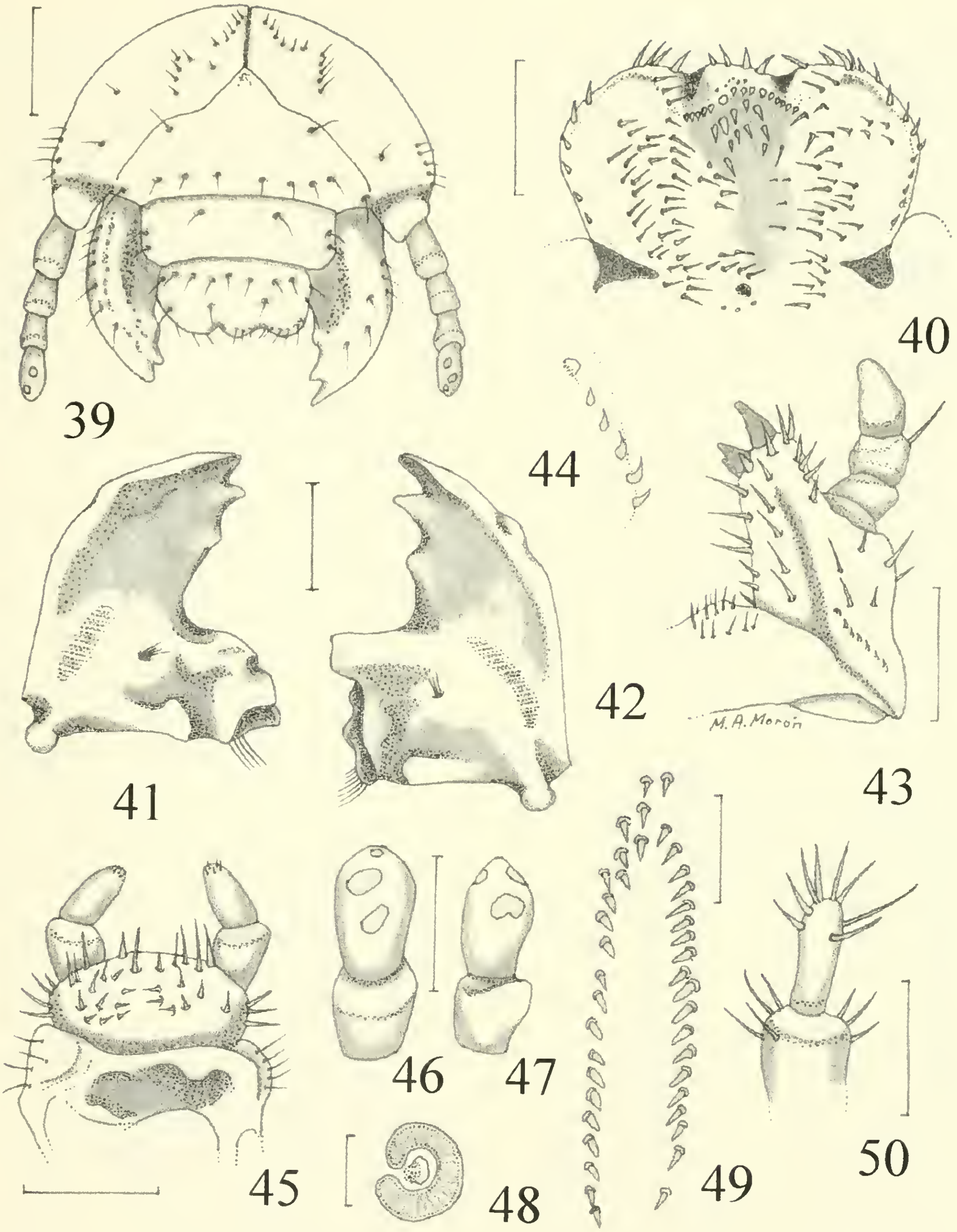
The larval description of *Gymnetis hebraica difficilis* Burmeister from Mexico is the second larva described in the genus. *Gymnetis flavomarginata sallei* Schaum from Texas was described by Ritcher (1966). As we indicated previously, larvae of *Gymnetis* are closely similar morphologically to those of *Hoplopyga* species.

The genus *Gymnetis* (including *Paragymnetis* MacLeay and *Gymnetosoma* Martínez) contains about 26 species, distributed from southern United States to Argentina. The genus is being revised by Brett C. Ratcliffe. Adults of *Gymnetis* species have been collected frequently attracted to rotting fruit traps (Morón 1995; Morón et al. 1997). The larvae feed on organic debris. Complete life cycle of *Gymnetis flavomarginata sallei* was studied by Arce and Morón (1999).

Gymnetis hebraica difficilis Burmeister
(Figs. 39–50)

Third instar larva.—This description is based on one third instar larvae reared from eggs obtained from an adult female, fixed 3-V-1995, collected with rotten banana trap in montane cloud forest. Locality data: México: State of Veracruz, Coatepec municipality, Briones, 2-IX-1994, 1,300 m elevation, M. A. Morón (1 larva) (IEXA).

Head (Fig. 39): Maximum width of head capsule 3.6 mm. *Cranium* nearly smooth,

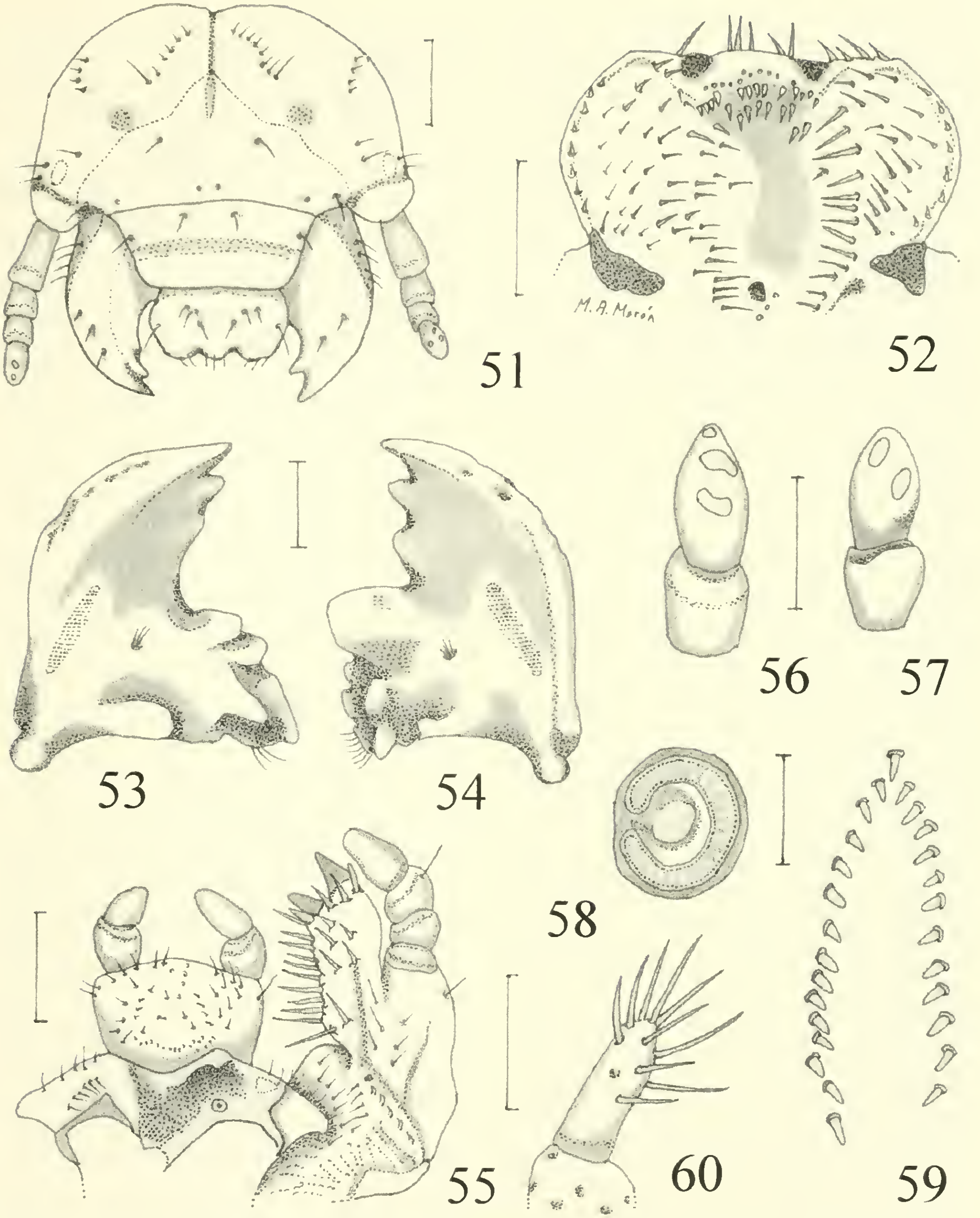


Figs. 39–50. *Gymnetis hebraica difficilis*, third instar larva. 39, Head, frontal view. 40, Epipharynx. 41, Right mandible, ventral view. 42, Left mandible, ventral view. 43, Right maxilla, dorsal view. 44, Stridulatory area of maxilla. 45, Hypopharynx, dorsal view. 46, Last antennal segment, dorsal view. 47, Last antennal segment, ventral view. 48, Abdominal spiracle. 49, Palidia. 50, Tarsungulus of posterior leg. Scale lines = 0.5 mm, except fig. 39 = 1 mm and fig. 48 = 0.25 mm.

without punctures, dark reddish brown. Frons with median, shallow depression at anterior end of epicraneal stem, a single posterior frontal seta and single anterior angle seta on each side, and 7 anterior frontal setae. Dorsoepicranium with 2 lines of 5–6 short setae diverging from center-base of head. Tentorial pits not defined. *Clypeus:* Shape subrectangular with 2 posterior clypeal setae and 2 exterior clypeal setae on each side. Preclypeus narrow, weakly sclerotized, without setae. Labrum trilobed, clithra present. *Epipharynx* (Fig. 40): Corypha with 4 stout, setae. Haptomeral region with cone-like process, with 5 sensilla, behind process a transverse row of 14 small heli, 11 stout spine-like setae behind row. Acanthoparia with 6–8 short setae. Chaetoparia with 28–34 setae on each side. Dexiotorma wide and long, with narrow pternotorma. Laeotorma short, acute, with wide rounded pternotorma. Nesia with sensorial cone. Haptolachus with 3 sensilla below sensorial cone. *Mandibles:* Right mandible (Fig. 41) with 1 scissorial tooth anterior to scissorial notch and 1 scissorial tooth well-developed and 1 vague tooth posterior to notch. Stridulatory area elongate, length 3.5 times its width. Molar area with 3 lobes. Calx short. Brustia formed by 5 setae. Lateral edge without setae. Left mandible (Fig. 42) with 1 scissorial tooth anterior to scissorial notch, 1 tooth posterior to notch, and 1 tooth on premolar area. Stridulatory area elongate, length 7 times its width. Molar area with 2 lobes. Acia absent. Brustia formed by 7 setae. Lateral edge without setae. *Maxilla.* Galea and lacinia fused (Fig. 43), forming mala. Mala with large uncus at apex and 1 subterminal uncus vaguely bifid. Surface with 3 indistinct rows of setae. Stridulatory area (Fig. 44) with row of 5 curved, acute teeth and a distal, truncate process. *Labium* (Fig. 45): Dorsal surface with large, curved, truncate process. Hypopharyngeal sclerome without setae on left side; both lateral lobes with 4–5 setae. Glossa with 7 short setae at middle, 4 setae near anterior margin, and 2 lateral irregular rows formed by 3–4 setae on each side. *Antenna:* First segment shorter than following 2 segments together. Surface (Figs. 46–47) of last segment with 2 dorsal and 3 ventral sensory spots. Ocelli not defined (Fig. 39). *Thorax:* Thoracic spiracles with C-shaped respiratory plate 0.43 mm high and 0.40 mm wide; plate with 23 holes across diameter at middle; holes irregularly oval. Dorsal surface of each segment with many short setae and some slender, long setae. *Abdomen:* Spiracles of abdominal segments I–VIII slightly increasing in size towards posterior segments. Distance between 2 lobes of respiratory plate much less than dorsoventral diameter of bulla (Fig. 48). Bulla irregularly oval, slightly convex. Dorsal areas of each segment with many short setae. Prescutum of abdominal segments I–VII with irregular, transverse rows of slender setae. Scutum of abdominal segments II–VII with transverse row of sparse, long setae. Scutellum of abdominal segments I–VI with irregular, transverse rows of sparse long setae. Segments IX and X fused, covered with short setae and some sparse, slender setae toward posterior borders. Spiracular area and pleural lobes of abdominal segments I–VIII with many short setae. Raster with pair of palidia (Fig. 49), each consisting of an irregular row of 20–21 pali, rows joined anteriorly. Septula elongate. Tegilla composed of many short, thick setae and some long setae. Lower anal lip with many short setae. *Legs:* Tarsungulus (Fig. 50) cylindrical, apex rounded and bearing 8 setae.

Gymnetis flavomarginata sallei Schaum
(Figs. 51–61)

Third instar larva.—This redescription is based on 40 third instar larvae reared from eggs obtained from breeding females, progeny of a female collected in montane cloud forest. Locality data: México: State of Veracruz, Xalapa municipality, Rancho Guadalupe, 10-IV-1995, 1,450 m elevation, R. Arce; fixed 8-X-1997 (20 larvae); fixed 10-IX-2000 (20 larvae) (IEXA).



Figs. 51–60. *Gymnetis flavomarginata sallei*, third instar larva. 51, Head, frontal view. 52, Epipharynx. 53, Right mandible, ventral view. 54, Left mandible, ventral view. 55, Hypopharynx and right maxilla, dorsal view. 56, Last antennal segment, dorsal view. 57, Last antennal segment, ventral view. 58, Abdominal spiracle. 59, Palidia. 60, Tarsungulus of posterior leg. Scale lines = 0.5 mm, except fig. 51 = 1 mm.

Head (Fig. 51): Maximum width of head capsule 4.3–4.8 mm. *Cranium* nearly smooth, without punctures, dark orange. Frons with a median, longitudinal, shallow depression extending anteriorly from epicraneal stem, a single posterior frontal seta and single anterior angle seta on each side, and 4 anterior frontal setiferous punctures. Dorsoepicranium with 1 line of 5–6 short setae and 1 long seta diverging from center-base of head, and 1 lateral line of 4–5 short setae on each side. Tentorial pits shallowly impressed. *Clypeus:* Shape subtrapezoidal, with 2 posterior clypeal setae and 1 exterior clypeal setae on each side. Preclypeus wide, weakly sclerotized, without setae. Labrum trilobed, clithra present. *Epipharynx* (Fig. 52): Corypha with 4–5 stout, setae. Haptomeral region with cone-like process, with 8–10 sensillae, behind process a transverse row of 10–12 small heli, 10–12 stout spine-like setae behind row. Acanthoparia with 8–9 short setae. Chaetoparia with 26–38 setae on each side. Dexiotorma wide and long, with short pternotorma. Laeotorma short, subtriangular, with wide, rounded pternotorma. Nesia with sensorial cone. Haptolachus with 3 sensilla below sensorial cone. *Mandibles:* Right mandible (Fig. 53) with 1 scissorial tooth anterior to scissorial notch and 1 scissorial tooth well-developed and 1 vague tooth posterior to notch. Stridulatory area elongate, length 4.5 times its width. Molar area with 3 lobes. Calx wide. Brustia formed by 3–4 setae. Lateral edge with 5–7 setae. Left mandible (Fig. 54) with 1 scissorial tooth anterior to scissorial notch, 1 tooth posterior to notch, and 1 tooth on premolar area. Stridulatory area elongate, length 4.5 times its width. Molar area with 2 lobes. Acia absent. Brustia formed by 6–7 setae. Lateral edge with 4–5 setae. *Maxilla:* Galea and lacinia fused (Fig. 55), forming mala. Mala with large uncus at apex and 1 subterminal uncus vaguely bifid. Surface with 3 indistinct rows of setae. Stridulatory area with row of 5 curved, acute teeth and a distal, small, truncate process. *Labium* (Fig. 55): Dorsal surface with large, curved, truncate process. Hypopharyngeal sclerome without setae on left side; both lateral lobes with 6–10 setae. Glossa with 7–8 short setae at middle, a transverse row of 12–14 sensilla near basal border, 3–4 setae near anterior margin, and 2 lateral irregular rows formed by 5–7 setae on each side. *Antenna:* First segment slightly shorter than following 2 segments together. Surface (Figs. 56–57) of last segment with 2–3 dorsal and 2 ventral sensory spots. Ocelli vaguely defined (Fig. 51). *Thorax:* Thoracic spiracles with C-shaped respiratory plate 0.53–0.58 mm high and 0.48–0.51 mm wide; plate with 25 holes across diameter at middle; holes irregularly oval. Dorsal surface of each segment with many short setae and sparse, slender, long setae. *Abdomen:* Spiracles of abdominal segments I–VIII similar in size. Distance between 2 lobes of respiratory plate much less than dorsoventral diameter of bulla (Fig. 58). Bulla regularly oval, slightly convex. Dorsal areas of each segment with many short setae. Prescutum of abdominal segments I–VII with irregular, transverse rows of slender setae. Scutum of abdominal segments II–VII with transverse rows of mixed medium size and long setae. Scutellum of abdominal segments I–VI with irregular, transverse rows of medium size setae. Segments IX and X fused, covered with short setae and long setae toward posterior borders. Spiracular area and pleural lobes of abdominal segments I–VIII with many short setae. Raster with pair of palidia (Fig. 59), each consisting of an irregular row of 12–16 pali, rows joined anteriorly. Septula elongate. Tegilla composed of many short, thick setae and some long setae. Lower anal lip with many short setae. *Legs:* Tarsungulus (Fig. 60) cylindrical, apex rounded and bearing 10–12 setae.

Second instar larva.—This description is based on three second instar larvae reared from eggs obtained from an adult female, fixed 12-VII-1997, with data as cited above (3 larvae) (IEXA). Similar to third instar except as follows: maximum width of head

Fig. 61. *Gymnetis flavomarginata sallei*, pupa., lateral view. Scale line = 5 mm.

capsule: 2.50–2.85 mm. Dorsoventral diameter of spiracles 0.25–0.28 mm. Each palidium with 10–12 pali.

First instar larva.—This description is based on 11 first instar larvae reared from eggs obtained from an adult female, fixed 9-V-1997, with data as cited above (11 larvae) (IEXA). Similar to second instar except as follows: maximum width of head capsule: 1.4–1.5 mm. Respiratory plates of spiracles kidney shaped; dorso ventral diameter of spiracles: 0.09–0.11 mm. With 1 acute, small eclosion spine, placed on ovate weakly sclerotized plate, on each side of metanotum. Palidia not defined.

Pupa, female.—This description is based on three pupae reared from eggs obtained from an adult female, fixed, 20-II-1998, with data as cited above (3 pupa) (IEXA).

Form: Body elongate, robust, exarate (Fig. 61). Yellowish white. Without velvety microtrichia on abdominal segments. *Head:* Strongly reflexed downward; antennae and mouth parts clearly separated. Ocular canthus, antennae, and compound eyes well-differentiated. Clypeus concave. Labrum tumid. Surface of frons irregularly convex. *Thorax:* Pronotal disk with irregular, shallow depressions toward sides; lateral margins not defined. Meso- and metanota differentiated. Meso- and metascutellum narrowed posteriorly, apex rounded. Pteroteca widened, free, with apex rounded or slightly acute, compressed around body; hind wing teca slightly longer than elytron teca. Meso-metasternal process large, with rounded apex emerging between pro- and mesocoxae. Protibia with 4 short process on external border; meso- and metatibiae each with 2 rounded, short, apical spurs; all tarsomeres vaguely defined. *Abdomen:* Tergites I–VIII convex, without dioneiform organs or transverse carina on posterior borders. Tergo-lateral tubercles II–V prominent, surrounded by fine rugae. Spiracle I elongate, not prominent, partially protected by posterodorsal fleshy fold. Spiracles II–IV tuberculiform, with ring-like, sclerotized peritreme. Spiracles V–VII closed, tuberculiform, prominent, surrounded by fine rugae. Sternites II–VII convex, with fine transverse lines. Last tergite with lateral rugae around small tubercle, and rounded, fleshy lobes on the posterior border, without urogomphi. Genital ampulla wide, slightly convex, with fine mesial sulcus.

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NOTE

New Records of Fruit Fly Parasitoids (Hymenoptera: Braconidae, Figitidae, Pteromalidae) for La Rioja Province, Northwestern Argentina

La Rioja Province is located in the southern part of northwestern Argentina, between 27°43′ and 32°00′ south latitude and 65°25′ and 69°40′ west longitude. The fruit-producing and horticultural areas include about 50,000 hectares restricted to irrigated valleys isolated from each other by wide desert plains or by high mountains where basically no native host plants of economically significant fruit fly species are found. The main fruit products are olive, grape, walnut, quince, fig, peach, plum, apricot, pear, and apple. *Ceratitis capitata* (Wiedemann) or Mediterranean fruit fly or medfly, and *Anastrepha fraterculus* (Wiedemann) or South American fruit fly, are the only economically important tephritid species present in the fruit producing valleys. One of these valleys, the Antinaco-Los Colorados Valley, is situated in the northwestern region of La Rioja Province (28°49′–29°53′S and 67°09′–67°41′W). The total cultivated area in this valley is about 8,200 hectares and it is restrained to zones where irrigation is possible. The altitude ranges from 1,000 to 1,500 m. The climate is temperate-arid, with −9°C of absolute minimum temperature in June–July (winter), and 42°C of absolute maximum temperature from November to February (summer). The rainy season occurs from December to March and averages 189.1 mm annually. Both *C. capitata* and *A. fraterculus* populations were detected in 1986 in this valley by fruit sampling and fly adult trapping activities (Nasca et al. 1996, Frissolo 1999).

The purpose of this note is to report the hymenopterous parasitoid species reared from *C. capitata* and *A. fraterculus* pupae in the Antinaco-Los Colorados Valley, La Rioja Province, during the 1988–1990 summer seasons. The survey of the parasitoids reported here was undertaken as part of a population study of fruit flies of economic importance in La Rioja. Prior to this report, only *Aganaspis pelleranoi* (Brèthes), a fruit fly eucoiline parasitoid, had been recorded from *C. capitata* in La Rioja (Wharton et al. 1998).

Ripe fruits were harvested and transported to the laboratory and placed in styrofoam containers with damp sand in the bottom as a pupation substrate. *Ceratitis capitata* and *A. fraterculus* pupae were recovered weekly and placed in closed styrofoam vials until all flies and/or parasitoid adults emerged. I identified the adult insects (flies and parasitoids). Voucher specimens are placed in the insect collection of the Fundación Miguel Lillo, San Miguel de Tucumán, Argentina.

A total of 69 parasitoids representing three species [*A. pelleranoi* (Hymenoptera: Figitidae, Eucoilinae), *Doryctobracon areolatus* (Szépligeti) (Hymenoptera: Braconidae, Opiinae), and *Pachycrepoideus vindemmiae* (Rondani) (Hymenoptera: Pteromalidae, Pteromalinae)] were recovered from 25,310 *C. capitata* and *A. fraterculus* pupae which were obtained from 642 fruit fly host fruits [198 figs (*Ficus carica* L., Moraceae), 100 quinces (*Cydonia oblonga* Miller, Rosaceae), 200 peaches (*Prunus persica* (L.) Batsch, Rosaceae), and 144 plums (*Prunus domestica* L., Rosaceae)]. Both, *A. pelleranoi* and *D. areolatus* are larval-pupal parasitoids, while *P. vindemmiae* is a pupal parasitoid. Because puparia of *C. capitata* and *A. fraterculus* were not sorted, it was impossible to determine which tephritid species was parasitized by which parasitoid species.

A new fruit fly parasitoid record for La Rioja Province is *D. areolatus*. On February 17, 1988, one female of *D. areolatus* was recovered from infested figs, and on December, 7–15, 1989, 3 females and 1 male, and 1 female and 1 male were recovered from infested peaches and plums, respectively. This parasitoid species has been previously recorded in the provinces of Misiones (25°30′–28°10′S and 53°38′–56°03′W), in the northeastern subtropical rainforest of Argentina, or Paranaense forest (Ogloblin 1937), and Tucumán (26°05′–28°01′S and 64°28′–66°13′W), in northwestern subtropical rainforest of Argentina, or Yungas forest (Ovruski 1995). The known distribution range of *D. areolatus* is thus extended nearly 400 km southward to a different region which is geographically isolated from the other areas where this parasitoid species has commonly been recorded in Argentina.

Between February 3 and March 3, 1988, and between February 2 and March 5, 1989, 25 females and 12 males, 6 females and 3 males, and 5 females and 3 males of *A. pelleranoi* was recovered from infested figs, quinces, and plums, respectively. Moreover, 16 females and 6 males of *A. pelleranoi* were obtained from infested peaches between December 7, 1989 and January 6, 1990.

Both *A. pelleranoi* and *D. areolatus* are typical fruit fly parasitoid species mainly associated with the genus *Anastrepha* and widely distributed in tropical and subtropical rainforest of the Neotropical Region (Ovruski et al. 2000). A probable explanation for the presence of *D. areolatus* and *A. pelleranoi* in the Antinaco-Los Colorados valley is via their introduction in fruit infested with *A. fraterculus* or *C. capitata* larvae parasitized by either the opiine or the eucoiline parasitoid transported from northern Argentina. Thus, the subtropical rainforest regions of northeastern and northwestern Argentina, with large numbers of wild host plants, present throughout the year, may provide fruit fly reservoirs for new introductions into the isolated fruit producing valleys of La Rioja. Given the extremely harsh climatic conditions of the Antinaco-Los Colorados valley, where extensive commercial fruit crops, smallholder farming, and small family fruit orchards are concentrated in irrigated oasis broadly separated by desert areas and high mountains, it is unlikely that both *A. pelleranoi* and *D. areolatus* have spread south naturally. Although *C. capitata* was recorded from cultivated plants of *Opuntia ficus-indica* (L.) Miller (Cactaceae) in La Rioja, there is no evidence of the medfly attacking native species belonging to the genus *Opuntia* Miller in the field (Nasca et al. 1996). Furthermore, the native parasitoids of *Anastrepha* Schiner appear to be poorly adapted to medfly. For example, from ca. 20,000 *C. capitata* puparia recently collected from several fruit species in the Yungas forest, it only was obtained a small number of *A. pelleranoi* (S. Ovruski, P. Schliserman and M. Aluja, unpublished data).

Another new fruit fly parasitoid record for La Rioja Province is the pteromalid *P. vindemmiae*, a pupal parasitoid of cyclorrhaphous Diptera. A total of 11 specimens were recovered from figs (4 females and 2 males) and quinces (2 females and 3 males) between February 17 and March 8, 1988. Probably, *P. vindemmiae* could be obtained from figs and quinces because fruit fly larvae pupated inside the fruits before they were sampled and transported to the laboratory. This cosmopolitan and polyphagous parasitoid species was introduced and released in Buenos Aires, Entre Rios (Turica et al. 1971), Tucumán (Nasca 1976), and Cordoba provinces (Fischetti et al. 1978) for fruit fly biological control between 1968 and 1973. However, *P. vindemmiae* was previously reported in Mendoza, Tucumán and Buenos Aires under other scientific names, such as *P. dubius* Ashmead and *P. tucumanus* Blanchard (DeSantis 1967, Ovruski and Fidalgo 1994).

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Note

Two Species of Western North American *Hylesinus* Fabricius (Coleoptera: Scolytidae) New to the Eastern United States

Historically, there have been three species of ash bark beetles, *Hylesinus* Fabricius, reported from the eastern United States: *Hylesinus aculeatus* Say, *H. fasciatus* LeConte, and *H. pruinosus* Eichhoff (Wood and Bright 1992). The eastern ash bark beetle, *H. aculeatus,* is a relatively common species infesting recently cut trees or those weakened by injury, disease or fire (Solomon 1995). Adults construct galleries in the bole or large branches of host trees in the genus *Fraxinus.* The biologies of *H. fasciatus* and *H. pruinosus,* although less well known, are similar to *H. aculeatus* (Solomon 1995, Wood 1982). *Hylesinus californicus* (Swaine) and *H. criddlei* (Swaine) are known from western and midwestern North America, respectively (Wood and Bright 1992). This note reports the first occurrence of these two species in the eastern United States.

Hylesinus californicus.—In the spring of 1999, adult *Hylesinus* were found boring into the bases of leaf petioles and constructing egg galleries in 1 to 3 year old twigs of healthy green ash, *Fraxinus pennsylvanica* Marshall, in suburban Maryland (Anne Arundel County, Linthicum, 9 July 1999). This behavior is atypical of the eastern species of *Hylesinus.* Beetles were collected and compared with specimens at the National Museum of Natural History, Smithsonian Institution, Washington D.C., and identified as *H. californicus* (this identification was later confirmed by Don Bright, Agriculture Canada, Ottawa). This is the first record of this species east of the Mississippi River.

In 2000, additional *H. californicus* were found infesting green ash in the Baltimore-Washington area (Anne Arundel Co., Glen Burnie, 20 July; Prince George's Co., Bowie, 2 June). In Bowie, green ash is a common landscape tree that has shown signs of decline for the past decade. When these trees were examined in 2000, many had evidence of past *H. californicus* attack in the portions of crowns with dieback. During 2001, additional evidence of *H. californicus* infestations was found in nursery stock (Montgomery Co., Ashton, September) and landscape trees (Baltimore City, July).

Hylesinus californicus is an occasional pest of green ash in the upper great plains of the United States and Canada (Langor 1994, McKnight and Aarhus 1973) and in California (Doane 1923). In Calgary, Alberta, Canada, a severe infestation of green ash occurred from 1987–1990 coincident with a drought in the area (Langor and Hergert 1993). In California, this species occasionally is a pest of olive trees (Essig 1917). Langor and Hergert (1993) give a detailed account of the life history and behavior of *H. californicus* in Alberta. Wood and Bright (1992) report the distribution of *H. californicus* as: USA: Arizona, California, Colorado, Montana, New Mexico, Oklahoma, Oregon, Texas, and Utah; Canada: Manitoba and Saskatchewan.

Although similar in appearance, *H. aculeatus* and *H. californicus* can be distinguished by the characters given in Table 1.

Hylesinus criddlei.—The reported range of *H. criddlei* is the upper mid-western United States (Colorado, Iowa, Illinois, Kansas, Michigan, Minnesota, Montana, North Dakota, and South Dakota) and Canada (Manitoba, Ontario, Quebec, and Saskatchewan) (Wood and Bright 1992). Hosts are listed as *Fraxinus pennsylvanica* and *F. americana* L. Very little is known of the biology of this species. McKnight and Aarhus (1973) report that *H. criddlei* adults often attack branches previously attacked by *H. californicus.*

Table 1. Characters used to distinguish *H. aculeatus* and *H. californicus*

Character	*Hylesinus aculeatus*	*Hylesinus californicus*
Male frons	Shallow, transversely impressed	Concave to upper level of eyes, with a smooth raised area
Female frons	Convex with a slight vertical carina	Convex with a distant vertical carina
Antenna	3 sutures visible, 3rd angulate	2 sutures visible
Propleuron	Setae hair-like, thin	Setae scale-like, divided into 2 or 3 filaments
Declivital interstrial scales	Median row of scales not noticeably different from other scales	Median row of scales much larger, more erect than others, especially in males

Since 1993, the Maryland Department of Agriculture has conducted detection surveys for *Tomicus piniperda* (L.) utilizing α-pinene-baited Lindgren funnel traps (PheroTech, Delta, BC, Canada). Traps are placed from late winter through early spring in Christmas tree plantations or forested areas dominated by *Pinus* species. Since 1993, all scolytids captured in these traps have been identified. Occasionally, specimens of *H. aculeatus* have been collected. In 2000, specimens of *H. criddlei* were collected in traps in Carroll Co., Manchester, 24 March and 20 April and in Garrett Co., Oakland, April 28, 2000. Specimens were identified and compared to specimens in the National Museum of Natural History, Smithsonian Institution, by the senior author, and later confirmed by Don Bright.

Hylesinus criddlei adults are distinguished from species of eastern North America *Hylesinus* by the paler coloration of scales; a weak, median frontal impression, and moderate sculpture on the interstriae (Wood 1982).

Evidence of semiochemical-based communication in *Hylesinus* was reported for *H. californicus* in Oregon (Rudinsky and Vernoff 1979) and *H. varius* (F.) (= *fraxini* (Panzer)) and *H. toranio* (Danthione) (= *oleiperda* (F.) in Europe (Rudinsky and Vallo 1979). Kohnle (1985) found *H. varius* responded to ethanol-baited traps, and trap catch was increased by the male-produced *exo*-brevicomin, while another male-produced compound, 7-methyl-1,6-dioxaspiro (4,5) decane (conophthorin) inhibited response.

In 2000, to see if *H. californicus* responded to *exo*-brevicomin, funnel traps baited with this compound (PheroTech) were placed where *H. californicus* or other *Hylesinus* were previously collected. During the four month trapping period (March–

Table 2. *Hylesinus* species collected in exo-brevicomin-baited funnel traps in Maryland during 2000.

County	*Location*	*Species*	*Number of Beetles*
Anne Arundel	Linthicum	*H. criddlei*	76
		H. aculeatus	76
		H. fasciatus	1
		H. pruinosus	1
Allegany	Flintstone	*H. criddlei*	14
Prince George's	Bowie	*H. criddlei*	8
		H. aculeatus	146
		H. fasciatus	1
		H. pruinosus	7

Table 3. *Hylesinus* species collected in baited funnel traps in Maryland, 2001.

Species	*exo-brevicomin*	*endo-brevicomin*	*conophthorin*
Hylesinus aculeatus	15	52	28
Hylesinus criddlei	54	108	8
Hyleusinus pruinosus	2	3	3

June), no *H. californicus* were collected in the *exo*-brevicomin-baited traps although *H. californicus* were collected in branches of trees containing some of the traps. In each location, however, *H. criddlei* and other *Hylesinus* were collected in the *exo*-brevicomin-baited traps (Table 2).

From March through June, 2001, additional funnel traps were baited with either *exo*-brevicomin, *endo*-brevicomin or conophthorin (PheroTech) in Anne Arundel Co., Linthicum; Baltimore Co., White Marsh; Carroll Co., Manchester; and Cecil Co., Port Deposit. Three species of *Hylesinus*, including *H. criddlei*, were collected in the traps (Table 3). Also in 2001, specimens of *H. criddlei* were collected in an Allison-Pike suction trap in Garrett Co., Accident.

Although trapping was not part of a controlled experiment, the data clearly show that *H. criddlei* is established in Maryland. In addition, trapping results suggest that *H. criddlei* is attracted to *exo*- and *endo*-brevicomin. Future experiments are planned to test the attraction of *H. criddlei* and *H. californicus* to semiochemicals.

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NOTE

First Report of *Hyalomma marginatum isaaci* Sharif (Acari: Ixodida: Ixodidae) from the Union of Myanmar, with a Concurrent Collection of *H. hussaini* Sharif

Though members of the biomedically important tick genus *Hyalomma* are chiefly associated with the vast xeric biomes of the southern Palearctic and Afrotropical Zoogeographic Regions (Hoogstraal 1973), two species–*H. hussaini* Sharif and *H. marginatum* Koch–have occasionally been reported from continental southeastern Asia (i.e., the Oriental Zoogeographic Region), where they apparently occur as small, widely disjunct populations in areas that are prone to dryness for at least a portion of the year (Kaiser and Hoogstraal 1964, Petney and Keirans 1995). Between 17 and 29 November 2000, one of us (SGP) participated in a herpetological expedition to the Minzontaung Wildlife Sanctuary (MWS), located within the dry zone of central Myanmar (formerly Burma), approximately 60 km southwest of Mandalay in Nwahtogyi Township, Myin Gyan District, Mandalay Division. On 24 November, at the end of the day's fieldwork, SGP and an associate each removed from his clothing a single male/female pair of *Hyalomma*; these were subsequently identified as *H. hussaini* and *H. marginatum isaaci* Sharif, the latter a new record for Myanmar.

Established in 1998–1999 for the protection of Eld's deer, *Cervus eldii* M'Clelland, MWS currently comprises 2,260 ha and is dominated by Minzon Taung, an isolated hill range with a maximum elevation of 398 m. The surrounding lowlands are 200–225 m above sea level and generally flat, except for a few deep gorges cut by watercourses. Previously, this area had been largely deforested by burning, fuelwood extraction, and livestock grazing, but the vegetation is rapidly regenerating from stump sprouts, and average canopy heights now exceed 4 m. The flora of MWS is similar to the thorn forest and thorn scrub associations described by Stamp and Lord (1923). Dominant trees include three species of *Acacia* (*A. arabica* (Lamarck) Willdenow, *A. catechu* (L. filius) Willdenow, and *A. leucophloea* Willdenow), *Tectona hamiltoniana* Wallich, *Terminalia oliveri* Brandis, and the exotic *Prosopis juliflora* (Swartz) Candolle. Dense stands of grasses, such as *Apluda mutica* L., *Diectomis fastigiata* (Swartz) Palisot de Beauvois, and *Grewia microcos* L., occur in open areas. Patches of Indaing forest, characterized by *Dipterocarpus* spp., *T. hamiltoniana, Xylia dolabriformis* Bentham, and scattered clumps of bamboo (*Dendrocalamus strictus* (Roxburgh) Nees), occupy the upper slopes and deep ravines on the eastern face of Minzon Taung. Some areas, especially along the sanctuary's northwestern and southwestern borders, continue to be intensively grazed by sheep and goats, and the lack of evident forage suggests that livestock numbers exceed sustainable levels. Agricultural lands centered on several villages surround MWS, with the result that little natural vegetation remains outside sanctuary boundaries.

Of particular importance to studies of tick distribution in MWS is the climate of central Myanmar, an area that lies within the rain shadow of the Arakan Yoma Mountains (Robbins and Platt 2001) and is therefore exceptionally dry. An attenuated monsoonal wet season, marked by erratic showers, moderate temperatures and overcast skies, extends from June to October, followed by a prolonged dry season that lasts from October to late May (Terra 1944, Roberts et al. 1968, Scott 1989). Annual precipitation in central Myanmar ranges from 50 to 100 cm (Terra 1944), MWS itself being astride the 30 in. (76 cm) isohyet of

Stamp and Lord (1923). There are no permanently flowing streams in MWS, and surface waters of all kinds are extremely limited during much of the year. In addition, central Myanmar experiences high diurnal temperatures during the dry season (maximum 43°C), and low nocturnal temperatures over the winter months (January–February, minimum 4°C) (Food and Agriculture Organization/United Nations Development Programme 1982).

The prevailing climate, topography, and human land use patterns in and around MWS are reminiscent of South Asian conditions well west of Myanmar, where *H. hussaini* and *H. marginatum isaaci* are regular components of the acarofauna. Though previously reported from central Myanmar, *H. hussaini* chiefly occurs in India and Pakistan (Kaiser and Hoogstraal 1964), most Indian collections having come from the north-central and northeastern states west of Bangladesh (e.g., Bihar, Madhya Pradesh, Madras, Maharashtra, Orissa) (Sharif 1928). Collections have also been made in Gujarat State on the Arabian Sea (Hiregaudar 1968). Interestingly, there appear to be no records of this xerophilous tick from India's humid easternmost states, which lie between Bangladesh and Myanmar (Geevarghese and Dhanda 1987).

Hyalomma marginatum isaaci is a widespread South Asian tick, occurring from Afghanistan, Pakistan, Kashmir and Nepal south through India to Sri Lanka (Kaiser and Hoogstraal 1964). Unlike *H. hussaini*, *H. marginatum isaaci* has been recorded from Arunachal Pradesh State (formerly the North-East Frontier Agency), bordering Myanmar (Dhanda and Rao 1964), so its presence at MWS is less surprising. Moreover, occasional reports from central and southeastern Vietnam of specimens closely resembling *H. marginatum isaaci*–namely, Toumanoff's (1944) *H. dromedarii indosinensis,* corrected by Hoogstraal (1956) to *H. marginatum,* and classified by Kolonin (1992, 1995) as *H. m. indosinense* Toumanoff–suggest that this complex may be thinly distributed throughout the humid tropics of southeastern Asia and hint at the possible topographic provenance of Minzontaung specimens.

During the Minzontaung expedition, collectors fanned out over the entire sanctuary, some remaining in the lowlands, while others hiked into high country. Though daily collector itineraries are unavailable, it may be that our pair of *H. hussaini* transferred to the clothing of a collector working in dry lowland scrub. However, *H. marginatum isaaci* may only have been encountered by entering the somewhat moist, high-altitude forests on Minzon Taung proper, where environmental conditions approximate those at Vietnamese localities that have yielded related representatives of the *H. marginatum* complex.

Our collections of *H. hussaini* (RML 123220) and *H. marginatum isaaci* (RML 123221) have been deposited in the U.S. National Tick Collection, Institute of Arthropodology and Parasitology, Georgia Southern University, Statesboro. We warmly thank the Wildlife Conservation Society, Bronx, New York, for supporting our fieldwork in Myanmar, and the Myanmar Forestry Department for granting permission to conduct research in MWS. Thanks also to Chief Warden U Khim Ag Soe and his wife for their generous hospitality throughout our stay. Field assistance was provided by Daw Aye Aye Cho, U Tin Lwin, U Win Ko Ko, Daw Khin Myo Myo, Daw Lay Lay Khaing, and Daw Thanda Swe. For logistical support and several critical references, we are grateful to U Saw Tun Khaing, U Thanh Minh, Stephan Johnson, and Thomas R. Rainwater. Portions of this research were funded by National Institute of Allergy and Infectious Diseases grant AI 40729 to JEK.

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NOTE

Cardiastethus luridellus Fieber (Hemiptera: Heteroptera: Anthocoridae), a Non-Indigenous Anthocorid Discovered in Oregon

A specimen of *Cardiastethus luridellus* Fieber (Anthocoridae) was recovered on 26 June, 2000, from a Lindgren funnel trap placed by the Oregon Department of Agriculture at businesses importing solid-wood packing material (SWPM) in Portland, Multnomah County, Oregon. The trap was baited with an ultra-high release ethanol lure. Described from Pennsylvania (Fieber 1860), this bug remained known only from the original description with the type from Pennsylvania until Lattin (1999a) collected it from a dead-leaf cluster of a newly fallen oak tree in west-central Michigan. All earlier literature records only repeated the original description (Blatchley 1926, Torre-Bueno 1930, Henry 1988). Lattin (1999a) suggested that adult *C. luridellus* fed on the psocids and other small arthropods found in the dead-leaf clusters. The absence of nymphs in the leaf clusters suggests that other habitats, including subcorticular habitats, might be utilized. The occurrence of this species from a chemical-baited trap at a site where solid wood products were received, far west of the known range of the bug, indicates that *Cardiastethus luridellus* is non-indigenous in Oregon. Other introduced species of Anthocoridae also known from Oregon include *Anthocoris nemoralis* (Fabricius), *Dufouriella ater* (Dufour), *Lyctocoris campestris* (Fabricius), *Orius minutus* (Linneaus), *Xylocoris cursitans* (Fallén), and *Xylocoris galactinus* (Fieber). (Henry 1988; Lattin et al. 1989, 1999b, 2000; Lattin unpublished; T. Lewis, personal communication 2000).

Lindgren funnel traps have been placed at sites in Oregon and Washington receiving imported wood and other wood products since 1996, to detect exotic insect species not known from the region (Mudge et al. 2001). These traps are baited with several types of lures to detect a variety of wood boring insects. Mudge et al. (2001) reported eight exotic species of wood-associated Coleoptera and Hymenoptera from these surveys. The attraction of a predatory bug to one of these traps may provide a link between the bug and the potential prey attracted to the same traps. Several Anthocoridae have been shown to be attracted to potential prey or to compounds released by plants being attacked by herbivorous insects (e.g., Lattin 1999b, 2000).

Torre-Bueno (1930) provided a key to the two species of *Cardiastethus* known to occur in the northeastern United States. *Cardiastethus luridellus* is a mostly shining species with distinct pale pubescence on the dorsum and a few longer setae along the edge of the pronotum. The matte-like appearance of the clavus and adjacent portion of the corium in contrast to the otherwise shining dorsum are characteristic. There is a vague fuscous vitta along the apical portion of the cuneus where it contacts the membrane. The membrane is uniformly fuscous except for a narrow portion adjacent to the apex of the cuneus. Only the outer vein of the membrane is distinct plus a trace of the inner-most vein, the two middle veins are not apparent. This is a small anthocorid (2.9 mm). *Cardiastethus pergandei* Reuter, the other species in Torre-Bueno's key, is smaller (1.75 mm) and is known only from the type from Washington, D.C. The Oregon specimen of *C. luridellus* has been deposited in the collections of the Oregon Department of Agriculture, along with other material from this survey.

Some of the insects from these traps are indigenous to eastern North America, while others are exotic species previously known to be established in that region. The discovery of a heteropteran native to the eastern United States adds further weight to concern about the continuing flow of eastern North America insects via the open conduit of solid-wood packing material and the potential of economic and ecological consequences for western North America.

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NOTE

First Report of *Hesperoctenes fumarius* Westwood (Hemiptera: Polyctenidae) from the Island of Dominica

Hesperoctenes fumarius (Westwood) is one of the most widely distributed and most frequently recorded polyctenids in the New World (Ueshima 1972, Ryckman and Sjogren 1980). It has been previously found on several islands in the West Indies, in southern Mexico, and in the northern regions of South America. Within the Caribbean, it has been recorded thus far from Cuba, Jamaica, Puerto Rico, and the Virgin Islands (Ueshima 1972, Ryckman and Sjogren 1980). Ueshima (1972) listed 11 species of bats in the family Molossidae as hosts of *H. fumarius* and he noted records, that he considered accidental, from Emballonuridae and Noctilionidae. The last complete revision of this little-known family was by Ferris and Usinger (1939). A good summary of the literature on Polyctenidae is provided by Schuh and Slater (1995), who adopted the subfamily classification of Maa (1964).

We report here the first record of *H. fumarius* from the island of Dominica as well as the first record of the family Polyctenidae from either the Leeward or Windward Islands of the Lesser Antilles. Bats and their ectoparasites have been sampled extensively from Dominica for more than twenty years (Pence et al. 1981), but this is the first report of the island fauna harboring ectoparasites from the family Polyctenidae. Though a relatively small island, Dominica is characterized by extensive forested habitats, marked altitudinal gradients, and a rich flora. Thirteen species of bats, representing six families, have been recorded from Dominica (Genoways et al. 2001). During the months of May and June, from 1998–2001, members of Texas A&M University's (TAMU) study abroad program in Dominica have participated in an on-going survey of Dominican bats and their ectoparasites. During this period, 150 bats representing eight species and five families were captured in mist nets, identified, examined for ectoparasites, and released. All ectoparasites that could be captured without injuring the bats were removed and preserved in 70% ethanol. Voucher specimens of bats are represented by tissue samples taken from wing plugs during the 2001 survey (Texas Cooperative Wildlife Collection, TAMU). Voucher specimens of ectoparasites are deposited in the TAMU Insect Collection and with the Forestry and Wildlife Division of Dominica. The vast majority of the ectoparasites collected during this survey consisted of mites (Acari) and parasitic flies of the family Streblidae. Polyctenidae were noted for the first time on Dominican bats on 5 June 2001. Seven specimens were removed from bats field identified by Thomas Lacher (TAMU) as *Molossus molossus* (Pallas 1766). These bats were taken in a mist net erected at the entrance of a sea cave near Rodney's Rock (15°22′N 61°29′W). Wing tissue was taken for additional identification and is currently being used as part of a study on population genetics and speciation of New World bats. The seven adult polyctenid specimens were identified by the authors as *H. fumarius*, using the keys in Ueshima (1972). Both females and males were represented. One additional specimen, presumed to be a pharate first instar based on the folded and incompletely developed nature of the legs, was tentatively identified as a member of this species. The adults were collected while traversing the body of the bat, but the immature specimen was discovered in the cavity between the second and third finger of the bat.

Hesperoctenes fumarius was found on the three *M. molossus* sampled from the sea cave population on the Caribbean side of the island, but not on any of the other 34 *M. molossus* examined from other roosting sites during this survey. Few *M. molossus* were infested with mites and none with streblids. Conversely, polyctenids were not found on any other bat species during this study. The presence of *H. fumarius* on Dominica links the distribution of this species to populations previously recorded from Venezuela (Ueshima 1972) and to those recorded from Cuba, Puerto Rico, and the Virgin Islands (Ryckman and Casdin 1977).

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BOOK REVIEW

Carabidae (Insecta: Coleoptera): Catalogue. A. Larochelle and M.-C. Lariviere. 2001. 285 pp. *In* Crosby, T. K., Series Editor, *Fauna of New Zealand*, No. 43. Manaaki-Whenua Press, Lincoln, Canterbury, New Zealand. ISBN: 0-478-09342-X. Price, U.S. $72.50. May be ordered by post through Landcare Research New Zealand Limited, Canterbury Agriculture and Science Centre, P.O. Box 40, Gerald Street, Lincoln, New Zealand; or, by e-mail at mwpress@landcare.cri.nz

The "Fauna of New Zealand" is a series of refereed biological publications the objective of which is "to provide authoritative and comprehensive guides to identification in a medium accessible to all would-be users and that will evolve as an accumulating descriptive index of our insects, spiders, mites, and other terrestrial invertebrates." So declared the first Series Editor, C. T. Duval, in the Preface to the excellent issue No. 1 (treating terebrant Thysanoptera), pp. 3–4, 1982. Over the following 19 years, some 42 more issues have appeared, averaging some 2 numbers per year (about a third of the number of issues annually, that was planned originally). Following the index (pp. 282–285) of the issue being reviewed here, all of the issues of "The Fauna of New Zealand" are listed by number, and the names of groups covered are summarized taxonomically.

Each number is a concise and comprehensive taxonomic treatment of the New Zealand members of non-marine invertebrate (principally insect) taxa of supraspecific rank (principally family). The carabid Catalogue is typical, particularly with regard to its very high quality, and consistency and uniformity of presentation, but differs in that means of identification of the included genera and species are not provided.

Far more than a catalogue, the present publication is a detailed review of the 424 known species of Carabidae of the New Zealand subregion, based on extensive detailed study of the literature from 1775 to December, 1999, recording information associated with several thousand specimens housed in some 14 museums and collections, and supplemented by 8 years of field work by the authors. Preceding the table of contents, the preliminary parts of the volume include: a "popular summary," in both English and Maori; a succinct biographical sketch accompanied by a color photograph of each author; a moving dedication of the volume to the indomitable Charles Watt, who has contributed so much to New Zealand coleopterology; a color frontispiece; and an abstract.

Following the Table of Contents, an introductory section includes: a Checklist; Acknowledgments; Introduction; and Methods and Conventions. Ready location of information about taxa is made possible by two means: a detailed, hierarchical checklist with page references, which follows immediately the table of contents; and by a taxonomic index toward the end of the volume.

The Introduction is a rich source of information about New Zealand carabids, treating history of carabid classification, overall geographical distribution, faunal composition and affinities, and an admirable summary of natural history ("ecology" and "biology") of the species.

The 228 page catalogue, organized taxonomically, uses a system which includes 3 supratribal ranks (division, subfamily, and supertribe), tribe, subtribe, genus, and species. The supratribal taxa are noted by name, only. For each tribe and subtribe, geographical range is specified in general terms. References are provided for keys and taxonomic treatment of included genera, along with notes about status of knowledge of the group—"in need of revision," or "under revision," and by whom.

For each genus, the following information is provided: reference to original description and synonymy; type species; geographical range (by island archipelago or country); references to keys; and taxonomic notes, as appropriate. Subgenera are treated similarly.

For each species, references are provided to the original description, synonymy, and type locality. Geographical distribution is specified by island and by "area" within the major large islands (North and South) of the New Zealand subregion, through reference to two-letter abbreviations of area codes, based on a standardized system of ecogeographical areas. Natural history is treated under 3 rubrics: "ecology," meaning habitat preference, altitudinal range by habitat (lowland; subalpine; alpine); and habits (diel activity periods, and resting places); "biology," meaning seasonality and food habits; and "dispersal power," meaning extent of wing development ("macropterous"; "brachypterous"; and "subapterous," with the implication of flight capability for macropterous individuals, and absence of such capability for brachypterous and subapterous individuals), and terrestrial locomotion (principally, subjectively judged speed of running).

Linkage between verbal abstractions and the beetles themselves is provided by simple, clear habitus illustrations (without legs or antennae) of one or more representatives of each carabid tribe. These figures were drafted by D. W. Helmore, who also executed the more elaborate figure of the exquisitely formed pamborine species, *Maoripamborus fairburni* Brookes, which graces the cover of this volume, and the figure of *Cicindela tuberculata* Fabricius, preceding the "popular summary". The frontispiece, a color photograph of the dorsal aspect of an adult of the endemic pterostichine, *Megadromus bullatus* (Broun), illustrates the archetypical form of a carabid.

A series of 422 outline maps illustrates in a generalized fashion the geographical range, in the New Zealand subregion, of all but two of the species treated. Each of these figures is unnumbered, but is accompanied by species name, and the maps (9 per page) are in the same order as are the species treatments in the text. They are referred to in the text by page number and species name. A particular map is easily located. Seven numbered outline maps illustrate form and position of the islands of the New Zealand subregion, ecogeographical areas of the North and South Islands, and various aspects of diversity by island and ecogeographical area.

An extensive bibliography precedes the appendices, habitus figures, and range maps. Summaries of information about the New Zealand Carabidae are provided in tables: supratribal classification; number of species within each tribe and genus, and whether the genus is "endemic," "native," or "adventive"; and distribution pattern of each of the 27 genera and species whose range is not confined to the New Zealand subregion.

Nine appendices include: a glossary of technical terms; a list of *nomina nuda*; an alphabetical list of unjustified emendations; an annotated list by name of species incorrectly or doubtfully recorded from New Zealand; an annotated list of names of species deliberately introduced to New Zealand; geographical coordinates of principal localities recorded in the text; an alphabetical list of valid species names for the New Zealand carabid fauna; an alphabetical list of names of valid taxa by area of New Zealand; and a list of type localities of carabid species described from New Zealand.

Although this publication is admirable overall, the reviewer has 2 observations with negative connotations. First, without increasing unduly the length of this volume, the authors could have enhanced its value substantially by inclusion of at least a key to tribes, and even more so by inclusion of keys to the genera of each of the polybasic tribes. Second, with reference to loss of flight capability, it would have been more instructive if the authors had referred to relative size of metathorax and whether the elytra are fused, rather than distinguishing between the flightless conditions of "brachypterous" and "subapterous."

If this work is found wanting by some because of a lack of more theoretical considerations, others will note that it is an excellent descriptive account of a regional, quite diverse, and pronouncedly endemic islandic fauna. The volume will serve very well those who wish to undertake taxonomic or ecological work on the New Zealand Carabidae, as well as those island biogeographers who seem to revel in mathematical manipulations of data about island faunas.

The authors, expatriate Canadians (a sorry loss for Canada but a great gain for New Zealand), are to be congratulated for producing a volume which is rich in carefully organized, and therefore easily located, information about a taxonomically and ecologically diverse, and divergent, component of the New Zealand subregion. Similarly, the present Series Editor, Trevor K. Crosby, should be commended for maintaining the very high quality of production of the "Fauna of New Zealand" which characterizes this serial publication.

The price seems rather high for this number, with a cost of about U.S. $0.25 per page. In 1982, the comparable sized Number 3, which treats the family Anthribidae, sold for U.S. $8.00, or about $0.03 per page. The difference between the two prices represents more than an 8-fold increase. Nonetheless, to the carabid specialists of the world, to those with a special interest in the New Zealand fauna, and perhaps to biogeographers interested in islandic faunas, this volume is well worth the asking price.

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BOOK REVIEW

Tiger Beetles: The Evolution, Ecology, and Diversity of the Cicindelids. Pearson, David L., and Alfried Vogler. 2001. Cornell Series in Arthropod Biology. Comstock Publishing. Cornell University Press. Ithaca and London. 333 pp. U.S. $39.95, cloth.

"Tiger Beetles" represents a timely contribution by two eminently-qualified authors. Their objective, "to synthesize the classical and modern biology of tiger beetles" is admirable. The book is, however, quite different from what I expected. I thought it would be something like the recent synthesis of odonatology by Philip Corbet (1999). Corbet presents a very fine review of the literature on dragonfly biology, adding opinions here and there, but on the whole acting as a compiler of information rather than the herald of a new synthesis. Pearson and Vogler, on the other hand, assert that tiger beetles are not just intrinsically interesting, they also hold the key to unlocking a variety of mysteries in biology. With this subtext at work throughout the book, the authors deftly attempt to please a very diverse potential readership.

Pearson and Vogler begin with a justification for the study of tiger beetles, followed by the first of many pitches for tiger beetles as model test organisms. I, however, began by skipping directly to Appendix B, in which the major genera of the tiger beetles of the world are characterized with respect to habits and habitats, and illustrated with fine black and white drawings. I then returned to the first chapter, in which I found a fine summary of tiger beetle structure and life history. Pearson and Vogler also present a fascinating account of tiger beetle evolution, that reads best with frequent reference to Appendix B. I began to think that this appendix was not as appendicular as it seems, and should have been part of this chapter and, in a perfect world, illustrated in color as well. By showing what various tiger beetles look like, and outlining their ecological and phylogenetic relationships, Pearson and Vogler really do bring the cicindelids to a general readership for the first time in a single volume.

The next chapter describes the achiasmatic multiple chromosome system shared by all but the most basal cicindelids. It leaves many questions unresolved, but is an interesting introduction to a rarely discussed aspect of tiger beetles. I was able to follow it with my limited understanding of genetics, but I suspect that most people without at least a college level background would skip over this chapter.

The biogeography chapter explores the difficulty of identifying the historical *versus* contemporary determinants of the composition of local faunas, with a plug for cladistic biogeography as the best technique for resolving such things. The cicindelids of the Indian subcontinent are used to illustrate the authors' points, and Vogler's conclusion that the subgenus *Cicindela* (*Cicindela*) is among the more derived clades within the genus is trumpeted as a triumph of molecular systematists. I know cicindelidologists who strongly question whether this interpretation can be reconciled with the comparative morphology of the male genitalia, but in my opinion the Vogler and Goldstein hypothesis is worth provisional acceptance, and is not awkward in other ways.

The book is divided into three Parts. Part 1 deals with the taxonomic diversity of tiger beetles, while Part 2 is devoted to the ecological diversity of tiger beetles. Chapters in Part 2 are devoted to surviving the elements, finding and courting mates, escaping and avoiding enemies, coping with competitors, and the economics and conservation issues associated with tiger beetles. The first three of these chapters are well presented and about what I would have expected, but the last chapter, on economics and conservation, is certainly the best. It begins with a case study of tiger beetles as biocontrol agents in India and then discusses other possible economic connections between tiger beetles and people. David Pearson has been heavily involved with conservation biology in recent years, and the rest of the chapter is a fine summary of his notion that tiger beetles are ideal "bioindicators." Since I have long held the opinion that the only thing bioindicators indicate is their own presence or absence, I read this section with interest. It reminded me that the strongest argument for the use of bioindicators of any sort is that surveying the indicators is easier than measuring other things that show "environmental health" more directly or thoroughly. Mind you, when Pearson and Vogler assert that tiger beetles are easier to survey than birds or butterflies, I'm not sure how this could be the case in any general sense.

Part 3 of the book is a synthesis of Parts 1 and 2. It supports the value of collections and databases, promotes the study of subspecies, and calls for careful, global studies of tiger beetle phylogeny, using not just molecular, but also morphological (and especially chaetotaxic) features. Following this, Appendix A, on study techniques, was too brief for my tastes, given the potential here to distribute more of the specialized information that tiger beetle researchers might need. However, it is still of great value, especially to the uninitiated.

This is a fascinating book. On the one hand, the authors obviously want to lay claim to a new synthesis of cicindelology, based on such things as molecular systematics, the phylogenetic species concept, and vicariance biogeography. On the other hand, they clearly recognize that there is still much to learn from morphological systematics, less "objective" views of species boundaries, and an eclectic approach to historical biogeography. They want to keep people like me as friends and colleagues, despite the conflicts that emerge between their modern, fashionable views and our own, admittedly unstylish approaches. Will they succeed? Yes, I think so. Tiger beetle people have always been a friendly and forgiving lot, and they are hungry for any and all printed matter devoted to their favorite subjects.

If I have any qualms about the book, it is that Pearson and Vogler go a bit too far when they characterize the testing of broad questions using model systems as "a second philosophy of science." I have to admit that, in my opinion, and to paraphrase a cliché of modern science, broad claims require broad evidence, not just studies of model test organisms. As well, the approach on which the book is based seems not to deliver much other than multiple falsifications of potentially grand ideas. For example, in the chapter on competition, Pearson and Vogler revisit the long-standing ecological debate on the role and existence of competition in natural communities. With considerable theoretical flourish, they test a number of hypotheses in this chapter, only to reject each of them, and leave the reader with not much to hold onto in return. This is an unfortunate outcome for proponents of the "second philosophy of science," which feels more like nay-saying than a means toward progress in our understanding of nature.

The book also fails to present a summary of the authors' preferred view of the higher-level classification of tiger beetles, except as a partially-labeled cladogram on page 46. Thus, it strikes me as at least a partial overstatement to assert that we now possess "a solid foundation of tiger beetle systematics." It is hard to ignore the fact that the history of higher-level tiger beetle systematics jumps from Walter Horn's work in 1915 clear up to the present era and the molecular systematics of Alfried Vogler and his colleagues. This is because, unlike most other adephagan beetle groups, the cicindelids were never given a thorough post-Hennigian analysis on morphological (or "whole evidence") grounds. Among the caraboid specialists I have quizzed about this, many felt that "doing" the tiger beetles would have been too large a project for either a graduate student or a working systematist needing to produce numerous shorter works.

The chapter on species and speciation underscores this issue, since it begins with a critique of the work of Rick Freitag (1965, but oddly not 1972). Freitag's studies, in my opinion, represent some of the only "modern" phylogeny reconstructions in existence for any group of cicindelids. The fact that Freitag's morphological studies conflict with Vogler, Welsh, and Barraclough's molecular results fell short of convincing me that the molecular results are self-evidently better than Freitag's. The authors also defend the phylogenetic species concept in this chapter, on the grounds that it is more objective than the biological species concept. Curiously, however, they continue to use subspecies names here and there throughout the text, rather than elevating these to species status when the subspecies are diagnosable. All of this becomes even more confusing when Pearson and Vogler come down in favor of lumping *Cicindela dorsalis dorsalis* and *C. d. media*, based on molecular work, even though they cite Barry Knisely's evidence that the two are only partially interfertile.

Despite these points of disagreement, I can easily recommend this book. For a tiger beetler, it will be a classic and a must for the bookshelf. In fact, I predict that all coleopterists will come to feel the same. As for whether the theory-driven biologists among us will embrace the broader claims of the authors, we'll have to wait and see. In my opinion, if they do, that's fine. If they don't, we've still got a great book here, about one of the most interesting groups of insects on earth.

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OBITUARY

Halbert Marion Harris ca. 1950 (1900–2000):
Biographical Sketch, Described Taxa, and List of Publications on Heteroptera

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The death of Halbert Harris on August 18, 2000, at the age of 100 years, in a real sense brings to a close a period of remarkable advance in the study of Heteroptera in the United States in the first half of the 20th century. Prof. Harris was the youngest of the Iowa State faculty that contributed so much to this discipline from the time of Herbert Osborn to the end of Harris's productive years. This was a tradition that flourished under Carl Drake and Harry Knight and continued in other places through the work of numerous graduate students such as J. C. M. Carvalho, Richard Froeschner, Leonard Kelton, Joseph Schaffner, James Slater, and many others.

Halbert Harris was born in Cascilla, Mississippi, on July 18, 1900. He received his B.S.A. at Mississippi A & M College in 1923 and entered the program at Iowa State College later that year as an M.S. student and assistant entomologist. He became an instructor in 1924 and was an assistant professor from 1925 to 1935, an associate professor from 1935 to 1942, and a full professor from 1942 to 1961. He married Katherine Day of Baton Rouge, Louisiana, in 1927. She remained his competent helpmate for the rest of her life. They had one son, Halbert M. Harris, Jr., who has lived in upstate New York since the late 1950s.

H. M. Harris served as a counselor at the junior college at Iowa State from 1924 to 1942 and became the chairman of the Department of Zoology and Entomology in 1946, a position he held until 1961. In that year he left Iowa State for a position with the Ford Foundation as a consultant for the Plant Protection India Field Office in New Delhi and became a visiting professor at the University of Agricultural Sciences at Bangalore. There he oversaw the development of the Ph.D. program. In 1964, he represented the Entomological Society of America at the Silver Anniversary Celebration of the Entomological Society of India. He returned to the United States early in the 1970s and after a short stay at Iowa State, he retired from there in 1972. He was persuaded at that time to go to Louisiana State University by the late Dale Newsom, the department head, and Edward C. Burns, who had received his Ph.D. from Iowa State. Dr. Harris was an official visiting professor at Louisiana State University from 1972 to 1980 and was listed as retired from 1981 to 1989. According to Joan B. Chapin, a good friend and colleague, Dr. Harris left his office at Louisiana State in the summer of 1980 because he was afraid he was occupying space needed by faculty and students.

As a young student at Iowa State, Halbert Harris almost immediately came under the overwhelming enthusiasm of Carl Drake, who initiated his interest in the Nabidae. His M.S. degree, awarded in 1925, was based on a study of the nabid fauna of the Gulf States. For his Ph.D. (1928), Harris completed a monographic study of the North American Nabidae. In the published monograph (1928), he described a new species of *Metatropiphorus* from Puerto Rico as *drakei*, commenting: "It is my pleasure to name this species after Dr. Carl J. Drake who is responsible for my interest in the Nabidae and who presented me with the first specimens of the genus *Metatropiphorus* that it ever was my privilege to examine."

Harris's work on the Heteroptera covered approximately 20 years. In that period, he was the author or coauthor of 82 papers in which he described 10 new genera, one new subgenus, 206 new species, and 8 new varieties in 13 families. Most of his primary types are deposited in the National Museum of Natural History, Smithsonian Institution, Washington, DC, with exception of the Berytidae, which are in the Carnegie Museum of Natural History, Pittsburgh, Pennsylvania. The bulk of his collection, totaling more than 20,000 specimens, is in the Louisiana State Arthropod Museum (Department of Entomology, Louisiana State University, Baton Rouge).

To appreciate Harris's contributions to entomology and hemipterology, we should consider his time at Iowa State, his association with colleagues there, and the stature of entomology at that institution during his productive years. Perhaps the most important of his associations was that with Carl Drake, who was the Department Head when Harris arrived and remained so throughout most of Harris's tenure there. Drake was a phenomenon, one who literally worked almost all the time; a driven taxonomist, he was enthralled by the beauty and variety of the hemipteran fauna. At the same time, he was also the State Entomologist, a position he held during two crucial periods in the history of economic entomology in Iowa. In the 1930s with the dust bowl devastating the Great Plains, an enormous outbreak of chinch bugs occurred, and it is obvious that Drake and his colleagues spent a major part of their time studying this outbreak and suggesting control measures. For example "Burn the Chinch Bug" was the title of one widely dispersed paper.

In the 1940s the European corn borer invaded Iowa. This pest threatened the welfare of a state whose wealth and well-being were based largely on a corn-hog economy. Harris was involved in economic work during the summer months of many of his years at Iowa State. Unfortunately, we do not have the space nor the ability to detail his work in this area. He was also active in political entomological circles and became a leader in the North Central Branch of the

American Association of Economic Entomologists (AAEE). When the AAEE merged with the Entomological Society of America (ESA), he became an important figure nationally in the latter society. In 1961, he was in fact elected President-Elect of the Entomological Society of America, a post he was unable to fulfill as we shall explain. As further evidence of Harris's involvement with applied entomology, we note his affiliation with ESA's Section E, extension and regulatory entomology, rather than with Section A and entomologists interested mainly in systematics, morphology, and evolution.

In hemipterology, Drake's habit of working night and day, seven days a week, was extremely stimulating to a young worker, but was a difficult routine for a man with a wife and an infant son to follow. When one views the work of Harris from the perspective of someone who chose and mastered a difficult group, the Nabidae, and for many years was recognized as the leading authority, and who at the same time worked with Drake on various other families (particularly the Gerridae and Veliidae), it becomes apparent that Harris was deeply involved in all of their joint papers. That Drake at the same time was able to concentrate on his specialty, the Tingidae or lace bugs, and to describe new taxa in other groups that interested him, indicates his high regard for Harris. In the last years of their collaborative efforts, Drake even made Harris the senior author of several of their papers (not a frequent habit with Drake).

This obituary is not the place to attempt a critical analysis of the work of Harris or that of Drake and Harris. We believe, however, that it is fair to say that the quality of their longer joint papers reflects the strong influence of Harris's involvement. In their coauthored papers, more frequently than in Drake's own papers, we find keys to genera and species and rather detailed descriptions and redescriptions.

Harris will be remembered especially for his work on the Nabidae. His 1928 monograph has remained the definitive work on the family for North America and was the unrivaled work on the group until I. M. Kerzhner, working in Russia, came to dominate the family on a world basis.

Since one of us (JAS) knew Harris personally and served under him when the latter was the head of Iowa State's Department of Zoology and Entomology, it is perhaps only fitting to mention Harris's abrupt departure from the field of hemipterology about 1946 and from Iowa State in 1961. The following indented text should be read in the context of "I" equals J. A. Slater.

> I joined the faculty of Iowa State in the fall of 1947 as an instructor to teach introductory Entomology, and several other courses. It was an interesting experience. After two decades of close relationship, Drake and Harris had had a falling out before I arrived. Without going into details, it had become acrimonious and resulted in the removal of Drake as the department head and his replacement by Harris. This administrative shift created a difficult situation; the faculty obviously had been deeply divided during the events that led to the change in department heads. As a result, I felt that Harris never could consult and discuss departmental policies with his faculty as openly as he might have been able to had he come in from outside the college. As department head, he was crippled by his inability to feel at ease with his faculty, and from time to time this impaired his relationships with younger faculty members. I believe that this was the direct cause of his ceasing to write papers on the Hemiptera. He was knowledgeable and helpful but handicapped because he did not have much of the necessary collection available once C. J. Drake's collection became inaccessible. During the late 1940s and early 1950s, there is evidence of his continued interest in Hemiptera from his work on a large bibliography. It looks as though he intended to prepare a

sequel to H. M. Parshley's bibliography of North American Hemiptera.

Iowa State's reputation in hemipterology and in entomology in general was very high at the time Harris was there. I recall that it was considered one of the very top institutions for graduate study. While I was there, it attracted Jose Carvalho (in parasitology primarily), Richard Froeschner, and Arlie Wilson, among others, and brought Philip Bonhag in as a new faculty member. The graduate group was unique in my experience. Most were highly motivated, hardworking veterans of World War II—"we want to see the lights on longer than in the Chemistry Building"—but the group also was mature and capable of doing a great deal of independent work. This was a good thing because I have only sad memories of the state of microscopes and other equipment (it was nice to be able to see the pretarsal structures of Miridae a few years later).

By 1961, a number of young faculty had moved on and the department, which had sometimes chafed under these events, made it difficult for Harris to remain. His son also believes that he was disappointed when he was not offered the position of Chair or Dean of what eventually became the College of Arts and Sciences. Although it meant relinquishing the Presidency of the Entomological Society of America, the Ford Foundation's offer to work in India was too attractive to turn down. He thus resigned from Iowa State and, to my knowledge, his only subsequent association with that institution was some years later to stay only long enough to qualify for retirement, to move his collection, and to sell his important library.

My recollections of H. M. Harris are of a tall gangly man, very friendly, with traditional southern hospitality. With his wife Katherine, they were very kind to young faculty families, often inviting them to their home for festive occasions.

I met Harris on two subsequent occasions: at the International Congress of Entomology in London in 1965 and later at a meeting of the Entomological Society of America in Dallas in 1973. On both occasions it was obvious that in his mind he had never given up his interest and enthusiasm for the Hemiptera, and we had good chats about his interest in returning to active work on the Anthocoridae and Nabidae.

H. M. Harris enjoyed a long and productive career in entomology and received several honors. He was a member of the Editorial Committee that produced the initial volume of the *Annual Review of Entomology* (1956) and was an ESA Governing Board member from 1954 to 1956 (Section E). He was one of the few entomologists who have been elected as an Honorary Member of ESA (ca. 1970) and as an ESA Fellow (ca. 1985). Dr. Harris made substantial contributions to hemipterology during the first half of the twentieth century. He was a complex man capable of first-class work. Under other circumstances, he might well have contributed a great deal more than he actually did.

LIST OF DESCRIBED TAXA

An asterisk (*) indicates taxa that are known junior synonyms.

ANTHOCORIDAE

Acompocoris feratis Drake & Harris 1926
Lasiochiloides socialis Drake & Harris 1926
Lasiochilus comitialis Drake & Harris 1926
Lasiochilus hirtellus Drake & Harris 1926
Lasiochilus mirificus Drake & Harris 1926
Macrotracheliella laevis var. *floridana* Drake & Harris 1926
Nidicola Harris & Drake 1941
Nidicola marginata Harris & Drake 1941
Plochiocoris comptulus Drake & Harris 1926
Scoloposcelis basilicus Drake & Harris 1926
Scoloposcelis mississippensis Drake & Harris 1926*
Scoloposcelis occidentalis Drake & Harris 1926
Temnostethus fastigiatus Drake & Harris 1926
Tetraphleps edacis Drake & Harris 1926*

Tetraphleps novitus Drake & Harris 1926
Tetraphleps pingreensis Drake & Harris 1926
Tetraphleps profugus Drake & Harris 1926*
Xenotracheliella Drake & Harris 1926
Xenotracheliella inimica Drake & Harris 1926
Xenotracheliella oculata Drake & Harris 1926
Xenotracheliella vicaria Drake & Harris 1926
Xylocoris betulinus Drake & Harris 1926

ARADIDAE

Acaricoris Harris & Drake 1944
Acaricoris ignotus Harris & Drake 1944
Allelocoris Drake & Harris 1944
Allelocoris dryadis Drake & Harris 1944
Asterocoris Drake & Harris 1944
Asterocoris australis Drake & Harris 1944
Eretmocoris Harris & Drake 1944
Eretmocoris tatei Harris & Drake 1944
Glyptocoris Harris & Drake 1944
Glyptocoris sejunctus Harris & Drake 1944
Notoplocoris potensis Drake & Harris 1944

BERYTIDAE

Acanthophysa idaho Harris 1941*
Jalysus balli Harris 1941*
Parajalysus nanus Harris 1943
Parajalysus pallidus Harris 1943
Phaconotus Harris 1943
Phaconotus ensis Harris 1943
Protacanthus nexus Harris 1943
Xenoloma Harris 1943
Xenoloma princeps Harris 1943

ENICOCEPHALIDAE

Systelloderus inusitatus Drake & Harris 1927
Systelloderus iowensis Drake & Harris 1927
Systelloderus terrenus Drake & Harris 1927*

GERRIDAE

Brachymetra anduze Drake & Harris 1942
Brachymetra mera Harris & Drake 1945
Cylindrostethus hungerfordi Drake & Harris 1934
Cylindrostethus palmaris Drake & Harris 1934
Eobates Drake & Harris 1934
Eobates morrisoni Drake & Harris 1934
Gerris ampla Drake & Harris 1938
Gerris beieri Drake & Harris 1934
Gerris carmelus Drake & Harris 1932
Gerris dissortis Drake & Harris 1930
Gerris firma Drake & Harris 1938
Gerris kahli Drake & Harris 1934
Gerris summatis Drake & Harris 1934
Halobatopsis delectus Drake & Harris 1941
Halobatopsis parvulus Drake & Harris 1935
Limnogonus aduncus Drake & Harris 1932
Limnogonus celeris Drake & Harris 1934
Limnogonus genticus Drake & Harris 1934
Limnogonus ignotus Drake & Harris 1934
Limnogonus profugus Drake & Harris 1930
Limnogonus recens Drake & Harris 1934
Limnogonus recurvus Drake & Harris 1930
Limnogonus visendus Drake & Harris 1934
Metrobates cubanus Drake & Harris 1932
Metrobates fugientis Drake & Harris 1945
Metrobates laudatus Drake & Harris 1937
Metrobates spissus Drake & Harris 1932
Potamobates osborni Drake & Harris 1928
Rheumatobates carvalhoi Drake & Harris 1944
Rheumatobates clanis Drake & Harris 1932
Rheumatobates minutus var. *flavidus* Drake & Harris 1942
Rheumatobates vegatus Drake & Harris 1942
Rheumatobates wrighti Drake & Harris 1937
Telmatometra panamensis Drake & Harris 1941
Telmatometra rozeboomi Drake & Harris 1937
Tenagogonus celocis Drake & Harris 1931
Trepobates becki Drake & Harris 1932
Trepobates comitialis Drake & Harris 1928*
Trepobates floridensis Drake & Harris 1928
Trepobates knighti Drake & Harris 1928
Trepobates trepidus Drake & Harris 1928

HEBRIDAE

Hebrus buenoi Drake & Harris 1943
Hebrus comatus Drake & Harris 1943
Hebrus ecuadoris Drake & Harris 1943
Hebrus gloriosus Drake & Harris 1943
Hebrus hungerfordi Drake & Harris 1943
Hebrus nubilus Drake & Harris 1943
Hebrus paulus Drake & Harris 1943
Hebrus priscus Drake & Harris 1943
Hebrus pudoris Drake & Harris 1943
Hebrus usingeri Drake & Harris 1943
Merragata sessoris Drake & Harris 1943

MESOVELIIDAE

Mesovelia hackeri Harris & Drake 1941
Mesovelia hambletoni Drake & Harris 1946

Mesovelia zeteki Harris & Drake 1941

NABIDAE

Alloeorhynchus bakeri Harris 1930
Alloeorhynchus bellipotens Harris 1940
Alloeorhynchus chinai Harris 1927
Alloeorhnchus delicatus Harris 1928
Alloeorhynchus distanti Harris 1940 (new name)
Alloeorhynchus flavomarginatus Harris 1928
Alloeorhychuis furcens Harris 1940
Alloeorhynchus incertus Harris 1940
Alloeorhynchus instabilis Harris 1940
Alloeorhynchus nigrofasciatus Harris 1928
Alloeorhynchus gegalis Harris 1940
Alloeorhynchus rubrofasciatus Harris 1937
Alloeorhynchus venator Harris 1940
Aphelonotus confusus Harris 1931
Aphelonotus fraterculus Harris 1931
Aphelonotus major Harris 1931
Aphelonotus medius Harris 1931
Arbela bakeri Harris 1938
Arbela cheesmanae Harris 1938
Arbela confusa Harris 1938
Arbela deusta Harris 1938
Arbela immista Harris 1938
Arbela inerma Harris 1938
Arbela insularis Harris 1938
Arbela pacifica Harris 1938
Arbela papuana Harris 1938
Arbela splendida Harris 1938
Camarochilus Harris 1930
Carthasis championi Harris 1928
Carthasis distinctus Harris 1925
Carthasis gracilis Harris 1925
Carthasis uhleri Harris 1928
Gorpis chinai Harris 1939
Gorpis clavatus Harris 1939
Gorpis flavicans Harris 1930
Gorpis longispinis Harris 1939
Gorpis neglectus Harris 1939
Gorpis papuanus Harris 1939
Gorpis philippinensis Harris 1930
Gorpis simillimus Harris 1939
Metatropiphorus drakei Harris 1928
Nabis alternatus var. *uniformis* Harris 1928
Nabis deceptivus Harris 1928
Nabis dentipes Harris 1928 (new name)
Nabis ferus var. *pallidipennis* Harris 1928*
Nabis gerhardi Harris 1928
Nabis jaczewskii Harris 1931
Nabis lovetti Harris 1925
Nabis panamensis Harris 1926
Nabis paranensis Harris 1931
Nabis seticrus Harris 1930
Pagasa bimaculata Harris 1930
Pagasa fasciventris Harris 1940
Pagasa fusca var. *nigripes* Harris 1926
Pagasa planipes Harris 1939
Phorticus abdominalis Harris 1940
Phorticus flavus var. *breviatus* Harris 1940
Phorticus speciosus Harris 1928
Phorticus socialis Harris 1940
Phorticus variegatus Harris 1930
Prostemma belidis Harris 1940

PACHYNOMIDAE

Pachynomus africanus Harris 1940
Pachynomus (*Camarochilus*) *americanus* Harris 1930
Pachynomus (*Camarochilus*) *confusus* Harris 1930

PENTATOMIDAE

Allopodops Harris & Johnston 1936
Allopodops mississippiensis Harris & Johnston 1936
Coenus inermis Harris & Johnston 1936

REDUVIIDAE

Elasmocoris comptus Harris & Drake 1944
Sirthenea anduzei Drake & Harris 1945
Sirthenea peruviana Drake & Harris 1945
Vescia nostratus Drake & Harris 1945

RHOPALIDAE

Arhyssus barberi Harris 1942
Arhyssus brevipilus Harris 1942*
Arhyssus crassus Harris 1942
Arhyssus usingeri Harris 1942
Harmostes confinis Harris 1942
Harmostes fusiformis Harris 1942
Harmostes gemellus Harris 1942*
Harmostes insitivus Harris 1942
Harmostes imitabilis Harris 1942
Harmostes petulans Harris 1942
Harmostes splendens Harris 1944
Stictopleurus knighti Harris 1942

SALDIDAE

Saldula severini Harris 1943

VELIIDAE

Halobatopsis spiniventris Drake & Harris 1936
Microvelia diffidentis Drake & Harris 1933
Microvelia irrasa Drake & Harris 1928
Microvelia oreadis Drake & Harris 1928
Microvelia pudoris Drake & Harris 1936
Microvelia sarpta Drake & Harris 1936
Microvelia summersi Drake & Harris 1928
Microvelia turmalis Drake & Harris 1933
Microvelia venustatis Drake & Harris 1933
Rhagovelia ainsliei Drake & Harris 1933
Rhagovelia becki Drake & Harris 1936
Rhagovelia callida Drake & Harris 1935
Rhagovelia calopa Drake & Harris 1927
Rhagovelia cuspidis Drake & Harris 1933
Rhagovelia excellentis Drake & Harris 1927*
Rhagovelia gregalis Drake & Harris 1927*
Rhagovelia hambletoni Drake & Harris 1933
Rhagovelia hirtipes Drake & Harris 1927
Rhagovelia ignota Drake & Harris 1933
Rhagovelia knighti Drake & Harris 1927
Rhagovelia mira Drake & Harris 1938
Rhagovelia panda Drake & Harris 1935
Rhagovelia plana Drake & Harris 1933
Rhagovelia regalis Drake & Harris 1927*
Rhagovelia reposita Drake & Harris 1931
Rhagovelia sinuata var. *calcaris* Drake & Harris 1935
Rhagovelia tantilla Drake & Harris 1933
Rhagovelia velocis Drake & Harris 1935
Rhagovelia verusta Drake & Harris 1935
Velia australis Drake & Harris 1938
Velia capillata Drake & Harris 1933
Velia capillata var. *cognata* Drake & Harris 1933
Velia egregia Drake & Harris 1935
Velia hungerfordi Drake & Harris 1933
Velia kahli Drake & Harris 1933
Velia mexa Drake & Harris 1933
Velia parilis Drake & Harris 1933
Velia recens Drake & Harris 1935
Velia splendoris Drake & Harris 1933
Velia tersa Drake & Harris 1941
Velia virtutis Drake & Harris 1935
Velia willei Drake & Harris 1940

LIST OF PUBLICATIONS ON HETEROPTERA

1925

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1926

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1927

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Drake, C. J. and H. M. Harris. 1927. Notes on the genus *Rhagovelia*, with descriptions of six new species. Proceedings of the Biological Society of Washington 40: 131–138.

1928

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Harris, H. M. 1928. Anent Blatchley's manual of Heteroptera, with description of a new nabid therefrom (Hemiptera, Nabidae). Bulletin of the Brooklyn Entomological Society 23: 143–146.

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1930

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1931

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1936

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1937

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1938

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Drake, C. J. and H. M. Harris. 1938. A new *Rhagovelia* from Cuba. Pan-Pacific Entomologist 14: 152–153.

Drake, C. J. and H. M. Harris. 1938. Concerning *Velia boliviana* Breddin (Hemiptera: Veliidae). Revista do Entomologia 9: 97–98.

Drake, C. J. and H. M. Harris. 1938. Veliidae y Gerridae sudamericanos descriptos por Carlos Berg. Notas del Museo de La Plata 3: 199–204.

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1940

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Harris, H. M. 1940. New and little-known species of *Alloeorrhynchus* (Hemiptera: Nabidae). Journal of the Kansas Entomological Society 13: 115–123.

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Harris, H. M. and C. J. Drake. 1941. A new genus and species of Anthocoridae (Hemiptera). Iowa State College Journal of Science 15: 343–344.

1942

Drake, C. J. and H. M. Harris. 1942. A new *Brachymetra* from Venezuela (Hemiptera-Gerridae). Boletin de Entomologia Venezolana 1: 95–96.

Drake, C. J. and H. M. Harris. 1942. Notas sôbre *Rheumatobates*, con descrição de uma nova espécie (Hemiptera: Gerridae). Revista Brasileira de Biologia. 2(4): 399–402.

Harris, H. M. 1942. Notes on *Harmostes*, with descriptions of some new species (Hemiptera: Corizidae). Journal of the Washington Academy of Sciences 32: 27–32.

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1945

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Drake, C. J. and H. M. Harris. 1945. Concerning the genus "Metrobates" Uhler (Hemiptera, Gerridae). Revista Brasileira de Biologia 5: 179–180.

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1946

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from Ecuador (Hemiptera, Mesovelidae [*sic*]). Bulletin of the Brooklyn Entomological Society 41: 8–9.

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SOCIETY MEETINGS

1,061st Regular Meeting—January 3, 2002

The 1061st regular meeting of the Entomological Society of Washington (ESW) was called to order in the Cathy Kerby room of the National Museum of Natural History, Washington, D.C., by President Gabriela Chavarria at 7:09 p.m. The meeting was attended by 17 members and 7 guests. The minutes of the 1060th meeting were approved as read. All guests were introduced.

President Chavarria announced that a long time, active member of the ESW, Harry Painter, recently passed away. For exhibits, Diane Calabrese passed around a book on Colombian butterflies. Edd Barrows solicited opinions on a cocoon resembling that of a tussock moth. Warren Steiner displayed the 1989 book "*Still Life with Insects,*" by B. Kiteley, and described it as the "biography of an entomologist when life gets in the way." Warren wore a potato-stamp beetle shirt and matching hankie, but he only passed around the hankie. David Furth almost came up empty-handed in the exhibits department, resorting to a dead cricket, the ESA 2002 calender, and the 2nd volume of "*American Beetles*" by the late R. H. Arnett, Jr. and M. C. Thomas.

Program Chair Ron Ochoa introduced the traditional January speaker—the former ESW President—this year the decidedly untraditional John Brown. Dr. Brown summed up "100 Years of Collecting Microlepidoptera on Plummers Island, Maryland." Plummers Island is a National Park of about 20 hectares along the Potomac River that is probably the most collected spot in the USA. It received much attention by early microlepidopterists of the National Museum of Natural History. Although data is scanty for many intervening years, Dr. Brown has set traps weekly since 1998, enabling him to assess species richness and turnover for several families. For Tortricidae, the total richness was 119 species (all backed up by specimens), but the highest richness in any decade was 71; 41 species dropped out and 29 moved in, yielding a turnover of 54%. The local extinctions are most likely the result of plant succession, as since 1901 the site has transformed from an open juniper grassland (a better habitat for tortricids) to a closed oak-maple-hickory forest. For Elachistidae the richness was stable at 17–18 species with a 6% turnover. And for Limacodidae the richness apparently increased by 11% to 15 species, but this may simply reflect the superiority of UV lights over kerosene lanterns for sampling, because no species dropped out but three new species were detected. The lessons learned are that because of species turnover, long term surveys that add old and new records may overestimate the actual richness of a site; that maintaining a successional habitat may be critical for maintaining a richness and particular fauna; and that management decisions based on one taxon may not be appropriate for others.

The meeting was adjourned around 8:19 p.m. Refreshments were provided by the Society.

Respectfully submitted,
Stuart H. McKamey,
Recording Secretary

1,062nd Regular Meeting—February 7, 2002

The 1062nd regular meeting of the Entomological Society of Washington (ESW) was called to order in the Cathy Kerby room of the National Museum of Natural History, Washington, D.C., by President Gabriela Chavarria at 7:05 p.m. The meeting was attended by 18 members and 11 guests. The minutes of the 1061st meeting were approved as read. All guests were introduced.

Membership chair Steve Lingafelter read

the names of two new applicants for membership: Renato Contin Marinoni and Gregory Setliff. Gregory was introduced.

For exhibits, Jill Swearingen modeled an insect motif purse. David Furth displayed two new books from Mexico, both in Spanish by J. Luis: "*Aquí Entre los Bichos*," a series of insect stories, and "*Tópicos Sobre Coleópteros de México*."

Program Chair Ron Ochoa introduced the evening's speaker, Dr. Eric F. Erbe, U.S. Department of Agriculture Electron Microscopist and Botanist, who spoke about "Microscopy Techniques for the Preparation and Study of Arthropods." The presentation complemented that of the 1058th meeting last October, detailing the benefits of low-temperature scanning electron microscopy when specimens are minute, soft bodied, tenuous-association, or have soluble coverings, with magnifications typically between 100,000–400,000 times. Specimens are freeze-immobilized on the stage from below and the technique is highly portable and even mailable using a tank of liquid nitrogen, stage-holders, and pennies (Dr. Erbe can provide details). Dr. Erbe demonstrated how the three dimensional shape of specimens can be visualized in two dimensions by animation of images from different views. The highlight of the night, however, was certainly when the attendants donned polarized glasses to see the stereoscopic images projected from two slide projectors that allowed us to appreciate the giant mites in real 3-D.

The meeting was adjourned around 8:38 p.m. Refreshments were provided by the Society.

Respectfully submitted,
Stuart H. McKamey,
Recording Secretary

1,063rd Regular Meeting—March 7, 2002

The 1063rd regular meeting of the Entomological Society of Washington (ESW) was called to order in the Cathy Kerby room of the National Museum of Natural History, Washington, D.C., by John Brown at 7:10 p.m. The meeting was attended by 9 members and 4 guests. The minutes of the 1062nd meeting were approved as read.

John Brown read the names of six new applicants for membership: Robert Rabaglia, Robert Foottit, Jim Whitfield, Becky Simmons, Victor López-Martínez, and Michael Heyn. No new members were present. One guest was introduced.

For exhibits, Ralph Eckerlin shared the news that a woman ate 35 live mealworms to win tickets on the radio. Dave Furth reviewed the status of biological specimen regulatory laws of Brazil: two years ago there was a restriction on all genetic material. The Smithsonian's reaction was to allow return of Brazilian material but prohibit new loans of SI specimens. Recently, one such package that had been sent several months ago arrived back at NMNH because it "lacked importation documents." New SI policy: not even returning Brazilian material, out of concern for its security. Furth then turned to a lighter note, displaying: a lunchbox from China sporting a large bamboo beetle on top; four 'Oh My!' demonstration drawers used for tours, media interviews, etc.; and a northwestern U.S. weed handbook funded by Invasive Species money.

John Brown changed hats once again to introduce the evening's speaker, ESW Program Chair and USDA Systematic Entomology Laboratory postdoc Ron Ochoa, who spoke about "The Mitey Plant-Feeding Mites (Acari)." These include the spider mites (Tetranychidae; about 7,000 described species), the flat mites (Tenuipalpidae), the white mites (Tarsonemidae), the gall mites (Eriophyidae), the peacock mites (Tuckerellidae), and the dust mites (Acaridae), which eat *any* organic material. The spider mites became a serious problem when DDT came into vogue in the 1950's because of increased fertility; the new cure-all insecticide, pyrethroids, increase spider mite fertility even more. The common theme for all groups was that while they are ubiquitous and have a huge impact on agriculture, their inconspicuous size leads to misdiagnosis of damage as being from nutrient deficiencies, fungus, or bacterial infections. He cited an example of phytopathologists discarding 60% of the samples for analysis because they were "contaminated with mites," rather than investigating if mites were the problem. Mite awareness needs to be improved and, as was obvious to everyone present, the mighty Dr. Ochoa will continue his crusade unwaveringly.

The meeting was adjourned at 8:39 p.m. Refreshments were provided by the Society.

Respectfully submitted,
Stuart H. McKamey,
Recording Secretary

1,064th Regular Meeting—April 4, 2002

The 1064th regular meeting of the Entomological Society of Washington (ESW) was called to order in the Cathy Kerby room of the National Museum of Natural History, Washington, D.C., by President Gabriela Chavarria at 7:05 p.m. The meeting was attended by 18 members and 12 guests. The minutes of the 1063rd meeting were approved as read.

Membership chair Steve Lingafelter read the names of six new applicants for membership: Duane Flynn, Gary Alpert, Jason Hall, Stephan Blank, Andrew Deans, and Cheslavo Korytkowski. No new members were present. Six guests were introduced.

In miscellaneous business, President Chavarria announced that the ESW Annual Banquet will be held on Tuesday, June 11 at the Uniformed Services University of Health Sciences in Bethesda, Maryland. Post 9-11 security measures require using a new entrance, providing social security numbers when buying tickets, and showing a picture ID at the banquet. Dan Janzen will speak on "How to Find All the Species of Caterpillars in a Large, Complex, Tropical Habitat," dividing his time between conservation and science. Dave Furth announced that the ESW sent flowers to long-time active ESW member Don Anderson, who recently had a stroke but continues to make amazing progress.

For exhibits, Diane Calabrese had a press release for Purdue University's Spring Fest, with the "Bug Bowl" getting top billing, and some insect-motif stamps from England with corresponding postcards. Ralph Eckerlin had on hand Volume 1, Issue 1 of "*Southeastern Naturalist,*" a new journal; a spell checker poem (witch razed sum I browns); a scanning electron micrograph of a hystrichopsyllid flea. Gary Miller passed around the CD "*Songs of Crickets and Katydids of the Mid-Atlantic States,*" by S. Rames, W. Hershberger, and J. Dillon, and a bedbug repellent bottle from the late 1800's that was recently excavated from an outhouse, the idea of which seemed even more repellent. Dave Furth held before us the only four issues of "*Cultural Entomology Digest*" ever published and described some of their contents.

Program Chair Ron Ochoa introduced the evening's speaker, USDA Systematic Entomology Laboratory researcher Gary Miller, who spoke about "Various Facets of Cultural Entomology." Cultural entomology refers to how insects have worked their way into all aspects of our culture: our literature, language, music, arts, history, religion, and recreation. Time constraints forced Dr. Miller to focus on lesser known examples from just a few of these topics, such as language and music. For examples: reference to insects in literature is often used to depict something dangerous; the word 'medicine' is derived from mead, a fermented honey drink that was once used to supposedly cure ailments. Dr. Miller later sang for us the little folk tune "Dirty Flies." Despite its history going back to the pharaohs of Egypt at least, cultural entomology as a recognized field is quite young. In 1984 the first conference on cultural entomology was held.

The meeting was adjourned at 8:05 p.m. Refreshments were provided by the Society.

Respectfully submitted,
Stuart H. McKamey,
Recording Secretary

1,065th Regular Meeting—May 2, 2002

The 1065th regular meeting of the Entomological Society of Washington (ESW) was held at the same old time in the same old place. Wielding the gavel was President-Elect Jonathan Mawdsley, pinch-hitting for President Chavarria, away on bug business. The meeting was attended by 17 members and 3 guests who braved the elements, or at least the forecasted elements. Minutes of the 1064th meeting were read by John Brown and were approved without modification, probably a reflection of how confidently they were delivered.

Membership chair Steve Lingafelter read the names of three new applicants for membership: David Novello, Audrey Painter, and Daniel Blackford. One new member was present (Dan Blackford); no guests were introduced—not even Ron Faycik, who, of course, needs no introduction.

President-Elect Mawdsley announced the time and place of the annual banquet and encouraged members to attend. Alma Solis shared a book entitled "*Of Moths and Men*"; Edd Barrows shared specimens of a local dioptid fly; Ron Ochoa modeled his new University of Maryland tee-shirt and commented briefly (anything less than 10 minutes is brief for Ron) on a new and unusual eriophyid mite; and Dave Furth offered comments on the new insect order from Namibia and shared 4 books.

Program Chair Ron Ochoa introduced the evening's speaker, Jon K. Gelhaus, Associate Curator at the Academy of Natural Sciences in Philadelphia (ANSP), who presented a fascinating talk entitled "Bug Hunting in Mongolia: Entomological Research at Hovsgol Nuur, An Ancient Lake." Dr. Gelhaus described an entomological expedition to Hovsgol, a large, pristine lake about the size of Lake Tahoe. The ANSP has a history of environmental monitoring of aquatic systems in Mongolia, and their assistance was solicited by Mongolian officials to help develop management and monitoring strategies for the preservation of this unique and scenic watershed. The research goal was an increased understanding of the biodiversity and biogeography of the lake and surrounding watershed, focused primarily on aquatic insects. Jon's specialty is "Tipuloidea," and his research revealed the following: (1) the lake has a limited fauna, as expected; (2) endemism is relatively low, although greater in the surrounding watershed; (3) there is a narrow season of adult activity; and (4) most species were recorded at only 1 or 2 of the many sampling sites.

The meeting was adjourned at about 8:30 pm, with refreshments provided by the Society—what a generous gesture.

Submitted by,
John W. Brown,
Pinch-hitting *Recording Secretary*

1,066th Regular Meeting—June 11, 2002

The 1066th meeting of the Entomological Society of Washington consisted of the Annual Banquet at the Uniformed Services University of Health Sciences in Bethesda, Maryland. The meeting was convened at 7:00 p.m., and a large crowd showed up. Dan Janzen's original title was "How to Find All the Species of Caterpillars in a Large, Complex, Tropical Habitat." However, having just come from a presentation/workshop at the Great Smoky Mountains National Park, he decided to change his talk to report on the new inventory initiatives of the National Park Services (NPS). Basically the NPS invited Janzen to explain the principles and practice of his All Taxon Biological Inventory (ATBI) which he developed in Costa Rica to help the NPS apply this idea for inventories of the park system. Many on-site NPS staff members are very interested in conducting extensive surveys of the biota of their parks, especially for some of the lesser-known groups. Recently, the Geat Smoky Mountains National Park has been conducting "bio-blitz" surveys of certain target groups. The Lepidoptera "bio-blitz" was going on while Janzen and many park officials from around the country were there and could see the process firsthand. NPS has begun these kinds of surveys and inventories at a few target parks and they are planning to expand these inventory initiatives to all national parks. Janzen suggested to NPS that they might consider funding taxonomist positions regionally around the courntry who would concentrate on the biota of the park system and even one such position based at the Smithsonian. Dan did offer to come back this fall to give a real caterpillar talk to ESW and we will take him up on his offer.

Respectfully submitted,
David Furth
Stuart McKamey

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