NOTA LEPIDOPTEROLOGICA

A journal devoted to the study of Lepidoptera
Published by Societas Europaea Lepidopterologica (SEL)

Vol. 28 No. 2 2005

SOCIETAS EUROPAEA LEPIDOPTEROLOGICA e.V.

http://www.soceurlep.org

ISSN 0342-7536
Type setting: blattwerk | dd · Markward Fischer
Printed by Lausitzer Druck- und Verlagshaus GmbH, Bautzen

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Volume 28 No. 2 Dresden, 12.08.2005 ISSN 0342-7536

Contents

Euphorbiaceae – a new host-plant family for *Carcharodus alceae* Esper, 1780 (Lepidoptera: Hesperiidae) and a discussion on the use of Euphorbiaceae by butterfly larvae (Papilionoidea, Hesperioidea) in the world

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Abstract. *Carcharodus alceae* is one of the most common and best known of the European hesperiids; its Malvaceae host-plant family was already known to Esper in the 18th century. *Chrozophora tinctoria* (L.) Raf. (Euphorbiaceae) was found to be both a new food-plant species and family for this hesperiid. Late-season use of this new host-plant by *C. alceae* may have its disadvantages as the plant does not afford adequate protection for the overwintering pupa. This is the first record of a host-plant for *C. alceae* that does not belong to the mallows; it is also the first record of a Palaearctic hesperiid feeding on Euphorbiaceae. The discovery, the biology of the skipper and the use of euphorbs by other butterflies in the world are presented and analysed.

Key words. *Chrozophora tinctoria*, Euphorbiaceae, host-plant, *Carcharodus alceae*, Hesperiidae, Palaearctic, Israel, Middle East.

Introduction

The species *Carcharodus alceae* was described as "*Papilio alceae*" by Esper in 1780 from Erlangen, South Germany. He named it after its host-plant the "*alcea rosea* ... Gartenmalve" (= *Althaea rosea*), otherwise known as the Common Hollyhock. It became the type species of the genus *Carcharodus* Hübner, 1819 by ICZN's opinion number 270 of 1954.

The butterfly is widely distributed in Southern and Central Europe up to 52°N and stretches eastwards across Turkey, the Middle East, the Caucasus, northern Iran, Turkmenistan, Uzbekistan, Kazakhstan, Afghanistan, and the Altai Mts. to East Siberia. Isolated populations of this Palaearctic skipper exist in the Sinai Peninsula (this is a recent isolation, Dr Rienk de Jong checked the genitalia to find that it is a 'normal *Carcharodus alceae*') and Yemen, as a distinct subspecies *wissmanni* Warnecke, 1934. The closely related *Carcharodus tripolinus* (Verity, 1925) (de Jong 1978), flies in the southern part of the Iberian Peninsula as far north as Murcia province, Spain and about 140 km north of Lisbon in Portugal (de Jong pers. comm.). In North Africa it extends from Morocco eastwards to Tunisia and Libya. Throughout their range, both species have always been associated with Malvaceae host-plants as evidenced by citations in numerous publications. The story is now known to be incomplete with the present record of an additional and exceptional host-plant family, the Euphorbiaceae.

The discovery

In mid-March 1988 a diapausing winter larva of *Carcharodus alceae* was found in Bet Arye, resting in typical fashion inside a folded leaf of *Alcea setosa* (Boiss.) Alef. (Malvaceae). An adult female emerged on 15 April 1988. Subsequently, on 14 May

1988, three eggs were found on small, stellate (star-like), hairy leaves of *Malvella sherardiana* (L.) Jaub. et Sp. (Malvaceae). This prostrate, new host-plant for Israel, appeared in my garden on alluvial soil which was imported from coastal lowlands. The larvae found difficulty in surviving on the small leaves, which did not provide sufficient shelter and, indeed, they all succumbed to parasitic braconid wasps. On 23 July 1988, I found eggs again on *M. sherardiana.* On 6 August 1988, I found small *C. alceae* larvae inside folded leaves of a third host-plant that grew next to the *Malvella* on the same black soil. The greyish leaves were large enough to provide shelter for the growing larvae but, when taken indoors for closer observation, the larvae were seen to reject this foodplant and quite often I found them wandering off the plants looking for other food. None of the larvae survived. Attempts were made to identify this unknown host-plant, which was covered with stellate tiny hairs but had no fruits at the time, it was provisionally considered to be *Glinus lotoides* L. Molluginaceae. (A resting *C. alceae* female was photographed in Cyprus on *Glinus lotoides* (Makris 2003: 272); following my request, Christodoulos Makris tried in late summer 2004 to find larvae of *C. alceae* within leaf pods of *Chrozophora* and *Glinus* plants, but it was too late in the season to find evidence of feeding). On 22 September 1990, a search was made in the public gardens of Bet Arye, where an irrigated area, originally prepared for the planting of flowers but later abandoned, allowed the invasion of various wild plants including various Crucifers, *Echinochloa colonum* (L.) Link, *Malva* sp. and *Chrozophora* sp. A thorough search for larvae ended successfully with one L4 *C. alceae* larva, 15 mm long, found inside a leaf pod on *Chrozophora tinctoria* (L.) Raf. (Euphorbiaceae). On 10 October 1990, the first observed *C. alceae* adult to complete its life cycle on *C. tinctoria* emerged successfully. It is important to note that the neighbouring *Malva* was devoid of larvae and that *Chrozophora* was apparently preferred as a host-plant.

No other butterfly is known to feed on this newly discovered Euphorbiaceae host-plant and thus *C. alceae* becomes the first butterfly (Rhopalocera) reported to feed on *Chrozophora tinctoria* (Robinson et al. 2004; Fiedler 1991 & pers. comm.).

The life history of *Carcharodus alceae*

The species is on the wing in Israel from February in the Negev until November in the Mediterranean region. In the South Sinai Massif it flies from March until September, and in Mt Hermon from the end of May at 1500 m to July-August at 2000 m. It has up to three annual broods depending upon the elevation above sea level and availability of host-plants.

Eggs and laying preferences. Eggs are laid singly on both surfaces of the leaves of *Alcea setosa*, its most common host-plant in Israel. The egg is brown when laid and is 0.75 mm in diameter and 0.6 mm high. Its spherical surface is covered with relatively few but tall bulges that may provide partial protection from parasites. These nodes converge upwards to create five prominent ridges, the tops of which circle the depression of the micropyle. Its typical texture, with a “flower” of 8–9 “leaves” around the micropyle is shown on Fig. 2. In mid-September 2004 three types of hollyhock were growing in my garden: 1) Wild, 2) Hybrids of wild x cultivated, and 3) Cultivated. Eggs

Fig. 1. *Chrozophora tinctoria*, the new host-plant of *Carcharodus alceae* at Kibutz Haogen, Hasharon district, Central Coastal Plain, Israel, 19.ix.2003 (circled: a leaf pod of *C. alceae* larva).

were laid only on the wild plants, at the base of the dry flower stalks where few green leaves still existed. The females totally ignored the other *A. setosa* plants which carried fresh and larger leaves. Only when the few leaves of the wild plants were consumed did the females start to lay on the hybrids. The cultivated *A. setosa* were not visited by any female and remained unused. It is quite astonishing that the *C. alceae* females could sense exactly, and with no mistake, which plant they preferred. Does it mean that these three types of plants are chemically different?

Larvae. The young larva hatches usually after five to seven days; it opens a hole in the upper side of the egg by cutting around and lifting the "flower" mark. It does not consume the egg shell and immediately cuts and/or folds a leaf to prepare its sheltered leaf pod (Figs. 1, 3, 4). It is 2 mm long, light green with short hairs, with a black head and a reddish "collar" behind the head. It grows to about 23 mm long and at this stage of development its body is whitish-green with bright short hairs. The head remains black and is covered with tiny brown and yellow setae, the "collar" is black with three yellow spots (Fig. 5). In mid-summer a larva which hatched on 22 July pupated 24 days later, on 15 August.

In July 1979 I bred, simultaneously, larvae from the isolated population around Santa Katarina Monastery, 1600 m, in the Southern Sinai Massif and from Yahud (10 km east of Tel Aviv, Israel, elev. approx. 100 m). I noticed slight differences in larval coloration; the Sinai larvae were usually much brighter.

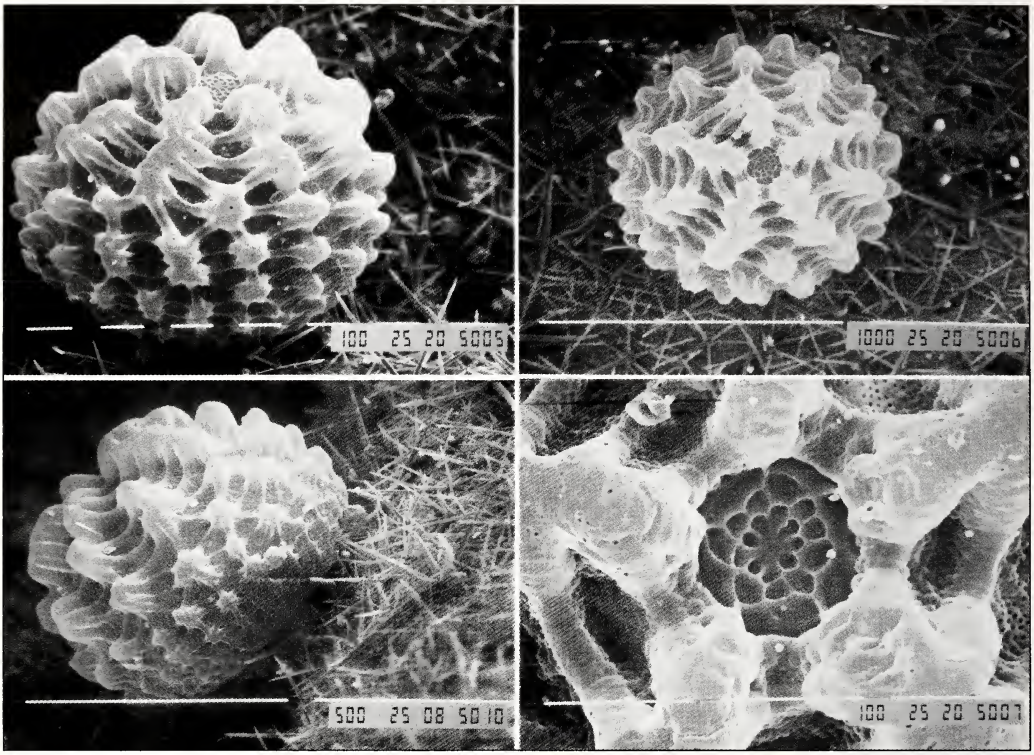

Fig. 2. *Carcharodus alceae* egg SEM (Scanning Electron Microscope) photographs (photo: Dr. Leonid Shikmanter).

Pupa. Pupation takes place inside the leaf pod (Fig. 6), the pupa being attached by means of the cremaster, sometimes with an additional thoracic girdle. It is up to 16 mm long, 5 mm in diameter, brown, and covered with white powder. The eyes and the spiracles are black. In August it hatches after 8–10 days (Fig. 7). On 21 February 1992, at the end of an exceptionally cold and wet winter, an overwintering L4 larva, 18 mm long, was found inside a leaf pod of *Alcea setosa* in Bet Arye, 310 m. It pupated on 15 March 1992, with the adult hatching a month later on 14 April 1992. On one occasion a winter-diapausing larva, which was found in Dvira, Northern Negev on 7 February 1981 inside an *A. setosa* leaf pod, emerged in July having spent some four months aestivating in the pupal stage.

Diapause. I noted three variations of diapause:

1) The autumn larvae of the final summer brood enter winter diapause which lasts until February in southern warmer localities, and until April in the central Mediterranean plateau. This is the only form of diapause reported until now in numerous books and other publications.

2) A pupal summer aestivation, spanning March to July, was found only once in a Northern Negev population (details were given above).

3) Winter pupal diapause – Two fully-grown larvae were found on 19 September 2003 inside leaf pods on *Chrozophora tinctoria* near Kibutz Haogen, Hasharon district, on

Fig. 3–9. 3. A young larva shown preparing its shelter on an *Alcea setosa* leaf. Santa Katarina Monastery, South Sinai, 1600 m, 22.vii.1979. **4.** *Carcharodus alceae* larval leaf pod on *Chrozophora tinctoria*. Same location and date as Fig. 1. **5.** Fully grown larva on *Chrozophora tinctoria*. Sasa, Upper Galilee, 880 m, 24.vii.2004. **6.** Winter diapausing *Carcharodus alceae* pupa. Kibutz Haogen, Hasharon district, Central Coastal Plain, Israel, 4.x.2003. **7.** Fresh *Carcharodus alceae* female from a larva which had developed on *Chrozophora tinctoria*. Sasa, Upper Galilee, 880 m, Israel, 4.viii.2004. **8.** Extrafloral nectaries of *Chrozophora tinctoria*. Attending beetles *Anthrenus* sp. (Dermestidae) and a fruit fly *Chaetorellia* sp. (Tephritidae) are possibly attracted to the nectaries. Rantis, Central Israel, ca. 200 m, 3.vii.2004. **9.** *Azanus jesous* nectaring on a flower of *Chrozophora tinctoria*. Hexagon Pool, Golan Heights, 50 m, 31.vii.2004 (Photos 8, 9: Eran Benyamini).

Fig. 10. Defoliated *Chrozophora tinctoria*. Rantis, Central Israel, ca. 200 m, 20.x.2004.
Fig. 11. 3 mm long L2 larva of *Carcharodus alceae* wandering over the stellate hairs of *Chrozophora tinctoria* leaf after being transferred from the original host-plant, *Alcea setosa*. Bet Arye, 310 m, 7.viii.2004.

the Mediterranean coastal plain in Central Israel. Both pupated on 2 October 2003. The pupae did not hatch and entered winter diapause (Fig. 6). On 29 February 2004 they were moistened with a few raindrops, but failed to hatch and later died. The precise timing of their demise is uncertain, as there were no external clues pointing to their change of condition. However, based on this very limited experience, it would appear that the late summer brood is potentially doomed; the adult‘s flight season is over, forcing the pupae to stay within the folded leaf. But the annual *C. tinctoria* dries up and loses all its leaves with the doomed pupae inside (Fig. 10).

This was my only experience with overwintering pupae of this species. However, in December 2004 Mr Evyatar Feingold, a young member of the Israeli Lepidopterist’s Society informed me that he found a larva of *Carcharodus alceae* on *Malvella* sp. in early November 2004 in Sde-Boker, Central Negev, elev. 465 m. This larva pupated on 14 November 2004 to become the second observation of a winter-diapausing pupa. It remains to be seen if this produces a viable adult.

Attending ants. At various locations small black ants were observed on host-plants. As the larvae were inaccessible inside their leaf pod, another reason had to be found to explain the ants‘ presence. (It was apparent that the ants were not attracted to the frass of the larvae). After close observation, the reason for their presence was revealed: tiny flat “buttons” on the undersides of leaves were found to be extrafloral nectaries (Fig. 8). On 31 July 2004 a large bush of *Chrozophora tinctoria* near the Hexagons Pool, on the Golan Heights, 50 m above sea level, was observed over a period of time. The flowers attracted adults of *Colotis fausta, Azanus jesous* (Fig. 9), *Tarucus balkanicus*, and one female of *Carcharodus alceae*. Numerous, small black ants were attending these special nectaries. The ants were identified by Armin Ionescu (Tel Aviv University) as *Crematogaster jehovae* Forel. It is quite reasonable to assume that their massive presence on the host-plant provided some protection to the larvae by discouraging potential parasitic wasps. However, in tropical forests where plants with extrafloral nectaries are very common (up to 53% in certain parts of Brazilian Amazon), the presence of numerous ants is a great threat to non myrmecophilous larvae

(Oliveira & Freitas, 2004). In the case of *C. alceae* larvae feeding on *C. tinctoria*, I did not find any evidence for such a threat in Israel.

Parasites and competing moths. Among ca. 20 larvae that were reared on *Chrozophora tinctoria* since 1988 none were attacked by parasites, thus demonstrating the effectiveness of their sealed leaf pod. Most of the leaf pods that were checked for *Carcharodus alceae* larvae were found to contain moth larvae. The microlepidopteran moths were identified by András Kun as Pyralidae of the family Phycitinae. The leaf pods of the moths are constructed as cylindrical webs that are not tightly sealed. In mid-June 2004 several leaf pods of *Chrozophora obliqua* were checked in Ein Gedi, Dead Sea valley (-370 m); all housed only moth larvae. One leaf pod was found to contain a white cocoon of a parasitoid wasp. *Apanteles glabratus* (Braconidae, Ichneumonidae) has been reported as parasitoid of young *C. alceae* larvae bred on *Alcea* sp. in Israel (Eisenstein 1983).

The host-plant

Chrozophora is a small genus in the large Euphorbiaceae family which contains 8100 species in 313 genera (Mabberley 2000). Twelve species are distributed from Portugal to Greece, Turkey, Cyprus, Africa and the Middle East to India and Thailand; two species grow in Southern Europe, and four in Israel: *C. tinctoria, C. obliqua* (Vahl) Ad. Juss. ex Spreng., *C. plicata* (Vahl) Ad. Juss. ex Spreng., and *C. oblongifolia* (Del.) Ad. Juss. ex Spreng. The latter two species are rare Sudanese plants growing in the Arava Valley and Southern Negev where *Carcharodus alceae* does not fly. However, *C. obliqua* has a distribution similar to that of *C. tinctoria* and therefore may be considered another possible host-plant.

C. tinctoria is distributed along the southern coast of Europe and was reported from Portugal, Spain, the Balearic Islands, France, Corsica, Sardinia, Italy, Sicily, ex Yugoslavia, and Greece to Turkey and Crimea (USSR) (Tutin et al. 1968). It is known from North-East Africa to west and central Asia (Loutfy 2000). In 'Flora of Turkey' it is reported from the East Aegean Islands of Lesvos, Khios, Leros, Kos and Rhodos to SW & Central Asia, and to Sokotra island in South Arabia (Davis 1982). Other sources indicate its existence also in Iraq and Iran. Its reported distribution overlaps completely with that of *Carcharodus alceae* (except lower Egypt where *C. alceae* does not fly). Thus *C. alceae wissmanni* may also feed on *C. tinctoria* in Yemen.

Chrozophora tinctoria is a summer-flowering annual bush, usually up to 50 cm high, growing from March to October, from sea level to 1650 m (Turkey). It grows in deep alluvial soils, in disturbed / waste places, sandy plains (Egypt), edges of cultivated surfaces, among summer crops, or in fallow fields where it may become a weed.

The external appearance of the plant is unique; its blade ovate-rhombic leaves are greyish-to-light-green (Fig. 1). This colour is the result of numerous stellate hirsute-to-woolly leaves, with minute white hairs covering their surface.

Its scientific name means the painter's *Chrozophora* and its properties have been known for thousands of years as a source of turn-sole dye (*Bezetta rubra*, tournesol). It was also used for colouring liqueurs, wine, pastries, linen, and Dutch cheeses (Mabberley 2000).

Other butterflies feeding on Euphorbiaceae and their distribution by zoogeographical regions

Hesperiidae. Euphorbiaceae are rarely used by skippers world wide; only 9 species of the world 3660 known species are recorded by Robinson et al. (2004); one of them (*Calpodes ethlius* in the New World) is possibly an error. Four species are listed in the Afrotropical Region: *Abanitis paradisea* on *Bridelia cathartica*, *Coeliades libeon* and *Gorgyra bibulus* on *Drypetes gerrardii*, and *Parosmodes moranti* on *Bridelia* sp. Two species in the Oriental Region: *Bibasis mahintha* on *Aporusa roxburghii* and *Hasora chromus* on the widespread Castor bean (*Ricinus communis*). One species in North America (Mexico) *Arteurotia tractipennis* on *Croton niveus*, which rarely penetrates south Texas. *Calpodes ethlius*, which was reported on *Phyllanthus* sp. for the New World, is almost certainly an error (de Jong, pers. comm.). One Neotropical species: *Dyscophellus porcius* on *Croton* sp. Braby (2000) added two species in Australia: *Chaetocneme beata* on *Croton insularis* and *Chaetocneme critomedia* on *Mallotus polyadenos* and *Macaranga* sp. None was recorded until now for the whole Palaearctic Region. The new total is therefore 11 species or 0.3% of all skippers worldwide.

Papilionidae. Only four species of four genera feeding on Euphorbiaceae are known from the Neotropical and Oriental-Australian Regions. Thus, 0.7% of the world‘s 572 known species of Papilionidae feed on Euphorbiaceae.

Pieridae. Fifteen species of four genera are given for the Oriental, Afrotropical, and Australian Regions. Only one (*Appias drusilla*) is known from the Nearctic and none is known yet from the Neotropical and Palaearctic Regions. This is 1.23% of the world‘s 1222 known species of Pieridae.

Nymphalidae. Euphorbiaceae feeders are most common in this family; no fewer than 150 species in 42 genera are known nowadays. This is 2.08% of the world‘s known 7222 species. The family is well represented in the tropics: 52 species in 11 genera in the Afrotropical Region, 47 in 17 in the Neotropics, 33 in 12 in Central America, 23 in 14 in the Oriental Region, but only 7 in 6 in the Nearctic, 3 in 3 in Australia, and one Palaearctic (the Japanese *Athyma perius*). There are no records of Euphorbiaceae being used by nymphalids in Europe and the Middle East, though *Vanessa cardui* (recorded on *Ricinus communis* in Hong Kong) and *Danaus chrys*ippus (recorded on *Euphorbia* in West Malaysia) are candidates.

Riodinidae. Few records exist for this family (only four species are recorded by Robinson et al. 2004), but thanks to the exceptional work by DeVries (1997) on the Costa Rican butterflies, we may summarize the situation there as follows: 255 species out of the world’s known 1402 Riodinids occur in Costa Rica. Of these 255, eight (3.14%) are recorded to feed on Euphorbiaceae. But since host-plants are known for only 85 species, the percentage of the Euphorbiaceae feeders may increases to 9.4% (of the known 85 species), which would be the highest in the world. The total world‘s known Euphorbiaceae feeders among Riodinidae are 12 species, making up 0.86%.

Lycaenidae. This extremely adaptable family stands second only to the Nymphalidae among world Euphorbiaceae feeders; 71 species in 37 genera are known Euphorbiaceae feeders, making up 1.37% of the known world‘s 5162 species. Most of them fly in the Old World tropics: 30 species in 20 genera in the Oriental Region, 16 in 8 in the Australian Region, 13 in 9 for Afrotropical blues, but only 8 in 6 in the Neotropical Region, 4 in 2 for the Nearctic, and 2 in 2 for the Palaearctic Region (*Megisba malaya* in Japan and *Chilades trochylus* in south-east Europe and the Middle East.).

Tables 1 and 2 present the known number of genera and species of butterfly feeding on Euphorbiaceae together with the number of genera and species of their host-plants by world regions.

The Palaearctic Region, Europe, and the Middle East. I was the first to report usage of a member of the Euphorbiaceae family as a host-plant by a butterfly in the Middle East: *Chilades trochylus* Freyer (= *Freyeria trochylus*) (Lycaenidae) eggs and larvae were found in Israel and the Sinai Peninsula on *Andrachne telephioides* L. (Benyamini 1984, 1990 & 2002). The present article adds a second European butterfly species to the very limited list of Euphorbiaceae feeders. In the whole Palaearctic Region there are only two other known Euphorbiaceae feeders; the widespread Oriental nymphalid *Athima perius* (L.) which ranges from India to Malaysia, South China (Hong Kong), Taiwan, and Japan, and *Megisba malaya* Horsfield (Lycaenidae), another Oriental species that reaches Japan. The genus *Megisba* Moore comprises only two species; the other is the Australian *M. strongyle*, which also feeds on Euphorbiaceae.

Among world regions the use of euphorbs as butterfly larval host-plants is lowest in the Palaearctic where just four species (0.21%) out of 1896 use Euphorbiaceae.

Neotropical Region. With 71 Euphorbiaceae feeders out of 7927 species, the percentage figure of 0.89% shows this to be the second lowest region. The ratio is highest in the nymphalids, where the larvae of no fewer than 47 species (1.64%) of the known 2857 are Euphorbiaceae feeders.

Oriental Region. 64 species of 4157 represent 1.54%. Use of euphorbs is most pronounced in the Pieridae where 7 out of 307 species account for 2.28%.

Nearctic Region. Despite having only 13 feeders, these represent 1.69% of the total known 767 species. The nymphalids are again evident, with 7 (3.27%) of 214 species.

Australian Region. 26 species out of 1226 represents 2.12%, which is second only to the Afrotropical Region (2.26%). The leading family is that of the lycaenids where 16 of 407 species make up 3.93%.

Afrotropical Region. This region holds the largest concentration of Euphorbiaceae feeders with 74 species representing 2.26% of the total 3267. The use of euphorbs is most pronounced in the nymphalids where they is used by 52 (4.49%) of the known 1156 species.

Central America. Costa Rica, where euphorbs are used by 7.62% of the nymphalids and 9.4% of the riodinids (where the host-plant is known), is a "hot spot" not only for butterfly biodiversity but also for Euphorbiaceae world feeders in these two families.

Feeding on milky/ toxic host-plants

The Euphorbiaceae family has been divided recently into five subfamilies (Webster 1994a, b): the Phyllanthoideae (no milky latex), the Oldfieldioideae (no milky latex),

Tab. 1. Distribution of World butterflies that feed on Euphorbiaceae; number of species per family per zone. Sources: Benyamini (1984, 1990), Braby (2000), Canals (2003), DeVries (1987, 1997), Heppner (1991), Robinson et al. (2004), and Scott (1986). * Costa Rican numbers are also included in the Neotropical totals. ** Unknown. *** Several species of butterflies fly in more than one zone. This row presents the real numbers of known Euphorbiaceae feeders.

	Papilionidae			**Pieridae**			**Nymphalidae**			**Riodinidae**			**Lycaenidae**			**Hesperiidae**			**Total per Region**		
	Euphorbiaceae Feeders	**Total Number of Species**	**Percentage (%)**	**Euphorbiaceae Feeders**	**Total Number of Species**	**Percentage (%)**	**Euphorbiaceae Feeders**	**Total Number of Species**	**Percentage (%)**	**Euphorbiaceae Feeders**	**Total Number of Species**	**Percentage (%)**	**Euphorbiaceae Feeders**	**Total Number of Species**	**Percentage (%)**	**Euphorbiaceae Feeders**	**Total Number of Species**	**Percentage (%)**	**Euphorbiaceae Feeders**	**Total Number of Species**	**Percentage (%)**
Palaearctic	0	84	0	0	167	0	1	1083	0,09	0	16	0	2	391	0,51	1	155	0,64	4	1896	0,21
Afrotropical	0	87	0	5	174	2,87	52	1156	4,49	0	11	0	13	1402	0,93	4	437	0,91	74	3267	2,26
Oriental	2	178	1.12	7	307	2,28	23	1563	1,47	0	20	0	30	1520	1,97	2	569	0,35	64	4157	1,54
Australia	0	70	0	5	187	2,67	3	349	0,86	0	22	0	16	407	3,93	2	191	1,05	26	1226	2,12
Nearctic	0	33	0	1	64	1,56	7	214	3,27	0	25	0	4	139	2,87	1	292	0,34	13	767	1,69
Costa Rica *	0	40	0	0	70	0	33	433	7,62	8	255	3,14	1	**		1	**		43	**	
Neotropical	2	120	1.67	1	323	0,31	47	2857	1,64	12	1308	0,92	8	1303	0,61	1	2016	0,05	71	7927	0,89
Total ***	4	572	0.7	15	1222	1,23	150	7222	2,08	12	1402	0,86	71	5162	1,37	11	3660	0,3	264	19240	1,37

Tab. 2. Quantities of known Euphorbiaceae host-plants for butterfly families in the world's major zoogeographical zones (Gen.=Genera ; Sp.=Species). Sources: Benyamini (1984, 1990), Braby (2000), Canals (2003), DeVries (1987, 1997), Robinson et al. (2004) & Scott (1986). * Several species of butterflies fly in more than one zone. This row presents real numbers.

	Papilionidae				**Pieridae**				**Nymphalidae**				**Riodinidae**				**Lycaenidae**				**Hesperiidae**			
	Butterflies		Hosts		Butterflies		Hosts		Butterflies		Hosts		Butterflies		Hosts		Butterflies		Hosts		Butterflies		Hosts	
	Gen.	Sp.	Gen.	Sp.	Gen.	Sp.	Gen.	Sp.	Gen.	Sp.	Gen.	Sp.	Gen.	Sp.	Gen.	Sp.	Gen.	Sp.	Gen.	Sp.	Gen.	Sp.	Gen.	Sp.
Palaearctic	0	0	0	0	0	0	0	0	1	1	2	4	0	0	0	0	2	2	3	4	1	1	1	1
Afrotropical	0	0	0	0	3	5	4	5	11	52	18	37	0	0	0	0	9	13	8	8	4	4	2	2
Oriental	2	2	2	2	3	7	5	10	14	23	20	35	0	0	0	0	20	30	11	20	2	2	2	2
Australia	0	0	0	0	2	5	3	7	3	3	3	3	0	0	0	0	8	16	7	14	1	2	2	2
Nearctic	0	0	0	0	1	1	1	1	6	7	6	10	0	0	0	0	2	4	1	2	1	1	1	1
C-America	0	0	0	0	0	0	0	0	12	33	7	20	6	8	5	5	1	1	1	1	1	1	1	2
Neotropical	2	2	2	2	1	1	1	1	17	47	14	38	4	5	2	2	6	8	1	2	1	1	1	1
Total *	4	4	4	4	4	15	7	22	42	150	36	118	7	12	6	6	37	71	24	46	11	12	9	11

the Acalyphoideae (latex absent), the Crotonoideae (latex reddish or yellowish-to-milky), and the Euphorbioideae (latex whitish, often caustic or poisonous).

Table 3 presents the number of butterfly species/feeders and their Euphorbiaceae host genera. The leading subfamily is the Acalyphoideae where 22 genera are used as host-plants by 141 species of butterfly. Phyllanthoideae are second with 13 genera and 81 butterflies, followed by Crotonoideae 6/ 52, Euphorbioideae 7/ 25 and Oldfieldioideae 1/ 2.

We calculated the number of genera used and their percentage in each subfamily. The results are presented in Tab. 4 with the total number of Euphorbiaceae feeders per subfamily.

Though toxicity of each plant genus within the subfamilies is not considered, the accumulated results of Tab. 4 suggest that butterfly preference among the Euphorbiaceae subfamilies declines as plants become more toxic. It also means that butterfly adaptation to toxic hosts, which may provide chemical defence, is slow, limited, and possibly problematic.

Rizk's (1987) phytochemical analysis of the Euphorbiaceae specifies the toxic compounds in this family; many of these host-plant genera appear in Tab. 3. It is important to note that Rizk's work presents chemicals that were found in specific plants; it does not mean that other plants including host-plants of the same genera have the same compounds. However, for the preliminary analysis in Tab. 5 I assume that each genus is homogeneous regarding chemical ingredients of its species.

Let us examine briefly the more common toxic compounds that were found in the Euphorbiaceae (Tab. 5):

Over 55 Terpenoids (tetra- and pentacyclic) have been identified; mostly in the latex of *Euphorbia* spp., but also in other parts (bark, leaves, flowers, stems, and roots). Such compounds were found also in the plant genera *Macaranga*, *Croton*, *Phyllanthus*, *Antidesma*, *Glochidion*, *Bridelia*, and *Sapium*.

Fatty acids have been reported from relatively few species. These include *Euphorbia* sp., *Trewia* sp. and *Hevea* sp.

Phenolic substances of the following types were identified: Flavonoids in several *Euphorbia* spp., Coumarins in *Mallotus* spp. and *Euphorbia* sp., Lignans in *Phyllanthus* sp., Tannins in *Mallotus* sp., *Euphorbia* sp., *Phyllanthus* sp., *Sapium* sp. and *Acalypha* sp., Quinones in *Acalypha* sp., *Euphorbia* sp., and *Hevea* sp., Phenolic acids in *Euphorbia* sp. and *Ricinus communis*.

Several types of Alkaloids exist especially in *Croton*, *Phyllanthus*, and *Securinega* species. Imidazole alkaloid was found only in *Glochidion* sp. Pyrimidine and Guanidine alkaloids were isolated only from *Alchornea* sp. Several Quinolizidine alkaloids were found in *Phyllanthus* and *Securinega* sp. Glycoalkaloids were found in *Euphorbia* sp.

Cyanogenic glucosides have been identified in Phyllanthoideae and Euphorbioideae. The taxa of these tribes can produce hydrocyanic acid. Several species of the following genera were found to be cyanogenic: *Andrachne, Bridelia, Euphorbia, Gymnanthes, Hevea, Manihot, Phyllanthus*, and *Securinega*.

Several *Euphorbia, Antidesma*, and *Croton* species are used as fish and arrow poisons. Extensive medicinal use of Euphorbiaceae plants has been known since antiquity. While many of these plants are extremely toxic, details of their use are beyond the scope of this article. However, the last column in Tab. 5 indicates which host-plant genus has medicinal importance.

Calculating the percentage of known toxic species in certain genera, and thus assuming which genus is toxic, yields interesting preliminary results for the use of toxic Euphorbiaceae genera as host-plants (Tab. 5). While 42.55% of the Acalyphoideae known host-plants are toxic (56.79% is given for the Phyllanthoideae), the figures for the subfamilies with toxic latex are much higher: 60% for Euphorbioideae and 92.31% for Crotonoideae. Further detailed research is needed to analyze these interesting results.

Lack of warning coloration

A straightforward comparison with other feeders of toxic plants, e.g. Papilionidae larvae on Aristolochiaceae and Danainae larvae on Asclepiadaceae, highlights other interesting differences: *Carcharodus alceae* and its larvae do not have warning coloration while it is highly pronounced in Papilionidae and Danainae.

Tab. 3. Usage of Euphorbiaceae subfamilies and genera by Rhopalocera. Sources: Tabs. 1–2, Mabberley (2000), Robinson (2004 and pers. comm.), DeVries (1997), G. L. Webster (1994a, 1994b, pers. comm.). * These figures include butterflies that feed on more than one Euphorbiaceae genus or tribe.

Euphorbiaceae subfamily	**Genus**	**Papilionidae**	**Pieridae**	**Nymphalidae**	**Riodinidae**	**Lycaenidae**	**Hesperiidae**	**Total**	**percent of world Euphorbiaceae feeders***
I. Phyllanthoideae	*Antidesma*			3		1		4	**26,91%**
No milky latex	*Drypetes*		12	3		3	2	20	
	Phyllanthus		5	3		1		9	
	Securinega			3				3	
	Hyeronima			1	1			2	
	Bridelia		1	5		4	2	12	
	Aporusa						1	1	
	Uapaca			2		1		3	
	Baccaurea					3		3	
	Glochidion			6		9		15	
	Breynia		3	2		1		6	
	Andrachne					1		1	
	Flueggea			2				2	
Subtotal		0	21	30	1	24	5	**81**	
II. Oldfieldioideae	*Petalostigma*			1		1		2	**0,66%**
No milky latex									
Subtotal		0	0	1	0	1	0	**2**	

Tab. 3. Continued.

III. Acalyphoideae	*Clutia*					1		1	**46,84%**
Latex absent, leaves often petiolar or laminar glands	*Chrozophora*						1	1	
	Alchornea			7		2		9	
	Acalypha			8	1			9	
	Macaranga	1		8		7	1	17	
	Mallotus			4		5	1	10	
	Ricinus		2	8	3		1	14	
	Trewia					1		1	
	Dalechampia			38				38	
	Conceveiba			1	1			2	
	Erythrococca					1		1	
	Micrococca					1		1	
	Bernardia					1		1	
	Aparisthmium			2				2	
	Claoxylon			1				1	
	Cnesmone			1				1	
	Platygyna			1				1	
	Pterococcus			1				1	
	Tetracarpidium			2				2	
	Tragia			25				25	
	Adelia			1				1	
	Adriana					2		2	
Subtotal		1	2	108	5	21	4	**141**	
IV. Crotonoideae	*Hevea*		1	1		2		4	**17,28%**
Latex reddish or yellow to milky	*Manihot*			2				2	
	Codiaeum			1				1	
	Croton	1		30	4	4	3	42	
	Omphalea				2			2	
	Trigonostemon					1		1	
Subtotal		1	1	34	6	7	3	**52**	
V. Euphorbioideae	*Excoecaria*			3				3	**8,31%**
Latex whitish, often caustic or poisonous	*Sapium*			10				10	
	Euphorbia	1		2		1		4	
	Actinostemon	1						1	
	Gymnanthes			1				1	
	Maprounea			2				2	
	Sebastiana			4				4	
Subtotal		2	0	22	0	1	0	**25**	

Tab. 4. Euphorbiaceae subfamily preference by feeding butterfly species. 1) including butterflies that feed on more than one genus or subfamily.

Euphorbiaceae	No. of genera used as host-plants and their percentage within each subfamily	No. of species of feeding butterfly larvae 1)	Preference %
Phyllanthoideae	13 (22.4%)	81	26.91
Oldfieldioideae	1 (3.6%)	2	0.66
Acalyphoideae	22 (18.6%)	141	46.84
Crotonoideae	6 (9.8%)	52	17.28
Euphorbioideae	7 (16.6%)	25	8.31
Total	49 (15.9%)	301	100.00

The lack of warning coloration in *C. alceae* suggests that its acceptance of Euphorbiaceae is a very recent one. Most Rhopalocera larvae of Euphorbiaceae feeders appear to be cryptic, yet the recognized association of warning colours and toxicity in other species indicates that the Euphorbiaceae feeders will possibly develop warning coloration in the future. It has already happened in the conspicuous and possibly toxic larva of the hawkmoth *Hyles euphorbiae* (Sphingidae). It is our lucky privilege being able to follow this change in real time and to measure how many years it will take for these warning colours to develop. I expect it to be much shorter than we can guess or estimate nowadays. More than that, the change will possibly be pronounced only in the *Chrozophora* feeders while other *C. alceae* will not change. Does this also foretell a future speciation event in *C. alceae*?

Switching from Malvaceae to Euphorbiaceae - Summary

On 4 August 2004 in Bet Arye, Central Israel, elevation 310 m, foodplants were in short supply. Five first and second instar larvae and one un-hatched egg were found on a tiny *Alcea setosa* plant having only three leaves, each of 5 cm diameter. It is obvious that in such circumstances, with no other foodplant available, larvae will starve to death. This seasonally repeated shortage of host-plants in the dry Mediterranean summer, is the key driver for searching and switching to alternative plants. The five young larvae with their tiny leaves were transferred into separate breeding vials where fresh *Chrozophora tinctoria* plants were added. Three larvae accepted it quite willingly and were observed feeding on young leaves on 7 August. The other two wandered restlessly (Fig. 11), and eventually were seen accepting the *Chrozophora* reluctantly, and tentatively, on 11 August. Closer observation suggested that the hairs on the plant acted as mild discouragement to feeding. Finally, three adults hatched between 26 August and 2 September 2004. This experiment demonstrated that all the larvae switched from *Alcea* to *Chrozophora* but the final rate of success was three out of five, measured in terms of transition from larva to adult, which is 60%. The limited observation, if repeated under natural conditions, suggests that acceptance of this host- plant developed over the last sixteen years from 0% in 1988 to 60% in 2004. Field observations indicate that eggs which were laid directly on the *Chrozophora* developed normally, though some adults failed to emerge successfully. Switching to this summer host-plant appears to have the dubious benefit of extending the breeding season to the autumn, so that larvae feeding in late-season produce pupae which then find themselves in the cold, unfavourable climate of early winter and are forced to overwinter. We still do not know if they can survive the winter in this stage of their life cycle.

Are we witnessing a switching process (or an acceptance of an alternative host-plant) that has started in the recent past, and is still evolving? Lack of warning coloration in both larvae and adults support this hypothesis. Is it linked to the desiccation of our biotopes due to the greenhouse effect? We postulate that both processes are happening within the same timetable.

Tab. 5. Toxic chemicals of the Euphorbiaceae host-plants of butterflies.

Euphorbiaceae		**Terpenoids**	**Fatty acids**	**Phenolic substances**	**Alkaloids**	**Cyanogenic Glucosides**	**Medicinal plants**	**Total species feeders**	**% of toxic genera ***	**% of plant species which are toxic and used as host-plants****
I. Phyllanthoideae	*Antidesma*	v					v	4	**53,80**	**56,79**
No milky latex	*Drypetes*							20		
	Phyllanthus	v		v	v	v	v	9		
	Securinega				v	v		3		
	Hyeronima							2		
	Bridelia	v				v	v	12		
	Aporusa						v	1		
	Uapaca							3		
	Baccaurea							3		
	Glochidion	v			v		v	15		
	Breynia						v	6		
	Andrachne					v	v	1		
	Flueggea			v	v		v	2		
Subtotal								**81**		
II. Oldfieldioideae	*Petalostigma*							2	**0,00**	**0,00**
No milky latex										
Subtotal								**2**		

Tab. 5. Continued.

III. Acalyphoideae	*Clutia*						v	1	**27,27**	**42,55**
Latex absent, leaves often petiolar or laminar glands	*Chrozophora*						v	1		
	Alchornea				v		v	9		
	Acalypha			v		v	v	9		
	Macaranga	v					v	17		
	Mallotus			v			v	10		
	Ricinus			v	v		v	14		
	Trewia		v		v		v	1		
	Dalechampia							38		
	Conceveiba							2		
	Erythrococca						v	1		
	Micrococca							1		
	Bernardia							1		
	Aparisthmium							2		
	Claoxylon							1		
	Cnesmone							1		
	Platygyna							1		
	Pterococcus							1		
	Tetracarpidium							2		
	Tragia						v	25		
	Adelia							1		
	Adriana							2		
Subtotal								**141**		
IV. Crotonoideae	*Hevea*		v	v		v		4	**50,00**	**92,31**
Latex reddish or yellow to milky	*Manihot*			v		v	v	2		
	Codiaeum							1		
	Croton	v		v	v		v	42		
	Omphalea							2		
	Trigonostemon							1		
Subtotal								**52**		
V. Euphorbioideae	*Excoecaria*						v	3	**42,85**	**60,00**
Latex whitish, often caustic or poisonous	*Sapium*	v		v			v	10		
	Euphorbia	v	v	v	v	v	v	4		
	Actinostemon							1		
	Gymnanthes					v		1		
	Maprounea							2		
	Sebastiana						v	4		
Subtotal								**25**		

Finally, Mabberley (1997) in his discussion on similarities of the five Euphorbiaceae subfamilies noted: "The seed structure….of the others [incl. *Chrozophora*] show more affinity with…..Malvaceae…". Does it mean that this switching was inevitable?

Acknowledgements

I am indebted to Prof. Avinoam Danin, Dept. of Evolution Systematics and Ecology, the Hebrew University of Jerusalem for his botanical advice. He identified all the plants that I collected from various biotopes in Israel and the Golan Heights and helped to clarify that the host-plant was definitely *Chrozophora tinctoria* rather than the first suspect, *Glinus lotoides*. Prof. Daniel Zohary of the Botanical Dept. of the Hebrew University of Jerusalem guided me in the botanical literature to analyze the distribution of the host-plant. I am greatly indebted to the trustees of the Lepidoptera section at the British Museum of Natural History, London for their help in analyzing the HOSTS database (Robinson et al. 2004) and especially Mr. Phil Ackery, Dr. Gaden Robinson, and Dr. George Beccaloni. Dr. Rienk de Jong, Leiden, The Netherlands, elaborated on the actual distribution of *Carcharodus tripolinus* in the Iberian Peninsula and North Africa as did Mr. John Tennent of the BMNH, London, who sent me his relevant publication regarding the distribution of *Carcharodus alceae* in north-west Africa. Dr Rienk de Jong dissected male genitalia of *C. alceae* that I bred from the Sinai Massif proving that this isolated population does not belong to the North African stock. Dr. Grady Linder Webster of the Division of Biological Sciences, section of Plant Biology at UCLA (Davis) deserves special thanks for his help in the preparation of Tabs. 3 and 5. Prof. Arthur Shapiro of UCLA (Davis), Dr. Kurt Johnson of the Ethical Society of New York, and Dr John Heppner, curator of the Florida State Collections of Arthropods helped with Nearctic and Neotropical Euphorbiaceae butterfly feeders. Dr. Armin Ionescu-Hirsch, curator of Formicidae and Hymenoptera at the Tel Aviv National Collection of Insects identified attending ants. Dr. András Kun, curator of microlepidoptera at the Hungarian National Museum of Natural History identified the competing moth. Mr. Leonid Friedman, Dept. of Zoology, Tel Aviv University, identified the attending insects in Fig. 8. Dr. Leonid Shikmanter took the excellent SEM photograph of the egg. Thanks to Mrs. Berit Pedersen, the librarian of the Royal Entomological Society of London at Queen's Gate, who is always on call to provide missing references. Prof. Konrad Fiedler of Vienna University encouraged me to publish my findings in Nota Lepidopterologica. Assaf Benyamini processed the HOSTS database for Tab. 1. Eran Benyamini took the photographs of Figs 8 and 9. Avishay Benyamini scanned the slides and prepared the files of the photographs for publications. Last but not least, Mr. Eddie John of the Vale of Glamorgan, U. K. read the manuscript; his editing suggestions were accepted willingly. To all these people and institutions that supported me in various stages of preparing the manuscript, giving me invaluable advice, I am greatly indebted.

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Acleris effractana (Hübner, 1799) – a Holarctic Tortricid

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Abstract. The discovery by Leraut (2003) of the existence of a species closely related to *Acleris emargana* (Fabricius, 1775) is confirmed. It is shown that this was already known to lepidopterists in the first half of the 19th century, but like many *Acleris* names later regarded as only a form, the name *Acleris effractana* (Hübner, 1799) is the oldest name for the species. A neotype for *A. effractana* is designated. *A. effractana* is shown to have a Holarctic distribution, with occurrence only in the northern part of Europe. *A. emargana blackmorei* Obraztsov, 1963 (**syn. n.**) and *Acleris stettinensis* Leraut, 2003 (**syn. n.**) are synonyms of *A. effractana* (Hübner). *A. effractana* is compared with *A. emargana* (Fabricius, 1775). Details of the variation in adults, biology and distribution of these two species are presented, and adults and genitalia are illustrated.

Zusammenfassung. Die Entdeckung der Existenz einer mit *Acleris emargana* (Fabricius, 1775) nahe verwandten Art durch Leraut (2003) wird bestätigt. Es wird nachgewiesen, dass diese Tatsache bereits Lepidopterologen der ersten Hälfte des 19. Jahrunderts bekannt war, wobei der Name *Acleris effractana* der älteste ist, aber wie viele andere *Acleris*-Namen später nur als Form behandelt wurde. Ein Neotypus für *A. effractana* wird hier designiert. *A. effractana* weist eine holarktische Verbreitung auf und ist in Europa auf die nördlichen Regionen beschränkt. *A. emargana blackmorei* Obraztsov 1963 (**syn. n.**) and *Acleris stettinensis* Leraut, 2003 (**syn. n.**) sind Synonyme von *A. effractana*. *A. effractana* wird mit *A. emargana* verglichen und die Variation, Biologie und Verbreitung beider Arten werden beschrieben sowie Imagines und Genitalien abgebildet.

Key words. Holarctic, variation, sibling species, *Salix*.

Introduction

Members of the genus *Acleris* Hübner, 1825 are among the most popular Microlepidoptera. The genus includes several beautiful species, and also some with extraordinary variability. During the 18th and 19th century many of the forms were thought to represent distinct species and were given names as such. Later on, especially during the first half of the 20th century, some authors, notably Sheldon (1930–31), tried to classify the forms of the variable species, proposing a large number of additional names for the forms. The nomenclature of many European *Acleris* species is thereby burdened by numerous synonyms and infrasubspecific names.

This variability also results in identification problems at the species level. One of the few European *Acleris* species which, in spite of remarkable variation, has always been considered easy to identify is *A. emargana* (Fabricius 1775) with its characteristic, and among European Tortricidae unique, emargination of the forewing costa. It was therefore surprising for us to see that Leraut (2003) described a new species of *Acleris* from northern Europe, allied to *A. emargana*. This author is well known for studying old literature in order to ‘dig’ up the oldest name of any species (see e.g. Leraut 1997), but in this case he only discussed the old nomenclature briefly and proposed a new name, *A. stettinensis*, for the species discovered by him. This description was not published in a scientific journal, but in a ‘semi-popular’ book showing colour pictures of numerous insects.

We decided to test the validity of Leraut´s findings, and below we present the results.

Material and methods

A. stettinensis was described as a close relative of *A. emargana*, both in wing markings and in genitalia. We dissected a number of *A. emargana* of both sexes and compared them without first separating them on external characters. It turned out that, despite the differences being only small, these genitalia slides fall into two groups. Comparing the moths from which the genitalia were dissected also resulted in two groups: one with more or less similar, brownish grey specimens, and one with some rather variable specimens. The latter group fits *A. emargana* as currently understood, whereas the first group matches Leraut´s *A. stettinensis*. Based on the differences described below we are of the opinion that Leraut is correct and these two groups represent distinct species. The type series of *Acleris emargana blackmorei* Obraztsov was borrowed from the USNM, and the genitalia of both sexes were compared with those of *A. stettinensis* and found to agree in every detail.

Abbreviations

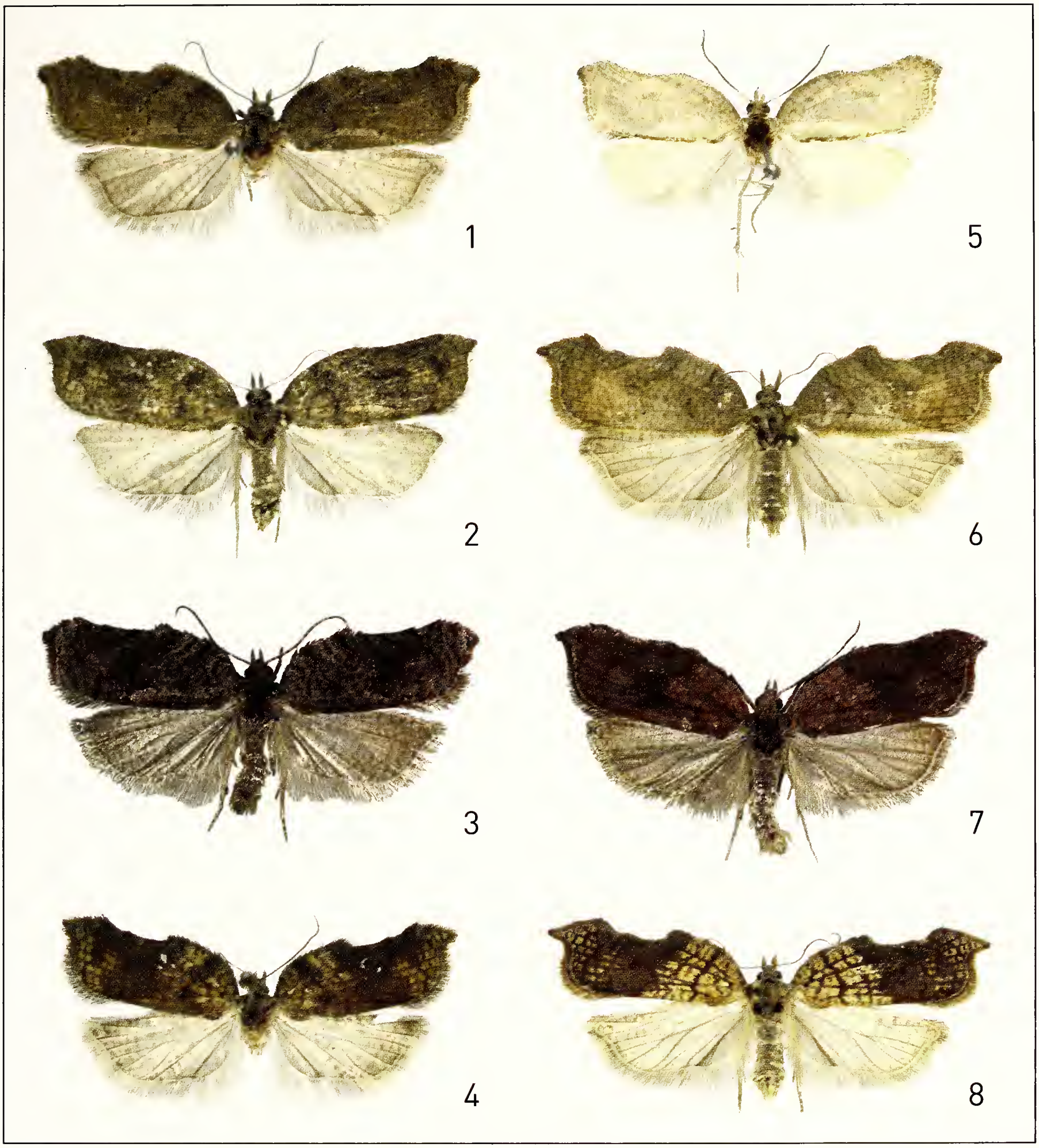
BMNH	The Natural History Museum, London, U. K.
HMUG	Hunterian Museum, University of Glasgow, Glasgow, U. K.
MTD	Staatliches Museum für Tierkunde, Dresden
MZHF	Zoological Museum, University of Helsinki, Finland
USNM	National Museum of Natural History, Washinton D. C., U.S.A.
ZMHB	Zoologisches Museum der Humboldt Universität, Berlin, Germany
ZMUC	Zoological Museum, University of Copenhagen, Denmark

RESULTS

Acleris effractana (Hübner, 1799) Figs. 1–4, 9, 11

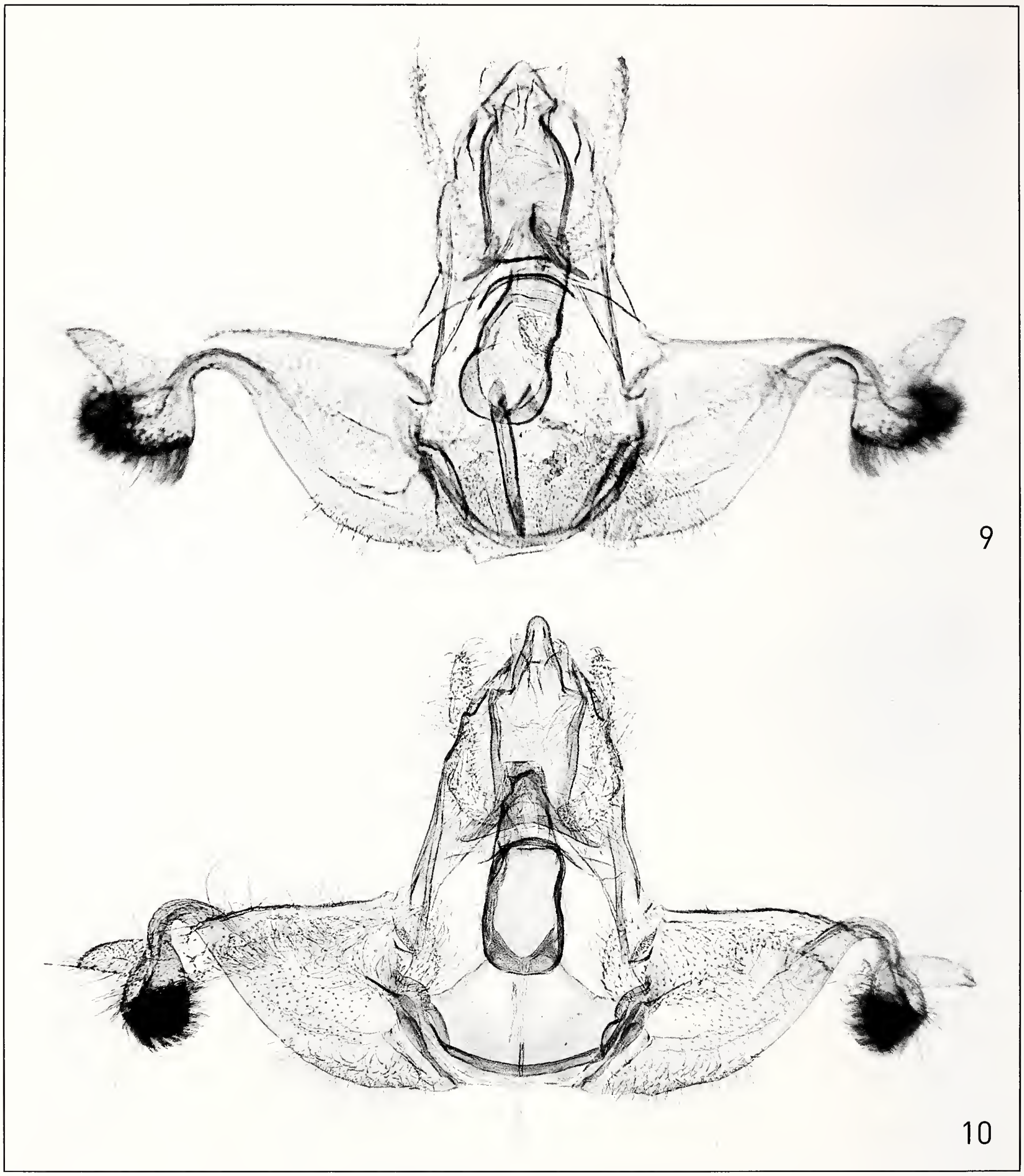
[*Tortrix*] *effractana* Hübner, 1799: pl. 28 fig. 175.
Rhacodia emargana f. *fuscana* Sheldon 1930: 148. Infrasubspecific name.
Acleris emargana blackmorei Obraztsov 1963: 268–269. **Syn. n.** (examined by DA & KT).
Acleris stettinensis Leraut 2003: 327, fig. 20; pp. 500–501, figs. 1, 3. **Syn. n.** (examined by OK).

Diagnosis (Figs. 1–4). Wingspan 21–23 mm. Forewing costa with emargination, ground colour brownish fuscous; pattern obsolete, costal triangle indicated as a darker shadow, and weak network pattern indicated by thin lines; groups of blackish erect scales form lines that emphasize the sub-basal fascia and inner edge of the median fascia. Hindwing light grey, more or less reticulate. The depth of the costal emargination varies, but is usually rather slight and not as deep as in most specimens of *A. emargana*. In some specimens the pre-tornal area appears weakly reddish.



Figs. 1–4. *Acleris effractana* (Hübner). **1–2.** ♀, Denmark (ZMUC, photos: Brovad). **3.** ♂, Great Britain (BMNH, photo: DA). **4.** ♀, Denmark (coll. K. Larsen, photo: Brovad).
Figs. 5–8. *A. emargana* (Fabricius). **5.** ♂, Denmark (ZMUC, photo: Brovad). **6.** ♀, Czech Republic (ZMUC, photo: Brovad). **7.** ♂, Great Britain (BMNH, photo: DA). **8.** ♀, Denmark (ZMUC, photo: Brovad).

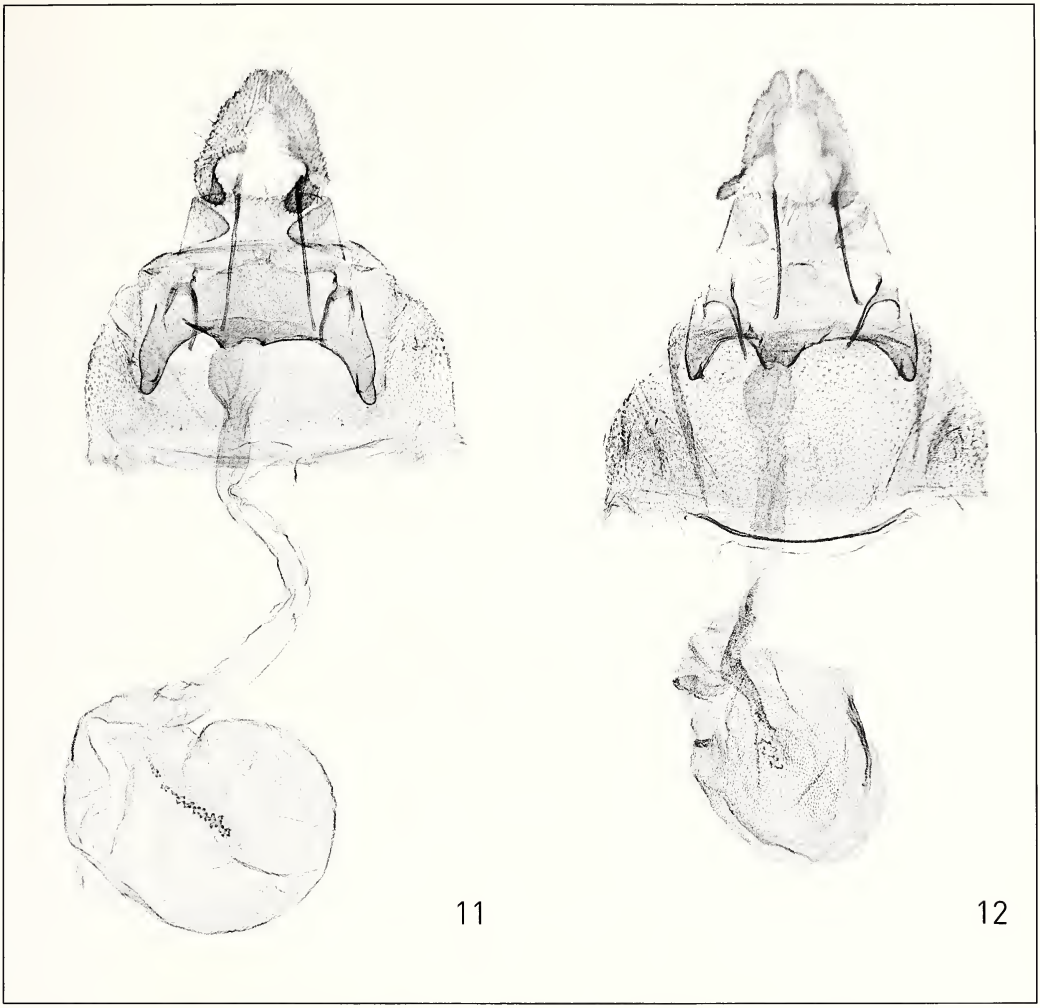
There is a form (Fig. 4) equivalent to the typical form of *A. emargana*, with ochreous ground colour and dark reticulate pattern. It differs from *A. emargana* by heavier dark suffusion, particularly the line forming the sub-basal fascia is thicker. It is apparently without a name. Dark, nearly unicolorous specimens with blackish groups of raised scales and weak emargination of costa certainly belong to *A. effractana*. One should, however, be aware that the raised scales are easily rubbed off, and are usually lacking in worn specimens. "Typical" *A. effractana* are figured by Bradley et al. (1973: fig. 11)



Figs. 9–10. Male genitalia (photos: PH, based on genitalia slides prepared by LA). **9.** *A. effractana* (Hübner). **10.** *A. emargana* (Fabricius).

under the infrasubspecific name *fuscana* Sheldon, by Buhl et al. (2004: fig. 3) and Leraut (2003: 327, fig. 20).

Male genitalia (Fig. 9). Socii slender, basally broader, reaching as far as tip of uncus, or even beyond this; uncus rather broad, nearly as a rounded triangle; sacculus of valva subterminally constricted; phallus short, straight, with small subterminal carina, no cornuti. The most reliable character versus *A. emargana* is the distinctly longer socii. The shape of uncus is variable in *A. emargana*, but is on the average narrower in



Figs. 11–12. Female genitalia (photos: PH, based on genitalia slides prepared by LA). **11.** *A. effractana* (Hübner). **12.** *A. emargana* (Fabricius).

A. emargana than in *A. effractana*. The carina of the phallus is smaller in *A. effractana* than in *A. emargana*, but this character is also variable to some extent.

Female genitalia (Fig. 11). Sterigma distally convex; the extensions of its anterior corners with small terminal process; ductus bursae membraneous, widening before ostium; signum weak, with small teeth, split in two or three parts. For differences from *A. emargana* see under that species. Leraut (2003: 501, fig. 3) in his description of *A. stettinensis* indicated differences between the two species in the size of the papillae analis, the shape of the anterior corners of the sterigma, and the shape of the posterior part of ductus bursae. However, study of numerous slides of the female genitalia of the two species has shown that these characters are variable. The only reliable specific character seems to be the difference in the relative length of the ductus bursae in the two species.

Life history. The larva is bluish green. It lives between leaves spun together in the terminal shoots of *Salix pentandra* (Buhl et al. 2004: 33, 41), in the British Isles it has been bred from tubed leaves of *Salix purpurea* and from spun leaves of *S. cinerea* and *S. purpurea*, larvae being found in June. Adults can be found (in Denmark) from the end of July to early October.

Distribution. Holarctic. Throughout North Europe and northern part of Central Europe: Single records from the west of Ireland and one old specimen from northern England (a single specimen from Surrey in southern England may be due to mislabelling); widespread in Scotland where it occurs with *A. emargana*, usually less common, but in the Hebrides and Northern Isles (Shetland and Orkney) it is the commoner species; in Denmark widely distributed, but more local than *A. emargana* (see Buhl et al. (2004: 40-41) for list of material); in Norway scattered all over the country, almost to North Cape; throughout Sweden (Svensson 2005: 32); nearly all of Finland, most common towards north (Kullberg et al. 2002); Estonia (U. Jürivete, in litt.); Latvia (N. Savenkov, pers. comm.); Germany (Braunschweig and Neustrelitz (Fischer von Röslerstamm 1839), Bautzen in Sachsen (coll. MTD)); Poland: Szczecin ['Stettin'] (Leraut 2003), (NW) Russia (Leraut 2003; Kullberg, in litt.), Japan (Yasuda 1965); Canada and north-western USA (Obraztsov 1963). The occurrence in Central Europe, especially in mountainous areas such as the Alps seems well possible but no specimens belonging to *A. effractana* could be examined so far.

Remarks. *Tortrix effractana* was figured and named by Hübner (1799: pl. 28 fig. 175) without accompanying description. The type locality is not stated, but Hübner´s figure was based on material received from Zincken (Fischer von Röslerstamm 1839: 141), and it is thus likely that it originated from the Braunschweig area in northern Germany where Zincken lived. Hübner´s figure 175 is difficult to interpret, as discussed by Frölich (1828: 27), and according to Fischer von Röslerstamm (1839) it is characterized by traits of both *Acleris* species discussed in this paper. However, Fischer von Röslerstamm was well aware of these two species, and he argued in details that Hübner´s *effractana* represents the grey brown species with two lines of small black scales in the middle of the forewing ("die ziemlich deutlichen (in der Natur aus schwarzen Schuppen-Puncten bestehenden) beiden Linien in Mittelraume").

As it is indeed possible that the figure is drawn from specimens of both we here, in order to stabilize nomenclature, designate a neotype [*Tortrix*] *effractana* Hübner. All the qualifying conditions of section 75.3 of the ICZN Code, 4th edition are met. We agree with Fischer von Röslerstamm´s opinion on the identity of *A. effractana*, and select as neotype a specimen of the species with two lines of small black scales in the middle of the forewing. It is a female in good condition, labelled: '9.8.[18]73' 'Stettin' 'ex collect. Staudinger' 'NEOTYPE Tortrix effractana Hübner, [1799] O. Karsholt design, 2005' (ZMHB). The locality Stettin [now Szczecin in Poland] was then a part of Germany.

The year of publication for *Tortrix effractana* (Hübner) was erroneously stated to be 1822 by Brown et al. (2005: 48).

A. blackmorei was described by Obraztsov as a subspecies of *A. emargana* from a series of specimens from western Canada (British Columbia and Ontario) and U.S.A.

(Washington State). He commented that the species name "had been adopted from labels on genitalia slides prepared by Busck who considered *A. blackmorei* to be a separate species". Obraztsov preferred to publish the taxon at subspecific rank as he believed, erroneously, that there were no genitalic differences between it and *A. emargana.*

Rhacodia emargana f. *fuscana* was described from an unstated number of specimens from Ireland (Sheldon 1930: 148). Infrasubspecific name.

A. stettinensis was described from 11 males and 7 females from Germany, Great Britain, Poland and Russia, all of them old specimens with insufficient label data. The holotype originated from Szczecin ['Stettin'] in Poland. None of the Russian specimens have exact locality data. The type series is exclusively of the rather unicolorous brown form.

Leraut (2003: 500) compared his *A. stettinensis* with *A. emargana, A. emargana tibetica* and *A. blackmorei*, stating that also the latter differs in the genitalia, but without stating the differences.

The figures of an adult and of female genitalia shown for *A. emargana* from Japan (Yasuda 1965: figs. 50, 79) most likely belong to *A. effractana.*

The form with ochreous ground colour and dark reticulate pattern is much rarer than the equivalent, typical form of *A. emargana*; we have only seen few specimens of this form from Denmark and Norway.

Acleris emargana (Fabricius, 1775) Figs. 5–8, 10, 12

Pyralis emargana Fabricius 1775: 651 (examined by DA & KT).
Pyralis caudana Fabricius 1775: 651 (examined by DA & KT).
Tortrix excavana Haworth 1811: 408 (examined by DA & KT).
Teras caudana var. *ochracea* Stephens 1834: 168.
Acalla emargana f. *fasciana* Müller-Rutz 1927: 505-506. Infrasubspecific name.
Rhacodia emargana f. *griseana* Sheldon 1930: 124. Infrasubspecific name.
Acalla var. *caudana* f. *brunneastriana* Weber 1945: 356. Infrasubspecific name.
Acleris emargana tibetica Razowski 1964: 412–414, fig. 93 (examined by DA & KT).

Diagnosis (Figs. 5–8). Wingspan 19–23 mm. Forewing costa with emargination that varies much in depth. Ground colour yellow-ochreous with reticulate pattern; median fascia sharply defined inwardly, becoming more diffuse distally, confluent with indistinct preapical spot. Hindwing greyish white, almost translucent, with slight reticulation, particularly in terminal half. This diagnosis applies to the typical form. The most common form (Fig. 6) has indistinct markings, ground colour ochreous, and grey suffusion except in tornal part. This form can easily be confused with *A. effractana.* It has groups of erect scales in the basal half of the wing, but these appear whitish, not black as the ones in *A. effractana.* The emargination of the forewing costa is generally deeper than in *A. effractana.* According to Bradley et al. (1973: 219) the name *caudana* should be restricted to a rare form with a reddish or orange streak along dorsum, whereas the common form should be called f. *griseana* Sheldon.

Male genitalia (Fig. 10). As in *A. effractana*, but socii not reaching as far as tip of uncus; uncus narrower than in *A. effractana*; subterminal carina of phallus larger than in *A. effractana.*

Female genitalia (Fig. 12). As in *A. effractana*, but ducus bursae shorter. The only reliable difference between *A. effractana* and *A. emargana* seems to be in the length of the ductus bursae. The ratio between the width of the sterigma and the length of ductus bursa is from 0.71 to 1.03 (in average 0.84; n=11) in *A. emargana*, and from 0.48 to 0.64 (in average 0.56; n=8) in *A. effractana*.

Life history. The larva is, when young, whitish green, later light green with almost similar coloured pinacula and a darker dorsal line. The head is honey-coloured with some black dots; thoracic plate and legs are light green. It feeds in late May and in June in folded leaves, or between two leaves, of especially *Salix caprea*, occasionally also on *Betula* and in Norway also on *Populus tremula*. It pupates in the second half of June between the leaves or among moss. The pupa is light brown, its proximal end is broad, horn-shaped, with two strong, curved thorns (Fischer von Röslerstamm 1839: 142, pl. 54). According to Bradley et al. (1973: 219) it also feeds on *Betula*, *Corylus* and *Alnus*. Adults can be found from July to September.

Distribution. North, Central and eastern Europe; recently recorded from Spain (Huesca) (Beltrán 2005); According to Razowski (1984: 200) throughout Siberia to China, Korea and Japan. These records probably refer to both *A. emargana* and *A. effractana*. In MZHF are specimens of *A. emargana* from Siberia (Altai and Buryatia) and from North China (Heilongjiang) (J. Kullberg in litt.). In Tibet subspecies *tibetica* Razowski, 1984.

Remarks. *Pyralis emargana* was described from an unspecified number of specimens from England, probably collected by Lee (Fabricius 1775: 651). The collection of J. Lee (or part of it) was stated to be in the University Museum of Oxford (Smith 1986: 133). DA sought there in vain for the types of *P. emargana* and *P. caudana*, and was informed that they may be in the HMUG, which turned out to be the case. We consider the single specimen there, which belong to the nominal form of *Acleris emargana*, to be the holotype of *P. emargana* Fabricius.

Pyralis caudana was described from an unspecified number of specimens from England. Fabricius (1775: 651) gives no origin of his specimens, but they may well have originated from Lee too. There are two specimens of the form with indistinct markings and ochreous-grey ground colour in the HMUG, and we consider these to be syntypes of *P. caudana* Fabricius.

Tortrix excavana was described from an unstated number of specimens from Great Britain. The name has in the past been attributed to Donovan (1794: 92). However, he did not describe *excavana*, but rather used it as an 'in litteris name', mentioning that it was "known among collectors" under that name. The name *excavana* represents specimens with ground colour varying from light to dark ferruginous-brown without the heavy strigulation or reticulation basally (Bradley et al. 1973: 219, pl. 46 figs. 9–10).

Teras caudana var. *ochracea* was described from an unstated number of specimens from England. It was stated to be of "a pale ochreous colour" (Stephens 1834: 168). As already pointed out by Sheldon (1930: 123) none of the specimens in the BMNH coming from the Stephens collection exactly matches that diagnosis, but are pale specimens of typical *emargana*.

Acalla emargana f. *fasciana* was described from two specimens from Switzerland (Schuls and Altberg an der Lägern) (Müller-Rutz 1927: 505–506). According to the description it is similar to the form figured by Bradley et al. (1973, pl. 46 fig. 10). Infrasubsepcific name.

Rhacodia emargana f. *griseana* was described from an unspecified number of specimens ("most frequently") from Great Britain (Sheldon 1930: 124). Infrasubspecific name.

Acalla var. *caudana* f. *brunneastriana* was described from an unspecified number of specimens from Switzerland. It represents the form with greyish brown forewings with the dorsal part of the forewing red-brown. From the description *brunneastriana* is clearly an infrasubspecific name.

Acleris emargana tibetica was described from 11 specimens collected in Gyangste, Tibet, at an altitude of 3900 m (Razowski 1964: 412–413). We follow here Razowski (1984: 201) in regarding *tibetica* as a subspecies of *A. emargana.*

Pyralis scabrana Fabricius, 1781 has been listed as a further synonym of *A. emargana* by, e.g., Razowski (1984: 198). The type, which is kept in the HMUG was studied by DA and KT. It is a synonym of *Acleris kochiana* (Goeze, 1783) (syn. rev.), but it is also a secondary homonym of *Acleris scabrana* ([Denis & Schiffermüller], 1775) and thus invalid.

It is no surprise that the two main forms of the dimorphic *A. emargana*, the bi-coloured nominate form and the rather plain grey form (f. *caudana*), originally were considered different species and described accordingly. The first to show that these two only represent forms of the same species was Fischer von Röslerstamm (1839: 141–142), who repeatedly bred both forms from larvae which were indistinguishable. From his bred material, originating from Bohemia, about 6% were the nominate form, the large majority belonging to f. *caudana*. In the collection of ZMUC there are 343 specimens of *A. emargana*. About 40% of these belong to the nominate form, but this may well be an artefact caused by collectors wish to collect more specimens of the rarer and more beautiful nominate form.

Acknowledgements

We thank Kaare Aagaard, Vitenskapsmuseet, Trondheim, Sigurd Bakke, Ås and Kai Berggren, Kristiansand, all Norway; John W. Brown, National Museum of Natural History, Washington D. C., USA; Geoff Hancock, HMUG; Urmas Jürivete, Tallinn, Estonia; Jaakko Kullberg, MZHF; Knud Larsen, Søborg, Denmark; Patrice Leraut, Musée national d'Histoire naturelle, Paris, France; Wolfram Mey, ZMHB; Matthias Nuss, MTD; Greg Pohl, Natural Resources Canada, Edmonton, Canada and Nikolay Savenkov, Riga, Latvia for information and the loan of specimens in their care, and two anonymous reviewers for their comments on the draft manuscript. We moreover thank Geert Brovad, ZMUC for taking photographs of figures 1–2, 4–6, 8 and for arranging the plates, and Henning Hendriksen, ZMUC for making a series of genitalia slides.

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The larval host plant of *Polyommatus eroides* (Frivaldszky, 1835) (Lycaenidae) from Poland with comments on the life history

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Abstract. *Polyommatus eroides* (Frivaldszky, 1835) (Lycaenidae) is an endangered species of little known life history. It is distributed mainly in south-eastern Europe and reaches west Siberia. *Oxytropis* sp. and *Astragalus* sp. (van Swaay & Warren 1999) and *Genista depressa* (Tolman 1997) were mentioned as larval hostplants. Tolman (1997) recorded little data on the life history (including the way larvae feed and larval attendance by *Tapinoma* sp. ants). *Chamaecytisus ruthenicus* (Fabaceae) is shown here to be a larval hostplant of *P. eroides* in young pine woods to the east of the Puszcza Knyszyńska Forest in north-eastern Poland. The life cycle was observed in the laboratory from a fertilised female captured at the locality of Narejki (UTM: FD98) and five adults reared. In the summer L1, L2 and L3 larvae fed on leaves, leaving round almost transparent traces on the cuticles. Third instar larvae hibernated. In the spring larvae fed on buds, developing leaves, flower buds, and then flowers. *C. ruthenicus* was also confirmed to be a larval hostplant in nature – eggs, early instar larvae and traces of feeding on leaves were found at the locality of Grzybowce (UTM: FD88). Interactions of larvae with ants were not recorded, but *Formica cinerea*, *Myrmica ruginodis* and *Tetramorium caespitum* were identified on flowering plants.

Key words. Lycaenidae, *Polyommatus eroides*, larval hostplant, *Chamaecytisus ruthenicus*, life history, Poland.

Introduction

The False Eros Blue (*Polyommatus eroides* Frivaldszky, 1835) (Lycaenidae) is a species of little known life history. Additionally, it is critically endangered in Europe, where the distribution has decreased by 50–80% between 1970–1995, and its populations are often small, fragmented and isolated (van Swaay & Warren 1999). In Poland it has been classified as endangered (Buszko & Nowacki 2002) and has been protected since 2001. It is distributed mainly in south-eastern Europe (Bulgaria, Greece, Albania, Republic of Macedonia, Yugoslavia), but also in Poland, Slovakia, Ukraine, Belarus, Russia, and Turkey, while in the east it reaches west Siberia (van Swaay & Warren 1999). It was observed at one locality in the Czech Republic – in the years 1950–1957 where later on it became extinct (Beneš et al. 2002). According to the region of occurrence, it inhabits dry calcareous and siliceous grasslands and steppes, alpine and subalpine grasslands, rocky or sandy places, edges of forests, young pine woodlands, wet forest meadows and small open places in forests with fresh soil between 1000 and 2000 m (van Swaay & Warren 1999; van Swaay pers. comm.). In most countries, there is no larval hostplant recorded. Van Swaay & Warren (1999) mentioned *Oxytropis* sp. and *Astragalus* sp. (Fabaceae) as *P. eroides* larval foodplants. This information was recorded from dry calcareous grasslands and steppes and dry siliceous grassland in Slovakia (van Swaay pers. comm.). Tolman (1997) mentioned another hostplant – *Genista depressa*. Moreover, he stated that eggs are laid on leaves, small larvae feed on leaves, hibernating larvae feed on flowers, and caterpillars are attended by *Tapinoma* sp. ants (Formicidae).

Figs. 1–8. Stages of development of *P. eroides*. **1.** The eggs (photo by J. Chobotow). **2.** 2nd instar larva feeding on leaves in August. **3.** 3rd instar larva feeding on buds in April. **4.** 4th instar larva feeding on flowers in May. **5.** The final instar larva on flowers in May. **6.** Four-days old pupa. **7.** Pupa before a male emergence. **8.** The male.

Figs. 9–10. The habitats of *P. eroides*. **9.** The locality of Narejki. **10.** The locality of Grzybowce.

Polyommatus eroides eroides (Frivaldszky, 1835) is the subspecies that occurs in Poland (Carbonell 1994). According to older data, it was very rare at several localities in the northern, central, and southern parts of the country (Romaniszyn 1929). In the Puszcza Białowieska Forest it was common in its eastern part (nowadays in Belarus) and rarer towards the west (Krzywicki 1967). Glades and edges of dry pine and coniferous forests were identified as a typical habitat for *P. eroides* (Krzywicki 1967). According to more recent data, *P. eroides* is found in Podlasie in north-eastern Poland (Buszko 2000; Buszko 1997; Klimczuk & Twerd 2000). It was also recorded in the southern part of the Puszcza Białowieska Forest and in areas to the south-east of it, towards the river Bug (Buszko 1997). Larval hostplants were not known. In 1998 *P. eroides* was found

Figs. 11–12. The larval hostplant of *P. eroides*. **11.** *Chamaecytisus ruthenicus* at the locality of Grzybowce in August. **12.** *Chamaecytisus ruthenicus* at the locality of Grzybowce in May.

north of the Puszcza Białowieska Forest, in the eastern part of the Puszcza Knyszyńska Forest (Klimczuk & Twerd 2000). Further observations carried out in this area resulted in obtaining more information on the life history of that species.

Material and methods

The study was divided into two parts. The first was initiated during routine observations of butterflies near the village of Narejki (UTM: FD98), to the east of the Puszcza Knyszyńska Forest. In the clearing of a dry pine forest I observed a flying male and a female of *P. eroides* (17.vii.1999) (Fig. 9). The female, when captured and placed in a small dark box, laid 10 eggs on the leaves of *Chamaecytisus ruthenicus*. This plant was selected based on an analysis of the floristic composition of the clearing and on a short observation of the female before it was captured. The caterpillars were reared on cut stems of the plant. The container with the larvae was exposed to natural temperatures (in winter the temperature decreased below 0 °C). The larvae survived the hibernation period on fallen leaves of the plant, kept in a container with humid soil. From the upper side and the soil side the hibernated larvae were covered with lignin for protection. Due to the small quantity of available material the rearing was focused on obtaining adults. The second part of the project involved field observations with the purpose of confirming the conclusions drawn from the laboratory results. The observations were carried out near the village of Grzybowce (UTM: FD88) in a long and narrow clearing in a dry, young pine forest (Fig. 10). *P. eroides* was first reported there in 1998 (Klimczuk & Twerd 2000); two males were found there as well on 03.vii.1999 (author's observation). The dwarf shrubs of *C. ruthenicus* (Figs. 11, 12) growing along a 2 km stretch were examined. Ova and larvae were collected in the field and reared in the same way as during the first stage of the research. Ants (5–10 workers of each species) were collected from flowering plants for identification.

Photographs of the localities, larval foodplant, and developmental stages of *P. eroides* were made.

Results

First part of the study. The life cycle of *Polyommatus eroides* was observed in the laboratory from the moment of oviposition by the captured female till the emergence of the imagines. From ten eggs five adults (3♂ and 2♀) were reared. The chronology of the rearing is presented in Table 1. In the summer, younger larvae (L1, L2 and L3) fed on upper and lower sides of leaves, leaving circular and almost transparent traces on the cuticle, but did not gnaw right through the leaves (Fig. 2). The third instar larvae (and one fourth instar larva) hibernated. The additional summer moult observed for one caterpillar was probably caused by an injury to this larva during its transfer to a fresh part of the plant. After an hibernation period lasting over seven months (from the first decade of September to the first half of April), two moults took place. In the early spring (April), after regaining activity, larvae fed on buds (Fig. 3), then on developing

Tab. 1. Rearing data – chronology. These events are presented only for trials resulting in the emergence of the adults.

Developmental stage	**Rearing initiated from a female captured (first part of research)**	**Rearing initiated from an ovum found in the field (second part of research)**
	oviposition: 17.vii.1999	ovum found: 13.viii.2000
ovum stage	17.–24.vii.1999 (7 days)	?–14.viii.2000
larva stage	24.vii.1999–16./19.v.2000 (> 9.5 months)	14.viii.2000–28.v.2001 (9.5 months)
first instar	24.vii.–30./31.vii.1999 (6–7 days)	14.–21.viii.2000 (7 days)
second instar second instar (only one larva) third instar (only one larva)	30.–31.vii.–24./29.viii.1999 (25–29 days) 31.vii.–18.viii.1999 (18 days) 18.viii.–03.ix.1999 (16 days)	21.viii.–03.ix.2000 (13 days)
third instar fourth instar (only one larva)	24./29.viii.1999 – 20./22.iv.2000 (ca. 8 months) 03.ix.1999–21.iv.2000 (ca. 8 months)	03.ix.2000–30.iv.2001 (8 months)
feeding stop	between 05.–10.ix.1999	15. or 16.ix.2000
diapause	7 months	7 months
regaining activity	14.–17.iv.2000	between 15.–18.iv.2001
fourth instar fifth instar (only one larva)	20.–22.iv. – 28./29.iv.2000 (7–8 days) 21.iv.–30.iv.2000 (9 days)	30.iv.2001–07.v.2001 (7 days)
final instar (incl. prepupal phase) final instar (only one larva)	28.–29.iv. – 16./18.v.2000 (18–19 days) 30.iv.–19.v.2000 (19 days)	07.v.–28.v.2001 (21 days)
termination of feeding	9.v.–12.v.2000	19.v.2001
pupa stage 1 – male 2 – male 3 – male 4 – female 5 – female	16.v.–05.vi.2000 (20 days) 17.v.–07.vi.2000 (21 days) 18.v.–07.vi.2000 (20 days) 18.v.–11.vi.2000 (24 days) 19.v.–11.vi.2000 (23 days)	28.v.–22.vi.2001 (25 days)

leaves, flower buds, and finally, from the end of April till mid May, on flowers (Figs. 4, 5). During the flowering period of *C. ruthenicus* larvae were reluctant to feed on leaves, and they only did so when flowers were not supplied to them. The green and green-yellowish larvae with black head and single bright lateral stripes grew to a length of over 15 mm. After they stopped taking food they became slightly glittering, started to wander, and finally, prior to pupation, they tended to hide themselves under plant fragments on the box floor. They linked plant fragments with delicate threads and fixed themselves to them by a girdle. The larval stage lasted over 9.5 months altogether. The pupae, about 12 mm in length, were yellow-greenish and amber (Fig. 6). No pupa shed the larval cuticle from the last segments of the abdomen. The pupal stage lasted 3–3.5 weeks (Figs. 6, 7). Imagines emerged in the first half of June. Males were the first to emerge (Fig. 8). Attempts at inbreeding failed. Eggs (Fig. 1) laid by one female were not fertilised.

Second part of the study. Based on the observations gathered in the laboratory, immatures were searched for in the locality of Grzybowce (UTM: FD88). The following specimens and traces of *P. eroides* in the field were found:

- 10.vii.2000 – two eggs were found on leaves of *C. ruthenicus*.
- 13.viii.2000 – fragments of egg covers, one larva of several days old, and one egg on the upper side of a leaf of *C. ruthenicus* were found; circular feeding spots were found on leaves (similar to those observed in the lab rearings but fewer per leaf than documented on Fig. 2).
- 20.vii.2001 – two eggs were found on leaves of *C. ruthenicus*; a male was observed exactly at the same place as on 03.vii.1999; it was flying and nectaring on flowers of *Thymus serpyllum*.

From the egg found on 13.viii.2000 a male of *P. eroides* was reared (the chronology of the rearing events is presented on Tab. 1). Thus, the eggs found in the field were confirmed to have been correctly identified. The following facts were also noted. During the first and second moults (before hibernation), the larvae positioned themselves on the main vein, on the upper side of leaves. During the fourth moult (in May), one surviving larva was sitting on the lower side of a flower bud with the head pointed towards the stem. One egg found on 10.vii.2000 was parasitised but the parasitoid was not identified.

Thus, the above research identified *Chamaecytisus ruthenicus* (Fisch. ex Woł.) Klásk. (Fabaceae) as a larval hostplant of *Polyommatus eroides* in north-eastern Poland.

The locality of Narejki (UTM: FD98), where the female was captured to initiate the rearing, is a new locality for *P. eroides*. Both sexes of that species were flying in a dry pine forest clearing. In the vicinity, there are several 12-year-old pine trees, separated by barren and grassy spots. In that slightly hilly area *C. ruthenicus* grows at the edges and inside the forests, but also in the clearings. At the time of occurrence of *P. eroides* three individuals of *Colias myrmidone* (2♂ and 1♀) were also observed. The locality is situated at about 2 km from the Belarus border.

Three species of ants visiting *C. ruthenicus* flowering stems in May (collected on 27.v.2004 at the locality of Grzybowce) were identified. These are: *Formica* (*Serviformica*) *cinerea* Mayr, 1853 (Formicidae), *Myrmica ruginodis* Nylander, 1846 (Formicidae) and *Tetramorium caespitum* Linnaeus, 1758 (Formicidae).

Discussion

Despite specific searches in the field, no larvae feeding on flowers in the spring were found and no interactions of larvae with ants were recorded, although facultative myrmecophily is possible. The three species of ants mentioned above are reported to tend lycaenid larvae and facultative myrmecophily within the genus *Polyommatus* is well known (Fiedler & Bálint 1992; Fiedler 1995). Tolman (1997) mentioned that *Tapinoma* sp. ants attend *P. eroides* caterpillars.

Chamaecytisus ruthenicus is a larval hostplant for *P. eroides* populations living in dry, young pine forests. Although the observation concerns only Poland, it is highly probable that *C. ruthenicus* is also a larval foodplant in neighbouring Belarus where *P. eroides* occurs in a similar habitat –young pine plantations (van Swaay and Warren

1999). The flowering period of *C. ruthenicus* lasts from April through June. That plant reaches the north-west limit of its range in Poland. It is also distributed in Belarus, Ukraine, reaching Crimea, the Caucasus, and west Siberia (Kostrakiewicz 1959). As mentioned in the Introduction, *Oxytropis* sp., *Astragalus* sp. (van Swaay and Warren 1999), and *Genista depressa* (Tolman 1997) were reported as larval foodplants for *P. eroides*. *Genista depressa* does not occur in Poland; it occurs in Ukraine and Bulgaria (Kostrakiewicz 1959). The way larvae feed on that plant, as described by Tolman (1997), is similar to that which I observed on *C. ruthenicus*. Although *Oxytropis pilosa* and *Astragalus* sp. (several species) do exist in the Puszcza Knyszyńska Forest (Sokołowski 1995), I have not observed *P. eroides* on these species in this region so far. It is possible that for the population of *P. eroides* inhabiting regions to the south-west of the Puszcza Białowieska Forest (Buszko 1997) there may be another larval foodplant closely related to *C. ruthenicus*, such as *Chamaecytisus ratisbonensis* (Schaeff.) Rothm. (Fabaceae), for which the flowering time is also from April through June, and which similarly reaches in Poland the north-west limit of its range. Nevertheless, *C. ruthenicus* reaches the Puszcza Knyszyńska Forest and its eastern vicinity (Sokołowski 1995; Zając & Zając 2001) while *C. ratisbonensis* only the Puszcza Białowieska Forest (Zając & Zając 2001). Interestingly, I observed individuals of *P. eroides* at sites where *Colias myrmidone* also was present.

I hope that my work will result in efforts being undertaken to preserve this beautiful endangered lycaenid. There is obvious evidence that further research is needed but the very low density of this *P. eroides* population will make it a serious difficulty. I have seen several males and only one female in the field so far.

Acknowledgements

I am grateful to Dr. Chris van Swaay for information on the hostplants and habitats of *P. eroides*. I thank Dr. Jacek Chobotow for taking the photograph of the eggs and Dr. Anna Stankiewicz for identifying the ants.

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This new volume of the „Microlepidoptera Palaearctica“ series is dedicated to *Stenoptilia* Hübner, 1825, which is the largest pterophorid genus in the Palaearctic region with 84 species. The larvae of the species included in *Stenoptilia* feed on certain Asterids and Saxifragaceae.

„Pterophoridae III“ starts with a short preface by the editor and a short introduction by the author. These are followed by a list of the species sorted by larval host-plant, and a systematic checklist of *Stenoptilia* species sorted by species groups, with the page and figure numbers where the taxa are treated in the book.

The systematic part starts with a key to the pterophorid tribes and a description of the genus *Stenoptilia*, including nomenclatural information, full synonymy and a key to its species. Within *Stenoptilia*, the author distinguishes five species groups characterised by their larval association to certain plant families, because morphological evidence is missing to support species groups in *Stenoptilia* otherwise.

For each species, the full synonymy with the reference to each original description and the type locality of each species-group taxon are given. A comprehensive list of the references in which each species was treated is provided. The descriptions of the species comprise the external characters of the adults, and their male and female genitalia; the number of specimens investigated is also stated. The life history is described with data on the host-plants of the larvae, where to find the eggs, larvae and pupae, and the phenology and habitat. A brief description of the preimaginal stages is included here as well. The distribution is provided in details by country and provinces and summarised in a table at the end of the systematic part, therefore providing a quick overview of the countries in which each species occurs. The book concludes with a list of the references used, plates with black & white drawings of male and female genitalia, as well as the usual and beautiful colour paintings of the moths by František Gregor, which have made the „Microlepidoptera Palaearctica“ series so famous. An index to scientific names of Pterophoridae at the end of the book enables the user to find the text and figures of every taxon quickly, which makes the book easy to use.

„Pterophoridae III“ is a contribution that gives an overview of all species of *Stenoptilia* from the Palaearctic region. The user will be enabled to identify the species sufficiently, though the genitalia drawings are of simple standard. It was not clear to me why one species, *S. mengeli* Fernald, 1898, was included because it is confined in distribution to the Nearctic region, where more species of this genus occur. Nevertheless, the book can be recommended to all who are interested in the systematics and life history of Pterophoridae and in the fauna of the Palaearctic region. Let‘s hope that the treatment of the Pterophoridae will be completed one day within the „Microlepidoptera Palaearctica“ book series.

MATTHIAS NUSS

Taxonomy of *Rhodostrophia jacularia* (Hübner, 1813) – a Sterrhinae moth with variable female wing shape (Lepidoptera: Geometridae)

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Abstract. The phenomenon of gradual transformation of the wing shape and size in the Palaearctic sterrhine moth *Rhodostrophia jacularia* (Hübner, 1813) is described (Geometridae). The females of this species have shorter wings than the males throughout the species' distribution area, but they are capable of flying, apart from a mountain population in the Russian Altai near the Chinese and Mongolian border. These earthbound females run and jump on the ground and their facies is characterized by concave wing margins and smaller wing surfaces, unlike other specimens studied. The taxonomy of *R. jacularia* is revised, and a neotype is designated for *R. jacularia* because the original syntype(s) has been lost. *R. jacularia* ssp. *minor* Alphéraky, 1892 **syn. n.** and *R. tyugui* Vasilenko, 1998 **syn. n.** are downgraded to the synonymy of *R. jacularia*. *R. jacularia* is redescribed, the adults and genitalia are illustrated and a distribution map of the species is given.

Key words. Lepidoptera, Sterrhinae, *Rhodostrophia*, narrow-winged, female, new synonyms, taxonomy.

Introduction

Modification of the wing shape has taken a variety of forms. Within Geometridae a well-documented and widespread example of this is brachyptery, or reduction of wing length. This feature is restricted to the females only and it is considered a derived state that has evolved independently many times, and it has been reported to occur at least in the subfamilies Alsophilinae, Larentiinae and Ennominae (Pellmyr 1980; Hausmann 2001; Sattler 1991). Brachyptery is most widespread among species that live as adults under cold conditions, i.e. they appear in early spring or late autumn.

So far, there has been no record of brachyptery in Sterrhinae, although other wing modifications, namely sexual dimorphism, is widespread in the subfamily, and in many instances the females have shorter wings compared to males. To mention a few examples, this is well seen in the European Sterrhini species *Limeria macraria* Staudinger, 1892 and *Idaea attenuaria* (Rambur, 1833) (Hausmann 2004). The reduction of wing length is pronounced in *Scopula (Stigma) kuldschaensis* (Alphéraky, 1883) (Scopulini) also, whose female is not only smaller than the male but it is also very reluctant to fly at all (Prout 1912–16; Sihvonen 2005). Other wing shape modifications of Sterrhinae have not been reported. In the summer of 2000 a Finnish lepidopterological expedition was made to the Altai Mountains, Russia, where a large number of *Rhodostrophia jacularia* (Hübner, 1813) specimens were collected from a high altitude locality. The females of this population differed from other known populations by having narrow wings with concave margins, and the specimens did not fly at all. Instead, if disturbed, the specimens ran and jumped on the ground like spiders.

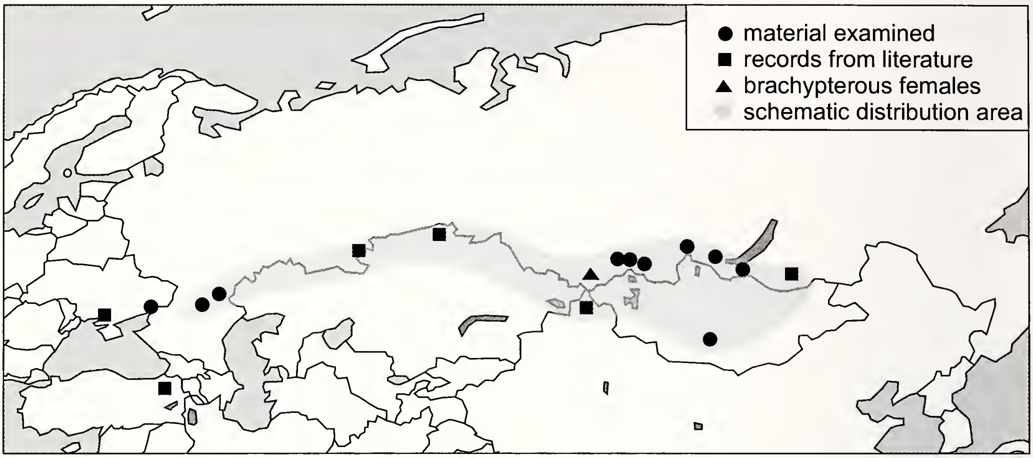


Fig. 1. Distribution area of *Rhodostrophia jacularia*. Literature records (black square): Vojnits 1976; Kostjuk et al. 1994; Riemis 1994; Viidalepp 1996; Hausmann 2004.

Fig. 2. Habitat of *Rhodostrophia jacularia* in Altai mountains, Russia (Kuraisky range, 2500 m), where narrow-winged females were found. Locality is dominated by *Artemisia* spp. (Asteraceae). Photo: Kari Nupponen, 26.vi.2000.

The description of *Rhodostrophia jacularia* is based on a specimen(s) whose type locality is given imprecisely as 'Europe'. The type specimen(s) has been lost but they probably originate from the lower Volga Region, Russia, because all the known old records of this species, i.e. those from the 18th century, are from that area. A closely related species to *R. jacularia* has been described from the Altai Mountains, Russia, namely *R. tyugui* Vasilenko, 1998. The description is based on males only, and the species was diagnosed to be separated from *R. jacularia* using structures of the male genitalia only: (roughly translatated from Russian): 'the valva of new species [*tyugui*] resembles that of *jacularia*, but it is considerably larger and has more massive sacculus, and by the structure of costa. In *tyugui* the margin of costa is round (in *jacularia* it is right-angled)'. Hausmann (2004) diagnosed the *jacularia* species-group and considered it to have three species: *jacularia* (Hübner), *tyugui* Vasilenko, 1998 and *solitaria* (Christoph, 1887). The species group is characterised by dark and undulated fasciae of the forewings, male hindtibia that has four spurs, valva of the male genitalia that is flat and phallus that has a single cornutus. Further, the female genitalia has short and stout apophyses anteriores and papillae anales are usually spinose.

Thus far, both sexes of *R. jacularia* are reported to be fully-winged although females tend to be slightly smaller. The wingspan of the males is between 25–28 mm, whereas those of the females is between 23–25 mm (Hausmann 2004). Both sexes are attracted to light and the females are capable of flying although the female ratio at light is very low, between 5–10%.

In this paper we review the taxonomy of *R. jacularia* and show that the above-mentioned diagnostic characters of *R. tyugui* are suspect. We also present material from the Altai Mountains, Russia, where a population of *R. jacularia* was found, whose females have markedly narrower wings, quite different in shape to other known specimens. These females are not capable of flight unlike specimens from other populations.

Material and conventions

Specimens have been studied from the following collections (acronyms after Evenhuis & Samuelson 2005):

coll. Nupponen	Private collection of Kari Nupponen, Espoo, Finland
FMNH	Finnish Museum of Natural History, Helsinki, Finland
SZMN	Siberian Zoological Museum,Institute of Animal Systematics and Ecology, Novosibirsk,Russia
ZIN	Zoological Institute, Russian Academy of Sciences, St Petersburg, Russia

Further, a large population sample from the Altai Mountains, Russia (coll. Nupponen), was studied, where *R. jacularia* occurs sympatrically with *R. tyugui*.

Specimen data are provided as they appear on the labels. Information from each type specimen is enclosed within single quotation marks, a vertical line with a space on each side separates lines of the label, a semicolon separates the labels, information enclosed by angled brackets includes comments and square brackets provides further details about the specimen or label.

Rhodostrophia jacularia (Hübner, 1813) Figs. 1–15

Geometra jacularia Hübner, 1813: pl. 84 fig. 431. Type locality: Europe (probably lower Volga region).

Eusarca jacularia var. *minor* Alphéraky, 1892: 71. Type locality: Western China: Ordosse, Tai-tou-ahi, near River Oulane-Morine. **syn. n.** Scoble 1999 (*Rhodostrophia acularia* ssp. *minor*).

Rhodostrophia tyugui Vasilenko, 1998: 1138, figs. 2, 4. Type locality: Russia, Altai, South Chyua Range. **syn. n.**

Figs. 3–5. Type specimens of examined material. **3.** *Rhodostrophia jacularia* (Hübner, 1813). Neotype from Sarepta, Russia (FMNH). **4.** *Rhodostrophia jacularia* var. *minor* (Alphéraky, 1892). Lectotype from western China, Ordosse (ZIN) (photo: Fritz, Erlacher & Hausmann, Zoologische Staatssammlung München). **5.** *Rhodostrophia tyugui*, Vasilenko, 1998. Holotype from Altai mountains, Russia (SZMN) (photo: Vasilenko, Siberian Zoological Museum, Novosibirsk).

Material. *Geometra jacularia* Hübner, 1813. Syntype(s) lost. – *Rhodostrophia jacularia* (Hübner, 1813). Neotype ♂ (Fig. 3) (hereby designated; external appearance of the selected neotype agrees with the specimen that is illustrated in the original description of this species by Hübner). Labelled: 'NEOTYPE | Rhodostrophia ♂ | jacularia (Hübner, 1813) [red rectangle label]; 22.6 [18]94 | S[a]r[e]pta' (FMNH). – *Eusarca jacularia* var. *minor* Alphéraky, 1892. Lectotype ♂ (Fig. 4) (designated by Hausmann 2004). Labelled: 'Lectotypus: ♂ | Rhodostrophia | jacularia minor | Alphéraky | design.: [red rectangle label]; v. minor | Alph | ♂[green rectangle label]; VIII 1884 | Ordos <western China, Ordosse, Tai-tou-hai, near River Oulane-morine> | Potanine [green rectangle label]; 85; Zool. Inst. | Acad. Sci. USSR | Leningrad' (ZIN). – *Rhodostrophia tyugui* Vasilenko, 1998. Holotype ♂ (Fig. 5) Labelled: 'HOLOTYPUS | Rhodostrophia tyugui | sp. nov. | S.V. Vasilenko det. [red rectangle label]; RUSSIA, Altai Republic | South Chuya Range | river Kokuzek headwater, locality Kyp, 2500 m | 30.VI. 1982 (Yu. E. Perunov leg) [in Russian]' (SZMN).

Rhodostrophia jacularia. 485♂ (12 genitalia), 30♀ (7 genitalia). **Russia**. Tuva republic, several locations: 71♂ (1 genitalia) Irbitei [50°44'N 93°08'E, 1000 m]; 1♂ Erzin [50°16'N 94°54'E, 1250 m]; 8♂ Kholoozha [50°45'N 94°29'E, 1250 m]; 10♂, 2♀ (2 genitalia) Ust-Ujuk [52°04'N 94°22'E, 670 m]; 26♂ Kyzyl [51°43'N 94°27'E, 700 m]; 3♂ Tannu-Ola mts. [50°45–50'N 92°29–94°19'E, 1250–2000 m]; 8♂ (1 genitalia), 2♀ (1 genitalia) Sarepta, 15.vi.[18]94, coll. Duske; 2♂ Irkut, coll. Duske; 2♂ Munko Sardyk, Sajan mt.; 1♂ Saratow, coll. Winter; 1♂ Ross., mer., Staudinger (all in FMNH). 2♂, 2♀ Volgograd district, Volgograd 80 km NW, near Ilovla village, sandy steppe, 02.vi.2001; 2♂, 2♀ Volgograd oblast, Frolovo village 20 km SW, sandy steppe, 16.–17.v.2005; 330♂ (6 genitalia), 20♀ (3 genitalia) Altai mountains, Kuraisky hrebet, 50°16'N 87°50–55'E, 1500–2500 m, 25.vi.–4.vii.2000; 9♂ (2 genitalia), 2♀ (1 genitalia) Altai mnts, Kuraiskaja steppe, 50°16–20'N 87°50–55'E, 1500–2800 m, 05.–11.vii.2001; 6♂ (2 genitalia) S-Buryatia, Hamar Daban mnts, Murtoy river, village 6 km NW of Gusinoe ozero, forest steppe, 51°11–13'N 106°10–12'E, 700 m, 19.vi.2002; 2♂ S-Buryatia, lake Gusinoe ozero, steppe, 51°09'N 106°16'E, 550 m, 18.vi.2002 (all leg. et coll. T. & K. Nupponen). 1♂ **Mongolia**, Omnogov, Aimak, Bayandalai, Somon, Zoolon uul, 1700 m, 43°21'N 103°11'E, 27–30.5.1997, Yu. Marusik (FMNH).

Rhodostrophia tyugui. 6♂ (3 genitalia) **Russia**, Altai mountains, Kuraisky hrebet, 50°16'N 87°50–55'E, 1500–2500 m, 28.vi.–3.vii.2000, T. & K. Nupponen leg. (coll. Nupponen).

Redescription. Measurements. Forewing length ♂ 14–18 mm, ♀ 12–14 mm.

Head. Labial palpi with erect, flat scales, light brown. Proboscis long. Front dark brown; interantennal ridge, scape, collar, antennae above light brown. Male antennae bipectinate, female antennae filiform.

Thorax. Thorax and legs beige except fore- and midleg femur and tibia dark brown cephally; male and female hind tibia with 2 + 2 spurs. Forewing colour variable, from light brown to dark brown to red brown; transverse lines wide, brown; transverse anterior line slightly concave, inner margin bordered with white; transverse posterior line wider, undulate, outer margin bordered with white; terminal line weakly developed,

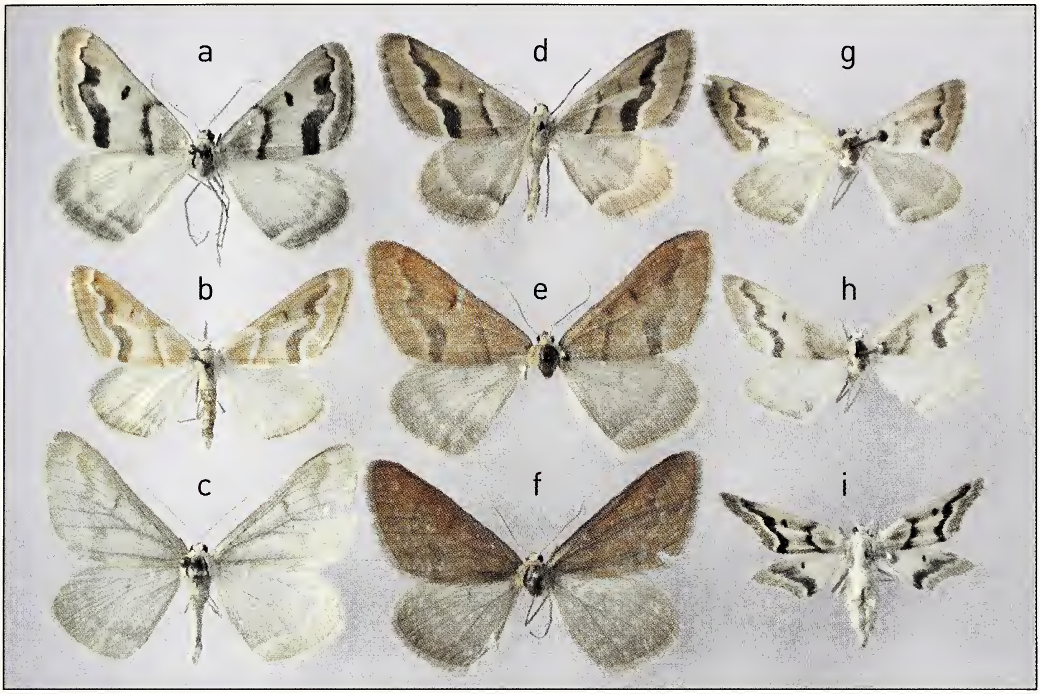
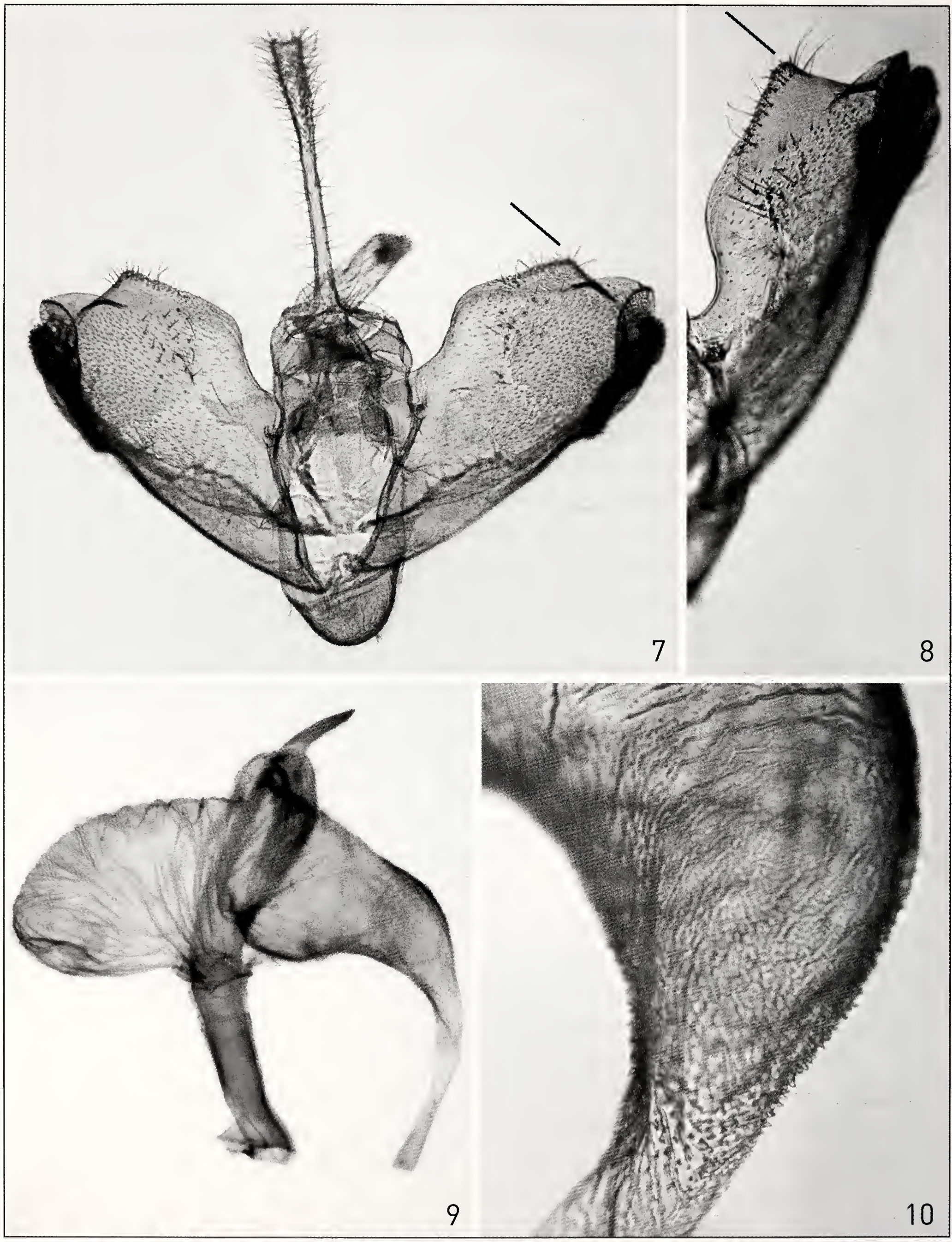


Fig. 6. Variation of external appearance of *Rhodostrophia jacularia*. **a.** ♂, Russia, Altai mountains (coll. Nupponen), **b.** ♂, Russia, Tuva, Tannu-Ola mountains (FMNH), **c.** ♂, Russia, Altai mountains (coll. Nupponen), **d.** ♂, Russia, Irkutsk (FMNH), **e.** ♂, Russia, Altai mountains (coll. Nupponen), **f.** ♂, Russia, Altai mountains (coll. Nupponen), **g.** ♀, Russia, Sarepta (FMNH), **h.** ♀, Russia, Tuva, Ust-Ujuk (FMNH), **i.** ♀, Russia Altai mountains (coll. Nupponen).

dark brown, complete; fringes concolorous with wings; discal spots distinct, round, brown. Hindwings paler; only transverse posterior line visible, outer margin bordered with white; wing margins of narrow-winged, brachypterous females concave. Wings below without markings.

Abdomen. Abdomen coloured as thorax and wings, light brown. Tympanal organs large, also in female; ansa narrow at base, widens above it, tip hammer-headed; medial pouch between cavi tympani absent. Sternites 3–7 and tergites 1–7 of male weakly sclerotized, undifferentiated; anterior margin of male 8th sternite with round, weakly sclerotized area, posterior margin with two round lobes, medially invaginated; male 8th tergite with narrow medial ridge (Fig. 11). Female sclerites undifferentiated.

Male genitalia (Figs. 7–10). Uncus long, narrow, slightly bifid at tip, setose apically. Tegumen weakly sclerotised. Gnathos fused, bare. Valva broad, concave, dorsal margin markedly bent, angle at costa margin appears different if viewed from different angles (Figs. 7, 8); ventro-terminal margin strongly spinose. Juxta plate-shaped. Transtilla fused, sclerotised, straight, wide plate. Vinculum small, margin evenly round. Phallus (Fig. 9) round, bent ventrally, apex with strong, cornutus-like projection; caecum small, round ending. Vesica (Fig. 9) without cornutus, large, opens ventrally, with three large diverticula, one dorsal and two lateral; dorsal and left lateral



Figs. 7–10. Male genitalia of *Rhodostrophia jacularia*. **7.** PS1015, valvae spread open but not pressed flat as in Fig. 15. **8.** PS1015, right valva, valva not spread open. **9.** PS1015, phallus in lateral view. **10.** PS1015, base of ductus ejaculatorius.
Shape of sacculus margin was used as a diagnostic feature by Vasilenko (1998) to separate *R. jacularia* and *R. tyugui*. Appearance of the costa margin depends on the angle from which the valva is examined (indicated in Figs. 7, 8).

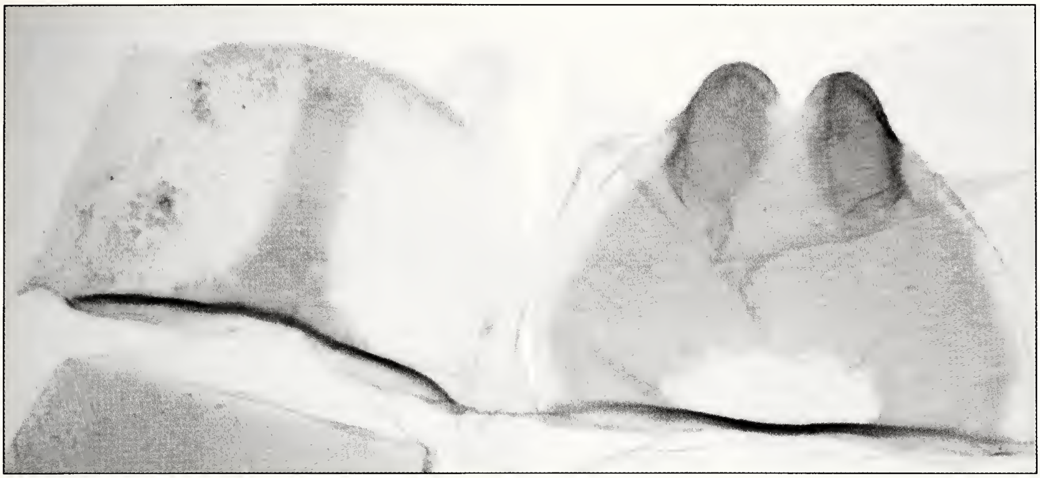


Fig. 11. *Rhodostrophia jacularia* ♂, PS965, 8th abdominal segment.

diverticula (when viewed dorsally) round, invaginated; right lateral diverticulum straight, tube-form, turns ventrally at distal end; ductus ejaculatorius opens from distal end of right lateral diverticulum, heavily serrated at base (Fig. 10).

Female genitalia (Fig. 12). Papillae anales rounded, fused, surface smooth; several laterally pointed spines caudally. Apophyses posteriores stout, straight, long; apophyses anteriores about 1/3 length of apophyses posteriores. Lamella postvaginalis absent; lamella antevaginalis a small, round plate; large membraneous invaginations laterally on 7th sternite. Ostium bursae in distal margin of 7th sternite, ventral margin sclerotised, round; ductus bursae sclerotised, round; ductus seminalis wide at base, opens from junction of ductus bursae and corpus bursae; corpus bursae round, elongated, two membraneous invaginated sacs dorsolaterally; signum horseshoe-shaped (Figs. 13–14).

Variation (Fig. 6). Sexually dimorphic species; females smaller, wings narrower and outer margin convex or concave. The thickness and colour of the transverse lines and the shape of the discal spots varies on the wings. The ground colour varies continuously from light brown (e.g. Sarepta) to dark brown (e.g. Altai, Irkutsk) to red-brown (Altai). The discal spot shape varies from lunular (e.g. Sarepta) to ovoid (Altai, Mongolia). Males from Altai are the largest and the forewing shape is rounded. A number of specimens from South Buryatia and Sarepta have a distinct white wedge-shaped area in forewing. The amount of intrapopulation variation in the external appearance of males in the Altai Mountains (Kuraisky range) (n=336) is large (Figs. 6a, c, e, f). Light brown is the dominant ground colour (n=325), transitional light brown-red brown (n=5) and red-brown (n=6) are considerably fewer. Females from Sarepta have a triangular wing shape and the wing margin is convex (Fig. 6g) whereas females from Altai have narrow, elongated wings and the wing margin is concave (Fig. 6i). There is little variation in the male and female genitalia.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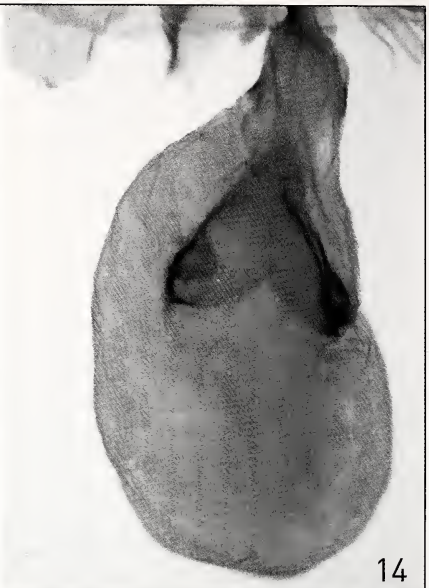
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Figs. 12–14. Female genitalia of *Rhodostrophia jacularia*. **12.** PS848, ventral view. **13.** PS848, corpus bursae in dorsolateral view showing membraneous invaginated sacs (transmitted light image). **14.** PS1016, corpus bursae in dorsal view showing horseshoe-shaped signum (stereo microscope image).

Fig. 15. Male genitalia of *Rhodostrophia tyugui*, a junior synonym of *R. jacularia*. Valvae are spread open fully, i.e. pressed flat, unlike in Fig. 7. Juxta is attached to phallus (upper right hand corner) (photo and slide: S. Vasilenko).

Discussion

Thus far, the morphologically distinct females that have narrow wings and concave wing margins are known from a single population of *R. jacularia* only. The associated, reduced ability to fly need not be confined to the Altai mountains only, but it may be a more widespread phenomonon within this species. Even in the areas where females are fully-winged, the female ratio at light is usually low, about 10%, and it may be an indication of this. There are several examples known within Geometridae where females are fully winged but are reluctant to fly, e.g. *Lycia hirtaria* (Clerck, 1759) (Ennominae, Bistonini) and *Lipomelia subusta* Warren, 1893 (Sterrhinae, Scopulini).

We have shown that variation in the external appearance of *R. jacularia* is a continuous character, ranging from light brown to red-brown (Fig. 6). Therefore we conclude that ground colour can not be used as a diagnostic feature to separate *R. tyugui* from *R. jacularia*. Further, the diagnostic difference of the costa margin of the male valva, i.e. the degree of the angle, as presented by Vasilenko (1998), depends on the angle from which the valva is examined. We consider this quantitative character artificial and uninformative at separating taxa at the species level (Figs. 7, 8). Similarly, the general appearance of the valva, including its shape and width, depends upon how the genitalia preparation has been made. If the valvae are partly spread open (judging from the angle that the ventral margins of the valvae create), as in Fig. 7, then they appear to be much narrower than if they are fully spread open (Fig. 15). Finally, as was expected, a continuous positive correlation was noted between specimen size and its genitalia. We infer this to explain the observed difference in size between types of *R. jacularia* and *R. tyugui*.

Because we have not found any other diagnostic differences in the genitalia structures between *R. jacularia*, *R. jacularia* ssp. *minor* and *R. tyugui*, we treat all these taxa as conspecific. The subspecies status of *minor* has been disputed already by Hausmann (2004), it is conformed and formally proposed here. It is also worth noting, contrary to Hausmann (2004) that vesica of *R. jacularia* is without cornutus. Apparently, he has mistakenly considered the sharp, elongated projection in the apical part of the phallus as the cornutus. Furthermore, the genitalia structures of the narrow-winged females from the Altai mountains match well with the genitalia of *R. jacularia* from other regions and we therefore consider them to be conspecific with the latter. The conclusion that the specimens from Altai are conspecific with *R. jacularia* is further strengthened by the observation that the males in that region are fully-winged, agreeing with other material examined.

In a few instances there is a correlation between the female wing reduction and the tympanal organs. For example in *Phigalia* Duponchel and *Erannis* Hübner (Ennominae, Bistonini), vestigially winged females have reduced tympanal organs or the structures are absent altogether whereas in males these structures are fully developed (Cook & Scoble 1992). We did not find this in *R. jacularia*, both males and females have fully developed tympanal organs. The variation of the female wing shape in *R. jacularia* is exceptional within Geometridae. We suspect that the exceptional feature of the Altai specimens has developed as an adaptation to local, harsh environmental conditions.

Acknowledgements

Axel Hausmann (Zoologische Staatssammlung, München) and Sergei Vasilenko (Siberian Zoological Museum, Novosibirsk) are thanked for providing photos and data. Our thanks are also due to Vladimir Olschwang (Ekaterinburg, Russia), Alexander Malozemov (Ekaterinburg, Russia) for organizing the Altai expedition, Pekka Vilkamaa (FMNH, Finland) for translation, as well as to Timo Nupponen (Espoo, Finland) for valuable help in collecting the material and to Diane Alaruikka for checking our English. The Lepidopterological Society of Finland supported the study through a travel grant.

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Faunistics of the Epermeniidae from the former USSR (Epermeniidae)

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Abstract. 26 species of Epermeniidae are recorded from the territory of the former USSR. Two of them (*Epermenia wockeella* und *E. vartianae*) are recorded for the first time. New distributional data for 11 species and new life history data for 5 species are given. The genitalia of the male of *E. wockeella* and female of *E. vartianae* are described and illustrated for the first time.

Zusammenfassung. Es werden 26 Epermeniidae-Arten für das Gebiet der ehemaligen UdSSR nachgewiesen, zwei von ihnen (*Epermenia wockeella* und *E. vartianae*) sind Erstnachweise. Für 11 Arten werden Neufunde und für 5 Arten neue Angaben zur Lebensweise gemacht. Die Genitalien der Männchen von *E. wockeella* und der Weibchen von *E. vartianae* werden erstmals beschrieben und abgebildet.

Key words. Lepidoptera, Epermeniidae, former USSR, *Epermenia wockeella*, *E. vartianae*.

Introduction

The family Epermeniidae is the only representative of the superfamily Epermenioidea (*sensu* Kristensen 1999). The phylogenetic relationships with the other superfamilies of the Apoditrysia are still unknown. Some characteristics of the recognized recent genera are known but the complete phylogenetic relationships between the genera are still uncertain. Only for some genera are some autapomorphies apparent. The family is divided into the subfamilies Epermeniinae and Ochromolopinae.

The family contains nearly 100 described species in eight genera, and is known from all faunal regions. The life histories indicate that the larvae live in mines (sometimes only in the first instars) of leaves, or that they skeletonize leaves or feed on seeds, mainly of Apiaceae. There are a few host records in other plant families: Araliaceae, Celastraceae, Epacridaceae, Fabaceae, Loranthaceae, Olacaceae, Pittosporaceae, and Santalaceae.

Data on taxonomy, distribution, and biology were compiled by Gaedike (1979, 1996a), including the hitherto known data from the former USSR. Since then several papers with descriptions of new taxa from various zoogeographical regions have been published (Buvat & Nel 2000; Gaedike & Kuroko 2000; Gaedike 2001, 2002, 2004a, 2004b; Budashkin 2003).

Material and methods

The aim of the following paper is to summarize our knowledge about the recent distribution of the family in a major part of the Palaearctic region, the former Soviet Union. The family was studied in this region only fragmentarily in the past. Information on the faunistics can be found in numerous papers by many authors (Eversmann 1844; Erschoff [= Jershov], N. G. & Fil'd 1870; Erschoff [= Jershov], N. G. 1881; Gjunther 1986; Rebel 1901; Krulikovskij 1907; Schille 1930; Lebedjev 1936; Sovyns'kyj

1938; Gerasimov 1948; Kuznetsov 1960; Merzhejevskaja et al. 1976; Tibatina 1976, 1977; Buszko & Skalski 1980; Kuznetsov & Stekol'nikov 1984; Gershenzon 1988; Kutenkova 1989; Budashkin 1990; Martin 1991; Budashkin & Satshkov 1991; Gaedike 1993; Ivinskis 1993; Kostjuk et al. 1994; Budashkin & Kostjuk 1994; Fal'kovitsh 1994; Bidzilja 1995; Satshkov et al. 1996; Savenkov et al. 1996; Budashkin 1996; Gaedike 1996b; Bidzilja & Budashkin 1997; Shutova et al. 1999; Jurivete et al. 2000; Shmytova 2001; Bidzilja et al. 2001; Bidzilja et al. 2002; Budashkin 2003), but none of these was exhaustive. The two recent keys for the studied territory (Fal'kovitsh 1981; Budashkin 1997) cover the fauna of the Western and Eastern parts, but the Central parts, including the regions of Siberia and Middle Asia, were not treated.

The examination of the material of the Zoological Institute of the Russian Academy of Sciences, St. Petersburg (ZIN) and of the Institute of Animal Systematics and Ecology, Siberian Zoological Musem, Novosibirsk (SZMN), the study of the collections of Finnish entomologists (Russian-Finnish Expeditions) in the Finnish Museum of Natural History, Helsinki (FNMH), and more detailed observations in Crimea enable the presentation of several new distributional records, new data on the biology of some species, and descriptions of the hitherto unknown male of one species and female of another. Previously unpublished distributional records from the distribution file of the second author were included.

Each species in the following list is presented as follows: (1) Name of the taxon with synonymy, (2) Material examined, (3) Distribution, (4) Life history, and (5) References for distributional records. Host plant data are taken from the specimen labels or from literature cited at the end of the paper.

Explanations of Russian words and abbreviations

balka	(gorge)
botsad.	botanicheskij sad (botanical garden)
cvetah	(flowers)
d.	derevnja (village)
gora	(mountains)
gornaja	(mountainous)
g.	gorod (city)
gub.	gubernia (gouvernement – administrative district)
hr.	hrebet (mountain range)
i	(and)
koshenije po ljucerne	(swept from lucerne)
kovyl'no-raznotravnyje stepi	(*Stipa*-steppe with species of different plant families)
kraj	(region – administrative district)
kvarc	(light) (na kvarcj: at light)
les	(forest)
m.	mys (cape)
na	(at, on)
list'jah	(leaves of)
svet	(light)
niz uschel'ja	(bottom of the gorge)
obl.	oblast (region – administrative district)

okr.	okres (region – administrative district)
p.	posjokok (settlement)
poljana	(clearing)
pos.	posjokok (settlement)
predg.	predgorje (foothills)
r-n	raion (region – administrative district)
s.	sever (north)
solonchakovaja step’	salt steppe
st.	step’ (steppe)
u podnozh’ja sopki	(foot of the hill)
uschel’je	(gorge)
verhov’ja r.	(upper course)
vyl.	vyletel (emerged)
zapovednik	(nature reserve)

Epermeniidae: Epermeniinae: Phaulernini

Phaulernis Meyrick, 1895: 690

Type species: *Aechmia dentella* Zeller, 1839: 204, by original designation.
= *Aechmia* sensu Stainton, 1854, nec Treitschke, 1833 [Glyphipterigidae], nec Zeller, 1847 [Heliozelidae]

Phaulernis dentella (Zeller, 1839: 204) (*Aechmia*)

Material. 1♂ **Russia**, Samarskaja obl., Zhiguljovskij zapovednik, Bahilova poljana, vi.1993 (Satshkov); 1♂, 1♀ Tul’skaja obl., Svoboda 20 km W Schjokino (Bol’shakov); 1♂ [Siberia] Myski, Kuzneckij Alatau, 9.vii.1956 (Fal’kovitsch). 5♀ **Ukraine**, Crimea, Karadag, 12.vi.1987 (Zagulajev).

Life history. Larvae in seeds of *Chaerophyllum bulbosum* L., *Ch. temulum* L., *Aegopodium podagraria* L., *Angelica silvestris* L. (Apiaceae). Overwintering as pupa.
Distribution. Central and East Europe, Caucasus, Western part of Siberia.
References. Estonia, Latvia, Lithuania, European part of Russia (Fal’kovitsh 1981: 436; Martin 1991: 35; Ivinskis 1993: 65; Savenkov et al. 1996: 25; Gaedike 1996b: 159; Jurivete 2000: 58), Russia: Kaluzhskaja oblast’ (Shmytova 2001: 90), Western Ukraine (Schille 1930: 224), Eastern part of Crimea (Budashkin 1990: 53), Caucasus and Western part of Siberia (Budashkin 1996: 15). The records from the Russian Far East (Gaedike 1993: 92) refer to *E. sergei* Budashkin.

Phaulernis fulviguttella (Zeller, 1839: 193) (*Oecophora*)

= *Oecophora flavimaculella* Stainton, 1849
= *Oecophora auromaculata* Frey, 1867
= *Phaulernis monticola* Moriuti, 1982

Material. 1♀ **Russia**, Murmansk, Pechenga, 8.vii.1910 (D’jakonov); 1♂ Murmanskaja obl., Pechengskij r-n, okr. Zapoljarnogo, 15.viii.1979 (Sinjov); 2♂, 6♀ Poljarnyj Ural, 110 km E Sejdy, na cvetah *Angelica* sp., 15. et 17.vii.2003 (Lvovsky); 1♀ Jaroslavskaja obl., Tutajevskij r-n, okr. d. Gorazdovo, les, 27.vii.1995 (Klepikov); 4 specimens, Petrosawodsk (Günther); Caucasus: 1♂ Kabardino-Balkarija, zapovednik, Bezengi, 5.vii.1997 (Bolov); 1♂ Kabardino-Balkaria, uschel’je Haznidon, 27.vii.1997 (Bolov); 2♀ Dombai, 2240 m, Lake Mussa Atschitara, 1.viii.1976 (Eichler); 2♀ Teberda, 1300 m, 29.vii.–11.viii.1976 (Eichler); 2♂ Kamchatka, 8 km W-S-W Ust’-Bol’sherecka, na list’jah *Ligusticum scoticum*, 10.viii.1992 (Kosterin); 1♂ Kommandeur Islands: Island Mednoj, 12.vii.1927 (Rostovoj). 1♂ **Georgia**, Lagodechi, 23.vii.1961 (Zagulajev).

Life history. Larvae in seeds of *Peucedanum* L., *Angelica* L., *Heracleum* L., *Pimpinella* L., and apparently on *Ligusticum scoticum* L. (Apiaceae). In Lapland the larva lives from July to September, the pupa overwintering (Koponen & Hurme 1986).
Distribution. All Europe, Caucasus, Russian Far East, Japan.
References. Russia: Peninsula Kola (Kozlov & Jalava 1994: 76; Shutova et al. 1999: 22), Northern and North-Western regions of European part (Erschoff & Fil'd 1870: 185), 'Rossia septentrionalis occidentalis' (Rebel 1901: 184), Estonia, Latvia, Lithuania, Karelia, Western Ukraine, Caucasus, Kamchatka Peninsula and Komandorskije Islands (Island Mednyj) (Gjunther 1986: 32; Schille 1930: 230; Fal'kovitsh 1981: 436; Martin 1991: 35; Ivinskis 1993: 65; Gaedike 1993: 93; Savenkov et al. 1996: 25; Gaedike 1996b: 159; Budashkin 1996: 16; 1997: 483; Jurivete 2000: 58).

Phaulernis pulchra Gaedike, 1993: 93–95, figs. 1–4, 12–13

Material. 2♀ **Russia**, Southern Primor'je, 20 km E Ussurijska, Gornotajozhnoje, na svet, 12., 18.vii.1994 (Omel'ko); 1♀ Primorskij kraj, 20 km E Ussurijska, Gornotajozhnoje, na svet, 12.vii.1996 (Sinjov); 1♀ Southern Kuril Islands: Kunashir Island, okr. Sernovodska, 13.viii.1967 (Zabello).

Life history. Foodplants of the larvae still unknown.
Distribution. Hitherto known only from the Russian Far East.
References. Russia: Primorje, Kuril Islands: Kunashir (Gaedike 1993: 93–96; Budashkin 1997: 483).

Phaulernis chasanica Gaedike, 1993: 95–97, figs. 5–11

Material. 2♂, 2♀ **Russia**, Southern Primor'je, Lozovyj hr., 22 km NO Nahodki, na svet, 19.–22.vii.1999 (Sinjov).

Life history. Foodplants of the larvae still unknown.
Distribution. Hitherto known only from the Russian Far East.
References. Russia: Primorje (Gaedike 1993: 94–97; Budashkin 1997: 483).

Epermeniini

Epermenia Hübner, 1825: 418

Type species: *Tinea pontificella* Hübner, 1796, by monotypy

= *Calotripis* Hübner, 1825; *Tichotripis* Hübner, 1825; *Chauliodus* Treitschke, 1833; *Lophonotus* Stephens, 1834; *Chauliomorpha* Blanchard, 1840; *Calotrypis* Herrich-Schäffer, 1854; *Heydenia* Hofmann, 1868, nec Förster, 1856; *Cataplectica* Walsingham, 1894; *Epimenia* Kearfott, 1903; *Acanthedra* Meyrick, 1917; *Epermeniola* Gaedike, 1968

Epermenia (*Calotripis*) Hübner, 1825: 424–425

Type species: *Tinea illigerella* Hübner, 1813, designated by Herrich-Schäffer, 1854: 207–208.

Epermenia (*Calotripis*) *insecurella* (Stainton, 1849: 24) (*Elachista*)

= *Chauliodus illigerellus* Stainton, 1848, nec Hübner, 1813
= *Elachista dentosella* Stainton, 1851
= *Calotrypis dentosella* Herrich-Schäffer, 1854
= *Epermenia plumbeella* Rebel, 1915

Material. 1♂ **Lithuania**, Vilnius, 1.vi.1978 (Ivinskis); 1♂ Lervynos, 6.vi.1979 (Ivinskis); 1♂ **Russia**, Rostov-na-Donu, 10.v.1927, koshenije po ljucerne; 1♂ Gornyj Altaj, p. Ulagan, na svet, 8.vii.1989 (Ustjuzhanin); 1♂ Altaj, Shebalinskij r-n, okr. s. Cherga, 21.vii.1995 (Ustjuzhanin); 3♂ Altaj, Kosh-Agachskij r-n, ploskogor'je Ukok, 2200 m, 11., 18., 22.vii.2001 (Bidzilja); 1♂ Jakutsk, bot. garden, 14.viii.1985 (Dubatolov); 1♂ Env. of Lugansk, 28.vi.1929 (Talitzkij); 1♂ Tuva, 16 km N Kyzyla, 1000 m, step', 14.–16.vi.2001 (Ustjuzhanin); 1♂ Tuva, 30 km NW Samagaltaj, predg. E Tannu-Ola, 1500 m, 24.vi.2001 (Ustjuzhanin); 1♂ Tuva rep., 52°04'N, 94°22'E, 670 m, Ust-Ujuk, 3.–5.vi.1995 (Jalava & Kullberg); 2♀ Tuva rep., 50°50'N, 94°19'E, 2175 m, E Tannu-Ola mts., timberline (*Larix*) steppe, 7.–8.vi.1995 (Jalava & Kullberg); 2♂ Uralsk, 18., 19.v.1907 (Bartel); 2♂ Sarepta (Christoph); 1♂ **Kazakhstan**, Zapadnyj Kazakhstan, Petrov, kovyl'no-raznotravnyje stepi, 2.vi.1949 (Martynova); 1♂ Vostochnyj Kazakhstan, Zajsanskij r-n, 5 km S g. Marbutsu, hr. Saur, 25.v.2000 (Ustjuzhanin); 6♂, 5♀ **Turkmenistan**, Central'nyj Kopetdag, Germab, 780 m, 18.–22.vi.1982 (Fal'kovitsh); 1♂ Aschchabatskaja obl., Kara-Kala, 25.v.1952; 1♀ Aschchabatskaja obl., gora Sjunt, 15.v.1953; 1♀ **Georgia**, Suchumi, UV-light, 7.–10.vi.1974 (Eichler); 1♀ **Armenia**, Erevan, 16.–18.vi.1974 (Eichler).

Life history. Larvae on *Thesium* spp. (Santalaceae), the first stages in mines, later on the surface of the leaves.

Distribution. Middle, South and East Europe, Asia Minor, Near East, Mongolia. New record for Tuva.

References. Estonia [the record from Estonia is probably in error], Central, South and Southeast part of the European part of Russia, Ukraine, Caucasus (Martin 1991: 35, under the name *E. plumbeella* Rebel; Fal'kovitsh 1981: 436; Gaedike 1996b: 159); Lower Povolzh'je (Rebel 1901: 179); Western Ukraine (Schille 1930: 226; Buszko & Skalski 1980: 17), South-East Ukraine (Bidzilja et al. 2001: 81); Turkmenia (Kuznetsov 1960: 30); Kazakhstan, Altai Mts., South-West Siberia, Baikal region, Southern Primorje and Jakutia (Gaedike 1993: 97; Kostjuk et al. 1994: 10; Budashkin & Kostjuk 1994: 17; Budashkin, 1996: 12; Budashkin 1997: 483; Bidzilja et al. 2002: 206).

Epermenia (*Calotripis*) *gaedikei* Budashkin, 2003: 57–58

Life history. Foodplants of the larvae still unknown.

Distribution. Known only from the type locality in Uzbekistan and the environs of Dekhanobad and Derbent (Budashkin 2003: 57).

Epermenia (*Calotripis*) *sinjovi* Gaedike, 1993: 99–102, figs. 14–22

Material. 1♀ **Russia**, Zabajkal'je, Ulan-Ude, u podnozh'ja sopki, 1.vii.1956 (collector unknown); 3♀ S. Primorye, 20 km E Ussurijsk, 12., 25.v., 10.viii.1983 (Kozlov); 1♂ Primor'je, GTS, 6.v.1993 (Lvovskij).

Life history. One larva was collected and reared by S. Ju. Sinjov on *Angelica* sp., (pers. comm.) and it seems to be the foodplant.

Distribution. See below.

References. Described from Southern Primor'je, Southern Kuril Islands (Kunashir) and from the Baikal region (Burjatija) (Gaedike 1993: 99–102); later the species was recorded from the same localities and additionally from Kamchatka and South-East Siberia (Budashkin 1996: 12–13, 1997: 483).

Epermenia (*Calotripis*) *chaerophyllella* (Goeze, 1783: 169, Nr. 292) (*Phalaena Tinea*)

= *Tinea testaceella* Hübner, 1813
= *Lophonotus fasciculellus* Stephens, 1834
= *Chauliodus nigrostriatellus* Heylaerts, 1883
= *Epermenia turatiella* Constantini, 1923

Material. 1♂ **Latvia**, Tapiau, 9.v.1912; 2♀ Libau, 16.v.1924 (Brehm); 1♀ Sortavala, 19.vi.1936 (Brandt). 3♂, 2♀ **Russia**, [Kirovskaja obl.], Urshum, 20.iv.1904, 24.v.1908 [Krulikovskij]; NW Caucasus: Dombai, 3.–5.vi.1974 (Eichler); 1♀ NW Caucasus, hr. Azshi-Tau, p. Kamyshanova poljana, 1350 m, 10.–21.viii.1999 (Schurov); 3♀ [Tatarstan], Sarapul, 1.v.1909 [Krulikovskij]; 1♂, 4♀ Petrosavodsk (Günther); 1♀ env. of Vitebsk, 26.v.1969 (Piskunov); 1♀ [East Siberia], Irkutskaja obl., 20 km S Sljudjanki, pik Cherskogo, 1442 m, 11.vi.1983 (Sinjov); 1♂ Irkutsk. 1♂ **Ukraine**, Zaporozhskaja obl., Vol'njanskij r-n, balka Bal'chanskaja 26.vi.1997 (Zhakov). 1♂, 1♀ **Kazakhstan**, Kuzneckij Alatau, Myski, 21.v.1956 (Fal'kovitsh); 2♂ Kazakhstan, 43°5'N, 77°15'E Zalijskij Ala-Tau, Almaatinskij zap., 1700 m, 23.vi., 12.vii.1990 (Kaila & Mikkola). 3♂, 8♀ **Uzbekistan**, 60 km ESE Tashkent, Chatkal'skij zapovednik, 11.–18.vi., 7., 18., 20.x.1992 (Zolotuchin).

Life history. Larvae recorded from many plants: *Chaerophyllum* L., *Conium* L., *Pimpinella* L., *Sium* L., *Seseli* L., *Silaum* Mill., *Angelica* L., *Heracleum* L., *Pastinaca* L., *Daucus* L., *Anthriscus* (Pers.) Hoffm., *Apium* L., *Carum* L., *Sison* L., *Torilis* Adans., *Oenanthe* L., *Levisticum* L., *Peucedanum* L.; the young larvae are miners, the later instars are skeletonizers, they live between leaves that are spun together. Two generations, the imago overwintering.

Distribution. All Europe, Asia Minor and Near East (Syria), Middle Asia and Siberia. New records for East Siberia and from Uzbekistan.

References. Estonia, Latvia, Lithuania (Martin 1991: 35; Ivinskis 1993: 65; Savenkov et al. 1996: 25; Gaedike 1996b: 159; Jurivete et al. 2000: 58), Belarus (Merzhejevskaja et al. 1976: 19), Ukraine (Schille 1930: 226; Gershenzon 1988: 285), the Mountains of Middle Asia, Siberia (Fal'kovitsh 1981: 434, 1994: 273), European part of Russia (Erschoff & Fil'd 1870: 187; Shutova et al. 1999: 22; Erschoff 1881: 220; Gjunther 1896: 32; Kozlov & Jalava 1994: 76; Krulikovskij 1907: 233; Kutenkova 1989: 24; Shmytova 2001: 90; Satshkov et al. 1996: 70), Caucasus, Western Siberia, Middle Asia, Kyrgyzstan, and Kazakhstan (Tibatina 1976: 353, 1977: 158–159; Gaedike 1993: 99; Budashkin 1996: 12; Dovnar-Zapolski 1969: 126).

Epermenia (*Calotripis*) *aequidentella* (Hofmann, 1867: 206–207) (*Chauliodus*)

= *Chauliodus daucellus* Peyerimhoff, 1870

Material. 1♂ **Russia**, Krasnodarskij kraj, okr. Abrau-Djurso, on *Daucus sativus*, e.l. 12.x.1997 (Schjurov); 1♂ Caucasus NW, Fl. Et. Loc. [?] Teberda, 4200 m, 4.viii.1912 (Tschetwerikow). 1♂ **Azerbaidjan**, village Kosporljak, 6.vii.1962 (Zagulajev); 1♂ Talysch, Kyz-Urdy, 8.viii.1932 (Rjabov). 4♂ **Turkmenistan**, Central'nyj Kopetdag, Germab, 780 m, 18. et 22.vi.1982 (Fal'kovitch).

Life history. Larvae on *Libanotis montana* Crantz., *Daucus carota* L., *Meum athamanticum* Jacq., *Anthriscus vulgaris* Pers., *Thapsia villosa* [L.], *Angelica* L., *Peucedanum* L. (Apiaceae).

Distribution. Central and South Europe, Madeira, Canary Islands, Near and Middle East, Mongolia. New record for Caucasus.

References. Without examination of the specimens the records from the older literature (before 1965) are doubtful, because the following species (*E. strictella*) was then regarded as a synonym of *E. aequidentella*. The records from Estonia and Latvia are probably an error (Martin 1991: 35; Budashkin 1996: 12; Gaedike 1996b: 159; Jurivete et al. 2000: 58). Southern part of European Russia (Fal'kovitsh 1994: 273: no material available for examination); Altaj (Gaedike 1993: 97); Altaj and Azerbaidzhan (Budashkin 1996: 12); the record from Western Ukraine (Schille 1930: 226) belongs to *E. strictella*.

Epermenia (*Calotripis*) *strictella* (Wocke, 1867: 209) (*Chauliodus*)

= *Epermenia infracta* Braun, 1926
= *Epermenia sublimicola* Meyrick, 1930
= *Epermenia anthracoptila* Meyrick, 1931
= *Epermenia srictelloides* Gaedike, 1977

Material. 1♂ **Latvia**, Libau, 26.v.1924 (Brehm). 1♂ **Ukraine**, Crimea, Staryj Krym, 2.viii.1913 (Chetverikov). 1♂, 2♀ Crimea, Karadag, na svet, 6.v.1985, 14.ix.1987, 16.x.2002 (Budashkin). 8♂ 5♀ Crimea, Karadag, plato, e.l. *Seseli arenarium* M. B., 26.–31.x.2002 (Budashkin), 1♂ Wolczkow, p. Zaleszcyki, 1.ix.1935 (Toll). 1♂ **Russia**, Kaukasus (Christoph); 1♀ Altaj, Aktash, 2.vii.1998 (L'vovskij). 1♀ S Tuva, 15 km NW pos. Dusdag, 1950 m, na svet, 26.vi.2001 (Ustjuzhanin); 1♀ Tuva, 20 km E Mugur-Aksy, hr. Cagan-Shibetu, 2200 m, 30.vi.2001 (Ustjuzhanin). 4♀ Tuva, 20 km W Mugur-Aksy, 2150 m, lug. step', 1.–3.vii.2001 (Ustjuzhanin); 2♂ Russia, Tuva rep., 52°47'N, 93°18'E, 1230 m, W-Sajan Mts., subalpine meadow/taiga, 20.–22.vi.1995 (Jalava & Kullberg); 1♂, 5♀ Burjatia, 54°47' N, 110°55'E, Bargazin range 920 m, Olso river valley, taiga, 4.–6.vii.1996 (Jalava & Kullberg); 1♀ Burjatia, 54°21'N, 110°12'E, Bargazin valley, Upper Kurumkan river, 700 m, 1.vii.1996 (Jalava & Kullberg); 2♀ Burjatia, 55°01'N, 111°08'E, Bargazin valley, Umhoj, 600 m, hot springs, 9.vii.1996 (Jalava & Kullberg). **Georgia**: 1♂, 5♀ Borshomi; 1♀ Russia, Altaj, 40 km E pos.[village] Kosh-Agach, 1.–5.vii.1997 (L'vovskij). 1♀ **Kazakhstan**, okr. Alma-Ata, Namok. uschel'je, v plodah zontichnogo (vyvodka Nr. 613), vii.1938 (Gerasimov). 1♀ **Kyrgyzstan**, Cholpon-Ata, za avtovokzalom na lugu, 6.viii.1987 (L'vovskij & Nikiforova). 1♂ 3♀ Kirgizija, 25 km S Kara-Balta, Sosnovka, 1100 m, 14.viii.1987 (L'vovskij & Nikiforova). 1♀ Kungej-Alatau, 2000 m, 29.vi.2000 (Kljuchko).

Life history. Larvae on *Pimpinella saxifraga* L., *Ferula communis* L., *Laserpitium* sp., on flowers and unripe fruits of *Seseli arenarium* M. B. (Apiaceae). Overwintering as imago (Crimea).

Distribution. Europe from Iberian Peninsula to Poland, Romania, Balkan Peninsula, North Africa, from Turkey to Japan, North America. New records for the faunas of Kyrgyzstan and the Tuva Region.

References. Latvia, South-Western and Southern part of European Russia, Caucasus (Gaedike 1996b: 159; Fal'kovitsh 1981: 434; Savenkov et al. 1996: 25; Jurivete et al. 2000: 58; Shmytova 2001: 90), Western Ukraine (Schille 1930: 226, under the name *E. aequidentella*), East Crimea (Budashkin 1990: 53), Kazahstan, Altaj Mts., South-western and East Siberia, Far East of Russia, Southern Kuril Islands (Kunaschir Island), Magadan region (Gaedike 1993: 98–99; Budashkin 1996: 12; Bidzilja & Budashkin 1997: 81; Budashkin 1997: 483; Bidzilya et al. 2002: 206), Kamchatka Peninsula (Gaedike 1993: 99; Budashkin 1997: 483). Records by Budashkin (1996) were misidentifications of *E. sinjovi*.

Epermenia (*Calotripis*) *petrusella* (Heylaerts, 1883: xi–xii) (*Chauliodus*)

= *Epermenia kroneella* Rebel, 1903
= *Epermenia notodoxa* Gozmany, 1952

Life history. Larvae on *Peucedanum alsaticum* L. and *Peucedanum montanum* (Apiaceae).

Distribution. Only recorded from some parts of Central and Southern Europe.

References. There are only records in the literature from the Kaluzhskaja oblast (Shmytova 2001: 90) and from Western Ukraine (Buszko & Skalski 1980: 17) [without examination this record is doubtful – it may be a misidentification of *E. falciformis*]

Epermenia (*Calotripis*) *falciformis* (Haworth, 1828: 555) (*Recurvaria*)

Material. 1♂ **Russia**, [Ural], Guberli, 23.vi.1892 (Christoph). 2♂ [East Siberia], Irkutsk, without any additional dates; 1♂ Primorskij kraj, 20 km E Ussurijsk, Gornotajozhnoje, na svet, 8.vii.1980 (Omel'ko).

Life history. Larvae on *Angelica sylvestris* (Apiaceae) (Scholz 1996). Tokar et al. (2002: 1–11) indicated *Aegopodium* as food plant, but this record probably refers to *E. illigerella*. The specimen should be re-examined.
Distribution. The species was reestablished as valid by Scholz (1996), it was previously thought to be a synonym of *E. illigerella*. Since this time recorded only from some parts of Middle and North Europe (Scholz 1996; Gaedike 1996b). New record for Russia.
References. Latvia (Jurivete et al. 2000).

Epermenia (*Calotripis*) *illigerella* (Hübner, 1813: pl. 48 fig. 333) (*Tinea*)

Material. 3♂ **Estonia**, 26.vi.1880 (Moravic). 1♀ **Belarus**, okr. Vitebska, d. Tulovo, 10.vi.1995 (Piskunov). 2♂ **Russia**, [Karelija], Jalguba (Günther); 2♂, 1♀ [Karelija], Petrozawodsk (Günther); 2♂ Karel'skij pereshejek, 4., 6.vii.1956 (Kellomjajn); 1♂ Petropol'; 1♀ Petrograd, Ozerki, 13.vii.1917; 1♂, 1♀ Petrograd, Liesnyi, 20.vii.1922; 2♂ Leningradskaja gub., Pavlovsk, 27.vi.1924 (Gerasimov); 1♂ okr. Starogo Petergofa, vyl. 15.vi.1956, N° 10, larvae on *Aegopodium podagraria* (Kuznetsov); 1♂ Leningradskaja obl., Tolmachovo, 9.vi.1960 (Fal'kovitsh); 1♂ Leningradskaja obl., st. Gor'kovskoje, 28.vi.1983 (Sinjov); 2♀ Arhangel'sk, m. Karela, 15.viii.1968, 21.viii.1969 (Zelenova); 1♀ Novgorodskaja obl., Torbino, 22.vi.1917 (Filip'jev); 2♀ okr. Pskova, 7., 9.vi.1907 (Chistovskij); 1♂, 1♀ Urshum, 11.vii.1902, 16.vii.1908 [Krulikovskij]; 4♂, 1♀ [Caucasus], Nal'chik, Malaja Kizilovka, les, 700 m, 13.vi.1986, 18.vi.1987 (Zagulajev); 1♀ [Caucasus], Nal'chik, botsad, na svet, 15.vi.1986 (Zagulajev); 2♂ [Tatarstan], Sarapul, v.1910 [Krulikovskij]; 1♀ Bashkirskij zapovednik, 50 km SE Uzjana, 24.vii.1937 (Filip'jev); 1♀ Novosibirsk, Ob'GES [hydroelectrical power-station at the river OB], na svet, 1.vii.1994 (Ustjuzhanin); 1♂ Kemerovskaja obl., Vaganovo, 22.vi.1955 (Fal'kovitsh); 3♂ Altaj, Kurajskij hrebet u Aktasha, verhov'ja r. Jarly-Jary, 2600 m, gornaja tundra, 6., 7., 13.vii.1974 (Ju. Kostjuk); 1♀ Siberia, Altay Mts., 42 km S Shebalino, 1230 m, 6.vii.1997 (Ustjuzhanin); 1♀ Siberia, Altay Mts., 14 km N Onguday, 1300 m, 15.vii.1997 (Ustjuzhanin).

Life history. Larvae in leaves of *Aegopodium podagraria* (Apiaceae).
Distribution. All Europe, Western Siberia, Altai region.
References. The records from the literature until 1996 need to be checked, as they may refer to *E. falciformis*. Recorded from Estonia, Latvia, Lithuania, and from the European part of Russia (Fal'kovitsh, 1981: 435; Martin, 1991: 35; Ivinskis, 1993: 65; Savenkov et al., 1996: 25; Gaedike, 1996b: 159; Jurivete, 2000: 58; Erschoff, Fil'd, 1870: 187; Kuznetsov & Stekol'nikov 1984: 71; Erschoff 1881: 220; Rebel 1901: 179; Krulikovskij, 1907: 233; Shmytova 2001: 90; Satshkov et al. 1996: 70); Karelia (Gjunther 1896: 32); Belarus (Merzhejevskaja et al. 1976: 19), Western and Northern parts of Ukraine (Schille 1930: 225; Sovyns'kyj 1938: 35); Ural Mts. (Eversmann 1844: 576); Caucasus Mts. (Budashkin 1996: 13); Western Siberia and Altai (Tibatina 1976: 353; Fal'kovitsh 1981: 435; Gaedike 1993: 102; Budashkin 1997: 483). The records from South Ural, East Siberia, and Southern Primorje (Gaedike 1993: 102; Budashkin 1996: 13; 1997: 483) refer to *E. falciformis*.

Epermenia (*Epermenia*)

Epermenia (*Epermenia*) *pontificella* (Hübner, 1796: 56, pl. 26 fig. 181) (*Tinea*)

Material. 1♂ **Ukraine**, Lemberg [= Lwow], Coll. Museum Bucuresti; 1♂, 1♀ Galizien [= Galicia], Krzywcze, p. Borsazczow, 31.v.1937, leg. S. Toll.

Life history. Larvae on *Thesium montanum* (Santalaceae).
Distribution. All Europe, Asia Minor (Turkey).
References. The species was recorded from West Ukraine (Schille 1930: 225), Estonia, Lithuania, and the European part of Russia (Ivinskis 1993: 65; Gaedike 1996b: 159; Jurivete et al. 2000: 58).

Epermenia (*Epermenia*) *scurella* (Stainton, 1851: 25) (*Elachista*)

Life history. Foodplants of the larvae are still unknown.
Distribution. Mountain regions of Central and South Europe.
References. There are only records in the literature from West Ukraine (Carpathian Mountains) (Schille 1930: 225; Falkovitsh 1981: 435).

Epermenia (*Epermenia*) *ochreomaculella ochreomaculella* (Milliere, 1854: 63–64) (*Chauliodus*)

= *Epermenia prohaskaella* Schawerda, 1921.

Material. 2♂ **Russia**, Saratovskaja obl., s. Nizhnjaja Bannovka, 28.vi.2003 (Sinjov); 3♂ Caucasus, Kabardino-Balkarija, s. Planovskoje, 8., 10.vi.1997 (Bolov). 3♂ **Ukraine**, Zaporozhskaja obl., Vol'njanskij r-n, balka Bal'chanskaja, 18., 22., 25.vi.1997 (Zhakov); 5♂, 1♀ Crimea, Krasnoles'je, 29.iv.1983; 4.vii.1984; 7., 8.v., 8., 21.vi.1985 (Zagulajev); 1♂ Crimea, Schastlivoje, kvarc, 3.vii.1984 (Zagulajev); 1♂ Crimea, Aj-Petri, 27.vii.1989 (Budashkin). 1♂ Crimea, s.Osovino, kvarc, 9.vi.1984 (Zagulajev).

Life history. Foodplants of the larvae are still unknown.
Distribution. South Europe from Iberian Peninsula to Bulgaria (New record for the Caucasus area).
References. Western Ukraine (Buszko & Skalski 1980: 17), South-eastern Ukraine (Bidzilja 1995: 35; Bidzilja et al. 2001: 81), Crimea (Budashkin 1990: 53).

Epermenia (*Epermenia*) *ochreomaculella asiatica* Gaedike, 1979: 278

Material. 1♂ **Russia**, [Zabajkal'je], Chitinskaja obl., 20 km N p. Kyra, 6.viii.1994 (Ustjuzhanin). 1♂ Amurskaja obl., 75 km W Svobodnogo, 12.vi.1959 (Fal'kovitsh).

Life history. Foodplants of the larvae are still unknown.
Distribution. From Near East (Lebanon) to Mongolia. New record from the Amur region.
References. Southern part of Siberia (Gaedike 1993: 102); Region Zabajkal'je (Kostjuk et al. 1994: 10; Budashkin & Kostjuk 1994: 17; Budashkin 1997: 483).

Epermenia (*Epermeniola*) Gaedike, 1968: 617

Epermenia (*Epermeniola*) *thailandica* Gaedike, 1987: 155–157

Material. 2♀ **Russia**, [Priamur'je], e.l. [1960] (larvae collected 14., 17.viii.1959) (T. Shel'deshova).

Life history. Larvae in fruits of *Eleutherococcus senticosus* (Araliaceae). The pupa overwinters.
Distribution. Thailand; Russian Far East.
References. Russian Far East (Gaedike 1993: 103–104; Budashkin 1997: 483).

Epermenia (*Cataplectica*) Walsingham, 1894: 199–200

Epermenia (*Cataplectica*) *wockeella* (Staudinger, 1880: 382) (*Chauliodus*)

Material. 1♂ **Turkmenistan**, Central'nyj Kopetdag, Firjuza, 29.–30.iv.1991, na svet (Dubatolov); 1♀ Zapadnyj Kopetdag, niz uschel'ja Aj-dere, na svet, 23.iv.1991(Dubatolov); 1♀ Kopetdag, 20 km E Nohura, uschel'je Karajalchi, 27.iv.1991 (Dubatolov & Zinchenko).

Life history. Foodplants of the larvae still unknown.
Distribution. Hitherto known only from Turkey (type locality) and Turkmenistan. New record for Turkmenistan.
Remarks. The examination of the male of this species confirms that *wockeella* belongs to the genus *Epermenia.* The structure of the male genitalia (narrow tegumen) shows that the species is a member of the subgenus *Cataplectica.* Figures 1–3 show the hitherto unknown male genitalia: Uncus with widened rounded apex, narrower in middle; tegumen narrow, apical edge more thickly sclerotized; valva with broad rectangular transtilla, sacculus with a blunt rounded tooth apically, ampulla curved, pointed, border of valva not clearly visible; phallus as long as valva, slightly curved, with two more sclerotized bands extending from base to distal half, cornutus as long as half of phallus, elongate and apically pointed.

Epermenia (*Cataplectica*) *iniquella* (Wocke, 1867: 208) (*Chauliodus*)

= *Calotrypis dentosella* auct., nec Herrich-Schäffer, 1854
= *Cataplectica kruegeriella* Schawerda, 1921

Material. 8♂, 11♀ **Ukraine**, Crimea, Cape Chauda, solonchakovaja step', na list'jah i cvetah *Ferula caspica*, 1.vi.2002 (Budashkin). 1♀ **Russia**, Caucasus Mts., Teberda, 1250 m, 10.–21.vii.1972 (Eichler). 1♀ **Kazakhstan**, Biesimas, 5 km S Topoljovki, Sardkanskogo r-na, Taldy-Kurganskoj obl., 2.vii.1957 (Kuznetsov). 1♀ **Tajikistan**, [Pamir], Horog, botanicheskij sad, na svet, 31.v.1969 (Martynova).

Life history. Larvae on *Peucedanum officinale* and on *Ferula caspica.*
Distribution. Europe (from Southern France to Greece, Poland, and Ukraine); from Turkey to Iran, Kazakhstan and Tajikistan. New record for Tajikistan.
References. European part of USSR (Gaedike 1996b: 159); Western Ukraine (Schille 1930: 226, under the name *E. dentosella* Herrich-Schäffer), Crimea (Budashkin 1996: 13); Caucasus Mts. (Fal'kovitsh 1981: 434, under the name *E. dentosella* Herrich-Schäffer); Kazakhstan (Gaedike 1993: 103).

Epermenia (*Cataplectica*) *vartianae* (Gaedike, 1971: 43–45) (*Cataplectica*)

Material. 1♂ **Tajikistan**, Kondara, 24.v.1973 (Fal'kovitsh); 1♀ Pamir, Horog, 2300 m, na kvarc, 22.vi.1965 (Gur'jeva); 1♂ 30 km N Duschanbe, Kondara, 4.vii.1986 (Puplesis).

Life history. Foodplants of the larvae are still unknown.
Distribution. SE Afghanistan (Safed Koh) (type locality), Tajikistan. New record for Tajikistan.
Remarks. The material from Tajikistan allows the description of the hitherto unknown female genitalia of this species (Fig. 4). Apical edge of last sternite more strongly sclerotized than rest of sternite; shorter part of forked apophyses very thin. Corpus bursae without signum.

Epermenia (*Cataplectica*) *farreni* (Walsingham, 1894: 200–201) (*Cataplectica*)

Material. 1♂, 1♀ **Russia**, Polar Ural, 66°55'N, 65°10'E, Krasnyj Kamen', 200 m, 7.vii.1994 (Jalava, Kullberg & Koponen). **Kazakhstan**: 1♀ Zailijskij Alatau, Medeo, 25.viii.1986 (Mironov). 2♀ **Kyrgyzstan**, 14 km E g. Naryn, hr. Karyktau, 2700 m, 4.viii.1988 (Mironov).

Life history. Larvae in seeds of *Peucedanum montanum*.
Distribution. Only recorded from some European countries (Great Britain, Sweden, Slovakia, Northern Russia); Kazakhstan, Kyrgyzstan. New records for Kazakhstan, Kyrgyzstan, and Russia.

Epermenia (*Cataplectica*) *profugella* (Stainton, 1856: 38–39) (*Asychna*)

Life history. Larvae in seeds of *Pimpinella saxifraga* and other species of this genus.
Distribution. North, Central, and East Europe.
References. Estonia, Latvia, European part of Russia (A. & I. Sulcs 1987; Ivinskis 1993: 65; Savenkov et al. 1996: 25; Gaedike 1996b: 159; Jurivete et al. 2000: 58), West Ukraine (Schille 1930: 230).

Epermenia (*Cataplectica*) *sergei* Budashkin, 1996: 13–15, figs. 1–2

= *Epermenia sergeyi* Budashkin, 1997 (lapsus calami)

Life history. Foodplants of the larvae are still unknown.
Distribution. Hitherto known only from the locality of the typical series: Russian Far East: Priamur'je and Primor'je (Budashkin 1996: 13–15; Budashkin 1997: 483 under the name *E. sergeyi* Budashkin). In the literature (Gaedike 1993: 92) the species was recorded erroneously as *Phaulernis dentella* Zeller.

Ochromolopinae

Ochromolopis Hübner, 1825: 408

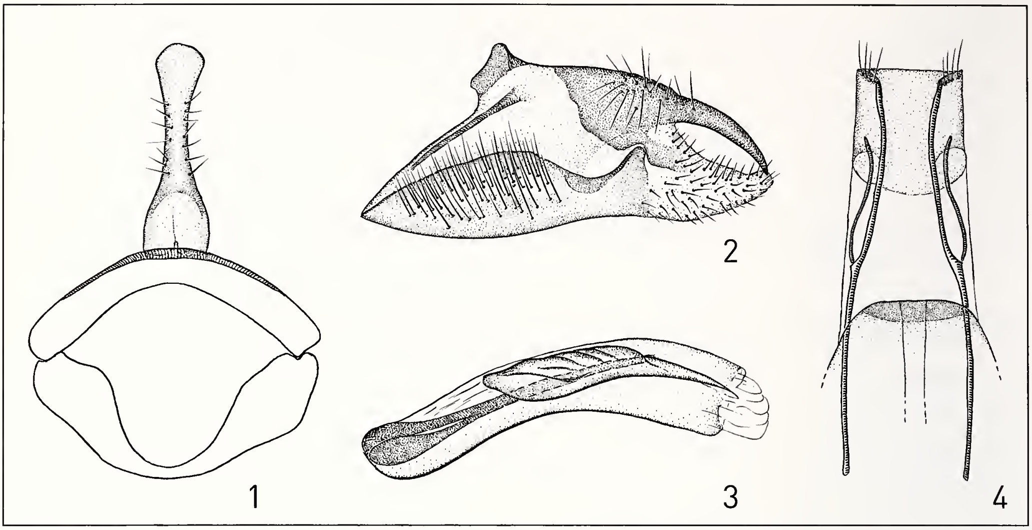
Type species: *Ochromolopis ictella* Hübner, 1813, designated by Herrich-Schäffer, 1854: 213

Ochromolopis ictella (Hübner, 1813: pl. 53 fig. 361)

= *Ornix ictipennella* Treitschke, 1833

Material. 1♂ **Ukraine**, Ubierzowa, p. Zaleszyki, 18.v.1936 (Toll).

Life history. Larvae are miners in *Thesium* spp. (Santalaceae).
Distribution. Central and South Europe, North Africa.
References. Estonia (Jurivete et al. 2000: 58), Belarus (Merzhejevskaja et al. 1976: 19), Western, Central, and Northern part of Ukraine, Caucasus Mts.* (Schille 1930: 232; Lebedev 1936: 64; Obraztsov 1936: 32); Sovyns'kyj, 1938: 85; Fal'kovitsh 1981: 445), Southern part of European Russia* (Gerasimov 1948: 976), probably in the west of European Russia (Budashkin & Satshkov 1991: 83), European Russia* (Gaedike 1996b: 159).
The records marked with an asterisk need revision because they may refer to *O. zagulajevi*. Other hitherto published records from Asia Minor and Near East need further examination because they may refer to *O. zagulajevi* also.



Figs. 1–4. *Epermenia (Cataplectica) wockeella.* **1.** ♂, Uncus-tegumen-vinculum complex. **2.** ♂, valva. **3.** ♂, phallus. **4.** ♀, *Epermenia (Cataplectica) vartianae.*

Ochromolopis zagulajevi Budashkin & Satshkov, 1991: 78–81, figs. 1–2

Material. 1♂ **Russia**, Saratovskaja obl., s. Nizhnjaja Bannovka, 28.vi.2003 (Sinjov).; 10♂, 2♀ Caucasus, 43'N, 43'E, Kabardino-Balkarskij zap., 35 km SE Elbrus, 2300 m, 9., 10., 11., 12., 13.vii.1990 (Jalava). 1♀ **Ukraine**, Zaporozhskaja obl., Vol'njanskij r-n, balka Bal'chanskaja, 25.vi.1997 (Zhakov). 1♀ **Moldova**, Kishinjov, na svet, 2.vi.1981 (Belousov). 1♂ **Georgia**, Umg. Tbilissi, 500–600 m, 30.5.–1.vi.1971 (Muche). 1♂ **Armenia**, Geghard, 1700 m, 40 km E Erevan, 26.–27.vii.1976 (Kasy & Vartian).

Life history. Foodplants of the larvae are still unknown.

Distribution. See below. New record for Moldova.

References. Middle part of Povolzh'je, Northern Part of Ukraine, Crimea, Caucasus Mts., Transcaucasus, Western Kazakhstan (Budashkin & Satshkov 1991: 78–81, 83: typical series); European part of Russia (Gaedike 1996b: 159); Middle part of Povolzh'je (Satshkov et al. 1996: 70); South-East of Ukraine (Bidzilja et al. 2001: 81); South-East Crimea (Reservat Karadag) (Budashkin 1990: 53, under the name *O. ? ictella* Hübner).

Ochromolopis kaszabi Gaedike, 1973: 96–97, figs. 1–4

Material. 6♂ **Russia**, SW-Altai, Kuragan valley, 15 km S Katanda, 1200 m, 23.–25.vii.1983, (Exp. Mikkola; Hippa & Jalava); 1♀ Burjatskaja ASSR, Ulan-Udenskij r-n, p. Kalenovo, na svet, 2.viii.1985 (Ustjuzhanin); 1♂ [Priamur'je], Klimoucy, 16.vi.1959 (Fal'kovitsh?); 1♂ Ju. Primor'je, Gornotajozhnoje, 20 km E Ussurijska, na svet, 25.vii.1999 (Sinjov).

Life history. Foodplants of the larvae are still unknown.

Distribution. Mongolia, Russian Far East, Siberia (Southern part).

References. Southern part of Siberia, Far East (Kuznetsov & Stekol'nikov 1984: 73; Budashkin & Satshkov 1991: 81–82; Gaedike 1993: 104; Kostjuk et al. 1994: 10; Budashkin & Kostjuk 1994: 17; Budashkin 1997: 487; Bidzilya et al. 2002: 206). In the Southern Primorje represented by a smaller subspecies *O. kaszabi minima* Budashkin & Satshkov (Budashkin & Satshkov 1991: 82).

Acknowledgements

We would like to express our special thanks for help to Dr. O. V. Bidzilja (Kijev), Dr. V. V. Dubatolov (SZMN), M. A. Klepnikov (Jaroslavl'), and Dr. S. Ju. Sinjov (ZIN). Dr. L. Kaila (FMNH) enabled study of the material from the Russian-Finnish Expeditions, and Mr. A. D. Liston (Waldsieversdorf) helped with linguistic corrections.

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A review of *Dibrachia* Sinev & Sruoga, 1992, a subgenus of *Elachista* (Elachistidae: Elachistinae)

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Abstract. The systematic position of the *Elachista* subgenus *Dibrachia* Sinev & Sruoga, 1992 is revised on the basis of a novel anatomical interpretation of the male juxta-valval process complex in the constituent species. The taxonomy of the species is outlined and new distributional data are presented. Five species are recognised, the following two of which are described as new: *Elachista alicanta* sp. n. (Spain) and *Elachista elksourensis* sp. n. (Tunisia). A redescription and diagnosis are given for all included species.

Key words. Elachistidae, Elachistinae, *Elachista*, *Dibrachia*, systematics, genital morphology, juxta-valval process complex, new species

Introduction

The *Elachista* subgenus *Dibrachia* Sinev & Sruoga, 1992 (Elachistidae: Elachistinae) is a small and structurally uniform group of Elachistinae moths distributed in the Palaearctic area. They are confined to xerothermic habitats and their known diversity is highest in the Mediterranean area. The present knowledge of their sites of occurrence indicates that they seem to occur in limestone areas in particular. The immature stages are not known for any of the species. The representatives of subgenus *Dibrachia* are characterised by their peculiarly shaped male genitalia with reduced uncus, uniquely developed and paired comb-shaped gnathos, and broad valvae. Externally, the three previously recognised species are unicolorously white, thus resembling some representatives of *Elachista* subgenus *Aphelosetia* Stephens, 1834. Examination of extensive unidentified samples of Elachistinae has revealed the existence of two new species attributable to subgenus *Dibrachia*.

The three previously recognised species, originally placed in *Elachista* (Chrétien 1908; Parenti 1978; Traugott-Olsen 1990), were transferred to their own genus (*Dibrachia*) owing to their peculiar genital features by Sinev & Sruoga (1992). Kaila (1999) shifted the rank of *Dibrachia* to that of a subgenus of *Elachista* on the basis of a phylogenetic analysis of the subfamily. In this analysis *Dibrachia* came up as the sister group of the clade containing *Elachista* subgenera *Hemiprosopa* Braun, 1948 and *Aphelosetia*.

A detailed scrutiny on the genital morphology of all five species led me to re-consider the anatomic interpretation of the juxta-valval process complex in *Dibrachia*. These species appear to share characteristics that are different from those of all other *Elachista* species. These structures had seemingly passed unnoticed by Parenti (1972), Kaila (1999), and partly also by Sinev & Sruoga (1992), all of whom had predominantly studied *E. kalki* Parenti, 1978, in which these structures are more like those of the 'usual' *Elachista* type. These structures had also partly been incorrectly interpreted by Traugott-Olsen (1990) in the description of *Elachista anatoliensis* (for details, see *Remarks* under the redescription of *E. anatoliensis*). In this paper the male juxta-valval

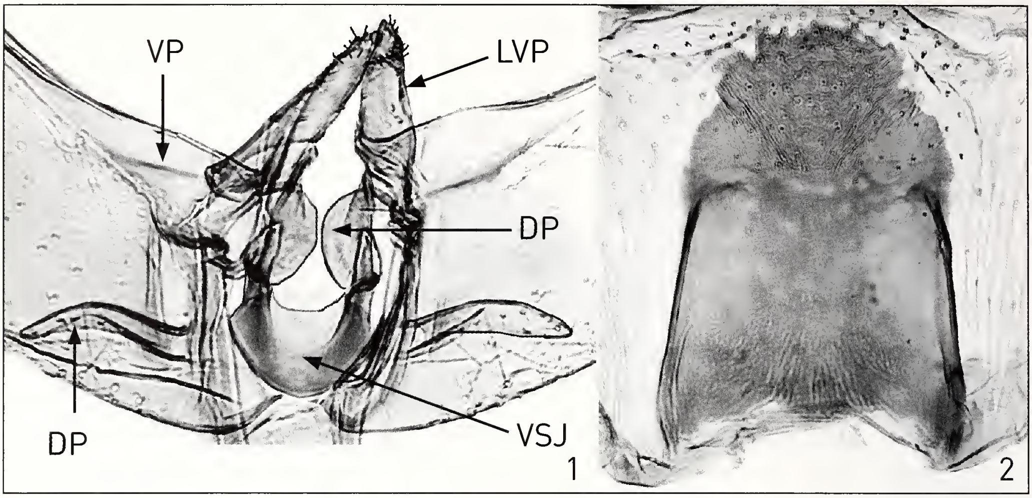


Fig. 1. The juxta – valval process complex of *Elachista* (*Dibrachia*) *alicanta* sp. n. with explanations of anatomic structures. DP digitate process; JL juxta lobes; LVP lobe of valval process; VP valval process; VSJ ventral shield of juxta.
Fig. 2. Sternum II of *Elachista kalki* (L. Kaila prep. n. 4258).

process complex of *Dibrachia* is described in detail and its significance regarding the phylogenetic position of *Dibrachia* is evaluated. The two new species are described and the three previously recognised species are redescribed.

Material and methods

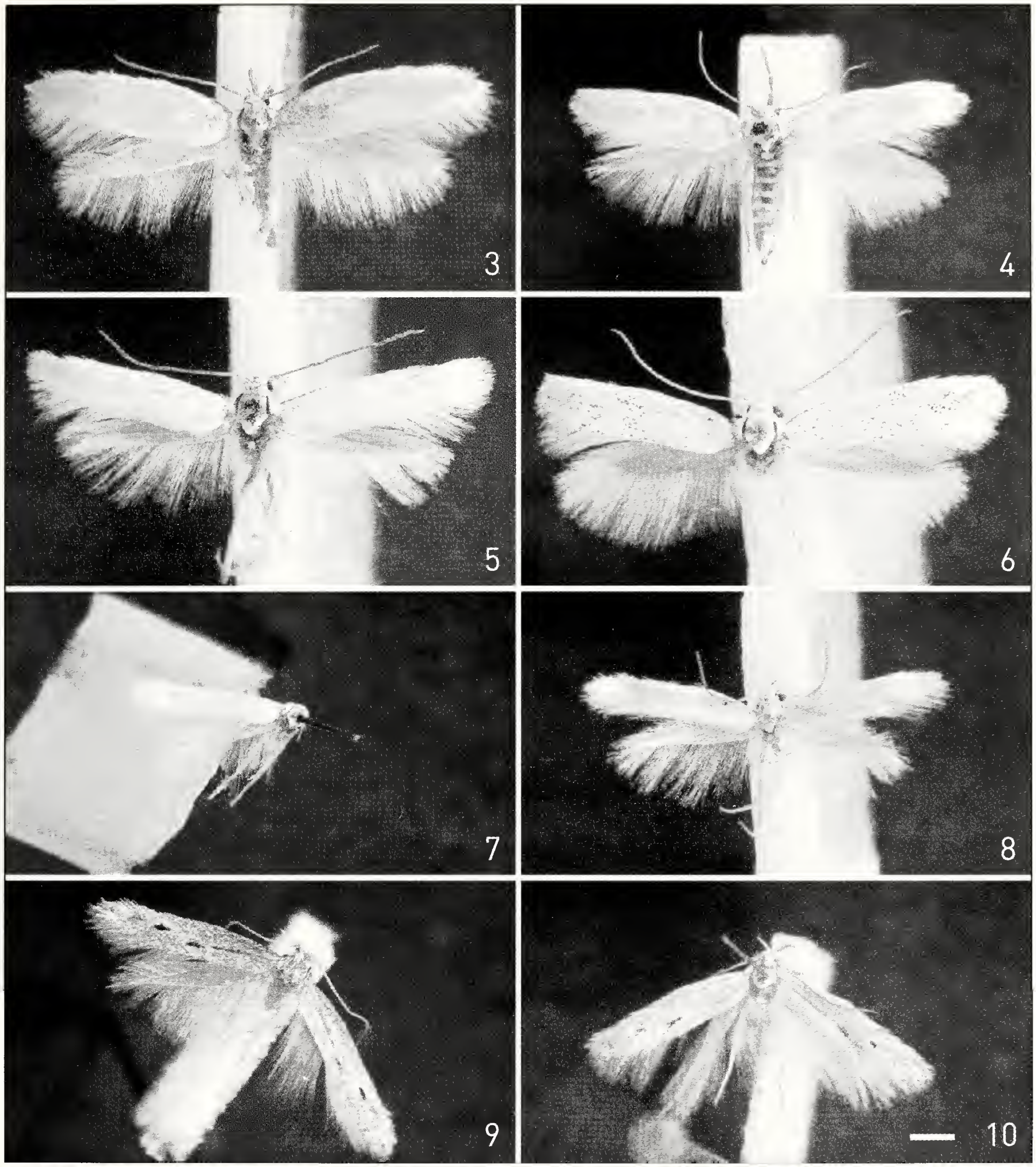
The terminology for morphological structures follows Traugott-Olsen & Schmidt Nielsen (1977) and Kaila (1999). The forewing length was measured from the base of the wing to the end of the fringe. Apart from the material studied for the present study, the described distribution of the included species over European countries follows Kaila (2004b). This paper is based on material obtained from the following collections:

TLMF	Tiroler Landesmuseum Ferdinandeum, Innsbruck, Austria (P. Huemer).
MZH	Zoological Museum, Finnish Museum of Natural History, University of Helsinki, Finland (L. Kaila).
SZMN	Siberian Zoological Museum, University of Novosibirsk, Russia (V. V. Dubatolov).
ZMUC	Zoological Museum, University of Copenhagen, Denmark (O. Karsholt).

Private collections of following persons: Jari Junnilainen (Vantaa, Finland), Jari Kaitila (Vantaa, Finland), Kari and Timo Nupponen (Espoo, Finland), Zdeno Tokár (Michalovce, Slovak Republic), and Vadim Zolotuhin (Ul'yanovsk, Russia).

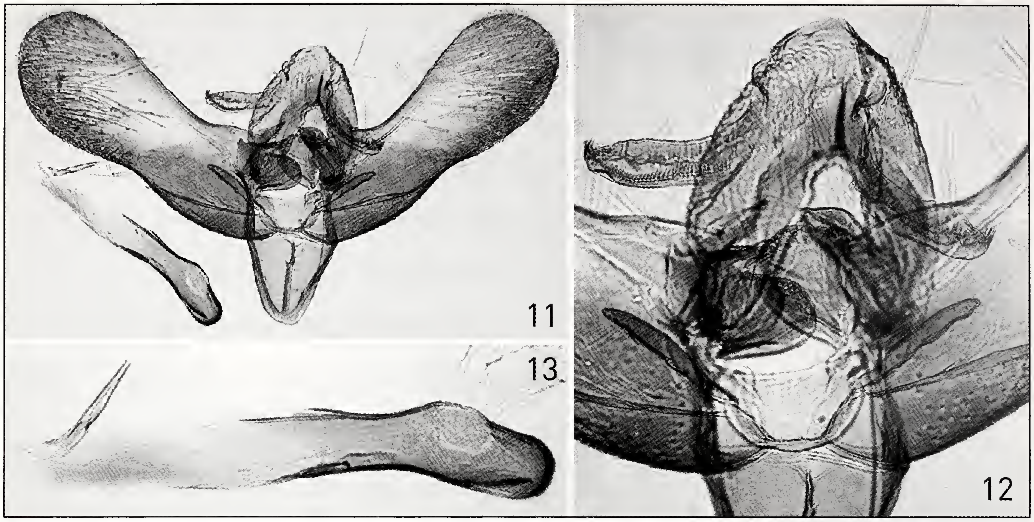
Systematic position of *Elachista* subgenus *Dibrachia*

In *Dibrachia kalki* the juxta lobes are bilobed and setose (cf. Parenti 1978: pl. 2; Figs. 12, 14). In other species of *Dibrachia* the lobes are entirely separate from each other, the 'real' juxta lobes are unsetose, and the other lobe is triangular or tongue-shaped



Figs. 3–10. Habiti of *Elachista* spp., scale 1 mm. **3.** *E. kalki* Parenti ♂ (Russia, S. Urals). **4.** *E. kalki* Parenti ♀ (Russia, S. Urals). **5.** *E. totalbella* Chrétien ♂ (Tunisia). **6.** *E. elksourensis* sp. n. ♂ holotype (Tunisia). **7.** *E. anatoliensis* Traugott-Olsen ♂ holotype (Turkey). **8.** *E. anatoliensis* Traugott-Olsen ♂ (Ürgüp, Turkey). **9.** *E. alicanta* sp. n. ♂ holotype (Spain). **10.** *E. alicanta* sp. n. ♀ paratype (Spain).

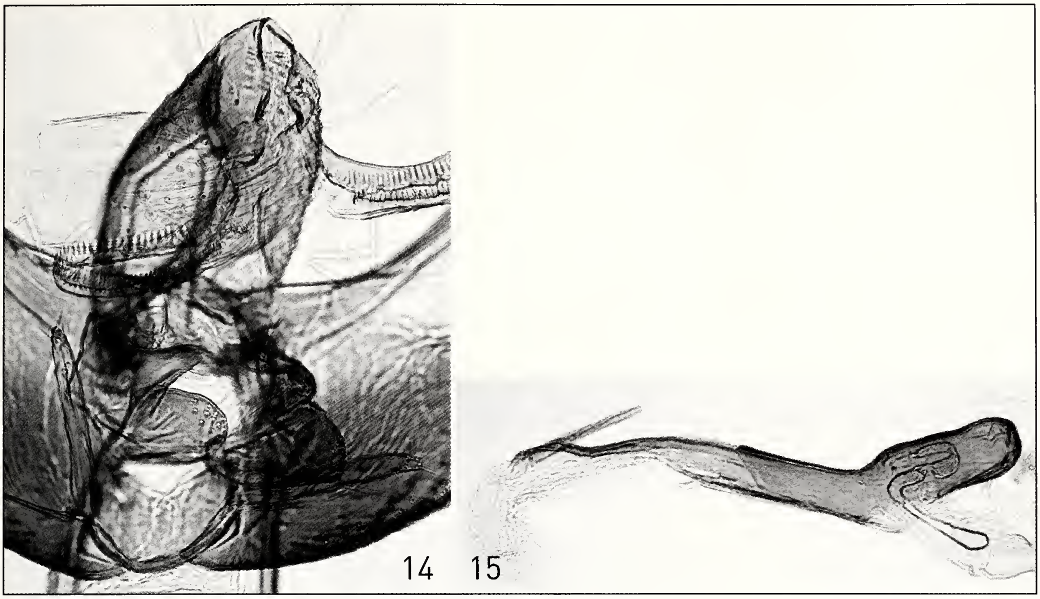
and apically setose (see Fig. 1 for explanations). This structure is similar to Kaila's (1999) character 51: 1 (valval process present as membranous connection between ventral surface of valva and juxta lobe that bears a tongue-shaped lobe medially). This characteristic was found to be a unique synapomorphy for the genus *Stephensia* Stainton, 1858 (Kaila 1999). It is not possible to evaluate whether the structure here called as the lobe of the valval process is really a derivative of the valval process



Figs. 11–13. Male genitalia of *Elachista kalki* (Greece, L. Kaila prep. n. 4013). **11.** General view. **12.** Details of uncus, gnathos, and juxta. **13.** Phallus.

or the juxta, and the terminological convention used here follows Kaila (1999). The ventral shield of the juxta of *Dibrachia* is typically sickle-shaped or semicircular with dorsolaterally directed extensions. The juxta lobes are connected to the ventral shield by a narrow joint. These characteristics appear unique to *Dibrachia*. Unlike other *Elachista*, the median plate of the juxta is simple, without folded margins, a condition that is primitive in the phylogenetic framework of Kaila (1999). The valval process is nearly membranous in *E. kalki*, but to some extent sclerotised in the other species of the subgenus *Dibrachia*.

Since the publication of the phylogenetic analysis of the Elachistinae by Kaila (1999) the data matrix has been updated by Kaila & Sugisima (2003, and unpublished data). This updating not only includes new outgroup taxa in accordance with Kaila (2004a), but also 35 additional ingroup taxa, many new characters, and a revision of some codings and character state definitions. The revised data matrix will be published in another context (Kaila & Sugisima, in preparation). A preliminary re-analysis of the revised data matrix in its present, yet incomplete form, with novel and revised findings regarding *Dibrachia* incorporated, was executed for evaluating the position of *Dibrachia*. The outcome (not shown) indicates that the monophyletic *Dibrachia* may be the basal lineage of *Elachista*. It would also indicate that the lobe of the valval process is of independent origin in *Stephensia* and *Dibrachia*, respectively. The position of *Dibrachia* indicates that the originally weakly supported monophyly of the clade containing subgenera *Dibrachia*, *Hemiprosopa* and *Aphelosetia* (Kaila 1999) would be broken. This position could allow the recognition of *Dibrachia* again as a genus, following Sinev & Sruoga (1992). However, such a change is not suggested here for the following reasons. Firstly, this result is based on a preliminary analysis of an incomplete data set. Secondly, the immature stages of *Dibrachia* and *Hemiprosopa* still remain unknown, a situation which unavoidably hampers our understanding of the position of these groups. Thirdly, the monophyly of *Elachista* s. l. seems much



Figs. 14–15. Male genitalia of *Elachista kalki* (Russia, Urals). **14.** Details of uncus, gnathos and juxta (L. Kaila prep. n. 4257). **15.** Phallus (L. Kaila prep. n. 4258).

better supported than the interrelationships of the constituent subgenera. This finding indicates that further modifications to the data matrix could easily again change their position, while the monophyly of *Elachista* s. l. is less likely challenged. Therefore, the nomenclatorial stability is better maintained if no changes are now made.

Diagnosis of *Elachista* subgenus *Dibrachia*

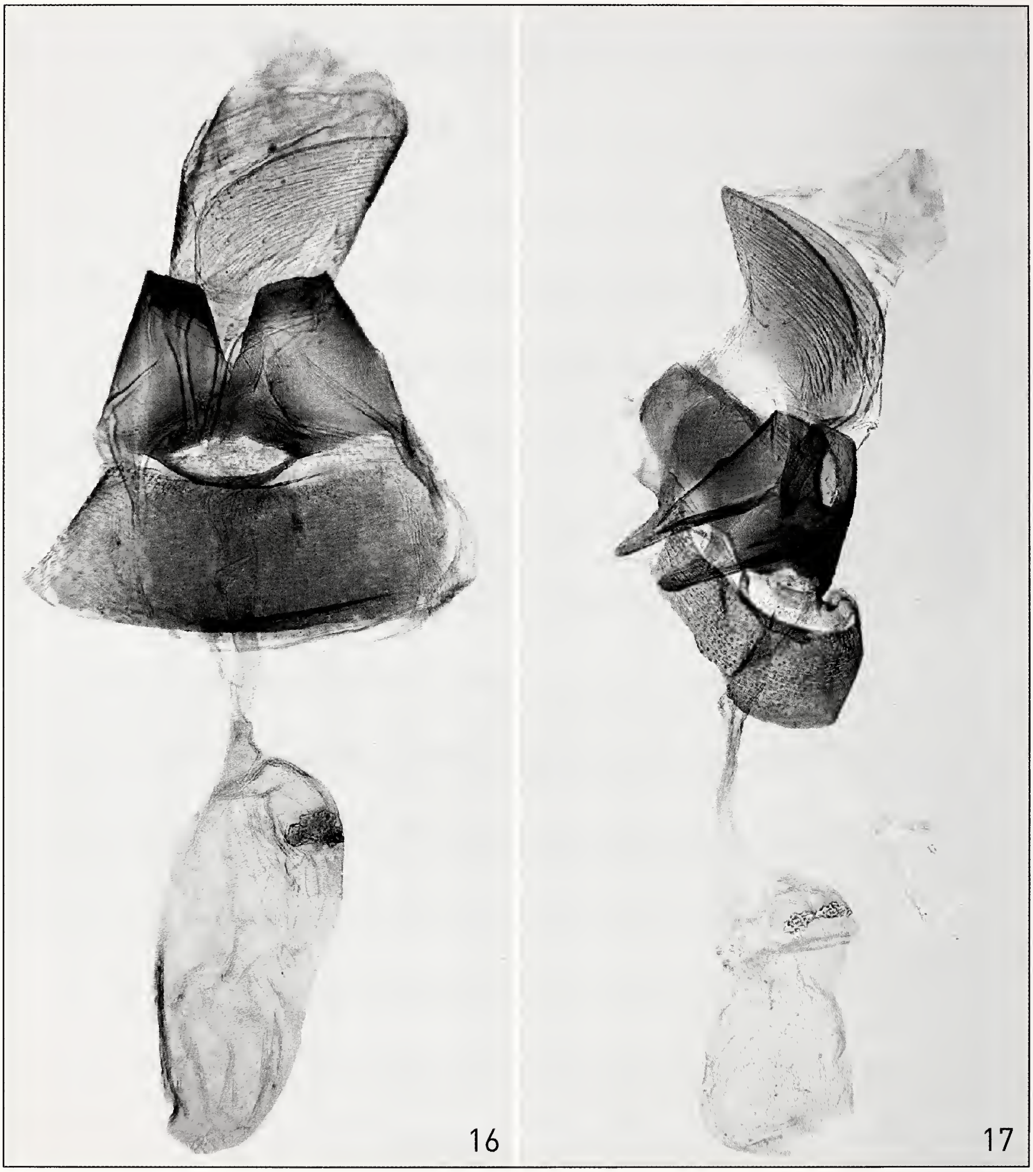
Notes on the distribution of some characters within Elachistinae are mentioned within brackets [].

Head. Smooth-scaled, neck tuft weakly raised. Tongue basally scaled, length less than diameter of head. Maxillary palpi vestigial, 2-segmented. Lateral external ocelli absent. Antenna extended to about 2/3 of forewing, scape basally with pecten consisting of numerous elongate, stiff hair-like scales; flagellum without visible ciliation. Length of labial palpus 0.8–1.5 times diameter of head.

Thorax. Forewing acute; five costally directed R-veins present; M1 stalked with R; M2 free, from end of cell; CuA1 and CuA2 present. Hindwing lanceolate, cell open; M2, CuA1 and CuA2 on common stalk. Tarsal articles with three stout spines distally, spines sometimes also present on ventral surface of tarsal articles of mid- and hindleg.

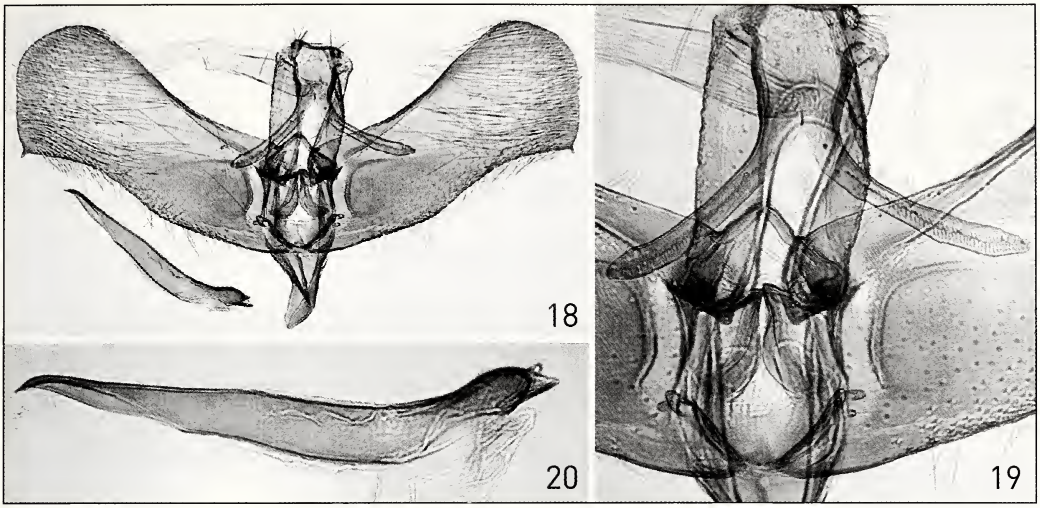
Pregenital abdomen. Sternum 2 with long and narrow, well distinguished sternal rods [also in *Stephensia* and some species in *Elachista* subgenus *Aphelosetia*], without apodemes (Fig. 2). Anterior margin of male tergum 8 sclerotised, without further modifications.

Male genitalia. Uncus lobes vestigial, present at most as low triangular, setose swellings. Socius present as a small group of small setae. Basal arms of gnathos fused medially; lobes of spinose knob of gnathos separate, elongate, tongue-shaped, with



Figs. 16–17. Female genitalia of *Elachista kalki*. **16.** L. Kaila prep. n. 4261 (Russia, Ul'yanovsk). **17.** L. Kaila prep. n. 4260 (Russia, Tuva).

comb-like longitudinal double row of spines. Without sclerotised anellus. Transtilla made of medially projected hook-like appendices of valval costa. Valva with more or less sclerotised valval process on ventral surface; also with tongue-shaped or triangular setose lobe between juxta lobe and valval process [also in *Stephensia*]. Costa unfolded [usually in *Elachista* the costal sclerotisation forms distinctive basal and distal folds]. Cucullus expanded, rounded, often with small spine at end of indistinct sacculus. Median plate of juxta sickle-shaped or oval, without lateral foldings, dorsolaterally extended



Figs. 18–20. Male genitalia of *Elachista totalbella* Chrétien (Tunisia, L. Kaila prep. n. 4142). **18.** General view. **19.** Details of uncus, gnathos and juxta. **20.** Phallus.

to give lateral support for phallus, without median or lateral pockets. Juxta lobes of variable shape, widely placed apart from each other, narrowly connected to median plate of juxta, distinctly sclerotised, ventral surface distally with or without group of setae. Dorsal shield of juxta absent. Elongate tongue-like, setose digitate process between median plate of juxta and ventral surface of valva present and fully developed, vestigial, or absent. Phallus not ankylosed, with or without manica; sometimes with cornuti.

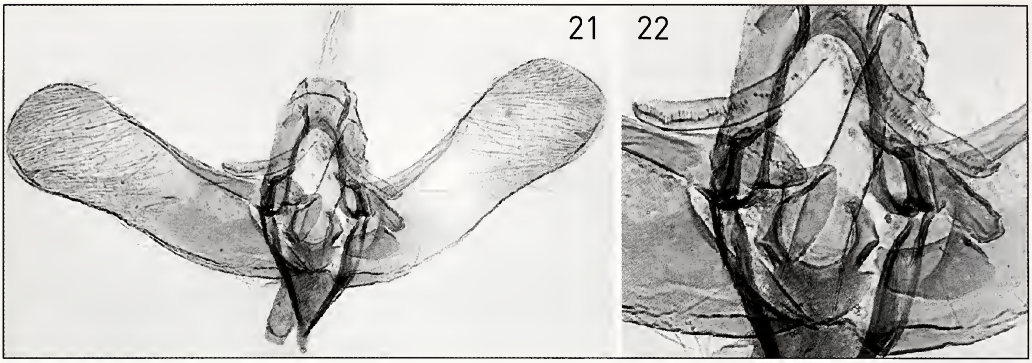
Female genitalia. Papillae anales sclerotised, dorsodistally fused, forming a sharp blade [papillae anales similarly dorsodistally fused in *Perittia* and *Elachista dissona* Kaila], sparsely covered by sensilla; lacking microtrichiae [microtrichiae absent also in *Perittia*, *Urodeta*, and *Elachista dissona* Kaila]. Posterior margin of sternum 8 reinforced, with deep mesal incision. Ostium bursae situated on sternum 8. No antrum present; ductus seminalis membranous, tubular, incepted to ductus bursae cephalad of colliculum; ductus bursae tubular, straight; corpus bursae with internally directed spiculae; with one dentate signum of variable shape.

The species of *Elachista* subgenus *Dibrachia*

Elachista kalki Parenti, 1978 (Figs. 2–4, 11–17)

Elachista kalki Parenti, 1978: 20, pl. 2.
Dibrachia kalki (Parenti, 1978); Sinev and Sruoga 1992: 154.
Elachista (*Dibrachia*) *kalki* Parenti, 1978; Kaila 1999: 164.

Material. 1♂, 1♀ **Germany**, Kyffhäuser, Kosacken Berg 27.v.1939, Jäckh leg. (ZMUC). 1♂ **Greece**, 15 km W Konsani 16.v.1997, Selling leg. (Kaila prep. n. 4283) (ZMUC); 1♂, 1♀ Makedonia, 35 km S Grevena 24.v.2001, leg. et coll. Junnilainen (L. Kaila prep. n. 4013 ♂). 1♂ **Hungary**, Örkény 2.-3.v.2003 Richter leg., (coll. Tokár). 6♂ 2♀ **Russia**, S. Ural, Cheliabinsk oblast, 52°39'N 59°34'E, 350 m, Arkaim reserve near Amurskii village, 18.–19.v.2004, Nupponen leg. (coll. Nupponen & MZH); 6♂

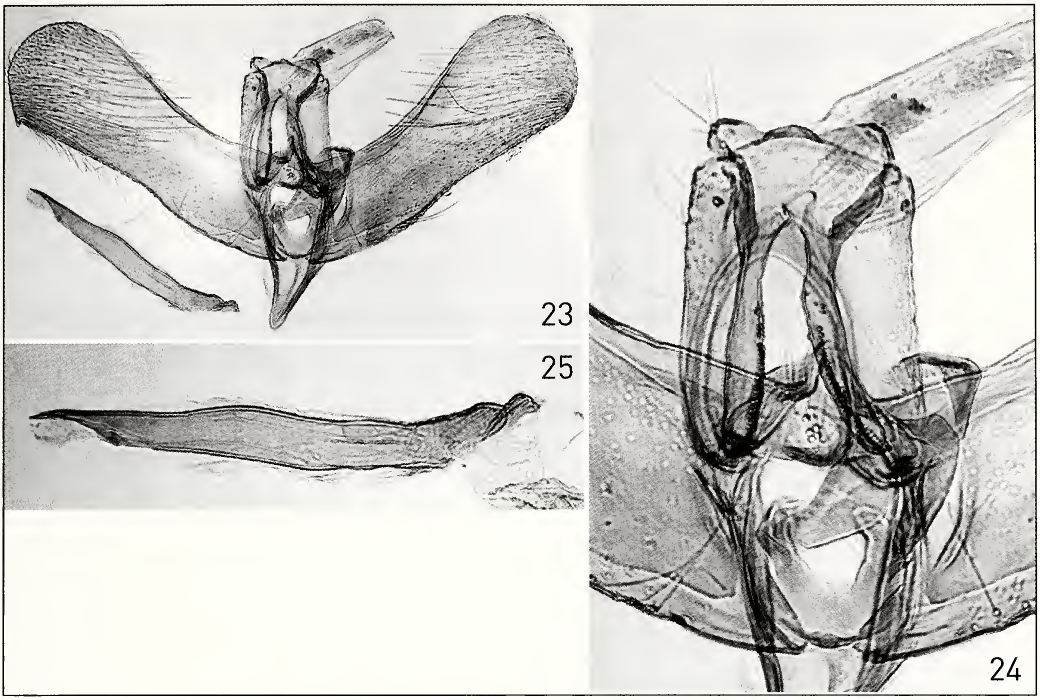


Figs. 21–22. Male genitalia of the holotype of *Elachista anatoliensis* Traugott-Olsen (ETO C.3.12.89). **21.** General view. **22.** Details of gnathos, and juxta.

Cheliabinsk oblast, 52°39'N 59°00'E, 300 m, 15 km S. Kizilskoye, near Ural river, 27.v.1998, Junnilainen leg., 30♂ same data, T. & K. Nupponen leg. (coll. Junnilainen, Nupponen, MZH); 1♂ Cheliabinsk oblast, 53°57'N 59°03'E, 650 m, near Moskovo village, 26.v.1998, Junnilainen leg. (coll. Junnilainen); 13♂ Orenburg oblast, 51°13'N 57°37'E, 350 m, 20 km S Mednogorsk, near Kidriasovo village 28.–29.v.1998, Junnilainen leg. (coll. Junnilainen); 2♂ same, T. & K. Nupponen leg. (coll. Nupponen); 3♂ Orenburg oblast, 51°23'N 56°49'E, 130–340 m, 6 km W. Donskoje village, Mount Verbljushka, 13.v.1999, Nupponen leg. (coll. Nupponen); 1♂ Cheliabinsk oblast, 53°59'N 61°12'E, 250 m, Troizkii reserve near Berlin village, 30.vi.1997, Nupponen & J. Junnilainen leg. (coll. Junnilainen, Nupponen); 6♂ 2♀ Orenburg distr. Arkaim near Amurskii village 18.–19.v.2004, Nupponen leg. (coll. Nupponen), 1♂, 1♀ in MZH); 3♂ 1♀ Ul'yanovsk obl., Akulovka, Nikolaevka distr. 150 km SWS Ul'yanovsk, limestone steppe, 53°06'N 47°29'E 16.v.1998, Zolotuhin leg.; 2♂ Vjazovka, 6 km S., Radishchevo distr., 166 km S Ul'yanovsk, 52°51'N 48°21'E, 6.–9.v.2000, Zolotuhin leg.; 1♂ Radishchevo distr., 160 km S Ul'yanovsk, 52°53'N 48°26'E 2.vi.1993, Zolotuhin leg.; 1♂, same data, 24.v.1994, Isajeva leg.; 1♂ Vjazovka, 8 km S., Radishchevo distr., 168 km S Ul'yanovsk, 52°50'N 48°18'E, 4.v.2002, Isajeva leg. (Specimens from Ul'yanovsk in coll. Zolotuhin and in MZH); 3♂ 3♀ Tuva rep. 50°16'N 94°54'E, 1250 m, 25 km W. Erzin, steppe/stony slopes, 7.–11.vi.1995, Jalava & Kullberg leg. (MZH).

Diagnosis. *Elachista kalki* is the most broad-winged of the *Dibrachia* species (Figs. 3–4), and its labial palpi are shorter than in the other species, at most as long as the diameter of the head. Its forewings are shiny white; the sheen distinguishes it from nearly all other white *Elachista* species, except *E. galacticella* Eversmann of subgenus *Aphelosetia*. These species are externally readily identifiable by the presence of the uncus in the male of *E. galacticella*, which can be seen without brushing the abdomen. The females of these species are identified by the blackish blade-shaped papillae anales of *E. kalki*, also visible without brushing. The male genitalia of *E. kalki* differ from those of other *Dibrachia* species by the very vestigial unsetose uncus, the valva without any distal spine on the cucullus, the setose juxta lobes, and the long straight cornutus on the vesica (Figs. 11–15).

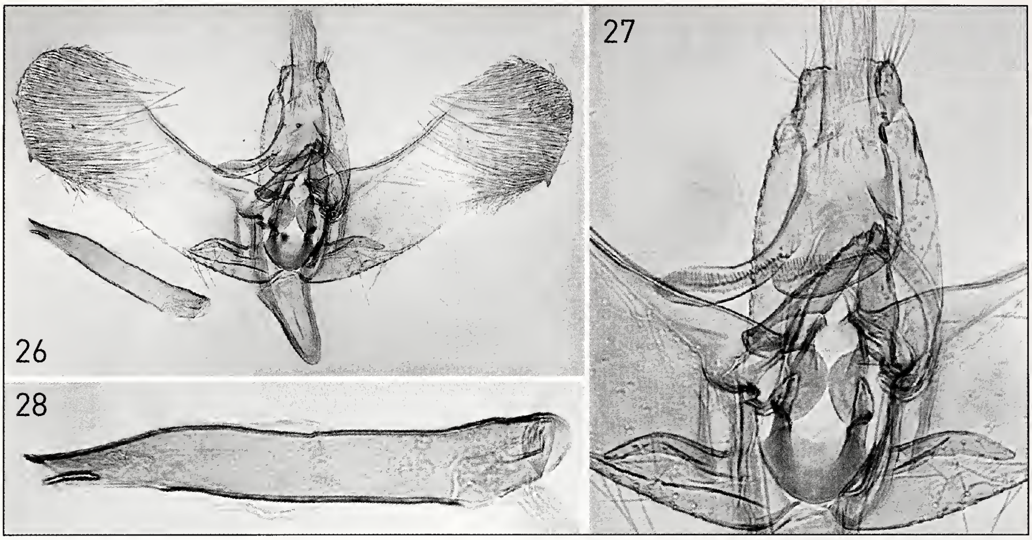
Description. Forewing length of ♂ 4.8–5.5 mm, ♀ 4.8–5.2 mm. Length of labial palpus 0.8–1.0 times diameter of head, almost straight, greyish white. Scape dense, white, pecten white, pedicel and flagellum grey. Head varying from grey to pale ochreous. Neck tuft, patagia, and thorax greyish white. Whole antenna concolorous with head. Abdominal segments basally shiny light grey, distally white. Fore- and midleg inwardly pale, outwardly pale or leaden grey, hindleg ochreous white. Forewing broad, unicolorous shiny white except basal 1/5 of costa narrowly dark grey; fringe concolorous. Hindwing pale grey, translucent; fringe white. Underside of fore- and hindwings grey, fringe white.



Figs. 23–25. Male genitalia of *Elachista anatoliensis* (Turkey, Ürgüp, L. Kaila prep. n. 3909). **23.** General view. **24.** Details of uncus, gnathos, and juxta. **25.** Phallus.

Male genitalia. Uncus lobes vestigial. Lobes of the spinose knob of gnathos separate, tongue-shaped, with comb-like longitudinal double row of spines, length 1/4 length of valva. Valva narrowest medially, three times longer than wide at narrowest point, with somewhat sclerotised valval process on ventral surface; costal sclerotisation unfolded; sacculus basally somewhat swollen, s-shaped, without distal spine, cucullus expanded, rounded. Ventral shield of juxta semicircular, dorsolaterally extended; juxta lobes widely set apart from each other, narrowly connected to median plate of juxta, broad, cusp-like, distally setose; triangular setose lobe present between juxta lobe and valval process. Digitate process narrow, straight, setose, 1/5 length of valva. Vinculum u-shaped, with distinctive median ridge. Phallus 2/3 length of valva, basally bent, distally tapered to blunt dorsal lobe; blunt caecum with or without small manica; vesica with straight prominent cornutus.

Female genitalia. Papillae anales sclerotised, dorsodistally fused, forming a sharp blade, longitudinally wrinkled, sparsely covered by sensilla, lacking microtrichiae. Apophyses posteriores short, broad; apophyses anteriores very short, triangular. Posterior margin of sternum 8 reinforced, with narrow v-shaped median incision. Ostium bursae on anterior margin of sternum 8, surrounded by strong sclerotised ring. No antrum present; ductus seminalis membranous, tubular, incepted to ductus bursae cephalad of colliculum at posterior 1/3 length of ductus bursae; ductus bursae tubular, straight, as long as corpus bursae; corpus bursae with internally directed spiculae; with one dentate signum of variable shape.



Figs. 26–28. Male genitalia of the holotype of *Elachista alicanta* sp. n. (L. Kaila prep. n. 4193). **26.** General view. **27.** Details of uncus, gnathos, and juxta. 28. Phallus.

Life history. Adults have been collected at light on steppe slopes usually rich in limestone.

Distribution. Austria, Germany, Greece, Hungary, Italy, Kazakhstan (Sinev & Sruoga 1992), Russia (southern Urals, Volga region, Tuva Republic).

Remarks. New to Greece.

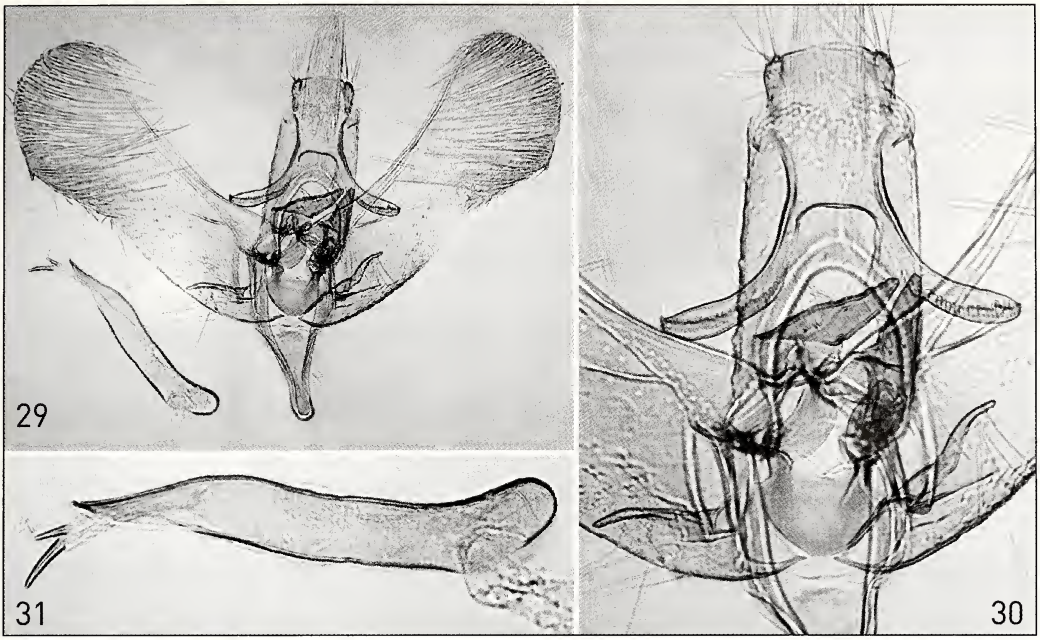
Elachista totalbella Chrétien, 1908 (Figs. 5, 18–20)

Elachista totalbella Chrétien, 1908: 203; Parenti 1972: 30, pl. 1 figs. A–D.
Dibrachia totalbella (Chrétien, 1908); Sinev and Sruoga 1992: 155.
Elachista (*Dibrachia*) *Dibrachia totalbella* Chrétien, 1908; Kaila 1999: 164.

Material. 1♂ **Tunisia**, Atlas Mts., Le Kef, chalk slope, 3.v.2000, leg. et coll. Nupponen.

Diagnosis. *Elachista totalbella* is a rather large unicolorous white species that can be identified most easily from the other *Dibrachia* species by its digitate process of male genitalia in the form of a small setose lobe (Fig. 19).

Description, ♂. Forewing length 5.2 mm. Length of labial palpus 1.3 times diameter of head, white, second segment slightly ochreous below. Head neck tuft, patagia, and thorax white. Scape dense, white, pecten white, pedicel and flagellum grey. Abdominal segments basally shiny light grey, distally white. Foreleg inwardly pale, outwardly mottled grey, mid- and hindleg ochreous white, tibia and tarsal articles outwards mottled grey, distally white. Forewing white except basal 1/5 costa narrowly dark grey, fringe concolorous. Hindwing dark grey, fringe white. Underside of forewing dark grey, fringe white; underside of hindwing dark grey on costal half and along Cu-vein, whitish on tornal half.



Figs. 29–31. Male genitalia of the paratype of *Elachista alicanta* sp. n. (L. Kaila prep. n. 4216). **29.** General view. **30.** Details of uncus, gnathos, and juxta. **31.** Phallus.

Male genitalia. Uncus lobes low triangular, setose. Lobes of spinose knob of gnathos separate, narrow, elongate, with comb-like longitudinal double row of spines, 1/3 length of valva. Valva narrowest medially, three times longer than wide at narrowest point, with somewhat sclerotised valval process on ventral surface; costal sclerotisation not folded; sacculus s-shaped, with small spine apically, cucullus expanded, rounded. Ventral shield of juxta sickle-shaped, dorsolaterally extended; juxta lobes widely set apart from each other, narrowly connected to median plate of juxta, distinctly sclerotised, without setae; triangular setose lobe present between juxta lobe and valval process. Digitate process vestigial, setose, accompanied [or flanked, surrounded?] by additional minute lobes (in studied specimen) that seem absent on lectotype. Vinculum narrow, u-shaped, with distinctive median ridge. Phallus 3/4 length of valva, basally bent, distally tapered to pointed, inwardly-curved apex; blunt caecum with bilobed manica; without cornutus.
Female. Unknown.

Life history. The specimen from Tunisia was collected with a light trap on a xerothermic limestone mountain (K. Nupponen, personal communication).

Distribution. Algeria, Tunisia.

Remarks. The genitalia of the lectotype male as well as those of a paralectotype female were illustrated by Parenti (1972). The male genitalia photos of Parenti (1972: figs. 1A–D) enable unambiguous identification. Therefore, the lectotype was not examined again in the present study. The characteristics of the female specimen illustrated by Parenti (1972: figs. 10A–C, E) disagree with those of the two other *Elachista* (*Dibrachia*)

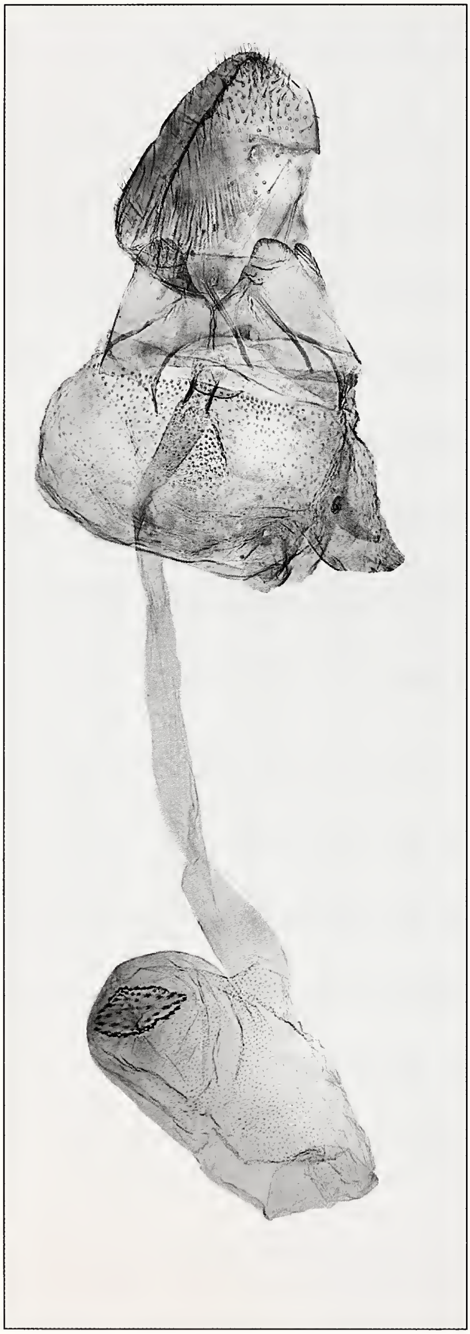


Fig. 32. Female genitalia of *Elachista alicanta* sp. n. (paratype, L. Kaila prep. n. 4222).

species for which the female is known, i.e. *E. kalki* and *E. alicanta.* In particular, the basally bulbous, unsclerotised papillae anales are quite different in shape, resembling those found in the *Elachista dispunctella* complex. On picture 10: A of Parenti (1972) also microtrichiae are discernible on the papillae anales. This is a typical feature of all *Elachista* species except those of subgenus *Dibrachia.* It is here presumed that the female paralectotype of *E. totalbella* actually is a member of *Elachista* subgenus *Aphelosetia*, probably in the *dispunctella* complex. Therefore, the true female of *E. totalbella* is considered unknown.

Elachista anatoliensis Traugott-Olsen, 1990 (Figs. 7–8, 21–25)

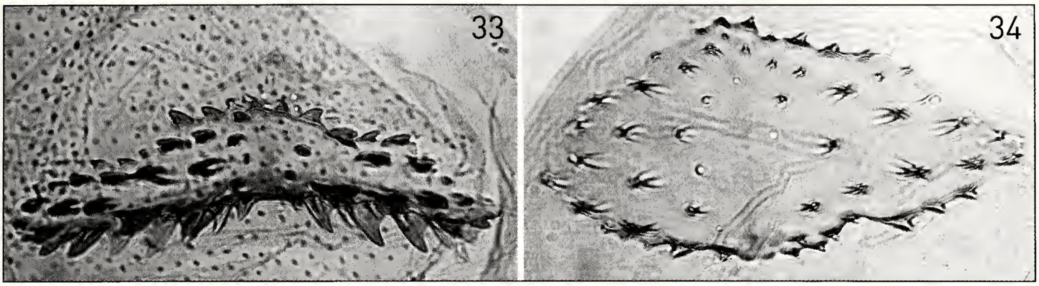
Elachista anatoliensis Traugott-Olsen, 1990: 275, figs. 3, 12, 13, 23, 24.

Dibrachia anatoliensis (Traugott-Olsen, 1990); Sinev and Sruoga 1992: 155.

Elachista (*Dibrachia*) *anatoliensis* Traugott-Olsen, 1990; Kaila 1999: 164.

Material. Holotype ♂, labelled: ”Type” [rounded label with red margin], ”genital praeparat | nr. C.3.12.89 sex: ♂ | E. Traugott-Olsen | WING praeparat | nr. B. 17.6.90 sex: ♂ | E. Traugott-Olsen”, ”Anatolia | Kizilcahaman | 1965”, ”*Elachista* | *anatoliensis* sp. n. | det. E. Traugott-Olsen” (TLMF). – 1♂ **Turkey**, Prov. Kayseri, 5 km NW Ercios Dagh., 2000 m, 22.vii.1986, Fibiger leg. (slide ETO E.19.6.89 [with identification label ‘*Elachista totalbella* Chrét. ETO det.]) (ZMUC); 1♂, same data, (slide A28.6.90 E. Traugott-Olsen, [with identification label ‘*E. anatoliensis* ETO det.]); 1♂ Ankara, Kizilcahaman, 20 km NW, 1200 m, 1.vii.1987, Fibiger leg. (slide G28.6.90 E. Traugott-Olsen, [with identification label ‘*E. anatoliensis* ETO det.]) (ZMUC); 2♂ Ürgüp, 30.vi.1998, Nupponen leg. (Kaila slides 3557, 3909) (coll. Nupponen, MZH). 1♂ **Turkmenistan**, Central part of the Kopetdagh Mts., 15 km W from Firyuza (now Poevryuze), Mt. Dushak, [2100 m, mountain xerophytous belt, *Juniperus* tree savanna-like forest], by light trap, 7.vii.1990, Dubatolov leg. (Kaila prep. n. 1682) (SZMN).

Diagnosis. An unicolorous white species that is externally separable from the similarly coloured species of subgenus *Dibrachia* as well as from the *Elachista* (*Aphelosetia*) *argentella* group by the very narrow forewings (Figs. 7–8). The genitalia also readily separate *E. anatoliensis* from the *E. argentella* group species. The genitalia of



Figs. 33–34. Signum of *Elachista alicanta* sp. n. **33.** Paratype, L. Kaila prep. n. 4217. **34.** Paratype, Kaila prep. n. 4222.

E. anatoliensis differ from other *Dibrachia* species as follows: The valva is longer and narrower than in the other species, being four times longer than wide, and the digitate process is absent. The juxta lobes are broader than in *E. totalbella* for which the digitate process is very small (Figs. 21–25).

Description, ♂. Forewing length 4.4–4.9 mm. Length of labial palpus 1.3 times diameter of head, white, second segment slightly ochreous below. Scape dense, white, pecten and pedicel of antenna white, flagellum grey. Head white, ochreous above; neck tuft, patagia and thorax white. Abdominal segments basally shiny light grey, distally white. Fore- and midleg inwardly pale, outwardly mottled grey, hindleg ochreous white, tibia and tarsal articles outwards mottled grey, distally white. Forewing very narrow, unicolorous white, fringe concolorous. Hindwing pale grey, somewhat translucent, fringe ochreous white. Underside of forewing grey, fringe white; underside of hindwing as upper side. Female unknown.

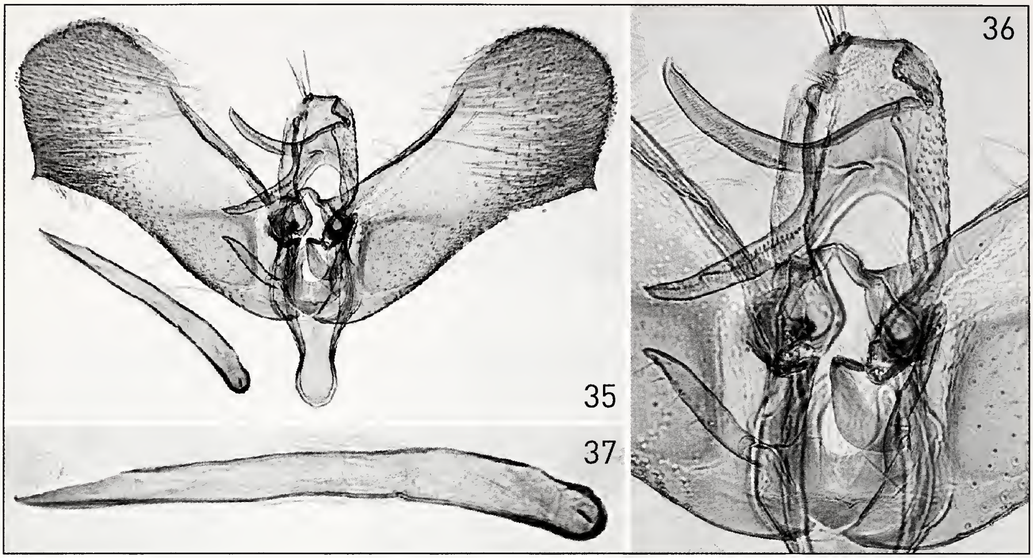
Male genitalia. Uncus lobes low, triangular, setose. Lobes of spinose knob of gnathos separate, narrow, elongate, with comb-like, longitudinal double row of spines, over 1/4 length of valva. Valva narrowest medially, four times longer than wide at narrowest point, with somewhat sclerotised valval process on ventral surface; costal sclerotisation not folded; sacculus weakly s-shaped, with small spine apically, cucullus expanded, rounded. Ventral shield of juxta sickle-shaped, dorsolaterally extended; juxta lobes widely set apart from each other, narrowly connected to median plate of juxta, distinctly sclerotised, without setae; triangular setose lobe present between juxta lobe and valval process. Digitate process absent. Vinculum narrow, v-shaped, with distinctive median ridge. Phallus 2/3 length of valva, basally bent, distally tapered to pointed, straight apex; blunt caecum with manica; vesica without cornuti.

Female. Unknown.

Life history. The specimens from Ürgüp were found in an area with exposed limestone (K. Nupponen, personal communication).

Distribution. Greece, Turkey, Turkmenistan.

Remarks. New to Turkmenistan. Traugott-Olsen (1990: fig. 24) mentions that *E. anatoliensis* possesses a paddle-shaped, unsetose digitate process. This structure is actually the juxta lobe (cf. Figs. 22, 24) and the structure interpreted to be the 'usual' juxta lobe as in *Elachista* in general is the lobe of the valval process.



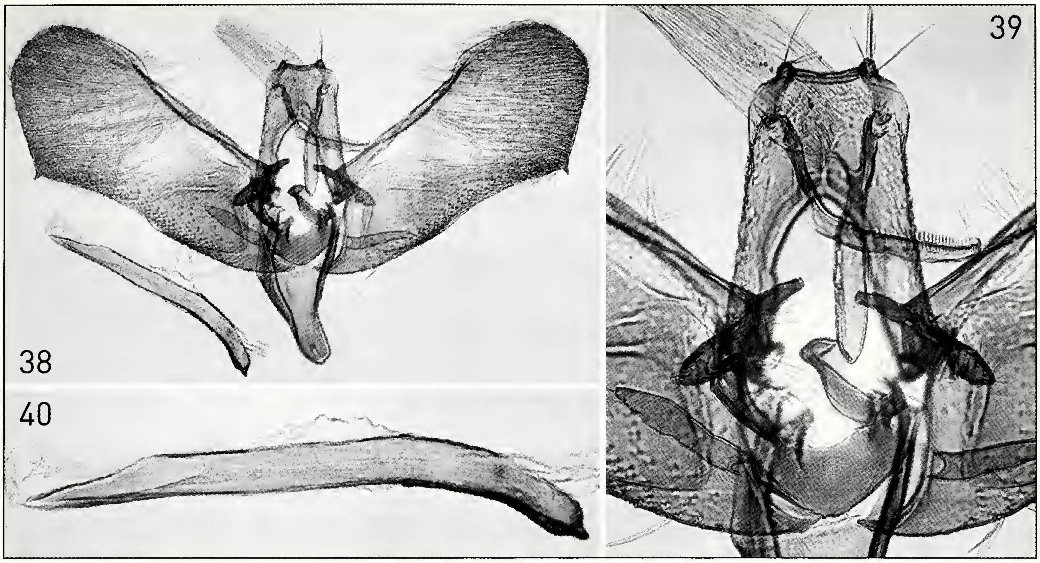
Figs. 35–37. Male genitalia of the holotype of *Elachista elksourensis* sp. n. (L. Kaila prep. n. 4141). **35.** General view. **36.** Details of uncus, gnathos, and juxta. **37.** Phallus.

Elachista alicanta sp. n. (Figs. 1, 9–10, 26–34)

Material. Holotype ♂: “Spanien, Alicante | Sierra de Crevillente | 5 km N. Albatera, 450 m | 38°15.22’N, 00°54,86’W | 23.v.2004 leg. P. Huemer leg. | TLMF2005-04”, “L. Kaila | prep. no. 4193”, “TLMF”, “Holotype | *Elachista* | *alicanta* | Kaila” (TLMF). – Paratypes: 22♂, 15♀, same data as holotype, except 2♀ 24.v.2004, 5♀ 26.v.2004 (TLMF, 2♂ 2♀ MZH).

Diagnosis. A very narrow-winged species, like *E. anatoliensis*. The forewing colour is, however, mottled grey with distinct plical and discal spots, unlike any other species of subgenus *Dibrachia* which all share a typical silky white forewing ground colour (Figs. 9, 10). Externally, *E. alicanta* could rather be mixed with *Stephensia unipunctella* Nielsen & Traugott-Olsen, *E. fuscibasella* Chrétien of the *Elachista* (*Aphelosetia*) *argentella* group, or representatives of the *Elachista* (*Elachista*) *biatomella* complex, all of which may co-occur with *E. alicanta* in southern Spain. However the new species has narrower forewings than any of these species. The genitalia also readily separate these unrelated taxa, and the absence of a developed uncus is visible without dissection. From other *Dibrachia* species it is characterised by the following characteristics in the male genitalia: the digitate process is elongate and narrow, resembling that of *E. elksourensis*, but the phallus contains one or two small cornuti (Figs. 26–31).

Description. Forewing length of ♂ 5.0–5.5 mm, ♀ 4.0–4.5 mm. ♂: Labial palpus 1.5 times longer than diameter of head, bluish white, second and third segments fuscous below on distal halves. Head white, scales more or less dark grey-tipped above. Scape and pedicel of antenna covered with pale grey and dark grey-tipped scales, pecten leaden grey; flagellum grey, weakly annulated by slightly darker rings. Neck tuft, tegula, and thorax covered with pale grey and dark grey-tipped scales, abdomen ochreous grey. Legs inwardly pale grey, outwardly leaden grey, tibia and tarsal articles of hindleg with bluish white distal rings. Forewing narrow, ground colour appearing mottled grey due



Figs. 38–40. Male genitalia of the paratype of *Elachista elksourensis* sp. n. (L. Kaila prep. n. 4259). **38.** General view. **39.** Details of uncus, gnathos, and juxta. **40.** Phallus.

to basally greyish white and distally dark grey-tipped scales, basal 1/5 of costa dark grey; elongate black spot at 1/2 wing length on fold, another similar spot at 3/4 wing length in middle. Fringe basally greyish white, distally dark grey, with blackish fringe line. Hindwing grey with concolorous fringe. Underside of forewing dark grey, fringe paler with creamy tinge. Underside of hindwing as upper side. Female otherwise as male but forewing shorter and broader, paler, ground colour formed by basally white and distally grey scales.

Male genitalia. Uncus lobes low, triangular, setose. Lobes of spinose knob of gnathos separate, narrow, elongate, with comb-like longitudinal double row of spines, 1/4 of length of valva. Valva narrowest medially, three times longer than wide at narrowest point, with somewhat sclerotised valval process on ventral surface; costal sclerotisation not folded; sacculus weakly s-shaped, with small spine apically, cucullus expanded, rounded. Ventral shield of juxta semicircular, dorsolaterally extended; juxta lobes widely set apart from each other, narrowly connected to median plate of juxta, distinctly sclerotised, without setae; narrow, triangular and distally pointed setose lobe present between juxta lobe and valval process. Digitate process s-shaped, elongate and narrow, setose. Vinculum narrow, u- or v-shaped, with weak median ridge. Phallus 2/3 length of valva, basally bent, distally tapered to pointed, straight apex; blunt caecum without manica; vesica with one or two straight cornuti.

Female genitalia. Papillae anales sclerotised, dorsodistally fused forming sharp blade, basally longitudinally wrinkled, sparsely covered with sensilla, lacking microtrichiae. Apophyses posteriores short, narrow; apophyses anteriores very short, triangular, distally pointed. Posterior margin of sternum 8 reinforced, with u-shaped median incision. Ostium bursae at anterior margin of sternum 8, membranous. Without

antrum; ductus seminalis membranous, tubular, incepted to ductus bursae cephalad of colliculum at posterior 1/20 length of ductus bursae; ductus bursae tubular, straight, three times longer than corpus bursae; corpus bursae with internally directed spiculae; with one dentate signum variable in shape.
Life history. Specimens were collected flying freely at dusk while some were attracted to light. The habitat is a xerothermic steppe slope on calcareous soil.
Distribution. Only known from southern Spain.

Elachista elksourensis sp. n. (Figs. 6, 35–40)

Material. Holotype ♂: "Tunisia, Atlas Mtns. | Le Kef 40 km SE | nr. El Ksour village | dry meadow close to chalk | mine, 800 m, 02.v.2000 | K. Nupponen leg"., "L.Kaila | prep. no. 4141", "Holotype | *Elachista* | *elksourensis* | Kaila", coll. Nupponen. – Paratype: ♂, same data as holotype (Kaila prep. n. 4259), MZH.

Diagnosis. A white species for which the sharp black irroration characterises it within subgenus *Dibrachia* (Fig. 6). Externally it resembles large representatives of the *Elachista* (*Aphelosetia*) *dispunctella* complex, which, however, usually show forewing plical and discal spots, even though these are sometimes irregularly delimited. The genitalia, notably the externally discernible absence of a well-developed uncus, will immediately distinguish *E. elksourensis* from them. From other *Dibrachia* species it is characterised by the following characteristics in the male genitalia: the digitate process is elongate as in *E. alicanta*, but the phallus contains no cornuti (Figs. 35–40).
Description, ♂. Forewing length 5.0 mm. Length of labial palpus 1.3 times diameter of head, white, second segment slightly ochreous – fuscous below. Scape, pecten, and pedicel of antenna white, flagellum grey. Head, neck tuft, patagia, and thorax white. Abdominal segments basally shiny light grey, distally white. Fore- and midleg inwardly pale, outwardly mottled grey, hindleg ochreous white, tibia and tarsal articles outwards mottled grey, distally white. Forewing white, irregularly irrorated with black-tipped scales especially in median and distal area, basal 1/5 costa narrowly dark grey; fringe white. Hindwing grey, fringe ochreous white. Underside of forewing leaden grey, fringe white; underside of hindwing as upper side. Female unknown.
Male genitalia. Uncus lobes low triangular, setose. Lobes of spinose knob of gnathos separate, narrow, elongate, with comb-like longitudinal double row of spines, 1/5 length of valva. Valva narrowest medially, three times longer than wide at narrowest point, with somewhat sclerotised valval process on ventral surface; costal sclerotisation not folded; sacculus weakly s-shaped, with small spine apically; cucullus expanded, rounded. Ventral shield of juxta sickle-shaped, dorsolaterally extended; juxta lobes widely set apart from each other, narrowly connected to median plate of juxta, distinctly sclerotised, without setae; triangular setose lobe present between juxta lobe and valval process. Digitate process elongate tongue-shaped, setose, distally obliquely tapered. Vinculum narrow, u-shaped, distally broadened, with indistinct median ridge. Phallus 2/3 length of valva, basally bent, distally tapered to pointed, straight apex; blunt caecum without or with small manica; without cornutus.
Female. Unknown.

Life history. The specimens were collected in a dry treeless meadow close to chalk mine. The area is calcareous, although no exposed limestone was visible on the surface.
Distribution. Only known from Tunisia, Atlas Mts.

Acknowledgements

I would like to express my gratitude for the loan or donation of material to Vladimir Dubatolov (Novosibirsk, Russia), Peter Huemer (Innsbruck, Austria), Ole Karsholt (Copenhagen, Denmark), Jari Junnilainen (Vantaa, Finland), Jari Kaitila (Vantaa, Finland), Kari and Timo Nupponen (Espoo, Finland), Zdeno Tokár (Michalovce, Slovak Republic), and Vadim Zolotuhin (Ul'yanovsk, Russia). Peter Huemer, Bernard Landry, and Kazuhiro Sugisima are thanked for their comments on the manuscript.

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(ISBN 87-88757-64-1). DKK 760.00 (excluding postage). (in English)

In many terms Gracillariidae are a remarkable group of Lepidoptera. Many species are characterised by beautiful forewings showing a metallic pattern through the stereo-microscope. The larvae are leafminers with a tendency to oligophagy or monophagy; therefore, they are easy to find in nature, and they are easy to breed. With these characters, a number of entomologists became fascinated by gracillariids and started to work on Microlepidoptera. Due to their phytophagous habits, some gracillariids are of economic importance and the group is of interest to applied entomologists also. Just during the last decade, the horse-chestnut leafminer (*Cameraria ohridella* Deschka & Dimic, 1986) spread throughout Europe, heavily infesting the leaves of *Aesculus hippocastanum*, to become one of the most studied lepidopterous species in Europe and remarkably well known to non-entomologists who are normally hardly able to recognise more than 15 species of Lepidoptera by their common name.

The sixth volume of the "World catalogue of insects" series, by Willy & Jurate De Prins, is dedicated to the Gracillariidae, a diverse family counting 1809 species, for which 517 synonyms are recorded. The species are grouped into 98 genera, for which 34 synonyms are mentioned.

The introductory section gives statistics on the number of descriptions of gracillariid species during the decades since 1758 and detailed information on the sources used to compile the catalogue as well as on the organisation of the database on which the catalogue is based. Details are also given on the arrangement of the catalogue and on the definitions of the zoogeographical regions. A list of abbreviations of museums storing gracillariid types is given. The introductory part ends with an overview of the changes in the classification of this lepidopterous group through time.

The catalogue itself is divided into seven parts: (1) family group names, (2) genus- and species-group names, (3) fossil species, (4) unavailable names, (5) unplaced species, (6) taxa transferred to other families, and (7) addenda. The catalogue is comprehensive regarding the information given. It starts with the currently valid family-group names Gracillariidae, Gracillariinae, Lithocolletinae, and Phyllocnistinae, giving author, year and reference of original description, the original spelling of the taxon name as well as the same information for the synonyms belonging to each valid name. Additional nomenclatural remarks are made where necessary. The same information is given for genera, which are ordered alphabetically, and for species, which are ordered alphabetically within each genus. For generic names, type species and designation of type species are given too. In the comprehensive treatment of the species, information is also given on type locality, number and deposition of type specimens, larval host-plants and parasitoids with references to the source for this information, as well as distribution by zoogeographical region and country. At the end of the book, a full bibliography and three indices for the scientific names of parasitoids, plants, and lepidopterans are given.

The book is easy to use, as different starting points can be used to find information via the contents, the alphabetical order within the catalogue and/ or the indices. All information given is linked to the relevant literature sources, of which the references are given in the bibliography. This makes all nomenclatural and additional information given verifiable. Hopefully this format will be used as a standard for similar projects in other groups of Lepidoptera.

The world catalogue of Gracillariidae is an excellent and comprehensive source of information to all those working with these insects, whether they are basic or applied entomologists or whether they are interested in the systematics or the relationships of gracillariids with plants and parasitoids. The book will certainly stand as a basic tool for working with Gracillariidae, though the current zeitgeist seems to favour electronic databases. Still, many readers prefer to have a 'stand-alone' source of information that shows the 'state of the art' at a certain date.

Matthias Nuss

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