

A Taxonomic Revision of the Korean Epipleminae (Lepidoptera: Uraniidae), with Phylogenetic Comments on the Involved Genera

Jae-Cheon Sohn¹ and Shen-Horn Yen^{2,*}

¹Insect Systematic Bioinformatics Laboratory, Department of Plant Medicine, Chungbuk National University, Gaesin-dong San 48, Heungdeok-gu, Cheongju 361-763, Chungbuk, Korea

²Department of Biological Sciences, National Sun Yat-Sen University, Kaohsiung, Taiwan 804, R.O.C.

(Accepted November 11, 2004)

Jae-Cheon Sohn and Shen-Horn Yen (2005) A taxonomic revision of the Korean Epipleminae (Lepidoptera: Uraniidae), with phylogenetic comments on the involved genera. *Zoological Studies* 44(1): 44-70. The Korean fauna of the Epipleminae (Uraniidae) is revised based on the most-recent taxonomic reassessment of this subfamily. Except for 2 unplaced species of the '*Epiplema*' *styx* complex, 9 species in 5 genera are recognized with 4 new to the Korean Peninsula and 2 new synonyms (*Epiplema sponsa* Swinhoe, 1895 of *Oroplema plagifera* (Butler, 1881), and *Gathynia fasciaria*, 1897 of *Monobolodes prunaria* (Moore, 1887)) established. Diagnoses and illustrations are given for all involved species. Keys to the identification of adults are provided for the genera and species. The phylogenetic implications of wing patterns, genitalia, and the androconial organ are discussed. The monophyletic status of the genera *Monobolodes* and *Phazaca* is yet to be tested. <http://www.sinica.edu.tw/zool/zoolstud/44.1/44.pdf>

Key words: Tympanal organ, Androconial organ, Wing pattern, Wing-folding behavior.

Moths of the subfamily Epipleminae constitute the most-diverse and cosmopolitan lineage of the Uraniidae (Minet and Scoble 1999), a family possessing a sexually dimorphic tympanal organ, which is unique among the Lepidoptera (Minet [1995]1994). To date, the global fauna of the Epipleminae comprises more than 600 species in 70 genera (summarized from Dalla Torre 1924, Gaede 1928 1929 1936, Seitz [1906-]1912 1912 [1926-]1930 1934 1940, Janse 1932, Boudinot 1982, Inoue 1982 1998, Chu and Wang 1983, Zhu and Wang 1994, Edwards 1996, Chen 1997, Holloway 1998), and many more taxa are yet to be described and reassessed. This subfamily is predominantly pantropical, e.g., in the Indo-Australian (Holloway 1998), Afrotropical, and Neotropical regions, but extending only weakly into Palearctic and Nearctic regions (Chen 1997, Holloway 1998). The most-spectacular feature of this subfamily concerns its resting posture. The forewings and

hindwings can be conspicuously rolled to be stick-like or are held flat against the substrate at rest, but this behavior has only been reported for species of the eastern Palearctic, Oriental (Chen 1997: figs. 73, 74), Indo-Australasian (Common 1990: figs. 53.10, 53.11, Scoble 1992: pls. 1-8) regions, and currently from Costa Rica (S.H. Yen pers. observ. 2003). In addition to the epiplemines, a few species of the ennomine Geometridae have been noted to have similar behavior (Nakata 1993).

The host plant range of epiplemine larvae comprises more plant families than those of the Uraniinae and Microniinae, and there appears to be a trend for specialization within epiplemine genera or species groups within genera (Holloway 1998), although our knowledge of host plant associations of this subfamily remains scanty. In general, the epiplemines are not of any economic importance except for 3 species, namely

* To whom correspondence and reprint requests should be addressed. Department of Biological Sciences, National Sun Yat-Sen University, Kaohsiung 804, Taiwan. E-mail: shenhornyen@hotmail.com

Leucoplemma doherlyi (Warren, 1904) (of Kenya), “*Epiplema*” *fulvilinea* Hampson, 1895 (of India), and “*Epiplema moza*” (of China) (see below for comments on this record), which are reported to be minor pests of coffee (*Coffea arabica* L.) (Rubiaceae) (Masaba 1996), *Gmelina arborea* (Verbenaceae) (Nair 2001), and *Paulownia* sp. (Scrophulariaceae) (Chang and Hu 1992) (see the section on *Dysaethria moza*), respectively. Although the Epipleminae harbor most species of the Uraniidae in tropical regions, they have very seldom been addressed in any moth faunistic survey. Their significance with respect to biodiversity research has just recently been noted in 2 studies: a comparison of moth faunas between plantation and natural forests in Sabah, Borneo (Chey et al. 1997), and an overall survey of arthropods of Samoa I. (Kami and Miller 1998). Novotny et al. (2002) also sampled some epiplemine species of New Guinea to investigate insect-host plant interactions.

Like many other lepidopteran groups, the systematic concept and relationships of this subfamily have been controversial since the 1850s (see also Minet 1991, Heppner 1998, Minet and Scoble 1999) because the earlier classifications were largely based on wing shapes (e.g., angled forewing apex, incised forewing margin, and short hindwing tails) and wing patterns, which are often thought to be unreliable for classification. The previous concepts of the Epipleminae involved various family groups, e.g., ennomine Geometridae, drepanine Drepanidae, auzeine Uraniidae, and Epicopeiidae (see Dalla Torre 1924, Gaede 1928 1929 1936, Seitz [1906-]1912 1912 [1926-]1930 1934 1940, Fletcher 1979, Minet and Scoble 1999). Even in modern museum collections, the epipleminae are often misfiled with the Drepanidae and Geometridae. This subfamily has also been given family status in past literature (e.g., Bryk 1949, Pak 1970, Kuznetzov and Stekolnikov 1981, Boudinot 1982, Inoue 1982, Chu and Wang 1983, Shin 1983a b, Lee et al. 1985, Stehr 1987, Sugi 1987, Wang 1987 1993 1996, Shin et al. 1989, Kim 1991, Chang 1992, Zhu and Wang 1994, Byun and Lee 1996, Byun et al. 1996, Paek et al. 1997). However, comparative morphological studies on the sexually dimorphic tympanal organ (Sick 1937, Minet [1995]1994) and immature stages (Nakamura and Yoshiyasu 1992) have already suggested a close affinity between the Epipleminae and Uraniidae. Minet (1986 1991 [1995]1994) proposed a phylogenetic framework of ((Uraniinae + Microniinae) + Epipleminae) +

Auzeinae), and this hypothetical relationship supports the viewpoint that the Epipleminae are better treated as a subfamily of the Uraniidae. Despite several faunistic studies which have ignored Minet’s viewpoint (e.g., Wang 1993, Zhu and Wang 1994), the redefined concept of the Epipleminae has been followed by most recent authors (e.g., Holloway 1976 1998, Sugi 1994a 2000, Edwards 1996, Chen 1997, Inoue 1998, Minet and Scoble 1999, Sugi 2000, Wagner et al 2001) as well as the present study.

Compared with the other uraniid subfamilies, the epipleminae are usually a small to moderate size (with a wingspan of 8~60 mm), and it is hard to determine their generic placements merely from wing patterns and wing shapes. Minet ([1995] 1994) considered that the internal projection of the male tympanal organ may support the monophyly of Epipleminae; the organ is basally broad and arises from the anterior part of the tympanal frame (on A2) (see Sick 1937: figs. 7-10, 23-26, 30, 31, Minet [1995]1994: fig. 3, Chen 1997: fig. 1, Holloway 1998: figs. 162, 163, 165, Minet and Surlykke 2003: fig. 11.11-F). Holloway (1998) and Minet and Scoble (1999) further provided additional diagnostic characters, e.g., male antennae lamellate or uniserrate, forewing with M2 and Rs4 + M1 often connate, tympanum opening posteriorly in male and at base of abdomen in female, valvae with 1 or 2 pairs of hair pencils, and hindwing with an irregular termen. All of these characters have yet to be examined on a global basis and tested by phylogenetic methods.

The generic classification of the Epipleminae has been very unsatisfactory since the 1850s. Most of the problems are historical, owing to inappropriate placements of the Old World species in the Neotropical *Epiplema* Herrich-Schäffer, 1855 (type species: *Epiplema acutangularia* Herrich-Schäffer, 1855) (Fig. 2h). Chen (1997) and Holloway (1998) attempted to rationalize the generic classification in the Oriental and Indo-Australasian tropics, though appropriate generic placements for many species have yet to be found in the absence of satisfactory phylogenetic framework. Before carrying out a phylogenetic analysis on such a diverse group with numerous unsolved taxonomic problems, we considered that it would be realistic to revise regional faunas, with those results offering reliable references for taxon sampling in future phylogenetic studies.

Among the countries that belong to the East Palaearctic region, the epiplemine faunas have only been fully investigated in Japan (Butler 1878

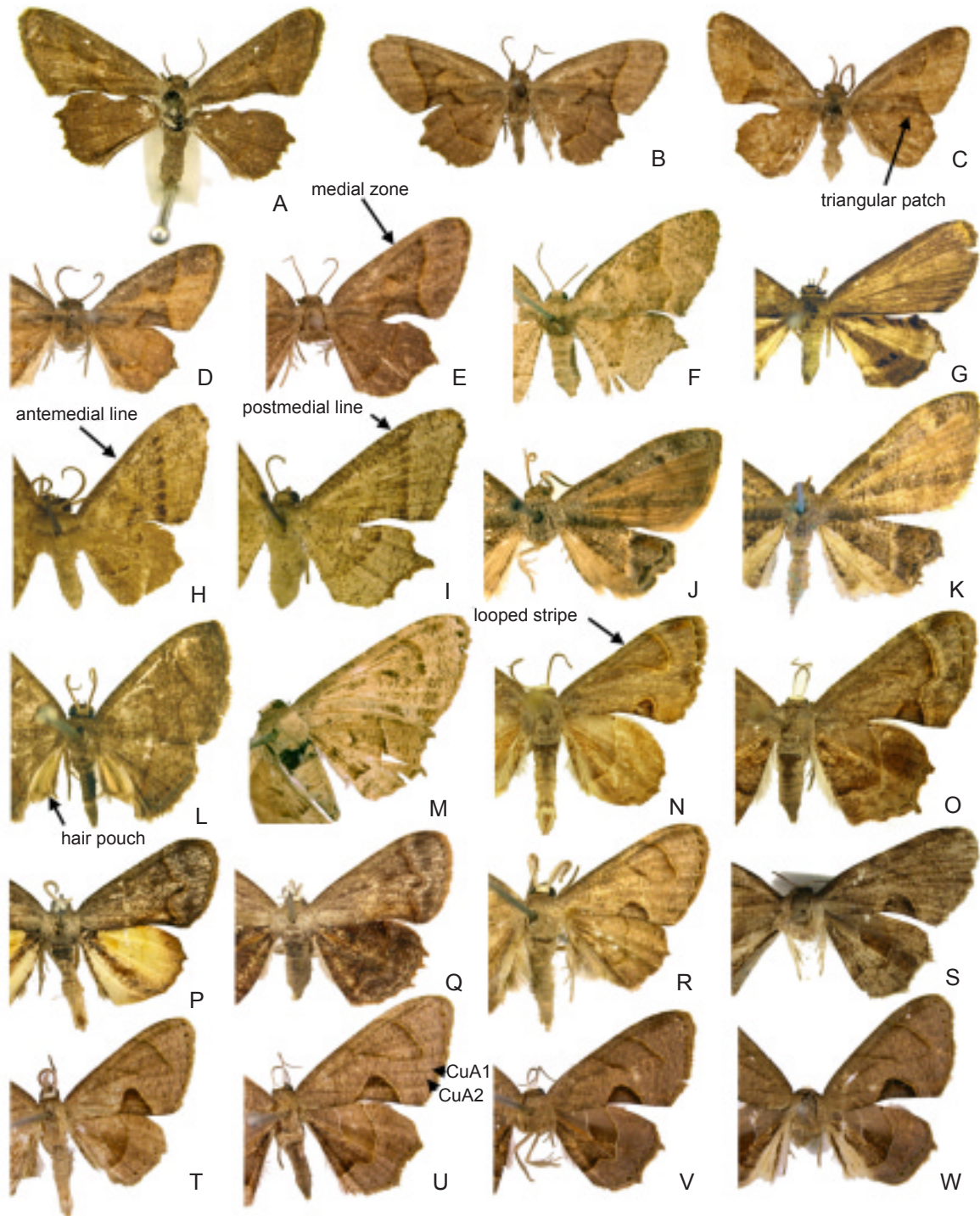


Fig. 1. Adult epipleminid species. (A) *Monobolodes prunaria*, ♀, holotype of *Dirades prunaria* Moore, Sri Lanka; (B) ditto, ♀, holotype of *Gathynia fasciaria* Leech, Korea; (C) ditto, ♂, holotype of *Phazaca oribates* West, Taiwan; (D) ditto, ♂, Taiwan; (E) ditto, ♀, Taiwan; (F) *Monobolodes subfalcata* Warren, ♀, Queensland; (G) *Gathynia miraria* Walker, ♀, Sri Lanka; (H) *Monobolodes euthysticha* (Turner) (= *Acachmena euthysticha*, *Cathetus euthysticha*), ♂, Queensland; (I) ditto, ♀, Queensland; (J) *Phazaca interrupta* (Warren) (= *Lobogethes interrupta*), ♂, Queensland; (K) ditto, ♀, Queensland; (L) *Phazaca planimargo* (Warren) (*Homoplexis planimargo*), ♂; (M) *Phazaca microthyris* (Turner) (= *Balantiucha microthyris*), Queensland; (N) *Phazaca theclata* (Guen?) (= *Phazaca binotata* Walker), ♂, Sri Lanka; (O) ditto, ♀, Sri Lanka; (P) *Phazaca erosioides* Walker, ♂, Sarawak; (Q) ditto, ♀, Sarawak; (R) *Phazaca perfallax* (Warren) (= *Diradopsis perfallax*), ♂, Papua New Guinea; (S) *Phazaca alikangensis* (Strand), ♀, Korea; (T) ditto, ♂, Taiwan; (U) ditto, ♀, Taiwan; (V) *Phazaca kosemponicola* (Strand), ♂, Taiwan; (W) ditto, ♀, Taiwan. All specimens in the BMNH collection.

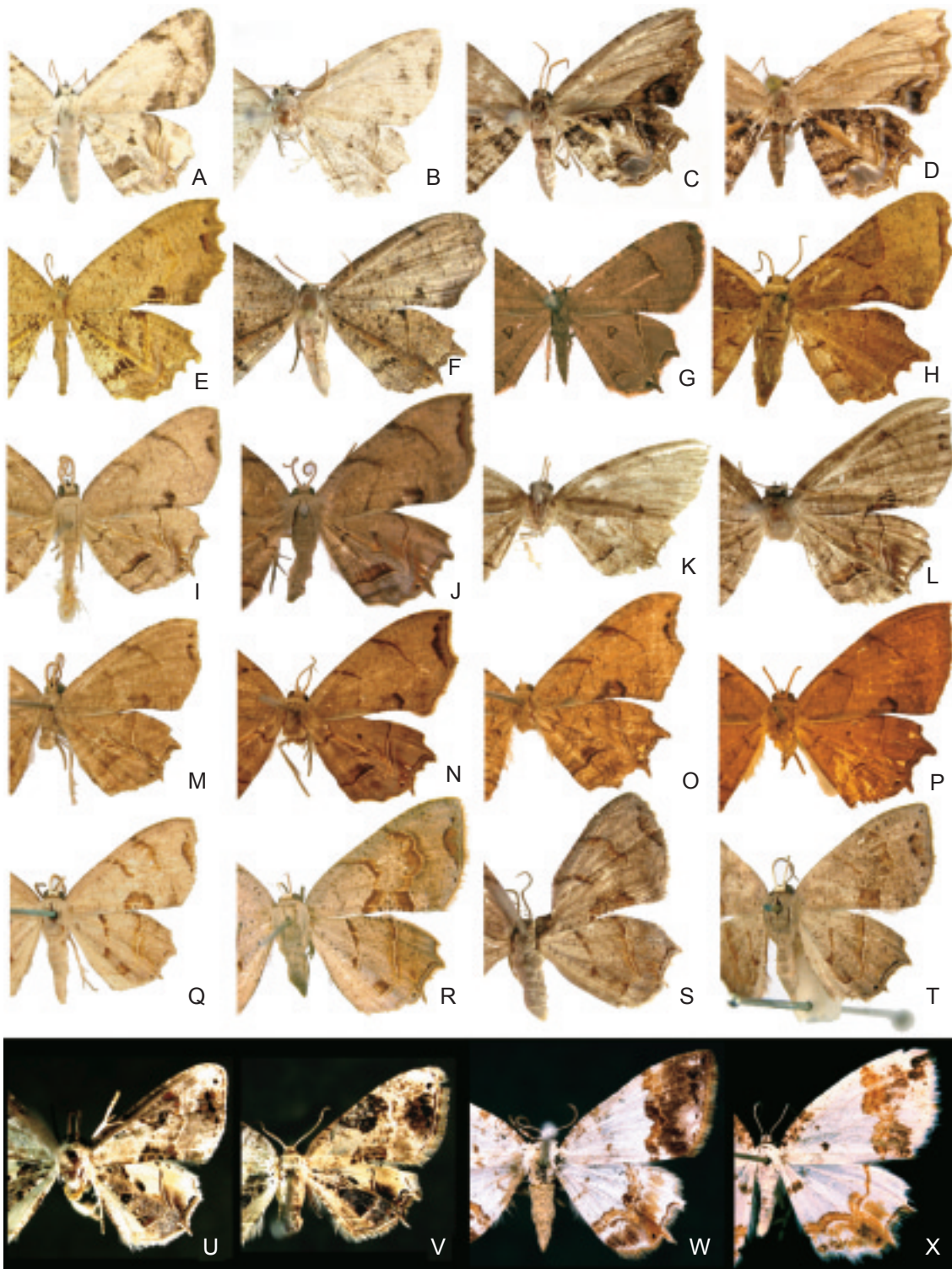


Fig. 2. Adult epiplemine species. (A) *Dysaethria cretacea* (Butler), ♀, Japan; (B) ditto, ♂, Korea; (C) *D. erasaria* (Christoph), ♀, Japan; (D) ditto, ♀, Korea; (E) *D. flavistriga* (Warren), ♀, Taiwan; (F) ditto, ♀, Korea; (G) *D. indignaria* (Walker), ♀, Sumatra; (H) *Epiplema acutangularia* Herrich-Schaffer, ♀, Brazil; (I) *D. moza* (Butler), ♂, Japan; (J) ditto, ♀, Japan; (K) ditto, ♂, Korea; (L) ditto, ♀, Korea; (M) *D. meridiana* (Inoue), ♂, Okinawa; (N) ditto, ♀, Okinawa; (O) *D. shuisharyonis* (Strand), ♂, Taiwan; (P) *D. subflavida* (Swinhoe), ♀, Sarawak; (Q) *Oroplema oyamana* (Matsumura), ♂, Japan; (R) ditto, ♀, Japan; (S) ditto, ♀, Korea; (T) *O. simplex* (Warren), ♀, Sri Lanka; (U) *O. plagifera* (Butler), ♀, Korea; (V) ditto, ♂, Korea; (W) "*Epiplema*" *fuscifrons* (Warren), ♀, N. India; (X) *Eversmannia exornata* (Eversmann), ♂, Russian Far East. All specimens in the BMNH collection.

1881, Leech 1897 1901, Matsumura 1931, Inoue 1982 1984 1989, Sugi 2000) and the Russian Far East (Eversmann 1837, Bremer 1864, Christopher 1881, Dubatolov et al. 1994). The Chinese epiplemine fauna was studied by Leech (1897 1901), Chu and Wang (1983), and Zhu and Wang (1994), but an extensive revision based on a thorough examination of museum material and application of modern methodologies is not yet available. On the Korean Peninsula, Leech (1897) first reported 2 species, *Epiplema moza* (Butler, 1878) and *Gathynia fasciaria* Leech, 1897, both collected from Gensan (=Weonsan). Bryk (1949), Pak (1970), and Shin (1983b) each added 1 species, *Epiplema flavistriga* (Warren, 1901), *Epiplema erasaria* (Christoph, [1881]1880), and *Epiplema plagifera* (Butler, 1881), respectively. For a long

time these 5 species were regarded as the only Korean representatives of the Epipleminae.

Since 2000, our survey in various institutions has confirmed that 11 epiplemine species occur on the Korean Peninsula. Therefore the aims of the study were (1) to revise the Korean epiplemine fauna according to the generic classification reassessed by Holloway (1998), (2) to provide a practical identification key to the genera and species, (3) to discuss the systematic problems relevant to the taxa in this area, and (4) also to comment on wider aspects of studies on this subfamily. Among the 11 species recognized, 2 undescribed species which belong to the "*Epiplema*" *styx* complex are not included in this study because the generic status of this complex, comprising about 8 species in East Asia and the

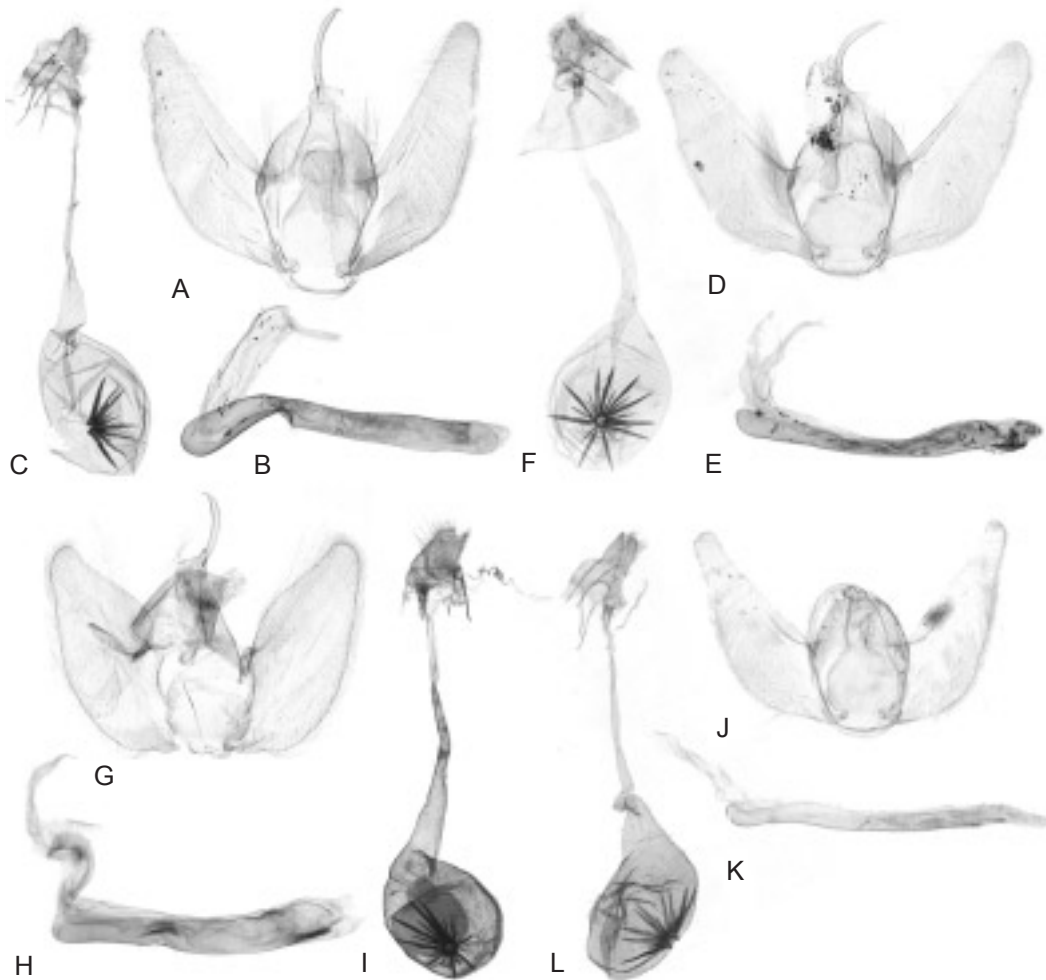


Fig. 3. Genitalia of *Monobolodes prunaria sensu lato*. (A) male genitalia, BMNH Uraniidae slide no. 463, Taiwan; (B) ditto, aedeagus; (C) female genitalia, BMNH Uraniidae slide no. 464, Taiwan; (D) male genitalia, BMNH Uraniidae slide no. 9706, Amami Island; (E) ditto, aedeagus; (F) female genitalia, BMNH Uraniidae slide no. 9707, Amami Island; (G) male genitalia, BMNH Uraniidae slide no. 460, Borneo; (H) ditto, aedeagus; (I) female genitalia, holotype of *Gathynia fasciaria*, Korea; (J) male genitalia, BMNH Uraniidae slide no. 467, Sri Lanka; (K) ditto, aedeagus; (L) female genitalia, BMNH Uraniidae slide no. 465, Sri Lanka.

Himalayas, cannot be determined without a phylogenetic study. The diagnostic characters of this complex in Korea are therefore only referred to in the identification keys. In addition, *Nossa alpherakyi* Herz, 1904, a rare species described from Korea, was originally considered to be an epiplemine species (as *Nossa palaeartica* in Dubatolov et al. 1994). However, the genus *Nossa* Kirby, 1892 has been transferred to the Epicopeiidae (Minet 1986, Minet and Scoble 1999) and is considered to be the sister group of *Schistomitra* Butler, 1881 (Minet [2003]2002), so this species is also excluded from the present study.

MATERIALS AND METHODS

All identifications were based on primary types, and on extensive series of other specimens, examined from the following sources: The Natural History Museum, London, UK (BMNH), Deutsches Entomologische Institut, Eberswalde, Germany (DEI), National Museum of Natural History, Smithsonian Institutions, Washington DC, USA (NMNH), Faculty of Agriculture, Univ., Hokkaido, Japan (HUFA), Center for Insect Systematics, Kangwon National Univ., Chuncheon, Korea (CIS), Department of Biology, Kyeongsang National Univ., Jinju, Korea (KSU), Department of Biology, Incheon Univ., Incheon, Korea (IU), and Department of Biological Education, Mokpo National Univ., Mokpo, Korea (MNU).

External features and genitalia were examined in the type species of all involved genera to confirm the generic identities. Genitalia and tympanal organs were examined and prepared following the general protocol described by Holloway et al. (1987) and Minet [1995]1994. Measurement of wingspan was based on Korean material. Morphological terminology followed Common (1990) for wing venation, Holloway (1998) for wing pattern with slight modification, Klots (1970) for genitalia, and Minet [1995]1994 for tympanal organs. All illustrations were made using the digital cameras, Coolpix 4500 and Coolpix 5700 (Nikon) and an Olympus SZX 12 microscope. Geographical data for comparing distribution patterns were extracted from the following sources: Leech (1897), Bryk (1949), Pak (1970), Shin (1983a b), Lee et al. (1985), Shin et al. (1990), Kim (1991), Lee et al. (1996), Byun and Lee (1996), Byun et al. (1996), Jeong et al. (1997), Paek et al. (1997), Park et al. (2001).

Abbreviations for the Korean locality names

are: Hamnam (HN) and Pyeongnam (PN) of North Korea; and Chungnam (CN), Gwangju City (GJ), Gyeongbuk (GB), Gyeonggi (GG), Gyeongnam (GN), Gangwon (GW), Jeonbuk (JB), Jeju (JJ), Jeonnam (JN) and Seoul (SE) of South Korea.

SYSTEMATIC ACCOUNTS

Epipleminae Hampson, 1892

Key to the Korean epiplemine genera based on adult wings

1. Forewing with prominent triangular patch at hind margin, severely folded in resting posture; hindwing shape sexually dimorphic, female with short tails at Rs and M1.....5
 - Forewing with or without a rectangular or semicircular patch at hind margin, not folded in resting posture; hindwing shape sexually monomorphic, both sexes with short tails at R2 and M1.....2
2. Forewing suffused with white from postmedial line to submarginal line, background white, no rectangular patch at forewing hind margin3
 - Forewing with defined postmedial or submarginal line, background brown, rarely white, rectangular or semicircular patch at forewing hind margin present.....4
3. R2 separated from R3+R4.....
 - "*Epiplema*" *styx* species-complex
 - R2 stalked with R3+R4.....*Eversmannia* Staudinger
4. Hindwing with postmedial patch running to inner margin....
 -*Dysaethria* Turner
 - Hindwing with postmedial patch running to 1A.....
 -*Oroplema* Holloway
5. Forewing triangular patch well-bordered, antemedial and postmedial lines forming a closed looped stripe, hindwing with well-defined antemedial and postmedial lines.....
 -*Monobolodes* Warren
 - Forewing triangular patch not bordered or connected to costal looped patch, hindwing without well-defined antemedial and postmedial lines.....*Phazaca* Walker

Key to the Korean epiplemine genera based on male genitalia

1. Valva not significantly differentiated into 2 parts.....2
 - Valva differentiated into 2 parts, ventral parts with 1 or 2 bunches of scent hairs.....*Phazaca* Walker
2. Uncus single, elongate; socius absent.....3
 - Uncus not elongate, blunt at apex; socius developed.....
 -*Dysaethria* Turner
3. Valva elongate, dorsal and ventral margins parallel.....4
 - Valva triangular, fan-like, dorsal and ventral margins not parallel.....5
4. Gnathos absent; cornutus absent.....
 - "*Epiplema*" *styx* species-complex
 - Gnathos present; cornutus present.....
 -*Eversmannia* Staudinger
5. Valva fan-like, broader at medioventral part
 -*Oroplema* Holloway
 - Valva triangular, broader near base and attenuated toward apex.....*Monobolodes* Warren

Key to the Korean epiplemin genera based on female genitalia

1. Corpus bursae extending to 6th abdominal segment, pair of small signa present, ductus spiralis developed, small sac with scobination present at frontal end of rectum.....*Oroplema* Holloway
- Corpus bursae extending beyond 6th abdominal segment, signa present or absent, ductus spiralis small, rectum lacking small terminal sac.....2
2. Ductus bursae short, corpus bursae oblong.....3
- Ductus bursae long, corpus bursae orbicular or spherical.....4
3. Signum rectangular, serrate at margins, posterior end with a notch.....*Eversmannia* Staudinger
- Signum oblong, with 2 rows of small dentations.....*"Epiplema"* styx species-complex
4. Ductus bursae about as long as corpus bursae, signum variably shaped.....*Dysaethria* Turner
- Ductus bursae much longer than corpus bursae, signum stellate.....5
5. Ductus bursae without granulate surface.....*Monobolodes* Warren
- Ductus bursae with granulate surface.....*Phazaca* Walker

Genus *Monobolodes* Warren, 1898 (Figs. 1A-I, 3, 11A)

Monobolodes Warren 1898: 229. Type species: *Monobolodes subfalcata* Warren 1898 (Queensland) (Fig. 1F).

Cathetus Fletcher 1979: 37 (replacement name of *Acachmena* Turner 1911). Type species: *Acachmena euthysticha* Turner 1911 (Queensland) (fig. 1H, I). Synonymized by Holloway 1998: 120.

Diagnosis: Antennae laminate in male, filiform in female. Forewing usually with curved medial band and smooth outer margin. Hindwing veins and tails sexually dimorphic (distinctively stronger angle of tail at Rs in male). Male genitalia with curved, acute uncus; valva simple, ovate; sacculus membranous on basal part, with or without pair of hair-pencils; aedeagus vesica usually with or without scobinate zone and bundle of slender spines. Female genitalia with elongate, slender ductus bursae; corpus bursae pyriform; single stellate signum present or not.

Remarks: In the checklist by Dalla Torre (1924), only 6 species (*fuscibrunnea* Warren, 1899, *pallens* Warren, 1899, *rectifascia* Warren, 1899, *schistacea* Warren, 1905, *subfalcata* Warren, 1898, and *ustimacula* Warren, 1903) were included in *Monobolodes*. Its generic concept was reassessed by Holloway (1998) by including several species which were previously associated with *Gathynia*, *Phazaca*, and *Dirades*. The monophyly of the revised *Monobolodes*, however, is still uncertain because none of the diagnostic charac-

ters mentioned above is unique to this genus or consistent among species. The species having black ground color and an antemedial band on the forewings (the *subfalcata* group and *pernigrata* group) have developed hair tufts situated in a loop-like structure formed by the valval sacculus (Holloway 1998: figs. 280-282, 284), while valval bases of the species with brownish ground color and an obscure black medial band on the forewings (*prunaria* group sensu Holloway) do not have these characters (Fig. 3A, D, G, J; see also Holloway 1998: figs. 283, 286). In female genitalia, the well-developed stellate signa of the corpus bursae are present in the *subfalcata*, *pernigrata* (Chen 1997: fig. 37), and *prunaria* groups (Figs. 3C, F, I, L), but in *Monobolodes simulans* (Butler, 1889) (see Chen 1997: fig. 38), a species included in the *prunaria* group by Holloway (1998), the stellate signum is absent, and appendix bursae are present. An intermediate condition is present in *M. parvinigrata* Holloway, 1998, which has similar external features to *pernigrata*. This species has no sacculus loops in the male, but a well-developed stellate signum is present in the female. These inconsistent character distributions show that using either wing patterns, or male or female genitalia may generate incongruent phylogenetic relationships within *Monobolodes*. In addition, the wing patterns and wing shape of *Monobolodes* are also very similar to those of the Nearctic *Antiplecta* Warren, 1900 and the Neotropical *Capnophylla* Warren, 1897, *Nyctibadistes* Warren, 1897, and *Symphytophleps* Warren, 1909. These similarities may prove to be convergent or homologous in future studies.

Monobolodes prunaria (Moore, 1887) (Figs. 1A-E, 3A-F, I-K, 3A-F, 3I-L, 11A)

Dirades prunaria Moore 1887: 400. Type locality: Sri Lanka (as Ceylon) (Fig. 1a), holotype in BMNH.

Gathynia fasciaria Leech 1897: 187. Type locality: Korea, Gensan. syn. nov. (Fig. 1b), holotype in BMNH.

Phazaca oribates West 1932: 218. Type locality: [Taiwan], [Tainan County], Kanshirei [=Guanziling] (Fig. 1c), holotype in BMNH. Synonymized by Holloway 1998: 123.

Phazaca prunaria, Inoue 1982: II, 64, 312, pl. 110, figs. 33, 34.
Monobolodes ? prunaria, Holloway 1998 (part): 123, fig. 283, pl. 7: 45.

External features: Wingspan 16 mm in female. Head dark grayish-brown. Thorax dark grayish-brown. Forewing dark grayish-brown, with dark-brown striations, with round apex; ante- and postmedial lines dark brown, forming a broad dark-brown band constricted medially; a dark-brown tri-

angular spot present at middle of posterior margin. Hindwing dark grayish-brown, suffused with dark-brown scales; postmedial line dark brown, angled centrally; basal line dark brown, weakly present; a tooth-like tail present on Rs; 2 tiny tails present on M1 and M3.

Male genitalia: Since no male specimen was available from Korea in the present study, diagnosis of the male genitalia was made according to Chen's (1997: 89-91) descriptions and genitalia slides of this species in the BMNH collection (see Appendix 1). Uncus slender, slightly curved with a sharp apex and subtriangular base; tegumen broad; saccus undeveloped; juxta forming a broad sclerite from saccus to lower margin of tegumen; valva simple, ovate with slightly expanded base; no differentiation between sacculus and valvula apparent; aedeagus slender, apex without scobination or cornutus, phallobase present.

Female genitalia: Papillae anales laterally triangular; apophyses posteriores slightly longer than papillae anales; antrum slightly sclerotized near ostium ring; ductus bursae long, slender, without granulated surface; corpus bursae oblique, signum stellate, with about 20 sharp spines.

Material examined: Korea: 1 ♀, Gensan (= Weonsan), July 1887 (Ito) (BMNH) (holotype of *Gathynia fasciaria*).

Distribution: Korea, Japan (Honshu, Shikoku, Kyushu, and the Ryukyu Archipelago), Taiwan, S. China (Hong Kong), and Sri Lanka.

Host plant: *Gardenia jasminoides* Ellis (Rubiaceae) in Japan (Inoue 1982, Murase 1998) and Taiwan (Chen 1997).

Remarks: This species was placed in *Gathynia* Walker, (1863) (type species: *Gathynia miraria* Walker, (1863)), *Dirades*, 1866, and *Phazaca* Walker, 1863, all unrelated to *Monobolodes*. The male genitalia of *M. prunaria* share none of the potential synapomorphies of *Phazaca* sensu Holloway (see discussion of *Phazaca*), e.g., a divided sacculus and valvula, and developed hair tufts arising from the blade-like sacculus. Compared with *Gathynia miraria*, *M. prunaria* has much greater development of the uncus (vestigial in *G. miraria*), but lacks hair tufts arising from the sacculus and apical spine of the valva costa. Although the monophyly and potential synapomorphies of *Monobolodes* remain uncertain, we still suggest placing *prunaria* in this genus because its male genitalia share the following characters with those of the nominotypical *M. subfalcata*: valva attenuated towards the apex, sacculus not significantly differentiated from the valvula,

and no hair tuft arising from the sacculus.

Holloway (1998) synonymized *Phazaca oribates* with *Dirades prunaria* based on a comparison of the material from Taiwan and Sri Lanka, respectively. When examining the Epipleminae collection in the BMNH, we found that *Gathynia fasciaria* Leech, only known from a female type (Fig. 1b), was also very similar to *M. prunaria*. Compared with specimens from Japan, Taiwan, and Sri Lanka, the type of *G. fasciaria* is smaller and has a more-distinct hindwing medial line, while its genitalia (Fig. 3i) show no differences from those of *prunaria*. We also examined the female genitalia of *M. simulans*, another continental Asian species, but we did not find that *fasciaria* could be related to *simulans*, because the former lacks appendix bursae and the multiple short scobinations on the anterior end of the corpus bursae. We therefore came to the conclusion that *fasciaria* is conspecific with *prunaria*.

This synonymy has also extended the known distribution of this species. However, on the Korean peninsula, *Gardenia jasminoides* Ellis is not a native plant but was introduced from China about 1500 years ago (Lee 1974, Kim 1996). Therefore, the rarity of *M. prunaria* in Korea is possibly due to an incidental invasion by *Gardenia* from China, or *prunaria* possibly utilizes other plants of the Rubiaceae in Korea.

In addition, Holloway (1998) noticed that the specimens of "*prunaria*" from Borneo (Fig. 3g, h) have shorter and broader valvae and a slightly protruded valva costa. These characters are not seen in the populations from Korea, Japan, Taiwan, China, and Sri Lanka. We therefore suggest excluding Borneo from the distribution of this species. The taxonomic status of the Bornean specimens is yet to be resolved once more material and information on the biology become available.

Genus *Phazaca* Walker, 1863

(Figs. 1J-W, 4-6, 11A)

Phazaca Walker 1863: 20. Type species: *Phazaca erosoides* Walker 1863 (Malaysia: Borneo) (Figs. 1H, I, 4A-E).

Dirades Walker 1866: 1650. Type species: *Dirades binotata* Walker 1866 (Sri Lanka) (junior synonym of *Erosia theclata* Guenée, 1857) (Figs. 1J, K, 4F-J). Synonymized by Holloway (1998).

Lobogethes Warren 1896: 351. Type species: *Lobogethes interrupta* Warren 1896 (Australia: Queensland) (Fig. 1M, 6D-I). Synonymized by Holloway (1998).

Diradopsis Warren 1898: 425. Type species: *Diradopsis perfallax* Warren 1898 (Indonesia: Key Is.) (Fig. 1N). Synonymized by Holloway (1998).

Homoplexis Warren 1907: 117. Type species: *Epiplema planimargo* Warren 1906 (Papua New Guinea) (Fig. 1G, 6A-C). Synonymized by Holloway (1998).

Balantiucha Turner, 1911: 74, 76. Type species: *Balantiucha microthyris* Turner 1911 (Australia: Queensland) (Fig. 1I). Synonymized by Holloway (1998).

Diagnosis: Antennae densely unipectinate, laminate, with longer rami in male, but shorter and filiform in female. Forewing usually with looped stripe (absent in *P. erosioides*) and rounded outer margin. Hindwing tails sexually dimorphic (vestigial or absent in male, 2-tailed in female) and veins. Male genitalia with distinctive shape of valvae; uncus simple, with laterobasal flanges; sacculus separated from distal part of valvula; apex of valva rounded (Fig. 5D, I) or arched interiorly (Figs. 4A, F, 5A, C), sacculus oblique or blade-like with 2 bundles of androconial hairs, juxta urn-shaped, long, strap-like, vinculum not developed. Female genitalia with very long ductus bursae, narrow; corpus bursae globular; a single stellate signum present (weakly developed in *P. erosioides*) (Fig. 4C-E).

Remarks: The traditional concept of *Phazaca* comprised only 2 species, *P. erosioides* (Dalla Torre 1924) (Fig. 1P, Q) and *Monobolodes prunaria* (as *Phazaca oribates* in West 1932 and Inoue 1992). Holloway (1998) has broadened the concept of *Phazaca* to embrace all of the species previously placed in *Dirades*, *Lobogethes*, *Diradopsis*, *Homoplexis*, and *Balantiucha*. All of these species share a significant synapomorphy: the valva of the male genitalia is differentiated into a long blade-like or fan-like valvula and the oblong sacculus at which 1 or 2 bunches of androconial hair tufts are situated. This peculiar type of valva seems to be unique within the Epipleminae and strongly supports the monophyly of *Phazaca* sensu lato. However, the internal relationships of this genus and its affinities with other genera are still unclear. The external features of *interrupta* (Fig. 1J, K) and *planimargo* (Fig. 1L) are very distinct from all the other species. In *interrupta*, the forewing lacks a looped stripe (see Fig. 1N), hindwing tails, an ante-medial line, and a slightly dentate submarginal line, but has transverse bands on the fore- and hindwings. In *planimargo*, both the fore- and hindwings are much shorter and lack any marginal incision and tails; the looped stripe and triangular patch are absent; and a eversible pouch (Fig. 1L) enclosing numerous androconial hairs is present at the hindwing inner margin. A similar eversible pouch is also found in several Neotropical species, e.g., "*Epiplema*" *birostrata* (Guénee, 1852) from

Brazil. Compared with other *Phazaca* species, the male genitalia of *interrupta* and *planimargo* have a much-broader distal part of the valvula, a more interiorly curved valval apex, a narrower sacculus, and a scobinated juxta. These 2 species apparently have many autapomorphic characters, but none of these characters immediately justifies these species being placed back into their original genera, *Lobogethes* and *Homoplexis*, because the phylogenetic structure of *Phazaca* sensu lato is not available at the present. In the Neotropical region, the wing patterns and wing shapes of 4 genera, namely *Philagraula* Hulst, 1896, *Gymnoplocia* Warren, 1905, *Neodeta* Warren, 1906, and *Nototypa* Warren, 1906, greatly resemble those of *Phazaca*, and their relationships with *Phazaca* need to be clarified.

***Phazaca alikangensis* (Strand, 1916)**
(Figs 1S-U, 5A-I, 11A)

Dirades alikangensis Strand 1916: 139. Type locality: Alikang, Taiwan, holotype in DEI.

Balantiucha mutans minuscula (part.): Kawazoe and Ogata 1962: 20.

Dirades kosemponicola (part.): Inoue 1965: 357.

Phazaca alikangensis: Holloway 1998: 127, fig. 300, pls. 7: 53; 8: 22.

External features: Wingspan 18 mm in female. Head dark brown, covered with white scales on vertex. Thorax grayish-brown. Forewing dark grayish-brown, with dark-brown striations, with round apex; ante- and postmedial lines dark brown, curved moderately at middle; dark-brown triangular spot present in middle of posterior margin. Hindwing dark grayish-brown, suffused with dark-brown scales; postmedial line pale dark brown, fine, angled centrally, diffused with dark reddish-brown interiorly; submarginal line dark brown, dotted; Rs and M3 with tiny tooth-shaped tails. Abdomen dark grayish-brown. Extremely similar to *P. kosemponicola* (Strand, 1916) (Figs. 1V, W, 5J, K), but forewing triangular patch extending to CuA1 (Fig. 1U), postmedial line of male hindwing smooth (Fig. 1T), sacculus of male genitalia shorter, cornuti absent, and posterior part of ductus bursae not sclerotized.

Male genitalia: Because no male material from Korea was available, the diagnosis is based on the genitalia slides examined (see Appendix 1) and figures in Chen (1997). Uncus long, slender, falcate, hooked at apex; tegumen narrow, rounded; distal part of valvula simple, elongate with rounded apex; sacculus oblique, short, about 1/5 of valvula,

with 2 bundles of hairs at base; vinculum not developed; aedeagus long, slender; cornutus absent.

Female genitalia: Ovipositor short, conical; papillae anales triangular, densely setose; apophyses as long as 7th abdominal segment; ostium bursae weakly sclerotized; ductus bursae long, weakly sclerotized, densely covered with minute granules; corpus bursae membranous, oval;

signum composed of 15~17 long spines, stellate.

Material examined: Korea: 1 ♀, GW, Chuncheon, 1 Aug. 1995, HK Lee and MS Go (genitalia slide no. SJC-78) (CIS).

Distribution: Korea, Japan (Yakushima, Amami Oshima, Okinawa Is., Ishigaki Is., and Iriomote Is.), Taiwan, and Borneo.

Host plants: *Mussaenda parviflora* Matsum. from Taiwan (Chen 1997) and Okinawa (Tominaga

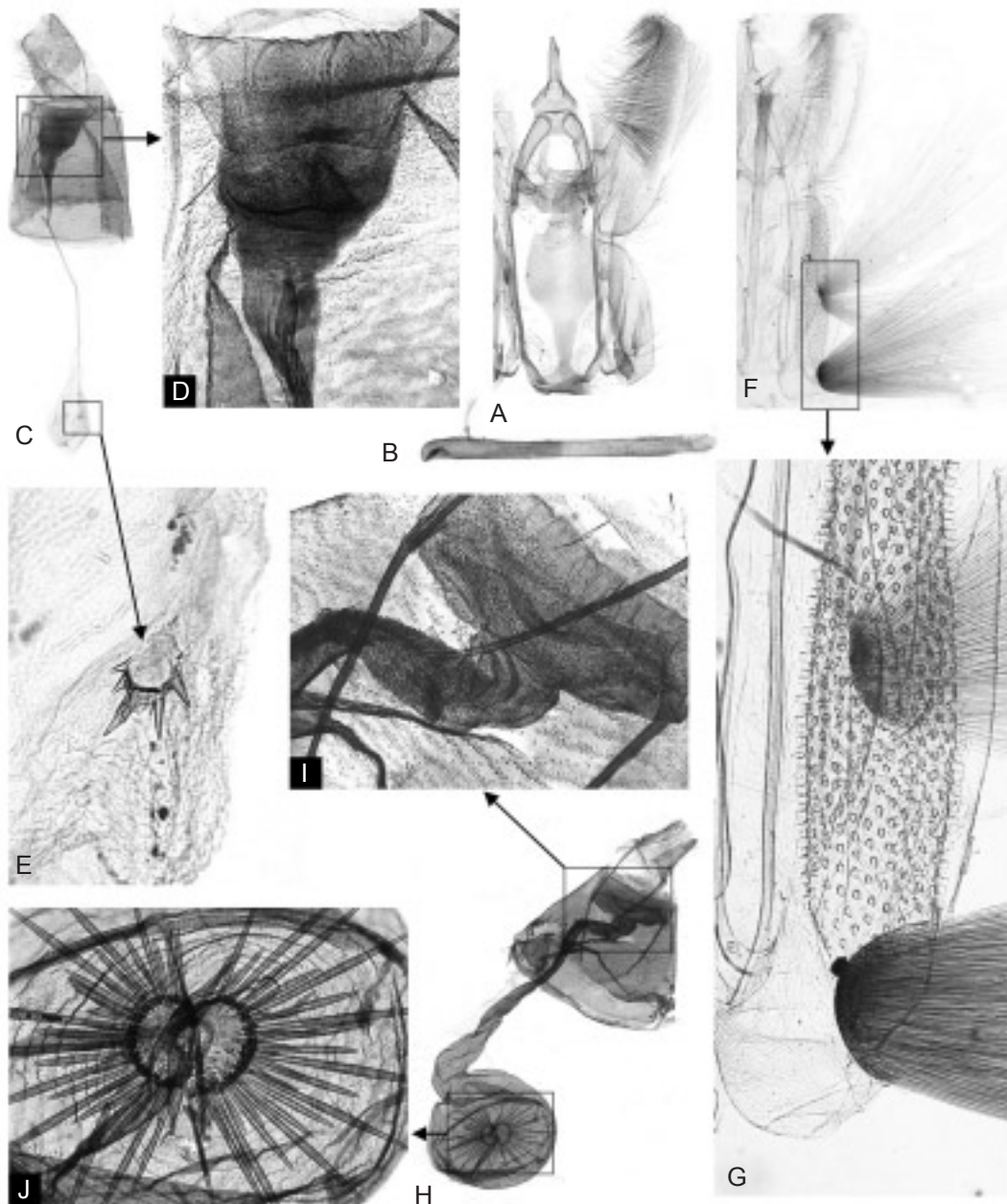


Fig. 4. Genitalia of *Phazaca* species. (A-B, H-J) *Phazaca theclata*; (C-G) *Phazaca erosioides*; (A) male genitalia, ventral view, BMNH Uraniidae slide no. 205, Kwar; (B) ditto, aedeagus; (C) female genitalia, BMNH Uraniidae slide no. 185, Sarawak; (D) ditto, ostium bursae; (E) ditto, signum; (F) male genitalia, BMNH Uraniidae slide no. 80, Kinabalu; (G) ditto, androconial hair tufts; (H) female genitalia, BMNH Uraniidae slide no. 208, S. India; (I) ditto, ostium bursae; (J) ditto, signum.

2000), and *M. macrophylla* Wall. (Rubiaceae) from Taiwan (Chen 1997).

Remarks: *Mussaenda* is the only confirmed host plant genus of *alikangensis*; however, this plant genus is completely absent from Korea. Therefore we doubt if the female collected from Chuncheon was an incidentally invading individual. Holloway (1998) mentioned that a female specimen, tentatively identified as *alikangensis*, was collected from Borneo. We examined the Bornean

specimen and its genitalia (see Appendix 1), but its taxonomic identity cannot be determined because the female genitalia of *Phazaca*, except for those of *erosioides*, *interrupta*, and *planimargo*, are rather uniform among species. Also, the absence of this species from the areas between Taiwan and the Ryukyus, and Borneo seems to be unusual in the distribution pattern of Epipleminae. We therefore retain the record in Borneo and leave this question to future study.

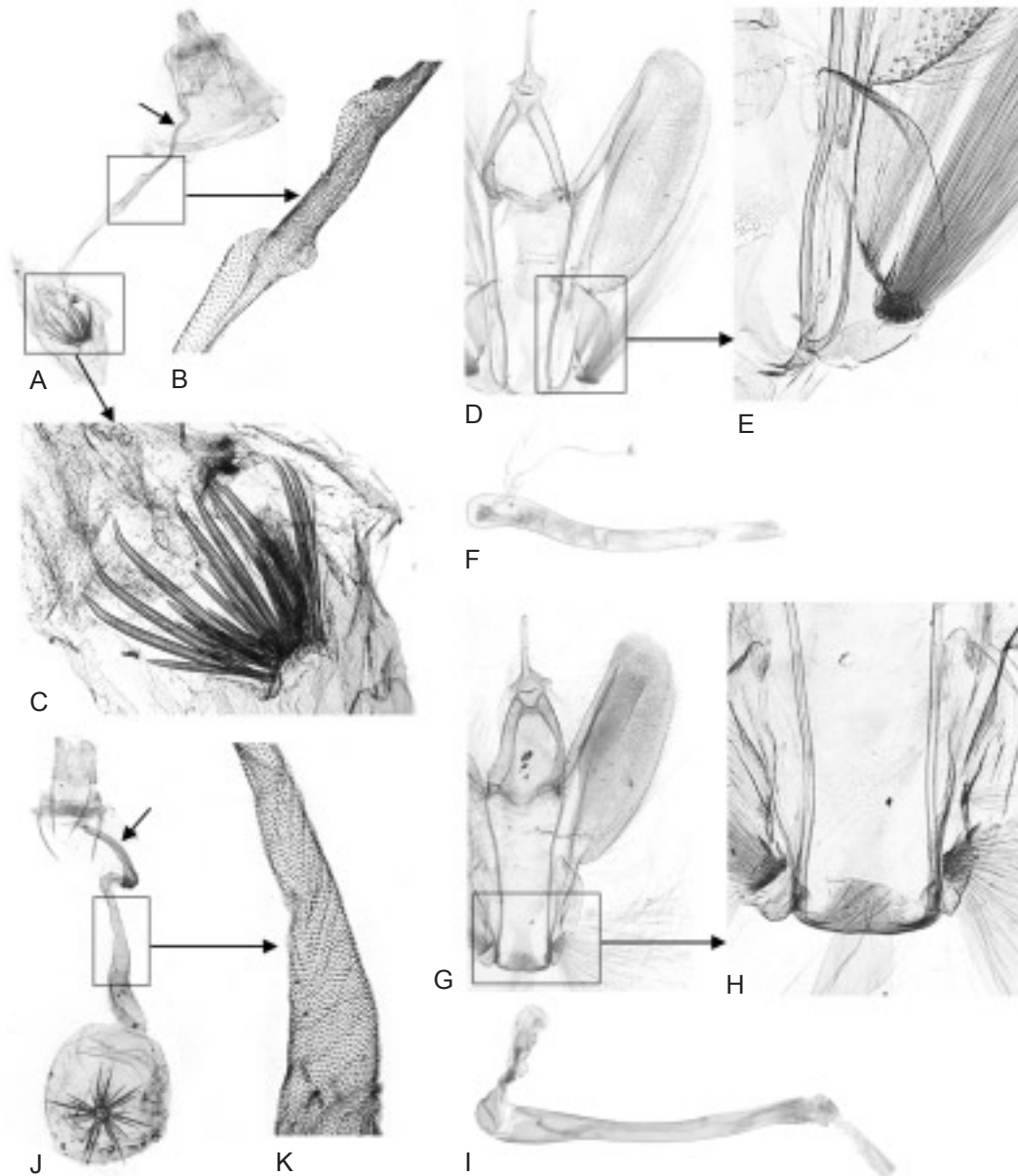


Fig. 5. Genitalia of *Phazaca*. (A-I) *P. alikangensis*; (J-K) *P. kosemponicola*. (A) female genitalia, SJC78, Korea; (B) ditto, granulate surface of ductus bursae; (C) ditto, signum; (D) male genitalia, BMNH Uraniidae slide no. 301, Borneo; (E) ditto, androconial hair tufts and juxtal area; (F) ditto, aedeagus; (G) male genitalia, BMNH Uraniidae slide no. 440, Taiwan; (H) ditto, vinculum, androconial hair tufts and juxtal area; (I) ditto, aedeagus; (J) female genitalia, showing sclerotization in posterior part of ductus bursae; (K) ditto, granulate surface of ductus bursae.

Genus *Dysaethria* Turner, 1911

(Figs. 2A-P, 7-9, 11B)

Dysaethria Turner 1911: 75, 80. Type species: *Dysaethria pas-teopa* Turner 1911 (Queensland).

Diagnosis: Head with uniserrate antennae, lamellate, rarely bipectinate. Forewing triangular, with rounded or acute apex, margin smooth or slightly dentate. Hindwing 2-tailed, with only 1 anal vein. Male genitalia with uncus modified into

an inverted gutter around anal tube, flaked by a pair of soci and a pair of posterolateral tegumental processes; valva ovate to elongate distally, often with broad, flat membranous lobe at apex and sometimes medially with fans or rows of modified setae, usually with a hair-pencil at base of sacculus; vesica of aedeagus with scobinate patches or bundles of slender cornuti. Female genitalia diverse in form; ductus bursae long; corpus bursae with signa in various shapes.

Remarks: Since Turner (1911) described

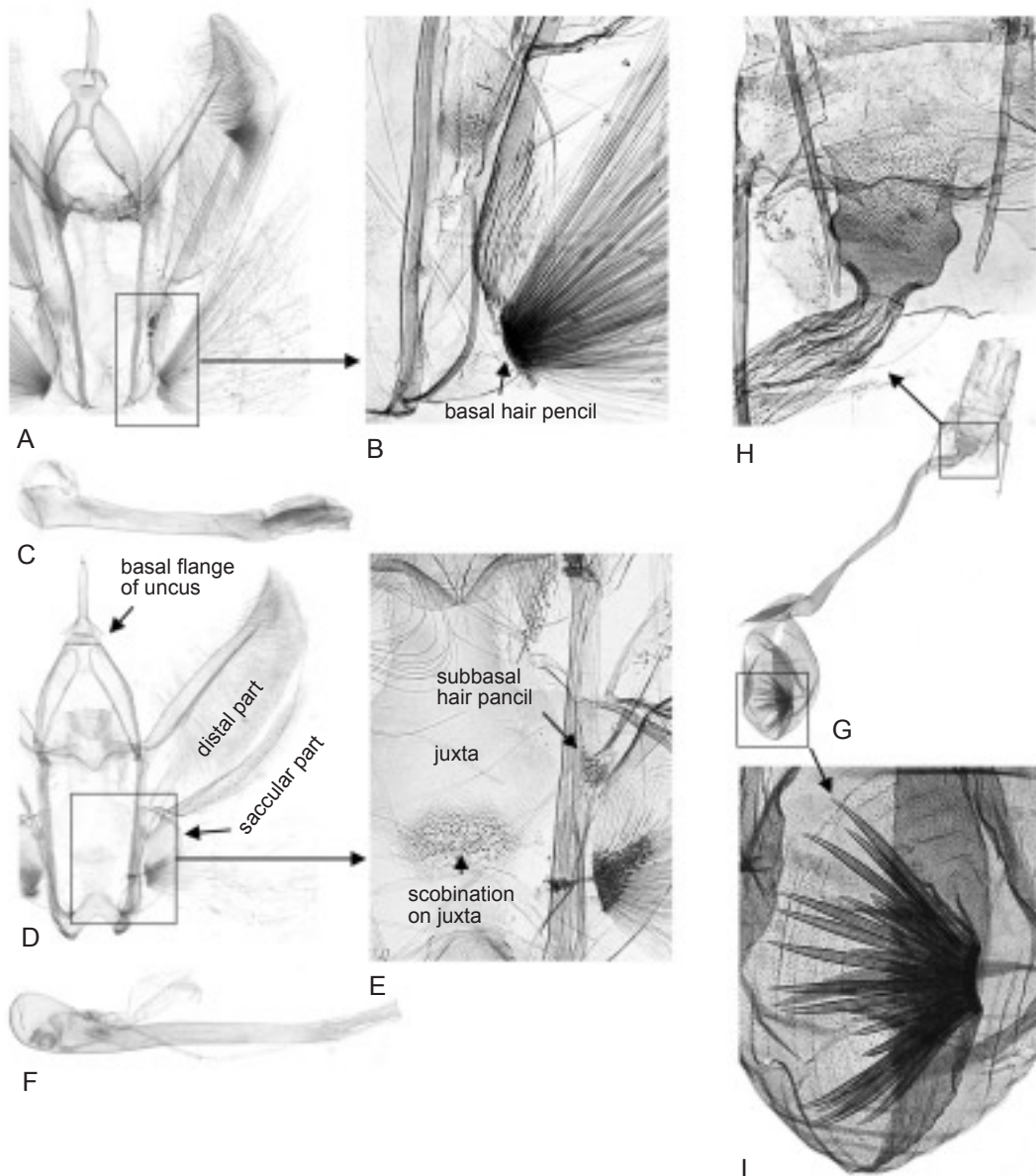


Fig. 6. Genitalia of *Phazaca* species. (A-C) *P. planimargo* (= *Homoplexis planimargo*); (D-I) *P. interrupta* (= *Lobogethes interrupta*); (A) male genitalia, ventral view, BMNH Uraniidae slide no. 268, Papua New Guinea; (B) ditto, androconial hair tufts in sacculus; (C) ditto, aedeagus; (D) male genitalia, BMNH Uraniidae slide no. 271, N. Queensland; (E) bases of androconial hair tufts and juxtal region; (F) ditto, aedeagus; (G) female genitalia; (H) ditto, ostium bursae; (I) ditto, signum.

Dysaethria from Queensland, this genus was regarded as being monotypic (Dalla Torre 1924) and totally ignored until Holloway (1998) "rediscovered" that this generic name could be applied to many Oriental, Indo-Australian, and African species, which had been misplaced in *Epiplema* for a long time. The Taiwanese species of *Dysaethria* were suggested to be associated with *Chaetoceras* Warren, 1896 (type species: *C. simplex* Warren, 1896) by Chen (1997). However, this treatment was based on an error that misapplied *Dysaethria candidaria* (Walker, 1866)

(=*Chaetoceras candidaria*) to represent *Chaetoceras*, a genus that has no close relationship with *Dysaethria*. *Dysaethria* may exhibit the highest diversity and complexity in both the male and female genitalic structure and host plant association in Old World epiplemines (Chen 1997, Holloway 1998). It can only be distinguished from other genera by the genitalic structures because the wing patterns vary with different species groups and every one of its wing pattern types is shared by several unrelated genera, e.g., *Calledapteryx* Grote, 1868, *Heteroplema* Warren,

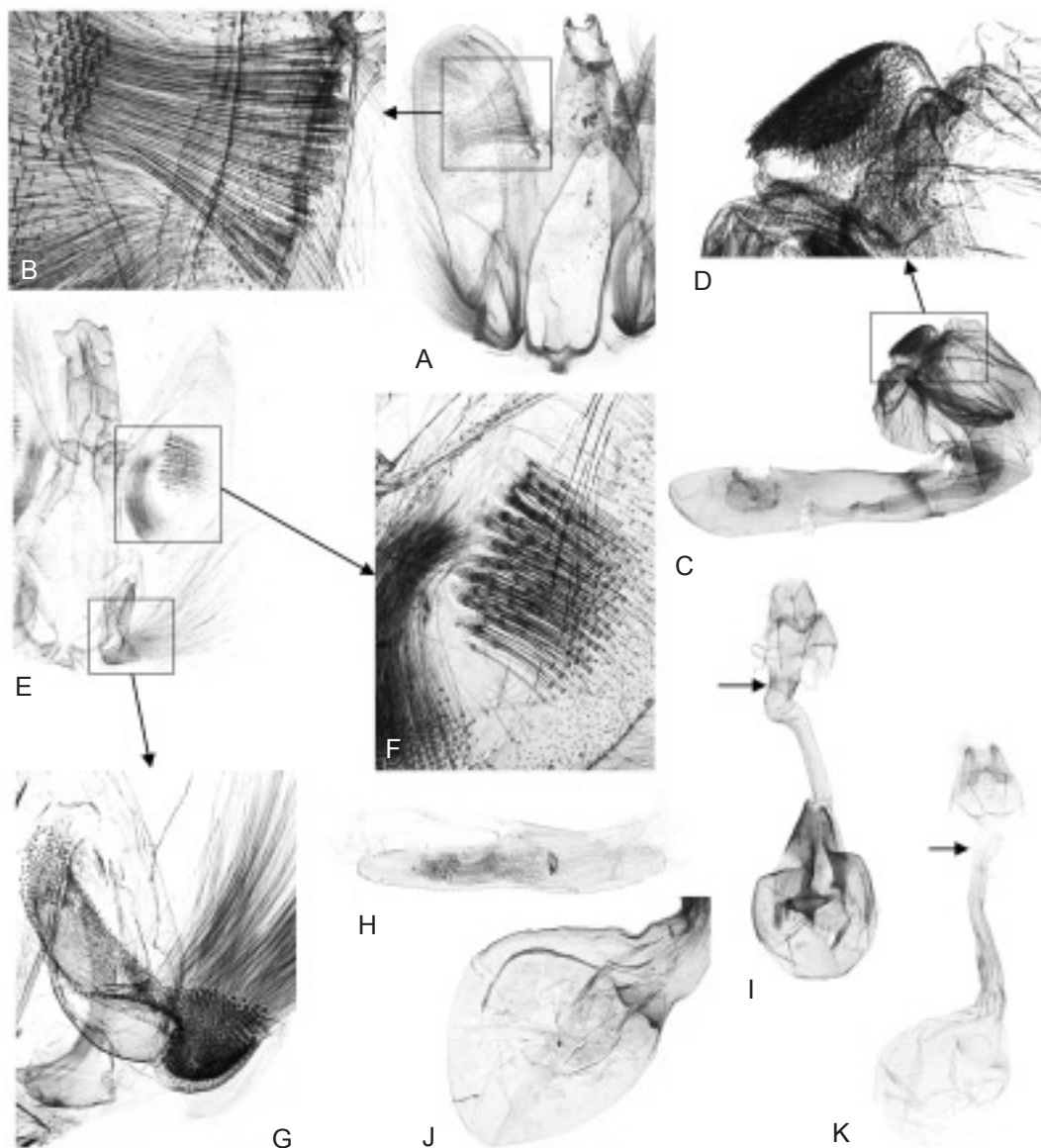


Fig. 7. Genitalia of *Dysaethria* species. (A-D) *D. flavistriga*; (E-H, J-K) *D. moza*; (A) male genitalia, ventral view, SJC80, Korea; (B) ditto, comb-like setae; (C) ditto, aedeagus; (D) ditto, magnification of scobination on vesica; (E) male genitalia, BMNH Uraniidae slide no. 159, Japan; (F) comb-like setae, SJC155, Korea; (G) ditto, sacculus and hair tuft; (H) ditto, aedeagus, with vesica concealed; (I) female genitalia, BMNH Uraniidae slide no. 397; (J) corpus bursae, SJC156, Korea; (K) female genitalia, BMNH Uraniidae slide no. 368, Japan.

1902, *Hypoplema* Janse, 1932, and *Oroplema* Holloway, 1998. Several species-groups of *Dysaethria*, e.g., *moza* and *conflictaria*, were suggested by Chen (1997) and Holloway (1998), but their monophyletic status and internal relationships have not been proven.

Key to the Korean species of *Dysaethria* based on adult wings

1. Hindwing speckled with blackish patches; arising exteriorly; tegumen rather broad, quadrate; ductus bursae tapering to corpus bursae.....*Dysaethria erasaria* (Christoph)

- Hindwing mainly grayish-brown; gnathos folded interiorly; tegumen rather narrow, rectangular, ductus bursae not tapering to corpus ursa.....2
- 2. Forewing with rounded apex; socii large, thick; cornuti present as several minute spines.....*Dysaethria cretacea* (Butler)
- Forewing with acute apex; socii small; cornuti present as a sclerotized plate or thick spine.....3
- 3. Distal 1/2 of hindwing postmedian line dotted, black; aedeagus with process apically; cornutus represented by several small spines; signum represented by broad sclerotized plates, without serrate edge.....*Dysaethria flavistriga* (Warren)
- Distal 1/2 of hindwing postmedian line continuous, dark brown; aedeagus without process apically; cornutus rep-

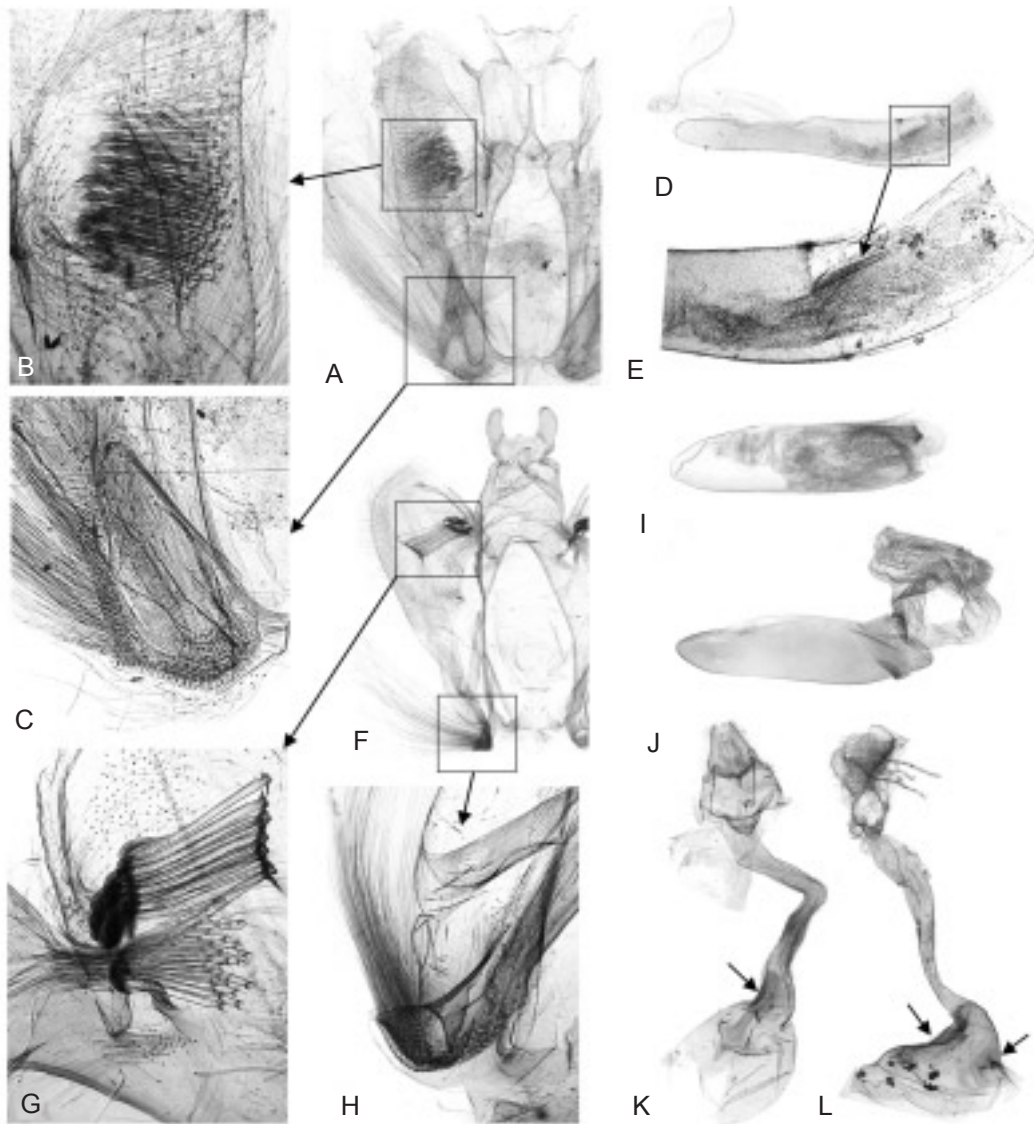


Fig. 8. Genitalia of *Dysaethria* species. (A-E, L) *D. erasaria*; (F-K) *D. cretacea*; (A) male genitalia, ventral view, SJC80, Seoul; (B) ditto, comb-like setae; (C) ditto, sacculus and hair tuft; (D) ditto, aedeagus; (E) ditto, enlargement of cornutus; (F) male genitalia, SJC157, Korea; (G) ditto, comb-like setae; (H) ditto, sacculus and hair tuft; (I) ditto, aedeagus, with vesica concealed; (J) aedeagus, with vesica everted, BMNH Uraniidae slide no. 358, Okinawa; (K) female genitalia, BMNH Uraniidae slide no. 9689, Amami Island; (L) female genitalia.

resented by tooth-like spines; signum represented by narrow sclerotized plates, with serrate edge.....*Dysaethria moza* (Butler)

Key to the Korean species of *Dysaethria* based on male genitalia

- 1. Cornuti presented by single spine.....*Dysaethria erasaria* (Christoph)
- Cornuti presented by multiple small spines.....2
- 2. Apex of comb-like setae forming flattened, paddle-like structure.....*Dysaethria cretacea* (Butler)

- Apex of comb-like setae multi-forked.....3
- 3. Apical part of valva rounded, no additional hair tufts.....*Dysaethria flavistriga* (Warren)
- Apical part of valva attenuated, additional hair tufts present.....*Dysaethria moza* (Butler)

Key to the Korean species of *Dysaethria* based on female genitalia

- 1. Sclerotization of corpus bursae separated into 2 parts.....*Dysaethria erasaria* (Christoph)
- Sclerotization of corpus bursae not significantly separat-

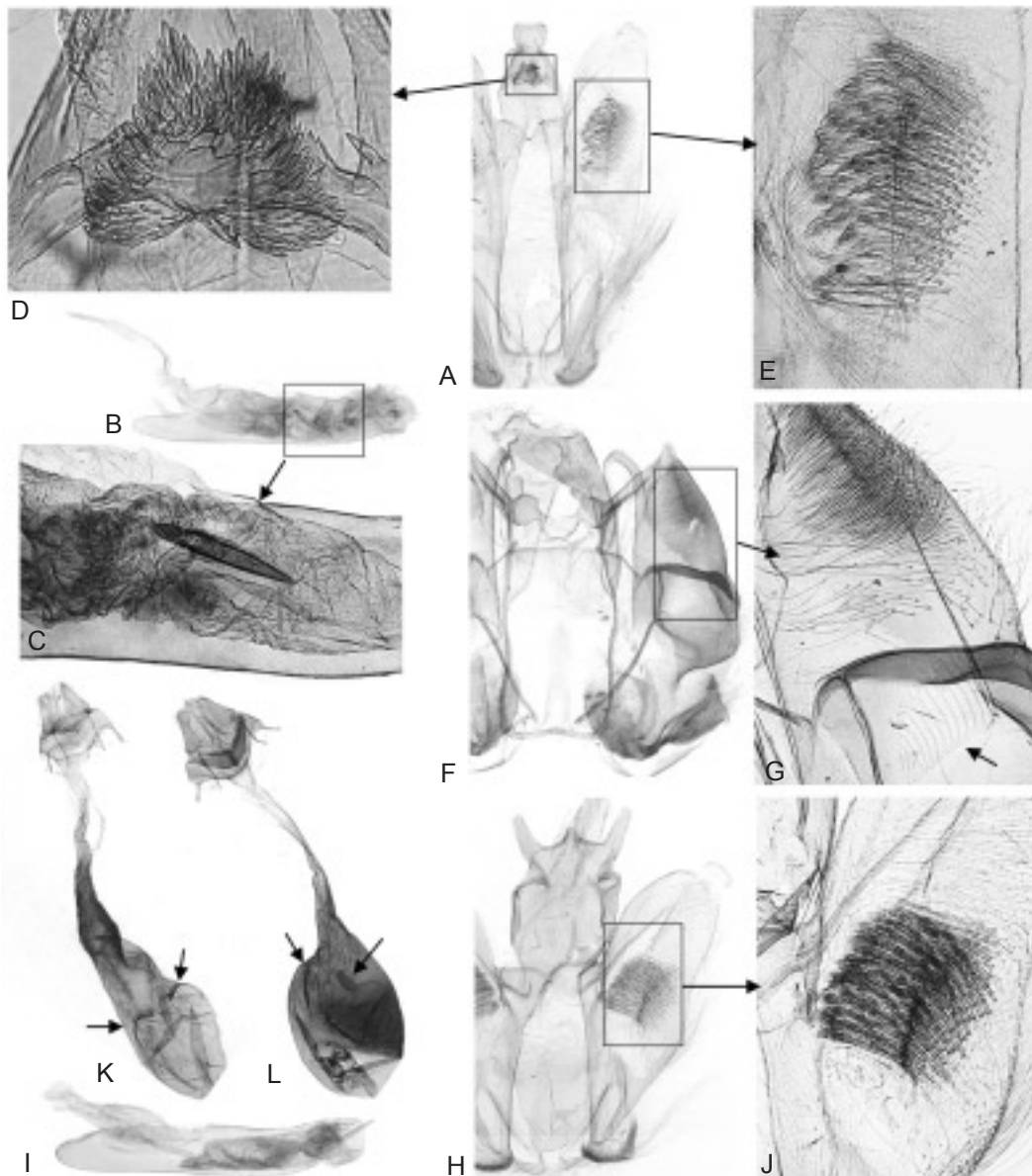


Fig. 9. Genitalia of *Dysaethria* species. (A-D, K) *D. meridiana*; (F-G) *D. indignaria*; (H-J) *D. suisharyonis*; (L) *D. subflavida*. (A) male genitalia, BMNH Uraniidae slide no. 165, Okinawa; (B) ditto, aedeagus; (C) ditto, enlargement of cornutus; (D) ditto, subscaphium; (E) ditto, comb-like setae; (F) male genitalia, BMNH Uraniidae slide no. 280, Pulo Laut; (G) ditto, transverse and longitudinal ridges in valva; (H) male genitalia, BMNH Uraniidae slide no. 321, Taiwan; (I) ditto, aedeagus; (J) ditto, comb-like setae; (K) female genitalia, BMNH Uraniidae slide no. 9715, Kyushu; (L) female genitalia, BMNH Uraniidae slide no. 362, Malaysia.

- ed.....2
- 2. Ostium ring heavily sclerotized.....
.....*Dysaethria flavistriga* (Warren)
- Ostium ring not sclerotized.....3
- 3. Medial part of ductus bursae forming right angle.....
.....*Dysaethria cretacea* (Butler)
- Medial part of ductus bursae straight.....

.....*Dysaethria moza* (Butler)

***Dysaethria cretacea* (Butler, 1881)**
(Figs. 2A, B, 8F-K, 11B)

Erosia cretacea Butler 1881: 414. Type locality: Tokyo, Japan;

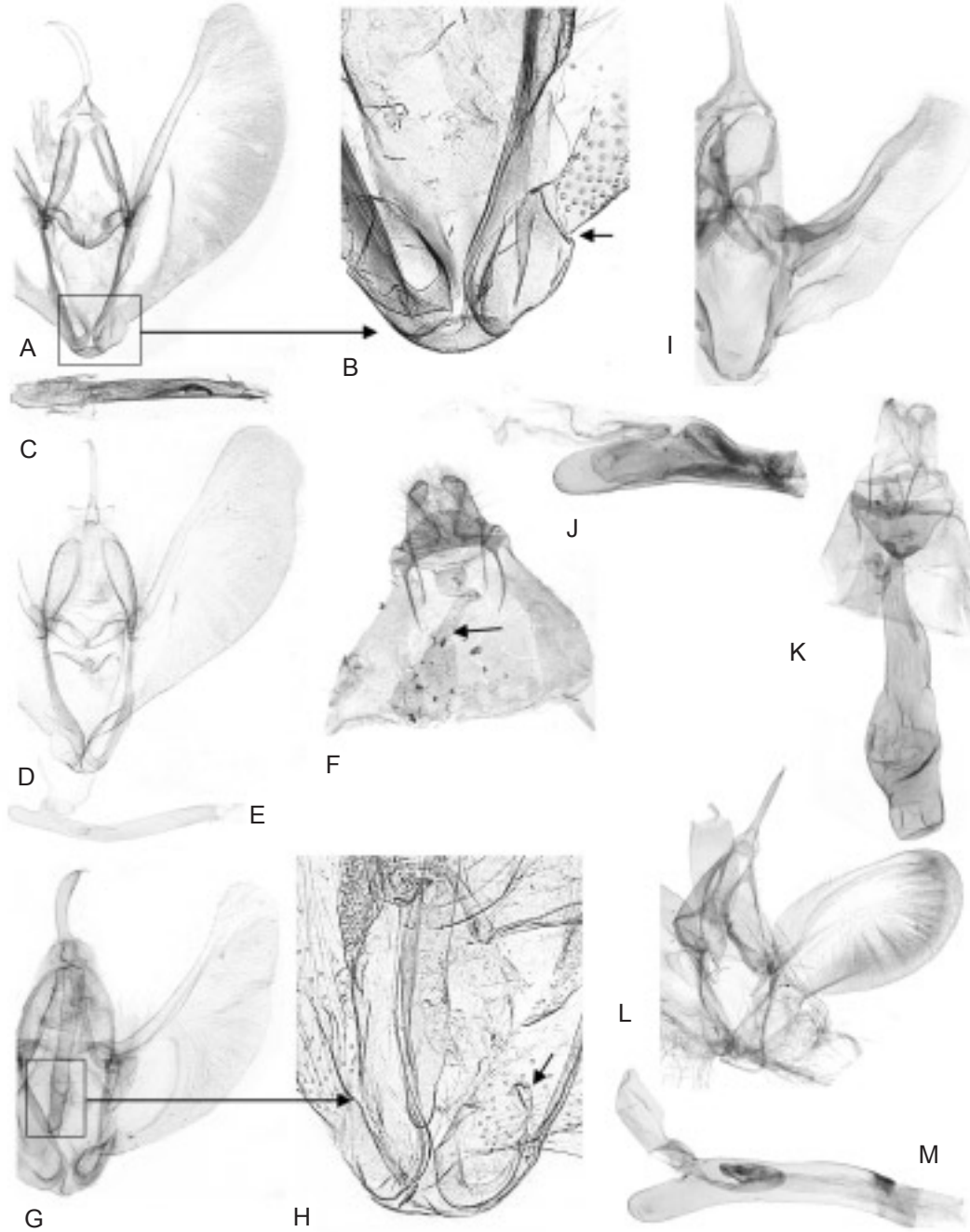


Fig. 10. Genitalia of *Oroplema*, *Eversmannia* and *Epiplema* species. (A-F) *O. oyamana*; (G-H) *O. plagifera*; (I-K) *E. exornata*; (L-M) *E. acutangularia*. (A) male genitalia, SJC154, Korea; (B) ditto, subdivision between sacculus and valvula; (C) ditto, aedeagus; (D) male genitalia, BMNH Uraniidae slide no. 9695, Japan; (E) ditto, aedeagus; (F) female genitalia, BMNH Uraniidae slide no. 9694, Taiwan; (G) male genitalia, BMNH Uraniidae slide no. 9690, Iruma City, Japan; (H) ditto, subdivision between sacculus and valvula; (I) male genitalia, Russian Far East; (J) ditto, aedeagus; (K) female genitalia; (L) male genitalia, BMNH Uraniidae slide no. 266; (M) ditto, aedeagus.

holotype in BMNH.

Epilema cretacea: Seitz 1912: 279, fig. 481; Dalla Torre 1924: 14; Inoue 1982, I: 577, II: 110, 1992: 110; Wang 1996: 165.

Chaetoceras cretacea: Chen 1997: 22-25, figs. 47, 60A, B, 71G, H.

Dysaethria cretacea: Holloway 1998: 104; Sugi 2000: 105.

Disaethria cretacea [sic]: Sugi, 2004: 63.

External features: Wingspan 21 mm in male. Head dark brown, covered with whitish scales on vertex. Antennae covered with whitish scales on dorsal surface, laminate in male, filiform in female. Thorax brownish-white. Forewing brownish-white, speckled with dark-brown scales; postmedial line brownish-black, roundly convex before middle, forming dark-brown semicircular spot at posterior end; dark-brown submarginal line present; termen streaked with brownish-black; fringes dark brown. Hindwing brownish-white, speckled with dark-brown scales; black spot present at end of median cell; postmedial line brown, acutely angled medially, suffused with dark-brown scales anteriorly; termen streaked with brownish-black; tornus speckled with brownish-black; fringes dark brown; tails present as typical epiplemine form. Abdomen brownish-white.

Male genitalia: Uncus short, blunt at apex, ellipsoid, semi-articulated with tegumen; socius slender, thumb-like; tegumen trapezoidal, with pair of dorsal digitate processes; valva elongate, somewhat rectangular, with row of comb-like setae in middle, tips of comb-like setae paddle-like; sacculus with bundle of long hairs at base; vinculum extending downward, ovate; saccus small; aedeagus straight, rather stout, cornutus present as numerous minute spines.

Female genitalia: No material was available from Korea so the diagnosis is based on a female from Okinawa (see Appendix 1). Papillae anales broadly triangular, apophyses posteriores as long as length of papillae anales. Base of ductus bursae sclerotized as semicircular ring, ductus bursae straight, without granules. Corpus bursae orbicular, with 2 T-shaped signa gradually fused at their posterior ends.

Material examined: Korea: 1 ♂, JN, Mt. Duryun-san, Haenam, 22 June 2002 (collector unknown) (genitalia slide no. SJC-157) (MNU).

Distribution: South Korea, Japan (Honshu, Shikoku, Kyushu, Tanegashima Is., Yakushima Is., Tokara Is., Amami Oshima Is., and Okinawa Honto Is.), and Taiwan.

Host plants: *Daphniphyllum glaucescens* (Hemsl.) Rosenth (Daphniphyllaceae) from Japan

(Kodama 1959, Inoue 1982) and Taiwan (Chen 1997). In Korea, *D. himalaense* (Benth.) Muell. ssp. *macropodum* (Miq.) and *D. humile* Maxim. are possibly utilized by the local population.

Remarks: Based on the presence of a row of paddle-like "scales" directed inwards from the middle of the valvae, Holloway (1998) considered *cretacea* to be associated with the *subalbata* species-group, which comprised *D. subalbata* (Guenée, 1857) (Borneo and Peninsular Malaysia), *D. albidaria* (Walker, 1844) (= *Epilema lacteata* Holland, 1900) (New Guinea), and *D. cretacea*. However, we consider *cretacea* to be very distinct from the *subalbata* species-group because (1) the comb-like setae at the valva of *cretacea* are long, curved, and paddle-like (Fig. 8G), but those setae in *subalbata* (Holloway 1998: fig. 224) are short, straight, and bar-like, and are located near the base of the valva; (2) the uncus of *cretacea* is broad and blade-like, while *subalbata* has a rather slender uncus; (3) the inner margin of the valval apex of *cretacea* is not densely setose, but that of *subalbata* has a clump of very dense setae; and (4) the aedeagus of *cretacea* has numerous serrate granules on the vesica, while this structure is absent from *subalbata* and replaced by a row of longer and shorter cornuti. The genitalia of *subalbata* are in fact more similar to those of *D. nigrifrons* (Hampson, 1896) (Borneo, Burma, Java, and Flores), *D. exprimataria* (Walker, 1861) (Borneo), and *D. punctata* (Holloway, 1976) (Borneo) by sharing the peculiar bar-like setae on the valvae.

***Dysaethria flavistriga* (Warren, 1901)**

(Figs. 2E, F, 7A-D, L, 11B)

Epilema flavistriga Warren 1901: 21; Pak 1970: 39. Type locality: Khasia Hills, India, 2 syntypes in BMNH.

Epilema ochrimedia Warren year unknown. "Type locality": N. India, specimen in BMNH. nom. nud.

Chaetoceras flavistriga: Chen 1997: 28-30, figs. 2B, 13, 44, 61E-H, 67J, 73A, B.

Dysaethria flavistriga: Holloway 1998: 109, figs. 240, 250, pl. 7: 19.

Disaethria flavistriga [sic]: Sugi, 2004: 63.

External features: Wingspan 24 mm in male. Head black, covered with brownish-white scales on vertex; antennae covered with brownish-white scales on dorsal surface. Thorax brownish-white. Forewing grayish-brown, striated and speckled with brownish-black; apex acute; postmedial line dark brown, convex at middle, forming black triangular spot on posterior end; subterminal line

reduced to dark-brownish semicircular spot, present below apex; tornus suffused with gray; termen undulated, strongly concave beyond middle; fringe brownish-black. Hind wings grayish-brown, striated and speckled with brownish-black; postmedial line brownish-black, forming dotted line after middle, acutely angled medially; brownish line present to M2; termen streaked with brownish-black; dentate tails present at Rs and M3; fringes brownish-black. Abdomen brownish-white.

Male genitalia: Uncus short, quadrate, semi-articulated with tegumen; socius short, erect, slightly hooked; tegumen long, narrow with pair of digitate processes; valva elongate, rectangular, with bundle of comb-like setae in middle, tips of

comb-like setae rounded or slightly sharp; sacculus with bundle of long hairs at base; vinculum with rectangular; saccus; aedeagus straight; vesica globular; cornuti present as sclerotized granulate plate.

Female genitalia: No Korean material was available for the present study. Material from Japan, Taiwan, and India with trapezoidal papillae anales, densely setose; apophyses posteriores as long as papillae anales; ostium bursae cylindrical, slightly sclerotized; ductus bursae long, membranous, cylindrical; corpus bursae pyriform, with pair of asymmetrical trifurcate signa.

Material examined: Korea, 1 ♂, JN: Mt. Duryun-san, Haenam, 13 May 2002 (SW Choi et

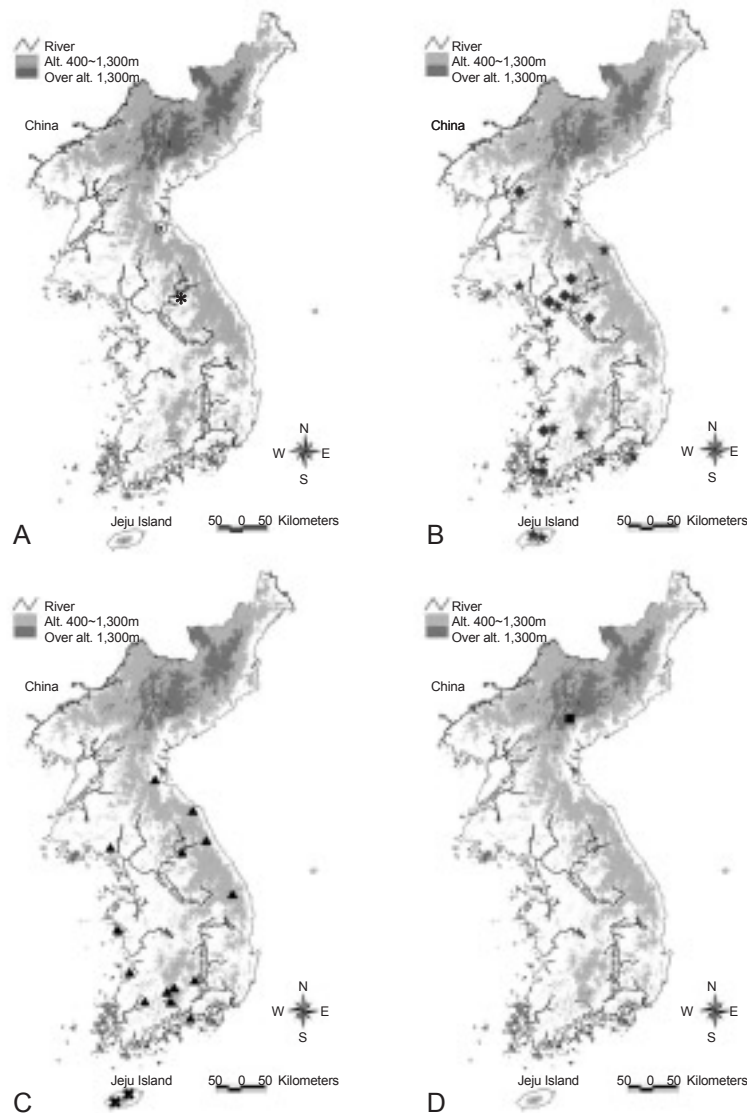


Fig. 11. Distribution maps of Korean Epipleminae. (A) ○ *Monobolodes prunaria*; * *Phazaca alikangensis*; (B) ◆ *Dysaethria erasaria*; ★ *D. moza*; ● *D. cretacea*; ☆ *D. flavistriga*; (C) ▲ *Oroplema plagifera*; ✕ *O. oyamana*; (D) ■ *Eversmannia exornata*.

al.) (genitalia slide no. SJC-160) (MNU).

Distribution: Korea (Geojae-do) (Pak 1970), Japan (Honshu, Shikoku, Kyushu, Yakushima, Amami, Okinawa, Ishigaki, and Iriomote), Taiwan, China (Hong Kong and Sichuan), Malaysia, India, and Nepal (NE Himalayas).

Host plants: *Daphniphyllum glaucescens* (Hemsl.) Rosenth (Daphniphyllaceae) from Japan (Inoue 1982) and Taiwan (Chen 1997).

Remarks: A "type" specimen, labeled "*Epiplema ochrimedia* Warren", was found in the BMNH collection. This specimen apparently agrees with *D. flavistriga*, but we failed to locate any reference in which Warren described *ochrimedia*. We therefore consider that *ochrimedia* is a nomen nudum. Holloway (1998) stated that *D. secutaria* (Walker, 1866) from Sumatra might be the most-closely related species to *flavistriga*. Also, *flavistriga* is possibly related to *cretacea* because both these species have an aedeagus with numerous serrations on the vesica, and their larvae both feed on the Daphniphyllaceae.

***Dysaethria moza* (Butler, 1878)**

(Figs. 2I-L, 7E-H, J, K, 11B)

Erosia moza Butler 1878: 402. Type locality: Yokohama, Japan, holotype in BMNH.

Epiplema moza: Seitz 1912: 279; Leech 1897: 184; Inoue 1982 I: 577.

Epiplema suisharonis [sic.]: Bryk 1944: 27, pl. 3-17 (misidentification).

Eversmannia moza: Dubatolov et al. 1994: 19.

Dysaethria moza: Holloway 1998: 105.

External features: Wingspan 25~28 mm in male ($n = 5$), 25~32 mm in female ($n = 12$). Head dark brown, covered with brownish-gray scales on vertex; antennae covered with brownish-gray scales on dorsal surface. Thorax grayish-brown. Forewing grayish-brown to reddish-brown, striated with dark brown; ante- and postmedial lines acutely angled in middle; 3 dark-brown submarginal specks present below apex; dark-brown semicircular spot present in middle of posterior margin; fringe dark brown. Hindwing grayish-brown to reddish-brown, striated with dark brown; subbasal line dark brown, present from medial nervure to inner margin; postmedial line white edged with brown lines, acutely angled in middle, diffused with reddish-brown on the latter; Rs and M3 with tooth-shaped tails; fringe dark brown. Abdomen grayish-brown.

Male genitalia: Uncus short, slightly emarginate; socius short with rounded tip; tegumen long

rectangular, moderately tapered at base, pair of hook-like processes present; valva elongate, weakly sclerotized; bundle of comb-like setae present at middle of valva, tips of comb-like setae 3- or 4-forked, additional up-curved hair tufts arising below comb-like setae; bundle of long curved hairs present on basal part of sacculus; vinculum slender laterally; saccus small, fan-shaped; aedeagus moderately short, vesica with single, short cornutus.

Female genitalia: Papillae anales widely triangular, densely setose; apophyses posteriores slender, as long as papillar anales; ostium bursae oval, weakly sclerotized; ductus bursae long, membranous; corpus bursae globular, with broad, sclerotized band present on ventral surface, 2 plate-like signa present near base of corpus bursae.

Materials examined: Korea, 1 ♀, SE, Seoul, 18 May 1960 (SW Pak) (BMNH); 1 ♂, same locality, 29 May 1960 (SW Pak) (genitalia slide no. 6777); 1 ♂, GG, Mt. Suri-san, Gunpo, 9 Sept. 1997 (YD Kwon and HK Lee) (genitalia slide no. SJC-42) (CIS); 1 ♀, CN, Is. Anmyeon-do, 25 Aug. 1998 (JC Sohn); 2 ♀♀, JB, Mt. Naeyun-san, Buan, 4~5 Aug. 1992 (KT Park and BK Byun) (genitalia slide no. SJC-43 and 156); 1 ♂, JN, Mt. Weolchul-san, 23 May 1988 (SS Kim); 1 ♀, Piagol, Mt. Jiri-san, 7 Aug. 1982 (KR Jang); 2 ♀♀, GN, Namhae, 1 June 1994 (BK Byun); 1 ♂, JJ, Seongpanak, 5 Aug. 1994 (HK Lee and MS Go) (genitalia slide no. SJC-76); 1 ♂ 3 ♀♀, Temp. Gwanum-sa, 21~22 Aug. 2000 (JC Sohn) (genitalia slide no. SJC-155; ♂); 1 ♀, Mt. Sambangsan, Geojae-do, 17~18 Sept. 1995 (collector unknown) (KSU); 1 ♀, JN, Mt. Duryun-san, Haenam, 24 May 2001 (SW Choi) (genitalia slide no. SJC-159) (MNU).

Distribution: Korea (GW, GG, JN, GN, and JJ) (Shin 1983b, Lee et al. 1985, Shin et al. 1989, Jaroes et al. 1992, Byun et al. 1996, Byun and Lee 1996, Paek et al. 1997, Jeong et al. 1997), Japan (Hokkaido, Honshu, Shikoku, Kyushu, Tsushima Is., Tanegashima Is., Yakushima Is., and Amami Oshima Is.), and Russia (Kunashir Is.).

Host plants and biology: *Viburnum dilatatum* Thunberg and *V. erosum* Thunberg from Japan (Iwata 1969, Inoue 1982, Sugi 1987). Chang and Hu (1992) recorded the Chinese "*moza*" as a pest of *Paulownia* sp. (Scrophulariaceae). We suspect that this record is based on a misidentification because *moza* is a specialist on *Viburnum* (Caprifoliaceae). The species is supposed to be bivoltine in Korea (flight from May to June and from Aug. to Oct.).

Remarks: This species is considered to be closely related to *suisharyonis* (Strand, 1916) (Taiwan) (Figs. 2O, 9H-J) and *subflavida* (Swinhoe, 1906) (Sundaland) (Figs. 2P, 9L) (Holloway 1998). They seem to share an extremely similar wing pattern: both fore- and hindwings are brown or brownish-gray with a dark patch at the hind margin of the forewing and a dark transverse band running from the inner margin to M3 of the hindwing. However, these characters are not unique to these species but inconsistently distributed in several unrelated genera. Compared with *moza*, *suisharyonis*, *meridiana* (Inoue, 1982) (Figs. 2M, N, 9A-D, K), and *illotata* (Christoph, 1880) (= *Epiplema mozzetta* Inoue, 1982), *subflavida* is very distinct from the former species because it lacks the comb-like setae on the inner surface of the valva and has much broader soci. The monophyletic status and taxonomic range of the *moza* group are yet to be clarified.

***Dysaethria erasaria* (Christoph, 1881)**

(Figs. 2C, D, 8A-E, L, 11B)

- Eversmannia erasaria* Christoph 1881: 70; Dubatolov et al. 1994: 19. Type locality: Amursk, Russia.
- Erosia schidacina* Butler 1881: 415. Type locality: China, holotype in BMNH. Designated by Inoue 1982: 312.
- Epiplema pallidistriata* Warren 1899: 321. Type locality: Penang, Malaysia, holotype in BMNH. Synonymized by Holloway 1998: 106.
- Epiplema illotata* (nec. Christoph 1881): Bryk 1944: 27, pl. 3: 17 (misidentification).
- Epiplema erasaria*: Bryk 1949: 29; Inoue 1982: 1, 576, 2: 312, pl. 110: 12.
- Epiplema erasaria schidacina*: Chu and Wang 1983: 107, pl. 26, fig. 710.
- Chaetoceras erasaria*, Chen 1997: 25-27, figs. 12, 43, 62A, B, 71A, B.
- Dysaethria erasaria*: Holloway 1998: 106, fig. 239, pl. 8: 10.

Diagnoses: Wingspan 21~24 mm in male ($n = 3$), 25 mm in female ($n = 1$). Head dark brown, covered with gray scales. Thorax bright grayish-brown. Forewing bright grayish-brown; postmedial line dark brown, curved in middle; diffused with reddish-brown on the latter; submarginal line dark brown, weakly present, diffused with reddish-brown; tornus bluish-gray; fringe brown. Hindwing bright grayish-brown, suffused with brownish-black and bluish-gray scales; basal line black; postmedial line white, edged with dark-brown lines, acutely angled at middle, diffused with bluish-gray; submarginal line black, tinged with yellowish-brown; Rs and M3 with tooth-shaped tails; fringe brown. Abdomen bright brownish-gray, covered with black scales dorsally on 2nd and 3rd segments.

Male genitalia: Uncus slightly convex, with a pair of soci; tegumen quadrate, with digitate lateral processes; valva elongate, weakly sclerotized, setose, comb-like setae present at middle with sharp, beak-like tips; sacculus with club-like and long curved hairs; vinculum slender; saccus small, slightly convex; aedeagus slender; vesica with 2 cornuti.

Female genitalia: Papillae anales elliptical, densely setose; apophyses anteriores as long as papillae anales; ostium bursa cup-like, sclerotized; ductus bursae long, membranous; corpus bursae compressed oval, with 1 triangular and 1 V-shaped signa.

Materials examined: Korea: 1 ♂, SE, Seoul, 21 May 1960 (SW Pak) (BMNH), 1 ♀, same locality, 23 June 1960 (SW Pak) (BMNH Uraniidae slide no. 9683) (BMNH); GW: 1 ♂, Temp. Weona-sa, Cheolweon, 24 June 1994 (BK Byun) (genitalia slide no. SJC-80) (CIS); 1 ♂, Chuncheon-dem, Chuncheon, 15 June 1996 (MS Go) (CIS).

Distribution: Korea (PN, GG, and JN) (Kim 1991, Byun et al. 1996, Lee et al. 1996, Jeong et al. 1997, Park et al. 2001), Japan (Hokkaido and Honshu), China, Russia (Amurland), Taiwan, India, Peninsular Malaysia, Sumatra, and Borneo (Holloway 1998).

Host plants: In Korea, *Viburnum sargentii* Koehne (Caprifoliaceae) is utilized by this species, while in Taiwan and Japan, *V. luzonicum* Rolfe is utilized as a host plant (Sugi 1987, Chen 1997).

Remarks: The wing pattern of this species is distinct from those of other *Dysaethria* species by having a broad fawn-brown zone on the forewing, while the genitalic structure and host plant association suggest it may have a closer affinity with the *moza* group. Holloway (1998) suggested that it may be related to *moza* and commented on larval similarities.

Genus *Oroplema* Holloway, 1998

(Figs. 2Q-V, 10A-H, 11C)

Oroplema Holloway 1998: 101. Type species: *Epiplema dealbata* Warren 1899 (New Guinea).

Diagnosis: Forewing color pattern distinct between species; antemedial and postmedial lines nearly parallel, forewing crescentic patch along outer margin present, hindwing without transverse dark patch extending from inner margin to M3. M2 absent in hindwing. Male genitalia with slender acute uncus at apex, valva simple, with strong costal margin, setose lobe present at base of

valva, aedeagus slender with vesica containing a single cornutus. Female genitalia with very short ductus bursae and corpus bursae, anterior end of rectum with small granulate projection.

Remarks: Holloway (1998) suggested that *Oroplema* was “superficially similar” to *Pterotosoma* Warren, 1903 (type species: *Pterotosoma bilieanata* Warren, 1903) because their valvae are narrower near the base and broader near the apex, and the tegumental cavities are simple. But *Oroplema* differs from *Pterotosoma* in lacking the neck-like uncus and having a broader tegumen and more developed transtilla. This type of genitalia is not only possessed by these 2 genera, but it is also present in 2 Nearctic genera, *Callizzia* Packard, 1876 (type species: *Callizzia amorata* Packard, 1876) and *Calledapterx* (type species: *Calledapteryx dryopterata* Grote, 1868), 2 Malagasy species, “*Epiplema*” *carayoni* Boudinot, 1982 and “*Epiplema*” *ankafina* Boudinot, 1982, and the “*Dirades*” *pygmeata* species-group. The Neotropical genera may also harbor additional species which have this genitalic type.

Keys to the Korean species of *Oroplema* based on adult wings

1. Wings grayish-brown with dark-brown stripes; cornutus present.....*Oroplema oyamana* (Matsumura)
- Wings white with dark [stripes] or markings; cornutus absent.....*Oroplema plagifera* (Butler)

***Oroplema oyamana* (Matsumura, 1931)**
(Figs. 2Q-S, 10A-F, 11C)

Epiplema oyamana Matsumura 1931: 942. Type locality: Oyama, Honshu, Japan, holotype in HUFA.

Epiplema dealbata (nec Warren, 1899): Holloway 1976: 683.

Epiplema simplex (nec Warren, 1899): Inoue 1982 I: 577, II: 311, pl. 110: 22, 23.

Epiplema indignaria (nec Walker, 1866): Inoue 1992: 110; Wang 1993: 79; Chen 1997: 57-60, figs. 4D, 7, 47, 60C, D, 71E, F.

Oroplema oyamana: Holloway 1998: 102, figs. 210, 211, pl. 7: 21.

Diagnosis: Wingspan 25~28 mm in female ($n = 10$). Head blackish-brown, covered with white scales on vertex; antennae covered with white scales on dorsal surface. Thorax grayish-brown. Forewing grayish-brown with white hairs along to posterior margin; antemedial and postmedial lines dark brown, diffused with reddish-brown in area between lines, dilated posteriorly forming brown semicircular area; subterminal line dark brown, present on only anterior 1/2 of outer margin, termi-

nally diffused with brown. Hindwing grayish-brown: antemedial line brown, curved interiorly; postmedial line white, edged with brown lines; adterminal line brown: Rs and M3 with tooth-shaped tails, fringes of both wings grayish-brown. Abdomen grayish-brown.

Male genitalia: According to specimens of Taiwanese and Japanese populations (see Appendix 1), male genitalia with long, falcate, slender, uncus hooked at apex; valva elongate, fan-shaped, weakly sclerotized ventrally, sacculus not developed but with clear border with rest of valva (Fig. 10B); aedeagus long, slender; cornutus present as thick spine.

Female genitalia: Papillae anales trapezoidal, densely setose; apophyses posteriores and apophyses anteriores equal in length; surrounding area of ostium bursae weakly sclerotized, U-shaped; ostium bursae membranous, funnel-shaped; ductus bursae short, membranous; corpus bursae long, spindle-like; signum barely visible, represented by 2 tiny spots composed of minute granules.

Materials examined: Korea: JJ, 1 ♀, Yeongsil, 8 June 1993 (KT Park) (genitalia slide no. SJC-45) (CIS); 1 ♀, Andeok Valley, 2 July 1994 (HK Lee and MS Go) (genitalia slide no. SJC-79) (CIS); 1 ♀, Seongpanak, 5 July 1994 (HK Lee and MS Go) (genitalia slide no. SJC-131) (CIS); 7 ♀♀, Yeongsil, 16 July 1994 (HK Lee and MS Go) (genitalia slide no. SJC-44 and 63) (CIS).

Distribution: Korea (Jeju I.), Japan (Honshu, Shikoku, Kyushu, and Yakushima I.), Taiwan, India (northern), Nepal (NE Himalayas), Borneo, and the Philippines (Luzon).

Host plants: According to Inoue (1982) and Chen (1997), *Daphniphyllum himalaense* Miq. (Daphniphyllaceae) is utilized as the host plant in Japan and Taiwan. Since this plant is not found on the Korean Peninsula, the congeneric *D. teysmanni* Zoll. and *D. macropodum* Miq. are supposedly potential host plants of the Korean population.

Remarks: This species was misidentified as either *Oroplema simplex* (Warren, 1899) (as *Epiplema simplex*) or *Dysaethria indignaria* (Walker, 1866) (as *Epiplema indignaria*) in the Japanese and Taiwanese literature for a long time. However, the true *Oroplema simplex* (Fig. 2T), exclusively distributed in S. India and Sri Lanka, is still the most closely related species to *O. oyamana* because of their extremely similar wing patterns and genitalic structures. *Oroplema simplex* can be distinguished from *oyamana* by having a narrower dark patch at the forewing hind margin

and a straighter antemedial line of the hindwing. The true *indignaria* (= *Epiplema fucina* Swinhoe, 1902) (Figs. 2G, 9F, G), found in Borneo and Papua New Guinea (Holloway 1998: 109), is not related to *oyamana*. The genitalia of *D. indignaria* obviously belongs to the “*Dysaethria*” -type, in that the unci and tegumental processes are developed, the tegumen and vinculum are slender and almost parallel to each side, and the valvae are well differentiated into 2 parts. The phylogenetic relationships of *indignaria* to other *Dysaethria* species are not clear, because the specialized comb-like setae (e.g., Fig. 9E) present in all the other species are absent, and a series of unusual longitudinal ridges (Fig. 9G) plus a large transverse ridge are present in this species. Among all the species included in *Oroplema*, *oyamana* seems to have the widest distribution range (Holloway 1998).

***Oroplema plagifera* (Butler, 1881)**

(Figs. 2U, V, 10G, H, 11C)

Eriosia plagifera Butler 1881: 414. Type locality: Yokohama, Japan, holotype in BMNH.

Epiplema plagifera: Seitz 1912: 279; Inoue 1982 I: 577, II: pl. 110-18, 19; Shin et al. 1990: 282, fig. F; Wang 1993: 81; Chen 1997: 60-62, figs. 8, 41, 60I, J.

Epiplema spona Swinhoe 1895: 293. Type locality: Cherra Punji, India, syntypes in BMNH; Matsumura 1931: 942. syn. nov.

Epiplema plagiata [sic]: Inoue 1992, in Hoppner and Inoue, 1992: 110.

Eversmannia plagifera, Dubatolov et al. 1994: 19.

Oroplema plagifera: Sugi 2000: 105.

External features: Wingspan in male 15~18 mm ($n = 7$) and in female 17~21 mm ($n = 16$). Head brownish-black, covered with white scales on vertex; antennae covered with white scales on dorsal surface. Thorax white dorsally. Forewing white, suffused sparsely with grayish scales; area between antemedial and postmedial lines diffused with dark brown, forming brownish-black to bluish-gray quadrate dot on costal margin; submarginal line dotted; area of M veins diffused with brownish-black; fringe white, dark brown centrally. Hindwing white; antemedial line dark brown, with 2 black spots centrally; postmedial line dark brown, diffused with dark brown; submarginal line dark brown; area of Cu veins diffused with brownish-black to bluish-gray; Rs and M3 with tooth-shaped tails; fringe dark brown, white on apex. Abdomen white, tinged with dark gray dorsally.

Male genitalia: Uncus long, falcate, slender, dilated distally, with hooked apex; tegumen narrow, long; valva elongate, rectangular, distally rounded,

weakly sclerotized on basal part; costa long, narrow, present along with costal margin of valva; saccus reversed triangular; aedeagus slender, straight, truncated distally; vesica membranous; cornutus absent.

Female genitalia: Papillae anales semi-oval, densely setose; apophyses slightly longer than papillae anales; area surrounding ostium bursae weakly sclerotized; ostium bursae funnel-shaped; ductus bursae short; corpus bursae rather small, spindle-shaped, without signum.

Materials examined: Korea: GW: 1 ♀, Mt. Jeombong-san, 10 Aug. 1992 (KT Park) (CIS); 1 ♂, Garakjae, Chuncheon, 9 Aug. 2000 (JC Sohn) (CIS); CN: 1 ♂, Is. Ahnmyeon-do, Taean, 25 Aug. 1998 (JC Sohn) (genitalia slide no. SJC-84) (CIS); JB: 1 ♂, Buan, 5 Aug. 1992 (KT Park and BK Byun) (genitalia slide no. SJC-47); JN: 1 ♀, Temp. Hwaum-sa, Mt. Jiri-san, 1 Aug. 1984 (collector unknown) (KSU). GN: 1 ♀, Samga High School, Hapcheon, 23 June 1987 (KSU); 1 ♀, Mt. Geum-san, Namhae, 28~29 July 1990 (JI Eun) (KSU); 1 ♀, Sangju-ri, Namhae, 28~29 Aug. 1998 (TH Ahn) (KSU); 2 ♂♂, 3 ♀♀, Pyeonbaek Recreation Forest, Namhae, 16~18 June 1999 (JS Jeon et al.) (KSU); 1 ♂, 6 ♀♀, same locality, 19~21 June 2000 (GM Kim et al.) (JSU); 1 ♀, Sangbu Reservoir, Sancheong, 10~11 May 1997 (JH Gang) (KSU); JN: 1 ♀, Mt. Baekun-san, Gwangyang, 3 May 1998 (Paek et al.) (genitalia slide no. SJC-82) (IU); GJ: 1 ♂, Mt. Mudeung-san, 8 Sept. 2002 (SW Choi) (genitalia slide no. SJC-158) (MNU).

Distribution: Korean Peninsula (Jeong et al. 1997, Shin et al. 1990, Park et al. 2001), Japan (Hokkaido, Honshu, Shikoku, Kyushu, and Yakushima I.), China (East), Russia (Sakhalin I.), Taiwan, and N. India.

Host plants and Biology: *Viburnum dilatatum* Thunb. and *V. furcatum* Bl. (Caprifoliaceae) are utilized by Japanese populations (Inoue 1982, Sugi 1987). The species is supposed to be bivoltine in Korea. The adults have a resting posture in which the forewings are rolled up and extended horizontally and the hindwings are folded along the sides of the abdomen. The overall color pattern is supposedly a form of camouflage or cryptic coloration as it looks like bird droppings.

Remarks: The association of *plagifera* with *Oroplema* was first anticipated by Inoue (2000) when he introduced Holloway's work to Japanese readers. Subsequently, this taxonomic change was formally proposed by Sugi (2000). Swinhoe's “*Epiplema*” *spona* was described in 1895 based

on material from India. Besides the original description, this name was only mentioned by Dalla Torre (1924) and Matsumura (1931) and has been ignored in the subsequent literature. Having examined the syntypes of *sponsa* in the BMNH, we have come to the conclusion that *sponsa* is conspecific with *plagifera*.

Genus *Eversmannia* Staudinger, 1871
(Figs. 2X, 10I-K, 11D)

Eversmannia Staudinger 1871: 159. Type species: *Idaea exornata* Eversmann 1837.

Diagnosis: Forewing ground color white with brownish postmedial line; R2, R3, and R4 forked. Hindwing speckled with black and brown patches on posterior 1/2 of upper surface; M2 vestigial, forming folding line; tails present as typical epipleminine form.

Male genitalia: Uncus protruding, obtuse at apex; gnathos well developed, articulating medially with tegumen, hook-shaped in lateral view; valva simple, elongate, enlarged distally; sacculus basally with digitate process; aedeagus with developed coecum and cornutus composed of several thick spines.

Female genitalia: Ductus bursae sclerotized; corpus bursa membranous, globular to cucumiform; signum present as a bundle of minute spines or small sclerotized plate.

Remarks: According to Fletcher (1979), this genus was originally proposed in the Geometridae, but was subsequently transferred to the Epiplemidae by Staudinger (1901). The definition of *Eversmannia* remains inconsistent, ranging from being a monobasic and northeastern Palaearctic genus to including several unrelated species. Dubatolov et al. (1994) considered that *Eversmannia* should include *Oroplema plagifera*, *Dysaethria erasaria*, *D. illotata*, and *D. moza* because the genus *Epiplema*, which these species were associated with, was not appropriate for accommodating the Palaearctic and Oriental species. Chen (1997) suggested using *Eversmannia* for 5 Taiwanese species, which are now placed in *Europlema* (Holloway 1998), because all of these species have a well-developed gnathos and a spiral ductus ejaculatorius. However, we can agree to place neither the Russian *Oroplema* and *Dysaethria* nor the Taiwanese *Europlema* in *Eversmannia*. The most-striking character of *Eversmannia exornata* is the presence of a trifurcate gnathos articulated with the tegumen, and this

character is completely absent from *Oroplema*, *Dysaethria*, and their potential sister-groups. The presence of a gnathos is also seen in *Europlema*, the "*Epiplema*" *bicaudata* species-complex, and "*Epiplema*" *arcuata* Warren, 1898 (Chen 1997). In *Europlema*, the lateral arms of the gnathos are separated near the base and are fused to a sharp apex. In the gnathos of "*Epiplema*" *arcuata*, the lateral arms of the gnathos are robust and partly fused near the base and dorsal parts. The "*Epiplema*" *bicaudata* species-complex may be the most-closely related to *Eversmannia exornata* in the shapes of the valvae, uncus, gnathos, and female genitalia, but their relationships cannot be clarified until the taxonomy of the "*Epiplema*" *bicaudata* species-complex is studied and the generic level phylogeny of Epipleminae is reconstructed.

***Eversmannia exornata* (Eversmann, 1837)**
(Figs. 2X, 10I-K, 11D)

Idaea exornata Eversmann 1837: 65. Type locality: Kazan, Tatarstan, Russia.

Eversmannia exornata: Staudinger 1871: 159; Fletcher 1971; Dubatolov et al. 1994: 19; Chen 1997: 65, fig. 59: A, B.

Epiplema exornataria, Herrich-Schäfer 1847: 29, fig. 418 (misspelled).

Erosia rapha Butler 1878: 403. Type locality: Hakodaté, Japan, holotype in BMNH.

Epiplema rapha: Leech 1897: 187.

Epiplema exornata: Seitz 1912: 278, t. 48i; Matsumura 1931: 941; Bryk 1949: 28; Inoue 1982: 576.

Epiplema exornata sibirica Kozhantschikov 1924: 66-75. Designated by Dubatolov et al. 1994: 19.

External features: Wingspan 17~18 mm in male ($n = 3$), 17~18 mm in female ($n = 2$) (based on Japanese material). Head white. Thorax white dorsally. Forewing white, subbasal zone with black and brown spots scattered along costal margin and anal cells; brownish-orange medial-postmedial stripe running from costal margin to inner margin with darker inner part; submarginal zone white with black spot at apex. Hindwing white with subbasal, medial, and submarginal zones tinged brown; subbasal line forming black patch near inner margin; medial zone with inner line running from M1 to inner margin and outer line extending from costal margin to inner margin; postmedial patch distributed from M1 to anal cells with patch below M3 tail much darker than surrounding areas. Abdomen white dorsoventrally.

Male genitalia: As described for the genus.

Female genitalia: As described for the genus.

Distribution: North Korea, Japan (Hokkaido

and Honshu) (Inoue 1982), and Russia (Amurland, SE and W Siberia, Moskow, Ryazan, Ivanovo, Bryansk, and Tula regions) (Dubatolov et al. 1994).

Host plants: An unidentified species of *Salix* (Salicaceae) was reported to be the host plant from the European part of Russia (Dubatolov et al. 1994).

Remarks: Bryk (1949) documented the 1st record of this species from Gekatsungu (=Hagalgu, Jangjin, HN), but no additional records or specimens have been found in Korea since then until 2001, when the 1st author observed an individual from Mt. Changbai-shan, close to the River Duman, lying on the national border between North Korea and China. The taxonomic identity of *E. exornata* has historically been confused with "*Epiplema*" *bicaudata* (Moore, 1868), which was described from Bengal. Hampson (1895) considered that *E. exornata* should be treated as a northern Asian subspecies of the Himalayan *bicaudata*, but Seitz (1912) considered that *E. exornata* was also distributed to southern China and India. Seitz's statement was followed by Inoue (1982), and the distribution of *exornata* has been extended to include India and China. Having examined the type specimen and a long series of Himalayan *bicaudata* in the BMNH, we have come to the conclusion that *exornata* and *bicaudata* are distinct species. The wing pattern of *bicaudata* (Inoue 1998: pl. 138-3) can easily be distinguished from that of *exornata* by having the dark patches ranging from the medial zone to the marginal zone and the hindwing postmedial patches confined to the area around the tails. The literature records of *exornata* from China are doubtful because we have located no Chinese specimen in all the museum collections examined. The literature records of *exornata* from India are also very likely based on an error by Dalla Torre (1924), where Japan, the type locality of *Epiplema rapha* Butler, 1878 (a junior synonym of *Idaea exornata*), was misquoted as "India". In addition, the wing pattern of *E. exornata* is also very similar to that of "*Epiplema*" *fusci-formis* Warren, 1896 (Fig. 2W), but its forewing termen slightly protrudes, the submarginal zone is not occupied by dark patches, the inner line of the hindwing medial zone begins from M1, and the subapical area of the hindwing is not stained brown.

Acknowledgments: We are indebted to Hiroshi Inoue (Iruma City, Japan) for his encouragement in the study of the Epipleminae. Jeremy Holloway

(BMNH) read an early draft and made many helpful comments on it. We also thank Kyu-Tek Park (Kangwon National Univ., Chuncheon, Korea), Jung-Seok Park (Kyeongsang National Univ., Jinju, Korea), Yang-Seop Bae (Incheon Univ., Incheon, Korea), Sei-Woong Choi (Mokpo National Univ., Mokpo, Korea), and Seong-Soo Kim (Seoul City, Korea) for the loan of Korean material. Finally, we want to thank Yung-Jye Chen (Society of Wildlife and Nature, Taiwan) for providing his unpublished thesis and comments on identifications.

REFERENCES

- Boudinot J. 1982. Insectes, Lepidopteres Epiplemidae. Faune Madagascar **60**: 1-55.
- Bremer O. 1864. Lepidopteren Ost-Sibiriens, insbesondere des Amur-Landes, gesammelt von den Herrn G. Radde, R. Maack und P. Wulffius. Mém. Acad. Imp. Sci. St.Pétersb. **8**: 1-103, 8 pls.
- Bryk F. 1949. Zur Kenntnis der Grossschmetterlinge von Korea, Pars II. Macrofrenata II (finis). Ark. Zool. **41A**: 1-225, pl. 7.
- Butler G. 1878. Descriptions of new species of Heterocera from Japan. Part III, Geometrites. Ann. Mag. nat. Hist. **1**: 309-407, 440-452.
- Butler G. 1881. Descriptions of new genera and species of heteroneurous lepidoptera from Japan. Trans. Ent. Soc. Lond. **1881**: 401-426.
- Byun BK, BY Lee. 1996. Lepidopterous insect fauna in Kwangnung and Namhae Experimental Forest. For. Res. Inst. J. For. Sci. **53**: 10-27.
- Byun BK, GJ Weon, BY Lee. 1996. List of species in insect collection of Forestry Research Institute 3. Geometroidea (Lepidoptera). For. Res. Inst. J. For. Sci. **54**: 116-140.
- Chang SM, MT Hu. 1992. *Epiplema moza* Butler. In GR Hsiao, ed. Forest insects of China. 2nd ed. Beijing: China Forestry Publishing. (in Chinese)
- Chen YJ. 1997. Taxonomy of Epipleminae of Taiwan (Lepidoptera: Uraniidae). Master's thesis, Graduate Institute of Plant Pathology and Entomology, National Taiwan Univ., Taipei, Taiwan.
- Chey VK, JD Holloway, MR Speight. 1997. Diversity of moths in forest plantations and natural forests in Sabah. Bull. Entomol. Res. **87**: 371-385.
- Christoph H. 1881. Neue Lepidopteren des Amurgebietes. Bull. Soc. Imp. Nat. Moscou **55**: 33-121.
- Chu HF, LY Wang. 1983. Epiplemidae. In PY Wang, LY Wang, CL Fang, et al., ed. Iconographia Heterocerorum Sinicorum Vol. 1. Beijing: Science Press.
- Common IFB. 1990. Moths of Australia. Melbourne: Melbourne Univ. Press.
- Comstock JH. 1940. An introduction to entomology. 9th ed. New York: Comstock Publishing.
- Dalla Torre KW. 1924. Epiplemidae. Lepid. Cat. **30**: 1-38.
- Dubatolov VV, EM Antonova, OE Kosterin. 1994. *Eversmannia exornata* (Eversmann, 1837), the only known representative of the Epiplemidae family (Lepidoptera) in West Palaearctic. Actias **1**: 19-23.
- Edwards ED. 1996. Uraniidae. In ES Nielsen, ED Edwards,

- TV Rangsi, eds. Checklist of the Lepidoptera of Australia. Monographs on Australian Lepidoptera 4. Canberra: CSIRO.
- Eversmann E. 1837. Kurze Notizen über einige Schmetterlinge Russlands. Bull. Soc. Imp. Nat. Moscow **1837**: 29-66.
- Fletcher DS. 1979. The generic names of moths of the world. Vol. 3. London: British Museum (Natural History).
- Gaede M. 1928. Epipleminae. In A Seitz, ed. Die Gross-Schmetterlinge der Erde, Fauna Africana Band 14. Stuttgart: Alfred Kernen Verlag.
- Gaede M. 1929. Epiplemidae. In A Seitz, ed. Die Gross-Schmetterlinge der Erde, Die Indo-Australischen Spinner und Schwärmer. Stuttgart: Alfred Kernen Verlag.
- Gaede M. 1936. Epiplemidae. In A Seitz, ed. Die Gross-Schmetterlinge der Erde, Die Amerikanischen Spinner und Schwärmer. Band 6. Stuttgart: Alfred Kernen Verlag.
- Guenée A. 1857a. Uranides et Phalenites I. In JA Boisduval, A Guenée, eds. Histoire Naturelle des Insects. Species Général des Lépidoptères 9. Paris: Librairie Encyclopedique de Roret.
- Guenée A. 1857b. Uranides et Phalenites II. In JA Boisduval, A. Guenée, eds. Histoire Naturelle des Insects. Species Général des Lépidoptères 10. Paris: Librairie Encyclopedique de Roret.
- Gyotoku N. 1983. The new locality and foodplant of *Epiplema meridiana* Inoue. Korasana **21**: 10-12.
- Hampson GF. 1891. The Lepidoptera Heterocera of the Nilgiri District. Illus. Typ. Spec. Lepid. Heteroc. Coll. Br. Mus. (Lond.) **8**: 1-144, pls. 139-156.
- Hampson GF. 1892. Moths I. In WT Blandford, ed. The fauna of British India, including Ceylon and Burma. London: Taylor and Francis.
- Hampson GF. 1893. The Macrolepidoptera Heterocera of Ceylon. Illus. Typ. Spec. Lepid. Heteroc. Coll. Br. Mus. (Lond.) **9**: 1-182, pls. 157-176.
- Hampson GF. 1895. Moths III. In WT Blandford, ed. The fauna of British India, including Ceylon and Burma. London: Taylor and Francis.
- Hampson GF. 1896. Moths IV. In WT Blandford, ed. The fauna of British India, including Ceylon and Burma. London: Taylor and Francis.
- Hampson GF. 1903. Catalogue of the Lepidoptera Phalaenae of the Collection of the British Museum 4. Catalogue of the Noctuidae in the Collection of the British Museum. London: British Museum (Natural History).
- Heppner JB. 1998. Classification of Lepidoptera Part 1. Introduction. Holarctic Lepidoptera **5 (Supplement 1)**: iv + 148 pp. + 6 (index).
- Herrich-Schäffer GAW. 1843-1856. Systematische Bearbeitung der Schmetterlinge von Europa, zugleich als Text, Revision und Supplement zu Jakob Hübner's Sammlung europäischer Schmetterlinge. Regensburg: GJ Manz.
- Herrich-Schäffer GAW. 1850-1869. Sammlung neuer oder wenig bekannter aussereuropäischer Schmetterlinge. Regensburg: GJ Manz.
- Herz O. 1904. Lepidoptera von Korea, Noctuidae and Geometridae. Ann. Mus. Zool. Acad. Imp. Sci. St.-Petersb. **9**: 263-390, pl.1.
- Hinton HE. 1946. On the homology and nomenclature of the setae of lepidopterous larvae and some notes on the phylogeny of the Lepidoptera. Trans. Ent. Soc. Lond. **97**: 1-37.
- Holloway JD. 1976. Moths of Borneo with special reference to Mount Kinabalu. Kuala Lumpur: The Malayan Nature Society.
- Holloway JD. 1998. The moths of Borneo: families Castniidae, Callidulidae, Drepanidae and Uraniidae. Malay. Nat. J. **52**: 1-155, 317 figs., 10 pls.
- Holloway JD, JD Bradley, DJ Carter. 1987. Lepidoptera. In CR Beets ed. CIE guides to insects of importance to man 1. Wallingford: CAB International.
- Inoue H. 1965. List of moths from the Ryukyu Islands taken by the 1963 and 1964 field works, with description of a new species and subspecies (Lepidoptera). Kontyu **33**: 351-363.
- Inoue H. 1982. Uraniidae, Epicopeiidae, Epiplemidae. In H Inoue, S Sugi, H Kuroko, S Moriuti, A Kawabe, M Owada, eds. Moths of Japan. 2 Vols. Tokyo: Kodansha.
- Inoue H. 1984. One species of the Epiplemidae and ten species of the Pyralidae new to the fauna of Japan. Jpn. Heterocer. J. **124**: 377-382.
- Inoue H. 1989. Notes on five species of the Epiplemidae from Japan. Jpn. Heterocer. J. **151**: 1-4.
- Inoue H. 1992. Epiplemidae. In JB Heppner, H Inoue, eds. Lepidoptera of Taiwan 1 (2) (Checklist). Gainesville, FL: Association for Tropical Lepidoptera.
- Inoue H. 1998. Uraniidae from Nepal. In T Haruta, ed. Moths of Nepal Part 5. Tinea **15 (Supplement 1)**: 81-83.
- Inoue H. 2000. [Book review of] The moths of Borneo: Families Castniidae, Callidulidae, Drepanidae and Uraniidae. Jpn. Heterocer. J. **207**: 135-136.
- Iwata K. 1969. *Epiplema moza* feeding on *Viburnum*. Jpn. Heterocer. J. **58**: 684. (in Japanese)
- Iwata K. 1969. *Viburnum*, hostplant of *Epiplema moza*. Jpn. Heterocer. J. **202**: 23-30.
- Janse AJT. 1932. The moths of the South Africa I. Durban: EP and Commercial Printing.
- Jeong HC, SC Choi, SS Kim. 1997. On the Lepidoptera fauna of Paekyangsa area in Chollanam-do. J. Lep. Soc. Korea **10**: 17-44. (in Korean)
- Jaros J, K Spitzer, J Havelka, KT Park. 1992. Synecological and biogeographical outlines of Lepidoptera communities in North Korea. Ins. Koreana **9**: 78-104.
- Kami KS, SE Miller. 1998. Samoan insects and related arthropods: checklist and bibliography. Bishop Mus. Tech. Rep. **13**: 1-121.
- Kawazoe A., M Ogata. 1962. A list of the moths from the Amami Islands (I). Tyô to Ga **13**: 13-27.
- Kim HC. 1991. Insect-fauna of Club 700 C. C. area in Yeosu-gun, Kyunggi-do. J. Amat. Lepidop. Soc. Korea **4**: 20-26. (in Korean)
- Klots AB. 1970. Lepidoptera. In SL Tuxen, ed. Taxonomist's glossary of genitalia in insects. 2nd revised and enlarged ed. Copenhagen: Munksgaard.
- Kodama T. 1959. The larva of *Epiplema cretacea* Butler (Epiplemidae). Tyô to Ga **10**: 7-9. (in Japanese with English summary)
- Kozhantschikov W. 1924. Materialien zur Macrolepidopteren Fauna des Minussinsk Bezirks II, Jahrb. Martjanov'schen Staatsumus. Minussinsk **2**: 66-75.
- Kuznetsov VI, AA Stekolnikov. 1981. Functional morphology of genitalia of some relict Asiatic moths (Lepidoptera, Papilionomorpha: Epiplemidae, Uraniidae, Drepanidae, Callidulidae) and their systematic position. Proc. Zool. Inst. Acad. Sci. USSR **103**: 19-43.
- Lee BY, BK Byun, GJ Won, BW Byun. 1996. Catalogue of species in insect collection of Forestry Research Institute I. Lepidoptera. Res. Materials For. Inst. **129**: 120-121. (in

- Korean)
- Lee YI, WT Kim, DH Kim. 1985. Insect fauna of Halla Mountain. Academic Research Report for the Mt. Halla. Cheju Island: Cheju Island Government. (in Korean)
- Leech JH. 1897. Lepidoptera Heterocera from China, Japan, and Corea. *Ann. Mag. Nat. Hist.* **6**: 180-235, pls. VI-VII.
- Leech JH. 1901. Lepidoptera Heterocera from China, Japan, and Corea. Part V. With descriptions of new species by Richard South. *Trans. Ent. Soc. Lond.* **1901**: 385-514, pls. 14, 15.
- Matsumura S. 1931. 6000 illustrated insects of the Japan-Empire. Tokyo: Teiseisha, 191 pp, 1497 figs, 10 pls. (in Japanese)
- Minet J. 1986. Ébauche d'une classification moderne de l'ordre des Lépidoptères. *Alexandria* **14**: 291-313.
- Minet J. 1991. Tentative reconstruction of the ditrysian phylogeny (Lepidoptera: Glossata). *Ent. scand.* **22**: 69-95.
- Minet J. [1995]1994. A new type of tympanal organ in male Uraniidae (Lepidoptera). *C. r. Acad. Sci. Paris (série III), Sci. vie/Life sci.* **317**: 1089-1097.
- Minet J, MJ Scoble. 1999. The Drepanoid/ Geometroid assemblage. In NP Kristensen, ed. *Handbuch der Zoologie Band IV Arthropoda: Insecta Teilband 35, Lepidoptera, moths and butterflies, Vol. 1: Evolution, systematics, and biogeography.* Berlin and New York: Walter de Gruyter.
- Minet J, A Surlykke. 2003. Auditory and sound producing organs. In NP Kristensen, ed. *Handbuch der Zoologie Band IV Arthropoda: Insecta Teilband 36, Lepidoptera, moths and butterflies, Vol. 2: Morphology, physiology, and development.* Berlin and New York: Walter de Gruyter.
- Moore F. [1884-]1887. *Lepidoptera of Ceylon.* 3 Vols. London: Reeve.
- Moore F. 1888. Descriptions of new Indian lepidopterous insects from the collection of the late Mr. W.S. Atkinson. Heterocera continued (Pyrilidae, Crambidae, Geometridae, Tortricidae, Tineidae). Calcutta: Asiatic Society of Bengal.
- Murase M. 1993. Record of several moths in Wakayama Prefecture with developmental stages of some species II. *Nanki Seibutu* **35**: 141-144. (in Japanese)
- Murase M. 1998. Larvae of two epiplemine moths: *Epiplema meridiana* Inoue and *Phazaca prunaria* (Moore). *Jpn. Heterocer. J.* **198**: 381-382.
- Nakamura K. 1972. Host plants of two species of *Epiplema*. *Jpn. Heterocer. J.* **68**: 119. (in Japanese)
- Nakata Y. 1993. *Apochima praecutaria* (Inoue) (Geometridae) from Shikoku. *Jpn. Heterocer. J.* **174**: 419.
- Novotny V, Y Basset, SE Miller, P Drozd, L Cizek. 2002. Host specialization of leaf-chewing insects in a New Guinea rainforest. *J. Anim. Ecol.* **71**: 400-412.
- Paek MK, BW Lee, NH Ahn, KS Oh, YS Bae. 1997. A faunistic study of Mt. Mani, Gangwha Island, Korea. *Theses Collect. Univ. Incheon* **9**: 111-127.
- Pagenstecher A. 1884. Beitrage zur Lepidopteren-Fauna von Amboina. *Jahrbuecher nassauischen vereins Naturkunde* **37**: 150-257, 2 pls.
- Pak SW. 1970. Moths from Geoje Island, southern part of Korea. *Jpn. Heterocer. J.* **63**: 37-41.
- Park KT, L Ronkay, L Przybylowicz, A Kun, L Peregovits. 2001. Moths of North Korea (Lepidoptera, Heterocera, Macrolepidoptera--parts). Seoul: Korea Research Institute of Bioscience and Biotechnology and Center for Insect Systematics.
- Scoble MJ. 1992. The Lepidoptera: form, function and diversity. Natural History Museum Publications. Oxford, UK: Oxford Univ. Press.
- Seitz A. [1906-]1912. Epipleminae. In A Seitz, ed. *Die Gross-Schmetterlinge der Erde, Die Palaearktischen Spinner und Schwärmer.* Band 2. Stuttgart: Alfred Kernen Verlag.
- Seitz A. 1912. Epiplemidae. In A Seitz, ed. *Die Gross-Schmetterlinge der Erde, Die Palaearktischen Spinner und Schwärmer.* Band 2. Stuttgart: Alfred Kernen Verlag.
- Seitz A. [1926-]1930. Epipleminae. In A Seitz, ed. *Die Gross-Schmetterlinge der Erde, Die Afrikanischen Spinner und Schwärmer.* Band 14. Stuttgart: Alfred Kernen Verlag.
- Seitz A. 1934. Epiplemidae. In A Seitz, ed. *Die Gross-Schmetterlinge der Erde, Die Indo-Australischen Spinner und Schwärmer.* Stuttgart: Alfred Kernen Verlag.
- Seitz A. 1940. Epiplemidae. In A Seitz, ed. *Die Gross-Schmetterlinge der Erde, Die Amerikanischen Spinner und Schwärmer.* Band 6. Stuttgart: Alfred Kernen Verlag.
- Shin YH. 1983a. Epiplemidae. In YH Shin, SH Nam, KT Park, eds. *Illustrated flora and fauna of Korea.* Vol. 27. Seoul: Ministry of Education, pp. 166-168. (in Korean)
- Shin YH. 1983b. On the Lepidopterous fauna in the climax forest of Piagol valley in Mt. Chiri. *Rep. KACN* **21**: 107-121. (in Korean)
- Shin YH, MS Jeong, SS Kim. 1990. On the moth fauna of Mt. Taebaek, Kangwon-do, in Korea. *Theses Collect. Kyung Hee Univ.* **19**: 269-291. (in Korean)
- Shin YH, SS Kim, HC Kim. 1989. Notes on the Lepidoptera of Mt. Wolch'ul, Chollanam-do, Korea. *Rep. KACN* **27**: 121-133. (in Korean)
- Sick H. 1937. Die Tympanalorgane der Uraniden und Epiplemiden. *Zoologische Jahrbücher. Abteilung Anat. Ontog. Tiere* **63**: 351-398.
- Staudinger O. 1871. *Eversmannia exornata.* In O Staudinger, M Wocke, eds. *Catalog der Lepidopteren des Europäischen Faunengebiets I. Macrolepidoptera.* Dresden: Dr. O. Staudinger.
- Staudinger O. 1897. Die Geometriden des Amurgebietes. *Dtsch. Ent. Zeit. Iris (Dresden)* **10**: 1-122, pl. 1-3.
- Staudinger O. 1901. Epiplemidae. In O Staudinger, H Rebel, eds. *Catalog der Lepidopteren des Europäischen Faunengebiets II. Microlepidoptera.* Berlin: R. Friedländer und Sohn.
- Stehr FW. 1987. Epiplemidae. In FW Stehr, ed. *Immature insects.* Vol. 1. Dubuque, IO: Kendall/Hunt Publishing.
- Strand E. 1916. H. Sauter's Formosa-Ausbeute: Epiplemidae u. teilweise Noctuidae, Lymantriidae, Drepaniidae, Thyrididae u. Aegeriidae. *Arch. Naturg. (Berlin)* **82A**: 137-152.
- Strand E. 1917. H. Sauter's Formosa-Ausbeute. *Abbildungen von einigen fruher beschriebenen Heterocera.* *Ent. Mitt.* **6**: 312-316.
- Sugi S. 1987. Epiplemidae. In S Sugi., eds. *Larvae of larger moths in Japan.* Japan: Kodansha, pp. 114-115, 278.
- Sugi S. 1994. Additions of species and changes in names of Japanese moths. Tokyo: The Japan Heterocerists' Society.
- Sugi S. 1994. Notes on *Epiplema meridiana* Inoue (Epiplemidae) discovered from Honshu. *Jpn. Heterocer. J.* **176**: 1-2. (in Japanese with English summary)
- Sugi S. 2000. "Post-MJ", additions of species and changes in names of Japanese moths. Tokyo: The Japanese Heterocerists' Society.
- Sugi S. 2004. Two species of *D[?]saethria* (Uraniidae, Epipleminae) feeding on *Daphniphyllum teijsmanni* in Okinawa. *Tinea* **229**: 63.

- Tominaga S. 2000. Larval hostplants of three epipleminine moths in Okinawa. *Yugato* **161**: 103-104.
- Turner AJ. 1903. Revision of Australian Lepidoptera. *Proc. Linn. Soc. N.S.W.* **28**: 42-92.
- Turner AJ. 1911. Studies in Australian Lepidoptera. *Ann. Qld. Mus.* **10**: 59-135.
- Wagner DL, DC Ferguson, TL MacCabe, RC Reardon. 2001. Geometroid caterpillars of northeastern and Appalachian forests. Washington, DC: US Department of Agriculture.
- Walker F. 1859. List of the specimens of lepidopterous insects in the collection of the British Museum. **17**: 255-508.
- Walker F. 1862. Catalogue of the heterocerous Lepidoptera collected at Sarawak, in Borneo. *J. Proc. Linn. Soc. (Zool.)* **6**: 116-117.
- Walker F. 1866. List of the specimens of lepidopterous insects in the collection of the British Museum. **34**: 1121-1533.
- Wang LY. 1987. Lepidoptera: Bombycidae, Saturniidae, Brahmaeidae, Thyrididae, Epipleminidae, Callidulidae, Drepanidae. *In* SM Zhang, ed. *Agricultural insects, spiders, plant diseases and weeds of Xizang*. Lhasa: Xizang People Press.
- Wang HY. 1993. Illustration of day-flying moths in Taiwan. Guide book to insects in Taiwan (2). Taipei: Shu-Hsin Publishing. (in Chinese)
- Wang HY. 1996. Supplement of moths. Guide book to insects in Taiwan (17). Taipei: Shu-Hsin Publishing. (in Chinese)
- Warren W. 1896. New genera and species of Pyralidae, Thyrididae, and Epipleminidae. *Ann. Mag. nat. Hist.* **17**: 131-150, 202-216.
- Warren W. 1898. New species and genus of the families Drepanidae, Thyrididae, Uraniidae, Epipleminidae, and Geometridae from the Old-World regions. *Novit. Zool.* **5**: 221-258.
- Warren W. 1899. New Drepanidae, Thyrididae, Epipleminidae, Uraniidae, and Geometridae from the Oriental and Palaearctic regions. *Novit. Zool.* **6**: 1-66. 313-359.
- Warren W. 1901. New Uraniidae, Epipleminidae, and Geometridae from the Oriental and Palaearctic regions. *Novit. Zool.* **8**: 21-37.
- Warren W. 1906. New Drepanidae, Thyrididae, Uraniidae, and Geometridae from British New Guinea. *Novit. Zool.* **13**: 61-161.
- Warren W. 1907. New Drepanidae, Thyrididae, Uraniidae, and Geometridae from British New Guinea. *Novit. Zool.* **14**: 1-186.
- West RJ. 1932. Further descriptions of new species of Japanese, Formosan and Philippines Heterocera. *Novit. Zool. (Tring)* **37**: 207-228.
- Wileman AE. 1911. New and unrecorded species of Lepidoptera Heterocera from Japan. *Trans. Ent. Soc. Lond.* **1911**: 189-407, pl. 31.
- Wileman AE. 1916. New Lepidoptera-heterocera from Formosa. *Ent. (Lond.)* **49**: 178-182, 201-204, 266-268.
- Zhu HF, LY Wang. 1994. Epipleminidae of China (Lepidoptera). *Sinozoologia* **11**: 87-95.