

ISSN 1341-1160

**Taxonomic study of the Japanese Trichopterygini
(Lepidoptera: Geometridae: Larentiinae),
with a proposal of a new tribe Heterophlebini**

Satoshi HASHIMOTO



Japanese Journal of Systematic Entomology
Monographic Series
No. 6

April 30, 2021

Published by
Japanese Society of Systematic Entomology
Matsuyama, Japan

Japanese Journal of Systematic Entomology

ISSN 1341-1160

Continuation of the

Transactions of the Shikoku Entomological Society

(ISSN 0037-3680)

Chief Editor: Kazuhiko KONISHI

Editorial Board

Kiyoshi ANDO	Masami HAYASHI	Hiromu KURAHASHI
Shûhei NOMURA	Nobuo OHBAYASHI	Mamoru OWADA
Shun-Ichiro NAOMI	Tatsuya NIISATO	Masahiro SAKAI
Akihiko SHINOHARA	Satoshi SHINONAGA	Sadao TAKAGI
Masaaki TOMOKUNI	Seiki YAMANE	Hiroyuki YOSHITOMI

The Japanese Journal of Systematic Entomology is published biannually by the Japanese Society of Systematic Entomology. We are willing to exchange with any publication relating to the study of entomology.

All inquiries concerning the journal should be addressed to the Japanese Society of Systematic Entomology.

The publications of the Society including back volumes of the journal are obtainable through the Roppon-Ashi Entomological Books, c/o Kawamo & Co., Inc. Kyodo BLDG. (Honcho-Dori), 3-5-11, Nihonbashi-honcho, Chuo-ku, Tokyo, 103-0023 Japan (E-mail: roppon-ashi@kawamo.co.jp; Fax: +81-3-3279-2678; Home page: <http://kawamo.co.jp/roppon-ashi/>)

Annual subscription: ¥ 7,000 for institutional or private.

Japanese Society of Systematic Entomology

c/o Entomological Laboratory, Faculty of Agriculture, Ehime University, Tarumi 3-5-7, Matsuyama, 790-8566 Japan

Home page URL (<https://sites.google.com/site/jssystement/>)

President: Kazuhiko KONISHI

Vice President: Masahiro SAKAI

Councilors:

Kiyoshi ANDO, Yutaka ARITA, Masami HAYASHI, Toshiya HIROWATARI, Yoshihiro HORI, Hiromu KURAHASHI, Munetoshi MARUYAMA, Yorio MIYATAKE, Takeyuki NAKAMURA, Shun-Ichiro NAOMI, Tatsuya NIISATO, Nobuo OHBAYASHI, Mamoru OWADA, Akihiko SHINOHARA, Satoshi SHINONAGA, Sadao TAKAGI, Masaaki TOMOKUNI, Kazutaka YAMADA, Seiki YAMANE, Takeo YAMAUCHI, Hiroyuki YOSHITOMI.

Cover illustration: *Otoplecta frigida* (Butler, 1878) (by Satoshi Hashimoto)

Taxonomic study of the Japanese Trichopterygini (Lepidoptera: Geometridae: Larentiinae), with a proposal of a new tribe Heterophlebini

Satoshi HASHIMOTO

56–203, Higashi-sukaguchi, Kiyosu, Aichi, 452–0904 Japan

Abstract The monophyly of the tribe Trichopterygini is considered. The currently used Trichopterygini are polyphyletic. The present Trichopterygini are defined by the following autapomorphies: the enlarged metepimeron in both sexes and a pair of triangular expansions on the male abdominal sternum II, and are redescribed mainly based on adult characters. Phylogenetic relationships among the Japanese genera are analyzed cladistically with the inclusion of two European, three Oriental, and one New Zealand genera. Japanese Trichopterygini are composed of 15 genera, of which two are new, one is upgraded from a subgeneric rank, and one is synonymized: *Pseudacasis* gen. nov., *Paratrachopteryx* gen. nov., *Paralobophora* Inoue (upgraded), *Lobophorodes* Hampson (a senior synonym of *Epilobophora* Inoue), *Lobophora* Curtis, *Neopachrophilla* Inoue, *Phthonoloba* Warren, *Trichopterigia* Hampson, *Acasis* Duponchel, *Otopecta* Warren, *Esakiopteryx* Inoue, *Cladara* Hulst, *Trichopteryx* Hübner, *Episteira* Warren, and *Sauris* Guenée. Except for *Phthonoloba* and *Lobophorodes*, the Japanese genera are classified into four genus-groups: 1, *Lobophora* genus-group consisting of *Lobophora* and *Neopachrophilla*; 2, *Trichopteryx* genus-group consisting of *Cladara*, *Esakiopteryx*, *Paralobophora*, *Paratrachopteryx* and *Trichopteryx*; 3, *Acasis* genus-group consisting of *Acasis*, *Otopecta*, *Pseudacasis* and *Trichopterigia*; 4, *Sauris* genus-group consisting of *Episteira* and *Sauris*. The Japanese genera are also redescribed mainly by the adult characters and a key to them is provided. Brief information on morphology, bionomics, and distribution of the Japanese species are also given together with their genital figures. Two *Trichopteryx* species, *T. miracula* Inoue and *T. muscigera* (Butler), are transferred to the genus *Cladara*. A new tribe Heterophlebini is established for the genera *Carige* Walker, *Heterophleps* Herrich-Schäffer, *Naxidia* Hampson, *Palaeomystis* Warren and their relatives.

Contents

Abstract	1
1. Introduction	2
2. Materials and methods	2
2.1. Materials	2
2.2. Terminology	2
2.3. Cladistic analysis	2
2.4. Abbreviations	2
3. Historical review of Trichopterygini	3
3.1. Tribal definition	3
3.2. Systematic position of tribe	3
3.3. Generic classification	3
3.4. Immature studies	4
4. Consideration on monophyly of Trichopterygini	4
5. Phylogenetic analysis	5
5.1. Geometrid genera used in analysis	5
5.2. Results and discussion	5
6. Taxonomy	10
6.1. Tribe Trichopterygini Warren	10
Diagnosis	10
Remarks	10
Morphology	10
Adult	10
Immature stages	24
Distribution	24
Bionomics	25
6.2. Classification of Japanese genera	25
Key to Japanese genera (based on adult external characters)	25
Descriptions of Japanese genera with brief information on Japanese species	26
Genus <i>Lobophora</i> Curtis	26

Genus <i>Neopachrophilla</i> Inoue	30
Genus <i>Phthonoloba</i> Warren	32
Genus <i>Lobophorodes</i> Hampson	38
Genus <i>Trichopterigia</i> Hampson	41
Genus <i>Pseudacasis</i> nov.	47
Genus <i>Acasis</i> Duponchel	50
Genus <i>Otopecta</i> Warren	56
Genus <i>Esakiopteryx</i> Inoue.....	58
Genus <i>Paralobophora</i> Inoue.....	64
Genus <i>Cladara</i> Hulst	69
Genus <i>Paratrachopteryx</i> nov.	77
Genus <i>Trichopteryx</i> Hübner	81
Genus <i>Episteira</i> Warren	98
Genus <i>Sauris</i> Guenée	104
6.3. Tribe Heterophlebini nov.	119
Etymology	119
Diagnosis	119
Remarks	119
General morphology.....	120
Adult	120
Immature stages	121
Distribution	121
Bionomics	121
List of Japanese Heterophlebini	122
6.4. Unresolved genera: their systematic position unclear..	123
7. Acknowledgements	128
8. References	128
9. Appendices	134
Appendix 1. Characters used in the phylogenetic analysis ..	134
Appendix 2. Characters matrix	142

1. Introduction

Trichopterygini, one of the large Larentiine tribes of the family Geometridae, were erected by Warren (1894) based on the genus *Trichopteryx* Hübner. Trichopterygini are known from all faunal regions except the far eastern Pacific (Dugdale, 1980) and show the species diversity in the Oriental and Neotropical regions. The tribe has been placed in a rather primitive lineage in the subfamily Larentiinae (Holloway, 1997; Yamamoto & Sota, 2007; Strutzenberger *et al.*, 2010; Viidalepp, 2011; Sihvonen *et al.*, 2011; Hausmann & Viidalepp, 2012; Öunap *et al.*, 2016). Trichopterygini have been currently defined by the reduced or modified (presence of a lobe or lappet) male hindwing (Meyrick, 1892; Prout, 1914; Dugdale, 1980; Li *et al.*, 2012; Parra *et al.*, 2017; and others). However, the morphological definition of the tribe has been somewhat different among the authors, as will be shown in the historical review.

Although many trichopterygine genera have been revised and redefined, some Palearctic genera still remain to be redefined with detailed examination of the morphological characters.

The aim of this study is as follows: 1, the monophyly of the tribe Trichopterygini is considered; 2, Trichopterygini are redefined and redescribed mainly by the adult morphological structures; 3, the phylogenetic relationships among the Japanese genera are inferred by the cladistic method; 4, the Japanese trichopterygine genera are redescribed in detail. Detail descriptions of the species are excluded in this study, but a key to the species of some genera and the genital figures of the Japanese species are given with brief information on their morphology, bionomics, and distributions. In addition, a new tribe Heterophlebini is proposed for the genus *Heterophleps* and its relatives which have been treated previously as members of the Trichopterygini.

2. Materials and methods

2.1. Materials

The present study is based on more than 1,500 specimens including material (adults, last instar larvae and pupae) preserved in 75% ethanol. For observation of the external structures, each component was detached and macerated in 10% KOH solution boiled for five to 10 minutes or left at room temperature for about 24 hours. The materials macerated in 10% KOH were washed and dissected in 75% ethanol, and then sometimes stained with aceto-carmin, and occasionally mounted in the xylol balsam. Observations and drawings were made on specimen in 75% ethanol under the binocular stereoscopic microscope. For observation of the wing venation, the scales were removed from the detached wing using a fine brush in 75% ethanol, and after that the wing was stained with aceto-carmin and mounted in xylol balsam. Observations and drawings were done using a binocular stereoscopic microscope. In the present study, the materials stored in 75% ethanol were excluded from the list of the specimens examined.

2.2. Terminology

Nomenclature of the wing venation follows that of Wootton (1979). The wing pattern (Table 1) is analyzed on the basis of those of Forbes (1948), McGuffin (1972), Heitzman & Enns (1978) and Hausmann (2001). Terminology of the genitalia used here refers to those of Pierce (1914), Okagaki *et al.* (1954), Sibatani *et al.* (1954), Ogata *et al.* (1957), Klots (1970), and Kristensen (2003), and especially for the valve structure, that of Sibatani *et al.* (1954). Muscle numbers of the male genitalia follow Forbes (1939). The names of the larval setae are mainly based on Hinton's system (1946) as modified by Stehr (1987) except that the subprimary L setae on 1st to 7th abdominal segments and the L setae on the anal proleg (Table 3), of these the subprimary L setal group follows the nomenclature of Dugdale (1961), and the L setae on the anal proleg that of Hashimoto (2019).

2.3. Cladistic analysis

A computer program, PAUP 4.0a167 test version (Swofford, 2020), was used for the phylogenetic analysis. All characters treated in the analysis were equally weighted and treated as unordered. Maximum parsimony analysis was performed using a heuristic search with random stepwise addition (number of replicates = 1,000). Successive approximations weighting method was executed to reduce the number of most parsimonious trees and to obtain more acceptable trees (Farris, 1969, 1989; Carpenter, 1994). For a successive approximations weighting method, the characters were weighted by maximum value of rescaled consistency indices (Table 7). Bremer support values (Bremer, 1994) were also calculated with PAUP using the constraint-trees.

The present analysis was based on the adult morphological characters, and some of the characters and character states treated here also referred to the following studies: Pierce (1914); Forbes (1948); McDunnough (1949); Holloway (1976, 1997); Inoue (1979, 1980); Dugdale (1980); Sato (1986); Yazaki (1986b, 1986b); Xue (1992); Hashimoto (1992, 1995a, 1995c, 1999, 2005); Xue & Zhu (1999); Yazaki *et al.* (2004); Hausmann & Viidalepp (2012); Yazaki & Wang (2018); Cui *et al.* (2019).

For the taxa used in the analysis, see "5.1. Geometrid genera used in analysis". The characters used in the analysis, the coding used for each character, and a matrix of the characters (Table 6) are shown in the appendices.

When there are the multiple character states in a character of a genus, in the present study a generic state was decided by the following points: 1, state found in most of species belonging to that genus; 2, state widely distributed in the related taxa or in the Larentiinae; 3, presence of the related characters. For the taxa and characters, see appendix 2.

2.4. Abbreviations

Abbreviations used in the specimens are as follows: HIC— Collections of late Dr Prof. Hiroshi Inoue (type materials now preserved in NHM, London); NHM— Natural History Museum, London, UK; OMNH— Osaka Museum of Natural History; OPU— Entomological Laboratory of the Osaka Prefecture University. Many specimens without abbreviations are deposited in OPU or are in my personal collection, and

in the future my personal collection will be deposited in the Ehime University Museum, Matsuyama; NSMT– National Museum of Nature and Science, Tsukuba.

3. Historical review of Trichopterygini

3.1. Tribal definition

Warren (1994) first established the tribe Trichopterygini as the subfamily Trichopteryginae based on the genus *Trichopteryx* Hübner without any definition.

Before Warren (1894), Meyrick (1892) already recognized a group of genera (*Celonoptera* Lederer, *Trichopteryx*, *Pterapherapteryx* Curtis, *Lobophora* Curtis, *Ptygmatophora* Gumpfenberg, *Leptostegna* Christoph, *Heterophleps* Herrich-Schäffer, and *Tyloptera* Christoph) with a characteristic lobe or pocket in the male hindwing as the *Lobophora* group. Later, Prout (1914) also indicated that a peculiar lobe (or lappet) at the base of the male hindwing is a distinctive character of the *Lobophora* group.

Pierce (1914) first presented the Trichopterygini (as Lobophorinae) using genital structures, but his tribe was an unnatural group based on superficial similarity.

Forbes (1948) classified the North American Larentiinae into eight tribes more comprehensively and included the tribes Chesiadini and Dyspteridini in the Trichopterygini (his Lobophorini). He added a hair-pencil on the male hind tibia as one of the characteristics of the tribe.

McGuffin (1958) divided the Nearctic Larentiinae into nine tribes using larval characters for the first time, but his definition of the Trichopterygini (as the Lobophorini) was based on the combination of characters as was case in other tribes.

Dugdale (1980) indicated that all genera belonging to the Trichopterygini have an anal area of the male hindwing modified or reduced.

Holloway (1997) considered that the reduced or modified male hindwing, the male abdominal sternum II pouch (sac), the costal and saccular ornamentation of the valve in the male genitalia, and the partly or wholly scobinate corpus bursae in the female genitalia were characters of the tribe, and suggested that the former two characters were important for the tribal definition.

Nakamura (2004) first attempted the phylogenetic study on the Japanese Geometridae by the pupal morphology. He classified the subfamily Larentiinae into three divisions consisting of seven subdivisions mainly by the number of the thoracic and abdominal setae. Regrettably, many of his divisional groups are unnatural, because they are defined by the plesiomorphic characters. In his division, the tribe Trichopterygini was treated as a polyphyly.

In his morphological review of the larentiine tribes, Viidalepp (2011) redefined the tribe Trichopterygini as a group based on the wide ostium and the corpus bursae with the petaloid signa in the female genitalia, and revived the tribe Dyspteridini which was founded by Hulst (1896) and later has been treated as a member of the tribe Trichopterygini (Forbes, 1917, 1948; Ferguson, 1983).

Hausmann & Viidalepp (2012) characterized the tribe by the peculiar venation of hindwing costa and anal region,

and the stout male antennae, but they first proposed that Trichopterygini are possibly polyphyletic without any discussion.

3.2. Systematic position of tribe

In his study on the larvae of Nearctic Larentiinae, McGuffin (1958) suggested that the tribe Trichopterygini (his Lobophorini) may have developed from a *Eupithecia*-like ancestor and is the most evolved group in the relationships.

Holloway (1997) presented a tentative phylogeny of the family Geometridae based on the adult morphology and placed the Trichopterygini in the most primitive lineage in the subfamily Larentiinae.

In the recent molecular phylogenetic studies of the family Geometridae (Yamamoto & Sota, 2007; Strutzenberger *et al.*, 2010; Sihvonen *et al.*, 2011; Öunap *et al.*, 2016), a few genera (one to four genera) had been analyzed as the representatives of the tribe Trichopterygini, and the tribe was regarded as a monophyletic group and was placed in a primitive lineage in the Larentiinae. Sihvonen *et al.* (2011) performed a rigorous and extensive molecular analysis of eight genes (the fragments of one mitochondrial and seven nuclear genes) to examine the geometrid affinities in a global context. They indicated that the tribe Trichopterygini is a sister taxon to the tribe Chesiadini, and both tribes constitute a sister lineage to the remaining larentiine tribes except for the Dyspteridini. Öunap *et al.*, (2016) analyzed the larentiine phylogeny using the fragments of one mitochondrial and eight nuclear genes, and suggested that the tribe Chesiadini is not a sister to the Trichopterygini and is more primitive lineage than the Trichopterygini.

3.3. Generic classification

In the last half century, some important studies on the generic classification have been done. Holloway (1976) classified the Oriental genera *Hypocomete* Warren and *Phthonoloba* Warren into several sections by the genital structures and later he (1997) divided the former genus into two genera, *Tristeiromete* Holloway and *Hypocomete*, based on the male genitalia.

In searching for the relatives of the New Zealand genus *Tatosoma* Butler, Dugdale (1980) attempted to characterize the Australian fauna and redefined the genera *Tympanota* Warren, *Episteira* Warren and *Sauris* Guenée, which are predominantly distributed in the Oriental region, mainly based on the wing venation, the male hindwing structure, and the male and female genitalia.

In his taxonomic study of the Chinese Trichopterygini, Xue (1992) reviewed the Holarctic and Palearctic genera such as *Trichopteryx*, *Acasis* Duponchel, *Lobophorodes* Hampson, *Epilobophora* Inoue and *Nothocasis* Prout on the basis of the external morphology including genital structures.

Li *et al.* (2012) revised the genus *Syzeuxis* Hampson and analyzed the phylogenetic relationships among the species by the cladistic method using adult morphological characters. As Holloway (1997) noticed, they also suggested that the tribe Trichopterygini can be divided roughly into two groups by the forewing pattern.

For the South American Trichopterygini, several genera

(the *Rhopalodes* generic complex, *Pachrophylla* Blanchard, *Hoplosauris* Butler, and others) have been reviewed with their phylogenetic relationships and with the descriptions of new genera and new species based on the adult characters (Parra, 1991; Parra & Santos-Salas, 1991; Parra *et al.*, 2009; Parra *et al.*, 2017; Ramos-González *et al.*, 2019).

3.4. Immature studies

Except for the European and Nearctic trichopterygine species (Spuler 1910; Forbes, 1948; McGuffin, 1958; Patočka, 1980, 1981), immature morphology and host plants information are rather scarce, especially in the Afrotropical, Oriental, and Neotropical species (Singh, 1953, 1956; Dugdale 1982; Holloway, 1987; Parra, 1991).

Although it is not enough, many studies have been done in the Japanese species as follows: Yazaki, 1972, 1974, 1975; Sato, 1976, 1987; Nakamura, 1980, 1981, 2005; Hashimoto, 1982, 1985, 1986, 1991a, 1991b; Murase, 1996; Inoue & Ohbayashi, 2003; Tominaga, 2003, 2013.

4. Consideration on monophyly of Trichopterygini

Up to the present, the following combination of characters have been indicated as the distinctive characteristics of the tribe Trichopterygini: 1, the male hind tibial hair-pencil (Figs. 7C–F, 9B–C); 2, the reduced or modified male hindwing (Figs. 11B, E, 80A, C, E); 3, the male abdominal sternum II pouch (Figs. 8A, E, F, 12A–D); 4, the costal and saccular ornamentation of the valve (Figs. 14E, 34E, 35D, 36D); 5, the partly or wholly scobinate corpus bursae (Figs. 15D, 29A, 37A). Of these characters, the reduced or modified male hindwing has been accepted as an important character defining the tribe by several authors (Prout, 1914; Forbes, 1948; Dugdale, 1980; Holloway, 1997; Li *et al.*, 2012, Parra *et al.*, 2017, and others). However, this character is common to the tribes Trichopterygini, Dyspteridini and Chesiadini (Viidalepp, 2011), which were comprised in the tribe Lobophorini by Forbes (1948), and also seen in some genera of the tribes Asthenini and Eupitheciini. Recent molecular phylogenetic studies (Strutzenberger *et al.*, 2010; Sihvonen *et al.*, 2011; Öunap *et al.*, 2016) indicated that the genus *Dyspteris* Hübner (Dyspteridini) is a sister group of the remaining genera of the subfamily Larentiinae. Therefore, the reduced or modified hindwing is probably plesiomorphic in the Trichopterygini. The male abdominal sternum II pouch is related to the hind tibial hair-pencil (Hashimoto, 2005; Viidalepp, 2011); a distal part of the hair-pencil is inserted into the abdominal pouch and held by the modified metameron (Fig. 9C; Hashimoto, 2005). These characters are also shared with the tribe Chesiadini (the genera *Aplocera* Stephens (Fig. 100B–C) and *Docirava* Walker). Consequently, the monophyly of the Trichopterygini cannot be determined by these characters alone. The costal and saccular ornamentation (projection or process) and the partly or wholly scobinate corpus bursae are also problematical by the following reasons. The former character is irregularly found at the generic level of the Trichopterygini; both costal and saccular processes are present (Figs. 14E, 34E, 36D, 40D, J), or one of them is present (Figs. 22D, 23D,

28D), or both are absent (Figs. 77E, 78E). In addition, either or both projections occur in many genera of the Larentiinae. The latter character is also seen in the Chesiadini, Eupitheciini (Fig. 104C) and Melanthiini (Viidalepp, 2011). Viidalepp (2011) presented the wide ostium and the corpus bursae with the petaloid signa in the female genitalia as the characteristics defining the genera of the Trichopterygini. However, the wide ostium is widely found in the family Geometridae (Pierce 1914; Sato, 1984; Scoble & Edwards, 1990; Holloway, 1992, [1994] 1993, 1997; Nakajima, 1998; Hausmann, 2001), especially in most tribes of the subfamily Larentiinae (Inoue, 1979, 1980; Hausmann & Viidalepp, 2012), and the petaloid signa is also found in the tribes Chesiadini, Eupitheciini, and Melanthiini as indicated by Viidalepp (2011) himself. Consequently, neither of the characteristics mentioned above is valid as an autapomorphy of the Trichopterygini.

Then, is the tribe Trichopterygini monophyletic or not? As mentioned above, the monophyly of the Trichopterygini is questionable, and the tribe may be polyphyletic as indicated by Hausmann & Viidalepp (2012).

Holloway (1997) and Li *et al.* (2012) indicated that the Trichopterygini are roughly divided into two groups by the forewing pattern: one is a simple pattern group (Figs. 90A–D, 101E–G) composed of the genera *Brabira* Moore, *Carige* Walker, *Chrioloba* Prout, *Cryptoloba* Warren, *Goniopteroloba* Hampson, *Heterophleps*, *Lobogonia* Warren, *Syzeuxis* Hampson and *Tyloptera*, and the other is a multiple waved pattern group consisting of the genera *Dystypoptila* Warren, *Episteira*, *Hypocometa*, *Phthonoloba*, *Sauris*, *Trichopterigia*, *Tristeirometa*, and *Tympanota*. These authors also suggested that this provisional division required a wider revision of the tribe for it to be established.

With a few exceptional genera, their division (Holloway, 1997; Li *et al.*, 2012) mentioned above is also supported by other morphological characters. The simple pattern group is distinguishable as follows: 1, male and female hindwings with Sc separate from discal cell and connected via a short vein of R (a cross vein of Li *et al.* (2012)) before or near middle of discal cell (this character may be not apomorphic, because the same condition is seen in the genus *Dyspteris* of the tribe Dyspteridini; figs. 148–149 in Forbes (1948); Figs. 93B–C, E–F, 94B–C, D–E); 2, both gnathii extending ventromedially and frequently fused with each other (probably a plesiomorphic character in the Larentiinae; Figs. 95A, 96B); 3, bursa copulatrix with several invaginate triangular sclerites or invaginate sclerotized long ridges (a series of longitudinal sclerotized ridges in Holloway (1997): fig. 270; a series of sclerotized folds in Li *et al.* (2012); Figs. 97, 98K, N) circularly, which is unique in the Larentiinae, but often secondarily absent at the species level (Xue & Zhu, 1999; Li *et al.*, 2012). On the other hand, the multiple waved pattern group is characterized by the following combination of characters: 1, enlarged metepimeron (swollen metepimeron; Figs. 8A–E, 9A), which is unique in the Larentiinae and probably autapomorphic in this group, but occasionally absent secondarily in a few genera (Dugdale (1980) treated this character as a characteristic of the generic level; Parra *et al.* (2017) regarded the swollen metepimeron as a synapomorphy

combining the South American genera and the New Zealand genus *Tatosoma*); 2, female hindwing with Sc fused with R + Rs (upper vein of discal cell) for most length of discal cell same as in most genera of Larentiinae; 3, male abdominal sternum II with a pair of triangular expansions (a pair of triangular flaps of Holloway (1997); Figs. 8A, C–E, 9C, 12A–B), which is also unique in the Larentiinae and probably autapomorphic in this group, but occasionally absent secondarily in the species or generic levels (this character was also regarded as a synapomorphy combining the South American genera and the New Zealand genus *Tatosoma* by Parra *et al.* (2017)); 4, both gnathii not so extending ventrally and never connected with each other ventro-medially as in most genera of the Larentiinae; 5, corpus bursae partly or fully scobinate (also seen in some tribes of the Larentiinae mentioned above).

Dugdale (1980) indicated that all genera of the tribe Trichopterygini have a modified or reduced anal area of the male hindwing, but his trichopterygine genera listed are almost identical with the multiple waved pattern group. Although Parra *et al.* (2017) also defined the Trichopterygini by the modified or reduced anal area of male hindwing and the male abdominal sternum II pouch, their Trichopterygini is consistent with the multiple waved pattern group by sharing the following characters as mentioned above: the expanded metepimeron and a pair of triangular expansions on the male sternum II.

The molecular phylogenetic studies (Strutzenberger *et al.*, 2010; Sihvonen *et al.* 2011; Öunap *et al.*, 2016) had suggested that the tribe Trichopterygini is a monophyletic entity. Although the number of trichopterygine genera used in their analyses is very limited, all genera treated belong to the multiple waved pattern group sensu Holloway (1997) and Li *et al.* (2012). Therefore, the present study limits the tribe Trichopterygini to the multiple waved pattern group, and for the taxa composing both the multiple waved pattern and simple pattern groups treats as the Trichopterygini sensu lato hereafter. Of the simple pattern group, for a group of genera sharing the bursa copulatrix with invaginate triangular sclerites or invaginate sclerotized long ridges, a new tribe Heterophlebini is proposed and described below. These results were also supported by the phylogenetic analysis in the following section.

5. Phylogenetic analysis

In this section, cladistic analysis is performed to demonstrate the monophyly of the present Trichopterygini and to examine the phylogenetic relationships among the Japanese trichopterygine genera. The adult morphological characters used in the analysis and the data matrix of them are shown in appendix 1 and appendix 2, respectively.

5.1. Geometrid genera used in analysis

In addition to the Japanese trichopterygine genera, one New Zealand, two European, and three Oriental genera are analyzed: *Tatosoma* (Fig. 75A), *Nothocasis* (Fig. 44C–D), *Pterapherapteryx* (Fig. 20E–F), *Archaeocasis* (Fig. 32E–F), *Tristeirometa* (Fig. 26A), and *Tympanota* (Fig. 75B). Although

the Afrotropical and Neotropical trichopterygine genera were excluded in this analysis, the number of genera analyzed occupies more than 80 % of the Northern Hemisphere trichopterygine genera. Therefore, a result of phylogenetic analysis is fully reliable.

For the purpose of consideration on the monophyly of the present Trichopterygini, the following larentiine genera were also analyzed; *Aplocera* (Fig. 101A) and *Chesias* Treitschke (Fig. 101B) (Chesiadini), *Eustroma* Hübner (Fig. 101C) (Cidariini), *Eupithecia* Curtis (Fig. 101D) (Eupitheciini), *Brabira* (Fig. 101F), *Carige* (Fig. 90A), *Heterophleps* (Fig. 90B), *Leptostegna* (Fig. 101E), *Naxidia* (Fig. 90C), *Palaeomystis* (Fig. 90D), and *Tyloptera* (Fig. 101G) (a simple pattern group in Trichopterygini sensu lato). The following two sterrhine genera, *Timandra* Duponchel (Fig. 101H) (Timandrini) and *Idaea* Treitschke (Fig. 101I) (Sterrhini), were selected as the outgroup taxa for two reasons: 1, both or either of Trichopterygini and Chesiadini are a sister lineage to other larentiine tribes except for Dyspteridini (Viidalepp, 2006; Sihvonen *et al.*, 2011; Öunap *et al.*, 2016); 2, the subfamilies Larentiinae and Sterrhinae constitute the sister groups (Holloway, 1997; Strutzenberger *et al.*, 2010; Sihvonen *et al.*, 2011; Öunap *et al.*, 2016). Because of the species diversity in the genus *Idaea*, the *biselata* species-group (= *Ptychopoda* Curtis) was adopted as a representative of the genus in this study. When a genus is divided into two or more species groups, each of them was also analyzed: for example, as *Sauris* A, *Sauris* B, *Sauris* C, and *Sauris* D.

5.2. Results and discussion

As a result of the analysis, approximately 3,525 equally most parsimonious trees were obtained (tree length = 435, consistency index = 0.5379, rescaled consistency index = 0.3918). The strict consensus tree (Fig. 1) of them suggested the following points: 1, the present Trichopterygini, a new tribe Heterophlebini, the tribe Chesiadini, and *Brabira* + *Tyloptera* were monophyletic, respectively; 2, Trichopterygini sensu lato was polyphyletic; 3, the simple pattern group was also polyphyletic, but the Heterophlebini and the genus *Leptostegna* constituted the sister groups.

A successive approximations weighting analysis resulted in nine trees. A strict consensus tree from the successive approximation weighting analysis is shown in the Fig. 2 and the character states optimization of the strict consensus tree is also presented in Figs. 3–4 by ACCTRAN. The following four genus-groups (Fig. 2) were recognized in the Japanese Trichopterygini: the *Trichopteryx* genus-group (A), the *Acasis* genus-group (B), the *Sauris* genus-group (C), and the *Lobophora* genus-group (D). The nine trees topologically differed in the systematic position of the genus *Lobophorodes* and in the generic relationships of the *Sauris* genus-group except for *Tatosoma*, and were composed of the combination of them. A systematic position of *Lobophorodes* was either of the following three positions: ((A + B) + C) + *Lobophorodes*, (A + B) + (C + *Lobophorodes*), or ((A + B) + *Lobophorodes*) + C. The relationships among the genera *Episteira*, *Sauris*, and *Tympanota* of the *Sauris* genus-group were either of the following three conditions: (*Episteira* + *Sauris*) + *Tympanota*, (*Episteira* + *Tympanota*) + *Sauris*, or

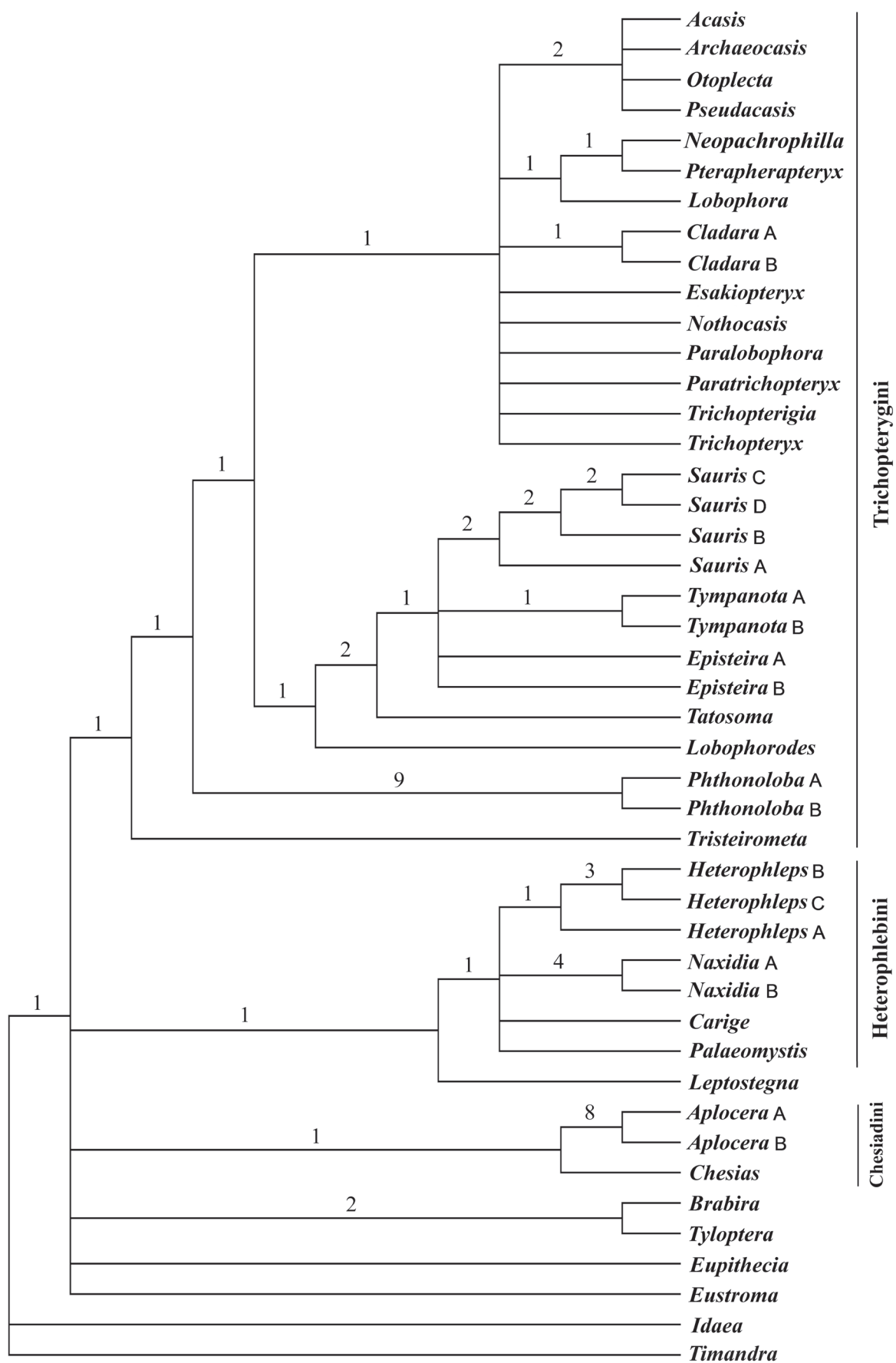


Fig. 1. Strict consensus tree of about 3,525 equally most parsimonious trees (tree length = 435, consistency index = 0.5379; retention index = 0.7284; rescaled consistency index = 0.3918). Numbers above branches are Bremer support values.

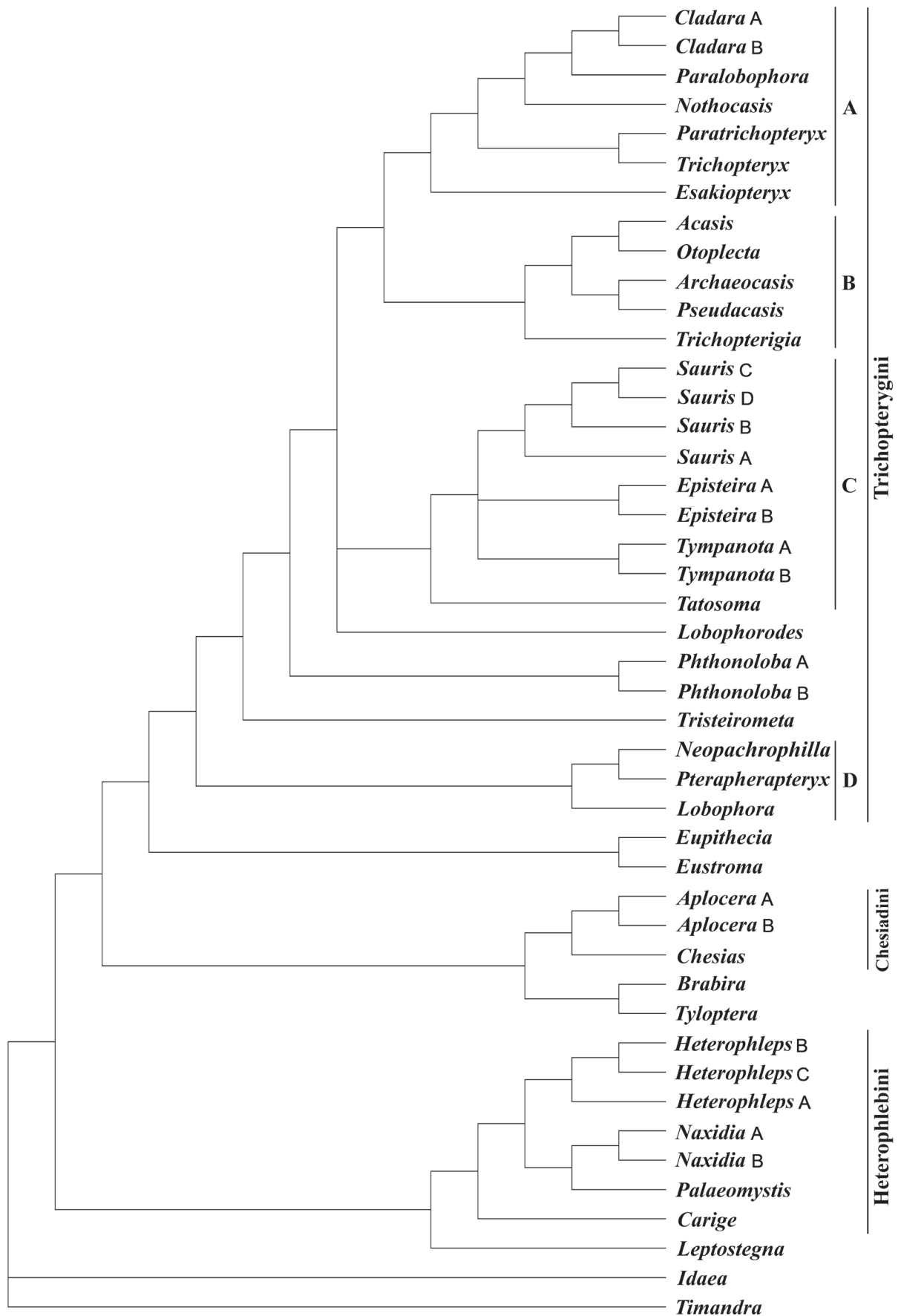


Fig. 2. Strict consensus tree of nine trees obtained by the successive approximation weighting analysis.

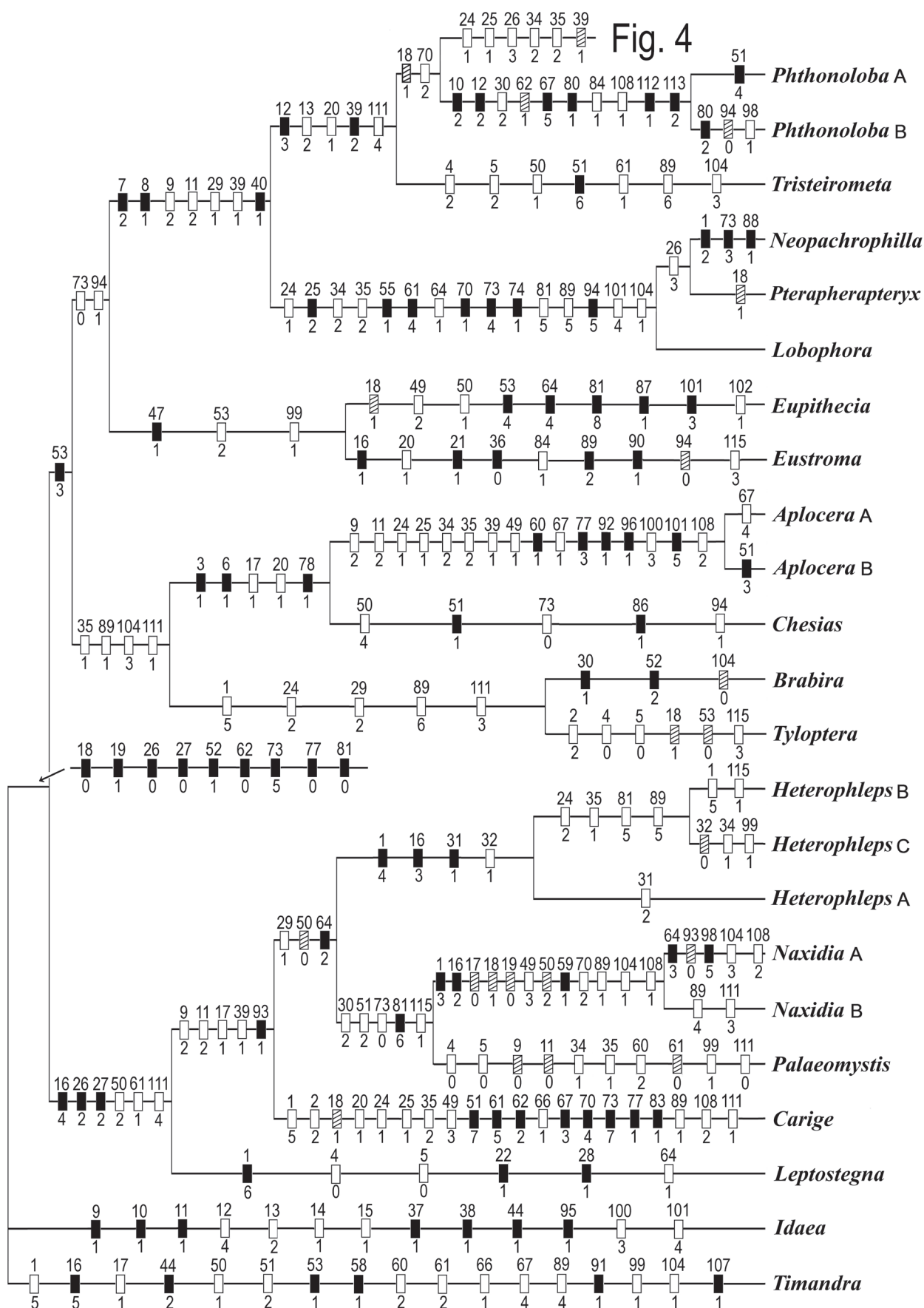


Fig. 3. Strict consensus tree of nine trees obtained by the successive approximation weighting analysis with character state optimization by ARRTRAN. Numbers above rectangles correspond to character numbers and those below rectangles to character states. Black rectangles represent non-homoplastic apomorphies, white rectangles homoplastic apomorphies, and diagonally striped rectangles reversal states. Character and character state numbers correspond to the data matrix (Table 6).

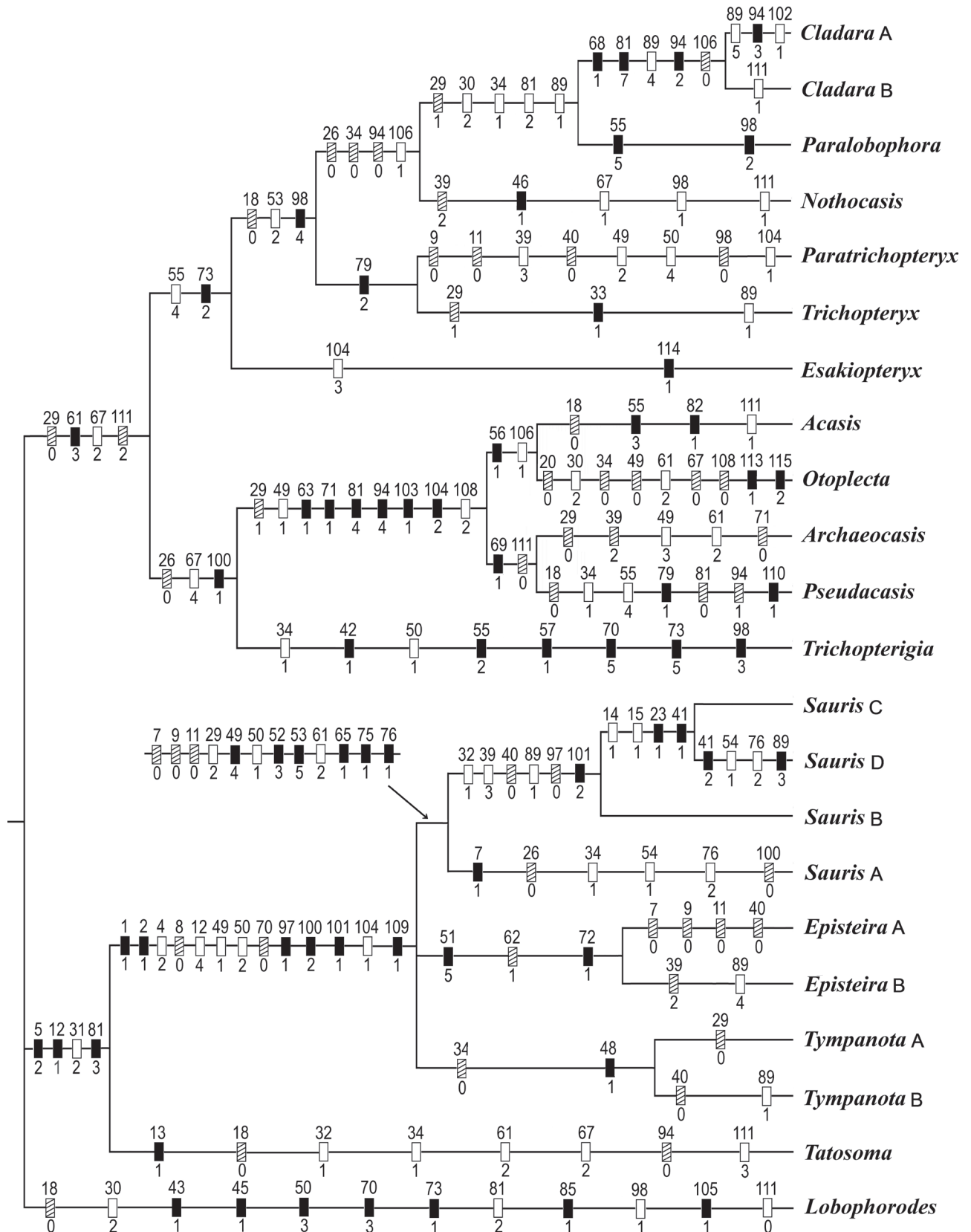


Fig. 4 (continued from Fig. 3). Strict consensus tree of nine trees obtained by the successive approximation weighting analysis with character state optimization by ARRTRAN. Numbers above rectangles correspond to character numbers and those below rectangles to character states. Black rectangles represent non-homoplastic apomorphies, white rectangles homoplastic apomorphies, diagonally striped rectangles reversal states. Character and character state numbers correspond to the data matrix (Table 6).

Episteira + *Tympanota* + *Sauris*.

The *Lobophora* genus-group was placed as a sister lineage to other trichopterygine genera (Figs. 2, 3). In the *Lobophora* genus-group, *Neopachrophilla* was more closely related to the European genus *Pterapherapteryx* than to *Lobophora*.

Although the genera *Phthonoloba* and *Tristeirometa* are phenetically similar to each other and their affinity was indicated by sharing the unmodified male hindwing (Holloway, 1997), *Tristeirometa* was a sister lineage to other trichopterygine genera except for the *Lobophora* genus-group, and *Phthonoloba* and the remaining genera formed the sister groups in the present analysis (Fig. 2).

Dugdale (1982) concluded that there are no close relationships between the New Zealand genus *Tatosoma* and three Oriental and Pacific genera (*Sauris*, *Episteira*, and *Tympanota*). In the present analysis (Figs. 2, 4), however, these four genera were monophyletic and constituted the *Sauris* genus-group, and *Tatosoma* was a sister lineage of other three genera.

The *Acasis* genus-group and the *Trichopteryx* genus-group formed the sister groups (Figs. 2, 4). In the *Acasis* genus-group, *Trichopterigia* was a sister group of other four genera, in which the genera *Acasis* and *Otopecta*, and the *Archaeocasis* and *Pseudacasis* showed a sister group relationship, respectively. In the *Trichopteryx* genus-group, *Esakiopteryx* was a sister group of other five genera, in which *Nothocasis* + (*Cladara* + *Paralobophora*) and *Trichopteryx* + *Paratrachopteryx* formed the sister groups.

Although McGuffin (1958) indicated a close affinity of the tribes Trichopterygini (his Lobophorini) and Eupitheciini, the tribe Eupitheciini was more closely related to the tribe Cidariini than to the Trichopterygini in the present analysis (Fig. 2), as already shown by the morphological or molecular phylogenetic studies (Holloway, 1997; Yamamoto & Sota, 2007; Strutzenberger *et al.*, 2010; Sihvonen *et al.*, 2011; Öunap *et al.*, 2016).

In the present analysis (Fig. 2), the tribe Chesiadini was not a sister taxon to the present Trichopterygini as shown by Öunap *et al.* (2007), but the Chesiadini was sister to *Brabira* + *Tyloptera*. Of the simple pattern group, Heterophlebini + *Leptostegna* was a sister lineage to other larentiine genera treated in this analysis (Fig. 2). For elucidation of the systematic positions of the tribes Chesiadini, Heterophlebini, and Trichopterygini, further phylogenetic analysis should be done using more taxa and more morphological data with the inclusion of the tribe Dyspteridini, as emphasized by Öunap *et al.* (2016) in their molecular phylogeny.

6. Taxonomy

6.1. Tribe Trichopterygini Warren

Trichopteryginae Warren, 1894: 397. Type genus: *Trichopteryx* Hübner, [1825] 1816: 323.

Lobophorinae Tutt, 1896: 253. Type genus: *Lobophora* Curtis, 1825: 81.

Lobophorini: Forbes, 1948: 132.

Trichopterygini: Dugdale, 1980: 303.

Trichopterigini: Valersky, 2011: 577 (an incorrect subsequent spelling).

Diagnosis. Probable synapomorphies of the Trichopterygini are as follows (Fig. 3): 1, the enlarged metepimeron (Fig. 8A–D, G) in both sexes; 2, a pair of triangular expansions on male abdominal sternum II (Figs. 8A, C–D, 9A, C–D, 12A–B, D); 3, the male arched metamer; 4, the male hind tibia with a hair-pencil; 5, the male abdominal sternum II pouch; 6, the male hindwing with Rs and M1 veins connate or separate. However, the latter four characters are homoplastic. The following combination of characters also distinguishes the Trichopterygini from other tribes of the Larentiinae: male hindwing with an anal fold (anal lobe); male gnathos generally recognized as a narrow sclerite along postero-lateral side of tegumen; valve usually with rounded cucullus covered with hairy setae; corpus bursae partly or fully covered with spines (scobinate).

Remarks. Although the tribe Dyspteridini could not be analyzed in the present study, the phylogenetic analysis resulted in that the present Trichopterygini are monophyletic and not a sister group relationship with the Chesiadini (Fig. 1).

The present Trichopterygini are composed of the following genera: *Acasis* Duponchel, **Aloba* Warren, **Aposteira* Prout, *Archaeocasis* Hashimoto, *Arrayanaria* Parra, **Baynia* Prout, *Butleriana* Parra, *Cladara* Hulst, *Danielaparra* Kemal & Kocak, **Dystypoptila* Warren, **Episauris* Rebel, *Episteira* Warren, *Esakiopteryx* Inoue, *Fueguina* Parra, *Hoplosauris* Butler, *Hypocometa* Warren, *Isosauris* Warren, *Lagynopteryx* Berg, *Llampidken* Parra & Santos-Salas, **Lobidiopteryx* Warren, *Lobophora* Curtis, *Lobophorodes* Hampson, *Neopachrophilla* Inoue, *Nothocasis* Prout, *Otopecta* Warren, **Oulobophora* Staudinger, *Pachrophylla* Blanchard, *Paralobophora* Inoue, *Parapachrophylla* Parra, *Paratrachopteryx* gen. nov., *Phthonoloba* Warren, **Physoloba* Warren, **Protosteira* Prout, *Pseudacasis* gen. nov., *Pterapherapteryx*, *Rhopalodes* Guenée, *Rindgenaria* Parra, *Sauris* Guenée, *Tatosoma* Butler, *Tomopteryx* Philippi, *Trichopterigia* Hampson, *Trichopteryx* Hübner, *Triptila* Warren, *Triptiloides* Parra & Santos-Salas, *Tristeirometa* Holloway, *Tympanota* Warren and *Warrenaria* Parra. The genera accompanied with asterisk, whose metepimeron could not be examined, are tentatively included into the present Trichopterygini based on the original description, especially on the genital structures.

In the above genera, *Cladara* and *Llampidken* were treated as position unclear in the geometrid moths of the world (Parsons *et al.*, 1999), but these genera are classified into the present Trichopterygini by the synapomorphies (expanded metepimeron, arched metamer, hindtibial hair-pencil, and a pair of triangular expansions on male abdominal sternum II).

Morphology

Adult

Head (Figs. 5–6): Head is usually densely covered with scales, and the frons has the rough scales protruding antero-ventrally especially in the northern temperate species. The antennal flagellomeres (Fig. 5) are generally filiform or compressed filiform in both sexes and very rarely serrate or bipectinate in males; each flagellum segment has a sensory process on the inner tip as in other Larentiinae. The maxillary

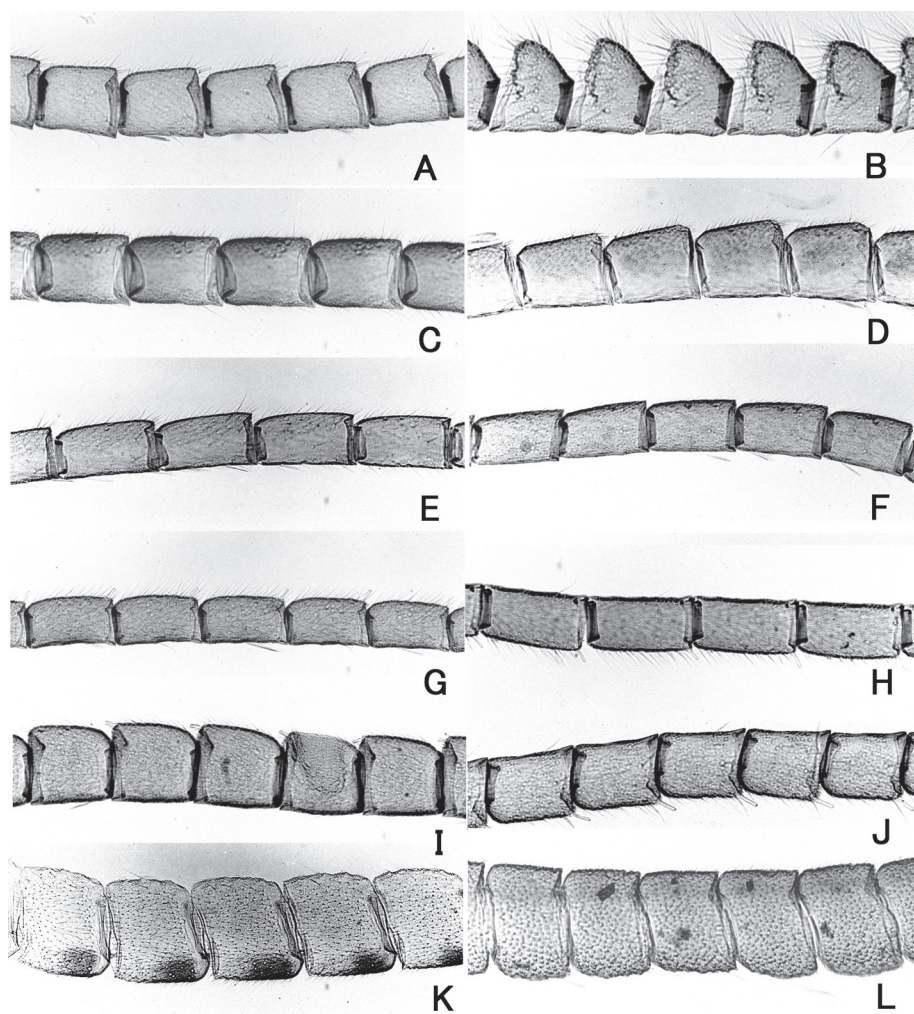


Fig. 5. Antennal flagellomeres, ♂. A, *Lobophora halterata ijimai* (Inoue); B, *Neopachrophilla albida* Inoue; C, *Phthonoloba viridifasciata* (Inoue); D, *Lobophorodes obscurarius* (Leech); E, *Trichopterigia consobrinaria* (Leech); F, *Otoplecta frigida* (Butler); G, *Esakiopteryx volitans* (Butler); H, *Cladara miracula* (Inoue); I, *Paratrachopteryx misera* (Butler); J, *Trichopteryx hemana* (Butler); K, *Episteira nigrilinearia nigrilinearia* (Leech); L, *Sauris nanaria* Leech.

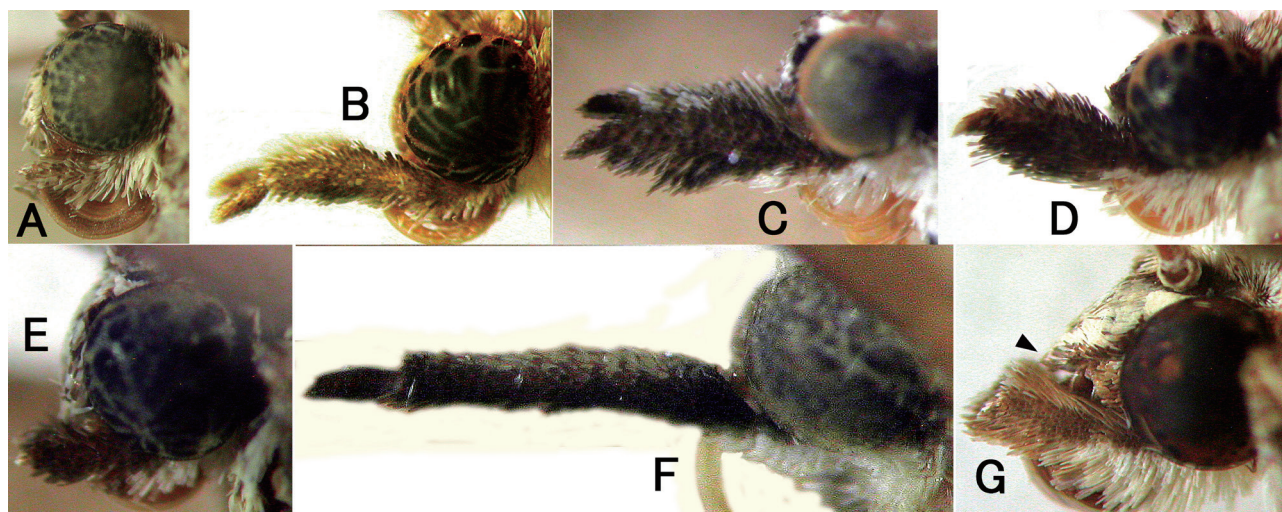


Fig. 6. Head, lateral. A, *Lobophora halterata ijimai* Inoue, ♂; B, *Phthonoloba viridifasciata* (Inoue), ♀; C, *Lobophorodes obscurarius* (Leech), ♂; D, *Acasis exviretata* Inoue, ♂; E, *Trichopteryx hemana* (Butler), ♂; F, *Episteira nigrilinearia nigrilinearia* (Leech), ♂; G, *Aplocera perelegans perelegans* (Warren), ♂.

palpus is minute and one-segmented. The labial palpus (Fig. 6) is prorect or slightly ascending, 3-segmented as in other geometrid moths and variable in length (about 1.0 to 3.5 times as long as a diameter of the compound eye). The proboscis is developed. The chaetosema is distinct.

Thorax (pleural region and legs) (Figs. 7–8, 9A–C): The spur formula is 0–2–0, 0–2–2, 0–2–3 or 0–2–4 in male and 0–2–2, 0–2–3 or 0–2–4 in female. The pro- and mesothoracic structures including the legs are the same condition as those of most larentiine moths. The male metathorax shows

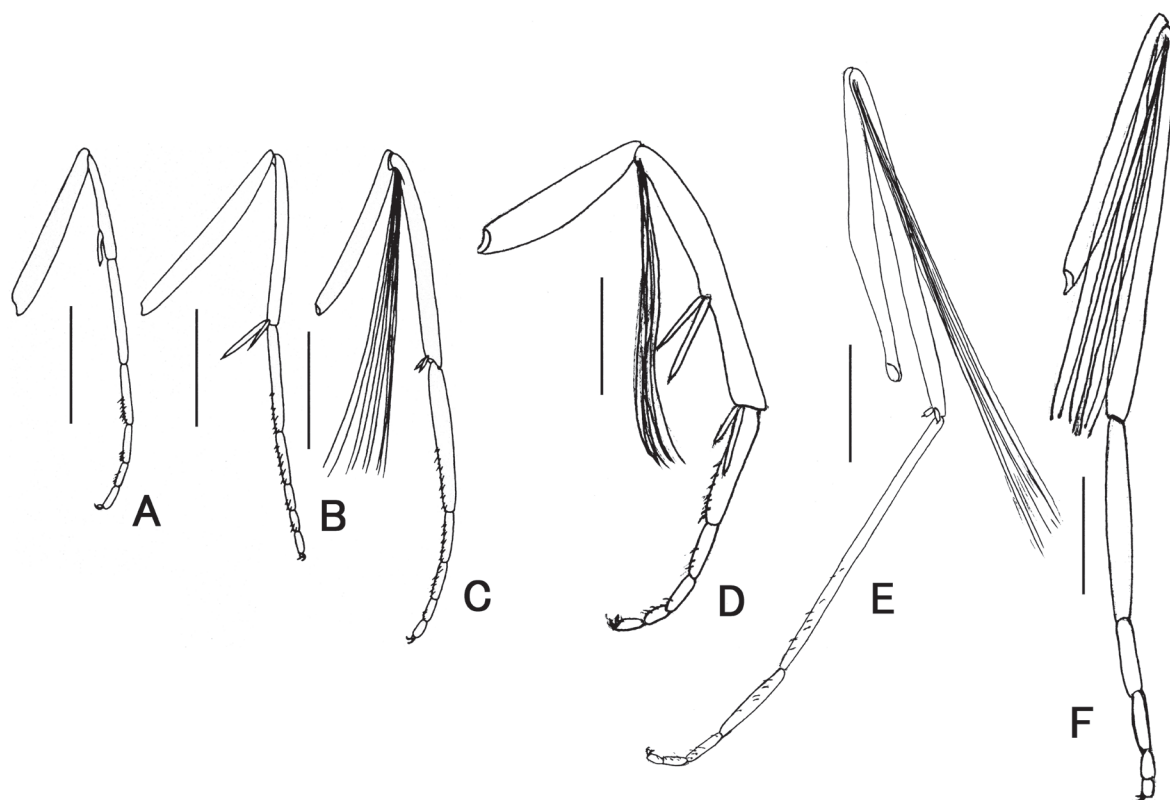


Fig. 7. Legs. A–C, *Trichopteryx hemana* (Butler), ♂; D, *Neopachrophilla albida* Inoue, ♂; E, *Phthonoloba viridifasciata* (Inoue), ♂; F, *Episteira nigrilinearia nigrilinearia* (Leech), ♂. A, foreleg; B, midleg; C–F, hindleg. Scales = 1.0 mm.

important modification; the epimeron is usually enlarged posteriorly and divided into the anterior and posterior parts by internal vertical ridge, and there are no muscle attachments in the posterior part; the metameron is modified into arched expansion posteriorly; the metaeucoxa is rarely elongate (it is probable that this structure is correlated to enlargement of the abdominal sternum II pouch); the hind tibia often has a hair-pencil at inner base (the hair-pencil is also present in the tribes Chesiadini and Heterophlebini nov.). The enlarged metepimeron is also seen in the female except for the genera *Episteira*, *Sauris*, and *Tympanota*. When the hair-pencil is secondarily absent, the metepimeron and metameron are not modified in the genera *Episteira*, *Sauris*, and *Tympanota*. In the genus *Sauris* the hind tibia is more or less incrassate and covered with the specialized hairy scales along outer margin, and the hind tarsus is reduced (Dugdale, 1980).

Thorax (fore- and hindwings) (Figs. 10–11, 27, 76): One of the characteristics of the subfamily Larentiinae is the forewing pattern composed of many adjacent lines (Minet & Scoble, 1998). It is probable that the basic pattern of the Larentiinae consists of 16 fine lines (Fig. 10A–B). These lines are also recognized in some genera of the Trichopterygini, but some lines become frequently indistinct and a few closely adjacent ones become more distinct or are fused with each other to form the distinct lines. Consequently, the forewing pattern of the tribe is mainly composed of the following eight elements (Fig. 10C; Table 1): basal (line 1 in Fig. 10B), postbasal (lines 2 + 3), antemedial (lines 6 + 7), postmedial (lines 9 + 10 or 9 + 10 + 11 + 12), subterminal (lines 13 + 14), adterminal (line 15) lines, discal spot (line 8) and a row of

terminal dots (line 16); the antemedial and postmedial lines are often close each other near the inner margin (dorsum) and rarely fused with each other to form the broad median band, in that case a distinct spot is rarely present on dorsum between them; in the tribe the medial line (line 8) is obscure and recognized as a discal spot on the discal vein and a terminal line (line 16) is usually discontinuous and consists of a row of terminal dots, which are present at both sides of the veins Rs3 to CuA2 and at both side of the claval furrow along outer margin (termen) or on terminal end of Rs4 to CuA1. The hindwing pattern of the tribe is usually indistinct and generally lacks the basal, postbasal and antemedial lines; the discal spot is often distinct; the postmedial, subterminal and adterminal lines and terminal dots are rarely recognized; very rarely rather broad terminal line is present along the termen.

The forewing shape is generally triangular as most species of the Larentiinae, but the male forewing is rather long; in male of most *Sauris* species the forewing has a cleft on the termen near the tornus between CuA1 and CuA2 as in Fig. 76H. The female hindwing is usually identical with the other larentiine moths, but the male hindwing is rather smaller and more or less modified. The male hindwing generally has an anal fold formed by two fold-lines at anal base (Fig. 11E); it is probable that these two fold-lines are homologous with a claval furrow and a vannal fold, namely an anterior concave fold-line is the claval furrow and a posterior convex fold-line is the vannal fold; according by Wootton (1979) the claval furrow lies along CuP, just behind CuP (when CuP is obsolete, the claval furrow locates at the position where CuP should be formerly assumed to have occurred) and the vannal fold lies

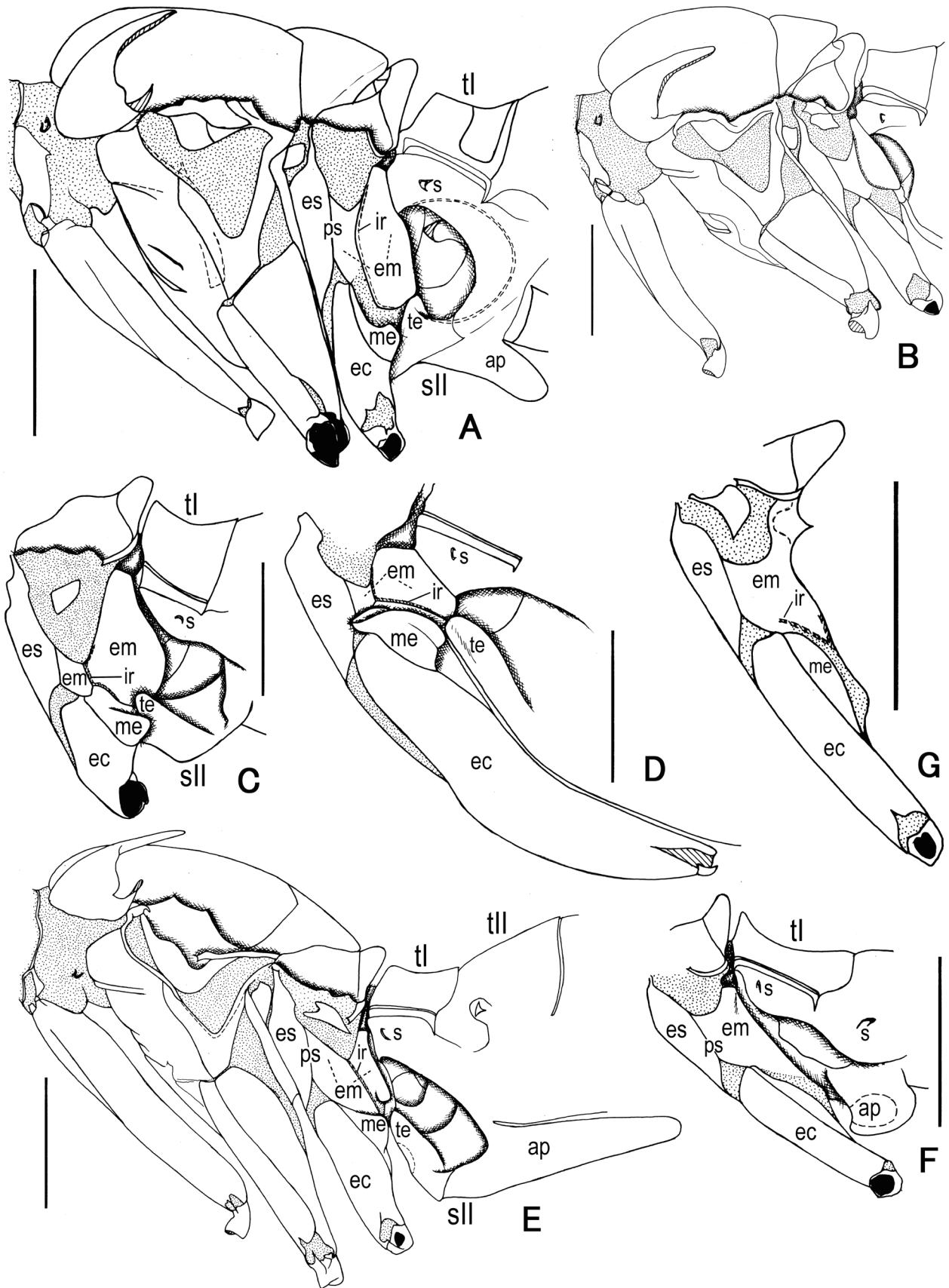


Fig. 8. Thorax and anterior abdomen, lateral. A, *Trichopteryx hemana* (Butler), ♂; B, ditto, ♀; C, *Lobophora halterata ijimai* Inoue, ♂; D, *Phthonoloba viridifasciata* (Inoue), ♂; E, *Episteira nigrilinearia nigrilinearia* (Leech), ♂; F, *Episteira eupena* Prout, ♂; G, *Sauris nanaria* Leech, ♂. ap, abdominal pouch; ec, eucoxa; em, epimeron; es, epsisternum; ir, internal ridge; me, meron; ps, pleural sulcus; s, spiracle; te, triangular expansion. Scales = 1.0 mm.

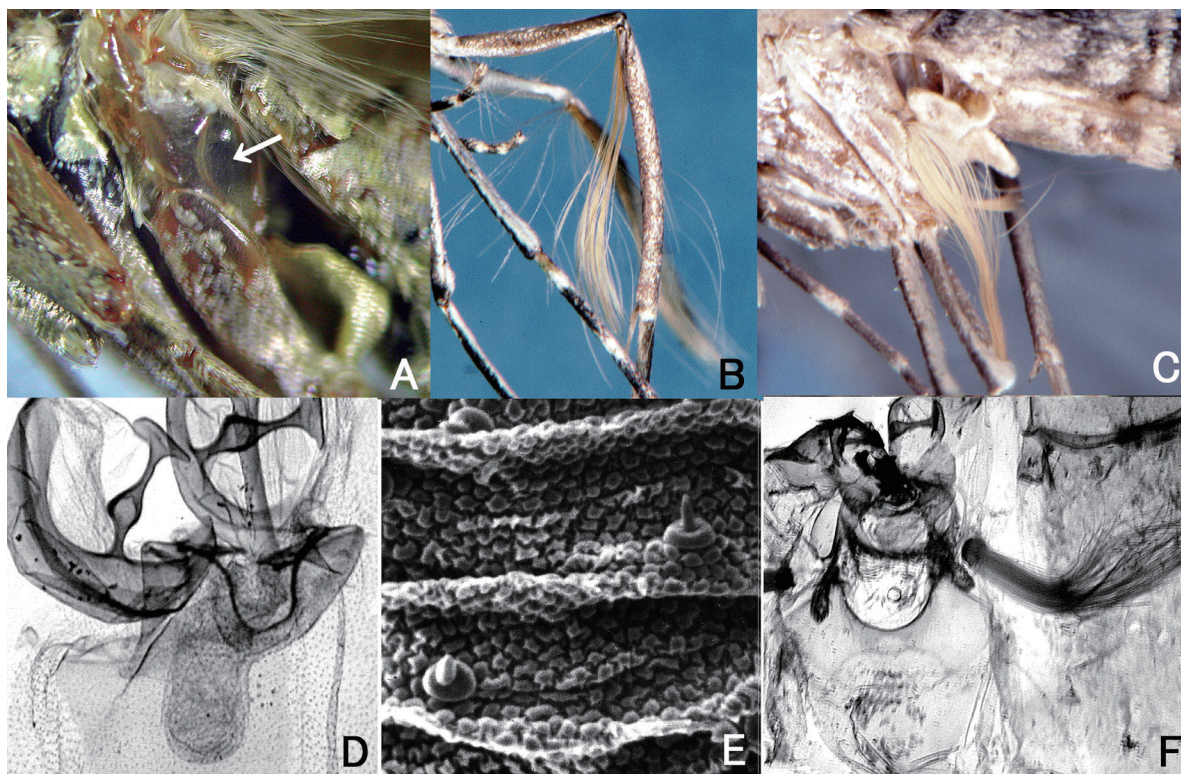


Fig. 9. Metathorax and anterior abdomen. A, *Tympanota ceramica* Rothschild, ♂ (pleural region; arrow: swollen part of metepimeron); B, *Trichopterygia costipunctaria* Leech, ♂ (hair-pencil); C, ditto, ♂ (hair-pencil, triangular expansion, and abdominal pouch); D, *Trichopteryx hemana* (Butler), ♂ (abdominal pouch); E, *Trichopteryx microloba* Inoue, ♂ (inner surface of abdominal pouch); F, *Sauris interruptata* (Moore), ♂ (anterior abdomen).

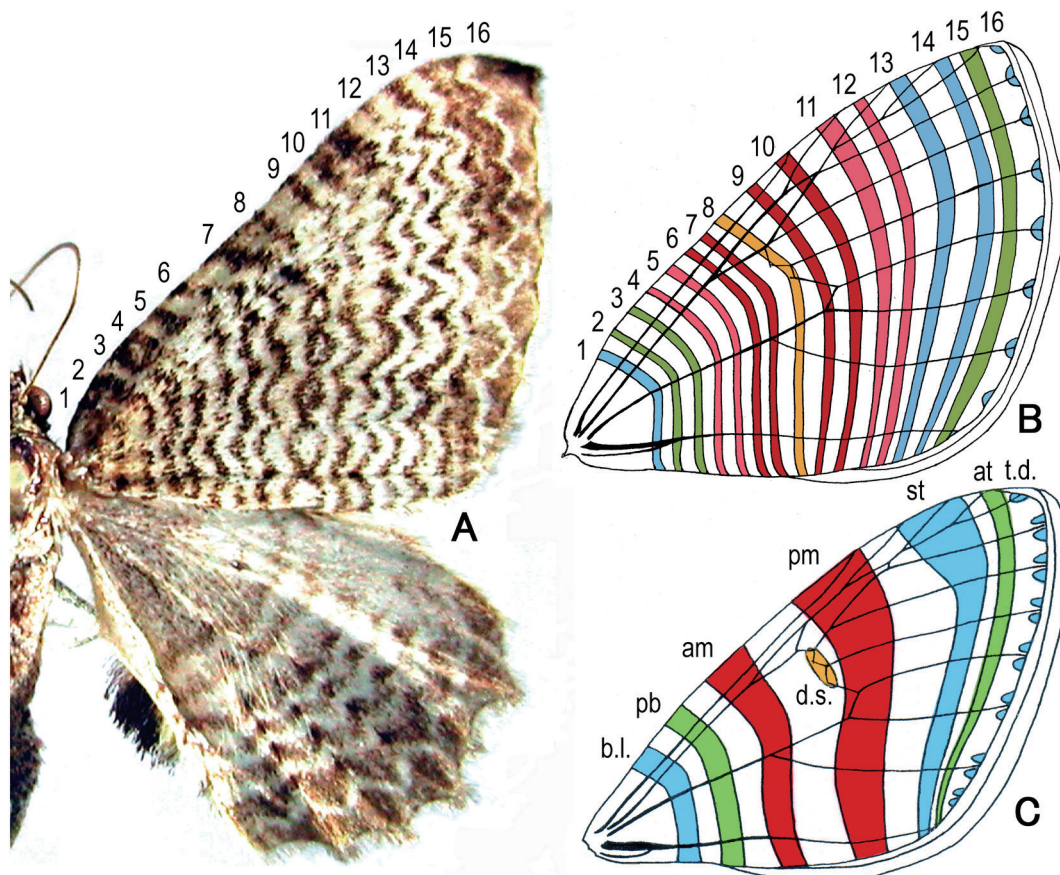


Fig. 10. Forewing pattern. A, *Rheumaptera undulata undulata* (Linnaeus); B, basic pattern; C, typical pattern. am: antemedial line; at: adterminal line; b.l.: basal line; d.s.: discal spot; pb: postbasal line; pm: postmedial line; st: subterminal line; t.d.: terminal dots.

Table 1. Wing pattern of the subfamily Larentiinae according to different authors.

Forbes, 1958	McGuffin, 1972	Heitzman & Enns, 1978	Hausmann, 2001	This study
basal line	b: basal line	b.l.: basal line	basal line	basal line
antemedial line	am: antemedial line	am.: antemedial line	postbasal line	postbasal line
—	—	—	antemedial line	antemedial line
discal spot	d.d: discal dot	d.d.: discal dot	discal spot	discal spot (medial line)
medial or shade line	m.l: medial line	m.l.: medial line	medial line	median band (antemedial + postmedial lines)
postmedial line	p.m.: postmedial line	pm.: postmedial line	postmedial line	postmedial line
antemedial line	st: subterminal line	st.: subterminal line	subterminal line	subterminal line
antemedial line	adt: adterminal line	adt.: adterminal line	wavy line	adterminal line
terminal line	t: terminal line	t.l.: terminal line	terminal line	terminal dots (terminal line)

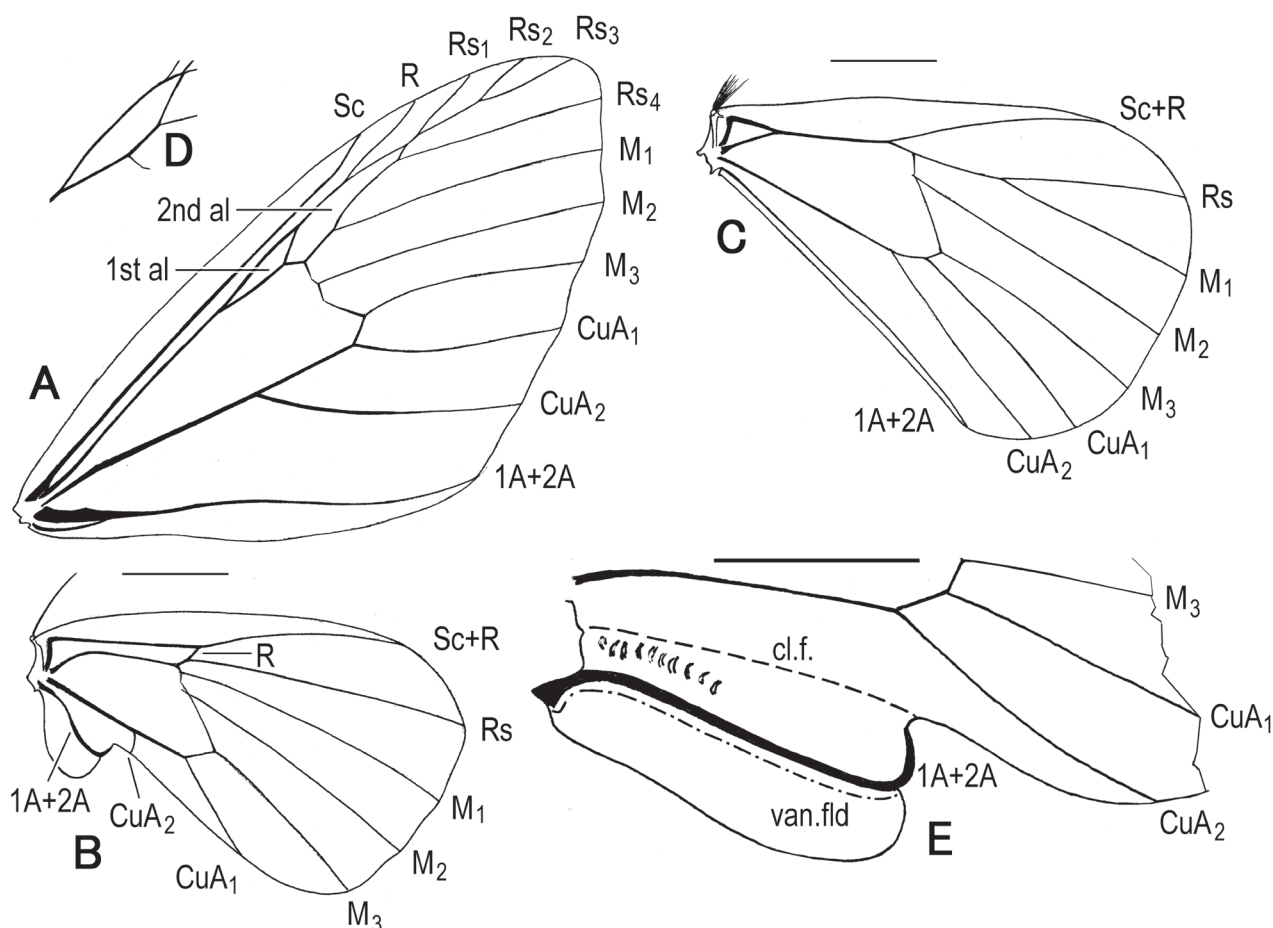


Fig. 11 Wing venation. A, *Trichopteryx hemana* (Butler), ♂ (forewing); B, ditto, ♂ (hindwing); C, ditto, ♀ (hindwing); D, *Trichopterygia consobrinaria* (Leech), ♂ (areole); E, *Otoplecta frigida* (Butler), ♂ (anal area of hindwing). al, areole; cl. f., claval furrow (concave fold line: dashed line); van. fld, vannal fold (convex fold line: alternate dashes and dots). Scales = 2.0 mm.

more commonly along 2A or just behind 2A; the anal fold is various in length and shape in the tribes Dyspteridini, Chesiadini, Heterophlebini and the present Trichopterygini. In most species of the genus *Sauris* (Prout, 1928; Dugdale, 1980) the male hindwing has an ovate outer marginal fold (Fig. 76I–J) between Sc + R and Rs + M₁ probably caused by elongation of the costal area and modification of the anal area. In the South American genera, *Butleriana*, *Rhopalodes*, *Tomopteryx* and *Triptiloides*, the male hindwing has one to three marginal clefts between CuA₁ and 1A + 2A (Parra, 1991; Parra & Santos-Salas, 1991). The forewing venation (Figs. 11A, D, 27A) is almost constant throughout the Larentiinae; one or two areoles (accessory cells) are formed

by a coalescence of R (radius) and the radial sector (Brock, 1971); M₁ is usually arising from the lower vein of the areole (when two areoles are present, arising from the 2nd areole), rarely arising from the discal vein or connate with Rs₃ + 4; M₂ is generally arising from middle of the discal vein, rarely near M₃. The hindwing venation of the Trichopterygini shows a sexual dimorphism in most genera and always lacks A₃ vein. The female hindwing venation (Figs. 11C, 27E) is similar to those of other larentiine moths: Sc anastomoses with R + Rs (upper vein of discal cell) for most length of the discal cell and separate near end of the discal cell as Sc + R, Rs and M₁ are stalked, rarely separate, and M₃ and CuA₁ are separate, rarely stalked. The male hindwing venation (Figs. 27B, D, 76B, D,

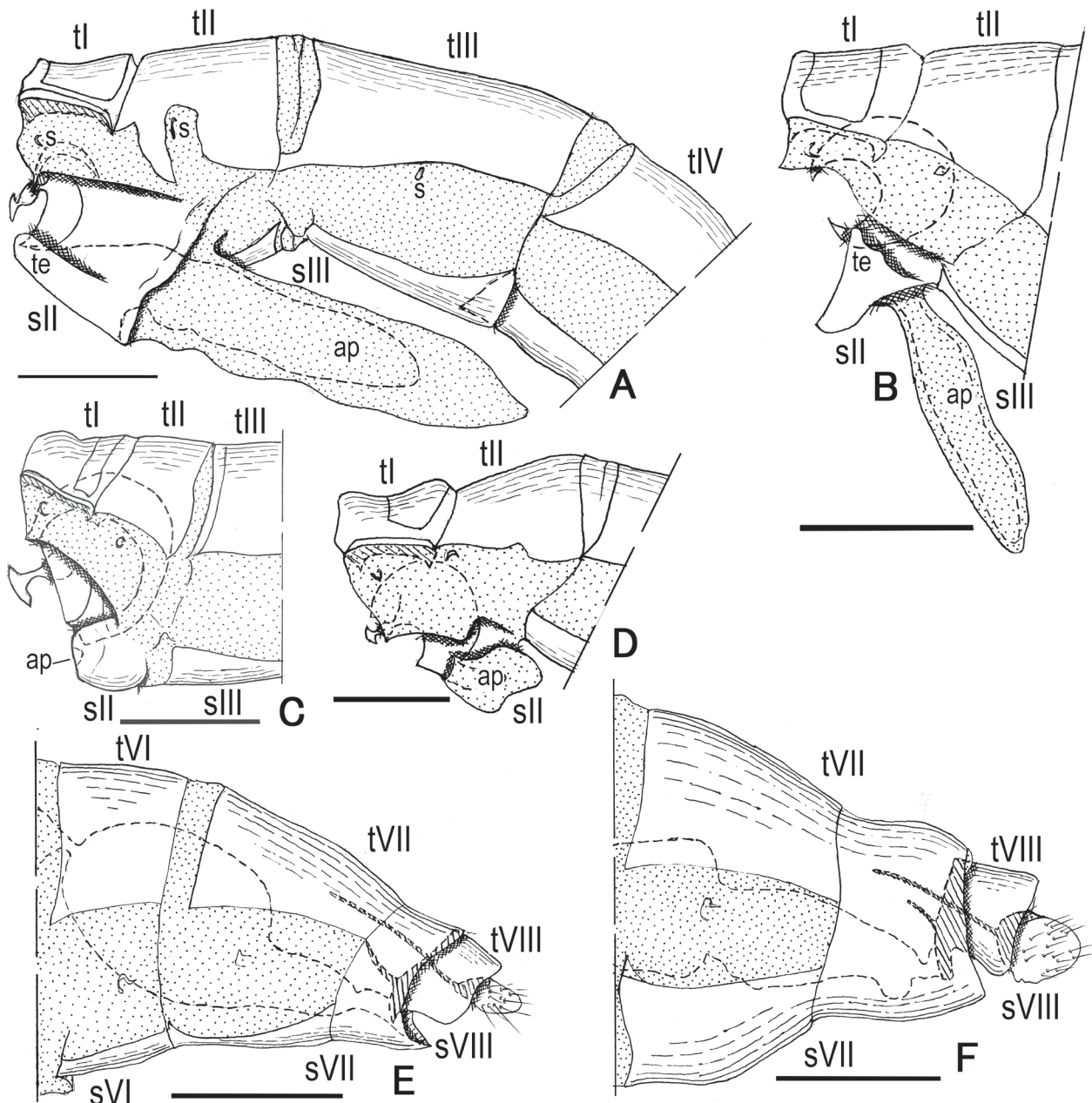


Fig. 12. Pregenital abdomen, lateral. A, *Phthonoloba viridifasciata* (Inoue), ♂; B, *Nothocasis sertata* (Hübner), ♂ (Czech); C, *Paratrachopteryx misera* (Butler), ♂; D, *Sauris nanaria* Leech, ♂; E, *Trichopterygia consobrinaria* (Leech), ♂; F, *Trichopterygia costipunctaria* Leech, ♂. A–D, anterior abdomen; D–E, posterior abdomen. ap, abdominal pouch; te, triangular expansion; s, spiracle. Scales = 1.0 mm.

F, I) shows some modifications: Sc is often separate from the discal cell and connected via a short vein of R (a cross vein in Forbes, 1948 and others) near end of the discal cell, Rs and M1 are stalked or separate, and M3 and CuA1 are usually separate; but in *Sauris* Rs and M1 are completely fused, and in *Episteira*, *Sauris*, *Tympanota*, *Tatosoma*, and a few South American genera, M3 and CuA1 are completely fused. When the male hindwing has an anal fold, CuA2 (occasionally also CuA1) is shorter than that of female, and 1A + 2A runs in the anal fold and is much shorter.

Pregenital abdomen (Figs. 9D–F, 12–13): The male sternum II usually has an abdominal pouch (a central hollow sac) and a pair of triangular expansions extending dorsally at antero-lateral sides. The hind tibial hair-pencil is fixed by

this expansion and the arched metamer (Fig. 9C) below the tympanal opening, and a terminal part of hair-pencil is inserted into the abdominal sternum II pouch whose inner surface is scattered with many sensilla (Fig. 9E), which probably function as the proprioceptors (Hashimoto, 2005). When the hind tibial hair-pencil is secondarily absent, the triangular expansions are also absent as in the genera *Paratrachopteryx*, *Episteira*, *Sauris*, and *Tympanota*. The anterior abdominal musculature also shows a few sexual variations (Fig. 13) in relation to the male sternum II structure, especially distinct in a lateral one of the inner ventrolongitudinals (sensu Kristensen, 2003) of the sternum II: this muscle originates on the anterior margin of sternum II and inserts in the anterior margin of sternum III in female, but in male on the anterior margin of

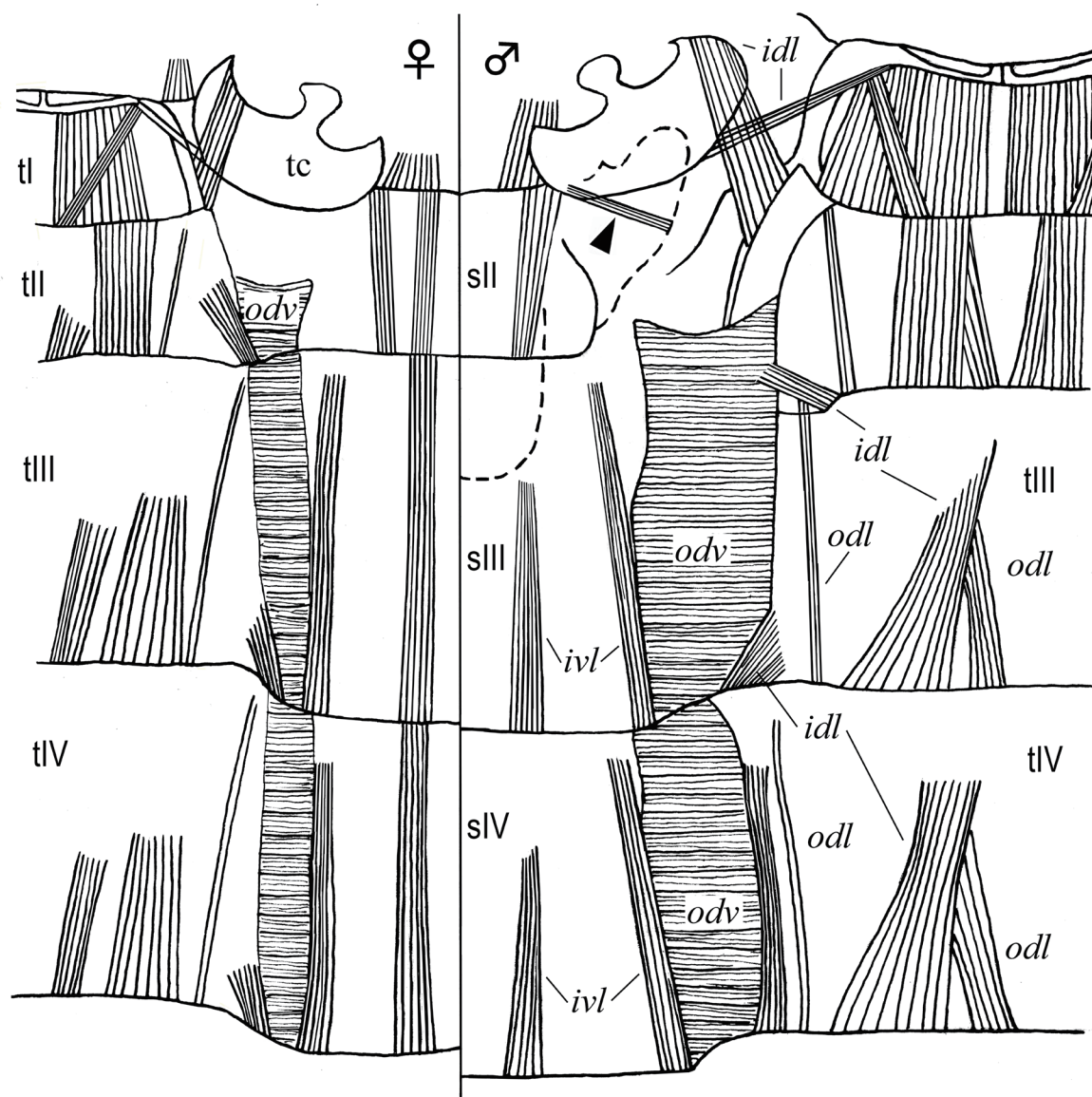


Fig. 13. Musculature of anterior abdomen of *Trichopteryx hemana* (Butler). idl: inner dorsolongitudinal; ivl: inner ventrolongitudinal; odl: outer dorsolongitudinal; odv: outer dorsoventral; tc: tympanal cavity.

sternum II and in the posterior margin of a triangular expansion (Fig. 13: arrow). The ansa, one of the important components of the tympanal organ of the Geometridae, has a hammer shaped tip, a characteristic of the larentiine moths (Cook & Scoble, 1992). In addition, a few modifications are also seen in the generic level: in the genus *Sauris*, the male abdomen often has a pair of setal tufts laterally on the sterna II and IV to VII (Dugdale, 1980); in the genus *Trichopterigia* (Fig. 12E–F), a posterior 1/3 to 2/5 of the female 7th abdominal segment is well sclerotized circularly.

Male genitalia (Figs. 14, 28, 30A, 34A–H, 36A–F, 82A–G): The genital structure of the Trichopterygini is diverse and very useful for the generic and/or specific classification. The male terminalia are composed of the segments VIII to X (Kristensen, 2003). In the Trichopterygini the segment VIII is almost identical with the preceding segments. Some *Tympanota* and a few *Sauris* species have a pair of coremata at the intersegmental membrane between the segments VIII and IX in male (Dugdale, 1980). The segment IX mainly consists

of the following components: tegumen (tergite IX), vinculum (sternite IX), valve (gonopod), phallus (intromittent organ) and juxta. The tegumen and the vinculum articulate with each other laterally and usually constitute a synscleritous ring; the tegumen is generally hood shaped; the vinculum is U- or V-shaped and its ventro-medial part (saccus) is more or less protruded anteriorly or antero-dorsally. The valve structure is as follows: an inner proximal membrane continuing from the anellus is the anellifer; the costa is situated on the dorsal margin, usually well sclerotized, and often has a posterior projection (costal arm of Pierce, 1914); the cucullus (subapical process of Dugdale, 1980) is the dorso-distal lobe continuing from the costa or the costal arm, covered with hairy setae and generally weakly sclerotized, but the cucullus is sometimes indistinct, probably fused with the costa and/or the valvula (Figs. 28D, 31D); the harpe, which is here defined as the attachment area of the intrinsic valve muscle (m5) followed Sibatani *et al.* (1954), usually occupies the central part of valve and slightly sclerotized, but rarely indistinct and

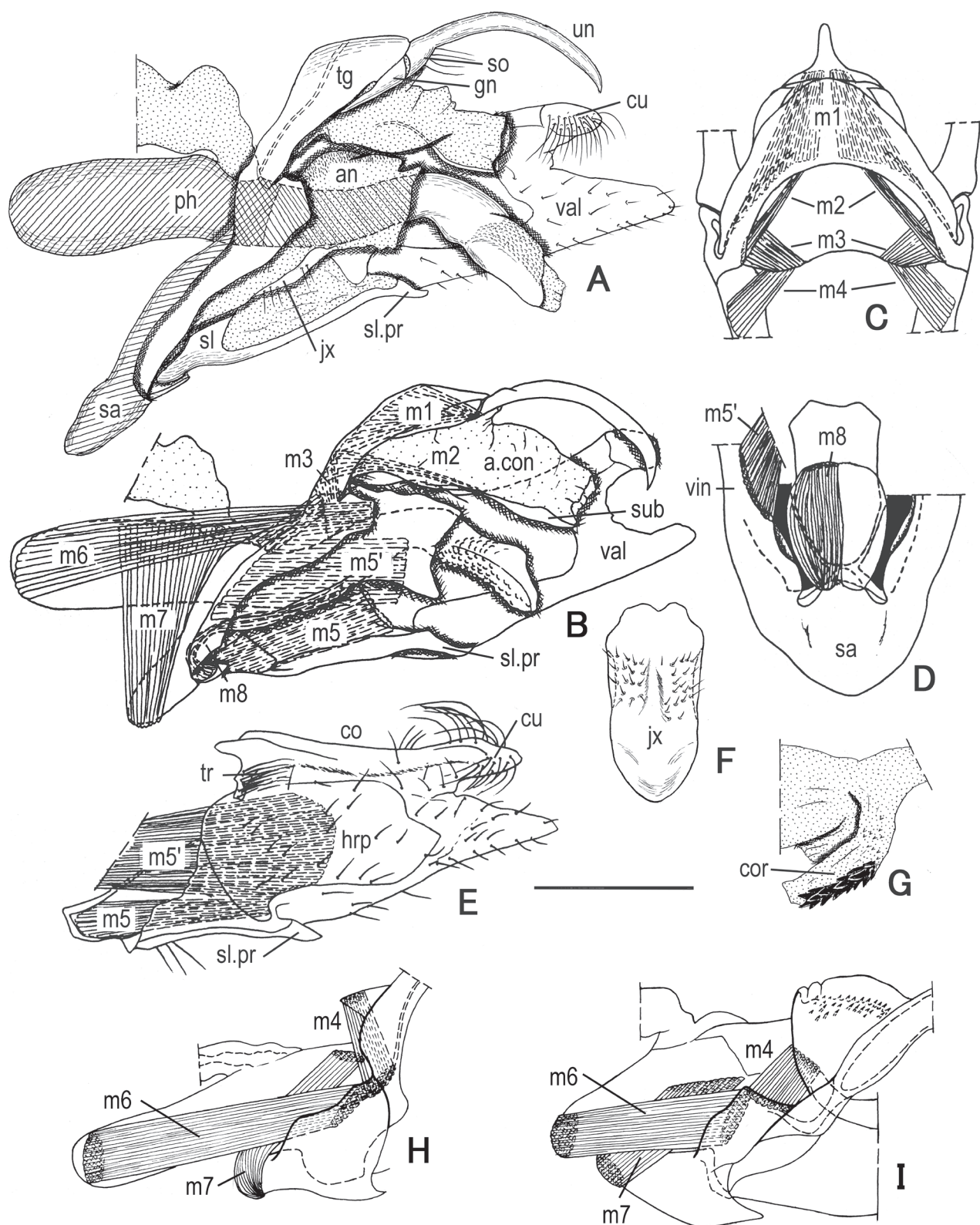


Fig. 14. Male genitalia and muscles. A–B, *Trichopteryx hemana* (Butler), lateral; C, ditto, tegumen, dorsal; D, ditto, saccus, dorsal; E, ditto, right valve, inner view; F, ditto, juxta, ventral; G, *Trichopteryx terranea* (Butler), vesica; H, *Lobophora halterata ijimai* Inoue, vinculum and anterior part of phallus, lateral; I, *Lobophorodes obscurarius* (Leech), vinculum and anterior part of phallus, lateral. a. con, anal cone; an, anellifer; co, costa; cor, cornuti; cu, cucullus; gn, gnathos; hrp, harpe; jx, juxta; ph, phallus; sa, saccus; sl, sacculus; sl. pr, saccular process; so, socius; sub, subscaphium; tg, tegumen; un, uncus; val, valvula; vin, vinculum. Scales = 0.5 mm.

Table 2. Male genital musculature in the twenty larentiine genera.

Genera \ Muscles	m1	m2	m3	m4	m5	m5'	m6	m7	m8	Tribes
<i>Carige</i>	Tg. - Un.	Tg. - Sub.	Tg. - Tr.	—	Vin. - Hrp	—	Vin. - Ph.	Sa. - Ph.	Sa. - Jx.	Heterophlebini
<i>Heterophleps</i>	Tg. - Un.	Tg. - Sub.	Tg. - Tr.	Vin. - Tr.	Sl. - Hrp.	—	Vin. - Ph.	Sa. - Ph.	Sa. - Jx.	Heterophlebini
<i>Naxidia</i>	Tg. - Un.	Tg. - Sub.	Tg. - Tr.	Vin. - Tr.	Sl. - Hrp.	—	Vin. - Ph.	Sa. - Ph.	Sa. - Jx.	Heterophlebini
<i>Aplocera</i>	Tg. - Un.	Tg. - Sub.	Tg. - Tr.	Vin. - Tr.	Sl. - Hrp.	—	Vin. - Ph.	Sa. - Ph.	Sa. - Jx.	Chesiadini
<i>Eupithecia</i>	Tg. - Un.	Tg. - Sub.	Tg. - Tr.	Vin. - Tr.	Sl. - Hrp.	—	Vin. - Ph.	Sa. - Ph.	Sa. - Jx.	Eupitheciini
<i>Lobophora</i>	Tg. - Un.	Tg. - Sub.	—	Vin. - Tr.	Sl. - Hrp.	—	Vin. - Ph.	Sa. - Ph.	Sa. - Jx.	Trichopterygini
<i>Neopachrophilla</i>	Tg. - Un.	Tg. - Sub.	Tg. - Tr.	Vin. - Tr.	Sl. - Hrp.	—	Vin. - Ph.	Sa. - Ph.	Sa. - Jx.	Trichopterygini
<i>Phthonoloba</i>	Tg. - Un.	Tg. - Sub.	Tg. - Tr.	Vin. - Tr.	Sl. - Hrp.	—	Vin. - Ph.	Sa. - Ph.	Sa. - Jx.	Trichopterygini
<i>Lobophorodes</i>	Tg. - Un.	Tg. - Sub.	—	Vin. - Tr.	Sl. - Hrp.	—	Vin. - Ph.	Sa. - Ph.	Sa. - Jx.	Trichopterygini
<i>Trichopterigia</i>	Tg. - Un.	Tg. - Sub.	Tg. - Tr.	Vin. - Tr.	Sl. - Hrp.	—	Vin. - Ph.	Sa. - Ph.	Sa. - Jx.	Trichopterygini
<i>Pseudacasis</i>	Tg. - Un.	Tg. - Sub.	Tg. - Tr.	Vin. - Tr.	Sl. - Hrp.	—	Vlv. - Ph.	Sa. - Ph.	Sa. - Jx.	Trichopterygini
<i>Acasis</i>	Tg. - Un.	Tg. - Sub.	Tg. - Tr.	Vin. - Tr.	Sl. - Hrp.	—	Vin. - Ph.	Sa. - Ph.	Sa. - Jx.	Trichopterygini
<i>Otopecta</i>	Tg. - Un.	Tg. - Sub.	Tg. - Tr.	Vin. - Tr.	Sl. - Hrp.	—	Vin. - Ph.	Sa. - Ph.	Sa. - Jx.	Trichopterygini
<i>Esakipteryx</i>	Tg. - Un.	Tg. - Sub.	Tg. - Tr.	Vin. - Tr.	Sl. - Hrp.	Vin. - Hrp.	Vin. - Ph.	Sa. - Ph.	Sa. - Jx.	Trichopterygini
<i>Paralobophora</i>	Tg. - Un.	Tg. - Sub.	Tg. - Tr.	Vin. - Tr.	Sl. - Hrp.	Vin. - Hrp.	Vin. - Ph.	Sa. - Ph.	Sa. - Jx.	Trichopterygini
<i>Cladara</i>	Tg. - Un.	Tg. - Sub.	Tg. - Tr.	Vin. - Tr.	Sl. - Hrp.	Vin. - Hrp.	Vin. - Ph.	Sa. - Ph.	Sa. - Jx.	Trichopterygini
<i>Paratrachopteryx</i>	Tg. - Un.	Tg. - Sub.	Tg. - Tr.	Vin. - Tr.	Sl. - Hrp.	Vin. - Hrp.	Vin. - Ph.	Sa. - Ph.	Sa. - Jx.	Trichopterygini
<i>Trichopteryx</i>	Tg. - Un.	Tg. - Sub.	Tg. - Tr.	Vin. - Tr.	Sl. - Hrp.	Vin. - Hrp.	Vin. - Ph.	Sa. - Ph.	Sa. - Jx.	Trichopterygini
<i>Episteira</i>	Tg. - Un.	Tg. - Sub.	Tg. - Tr.	Vin. - Tr.	Sl. - Hrp.	—	Vin. - Ph.	Sa. - Ph.	Sa. - Jx.	Trichopterygini
<i>Sauris</i>	Tg. - Un.	Tg. - Sub.	Tg. - Tr.	Vin. - Tr.	Sl. - Hrp.	—	Vin. - Ph.	Sa. - Ph.	Sa. - Jx.	Trichopterygini

—: absent; Hrp.: Harpe; Jx.: Juxta; Sa.: Saccus; Sl.: Sacculus; Sub.: Subscaphium; Tg.: Tegumen; Tr.: Transtilla; Un.: Uncus;

Vin.: Vinculum; Vlv.: Valve

fused with the sacculus ventrally (Fig. 34E); the sacculus is situated on the ventral margin, adjacent with the juxta basally, generally well sclerotized and often has a posterior projection; the valvula (cucullus of Dugdale, 1980; valve apex of Holloway, 1997) is located on the posterior part of harpe, weakly sclerotized (in the genus *Sauris* the valvula bears a brush consisting of many long hairy setae which are tucked in a central diaphragmal pouch (Dugdale, 1980; Holloway, 1997; Fig. 82A)); the transtilla (this is regarded as one of sclerites of the diaphragma (Kristensen, 2003), but in the Geometridae completely fused with an inner base of costa) is an expansion extending medially from the proximo-dorsal edge of costa, generally covered with the long setae, and both transtillae are rarely strongly fused with each other medially (Fig. 36E). A sclerotized intromittent organ is here named the phallus followed Kristensen (2003); the phallus is slightly curved or almost straight, surrounding with the anellus and supported ventrally by the juxta (it is variable in shape and partly homologous with the median plate in the lepidopterous ground plan (Kristensen, 2003)); a membranous tube continuing from the phallus is the vesica, on which a variable shaped sclerotized armature, cornutus, is often present. The segment X is represented by the uncus, the socius, the gnathos, and the anal cone. The uncus, a hook-like projection, is articulated with the posterior margin of tegumen and articulated with or completely fused with the socii which are setose and located at the antero-lateral sides of uncus. The gnathos (Fig. 14A) is generally recognized as a narrow sclerite along the postero-lateral side of tegumen, often obsolete or completely fused with the uncus-socius complex and rarely separate from it by thin membrane. The anal cone (tuba analis) is located below the tegumen and behind the uncus-socius complex, at the end of which the anal tube is opening (the anus); the subscaphium (ventral sclerite of the anal cone; probably pertaining to the sternum X (Kristensen, 2003)) is generally weakly sclerotized

and covered with finely minute hairs, but rarely well sclerotized in the specific level.

Male genital musculature (Table 2; Fig. 14): Although a few exceptions are present, the genital musculature of Trichopterygini is basically identical with that of many tribes of the subfamily Larentiinae (Valersky, 2011). The intrinsic muscles of phallus are not treated in this study.

Depressor of uncus (m1): this massive muscle originates on the antecosta of tegumen and inserts in the antero-lateral base of uncus.

Retractor of anal cone (m2): this thin muscle originates on the antero-lateral edge of tegumen and inserts in the lateral side of subscaphium.

Extensor of valve (m3): this is a short muscle originating on the antero-lateral edge of tegumen (outside of m2) and inserting in the transtilla, but this muscle is rarely reduced or absent in the generic level. Valersky (2011) examined the genital muscles of *Lobophora halterata* (Hufnagel) and indicated that absence of m3 (his M4) is one of characteristics of the tribe Trichopterygini. However, this characteristic is restrictive in the genera *Lobophora* and *Lobophorodes* (Table 2).

Extensor of valve (m4): this short muscle runs from the upper inner side of vinculum to the transtilla (near the attachment of m3).

Flexor of valve (m5): this is an intrinsic valve muscle usually running from the proximal part of sacculus to the harpe.

Flexor of valve (m5'): an additional massive muscle, which was probably derived from m5, is running from the lateral side of vinculum to the harpe, and peculiar to the genus *Trichopteryx* and its allied genera.

Protractor of phallus (m6): this muscle runs from the vinculum to the anterior part of coecum (phallobase), but from proximal edge of valve to phallus in the genus *Pseudacasis*.

Retractor of phallus (m7): this muscle runs from the anterior part of saccus to the lateral side of phallus.

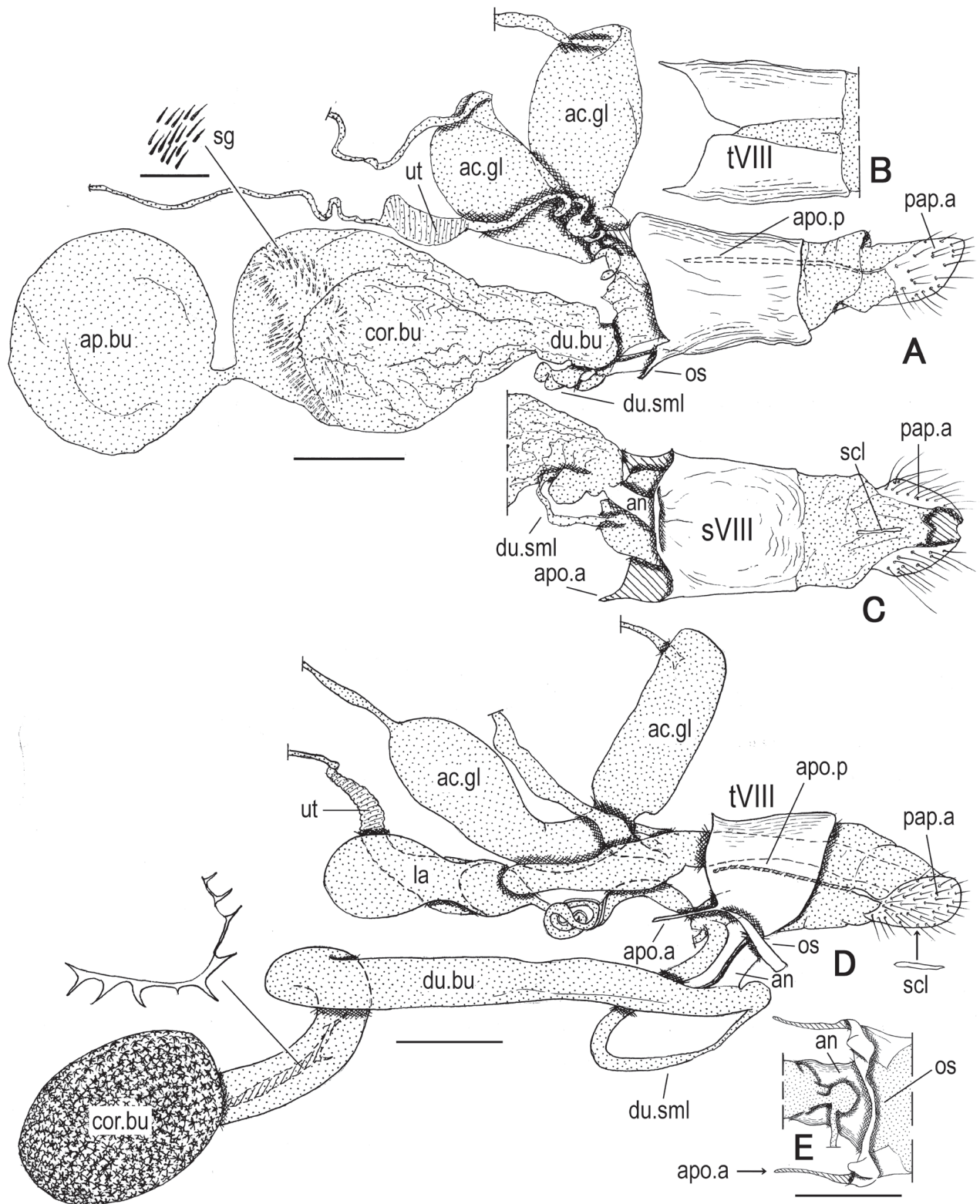


Fig. 15. Female genitalia. A, *Acasis viretata viretata* (Hübner), lateral; B, ditto, tergum VII, dorsal; C, ditto, posterior abdomen, ventral; D, *Trichopteryx hemana* (Butler), lateral; E, ditto, antrum, ventral. ac. gl; accessory gland; an, antrum; ap. bu, appendix bursae; apo. a, apophysis anterioris; apo. p, apophysis posteriors; cor. bu, corpus bursae; du. bu, ductus bursae; du. sml, ductus seminalis; la, lagena; os, ostium; pap. a, papilla analis; scl, sclerite; sg, signa; ut, utriculus. Scales = 0.5 mm, 0.125 mm (signa of A).

Flexor of valve (m8): this muscle originates on the postero-ventral part of saccus and inserts on the juxta.

Female genitalia (Figs. 15, 29, 77H–J, 78H–I, 82H–J): The female terminalia also consist of the segments VIII to X (Kristensen, 2003). The segment VIII is more or less variable in the tribe; the tergum is sclerotized and well developed as a semicylindrical hood, but rarely divided longitudinally by the median membrane (Fig. 15B); the sternum is usually membranous except for a narrow anterior sclerite and occasionally forms a sclerotized tube with the tergum (Fig. 15A, C); the apophyses anteriores (usually less than 1/2 length of apophyses posteriors, but rarely much reduced) are the paired apodemes arising from the antero-lateral sides (junction between the tergum and the antero-lateral ridge of sternum). In the tribe Trichopterygini the sterigma (lamella antevaginalis and postvaginalis) is usually undeveloped. The ostium bursae is a copulatory orifice of bursa copulatrix and generally opens to the anterior margin of sternum VIII. The bursa copulatrix is generally divided into the sac like anterior swollen part (corpus bursae) and the membranous tube (ductus

bursae) linking the corpus bursae with the ostium bursae, but junction between them is often indistinct; the corpus bursae is membranous, variable in shape, and partly or wholly covered with numerous spines forming star-shaped base on outer surface or with short needle-like spines (“scobinate” in several authors (Pierce, 1914; Holloway, 1997; Viidalepp, 2011)); the ductus bursae is variable in length, sometimes decorated with spines, and rarely has the cestum (Dugdale, 1980; a ribbon-like sclerite by Scoble, 1992; Figs. 77H, 78H, 82H) recognized as a swollen wrinkled part; the antrum (sterigma of Dugdale 1980; colliculum of Nakajima, 1998), a most posterior sclerotized part of ductus bursae continuing from the ostium bursae (ostium), is generally developed and concave dorsally; an appendix bursae (Figs. 15A, 77H, 78H) is present at the posterior end of corpus bursae or near the anterior end of ductus bursae in some genera; the ductus seminalis is generally arising near ostium, but occasionally from near corpus bursae or from middle of ductus bursae; the spermatheca lacks the lagena (Fig. 15A) as a lateral sac in a few genera (*Acasis*, *Otoplecta* and *Pseudacasis*). The

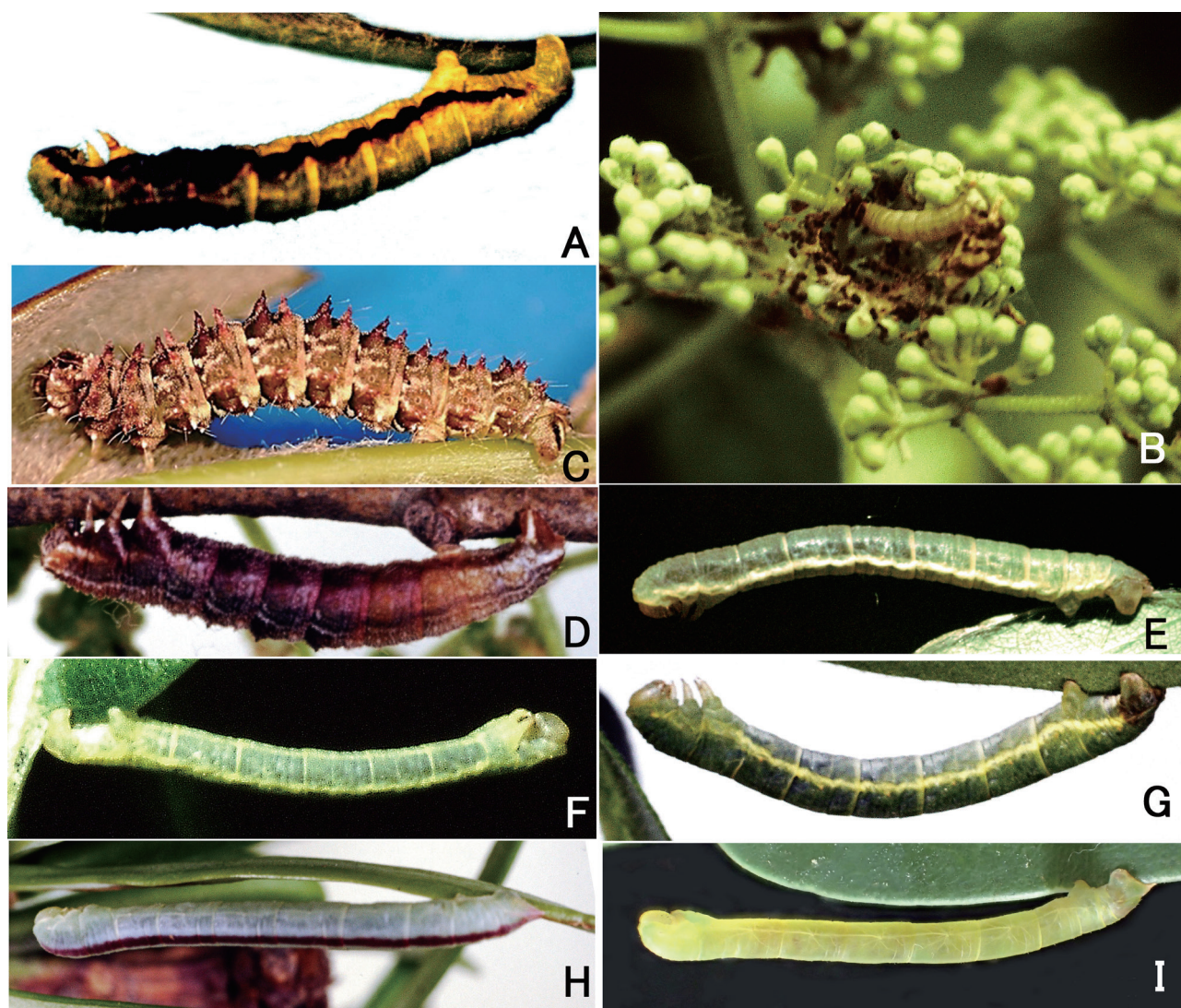
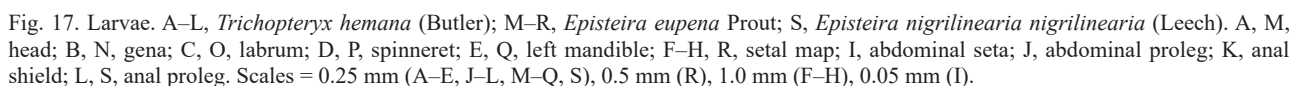


Fig. 16. Larvae. A, *Trichopterigia costipunctaria* Leech; B, *Otoplecta frigida* (Butler); C, *Esakiopteryx volitans* (Butler), photo by Teramoto D, *Paratrachopteryx misera* (Butler); E, *Trichopteryx fastuosa* Inoue, photo by Yazaki; F, *Trichopteryx hemana* (Butler); G, *Trichopteryx ussurica* (Wehrli); H, *Episteira nigrilinearia nigrilinearia* (Leech); I, *Sauris chlorosterna* Hashimoto, photo by Komai.



	Hinton (1946)	Singh (1953)	McGuffin (1958)	Dugdale (1961)	McGuffin (1972)	Stehr (1987)	Hashimoto (2019)	Types of setae
A1—A7	L1	L1	L1	L1	L1	L1	L1	Primary
	L2	L2	L2	L2	L2	L2	L2	Primary
	L3	L3	SV3	L3	SV3	SV3	L3	Subprimary
	—	LD	L3	L4	L3	L3	L4	Subprimary
Anal shield	—	D1	D1	D1	D1	D1	D1	Primary
	—	L1	D2	D2	D2	D2	D2	Primary
	—	L2	L1	L1	L1	SD1	SD1	Primary
	—	L3	SD1	SD1	SD1	SD2	SD2	Primary
Anal proleg	—	L1	—	L3	L3	L1	L3	Subprimary
	—	L2	—	L2	L2	L2	L1	Primary
	—	L3	—	L1	L1	L3	L2	Primary
	—	CD1	—	CD1	CD1	PP1	PP1	Primary
	—	CD2	—	CD2	CD2	SV1	SV1	Primary
	—	CP1	—	CP1	CP1	SV2	SV2	Primary
	—	CP2	—	CP2	CP2	SV3	SV3	Subprimary

April 30, 2021, JJSE Monographic Ser. (6)

segments IX and X are completely fused with each other to form the paired setose lobes (papillae anales), at the posterior end between them the anus and the ovipore are opening; a small narrow sclerite (sternite IX of Dugdale, 1980) is present on the ventral membrane (Fig. 15C); the apophyses posteriores

are also a pair of long apodemes extending from the antero-lateral sides of papillae anales; the papilla anales are weakly sclerotized and rounded, but in the genus *Phthonoloba* are sclerotized and tapering (Fig. 29A–B).

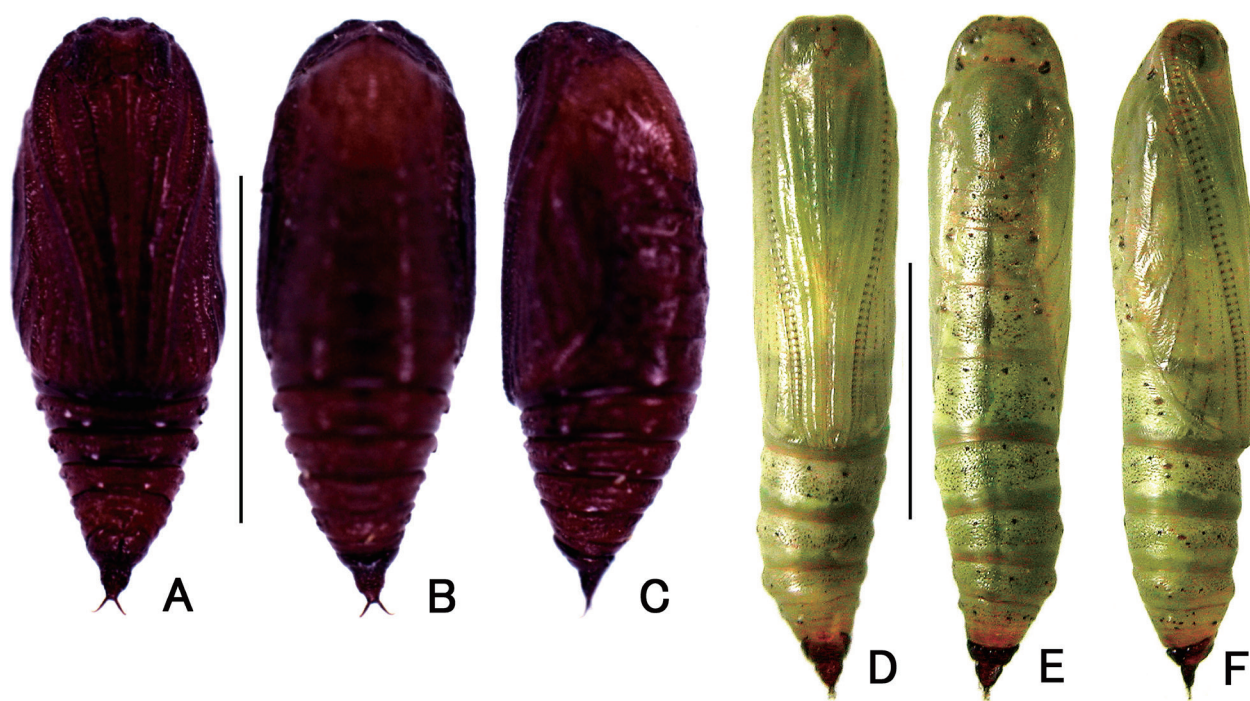


Fig. 18. Pupae. A–C, *Paratrachopteryx misera* (Butler); D–F, *Sauris interruptata* (Moore). A, D: ventral; B, E: dorsal; C, F: lateral. Scales = 5.0 mm.

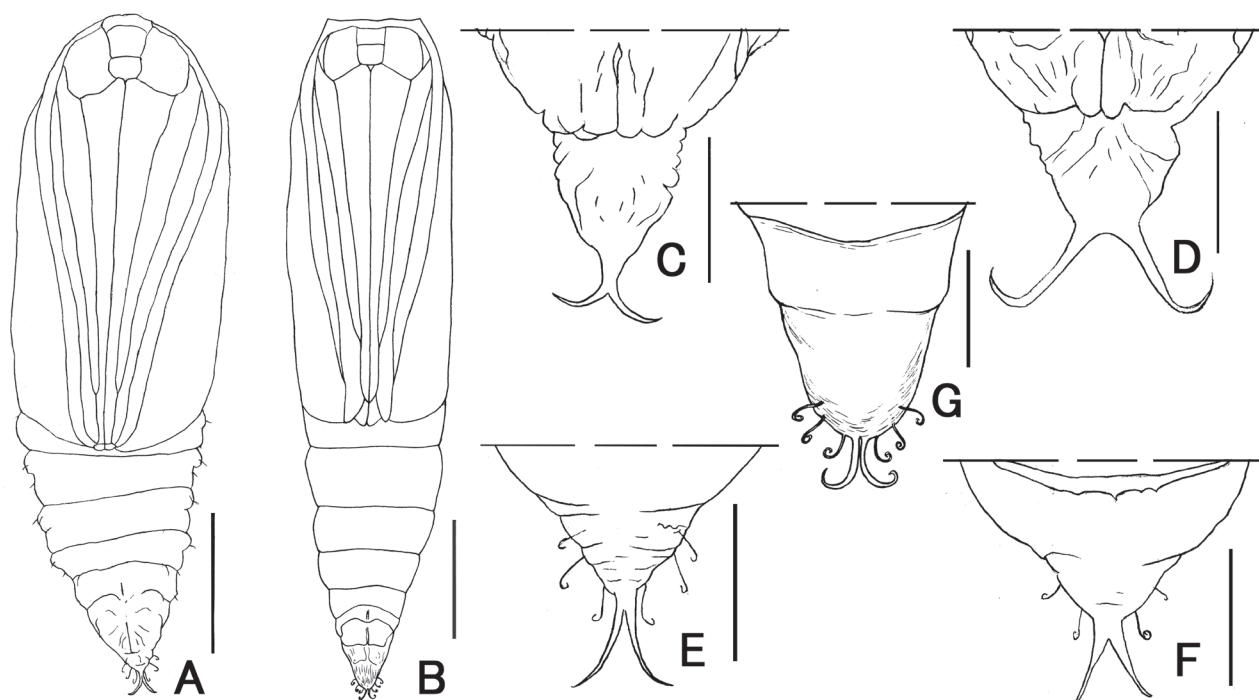


Fig. 19. Pupae. A, E, *Trichopteryx hemana* (Butler); B, G, *Episteira nigrilinearia nigrilinearia* (Leech); C, *Esakiopteryx volitans* (Butler); D, *Paratrachopteryx misera* (Butler); F, *Trichopteryx ussurica* (Wehrli). A–B, whole aspect, ventral; C–D, cremaster, ventral; E–G, ditto, dorsal. Scales = 2.0 mm (A–B), 0.5 mm (C–G).

Table 4. Host plant of the Japanese trichopterygine genera.

Genera	Host-families	Sources
<i>Lobophora</i>	Salicaceae*	Spuler, 1910; McGuffin, 1958
<i>Neopachrophilla</i>	Unknown	
<i>Phthonoloba</i>	Dryopteridaceae; Cyatheaceae	Tominaga, 2013; Sakagami, 2021
<i>Lobophorodes</i>	Cupressaceae	Murase, 1996
<i>Trichopterigia</i>	Fagaceae; Coriariaceae	Hashimoto, 1982; Holloway, 1997
<i>Pseudacasis</i>	Unknown	
<i>Acasis</i>	Adoxaceae*; Araliaceae*; Aquifoliaceae*; Fagaceae; Ranunculaceae; Rhamnaceae*	Spuler, 1910; Inoue, 1957; Nakajima, 1974; Owada, 1985
<i>Otopecta</i>	Adoxaceae	Nakamura, 1980
<i>Esakiopteryx</i>	Fagaceae	Yazaki, 1972; Hashimoto, 1982
<i>Paralobophora</i>	Sapindaceae	Yazaki, unpublished data
<i>Cladara</i>	Adoxaceae*; Beturaceae*; Fagaceae; Pinaceae*; Salicaceae*; Sapindaceae*	McGuffin, 1958; Yazaki, unpublished data; http://buggide.net/node/view/15372 (visited on 19. iii. 2018)
<i>Paratrachopteryx</i>	Fagaceae	Inoue, 1957; Nakajima, 1974; Hashimoto, 1982; Nakajima & Yazaki, 2011
<i>Trichopteryx</i>	Beturaceae; Caprifoliaceae*; Fagaceae; Hamamelidaceae; Oleaceae; Sapindaceae; Ulmaceae	Spuler, 1910; Yazaki, 1972, 1974, 1975; Hashimoto, 2011; Nakajima & Yazaki, 2011
<i>Episteira</i>	Podocarpaceae Celastoraceae*; Elaeocarpaceae; Euphorbiaceae*;	Nakamura, 1981
<i>Sauris</i>	Hamamelidaceae; Lauraceae; Lorantheae*; Lythraceae; Myricaceae; Myrtaceae; Oleaceae; Phyllanthaceae; Putranjivaceae; Rosaceae; Rutaceae; Sapindaceae; Theaceae	Holloway, 1997; Tominaga, 2003; Inoue & Ohbayashi, 2003; Hayashi, 2006; Ohbayashi, 2015; Hashimoto, 2019

*: Unknown in the Japanese species.

Immature stages

Morphological characters on the immature stages of the tribe are very limited so that the present paper gives a brief description in the following lines. Table 3 shows a comparison of the setal name of the L setal group on the abdominal segments I–VII (A1–A7), of the anal shield, and of the anal proleg according to several authors (Hinton, 1946; Singh, 1953; McGuffin, 1958, 1972; Dugdale, 1961; Stehr, 1987; Hashimoto, 2019).

Last instar Larva (Figs. 16–17, 50, 56, 63–65; Table 5): The larvae are generally cylindrical (or moniliform), rarely with the dorsal and lateral protrusions on which the D1, D2, L1 and L2 setae arise respectively; the head capsule is usually rounded, smooth or variably reticulate and diverse in colour; in the genera *Episteira* and *Sauris* the ecdysial cleavage line is absent (Hashimoto, 1991b, 2019; Fig. 17M); the spinneret is generally a cylindrical tube, but has a fringed wide tip in *Sauris* (Singh, 1956; Hashimoto, 2019), a fan-shaped tip in *Episteira* (Hashimoto, 1991b; Fig. 17P), and a small fan-shaped in some species of *Trichopteryx* (Fig. 64C, F, I, M); on the cranial setae A3 anterior to a line joining L1 and A2 (Figs. 17A, M, 63A, C, E, G, I, K); the thoracic and abdominal integument is finely or roughly granulate; on the prothorax SD setal group is unisetose or bisetose on the prothoracic shield or on the same pinaculum separate from the prothoracic shield; two SV setae (SV1 and SV2) are always present on the first to 5th and 7th abdominal segments, and four SV setae are present on the 6th abdominal proleg (McGuffin, 1958; Hashimoto, 1982, 1985, 1991b, 2019); on the anal shield D1 setae (Figs. 17K, 65A, C, E, G, I, K) are anterior to a line drawn between SD2s (this is unique in the Larentiinae, but also shown in the Chesiadini (Singh, 1956) and the Eupitheciini (McGuffin, 1958)); the paraproct (Fig. 17L, S) sensu McGuffin (1958) and Dugdale (1961), a postero-dorsal protrusion of the anal proleg (a protuberance bearing the seta PP1 (his CD1) of Singh(1953)), is usually developed, especially

in *Episteira* (Fig. 17S) and *Sauris*; on the anal proleg SV2 (CP1) and SV3 (CP2) are generally arranged along the anterior margin, but rarely SV2 is directly posterior to SV3 (Hashimoto, 2019), and SV3 is rarely absent (Hashimoto, 1982).

Pupa (Figs. 18–19): The pupae (Patočka, 1980, 1981; Hashimoto, 1982, 1985, 1991b, 2019; Nakamura, 2004) are usually stout, sclerotized and reddish brown to dark brown, but in a few genera are slender, rather soft and thin yellowish white cuticle (in that case a yellowish green to blueish green inner body colour is seen through the integument) except for the sclerotized and reddish brown to dark brown tenth segment. The labial palpus is exposed or not, when exposed, is very small and triangular; the fore femur is exposed or not; a tip of the hind tarsus is exposed or not; the cremaster is well sclerotized and dark brown and has one to four pairs of hooked setae, of which terminal one is always present, generally sclerotized and pointed.

Distribution

Trichopterygini are known from all faunal regions except the far eastern Pacific (Dugdale, 1980). The genera *Acasis*, *Cladara*, *Trichopteryx* and *Lobophora* are distributed in the Holarctic; *Lobophorodes* distributed in the Palearctic; *Pterapherapteryx*, *Nothocasis* and *Oulobophora* known from Europe; *Episauris* from Canaries and Madeira Isles.; *Lobidiopteryx*, *Aposteira* and *Protosteira* known from the Afrotropical region; *Neopachrophilla* and *Otopecta* endemic to Japan; *Esakiopteryx*, *Paralobophora*, *Paratrachopteryx* gen. nov., and *Pseudacasis* gen. nov. distributed in the Far East; *Dystypoptila*, *Episteira*, *Sauris*, *Tympanota*, *Archaeocasis*, *Trichopterigia*, *Hypocometa*, *Phthonoloba* and *Tristeirometa* known from the Oriental region, of these *Episteira*, *Sauris* and *Tympanota* extend to the Australian region; *Tatosoma* endemic to New Zealand; *Aloba*, *Arrayanaria*, *Baynia*, *Butleriana*, *Danielaparra*, *Fueguina*, *Hoplosauris*, *Isosauris*, *Lagynopteryx*,

Llampidken, *Lobidiopteryx*, *Pachrophylla*, *Parapachrophylla*, *Physoloba*, *Rhopalodes*, *Rindgenaria*, *Tomopteryx*, *Triptila*, *Triptiloides*, and *Warrenaria* are distributed in the Neotropical.

Bionomics

Many known larvae (MacGuffin, 1958; Dugdale, 1980; Hausmann & Viidalepp, 2012) of Trichopterygini are generally monophagous or oligophagous, but a few (Holloway, 1997; Hashimoto, 2019) are polyphagous. The larvae are usually exposed feeders on their host plants, but a few larvae are concealed in the flower buds loosely woven with silk and feed on them inside (Forbes, 1948; Hashimoto, 1985; Fig. 16B). The larval host range is rather wide and mainly utilize the deciduous trees and shrubs or the coniferous trees (Table 4 shows the host plant families), although host plant information is scarce except for the European and Nearctic species (Spuler, 1910; Forbes, 1948; McGuffin, 1958). The mature larvae pupate in the loosely woven leaves of the host plant or in the earthen cells loosely woven with silk in the soil on the ground.

The moths of Trichopterygini are generally nocturnal and well attracted at a light, but *Otopecta frigida* (Butler) exceptionally shows a diurnal habit. Most of the northern temperate species are mainly spring moths, inhabit in the deciduous forest, one generation a year (rarely two generations) and hibernate mainly in the pupal stage, but the subtropical and tropical species inhabit in the montane forests or the tropical forests, and are probably two or more generations a year, but their diapause is unknown (Dugdale, 1980; Holloway, 1997; Hashimoto, 2019).

6.2. Classification of Japanese genera

Key to Japanese genera (based on adult external characters)

1. Antennal flagellomeres compressed (Fig. 5K–L) ... 2
- . Antennal flagellomeres not compressed .. 3
2. Male hindwing with Rs and M1 separate or connate (Fig. 76B, D); frons and outer surface of labial palpus black or dark brown in both sexes (Fig. 6F) .. *Episteira*
- . Male hindwing with Rs and M1 completely fused (Fig. 76F, I–J); frons and outer surface of labial palpus largely or completely olive green in both sexes ... *Sauris*
3. Hind tibia with two pairs of spurs (mid and apical spurs) . 4
- . Hind tibia with a pair of spurs (apical spurs) .. 5
4. Forewing pattern indistinct, greyish to greyish brown (Fig. 20A–B); hindwing white, pale greyish white along termen; male hindwing with Sc and R + Rs (upper vein of discal cell) fused for most length of discal cell (Fig. 21B) *Lobophora*
- . Forewing pattern distinct, fuscous, with large fuscous discal spot in white broad median band (Fig. 20C–D); hindwing greyish brown; male hindwing with Sc separate from R + Rs, connected via a short vein of R near end of discal cell (Fig. 21E) *Neopachrophylla*
5. Frenulum consisting of a strong spine (Fig. 11B) .. 6 (males)
- . Frenulum consisting of several short bristles (Fig. 11C) 16 (females)
6. Hindwing without an anal fold; hindtibial apical spurs minute, usually invisible by scales (Fig. 7E)

- *Phthonoloba*
- . Hindwing with an anal fold (Fig. 11B); hindtibial apical spurs moderate length 7
7. Forewing with one areole (Fig. 11D) 8
- . Forewing with two areoles (Fig. 11A) 10
8. Forewing with M1 connate with Rs3 + 4 (Fig. 39D); hindwing with Rs and M1 separate (Fig. 39E) .. *Otopecta*
- . Forewing with M1 arising from areole (accessory cell) (Fig. 33A); hindwing with Rs and M1 stalked (Fig. 33B) 9
9. Hindwing with Sc fused with R + Rs for most length of discal cell, and CuA2 relatively long, almost straight (Fig. 33B) *Trichopterigia*
- . Hindwing with Sc separate from an upper vein of discal cell, connected via a short vein of R near end of discal cell, and CuA2 very short, curved (Fig. 45B) .. *Esakiopteryx*
10. Hindwing with Sc separate from an upper vein of discal cell, connected via a short vein of R near end of discal cell (Fig. 45E) 11
- . Hindwing with Sc fused with R + Rs for most length of discal cell (Fig. 33E) 13
11. Hind tibia without a hair-pencil; hindwing with Rs and M1 stalked (Fig. 45E) *Paratrachopteryx* gen. nov.
- . Hind tibia with a hair-pencil (Fig. 7C); hindwing with Rs and M1 separate (Fig. 11B) 12
12. Hindwing with CuA1 relatively long, slightly shorter than M1, and with CuA2 short, about 1/2 length of CuA1 (Fig. 27D) *Lobophorodes*
- . Hindwing with CuA1 short, about 1/2 length of M1, and with CuA2 very short, about 1/3 length of CuA1 (Fig. 11B) *Trichopteryx*
13. Forewing length 16–17 mm (forewing expanse more than 25 mm) 14
- . Forewing length 10–13 mm (forewing expanse less than 25 mm) 15
14. Forewing with ante- and postmedial lines fused with each other near middle of inner margin; antemedial line distinct near costal margin; postmedial line slightly curved outwardly (Fig. 51A–C, E, G) *Cladara*
- . Forewing with ante- and postmedial lines not fused; antemedial line indistinct; postmedial line distinct, fuscous, strongly protruded outwardly on M3 (Fig. 44E, G) *Paralobophora*
15. Forewing with more or less distinct blueish median band, without a white spot on middle of inner margin (Fig. 38A, C, E); hindwing with CuA2 short, less than 1/2 length of CuA1 (Fig. 39B) *Acasis*
- . Forewing with yellowish olive green antemedial and postmedial lines, with a white spot on middle of inner margin (Fig. 32G); hindwing with CuA2 long, about same length of CuA1 (Fig. 33E) *Pseudacasis* gen. nov.
16. Hindwing with Rs and M1 stalked (Fig. 33F) 17
- . Hindwing with Rs and M1 separate (Fig. 39F) 22
17. Forewing with one areole 18
- . Forewing with two areoles 19
18. Forewing with postmedial line almost straight or slightly curved outwardly, with reddish spots along lines, especially distinct two spots along subterminal line near M1 (Fig. 32B, D)..... *Trichopterigia*

- . Forewing with postmedial line strongly protruded outwardly on M1 to M2 (Fig. 44B) *Esakiopteryx*
- 19. Forewing with 1st areole medium, more than 1/3 length of 2nd areole *Trichopteryx*
- . Forewing with 1st areole very small, less than 1/3 length of 2nd areole 20
- 20. Forewing dark brown, with fuscous median band; hindwing dark brown (Fig. 59B) ... *Paratrachopteryx* gen. nov.
- . Forewing greyish brown tinged with olive green, with antemedial and postmedial lines blueish or greenish brown; hindwing whitish brown or greyish brown ... 21
- 21. Forewing with a white spot on middle of inner margin (Fig. 32H) *Pseudacasis* gen. nov.
- . Forewing without a white spot on middle of inner margin (Fig. 38B, D, F) *Acasis*
- 22. Forewing lengths 11–12 mm (forewing expanse less than 25 mm); hindwing white to greyish white, with distinct blackish discal spot and terminal dots on each vein (Fig. 38H) *Otoplecta*
- . Forewing length 14–18 mm (forewing expanse more than 25 mm); hindwing greyish white to dark brown, without blackish terminal dots on each vein 23
- 23. Forewing with a white spot on dorsum (inner margin) between antemedial and postmedial lines (Fig. 51D, F, H) ..
..... *Cladara*
- . Forewing without a white spot on dorsum 24
- 24. Forewing with olive green to dark green wing pattern (Fig. 26B) *Phthonoloba*
- . Forewing without such a wing colour pattern 25
- 25. Forewing greyish brown to dark brown (Fig. 26C–F), with distinct median band (antemedial and postmedial lines fused with each other) *Lobophorodes*
- . Forewing pale brownish grey, with distinct blackish postmedial line (Fig. 44F, H) *Paralobophora*

Descriptions of Japanese genera with brief information on Japanese species

Genus *Lobophora* Curtis

- Lobophora* Curtis, 1825: 81. Type species: *Geometra hexapterata* [Denis & Schiffermüller], 1775: 109, by original designation (a junior subjective synonym of *Phalaena halterata* Hufnagel, 1767: 608).
- Lobophora* Stephens, 1829: 44 (a junior homonym and a junior synonym of *Lobophora* Curtis). Type species: *Geometra hexapterata* [Denis & Schiffermüller], 1775 by subsequent designation.
- Philopsia* Hulst, 1896: 255 (key), 259. Type species: *Lobophora nivigerata* Walker, 1862: 1259, by original designation.
- Taliedegea* Hulst, 1896: 256 (key), 260. Type species: *Lobophora montanata* Packard, 1874: 40, by original designation.

Diagnosis. Definite apomorphies of the genus *Lobophora* were not recognized in this study (Fig. 3). *Lobophora* is distinguishable from other trichopterygine genera by the following combination of characters: hind tibia with 2 pairs of spurs; forewing pattern greyish brown, with obscure lines;

forewing with 2 areoles; forewing with M1 arising from discal cell (upper discocellular vein very short); hindwing white, tinged with greyish brown along termen; hindwing venation (Sc fused with R + Rs for most length of discal cell in both sexes; Rs and M1 separate in male, stalked in female); anal fold with a deep incision; valve rather slender; costa sclerotized with a long arm covered with hairs; cucullus sclerotized, covered with hairs; valvula sclerotized, with a sharply pointed tip; corpus bursae ovate, elongate, with two long ovate patches consisting of very small sharp spines.

Description. The generic description is mainly based on four species and the following studies: Pierce, 1914; Forbes, 1917, 1948; McGuffin, 1958; Yazaki *et al.*, 2004; Valersky, 2011; Hausmann & Viidalepp, 2012.

Adult

Head (Figs. 5A, 6A): Vertex clothed with scales thickly; antennal flagellomeres generally filiform, but in male of *L. clypeata* Yazaki & Huang, 2004 exceptionally bipectinate; frons slightly rounded; labial palpus ascending, short, almost same as eye diameter; proboscis developed.

Thorax (Figs. 8C, 20A–B, 21A–C): Thorax stout; metepimeron enlarged, divided into anterior and posterior parts by inner ridge in both sexes; male metameron arched posteriorly; hind tibia with two pairs of spurs (mid spurs and apical spurs), with or without a hair-pencil in male. Forewing white, densely covered with pale grey to dark grey scales, sometimes tinged with pale orange; forewing pattern rather obscure, but main lines (basal, postbasal, subterminal and adterminal dark grey lines, dark grey broad median band, and a row of terminal dots) distinguishable, discal spot indistinct in the Palearctic species, distinct in the Nearctic species; forewing with two areoles; M1 arising from outer margin of discal cell (upper discocellular vein short). Hindwing white, tinged with dark grey along termen; male with an anal fold (about 1/2 length of anal margin in the Holarctic species, but less than 1/4 in the Nearctic species) deeply incised from anal margin; Sc anastomosed with R + Rs (upper vein of discal cell) for most length of discal cell; Rs and M1 separate in male, stalked in female; M3 and CuA1 separate, almost equal in length; CuA2 very short, less than 1/6 of CuA1 in male; 1A + 2A short, in the anal fold in male.

Pregenital abdomen (Fig. 8C): Male sternum II pouch small or obsolete; male sternum II with a pair of triangular expansions.

Male genitalia (Fig. 22A–G): Anterior margin of tegumen moderately incurved, posterior margin strongly curved posteriorly; saccus widely rounded, slightly protruded anteriorly; uncus moderately long, slightly curved ventrally, rather wide at base, with a dull pointed tip; socius almost reduced at basal side of uncus; gnathos almost reduced, very narrow, synscleritous with uncus-socius complex; valve slender, well sclerotized; costa well sclerotized, with a long slender cylindrical hairy projection (costal arm); cucullus sclerotized, covered with hairs, being at distal part of costal arm, indistinguishable from costal arm; transtillae with a pair of semicircular hairy processes surrounding dorsal part of phallus; sacculus sclerotized, rather thick, without any projections; harpe sclerotized, indistinguishable from valvula;

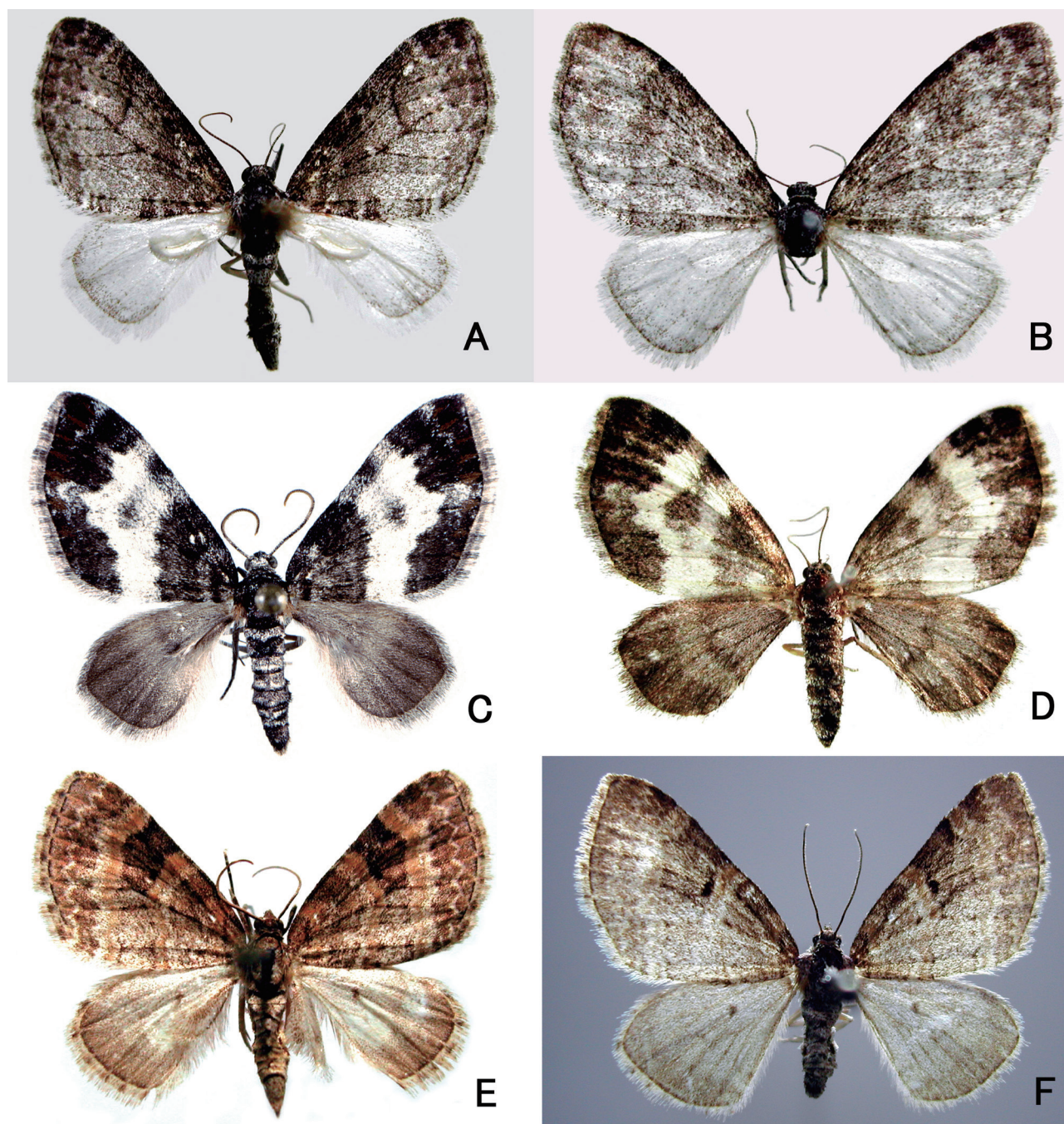


Fig. 20. Adults. A, *Lobophora halterata ijimai* Inoue, ♂; B, ditto, ♀; C, *Neopachrophilla albida* Inoue, ♂; D, ditto, ♀; E, *Pterapherapteryx sexalata* (Retzius), ♂ (Czech); F, ditto, ♀ (Czech).

valvula well sclerotized, rather slender, with a pointed apex; anellus covered with many spines on dorsal part of phallus; phallus slender, longer than valve; cornuti a long band of many short spines; coecum distinct, about 1/4 length of phallus; juxta hexagonal.

Male genital musculature (Fig. 14H; Table 2): Extensor of valve (m3) absent; any extra muscles and secondary movements not seen.

Female genitalia (Fig. 22H–I): Corpus bursae oblong, cylindrical, wrinkled on lateral sides, with two large ovate patches (signa) consisting of minute spines on dorsal and ventral sides mid-posteriorly; ductus bursae very short, rather thick; ductus seminalis arising near corpus bursae-ductus

bursae junction; antrum cup-shaped, sclerotized; 8th tergum developed, well sclerotized; ostium (ostium bursae) being at anterior margin of 8th sternum; 8th sternum membranous except for narrow anterior ridge of ostium; apophysis anterioris rather short, less than 1/2 length of apophysis posterioris; ventral sclerite (sternite IX) between papillae anales narrow.

Immature stages

Last instar larva: 16–22 mm in length; head pale yellow green to blue green, wider than long; labral emargination about 0.2 deep; mandible with six teeth, of which inner one is dull, finely serrate; spinneret cylindrical; body green with a fine yellow spiracular line, cylindrical, slightly rough; crochets of

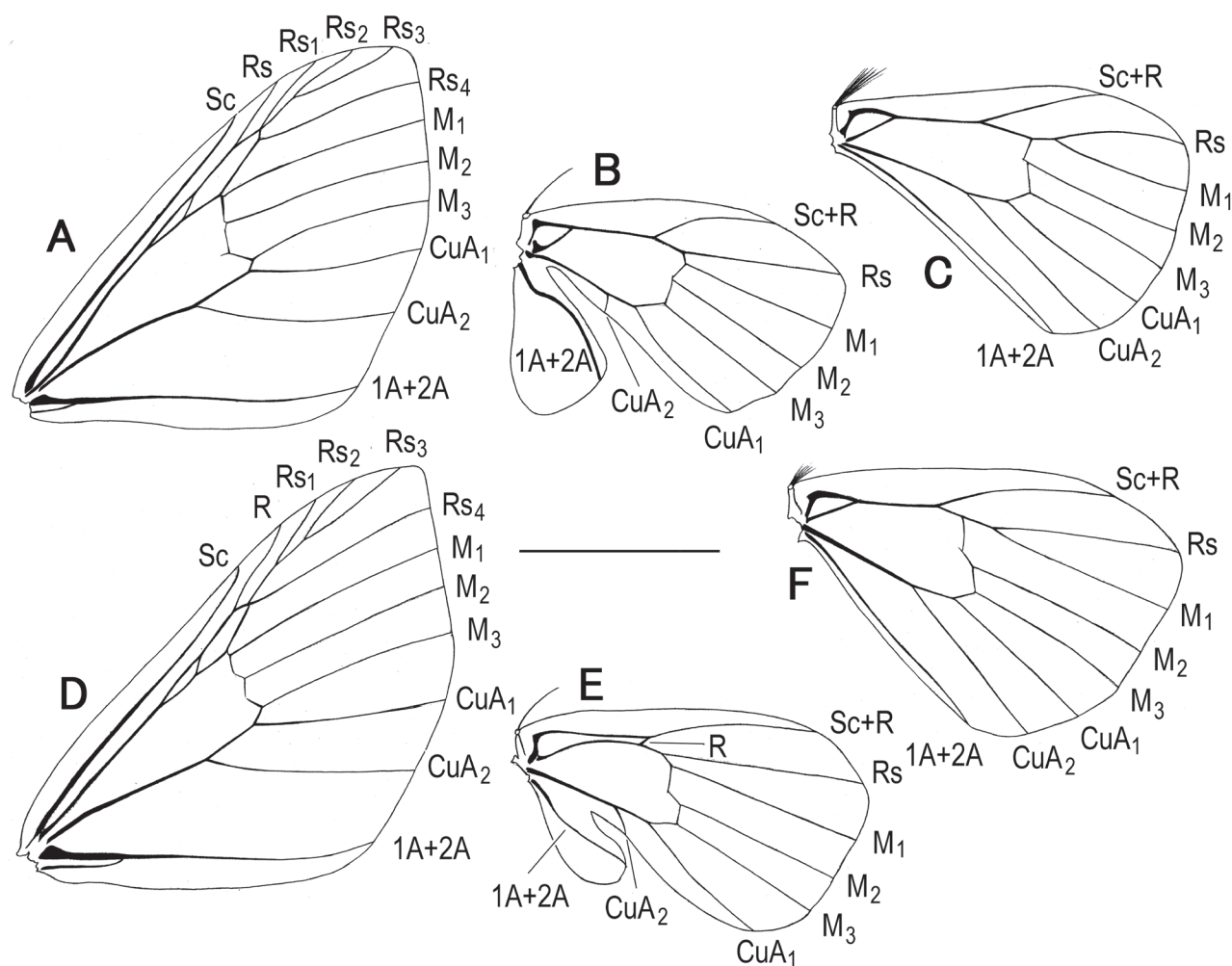


Fig. 21. Wing venation. A, *Lobophora halterata ijimai* Inoue, ♂ (forewing); B, ditto, ♂ (hindwing); C, ditto, ♀ (hindwing); D, *Neopachrophilla albida* Inoue, ♂ (forewing); E, ditto, ♂ (hindwing); F, ditto, ♀ (hindwing). Scale = 5.0 mm.

ventral proleg interrupted biordinal mesoseries; setae short, dull tipped, paler, paraproct developed. Chaetotaxy: Pb puncture anterior to a line joining P1 and P2; A3 ventral to a line joining L1 and A2; ventral proleg with four SV setae; on anal shield D1 setae slightly anterior to a line drawn between SD2s.

Pupa: Not examined, but a European species, *Lobophora halterata halterata* (Hufnagel), is described by Patočka, 1980.

Distribution. Europe to East Siberia, China, Japan, and North America.

Bionomics. There is a single generation per year. European and North American species utilize *Salix* spp., *Populus* spp. (Salicaceae: Spuler, 1910; McGuffin, 1958).

Remarks. *Lobophora* is a small Holarctic genus consisting of seven species (five Nearctic species and two Palearctic ones). The Nearctic taxa are distinguishable by the small anal fold in male from the Palearctic taxa, in which the male anal fold is large, almost 1/2 length of the anal margin, but otherwise very similar to each other except for *L. clypeata* with the bipectinate male flagellomeres.

In the phylogenetic analysis (Fig. 2), this genus constituted the *Lobophora* genus-group together with the European genus *Pterapherapteryx* (Figs. 20E–F, 25) and the Japanese genus *Neopachrophilla*, and formed a sister

group relationship with other two genera. These three genera are distinguishable from each other in the following points: the male antennal flagellomeres (filiform (Fig. 5A) in *Lobophora* and *Pterapherapteryx*, but dentate (Fig. 5B) in *Neopachrophilla*), the forewing length (10–11 mm in *Pterapherapteryx*, but more than 12 mm in *Neopachrophilla* and *Lobophora*), the forewing pattern (rather obscure (Fig. 20A–B) in *Lobophora*, but distinct (Fig. 20C–F) in *Neopachrophilla* and *Pterapherapteryx*), the forewing areoles (one in *Pterapherapteryx*, but two in *Lobophora* and *Neopachrophilla*), the male hindwing venation (Sc separate from R + Rs and connecting with R near end of discal cell (Fig. 21E) in *Pterapherapteryx* and *Neopachrophilla*, but Sc fused with R + Rs (Fig. 21B) in *Lobophora*), the hindwing pattern (almost white (Fig. 20A–B) in *Lobophora*, dark brown (Fig. 20C–D) in *Neopachrophilla*, and greyish brown (Fig. 20E–F) in *Pterapherapteryx*), the valvula of male genitalia (Figs. 22D, 23D, 25D) (triangular, with a dull tip in *Neopachrophilla*, but narrow, with a sharply pointed tip (Figs. 22D, 25D) in *Lobophora* and *Pterapherapteryx*), and the corpus bursae (with two long ovate patches (signa) consisting of minute spines on dorsal and ventral sides mid-posteriorly (Figs. 22H, 24A) in *Lobophora* and *Neopachrophilla*, but with rather short ovate

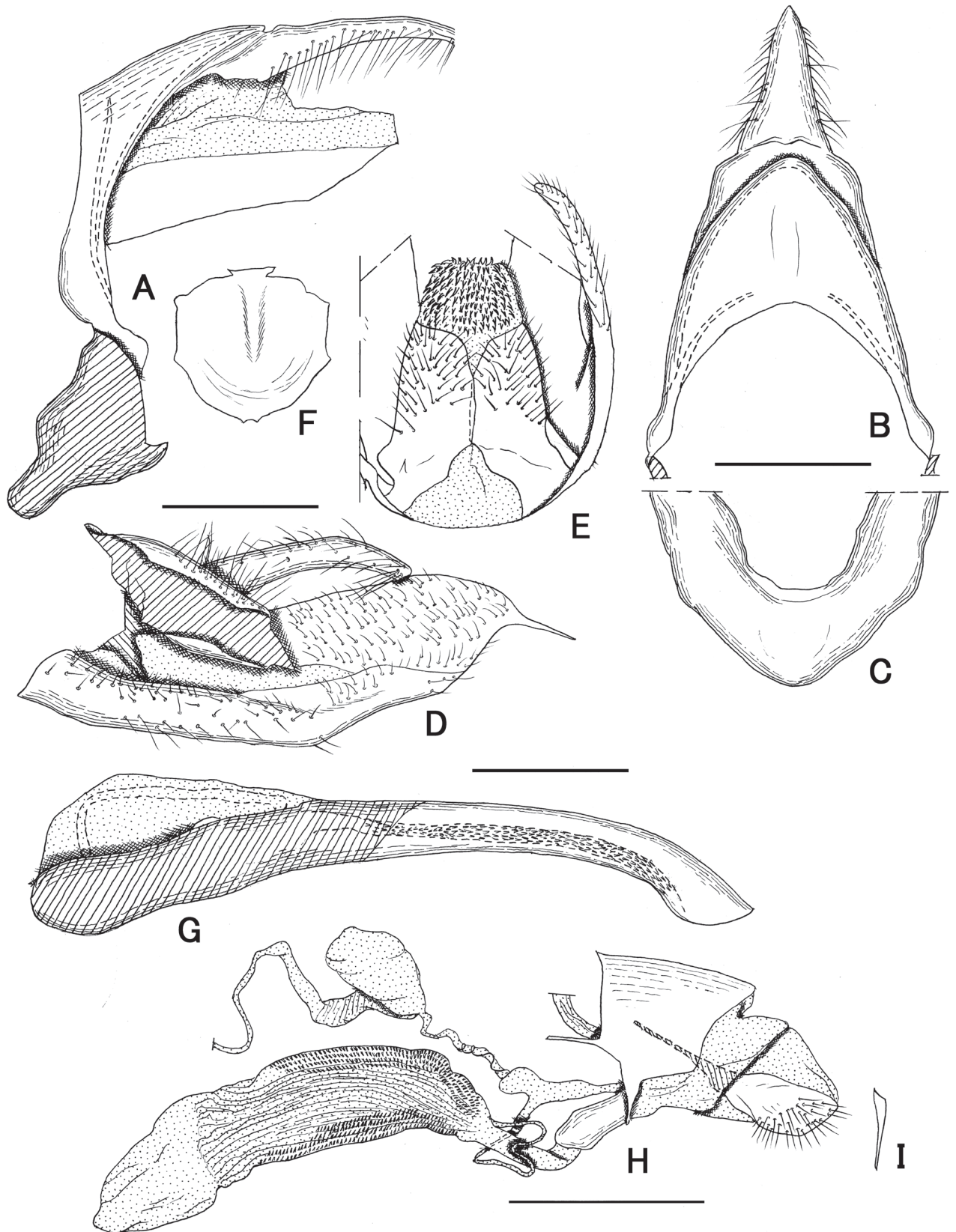


Fig. 22. Genitalia, *Lobophora halterata ijimai* Inoue (A–G, ♂; H–I, ♀). A, lateral; B, tegumen and uncus, dorsal; C, saccus, dorsal; D, right valve, inner; E, transtilla and anellus, dorsal; F, juxta, ventral; G, phallus, lateral; H, lateral; I, narrow sclerite (sternite IX). Scales = 0.5 mm (A–G), 1.0 mm H–I).

patches near posterior end (Fig. 25G) in *Pterapherapteryx*). Judging from the genital structures (Hausmann & Viidalepp, 2012: figs. 260–261 in male genitalia; figs. 260–261 in female genitalia), the East-Mediterranean genus *Oulobophora* is probably included into the *Lobophora* genus-group, but easily distinguishable from three genera of this genus-group in the forewing shape and pattern (Hausmann & Viidalepp, 2012: pl. 25: figs. 260–261) (termen protruded on vein M3; basal part of forewing paler, distinct).

***Lobophora halterata* (Hufnagel)**

Phalaena halterata Hufnagel, 1767: 608.

Geometra hexapterata [Denis & Schiffermüller], 1775: 109.

Phalaena zonata Thunberg, 1792: 60, pl.4, figured (a junior primary homonym of *Phalaena zonata* Fourcroy, 1785).

Trichopteryx hexapterata: Hübner, [1825] 1816: 323.

Lobophora hexapterata: Curtis, 1825: 81.

Lobophora halterata: Staudinger, 1871: 180.

Lobophora inequaliata Packard, 1876: 180, pl. 9, fig. 20.

Diagnosis. This species is distinguished from the Nearctic species in the small obscure discal spot (distinct large discal spot in the Nearctic species) and the large anal fold of male hindwing (small in the Nearctic ones), and from the Chinese species (Yazaki *et al.*, 2004), *L. clypeata* Yazaki & Huang, in the obscure forewing pattern (rather distinct in *clypeata*), the filiform male flagellomeres (shortly bipectinate in *clypeata*), the stout and dull tipped uncus (tapering and pointed in *clypeata*), a long costal arm (slightly short in *clypeata*), a short and narrow pointed apex of valvula (long and tapering in *clypeata*), and the two large ovate patches consisting of minute spines (signa) longer than half length of the corpus bursae (less than half length in *clypeata*).

Distribution. Japan, Europe to Russian Far East (Southeast Siberia), and China.

Host plants. *Salix* spp. and *Populus* spp. (Salicaceae; Spuler, 1910).

Immature stages. The larva of nominotypical subspecies is figured in Spuler (1910), and the description of the pupa is given by Patočka (1980).

Remarks. This species is divided into two subspecies: the European nominotypical subspecies, *L. halterata halterata* Hufnagel, and the Japanese subspecies, *L. halterata ijimai* Inoue.

***Lobophora halterata ijimai* Inoue** (Figs. 5A, 6A, 8C, 14H, 20A–B, 21A–C, 22)

Lobophora halterata: Leech, 1897: 73.

Lobophora halterata ijimai Inoue, 1955a: 76.

Diagnosis. See the above species diagnosis, but the Japanese subspecies differs from the European one in more obscure wing pattern and absence of pale orange borders on both sides of the median band. Forewing length 14–15 mm in male, 14–15 mm in female; male and female genitalia shown in Fig. 22.

Specimens examined. JAPAN: Hokkaido: Tokachi,

Kamishihoro, 1♂, 22. vi. 1966 (H. Ono); Honshu: Nagano, Minotoguchi, 1♀, 4. vi. 1979 (H. Kuroko); Gifu, Hikagedaira, 1♂, 3. vi. 1978 (S. Hashimoto); same locality, 2♂, 2. vi. 1979 (S. Hashimoto); same locality, 1♂, 11. v. 1980 (S. Hashimoto); same locality, 1♂, 28. v. 1981 (S. Hashimoto); same locality, 2♂, 12. vi. 1981 (S. Hashimoto); same locality, 4♂, 2♀, 18. v. 1985 (S. Hashimoto); Gifu, Harayama, 1♂, 2. v. 1976 (K. Ueda, H. Endo et S. Hashimoto); same locality, 1♂, 5. v. 1977 (S. Hashimoto).

Distribution. Japan (Hokkaido and Honshu: Chubu district).

Host plants. Unknown in the Japanese subspecies.

Immature stages. Unknown in the Japanese subspecies.

Bionomics. There is a single generation per year. The adult moths appear in late spring to early summer and are obtained from Hokkaido and the mountainous areas of Central Honshu.

Genus *Neopachrophilla* Inoue

Neopachrophilla Inoue, 1955b: 68. Type species:

Neopachrophilla albida Inoue, 1955b: 68, figs. 1, 3, by original designation.

Diagnosis. *Neopachrophilla* is distinct in possessing the following autapomorphies (Fig. 3): 1, male flagellomeres dentate (Fig. 5B); 2, valvula triangular, with a dull pointed tip (Fig. 23D); 3, ventral part of anellus with a pair of narrow sclerites behind juxta (Fig. 23E). The genus is distinguishable from other trichopterygine genera by the combination of characters as follows: male flagellomeres dentate; hind tibia with 2 pairs of spurs; forewing pattern distinct, with broad white median band; forewing with 2 areoles; forewing with M1 arising from discal cell (upper discocellular vein very short); hindwing fuscous brown, with darker postmedial line and broad marginal band; hindwing venation (Sc separate from an upper vein of discal cell (R + Rs) and connected with a short vein of R near end of discal cell in male, fused in female; Rs and M1 separate in male, stalked in female); anal fold large; valve broad at base, tapering; costa sclerotized, with a long arm covered with hairs; cucullus sclerotized, indistinguishable from costa; valvula sclerotized, indistinguishable from sacculus and harpe, with a blunt tipped; corpus bursae ovate, elongate, with two long ovate patches consisting of very small sharp spines.

Description. The generic description is based on *N. albida* Inoue and the original description of the genus (Inoue, 1955b).

Adult

Head (Fig. 5B): Head clothed with scales thickly; antennal flagellomeres dentate in male, filiform in female; frons rounded; labial palpus slightly curved upwards, short, almost as long as eye diameter; proboscis developed.

Thorax (Figs. 7D, 20C–D, 21D–F): Thorax stout; metepimeron enlarged, divided into anterior and posterior parts by inner ridge in both sexes; male metameron arched posteriorly; hind tibia with two pairs of spurs (mid spurs and apical spurs), with a hair-pencil in male. Forewing fuscous, scattered with white scales, consisting of basal, postbasal, subterminal, adterminal lines, terminal fuscous dots, and white broad median band with large pale fuscous discal spot;

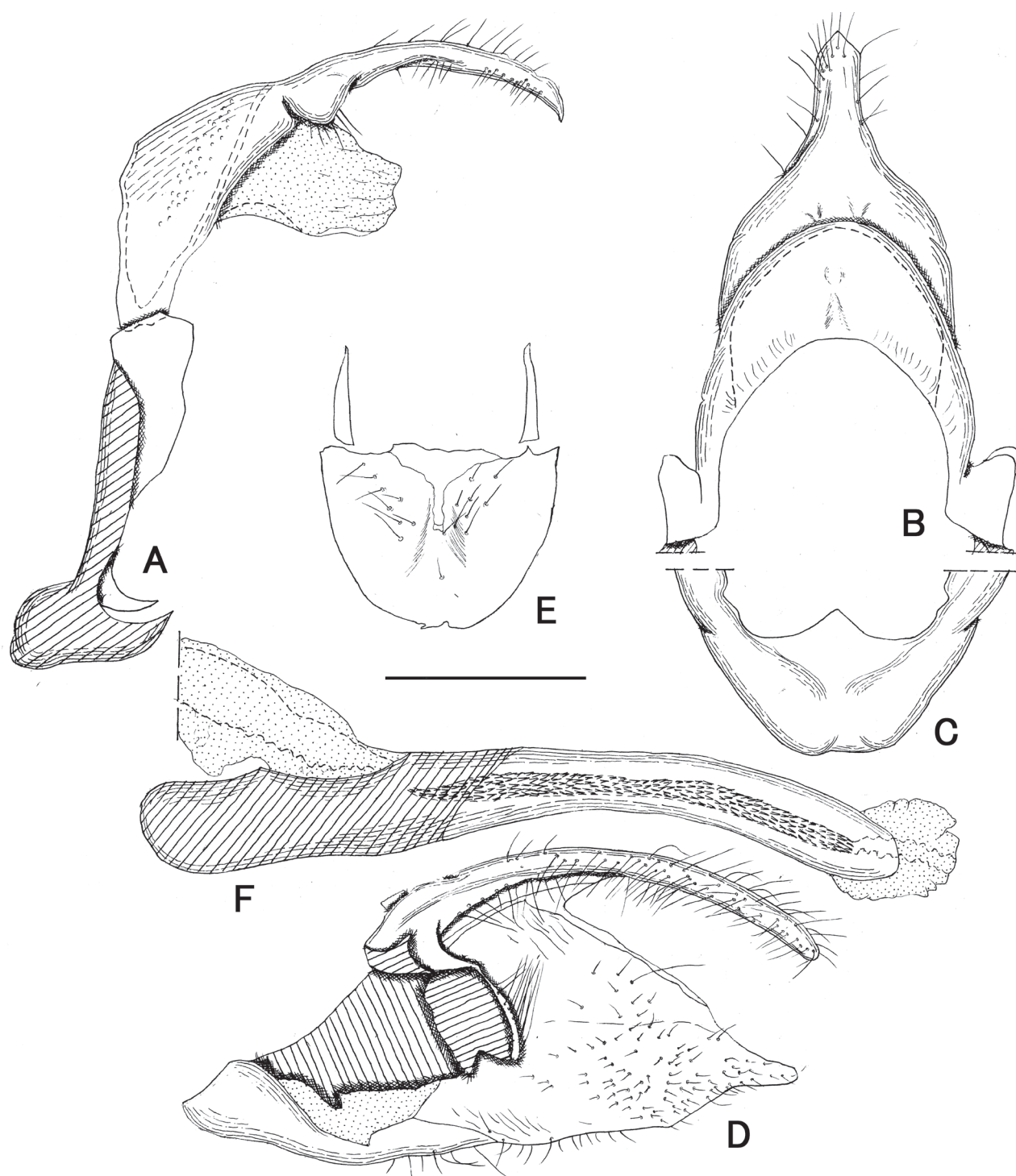


Fig. 23. Male genitalia, *Neopachrophilla albida* Inoue. A, lateral; B, tegumen and uncus, dorsal; C, saccus, dorsal; D, right valve, inner; E, juxta and a pair of narrow sclerites, ventral; F, phallus, lateral. Scale = 0.5 mm.

adterminal line with a transverse brown line on each vein; a row of terminal dots consisting of brown short lines on each vein, forewing with two areoles (in the original description (Inoue, 1955b), the forewing has a single areole, but all materials examined in this study have two areoles); M1 arising from outer margin of discal cell (upper discocellular vein short). Hindwing fuscous brown, scattered with white scales, and with darker median band and broad marginal band; male with a large anal fold (about 3/5 length of anal margin), moderately incised from anal margin; Sc separate from an

upper vein (R + Rs) of discal cell and connected with a short vein of R before end of discal cell in male, fused with R + Rs in female; Rs and M1 separate in male, stalked in female; M3 and CuA1 separate, almost equal length; CuA2 very short, less than 1/6 of CuA1 in male.

Pregenital abdomen: Male sternum II pouch very small; male sternum II with a pair of triangular expansions.

Male genitalia (Fig. 23): Anterior and posterior margins of tegumen moderately curved posteriorly; saccus widely rounded, protruded anteriorly; uncus wide at base, moderately

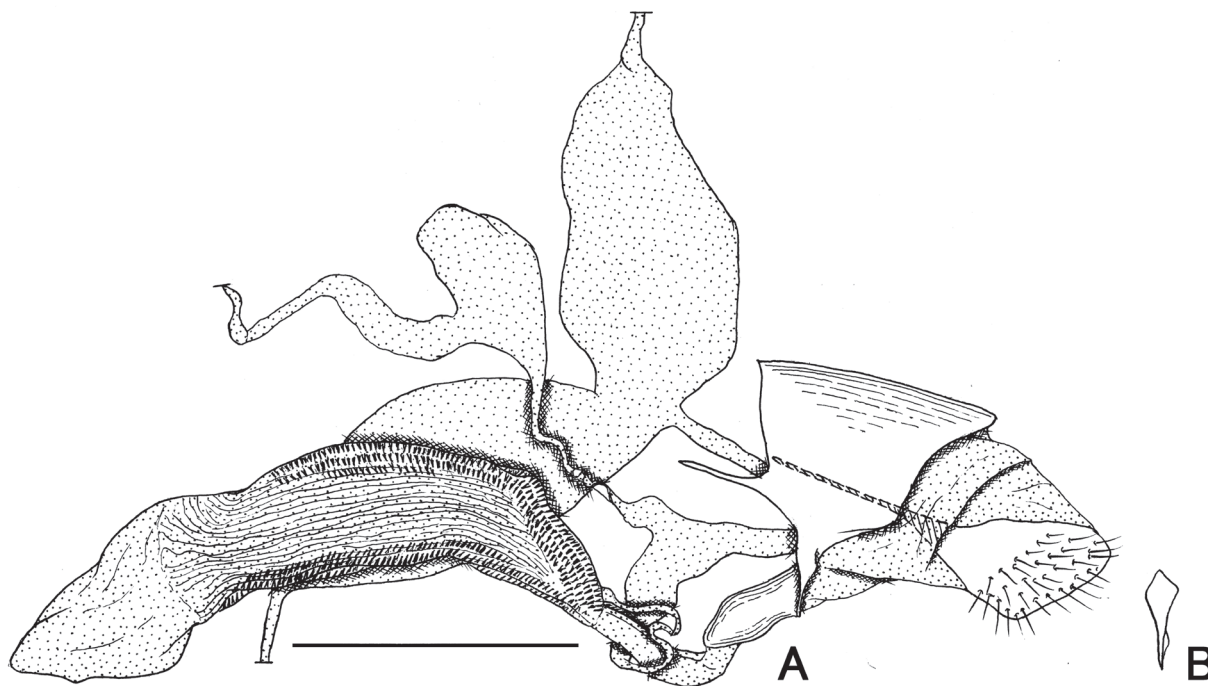


Fig. 24. Female genitalia, *Neopachrophilla albida* Inoue. A, lateral; B, narrow sclerite (sternite IX). Scale = 1.0 mm.

long, slightly curved, with a pointed tip; socius more or less reduced at basal side of uncus, recognized as a hairy part; gnathos recognized as narrow sclerite, synscleritous with uncus-socius complex; valve broad at base, tapering, well sclerotized; costa sclerotized, with a long slender cylindrical hairy process; cucullus sclerotized, indistinguishable from costa; transtillae with a pair of semicircular hairy processes surrounding dorsal part of phallus; sacculus sclerotized, rather thick basally; harpe sclerotized, indistinguishable from valvula; valvula rather broad, tapering, with a dull apex; phallus long, slender, longer than valve; cornuti a long band of many short spines; coecum rather short, less than 1/5 length of phallus; juxta semicircular; ventral part of anellus with a pair of narrow sclerites behind juxta.

Male genital musculature (Table 2): Extensor of valve (m3) reduced; any extra muscles and secondary movements not seen.

Female genitalia (Fig. 24): Corpus bursae elongate, cylindrical ovate, with two long ovate patches (signa) consisting of minute spines on dorsal and ventral sides; ductus bursae short, narrow; ductus seminalis arising from ductus bursae-corpus bursae junction; antrum cup-shaped, sclerotized; 8th tergum developed, well sclerotized; ostium being at anterior margin of 8th sternum; 8th sternum membranous except for narrow anterior ridge of ostium; apophysis anterioris short, less than 1/3 of apophysis posterioris; ventral sclerite (sternite IX) between papillae anales narrow.

Immature stages

Last instar larva and pupa: Unknown.

Distribution. Japan.

Bionomics. A single generation per year, but other bionomic information is unknown.

Remarks. *Neopachrophilla* is monobasic and endemic in Japan, and related to the genera *Lobophora*, *Oulobophora*, and *Pteraphapteryx*. As for differences among them, see the remarks of the genus *Lobophora*.

Neopachrophilla albida Inoue

(Figs. 5B, 7D, 20C–D, 21D–F, 23, 24)

Neopachrophilla albida Inoue, 1955b: 68, figs. 1, 3.

Diagnosis. Forewing length 12–14 mm in male, 14–15 mm in female; male and female genitalia shown in Figs. 23–24, respectively. This species is distinct and easily distinguishable in the wing pattern: forewing fuscous, with white broad median band and large pale fuscous discal spot; hindwing fuscous brown, with darker median band and broad marginal band. Other features see the above generic description.

Specimens examined. JAPAN: Honshu: Gifu, Amou-toge, 1♀, 17. vii. 1976 (H. Endo); same locality, 1♂, 11. vi. 1977 (H. Endo); Gifu, Hikagedaira, 3♂, 28. vi. 1979 (T. Tanabe); same locality, 8♂, 10–12. vi. 1980 (S. Hashimoto); same locality, 1♂, 14. vii. 1981 (T. Tanabe); Gifu, Kurumijima, 1♂, 4♀, 26. vi. 1982 (S. Hashimoto); same locality, 2♀, 14–15. vii. 1982 (S. Hashimoto); Gifu, Gujo-rokunori, 1♂, 14. vi. 1966 (S. Sawatani); Gifu, Shiratani, 1♂, 1♀, 21. v. 1977 (H. Endo); Toyama, Mt. Hakusan, 1♀, 30. vi. 1979 (I. Togashi); Shikoku: Kochi, Kajigamori, 1♂, 10. vi. 1979 (N. Yashiro).

Distribution. Japan (Honshu: Chubu district and Shikoku).

Host plants. Unknown.

Immature stages. Unknown.

Bionomics. There is a single generation per year. The adult moths appear in early summer and are restricted to the mountainous areas of Central Honshu and Shikoku.

Genus *Phthonoloba* Warren

Phthonoloba Warren, 1893: 363. Type species: *Phthonoloba olivacea* Warren, 1893: 363, pl. 31, fig. 20, by monotypy (a junior subjective synonym of *Remodes fasciata* Moore,

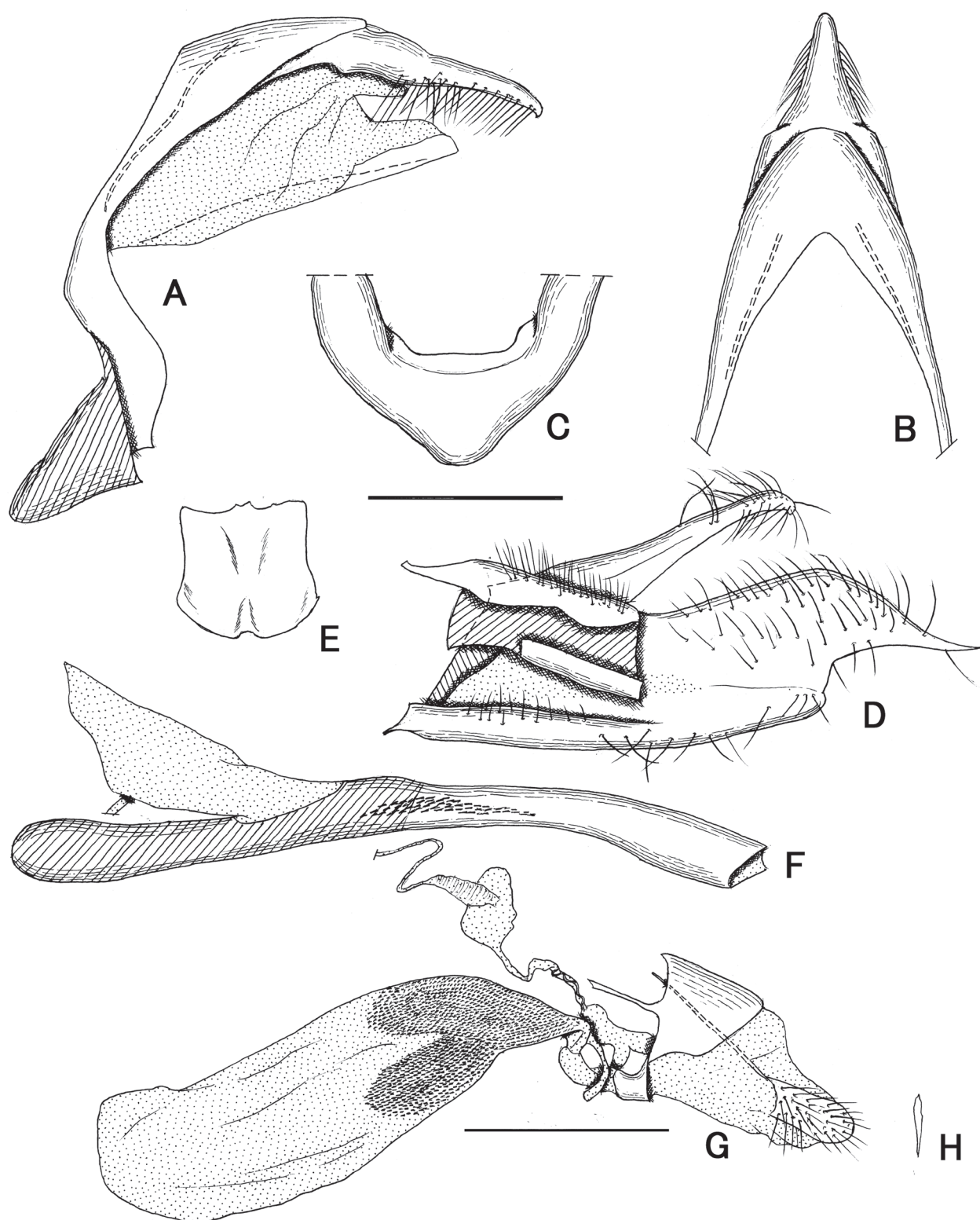


Fig. 25. Genitalia, *Pterapherapteryx sexalata* (Retzius) (A–F, ♂; G–H, ♀), (Czech). A, lateral; B, tegumen and uncus, dorsal; C, saccus, dorsal; D, right valve, inner; E, juxta; ventral; F, phallus, lateral; G, lateral; H, narrow sclerite (sternite IX). Scales = 0.5 mm (A–F), 1.0 mm (G–H).

1888: 270).

Steirophora Warren, 1897: 67. Type species: *Steirophora punctatissima* Warren, 1897: 67, by original designation.

Synneurodes Warren, 1899a: 37. Type species: *Synneurodes brevipalpis* Warren, 1899a: 37, by original designation.

Diagnosis. *Phthonoloba* is characterized by the following autapomorphies (Fig. 3): 1, male eucoxa of metathorax elongate (Fig. 8D); 2, male hind tibial spurs very short (Fig. 7E), externally invisible by scales; 3, distal processes of saccus bifurcate, flattened, expanding dorsally and posteriorly

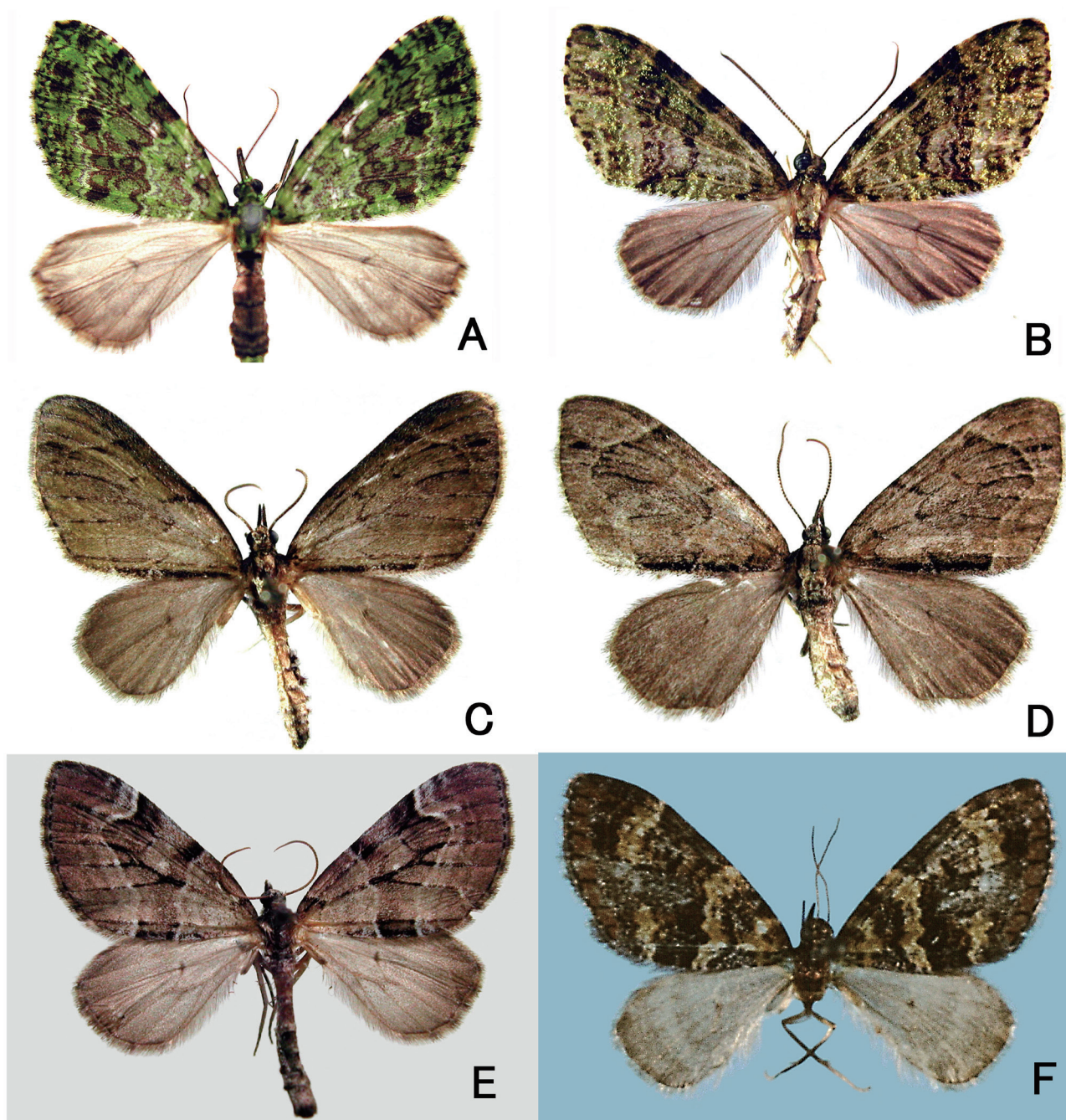


Fig. 26. Adults. A, *Tristeirometa decussata moltrechti* (Prout), ♂ (Taiwan); B, *Phthonoloba viridifasciata* (Inoue), ♀; C, *Lobophorodes obscurarius* (Leech), ♂; D, ditto, ♀; E, *Lobophorodes sabinatus* (Geyer), ♂ (Czech); F, *Lobophorodes undulans* Hampson, ♂ (Nepal).

(Fig. 28D); 4, posterior end of phallus tapering (Holloway, 1997: fig. 299); 5, intersegmental membrane between 8th segment and papillae anales very long, more than twice length of preceding one; 6, papillae anales slender, longer than height, strongly sclerotized, with a pointed apex (Fig. 29B). The following characters are also apomorphic for the genus, but are homoplastic or reversal (Fig. 3): 1, female hindwing with Rs & M1 separate; 2, transtilla reduced, as a non-setose narrow plate; 3, juxta with a pair of posterior setose lobes; 4, female sternum VIII sclerotized, semicylindrical, connected with 8th tergum at base of apophysis anterioris. *Phthonoloba* is also distinguishable from other genera of the Trichopterygini by the following combination of characteristics: hind tibia with a pair

of apical spurs (in male, apical spurs minute); forewing with one areole; forewing with M1 arising from areole; hindwing venation same in both sexes (Sc fused with R + Rs for most length of discal cell; Rs and M1 connate or slightly separate; M3 and CuA1 separate, equal in length; CuA2 slightly longer than CuA1; 1A + 2A long); male hindwing without an anal fold; costal arm absent; cucullus indistinguishable from costa and valvula; saccular process distinct, bifid, anterior one expanding dorsally, posterior one caudally; ovipositor lobes long, sclerotized, acute.

Description. The generic description is mainly based on Holloway (1976, 1997) and three species.

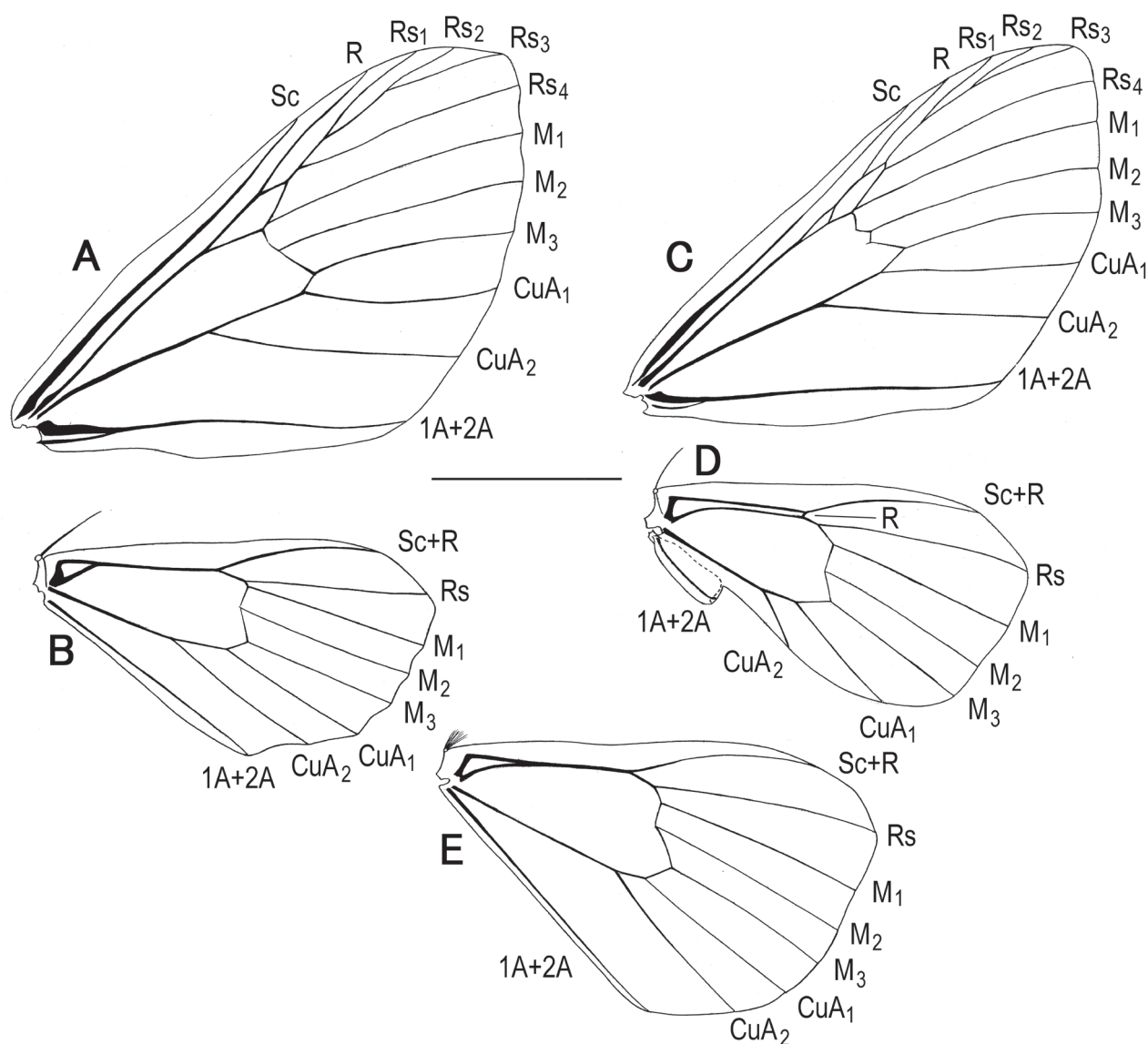


Fig. 27. Wing venation. A, *Phthonoloba viridifasciata* (Inoue), ♂ (forewing); B, ditto, ♂ (hindwing); C, *Lobophorodes obscurarius* (Leech), ♂ (forewing); D, ditto, ♂ (hindwing); E, ditto, ♀ (hindwing). Scale = 5.0 mm.

Adult

Head (Figs. 5C, 6B): Clothed with scales smoothly; antennal flagellomeres filiform; frons rounded; labial palpus correct, 1.5 times as long as diameter of eye in male and 2.0 in female; proboscis developed.

Thorax (Figs. 7E, 8D, 26B, 27A–B): Thorax stout; metepimeron modified, divided into anterior and posterior parts by inner ridge in both sexes; male metameron strongly arched posteriorly; male metaeucoxa very long; hind tibia with a pair of apical spurs (extremely minute in male), with a hair-pencil in male. Forewing dull green, with dark green or fuscous 16 lines, of these some close adjacent lines form several distinct fuscous lines: basal, postbasal, antemedial, postmedial, subterminal, and adterminal ones; two short transverse streaks between M1 and M3 being on subterminal line, fuscous; discal spot black; terminal dots fuscous; forewing with a areole; M1 arising from areole. Hindwing greyish brown, paler near base, with a small fuscous discal spot; male without an anal fold;

hindwing venation same in both sexes (Sc fused with R + Rs; hindwing Rs and M1 connate or slightly separate; M3 and CuA1 separate, almost equal length; CuA2 slightly longer than CuA1; 1A + 2A long, running along inner margin).

Pregenital abdomen (Figs. 8D, 12A): Male sternum II pouch very long, sometimes extending beyond 3rd abdominal segment; male sternum II with a pair of triangular expansions.

Male genitalia (Fig. 28): Anterior margin of tegumen deeply incurved, posterior margin strongly curved posteriorly; saccus widely rounded; uncus short, tapering, gently curved ventrally, single or bifurcate tipped, pointed at apex, wide and rounded basally (probably developed socius); socius recognized as a hairy part, completely fused with uncus; gnathos rather narrow, being at caudo-ventral side of tegumen, completely fused with uncus-socius complex; costa narrowly sclerotized, without costal arm; cucullus slightly swelling, indistinguishable from valvula, recognizable as more hairy dorso-terminal part of valvula; transtilla narrow, without hairs;

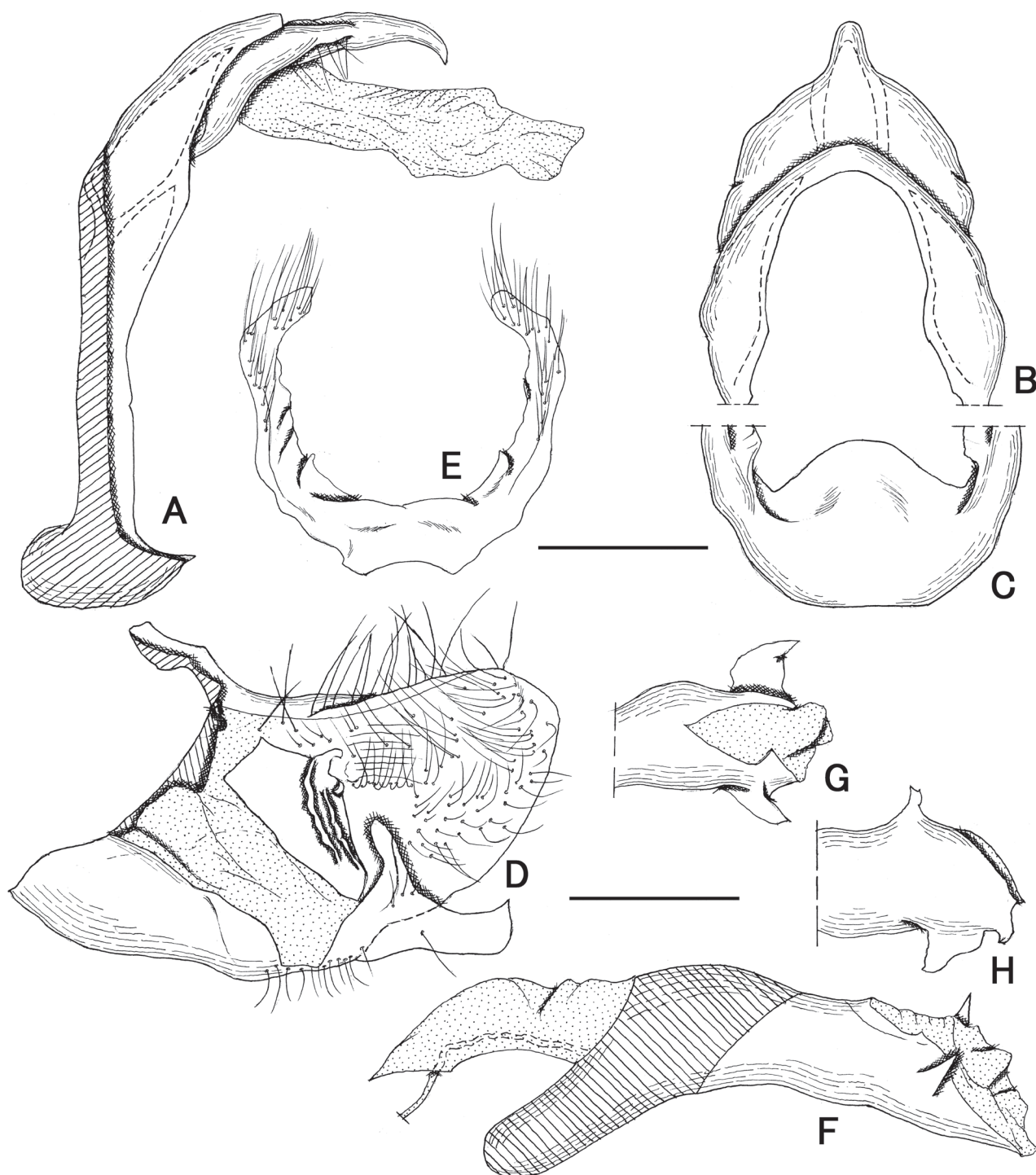


Fig. 28. Male genitalia, *Phthonoloba viridifasciata* (Inoue). A, lateral; B, tegumen and uncus, dorsal; C, saccus, dorsal; D, right valve, inner; E, juxta, ventral; F, phallus, lateral; G, caudal part of phallus, dorsal; H, ditto, ventral. Scales = 0.5 mm.

sacculus thick, sclerotized; saccular projection bifid, of which anterior one extending dorsally, posterior one caudally; harpe almost rectangular or oval, sclerotized, occupied median part of valve; valvula broad, rather elongate, rounded at posterior margin; phallus almost equal length with or longer than valve, thick, especially sclerotized posteriorly, tapering or not on posterior end, with or without a few acute small sclerites near posterior end; cornutus absent; coecum distinct, slender or tapering, about 1/4 to 1/3 length of phallus; juxta rather broad,

with a pair of setose lobes extending postero-dorsally and surrounding latero-ventral part of phallus.

Male genital musculature (Table 2): Any extra muscles and secondary movement of the muscles not seen.

Female genitalia (Fig. 29): Corpus bursae globular or subglobular, when globular without any spines, but subglobular covered with spines forming star-shaped base on outer surface partly or throughout; ductus bursae-corporis bursae junction distinct or indistinct; ductus bursae slightly

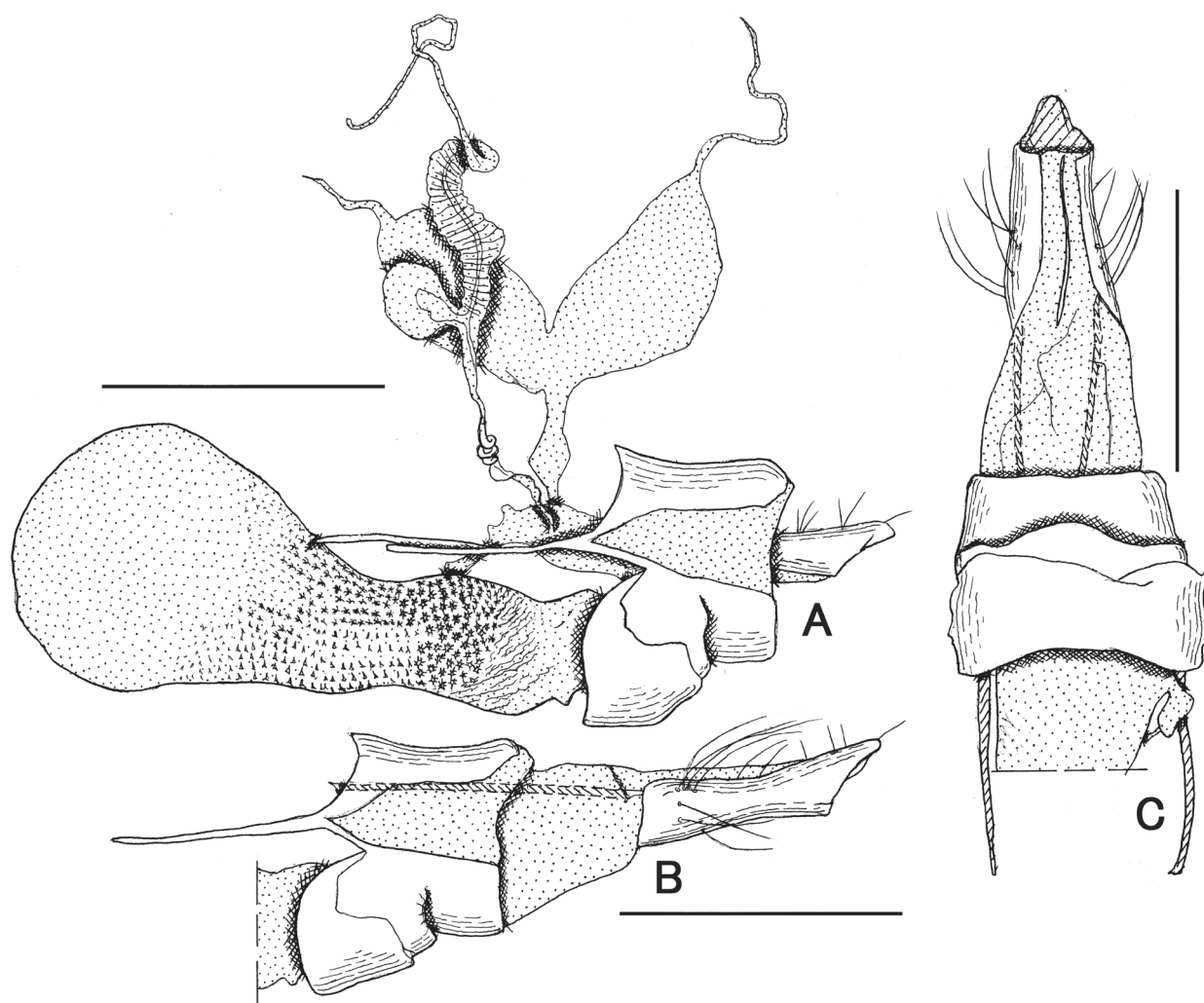


Fig. 29. Female genitalia, *Phthonoloba viridifasciata* (Inoue). A, lateral; B, post abdomen, lateral; C, ditto, ventral. Scales = 1.0 mm.

longer than corpus bursae, thick, covered with rasp-like teeth throughout; ductus seminalis arising from near antrum; antrum short, wide, weakly sclerotized; 8th sternum well sclerotized, almost semicylindrical, connected with 8th tergum at base of apophysis anterioris; ostium being at middle of 8th sternum; apophysis anterioris long, slightly shorter than posterioris; papillae anales sclerotized, long, with an acute tip; ventral sclerite (sternite IX) between papillae anales very long, narrow.

Immature stages

Larval morphology has not been described so far except for Singh's study (1953). Singh (1953) described the larva as near *Phthonoloba* sp., but it might belong to the different genus judging from the host plant (*Caesalpinia* sp.; Fabaceae). Pupa is unknown.

Distribution. Northern India, China, Taiwan, Japan, and extending to New Guinea through the Sunda Islands.

Bionomics. There are two or more generations per year. The adult moths are obtained through a year, but bionomic information is very scarce.

Remarks. The Indo-Australian genus *Phthonoloba* comprises 16 described species, of which three are endemic to Borneo and only one species, *P. viridifasciata* (Inoue), is known from Taiwan, China, and Japan (Holloway, 1976, 1997). In the above phylogenetic relationships (Fig.

2), this genus showed a sister lineage to other Japanese trichopterygine genera except for the *Lobophora* genus-group and the East Asian genus *Tristeirometa*.

Holloway (1976) divided this genus into three sections by the male and female genitalia. In the present paper, the genus is tentatively divided into the following two groups based on Holloway's study (1976): Group A is Holloway's section 1 and endemic to Borneo (uncus bifid tipped; posterior end of phallus tapering; corpus bursae subglobular; bursa copulatrix covered with rasp like spines throughout; corpus bursae-ductus bursae junction indistinct) and Group B is Holloway's section 2 + 3 (uncus single tipped; phallus with a few small acute sclerites near posterior end; corpus bursae globular or subglobular, corpus bursae without any spines; corpus bursae-ductus bursae junction rather distinct).

Phthonoloba is superficially similar to the genera *Hypocomete* and *Tristeirometa* (Fig. 26A), but distinguishable from *Hypocomete* by the male abdomen and the male and female genital structures (Holloway, 1997) (male sternum II pouch very long in *Phthonoloba*, but short in *Hypocomete*; saccular process bifid, short (Fig. 28D) in *Phthonoloba*, but long, slender, pointed (Holloway, 1997: figs. 288–289) in *Hypocomete*; papillae anales sclerotized, long, acute (Fig. 29B) in *Phthonoloba*, but rounded, weakly sclerotized (Holloway,

1997: figs. 290–291) in *Hypocomete*), and from *Tristeirometa* by the forewing pattern and the male and female genitalia (Holloway, 1997) (dull green with dark green or fuscous stripes (Fig. 26B) in *Phthonoloba*, but bright green (Fig. 26A) in *Tristeirometa*; uncus single (Fig. 28A) or bifid (Holloway, 1997: fig. 299) in *Phthonoloba*, but trifid (Holloway, 1997: figs. 280–283) in *Tristeirometa*; saccular process present (Fig. 28D) in *Phthonoloba*, but absent (Holloway, 1997: figs. 280–283) in *Tristeirometa*; papillae anales sclerotized, long, acute (Fig. 29B) in *Phthonoloba*, but rounded, weakly sclerotized (Holloway, 1997: figs. 284–285) in *Tristeirometa*).

***Phthonoloba viridifasciata* (Inoue)**

(Figs. 5C, 6B, 7E, 8D, 12A, 26B, 27A–B, 28–29)

Strophophora viridifasciata Inoue, 1963: 31, fig.3, pl. 7: 7.

Phthonoloba viridifasciata: Holloway, 1976: 72.

Diagnosis. Forewing length about 16 mm in male, 14–17 mm in female; male and female genitalia shown in Figs. 28–29, respectively. This species is distinguishable from other members of the group B in the combination of the male and female genital characters (saccular processes well sclerotized, flattened, separate from sacculus; phallus gently curved, with three flattened spines near distal end, almost same length with valve; corpus bursae globular, almost without spines; corpus bursae-ductus bursae junction indistinct).

Specimens examined. JAPAN: Ryukyus: Okinawa Island, Mt. Katsudake, 1♀, 25. iii. 1980 (K. Yasuda); Okinawa Island, Mt. Yonahadake, 1♀, 27. iii. 1996 (H. Yoshitomi); Okinawa Island, Yona, 1♀, 20. iii. 1997 (H. Yoshitomi); Ishigakijima Island, Mt. Omotodake, 1♂, 20. v. 1978 (S. Tsukaguchi); same locality, 2♀, 13. xi. 1982 (T. Tanabe); same locality, 1♀, 21. v. 1983 (T. Tanabe); Iriomotejima Island, Funaura, 2♀, 25. iii. 1982 (E. Nishida); same locality, 1♀, 12. xi. 1982 (T. Tanabe).

Distribution. Japan (Tanegashima Is., Yakushima Is., Nakanoshima Is., Amami-oshima Is., Okinawa Is., Ishigakijima Is., and Iriomotejima Is.), Taiwan, and China.

Host plants. *Ctenitis subglandulosa* (Hance) Ching (Dryopteridaceae; Tominaga, 2013); *Cyathea lepifera* John Smith (ex Hooker) Copeland (Cyatheaceae; Sakagami, 2021).

Immature stages. A brief description of the larva is given by Tominaga (2013: last instar larva 21 mm, glossy deep green) with figures. Chaetotaxy not examined. Pupa not described.

Bionomics. There are two or more generations per year. The adult moths are obtained through a year, but detail bionomic information is unknown.

Genus *Lobophorodes* Hampson

Lobophorodes Hampson, 1903: 645. Type species: *Lobophorodes undulans* Hampson, 1903: 645: figure; 646, by original designation.

Epilobophora Inoue, 1943: 9. Type species: *Lobophora obscuraria* Leech, 1891: 55, by original designation. **Syn. nov.**

Paramathia Herbulot, 1948: 118. Type species: *Geometra sabinata* Geyer, [1831] 1796: pl. 106, figs. 550–551, by original designation. **Syn. nov.**

Diagnosis. *Lobophorodes* is determined by the following apomorphies (Fig. 4): 1, forewing some adjacent lines indistinguishable, with a median band (Fig. 26C–F); 2, forewing with two areoles (Fig. 27C); 3, female hindwing with Rs & M1 separate (Fig. 27E); 4, female sternum VII longer than tergum (Fig. 31I); 5, intersegmental membrane between segments VII and VIII reduced in female (Fig. 31I); 6, harpe distinct, narrow triangular sclerite (Fig. 31D); 7, valvula serrate on posterior margin (Fig. 31D); 8, vesica with or without several stout spines (Fig. 31H); 9, juxta with a pair of triangular projections near middle (Fig. 31E); 10, ductus bursae broadly covered with spines (Fig. 31J); 11, anterior margin of segment VIII oblique postero-ventrally (Fig. 31I–J); 12, apophysis anterioris almost reduced or absent (Fig. 31I–J). However, some of them are homoplastic or reversal conditions (Fig. 4). Absence of extensor of valve muscle (m3) may be apomorphic, but this condition is also seen in the genus *Lobophora*. The genus is distinguished from other trichopterygine genera by the combination of characters as follows: labial palpus porrect; hind tibia with a pair of apical spurs; forewing pattern fuscous, with rather distinct broad median band; forewing with 2 areoles; forewing with M1 arising from areole; hindwing pale fuscous, with fuscous discal spot; Sc separate from discal cell and connected with a short vein of R near end of discal cell in male hindwing; Rs and M1 separate in both sexes; anal fold rather small, about 1/4 of anal margin; valve elongate, without costal and saccular processes; harpe narrow, well sclerotized; distal margin of valvula more or less serrate; transtilla without hairs; apophysis anterioris reduced or absent.

Description. The generic description is based on four species and the following studies: Hampson, 1903; Inoue, 1943, 1982a; Yazaki, 1986b; Xue, 1992; Gianti, 2007; Hausmann & Viidalepp, 2012; Yazaki & Wang, 2018.

Adult

Head (Figs. 5D, 6C): Head clothed with scales smoothly; antennal flagellomeres filiform; frons rounded; labial palpus porrect, variable in length (about 1.0 to 2.5 times as long as a diameter of eye), generally longer in female; proboscis developed.

Thorax (Figs. 26C–F, 27C–D): Thorax stout; metepimeron enlarged, divided into anterior and posterior parts by inner ridge in both sexes; male metameron arched posteriorly; hind tibia with a pair of spurs (apical spurs), with a hair-pencil in male. Forewing yellowish olive, olive brown, or purple brown to fuscous, with a distinct brown to fuscous broad median band and a row of terminal dots, but other lines (basal, post basal, and adterminal lines) usually indistinct; discal spot small, fuscous, but obscure; forewing with two areoles; M1 arising from 2nd areole (rarely connate with Rs in the intraspecific level). Hindwing greyish brown to pale fuscous, with darker small discal spot; male with an anal fold (about 1/4 length of anal margin); Sc separate from an upper vein (R + Rs) of discal cell and connected with a short vein of R before end of discal cell in male, fused with R + Rs in female; Rs and M1 separate; M3 and CuA1 separate, almost equal length; CuA2 short, less than 1/2 to 2/3 length of CuA1 in male.

Pregenital abdomen (Fig. 31I): Male sternum II pouch

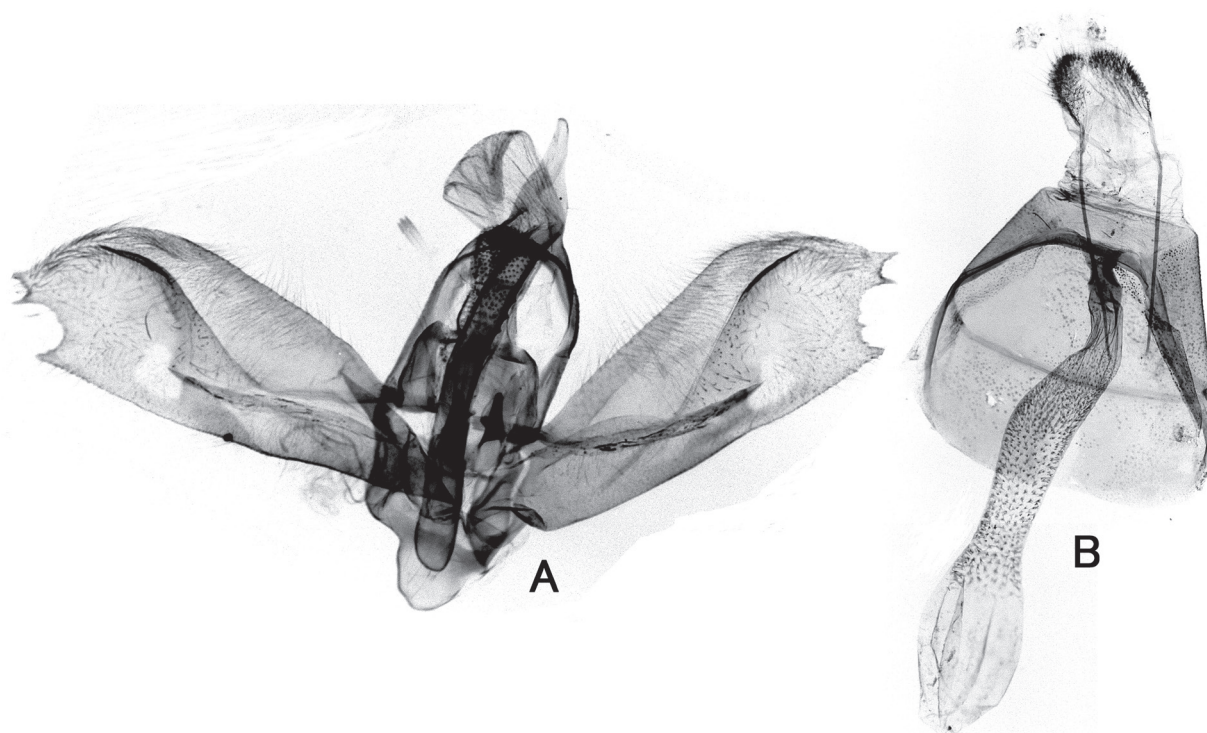


Fig. 30. Genitalia, *Lobophorodes undulans* Hampson, (Nepal). A, ♂, ventral; B, ♀, ventral.

small; male sternum II with a pair of triangular expansions; female 7th sternum expanded posteriorly, longer than 7th tergum; an intersegmental membrane between 7th and 8th segments reduced in female; female 8th segment not telescoped into 7th segment.

Male genitalia (Figs. 30A, 31A–G): Anterior margin of tegumen incurved deeply, posterior margin strongly curved posteriorly; saccus triangularly protruded, rounded anteriorly; uncus long, gently curved, pointed at tip; socius not developed at basal side of uncus, recognized as a hairy part; gnathos narrow sclerite, synscleritous with uncus-socius complex; vinculum protruded dorsally at middle; valve rather long, gently curved at costal margin; costa sclerotized, without any projections; cucullus indistinguishable from costa and valvula; transtilla without hairs; sacculus rather thick, sclerotized, without any projections; harpe almost rectangular, being at proximo-median part of valve, rather sclerotized; valvula rather broad, elongate, marginated posteriorly, roughly serrate at distal margin; phallus slightly thick, slender, shorter than valve, with or without spines caudo-laterally; cornuti present or absent; coecum distinct, about 1/4 to 1/3 length of phallus; juxta with a pair of triangular projections ventrally.

Male genital musculature (Fig. 14I; Table 2): Extensor of valve (m3) absent (this condition is also seen in the genus *Lobophora* and probably occurs in parallel between them); any extra muscles and secondary movements not seen.

Female genitalia (Figs. 30B, 31I–K): Corpus bursae subglobular, partly or wholly covered with numerous spines forming star-shaped base on outer surface; corpus bursae-ductus bursae junction rather distinct; ductus bursae thick, slightly shorter or longer than corpus bursae, broadly covered with spines forming star-shaped outer surface;

ductus seminalis arising near antrum; antrum short, slightly wider than long or almost same width and length, weakly sclerotized; 8th tergum developed, well sclerotized; ostium being at anterior margin of 8th sternum; 8th sternum reduced, as a thick sclerite along anterior edge, obliquely cutting postero-ventrally along anterior margin; apophysis anterioris reduced or absent; narrow sclerite (sternite IX) present, short.

Immature stages

Last instar larva and pupa: Not examined, but for the host plants and the larval colour pattern, see Spuler (1910) and Murase (1996).

Distribution. Europe, Nepal, China, Taiwan, and Japan.

Bionomics. There is a single generation per year. Except for a European species, *L. sabinatus* (Geyer), bionomic information is very scarce. European and Japanese species utilize the family Cupressaceae (Spuler, 1910; Murase, 1996) as the larval host plant. Overwintering with egg is known for the European species (Hausmann & Viidalepp, 2012). However, the Japanese species, *L. obscurarius*, probably hibernates in the larval stage, because the mature larvae were collected in April (Murase, 1996).

Remarks. Although the genus *Lobophorodes* is clearly defined by several autapomorphies, its systematic position in the tribe is rather ambiguous as indicated in the phylogenetic analysis (Fig. 2).

According to Xue (1992), difference between *Lobophorodes* and *Epilobophora* is restricted to the adult head structures: in *Lobophorodes* the face is protruded and the labial palpus is short and not beyond the face (about 1.0 times as long as eye diameter); in *Epilobophora* the face is rounded and the labial palpus beyond the face (1.5 to 2.5 times as long as eye diameter). However, the face of *Lobophorodes* is rounded as

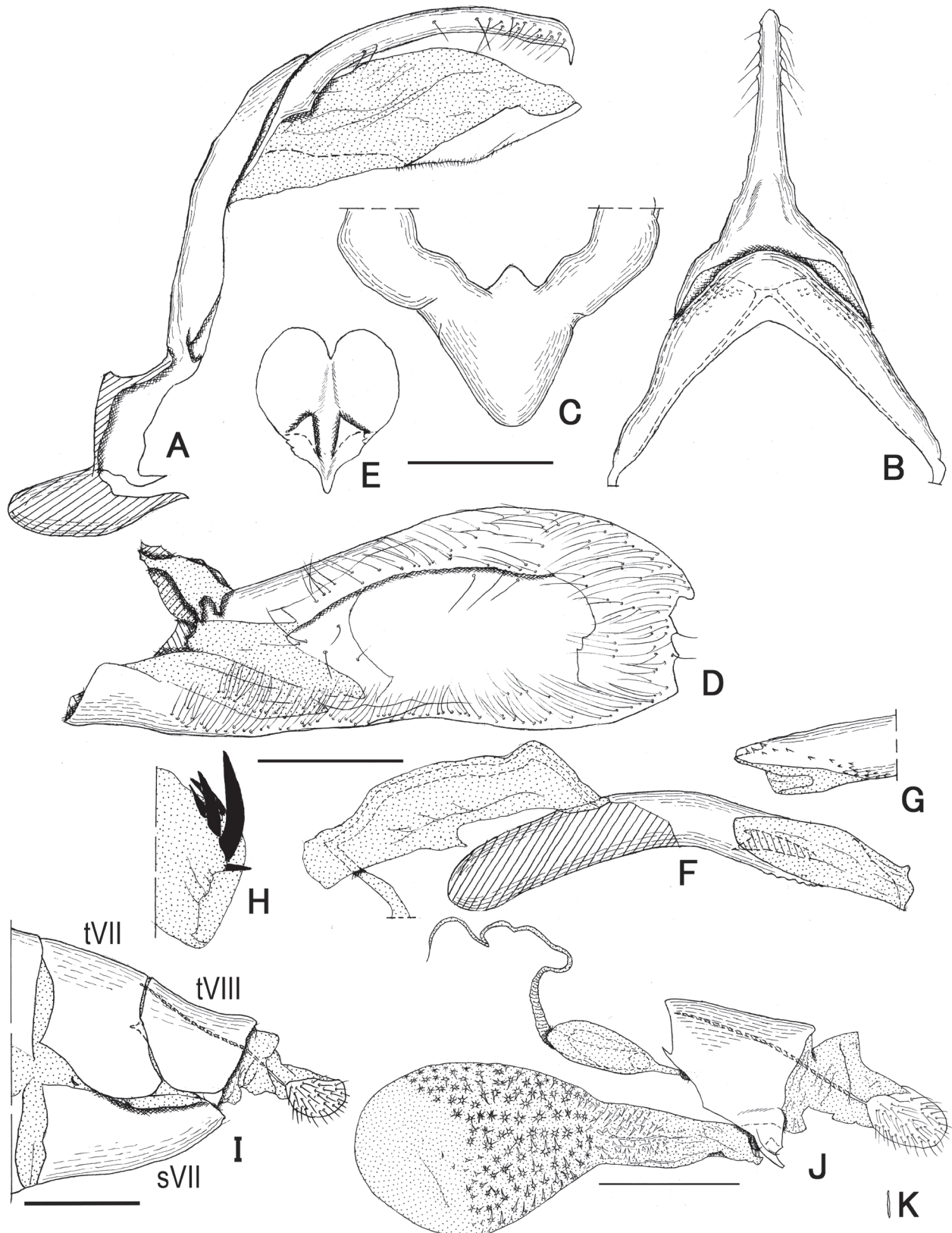


Fig. 31. Genitalia, *Lobophorodes obscurarius* (Leech) (A–H, ♂; I–K, ♀). A, lateral; B, tegumen and uncus, dorsal; C, saccus, dorsal; D, right valve, inner; E, juxta, ventral; F, phallus, lateral; G, caudal end of phallus, right; H, cornuti; I, post abdomen, lateral; J, lateral; K, narrow sclerite (sternite IX). Scales = 0.5 mm (A–H), 1.0 mm (I–K).

indicated in the original description (Hampson, 1903). Except for the length of labial palpus, these two genera are otherwise indivisible from each other, especially in the wing venation and

the male and female genital structures. Therefore, the present study treated the genus *Epilobophora* as a junior synonym of the genus *Lobophorodes*.

Lobophorodes comprises the following seventeen species, of which one species is distributed in Europe, one is distributed in West Asia, most of them are in Nepal to China, two are Taiwan, and only one species known from Japan (Tikhonov, 1994; Parsons *et al.*, 1999; Xue & Zhu, 1999; Gianti, 2007; Hausmann & Viidalepp, 2012; Yazaki & Wang, 2018):

- Lobophorodes bifasciatus* Inoue, 1982a (Nepal)
Lobophorodes depressus (Yazaki & Wang, 2018), comb. nov. (*Epilobophora depressa* Yazaki & Wang) (China)
Lobophorodes florianii (Gianti, 2007), comb. nov. (*Epilobophora florianii* Gianti) (China)
Lobophorodes fumosarius (Xue, 1992), comb. nov. (*Epilobophora fumosaria* Xue) (China)
Lobophorodes infuscatus (Yazaki & Wang, 2018), comb. nov. (*Epilobophora infusca* Yazaki & Wang) (China)
Lobophorodes kostjuki (Tikhonov, 1994), comb. nov. (*Epilobophora kostjuki* Tikhonov) (Caucasus)
Lobophorodes miniobscurarius (Xue, 1992), comb. nov. (*Epilobophora miniobscuraria* Xue) (China)
Lobophorodes mitis (Xue & Meng, 1995), comb. nov. (*Epilobophora mitis* Xue & Meng) (China)
Lobophorodes nishizawai (Yazaki, 1986b), comb. nov. (*Epilobophora nishizawai* Yazaki) (Taiwan)
Lobophorodes obscurarius (Leech, 1891), comb. nov. (*Lobophora obscuraria* Leech) (Japan)
Lobophorodes odontodes Xue, 1999 (China)
Lobophorodes paraobscurarius (Xue, 1999), comb. nov. (*Epilobophora paraobscuraria* Xue) (China)
Lobophorodes sabinatus (Geyer, [1831] 1796), comb. nov. (*Geometra sabinata* Geyer) (Fig. 26E) (Europe)
Lobophorodes subangulatus (Xue, 1992), comb. nov. (*Epilobophora subangulata* Xue) (China)
Lobophorodes undulans Hampson, 1903 (Figs. 26F, 30) (Nepal)
Lobophorodes venipictus (Wileman, 1914), comb. nov. (*Acasis venipicta* Wileman) (Taiwan)
Lobophorodes vividus (Xue, 1992), comb. nov. (*Epilobophora vivida* Xue) (China)

***Lobophorodes obscurarius* (Leech), comb. nov.**
 (Figs. 5D, 6C, 14I, 26C–D, 27C–D, 31)

Lobophora obscuraria Leech, 1891: 55.

Trichopteryx obscuraria: Leech, 1897: 75.

Nothopteryx obscuraria: Prout, 1914: 183.

Epilobophora obscuraria: Inoue, 1943: 10.

Diagnosis. Forewing length 15–17 mm in male, 16–18 mm in female; male and female genitalia shown in Fig. 31. This species is distinguishable from the Chinese and Taiwanese species of the genus in the combination of male and female genital characters (a pair of projections of the juxta is short, the phallus has many small spines along left distal side, the cornuti consist of short to long five horn-like projections, and the corpus bursae is subglobular and covered with spines at posterior half).

Specimens examined. JAPAN: Honshu: Gifu, Hikagedaira, 8♂, 14–16. vii. 1978 (S. Hashimoto); same locality, 2♀, 19. vii. 1981 (S. Hashimoto); same locality, 1♂, 2♀, 13–14. vii. 1982 (T. Tanabe); same locality, 2♂, 19. vii. 1981 (S. Hashimoto); Gifu, Kurumijima, 1♂, 20. vi. 1982 (S. Hashimoto); Mie, Hisai,

1♂, 1. vi. 1988 (T. Hirabayashi); Mie, Fudodani, 1♀, 1–2. vii. 1995 (S. Hashimoto); Osaka, Mt. Makiosan, 1♂, 20. vi. 1981 (S. Hashimoto); same locality, 3♂, 10. vi. 1982 (E. Nishida); same locality, 1♂, 23. vi. 1982 (S. Hashimoto); Osaka, Mt. Inunakisan, 1♂, 2♀, 29. v. 1987 (H. Kurashige); Osaka, Mt. Iwakisan, 1♂, 1♀, 14. vi. 1980 (S. Hashimoto); Wakayama, Mt. Koyasan, 1♂, 5. vi. 1980 (S. Hashimoto); Shikoku: Kochi, Takasu, 1♂, 6. vi. 1988 (A. Ichikawa).

Distribution. Japan (Honshu, Shikoku, Kyushu, and Tsushima Is.), Korea, and China.

Host plants. *Juniperus chinensis* Linnaeus (Cupressaceae; Murase, 1996).

Immature stages. A brief description of the larva was given in Murase (1996: Last instar larva deep green, with white spots on subdorsal and lateral areas and with a distinct subspiracular white stripe; 17 mm length, moniliform). Chaetotaxy not examined. Pupa not described.

Bionomics. There is a single generation per year. The adult moths appear in early summer and are known from the hilly to mountainous areas.

Genus *Trichopterigia* Hampson

Trichopterigia Hampson, 1895: 332 (key), 403. Type species: *Lobophora decorata* Moore, 1888: 272, by original designation.

Trichopterygia Hampson, 1898: 80 (an incorrect subsequent spelling).

Diagnosis. The genus *Trichopterigia* is characterized by the following apomorphies (Fig. 4); 1, male hindwing with CuA2 slightly shorter than CuA1 (Fig. 33B); 2, posterior 1/3 to 2/5 of female A7 well sclerotized annularly (Fig. 12E–F); 3, saccus widely U-shaped (Figs. 34C, 35C); 4, costal arm with cucullus long, slender, sclerotized on dorsal margin (Figs. 34E, 35D); 5, costa with a setose swelling expanding ventrally near base (Figs. 34E, 35D); 6, harpe indistinct, completely fused with basal part of saccular process (Figs. 34E, 35D); 7, valvula slender, with an obtuse apex (Figs. 34E, 35D); 8, ductus bursae scarcely covered with small spines and with a comb-like spinous ridge or a row of spines (Figs. 34I, 35G). However, a few of them are homoplastic (Fig. 4). This genus is distinguishable from other genera of the Trichopterygini by the combination of the following characters: hind tibia with a pair of apical spurs; forewing with one areole; M1 arising from areole; hindwing white, scattered with greyish brown scales, occasionally densely covered along termen; hindwing venation (Sc fused with R + Rs (an upper vein of discal cell) in both sexes; Rs and M1 stalked in both sexes; CuA2 slightly shorter than CuA1 in male); anal fold small; costal arm long, slender, with a swelling at proximo-ventral margin; cucullus oblong; sacculus thickly sclerotized; saccular process well developed; harpe reduced, completely fused with base of saccular process; valvula long, narrow; transtilla rounded; posterior 1/3 to 2/5 of female A7 well sclerotized annularly; corpus bursae wholly covered with spines, with globular appendix bursae at anterior end.

Description. The generic description is based on

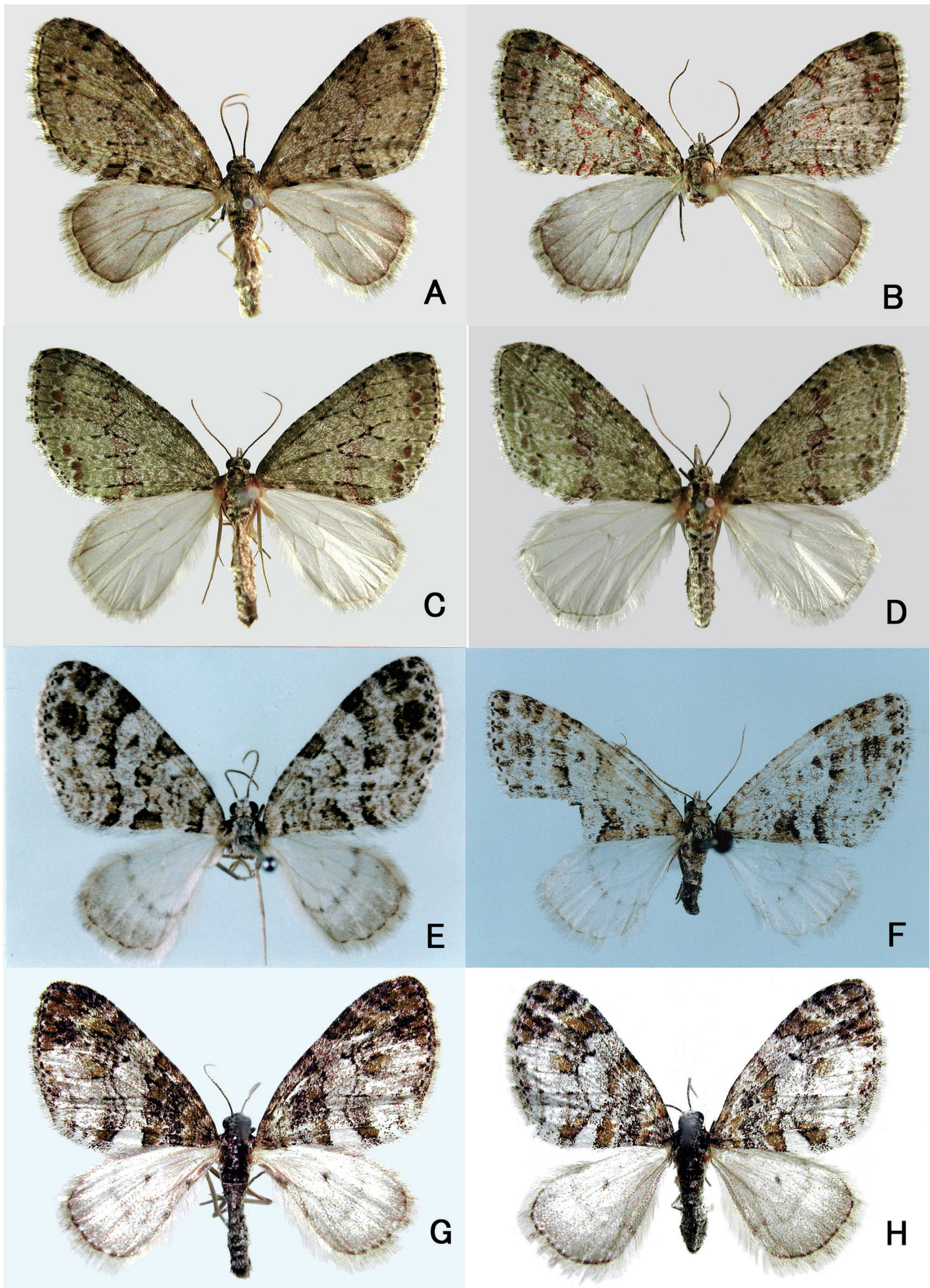


Fig. 32. Adults. A, *Trichopterigia consobrinaria* (Leech), ♂; B, ditto, ♀; C, *Trichopterigia costipunctaria* Leech, ♂; D, ditto, ♀; E, *Archaeocasis micradelpha* (Prout), ♂ (Taiwan); F, ditto, ♀ (paratype, coll. NHM, India: Sikkim); G, *Pseudacasis bellaria* (Leech), ♂; H, ditto, ♀.

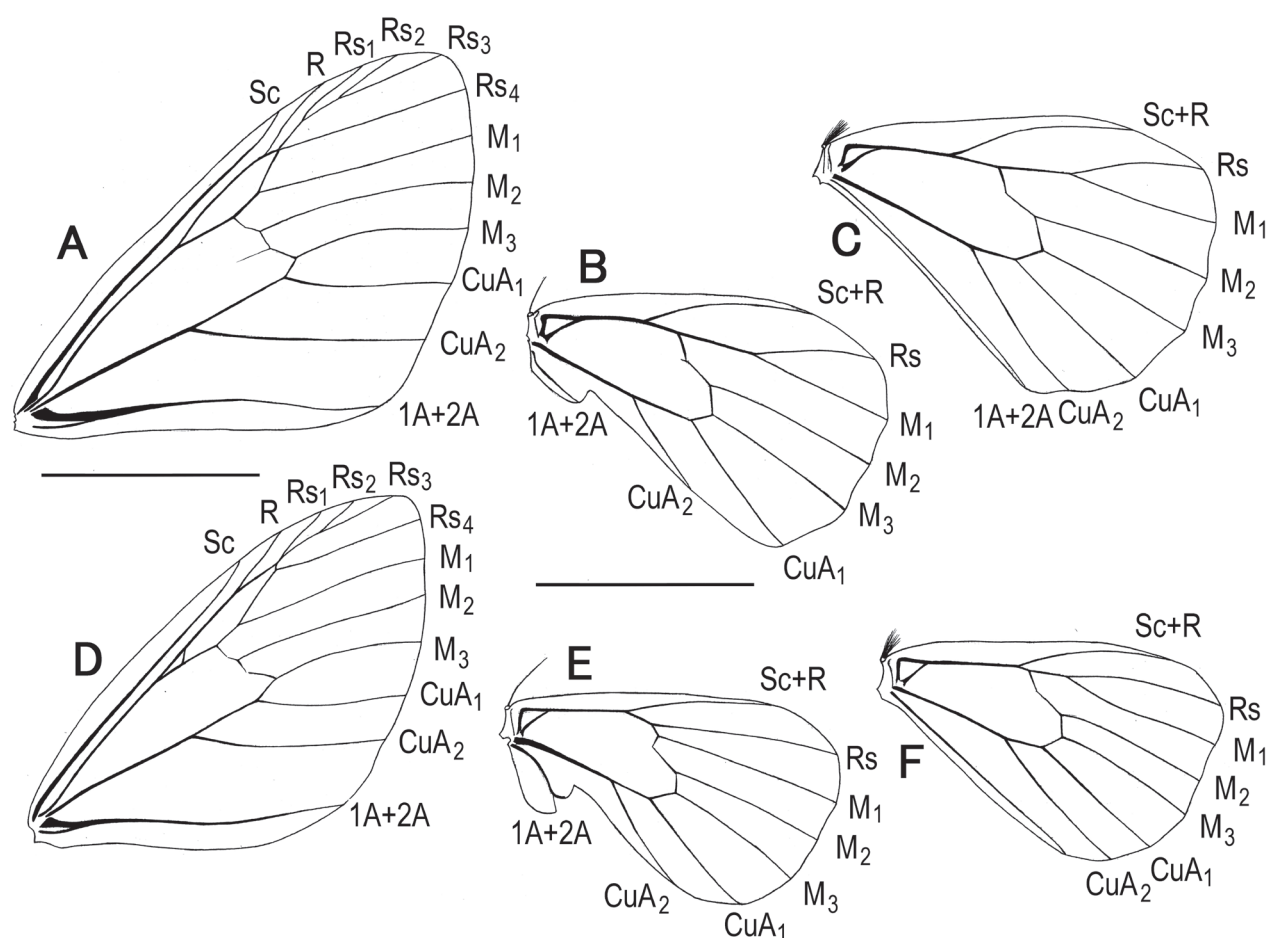


Fig. 33. Wing venation. A, *Trichopterigia consobrinaria* (Leech), ♂ (forewing); B, ditto, ♂ (hindwing); C, ditto, ♀ (hindwing); D, *Pseudacasis bellaria* (Leech), ♂ (forewing); E, ditto, ♂ (hindwing); F, ditto, ♀ (hindwing). Scales = 5.0 mm.

six species and the following studies: Hampson, 1895; Hashimoto, 1982, 1995b; Holloway, 1997; Xue & Zhu, 1999; Yazaki *et al.*, 2004.

Adult

Head: Head clothed with scales thickly; antennal flagellomeres filiform; frons rounded; labial palpus slightly curved or porrect, about 1.5 to 2.0 times as long as eye diameter in males and about 1.5 to 2.5 times in female; proboscis developed.

Thorax (Figs. 9B–C, 32A–D, 33A–C): Thorax stout; metepimeron enlarged, divided into anterior and posterior parts by inner ridge in both sexes; male metameron arched posteriorly; hind tibia with a pair of spurs (apical spurs), with a hair-pencil in male. Forewing pale yellowish olive to olive green or pale grey to greyish olive, with indistinct darker lines mainly consisting of basal, postbasal, antemedial, postmedial, and subterminal ones, occasionally accompanied with reddish spots on outer margin of subterminal line; discal spot and terminal dots distinct or not; forewing with one areole; M1 arising from areole. Hindwing white, scattered with greyish brown scales, occasionally densely covered along termen; discal spot small; male with an anal fold (less than 1/4 length of anal margin); Sc fused with R + Rs (an upper vein of discal cell); Rs and M1 stalked; M3 and CuA1 separate, almost equal length; CuA2 slightly shorter than CuA1 in male.

Pregenital abdomen (Figs. 9C, 12E–F): Male sternum II pouch small, distinct; male sternum II with a pair of triangular expansions; posterior 1/3 to 2/5 of female A7 well sclerotized annularly.

Male genitalia (Figs. 34A–H, 35A–F): Anterior margin of tegumen shallowly or deeply incurved; lateral sides of tegumen tapering, almost straight; posterior end of tegumen rounded; saccus widely U-shaped, slightly protruded anteriorly; uncus medium to long, stout, gently curved ventrally; socius reduced at basal side of uncus, recognizable as a hairy part; gnathos narrow, being at caudo-ventral side of tegumen, completely fused with uncus-socius complex; costa narrow, with a long arm (costal arm), with a basal hairy swelling extending ventrally; cucullus oblong, variable in shape; transtilla small, rounded; sacculus thick, well sclerotized; saccular projection long, rarely short, well sclerotized; harpe reduced, completely fused with basal part of saccular projection; valvula slender, long; phallus well sclerotized, shorter or longer than valve; coecum developed, about 1/5 length of phallus; juxta variable in shape.

Male genital musculature (Table 2): Any extra muscles and secondary movement of the muscles not seen.

Female genitalia (Figs. 34I–J, 35G–H): Corpus bursae subspherical (subglobular) or oblong, wholly covered with spines forming star-shaped base on outer surface, with globular appendix bursae at anterior end; ductus bursae-corporis

bursae junction distinct; ductus bursae thick, approximately as long as corpus bursae, partly covered with spines; ductus seminalis arising near ostium; antrum short, cup-shaped, sclerotized; 8th tergum well sclerotized, extending ventrally; 8th sternum almost membranous except for narrow anterior sclerite of ostium; ostium being at anterior margin of 8th sternum; apophysis anterioris rather short, 1/3 to 1/2 length of apophysis posterioris; ventral sclerite (sternite IX) between papillae anales narrow.

Immature stages

Last instar larva: More than 16 mm in length; head pale yellowish green or yellowish green, mottled with yellowish brown to blackish brown, wider than long; labral emargination about 0.2 deep; mandible with 6 teeth; body various in colour pattern, with various stripes; chrochets of ventral and anal prolegs arranged in broken biordinal mesoserries; paraproct developed. Chaetotaxy: SS2 in between stemma 5 & 6; A3 ventral to a line joining L1 and A2; SD setal group on prothorax bisetose; ventral proleg with four SV setae; on anal shield D1 setae anterior to a line drawn between SD2s; on anal proleg SV3 present or absent.

Pupa: About 7.5 mm to 12.6 mm in length, about 2.5 mm to 3.9 mm in width; reddish to dark brown; labial palpus exposed, small; forewing reaching near posterior margin or half length of 4th abdominal segment; antenna reaching apical margin of forewing; femur of foreleg exposed; hind tarsus exposed or not; dorsal and lateral grooves indistinct; cremaster with two or three pairs of setae, of which anterior one or two are coiled setae and terminal one is sclerotized and pointed.

Distribution. Mainly in the Oriental subtropics (Holloway, 1997): India, Nepal, Myanmar, Thailand, Philippines, China, Taiwan, and Japan.

Bionomics. The genus is most diverse in the mountainous areas of the Oriental subtropics (Holloway, 1997), but bionomic information is so scarce. The families Fagaceae (Hashimoto, 1982; Nakajima & Yazaki, 2011) and Coriariaceae (Holloway, 1997) are recorded as the larval host plants. The northern temperate species, *T. costipunctaria* Leech, is one generation per year, but many subtropical species are probably two or more generations per year.

Remarks. The genus *Trichopterigia* comprises about 35 described species mainly from the Oriental region. *Trichopterigia* forms the *Acasis* genus-group with the following four genera; *Acasis*, *Archaeocasis* (Fig. 32E–F), *Pseudacasis*, and *Otoptecta*, by sharing of the following characters: male hindwing venation (Sc fused with R + Rs for most length of discal cell; Fig. 33B, E, 39B, E; Hashimoto, 1995c: fig. 7); male genitalia (saccular process rather thick and long; Figs. 34E, 35D, 36D, 40D, J, 42D; Hashimoto, 1995c: figs. 9, 14); female genital structure (a globular appendix bursae on the anterior end of corpus bursae; Figs. 15A, 34I, 35G, 37A, 41A, D, 43I; Hashimoto, 1995c: figs. 18–19), but *Trichopterigia* is distinguishable from them in the following points: both transtillae separate; harpe reduced, completely fused with base of saccular projection (Figs. 34E, 35D); valvula narrow (Figs. 34E, 35D); corpus bursae wholly covered with spines forming star-shaped base on outer surface (Figs. 34I, 35G) in *Trichopterigia*, but both

transtillae completely fused medially (Figs 36E, 42E, 43E; Hashimoto, 1995c: fig. 12); harpe large, occupied at middle of valve (Figs. 40D, J, 42D, 43D; Hashimoto, 1995c: fig. 14); valvula rounded (Figs. 40D, J, 42D, 43D; Hashimoto, 1995c: fig. 14); corpus bursae partly covered with spines (Figs. 15A, 37A, 41A, D, 43I; Hashimoto, 1995c: figs. 18–19) in *Acasis*, *Archaeocasis*, *Pseudacasis*, and *Otoptecta*. Their relationships (Fig. 2) are as follows: *Trichopterigia* + ((*Archaeocasis* + *Pseudacasis*) + (*Acasis* + *Otoptecta*)).

The *Acasis* genus-group shows a sister group relationship with the *Trichopteryx* genus-group (Fig. 2).

Key to the Japanese species of *Trichopterigia* (based on adult characters)

1. Small (forewing length 10–14 mm); forewing greyish brown to greyish olive, scattered with reddish scales, with darker lines; hindwing white, scattered with greyish brown scales, especially densely along termen; subscaphium well sclerotized, without any hairs; phallus rather pointed at ventro-distal right side, with several small spines on distal left side; corpus bursae subglobular ... *T. consobrinaria*
- . Large (forewing length 16–18 mm); forewing olive green, with darker lines, accompanied with reddish spots on outer margin of subterminal one; hindwing silky white; subscaphium weakly sclerotized, covered with many minute hairs; phallus spatulate at distal right side, without spines on distal left side; corpus bursae tapering toward anterior end *T. costipunctaria*

Trichopterigia consobrinaria (Leech) (Figs. 5E, 11D, 12E, 32A–B, 33A–C, 34)

Lobophora consobrinaria Leech, 1891: 54.

Trichopteryx consobrinaria: Leech, 1897: 75.

Trichopterigia consobrinaria: Prout, 1914: 186.

Diagnosis. Forewing length 10–12 mm in male, 13–14 mm in female; male and female genitalia shown in Fig. 34. Difference between *T. consobrinaria* and *T. costipunctaria* is treated in the above key.

Specimens examined. JAPAN: Honshu: Osaka, Minoo, 2♂, 26. iv. 1958 (M. Takio) (OPU); same locality; 1♂, 1♀, 22. iv. 1960 (M. Takio) (OPU); same locality, 1♂, 3♀, 6. iv. 1961 (M. Takio) (OPU); same locality, 1♂, 3. v. 1978 (T. Saito); same locality, 1♀, 19. iv. 1978 (S. Hashimoto); same locality, 1♀, 20. v. 1978 (T. Saito); same locality, 1♀, 12. iv. 1979 (S. Hashimoto); same locality, 1♂, 23. iv. 1981 (S. Hashimoto); same locality, 1♂, 28. iv. 1981 (S. Hashimoto); same locality, 1♂, 1♀, 13. v. 1981 (T. Saito); Osaka, Mt. Makiosan, 1♂, 3. v. 1981 (K. Yasuda); Shikoku: Kochi, Ashizurimisaki, 1♀, 2. v. 1993 (T. Mano); Ryukyu: Amami-oshima Is., Asato, 2♂, 1♀, 16. iii. 1975 (Y. Fujimaki); Amami-oshima Is., Kominato, 1♂, 18. iii. 1975 (Y. Fujimaki); Amami-oshima Is., Mt. Yuidake, 5♂, 3♀, 21–22. iii. 1975 (Y. Fujimaki); Okinawa Is., Mt. Katsudake, 1♀, 25. iii. 1980 (K. Yasuda); Ishigakijima Is., Takeda, 1♂, 15. iii. 1998 (T. Mano); Iriomotejima Is., Komi-Ohtomi, 1♀, 20. iii. 1974 (Y. Fujimaki); Iriomotejima Is., Komi, 1♂, 16. xii. 1979 (F. Komai).

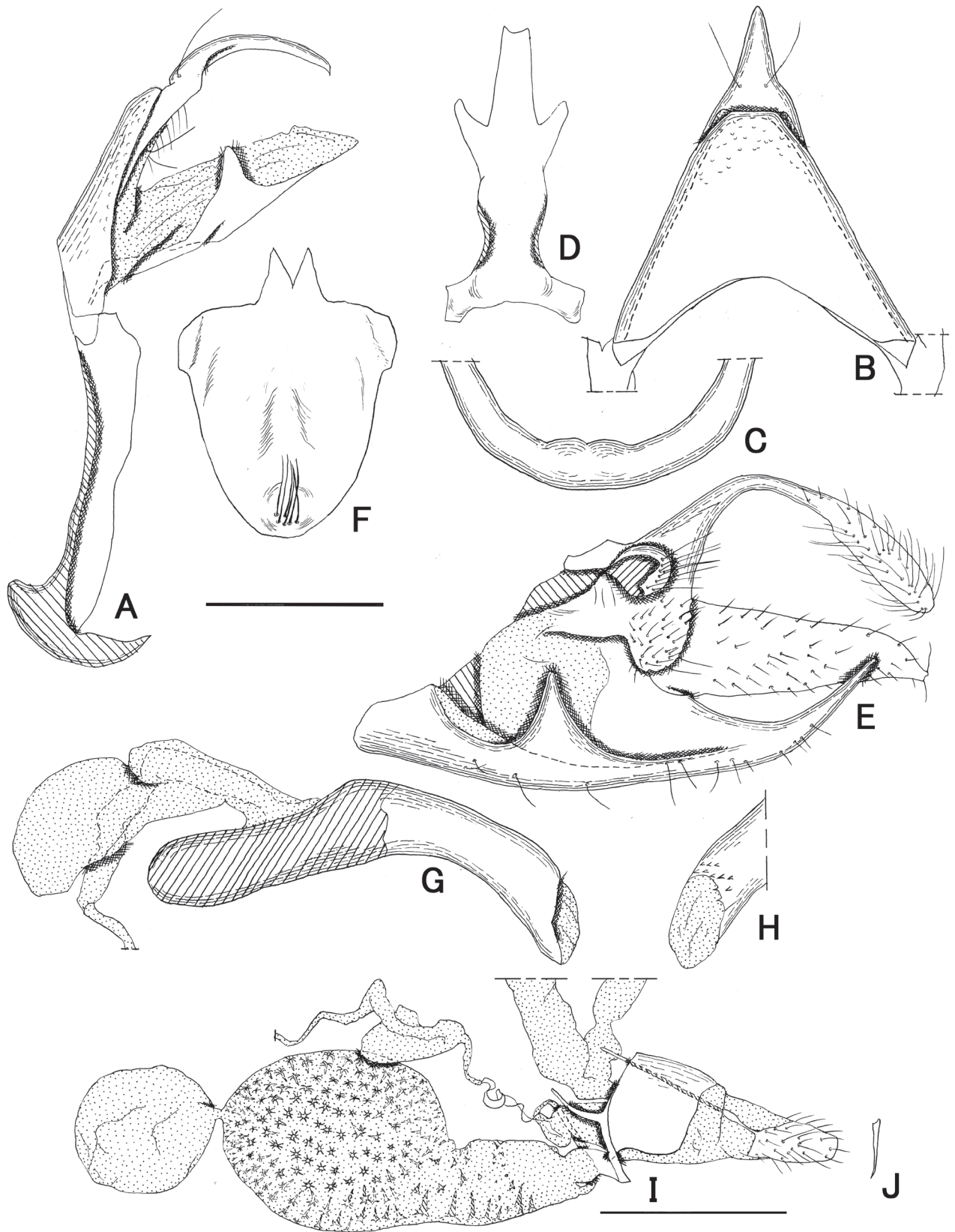


Fig. 34. Genitalia, *Trichopterigia consobrinaria* (Leech) (A–H, ♂; I–J, ♀). A, lateral; B, tegumen and uncus, dorsal; C, saccus, dorsal; D, subscaphium, ventral; E, right valve, inner; F, juxta, ventral; G, phallus, lateral; H, caudal end of phallus, right; I, lateral; J, narrow sclerite (sternite IX). Scales = 0.5 mm (A–H), 1.0 mm (I–J).

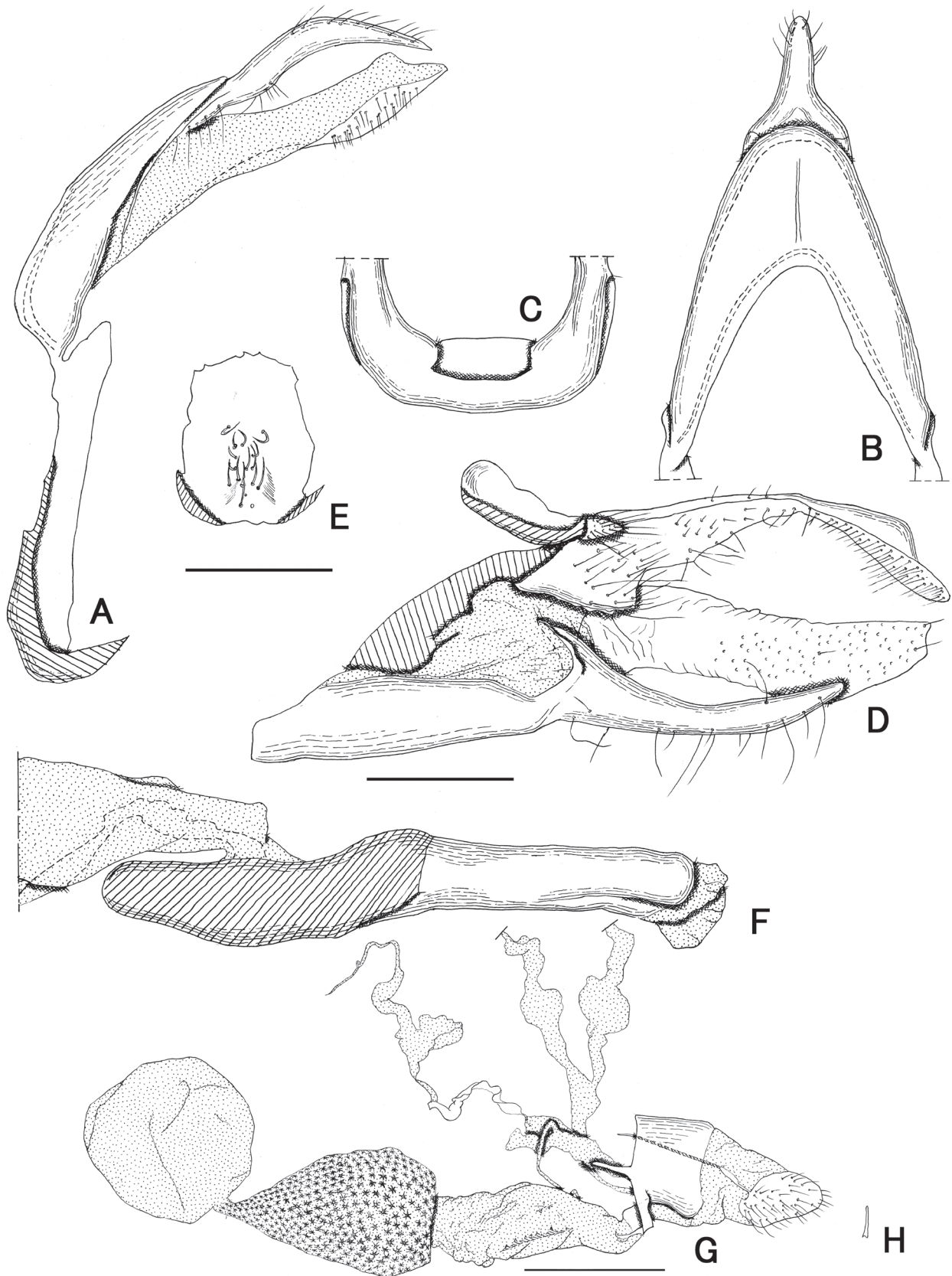


Fig. 35. Genitalia, *Trichopterigia costipunctaria* Leech (A–F, ♂; G–H, ♀). A, lateral; B, tegumen and uncus, dorsal; C, saccus, dorsal; D, right valve, inner; E, juxta, ventral; F, phallus, lateral; G, lateral; H, narrow sclerite (sternite IX). Scales = 0.5 mm (A–F), 1.0 mm (G–H).

Distribution. Japan (Honshu, Izu Isles., Shikoku, Kyushu, Tsushima Is., Yakushima Is., Amami-oshima Is., Tokunoshima Is., Okinawa Is., Ishigakijima Is., and Iriomotejima Is.) and Taiwan.

Host plants. *Quercus aliena* Blume accepted in rearing condition (Fagaceae; Hashimoto, 1982).

Immature stages. Description is based on Hashimoto (1982). Last instar larva about 16 mm in length; head pale yellowish green, mottled with yellowish brown; body pale yellowish green, with complicated brown or reddish brown to dark brown stripes; chrochets 18–23 in number on ventral proleg, 18 or 19 in number on anal one. Chaetotaxy: Pb puncture anterior to a line joining P1 and P2; prothoracic SD setae on prothoracic shield; on anal proleg SV3 absent. Pupa dark brown, about 7.5 mm in length, about 2.5 mm in width; forewing reaching near posterior margin of 4th abdominal segment; antenna reaching apical margin of forewing; proboscis and midleg reaching just before apical margin of forewing; hind tarsus exposed; cremaster with three pairs of setae, of which anterior two are coiled setae and terminal one is sclerotized and pointed.

Bionomics. This species is a single generation per year at the northern temperate areas and appears in spring in Honshu, but two or more generations in the subtropical areas.

***Trichopterigia costipunctaria* Leech**
(Figs. 9B–C, 12F, 16A, 32C–D, 35)

Trichopterigia costipunctaria Leech, 1897: 73.

Diagnosis. Forewing length about 17 mm in male, 16–18 mm in female; male and female genitalia shown in Fig. 35. Difference between *T. consobrinaria* and *T. costipunctaria* is treated in the above key.

Specimens examined. JAPAN: Honshu: Osaka, Minoo, 1♂, 24. iii. 1975 (T. Saito); same locality, 1♂, 17. iii. 1978 (S. Hashimoto); same locality, 1♂, 22. iii. 1978 (T. Saito); same locality, 1♂, 1♀, 25. iii. 1978 (S. Hashimoto); same locality, 2♂, 29. iii. 1978 (S. Hashimoto); same locality, 1♂, 31. iii. 1978 (S. Hashimoto); same locality, 3♂, 1♀, 5. iv. 1978 (S. Hashimoto); same locality, 3♀, 19. iv. 1978 (S. Hashimoto); same locality, 1♂, 26. ii. 1979 (S. Hashimoto); same locality, 4♂, 1♀, emerged 12–24. iii. 1979 (S. Hashimoto); same locality, 1♂, 3. iv. 1980 (S. Hashimoto); same locality, 3♂, 3♀, 8. iv. 1980 (S. Hashimoto); same locality, 1♂, 23. iii. 1981 (S. Hashimoto); same locality, 1♂, 3. iv. 1981 (S. Hashimoto); same locality, 1♂, 1♀, 6–8. iii. 1982 (T. Saito); same locality, 1♂, 12. iii. 1982 (T. Saito); same locality, 1♀, 18. iii. 1982 (T. Saito); same locality, 1♀, 2. iv. 1984 (S. Hashimoto); Osaka, Hiraoka-koen, 1♀, 18. iii. 1978 (S. Hashimoto).

Distribution. Japan (Honshu, Shikoku, and Kyushu).

Host plants. *Quercus myrsinaefolia* Blume (Fagaceae; Nakajima & Yazaki, 2011); *Q. glauca* Thunberg accepted in rearing condition (Hashimoto, 1982).

Immature stages. Description is based on Hashimoto (1982). Last instar larva (Fig. 16A) 19–25 mm in length; head pale yellowish green, mottled with blackish brown; body yellowish green, with dorsal and lateral fuscous stripes;

chrochets 18–23 in number on ventral proleg, 17–20 in number on anal one. Chaetotaxy: Pb puncture posterior to a line joining P1 and P2; prothoracic SD setae on same pinaculum separate from prothoracic shield; on anal proleg SV3 present. Pupa reddish to dark brown, about 12.6 mm in length, about 3.9 mm in width; forewing reaching half length of 4th abdominal segment; antenna, proboscis and midleg extending just beyond apical margin of forewing; hind tarsus not exposed; cremaster with two pairs of setae, of which anterior one is coiled and terminal one is sclerotized and pointed.

Bionomics. There is a single generation per year. The moths appear in rather early spring and are obtained from the laurel forest of the hilly to low mountainous areas.

Genus *Pseudacasis* nov.

Type species: *Lobophora bellaria* Leech, 1891: 54.

Diagnosis. *Pseudacasis* is characterized by two autapomorphies (Fig. 4): 1, posterior part of phallus covered with small several spines (Fig. 36H); 2, female sternum VIII triangularly expanded postero-laterally, deeply incised on posterior margin (Fig. 37A–B). The following characters also characterize the genus, but are homoplastic or reversal (Fig. 4): 1, male hindwing with CuA2 slightly shorter than CuA1; 2, costal arm short, rather broad, sclerotized on dorsal margin; 3, corpus bursae partly covered with spines forming star-shaped base. It is probable that the character state (running from proximal edge of valve to phallus) of the protractor (m6) of phallus is also an autapomorphy of the genus. The genus is distinguishable from other genera of the Trichopterygini by the combination of the following characters: hind tibia with a pair of apical spurs; forewing with two areoles; forewing with M1 arising from areole; hindwing white, scattered with pale brown scales, especially along termen; discal dot distinct; hindwing venation (Sc fused with R + Rs (an upper vein of discal cell) for most length of discal cell in both sexes; Rs and M1 separate in male, stalked in female; CuA2 slightly shorter than CuA1 in male); anal fold small; both transtillae completely fused with each other medially; saccular process large, with long stout spines; phallus slender, longer than valve; corpus bursae subglobular, covered with spines forming star-shaped base on outer surface antero-ventrally, with an appendix bursae at anterior end; spermatheca without lagena; 8th segment sclerotized; apophysis anterioris almost reduced.

Description. The generic description is based on only one species.

Adult

Head: Head clothed with scales thickly; antennal flagellomeres filiform; frons rounded; labial palpus porrect, 1.5 times as long as diameter of eye; proboscis developed.

Thorax (Figs. 32G–H, 33D–F): Thorax stout; metepimeron enlarged, divided into anterior and posterior parts by inner ridge in both sexes; male metameron arched posteriorly; hind tibia with a pair of spurs (apical spurs), with a hair-pencil in male. Forewing white mixed with blackish brown, with olive green lines consisting of basal, postbasal, antemedial, postmedial, subterminal, and adterminal ones; discal spot

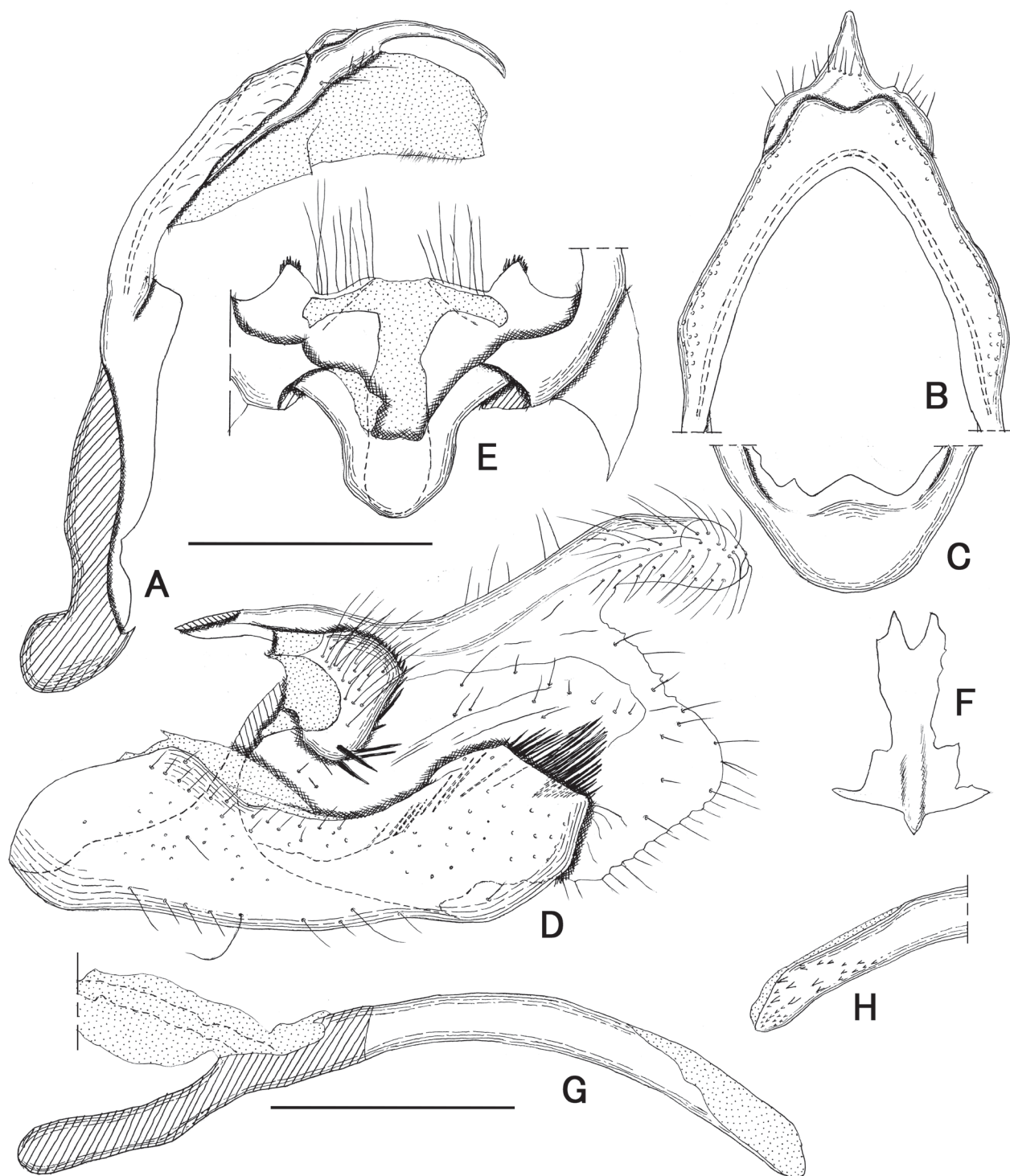


Fig. 36. Male genitalia, *Pseudacasis bellaria* (Leech). A, lateral; B, tegumen and uncus, dorsal; C, saccus, dorsal; D, right valve, inner E, transtilla, dorsal; F, juxta, ventral; G, phallus, lateral; H caudal part of phallus, right. Scales = 0.5 mm.

black; terminal dots fuscous; subterminal and adterminal lines obscure from M2 to inner margin; forewing with two areoles (1st areole small, less than 1/5 of 2nd areole); M1 arising from areole. Hindwing white scattered with greyish brown scales, with fuscous discal spot and pale fuscous postmedial line; male with an anal fold (about 1/4 length of anal margin); Sc fused with R + Rs for most length of discal cell; Rs and M1 separate in male, stalked in female; M3 and CuA1 separate, almost equal length; CuA2 slightly shorter than CuA1 in male.

Pregenital abdomen: Male sternum II pouch small, distinct; male sternum II with a pair of triangular expansions.

Male genitalia (Fig. 36): Anterior margin of tegumen deeply incurved, posterior end of posterior margin deeply invaginate; saccus rounded, well expanded anteriorly; uncus rather short, slender, gently curved ventrally; socius more or less reduced at basal side of uncus, distinguishable as a hairy part; gnathos narrow, being at caudo-ventral side of tegumen, completely fused with uncus-socius complex; costa rather

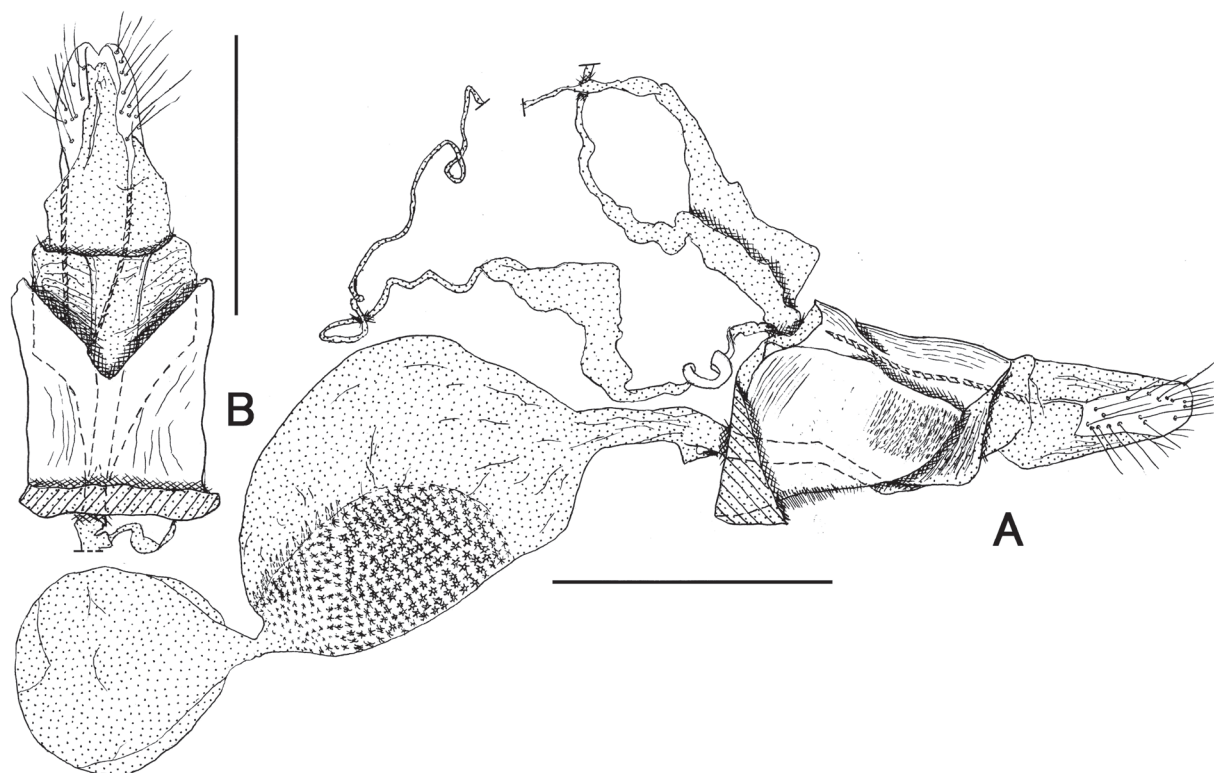


Fig. 37. Female genitalia, *Pseudacasis bellaria* (Leech). A, lateral; B, post abdomen, ventral. Scale = 1.0 mm.

thick, sclerotized; costal arm short; cucullus oblong; both transtillae completely fused medially, U-shaped; sacculus very thick, sclerotized; saccular projection short, very thick, curved upward, with many slightly long sclerotized spines at inner side of truncate apex; harpe large, oblong, occupied median part of valve, more or less sclerotized, with a sclerotized lobe proximodorsally, on which long stout spines and hairs arise; valvula broad, rounded at posterior margin; phallus very long, longer than valve, narrow, with many spines at right side near distal end; cornutus absent; coecum rather long, about 1/4 length of phallus; juxta anchor shaped, bifurcate at posterior end.

Male genital musculature (Table 2): Protractor (m6) of phallus runs from proximal edge of valve to phallus.

Female genitalia (Fig. 37): Corpus bursae large, subglobular, elliptically covered with spines forming star-shaped base on outer surface about anterior 2/3 of ventral part, with a globular appendix bursae at anterior end; ductus bursae-corporis bursae junction rather distinct; ductus bursae slightly shorter than corpus bursae, narrow, wrinkled, without spines; ductus seminalis arising from middle of ductus bursae (from anterior end of antrum); spermatheca without lagena as a lateral sac (according to Dugdale (1974), lagena being sometimes axial and sometimes lateral); antrum rather long, narrow, sclerotized; 8th segment completely sclerotized; 8th tergum strongly wrinkled postero-laterally, covered with triangular expansion of sternum; 8th sternum covered with fine hairs on antero-median part, triangularly expanded postero-laterally, on posterior margin deeply incised; ostium being at posterior margin of 8th sternum; apophysis anterioris almost reduced; ventral sclerite (sternite IX) between papillae anales narrow.

Immature stages

Last instar larva and pupa: Unknown.

Distribution. Russian Far East (Southeast Siberia), Korea (Choi, 2007b), and Japan.

Bionomics. There is a single generation per year. The moths appear in spring to early summer and are obtained from the hilly to mountainous areas.

Etymology. The generic name is based on the generic relationships: this genus is phenetically similar to the genus *Acasis*, but closely related to the genus *Archaeocasis* (Fig. 4). Gender is feminine.

Remarks. The monobasic genus *Pseudacasis* constitutes a sister group relationship with the genus *Archaeocasis* (Fig. 32E–F) and also related to the genera *Acasis* and *Otoplecta*. These genera are easily distinguishable from each other by the following combination of characters: forewing pattern (olive or greyish ground colour with blueish lines (Fig. 38A–F) in *Acasis*, white ground colour scattered with greyish olive and with greyish olive lines (Fig. 32E–F) in *Archaeocasis*, white ground colour with fuscous lines (Fig. 38G–H) in *Otoplecta*; and yellowish olive lines and a white spot on dorsum between antemedial and postmedial lines (Fig. 32G–H) in *Pseudacasis*); forewing areoles (two areoles in *Acasis* and *Pseudacasis*, but one in *Archaeocasis* and *Otoplecta*); hindwing venation (Rs and M1 separate in male, stalked in female in *Acasis* and *Pseudacasis*; stalked in both sexes in *Archaeocasis*; and separate in both sexes in *Otoplecta*); saccular projection with many long sclerotized spines at inner side (present (Fig. 36D; Hashimoto, 1995c: figs. 9, 14) in *Archaeocasis* and *Pseudacasis*, absent (Figs. 40D, J, 42D, 43D) in *Acasis* and *Otoplecta*); saccular projection (absent (Fig. 43D) in *Otoplecta*, present in *Acasis*, *Archaeocasis* and

Pseudacasis); female 8th tergum (divided by a longitudinal membrane (Figs. 15B, 43J) in *Acasis* and *Otoplecta*, but not separate by membrane in *Archaeocasis* and *Pseudacasis*); ventral sclerite (sternite IX) between papillae anales (narrow (Figs. 15C, 37B, 41B) in *Acasis*, *Archaeocasis*, and *Pseudacasis*, but broad (Fig. 43K) in *Otoplecta*).

Although the monotypic species *bellaria* generally has been treated as a member of the genus *Acasis*, a new genus *Pseudacasis* is proposed for this species in the present paper on the basis of the result of phylogenetic analysis (Figs. 2, 4).

***Pseudacasis bellaria* (Leech), comb. nov.**

(Figs. 32G–H, 33D–F, 36–37)

Lobophora bellaria Leech, 1891: 54.

Trichopteryx bellaria: Leech, 1897: 74.

Acasis bellaria: Prout, 1914: 182.

Nothocasis bellaria: Viidalepp, 1978: 758.

Diagnosis. Forewing length 11–12 mm in male, 11–12 mm in female; male and female genitalia shown in Figs. 36–37, respectively. This species is easily distinguishable from the *Acasis* species by the wing pattern (forewing with whitish spot on dorsum between antemedial and postmedial lines; hindwing paler) and the male and female genital features (male saccular process with many long spines; female corpus bursae covered with rasp-like spines ventrally).

Specimens examined. JAPAN: Honshu: Niigata, Sado Is., 1♂, 2–3. v. 1965 (R. Sato); Nagano, Ueda, 1♂, 24. iv. 1982 (S. Hashimoto); Nagano, Minotoguchi, 1♀, 4. vi. 1979 (H. Kuroko); Gifu, Hikagedaira, 1♀, 18. v. 1985 (S. Hashimoto); Gifu, Harayama, 1♂, 4. v. 1977 (S. Hashimoto); Osaka, Minoo, 1♂, 2♀, 1. v. 1978 (S. Hashimoto); same locality, 1♂, 3♀, 15. v. 1978 (S. Hashimoto); same locality, 3♂, 1♀, 21. iv. 1979 (S. Hashimoto); same locality, 3♂, 28. iv. 1981 (S. Hashimoto); Osaka, Mt. Inunakisan, 1♂, 30. iv. 1987 (H. Kurashige).

Distribution. Japan (Hokkaido, Honshu, Shikoku, Kyushu), Korea, and Russian Far East.

Host plants. Unknown.

Immature stages. Unknown.

Bionomics. See the generic description.

Genus *Acasis* Duponchel

Acasis Duponchel, [1845] 1844: 256. Type species: *Geometra viretata* Hübner, [1799] 1796: pl. 44, fig. 230, by monotypy.

Bryodis Gumpfenberg, 1887: 327 (key). Type species: *Geometra viretata* Hübner, by subsequent monotypy.

Cysteopteryx Hulst, 1896: 250. Type species: *Lobophora viridata* Packard, 1873: 56, by original designation (but listed as *viridata* Grote, an incorrect authorship).

Agia Hulst, 1896: 255 (key), 259. Type species: *Agia eborata* Hulst, 1896: 260 (a junior subjective synonym of *Lobophora viridata* Packard).

Diagnosis. The genus *Acasis* is characterized by two autapomorphies (Fig. 4): 1, costal arm short to medium, slender, sclerotized on dorsal margin (Figs. 40D, J, 42D); 2, coecum of phallus laterally expanded (Figs. 40G, 42H).

Acasis is distinguished from other trichopterygine genera by the following combination of characters: hind tibia with a pair of apical spurs; forewing with two areoles; forewing with M1 arising from areole; hindwing venation (Sc fused with R + Rs (an upper vein of discal cell) for most length of discal cell in both sexes; Rs and M1 separate in male, stalked in female; CuA2 about 1/2 length of CuA1 in male); anal fold small; both transtillae completely fused with each other medially; sacculus thick, with thick curved saccular process; phallus rather short, slender, shorter than valve, with a ventral pointed tip; coecum rounded laterally; female 8th tergum divided longitudinally by membrane; female 8th sternum sclerotized; corpus bursae covered with spines circularly near anterior end, with appendix bursae at anterior end; spermatheca without lagena; apophysis anterioris very short.

Description. The generic description is based on four species and the following studies: Pierce, 1914; Hausmann & Huemer, 2011; Hausmann & Viidalepp, 2012.

Adult

Head (Fig. 6D): Clothed with scales on vertex, relatively smooth on face; antennal flagellomeres filiform; frons slightly rounded; labial palpus porrect, about 2.0 to 2.5 times as long as diameter of eye in male and 2.5 times in female; proboscis developed.

Thorax (Fig. 38A–F, 39A–C): Stout; metepimeron enlarged, divided into anterior and posterior parts by inner ridge in both sexes; male metamerion arched posteriorly; hind tibia with a pair of spurs (apical spurs), with a hair-pencil in male. Forewing olive green, grey to purplish grey or greyish brown, with fuscous or dark blue irregular punctuated lines, consisting of basal, postbasal, antemedial, postmedial, subterminal, and subterminal ones, and distinct discal dot and outer marginal dots; forewing with two areoles; M1 arising from areole. Hindwing densely covered with grey to pale greyish brown scales, with fuscous discal spot and darker postmedial line; male with a small anal fold (less than 1/4 length of anal margin); Sc fused with R + Rs for most length of discal cell; Rs and M1 separate in male, stalked in female (in female of *A. viretata* rarely Rs and M1 separate as in male); M3 and CuA1 separate, almost equal length; CuA2 about 1/2 to 2/3 length of CuA1 in male.

Pregenital abdomen: Male sternum II pouch small, distinct; male sternum II with a pair of triangular expansions.

Male genitalia (Figs. 40, 42): Anterior margin of tegumen deeply incurved, posterior margin rather strongly curved posteriorly; saccus rounded, well expanded anteriorly; uncus moderate length, gently curved ventrally; socius reduced at basal side of uncus, recognizable as a hairy part; gnathos narrow, being at caudo-ventral side of tegumen, completely fused with uncus-socius complex; costa sclerotized, with many small spines along dorsal margin or with a serrate sclerite expanding mesad on mid-dorsal margin; costal arm short to long; cucullus rather small, slightly oblong, rounded, with many hairs; both transtillae completely fused medially, U-shaped; sacculus thick, sclerotized; saccular projection thick, slightly curved upward, tapering; harpe large, oblong, occupied median part of valve, sclerotized, with a sclerotized setose lobe proximo-dorsally, on which long stout spines and hairs arise; valvula broad, rounded

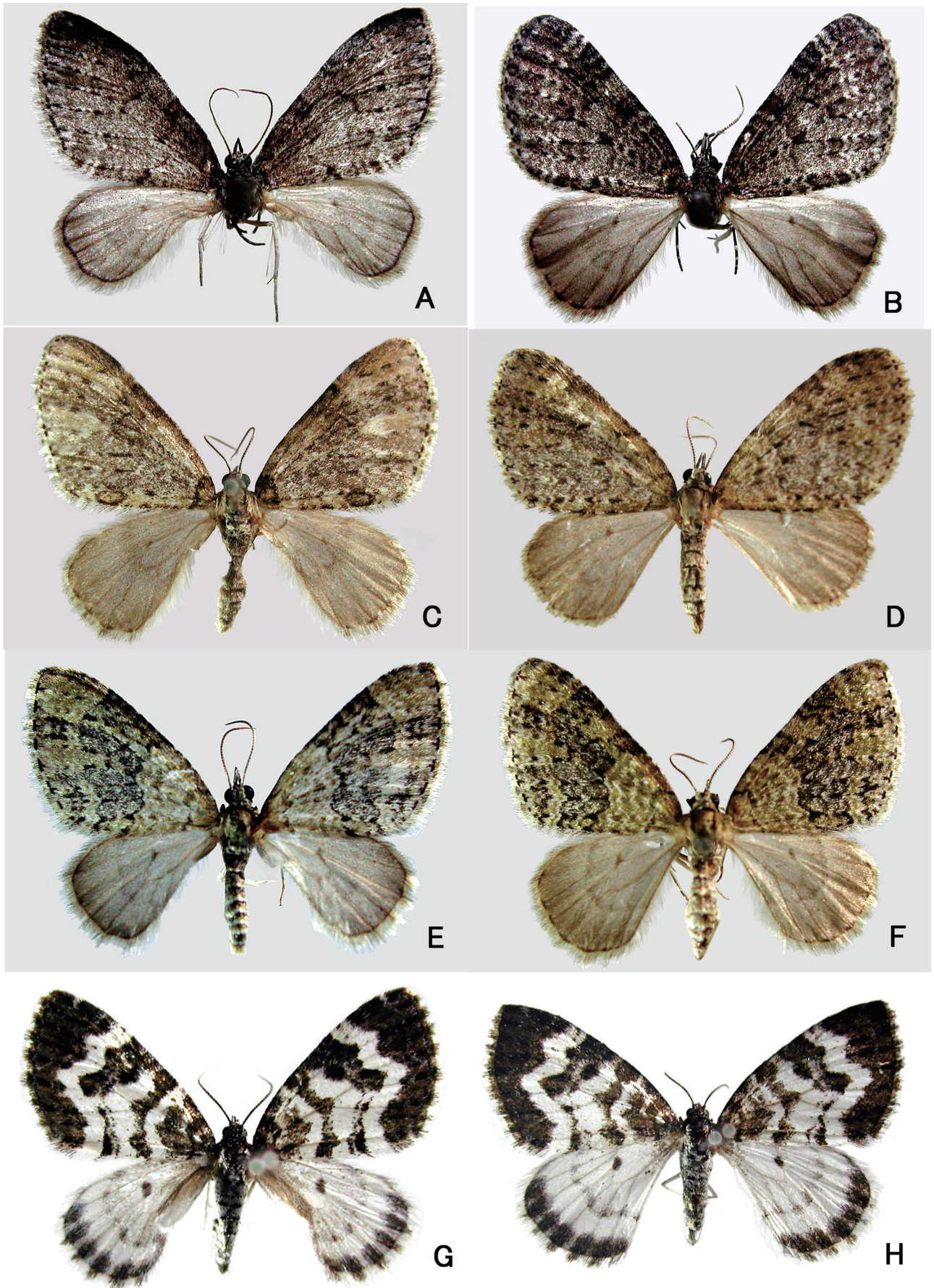


Fig. 38. Adults. A, *Acasis appensata* Eversmann, ♂ (Czech); B, ditto, ♀ (Czech); C, *Acasis exviretata* Inoue, ♂; D, ditto, ♀; E, *Acasis viretata viretata* (Hübner), ♂; F, ditto, ♀; G, *Otoplecta frigida* (Butler), ♂; H, ditto, ♀.

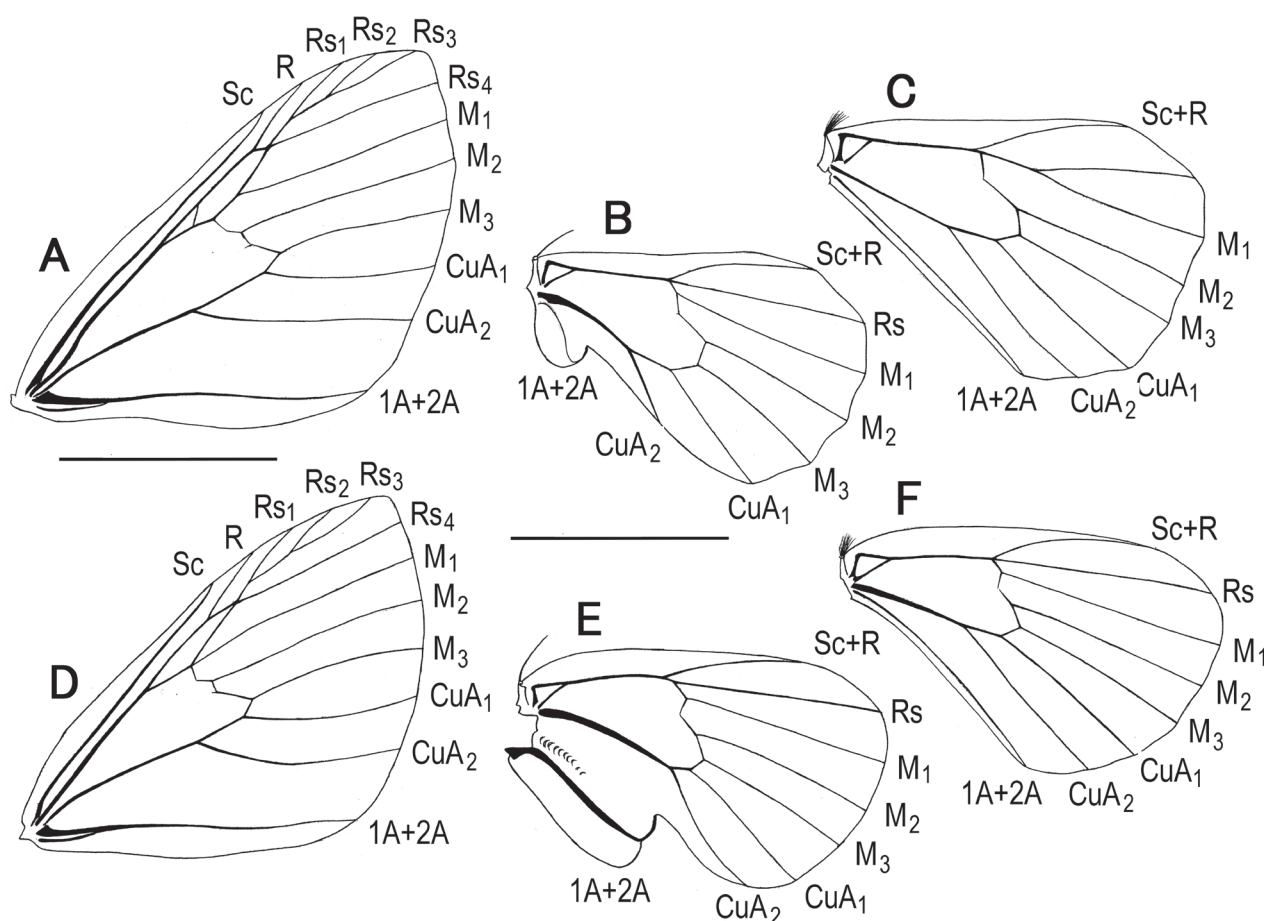


Fig. 39. Wing venation. A, *Acasis viretata viretata* (Hübner), ♂ (forewing); B, ditto, ♂ (hindwing); C, ditto, ♀ (hindwing); D, *Otoplecta frigida* (Butler), ♂ (forewing); E, ditto, ♂ (hindwing); F, ditto, ♀ (hindwing). Scales = 5.0 mm.

at posterior margin, weakly sclerotized; phallus shorter than valve, slightly curved, pointed at ventral apex, with cornuti composed of many fine granules or spines; coecum distinct, rounded laterally, about 1/4 to 1/3 length of phallus; juxta variable in shape, ventrally with a medial protrusion.

Male genital musculature (Table 2): Any extra muscles and secondary movement of the muscles not seen.

Female genitalia (Figs. 15A–C, 41): Corpus bursae subglobular, covered with small needle-like spines circularly near anterior end, with globular appendix bursae at anterior end; ductus bursae–corpus bursae junction indistinct; ductus bursae wrinkled, tapering posteriorly, indistinguishable from corpus bursae, without spines; ductus seminalis arising near antrum; spermatheca without lagena as a lateral sac; antrum narrow, slender, sclerotized; 8th tergum longitudinally divided by membrane; 8th sternum well sclerotized; ostium being at anterior or near posterior margin of 8th sternum; apophysis anterioris short to very short, less than 1/4 length of apophysis posterioris; ventral sclerite (sternite IX) between papillae anales narrow.

Immature stages

Last instar larva and pupa: Detail description not available, but the pupal description of the European species, *Acasis appensata* (Eversmann), is given by Patočka, 1980.

Distribution. Mainly temperate areas of the Palearctic and the Nearctic regions.

Bionomics. *Acasis viretata* (Hübner) and *A. viridata* Packard are the arboreal feeders (Forbes, 1948; Hausmann & Huemer, 2011), but *A. appensata* (Eversmann) and *A. exviretata* Inoue feed on *Actaea spicata* Linnaeus (Ranunculaceae; Hausmann & Huemer, 2011) and *Cimicifuga* spp. (Ranunculaceae; Owada, 1985; Sugi, 1987), respectively. For the host plant families, see also Spuler (1910). The adult moths are generally two generations per year.

Remarks. The genus *Acasis* is composed of three Palearctic and one Nearctic species, and forms a sister group relationship with the genus *Otoplecta* by sharing two apomorphies: 1, dorsal margin of costa with some spines or a serrate sclerite near middle (Figs. 40D, J, 43D); 2, female tergum VIII longitudinally divided by membrane (Figs. 15B, 43J). *Acasis* is also related to the genera *Archaeocasis* and *Pseudacasis*. As for differences among them, see the remarks of the genus *Pseudacasis*.

Key to Japanese species of *Acasis* (based on adult characters)

1. Forewing greyish brown, with indistinct dark greyish blue median band; uncus edged dorsally and laterally, slightly curved; costal arm long, narrow; ostium situated near posterior margin of 8th sternum *A. exviretata*
- . Forewing greenish olive, with distinct dark blue median band; uncus not edged, slender, strongly curved; ostium situated at anterior margin of 8th sternum . *A. viretata*

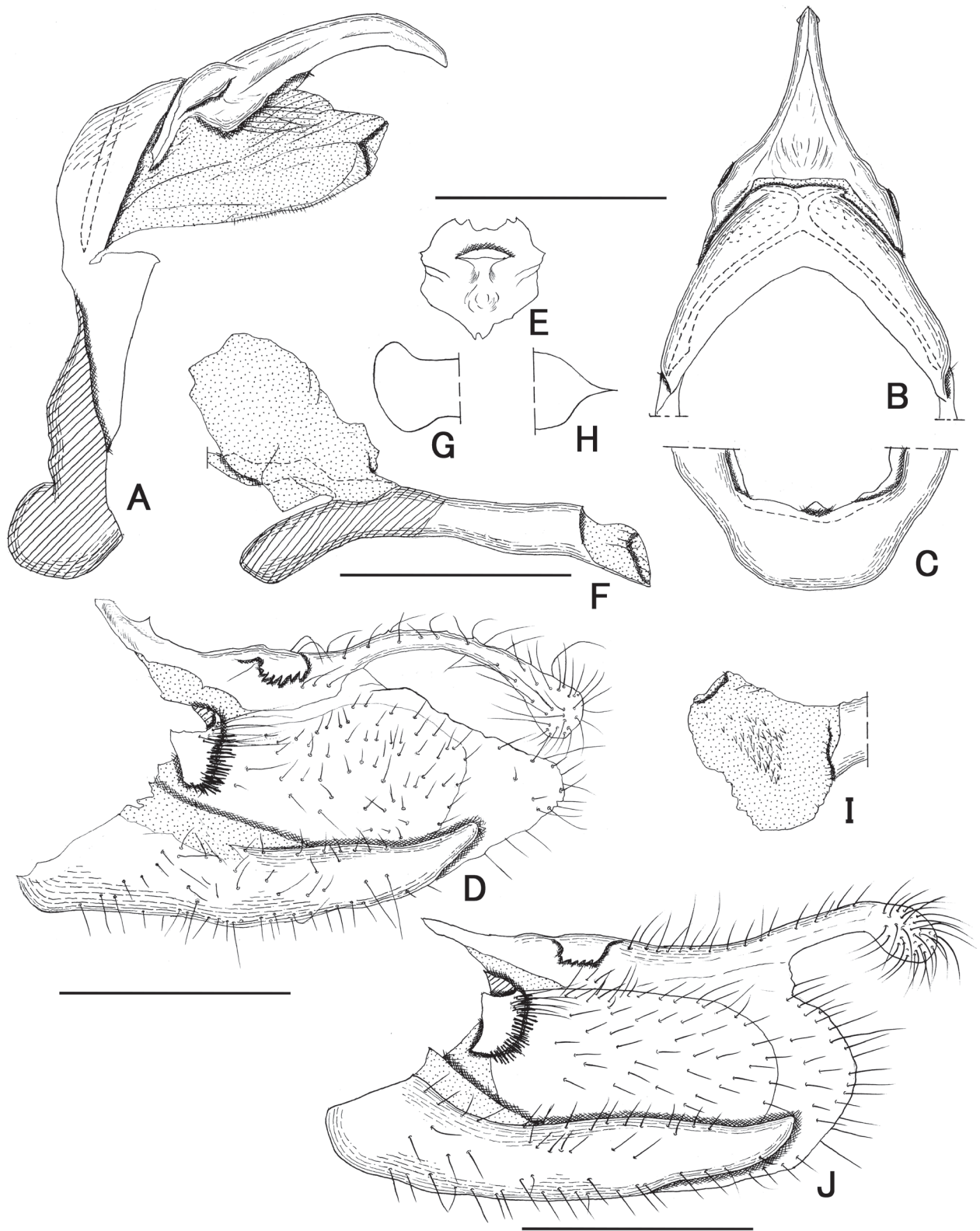


Fig. 40. Male genitalia, A–I, *Acasis exviretata* Inoue, J, *Acasis appensata* Eversmann, (Czech). A, lateral; B, tegumen and uncus, dorsal; C, saccus, dorsal; D, J, right valve, inner; E, juxta, ventral; F, phallus, lateral; G, anterior end of phallus, ventral; H, caudal end of phallus, ventral; I, cornuti. Scales = 0.5 mm.

Acasis exviretata Inoue
(Figs. 6D, 38C–D, 40A–I, 41A–C)

Acasis exviretata Inoue, 1982b, 1: 462, 2: 274, pl. 64, figs. 50–51, pl. 327, fig. 2, pl. 328, fig. 2.

Acasis appensata: Vasilenko, 1992: 283; Nakajima. & Yazaki, 2011: 248, pl. 1-051-12–13 (nec Eversmann, 1842).

Diagnosis. Forewing length 11–13 mm in male, about 12 mm in female; male and female genitalia shown in Figs. 40A–I, 41A–C. This species is closely related to the European *A. appensata* (Figs. 38A–B, 40J, 41D) and the North American *A. viridata* Packard in the male and female genital structures. *A. exviretata* is distinguishable from them as follows: forewing colour pattern of greyish brown with fuscous or dark blue irregular punctuated lines (grey to purplish grey with fuscous lines in *A. appensata*, greyish brown to olive green with fuscous or dark blue irregular punctuated lines in *A. viridata*), hindwing pale greyish brown with pale fuscous discal spot (grey with fuscous discal spot in *appensata*, pale greyish brown with pale fuscous discal spot in *viridata*), costal arm long, deeply incised (rather short, shallowly incised in *appensata* and *viridata*), valvula tapering, slightly rounded (clearly rounded in *appensata* and rounded but less than *appensata* in *viridata*), corpus bursae covered with spines rather sparsely near anterior end (densely in *appensata* and

viridata), and apophysis anterioris very short, less than 1/2 of that of *appensata* (more than twice in *appensata*, medium in *viridata*).

Vasilenko (1992) treated *A. exviretata* as a junior synonym of *A. appensata* without any comments. Although I could not examine the Kunashir specimens, the Japanese taxon is not identical with the European *A. appensata* as mentioned above. Choi (2007b) also regarded the Korean taxon as *A. appensata* and synonymized *A. exviretata* with *A. appensata*. Judging from his genital figures (Choi (2007b): figs. 8, 13), it is probable that the Korean taxon is identical with the Japanese one. From genetic distance of the molecular data (CO1 gene 5') and similarity of the male genital structure, Hausmann & Huemer (2011) indicated that North American *A. viridata* may better be downgraded to the subspecies rank of *A. appensata*. It is possible that *A. exviretata* is also downgraded to the subspecies rank of *A. appensata*, when the molecular data will be examined. Until the more detail molecular and morphological data of the *Acasis* species will be examined, it will be better to treat *A. exviretata* as an independent species.

Specimens examined. Paratypes: JAPAN: Hokkaido: Kushiro, Shibeche, 1♀ (HIC: Genitalia slide 5142), 1. viii. 1965 (K. Iijima); Honshu: Gumma, Yunotaira Spa, 1♂ (HIC: Genitalia slide 3558), 29. vi. 1968 (H. Inoue). Other materials: JAPAN: Hokkaido: Yubaridake-hüte, 1♀, 17. viii. 1976 (R. Sato); Honshu: Niigata, Okutainai, 1♀, 21. viii. 1971 (R. Sato); Niigata, Sakasamaki, 1♀, 2. vi. 1962 (R. Sato); same

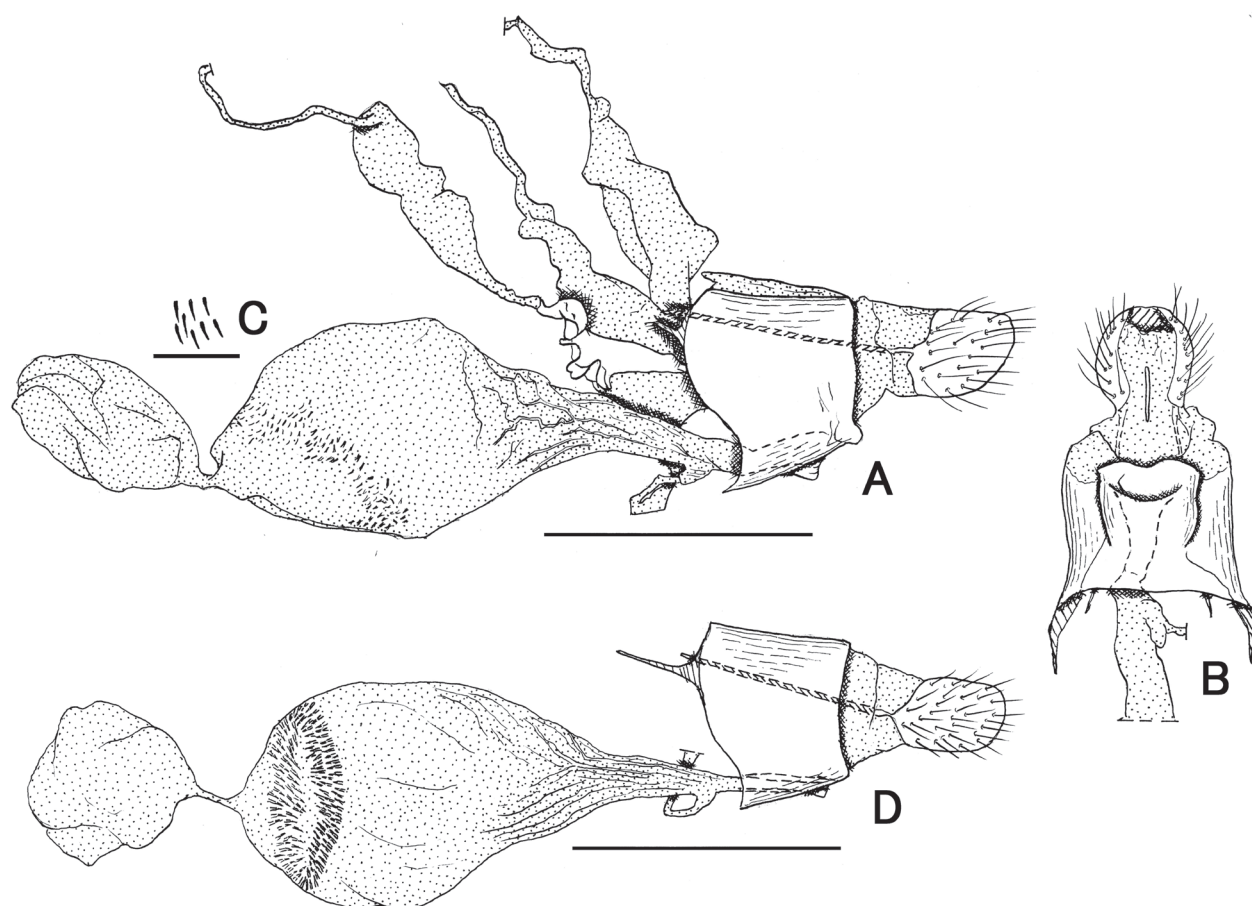


Fig. 41. Female genitalia. A, *Acasis exviretata* Inoue, lateral; B, ditto, post abdomen, ventral; C, ditto, spines (signa) of corpus bursae; D, *Acasis appensata* Eversmann, lateral (Czech). Scales = 1.0 mm (A–B), 0.125 mm (C).

locality, 1♂, 15. vii. 1963 (R. Sato); Niigata, Tsubame, 1♂, 20. vi. 1970 (R. Sato); Niigata, Mt. Atema, 1♂, 9. vi. 1972 (R. Sato); Nagano, Mikuri-toge, 1♀, 21. v. 1978 (H. Hara); Gifu, Hikagedaira, 1♂, 2. vi. 1978 (S. Hashimoto); same locality, 1♂, 15. vii. 1978 (S. Hashimoto); same locality, 1♂, 2. vi. 1979 (S. Hashimoto); same locality, 1♀, 12. vi. 1980 (S. Hashimoto); same locality, 2♂, 13. vi. 1981 (S. Hashimoto); same locality, 1♂, 1♀, 2. viii. 1981 (T. Tanabe); same locality, 1♂, 6–8. viii. 1981 (T. Sato); same locality, 1♀, 27–29. viii. 1981 (T. Saito); Gifu, Shiradani, 1♀, 20. viii. 1977 (H. Endo).

Distribution. Japan (Hokkaido and Honshu) and Korea (Choi, 2007b).

Host plants. *Cimicifuga simplex* (de Candolle) Wormskjold ex. Turczaninow (Ranunculaceae; Owada, 1985); *C. japonica* (Thunberg) Sprengel (Sugi, 1987).

Immature stages. Unknown except for the larval host plants.

Bionomics. This species has probably two generations per year and appears in early to late summer in the hilly to mountainous areas.

Acasis viretata (Hübner)

Geometra viretata Hübner, [1779] 1796: pl. 44, fig. 230.

Phalaena trinotata Donovan, 1810: 79, pl. 499, fig. 1.

Trichopteryx viretata: Hübner, [1825] 1816: 323.

Lobophora viretata: Curtis, 1825: 81.

Acasis viretata: Duponchel, [1845] 1844: 256.

Acasis viretaria: Duponchel, [1845] 1844: 256 (an incorrect subsequent spelling).

Bryodis viretata: Gumpfenberg, 1887: 327 (key).

Diagnosis. Difference between two Japanese species is treated in the key.

Distribution. Europe to Russian Far East, India, Myanmar, China, Taiwan, Korea, and Japan.

Host plants. *Hedera* sp. (Araliaceae; Inoue, 1950); *Ilex* sp. (Aquifoliaceae; Inoue, 1950); *Quercus serrata* Murray (Fagaceae; Inoue, 1971); *Rhamnus* sp. (Rhamnaceae; Spuler, 1910); *Viburnum* sp. (Adoxaceae; Inoue, 1950).

Remarks. This species is divided into two subspecies: *A.*

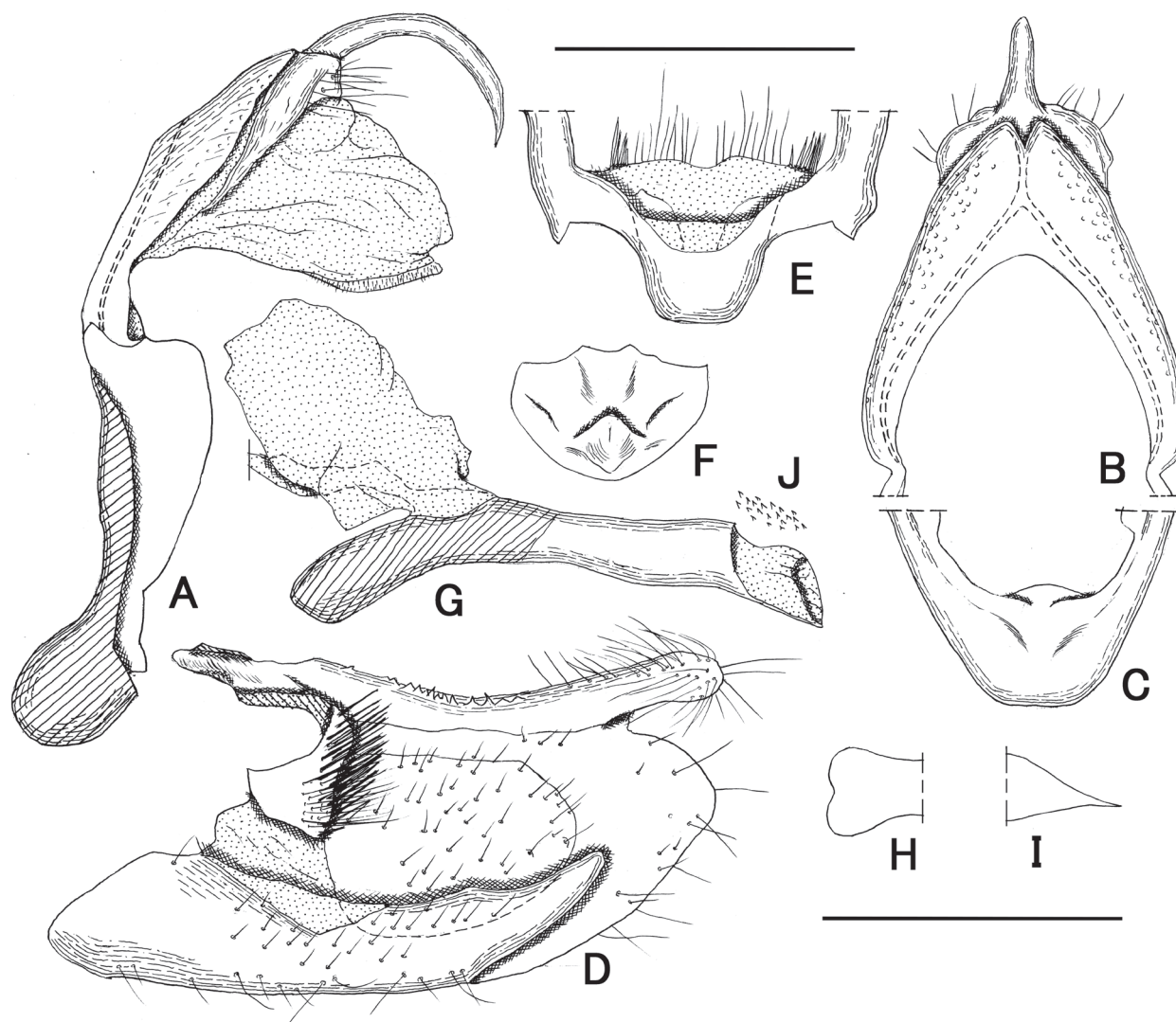


Fig. 42. Male genitalia, *Acasis viretata viretata* (Hübner). A, lateral; B, tegumen and uncus, dorsal; C, saccus, dorsal; D, right valve, inner; E, transtilla, dorsal; F, juxta, ventral; G, phallus, lateral; H, anterior part of phallus, ventral; I, caudal part of phallus, ventral; J, cornuti. Scales = 0.5 mm.

viretata viretata (Hübner) and *A. viretata himalayica* Prout, 1958. The Japanese subspecies belongs to the nominotypical one.

***Acasis viretata viretata* (Hübner)**
(Figs. 15A–C, 38E–F, 39A–C, 42)

Geometra viretata Hübner, [1779] 1796: pl. 44, fig. 230.

Diagnosis. Forewing length 10–12 mm in male, 12–13 mm in female; male and female genitalia shown in Figs. 15A–C, 42. This subspecies differs from *A. viretata himalayica* in the following points: inner margin of antemedial line gently curved in *viretata viretata*, but strongly angulate at Cu vein in *viretata himalayica*, and a costal spot of subterminal and adterminal lines indistinct in *viretata viretata*, but distinct in *viretata himalayica*.

Specimens examined. JAPAN: Hokkaido: Tokachi, Nukabira, 1♀, 31. v. 1979 (S. Hashimoto); same locality, 1♀, 2. vi. 1979 (S. Hashimoto); Honshu: Iwate, Amihari-spa, 1♀, 20. viii. 1979 (S. Hashimoto); Niigata, Mt. Oomine, 1♂, 13–14. vii. 1963 (R. Sato); Niigata, Hirudaira, 1♂, 29. vii. 1965 (R. Sato); Niigata, Sakasamaki, 1♀, 21. viii. 1973 (R. Sato); Niigata, Mt. Atema, 1♀, 27. vii. 1971 (A. Seino); Nagano, Togakushi, 1♀, 17. viii. 1965 (R. Sato); Nagano, Nishino, 1♂, 2. v. 1977 (K. Ueda); same locality, 1♂, 26. iv. 1982 (S. Hashimoto); Gifu, Hikagedaira, 1♂, 17. v. 1978 (S. Hashimoto); same locality, 3♀, 13–14. vi. 1981 (S. Hashimoto); same locality, 1♀, 22. vii. 1981 (T. Tanabe); same locality, 1♀, 3. viii. 1981 (T. Tanabe); Wakayama, Kojin, 1♀, 9. vii. 1984 (S. Hashimoto); Shikoku: Kochi, Ashizurimisaki, 1♂ (OMNH), 22. xi. 1976 (Y. Miyatake); Ryukyus: Okinawa Is., Hungawa-dam, 1♀, 10. vii. 1996 (T. Mano).

Distribution. Japan (Hokkaido, Honshu, Shikoku, Kyushu, Amami-oshima Is., Tokunoshima Is., and Okinawa Is), Korea, and Russian Far East to Europe.

Host plants. Japan: *Quercus serrata* Murray (Fagaceae; Inoue, 1971); *Q. dentata* Thunberg (Fagaceae; Nakajima, 1974).

Immature stages. Not examined.

Bionomics. The moths are two or more generations per year and arise at late spring to summer in Honshu, but in more warm areas (Southern Shikoku to the Ryukyus) arise also at late autumn to winter.

Genus *Otoplecta* Warren

Otoplecta Warren, 1895: 116. Type species: *Coremia frigida* Butler, 1878: 450, by original designation.

Diagnosis. The genus *Otoplecta* is characterized by the following apomorphies (Fig. 4): 1, forewing with M1 connate with Rs (Fig. 39D); 2, female hindwing with Rs and M1 separate (Fig. 39F); 3, male hindwing with CuA2 almost same length with CuA1 (Fig. 39E); 4, posterior margin of tegumen rounded (Fig. 43B); 5, cucullus hairy oblong lobe on dorsal end of valve (Fig. 43D); 6, distal process of sacculus absent; 7, female sternum VIII almost membranous except for anterior margin (Fig. 43K); 8, papillae anales slightly rounded,

sclerotized, longer than height (Fig. 43I); 9, ventral sclerite (sternite IX) between papillae anales nearly trapezoid (Fig. 43K). However, most of them are homoplastic or reversal (Fig. 4). *Otoplecta* is distinguished from other trichopterygine genera by the combination of characters as follows: hind tibia with a pair of apical spurs; forewing with one areole; forewing with M1 connate with Rs; hindwing white, with fuscous discal spot, pale fuscous postmedial line and a row of terminal dots fuscous, large, each of them on vein; hindwing venation (Sc fused with R + Rs (an upper vein of discal cell) for most length of discal cell in both sexes; Rs and M1 separate in both sexes; CuA2 almost same length with CuA1 in both sexes); anal fold large; both transtillae completely fused with each other medially; saccular process reduced; phallus slender, longer than valve; corpus bursae globular, covered with spines circularly near anterior end, with appendix bursae at anterior end; spermatheca without lagena; female 8th tergum divided longitudinally by membrane; ventral sclerite (sternite IX) between papillae anales broad.

Description. The generic description is based on only one species and the following studies: Warren, 1895; Hashimoto, 1985.

Adult

Head (Fig. 5F): Clothed with scales thickly; antennal flagellomeres filiform; frons rounded; labial palpus porrect, 2.0 times as long as diameter of eye; proboscis developed.

Thorax (Figs. 11E, 38G–H, 39D–F): Thorax stout; metepimeron enlarged, divided into anterior and posterior parts by inner ridge in both sexes; male metameron arched posteriorly; hind tibia with a pair of spurs (apical spurs), with a hair-pencil in male. Forewing white, with fuscous lines consisting of basal, postbasal, antemedial, postmedial, and broad terminal (subterminal + adterminal + terminal) ones; discal spot large, black, bordered with postmedial line; forewing with one areole; M1 connate with Rs. Hindwing white, with fuscous discal spot, pale fuscous postmedial line and a row of terminal dots fuscous, large, each of them being on terminal end of Rs to CuA2; male with an large anal fold (more than 1/2 length of anal margin); Sc fused with R + Rs for most length of discal cell; hindwing Rs and M1 separate in both sexes; M3 and CuA1 separate, almost equal length; CuA2 and CuA1 almost equal length in both sexes.

Pregenital abdomen: Male sternum II pouch very small; male sternum II with a pair of triangular expansions.

Male genitalia (Fig. 43A–H): Anterior margin of tegumen deeply incurved, posterior margin rather strongly curved posteriorly; saccus rounded, well protruded anteriorly; uncus short, slender, gently curved ventrally; socius reduced at basal side of uncus, recognizable as a hairy part; gnathos narrow, being at caudo-ventral side of tegumen, completely fused with uncus-socius complex; costa sclerotized, with a sclerite expanding mesad on mid-dorsal margin; costal arm reduced; cucullus small, oblong, with hairs; both transtillae completely fused medially, U-shaped; sacculus very thick, sclerotized; saccular projection absent; harpe large, oblong, occupied median part of valve, sclerotized, with a sclerotized lobe proximo-dorsally, on which long stout spines and hairs arise; valvula broad, rounded at posterior margin; phallus longer

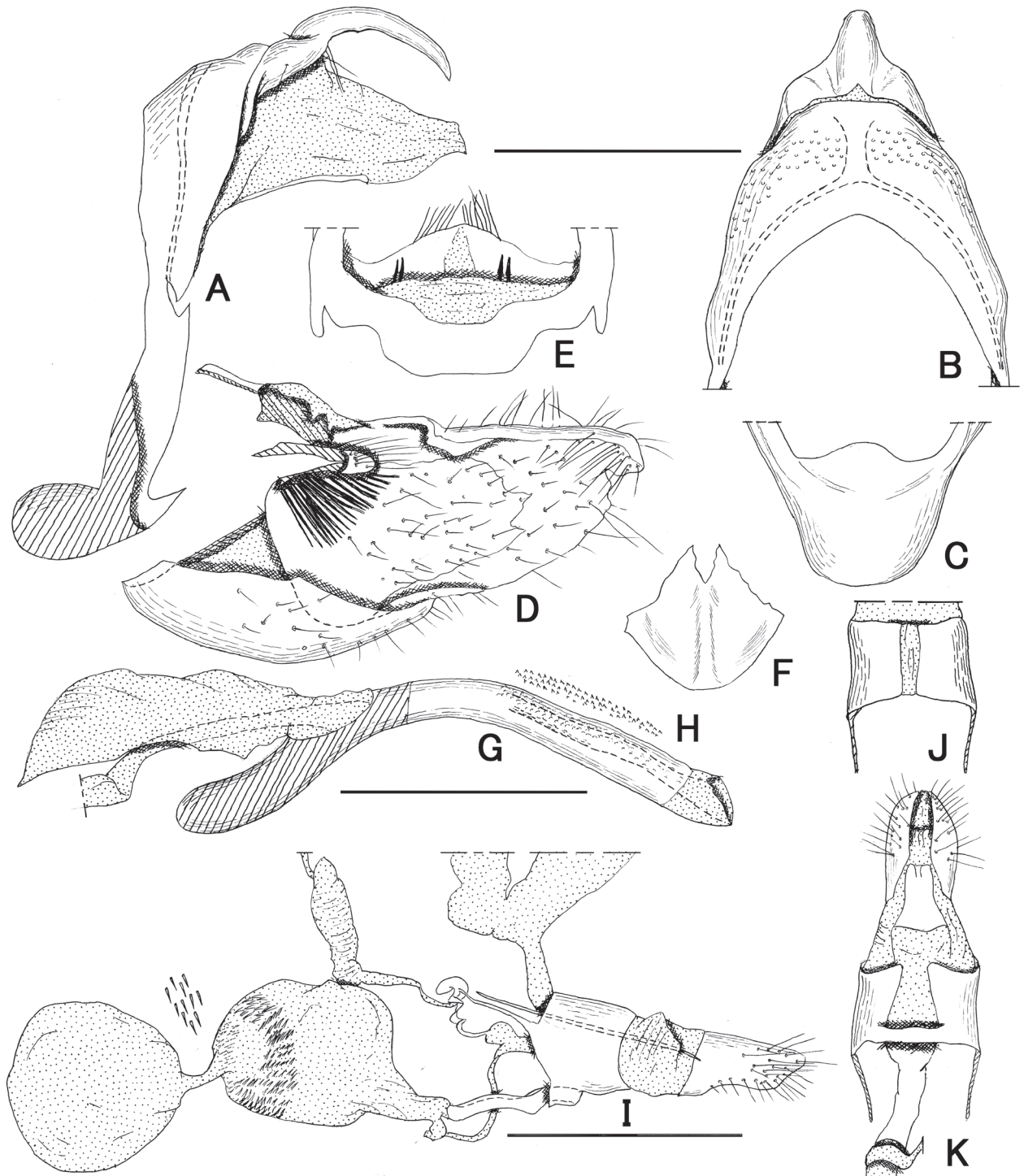


Fig. 43. Genitalia, *Otoplecta frigida* (Butler) ((A–H, ♂; I–K, ♀). A, lateral; B, tegumen and uncus, dorsal; C, saccus, dorsal; D, right valve, inner; E, transtillae, dorsal; F, juxta, ventral; G, phallus, lateral; H, cornuti; I, lateral; J, tergum VIII, dorsal; K, post abdomen, ventral. Scales = 0.5 mm (A–H), 1.0 mm (I–K).

than valve, very slender, with cornuti composed of many fine spines; coecum distinct, about 1/4 length of phallus; juxta rhombic, deeply invaginate at posterior end.

Male genital musculature (Table 2): Any extra muscles and secondary movement of the muscles not seen.

Female genitalia (Fig. 43I–K): Corpus bursae subglobular, covered with small needle-like spines circularly near anterior end, with globular appendix bursae at anterior end; ductus

bursae-corporis bursae junction rather distinct; ductus bursae slightly longer than corpus bursae, narrow, without spines; ductus seminalis arising from middle of ductus bursae (from anterior end of antrum); antrum narrow, long, well sclerotized; spermatheca without lagena as a lateral sac; 8th segment sclerotized semicylindrically, connected with opposite one by slender plate in front of ostium; sclerite in front of ostium narrow, well sclerotized; 8th tergum longitudinally divided by

membrane; ostium being at anterior margin of 8th sternum; apophysis anterioris rather long; apophysis posterioris very long, about 2.5 time as long as apophysis anterioris; papillae anales well sclerotized, slightly rounded, longer than height; ventral sclerite (sternite IX) between papillae anales broad, sclerotized, nearly trapezoid.

Immature stages

Last instar larva (Fig. 16B): 12–13 mm in length; head blackish brown to black, mottled with yellowish brown, wider than long, reticulate-rugose; labral emargination about 0.3 deep; mandible with 6 teeth; spinneret cylindrical, longer than labial palpus; body pale greenish yellow, with blackish brown prothoracic shield; body integument irregularly pustulate; ventral and anal prolegs small; crochets of ventral and anal prolegs arranged in biordinal mesoserries, 13–16 in number on ventral proleg, 16–19 in number on anal one; paraproct reduced. Chaetotaxy: SS2 in between stemma 5 & 6; Pb puncture anterior to a line joining P1 and P2 setae; A3 ventral to a line joining L1 and A2; prothoracic SD setal group unisetose on prothoracic shield; ventral proleg with four SV setae; on anal shield D1 setae slightly anterior to a line drawn between SD2s.

Pupa: 7.0–7.7 mm in length, 2.5–3.0 mm in width, brown; labial palpus not exposed; forewing reaching before posterior margin of 4th abdominal segment; antenna and midleg reaching apical margin of forewing; proboscis reaching just before apical margin of forewing; fore femur not exposed; hind tarsus exposed; dorsal groove distinct, narrow; lateral groove indistinct; cremaster with four pairs of setae, of which anterior three are coiled setae and terminal one is sclerotized and pointed.

Distribution. Japan.

Bionomics. There is a single generation per year. The moths appear in spring to late spring, show a diurnal habit, and are obtained from the low mountainous areas. The larvae are concealed in the flower buds of *Viburnum dilatatum* loosely woven with silk and feed on them inside (Fig. 16B).

Remarks. *Otoplecta* is monobasic and endemic to Japan, and constitutes a sister group relationship with the genus *Acasis* (see the remarks of *Acasis*). *Otoplecta* + *Acasis* and *Archaeocasis* + *Pseudacasis* constitute the sister groups (Figs. 2, 4). As for differences among them, see the remarks of the genus *Pseudacasis*.

Otoplecta frigida (Butler)

(Figs. 5F, 11E, 16B, 38G–H, 39D–F, 43)

Coremia frigida Butler, 1878: 450.

Otoplecta frigida: Warren, 1895: 116.

Diagnosis. Forewing length 9–12 mm in male, 11–12 mm in female; male and female genitalia shown in Fig. 43. This species is easily distinguishable from the *Acasis* and *Pseudacasis* species by the wing pattern (forewing white, with distinct fuscous lines and a large fuscous discal dot; hindwing white, with a fuscous discal dot and large terminal dots) and the male and female genital features (male saccular process absent; female sternite IX large, trapezoid).

Specimens examined. JAPAN: Honshu: Iwate, Iwaizumi,

1♂, 21. iv. 1973 (O. Saito); Iwate, Kuriyagawa, 1♀, 14. v. 1973 (O. Saito); Iwate, Kuzakai, 1♀, 4. vi. 1981 (K. Yasuda); Niigata, Mt. Kakuda, 2♂, 22. iv. 1972 (R. Sato); Niigata, Nagaoka, 2♂, 18. iv. 1992 (S. Hashimoto); Nagano, Taroyama, 1♀, 3. v. 1981 (T. Oosone); Nagano, Ueda, 2♂, 24–25. iv. 1982 (S. Hashimoto); Aichi, Mt. Rokushosan, 1♂, 16. iv. 1981 (S. Hashimoto); Hyogo, Sasabe, 1♀, 23. iv. 1981 (T. Saito); same locality, 1♂, 2♀, 26. iv. 1981 (S. Hashimoto); same locality, 1♂, em. 4. iv. 1983 (S. Hashimoto).

Distribution. Japan (Hokkaido, Honshu, Shikoku, and Kyushu).

Host plants. *Viburnum dilatatum* Thunberg (Adoxaceae; Nakamura, 1980).

Immature stages. See the generic description.

Bionomics. See the generic description.

Genus *Esakiopteryx* Inoue

Esakiopteryx Inoue, 1958: 247. Type species: *Lobophora volitans* Butler, 1878: 446, by original designation.

Diagnosis. *Esakiopteryx* is characterized by the following apomorphies (Fig. 4): 1, antrum indistinct, membranous (Fig. 46I); 2, papillae anales covered with crumpled membrane dorsally (Fig. 46H). This genus is distinguishable from other genera of the tribe Trichopterygini by the combination of characters as follows: hind tibia with a pair of apical spurs; forewing with one large areole; M1 arising from areole; hindwing white, scattered with pale brown scales, with indistinct postmedial, subterminal, and adterminal lines; hindwing venation (Sc separate from an upper vein of discal cell (R + Rs) and connected with a short vein of R near end of discal cell in male, fused in female; Rs and M1 stalked in both sexes; CuA2 very short, less than 1/4 length of CuA1 in male); saccular process very long, with a spatulate apex; corpus bursae subglobular, covered with wholly or partly numerous spines forming star-shaped base on outer surface; ductus bursae thick, without any spines; 8th tergum well developed, sclerotized; papillae anales more rounded, covered with crumple membrane dorsally.

Description. The generic description is based on two species and the following studies: Inoue, 1958; Yazaki, 1972, 1986a; Hashimoto, 1982.

Adult

Head (1G): Head clothed with scales thickly on vertex, smoothly on face; antennal flagellomeres filiform; frons slightly rounded; labial palpus porrect, about 1.0 to 1.5 times as long as diameter of eye in male and about 1.5 to 2.0 in female; proboscis developed.

Thorax (Figs. 44A–B, 45A–C): Thorax stout; metepimeron enlarged, divided into anterior and posterior parts by inner ridge in both sexes; male metameron arched posteriorly; hind tibia with a pair of spurs (apical spurs), with a hair-pencil in male. Forewing colour pattern variable, white or olive green, scattered by reddish brown scales, with fuscous short line on each vein along termen, with olive green to fuscous lines mainly consisting of basal, postbasal, antemedial, postmedial, subterminal, and adterminal ones; antemedial and postmedial lines margined by fuscous line, frequently fused with each

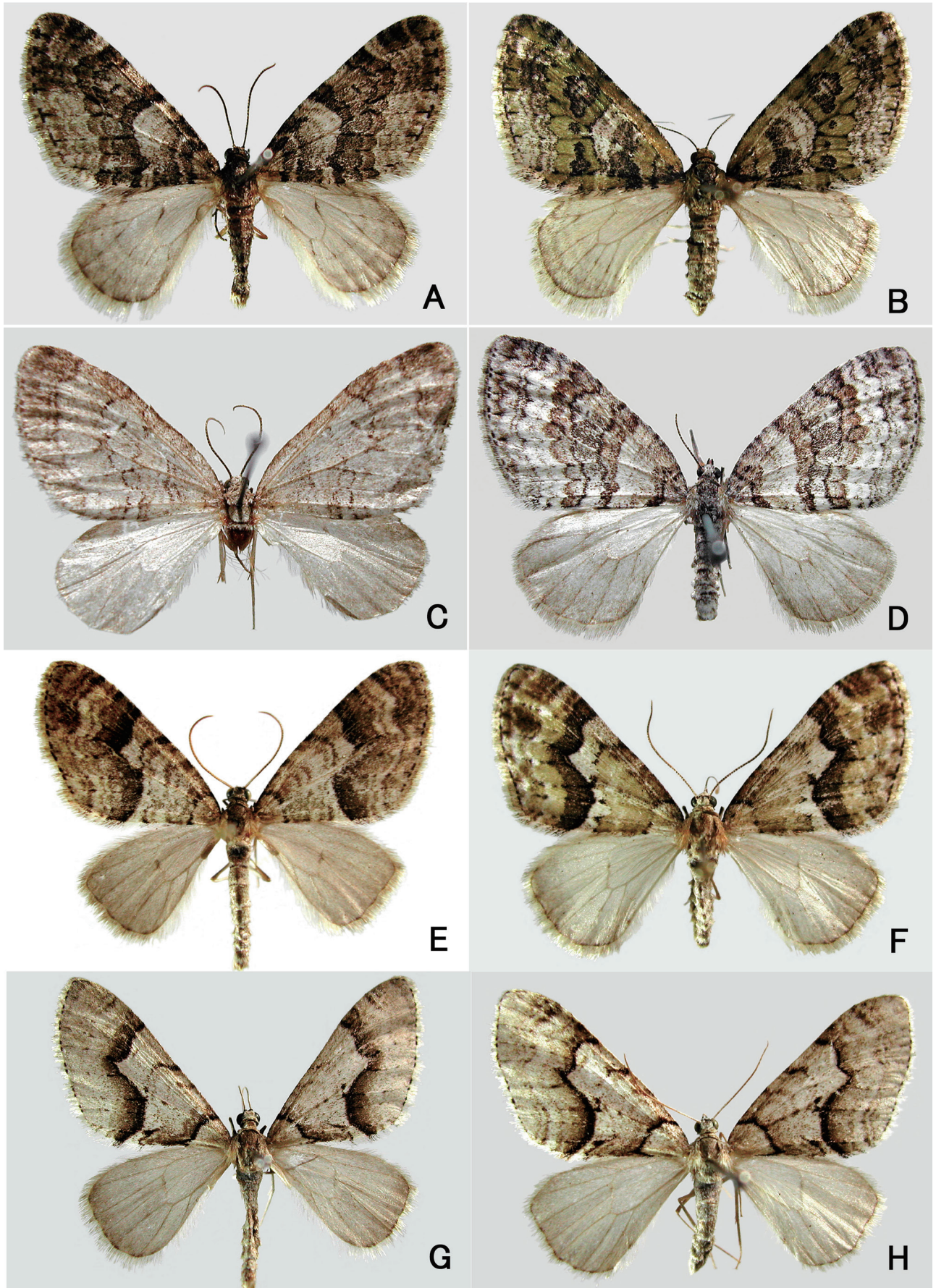


Fig. 44. Adults. A, *Esakiopteryx volitans* (Butler), ♂; B, ditto, ♀ C, *Nothocasis sertata* (Hübner), ♂ (Czech); D, ditto, ♀ (Czech); E, *Paralobophora auricilla* (Inoue), ♂; F, ditto, ♀ G, *Paralobophora ustata* (Christoph), ♂; H, ditto, ♀.

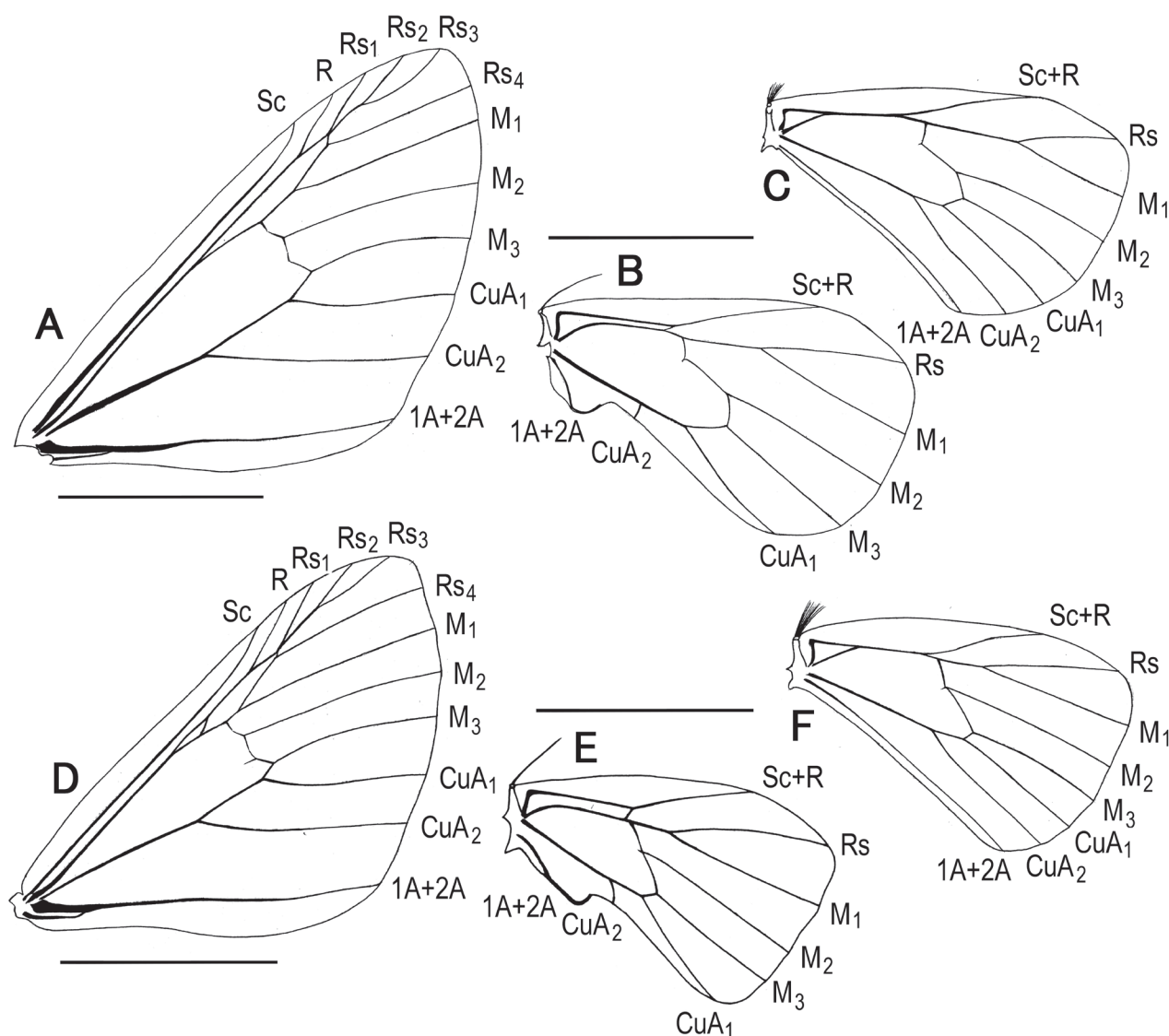


Fig. 45. Wing venation. A, *Esakiopteryx volitans* (Butler), ♂ (forewing); B, ditto, ♂ (hindwing); C, ditto, ♀ (hindwing); D, *Paratrachopteryx misera* (Butler), ♂ (forewing); E, ditto, ♂ (hindwing); F, ditto, ♀ (hindwing). Scales = 5.0 mm.

other except for whitish surrounding part of fuscous discal spot; subterminal line consisting of two close adjacent lines; termen between M2 and tornus whitish; terminal dots forming discontinuous short line; forewing with a long areole; M1 arising from areole. Hindwing white, scattered by pale greyish brown scales, with indistinct postmedial, subterminal, and adterminal pale fuscous lines; discal spot indistinct; male with an anal fold (about 1/5 length of anal margin); Sc separate from an upper vein of discal cell (R + Rs) and connected with a short vein of R before end of discal cell in male, fused in female; Rs and M1 stalked; M3 and CuA1 separate, almost equal length; CuA2 very short, less than 1/5 length of CuA1 in male.

Pregenital abdomen: Male sternum II pouch reduced, externally indistinguishable; antero-lateral sides of A2 sternum slightly expanded upward triangularly.

Male genitalia (Fig. 46A–G; Yazaki, 1986: fig. 2): Anterior margin of tegumen shallowly incurved, posterior margin rather strongly curved posteriorly; saccus rounded, slightly extending anteriorly; uncus long, slender, gently curved, slightly swollen

before apex, with a pointed apex; socius more or less reduced at basal side of uncus, recognized as a hairy part; gnathos recognized as slender sclerite along postero-lateral side of tegumen, synscleritous with uncus-socius complex; costa sclerotized; cucullus distinct, triangularly rounded, with hairs; costal arm short, compressed; transtilla triangular, with many hairs; saccules sclerotized, slender, constricted on basal 1/3, with a long spatulate projection; harpe large, rather oval, occupying median part of valve, more or less sclerotized; valvula triangular, weakly sclerotized; phallus shorter than valve, with 3 or 4 spines at distal right side or without spines; coecum distinct, moderate, about 1/4 to 1/3 length of phallus; juxta longer than wide, parallel sided.

Male genital musculature (Table 2): Extra muscle (m5') originating on vinculum and inserting into harpe is present.

Female genitalia (Fig. 46H–I; Yazaki, 1986: fig. 4): Corpus bursae subglobular, covered with numerous spines forming star-shaped base on outer surface wholly or partly; ductus bursae shorter or longer than corpus bursae, rather thick, without any

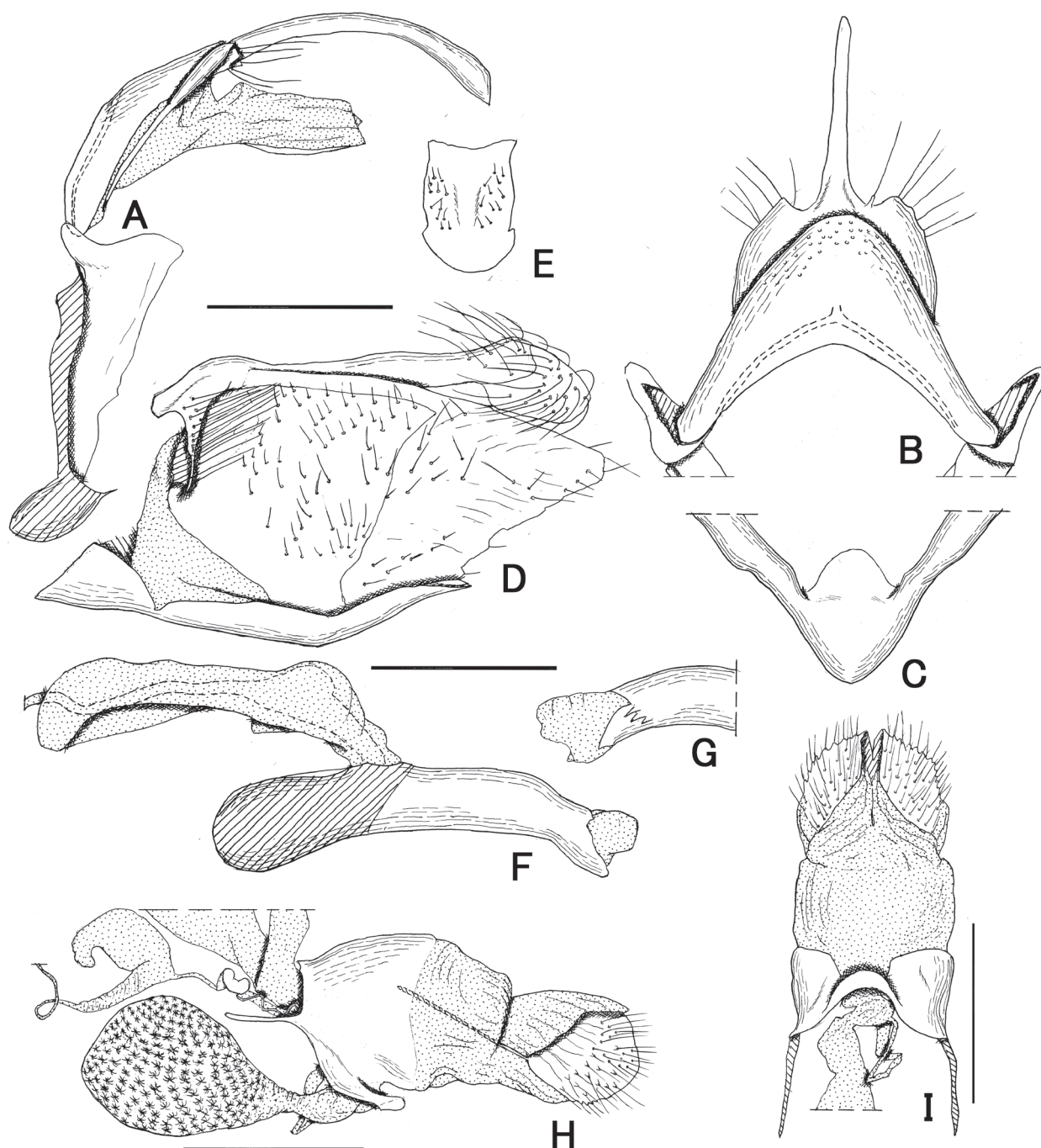


Fig. 46. Genitalia, *Esakiopteryx volitans* (Butler) (A–G, ♂; H–I, ♀). A, lateral; B, tegumen and uncus, dorsal; C, saccus, dorsal; D, right valve, inner; E, juxta, ventral; F, phallus, lateral; G, caudal part of phallus, right; H, lateral; I, post abdomen, ventral. Scales = 0.5 mm (A–G), 1.0 mm (H–I).

spines; ductus bursae-corporis bursae junction distinct; ductus seminalis arising near ostium; antrum indistinct, rather thick, membranous; 8th segment almost cylindrical, well sclerotized except for narrow membranous posterior part (8th sternum) of ostium; ostium being at anterior margin of 8th sternum; apophysis anterioris rather short, about 1/2 length of apophysis posterioris; papillae anales more rounded, covered with crumpled membrane dorsally on which many minute hairs, with many small protuberances from which stout hairs arise; ventral sclerite (sternite IX) between papillae anales very slender.

Immature stages

Last instar larva (Fig. 16C; Table 5): About 16 mm in length; colour pattern and features as in Yazaki (1972) and Hashimoto (1982); head rounded, longer than wide; body with distinct dorsal and lateral protrusions, on each protrusion the seta is bearing respectively; prothorax without protrusions; meso- and metathoraces with five protrusions (D1, D2, SD1, L1 and L2 are bearing on each protrusion) respectively, especially dorsal two protrusions large; 1st to 7th abdominal segments with two dorsal and two lateral protrusions (D1, D2, L1 and L2

Table 5. Larval characters of the *Trichopteryx* genus group (1/2).

Species	Head						Body		
	Pattern	Pb puncture	SS2 seta	Spinneret	Labral emargination	Left mandible	Skin	pattern	Protrusions
<i>Esakiopteryx volitans</i> ^{2), 5)}	fuscous mottles	anterior	near stemma 6	cylindrical, longer than LP	about 0.3 deep	6 teeth, most inner one finely bifid	granulated	wholly tinged with reddish brown and with reddish purple on	present on dorsal and lateral
<i>Paralobophora auricilla</i>	absent	anterior	near stemma 5	cylindrical, longer than LP	about 0.3 deep	6 teeth, most inner one dull	finely roughened	fuscous around spiracle and SD1& L2 pinacula	absent
<i>Paralobophora ustata</i>	absent	anterior	near stemma 5	cylindrical, longer than LP	about 0.3 deep	6 teeth	finely roughened	fuscous around L2 pinaculum	absent
<i>Cladara limitaria</i> ¹⁾	absent	posterior to a line joining P1 & P2	between stemmata 5 & 6	cylindrical, shorter than LP	about 0.2 deep	6teeth, most inner one finely serrate	finely roughened	yellow subspiracular line	absent
<i>Cladara miracula</i>	absent	almost on a line	between stemmata 5 & 6	fan-shaped apex, almost same length with LP	about 0.3 deep	6 teeth, most inner one dull	finely roughened	—	absent
<i>Paratrachopteryx misera</i> ⁵⁾	fuscous mottles	anterior	between stemmata 4 & 6	cylindrical, longer than LP	about 0.25 deep	6 teeth, most inner one dull	granulated	wholly tinged with reddish brown and	present on dorsal
<i>Trichopteryx fastuosa</i> ²⁾	absent	slightly anterior	between stemmata 5 & 6	small fan-shaped apex, longer than LP	about 0.3 deep	6 teeth	finely granulated	yellowish white subspiracular line	absent
<i>Trichopteryx hemana</i> ³⁾	absent	almost on a line	between stemmata 5 & 6	small fan-shaped apex, longer than LP	about 0.3 deep	6 teeth	finely roughened	yellow subspiracular line	absent
<i>Trichopteryx ignorata</i>	absent	posterior	between stemmata 5 & 6	small fan-shaped apex, longer than LP	about 0.25 deep	6 teeth	finely roughened	yellow subspiracular line	absent
<i>Trichopteryx microloba</i> ²⁾	absent	anterior	between stemmata 5 & 7	small fan-shaped apex, longer than LP	about 0.35 deep	6 teeth	finely granulated	white subspiracular line	absent
<i>Trichopteryx nagaii</i>	absent	almost on a line	between stemmata 5 & 8	cylindrical, longer than LP	about 0.3 deep	6 teeth	finely roughened	—	absent
<i>Trichopteryx teranea</i> ³⁾	absent	almost on a line	between stemmata 5 & 9	small fan-shaped apex, longer than LP	about 0.3 deep	6 teeth	finely roughened	yellowish white subspiracular line	absent
<i>Trichopteryx ussurica</i>	absent	anterior	between stemmata 5 & 6	cylindrical, longer than LP	about 0.25 deep	6 teeth, most inner one dull	finely roughened	yellow subspiracular line	absent

LP: labial palpus; PS: prothoracic shield; —: not examined; 1) McGuffin, 1945, 1958; 2) Yazaki, 1972; 3) Yazaki, 1974; 4) Yazaki, 1975; 5) Hashimoto, 1982.

Table 5. Larval characters of the *Trichopteryx* genus group (2/2).

Species	Body								
	Setae		T1	T2-T3	A1 to A9		A10		
	Thorax	Abdomen	SD setae	SD1	Pinacula on A1-A9	Chrochets on A5	Anal shield	Anal proleg	Crochets
<i>Esakiopteryx volitans</i> ^{2), 5)}	long, slender pointed	long, pointed	unisotose on PS	long, but shorter than D1 & D2, almost same length as L1	small	16-21	D2 shortest	SV2 longer than SV3	18-21
<i>Paralobophora auricilla</i>	very long, slender, pointed	very long, slender, pointed	disetose on PS	almost same length as others	moderately large	20-28	D2 shortest	SV2 longer than SV3	22-28
<i>Paralobophora ustata</i>	very long, slender, pointed	short, bulant-tipped	disetose on PS	almost same length as others	moderately large	17-20	D1 shortest	SV2 same length with SV3	23-24
<i>Cladara limitaria</i> ¹⁾	short, longer than abdominal setae	short, bulant-tipped	disetose on PS	longest	indistinct	8-18	D2 shortest	—	8-18
<i>Cladara miracula</i>	short, longer than abdominal setae	short, bulant-tipped	disetose on PS	longest	small	16-20	D2 shortest	SV2 shorter than SV3	24-26
<i>Paratrachopteryx misera</i> ⁵⁾	longer than abdominal setae	rather long, pointed	unisotose on PS	long, but shorter than D2, almost same length as D1	small	17	D1 shortest	SV2 same length with SV3	20-21
<i>Trichopteryx fastuosa</i> ²⁾	short, but longer than abdominal setae	very short, bulant-tipped	unisotose on PS	longest	indistinct	13-16	almost same length	SV2 same length with SV3	14-17
<i>Trichopteryx hemana</i> ³⁾	short, longer than abdominal setae	very short, bulant-tipped	unisotose on PS	short, same length as SD2	small	15-17	D2 shortest	SV2 longer than SV3	17-18
<i>Trichopteryx ignorata</i>	short, longer than abdominal setae	very short, bulant-tipped	unisotose on PS	longest	indistinct	14-18	D2 shortest	SV2 same length with SV3	18-23
<i>Trichopteryx microloba</i> ²⁾	short, longer than abdominal setae	very short, bulant-tipped	unisotose on PS	longest	indistinct	13-18	D2 shortest	SV2 same length with SV3	15-22
<i>Trichopteryx nagaii</i>	short, longer than abdominal setae	very short, bulant-tipped	unisotose on PS	longest	indistinct	12-14	almost same length	SV2 same length with SV3	16-22
<i>Trichopteryx teranea</i> ³⁾	short, longer than abdominal setae	very short, bulant-tipped	unisotose on PS	longest	indistinct	15-17	almost same length	SV2 longer than SV3, slightly dorso-caudal to SV3	18
<i>Trichopteryx ussurica</i>	short, longer than abdominal setae	very short, bulant-tipped	unisotose on PS	longest	indistinct	17-20	almost same length	SV2 same length with SV3, caudal to SV3	17-23

bearing on each protrusion), respectively, dorsal two large; 8th abdominal segment with two dorsal and one lateral protrusions (D1, D2 and L1 bearing on each); 9th abdominal one with one dorsal (D1 bearing) protrusion; paraproct not developed. Chaetotaxy: on cranium A3 ventral to a line joining L1 and A2; on prothorax L setae and SV setae on same pinaculum respectively; ventral proleg with four SV setae; on anal shield D1 setae anterior to a line drawn between SD2s.

Pupa (Fig. 19C): Brown to dark brown, about 8.4 mm in length, about 2.8 mm in width; labial palpus not exposed; forewing reaching near posterior margin of 4th abdominal segment; antenna, proboscis and mid leg extending beyond apical margin of forewing; femur of foreleg exposed; hind

tarsus exposed or not; dorsal and lateral grooves distinct; cremaster with a pair of anchor shaped, sclerotized and pointed setae (Fig. 19C).

Distribution. Russian Far East (Southeast Siberia), China, Taiwan, Korea, and Japan.

Bionomics. There is a single generation per year. The adults are spring moth and obtained from the laurel forest or the deciduous forest in the low to high mountains. Japanese species utilizes the family Fagaceae as the larval host plant.

Remarks. The genus *Esakiopteryx* is composed of two species known from temperate East Asia (Yazaki, 1986). Sugi (1987) represented that the distinctive larval characters also warrant the validity of separating this taxon genetically.

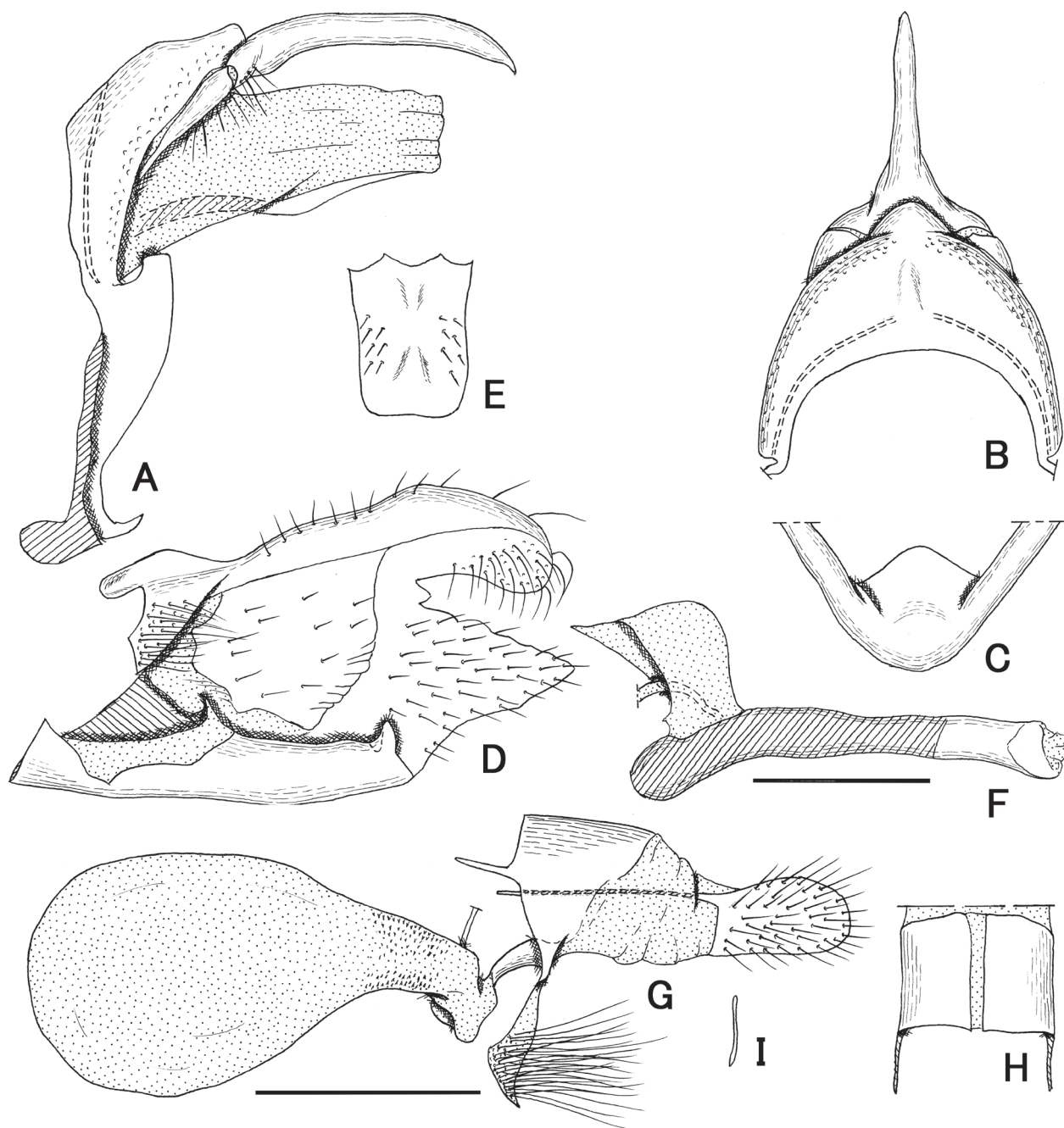


Fig. 47. Genitalia, *Nothocasis sertata* (Hübner) (A–F, ♂; G–I, ♀), (Czech). A, lateral; B, tegumen and uncus, dorsal; C, saccus, dorsal; D, right valve, inner; E, juxta, ventral; F, phallus, lateral; G, lateral; H, tergum VIII, dorsal; I, narrow sclerite (sternite IX). Scales = 0.5 mm (A–F), 1.0 mm (G–I).

As a result of the phylogenetic relationships (Figs. 2, 4), *Esakiopteryx* were included into the *Trichopteryx* genus-group together with *Nothocasis*, *Cladara*, *Paralobophora*, *Paratrachopteryx*, and *Trichopteryx*, and was a sister group of the remaining genera. This genus-group is based on the following two characters: 1. costal arm short to medium, rather broad, sclerotized on dorsal margin, and 2. valvula triangular, with an obtuse apex (Figs. 14E, 46D, 47D, 48D, 53D, 60D). An additional massive muscle m5' might be also an autapomorphy of this genus group. Their relationships are as follows (Figs. 2, 4): *Esakiopteryx* + (((*Nothocasis* + (*Cladara* + *Paralobophora*))

+ (*Paratrachopteryx* + *Trichopteryx*)). *Esakiopteryx* is easily distinguishable from others by the forewing areoles; one (Fig. 45A) in *Esakiopteryx* and two (Figs. 11A, 45D, 52A, D) in others.

In the Table 5, the larval characters of the *Trichopteryx* genus-group are briefly described and compared with each other.

***Esakiopteryx volitans* (Butler)**
(Figs. 5G, 16C, 19C, 44A–B, 45A–C, 46)

Lobophora volitans Butler, 1878: 446.
Lobophora volitans var. *elegans* Butler, 1878: 446.
Lobophora expressata Christoph, 1881: 88.
Trichopteryx expressata: Meyrick, 1892: 62.
Trichopteryx volitans: Leech, 1897: 73.
Trichopterigia volitans: Prout, 1914: 186.
Esakiopteryx volitans: Inoue, 1958: 247.

Diagnosis. Forewing length 13–15 mm in male, 13–15 mm in female; male and female genitalia shown in Fig. 46. This species is distinguishable from the Taiwanese species, *E. venusta* Yazaki, 1986 as follows: saccular process bent caudo-dorsally at middle in *E. volitans*, but almost straight in *E. venusta*; phallus with three or four small spines at right side near distal tip in *E. volitans*, but without in *E. venusta*; corpus bursae large, wholly scobinate in *E. volitans*, but small, partly scobinate in *E. venusta*; ductus bursae short in *E. volitans*, but long, rather thick in *E. venusta*.

Specimens examined. JAPAN: Hokkaido: Tokachi, Nukabira, 1♂, 3♀, 30–31. v. 1977 (S. Hashimoto); Kushiro, Futatsuyama, 1♂, 1♀, 12. v. 1980 (K. Iijima); Honshu: Niigata, Sado Is., Nyugawa, 2♂, 1♀, 2. v. 1965, (R. Sato); Niigata, Okutainai, 1♀, 24–25. iv. 1971 (R. Sato); Niigata, Miomote, 1♂, 1♀, 18. v. 1974 (R. Sato); 1♀, same data, (A. Seino); Niigata, Akadani, 1♂, 3♀, 28. iv. 1968 (R. Sato); same locality, 1♀, 2. v. 1970 (A. Seino); Niigata, Mt. Kakuda, 1♂, 15. iv. 1972 (H. Hara); same locality, 1♀ (Host plant: *Quercus crispula* Blume), emerged 16. iv. 1972 (R. Sato); Niigata, Sugigawa, 1♂, 20. iv. 1963 (R. Sato); Nagano, Ohisawa, 1♂, 4. v. 1978 (H. Hara); Nagano, Umanokoshi, 1♂, 1♀, 12. v. 1978 (H. Hara); Nagano, Nishino, 1♀, 2. v. 1977 (K. Ueda); same locality, 1♀, 26. iv. 1982 (S. Hashimoto); Gifu, Ho, 2♀, 4. V. 1978 (S. Hashimoto); Gifu, Hikagedaira, 8♂, 23. iv. 1978 (S. Hashimoto); same locality, 1♀, 5. v. 1978 (S. Hashimoto); same locality, 1♂, 1♀, 28. iv. 1979 (T. Tanabe); same locality, 2♀, 30. iv. –2. v. 1979 (S. Hashimoto); same locality, 1♀, 11. v. 1980 (S. Hashimoto); same locality, 1♂, 2♀, 6. v. 1981 (S. Hashimoto); Gifu, Harayama, 1♂, 24. iv. 1977 (S. Hashimoto); Gifu, Yabudani, 1♀, 29. iii. 1979 (T. Tanabe); Aichi, Mt. Rokushosan, 2♂, 8♀, 15. iv. 1978 (S. Hashimoto); Aichi, Fusso-mizube-koen, 1♂, 15. iv. 1994 (S. Hashimoto); Osaka, Minoo, 1♂, 27. iii. 1975 (T. Saito); same locality, 4♂, 25. iii. 1978 (S. Hashimoto); same locality, 6♂, 29. iii. 1978 (S. Hashimoto); same locality, 8♂, 31. iii. 1978 (S. Hashimoto); same locality, 7♂, 5♀, 5. iv. 1978 (S. Hashimoto); same locality, 3♀, 8. iv. 1978 (S. Hashimoto); same locality, 2♀ (Host plant: *Quercus aliena* Blume), emerged 25. iii. 1980 (S. Hashimoto); same locality, 3♂, 1♀, 23. iii. 1981 (S. Hashimoto); same locality, 3♂, 2. iv. 1984 (S. Hashimoto); Osaka, Hiraoka, 4♂, 1♀, 18. iii. 1978 (S. Hashimoto); Hyogo, Kamiakodani, 1♂, 28. iii. 1979 (S. Hashimoto); Kyushu: Fukuoka, Mt. Hikosan, 1♀ (OPU), 30. iii. 1954 (H. Kuroko); same locality, 1♀ (OPU), 16. vi. 1956 (H. Kuroko).

Distribution. Japan (Hokkaido, Honshu, Shikoku, Kyushu, and Tsushima Is.), Korea, China, and Russian Far East (Southeast Siberia).

Host plants. *Fagus japonica* Maximowicz & *Quercus glauca* Thunberg accepted in rearing condition (Fagaceae; Yazaki, 1972); *Q. aliena* Blume accepted in rearing condition

(Hashimoto, 1982); *Q. crispula* Blume (Sato, unpublished data).

Immature stages. See the generic description.

Bionomics. There is a single generation per year. The moths appear in early to late spring and obtained from the hilly to mountainous areas.

Genus *Paralobophora* Inoue

Paralobophora Inoue, 1943: 9 (as a subgenus of *Trichopteryx* Hübner). Type species: *Lobophora ustata* Christoph, 1881: 91, by original designation.

Diagnosis. *Paralobophora* is characterized by the following autapomorphies (Fig. 4): 1, costal arm medium in length, broad, wholly sclerotized except for distal part (cucullus) (Figs. 48D, 49D); 2, ductus bursae covered with small spines (sometimes forming star-shaped base) near anterior end of ductus bursae (Figs. 48H, 49I). This genus is distinguishable from other genera of the tribe Trichopterygini by the combination of characters as follows: hind tibia with a pair of apical spurs; forewing with two areoles; forewing with M1 arising from 2nd areole; hindwing white, scattered with pale brown scales; hindwing venation (Sc fused with R + Rs (an upper vein of discal cell) for most length of discal cell in both sexes; Rs and M1 separate in both sexes; CuA2 slightly shorter than CuA1 in male); anal fold small; costal arm long, completely sclerotized except for cucullus; valvula slightly tapering, long; saccular process rather short; 8th tergum longitudinally divided by membrane; corpus bursae globular, without any spines; ductus bursae thick, longer than corpus bursae; ductus seminalis arising near ostium.

Description. The generic description is based on two species and Inoue's (1943) original description.

Adult

Head: Head clothed with scales thickly on vertex, smoothly on face; antennal flagellomeres filiform; frons rounded; labial palpus slightly ascending, short, about 1.0 times as long as diameter of eye in both sexes; proboscis developed.

Thorax (Figs. 44E–H, 52A–C): Thorax stout; metepimeron enlarged, divided into anterior and posterior parts by inner ridge in both sexes; male metameron arched posteriorly; hind tibia with a pair of spurs (apical spurs), with a hair-pencil in male. Forewing dull white, densely or sparsely covered with brown scales, with fuscous lines (all lines present, but indistinct except for basal, postmedial and subterminal lines); subterminal line rather distinct on costal margin to M2, consisting of three lines; discal spot indistinct; terminal dots fuscous; forewing with two areole; 1st areole small, about 1/2 length of 2nd areole; M1 arising from 2nd areole. Hindwing dull white, scattered with pale brown scales, densely along termen; discal spot recognized; male with a small anal fold (about 1/4 length of anal margin); Sc fused with R + Rs for most length of discal cell in both sexes; Rs and M1 separate in both sexes; M3 and CuA1 separate, almost equal length; CuA2 short, about 1/2 length of CuA1 in male.

Pregenital abdomen: Male sternum II pouch small; male sternum II with a pair of triangular expansions.

Male genitalia (Figs. 48A–F, 49A–G): Anterior and

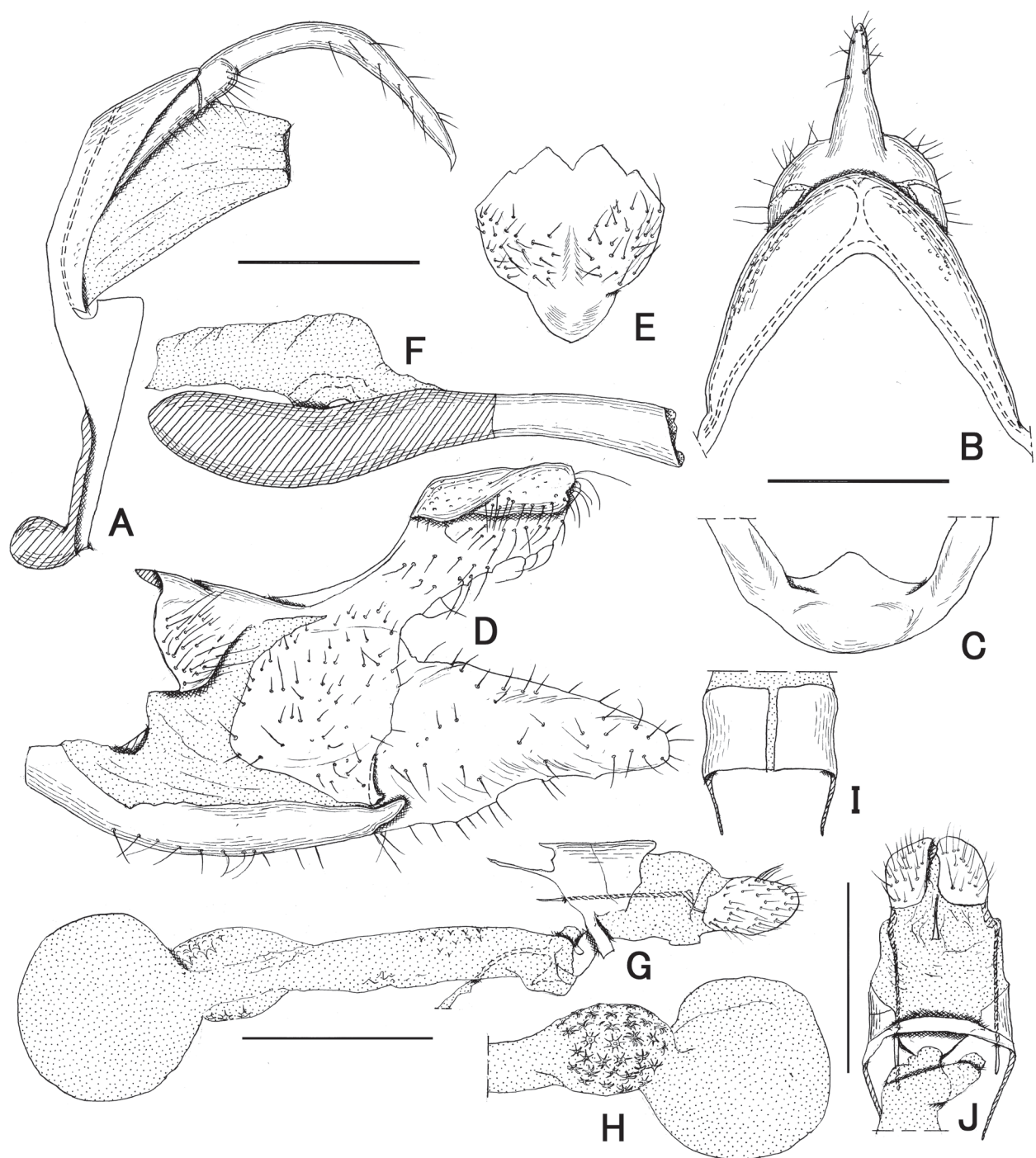


Fig. 48. Genitalia, *Paralobophora auricilla* (Inoue) (A–F, ♂; G–J, ♀). A, lateral; B, tegumen and uncus, dorsal; C, saccus, dorsal; D, right valve, inner; E, juxta, ventral; F, phallus, lateral; G, lateral; H, anterior part of bursa copulatrix, right; I, tergum VIII, dorsal; J, post abdomen, ventral. Scales = 0.5 mm (A–F), 1.0 mm (G–J).

posterior margin of tegumen strongly curved posteriorly; saccus widely rounded, extended anteriorly; uncus long, slender, gently curved ventrally, pointed at apex; socius reduced at basal side of uncus, recognized as a hairy part; gnathos slender, separate partly from uncus-socius complex by slender membrane; costa well sclerotized, posteriorly curved upward; costal arm rather long, compressed, wholly sclerotized; cucullus rather large, oblong; transtilla developed, triangular, with many hairs; sacculus slender, sclerotized, with a distal projection curved dorsally and dull tipped; harpe

large, slightly oval, sclerotized, occupied median part of valve; valvula elongate, triangular, gradually tapering, weakly sclerotized, with many hairs; phallus shorter than valve, rather thick, almost straight, without any spines near terminal end; with or without cornuti; coecum long, about $2/5$ length of phallus; juxta more or less semicircular.

Male genital musculature (Table 2): Extra muscle (m5') originating on vinculum and inserting into harpe is present.

Female genitalia (Figs. 48G–J, 49H–J): Corpus bursae globular, membranous, without any spines; ductus bursae very

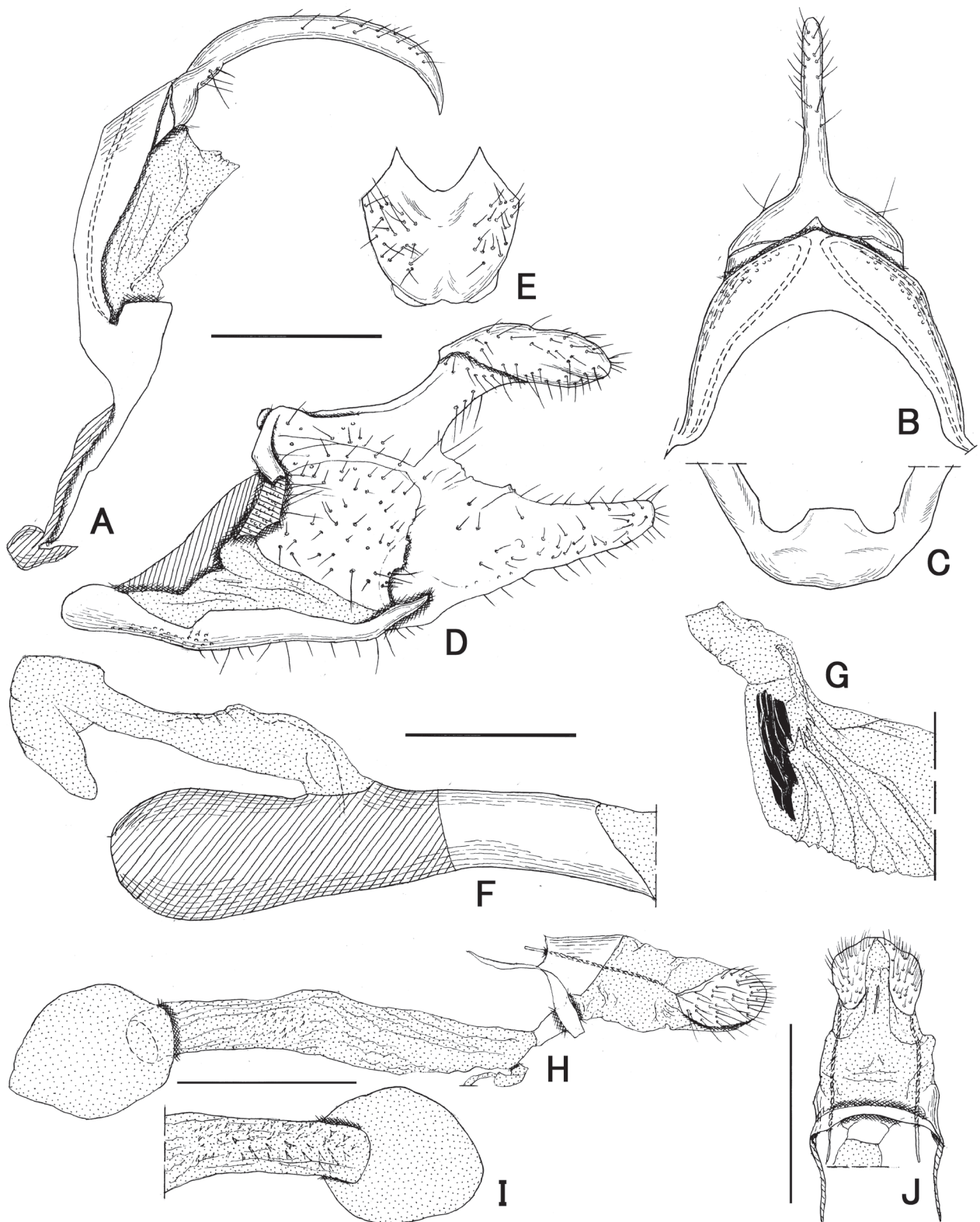


Fig. 49. Genitalia, *Paralobophora ustata* (Christoph) (A–G, ♂; H–J, ♀). A, lateral; B, tegumen and uncus, dorsal; C, saccus, dorsal; D, right valve, inner; E, juxta, ventral; F, phallus, lateral; G, cornuti; H, lateral; I, anterior part of bursa copulatrix, right; J, post abdomen, ventral. Scales = 0.5 mm (A–G), 1.0 mm (H–J).

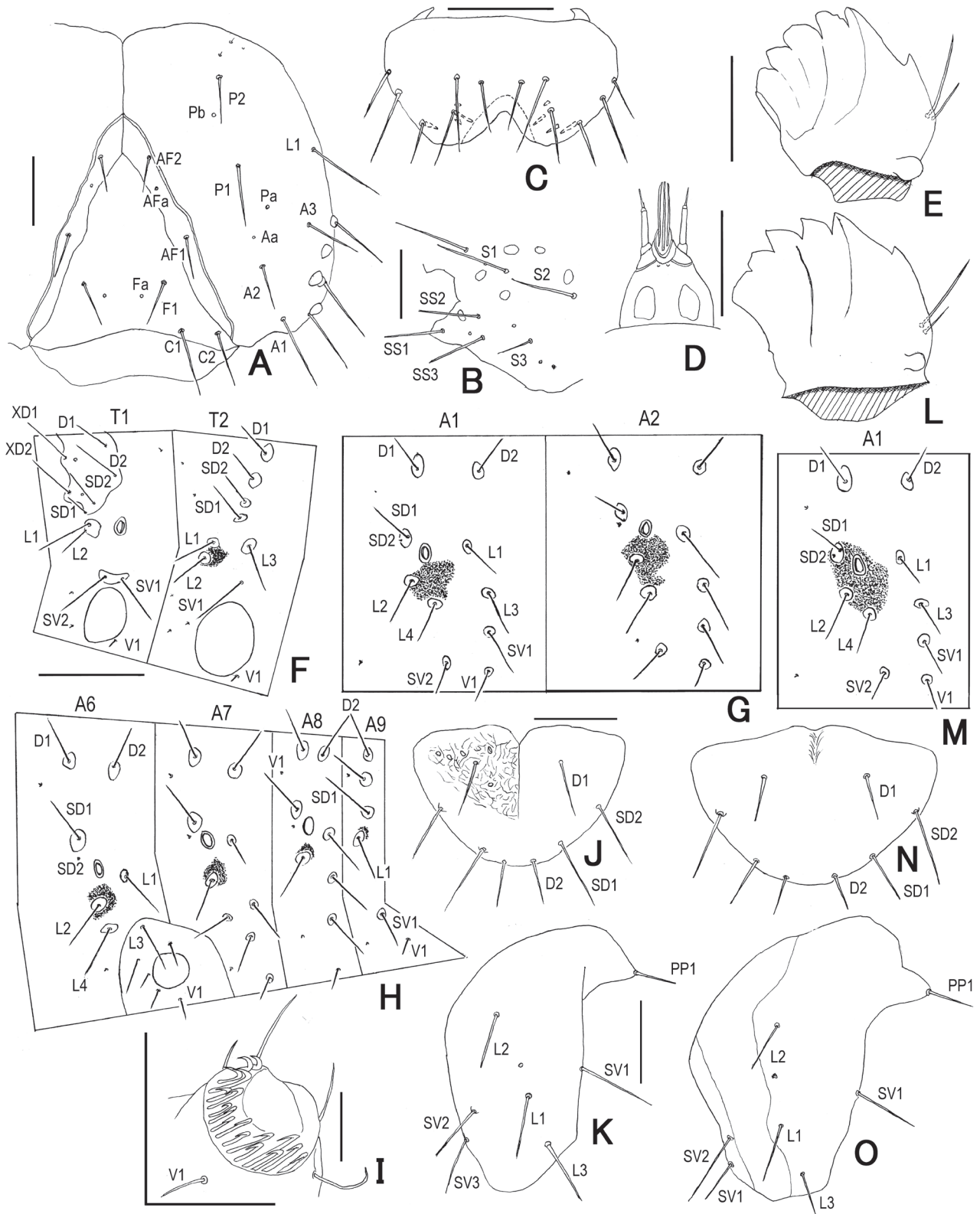


Fig. 50. Larvae. A–K, *Parolobophora ustata* (Christoph); L–O, *Parolobophora auricilla* (Inoue); A, head; B, gena; C, labrum; D, spinneret; E, L, left mandible; F–H, M, setal map; I, abdominal proleg; J, N, anal shield; K, O, anal proleg. Scales = 0.25 mm (A–E, I, L), 0.5 mm (J–K, N–O), 1.0 mm (F–H, M).

long, thick, almost cylindrical, wrinkled or not, partly covered with small spines sometimes forming star-shaped base on outer surface; ductus seminalis arising near antrum; 8th tergum longitudinally divided by membrane; 8th sternum membranous; ostium being at anterior margin of 8th sternum; antrum wide, sclerotized; 8th sternum membranous except for slender anterior sclerite of ostium; apophysis anterioris moderately short, about 1/2 length of apophysis posterioris; ventral sclerite (sternite IX) between rounded papillae anales slender.

Immature stages

Last instar larva (Fig. 50; Table 5): Cylindrical; head rounded, wider than long; body finely roughened; spiracular or subspiracular area pale fuscous; chrochets arranged in irregular biordinal mesoserries; paraproct distinct; abdominal setae very long, slender; pinaculum distinct. Chaetotaxy: on cranium A3 ventral to a line joining L1 and A2; prothoracic SD group bisetose on prothoracic shield; on ventral proleg SV group quadrossetose; on anal shield D1 setae distinctly anterior to a line drawn between SD2s.

Pupa: Not examined.

Distribution. Temperate areas of East Asia (Russian Far East, China Korea, and Japan).

Bionomics. There is a single generation per year. The adults are spring moth and emerge at the mountainous areas. Two Japanese species utilize the family Sapindaceae (Yazaki, unpublished data) as the larval host plant.

Remarks. Although *Paralobophora* was described by Inoue (1943) as a subgenus of the genus *Trichopteryx*, *Paralobophora* was upgraded to the generic rank based on the result of phylogenetic analysis (Figs. 2, 4) in this study. This genus forms a sister group relationship with the genus *Cladara*, and these two genera constitute the sister groups with the European genus *Nothocasis* (Figs. 12B, 44C–D, 47). These three genera belong to the *Trichopteryx* genus-group together with *Esakiopteryx*, *Paratrachopteryx*, and *Trichopteryx*.

Paralobophora and *Cladara* are distinguishable from other genera of the *Trichopteryx* genus-group by the hindwing venation: in these genera Sc fused with R + Rs for most length of discal cell and separate as Sc + R near upper angle of discal cell, Rs and M1 separate in both sexes; in *Nothocasis* Sc fused with R + Rs as in *Paralobophora* and *Cladara*, but Rs and M1 stalked in both sexes; in *Paratrachopteryx* and *Esakiopteryx* Sc separate from R + Rs and connecting with R near end of discal cell in male, Sc fused with R + Rs in female, and Rs and M1 stalked in both sexes; and in *Trichopteryx* Sc separate from R + Rs and connecting with R near end of discal cell as in *Esakiopteryx* and *Paratrachopteryx*, but Rs and M1 separate in male, and in female same as those of *Nothocasis*, *Esakiopteryx*, and *Paratrachopteryx*.

From *Cladara*, *Paralobophora* is distinguished by the following characters: in male genitalia costal arm except for cucullus completely sclerotized and gently incurved (Figs. 48D, 49D), sacculus without any protrusion extending upward (Figs. 48D, 49D), female tergum VIII longitudinally divided by membrane (Fig. 48I), and corpus bursae globular, without any spines (Figs. 48G–H, 49H–I) in *Paralobophora*, but costal arm sclerotized along dorsal margin and almost straight (Figs. 53D, 54A, 55D, 57D), sacculus with a protrusion extending upward

on about distal 1/3 (Figs. 53D, 54A, 55D, 57D), female tergum VIII not divided, and corpus bursae elongate, partly covered with spines (Figs. 53G, 54D–E, 55H, 58) in *Cladara*.

The European genus *Nothocasis* is characterized and distinguishable from other genera of the *Trichopteryx* genus-group by the male and female genital structures: sacculus process short, extending upward (Fig. 47D), ventral intersegmental membrane between segments VII and VIII covered with hairy setae (Fig. 47G) in female, and corpus bursae subglobular, partly covered with minute star-shaped spines posteriorly (Fig. 47G).

Paralobophora consists of only two species, but a few species of the genus *Nothocasis* (Xue, 1992; Parsons *et al.*, 1999; Xue & Zhu, 1999; Scalercio *et al.*, 2016) might be a member of *Paralobophora*.

The following larval characters (Fig. 50) are probably apomorphic for the genus *Paralobophora*: thoracic and abdominal setae distinctively long; fuscous maculation around pinaculum of L2 seta on T2 to A9.

Key to the Japanese species of *Paralobophora* (based on adult characters)

1. Forewing with indistinct basal line gently curved; male genitalia with a costal sclerotization united with harpe; phallus without cornutus; ductus bursae swollen near corpus bursae, not wrinkled *P. auricilla*
- . Forewing with distinct basal line running outwardly from costa to near dorsum and then acutely incurved basally; costal sclerotization separate from harpe; phallus with stout cornuti; ductus bursae not swollen near corpus bursae, wrinkled *P. ustata*

Paralobophora auricilla (Inoue), **comb. nov.** (Figs. 44E–F, 48, 50L–O)

Trichopteryx (*Paralobophora*) *auricilla* Inoue, 1955a: 75, pl. 6: figs. 3–4, pl. 7: fig. 8.

Diagnosis. Forewing length 15–16 mm in male, 15–17 mm in female; male and female genitalia shown in Fig. 48. This species is closely related to *P. ustata*, and difference between them is treated in the key.

Specimens examined. JAPAN: Niigata, Miomote, 3♂, 1♀, 17–18. v. 1974 (R. Sato); Nagano, Ohtaki-mura, 1♀, 29. iv. 1978 (H. Hara); Nagano, Nishino, 2♀, 26. iv. 1982 (S. Hashimoto); Gifu, Tsunokawa, 1♂, 12. iv. 1975 (K. Ujihara); Gifu, Kamikotori, 1♀, 6. v. 1977 (S. Hashimoto); Gifu, Hirayu, 1♀, 28. v. 1975 (H. Endo); Gifu, Hikagedaira, 3♂, 2♀, 3–6. v. 1978 (S. Hashimoto); same locality, 1♂, 20. v. 1979 (S. Hashimoto); same locality, 3♂, 11. v. 1980 (S. Hashimoto); same locality, 4♂, 4♀, 6–8. v. 1981 (S. Hashimoto); Gifu, Ho, 1♂, 3♀, 4. v. 1978 (S. Hashimoto); Gifu, Terashiyama, 1♂, 10. v. 1977 (S. Hashimoto); Gifu, Fujihashi-mura, 1♀, 29. iv. 2001 (H. Fukutomi); Gifu, Oyadani, 2♀, 22. iv. 1994 (N. Okimoto); Gifu, Kishodani, 1♂, 1♀, 30. iv. 1994 (H. Yoshitomi); Gifu, Hindani, 5♂, 2♀, 14. iv. 1977 (H. Endo); Gifu, Neo-kamiosu, 1♂, 24. iv. 1975 (H. Endo); same locality, 3♂, 4. v. 1975 (H.

Endo); Gifu, Yabudani, 1♂, 29. iii. 1979 (T. Tanabe); Kyoto, Sasari-toge, 1♂, 3♀, 2. iv. 1982 (S. Kinoshita); Hyogo, Aze-keikoku, 1♂, 1♀, 1. v. 1978 (B. Tanaka).

Distribution. Japan (Honshu and Shikoku).

Host plants. *Acer pictum* Thunberg accepted in rearing condition (Sapindaceae; Yazaki, unpublished data).

Immature stages. Larval features are shown in Table 5. Last instar larva cylindrical; head rounded, wider than long; body with a dorsal and two supraspiracular discontinuous stripes; spiracular area pale fuscous on A1–A9. Pupa not examined. Present description is based on ten last instar larvae reared by Yazaki from the eggs oviposited by a captured female (Yamanashi Pref., Koganezawa-rindo, 14. iv. 1979, K. Yazaki leg.).

Bionomics. See the generic description.

***Paralobophora ustata* (Christoph), comb. nov.**
(Figs. 44G–H, 49, 50A–K, 52A–C)

Lobophora ustata Christoph, 1881: 91.

Lobophora choaspitis Oberthür, 1884: 33, pl. 1, fig. 10.

Trichopteryx ustata: Meyrick, 1892: 62.

Trichopteryx choaspitis: Leech, 1897: 74.

Nothopteryx ustata: Prout, 1914: 183.

Trichopteryx (Paralobophora) ustata: Inoue, 1943: 9

Trichopteryx usitata: Inoue, 1955a: 87, Pl. 6: fig. 5 (an incorrect subsequent spelling).

Diagnosis. Forewing length 15–16 mm in male, about 15 mm in female; male and female genitalia shown in Fig. 49. This species is closely related to *P. auricilla*, and difference between them is treated in the key.

Specimens examined. JAPAN: Hokkaido: Tokachi, Nukabira, 16♂, 45♀, 31. v. –3. vi. 1977 (S. Hashimoto); Honshu: Niigata, Sado Is., Nyugawa, 1♂, 2♀, 2. v. 1965 (R. Sato); Niigata, Sakasamaki, 1♀, 2. vi. 1962 (R. Sato); Nagano, Umanokoshi, 1♀, 12. v. 1978 (H. Hara); Nagano, Mikuni-toge, 1♂, 27. v. 1978 (H. Hara); Nagano, Nishino, 6♂, 3♀, 21. iv. 1982 (S. Hashimoto); Gifu, Ho, 1♂, 1♀, 4. v. 1978 (S. Hashimoto); Gifu, Hikagedaira, 11♂, 4♀, 3–6. v. 1978 (S. Hashimoto); same locality, 1♂, 17. v. 1978 (S. Hashimoto); same locality, 3♂, 1♀, 8. v. 1981 (S. Hashimoto); Gifu, Harayama, 1♀, 6. v. 1977 (S. Hashimoto); Gifu, Hindani, 1♀, 4. iv. 1979 (T. Tanabe); Gifu, Neo-kamiosu, 1♂, 25. iv. 1975 (H. Endo).

Distribution. Japan (Hokkaido, Honshu, Shikoku and Kyushu), China, Korea (Choi, 2007a), and Russian Far East (Southeast Siberia).

Host plants. *Acer pictum* Thunberg accepted in rearing condition (Sapindaceae; Yazaki, unpublished data).

Immature stages. Larval features are shown in Table 5. Last instar larva cylindrical; head rounded, wider than long; subspiracular area pale fuscous on A1–A9. Pupa not examined. Present description is based on two last instar larvae reared by Yazaki from the eggs oviposited by a captured female (Tokyo Metro., Mt. Takao-san, 14. iv. 1975, K. Yazaki leg.).

Bionomics. See the generic description.

Genus ***Cladara*** Hulst

Nyctobia Hulst, 1896: 250 (key), 251 (a junior homonym of *Nyctobia* Thorell, 1869: 36, 59, 62. – Arachnida). Type species: *Cleora limitaria* Walker, 1860: 487, by original designation, but listed as *limitata* (an incorrect subsequent spelling).

Cladara Hulst, 1896: 250 (key), 251. Type species: *Lobophora atroliturata* Walker, [1863] 1862: 1710, by original designation.

Cladara Dyar, [1903] 1902: 265 (an incorrect subsequent spelling).

Diagnosis. The genus *Cladara* is characterized by the following autapomorphies (Fig. 4): 1, sacculus with dorsally expanding process on distal 1/3 to 1/4; 2, cornuti consisting of many granules; 3, corpus bursae partly covered with spines forming star-shaped base on outer surface and a row of spines in lateral sides. The following two characters also define the genus, but homoplastic or reversal (Fig. 4): 1, corpus bursae oblong, occasionally constricted at middle; 2, female tergum VIII not divided longitudinally by membrane. *Cladara* is distinguishable from other genera of the tribe Trichopterygini by the combination of characters as follows: hind tibia with a pair of apical spurs; forewing with two areoles; M1 arising from 2nd areole; forewing with a white spot being on dorsum between antemedial and postmedial lines; hindwing white scattered with pale brown scales; discal dot rather distinct; hindwing venation (Sc fused with R + Rs (an upper vein of discal cell) for most length of discal cell in both sexes; Rs and M1 separate in both sexes; CuA2 slightly shorter than CuA1 in male); anal fold small; costal arm long; valvula narrow, gently tapering; sacculus with protrusion extending dorsally on about distal 1/3 or 1/4; saccular process almost straight or slightly curved; corpus bursae oblong, with spines partly; ductus bursae shorter than corpus bursae, with spines; ductus seminalis arising near ostium.

Description. The generic description is based on five species, Hulst's (1896) original description, and McGuffin (1945, 1958).

Adult

Head (Fig. 5H): Head clothed with scales thickly; antennal flagellomeres filiform; frons rounded; labial palpus slightly ascending, rarely porrect, generally short, about 1.0 to 1.5 times as long as eye diameter in male and about 1.0 to 1.5 times in female (about 2.5 times in female of *C. muscigera*); proboscis developed.

Thorax (Figs. 51A–H, 52D–F): Thorax stout; metepimeron enlarged, divided into anterior and posterior parts in both sexes; male metameron arched posteriorly (not arched in *C. atroliturata*; hind tibia with a pair of spurs (apical spurs), with a hair-pencil in male (absent in *C. atroliturata*). Forewing creamy white, tinged with olive or blueish green, with olive and pale fuscous to black lines, mainly consisting of basal, postmedial, antemedial, postmedial, subterminal and adterminal ones; subterminal line consisting of one to three close adjacent lines, discontinuous; discal spot distinct; a white spot being on

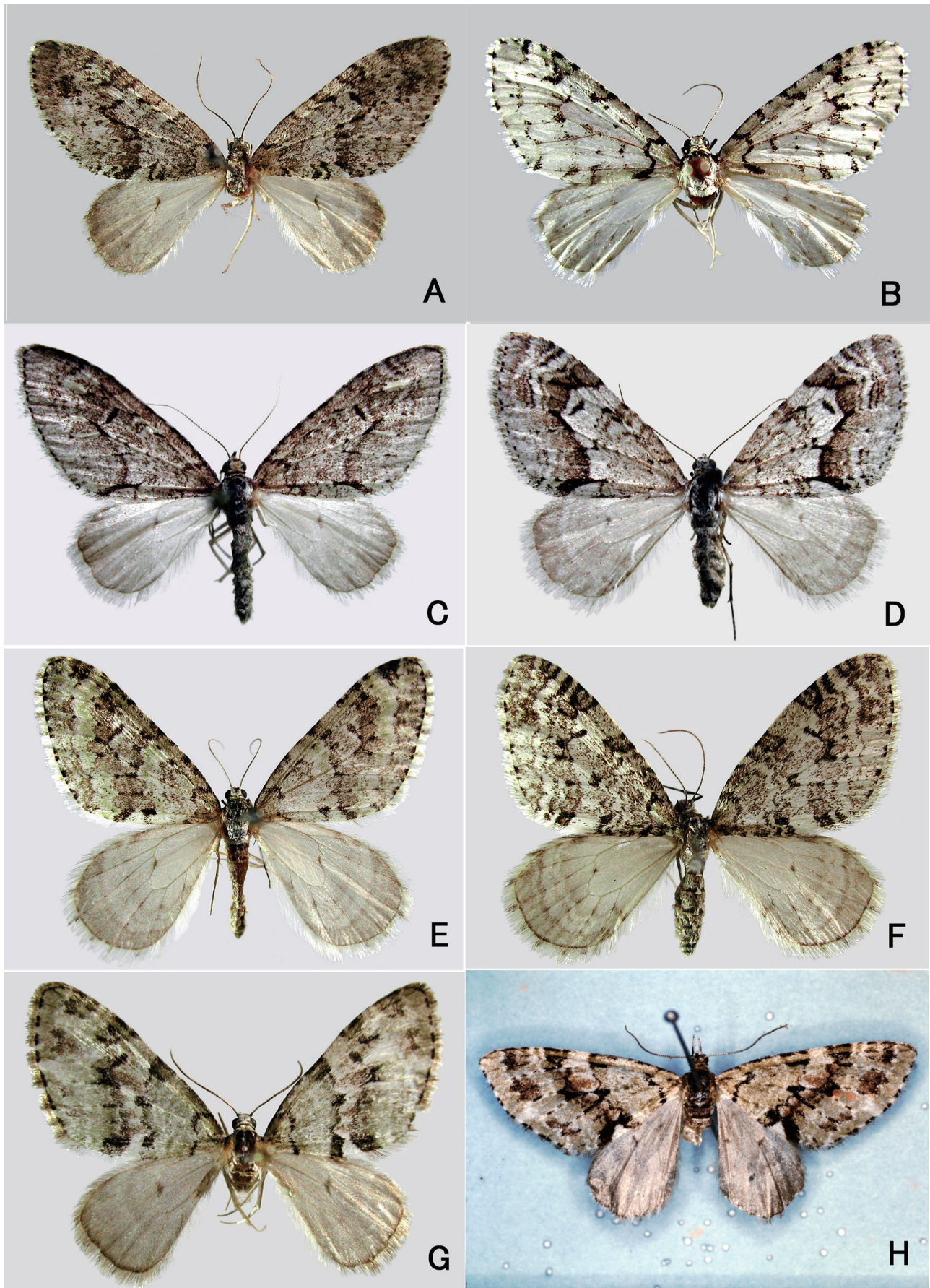


Fig. 51. Adults. A, *Cladara anguilineata* (Grote & Robinson), ♂ (Canada); B, *Cladara atroliturata* (Walker), ♂ (Canada); C, *Cladara limitaria* (Walker), ♂ (Canada); D, ditto, ♀ (Canada); E, *Cladara miracula* (Inoue), ♂; F, ditto, ♀; G, *Cladara muscigera* (Butler), ♂; H, ditto, ♀, holotype, coll. NHM (Japan: Yokohama).

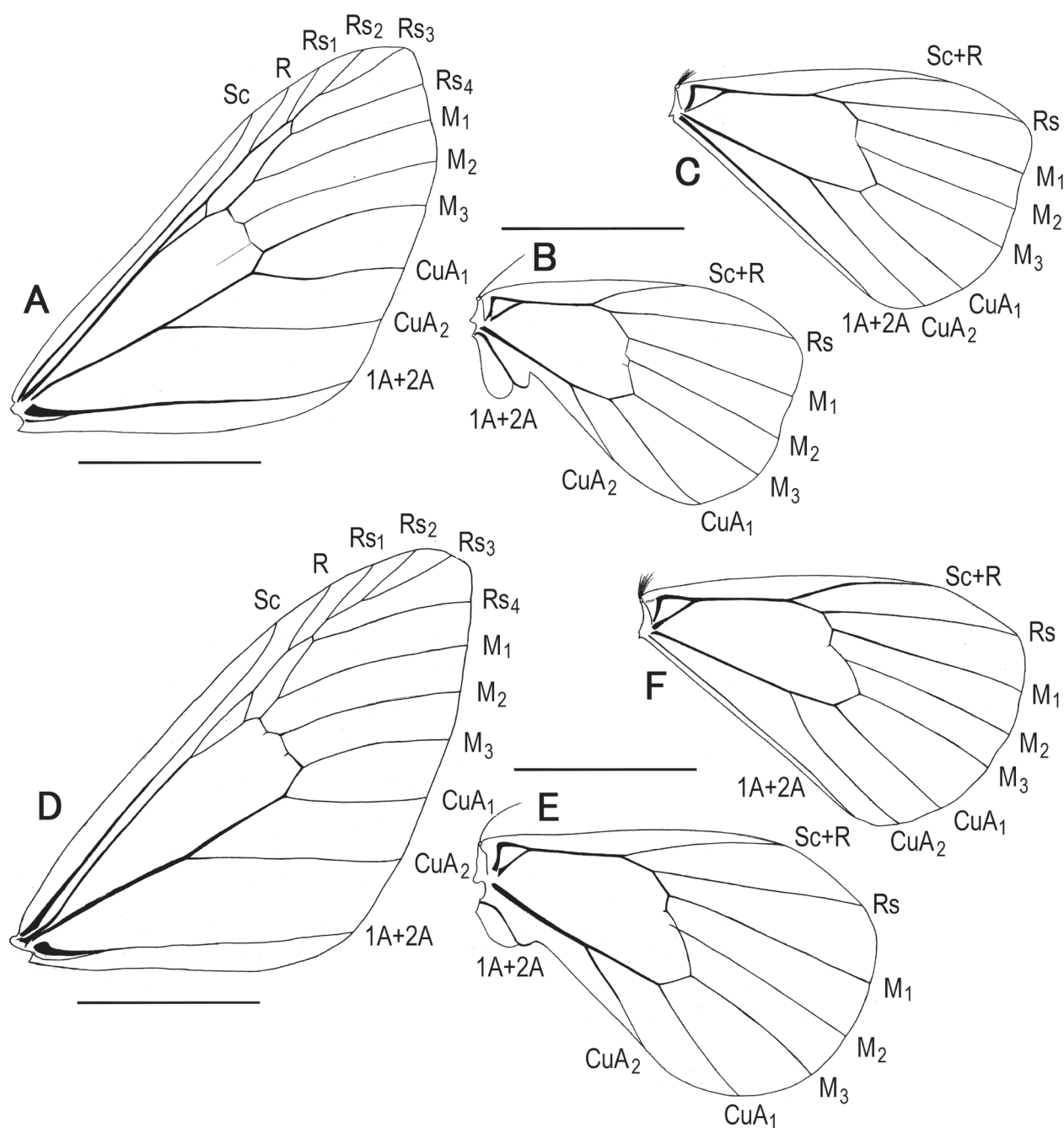


Fig. 52. Wing venation. A, *Parolobophora ustata* (Christoph), ♂ (forewing); B, ditto, ♂ (hindwing); C, ditto, ♀ (hindwing); D, *Cladara miracula* (Inoue), ♂ (forewing); E, ditto, ♂ (hindwing); F, ditto, ♀ (hindwing). Scales = 5.0 mm.

dorsum between antemedial and postmedial lines; terminal dots black; forewing with two areoles; 1st areole smaller than 2nd; M1 arising from 2nd areole. Hindwing white, covered densely or sparsely with greyish brown scales, especially densely along termen; discal spot distinct; male with a small anal fold (about 1/4 length of anal margin); Sc fused with R + Rs (an upper vein of discal cell) for most length of discal cell in both sexes; Rs and M1 separate in both sexes; M3 and CuA1 separate, almost equal length; CuA2 short, about 2/3 length of CuA1 in male.

Pregenital abdomen: Male sternum II pouch small (vestigial, but inner hole present in *C. atroliturata*); male sternum II with a pair of triangular expansions.

Male genitalia (Figs. 53A–F, 54A–C, 55A–G, 57): Anterior

and posterior margin of tegumen strongly curved posteriorly; saccus rounded, not extended anteriorly; uncus long, slender, gently curved ventrally, with a pointed apex; socius reduced at basal side of uncus, recognized as a hairy part; gnathos narrow, separate partly from uncus-socius complex by narrow membrane; costa sclerotized, almost straight at dorsal margin; costal arm short, compressed; cucullus developed, oblong, with many hairs; transtilla triangular, with many hairs; sacculus narrow, sclerotized, with a protrusion extending dorsally on about apical 1/3 and with a rather straight terminal projection; harpe large, rather oval, sclerotized, occupied median part of valve, occasionally fused with saccular protrusion; valvula triangular, gently tapering, weakly sclerotized, with many hairs;

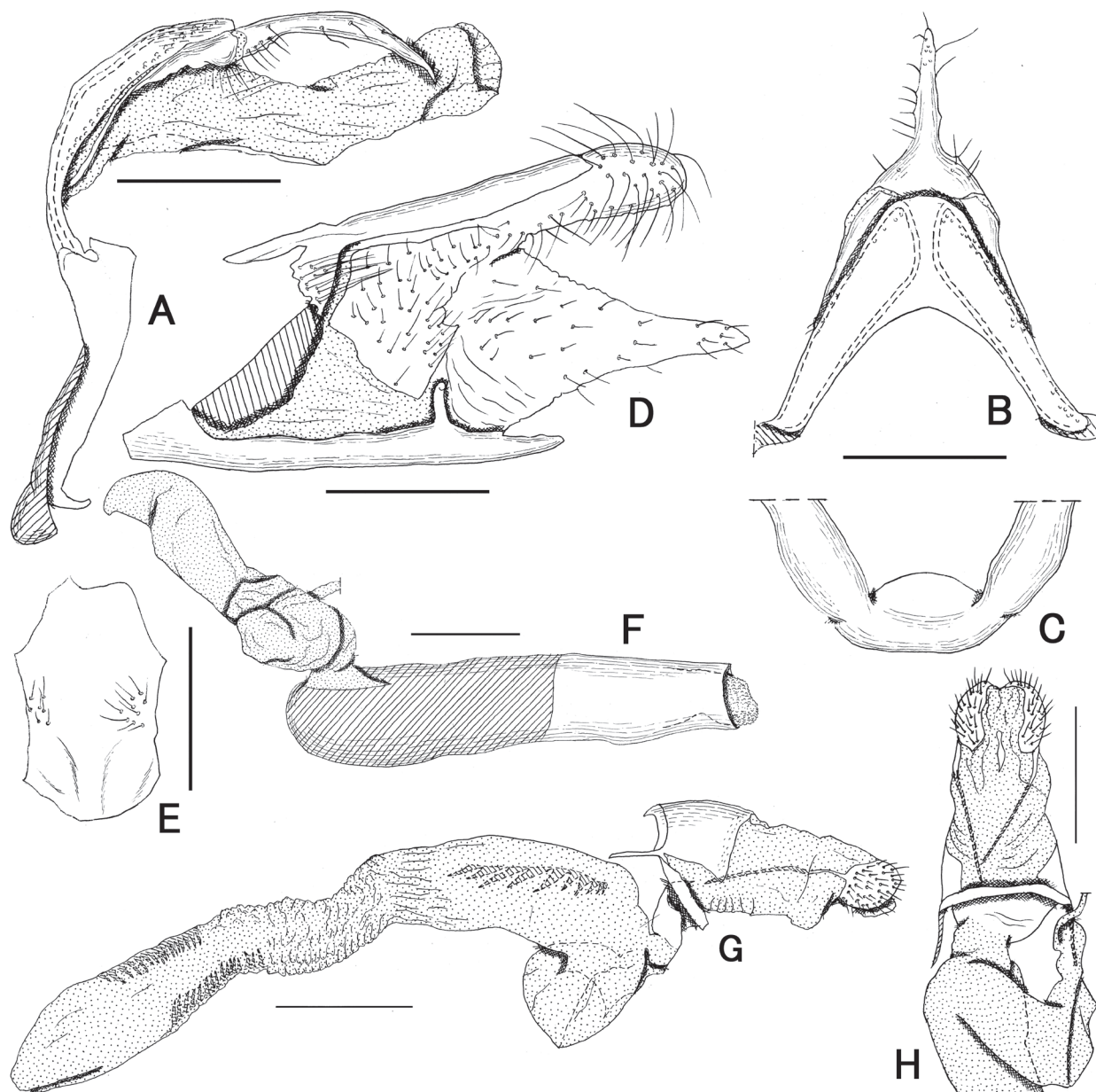


Fig. 53. Genitalia, *Cladara atroliturata* (Walker) (A–F, ♂; G–H, ♀), (Canada). A, lateral; B, tegumen and uncus, dorsal; C, saccus, dorsal; D, right valve, inner; E, juxta, ventral; F, phallus, lateral; G, lateral; H, post abdomen, ventral. Scales = 0.5 mm (A–F), 1.0 mm (G–H).

phallus almost straight, rather thick, shorter or longer than valve (if longer than valve, phallus very thick), without any spines on posterior part, with cornuti consisting of many granules; coecum short (less than 1/5 length of phallus) or very short (rounded but vestigial); juxta as long as wide or longer than wide.

Male genital musculature (Table 2): Extra muscle (m5') originating on vinculum and inserting into harpe is present.

Female genitalia (Figs. 53G–H, 54D–E, 55H–I, 58): Corpus bursae oblong cylindrical or oblong constricted at middle, longer than ductus bursae, with comb-like spinous ridge dorsally and ventrally, partly covered with spines, sometimes forming star-shaped base on the outer surface; corpus bursae-ductus bursae junction distinct or indistinct; ductus bursae thick, with comb-like spinous ridge; ductus seminalis arising near antrum (basal part of ductus seminalis

very thick in *C. atroliturata* and *C. miracula*, but rather narrow in others); antrum wide, sclerotized; 8th sternum membranous except for narrow anterior sclerite of ostium; ostium being at anterior margin of 8th sternum; apophysis anterioris moderate to short, less than 1/2 length of apophysis posterioris; ventral sclerite (sternite IX) narrow between rounded papillae anales.

Immature stages

Last instar larva (Fig. 56; Table 5): Cylindrical; head rounded, but lateral margin straight, wider than long; body finely roughened; subspiracular stripe distinct; chrochets arranged in biordinal mesoserries; paraproct distinct; abdominal setae short (but longer than those of the genus *Trichopteryx*), slightly blunt tipped. Chaetotaxy: on cranium A3 ventral to a line joining L1 and A2; prothoracic SD group bisetose on prothoracic shield; on ventral proleg SV group quadrossetose;

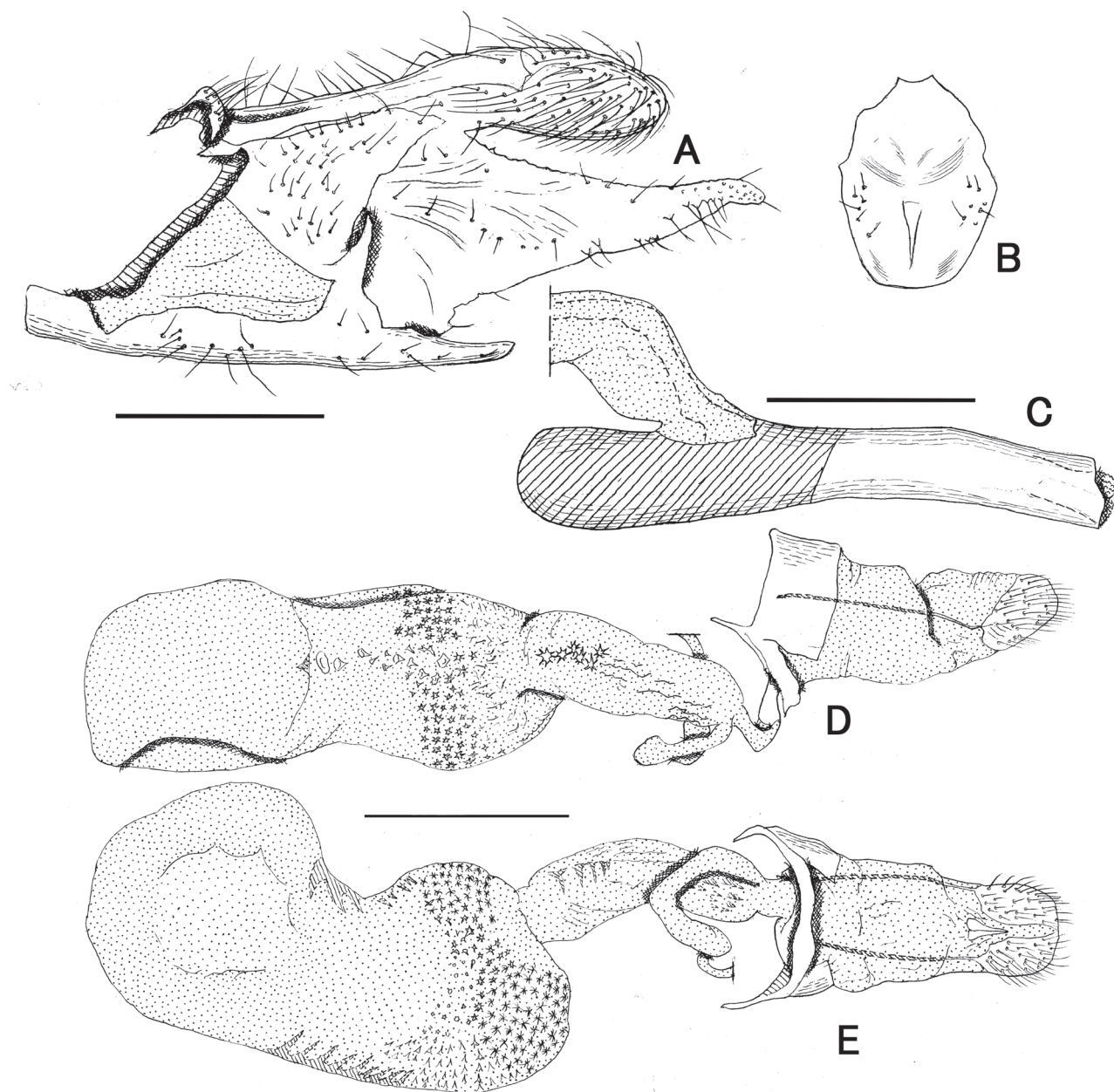


Fig. 54. Genitalia, *Cladara limitaria* (Walker) (A–C, ♂; D–E, ♀), (Canada). A, right valve, inner B, juxta, ventral; C, phallus, lateral; D, lateral; E, ventral. Scales = 0.5 mm (A–C), 1.0 mm (D–E).

on anal shield D1 setae anterior to a line drawn between SD2s.

Pupa: Not examined.

Distribution. Temperate areas of East Asia (China and Japan) and North America.

Bionomics. There is a single generation per year. The adults are spring moths and mainly obtained from the mountainous areas. Of three North American species, *C. limitaria* (Walker) feeds on conifers (Pinaceae; McGuffin, 1945, 1958) and *C. atroliturata* (Walker) feeds on the deciduous trees (Betulaceae, Salicaceae, and Sapindaceae; <http://buggide.net/node/view/15372> visited on 19. iii. 2018), and the Japanese species, *C. miracula* (Inoue), utilizes the family Fagaceae as the larval host plant (Yazaki, unpublished data).

Remarks. The genus *Cladara* now consists of three Nearctic species and two East Asian species. As mentioned above, *Cladara* constitutes a sister group relationship with the genus *Paralobophora* and distinction between them is presented in the remarks of *Paralobophora*. Two Japanese species have been treated as a member of *Trichopteryx* in Japan (Inoue, 1982b; Nakajima & Yazaki, 2011), but their wing venation and genital structures suggested that these are included into the genus *Cladara*.

The genus *Nothocasis* are composed of thirteen Palearctic species (Xue, 1992; Parsons *et al.*, 1999; Xue & Zhu, 1999; Scalercio *et al.*, 2016). Judging from the hindwing venation and the genital structures (Xue & Zhu, 1999; Hausmann &

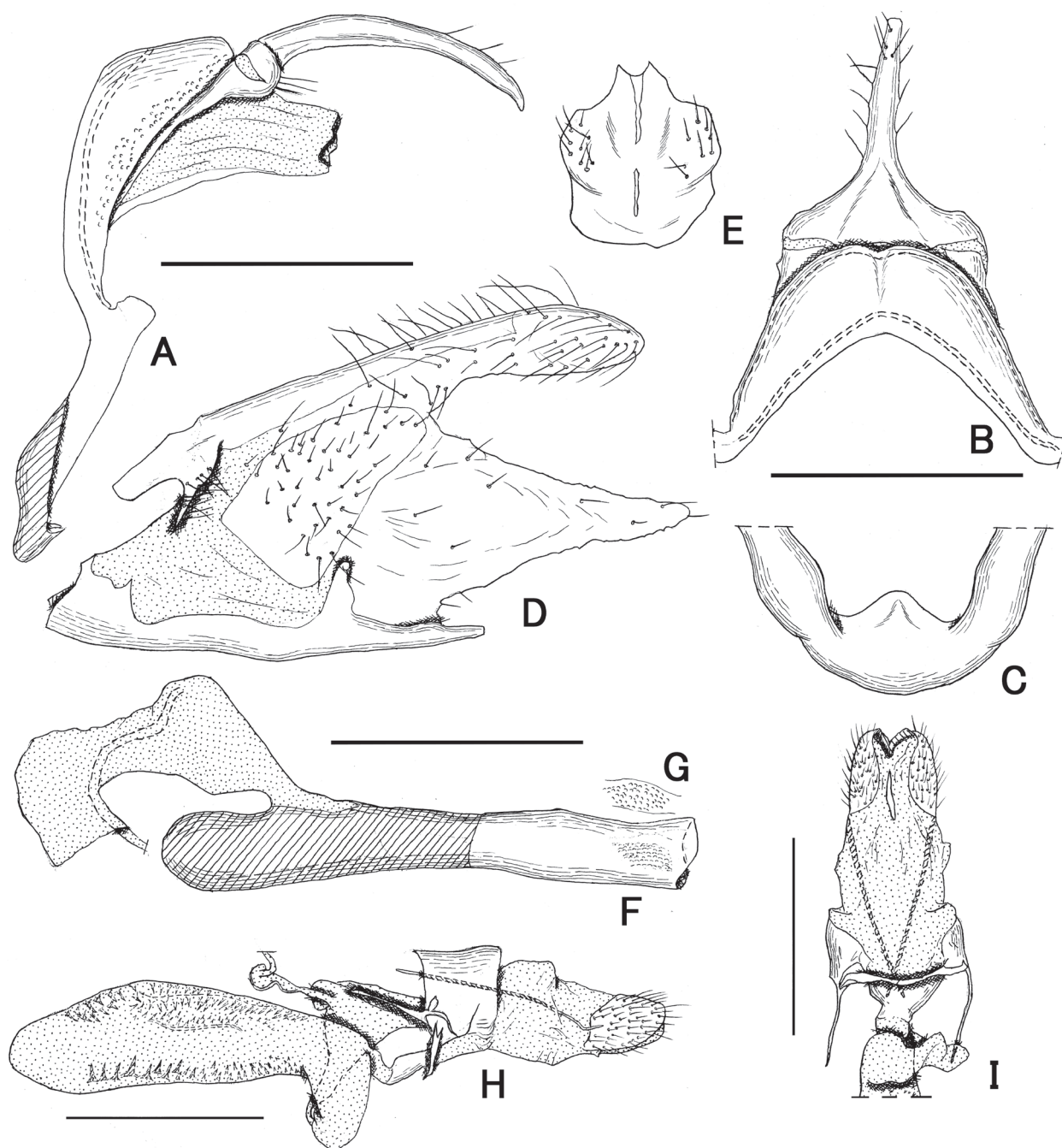


Fig. 55. Genitalia, *Cladara miracula* (Inoue) (A–G, ♂; H–I, ♀). A, lateral; B, tegumen and uncus, dorsal; C, saccus, dorsal; D, right valve, inner; E, juxta, ventral; F, phallus, lateral; G, cornuti; H, lateral; I, post abdomen, ventral. Scales = 0.5 mm (A–G), 1.0 mm (H–I).

Viidalepp, 2012), however, many of them except for two European species (*N. sertata* (Hübner) and *N. rosariae* Scalercio, Infusino & Hausmann) may be better transferred to other genera, and a few is possibly classified into the genus *Cladara* as in *C. muscigera* Butler.

Cladara is divided into two groups by the female genitalia:

Group A: corpus bursae oblong cylindrical, partly covered with spines dorsally and ventrally; corpus bursae-ductus bursae junction indistinct; basal part of ductus seminalis very thick; apophysis anterioris moderate in length, less than 1/2 of posterioris. *Cladara atroliturata* (Walker) (Fig. 51B, 53) and *C. miracula* (Inoue).

Group B: corpus bursae rather thick, constricted, covered with spines forming star-shaped base at posterior part; corpus bursae-ductus bursae junction distinct; ductus seminalis rather narrow throughout; apophysis anterioris short, less than 1/4 length of posterioris. *Cladara anguilineata* (Grote & Robinson) (Fig. 51A), *C. limitaria* (Walker) (Fig. 51C–D, 54), and *C. muscigera* (Butler).

Key to the Japanese species of *Cladara* (based on adult characters)

1. Labial palpus short, about 1.0 times as long as eye diameter; forewing with pale fuscous two or three brown

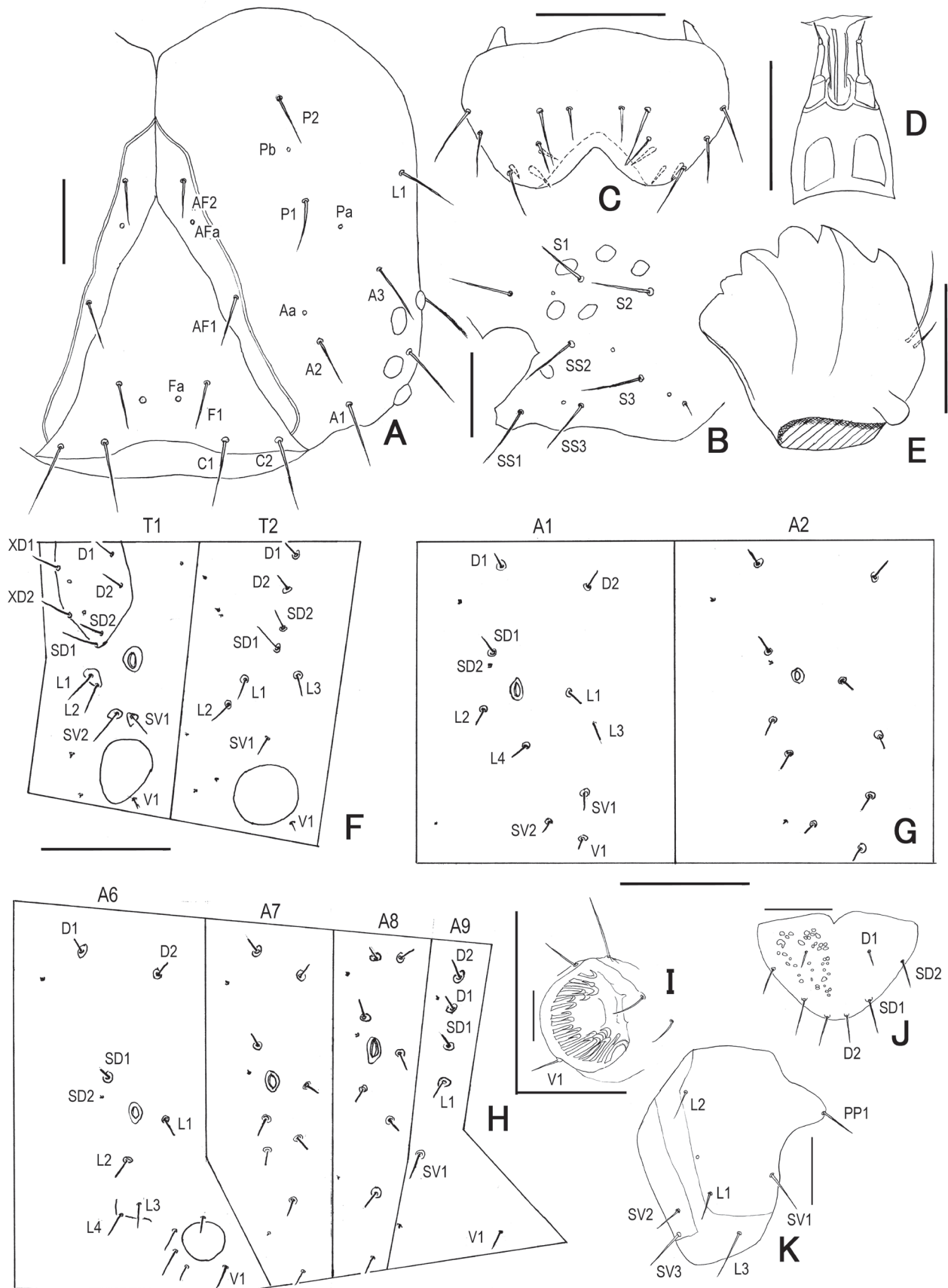


Fig. 56. Larva, *Cladara miracula* (Inoue). A, head; B, gena; C, labrum; D, spinneret; E, left mandible; F–H, setal map; I, abdominal proleg; J, anal shield; K, anal proleg. Scales = 0.25 mm (A–E, I), 0.5 mm (J–K), 1.0 mm (F–H).

lines between basal line and antemedial line; hindwing white, scattered with pale greyish brown scales along termen; hindwing with rather small discal spot; phallus without cornuti; corpus bursae without constriction; proximal part of ductus seminalis thick, arising from posterior end of bursa copulatrix *C. miracula*

–. Labial palpus rather long, more than 1.5 times as long as eye diameter in male, about 2.5 in female; forewing with two or three olive lines between basal line and antemedial line; hindwing scattered with pale greyish brown scales throughout; hindwing with rather large discal spot; phallus with cornuti; corpus bursae with a constriction;

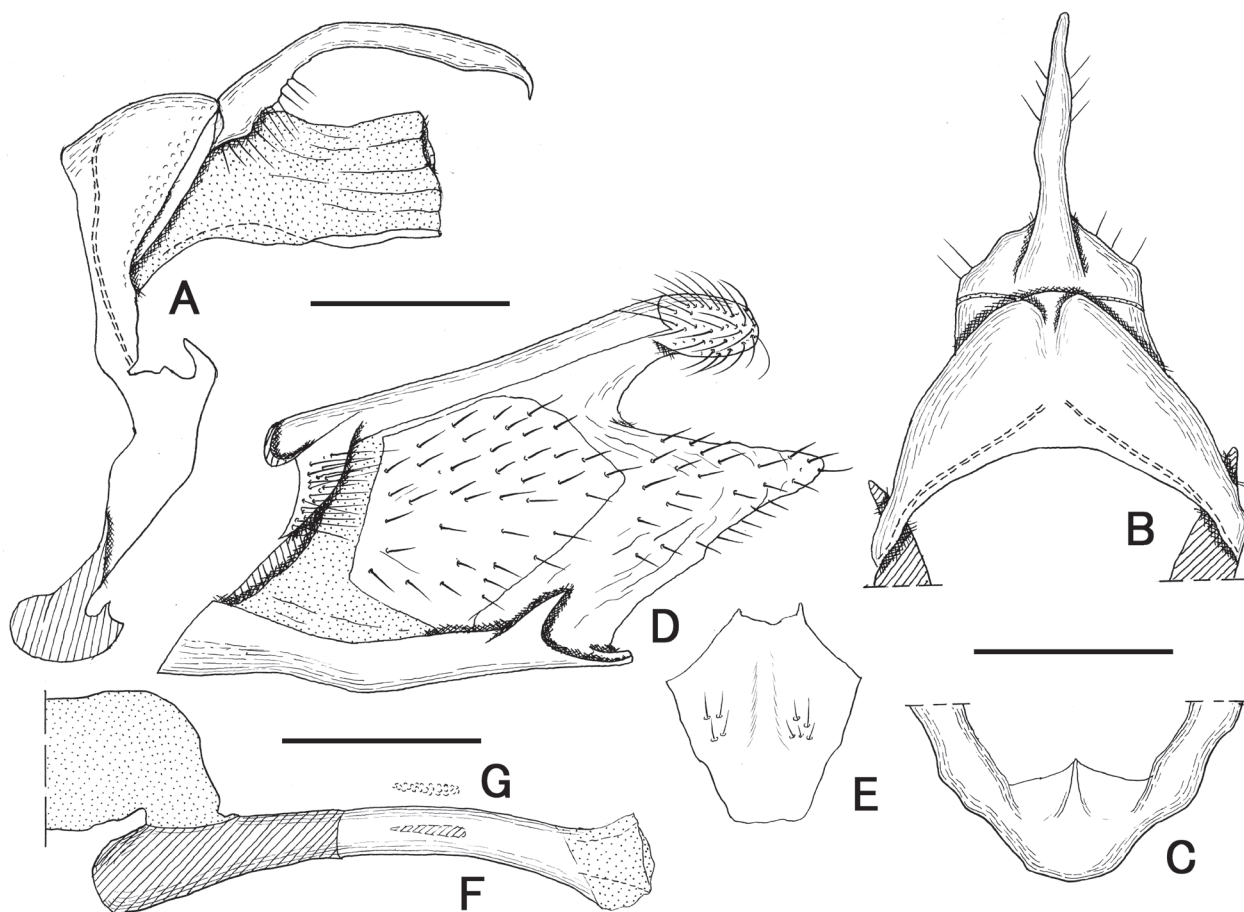


Fig. 57. Male genitalia, *Cladara muscigera* (Butler). A, lateral; B, tegumen and uncus, dorsal; C, saccus, dorsal; D, right valve, inner; E, juxta, ventral; F, phallus, lateral; G, cornuti. Scales = 0.5 mm (A–G).

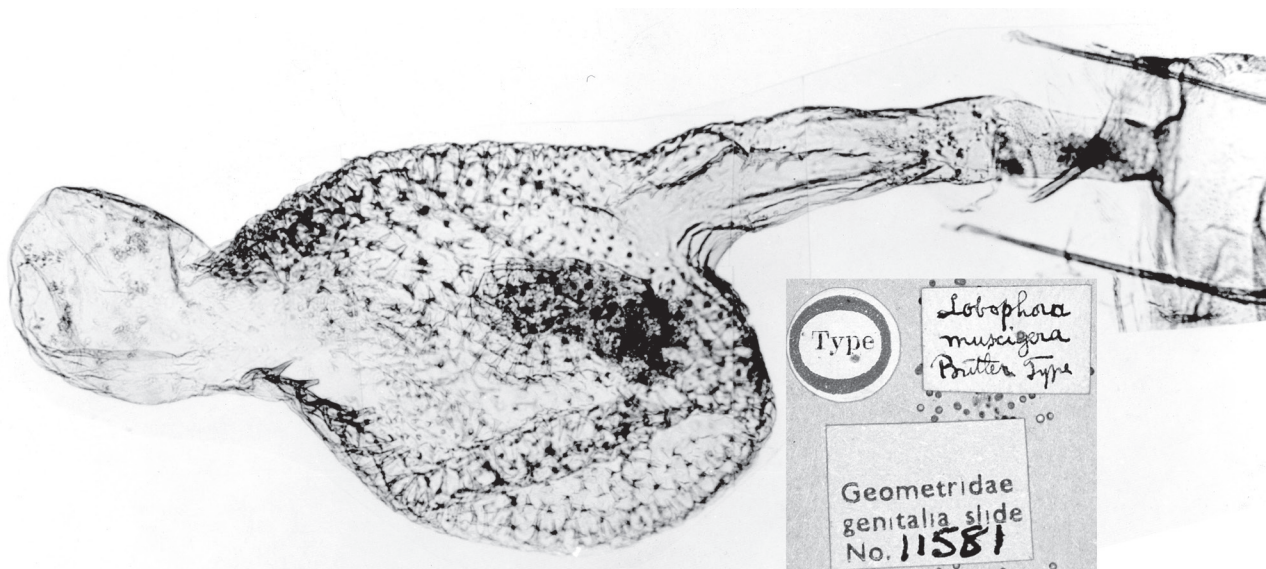


Fig. 58. Female genitalia, *Cladara muscigera* (Butler), holotype, genitalia slide No. 11581 (NHM) (Japan: Yokohama).

proximal part of ductus seminalis slender, arising near ostium..... *C. muscigera*

***Cladara miracula* (Inoue), comb. nov.**
(Figs. 5H, 51E–F, 52D–F, 55–56)

Trichopteryx miracula Inoue, 1942: 11, pl. 4: fig. 4.

Diagnosis. Forewing length 16–17 mm in male, 15–16 mm in female; male and female genitalia shown in Fig. 55. This species is rather related to the North American *C. atroliturata* in the female genitalia and easily distinguishable from each other in the following points: forewing tinged with olive green, with dark brown basal, postbasal, antemedial, postmedial, and subterminal lines, male hind tibia with a hair-pencil, phallus rather slender, and bursa copulatrix rather short in *C. miracula*, but forewing tinged with blueish green, with fuscous basal, postbasal, antemedial, postmedial, and subterminal lines, male hind tibia without a hair-pencil, phallus very thick, and bursa copulatrix long in *C. atroliturata*. Difference between *C. miracula* and *C. muscigera* is treated in the above key.

Specimens examined. JAPAN: Hokkaido: Tokachi, Nukabira, 1♂, 8. vi. 1966 (H. Ono); same locality, 1♀, 24. iv. 1968 (H. Ono); Honshu: Niigata, Sado Is., Nyugawa, 1♀, 2. v. 1965 (R. Sato); Niigata, Sado Is., Mt. Myoken, 1♂, 4. iii. 1967 (R. Sato); Niigata, Yahiko-yama, 1♂, 19. iii. 1959 (R. Sato); Nagano, Nishino, 1♂, 26. iv. 1982 (S. Hashimoto); Shizuoka, Kareyama, 2♂, 22. iv. 2000 (H. Fukutomi); Gifu, Kamikotori, 1♀, 6. v. 1977 (S. Hashimoto); Gifu, Hikagedaira, 13♂, 23. iv. 1978 (S. Hashimoto); same locality, 4♂, 2♀, 3–6. v. 1978 (S. Hashimoto); Gifu, Harayama, 3♀, 22. iv. 1976 (H. Endo); same locality, 2♂, 20. iv. 1977 (S. Hashimoto); Gifu, Terashiyama, 1♂, 10. v. 1977 (S. Hashimoto); Gifu, Itadori, 1♂, 20. v. 1981 (T. Tanabe); Aichi, Asahi-kogen, 1♂, 2. iv. 2000 (H. Fukutomi); Aichi, Mt. Rokusho-san, 1♂, 15. iv. 1978 (S. Hashimoto); Kyoto, Sasari-toge, 2♂, 1♀, 2. iv. 1982 (S. Kinoshita); Osaka, Minoo, 2♂ (OMNH), 11. iii. 1975 (Y. Miyatake); same locality, 1♂, 6. iii. 1978 (S. Hashimoto); same locality, same locality, 6♂, 2♀, 24–25. iii. 1978 (S. Hashimoto); same locality, 1♂, 20. iii. 1978 (T. Saito); same locality, 2♂, 16. iii. 1979 (S. Hashimoto); same locality, 1♀, 6. iii. 1982 (S. Saito); Osaka, Inunaki, 1♂, 1♀ (OMNH), 11. iii. 1977 (M. Umano).

Distribution. Japan (Hokkaido, Honshu, Shikoku, and Kyushu).

Host plants. *Quercus glauca* Thunberg accepted in rearing condition (Fagaceae; Yazaki, unpublished data).

Immature stages. Larval features are shown in Table 5. Last instar larva (Fig. 56) cylindrical; head rounded, but lateral margin almost straight, finely reticulate; body finely roughened; crochets 16–20 in number on ventral proleg; 24–26 on anal proleg. Pupa not examined. Present description is based on 3 last instar larvae reared by Yazaki from the egg oviposited by a captured female (Yamanashi Pref., Sanjo, 10. iv. 1977, K. Yazaki leg.).

Bionomics. There is a single generation per year. The adult moths appear in rather early spring and are obtained from the hilly to mountainous areas.

***Cladara muscigera* (Butler), comb. nov.**
(Figs. 51G–H, 57–58)

Lobophora muscigera Butler, 1881: 421.

Trichopteryx olivaria Leech, 1897: 75.

Trichopteryx muscigera: Leech, 1897: 75.

Acasis muscigera: Prout, 1914: 182.

Nothocasis muscigera: Xue, 1992: 291.

Diagnosis. Forewing length 16–17 mm in male, about 16 mm in female; male and female genitalia shown in Figs. 57–58, respectively. *C. muscigera* is related to the North American *C. limitaria* and *C. anguilineata* Grote & Robinson in the female genitalia and easily distinguishable from them in the forewing pattern (antemedial line distinct, rather broad; postmedial line weakly curved inward from under vein of discal cell to dorsum in *C. muscigera*, but antemedial line indistinct, slender; postmedial line rather strongly curved in *C. limitaria* and *C. anguilineata*). Difference between *C. miracula* and *C. muscigera* is treated in the above key.

Specimens examined. JAPAN: Honshu: Kanagawa, Yokohama, 1♀ (holotype of *Lobophora muscigera*), genitalia slide No. 11581 (NHM); Japan, 1♀ (holotype of *Lobophora olivaria*) (NHM); Gifu, Abou-toge, 1♂, 25. vi. 1974 (H. Endo); Gifu, Nomugi-toge, 1♂, 14. v. 1994 (H. Yoshitomi); same locality, 1♂, 18. v. 1994 (H. Yoshitomi & N. Okimoto).

Distribution. Japan (Honshu: Kanto and Chubu districts) and China.

Host plants. Unknown.

Immature stages. Unknown.

Bionomics. There is a single generation per year. The adult moths appear in late spring to early summer and are obtained mainly from the mountainous areas.

Genus *Paratrachopteryx* nov.

Type species: *Lobophora misera* Butler, 1879: 443.

Diagnosis. *Paratrachopteryx* is characterized by the following apomorphies (Fig. 4): 1, metameron not modified; 2, male hind leg without hair-pencil; 3, male abdominal sternum II pouch vestigial (Fig. 12C); 4, antero-lateral side of male sternum II not modified (Fig. 12C); 5, posterior margin of tegumen pointed (Fig. 60B); 6, saccus pointed (Fig. 60C); 7, ductus bursae without spines (Fig. 60G); 8, antrum distinct, cup-shaped, longer than wide (Fig. 60G). However, all characteristics are homoplastic or reversal (Fig. 4). This genus is distinguished from other trichopterygine genera by the following combination of characters: hind tibia with a pair of apical spurs; male hind tibia without a hair-pencil; forewing with two areoles; M1 arising from areole; hindwing dark brown; Sc separate from an upper vein of discal cell (R + Rs) and connected with a short vein of R near end of discal cell in male hindwing, fused in female; hindwing venation (Rs and M1 stalked in both sexes; CuA2 very short, less than 1/4 length of CuA1 in male); anal fold small; valvula with a short triangular tip; saccular process short, more or less pointed at apex; corpus

bursae subglobular, covered with numerous spines forming star-shaped base on outer surface; ductus bursae slightly shorter than corpus bursae, without spines.

Description. The generic description is based on one species and the following study: Hashimoto, 1982.

Adult

Head (Fig. 5I): Head clothed with scales thickly; antennal flagellomeres filiform; frons rounded; labial palpus porrect, 1.0 times as long as diameter of eye in male and 1.5 times in female; proboscis developed.

Thorax (Fig. 45D–F, 59A–B): Thorax stout; metepimeron enlarged, divided into anterior and posterior parts by inner ridge in both sexes; male metameron not modified; hind tibia with a pair of spurs (apical spurs), without a hair-pencil in male. Forewing brown, scattered with white scales, with fuscous lines mainly consisting of basal, postbasal, antemedial, postmedial, subterminal, and adterninal ones; antemedial and postmedial lines fused with each other under discal cell; subterminal line consisting of two close adjacent lines; terminal dots fuscous; forewing with two areoles; M1 arising from areole. Hindwing greyish brown with fuscous discal spot; other lines indistinct; male with an anal fold (about 1/4 length of anal margin); Sc separate from an upper vein of discal cell (R + Rs) and connected with a short vein of R before end of discal cell in male, fused with R + Rs as an upper vein of discal cell in female; Rs and M1 stalked; M3 and CuA1 separate, almost equal in length; CuA2 very short, less than 1/5 length of CuA1 in male.

Pregenital abdomen (Fig. 12C): Male sternum II pouch obsolete, externally indistinguishable; antero-lateral sides of A2 sternum not expanded dorsally.

Male genitalia: Tegumen triangular in dorsal view, anterior margin of tegumen shallowly incurved, rather pointed at middle of posterior margin; saccus triangularly pointed anteriorly; uncus long, ventrally bent at basal 1/3, rather thick at posterior 2/3, with a ventrally pointed apex; socius reduced at basal side of uncus, recognized as a hairy part; gnathos recognized as rather thick sclerite along postero-lateral side of tegumen, separate from uncus-socius complex by narrow membrane; costa sclerotized; costal arm very short, compressed; cucullus oblong; transtilla with many hairs; sacculus slender except for triangular proximal part, sclerotized, with a short projection; harpe large, oval, occupied median part of valve, more or less sclerotized; valvula triangular, short; phallus longer than valve, covered with granules and minute spines near posterior end; cornutus absent; coecum rather short about 1/5 length of phallus; juxta slightly longer than wide.

Male genital musculature (Table 2): Extra muscle (m5') originating on vinculum and inserting into harpe is present.

Female genitalia: Corpus bursae subglobular, wholly covered with many spines forming star-shaped base on outer surface; ductus bursae-corporis bursae junction distinct; ductus bursae shorter than corpus bursae, slightly thick, wrinkled, without spines; ductus seminalis arising near antrum; antrum sclerotized, rather long, cup shaped; 8th sternum membranous except for narrow anterior sclerite of ostium; ostium being at anterior margin of 8th sternum; apophysis anterioris, slightly

long, about 1/2 length of apophysis posterioris; ventral sclerite (sternite IX) between papillae anales narrow.

Immature stages

Last instar larva (Fig. 16D; Table 5): About 17 mm in length; colour pattern and features as in Hashimoto (1982); head rounded, longer than wide; body with small dorsal protrusions, on each protrusion the seta is bearing respectively; prothorax without protrusions; meso- and metathoraces and 1st to 8th abdominal segments with two dorsal projections (D1, D2 bearing on each protrusion respectively); 9th abdominal one with one dorsal (D1 bearing) protrusion; paraproct moderate. Chaetotaxy: on cranium A3 ventral to a line joining L1 and A2; setal pinaculum distinct except for dorsal ones; on prothorax L setae on same pinaculum, but SV setae on each pinaculum; ventral proleg with four SV setae; on anal shield D1 setae slightly anterior to a line drawn between SD2s.

Pupa (Figs. 18A–C, 19D): Reddish brown, about 8.5 mm in length, about 3.2 mm in width; labial palpus not exposed; forewing reaching near posterior margin of 4th abdominal segment; proboscis reaching near apical margin of forewing; antenna and mesothoracic leg extending slightly beyond apical margin of forewing; femur of foreleg not exposed; hind tarsus slightly exposed; dorsal and lateral grooves distinct; cremaster with a pair of sclerotized, curved and pointed setae basally separate.

Distribution. Japan and Korea (Choi, 2007a).

Bionomics. There is a single generation per year. The moths appear in spring and mainly restricted to the deciduous forest in the hilly to low mountainous areas.

Etymology. *Paratrichopteryx* is derived from an affinity with the genus *Trichopteryx*. Gender is feminine.

Remarks. *Paratrichopteryx* is monobasic and constitutes the sister groups with the genus *Trichopteryx* by sharing the character of phallus (posterior part of phallus covered with small spines or granules circularly; Figs. 60F, 66F, 72F). *Paratrichopteryx* is distinguished from *Trichopteryx* by the following characters: male hindtibia without hair-pencil, hindwing greyish brown with fuscous discal dot (Fig. 59A–B), male hindwing with Rs and M1 stalked (Fig. 45E), tegumen (middle of posterior margin) and saccus (middle of anterior margin) pointed (Fig. 60B–C), uncus rather stout (Fig. 60A), corpus bursae subglobular, ductus bursae without spines, and antrum longer than wide (Fig. 60G) in *Paratrichopteryx*, but male hindtibia with hair-pencil (Fig. 7C), hindwing white with pale brown postmedial line (Figs 59C–H, 61A–H, 62A–F), male hindwing with Rs and M1 separate (Fig. 11B), tegumen and saccus rounded (Fig. 14C–D), uncus rather slender (Fig. 14A), corpus bursae globular (Fig. 15D), ductus bursae with a comb-like spinous ridge (Fig. 15D), and antrum wider than long (Fig. 15E) in *Trichopteryx*.

A monobasic species *misera* generally has been treated as a member of the genus *Trichopteryx*, but the present paper establishes a new genus for this species based on the adult characters. The immature characters (Figs. 16D, 19D; Table 5) also support this treatment: larval body tinged with reddish brown (Fig. 16D) in *Paratrichopteryx*, but almost yellowish green with whitish yellow subspiracular stripe (Fig. 16E–G) in *Trichopteryx*; basal part of dorsal setae slightly protruded (Fig.

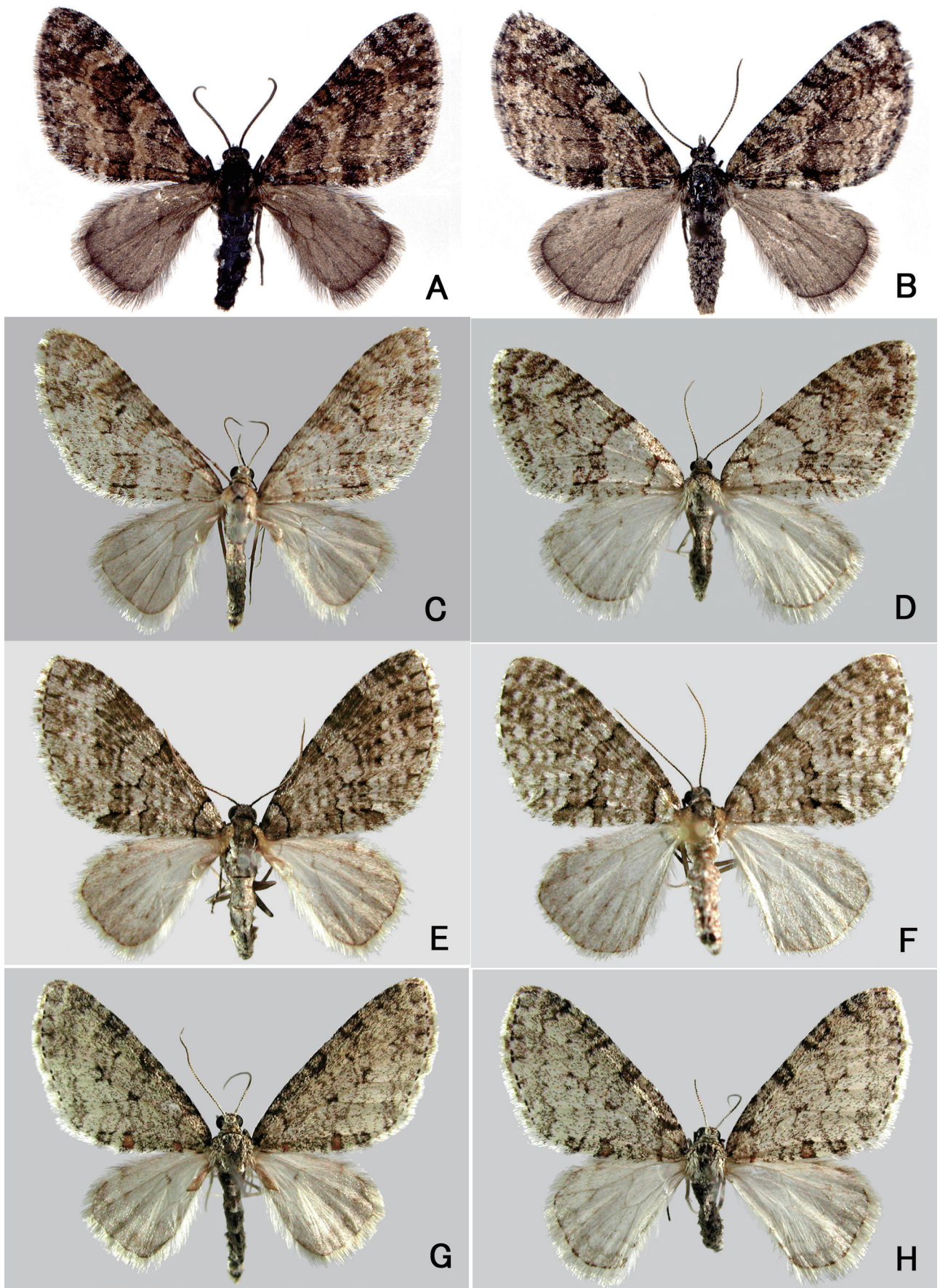


Fig. 59. Adults. A, *Paratrachopteryx misera* (Butler), ♂; B, ditto, ♀; C, *Trichopteryx fastuosa* Inoue, ♂; D, ditto, ♀; E, *Trichopteryx grisearia* (Leech), ♂; F, ditto, ♀; G, *Trichopteryx hemana* (Butler), ♂; H, ditto, ♀.

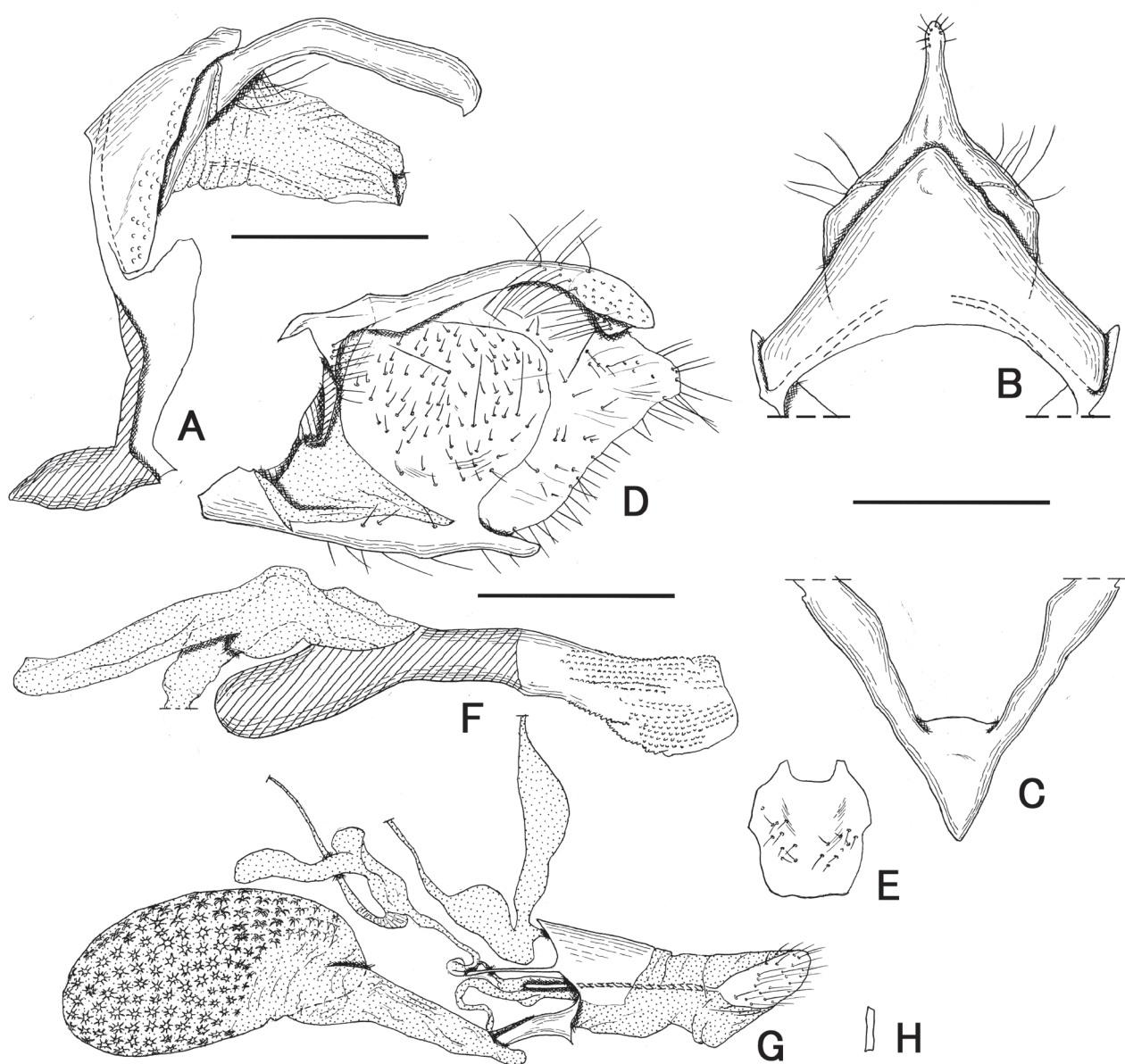


Fig. 60. Genitalia, *Paratrichopteryx misera* (Butler) (A–F, ♂; G–H, ♀). A, lateral; B, tegumen and uncus, dorsal; C, saccus, dorsal; D, right valve, inner; E, juxta, ventral; F, phallus, lateral; G, lateral; H, narrow sclerite (sternite IX). Scales = 0.5 mm (A–F), 1.0 mm (G–H).

16D) in *Paratrichopteryx*, but not protruded (Fig. 16E–G) in *Trichopteryx*; and pupal cremaster with a pair of sclerotized, strongly curved and pointed setae basally separate (Fig. 19D) in *Paratrichopteryx*, but with two to four pairs of setae, of which terminal one is gently curved (Fig. 19E–F) in *Trichopteryx*.

***Paratrichopteryx misera* (Butler), comb. nov.**
(Figs. 51, 12C, 16D, 18A–C, 19D, 45D–F, 59A–B, 60)

Lobophora misera Butler, 1879: 443.

Trichopteryx misera: Leech, 1897: 74.

Nothopteryx misera: Prout, 1914: 185.

Diagnosis. Forewing length 10–12 mm in male, 10–13 mm in female; male and female genitalia shown in Fig. 60. This species is easily distinguishable from the *Trichopteryx* species by the rather small size and the fore- and hindwing

colour pattern (pale greyish brown with blackish brown lines; hindwing pale greyish brown with a fuscous discal spot).

Specimens examined. JAPAN: Honshu: Kanagawa, Fujino, 1♀, 16. iv. 1977 (K. Yazaki); Kanagawa, Ohdarumi, 1♂, 23. iv. 1977 (K. Yazaki); Aichi, Mt. Rokushosan, 1♀, 15. iv. 1978 (B. Tanaka); same locality, 2♀, 7. iv. 1979 (S. Hashimoto); same locality, 2♂, 3♀ (Host plant: *Quercus aliena* Blume), emerged. 27–31. iii. 1980 (S. Hashimoto); Aichi, Toyota, 1♂, 2♀, 15. iv. 1994 (S. Hashimoto); Aichi, Aioiyama, 1♂ (Host plant: *Quercus serrata* Murray), emerged 23. ii. 2001 (H. Fukutomi); Aichi, Yagoto, 1♂, 1♀, 2. iv. 2001 (S. Onodera); Shiga, Azari-cho, 1♂ (Host plant: *Quercus variabilis* Murray), emerged 26. iii. 1986 (N. Teramoto); same locality, 1♀ (Host plant: *Quercus variabilis* Murray), emerged 30. iii. 1986 (N. Teramoto); Osaka, Mt. Ryuzoan, 1♀, 8. iv. 1981 (S. Kinoshita); Osaka, Kurumatsukuri, 1♂, 18. iv. 1981 (S. Kinoshita); Hyogo, Sasabe, 1♂, 26. iv. 1981 (S. Hashimoto).

Distribution. Japan (Hokkaido and Honshu) and Korea.

Host plants. *Quercus serrata* Murray (Fagaceae; Inoue, 1971); *Q. dentata* Thunberg (Nakajima, 1974); *Q. aliena* Blume accepted in rearing condition (Hashimoto, 1982); *Q. glauca* Thunberg accepted in rearing condition (Yazaki, unpublished data); *Q. acutissima* Carruthers & *Q. variabilis* Blume (Teramoto, 1996).

Immature stages. See the generic description.

Bionomics. See the generic description.

Genus *Trichopteryx* Hübner

Trichopteryx Hübner, [1825] 1816: 323. Type species: *Geometra lobulata* Hübner, [1813] 1796: pl. 70, fig. 362, by subsequent designation (a junior subjective synonym of *Phalaena Geometra carpinata* Borkhausen, 1794: 295). *Trichopterix* Hübner, 1825: 51 (an incorrect subsequent spelling). *Nothopteryx* Prout, 1909: 157 (an unnecessary replacement name based on the mistaken belief on the dates of Hübner's Verz. bekannter Schmett.).

Diagnosis. Apomorphies (Fig. 4) of *Trichopteryx* are as follows: 1, male hindwing with Rs and M1 separate (Fig. 11B); 2, male hindwing with CuA1 shorter than M3 (Fig. 11B); 3, corpus bursae globular (Figs. 15D, 66G). *Trichopteryx* is distinguished from other trichopterygine genera by the following combination of characters: hind tibia with a pair of apical spurs; forewing with two areoles; M1 arising from areole; hindwing venation (Sc separate from an upper vein of discal cell (R + Rs) and connected with a short vein of R in male, fused in female; Rs and M1 separate in male, stalked in female; CuA1 shorter than M3 in male; CuA2 short or very short, 1/2 to 1/4 length of CuA1 in male); valvula tapering; corpus bursae globular, covered with wholly spines forming star-shaped base on outer surface; ductus bursae thick, longer than corpus bursae, with comb-like spinous ridge.

Description. The generic description is based on thirteen species and the following studies: Forbes, 1917; Hashimoto, 2011; Hausmann & Viidalepp, 2012; Yazaki & Wang, 2018).

Adult

Head (Figs. 5J, 6E): Head clothed with scales thickly; antennal flagellomeres filiform; frons rounded; labial palpus slightly curved, 1.0 to 2.0 times as long as eye diameter (usually 1.0) in male and 1.0 to 2.0 (usually 1.5) times in female; proboscis developed.

Thorax (Figs. 7A–C, 8A–B, 11A–C, 59C–H, 61A–H, 62A–F): Thorax stout; metepimeron enlarged, divided into anterior and posterior parts by inner ridge in both sexes; male matameron arched; hind tibia with a pair of apical spurs, with a hair-pencil in male. Forewing creamy white covered with greyish olive, blueish grey or brownish grey scales, occasionally tinged with brown to reddish brown, with darker lines distinctly consisting of basal, postbasal, antemedial, postmedial, subterminal and adterminal ones; antemedial and postmedial lines fused or close to each other between discal cell and dorsum; discal spot fuscous, distinct or indistinct; terminal dots black; forewing with two areoles (Hausmann & Viidalepp

(2012) described that the forewing has a single areole, but all the species including two European ones examined in this study have two areoles as already indicated by Meyrick (1892), Forbes (1917), Inoue (1982), Xue (1999), and so on.); M1 arising from areole. Hindwing usually white with pale brown postmedial line, scattered with pale brown scales along termen, rarely covered with greyish brown scales densely; discal spot pale brown; male with an anal fold (less than 1/3 length of anal margin); Sc separate from an upper vein of discal cell (R + Rs) and connected with a short vein of R near end of discal cell in male, fused with R + Rs as an upper vein of discal cell in female; Rs and M1 separate in male, stalked in female; M3 and CuA1 separate; male CuA1 shorter than M1; male CuA2 shorter than CuA1 (1/2 to 1/4 length).

Pregenital abdomen (Figs. 8A–B, 9D–E, 13): Male sternum II pouch distinct, small or very small; male sternum II with a pair of triangular expansions.

Male genitalia (Figs. 14A–G, 66A–F, 67A–G, 68A–F, 69A–F, 70A–F, 71A–F, 72A–F, 73A–G, 74A–F): Anterior margin of tegumen rather deeply incurved, posterior margin strongly curved posteriorly; saccus rounded; uncus generally long, gently curved, with a pointed tip; socius more or less reduced at basal side of uncus, recognized as a hairy part; gnathos a narrow sclerite along postero-lateral side of tegumen, separate from uncus-socius complex by narrow membrane or synscleritous with it; costa sclerotized; costal arm distinct, rather short, compressed; cucullus oblong, with hairs, being at end of costal arm; transtilla triangular, with many hairs; sacculus narrow, sclerotized, occasionally thick at base, usually with a short projection; harpe large, oval, occupying median part of valve, weakly sclerotized, generally fused with sacculus; valvula triangular, slender; phallus covered with many granules or minute spines near posterior end; coecum distinct, about 1/4 to 1/3 length of phallus; cornuti present or absent; juxta longer than wide.

Male genital musculature (Fig. 14B–E; Table 2): Extra muscle (m5') originating on vinculum and inserting into harpe is present.

Female genitalia (Figs. 15D–E, 66G–H, 67H–I, 68G–I, 69G–H, 70G–H, 71G–H, 72G–H, 73H–I, 74G–H): Corpus bursae globular, wholly covered with numerous spines forming star-shaped base on outer surface; ductus bursae-corporis bursae junction distinct; ductus bursae longer than corpus bursae, thick, cylindrical, with a comb-like spinous ridge or a row of spines; ductus seminalis arising near antrum; antrum sclerotized, cup shaped; 8th sternum membranous except for narrow anterior sclerite of ostium; ostium being at anterior margin of 8th sternum; apophysis anterioris rather short, about 1/3 to 1/2 length of apophysis posterioris; papillae anales rounded; ventral sclerite (sternite IX) present, narrow between papillae anales.

Immature stages

Last instar larva (Figs. 16E–G, 17A–L, 63–65; Table 5): Cylindrical; head rounded, wider than long; body smooth or finely granulated, almost yellowish green; intersegmental area paler; subspiracular stripe whitish yellow, distinct; venter paler, with a white ventral stripe; peritreme of spiracle pale yellowish brown; chrochets arranged in broken biordinal mesoserries; paraproct distinct; abdominal setae very short, blunt tipped.

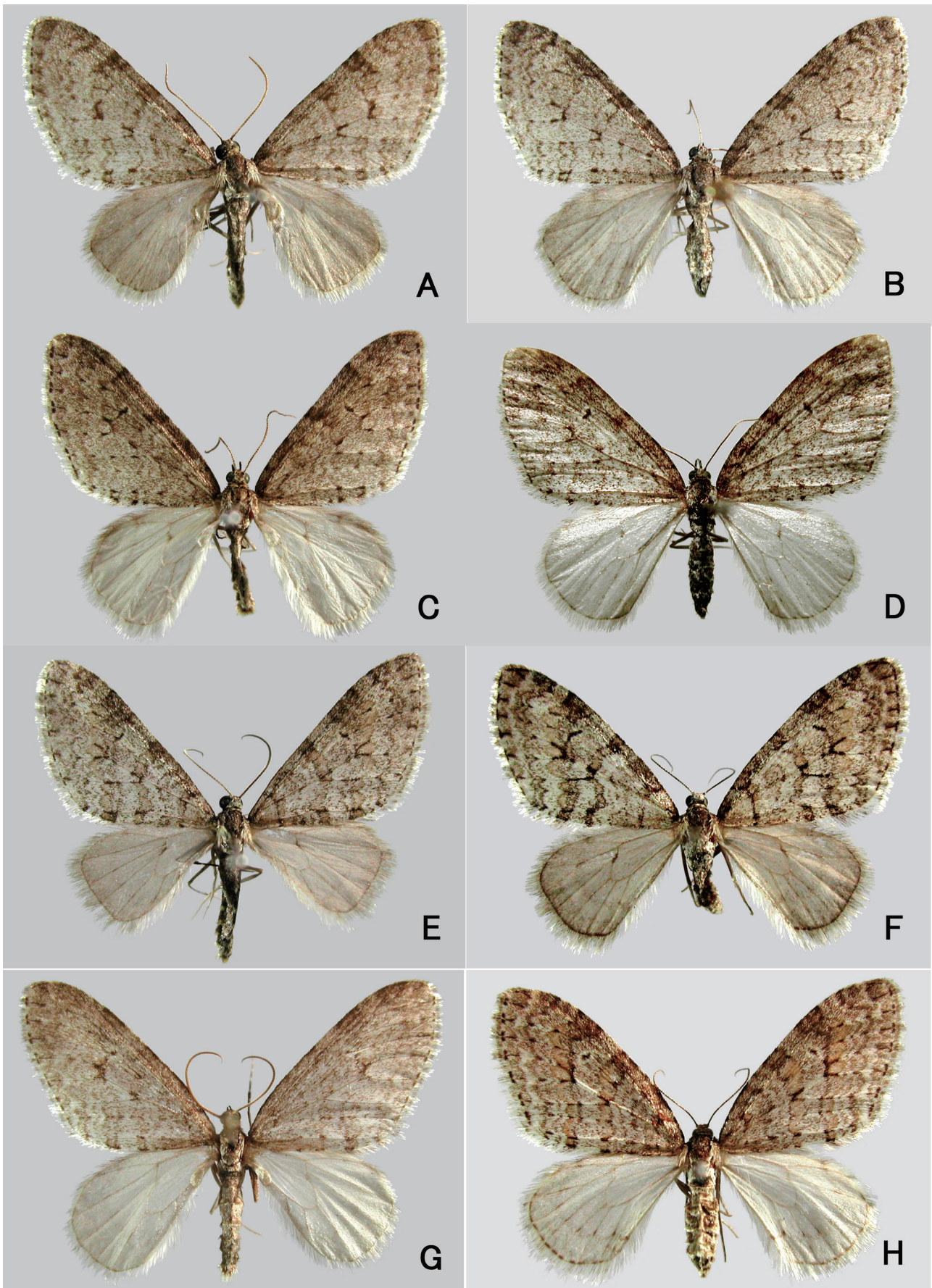


Fig. 61. Adults. A, *Trichopteryx ignorata* Inoue, ♂; B, ditto, ♀; C, *Trichopteryx incerta* Yazaki, ♂; D, ditto, ♀; E, *Trichopteryx microloba* Inoue, ♂; F, ditto, ♀; G, *Trichopteryx nagaii* Inoue, ♂; H, ditto, ♀.

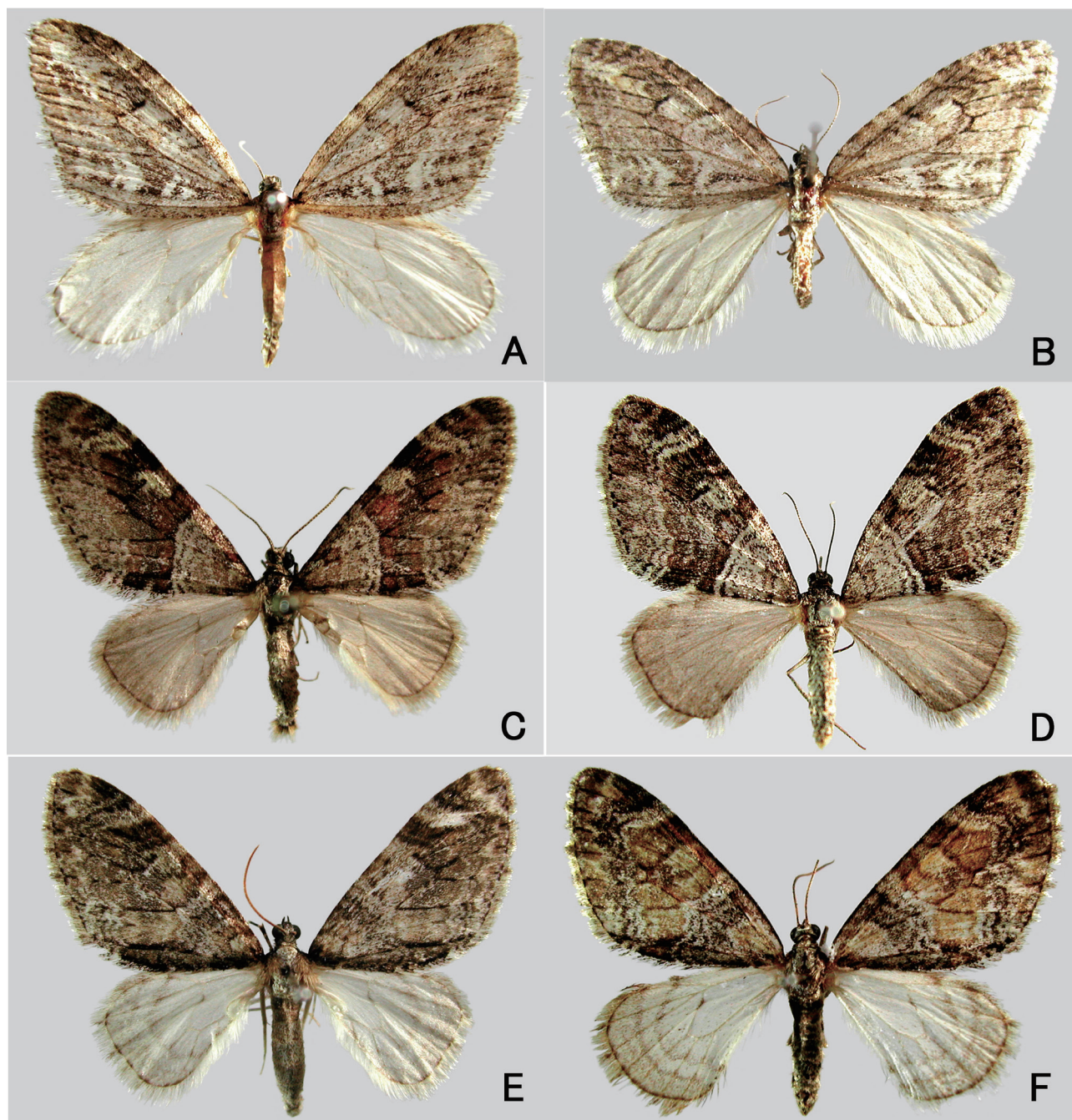


Fig. 62. Adults. A, *Trichopteryx polycommata anna* Inoue, ♂; B, ditto, ♀; C, *Trichopteryx terranea* (Butler), ♂; D, ditto, ♀; E, *Trichopteryx ussurica* (Wehrli), ♂; F, ditto, ♀.

Chaetotaxy: on cranium A3 ventral to a line joining L1 and A2; prothoracic SD group unisetose on prothoracic shield; on ventral proleg SV group quadrossetose; on anal shield D1 setae distinctly anterior to a line drawn between SD2s.

Pupa (Fig. 19A, E, F): Reddish brown to dark brown; labial palpus not exposed; fore femur not exposed; hind tarsus slightly exposed; lateral groove indistinct; cremaster with two to four pairs of setae, of which terminal one is sclerotized, pointed and curved outwards, others coiled.

Distribution. Temperate areas of the Palearctic and Nearctic regions.

Bionomics. There is a single generation per year. The adults are spring moth and mainly obtained from the mountainous

areas. The known larvae feed on the deciduous trees and shrubs (Betulaceae; Caprifoliaceae; Fagaceae; Hamamelidaceae; Sapindaceae; Oleaceae; Ulmaceae) and probably oligophagous (Hausmann & Viidalepp, 2012).

Remarks. The genus *Trichopteryx* comprises of about 25 Palearctic species and one Nearctic species, but some of the Himalayan species might be transferred into other genera. The genus is closely related to the genus *Paratrachopteryx*. As for differences between them, see the remarks of the genus *Paratrachopteryx*.

Key to the Japanese species of *Trichopteryx* (based on adult characters)

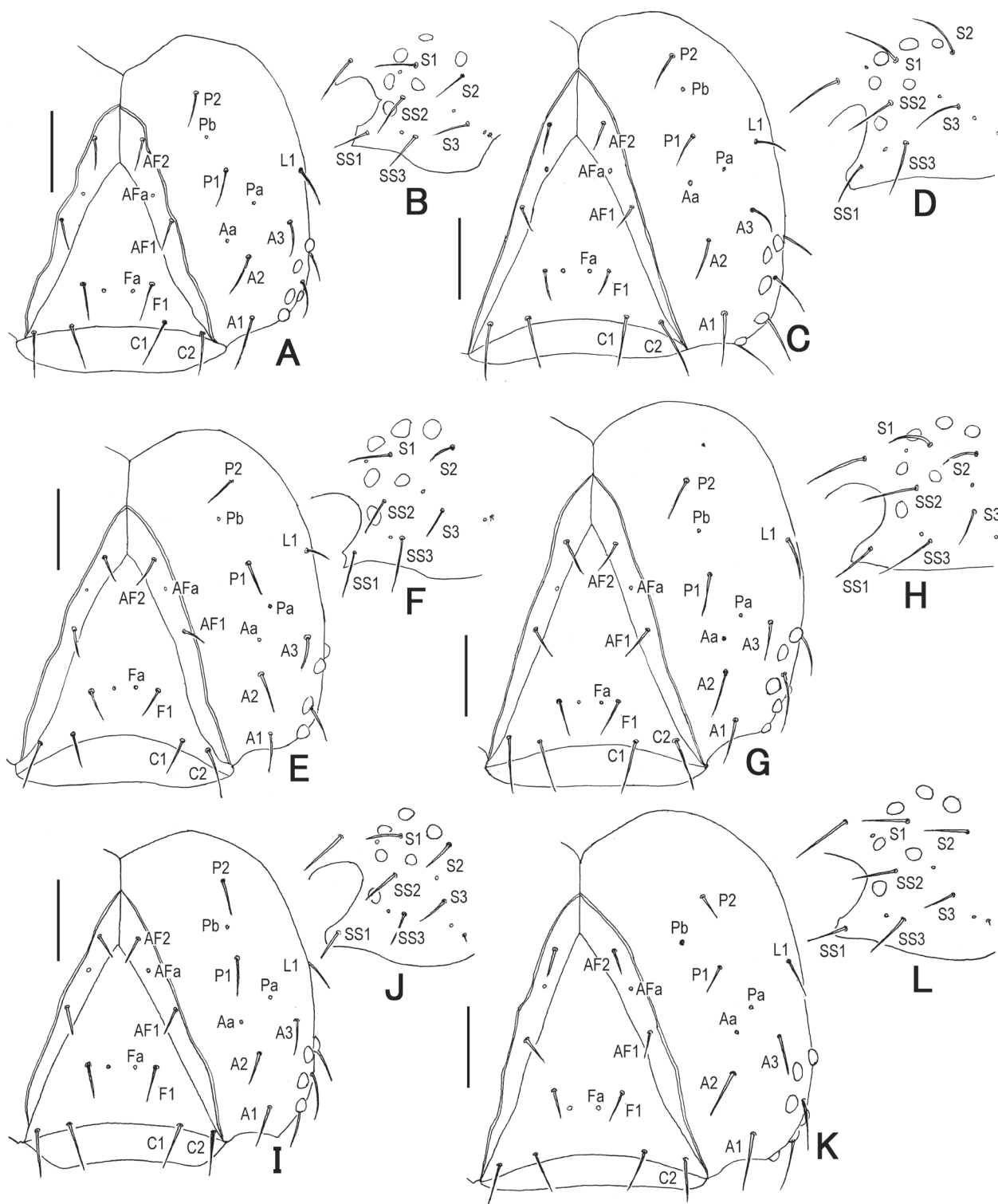


Fig. 63. Larvae, head (A, C, E, G, I, K), gena (B, D, F, H, J, L). A–B, *Trichopteryx fastuosa* Inoue; C–D, *Trichopteryx ignorata* Inoue; E–F, *Trichopteryx microloba* Inoue; G–H, *Trichopteryx nagaii* Inoue; I–J, *Trichopteryx terranea* (Butler); K–L, *Trichopteryx ussurica* (Wehrli). Scales = 0.25 mm.

1. Forewing with antemedial and postmedial lines fused with each other or closely adjacent between discal cell and dorsum 2
- . Forewing with antemedial and postmedial lines separate with each other 5
2. Termen of forewing gradually curved; hindwing triangular;

- uncus slender, not swollen 3
- . Termen of forewing almost straight; hindwing rather elongate, elliptical; uncus swollen near terminal end; (costal arm distinct; phallus almost straight, longer than valve; coecum long, about 1/3 length of phallus; ductus bursae long, gently curved, with a long comb-like spinous ridge,

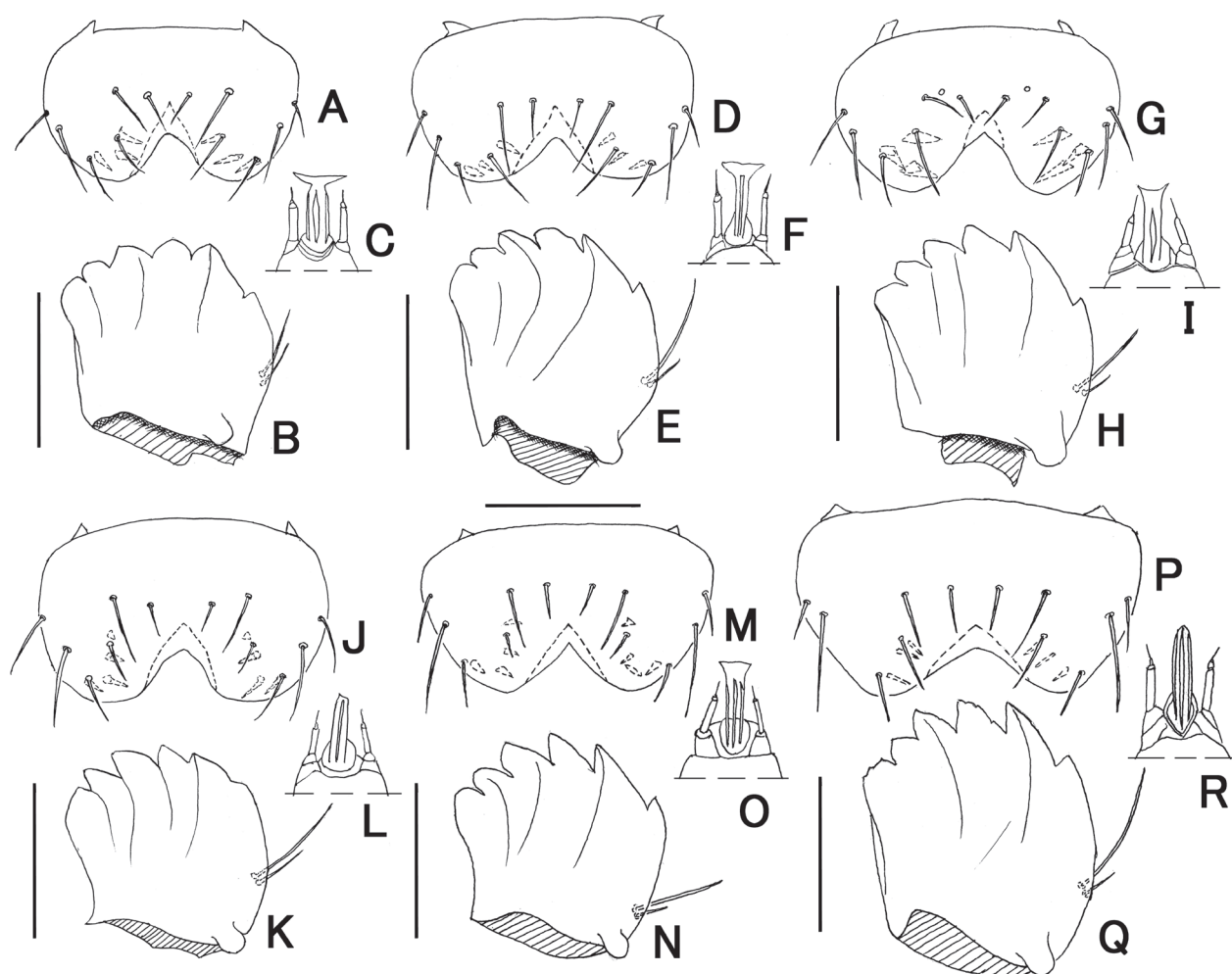


Fig. 64. Larvae, labrum (A, D, G, J, M, P), left mandible (B, E, H, K, N, Q), spinneret (C, F, I, L, O, R). A–C, *Trichopteryx fastuosa* Inoue; D–F, *Trichopteryx ignorata* Inoue; G–I, *Trichopteryx microloba* Inoue; J–L, *Trichopteryx nagaii* Inoue; M–O, *Trichopteryx terranea* (Butler); P–R, *Trichopteryx ussurica* (Wehrli). Scales = 0.25 mm.

- about 1/2 length of ductus bursae; apophysis anterioris about 1/3 length of posterioris) *T. polycommata anna*
3. Forewing with antemedial and postmedial lines narrow, pale brown or dark brown to reddish dark brown; post basal line indistinct; subterminal line indistinct between M3 and dorsum 4
 - . Forewing with median band broad, brown to dark brown (antemedial and postmedial lines fused); post basal line broad, fuscous; subterminal line broad, fuscous; black transverse line being along dorsum; (saccus long, rounded; costal arm indistinct; saccular projection with a dull tip extending dorsally; phallus almost straight, rather thick, shorter than valve; cornuti consisting of four small spines; coecum less than 1/3 length of phallus; ductus bursae long, curved at anterior half, with a long comb-like spinous ridge, about 1/2 length of ductus bursae, with small spines; apophysis anterioris about 1/3 length of posterioris) *T. ussurica*
 4. Forewing white, densely covered with dark brown scales; basal line broad, light brown; antemedial and postmedial lines dark brown to reddish dark brown; hindwing white, densely covered with brown scales; uncus long, slender;

- costal arm distinct, short; valvula tapering; saccular process spatulate; phallus thick, as long as valve; cornuti consisting of long sclerite with many spines and several minute spines; coecum thick, about 1/3 length of phallus; ductus bursae long, swelling near corpus bursae, with a long comb-like spinous ridge about 1/2 length of ductus bursae, with small spines; apophysis anterioris about 1/3 length of posterioris *T. terranea*
- . Forewing white, scattered with dark brown scales; basal line narrow, fuscous; antemedial and postmedial lines pale brown; hindwing white, scattered with pale brown; uncus rather short, slender; costal arm distinct, thick; valvula narrow, tapering; saccular process spatulate, longer; phallus slender, shorter than valve; cornutus absent; coecum slender, less than 1/3 length of phallus; ductus bursae long, straight, with a long comb-like spinous ridge more than 1/2 length of ductus bursae; apophysis anterioris about 1/3 length of posterioris *T. fastuosa*
 5. Forewing white densely covered with blueish grey, light brown to dark brown or greyish brown scales; basal line darker, more or less indistinct 6
 - . Forewing white scattered with olive green, with indented

olive green lines (especially basal, antemedial and postmedial lines distinct) and a series of white spots between two adjacent lines; inner margin of basal line margined by a narrow black line; (uncus long, with a sharply pointed apex; saccus rounded, developed; costal arm indistinct; valvula tapering; saccular process slender, with a dull tip; phallus rather thick, straight, longer than valve, with a concavity at right side near

posterior end and with flattened right side posteriorly; coecum less than 1/3 length of phallus; ductus bursae long, almost straight, with a long comb-like spinous ridge less than 1/2 length of ductus bursae; apophysis anterioris about 1/2 length of posterioris) *T. grisearia*

6. Forewing white densely covered with greyish brown or light brown to dark brown scales; basal and antemedial lines without an orange spot on dorsum (inner

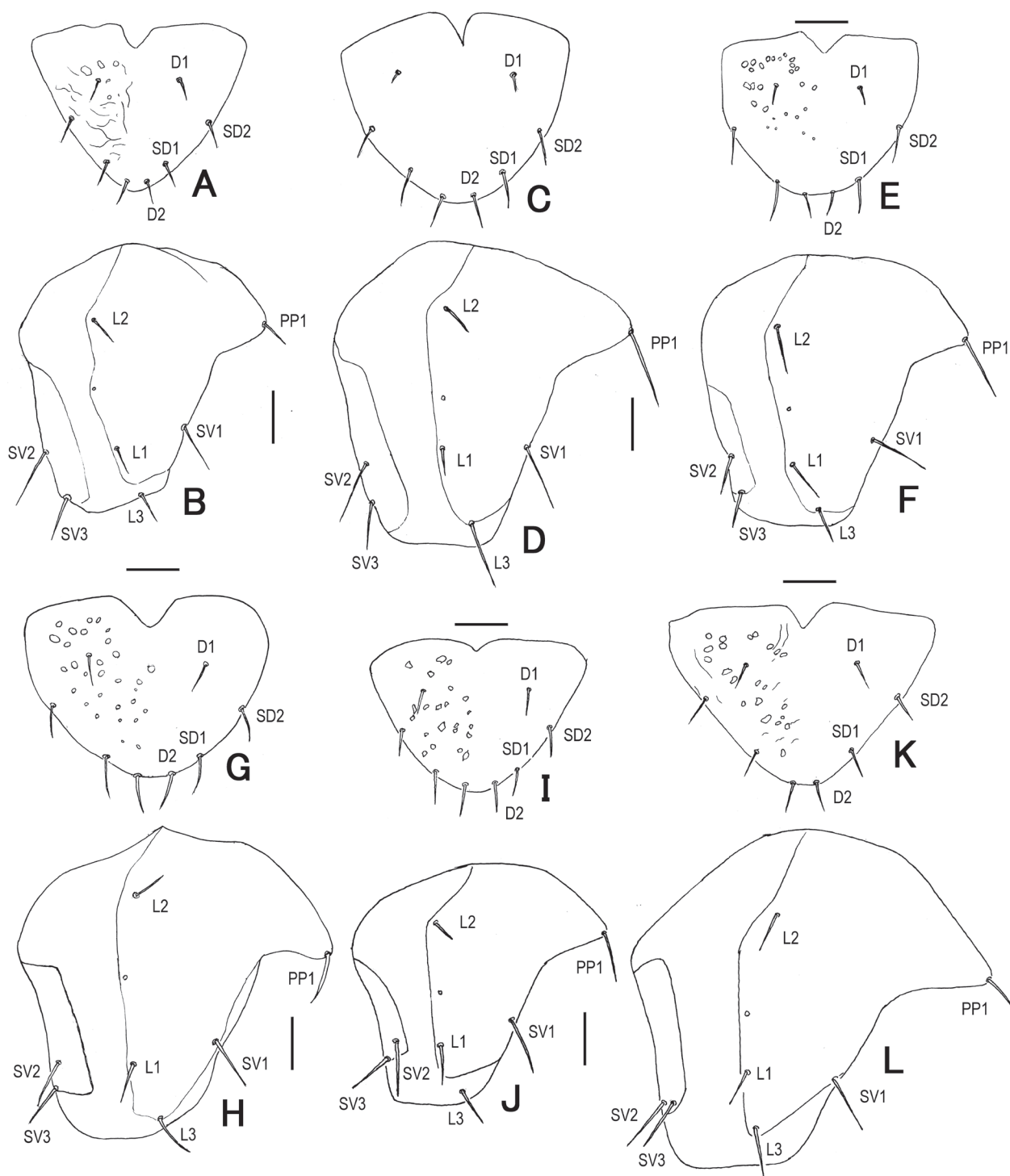


Fig. 65. Larvae, anal shield (A, C, E, G, I, K), anal proleg (B, D, F, H, J, L). A–B, *Trichopteryx fastuosa* Inoue; C–D, *Trichopteryx ignorata* Inoue; E–F, *Trichopteryx microloba* Inoue; G–H, *Trichopteryx nagaii* Inoue; I–J, *Trichopteryx terranea* (Butler); K–L, *Trichopteryx ussurica* (Wehrli). Scales = 0.25 mm.

- margin); male hindwing with a rounded anal fold 7
- Forewing white densely covered with blueish grey, with darker lines; basal and antemedial lines with an orange spot on dorsum; male hindwing with an angulate anal fold; (uncus sharply pointed; saccus widely rounded; cucullus small; costal arm very short; valvula tapering; saccular process rather short, with a slightly pointed tip; phallus twisted at posterior half, as long as valve; coecum thick, about 1/3 length of phallus; ductus bursae long, twisted near corpus bursae, with a long twisted comb-like spinous ridge less than 1/3 length of ductus bursae; apophysis anterioris about 1/3 length of posterioris) *T. hemana*
7. Forewing white densely covered with dark brown or light brown scales, with darker or reddish brown lines, with slightly distinct antemedial and postmedial darker or reddish brown lines; anal fold of male hindwing small, more than 1/5 length of inner margin 8
- Forewing white rather sparsely covered with greyish brown scales, with distinct basal, antemedial, postmedial and subterminal pale yellowish brown lines; anal fold of male hindwing very small, less than 1/6 length of inner margin; (uncus long, with a sharply pointed apex; saccus rounded; cucullus rounded, large; costal arm short; valvula narrow, tapering; saccular process with spatulate apex; phallus rather slender, straight, shorter than valve; coecum less than 1/4 length of phallus; ductus bursae very long, slightly curved, with a long comb-like spinous ridge less than 1/4 length of ductus bursae; apophysis anterioris about 1/3 length of posterioris) .. *T. microloba*
8. Forewing white densely covered with dark brown scales, with darker lines 9
- Forewing white densely covered with light brown scales, with reddish brown; (uncus slender; saccus rather small, rounded; cucullus rounded, large; costal arm distinct, short; valvula narrow, tapering; saccular process slightly curved, with a dull tip; phallus almost straight, thicker towards posterior end, shorter than valve; coecum less than 1/4 length of phallus; corpus bursae oblong; ductus bursae short, slightly longer than corpus bursae, with a row of one to five spines; apophysis anterioris about 1/3 length of posterioris) *T. nagaii*
9. Forewing with discal spot indistinct; hindwing white rather densely covered with pale brown scales; uncus long, slender, gently curved; saccus triangular, rather long; cucullus large, rounded; costal arm indistinct; valvula short, narrow, tapering; saccular process well curved, with a dull tip; phallus as long as valve, slightly curved; coecum thick, about 1/4 length of phallus; ductus bursae long, narrow, swelling at mid-ventral, curved at middle, with a long comb-like spinous ridge about 1/2 length of ductus bursae; apophysis anterioris about 1/3 length of posterioris; papillae anales rounded, with long hairs . *T. ignorata*
- Forewing with discal spot distinct; hindwing white sparsely covered with pale brown scales; uncus short, thicker near base, weakly curved; saccus widely rounded, short; cucullus small, rounded; costal arm long; valvula tapering; saccular process short, curved, with a pointed tip;

phallus almost straight, shorter than valve, weakly twisted at posterior 1/3; coecum thick, less than 1/4 length of phallus; ductus bursae long, curved at anterior half, with a long curved comb-like spinous ridge about 1/2 length of ductus bursae; apophysis anterioris about 1/2 length of posterioris; papillae anales swelling dorsally, with apically curved hairs and apically swelling hairs *T. incerta*

Trichopteryx fastuosa Inoue

(Figs. 16E, 59C–D, 63A–B, 64A–C, 65A–B, 66)

Trichopteryx grisearia: Inoue, 1956: 251 (nec Leech, 1891).

Trichopteryx fastuosa Inoue, 1958: 246.

Diagnosis. Forewing length 12–14 mm in male, 13–15 mm in female; labial palpus slightly curved about 1.0 times as long as eye diameter in both sexes; CuA1 about 2/3 length of M3, CuA2 less than 1/4 of CuA1 in male; male and female genitalia shown in Fig. 66. This species is similar to *T. microloba* in the forewing pattern, but distinguishable from it in the antemedial and postmedial lines (fused or closely adjacent between discal cell and dorsum in *fastuosa*, but separate in *microloba*). Distinction among the Japanese *Trichopteryx* species is treated in the key.

Specimens examined. JAPAN: Hokkaido: Tokachi, Nukabira, 2♂, 2♀, 30. v. –1. vi. 1977 (S. Hashimoto); Honshu: Niigata, Sado Is., Mt. Myoken, 1♂, 5. v. 1967 (R. Sato); Niigata, Miomote, 1♀, 18. v. 1974 (R. Sato); same locality, 1♀, 14. vi. 1974 (R. Sato); Niigata, Kurokawa, 1♂, 3♀, 24–25. iv. 1971 (R. Sato); same locality, 1♂, 22. v. 1971 (R. Sato); Niigata, Akadani, 1♀, 28. iv. 1967 (R. Sato); same locality, 1♂, 1♀, 28. iv. 1968 (R. Sato); same locality, 1♂, 1♀, 2. v. 1970 (A. Seino); Niigata, Sugigawa, 1♀, 20. iv. 1963 (R. Sato); Niigata, Yunotani, 1♂, 2♀, 26. v. 1973 (Larva coll.), emerged 29. iii. 1974 (R. Sato); Nagano, Nishino, 4♂, 5♀, 26. iv. 1982 (S. Hashimoto); Gifu, Ho, 1♀, 4. v. 1978 (S. Hashimoto); Gifu, Nakao, 1♀, 3. v. 1978 (S. Hashimoto); Gifu, Hikagedaira, 11♂, 4♀, 3–6. v. 1978 (S. Hashimoto); same locality, 9♂, 3♀, 11. v. 1980 (S. Hashimoto); same locality, 9♂, 3♀, 6–8. v. 1981 (S. Hashimoto); Gifu, Terashiyama, 2♀, 10. v. 1977 (S. Hashimoto); Gifu, Neo-kamiosu, 2♂, 24–25. iv. 1975 (H. Endo); Gifu, Hindani, 3♂, 2♀, 14. 1v. 1977 (H. Endo); same locality, 1♂, 2♀, 4. iv. 1979 (T. Tanabe); Kyushu: Fukuoka, Mt. Hiko, 1♀, 15. iv. 1975 (K. Setoya).

Distribution. Japan (Hokkaido, Honshu, Shikoku, and Kyushu) and Taiwan.

Host plants. *Fagus japonica* Maximowicz accepted in rearing condition (Fagaceae: Yazaki, 1972); *Carpinus japonica* Blume (Betulaceae; Nakajima & Yazaki, 2011); *Acer amoenum* Carrière var. *matsumurae* (Koidzumi) K. Ogata (Sapindaceae: Sato, unpublished data).

Immature stages. The larval characters are as in Table 5. Last instar larva (Figs. 16E, 63A–B, 64A–C, 65A–B) 20–22 mm in length; head dull yellow, rounded, wider than long; body dark green; intersegmental area paler; subspiracular line yellowish white, distinct, broad; venter greyish white, with a broad white ventral stripe; thoracic legs pale yellowish brown; anal shield and anal proleg dark green; peritreme of spiracle pale yellowish

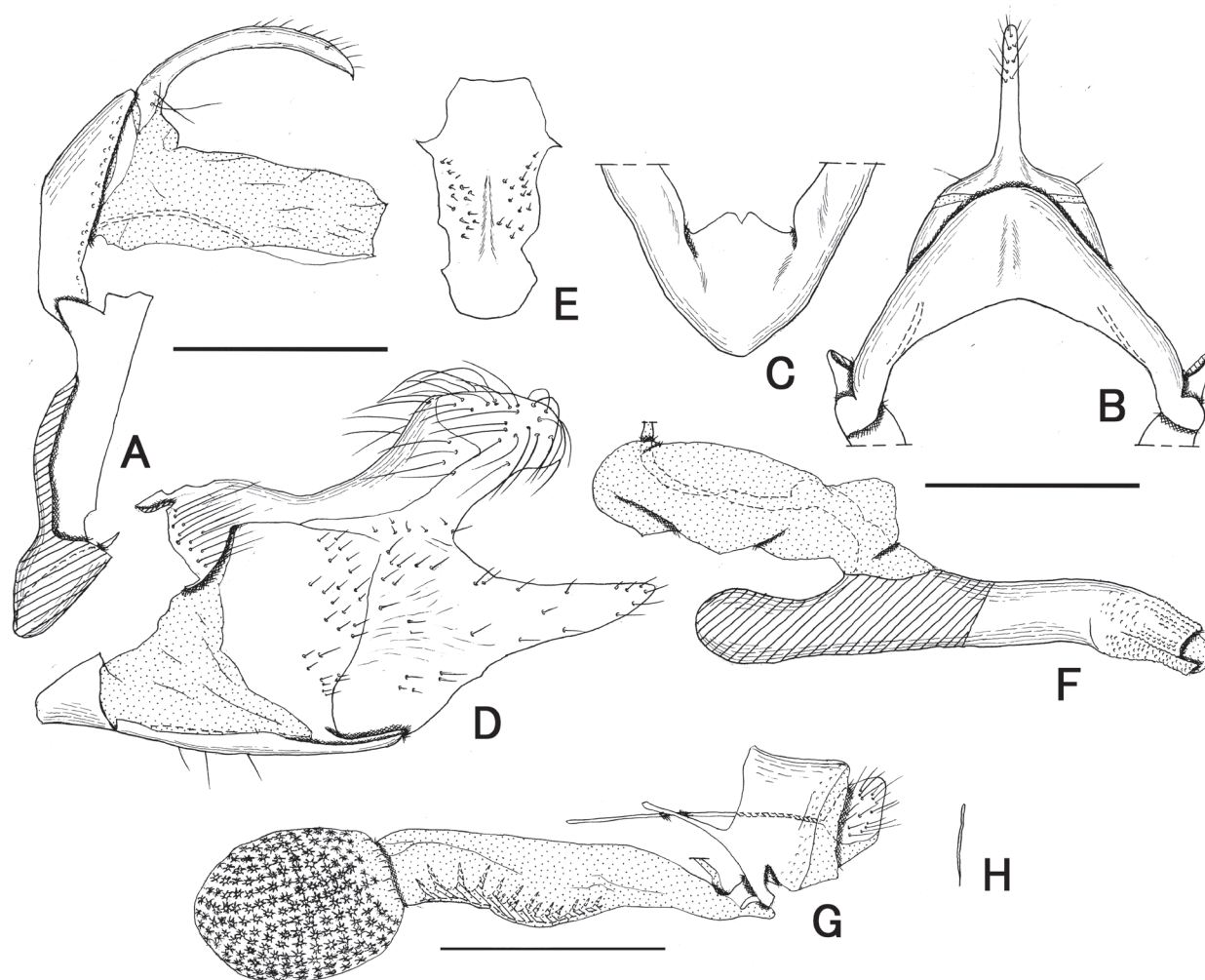


Fig. 66. Genitalia, *Trichopteryx fastuosa* Inoue (A–F, ♂; G–H, ♀). A, lateral; B, tegumen and uncus, dorsal; C, saccus, dorsal; D, right valve, inner; E, juxta, ventral; F, phallus, lateral; G, lateral; H, narrow sclerite (sternite IX). Scales = 0.5 mm (A–F), 1.0 mm (G–H).

brown; chrochets 13–16 in number on ventral proleg, 14–17 on anal proleg; paraproct rather short. Pupa unknown. Present description is based on Yazaki (1972) and on nine last instar larvae reared by Yazaki from the eggs oviposited by a captured female (Yamanashi Pref., Sanjo, 10. iv. 1977, K. Yazaki leg.).

Bionomics. See the generic description.

***Trichopteryx grisearia* (Leech)**
(Figs. 59E–F, 67)

Lobophora grisearia Leech, 1891: 54.

Trichopteryx grisearia: Leech, 1897: 74.

Nothopteryx grisearia: Prout, 1914: 184.

Diagnosis. Forewing length 13–14 mm in male, about 14 mm in female; labial palpus slightly curved less than 1.0 times as long as eye diameter in both sexes; CuA1 about 1/2 length of M3, CuA2 about 1/2 of CuA1 in male; male abdominal sternum II pouch small; male and female genitalia shown in Fig. 67. Distinction among the Japanese *Trichopteryx* species is treated in the key.

Specimens examined. JAPAN: Honshu: Kanagawa, Fujino, 1♂, 26. iii. 1977 (K. Yazaki); Yamanashi, Fukushima, 1♂, 27. iii.

1976 (K. Yazaki); same locality, 1♂, 17. iv. 1976 (K. Yazaki); 1♂, 6. iv. 1977 (K. Yazaki); Yamanashi, Uenohara, 1♀, 17. iv. 1976 (K. Yazaki); Gifu, Ho, 1♀, 4. v. 1978 (S. Hashimoto); Gifu, Korigawa, 1♀, 12. iv. 1975 (H. Endo); Gifu, Fujihashimura, 2♀, 29. iv. 2001 (H. Fukutomi); Gifu, Yabudani, 1♂, 29. iii. 1979 (T. Tanabe); Osaka, Minoo, 1♀, 8. iv. 1980 (S. Hashimoto); same locality, 1♂, 30. iii. 1982 (T. Saito); same locality, 1♀, 2. iv. 1982 (T. Saito); same locality, 1♀, 8. iv. 1985 (S. Hashimoto); Hyogo, Azekeikoku, 1♀, 1. v. 1976 (B. Tanaka); Hyogo, Hyonosen, 1♂, 7. iv. 1979 (S. Kinoshita); Kyushu: Fukuoka, Mt. Hikosan, 1♂ (OPU), 1. iv. 1954 (H. Kuroko); same locality, 1♂, 15. iv. 1975 (K. Setoya).

Distribution. Japan (Honshu, Hachijojima Is., Shikoku, Kyushu, and Tsushima Is.), Korea (Choi, 2007a), China, and Russian Far East (Southeast Siberia).

Host plants. Unknown.

Immature stages. Unknown.

Bionomics. See the generic description.

***Trichopteryx hemana* (Butler)**
(Figs. 5J, 6E, 7A–C, 8A–B, 9D, 11A–C, 13, 14A–F, 15D–E, 16F, 17A–L, 19A, E, 59G–H)

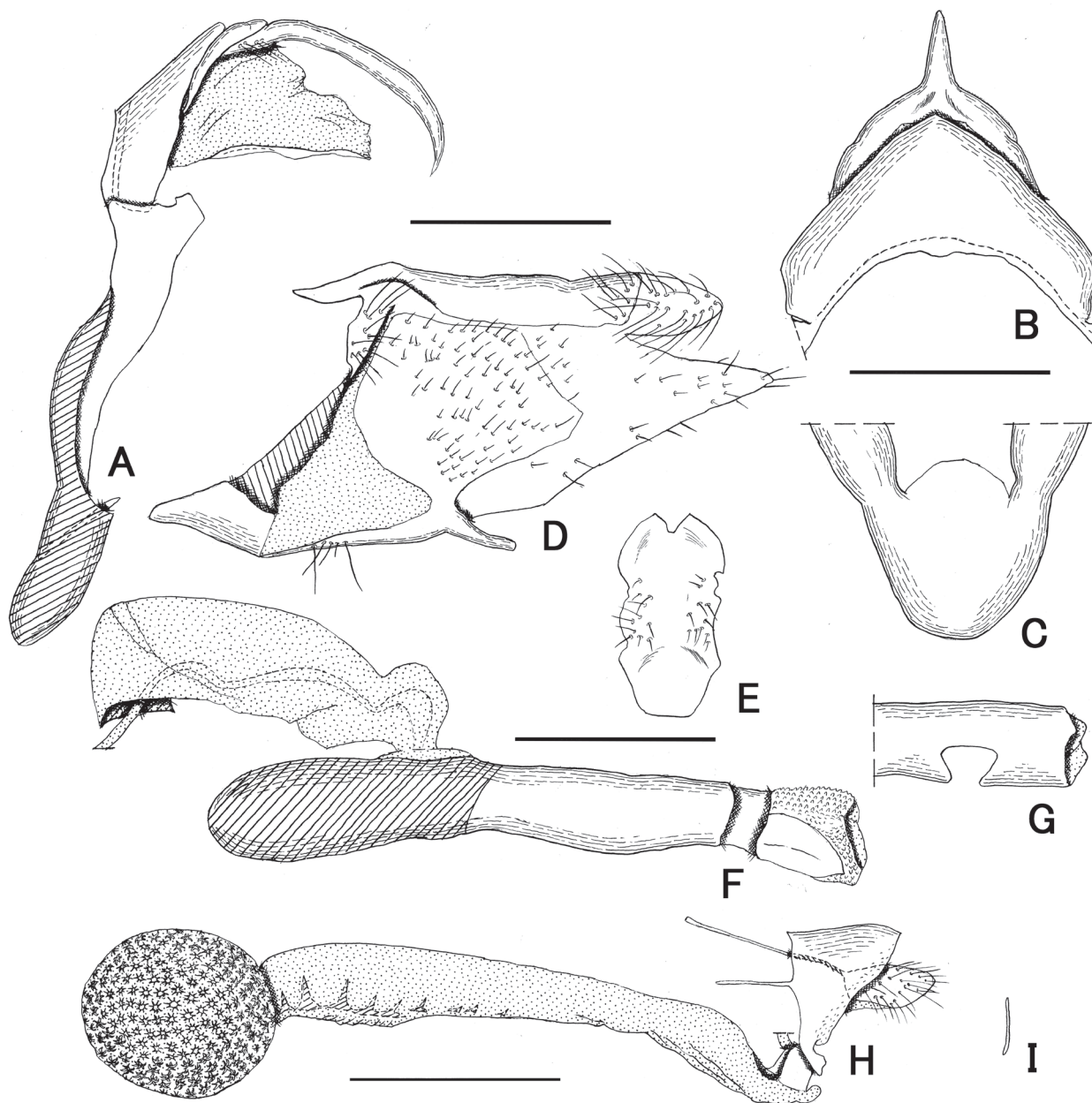


Fig. 67. Genitalia, *Trichopteryx grisearia* (Leech) (A–G, ♂; H–I, ♀). A, lateral; B, tegumen and uncus, dorsal; C, saccus, dorsal; D, right valve, inner; E, juxta, ventral; F, phallus, lateral; G, caudal part of phallus, dorsal; H, lateral; I, narrow sclerite (sternite IX). Scales = 0.5 mm (A–G), 1.0 mm (H–I).

Larentia hemana Butler, 1878: 444.

Lobophora carpinata var. *insontata* Christoph, 1881: 90.

Trichopteryx hemana: Leech, 1897: 74.

Nothopteryx insontata: Wileman, 1911: 331.

Nothopteryx hemana: Prout, 1914: 184.

Diagnosis. Forewing length 13–15 mm in male, 13–15 mm in female; labial palpus slightly curved, about 1.0 times as long as eye diameter in both sexes; CuA1 about 1/2 length of M3, CuA2 about 1/2 of CuA1 in male; male abdominal sternum II pouch small; male and female genitalia shown in Figs. 14A–F, 15D–E. Distinction among the Japanese *Trichopteryx* species is treated in the key.

Specimens examined. JAPAN: Hokkaido: Kushiro,

Futatsuyama, 1♂, 1♀, 12. v. 1980 (K. Iijima); Tokachi, Nukabira, 26♂, 19♀, 30. v. –3. vi. 1977 (S. Hashimoto); Honshu: Akita, Momoyake, 1♂, 29. iv. 1973 (R. Sato); Iwate, Kuzakai, 1♂, 6♀, 30. v. 1980 (K. Yasuda); Niigata, Sado Is., Mt. Myoken, 1♀, 5. v. 1967 (R. Sato); Sado Is., Nyugawa, 1♂, 3♀, 2. v. 1965 (R. Sato); Sado Is., Ogi, 1♂, 2♀, 24. vi. 1976 (R. Sato); Sado Is., Shirose, 1♀, 1. v. 1965 (R. Sato); Niigata, Okutainai, 1♂, 31. v. –1. vi. 1959 (R. Sato); Niigata, Miomote, 1♂, 7♀, 17–18. v. 1974 (R. Sato); Niigata, Akadani, 1♂, 28. iv. 1967 (R. Sato); Niigata, Kakumi, 1♀, 20. iv. 1974 (R. Sato); Niigata, Mt. Kakuda, 2♂, 1♀, 15. iv. 1972 (R. Sato); Niigata, Mt. Akiba, 1♀, 2. v. 1959 (R. Sato); Niigata, Yahikoyama, 1♂, 12. iv. 1959 (R. Sato); same locality, 1♂, 6♀, 25. iv. 1959 (R. Sato); Nagano, Kakeyu, 1♀, 24. iv. 1982 (S. Hashimoto);

Nagano, Ueda, 1♂, 4♀, 24–25. iv. 1982 (S. Hashimoto); Nagano, Minotoguchi, 1♀, 1. v. 1977 (H. Kuroko); Nagano, Nishino, 1♂, 26. iv. 1982 (S. Hashimoto); Aichi, Rokushosan, 9♂, 15–16. iv. 1978 (S. Hashimoto); Gifu, Hikagedaira, 9♂, 8♀, 5–7. v. 1978 (S. Hashimoto); same locality, 3♂, 2♀, 2. vi. 1978 (S. Hashimoto); same locality, 10♂, 3♀, 1–3. v. 1979 (S. Hashimoto); same locality, 1♂, 4. v. 1982 (S. Hashimoto); Gifu, Harayama, 10♂, 21–27. iv. 1977 (S. Hashimoto); Gifu, Oyadani, 2♀, 22. iv. 1994 (N. Okimoto); Osaka, Minoo, 1♂, 19. iv. 1978 (S. Hashimoto); Osaka, Izumi-katsuragi, 1♂, 12. v. 1978 (E. Nishida); Kyushu: Fukuoka, Mt. Hikosan, 1♀ (OPU), 7. v. 1954 (H. Kuroko); same locality, 1♂ (OPU), 31. iii. 1955 (H. Kuroko); same locality, 1♂, 1♀, 15. vi. 1975 (K. Setoya).

Distribution. Japan (Hokkaido, Honshu, Shikoku, Kyushu and Tsushima Is.), Korea (Choi, 2007a), China, and Russian Far East (Southeast Siberia).

Host plants. *Quercus glauca* Thunberg accepted in rearing condition (Fagaceae; Yazaki, 1974); *Q. actissima* Carruthers (Yazaki, 1975); *Q. aliena* Blume & *Q. serrata* Murray accepted in rearing condition (Hashimoto, unpublished data); *Acer pictum* Thunberg (Sapindaceae; Yazaki, 1975); *Hamamelis japonica* Siebold et Zuccarini (Hamamelidaceae; Inoue, 1982b).

Immature stages. The larval characters are as in Table 5. Last instar larva (Figs. 16F, 17A–L) about 20 mm in length; head yellowish green, rounded, wider than long; body green; intersegmental area yellow; subspiracular stripe yellow, broad, paler on thorax; venter whitish green, with a white ventral stripe; thoracic legs yellowish green; ventral and anal prolegs and anal shield concolorous with body; peritreme of spiracle pale yellowish brown; chrochets 15–17 in number on ventral proleg, 17–18 on anal proleg. Pupa (Fig. 19A, E) reddish

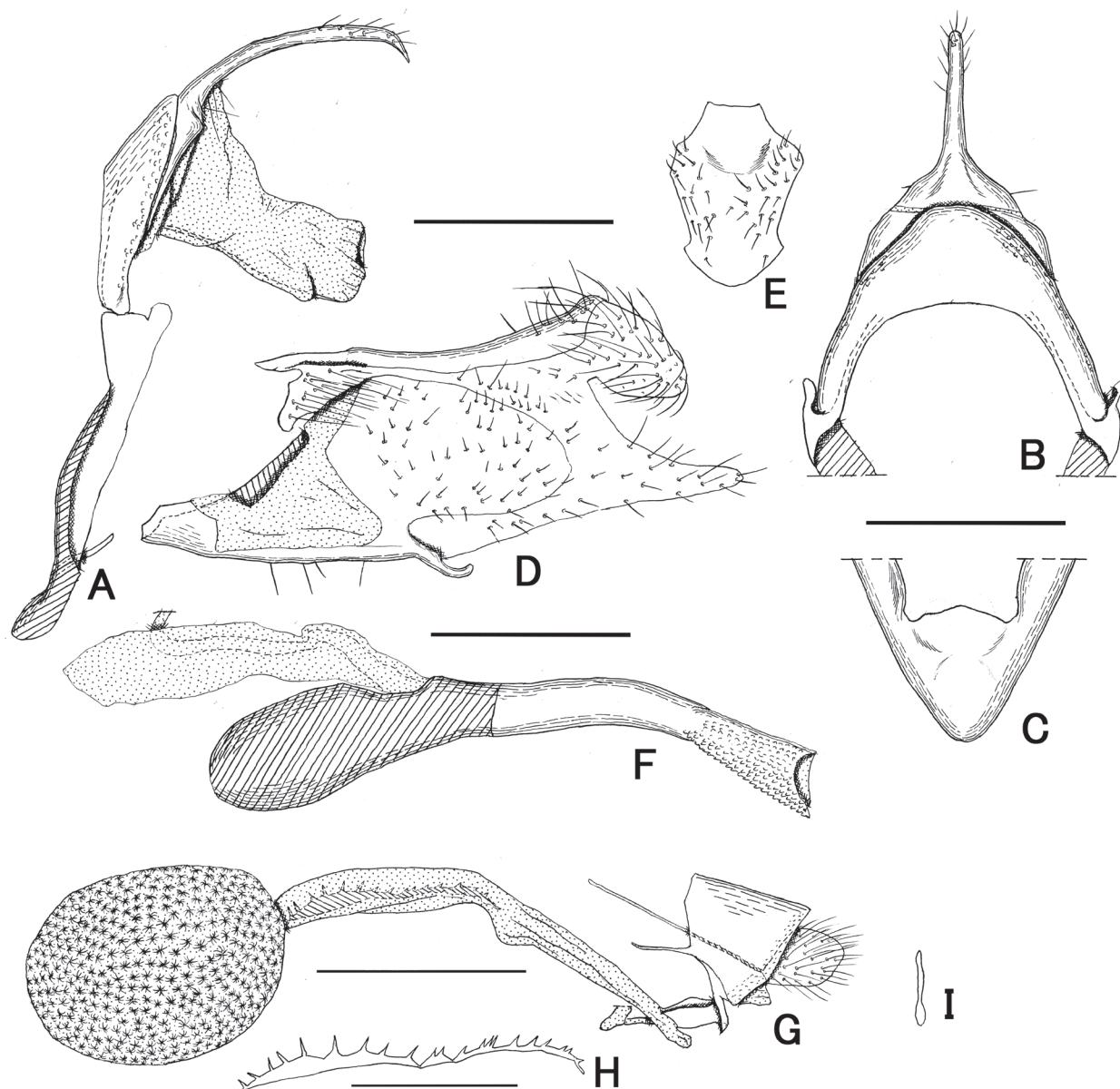


Fig. 68. Genitalia, *Trichopteryx ignorata* Inoue (A–F, ♂; G–I, ♀). A, lateral; B, tegumen and uncus, dorsal; C, saccus, dorsal; D, right valve, inner; E, juxta, ventral; F, phallus, lateral; G, lateral; H, comb-like spinous ridge of ductus bursae; I, narrow sclerite (sternite IX). Scales = 0.5 mm (A–F), 1.0 mm (G–I).

brown to dark brown, about 8.5 mm in length, about 2.7 mm in width; vertex rounded; labial palpus not exposed; forewing reaching near caudal margin of 4th abdominal segment; proboscis, antenna and mesothoracic leg reaching near apical margin of forewing; fore femur not exposed; fore leg reaching about 1/7 length of forewing; hind tarsus slightly exposed; lateral groove indistinct; dorsal groove distinct; cremaster with four pairs of setae, of which anterior three coiled, most caudal one sclerotized, pointed, curved outwards. Present description is based on two last instar larvae and one pupa reared from the eggs oviposited by a captured female (Gifu Pref., Hikagedaira, 3. v. 1979, S. Hashimoto).

Bionomics. See the generic description.

***Trichopteryx ignorata* Inoue**
(Figs. 61A–B, 63C–D, 64D–F, 65C–D, 68)

Trichopteryx ignorata Inoue, 1958: 245, pl. 34: figs. 8–9.

Diagnosis. Forewing length 13–14 mm in male, 13–15 mm in female; labial palpus slight curved, about 1.0 times as long as eye diameter in both sexes; CuA1 less than 2/3 length of M3, CuA2 less than 1/3 of CuA1 in male; male abdominal sternum II pouch small; male and female genitalia shown in Fig. 68. Distinction among the Japanese *Trichopteryx* species is treated in the key.

Specimens examined. JAPAN: Hokkaido: Tokachi, Nukabira, 1♀, 14. v. 1963 (H. Ono); Tokachi, Obihiro, 1♂, 3. v. 1960 (H. Ono); Honshu: Niigata, Sado Is., Nyugawa, 1♀, 2. v. 1965 (R. Sato); Sado Is., Shirose, 3♀, 1. v. 1965 (R. Sato); Niigata, Miomote, 1♀, 18. v. 1974 (R. Sato); Niigata, Kurokawa, 3♂, 2♀, 24–25. iv. 1971 (R. Sato); Niigata, Akadani, 1♂, 1♀, 28. vi. 1967 (R. Sato); same locality, 1♀, 26. iv. 1968 (R. Sato); same locality, 1♂, 28. vi. 1968 (R. Sato); Niigata, Yunotani, 1♂, 6. v. 1973 (Larva coll.), emerged 4. iv. 1974 (R. Sato); Nagano, Ohtaki, 1♂, 23. iv. 1982 (S. Hashimoto); Gifu, Hikagedaira,

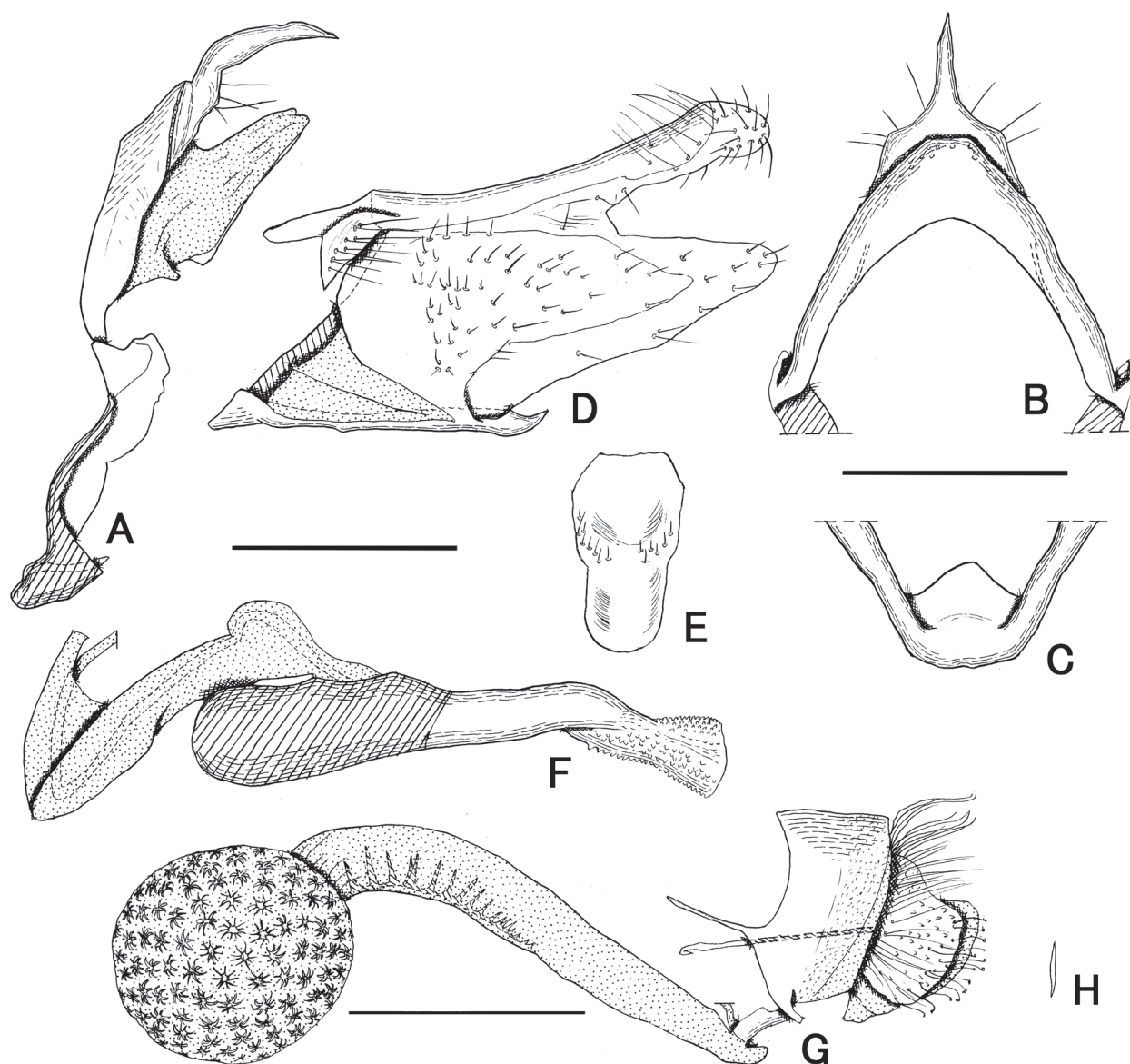


Fig. 69. Genitalia, *Trichopteryx incerta* Yazaki (A–F, ♂; G–H, ♀). A, lateral; B, tegumen and uncus, dorsal; C, saccus, dorsal; D, right valve, inner; E, juxta, ventral; F, phallus, lateral; G, lateral; H, narrow sclerite (sternite IX). Scales = 0.5 mm (A–F), 1.0 mm (G–H).

9♂, 1♀, 3–6. v. 1978 (S. Hashimoto); same locality, 1♂, 3. v. 1979 (S. Hashimoto); same locality, 8♂, 3♀, 10–16. v. 1980 (S. Hashimoto); same locality, 2♂, 8. v. 1981 (S. Hashimoto); same locality, 1♂, 26. iv. 1982 (S. Hashimoto); Gifu, Hindani, 2♀, 14. iv. 1988 (H. Endo); same locality, 2♂, 2♀, 4. iv. 1979 (T. Tanabe); same locality, 1♀, 14. iv. 1979 (T. Tanabe); Gifu, Oyadani, 2♀, 22. iv. 1994 (N. Okimoto); Gifu, Yabudani, 1♂, 29. iii. 1979 (T. Tanabe); same locality, 1♀, 30. iv. 1994 (H. Yoshitomi); Osaka, Minoo, 1♂, 5. iv. 1978 (S. Hashimoto); Kyushu: Fukuoka, Mt. Hiko, 1♀, 15. iv. 1975 (K. Setoya).

Distribution. Japan (Hokkaido, Honshu, Shikoku, and Kyushu).

Host plants. *Quercus aliena* Blume accepted in rearing condition (Fagaceae; Hashimoto, unpublished data); *Q. glauca* Thunberg accepted in rearing condition (Yazaki, unpublished data); *Acer amoenum* var. *matsumurae* (Koidzumi) K. Ogata (Sapindaceae: Sato, unpublished data).

Immature stages. The larval characters are as in Table 5. Last instar larva (Figs. 63C–D, 64D–F, 65C–D) 18–19 mm in length; head pale yellowish brown, rounded, wider than long; body yellowish green to yellowish brown; intersegmental area greenish yellow; subspiracular stripe clear yellowish green; venter paler, with white ventral stripe; thoracic legs pale yellowish brown; abdominal and anal prolegs paler; anal shield paler margined with yellowish brown; peritreme of spiracle pale yellowish brown; chrochets 14–19 in number on ventral proleg, 18–23 on anal proleg; peritreme distinct. Pupa not examined. Present description is based on nine last instar larvae reared from the eggs oviposited by a captured female (Gifu Pref., Hikagedaira, 19. v. 1979, S. Hashimoto) were observed.

Bionomics. See the generic description.

***Trichopteryx incerta* Yazaki**
(Figs. 61C–D, 69)

Trichopteryx incerta Yazaki, 1978: 111.

Diagnosis. Forewing length 13–16 mm in male, 14–15 mm in female; labial palpus porrect, about 2.0 times as long as eye diameter in both sexes; CuA1 slightly shorter than M3, CuA2 about 1/2 of CuA1 in male; male abdominal sternum II pouch very small; male and female genitalia shown in Fig. 69. Distinction among the Japanese *Trichopteryx* species is treated in the key.

Specimens examined. Paratypes: JAPAN: Honshu: Saitama, Bushi, 1♂ (HIC: Genitalia slide 3555; Slide No. KY-199), 20. iii. 1975 (H. Inoue); Shizuoka, Mt. Ogasa, 1♀ (HIC: Genitalia slide 3556; Slide No. KY-200), 9. iii. 1959 (Y. Saitoh). Other materials: JAPAN: Honshu: Gifu, Harayama, 4♂, 10. iv. 1975 (H. Endo); same locality, 1♀, 22. iv. 1976 (H. Endo); Gifu, Neo-kamiosu, 1♂, 25. iii. 1985 (H. Endo); Osaka, Minoo, 1♂, 17. iii. 1975 (T. Saito); same locality, 1♂, 22. iii. 1975 (T. Saito); same locality, 1♂, 16. iii. 1979 (S. Hashimoto); same locality, 1♀, 2. iv. 1980 (S. Hashimoto); same locality, 1♂, 1♀, 8. iv. 1980 (S. Hashimoto); same locality, 2♂, 1♀, 23. iii. 1981 (S. Hashimoto); same locality, 1♂, 3. iv. 1981 (S. Hashimoto); same locality, 1♀, 23. iii. 1981 (S. Hashimoto); same locality, 1♂, 1♀, 21–22. iii. 1982 (T. Saito); same locality, 1♀, 30. iii.

1982 (T. Saito); same locality, 1♀, 2. iv. 1982 (T. Saito); Osaka, Inunaki, 1♂ (OMNH), 11. iii. 1977 (M. Umeno); Hyogo, Mt. Mayasan, 3♀, 14. iv. 1963 (B. Tanaka); Kyushu: Fukuoka, Mt. Hikosan, 1♀ (OPU), 30. iii. 1954 (H. Kuroko).

Distribution. Japan (Honshu, Shikoku, and Kyushu) and Korea (Choi, 2007a).

Host plants. Unknown.

Immature stages. Unknown.

Bionomics. See the generic description.

***Trichopteryx microloba* Inoue**
(Figs. 9E, 61E–F, 63E–F, 64G–I, 65E–F, 70)

Trichopteryx microloba Inoue, 1943: 9.

Diagnosis. Forewing length 13–14 mm in male, about 14 mm in female; labial palpus slightly curved, about 1.0 times as long as eye diameter in both sexes; CuA1 less than 2/3 length of M3, CuA2 less than 1/3 of CuA1 in male; male abdominal sternum II pouch very small, indistinct; male and female genitalia shown in Fig. 70. This species is similar to *T. fastuosa* in the forewing pattern and difference between them is shown in diagnosis of *T. fastuosa*. Distinction among the Japanese *Trichopteryx* species is treated in the key.

Specimens examined. JAPAN: Honshu: Tokyo, Mt. Takao, 1♂, 1. iv. 1973 (K. Yazaki); same locality, 1♀, 18. iii. 1976 (K. Yazaki); Yamanashi, Ushiroyama-rindo, 2♂, 10. iv. 1977 (K. Yazaki); Yamanashi, Fukushima, 1♂, 2♀, 27. iii. 1976 (K. Yazaki); same locality, 1♂, 26. iii. 1977 (K. Yazaki); same locality, 1♀, 29. iii. 1977 (K. Yazaki); Nagano, Ueda, 1♀, 24. iv. 1982 (S. Hashimoto); Gifu, Sugorokudani, 1♀, 4. v. 1978 (S. Hashimoto); Gifu, Ho, 1♂, 2♀, 4. v. 1978 (S. Hashimoto); Gifu, Hikagedaira, 3♂, 1♀, 5–6. v. 1978 (S. Hashimoto); same locality, 1♀, 30. iv. 1979 (S. Hashimoto); same locality, 5♂, 2♀, 10–11. v. 1980 (S. Hashimoto); same locality, 8♂, 3♀, 6–8. V. 1981 (S. Hashimoto); Gifu, Terashiyama, 2♀, 10. v. 1977 (S. Hashimoto); Gifu, Kurumijima, 1♂, 12. v. 1977 (S. Hashimoto); Gifu, Neo-kamiosu, 1♀, 25. iv. 1975 (H. Endo); Kyoto, Sasari-toge, 1♂, 2. iii. 1982 (S. Kinoshita).

Distribution. Japan (Honshu, Shikoku, Kyushu, and Tsushima Is.).

Host plants. *Fagus japonica* Maximowicz accepted in rearing condition (Fagaceae: Yazaki 1972).

Immature stages. The larval characters are as in Table 5. Last instar larva (Figs. 63E–F, 64G–I, 65E–F) about 22 mm in length; head yellowish orange, rounded, wider than long; body yellowish brown; subspiracular stripe white, distinct, broad; venter greyish white, with a broad white ventral stripe; thoracic legs, anal shield and anal proleg paler; peritreme of spiracle pale yellowish brown; chrochets 13–18 in number on ventral proleg, 18–22 on anal proleg; paraproct distinct. Pupa (Nakamura, 2004) brown, about 8 mm in length; vertex rounded; labial palpus not exposed; forewing reaching posterior margin of 4th abdominal segment; proboscis and fore leg reaching just before apical margin of forewing; antenna and mesothoracic leg reaching just before apical margin of forewing; fore femur not exposed; hind tarsus slightly exposed; lateral and dorsal grooves indistinct; cremaster with two pairs

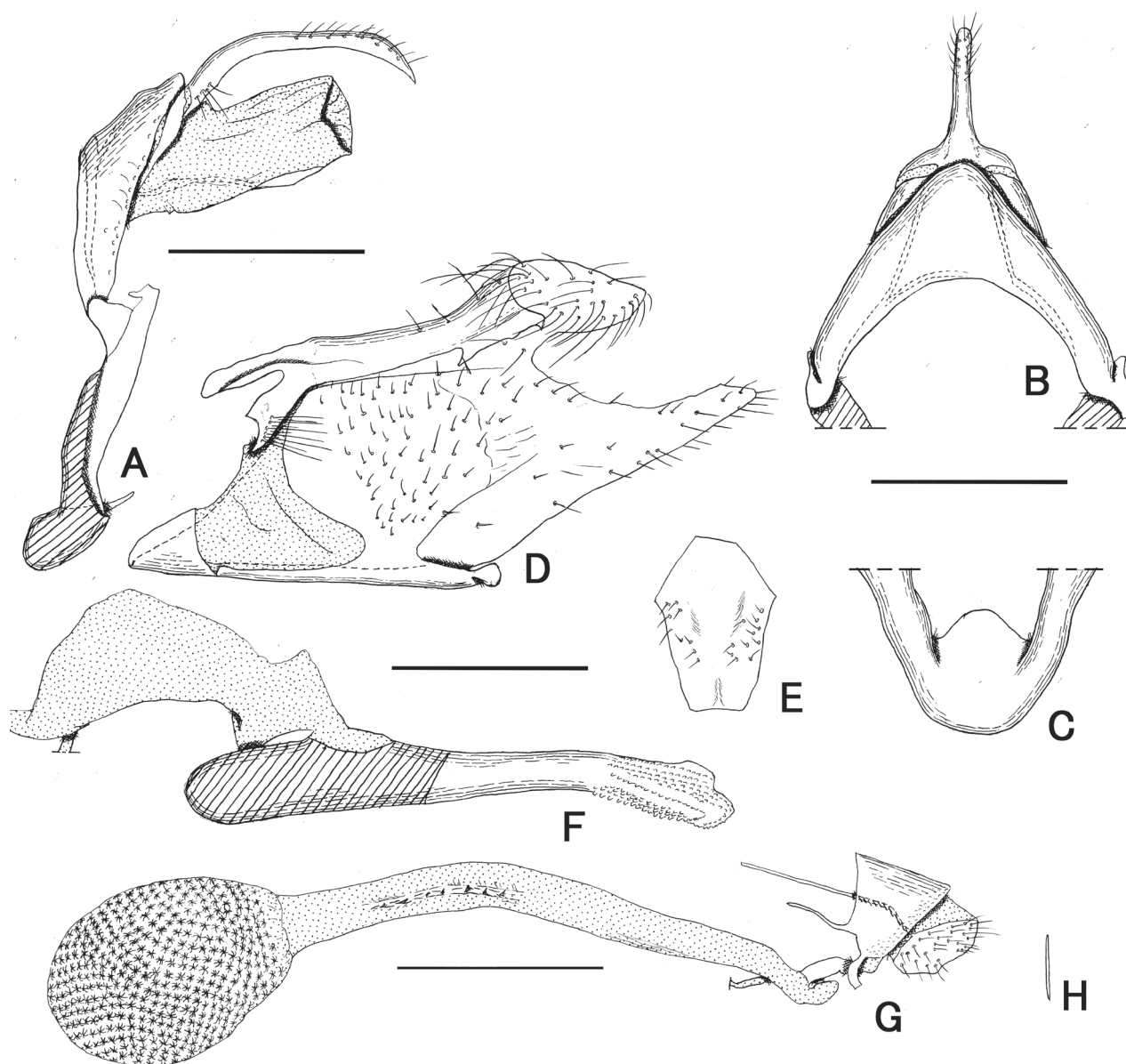


Fig. 70. Genitalia, *Trichopteryx microloba* Inoue (A–F, ♂; G–H, ♀). A, lateral; B, tegumen and uncus, dorsal; C, saccus, dorsal; D, right valve, inner; E, juxta, ventral; F, phallus, lateral; G, lateral; H, narrow sclerite (sternite IX). Scales = 0.5 mm (A–F), 1.0 mm (G–H).

of setae, of which anterior one coiled, caudal one sclerotized, pointed, curved outwards. Present description is based on Yazaki (1972), Nakamura (2004), and ten last instar larvae reared by Yazaki from the eggs oviposited by a captured female (Tokyo Metro., Mt. Takao-san, 21. iii. 1974, K. Yazaki leg.).

Bionomics. See the generic description.

***Trichopteryx nagaii* Inoue**

(Figs. 61G–H, 63G–H, 64J–L, 65G–H, 71)

Trichopteryx nagaii Inoue, 1958: 245, pl. 34: fig. 10.

Diagnosis. Forewing length 14–15 mm in male, 13–15 mm in female; labial palpus slightly curved, about 1.5 times as long as eye diameter in both sexes; CuA1 less than 2/3 length of M3, CuA2 about 1/2 of CuA1 in male; male abdominal sternum II pouch very small, indistinct; male and female

genitalia shown in Fig. 71. Distinction among the Japanese *Trichopteryx* species is treated in the key.

Specimens examined. JAPAN: Honshu: Yamanashi, Fukushima, 1♀, 21. iii. 1977 (K. Yazaki); same locality, 1♀, 29. iii. 1977 (K. Yazaki); Yamanashi, Ushiroyama-rindo, 1♂, 10. iv. 1977 (K. Yazaki); Nagano, Nishino, 4♂, 7♀, 26. iv. 1982 (S. Hashimoto); Shizuoka, Mt. Ogasa, 1♂, 9. iii. 1959 (Y. Saitoh); Gifu, Yabudani, 1♀, 24. iii. 1979 (T. Tanabe); same locality, 1♀, 27. iii. 1979 (T. Tanabe); same locality, 1♀, 29. iii. 1979 (T. Tanabe); Aichi, Mt. Rokushosan, 1♀, 15. vi. 1978 (S. Hashimoto); Kyoto, Sugi-toge, 3♂, 29. iii. 1979 (S. Kinoshita); Nara, Tsuge-mura, 1♂, 20. iii. 1979 (T. Saito); Osaka, Minoo, 1♂, 22. iii. 1978 (T. Saito); same locality, 1♀, 5. iv. 1978 (S. Hashimoto); same locality, 2♂, 28. iii. 1980 (T. Saito); same locality, 2♀, 2. iv. 1980 (S. Hashimoto); same locality, 1♀, 8. vi. 1980 (S. Hashimoto); same locality, 1♀, 8. iii. 1982 (T. Saito); same locality, 1♀, 2. iv. 1984 (S. Hashimoto); Osaka,

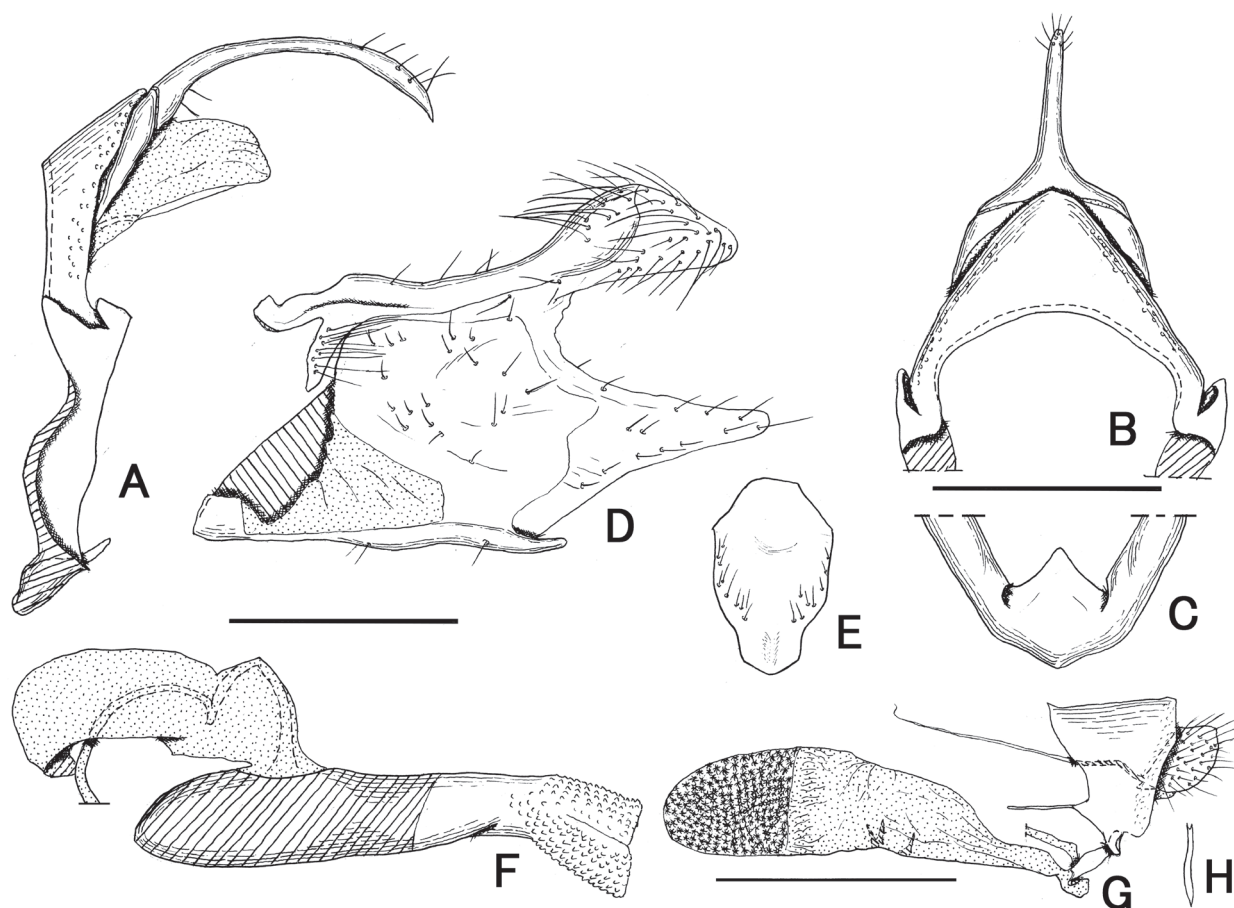


Fig. 71. Genitalia, *Trichopteryx nagaii* Inoue (A–F, ♂; G–H, ♀). A, lateral; B, tegumen and uncus, dorsal; C, saccus, dorsal; D, right valve, inner; E, juxta, ventral; F, phallus, lateral; G, lateral; H, narrow sclerite (sternite IX). Scales = 0.5 mm (A–F), 1.0 mm (G–H).

Mt. Izumikatsuragi-san, 1♀ (OMNH), 30. iii. 1976 (M. Miyatake *et al.*).

Distribution. Japan (Honshu, Shikoku, and Kyushu).

Host plants. *Quercus glauca* Thunberg accepted in rearing condition (Fagaceae; Yazaki, unpublished data).

Immature stages. The larval characters are as in Table 5. Present description is based on two last instar larvae reared by Yazaki from the eggs oviposited by a captured female (Yamanashi Pref., Otsuki-shi, Fukushima, 5. iv. 1975, K. Yazaki leg.).

Bionomics. See the generic description.

***Trichopteryx polycommata* ([Denis & Schiffermüller])**

Geometra polycommata [Denis & Schiffermüller], 1775: 109.

Phalaena solata Schrank, 1802: 38.

Lobophora polycommata: Curtis, 1825: 81.

Trichopteryx polycommata: Meyrick, 1895: 181.

Nothopteryx polycommata: Pierce, 1914: 60, pl. 37.

Diagnosis. This species is easily distinguishable from other *Trichopteryx* species in the elongate and rounded hindwing.

Distribution. Europe to Russian Far East, China, Korea (Choi, 2007a), and Japan.

Host plants. *Lonicera* spp. (Caprifoliaceae; Spuler, 1910);

Fraxinus spp. (Oleaceae; Spuler, 1910).

Immature stages. The larva of nominotypical subspecies is figured in Spuler (1910), but other morphological features are not given.

Remarks. This species is divided into three subspecies: *T. polycommata polycommata* ([Denis & Schiffermüller]), *T. polycommata grisea* Djakonov, and the Japanese subspecies, *T. polycommata anna* Inoue. The Japanese subspecies differs from the nominotypical one in more obscure median band and outer margin of median band strongly curved between M1 and M2, and from *grisea* in rather larger size and more brownish forewing (Hausmann & Viidalepp, 2012).

***Trichopteryx polycommata anna* Inoue**
(Figs. 62A–B, 72)

Trichopteryx polycommata anna Inoue, 1955a: 76, pl. 6: fig. 6.

Diagnosis. Forewing length 14–15 mm in male, 14–15 mm in female; labial palpus slightly curved, about 1.5 times as long as eye diameter in both sexes; forewing white, densely scattered with dark brown scales, with darker lines, of which postmedial line incurved acutely between M1 and M2; discal spot black, distinct; hindwing white, with pale postmedial line, marginal band, and indistinct discal spot; CuA1 about 2/3 length of M3, CuA2 about 2/3 of CuA1 in male; valvula

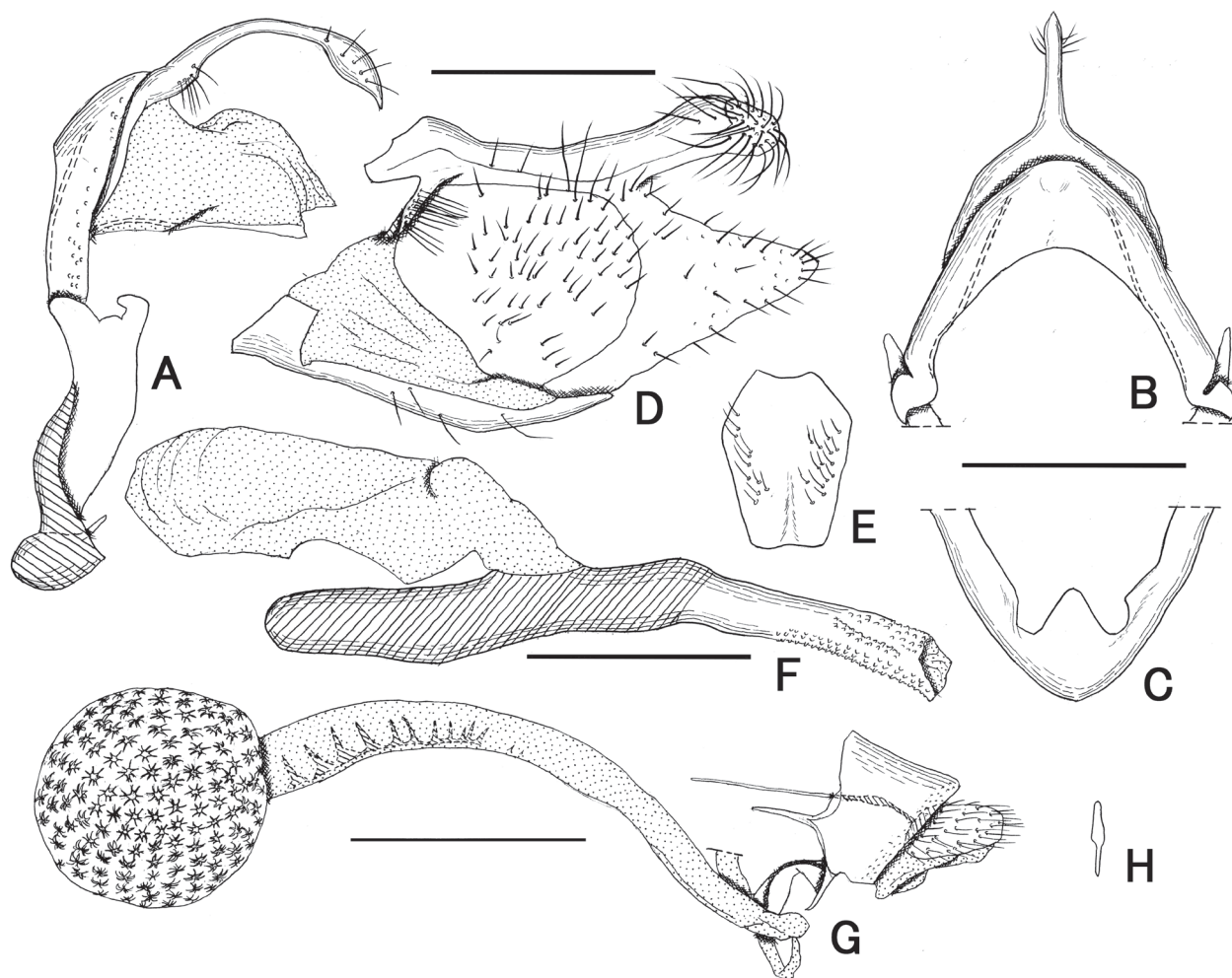


Fig. 72. Genitalia, *Trichopteryx polycommata anna* Inoue (A–F, ♂; G–H, ♀). A, lateral; B, tegumen and uncus, dorsal; C, saccus, dorsal; D, right valve, inner; E, juxta, ventral; F, phallus, lateral; G, lateral; H, narrow sclerite (sternite IX). Scales = 0.5 mm (A–F), 1.0 mm (G–H).

triangular; apophysis anterioris about 1/3 length of posterioris; male and female genitalia shown in Fig. 72.

Specimens examined. JAPAN: Hokkaido; Kushiro, Futatsuyama, 1♀, 11. v. 1953 (K. Iijima); same locality, 1♂, 13. iv. 1964 (K. Iijima); same locality, 2♂, 1♀, 4–5. v. 1980 (K. Iijima); same locality, 3♂, 2♀, 12. v. 1980 (K. Iijima); same locality; 6♂, 1–2. v. 1982 (K. Iijima); same locality, 1♂, 2♀, 12 v. 1982 (K. Iijima).

Distribution. Japan (Hokkaido).

Host plants. Unknown in the Japanese subspecies.

Immature stages. Unknown in the Japanese subspecies.

Bionomics. The moths emerge at early spring and are only known from Hokkaido.

Trichopteryx terranea (Butler)

(Figs. 14G, 62C–D, 63I–J, 64M–O, 65I–J, 73)

Lobophora terranea Butler, 1878: 446.

Trichopteryx terranea: Leech, 1897: 74.

Nothopteryx terranea: Prout, 1914: 184.

Diagnosis. Forewing length 14–15mm in male, 13–15 mm in female; labial palpus, slightly curved, about 1.5 times as long as eye diameter in both sexes; CuA1 slightly shorter

than M3, CuA2 less than 1/4 of CuA1 in male; tegumen narrow, curved posteriorly; saccus rounded; male and female genitalia shown in Fig. 73. Distinction among the Japanese *Trichopteryx* species is treated in the key.

Specimens examined. JAPAN: Hokkaido: Kushiro, Futatsuyama, 8♂, 2♀, 12. v. 1980 (K. Iijima); Tokachi, Nukabira, 4♂, 7♀, 30. v. –1. vi. 1977 (S. Hashimoto); Honshu: Niigata, Sado Is., Nyugawa, 1♂, 2. v. 1965 (R. Sato); Niigata, Sado Is., Ogi, 1♂, 2♀, 24. iv. 1976 (R. Sato); Niigata, Kurokawa, 1♀, 24–25. iv. 1971 (R. Sato); Niigata, Akadani, 1♀, 28. iv. 1967 (R. Sato); same locality, 1♀, 28. iv. 1968 (R. Sato); same locality, 1♀, 26. v. 1968 (R. Sato); Niigata, Sugigawa, 3♂, 1♀, 20. vi. 1963 (R. Sato); Niigata, Mt. Kakuda, 1♂, 1♀, 15. iv. 1972 (R. Sato); same locality, 1♀, 20. iv. 1974 (R. Sato); Nagano, Ueda, 2♂, 2♀, 24. iv. 1982 (S. Hashimoto); Nagano, Shimajima-dani, 1♂, 1♀, 8. v. 1988 (S. Hashimoto); Nagano, Nishino, 1♂, 1♀, 26. iv. 1982 (S. Hashimoto); Gifu, Ho, 1♂, 7♀, 4. v. 1978 (S. Hashimoto); Gifu, Hikagedaira, 1♂, 5. v. 1978 (S. Hashimoto); same locality, 3♂, 10–11. v. 1980 (S. Hashimoto); Gifu, Terashiyama, 5♂, 3♀, 10. v. 1977 (S. Hashimoto); Gifu, Oyadani, 1♀, 22. iv. 1994 (N. Okimoto); Osaka, Minoo, 1♂, 31. iii. 1978 (S. Hashimoto); same locality, 1♂, 21. iv. 1978 (T. Saito); same locality, 1♂, 30. iii. 1980 (T.

Saito); same locality, 1♂, 8. iv. 1980 (S. Hashimoto); Kyushu: Fukuoka, Mt. Hikosan, 1♀ (OPU), 1. iv. 1954 (H. Kuroko); same locality, 1♀ (OPU), 7. iv. 1954 (H. Kuroko); same locality, 1♀ (OPU), 1. iv. 1955 (H. Kuroko); same locality, 1♂, 15. iv. 1975 (K. Setoya).

Distribution. Japan (Hokkaido, Shikoku, Kyushu, and Tsushima Is.), Korea (Choi, 2007), China, and Russian Far East (Southeast Siberia).

Host plants. *Quercus myrsinaefolia* Blume (Fagaceae; Yazaki, 1975); *Q. glauca* Thunberg accepted in rearing condition (Yazaki, 1975); *Zelkova serrata* (Thunberg) Makino (Ulmaceae; Yazaki, 1975).

Immature stages. The larval characters are as in Table 5. Last instar larva (Figs. 63I–J, 64M–O, 65I–J) about 20 mm in length; head dull yellow, rounded, wider than long; body bright yellowish green; intersegmental area pale yellow; supraspiracular stripe white, narrow, intermittent; subspiracular stripe yellowish white, rather thick; venter yellowish white; thoracic legs, ventral and anal prolegs pale yellowish green; anal shield pale yellow margined with yellowish white; chrochets 15–17 in number on ventral proleg, 18 in number on anal proleg; paraproct distinct. Pupa not examined. Present description is based on Yazaki (1975) and one last instar larva reared by Yazaki from the egg oviposited

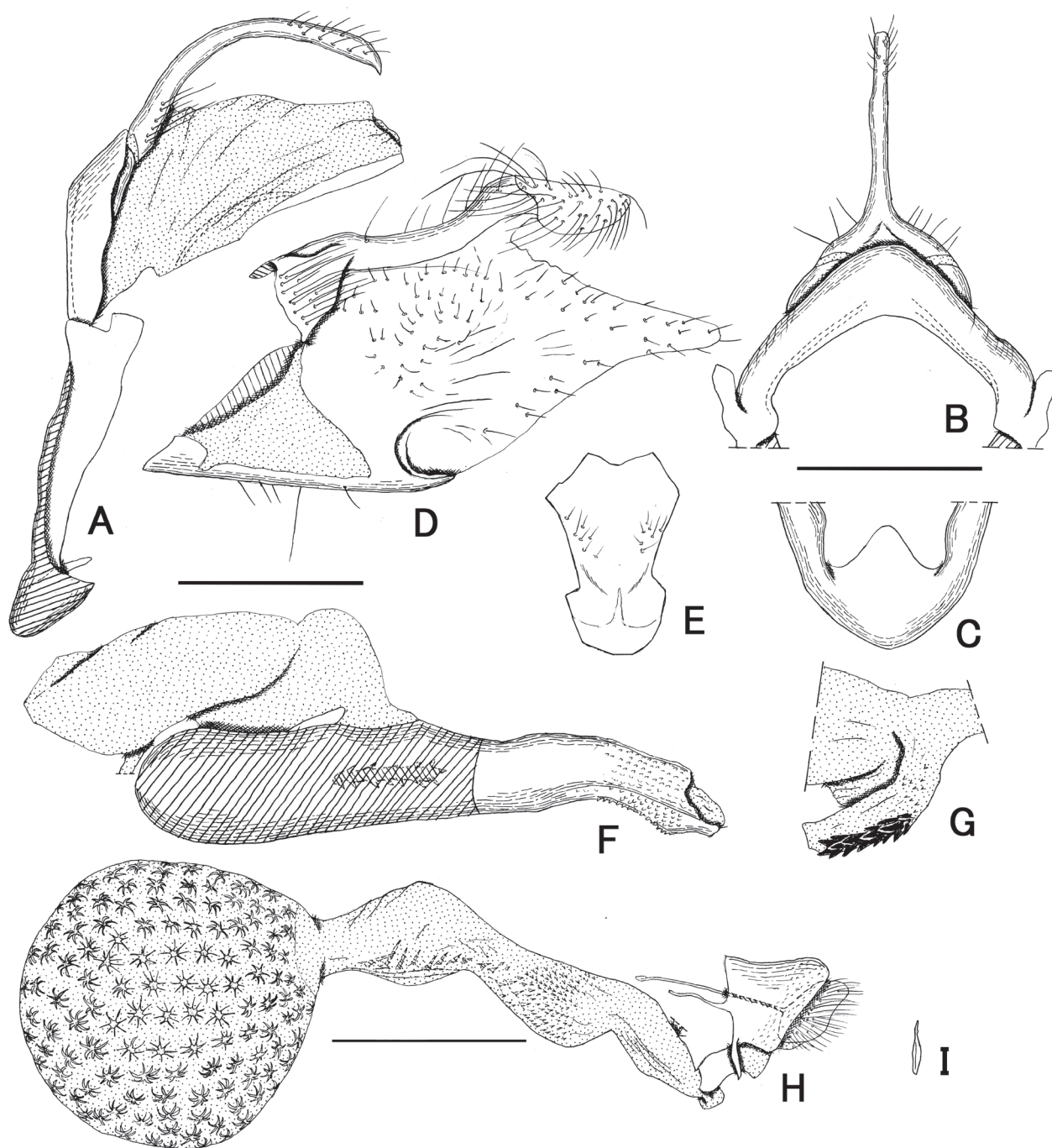


Fig. 73. Genitalia, *Trichopteryx terranea* (Butler) (A–G, ♂; H–I, ♀). A, lateral; B, tegumen and uncus, dorsal; C, saccus, dorsal; D, right valve, inner; E, juxta, ventral; F, phallus, lateral; G, cornuti; H, lateral; I, narrow sclerite (sternite IX). Scales = 0.5 mm (A–G), 1.0 mm (H–I).

by a captured female (Yamanashi Pref., Otsuki-shi, Fukushima, 5. iv. 1975, K. Yazaki leg.).

Bionomics. See the generic description.

***Trichopteryx ussurica* (Wehrli)**

(Figs. 16G, 19F, 62E–F, 63K–I, 64P–R, 65K–I, 74)

Acasis ussurica Wehrli, 1927: 93, pl. 11: fig. 19.

Nothopteryx ussurica: Prout, 1937: 90.

Trichopteryx ussurica: Inoue, 1942: 11.

Diagnosis. Forewing length about 17 mm in male, 16–17 mm in female; labial palpus slightly curved, about 1.0 times as long as eye diameter in male, 1.5 times in female; forewing

brown, with darker or fuscous lines; median band broad, brown; black transverse line being along dorsum; hindwing white, with pale brownish postmedial line, marginal band, and distinct discal spot; CuA1 about 2/3 length of M3 and CuA2 about 1/2 of CuA1 in male; male abdominal sternum II pouch very small; male and female genitalia shown in Fig. 74. Distinction among the Japanese *Trichopteryx* species is treated in the key.

Specimens examined. JAPAN: Hokkaido: Tokachi, Kamishihoro, 1♂, 22. v. 1966 (R. Sato); Honshu: Niigata, Miomote, 1♂, 2♀, 18. v. 1978 (R. Sato); Niigata, Sado Is., Nyugawa, 1♂, 2♀, 1–2. v. 1965 (R. Sato); Nagano, Ohisawa, 2♂, 4. v. 1978 (H. Hara); Nagano, Ohtani, 1♂, 23. iv. 1982 (S. Hashimoto); Nagano, Nishino, 1♂, 26.

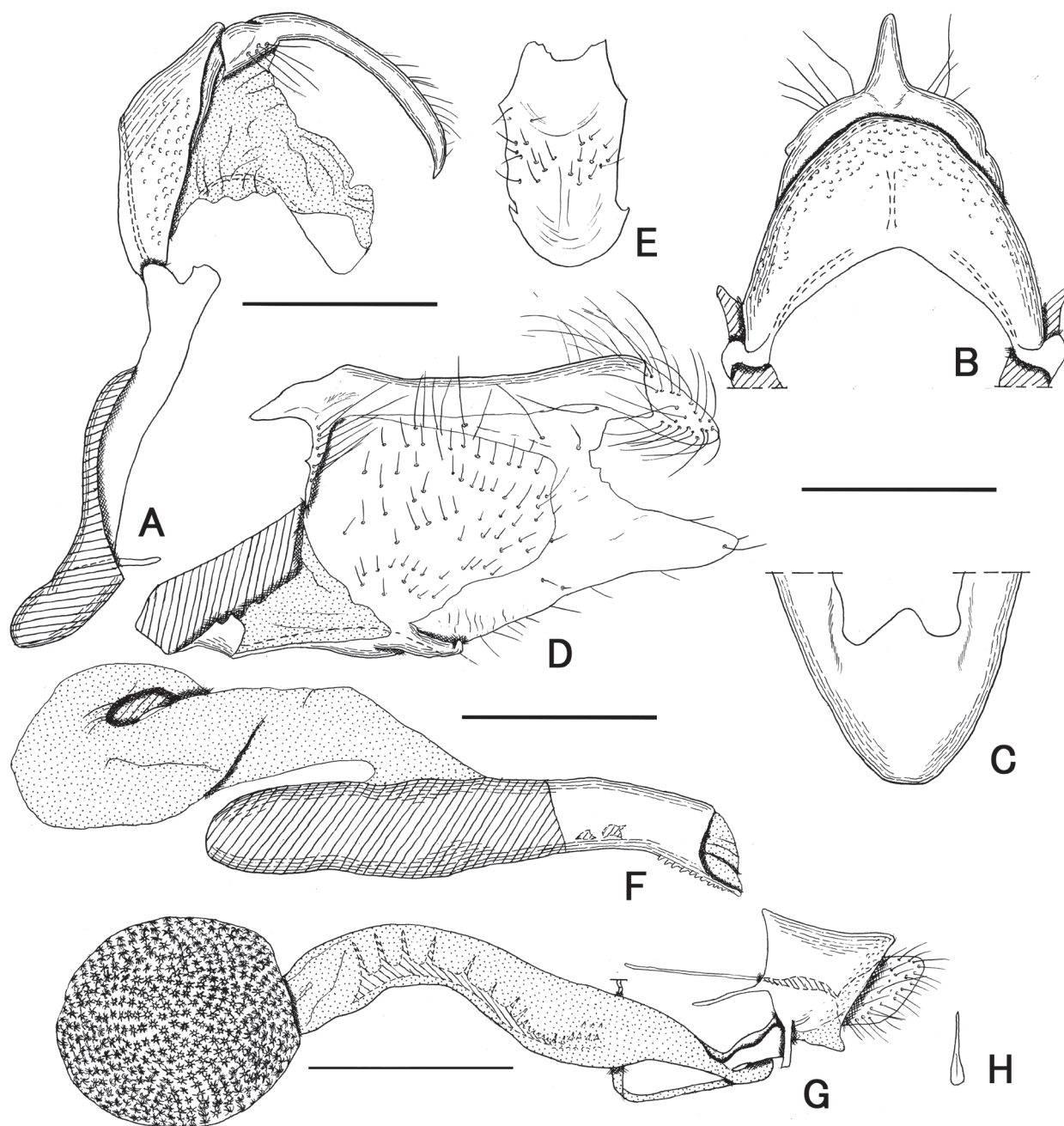


Fig. 74. Genitalia, *Trichopteryx ussurica* (Wehrli) (A–F, ♂; G–H, ♀). A, lateral; B, tegumen and uncus, dorsal; C, saccus, dorsal; D, right valve, inner; E, juxta, ventral; F, phallus, lateral; G, lateral; H, narrow sclerite (sternite IX). Scales = 0.5 mm (A–F), 1.0 mm (G–H).

iv. 1982 (S. Hashimoto); Gifu, Hikagedaira, 2♂, 2♀, 5. v. 1978 (S. Hashimoto); same locality, 1♂, 1♀, 11. v. 1980 (S. Hashimoto); same locality, 5♂, 1♀, 6–8. v. 1981 (S. Hashimoto); same locality, 1♂, 1♀, 5. v. 1982 (S. Hashimoto); Gifu, Terashiyama, 1♂, 27. iv. 1974 (H. Endo); Gifu, Harayama, 2♂, 10. iv. 1975 (H. Endo); same locality, 1♀, 22. iv. 1976 (H. Endo); Gifu, Ho, 2♂, 2. v. 1976 (K. Ueda, H. Endo & S. Hashimoto); Gifu, Neo-kamiosu, 1♀, 4. v. 1975 (H. Endo); Gifu, Hindani, 1♂, 14. iv. 1977 (H. Endo); Gifu, Yabudani, 1♂, 2♀, 29. iii. 1979 (T. Tanabe); Osaka, Minoo, 1♂, 3. iv. 1981 (S. Hashimoto); Kyushu: Fukuoka, Mt.Hikosan, 1♀ (OPU), 12. iv. 1964 (H. Kuroko)

Distribution. Japan (Hokkaido, Honshu, Shikoku, Kyushu, and Tsushima Is.), Korea (Choi, 2007a), and Russian Far East (Southeast Siberia).

Host plants. *Ligstrum obtusifolium* Siebold et Zuccarini accepted in rearing condition (Oleaceae; Hashimoto, 2011).

Immature stages. The larval characters are as in Table 5. Last instar larva (Figs. 16G, 63K–I, 64P–R, 65K–I) 20–22 mm in length; head pale yellowish green, rounded, wider than long; body green; intersegmental area greenish yellow; subspiracular stripe yellow, distinct, thick; venter pale greenish white; thoracic legs concolorous with head; ventral and anal prolegs and anal shield concolorous with body; peritreme of spiracle pale yellowish brown; chrochets 17–20 in number on ventral proleg, 19–23 on anal proleg; paraproct long. Pupa (Fig. 19F) reddish brown to dark brown tinged with green, 8.3–10 mm in length, 2.8–3.0 mm in width; vertex slightly protruded; labial palpus not exposed; forewing reaching about 2/3 of 4th abdominal segment; proboscis reaching just before apical margin of forewing; antenna and mid leg reaching posterior margin of forewing; fore femur not exposed; fore leg reaching about 1/9 length of forewing; hind tarsus very slightly exposed; lateral groove indistinct; dorsal groove distinct; cremaster with tree pairs of setae, of which anterior two are coiled, and most caudal one is sclerotized, pointed, and curved outwards. Present description is based on five last instar larvae and two pupae reared from the eggs oviposited by a captured female (Gifu pref., Hikagedaira, 8. v. 1981, S. Hashimoto leg.).

Bionomics. See the generic description.

Genus *Episteira* Warren

Episteira Warren, 1899a: 36. Type species: *Episteira colligata* Warren, 1899a: 36, by original designation.

Diagnosis. *Episteira* is characterized by the following apomorphies (Fig. 4): 1, apical part of uncus bifid, narrow, and sharply pointed (Figs. 77B, 78B); 2, transtilla reduced, as a non-setose narrow plate (Figs. 77E, 78E); 3, harpe with a median flap expanding basally (Figs. 77E, 78E). The genus is distinguishable from other trichopterygine genera by the following combination of characters: antennal flagellomeres compressed filiform; thorax slender, oblique postero-ventrally; hind tibia without spurs in male, with a pair of apical spurs in female; forewing with one areole; M1 arising from areole; hindwing without discal spot; hindwing venation (Sc separate

from an upper vein of discal cell and connected with a short vein of R before end of discal cell in male, fused in female; Rs and M1 connate or just separate in male, stalked in female; M3 and CuA1 completely fused in male, connate or just separate in female; CuA2 minute or absent in male); cucullus reduced, indistinguishable valvula; sacculus narrow, without any process; harpe with a rounded flap extending basally; corpus bursae wholly covered with minute spines forming star-shaped base on outer surface; ductus bursae narrow, with thickened and wrinkled part at middle; appendix bursae globular, arising near corpus bursae; ductus seminalis arising from end of thickened and wrinkled part of ductus bursae.

Description. The generic description is based on two Japanese species and the following studies: Dugdale, 1980; Hashimoto, 1991b; Holloway, 1997.

Adult

Head (Figs. 5K, 6F): Head closed with fine scales smoothly; antennal flagellomeres compressed filiform; frons rounded; labial palpus correct, very long, 2.5 to 3.0 times as long as eye diameter in male and 3.0 to 3.5 in female; proboscis developed.

Thorax (Figs. 7F, 8E–F, 75C–F, 76A–D): Thorax slender, well oblique postero-ventrally; legs very slender; metepimeron modified or not, if modified divided into anterior and posterior parts by inner ridge in male, not modified in female; male metameron arched posteriorly or not; hind tibia without spurs in male, with a pair of spurs (apical spurs) in female, with or without a hair-pencil in male. Forewing grey to greenish olive, with fuscous or dark greenish olive 14 lines, of these subterminal and adterminal ones occasionally distinct; discal spot fuscous; terminal dots indistinct; forewing with an areole; M1 arising from areole. Hindwing greyish brown to glossy greyish brown, without any maculation; male hindwing with a large (more than 1/2 length of inner margin) or small (less than 1/4) anal fold; Sc separate from an upper vein (R + Rs) of discal cell and connected with a short vein of R before end of discal cell in male, fused with R + Rs for most length of discal cell in female; Rs and M1 connate or just separate in male, stalked in female; M3 and CuA1 completely fused in male, connate or just separate in female; male CuA2 minute or absent.

Pregenital abdomen (Fig. 8E–F): Abdomen compressed dorso-ventrally, slender in both sexes; male sternum II pouch distinct or vestigial; antero-lateral sides of male sternum II extending antero-dorsally or extending anteriorly as a narrow sclerite.

Male genitalia (Figs. 77A–G, 78A–G): Anterior margin of tegumen shallowly or deeply incurved; posterior margin of tegumen shallowly incurved at middle; saccus U-shaped, narrow, shallowly incurved, not extended anteriorly; uncus rather short, slender, curved ventrally, wide basally, with a bifurcate pointed tip; socius reduced, completely fused with uncus, recognized as a hairy part; gnathos being at caudo-ventral side of tegumen, completely fused with uncus-socius complex; costa narrow; sclerotized; cucullus indistinct, completely fused with valvula; transtilla narrow, without hairs; sacculus very narrow, without a terminal projection; harpe weakly sclerotized, occupying central part of valve,

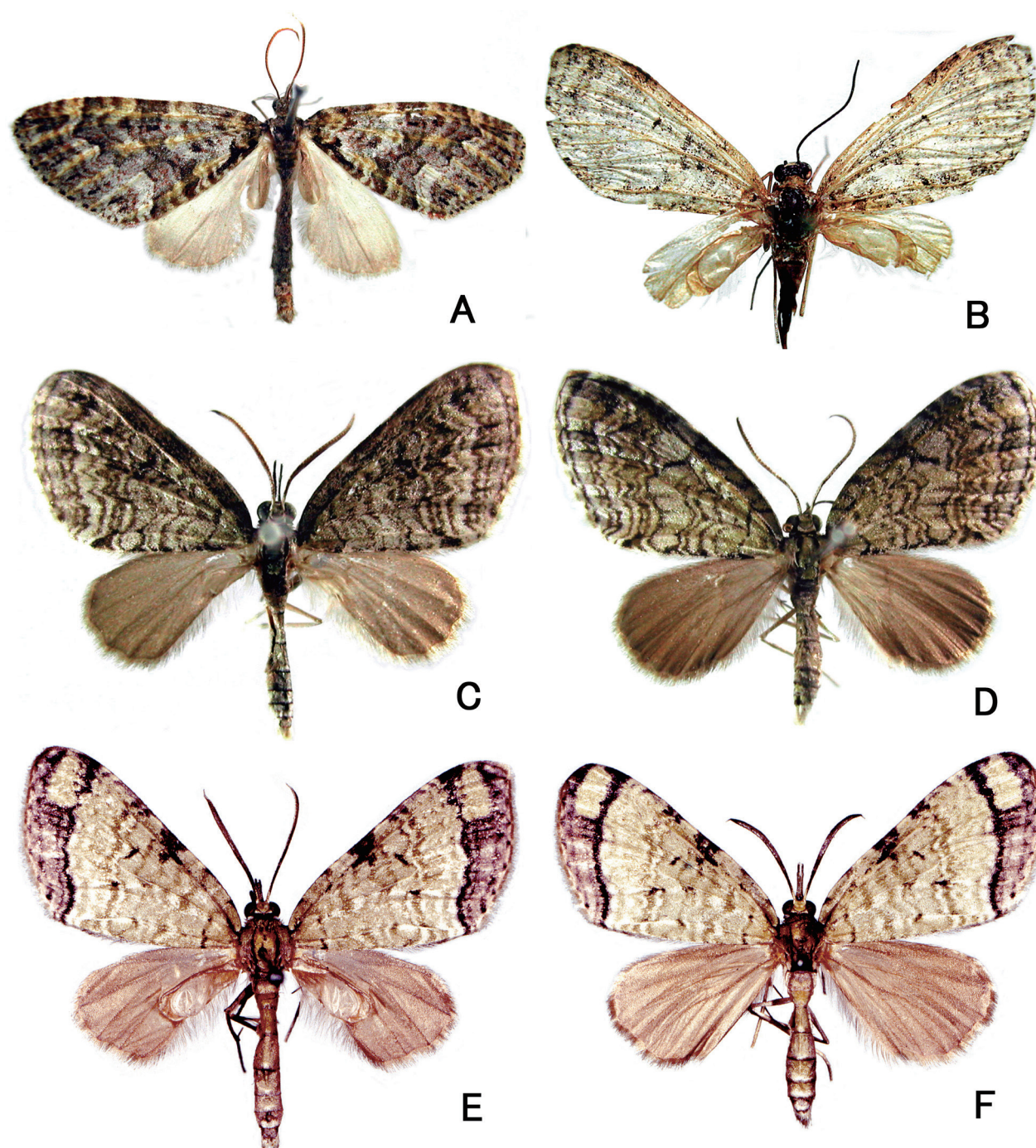


Fig. 75. Adults. A, *Tatosoma agrionata* (Walker), ♂ (New Zealand); B, *Tympanota ceramica* Rothschild, ♂ (Malaysia); C, *Episteira eupena* Prout, ♂; D, ditto, ♀; E, *Episteira nigrilinearia nigrilinearia* (Leech), ♂; F, ditto, ♀.

with a flap extending cephalad; valvula broad, rounded at posterior margin, more or less fan-shaped, indistinguishable from cucullus; phallus slender, longer than valve, with cornuti consisting of many minute spines; coecum very small, less than 1/8 length of phallus; surrounding part (anellus) of phallus covered with many fine spines postero-dorsally; juxta wider than long.

Male genital musculature (Table 2): Any extra muscles and secondary movement of the muscles not seen.

Female genitalia (Figs. 77H–J, 78H–I): Corpus bursae subglobular (pear shaped) or oblong ovate strongly constricted at middle, wholly covered with minute spines forming star-

shaped base on outer surface; ductus bursae-corporis bursae junction distinct; ductus bursae very narrow, but shorter than corpus bursae, with a swollen wrinkled part at middle, with globular appendix bursae near corpus bursa; ductus seminalis arising from anterior end of a swollen wrinkled part of ductus bursae; antrum long, cup-shaped, weakly sclerotized, about 1/3 length of ductus bursae; 8th sternum membranous, with a pair of scales tuft at antero-lateral sides; ostium being at anterior margin of 8th sternum; apophysis anterioris long, slightly shorter than posterioris; papillae anales rounded, with many hairs; ventral sclerite (sternite IX) between papillae anales narrow.

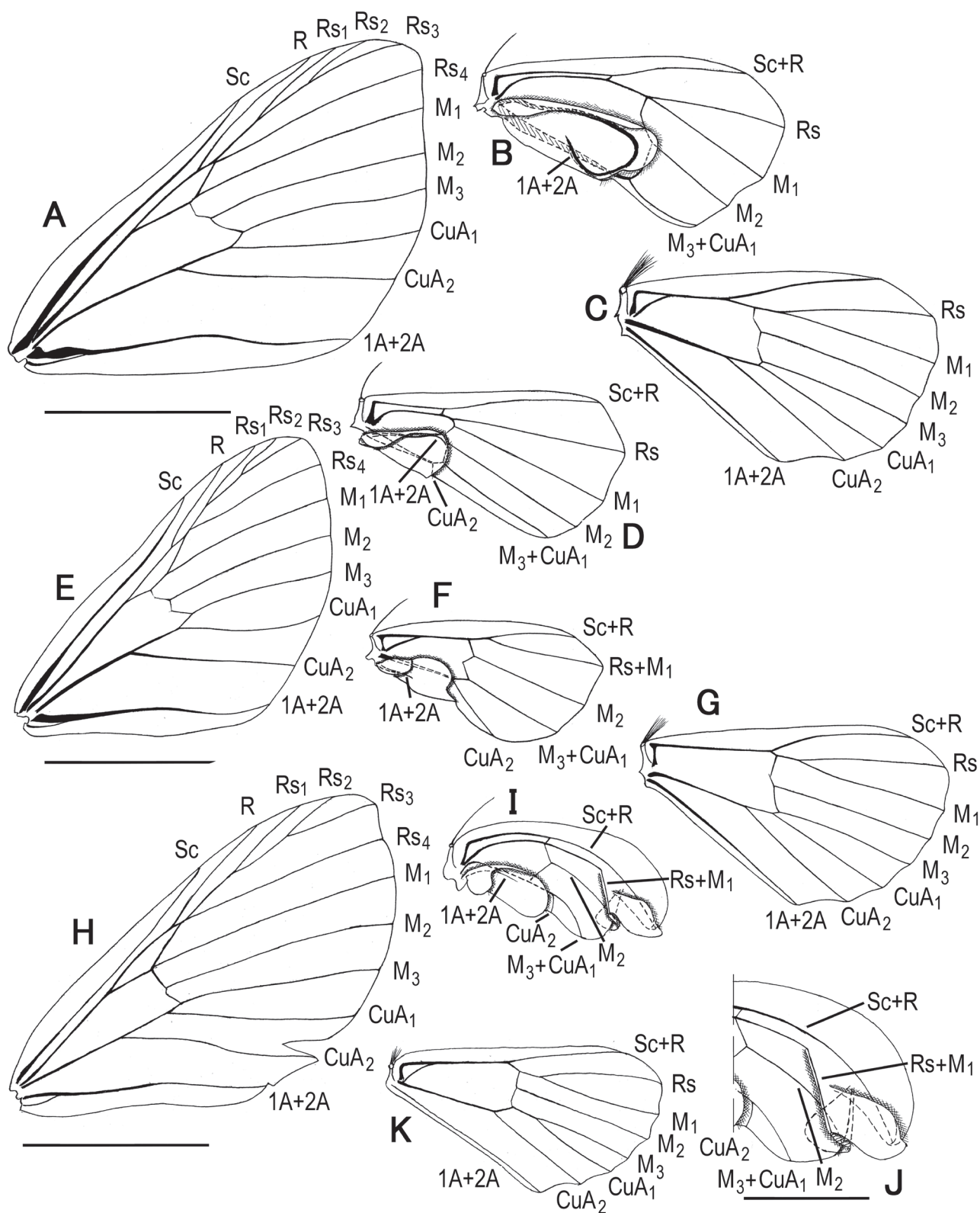


Fig. 76. Wing venation. A, *Episteira nigrilinearia nigrilinearia* (Leech), ♂ (forewing); B, ditto, ♂ (hindwing); C, ditto, ♀ (hindwing); D, *Episteira eupena* Prout, ♂ (hindwing); E, *Sauris nanaria* Leech, ♂ (forewing); F, ditto, ♂ (hindwing); G, ditto, ♀ (hindwing); H, *Sauris hirudinata* Guenée, ♂ (forewing); I, ditto, ♂ (hindwing); J, ditto, ♂ (outer marginal fold); K, ditto, ♀ (hindwing). Scales = 5.0 mm.

Immature stages

Last instar larva (Figs. 16H, 17M–S): About 18 mm in length; head yellowish green, wider than long, almost smooth; ecdysial cleavage line (adfrontal suture of Hashimoto, 1991b) absent; labral emargination about 0.25 deep; mandible with 6 teeth, of which inner one is dull, serrate; spinneret broadly fan-shaped near apex, longer than labial palpus; body whitish green to yellowish green, slender, cylindrical, almost smooth; abdominal setae minute; ventral proleg small, well extending to 7th abdominal segment postero-ventrally; crochets of ventral prolegs rather small, reduced in number; crochets of anal prolegs arranged in biordinal mesoseries, interrupted in middle; paraproct well developed. Chaetotaxy: SS2 near stemmata 5; Pb puncture anterior to a line joining P1 and P2 setae; A3 ventral to a line joining L1 and A2; prothoracic SD setal group bisetose on same pinaculum separate from prothoracic shield; abdominal setae minute; ventral proleg with four SV setae; on anal shield D1 setae distinctly anterior to a line drawn between SD2s; on anal proleg SV2 (CP1) being postero-dorsal to SV3 (CP2).

Pupa (Fig. 19B, G): Yellowish green except for brown 10th abdominal segment, slender, angulated at both side of vertex; cuticle thin; labial palpus exposed; forewing reaching half length of 4th abdominal segment; antenna and proboscis not reaching apical margin of forewing; midleg reaching apical margin of forewing; hind tarsus well exposed; dorsal and lateral grooves indistinct; cremaster with four pairs of coiled setae, of which terminal one is well sclerotized.

Distribution. India to Fiji, China, Russian Far East, and Japan.

Bionomics. There are two or more generations per year. The adult moths are obtained from the laurel forest of the hilly to low mountainous areas, but bionomic information is so scarce. Two Japanese species utilize the plant family Podocarpaceae as the larval host plant.

Remarks. Although the genus *Episteira* comprises twelve species (Parsons *et al.*, 1999; Bolotov *et al.*, 2014), of which four African species should be reexamined as for their generic status (Dugdale, 1980; Holloway, 1997).

In the phylogenetic relationships (Fig. 2), the genera *Episteira*, *Sauris*, and *Tympanota* (Figs. 9A, 75B) formed the *Sauris* genus-group together with the New Zealand *Tatosoma* (Fig. 75A). This genus-group is characterized by the following structures: 1, female labial palpus very long, more than 2.5 times as long as eye diameter; 2, male hindwing venation with M3 and CuA1 completely fused (Fig. 76B, D, F, I–J); 3, vesica circularly covered with many fine spines (Figs 77G, 78G, 84F, 88G). However, the relationships of three genera except for *Tatosoma* are unclear. Probably the Oriental genus *Dystypoptila* is also included into this genus-group (see the remarks of the genus *Sauris*). In this genus-group, *Tatosoma*, a sister group of other genera of the *Sauris* genus-group, is easily distinguishable from others by three hind tibial spurs. *Episteira* is distinguishable from *Dystypoptila* and *Sauris* by the male hindwing venation (Rs and M1 connate or just separate (Fig. 76B, D) in *Episteira*, but completely fused (Fig. 76F, I) in *Dystypoptila* and *Sauris*), the male genitalia (uncus bifurcate, socius reduced, cucullus indistinguishable,

and harpe with a rounded flap (Fig. 77A–G) in *Episteira*, but uncus single, socius well developed, cucullus rounded or digital process, and harpe without a rounded flap (Fig. 82A–G; Holloway, 1997: fig. 286) in *Dystypoptila* and *Sauris*, and the female genitalia (ductus seminalis arising from middle of ductus bursae (Fig. 77H) in *Episteira*, but from near corpus bursae (Fig. 87H–I) in *Sauris*, unknown in *Dystypoptila*), and from *Tympanota* in the male hindwing (CuA2 very short or absent (Fig. 76B, D) in *Episteira*, but long (Dugdale, 1980: figs. 22–23, 26) in *Tympanota*), and the male genitalia (uncus bifurcate (Fig. 77B) and harpe with a rounded flap (Fig. 77E) in *Episteira*, but uncus single and harpe without a rounded flap (Dugdale, 1980: figs. 55–56) in *Tympanota*).

Although the host plants information is very few, previously known host plants of the genera *Episteira* and *Tympanota* are restricted to the *Podocarpus* spp. (Podocarpaceae; Dugdale, 1980; Holloway, 1997).

Dugdale (1980) recognized two groups of the species in *Episteira*: the *vacuefacta* group with a minute anal fold, and the *nigrilinearia* group with a large anal fold. In the present paper, followed Dugdale (1980) the genus is divided into two groups:

Group A (*vacuefacta* group of Dugdale, 1980): male metepimeron not modified (Fig. 8F); male hindtibia without a hair-pencil; male abdominal sternum II pouch vestigial; antero-lateral sides of male sternum II not expanding; corpus bursae subglobular (pear-shaped) (Fig. 77H). *Episteira eupena*.

Group B (*nigrilinearia* group of Dugdale, 1980): male metepimeron modified (Fig. 8E); male hindtibia with a hair-pencil; male abdominal sternum II pouch distinct, long; antero-lateral sides of male sternum II triangularly expanding dorsally; corpus bursae oblong ovate strongly constricted at middle (Fig. 78H). *Episteira nigrilinearia*.

Key to the Japanese species of *Episteira* (based on adult characters)

1. Forewing brownish grey, with fuscous lines; male hindwing with a small anal fold (less than 1/3 of anal margin); corpus bursae pear shaped *E. eupena*
- . Forewing olive green, with dark olive green and fuscous subterminal and adterminal lines; male hindwing with a large anal fold (more than 1/2 length of anal margin); corpus bursae oblong ovate strongly constricted at middle *E. nigrilinearia*

Episteira eupena (Prout) (Figs. 8F, 17M–R, 75C–D, 76D, 77)

Sauris eupena Prout, 1937: 93, pl. 9c.

Episteira carchara Prout, 1958: 456, fig. 56.

Episteira eupena: Dugdale, 1980: 309.

Diagnosis. Forewing length 11–13 mm in male, 11–15 mm in female; male and female genitalia shown in Fig. 77. Difference between two Japanese species is given in the key. This species is included into the *vacuefacta* group of Dugdale (1980).

Specimens examined. JAPAN: Honshu: Chiba, Tomisato, 1♂, emerged 16. viii. 1992 (S. Hashimoto); Mie, Fudodani,

1♀, 1–2. vii. 1995 (S. Hashimoto); Osaka, Mt. Makiosan, 1♀, 23. vii. 1981 (S. Hashimoto); same locality, 4♂, 5♀, emerged 9–14. xi. 1982 (S. Hashimoto).

Distribution. Japan (Honshu, Shikoku, Kyushu, Tanegashima Is., Yakushima Is., Amami-oshima Is., and Okinawa Is.) and China (Xue & Zhu, 1999).

Host plants. *Podocarpus macrophyllus* (Thunberg) Sweet (Podocarpaceae; Nakamura, 1981).

Immature stages. Last instar larva 18–20 mm in length; chrochets 6–11 in number on ventral proleg, 15–20 in number on anal one. Chaetotaxy: Seta L1 anteroventral to L3 on meso- and metathoraces. Pupa yellowish green, about 10.5 mm in length, about 2.7 mm in width; hind tarsus oblong.

Bionomics. There are two or more generations per year. This species is rather rare and obtained from early summer to autumn in the laurel forest.

Episteira nigrilinearia (Leech)

Sauris nigrilinearia Leech, 1897: 76 (type locality: Japan).

Episteira nigrilinearia: Dugdale, 1980: 309.

Diagnosis. Difference between two Japanese species is treated in the key.

Distribution. Fiji, West Celebes, China, Russian Far East, and Japan.

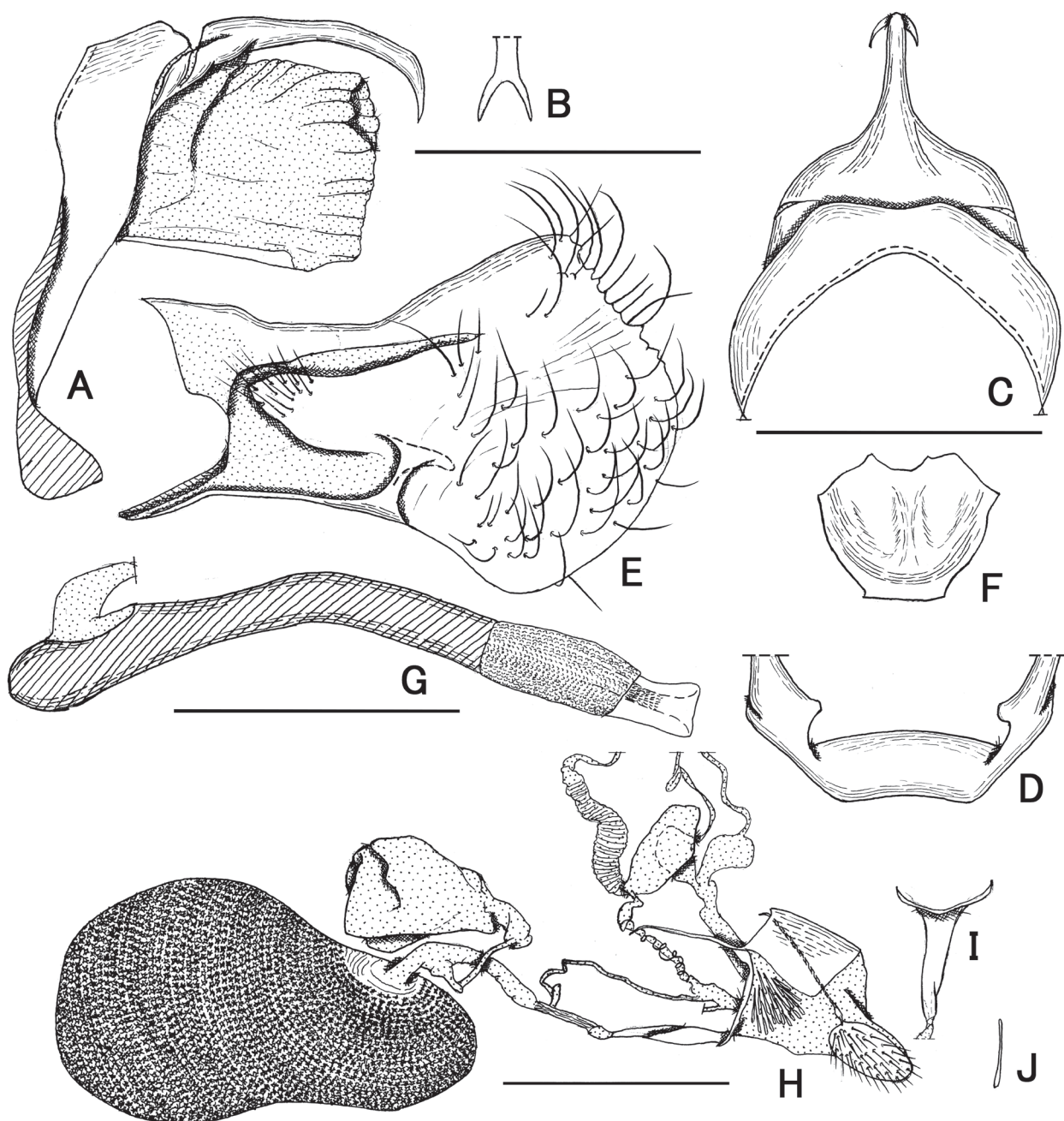


Fig. 77. Genitalia, *Episteira eupena* Prout (A–G, ♂; H–J, ♀). A, lateral; B, apical part of uncus, caudal; C, tegumen and uncus, dorsal; D, saccus, dorsal; E, right valve, inner; F, juxta, ventral; G, phallus, lateral; H, lateral; I, antrum, ventral; J, narrow sclerite (sternite IX). Scales = 0.5 mm (A–G), 1.0 mm (H–J).

Host plants. *Podocarpus macrophyllus* (Thunberg) Sweet (Podocarpaceae; Inoue, 1950).

Remarks. This species is classified into three subspecies; *E. nigrilinearia nigrilinearia*, *E. nigrilinearia enochra* (Prout) from Fiji, and *E. nigrilinearia euneta* (Prout) from West Celebes. The Japanese subspecies belongs to the nominotypical one.

***Episteira nigrilinearia nigrilinearia* (Leech)**
(Figs. 5K, 6F, 7F, 8E, 16H, 17S, 19B, G, 75E–F, 76A–C, 78)

Sauris nigrilinearia Leech, 1897: 76 (type locality: Japan).

Episteira nigrilinearia: Dugdale, 1980: 309.

Diagnosis. Forewing length 13–14 mm in male, 14–16 mm in female; male and female genitalia shown in Fig. 78. This subspecies is distinguishable from other subspecies (Prout, 1958; Robinson, 1975) as follows: forewing ground colour olive green, costal patch between subterminal and adterminal lines olive green and subterminal and adterminal lines rather narrow and paler (posterior 2/3 of forewing and costal spot much whiter and subterminal and adterminal lines fuscous and distinct in *euneta*); hindwing glossy greyish brown (pinkish cream in *enochra*).

Specimens examined. JAPAN: Honshu: Chiba, Osakabe, 1♀, 22. ix. 1990 (S. Hashimoto); Chiba, Nara, 1♀, emerged

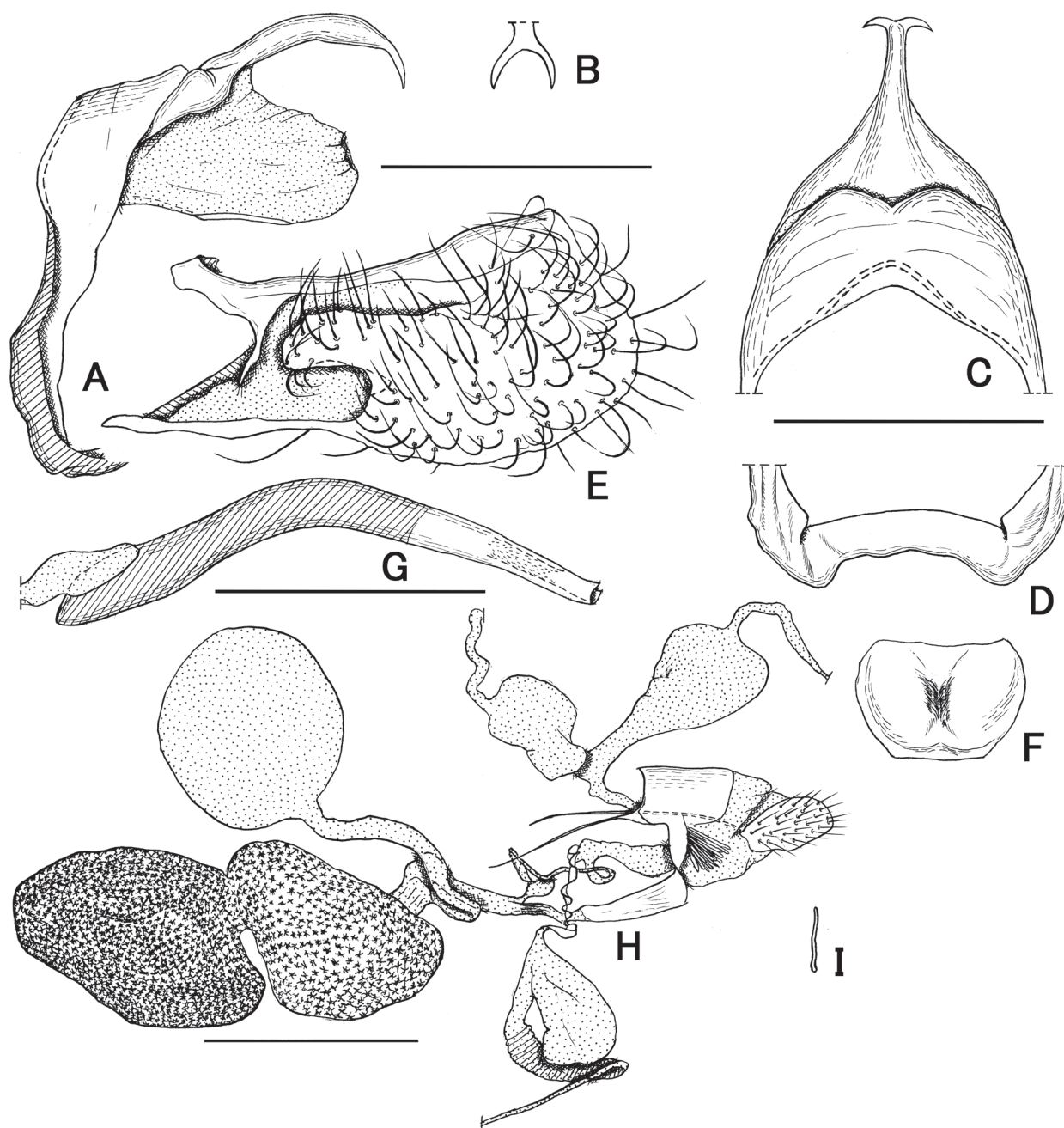


Fig. 78. Genitalia, *Episteira nigrilinearia nigrilinearia* (Leech) (A–G, ♂; H–I, ♀). A, lateral; B, apical part of uncus, caudal; C, tegumen and uncus, dorsal; D, saccus, dorsal; E, right valve, inner; F, juxta, ventral; G, phallus, lateral; H, lateral; I, narrow sclerite (sternite IX). Scales = 0.5 mm (A–G), 1.0 mm (H–I).

8–14. x. 1992 (S. Hashimoto): same locality, 3♂, emerged 20. ix. 1992 (S. Hashimoto); Aichi, Kiyosu, 1♂, 2♀, emerged 21–22. xi. 2000 (A. & S. Hashimoto); Mie, Fudodani, 1♀, 1–2. vii. 1995 (S. Hashimoto); Nara, Mt. Obako, 1♂, 1♀, 14–18. vii. 1976 (A. Tatara & K. Yasuda); Osaka, Minoo, 1♀, 2. xi. 1978 (T. Saito); Osaka, Sakai, Mozu, 1♀, 11. xi. 1979 (E. Nishida); same locality, 1♀, 11. x. 1981 (H. Hara); same locality, 1♀, 12. x. 1981 (K. Yasuda); same locality, 1♂, 16. x. 1981 (S. Hashimoto); same locality, 7♂, 6♀, emerged 11–24. xi. 1981 (S. Hashimoto); same locality, 1♂, 3♀, emerged 6. ix. 1982 (S. Hashimoto); same locality, 3♂, 15. x. 1982 (E. Nishida); Wakayama, Mt. Ootou-san, 1♀, 4. vii. 1981 (S. Hashimoto); Kyushu: Fukuoka, Mt. Hikosan, 1♀ (OPU), 16. vi. 1955 (H. Kuroko).

Distribution. Japan (Hokkaido, Honshu, Izu Islands. (Izu-oshima Is., Hachijojima Is., and Mikurajima Is.), Ogasawara Islands (Chichijima Is.), Shikoku, Kyushu, Tsushima Is., Yakushima Is., Tanegashima Is., Amami-oshima Is., Tokunoshima Is., Okinawa Is., Kumejima Is., Ishigakijima is., and Iriomotejima Is.), China, Russian Far East (Southeast Siberia).

Host plants. *Podocarpus macrophyllus* (Thunberg) Sweet (Podocarpaceae; Inoue, 1950).

Immature stages. Last instar larva (Fig. 16H) 20–22 mm in length; chrochets 1–2 in number on ventral proleg, 11–15 in number on anal one. Chaetotaxy: Seta L1 anterodorsal to L3 on meso- and metathoraces. Pupa (Fig. 19B, G) yellowish green, brown to fuscous along dorsal margin of vertex; about 11.5 mm in length, about 2.8 mm in width; hindtarsus trapezoidal.

Bionomics. There are two or more generations per year. This species is rather common and obtained from the urban district of the plain to the low mountainous area. The host plant (*Podocarpus macrophyllus*) is usually planting as a hedge in the urban district, so it is considered that distribution of this species is extending artificially. The distributional record (Inoue, 1971, 1982b; Nakajima & Yazaki, 2011) of this species from Hokkaido is probably unnatural, because the larval host plant distributes west of the Kanto region.

Genus *Sauris* Guenée

Sauris Guenée, 1857: 361. Type species: *Sauris hirsutinata* Guenée, 1857: 362, by monotypy.

Remodes Guenée, 1857: 362. Type species: *Remodes abortivata* Guenée, 1857: 364, pl.21: fig. 9, by monotypy.

Holorista Warren, 1894: 397. Type species: *Sauris proboscidea* Walker, 1862: 1252, by original designation.

Pseudoschista Warren, 1896a: 120. Type species: *Pseudoschista bicolor* Warren, 1896a: 120, by subsequent designation.

Coptogonia Warren, 1896b: 380. Type species: *Coptogonia turpennisi* Warren, 1896b: 381, by original designation.

Helminthoceras Warren, 1896b: 381. Type species: *Helminthoceras sinuaticornis* Warren, 1896b: 381, by original designation.

Anisocolpia Warren, 1899a: 35. Type species: *Sauris ignobilis* Butler, 1880b: 227, by original designation.

Anthierax Warren, 1905: 11. Type species: *Anthierax subfulva* Warren, 1905: 11, by position.

Diagnosis. The genus *Sauris* is characterized by the following apomorphies (Fig. 4), but some of them are homoplastic or reversal: 1, male hind tibia without hair-pencil (Fig. 81A–G); 2, male hindwing with Rs and M1 completely fused (Fig. 76F, I–J); 3, posterior margin of tegumen wide, slightly incurved (Figs. 82C, 83B, 86B, 88B, 89B); 4, saccus thick, anterior margin wide, slightly rounded or incurved (Figs. 82D, 83C); 5, socius well developed, thick, with long hairy setae along inner margin (Figs. 82B, 83A); 6, gnathos very thick, completely fused with uncus-socius complex; 7, cucullus hairy oblong lobe on dorsal end of valve (Figs. 82B, 83A); 8, sacculus vertically pleated (Figs. 82E, 84D); 9, posterior end of valvula broadly marginated (Figs. 82E, 84D); 10, valvula with long hairy tufts (brushes) along posterior margin (Figs. 82E, 84D). The genus is also distinguishable from other trichopterygine genera by the following combination of characters: antennal flagellomeres compressed filiform; thorax slender, well oblique postero-ventrally; male hind tibia without a hair-pencil and spurs; forewing with one areole; M1 arising from areole; hindwing without discal spot; hindwing venation (Rs and M1 completely fused in male; M3 and CuA1 completely fused in male; M3 and CuA1 connate or just separate in female); male abdominal sternum II pouch small or vestigial; uncus short; socius well developed, with long hairs along medio-ventral margin; saccus U-shaped; cucullus digitiform; sacculus weakly sclerotized, with transverse pleats; harpe weakly sclerotized; valvula rounded, marginated; phallus shorter than valve, gently curved; corpus bursae wholly covered with minute spines forming star-shaped base on outer surface; ductus bursae narrow, long; appendix bursae globular, arising near corpus bursae; ductus seminalis arising near corpus bursae.

Many *Sauris* species have green or olive green forewings, but regrettably most specimens of them gradually turn yellow or yellowish brown over time.

Description. The generic description is based on seven Japanese species and the following studies: Dugdale, 1980; Hashimoto, 1995b, 2019; Holloway, 1997; Prout, 1928; Singh, 1953, 1956.

Adult

Head (Fig. 5L): Clothed with fine scales smoothly; antennal flagellomeres compressed filiform; frons rounded; labial palpus porrect, very long, 2.0 to 3.5 times as long as eye diameter in male and 2.5 to 3.5 times in female; proboscis developed.

Thorax (Figs. 8G, 76E–K, 79A–C, E–F, 80, 81): Thorax rather slender, oblique postero-ventrally; legs very slender; male mid tibia occasionally with scale tuft; metepimeron not modified, but short inner ridge present ventrally in male of *S. nanaria* (Fig. 8G); male metameron not arched; hind tibia without a hair-pencil and spurs in male, with a pair of apical spurs in female; male hind tibia usually incrassate, with hairy scales, in that case male hind tarsus reduced. Forewing generally olive green or green, rarely grey to greyish purple, with darker greenish olive or fuscous 14 indented fine lines, darker discal spot, and a row of terminal spots black, each of them being at end of R5 to CuA2 veins; antemedial (consisting of two fine lines), postmedial (four), subterminal (two), and

adterminal lines generally distinct; frequently a cleft being between CuA1 and CuA2 in male, in that case the whorl scales is present around a cleft and near distal end of 1A + 2A, and occasionally darker scales mass is also present near distal end of 1A + 2A on undersurface; forewing with one areole; M1 arising from areole. Hindwing greyish brown to glossy greyish brown in female, darker in male, without any lines and discal spot; male with a small to large anal fold, frequently with a dark coloured outer marginal fold between Sc + R and M2; Sc separate from discal cell and connected with Rs near end of discal cell or Sc fused with discal cell in male, fused in female; Rs and M1 completely fused in male, stalked in female; Sc + R and Rs + M1 separate or stalked; M3 and CuA1 completely fused in male, stalked, connate or just separate in female; CuA2 rather long about 2/3 length of M3 + CuA1 or short less than 1/2 of M3 + CuA1 in male.

Pregenital abdomen (Fig. 9F, 12D): Abdomen compressed dorso-ventrally, slender in both sexes; male sternum II pouch very small or vestigial; antero-lateral sides of male sternum II not extending except for that of *S. nanaria*; male abdominal sterna often with a pair of brushes or setal tufts laterally on A2 and on A4 to A7, of these those on A5 to A7 easily lost after maceration in 10 % KOH, when a pair of brushes is present on A2, anterior margin of A3 is rather sclerotized and deeply incurved as a semicircle or deeply V-shaped; rarely with a pair of coremata being between A8 and A9.

Male genitalia (Figs. 82A–G, 83A–F, 84, 86A–G, 87A–G, 88A–G, 89A–F): Anterior margin of tegumen deeply incurved; posterior margin of tegumen shallowly incurved widely; saccus widely U-shaped, protruded cephalad; uncus short, gently curved, with a sharply pointed tip, broadly membranous dorsally between tegumen and uncus; socius well developed as a thick posterior protrusion with hairy scales along medio-ventral margin, broadly expanded anteriorly along ventral margin of tegumen; gnathos rather thick completely fused with uncus-socius complex; diaphragmal pouch developed or reduced, when developed valvula brush is retained; costa weakly sclerotized, with a sclerotized long ridge along dorsal margin; cucullus (subapical process of Dugdale (1980); costal characteristic lobe of Holloway (1997)) oblong, with many hairs; costal arm absent; transtilla more or less triangular, with hairs; sacculus weakly sclerotized, without any process, thickly margined with pleats, joining with valvula margin; harpe weakly sclerotized, occupying basal median part of valve, with setae, indistinguishable from valvula; valvula (cucullus of Dugdale (1980); valve apex of Holloway (1997)) oblong, rounded at posterior margin, with thick margin continuing from saccular margin, with brush consisting of many long hairy setae along inner margin, frequently with a prominent lobe (valvula lobe) expanding anteriorly; phallus rather slender, gently curved, with cornuti consisting of many minute spines; coecum short, less than 1/6 length of phallus; surrounding part (anellus) of phallus covered with many fine spines postero-dorsally; juxta wider than long.

Male genital musculature (Table 2): Any extra muscles and secondary movement of the muscles not seen.

Female genitalia (Figs. 82H–J, 83G–H, 85, 86H–I, 87H–I, 88H–J, 89G–I): Corpus bursae globular, subglobular,

oval or flattened oval, wholly covered with minute spines forming star-shaped base on outer surface; ductus bursae-corporis bursae junction distinct; ductus bursae very narrow, longer than corpus bursae, rarely with a swollen wrinkled part at middle, with or without globular appendix bursae near posterior end of corpus bursae; ductus seminalis arising near or posterior end of corpus bursae, opposite to arising point of ductus seminalis; ductus bursae-corporis bursae junction distinct; antrum cup-shaped, weakly sclerotized; 8th sternum membranous, with a pair of scales tuft at antero-lateral sides; ostium being at anterior margin of sternum VIII; apophysis anterioris long, as long as or slightly shorter than posterioris; papillae anales rounded, with many hairs; ventral sclerite (sternite IX) between papillae anales narrow.

Immature stages

Last instar larva (Fig. 16I): More than 20 mm in length; head lemon yellow to greenish yellow, rarely reddish yellow, wider than long, almost smooth (very finely granulate); ecdysial cleavage line absent; labral emargination about 0.2 to 0.25 deep; mandible with 6 teeth, of which inner one is dull, serrate; labial palpus with a fringed wide apex, longer than labial palpus; stemma 5 & 6 smaller than others; cranial setae rather long; body lemon yellow to greenish yellow, rarely reddish orange, almost smooth (extremely finely roughened), trachea well distinct through integument; A1–A5 segments longer than high; ventral proleg small, well extending to 7th abdominal segment postero-ventrally; crochets of ventral and anal prolegs arranged in biordinal mesoserries, slightly interrupted in middle; paraproct well developed, green to yellowish brown or orange; abdominal setae, most of them dull tipped, extremely minute except for those of anal shield and anal proleg. Chaetotaxy: Pb puncture anterior to a line joining P1 and P2 setae; A3 ventral to a line joining L1 and A2; SS2 in between stemma 5 & 6 or near stemmata 5; mandible with only one seta; prothoracic SD setal group unisetose, not on prothoracic shield; prothoracic L1 shorter than L2, thicker than L2, antero-dorsal to L2; prothoracic L2 slender, longer than twice of L1; on meso- and metathoraces SD1 seta longest; D2 below, slightly anterior to D1; SD2 below, slightly posterior to D2; L3 almost directly behind to L1; abdominal SD2 microscopic, slightly antero-ventral to SD1 on A1 and A7–8, postero-ventral on A2–A6; ventral proleg with four SV setae on same pinaculum, of these the antero-ventral one is longest and pointed; on anal shield D1 setae distinctly anterior to a line drawn between SD2s; on anal proleg SV2 (CP1) just postero-ventral to SV3 (CP2), which is stout, longest, more than twice length of SV2, and at antero-ventral corner of anterior shield.

Pupa (Fig. 18D–F): Slender, more than 9 mm in length, more than 2.0 mm in width; greenish yellow to yellowish green or pale reddish brown tinged with blueish green except for blueish green forewing, finely fuscous around each setal base; cuticle thin except for 10th abdominal segment, which is glossy reddish fuscous and stout; labial palpus exposed, very small; forewing reaching posterior margin of 4th abdominal segment; proboscis reaching apical margin of forewing or not (when not reaching, hind tarsus exposed); fore femur not exposed; antenna and midleg reaching apical margin of

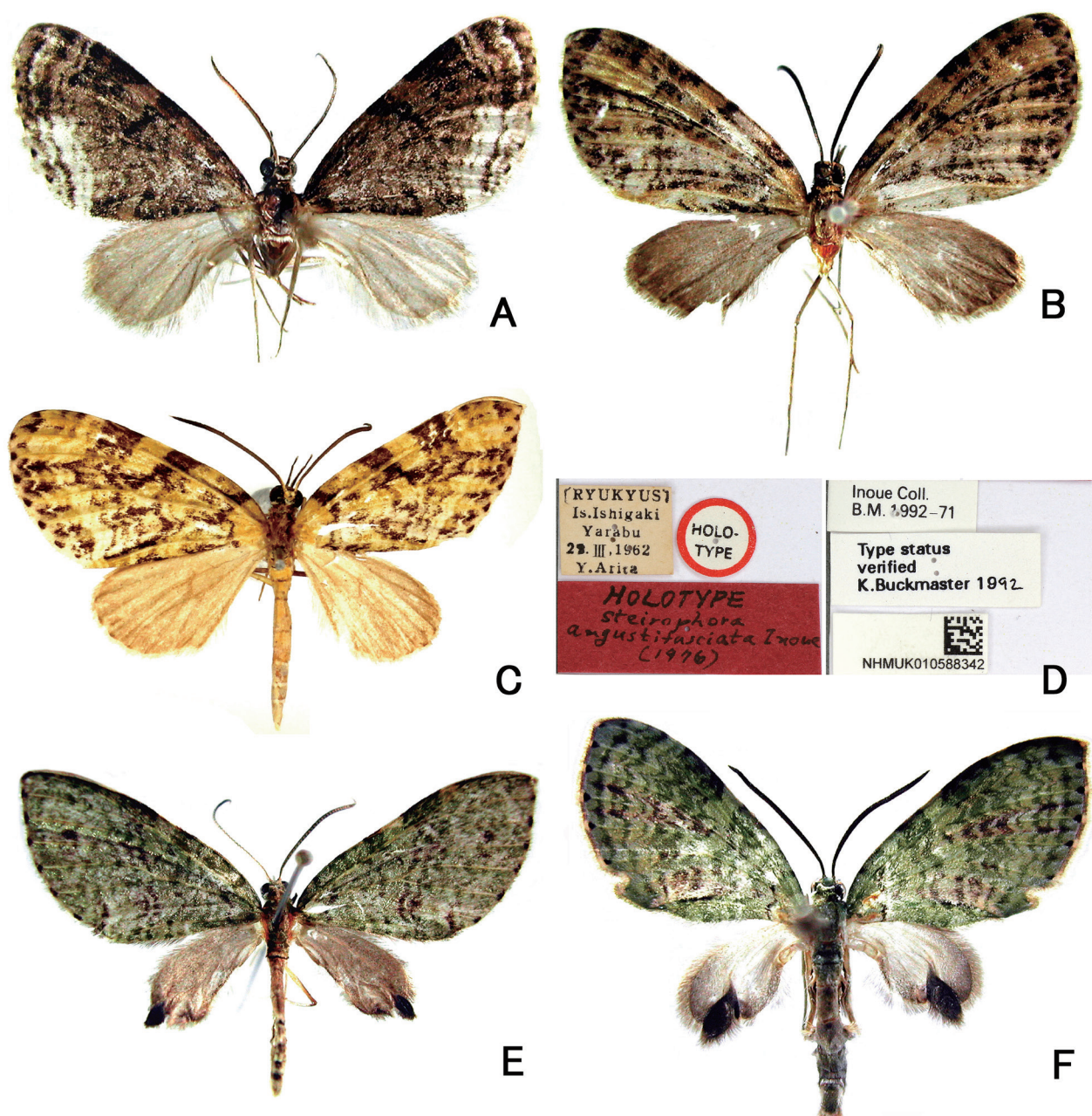


Fig. 79. Adults. A, *Sauris nanaria* Leech, ♂; B, *Sauris angustifasciata* (Inoue), ♂; C, ditto, ♀, holotype, coll. NHM (Japan: Ishigaki Is.); D, ditto, labels; E, *Sauris marginepunctata* (Warren), ♂; F, *Sauris chlorosterna* Hashimoto, ♂, holotype, coll. NSMT (Japan: Okinawa Is.).

forewing or slightly beyond posterior margin; foreleg reaching before end of proboscis; hind tarsus exposed or not; dorsal and lateral grooves distinct; cremaster with four pairs of coiled setae, of which terminal one is most sclerotized.

Distribution. Extending from Indian subregion to the Pacific (Niue Is.), Australia, China, Taiwan, and Japan.

Bionomics. This genus is most diverse in the tropical or subtropical regions of East Asia to the Pacific Islands, but bionomic information is so scarce. There are two or more generations per year. The host information is totally lacking (Dugdale, 1980), but the moths are probably polyphagous and the many plant families have been listed as the larval host plants (Singh, 1953; Inoue, 1982b; Holloway, 1997; Inoue & Ohbayashi, 2003; Tominaga, 2003; Nakajima & Yazaki, 2011; Ohbayashi, 2015; Hayashi, 2006; Hashimoto, 2019):

Celastraceae; Elaeocarpaceae, Euphorbiaceae, Hamamelidaceae, Lauraceae, Lorantheae, Lythraceae, Myricaceae, Myrtaceae, Oleaceae, Phyllanthaceae, Putranjivaceae, Rosaceae, Rutaceae, Sapindaceae, and Theaceae. The larvae feed on the edge of younger leaf, rest on the leaf edge or the leafstalk and hold out the body at about 30 degrees (Holloway, 1997; Inoue & Ohbayashi, 2003; Hashimoto, 2019). Under the rearing condition, the mature larva pupates in a rough cell attached by the cremastral setae (Hashimoto, 2019).

Remarks. The genus *Sauris* is composed of about 80 described species and closely related to the genera *Dystypoptila*, *Episteira*, and *Tympanota*, whose distribution ranges almost overlap with that of *Sauris* (Dugdale, 1980; Holloway, 1997). As for differences among them, see the remarks of the genus *Episteira*.

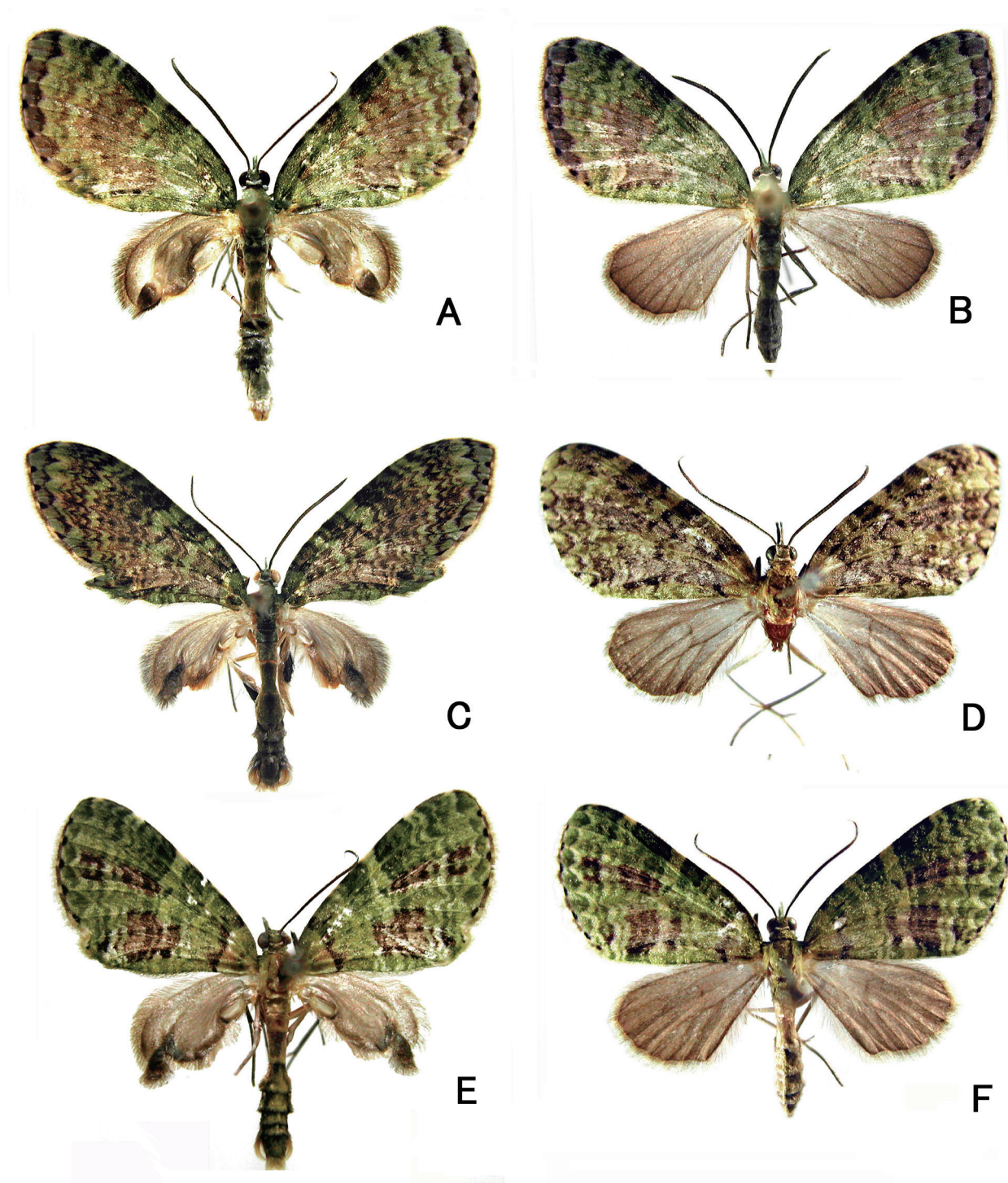


Fig. 80. Adults. A, *Sauris hirudinata* Guenée, ♂; B, ditto, ♀; C, *Sauris interruptata* (Moore), ♂; D, ditto, ♀; E, *Sauris purpurotincta* Galsworthy, ♂; F, ditto, ♀.

Sauris had been classified into several genera on account of diversity of the secondary sexual characters. Prout (1928) recognized thirteen structure-groups in the genus and presented that the following “genera” of Guenée and Warren: *Dystypoptila*, *Holorista*, *Pseudoschista*, *Helminthoceras*, *Remodes*, *Anisocolpia*, *Coptogonia*, and *Anthierax*, are classified into his structure-groups, but one or two of them may prove genetically tenable. On the basis of similarity of the male and female genital structures, Dugdale (1980) treated above seven genera except for *Dystypoptila* as the synonyms of the genus *Sauris* followed

Prout (1928), and he showed that *Dystypoptila* and *Sauris* are very closely related to each other and distinguishable by the male hindwing structure (triangular (Holloway, 1997; pl. 8: 1) in *Dystypoptila*, but oval or with outer marginal fold (Fig. 79A–B, E–F) in *Sauris*). Dugdale (1980) divided the Australian species into three groups, but the present paper classifies tentatively the Japanese *Sauris* species into four groups as follows mainly based on the male secondary sexual characters and the female hindwing venation and genitalia:

Group A (Dugdale’s *lichenias* group): male hind tibia and



Fig. 81. Male hind tibia and tarsus. A, *Sauris nanaria* Leech, right; B, *Sauris angustifasciata* (Inoue), right; C, *Sauris marginepunctata* (Warren), right; D, *Sauris chlorosterna* Hashimoto, left; E, *Sauris hirudinata* Guenée, left; F, *Sauris interruptata* (Moore), right; G, *Sauris purpurotincta* Galsworthy, left.

tarsus not modified (Fig. 81A); metepimeron not modified, but short inner ridge present ventrally in male (Fig. 8G); male forewing without cleft between CuA1 and CuA2 (Fig. 79A); male hindwing without marginal fold (Figs. 76F, 79A); male hindwing venation (Fig. 76F) (Sc fused with upper vein (R + Rs) of discal cell; Sc + R and Rs + M1 stalked; M3 + CuA1 and CuA2 separate; CuA2 rather long, about 2/3 length of M3 + CuA1); female hindwing (Fig. 76G) with M3 and CuA1 connate or just separate; male abdominal sternum II pouch small (Fig. 12D); male abdomen without any scale tufts; male genitalia with diaphragmal pouch and with very long hairs on valvula (Fig. 82A); female genitalia (Fig. 82H) without appendix bursae; corpus bursae subglobular; ductus bursae with a thick wrinkled part at middle. *Sauris nanaria*.

Group B (almost same as Dugdale's *communi* group, but differs in the unmodified male hind leg): male hind tibia and tarsus not modified (Fig. 81B); metepimeron not modified, without inner ridge; male forewing without cleft (Fig. 79B); male hindwing without marginal fold (Fig. 79B); male hindwing venation (Sc separate from upper vein (R + Rs) of discal cell and connected with a short vein of R near end of discal cell; Sc + R and Rs + M1 separate; M3 + CuA1 and CuA2 separate; CuA2 rather long, about 2/3 length of M3 + CuA1); female hindwing with M3 and CuA1 stalked; male abdominal sternum II pouch vestigial; male abdomen without any scale tufts; male genitalia (Fig. 83A) without diaphragmal pouch; female genitalia (Fig. 83H) with appendix bursae; corpus bursae globular. *Sauris angustifasciata*.

Group C: male hind tibia incurved and tarsus weakly modified (Fig. 81C); male forewing without cleft (Fig. 79E); metepimeron not modified, without inner ridge; male hindwing with marginal fold (Fig. 79E); male hindwing venation (Sc separate from upper vein (R + Rs) of discal cell and connected with a short vein of R near end of discal cell; Sc + R and Rs + M1 stalked; M3 + CuA1 and CuA2 separate; CuA2 shorter than 1/2 length of M3 + CuA1); female hindwing with M3 and CuA1 stalked; male abdominal sternum II pouch vestigial; male abdominal sternum V with a

pair of setal tufts on sclerite; male genitalia (Fig. 84A) without diaphragmal pouch; female genitalia with appendix bursae; corpus bursae globular. *Sauris marginepunctata*.

Group D (Dugdale's *malaca* group): male hind tibia modified (Fig. 81D–G); tarsus reduced (Fig. 81D–G); male forewing with cleft (Figs. 76H, 79F, 80A, C, E); metepimeron not modified, without inner ridge; male hindwing with marginal fold (Figs. 76I–J, 79F, 80A, C, E); male hindwing venation (Sc separate from upper vein (R + Rs) of discal cell and connected with a short vein of R near end of discal cell; Sc + R and Rs + M1 separate or stalked; CuA2 and M3 + CuA1 separate or stalked; M3 + CuA1 separate or stalked; CuA2 short, about 1/2 or less than 1/2 of M3 + CuA1); female hindwing with M3 and CuA1 stalked; male abdominal sternum II pouch vestigial (Fig. 9F); male abdominal sternum II, IV, V, VI, and VII with a pair of brushes or setal tufts; male genitalia (Figs. 86A, D, E, 87A, D, E, 88A, D, E, 89A, D) with diaphragmal pouch and with very long hairs on valvula; female genitalia (Figs. 86H–I, 87 H–I, 88 H–I, 89 G–H) with appendix bursae; corpus bursae oval or flattened oval. *Sauris chlorosterna*, *S. hirudinata*, *S. interruptata*, and *S. purpurotincta*.

Key to the Japanese species of *Sauris* (based on adult characters)

1. Hind tibia without spurs; hindwing with an anal fold 2 (male)
- Hind tibia with a pair of apical spurs; hindwing without an anal fold 8 (female)
2. Forewing without cleft on termen between CuA1 and CuA2 3
- Forewing with cleft on termen between CuA1 and CuA2 .. 5
3. Forewing olive green with fuscous lines; hindwing venation (Sc separate from discal cell and connected with R beyond discal cell; hindwing CuA2 short, less than 2/3 length of M3 + CuA1); anal fold small, less than 1/3 length of anal margin; abdominal sternum II pouch vestigial; diaphragmal pouch absent; dorsal base of uncus narrow

- or slightly wide; valve narrow or slightly broad 4
- Forewing purplish brown with fuscous and darker lines, and with white band from M3 to dorsum between postmedial and subterminal lines; hindwing venation (Sc fused with dical cell; hindwing CuA2 rather long, about 2/3 length of M3 + CuA1); anal fold about 1/3 length of anal margin; male abdominal sternum II pouch distinct, but small; diaphragmal pouch present; dorsal base of uncus very wide; valve broad; (phallus rather slender; shorter than valve, gently curved; cornuti consisting of many fine spines annularly) *S. nanaria*
 - 4. Forewing olive green with fuscous postmedial line sharply incurved at M2; hindwing without an outer marginal fold; hindwing with CuA2 about 1/2 length of M3 + CuA2; anal fold very small, about 1/5 length of anal margin; hind tibia not modified; uncus wide at dorsal base; valve rather broad; phallus thick, slightly shorter than valve, gently curved; cornutus absent ... *S. angustifasciata*
 - Forewing with postmedial line gently incurved; hindwing with an outer marginal fold on termen between Sc + R and Rs + M1; hindwing with CuA2 very short, less than 1/3 length of M3 + CuA1; anal fold small, about 1/3 length of anal margin; hind tibia thick, incurved; uncus slender; valve narrow; phallus almost as long as valve, slender, slightly curved; cornuti consisting of many fine spines
..... *S. marginepunctata*
 - 5. Forewing olive green with dark green indented lines, partly overlaid with purple, greyish brown or black on postmedial and subterminal lines; hindwing without orange setae on tornal area; mid tibia without hairy scales; hind tibia with hairy scales glossy pale yellowish white or dark green .. 6
 - Forewing olive green with fuscous sharply indented lines; hindwing grey, darker along termen; anal fold about 2/5 length of anal margin; outer marginal fold rather large, greenish fuscous, with orange scales on tornal area; mid tibia with glossy yellowish brown hairy scales on middle; hind tibia reduced, with fuscous hairy scales on outer tip; 7th abdominal brushes well developed; (diaphragmal pouch about 1.5 times as long as valve; uncus slender, longer than socius; basal side of socius slightly curved; valvula lobe well expanded ventrally; phallus shorter than valve, gently curved) .. *S. interruptata*
 - 6. Forewing with postmedial line (consisting of four fine lines) dark green partly or mostly overlaid with fuscous or greyish brown, with a transverse black line on 1A + 2A; discal spot greenish fuscous; abdominal sternum II pale yellowish white or greyish green 7
 - Forewing with postmedial line dark green overlaid with purple between M1 and M3 and between CuA1 and 1A + 2A; subterminal line dark green overlaid with purple between CuA1 and 1A + 2A; discal spot distinct, dark green; hindwing greyish brown, greenish fuscous along termen; anal fold about 2/5 length of anal margin; outer marginal fold rather large, greenish fuscous; hind tibia gradually thick towards apex, with a small pale grey scale tuft on inner apex; abdominal sternum II yellowish brown; diaphragmal pouch slightly longer than valve; uncus slender, longer than socius; socius curved, with long hairy setae curled apically; socius base well rounded; valve gradually broad distally; valvula lobe developed, especially ventral half; phallus shorter than valve, well curved *S. purpureotincta*
 - 7. Forewing with postmedial line dark green overlaid with fuscous between M1 and M3 and between CuA1 and 1A + 2A; subterminal line overlaid with a black transverse wedge-shaped spot between M1 and M2 and between M2 and M3, respectively; a narrow area between adterminal line and termen darker; hindwing white, scattered with grey scales along termen; anal fold small about 1/3 length of anal margin; outer marginal fold rather large, greenish fuscous; hind tibia with fuscous scales on inner middle, glossy green scales on outer tip, and glossy straw yellow hairy scales on inner tip; hind tarsus covered with glossy green scales on proximal outer surface; abdominal sterna II & III greyish green; diaphragmal pouch about 2.0 times as long as valve; uncus slender, slightly longer than socius; posterior part of socius strongly curved ventrally, rather blunt tipped; valve gradually broad posteriorly, with well developed valvula lobe, cleft at middle; phallus shorter than valve, strongly curved at middle *S. chlorosterna*
 - Forewing with antemedial, postmedial and subterminal lines dark green overlaid with greyish brown from costa to 1A + 2A; adterminal line consisting of a row of fuscous spots; a narrow area between adterminal line and termen purplish grey, but occasionally dark olive green; hindwing dark grey, with oblong white spot before outer marginal fold; anal fold large, ear-shaped, more than 1/2 length of anal margin; outer marginal fold rather small, greenish fuscous; male hind tibia covered with greyish green scales on outer surface, with glossy yellowish brown hairy scales on inner tip and glossy straw yellow hairy scales on outer tip; hind tarsus with glossy straw yellow hairy scales on proximal outer surface; abdominal sterna glossy whitish grey; diaphragmal pouch about 2.0 times as long as valve; uncus slender, slightly longer than socius; socius distally curved ventrally, sharply pointed; valve gradually broad posteriorly, with well-developed valvula lobe, cleft deeply and broadly at middle; phallus rather slender, gently curved *S. hirudinata*
 - 8. Forewing olive green with fuscous or darker lines; hindwing with M3 and CuA1 stalked; corpus bursae globular or flattened oval; appendix bursae present; ductus bursae very narrow 10
 - Forewing purplish brown with darker lines, and with white band from M3 to dorsum between postmedial and subterminal lines; female hindwing with M3 and CuA1 connate or just separate; corpus bursae subglobular; appendix bursae absent; ductus bursae thickened and wrinkled at middle, arising from posterior end of corpus bursae; (ductus seminalis arising between anterior end of ductus bursae and a thick wrinkled part of ductus bursae; apophysis anterioris as long as posterioris) *S. nanaria*
 - 9. Forewing olive green with fuscous sharply indented lines 10
 - Forewing olive green with dark green indented lines, partly overlaid with purple, greyish brown or black on postmedial

- and subterminal lines 12
10. Forewing with postmedial line sharply incurved at M2; corpus bursae globular; ductus seminalis arising near posterior end of corpus bursae; (apophysis anterioris slightly shorter than posterioris) *S. angustifasciata*
- . Forewing with postmedial line gently curved; corpus bursae globular or flattened oval; ductus seminalis slightly thick, arising from posterior end of corpus bursae .. 11
11. Forewing with each line darker and rather broad on costal margin; corpus bursae flattened oval, long; ductus bursae and appendix bursae arising from posterior end of corpus bursae separately; apophysis anterioris almost as long as posterioris *S. interruptata*
- . Forewing with uniformly narrow and fuscous lines; corpus bursae oval; ductus seminalis very narrow; appendix bursae arising from posterior end of corpus bursae; apophysis anterioris slightly shorter than posterioris *S. marginepunctata*
12. Forewing with postmedial line (consisting of four fine lines) dark green partly or mostly overlaid with fuscous or greyish brown, with transverse black line on 1A + 2A .. 13
- . Forewing with postmedial line (four fine lines) dark green overlaid with purple between M1 and M3 and between CuA1 and 1A + 2A; subterminal line (two fine lines) dark green overlaid with purple between CuA1 and 1A + 2A; discal spot distinct, dark green; (corpus bursae flattened oval; ductus bursae arising near postero-dorsal end of corpus bursae; ductus seminalis and appendix bursae arising near anterior end of ductus bursae; apophysis anterioris as long as posterioris) *S. purpurotincta*
13. Forewing with postmedial line (four fine lines) dark green overlaid with fuscous between M1 and M3 and between CuA1 and 1A + 2A; subterminal line (two fine lines) overlaid with a black transverse wedge-shaped spot between M1 and M2 and between M2 and M3, respectively; a narrow area between adterminal line and termen darker green; corpus bursae flattened oval, with a dome-like protrusion caudo-ventrally; ductus bursae arising from a dome-like protrusion; ductus seminalis and appendix bursae arising near anterior end of ductus bursae; apophysis anterioris slightly shorter than posterioris *S. chlorosterna*
- . Forewing with antemedial, postmedial and subterminal lines dark green overlaid with greyish brown from costa to 1A + 2A; adterminal line consisting of a row of fuscous spots; a narrow area between adterminal line and termen purplish grey; corpus bursae flattened oval, slightly expanded mid-ventrally; ductus bursae arising from postero-ventral 1/3 of corpus bursae; ductus seminalis and appendix bursae arising from anterior end of ductus bursae; apophysis anterioris almost as long as posterioris .. *S. hirudinata*

***Sauris nanaria* Leech**

(Figs. 5L, 8G, 12D, 76E–G, 79A, 81A, 82)

Sauris nanaria Leech, 1897: 76.

Diagnosis. Forewing length 11–13 mm in male, 12–13

mm in female; labial palpus about 2.5 times as long as eye diameter in male, more than 2.5 times in female; male abdominal sternum II pouch small; antero-lateral sides of abdominal sternum II slightly extending cephalo-dorsally; male abdominal sterna without a pair of brushes and scale tufts; male and female genitalia shown in Fig. 82. Distinction among the Japanese *Sauris* species is treated in the key.

Specimens examined. JAPAN: Honshu: Aichi, Dando-uradani, 1♂, 16. viii. 1969 (B. Tanaka); Aichi, Mt. Sanage, 1♂, 22. iv. 1996 (B. Tanaka); Kyoto, Mt. Hiei, 1♂ (OPU), 29. vi. 1956 (K. Takeuchi); Osaka, Mt. Makiosan, 1♀, 10. vi. 1982 (T. Sato); Kyushu: Fukuoka, Mt. Hikosan, 1♀ (OPU), 4 ix. 1953 (H. Kuroko).

Distribution. Endemic to Japan (Honshu, Kyushu, and Shikoku).

Host plants. Unknown.

Immature stages. Larva is not described. The pupa of this species was described by Nakamura (2004) based on the Okinawa's material, but the host plant information and the larval characters were not given. Pupa light green, with some black spots on abdominal segment; 10th abdominal segment reddish brown; about 12 mm in length; hind tarsus exposed. However, judging from the pupal length and the distributional range, it is questionable whether this pupa is *S. nanaria* or not.

Bionomics. This species is endemic to Japan and distributed in the most northern part in the genus, but other bionomic information is unknown.

***Sauris angustifasciata* (Inoue)**

(Figs. 79B–D, 81B, 83)

Steirophora angustifasciata Inoue, 1976: 13, fig. 18.

Phthonoloba angustifasciata: Inoue, 1977: 255.

Sauris angustifasciata: Inoue, 1982: 470.

Diagnosis. Forewing length about 14 mm in male, 15–17 mm in female; labial palpus about 3.0 times as long as eye diameter in both sexes; male abdominal sternum II very small; male abdominal sterna without a pair of brushes and scale tufts; male and female genitalia shown in Fig. 83.

Distinction among the Japanese *Sauris* species is treated in the key.

Specimens examined. Holotype: ♀ (NHM), [RYUKYUS]: Is. Ishigaki, Yarabu, 29. III. 1962, Y. Arita. Paratype: JAPAN: Kyushu: Kagoshima, Yakushima Is., Kurio, 1♀ (HIC: Genitalia slide 4659), 4. iii. 1973 (T. Watanabe). Other materials: JAPAN: Ryukyus: Ishigakijima Is., Yarabu, 1♂, 14. xi. 1982 (T. Tanabe); Iriomotejima Is., Mt. Ushiku, 1♂ (HIC: Genitalia slide 3661; No. 1192), 7–10. x. 1963 (G. A. Samuelson); TAIWAN: Taichun, Chipen, 1♀, 9. iii. 1982 (S. Hashimoto).

Distribution. Japan (Yakushima Is., Okinawa Is., Ishigakijima Is., and Iriomotejima Is.), Taiwan, and China.

Host plants. *Litchi chinensis* Sonnerat (Sapindaceae; Nakajima & Yazaki, 2011).

Immature stages. Not described.

Bionomics. Almost unknown except for the larval host plant.

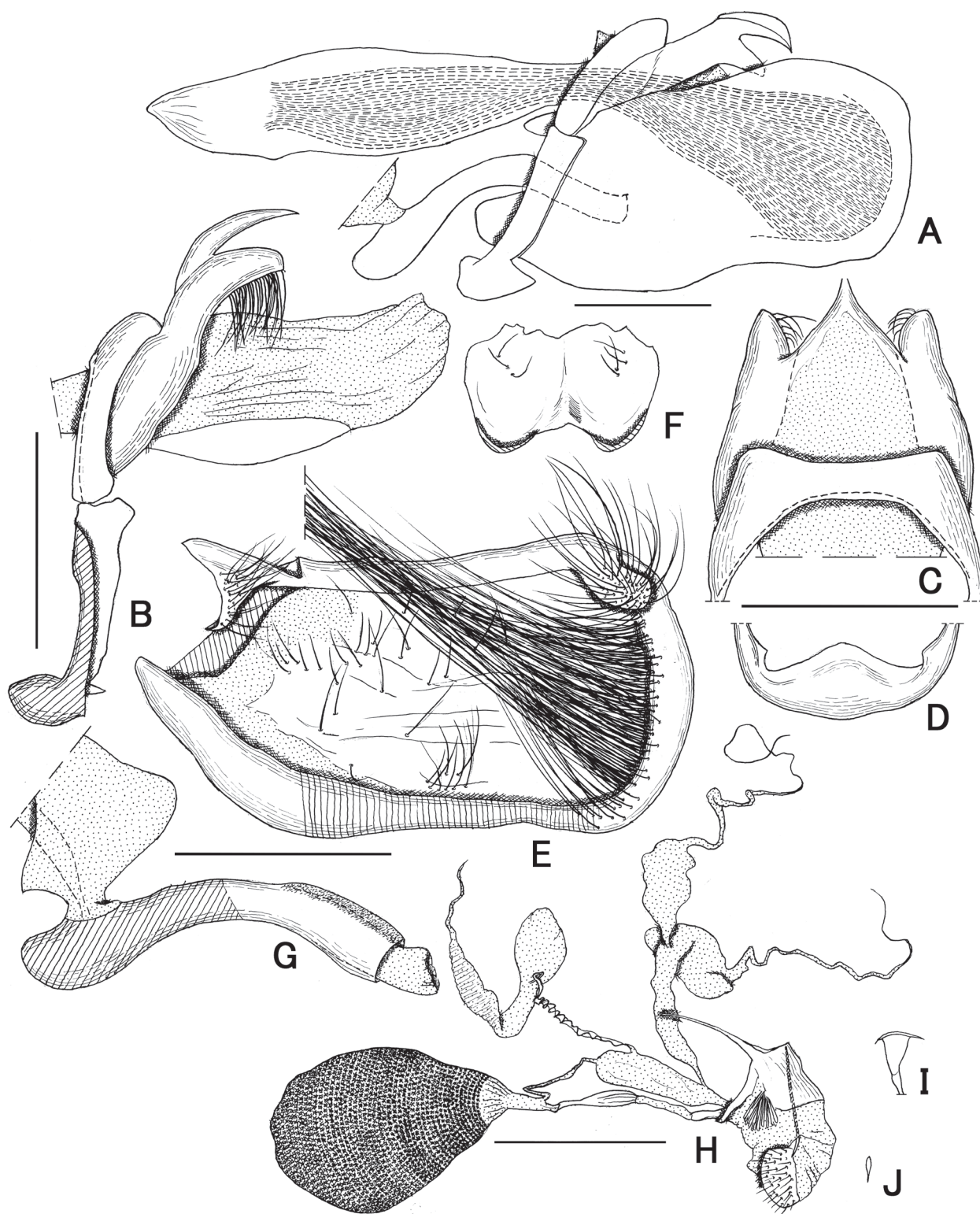


Fig. 82. Genitalia, *Sauris nanaria* Leech (A–G, ♂; H–J, ♀). A, whole, lateral; B, lateral; C, tegumen and uncus, dorsal; D, saccus, dorsal; E, right valve, inner; F, juxta, ventral; G, phallus, lateral; H, lateral; I, antrum, ventral; J, narrow sclerite (sternite IX). Scales = 0.5 mm (A–G), 1.0 mm (H–J).

***Sauris marginepunctata* (Warren)**
(Figs. 79E, 81C, 84–85)

Holorista marginepunctata Warren, 1899b: 339.

Sauris plagulata Bastelberger, 1911: 241.
Sauris marginepunctata: Dugdale, 1980: 338.

Diagnosis. Forewing length 15–16 mm in male, about 15 mm in female; labial palpus about 3.5 times as long as eye diameter in male, about 3.5 times in female; male hind leg not

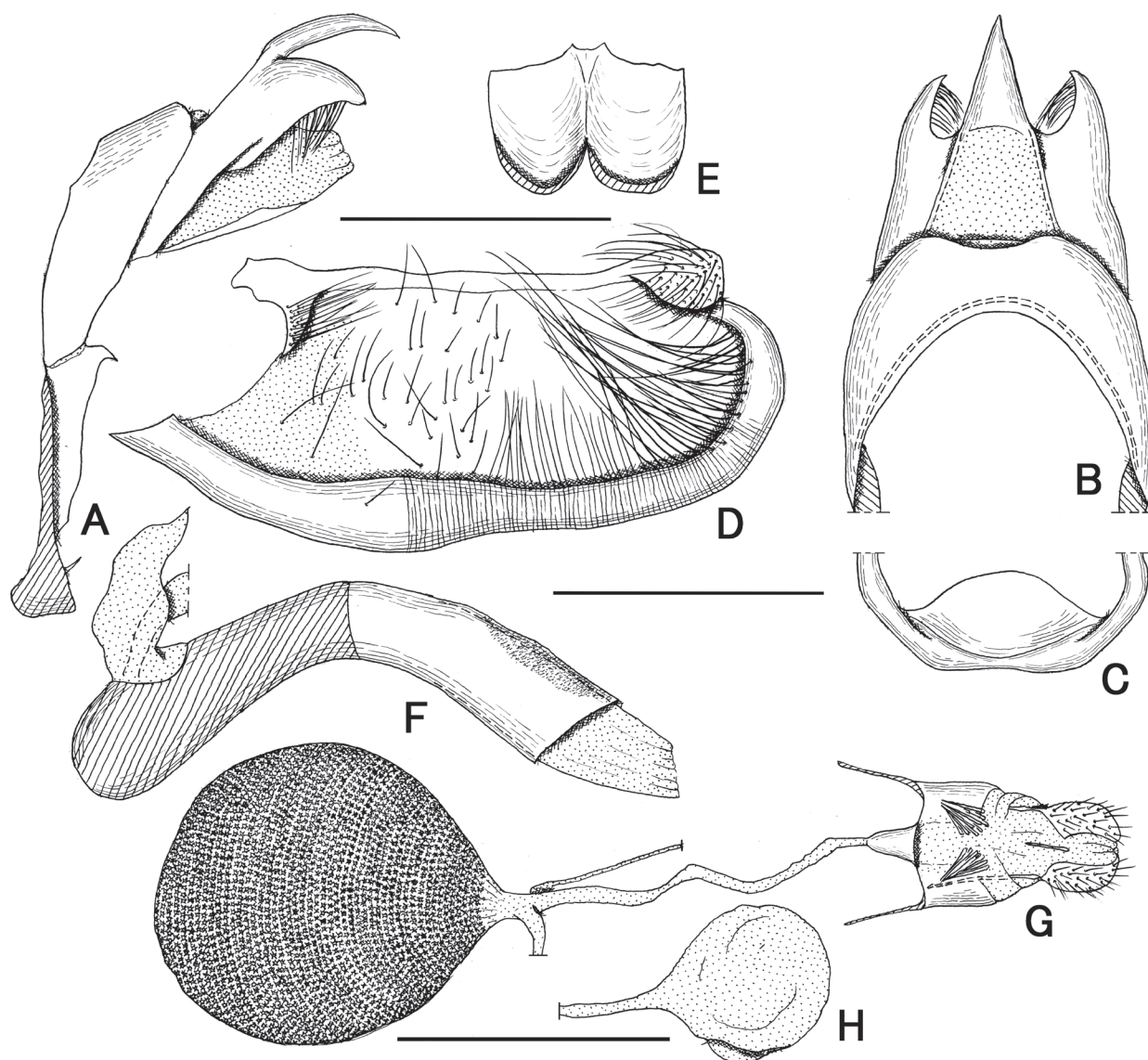


Fig. 83. Genitalia, *Sauris angustifasciata* (Inoue) (A–F, ♂; G–H, ♀). A, lateral; B, tegumen and uncus, dorsal; C, saccus, dorsal; D, right valve, inner; E, juxta, ventral; F, phallus, lateral; G, ventral; H, appendix bursae, ventral. Scales = 0.5 mm (A–F), 1.0 mm (G–H).

modified; male abdominal sternum II pouch very small; male abdominal sternum II slightly swelling; male sternum IV with a pair of hairs on sclerite; male and female genitalia shown in Figs. 84–85, respectively. Distinction among the Japanese *Sauris* species is treated in the key.

Specimens examined. JAPAN: Honshu: Shizuoka, Izu, 1♂, 26. vii. 2012 (H. Ohgane); Yamaguchi, Oshima-cho, 1♂, 4. i. 1994 (N. Okimoto); Shikoku: Ehime, Omogo, 1♀ (HIC: genitalia slide 8242), 27–28. viii. 1955 (M. & Y. Miyatake); Kyushu: Fukuoka, Mt. Hikosan, 1♂ (HIC: genitalia slide 1529; No. 893), 22. viii. 1955 (H. Kuroko); Kagoshima, Shibushi, 2♂, emerged 21. i. 2007 (E. Hayashi).

Distribution. Japan (Honshu, Hachijojima Is., Shikoku, Kyushu, and Yakushima Is.), Taiwan, Philippines, and Borneo.

Host plants. *Prunus zippeliana* Muel, *Rosa* sp. (Rosaceae; Inoue 1982b), *Machilus thunbergii* Siebold et Zuccarini (Lauraceae; Hayashi 2006).

Immature stages. The larvae of this species were figured by Hayashi (2006), but any descriptions of the larval and

pupal features were not given.

Bionomics. Almost unknown except for the larval host plant.

Sauris chlorosterna Hashimoto

(Figs. 16I, 79F, 81D, 86)

Sauris hirudinata: Inoue & Ohbayashi, 2003: 411; Ohbayashi, 2015: 632 (nec Guenée, 1857).

Sauris chlorosterna Hashimoto, 2019: 46, figs. 1, 2, 7, 8, 11, 14, 15, 36, 37, 43.

Diagnosis. Forewing length 13–14 mm in male, 14–16 mm in female; labial palpus about 2.5 times as long as eye diameter in male, about 3.0 times in female; male hind tibia thick, with fuscous scales on inner middle, glossy green scales on outer tip, and glossy straw yellow hairy scales on inner tip; male hind tarsus reduced, thick, covered with glossy green scales on proximal outer surface; male abdominal sternum II

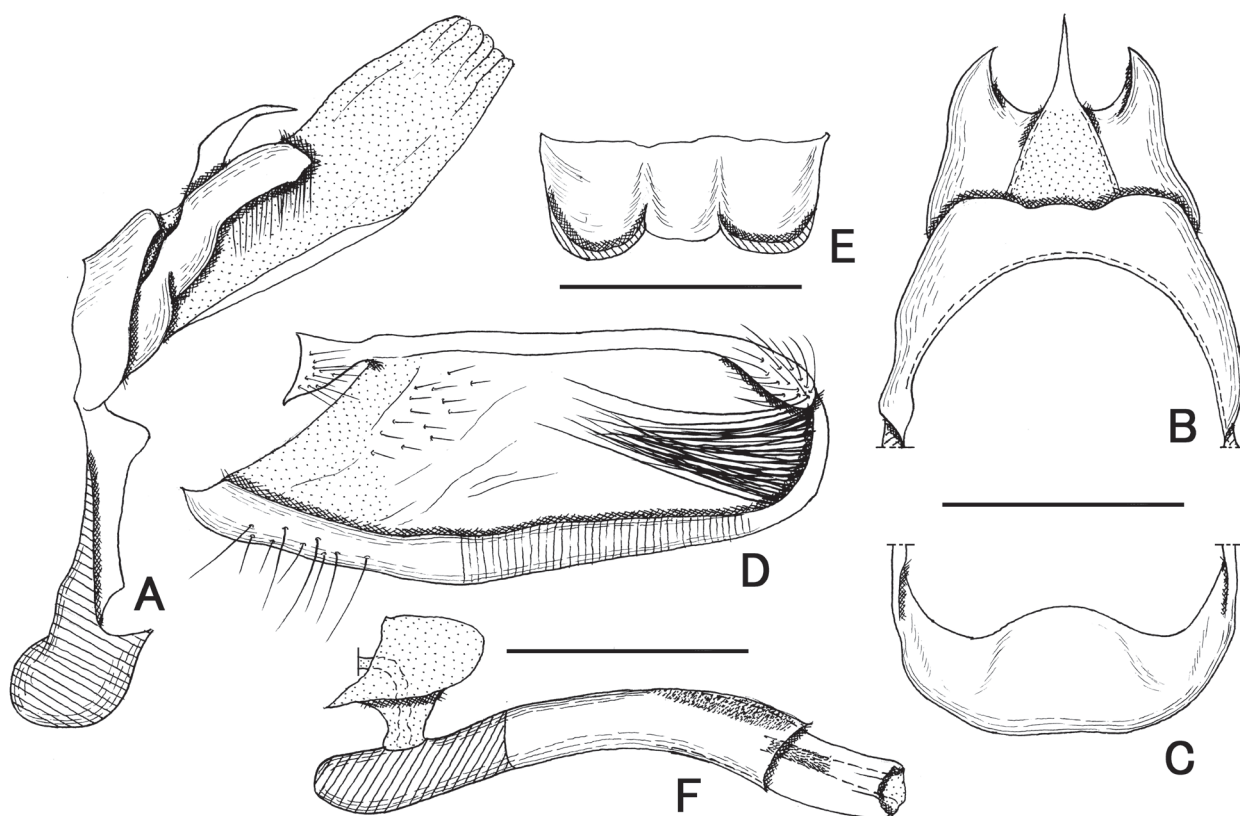


Fig. 84. Male genitalia, *Sauris marginepunctata* (Warren) (A–F, ♂). A, lateral; B, tegumen and uncus, dorsal; C, saccus, dorsal; D, right valve, inner; E, juxta, ventral; F, phallus, lateral. Scales = 0.5 mm.

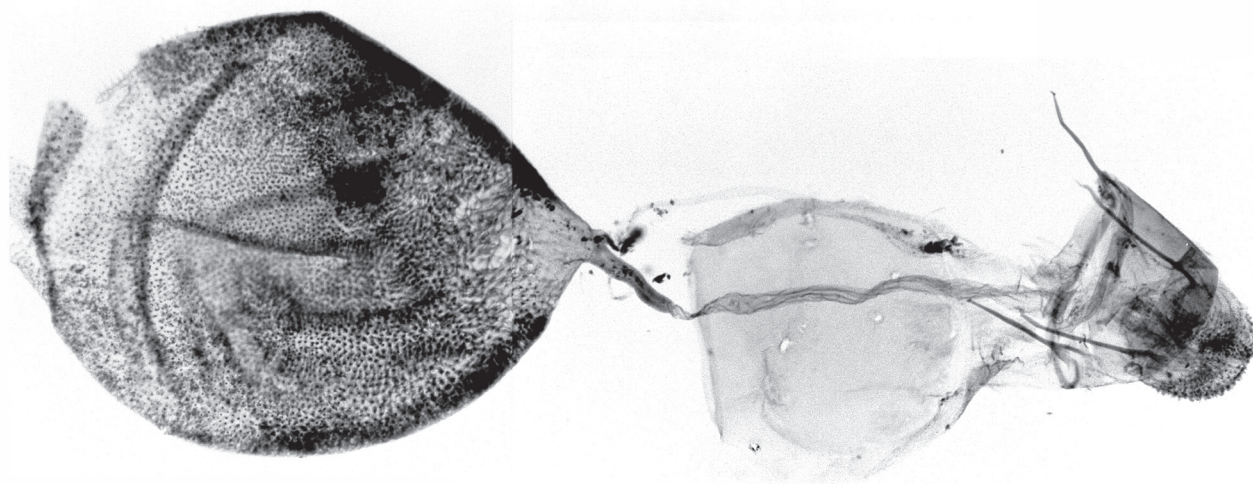


Fig. 85. Female genitalia, *Sauris marginepunctata* (Warren).

pouch completely reduced; anterior margin of male abdominal sternum III sclerotized, deeply V-shaped; each of male abdominal sterna II, IV, and VII with a pair of brushes, and each of V and VI with a pair of scale tufts; an intersegmental membrane of male abdominal segments VIII and IX (genital segment) laterally with a pair of long hairy blunt tipped scale tufts, but easily lost by KOH maceration; male and female genitalia shown in Fig. 86. Distinction among the Japanese *Sauris* species is treated in the key.

Specimens examined. Holotype (NSMT): JAPAN: Ryukyus,

Okinawa Is., Yaese-cho, Yaese-koen, ♂, emerged 17. vi. 2007 (S. Tominaga). Paratypes (NSMT): JAPAN: Chichijima Is., Higashidaira, 1♀, emerged 23. iv. 2018 (F. Komai); Chichijima Is., Nagatani, 1♀, 16. iii. 2018 (K. Takahashi); Ryukyus: same locality with holotype, 1♂, emerged 17. vi. 2007 (S. Tominaga).

Distribution. Chichijima Is. and Okinawa Is.

Host plants. *Syzygium samarangense* (Blume) Merrill & L. M. Perry (Myrtaceae; Inoue & Ohbayashi, 2003), *Litchi chinensis* Sonnerat (Sapindaceae; Inoue & Ohbayashi, 2003), *Bischofia javanica* Blume (Phyllanthaceae; Ohbayashi, 2015),

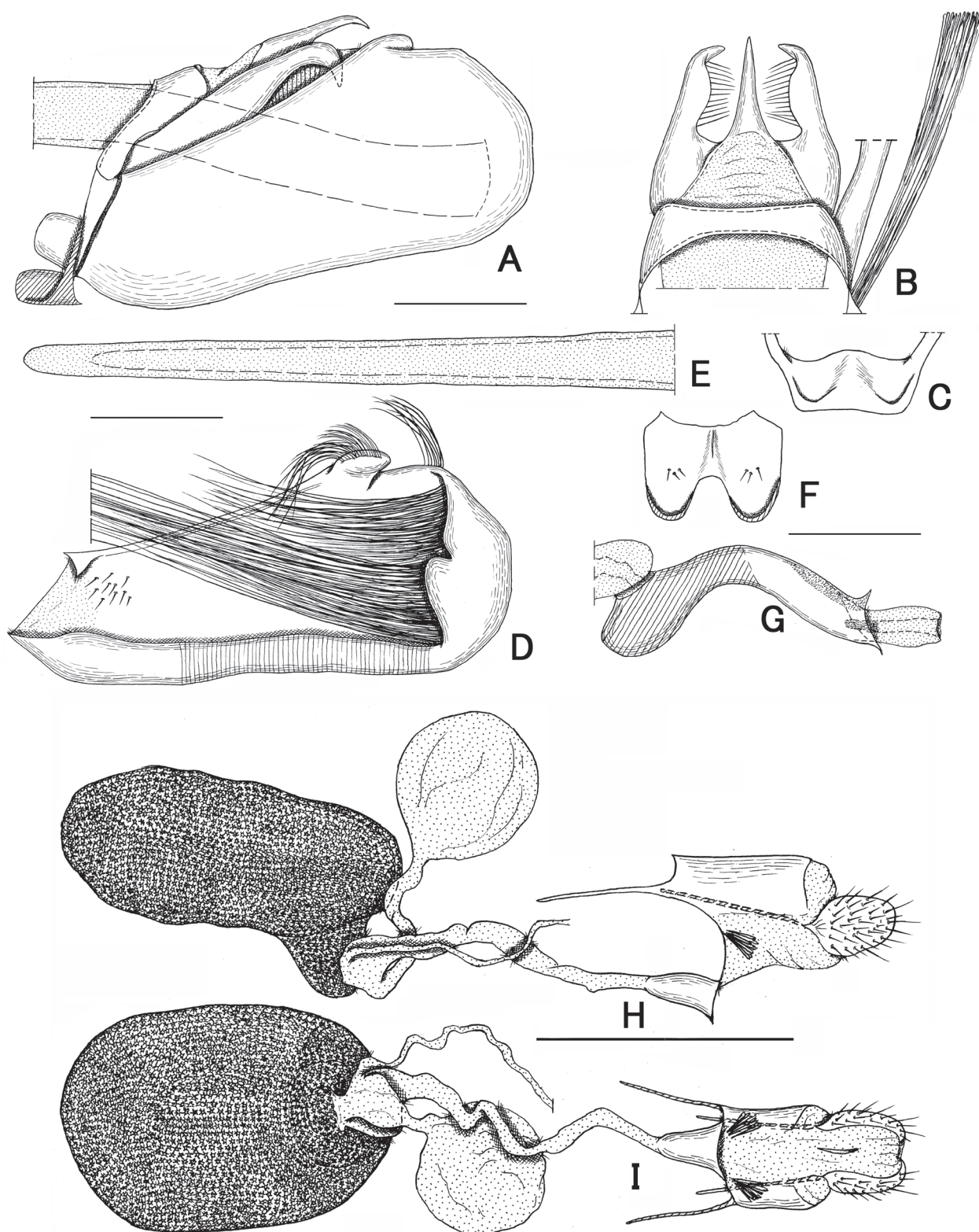


Fig. 86. Genitalia, *Sauris chlorosterna* Hashimoto (A–G ♂; H–I, ♀). A, lateral; B, tegumen and uncus, dorsal; C, saccus, dorsal; D, right valve, inner; E, diaphragmal pouch, lateral; F, juxta, ventral; G, phallus, lateral; H, lateral; I, ventral. Scales = 0.5 mm (A–G), 1.0 mm (H–I).

Drypetes integerrima (Koidzumi) Hosokawa (Putranjivaceae; Ohbayashi, 2015), *Cinnamomum* sp. (Lauraceae; Ohbayashi, 2015), *Machilus boninensis* Koidzumi (Lauraceae; Hashimoto, 2019); *Cinamomum yabunikkei* H. Ohba (Lauraceae; Hashimoto, 2019).

Immature stages. Last instar larva (Fig. 16I) about 20 mm in length; head yellowish green to dull yellowish green, rounded, wider than long; body glossy yellowish green or glossy lemon yellow to reddish brown; almost smooth (extremely finely roughened); trachea well distinct through integument;

abdominal setae pale yellowish brown, minute; crochets 11–12 in number on ventral proleg, 18–19 on anal proleg. Chaetotaxy: see the generic description. Pupa slender, 9.5–11 mm in length, 2.0–2.2 mm in width; cuticle thin, transparent, yellowish green or pale reddish brown tinged with blueish green except for blueish green forewing, finely fuscous around each setal base; labial palpus very small; forewing reaching posterior margin of 4th abdominal segment; proboscis reaching near apical margin of forewing; antenna and midleg reaching near apical margin of forewing; foreleg reaching near apical margin of proboscis; hind tarsus exposed.

Bionomics. See the generic description and Hashimoto (2019).

***Sauris hirudinata* Guenée**
(Figs. 76H–K, 80A–B, 81E, 87)

Sauris hirudinata Guenée, 1857: 362.

Remodes abortivata Guenée, 1857: 364.

Remodes lobata Warren, 1895: 107.

Steirophora angustifasciata: Inoue, 1976: fig. 19, partim (nec Inoue, 1976).

Sauris angustifasciata: Nakajima & Yazaki, 2011: fig. 1–053–45 (nec Inoue, 1976).

Diagnosis. Forewing length 13–17 mm in male, 13–17 mm in female; labial palpus about 3.0 times as long as eye diameter in both sexes; male hind tibia reduced, thick, covered with greyish green scales on outer surface, with glossy yellowish brown hairy scales on inner apex and glossy straw yellow hairy scales on outer apex; male hind tarsus reduced, thick, with glossy straw yellow hairy scales on proximal outer surface; male abdominal sternum II pouch vestigial; male sternum II slightly swelling; anterior margin of male sternum III sclerotized, deeply incurved as a semicircle; each of male abdominal sterna II, IV, VI, and VII with a pair of brushes, and sternum V with a pair of scale tufts, but those on V to VII easily lost; male and female genitalia shown in Fig. 87. Distinction among the Japanese *Sauris* species is treated in the key.

Specimens examined. Type materials: Holotype of *Sauris hirudinata*, ♀, Ceylon (Sri Lanka) (NHM); holotype of *Remodes abortivata*, ♂, Borneo (NHM); holotype of *Remodes lobata*, ♂, Peninsular Malaysia: Padang (NHM). Other materials (Adults): Ceylon (Sri Lanka): Punduloya, 1 ♀ (NHM: genitalia slide 6467 identified as *S. remodesaria*), v. 1997; Borneo: Bulunei, Ulu Tembrong, 1 ♂ (NHM: a figured specimen in Moths of Borneo Part 10; genitalia slide 19104), x. 1978; S. E. Borneo, Doherty, 1 ♀ (a figured specimen in Moths of Borneo Part 10), v. 1991; JAPAN: Ryukyus: Okinawa Is., Yona, 2 ♂, 2 ♀, emerged 21. x. – 2. xi. 2007 (S. Tominaga); Okinawa Is., Oppa-dake, 1 ♀, emerged 25. 1. 2001 (S. Tominaga); same locality, 1 ♀, emerged 27. v. 2003 (S. Tominaga); Okinawa Is., Kanna-dam, 1 ♂, emerged 22. v. 2004 (S. Tominaga); same locality, 1 ♀, emerged 25. vi. 2005 (S. Tominaga); same locality, emerged 23. iv. 2007 (S. Tominaga); same locality, 1 ♀, emerged 23. v. 2007 (S. Tominaga); same locality, 1 ♂, emerged 25. v. 2007 (S. Tominaga); same locality, 2 ♂, 2 ♀, emerged 3–7. vi. 2007 (S. Tominaga); same locality, 1 ♂, emerged 21. vi. 2007 (S.

Tominaga); Okinawa Is., Yaka, 1 ♂, 28. v. 2007 (S. Tominaga); same locality, 1 ♀, emerged 10. vi. 2007 (S. Tominaga); same locality, 1 ♀, emerged 12. vi. 2007 (S. Tominaga); same locality, 1 ♂, emerged 5. vii. 2007 (S. Tominaga); same locality, 1 ♀, emerged 31. vii. 2007 (S. Tominaga); Okinawa Is., Kurashiki-dam, 1 ♂, emerged 22. v. 2007 (S. Tominaga); Okinawa Is., Kochinda, 3 ♂, 1 ♀, emerged 6–9. vi. 2000 (S. Tominaga); same locality, 2 ♂, 4 ♀, 23–25. vi. 2000 (S. Tominaga); same locality, 1 ♂, 2 ♀, emerged 3–5. vii. 2000 (S. Tominaga); same locality, 1 ♂, emerged 21. vii. 2000 (S. Tominaga); same locality, 4 ♂, 1 ♀, emerged 28–29. vii. 2000 (S. Tominaga); same locality, 1 ♀, emerged 3. v. 2007 (S. Tominaga); Okinawa Is., Yaese-koen, 3 ♂, 1 ♀, emerged 17–19. xi. 2007 (S. Tominaga); Loochoo, 1 ♂, 1 ♀, (NHM: labeled with a manuscript name *Sauris trifasciaria*, 1886 (H. Pryer).

Distribution. Japan (Amami-oshima Is., Okinawa Is., Ishigakijima Is., and Iriomotejima Is.), Sri Lanka, India, Peninsular Malaysia, Borneo, China, and Taiwan.

Host plants. *Alseodaphne* sp. (Lauraceae; Holloway, 1997); *Lagerstroemia* sp. (Lythraceae; Holloway, 1997); *Acer oblongum* Wallich ex de Candolle (Sapindaceae; Tominaga, 2003); *Distylium racemosum* Siebold et Zuccarini (Hamamelidaceae; Tominaga, 2003); *Cinnamomum doederleinii* Engler (Lauraceae; Tominaga, unpublished data); *C. yabunikkei* H. Ohba (Lauraceae; Hashimoto, 2019); *Machilus thunbergii* Siebold et Zuccarini (Lauraceae; Tominaga, 2003); *Ligustrum japonicum* Thunberg (Oleaceae; Tominaga, 2003); *Prunus zippeliana* Miquel (Rosaceae; Tominaga, 2003); *Rhaphiolepis indica* (Linnaeus) Lindley ex Ker var. *umbellata* (Thunberg) H. Ohashi (Rosaceae; Hashimoto, 2019); *Schima liukiuensis* Nakai (Theaceae; Tominaga, 2003); *Morella rubra* Siebold et Zuccarini (Myricaceae; Hashimoto, 2019); *Syzygium jambos* (Linnaeus) Alston (Myrtaceae; Hashimoto, 2019).

Immature stages. Last instar larva very slender, 23–26 mm in length; head greenish yellow or reddish yellow, rounded, wider than long, almost smooth (very finely granulate); labral emargination about 0.25 deep; mandible with 6 teeth, of which inner one is dull, serrate; body glossy yellowish green or reddish orange, almost smooth (extremely finely roughened); abdominal setae pale yellowish brown, transparent, extremely minute except for those of anal shield and anal proleg; crochets 11–12 in number on ventral proleg, 18–20 on anal proleg; paraproct orange, distinct, long. Chaetotaxy: see the generic description. Pupa slender, 10.0–12.5 mm in length, 2.0–2.7 mm in width; cuticle thin, transparent, greenish yellow to yellowish green, finely fuscous around each setal base; labial palpus very small; forewing reaching just before apical margin of 4th abdominal segment; proboscis reaching near apical margin of forewing; antenna, fore- and midlegs reaching near apical margin of forewing; hind tarsus exposed or not.

Bionomics. See the generic description, Hashimoto (2019), and Holloway (1997).

***Sauris interruptata* (Moore)**
(Figs. 9F, 18D–F, 80C–D, 81F, 88)

Remodes interruptata Moore, 1888: 270.

Remodes cinerosa Warren, 1894: 397.

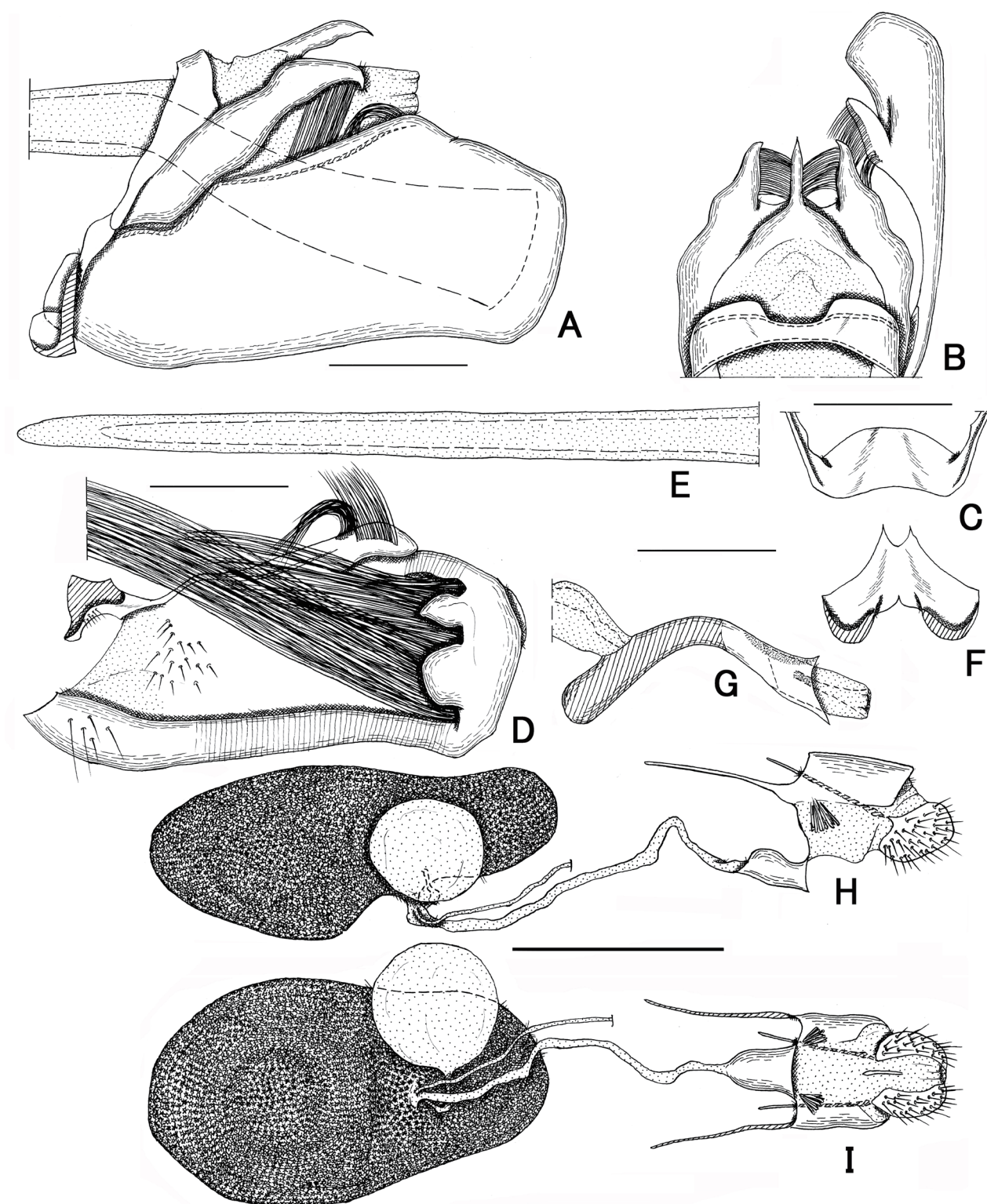


Fig. 87. Genitalia, *Sauris hirudinata* Guenée (A–G ♂; H–I, ♀). A, lateral; B, tegumen and uncus, dorsal; C, saccus, dorsal; D, right valve, inner; E, diaphragmal pouch, lateral; F, juxta, ventral; G, phallus, lateral; H, lateral; I, ventral. Scales = 0.5 mm (A–G), 1.0 mm (H–I).

Sauris mirabilis Hampson, 1895: 411.

Sauris interruptata: Inoue, 1964b: 541.

Sauris interruptaria: Inoue, 1977: 254; Inoue, 1982b: 470 (an incorrect subsequent spelling).

Diagnosis. Forewing length 15–18 mm in male, 16–18 mm in female; labial palpus about 3.0 times as long as eye

diameter in both sexes; male abdominal sternum II pouch vestigial; mid tibia with glossy yellowish brown hairy scales; hind tibia reduced, rather thick, with fuscous hairy scales on outer apex; hind tarsus thick; male abdominal sternum II with a pair of digitiform protrusion; anterior margin of male sternum III sclerotized, deeply incurved as a semicircle; each of male abdominal sterna II, IV, and VII with a pair of brushes

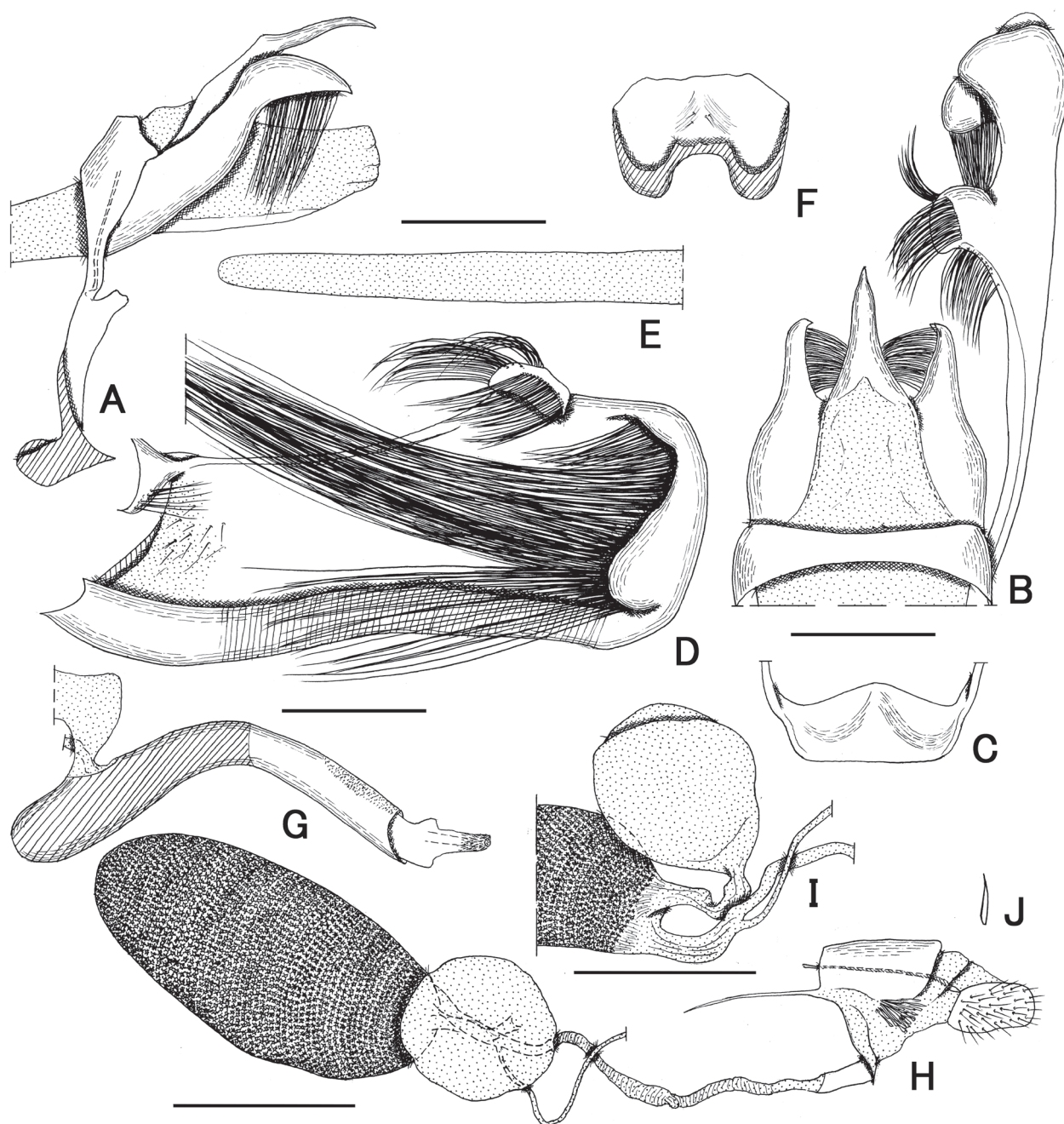


Fig. 88. Genitalia, *Sauris interruptata* (Moore) (A–G ♂; H–J, ♀). A, lateral; B, tegumen and uncus, dorsal; C, saccus, dorsal; D, right valve, inner; E, diaphragmal pouch, lateral; F, juxta, ventral; G, phallus, lateral; H, lateral; I, appendix bursae, ventral; J, narrow sclerite (sternite IX). Scales = 0.5 mm (A–G), 1.0 mm (H–J).

scale tufts, and each of V to VII easily lost, those of VII well developed; male and female genitalia shown in Fig. 88. Distinction among the Japanese *Sauris* species is treated in the key.

Specimens examined. JAPAN: Ryukyus: Amami-oshima Is., Nase, 1♂ (HIC: Genitalia slide 5965; No. 981), 20. xi. 1962 (M. Sakae); Okinawa Is., Yona, 1♀, 14. iv. 1981 (S. Hashimoto); Okinawa Is., Oppa-dake, 1♂, emerged 5. vi. 2003 (S. Tominaga); Okinawa Is., Kanna-dam, 1♀, emerged 1. iv. 2006 (S. Tominaga); Okinawa Is., Yaka, 1♂, emerged 12. vi. 2007 (S. Tominaga).

Distribution. Japan (Kyushu, Yakushima Is., Amami-oshima Is., Tokunoshima Is., and Okinawa Is.), Sri Lanka, India, Myanmar, Peninsular Malaysia, Philippines, Borneo, New Guinea, and Taiwan.

Host plants. *Elaeocarpus sylvestris* (Loureiro) Poiret var. *ellipticus* H. Hara (Elaeocarpaceae; Tominaga, 2003); *Machilus thunbergii* Siebold et Zuccarini (Lauraceae; Tominaga, 2003); *Schima liukuensis* Nakai (Theaceae; Tominaga, 2003).

Immature stages. Last instar larva very similar to that of *S. hirudinata*, more than 27 mm in length (Tominaga, 2003), otherwise not indistinguishable in appearance. Chaetotaxy not

examined. Pupa (Fig. 18D–F) slender, 13.5 mm in length, 3.0 mm in width, greenish yellow tinged with white, finely fuscous around each spiracle and each setal base, scattered with many fine fuscous concaves on abdomen, pale reddish brown on 9th abdominal segment; labial palpus exposed, very small; forewing reaching posterior margin of 4th abdominal segment; proboscis reaching before apical margin of forewing; antenna and midleg reaching apical margin of forewing; foreleg reaching before tip of proboscis; hind tarsus exposed, small.

Bionomics. Almost unknown except for the larval host plant.

***Sauris purpureotincta* Galsworthy**
(Figs. 80E–F, 81G, 89)

Sauris purpureotincta Galsworthy, 1999: 35, figs. 1, 2, 5.

Diagnosis. Forewing length 13–14 mm in male, 14–15 mm in female; labial palpus about 2.0 times as long as eye diameter in male, about 3.0 times in female; male hind tibia gradually thick towards apex, with a small pale grey scale tuft on inner apex; male hind tarsus reduced, thick; male abdominal sternum II pouch vestigial; anterior margin of male A3 sclerotized, shallowly incurved as a semicircle; each of male abdominal sterna II, IV, and VII with a pair of brushes, especially well developed on VII, and each of V and VI with a pair of scale tufts respectively, but those on V to VII easily lost; male and female genitalia as in Fig. 89. Distinction among the Japanese *Sauris* species is treated in the key.

Specimens examined. JAPAN: Ryukyu: Ishigakijima Is., Yonehara, 1♂, 1♀, emerged 25–26. x. 2007 (S. Tominaga);

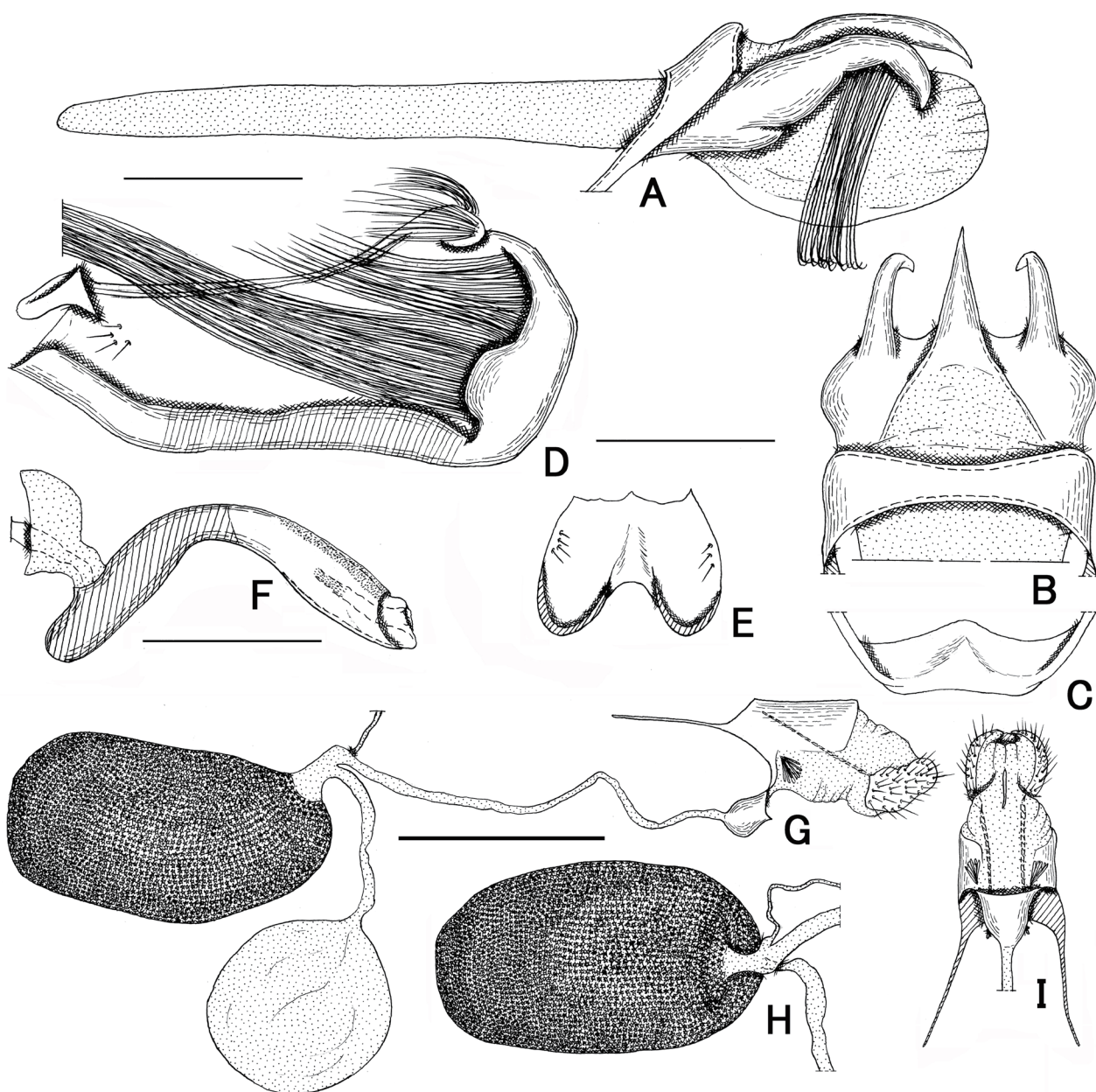


Fig. 89. Genitalia, *Sauris purpureotincta* Galsworthy (A–F ♂; G–I, ♀). A, lateral; B, tegumen and uncus, dorsal; C, saccus, dorsal; D, right valve, inner; E, juxta, ventral; F, phallus, lateral; G, lateral; H, corpus bursae, dorsal; I, postabdomen, ventral. Scales = 0.5 mm (A–F), 1.0 mm (G–I).

same locality, 2♂, 2♀, emerged 1–2. xi. 2007 (S. Tominaga); same locality, 1♀, emerged 4. xi. 2007 (S. Tominaga); same locality, 1♀, emerged 11. xi. 2007 (S. Tominaga)

Distribution. Japan (Ishigakijima Is.) and China (Hong Kong).

Host plants. *Zanthoxylum ailanthoides* Siebold et Zuccarini (Rutaceae; Hashimoto, 2019).

Immature stages. Last instar larva very slender, 22–24 mm in length; head greenish yellow, wider than long; body glossy deep green, almost smooth (extremely finely roughened); abdominal setae transparent, extremely minute except for those of anal shield and anal proleg; crochets 10–11 in number on ventral proleg, 18–19 on anal proleg; paraproct distinct, long. Chaetotaxy: see the generic description. Pupa slender, 11.0–12.0 mm in length, 2.5–2.8 mm in width; cuticle thin, transparent, yellowish green, finely fuscous around each setal base; labial palpus very small; forewing reaching just before posterior margin of 4th abdominal segment; proboscis reaching near apical margin of forewing; antenna, fore- and midlegs reaching apical margin of forewing; hind tarsus exposed.

Bionomics. See the generic description and Hashimoto (2019).

6.3. Tribe Heterophlebini nov.

Type genus: *Heterophleps* Herrich-Schäffer, [1854] 1850–1858: wrapper, pl. 41, fig. 202.

Etymology. The tribe Heterophlebini is named after the genus *Heterophleps* (heteros ἕτερος (= of another kind, different) + phleps φλεψ, φλεβος (= vein)). A genitive singular of “phleps” is “phlebos” and its classical compound is “phleb-” or “phlebo-”.

Diagnosis. Heterophlebini are characterized by a series of the internal triangular sclerites on the bursa copulatrix (Figs. 95G, 97B, D–E, 98N), which occasionally become the internal long ridges (Figs. 97A, 98K); this character is probably autapomorphic in this tribe (see the phylogenetic relationships of the Japanese trichopterygine genera (Fig. 3)), but frequently lacks secondarily in the species level (Holloway, 1997; Xue & Zhu, 1999; Li *et al.*, 2012). The following characters also characterize the Heterophlebini, but all of them are homoplastic (Fig. 3): 1, male metameron arched posteriorly (Fig. 92A); 2, male hind tibia with a hair-pencil (Fig. 92B); 3, forewing apex pointed (Fig. 90A–B, D); 4, male abdominal sternum II pouch present (Fig. 92A).

Remarks. It is possible that this tribe is a primitive lineage (Fig. 2) in the subfamily Larentiinae and may be more related to the tribe Dyspteridini than to the Trichopterygini, because the hindwing venation (Figs. 93B–C, E–F, 94B–E) in both sexes is common with the Dyspteridini (Forbes, 1948: figs. 148–149), which is regarded as a primitive taxon in the Larentiinae by the molecular phylogeny (Strutzenberger *et al.*, 2010; Sihvonen *et al.*, 2011; Öunap *et al.*, 2016). Regrettably, the heterophlebini genera had been not analyzed in the molecular phylogeny (Yamamoto & Sota, 2007; Strutzenberger *et al.*, 2010; Sihvonen *et al.* 2011; Öunap *et al.*, 2016).

The tribe Heterophlebini is composed of the following Oriental genera: *Carige* Walker, *Chrioloba* Prout, *Cryptoloba*

Warren, *Emmesomia* Warren, *Goniopteroloba* Hampson, *Heterophleps* Herrich-Schäffer, *Isoloba* Warren, *Lobogonia* Warren, *Naxidia* Hampson, *Palaeomystis* Warren, *Syzeuxis* Hampson, and *Tamurhydreli* Inoue.

The genus *Tamurhydreli* was originally described by Inoue (1987) as a close genus of *Hydreli* Hübner. In the geometrid moths of the world (Parsons *et al.*, 1999), this genus is treated as position unclear. The present study included this genus into the Heterophlebini by the genital structures (Inoue, 1987: fig. 62).

The genus *Palaeomystis* has been classified into the tribe Chesiadini by similarity of the hindwing shape and wing pattern with the genus *Schistostege* Hübner (Xue & Zhu, 1999; Öunap *et al.*, 2016), but *Palaeomystis* clearly belongs to the Heterophlebini in the following points: the hindwing venation (Sc separate from discal cell and connected by a short vein of R at middle of discal cell: Fig. 93F; fig. 71c in Xue & Zhu, 1999) and the female genital structure (corpus bursae with a series of the internal triangular sclerites circularly (Fig. 97F); Xue & Zhu, 1999: fig. 73). In addition, *Palaeomystis* lacks an apical tooth of the foretibia, which is a synapomorphy of the tribe Chesiadini (Hausmann & Viidalepp, 2012). This result was also supported by the phylogenetic analysis (Figs. 2–3).

The genus *Heterophleps* has been classified into four subgenera (Forbes, 1917; Xue & Zhu, 1999) mainly by the male secondary sexual characters (male antennal and hindwing structures), but it should probably be better to reexamine the subgeneric division because of diversity of the male hindwing venation (Fig. 94B, D–E) and the female genital structures (Fig. 97A–B, D). Although the Japanese species have been not classified into these subgenera (Inoue, 1982b; Nakajima & Yazaki, 2011), the present study tentatively divides them into three groups for the phylogenetic analysis by the female genital structure (Fig. 97A–B, D): group A consists of *H. confusa* (Wileman), group B consists of *H. fusca* (Butler) and group C consists of *H. pallescens* (Warren). However, *Heterophleps endoi* Inoue could not be classified into any groups because of no information on the female characters.

The genus *Naxidia* was divided into two subgenera, *Naxidia* and *Binareolaria*, by Wehrli (1931) based on the forewing areoles (one areole in *Naxidia*; two areoles in *Binareolaria*). Xue & Zhu (1999) indicated that in *Binareolaria* the number of areoles is usually two, but frequently one or different even in the both wings of the same individual, and added the semidisc-like labides as a characteristic of *Binareolaria*. However, these two characteristics are probably plesiomorphous or homoplastic apomorphous in the genus *Naxidia*. Therefore, it would be better to treat the subgenus *Binareolaria* as a synonym of *Naxidia*. Compared with other *Naxidia* species, two Japanese representatives are rather heterogeneous in the forewing pattern and the genital structures. For the purpose of the phylogenetic analysis, the *Naxidia* species are treated as two groups in this study: group A consists of two Japanese species and group B consists of other *Naxidia* species.

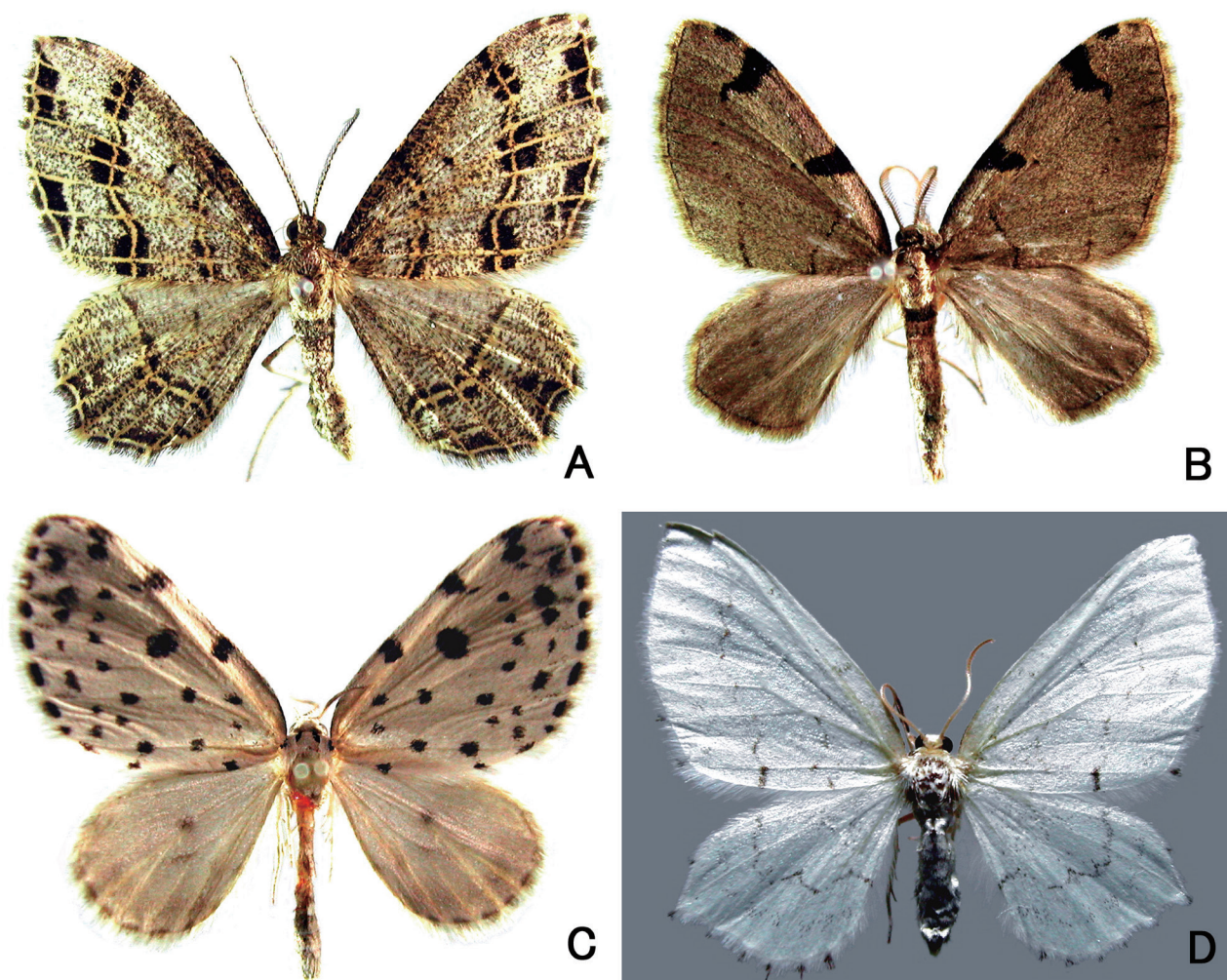


Fig. 90. Adults. A, *Carige scutimbata* Prout, ♀; B, *Heterophleps fusca fusca* (Butler), ♂; C, *Naxidia maculata* (Butler), ♂; D, *Palaeomystis mabillaria* (Poujade), ♀.

General morphology

The tribal description is based on four Japanese genera and the following studies: Hashimoto, 1986, 1991a; Holloway, 1997; Xue & Zhu, 1999; LI *et al.*, 2012.

Adult

Head (Fig. 91): Antenna usually laminate, fasciculate, or bipectinate in male, filiform, but rarely bipectinate in female; labial palpus 3-segmented, porrect or slightly ascending, short to medium (about 1.0 to 2.0 times as long as a diameter of compound eye).

Thorax (Figs. 90, 92A–B, 93–94): Spur formula 0–2–4; male hind tibia generally with a hair-pencil; male metameron with an arched expansion; forewing pattern simple, mainly consisting of antemedial, postmedial, subterminal lines or spots and discal spot; forewing with usually one or two areoles, rarely areole absent, M1 arising from areole or from discocellular vein; hindwing pattern more simple than forewing pattern, with only discal spot or with discal spot and postmedial line; hindwing with usually an anal fold or a narrow anal fold along inner margin in male, Sc separate from discal cell and connected by a short vein of R before or near middle of discal cell, Rs and M1 separate or stalked, M3 and CuA1 separate or short stalked,

CuA1 and CuA2 also relatively long in male as in those of female, 1A + 2A shorter in male, when the anal fold is present, a very short 1A + 2A is running in the anal fold.

Pregenital abdomen (Fig. 92A, C–D): male sternum II with a central pouch, but antero-lateral sides of sternum II not dorsally protruded, but with a triangular small flap expanding laterally in *Heterophleps fusca*.

Male genitalia (Figs. 95A–F, 96, 98A–J): Tegumen rarely bilobed; uncus variable in shape and length; socius generally reduced, recognized as a hairy part; both gnathii extending antero-ventrally and fused with each other medio-ventrally or close each other medio-ventrally; saccus not protruded antero-dorsally; valve generally simple, rarely much modified in a few genera (Xue & Zhu, 1999); phallus rather thick, various in shape, with or without cornuti, completely fused with juxta in the genus *Carige*.

Male genital musculature (Table 2): Usually eight pairs of muscles present as in most tribes of Larentiinae (Varlersky, 2011), but in the genus *Carige* extensor (m4) of valve absent and flexor (m5) of valve originating from vinculum (generally from sacculus) and inserting to harpe.

Female genitalia (Figs. 95G–H, 97, 98K–N): Bursa copulatrix (either of corpus bursae or ductus bursae) usually

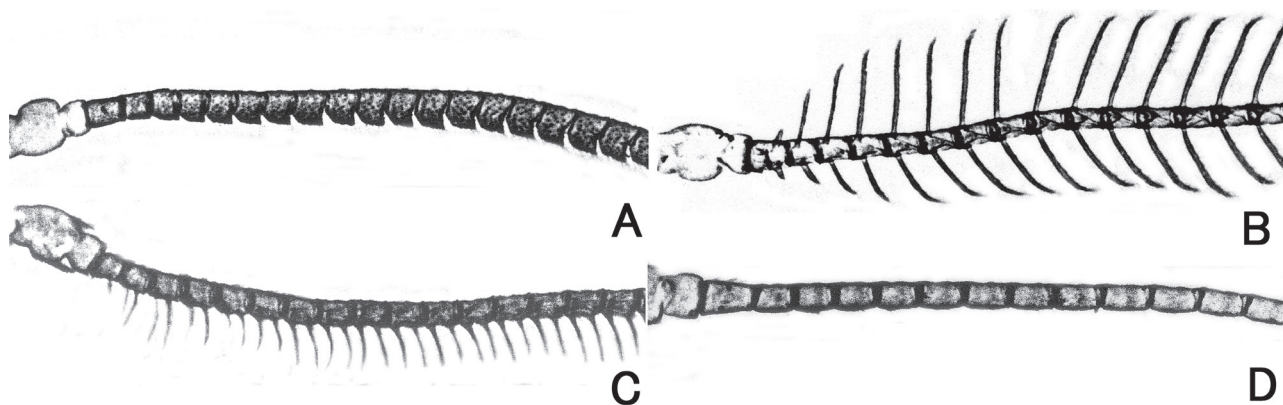


Fig. 91. Antennal flagellomeres. A, *Naxidia maculata* (Butler), ♂; B, *Heterophleps fusca fusca* (Butler), ♂; C, *Heterophleps confusa confusa* (Wileman), ♂; D, ditto, ♀.

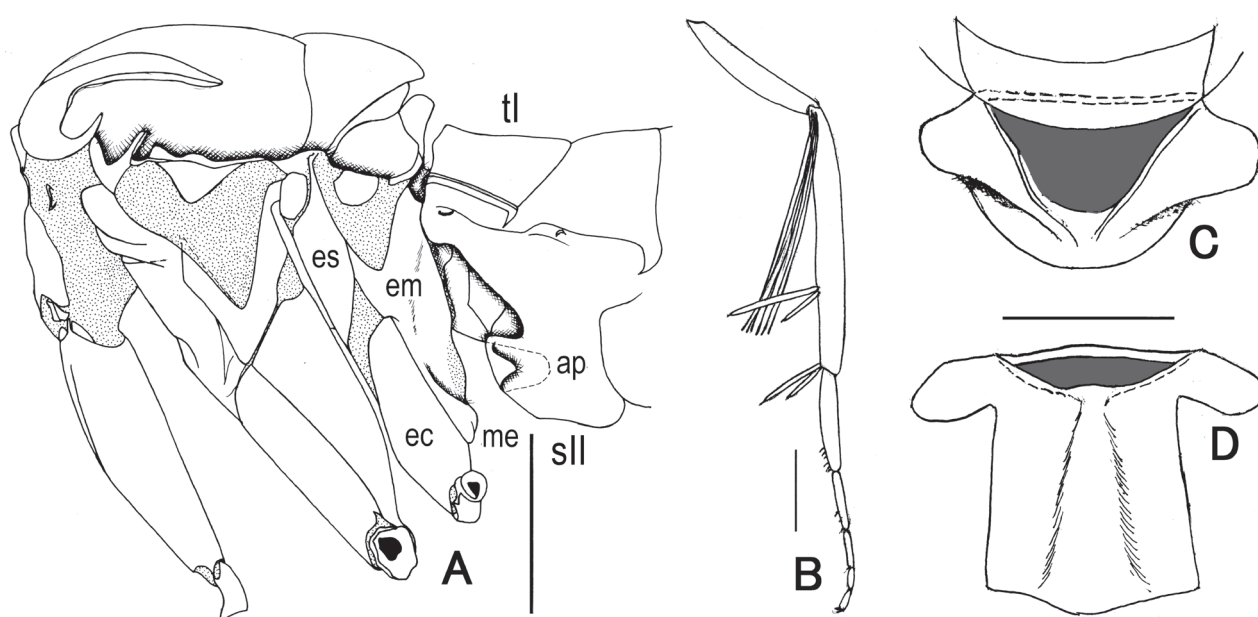


Fig. 92. Thorax and anterior abdomen, *Heterophleps fusca fusca* (Butler), ♂. A, lateral; B, hindleg; C, abdominal sternum II, anterior; D, ditto, ventral. ap, abdominal pouch; ec, eucoxa; em, epimeron; es, epsisternum; me, meron. Scales = 1.0 mm (A–B), 0.5 mm (C–D).

with a series of several invaginate triangular sclerites or invaginate sclerotized long ridges circularly; corpus bursae various in shape; ductus bursae rather long; ductus seminalis arising near ostium bursae; apophysis anterioris shorter than posterioris; ventral sclerite (sternite IX) present between papillae anales, variable in shape.

Immature stages

Little known; mature larvae and pupae of two Japanese species, *Carige scutimbata* Prout and *Heterophleps fusca fusca* (Butler), are described (Hashimoto, 1986, 1991a).

Last instar larva: Slender, first to 6th abdominal segments especially long; SV2 seta absent in *Heterophleps fusca fusca*; on anal shield D1 setae slightly posterior to a line drawn between SD2s; on anal proleg L1 seta posterior to a line drawn between L2 and L3 (this character may be apomorphic in the Heterophlebini).

Pupa: Labial palpus exposed; fore femur exposed; cremaster with four pairs of setae, of which terminal one is sclerotized,

pointed, and slightly curved, and the other three have a hooked tip (Hashimoto, 1986, 1991a).

Distribution

The members of the tribe Heterophlebini are mainly distributed in the tropical and subtropical zones of the Oriental region (Holloway, 1997; LI *et al.*, 2012). A few genera extend to the temperate zone of Russian Far East, Korea and Japan through the continental China, and only the genus *Heterophleps* reaches to the temperate zone of North America. The genus *Goniopteroloba* Hampson extends to the southern part of Asia and reaches to the Philippines and Sulawesi (Holloway, 1997).

Bionomics

Very little is known about the life cycle of the moths of Heterophlebini. About a few species of the genera *Carige* and *Heterophleps*, the larval host plants are known: *Carige cruciplaga* (Walker) utilizes *Artemisia indica* Willenow. var. *maximowochii* (Nakai) H. Hara (Asteraceae; Sato, 1976, 1987).

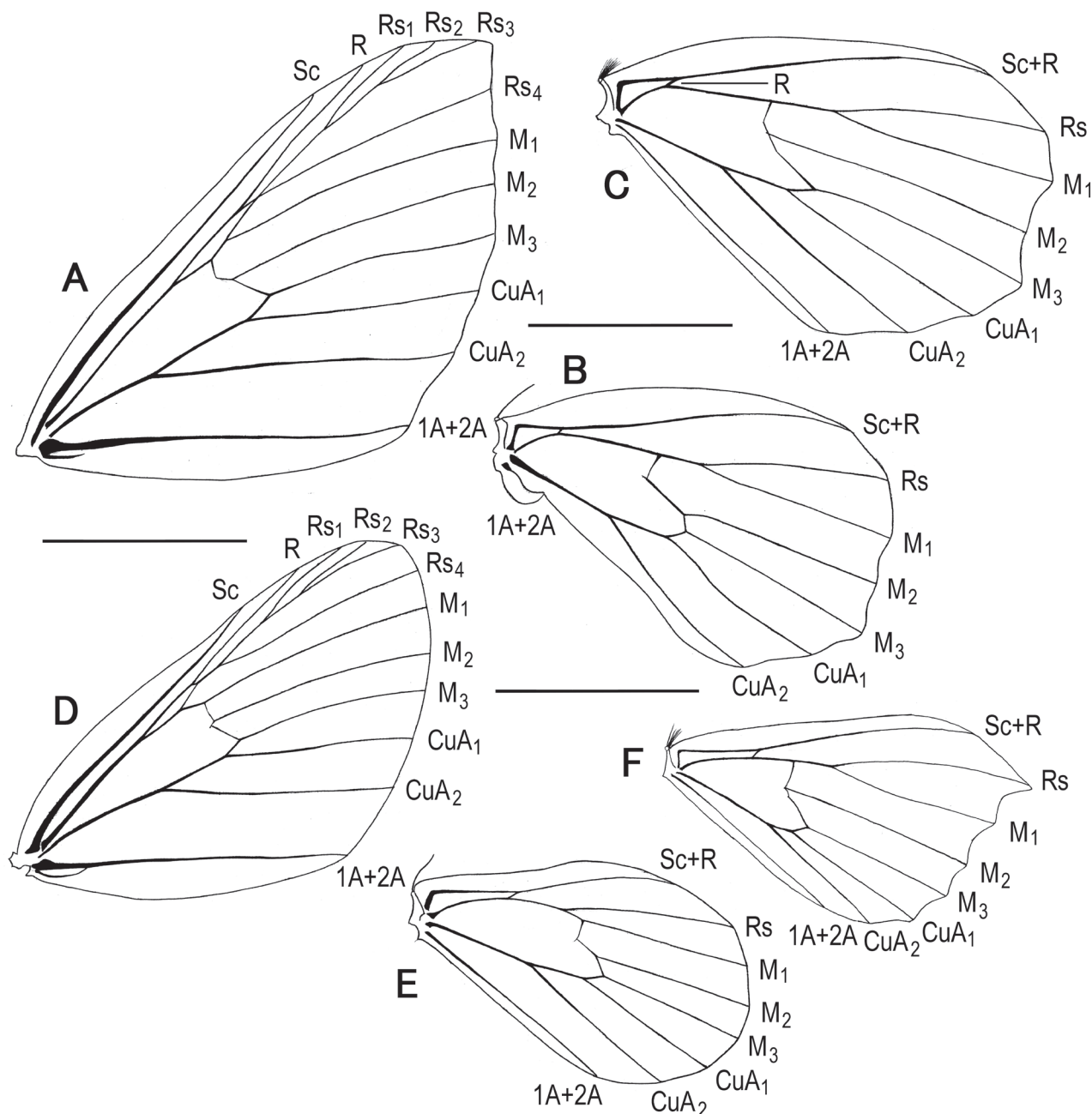


Fig. 93. Wing venation. A, *Carige scutimbata* Prout, ♂ (forewing); B, ditto, ♂ (hindwing); C, ditto, ♀ (hindwing); D, *Naxidia maculata* (Butler), ♂ (forewing); E, ditto, ♂ (hindwing); F, *Palaeomystis mabillaria* (Poujade), ♀ (hindwing). Scales = 5.0 mm.

as a host plant and *C. scutimbata* was reared by *A. indica* Wilenow var. *maximowochii* (Nakai) H. Hara (Hashimoto, 1991a); *Heterophleps fusca fusca* was reared by *Boehmeria spicata* Thunberg (Thunberg) (Urticaceae; Hashimoto, 1986) and *Heterophleps triguttaria* Herrich-Schäffer, North American species, feeds on *Acer* spp. (Sapindaceae; Forbes, 1948). The moths are nocturnal, generally attracted at a light trap and are one or two generations a year in the northern temperate zone.

List of Japanese Heterophlebiini

Genus *Carige* Walker

Carige Walker, [1863] 1862: 1631. Type species: *Carige duplicaria* Walker, 1862: 1632, by monotypy.
= *Epimacaria* Staudinger, 1897: 42. Type species:

Macaria nigronotaria Bremer, 1864: 80, pt.7, fig. 6, by monotypy. *Macaria nigronotaria* is a junior subjective synonym of *Carige cruciplaga duplicaria* Walker, 1862.

Carige cruciplaga (Walker, 1861): 937.

Carige cruciplaga cruciplaga (Walker, 1861): 937.

Carige irrorata (Butler, 1879): 440.

= *Carige absorpta* Warren, 1899b: 338.

Carige obsoleta (Inoue, 1971): 156, pl. 1: 12.

Carige scutimbata Prout, 1936: 94, pl. 9: g.

Genus *Heterophleps* Herrich-Schäffer

Heterophleps Herrich-Schäffer, [1854] 1850–1858: wrapper, pl. 41, fig. 202. Type species: *Heterophleps triguttaria* Herrich-Schäffer, [1854].

= *Lygranoa* Butler, 1878: 447. Type species: *Lygranoa fusca* Butler, 1878: 447, by original designation.

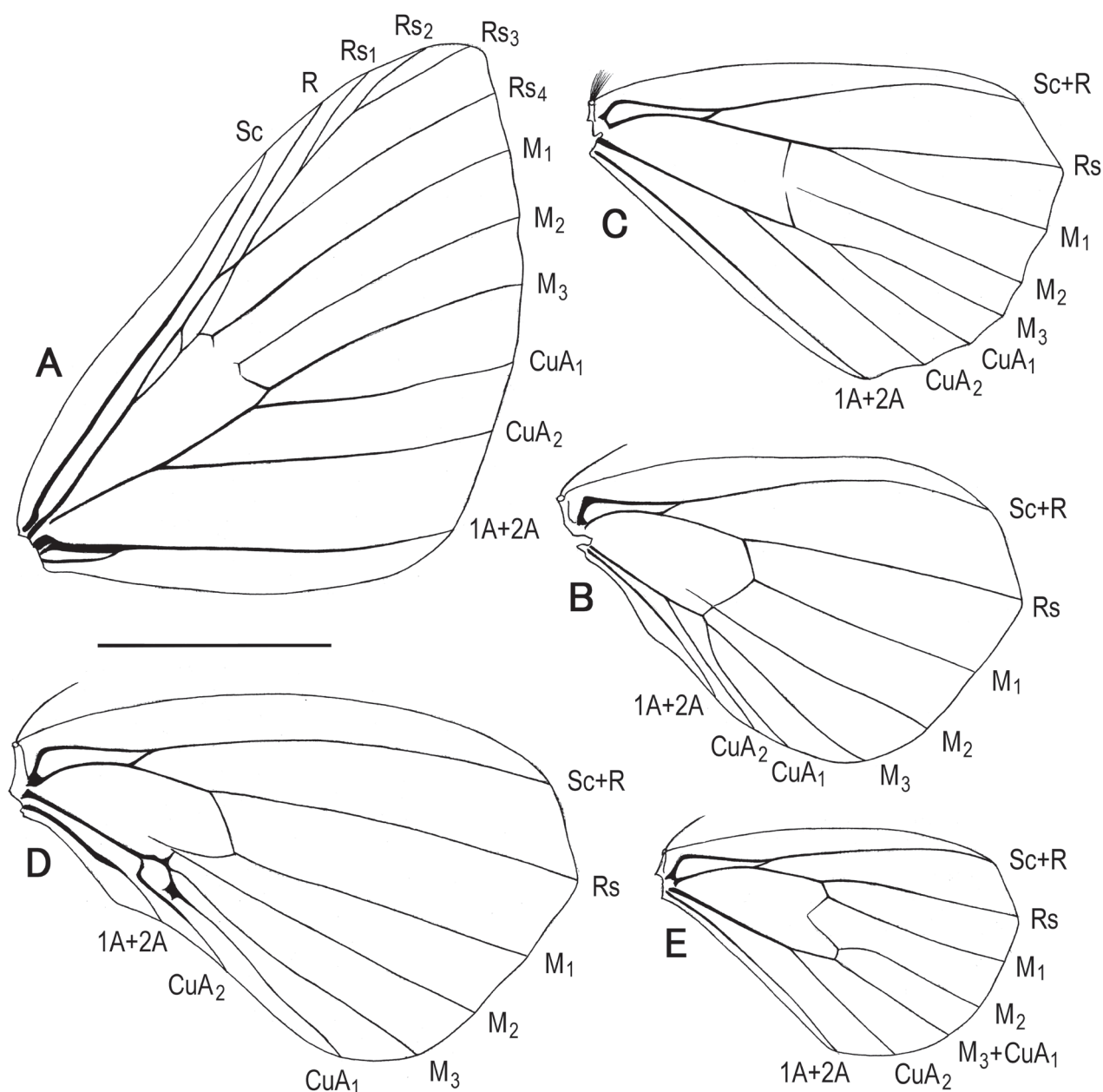


Fig. 94. Wing venation. A, *Heterophleps fusca fusca* (Butler), ♂ (forewing); B, ditto, ♂ (hindwing); C, ditto, ♀ (hindwing); D, *Heterophleps pallescens* (Warren), ♂ (hindwing); E, *Heterophleps confusa confusa* (Wileman), ♂ (hindwing). Scale = 5.0 mm.

= *Dysethia* Warren, 1893: 347. Type species: *Dysethia bicommatata* Warren, 1893: 348, pl. 32, fig. 1, by original designation.

= *Dysethiodes* Warren, 1895: 106. Type species: *Coremia ocyptaria* Swinhoe, 1893: 157, by original designation.

= *Nannia* Hulst, 1896: 256 (key), 262. Type species: *Macaria refusaria* Walker, 1861: 861, by original designation.

= *Ortholithoidia* Wehrli, 1932: 221, as a subgenus of *Heterophleps*. Type species: *Heterophleps euthygramma* Wehrli, 1932: 221, fig. 2, by original designation.

Heterophleps confusa (Wileman, 1911): 321, pl. 21: 8.

Heterophleps confusa confusa (Wileman, 1911): 321, pl. 21: 8.

Heterophleps endoi Inoue, 1982b, 1: 468, 2: 277, pl. 66: 39.

= *Heterophleps variegata*: Inoue, 1976: 13 (nec Wileman, 1911).

Heterophleps fusca (Butler, 1878): 447.

Heterophleps fusca fusca (Butler, 1878): 447.

Heterophleps fusca amamiensis Inoue, 1964a: 336, pl. 8: 1.

Heterophleps pallescens (Warren, 1896a): 118.

Genus *Naxidia* Hampson

Naxidia Hampson, 1895: 329 (key), 334. Type species: *Argidava punctata* Butler, 1880a: 128, by original designation.

= *Binareolaria* Wehrli, 1931: 20, as a subgenus of *Naxidia*. Type species: *Naxidia roseni* Wehrli, 1931: 19, by original designation.

Naxidia maculata (Butler, 1879): 373.

= *Naxidia nigrifrons* (Matsumura, 1930): 40.

Naxidia semiobscura Inoue, 1955a: 76, pl. 7: 18.

Genus *Palaeomystis* Warren

Palaeomystis Warren, 1894: 379. Type species: *Ourapteryx falcata* Moore, 1868: 613, by original designation.

Palaeomystis mabillaria (Poujade, 1895): 57.

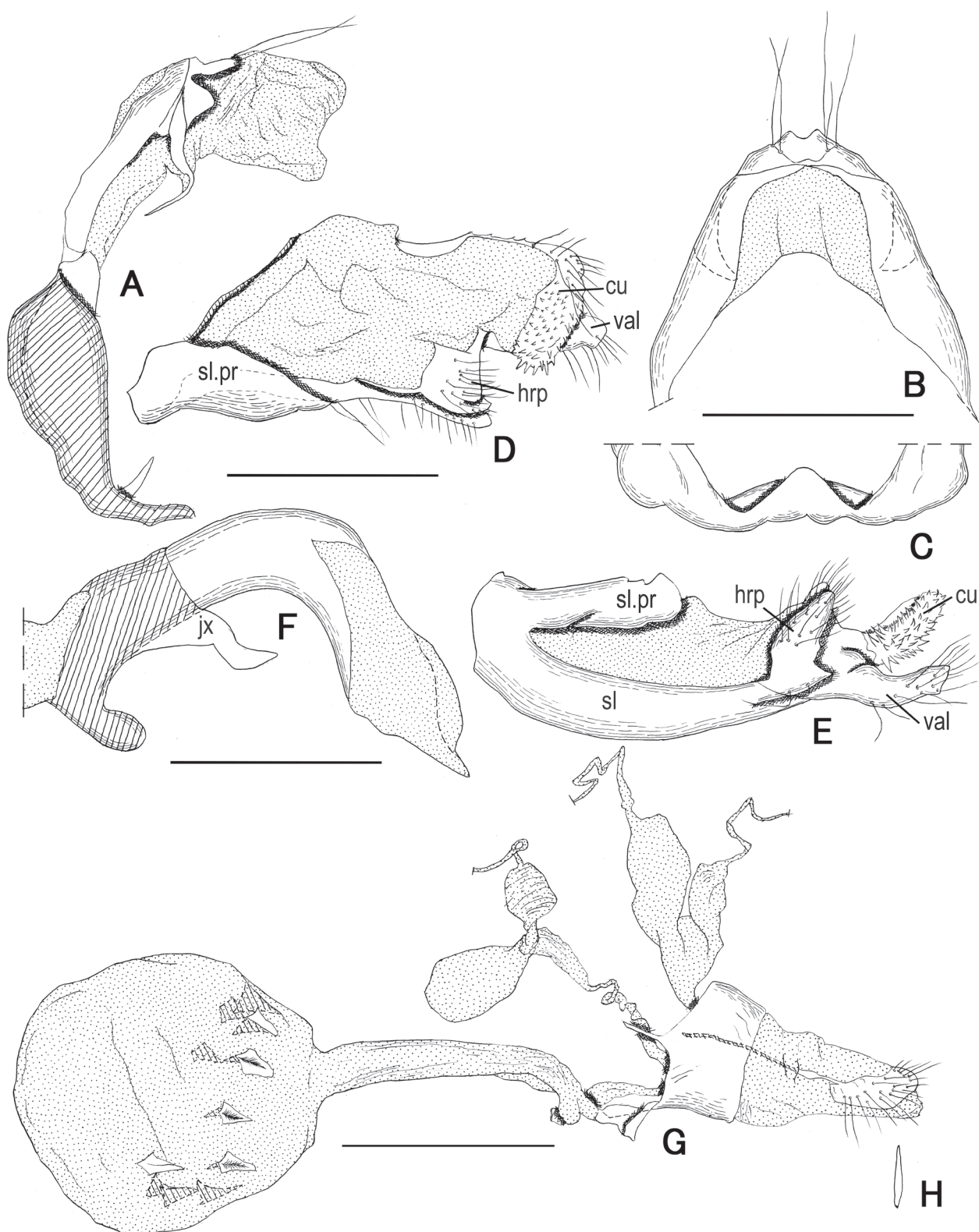


Fig. 95. Genitalia, *Carige cruciplaga cruciplaga* (Walker) (A–F ♂; G–H, ♀). A, lateral; B, tegumen and uncus, dorsal; C, saccus, dorsal; D, right valve, inner; E, ditto, ventral; F, phallus and juxta, lateral; G, lateral; H, narrow sclerite (sternite IX). cu, cucullus; hrp, harpe; jx, juxta; sl, sacculus; sl. pr, saccular process; val, valvula. Scales = 0.5 mm.

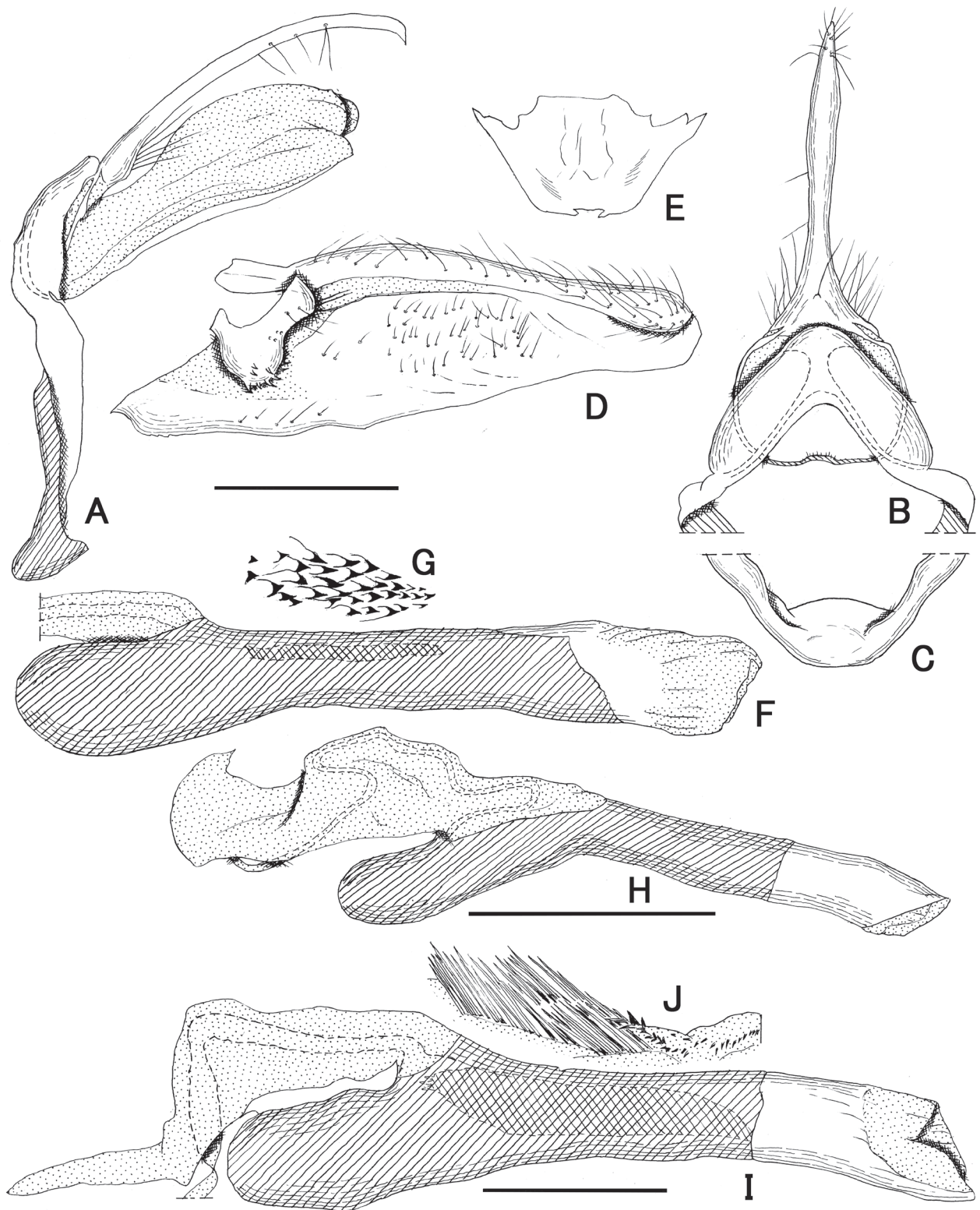


Fig. 96. Male genitalia, *Heterophleps fusca fusca* (Butler) (A–G), *Heterophleps confusa confusa* (Wileman) (H), *Heterophleps pallescens* (Warren) (I–J). A, lateral; B, tegumen and uncus, dorsal; C, saccus, dorsal; D, right valve, inner; E, juxta, ventral; F, H, I, phallus, lateral; G, J, cornuti. Scales = 0.5 mm.

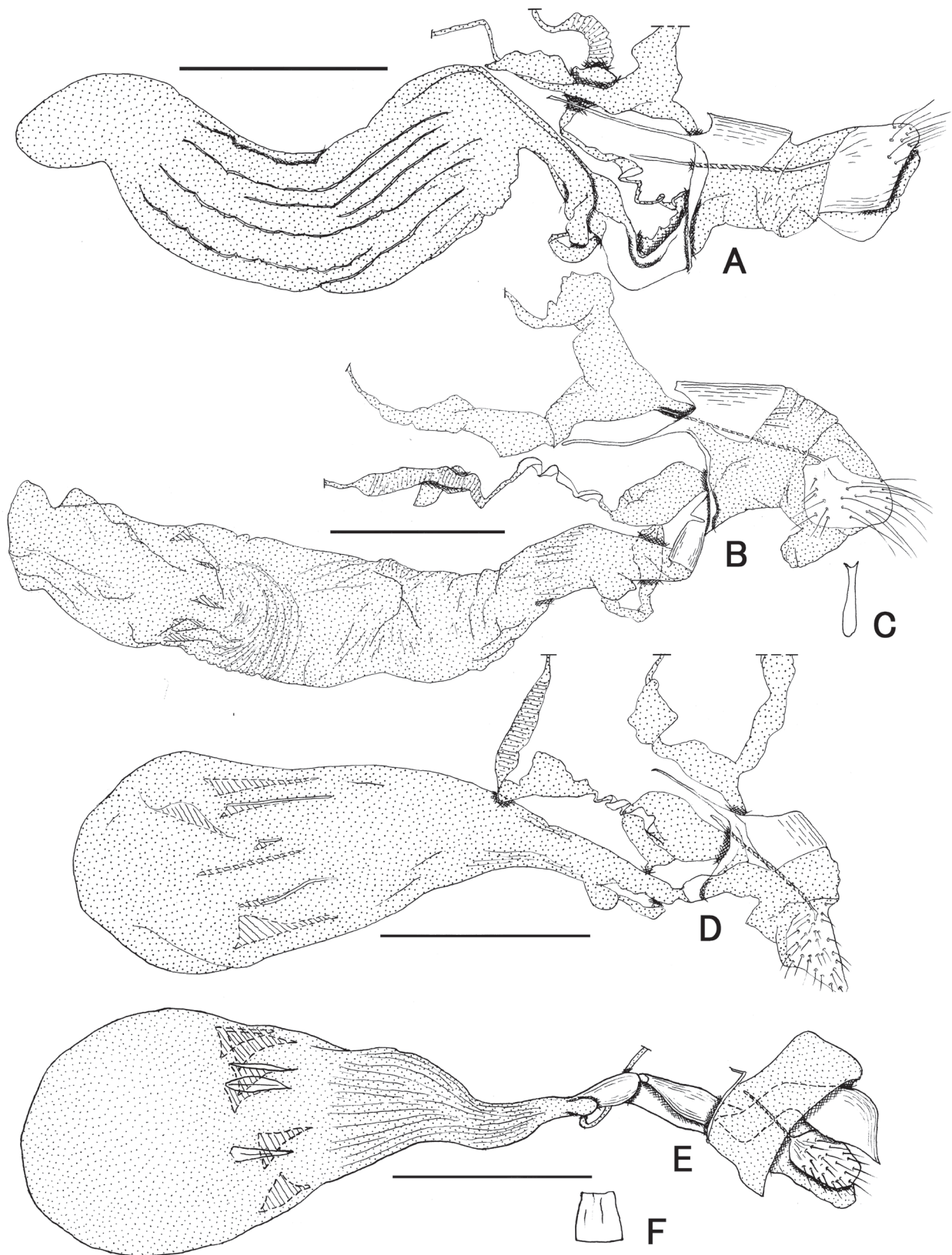


Fig. 97. Female genitalia, *Heterophleps fusca fusca* (Butler) (A), *Heterophleps pallescens* (Warren) (B–C), *Heterophleps confusa confusa* (Wileman) (D), *Palaeomystis mabillaria* (Poujade) (E–F). A, B, D–E, lateral; C, F, sclerite (sternite IX). Scales = 1.0 mm.

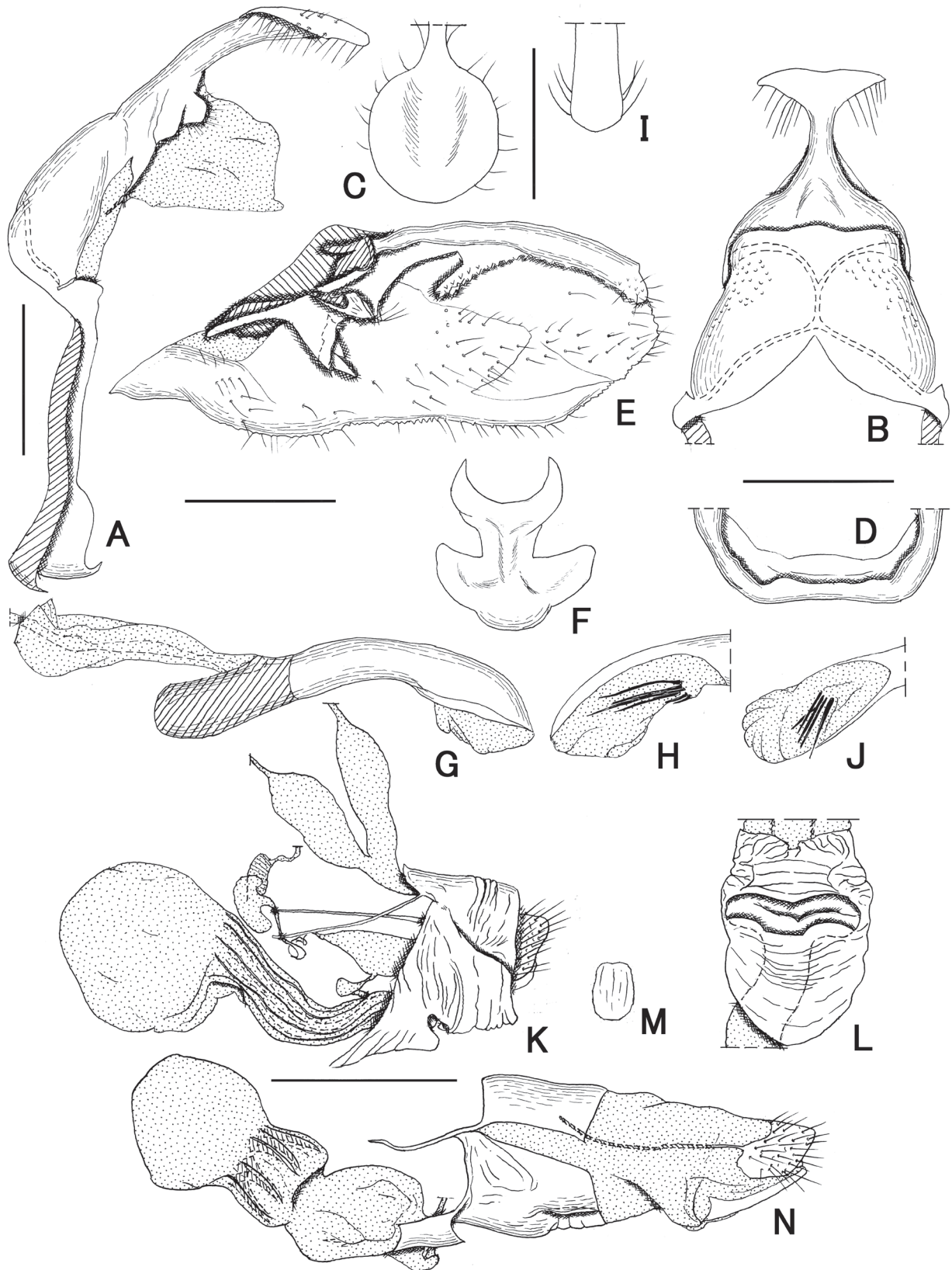


Fig. 98. Genitalia, *Naxidia maculata* (Butler) (A–H ♂; K–M ♀), *Naxidia semiobscura* Inoue (I–J ♂), *Naxidia punctata* (Butler) (N ♀), (Taiwan). A, lateral; B, tegumen and uncus, dorsal; C, I, apical part of uncus, caudal; D, saccus, dorsal; E, right valve, inner; F, juxta, ventral; G, phallus, lateral; H, J, cornuti; K, N, lateral; L, sternum VIII, ventral; M, sclerite (sternite IX). Scales = 0.5 mm (A–J), 1.0 mm (K–N).

6.4. Unresolved genera: their systematic position unclear

The following genera, *Brabira* (Fig. 101F), *Celonoptera*, *Leptostegna* (Fig. 101E), *Pseudeuchlora* Hampson, *Ptygmatothora*, *Teinoloba* Yazaki, and *Tyloptera* (Fig. 101G), have often been included into the tribe Trichopterygini sensu lato (Meyrick, 1892; Inoue, 1992; Holloway, 1997; Xue & Zhu, 1999; Viidalepp, 2011; Hausmann & Viidalepp, 2012; Li *et al.*, 2012). Most of them are phenetically similar to the simple pattern group sensu Holloway (1997) and Li *et al.* (2012), but the present study treats them the tribe incertae sedis due to lack of synapomorphies with both of Heterophlebini and the present Trichopterygini. The phylogenetic analysis (Figs. 2–3) resulted in that *Brabira* and *Tyloptera* constitute the sister groups, and two genera formed a sister group relationship with the genera *Chesias* and *Aplocera* of the tribe Chesiadini.

Viidalepp (2011) classified the European genus *Celonoptera* into the tribe Dyspteridini, but after then Hausmann & Viidalepp (2012) tentatively included this genus into the Trichopterygini sensu lato. Although the genus *Leptostegna* and the tribe Heterophlebini constituted the sister groups in the phylogenetic relationships (Figs. 2–3), most of the characters combining them are common with the genera *Celonoptera* and *Dyspteris*. *Celonoptera* and *Leptostegna* are similar to the genus *Dyspteris* in the wing pattern and colouration, the male and female hindwing venation on the costal area, and lack of the frenulum, but their genital structures are quite different from each other (Xue & Zhu, 1999; Viidalepp, 2011; Hausmann & Viidalepp, 2012; Öunap *et al.*, 2016). Öunap *et al.* (2016) presented that the tribal status of *Celonoptera* and *Leptostegna* is a subject of further study.

The Chinese genus *Tricalcaria* Han was described as a member of the Trichopterygini sensu lato (Xue *et al.*, 2008) based on the following characters: the male sternum II pouch, the male genitalia with costal and saccular processes, and the female genitalia with scobinate corpus bursae. The genus is similar to the New Zealand *Tatosoma* in having three hind tibial spurs (one mid spur and two apical spurs: Forbes, 1917; Prout, 1928; Viidalepp, 2011) and to the Oriental *Hypocomete*, *Phthonoloba* and *Tristeirometa* in the non-modified male hindwing (this character is common in the Larentiinae), but otherwise not related to them. The present study treats this genus as position unclear due to lack of any information on the metathoracic structures.

The following South American genera: *Anomozela* Fletcher, *Aperusia* Warren, *Apleria* Warren, *Chlorotimandra* Butler, *Crocypus* Herrich-Schäffer, and *Graphidipus* Herrich-Schäffer, are also classified into the tribe Trichopterygini sensu lato (Parsons *et al.*, 1999). In this study, however, these genera are also treated as a tribe incertae sedis, because any morphological information more than their original descriptions (Herrich-Schäffer, [1855] 1850–1858; Butler, 1882; Warren, 1901, 1905) could not be obtained in this study.

7. Acknowledgements

The present study is revised from a doctoral thesis submitted to Osaka Prefecture University. For their continuous guidance and encouragement, I thank the staff of the Entomological

Laboratory at that time: the late Dr Syusiro Ito, the late Dr Hiroshi Kuroko, Dr Tosihiro Yasuda, and the late Dr Sigeru Moriuti. I am greatly appreciated to the late Dr Hiroshi Inoue for his kind guidance and the loan or gift of useful specimens and literatures, without his help I could not start this study. My sincere thanks are due to Dr Yutaka Yoshiyasu (Kyoto), Dr Malcolm J. Scoble, (NHM, London), Dr Jeremy D. Holloway (NHM, London), and Dr Ian J. Kitching (NHM, London) for their critical readings of this manuscript and giving me the useful suggestions. My thanks are also due to Dr Toshihisa Saito (Osaka) and Dr Furumi Komai (Osaka) for their kind support to this study and the offering of invariable specimens. I wish to thank the following persons for kind help and for gift or loan of the useful specimens and materials (photographs of the type specimens and their genitalia): the late Dr John S. Dugdale (New Zealand), Dr Hiroshi Endo (Gifu), Alessandro Giusti (NHM, London), Dr Oleg G. Gorbunov (Russian Academy of Sciences, Russia), Dr Hideho Hara (Hokkaido), Etsuko Hayashi (Kagoshima), Soichiro Kinoshita (Osaka), Dr František Krampl (Czech), Takahiro Mano (Aichi), Hiromichi Ohgane (Aichi), Dr Luis E. Parra (Concepción University, Chile), Dr Rikio Sato (Niigata), Akio Seino (Niigata), Tatsuya Tanabe (Gifu), the late Ban Tanaka (Aichi), Dr Noriyuki Teramoto (Shiga), Dr Satoru Tominaga (Okinawa), Dr Shigehiko Tsukaguchi (Hyogo), Dr Kyoichiro Ueda (Saga), Dr Naoya Yashiro (Hyogo), Dr Koji Yasuda (Ibaraki), Katsumi Yazaki (Tokyo), Dr Hiroyuki Yoshitomi (Ehime University), and Dr Yutaka Yoshiyasu (Kyoto). I wish to express my hearty thanks to Mrs Akemi Hashimoto for her continuous assistance.

8. References

- Bastelberger, M. J., 1911. Neubeschreibungen von Geometriden aus dem Hochgebirge von Formosa. *Internationale entomologische Zeitschrift*, **4**: 241–242.
- Bolotov, I. N., A. A. Frolov, Y. S. Kolosova, & A. V. Kondakov, 2014. The male of *Sauris moulinie* (Legrand, 1971) comb. n. (Lepidoptera: Geometridae: Larentiinae: Trichopterygini), an endemic Inner Seychelles moth. *Zootaxa*, **3765**: 397–400.
- Borkhausen, M. B., 1794. Naturgeschichte der europäischen Schmetterlinge nach Systematischer Ordnung. 5. Theil: der Phalaenen dritte Horde: Spanner. 572 pp. Frankfurt.
- Bremer, K., 1994. Branch support and tree stability. *Cladistics*, **10**: 295–304.
- Bremer, O., 1864. Lepidopteren Ost-Sibiriens, insbesondere des Amur-Landes, gesammelt von den Herrn G. Radde, R. Maack und P. Wulffius. *Mémoires de l'Académie Impériale des Sciences de St. Pétersbourg*, (7) **8**: 1–103, pls. 8.
- Brock, J. P., 1971. A contribution towards an understanding of the morphology and phylogeny of the Ditrysian Lepidoptera. *Journal of Natural History*, **5**: 29–102.
- Butler, A. G., 1878. Descriptions of new species of Heterocera from Japan. Part III. Geometrites. *Annals and magazine of natural history, including zoology, botany, and geology*, (5) **1**: 440–452.
- Butler, A. G., 1879. Descriptions of new species of Heterocera from Japan. *Annals and magazine of natural history, including zoology, botany, and geology*, (5) **4**: 349–457.
- Butler, A. G., 1880a. Descriptions of new species of Asiatic Lepidoptera Heterocera. *Annals and magazine of natural history, including zoology, botany, and geology*, (5) **6**: 119–129.
- Butler, A. G., 1880b. Descriptions of new species of Asiatic Lepidoptera Heterocera. *Annals and magazine of natural*

- history, including zoology, botany, and geology, (5) 6: 214–230.
- Butler, A. G., 1881. Descriptions of new genera and species of heterocerous Lepidoptera from Japan. Geomtrites. *Transactions of the entomological Society of London*, **1881**: 401–426.
- Carpenter, J. M., 1994. Successive weighting, reliability and evidence. *Cladistics*, **10**: 215–220.
- Choi, S-W., 2007a. Taxonomic study of the genus *Trichopteryx* Hübner (Lepidoptera: Geometridae) in Korea. *Entomological Research*, **37**: 46–53.
- Choi, S-W., 2007b. Taxonomic review of the genus *Acasis* Duponchel (Lepidoptera: Geometridae) from Korea. *Entomological Research*, **37**: 203–207.
- Christoph, H., 1881. Neue Lepidopteren des Amurgebites. *Bulletin de la Société impériale des naturalistes de Moscou*, **55** (3): 33–121.
- Cook, M. A. & M. J. Scoble, 1992. Tympanal organs of geometrid moths: A review of their morphology, function, and systematic importance. *Systematic Entomology*, **17**: 219–232.
- Cui, L., D. Xue, & N. Jiang, 2019. A review of *Timandra* Duponchel, 1829 from China, with description of seven new species (Lepidoptera, Geometridae). *ZooKeys*, (829): 43–74.
- Curtis, J., 1825. Illustrations and descriptions of the genera of Insects found in the Great Britain and Ireland. *British Entomology*, 2: pls. 51–98.
- [Denis, M. & I. Schiffermüller], 1775. Ankündigung eines systematischen Werkes von den Schmetterlingen der Wienergegend. 322 pp., 3pls. Wien.
- Donovan, E., 1810. The natural history of the British Insects **14**. 96 pp. + 36pls. London.
- Dugdale, J. S., 1961. Larval characters of taxonomic significance of New Zealand ennomines (Lepidoptera: Geometridae). *Transactions of the Royal Society of New Zealand*, **1**: 215–233.
- Dugdale, J. S., 1974. Female genitalia configuration in the classification of Lepidoptera. *New Zealand Journal of Zoology*, **1**: 127–146.
- Dugdale, J. S., 1980. Australian Trichopterygini (Lepidoptera: Geometridae) with descriptions of eight new taxa. *Australian Journal of Zoology*, **28**: 301–340.
- Duponchel, P. A. J., [1845] 1844. Catalogue méthodique des Lépidoptères d'Europe distribués en familles, tribus et genres. xxxii + 523 pp. Paris.
- Dyar, H. G., [1903] 1902. A list of North American Lepidoptera and key to the literature of this order of insects. Bulletin of the United States National Museum (52). xix + 723 pp.
- Eversmann, E., 1842. Quaedam lepidopterorum species novae in Rossia orientali observatae, nunc descriptae et depictae. *Bulletin de la Société Impériale des naturalists de Moscou*, **15**: 543–565.
- Farris, J. S., 1969. A successive approximations approach to character weighting. *Systematic Zoology*, **18**: 374–385.
- Farris, J. S., 1989. The retention index and the rescaled consistency index. *Cladistics*, **5**: 417–419.
- Ferguson, D. C., 1983. Geometridae. In Hodges, R. W. et al., *Check list of the Lepidoptera of America North of Mexico*: 88–107. E. W. Classey Ltd. & the Wedge entomological research foundation, London.
- Forbes, W. T. M. 1917. The genera of Hydrimeninae of the United States (Lep.). *Journal of the New York Entomological Society*, **25**: 44–67.
- Forbes, W. T. M., 1939. The muscles of the lepidopterous male genitalia. *Annals of the Entomological Society of America*, **32**: 1–10.
- Forbes, W. T. M., 1948. Lepidoptera of New York and neighboring states, 2: Geometridae, Sphingidae, Notodontidae, Lymantridae. *Memoirs of the Cornell University Agricultural Experiment Station*, 274: 1–263.
- Fourcroy, A. F., 1785. Entomologia Parisiensis; sive, Catalogus insectum quae in agro Parisiensi reperiuntur, **2**. viii + 231 pp.
- Galsworthy, A. C., 1999. Two new species of *Sauris* (Lepidoptera, Geometridae, Larentiinae) from Hong Kong. *Transactions of the lepidopterological Society of Japan*, **50**: 35–37.
- Geyer, C., [1831] 1796, in Hübner, J., Sammlung europäischer Schmetterlinge, **5**. 113 pls. Augsburg.
- Gianti, M., 2007. Una nuova specie del genere *Epilobophora* Inoue, 1943 della Cina (Lepidoptera: Geometridae, Larentiinae). *SHILP Revista de Lepidopterologia*, **35**: 257–260. [In Italian with English abstract and key words.]
- Guenée, A., 1857. Uranides et Phalénites 2. In Boisduval et Guenée, Histoire Naturelle des Insectes (Species Général des Lépidoptères), **10**: 1–584, pls. 1–23.
- Gumpenberg, C. F. v., 1887. Systema Geometraum zonae temperationis septentrionalis. *Nova Acta Academiae Caesareae Leopoldino-Carolinae Germanicae Naturae Curiosorum*, **49**: 233–400, 3 pls.
- Hampson, G. F., 1895. The fauna of British India, including Ceylon and Burma. Moths **3**. xxviii + 546 pp. London.
- Hampson, G. F., 1898. The moths of India. Supplementary paper to the volumes “The fauna of British India.” Part IV. *The Journal of the Bombay Natural History Museum*, **12**: 73–98.
- Hampson, G. F., 1903. The moths of India. Supplementary paper to the volumes in “The fauna of British India.” Series II. Part III. *The Journal of the Bombay Natural History Museum*, **14**: 639–659.
- Hashimoto, S., 1982. Immature stages of four Japanese Trichopterygini (Lepidoptera: Geometridae; Larentiinae). *Tinea*, **11**: 99–112.
- Hashimoto, S., 1985. Immature stages of *Otoplectra frigida* (Butler) (Lepidoptera, Geometridae). *Kontyû*, **53**: 134–137.
- Hashimoto, S., 1986. Immature stages of *Heterophleps fusca* (Butler) (Geometridae, Larentiinae). *Tinea*, **12**: 81–84.
- Hashimoto, S., 1991a. Immature stages of *Carige scutimbata* (Geometridae, Larentiinae). *Tinea*, **13**: 107–111.
- Hashimoto, S., 1991b. The immature stages of Japanese species of the genus *Episteira* Warren (Lepidoptera, Geometridae). *Natural History Research*, **1**: 59–64.
- Hashimoto, S., 1992. Tibial scent organ and its related structures in the genera *Idaea* and *Scopula* of the subfamily Sterrhinae (Lepidoptera: Geometridae). *Akitsu, New Series*, (130): 1–8.
- Hashimoto, S., 1995a. Taxonomic consideration of three diurnal larentiine genera, *Baptria*, *Trichobaptria* and *Trichodezia*, based on the external structures of the Japanese species (Lepidoptera, Geometridae). *Japanese Journal of systematic Entomology*, **1**: 113–124.
- Hashimoto, S., 1995b. New and unrecorded species of the tribe Trichopterygini (Lepidoptera, Geometridae) from Thailand. *Transactions of lepidopterological Society of Japan*, **46**: 129–136.
- Hashimoto, S., 1995c. A proposal of a new genus *Archaeocasis* for *Trichopterigia micradelpha* Prout (Lepidoptera, Geometridae). *Transactions of lepidopterological Society of Japan*, **46**: 167–173.
- Hashimoto, S., 2005. Homology and taxonomic importance of the tibial hair-pencil and its related structures in the family Geometridae (Lepidoptera). *Tinea*, **18**, Supplement 3: 146–158.
- Hashimoto, S., 2011. *Trichopteryx ussurica* Wehrli. In Komai, F., Yoshiyasu, Y., Nasu, Y. & Saito, T. (eds.), *A guide to the Lepidoptera of Japan*: 848, pl. 182, fig. 728. Tokai University Press, Kanagawa. [In Japanese.]
- Hashimoto, S., 2019. New and newly recorded species of the genus *Sauris* Guenée (Geometridae: Larentiinae) from Japan, with a taxonomic review of *S. hirudinata* Guenée. *Tinea*, **25**: 45–65.

- Hausmann, A., 2001. Introduction. Archiearinae, Orthostixinae, Desmobaethrinae, Alsophilinae, Geometrinae. In Hausmann, A. (ed.), *The Geometrid Moths of Europe*, **1**. 282 pp. Apollo Books, Denmark.
- Hausmann, A. & P. Huemer, 2011. Taxonomic decision as a compromise: *Acasis appensata* (Eversmann, 1842) in Central Italy—a case of conflicting evidence between DNA barcode and morphology (Lepidoptera: Geometridae). *Zootaxa*, **3070**: 60–68.
- Hausmann, A. & J. Viidalepp, 2012. Subfamily Sterrhinae (II) (Lythrini); Subfamily Larentiinae II. In Hausmann, A. (ed.), *The Geometrid Moths of Europe*, **3**. 743 pp. Apollo Books, Denmark.
- Hayashi, E., 2006. A new locality of *Sauris interruptata* (Moore) and a new host plant of *Sauris marginepunctata* (Warren) (Geometridae). *Japan Heterocerists' Journal*, (241): 286–287. [In Japanese with English summary.]
- Heitzman, R. L. & W. R. Enns, 1978. Annotated list and keys to the geometrid subfamily Larentiinae (Lepidoptera: Geometridae) of Missouri. *Transactions, Missouri Academy of Science*, **12**: 47–73.
- Herbulot, C., 1948. *Paramathia*, nouveau genre de Larentiinae paléarctique (Lepidoptera, Geometridae). *Miscellanea Entomologica*, **45**: 118.
- Herrich-Schäffer, G. A. W., [1854] 1850–1858. *Sammlung neuer oder wenig bekannter aussereuropäischer Schmetterlinge*, **1** (1): 1–84, pls. 1–118. Regensburg.
- Hinton, H. E., 1946. On the homology and nomenclature of the setae of lepidopterous larvae, with some notes on the phylogeny of the Lepidoptera. *Transactions of the Royal Entomological Society of London*, **97**: 1–37.
- Holloway, J. D., 1976. Moths of Borneo with special reference to Mount Kinabalu. 264 pp. Kuala Lumpur: Malayan Nature Society.
- Holloway, J. D., 1992. The moths of Borneo 9: family Geometridae, subfamilies Oenochrominae, Desmobaethrinae and Geometrinae. *Malayan Nature Journal*, **49**: 147–326 + 427 figs. + 12 pls.
- Holloway, J. D. [1994] 1993. The moths of Borneo 11: family Geometridae, subfamily Ennominae. *Malayan Nature Journal*, **47**: 1–309 + 593 figs. + 19 pls.
- Holloway, J. D., 1997. The moths of Borneo 10: family Geometridae, subfamilies Sterrhinae and Larentiinae. *Malayan Nature Journal*, **51**: 1–242 + 608 figs. + 12 pls.
- Hübner, J., 1796 – [1813]. *Sammlung europäischer Schmetterlinge*, **5**. 113 pls. Augsburg.
- Hübner, J., 1816–[1825]. *Verzeichniss bekannter Schmetterlinge* [sic]. 431 + 72 pp. Augsburg.
- Hufnagel, J. S., 1767. III. Fortsetzung der Tabelle von den Nachtvögeln, welche die 3te Art derselben, nemlich die Spannmesser (Phalaenas Geometras [sic] Linnaei) enthält. *Berlinisches Magazin*, **4**: 599–626.
- Hulst, G. D., 1896. A classification of the Geometrina of North America, with descriptions of new genera and species. *Transactions of the American entomological Society*, **23**: 245–386, pl. 10–11, figs. 1–21.
- Inoue, H., 1942. New and unrecorded Geometridae from Japan. *Transactions of the Kansai Entomological Society*, **12** (1): 8–23, pl. 1.
- Inoue, H., 1943. New and little known Geometridae from Japan. *Transactions of the Kansai Entomological Society*, **12** (2): 1–25, pl. 11.
- Inoue, H., 1950. A list of feeding plants of the Japanese Geometridae. *Bulletin of the Takarazuka Insectarium*, (74): 1–20.
- Inoue, H., 1955a. Descriptions and records of some Japanese Geometridae. *Tinea*, **2**: 73–89, pl. 6: figs. 1–15, pl. 7: figs. 1–19.
- Inoue, H., 1955b. Descriptions of one new genus and two new species of the Geometridae from Japan (Lepidoptera). *Kontyû*, **23**: 68–78.
- Inoue, H., 1958. Descriptions and records of some Japanese Geometridae (II). *Tinea*, **4**: 241–257, pl. 34: figs. 1–30.
- Inoue, H., 1971. Geometridae. In Esaki, T. et al., *Icones Heterocerorum Japonicorum in Coloribus Naturalibus* (rev. new ed.), **1**: 163–292, pls. 30–64. Hoikusha Publishing Co. Ltd., Osaka. [In Japanese.]
- Inoue, H., 1979. Revision of the genus *Eupithecia* of Japan, Part 1 (Lepidoptera: Geometridae). *Bulletin of Faculty of Domestic Sciences, Otsuma Woman's University*, (15): 157–224.
- Inoue, H., 1980. Revision of the genus *Eupithecia* of Japan, Part 2 (Lepidoptera: Geometridae). *Bulletin of Faculty of Domestic Sciences, Otsuma Woman's University*, (16): 153–213.
- Inoue, H., 1982a. Geometridae of Eastern Nepal based on the collection of the Lepidopterological research expedition to Nepal Himalaya by the lepidopterological society of Japan in 1963. Part II. *Bulletin of Faculty of Domestic Sciences, Otsuma Woman's University*, (18): 129–190.
- Inoue, H., 1982b. Geometridae. In Inoue, H. et al., *Moths of Japan*, **1**: 425–573, **2**: 263–310, pls. 55–108, 314–344. Kodansha, Tokyo. [In Japanese.]
- Inoue, H., 1987. Geometridae of Eastern Nepal based on the collection of the Lepidopterological research expedition to Nepal Himalaya by the lepidopterological society of Japan in 1963. Part III. *Bulletin of Faculty of Domestic Sciences, Otsuma Woman's University*, (23): 215–270.
- Inoue, H., 1992. Geometridae. In Heppner, J. B. & H. Inoue (ed.), *Lepidoptera of Taiwan*, **1**, Part 2, Checklist: 111–129. Gainesville, Florida: Association for Tropical Lepidoptera Scientific Publishers.
- Inoue, H. & T. Ohbayashi, 2003. An unrecorded species of Larentiinae (Geometridae) from Ogasawara, Japan. *Japan Heterocerists' Journal*, (222): 411–413. [In Japanese with English summary.]
- Klots, A. B., 1970. 20. Lepidoptera. In Tuxen, S. L. (ed.), *Taxonomist's glossary of genitalia in Insects* (Edition 2): 115–130. Munksgaard, Copenhagen.
- Kristensen, N. P., 2003. 4. Skelton and muscles: adults. In Kristensen, N. P. (ed.), *Lepidoptera, moths and butterflies 2: Morphology, phylogeny, and development. Handbook of Zoology/Handbuch der Zoologie*, **4**(36): 39–131. Walter de Gruyter, Berlin & New York.
- Leech, J. H., 1891. Descriptions of new species of Geometridae from China, Japan, and Korea. *Entomologist* **24**, Supplement: 42–56.
- Leech, J. H., 1897. On Lepidoptera Heterocera from China, Japan, and Korea. Part 2. Family Geometridae; Subfamilies (Oenochrominae, Orthostixinae, Larentiinae, Acidaliinae, and Geometrinae). *Annals and magazine of natural history, including zoology, botany, and geology*, (6) **20**: 65–110, pls. vii & viii.
- Li, J., D. Xue, H. Han, & A. C. Galsworthy, 2012. Taxonomic review of *Syzeuxis* Hampson, 1895, with a discussion of biogeographical aspects (Lepidoptera, Geometridae, Larentiinae). *Zootaxa*, **3357**: 1–24.
- Matsumura, S., 1930. New species of Acrotiidae from Japan. *Insecta matsumurana*, **5**: 3140, pl. 1. [In Japanese.]
- McDunnough, J. H., 1949. Revision of the North American species of the genus *Eupithecia* (Lepidoptera, Geometridae). *Bulletin of the American Museum of Natural History*, **93** (8): 533–728, pls. 26–32.
- McGuffin, W. C., 1945. New descriptions of larvae of forest insects: *Nyctobia*, *Eufidonia* (Lepidoptera, Geometridae). *The Canadian Entomologist*, **77**: 197–199.

- McGuffin, W. C., 1958. Larvae of the Nearctic Larentiinae (Lepidoptera: Geometridae). *The Canadian Entomologist*, Supplement, **8**: 1–104.
- McGuffin, W. C., 1972. Guide to the Geometridae of Canada (Lepidoptera). II. Subfamily Ennominae. 1. *Memoirs of the Entomological Society of Canada*, (86): 1–159.
- Meyrick, E., 1892. On the classification of the Geometrina of the European fauna. *Transactions of the entomological Society of London*, **1892**: 53–140, pl.3.
- Meyrick, E., 1895. A handbook of British Lepidoptera. i–viii + 843 pp. London.
- Minet, J. & M. J. Scoble, 1998. 17. The Drepanid/Geometrid Assemblage. In Kristensen, N. P. (ed.), *Lepidoptera, moths and butterflies 1: Evolution, systematics, and biogeography. Handbook of Zoology/Handbuch der Zoologie*, **4** (35): 301–320. Walter de Gruyter, Berlin & New York.
- Moore, F. 1868. On the lepidopterous insects of Bengal. *Proceedings of the zoological Society of London*, **1897**: 612–686, pls. 32–33.
- Moore, F., 1888. In Hewitson & Moore, Descriptions of Indian Lepidoptera Heterocera from the collection of the late Mr. W. S. Atkinson, (3): 199–299, pls. VII & VIII. Calcutta.
- Murase, M., 1996. Larvae of a larentiine and an ennomine species (Geometridae) associated with *Juniperus*. *Japan Heterocerists' Journal*, (190): 246. [In Japanese with English summary.]
- Nakajima, H., 1974. [Notes on the larvae of Geometridae] VI. *Yugato*, (56): 38–40. [In Japanese.]
- Nakajima, H., 1998. A taxonomical and ecological study of the winter geometrid moths (Lepidoptera, Geometridae) from Japan. *Tinea*, 15, Supplement 2: 1–246. [In Japanese with English summary.]
- Nakajima, H. & K. Yazaki, 2011. Geometridae; Larentiinae. In Kishida, Y. (ed.), *The standard of moths in Japan*, 2: 248–316. Gakken Education Publishing, Tokyo. [In Japanese.]
- Nakamura, M., 1980. New host plants of Pyralidae and Geometridae. *Yugato*, (81): 103–104. [In Japanese.]
- Nakamura, M., 1981. Brief notes on some Japanese inch-worms. *Yugato*, (83): 1–7. [In Japanese.]
- Nakamura, M., 2004. A morphological and phylogenetic study on the pupae of Geometridae (Insecta: Lepidoptera) from Japan. *Tinea*, 18, Supplement 1: 1–227.
- Oberthür, C., 1884. Descriptions d'insectes nouveaux ou peu connus. *Études d'Entomologies*, **10**. 35 pp, 3 pls.
- Ogata, M., Y. Okada, H. Okagaki, & A. Sibatani, 1957. Male genitalia of Lepidoptera: Morphology and nomenclature. III. Appendages pertaining to the tenth somite. *Annals of the entomological Society of America*, **50**: 237–244.
- Ohbayashi, T., 2015. Occurrence of *Sauris hirudinata* Guenée, 1857 (Geometridae, Larentiinae) on *Cinnamomum* verum J. Presl, 1825 in Chichijima Island of the Ogasawara (bonin) Islands, Japan. *Japan Heterocerists' Journal*, (275): 632–633. [In Japanese with English summary.]
- Okagaki, H., A. Sibatani, M. Ogata, & Y. Okada, 1954. Male genitalia of Lepidoptera: Morphology and nomenclature. II. Morphological significance of sacculus and furca. *Annals of the entomological Society of America*, **48**: 438–442.
- Öunap, E., J. Viidalepp, & A. Truuverk, 2016. Phylogeny of the subfamily Larentiinae (Lepidoptera: Geometridae): integrating molecular data and traditional classifications. *Systematic Entomology*, **41**: 824–843.
- Owada, M., 1985. Larva of a larentiine moth, *Acasis exviretata* Inoue, found on *Cimicifuga simplex*. *Japan Heterocerists' Journal*, (132): 107. [In Japanese.]
- Packard, A. S., 1873. Descriptions of new American Phalaenidae. Fifth annual report of the trustees of the Peabody Academy of Science: 52–81.
- Packard, A. S., 1874. Descriptions of new North American Phalaenidae. Sixth annual report of the trustees of the Peabody Academy of Science: 39–53.
- Packard, A. S., 1876. A monograph of the geometrid moths or Phalaenidae of the United States. Report of the United States geographical survey of the territories, **10**. 607 pp., 13 pls.
- Parra, L. E., 1991. Revision and phylogeny of the genus *Pachrophylla* Blanchard, 1852 (sensu auctum) (Geometridae; Larentiinae: Trichopterygini). *Gayana Zoologica*, **52** (2): 145–199. [In Spanish with English abstract.]
- Parra, L. E., 1996. Neotropical Trichopterygini IV: description of new genera and species from Chile (Lepidoptera: Geometridae). *SHILAP Revista de Lepidopterología*, **24** (93): 37–54. [In Spanish with English abstract.]
- Parra, L. E. & C. P. Santos-Salas, 1991. Neotropical Trichopterygini II (Lepidoptera: Geometridae): The complex *Rhopalodes* Guenée, 1857. Trichopterygini Neotropicales II (Lepidoptera: Geometridae): El complejo *Rhopalodes* Guenée, 1857. *Gayana Zoologica*, **53** (4): 267–303. [In Spanish with English abstract.]
- Parra, L. E. & C. P. Santos-Salas, 1992. Neotropical Trichopterygini III: a new genus and species from Chile (Lepidoptera: Geometridae). *Boletín de la Sociedad de Biología de Concepción, Chile*, **63**: 151–156. [In Spanish with English abstract.]
- Parra, L. E., M. C. Jiménez-Urrutia, & C. Zamora-Manzur, 2009. Revision of the genus *Hoplosauris* Butler, 1882 (Lepidoptera: Geometridae). *Zootaxa*, **1989**: 39–54.
- Parra, L. E., H. A. Vargas, M.-J. Sanzanai, & C. Hernández, 2017. Phylogenetic study of the genera of Trichopterygini from Austral South America (Lepidoptera: Geometridae): a new classification. *Gayana*, **81** (2): 64–99.
- Parsons, M. S., M. J. Scoble, M. R. Honey, L. M. Pitkin, & B. P. Pitkin, 1999. In Scoble, M. J. (ed.), *Geometrid Moths of the World: A Catalogue* (Lepidoptera, Geometridae). 1016 pp. (+ Index 129 pp.) CSIRO Publishing/ Apollo Books, Collingwood (Australia)/ Stenstrup (Denmark).
- Patočka, J., 1980. Beitrag zur Kenntnis der Spanner-puppen aus der Subfamilie Larentiinae (Lepidoptera, Geometridae). *Biología (Brasília)*, **35**: 97–109.
- Patočka, J., 1981. Ein weiterer Beitrag zur Puppentaxonomie der Mitteleuropäischen Larentiinae (Lepidoptera, Geometridae). *Biología (Brasília)*, **36**: 583–593.
- Pierce, F. N., 1914. The genitalia of the group Geometridae of the Lepidoptera of the British Islands. 84 pp., 77 pls. Liverpool.
- Poujade, M. G.-A., 1895. Nouvelles espèces de Phalaenidae recueillies à Moupin par l'abbé A. David. *Bulletin du Muséum d'Histoire naturelle Paris*, **1** (2): 55–59.
- Prout, L. B., 1909. Two generic homonyms: *Arcia*; *Trichopteryx*. *Entomologist's Record and Journal of Variation*, **21**: 156–157.
- Prout, L. B., 1912–1916. In Seitz, A., *The macrolepidoptera of the world*, 4: 1–479, pls 1–25. Stuttgart.
- Prout, L. B., 1928. Geometridae. In *Insects of Samoa and other Samoan terrestrial Arthropoda*. Part III. Lepidoptera, fasc. 3: 117–168. British Museum (Natural History), London.
- Prout, L.B., 1934–1954. The Palearctic Geometridae. In Seitz, A. *The Macrolepidoptera of the World*, 4 (Supplement). viii + 766 pp., 53 pls. Stuttgart.
- Prout, L. B., 1958. New species of Indo-Australian Geometridae. *Bulletin of the British Museum (Natural History), Entomology*, **6**: 367–463, 4 pls.
- Ramos-González, M. I., C. Zamora-Manzur, D. S. Menés, & L. I. Parra., 2019. The Trichopterygini (Lepidoptera, Geometridae) of Austral South America: description of new species from Chile. *ZooKeys*, (832): 91–111.
- Robinson, G. S., 1975. Macrolepidoptera of Fiji and Rotuma: a taxonomic and biogeographic study. i–vi + 362 pp., 15 maps,

- 30 pls. E W Classey Ltd., London.
- Sakagami, K., 2021. Larvae of *Olethreutes mori* (Matsumura) (Tortricidae) and *Phthonoloba viridifasciata* (Inoue) (Geometridae) feeding on *Cyathea lepifera* (Cyatheaceae). *Japan Heterocerists' Journal*, (297): 583–584. [In Japanese with English summary.]
- Sato, R., 1976. [Notes of the larvae of the family Geometridae (XXVII)]. *Yugato*, (66): 155–157. [In Japanese.]
- Sato, R., 1984. Taxonomic study of the genus *Hypomecis* Hübner and its allied genera from Japan (Lepidoptera: Geometridae: Ennominae). *Special Bulletin of Essa Entomological Society*, (1): 1–213, pls 91. [In Japanese with English summary.]
- Sato, R., 1986. Descriptions of a new species of *Brabira* from North Honshu and a new subspecies of *Tyloptera bella* (Butler) (Geometridae: Larentiinae) from Amami-Oshima Island. *Japan Heterocerists' Journal*, (134): 129–131. [In Japanese with English summary.]
- Sato, R., 1987. Geometridae. In Sugi, S. (ed.), *Larvae of larger moths in Japan*: 50, pl.19: 17, 18. Kodansha, Tokyo. [In Japanese.]
- Scalercio, S., M. Infusino, & A. Hausmann, 2016. *Nothocasis rosariae* sp. n., a new sylvicolous, montane species from southern Europe (Lepidoptera: Geometridae, Larentiinae). *Zootaxa*, **4161** (2): 177–192.
- Schrank, F. P., 1802. *Fauna Boica*, **2** (2). 412 pp. Nürnberg.
- Scoble, M. J. & E. D. Edwards, 1990. *Parepisparis* Bethune-Baker and the composition of the Oenochrominae (Lepidoptera: Geometridae). *Entomologica scandinavica*, **20**: 371–399.
- Scoble, M. J., 1992. The Lepidoptera: Form, function and diversity. i–xi + 404 pp. Oxford University Press, London.
- Sibatani, A., M. Ogata, Y. Okada, & H. Okagaki, 1954. Male genitalia of Lepidoptera: Morphology and nomenclature. I. Divisions of the valvae in Rhopalocera, Phalaenidae (= Noctuidae) and Geometridae. *Annals of the entomological Society of America*, **47**: 93–103.
- Sihvonen, P., M. Mutanen, L. Kaila, G. Brehm, A. Hausmann, & H. S. Staude, 2011. Comprehensive molecular sampling yields a robust phylogeny for geometrid moths (Lepidoptera: Geometridae). *PloS one*, **6** (6): 1–111.
- Singh, B., 1953. Immature stages of Indian Lepidoptera No. 8–Geometridae. *Indian Forest Records (New Series)*, **8** (7): 67–158.
- Singh, B., 1956. Some more Indian geometrid larvae (Lepidoptera), with a note on the identity of components of various groups of setae. *Indian Forest Records (New Series)*, **9** (6): 131–163.
- Spuler, A., 1910. Die Schmetterlinge Europas, II: 523 pp.; III: 91 pls.; IV: 50 pls. + 10 pls. Stuttgart.
- Staudinger, O., 1871. I. Macrolepidoptera. In Staudinger, O & M. Wocke, *Catalog der Lepidopteren des Europaischen Faunengebiets*. xxxvii + 426 pp. Dresden.
- Staudinger, O., 1897. Die Geometriden des Amurgebietes. *Deutsche Entomologische der Zeitschrift, Iris*, **10**: 1–122, pls.1–3.
- Stehr, F. W. (ed.), 1987. *Immature insects 1*. xiv + 754 pp. Kendall/Hunt Publishing Company, Dubuque, Iowa.
- Stephens, J. F., 1829. *The nomenclature of British Insects*. ix + 68 pp. London.
- Strutzenberger, P., G. Brehm, F. Bodner, & K. Fiedler, 2010. Molecular phylogeny of Eois (Lepidoptera, Geometridae): evolution of wing patterns and host plant use in a species rich group of Neotropical moths. *Zoologica Scripta*, **39**: 603–1620.
- Sugi, S., 1987. A summary: general views on immature stages and life-histories of larger moths in Japan. In Sugi S. (ed.), *Larvae of Larger Moths in Japan*: 267–301. Kodansha, Tokyo.
- Swinhoe, C., 1893. New Geometers. *Annals and magazine of natural history, including zoology, botany, and geology*, (6) 12: 147–157.
- Swofford, D. L., 2020. PAUP*: Phylogenetic analysis using parsimony (* and other methods). Version 4.0a 157, test version for Microsoft Windows.
- Teramoto, N., 1996. Studies on lepidopterous insect fauna on Fagaceae plants, as the food plants of the wild silk moth, *Antheraea yamamai*. *Special Bulletin of the Shiga Agricultural Experiment Station*, (19): i–iv, 1–216. [In Japanese.]
- Thorell, T., 1869. On European spiders. Part I Review of the European genera of spiders, preceded by some observation on zoological nomenclature. *Nova Acta Regiae Societatis Scientiarum Upsaliensis*, (3) 7: 1–108.
- Thunberg, C. P., 1792. *Dissertation entomologica sistens insecta Sueciae, Upsaliae*, **4**: ii + 53–62, pl. 4.
- Tikhonov, V., 1994. Zwei neue Geometriden-Arten aus dem Kaukasus (Lepidoptera, Geometridae). *Atalanta*, **25**: 373–379, pl. XVIIb.
- Tominaga, S., 2003. Biological notes on seven species of the Geometridae in Okinawa Island. *Yugato*, (173): 105–109. [In Japanese.]
- Tominaga, S., 2013. Biological notes on four Larentiinae (Geometridae) species in Ishigaki-jima Island. *Yugato*, (214): 130–134. [In Japanese.]
- Tutt, J. W., 1896. *British Lepidoptera*. i–xii, 368 pp. + 12 pls. London: George Routledge & Sons. Limited.
- Valersky, O. V. 2011. Musculature of the male terminalia in geometrid moths of the subfamily Larentiinae (Lepidoptera, Geometridae). *Entomological Review*, **91**: 566–584.
- Vasilenko, S. V., 1992. Moths from Southern Sakhalin and Knashir, collected in 1989. Part 3. Geometridae excluding Ennominae. *Japan Heterocerists' Journal*, (166): 282–285.
- Viidalepp, J., 1978. A list of Geometridae (Lepidoptera) of the USSR II. *Enomologicheskoe Obozrenie*, **57**: 752–761. [In Russian.]
- Viidalepp, J., 2006. Cladistic analysis of the subfamily Larentiinae. In Hausmann, A. & P. McQuillan (eds.) *Proceedings of the Forum Herbulot 2006. Integration of molecular, ecological and morphological data: Recent progress towards the higher classification of the Geometridae*. *Spixiana*, **29**: 202–203.
- Viidalepp, J., 2011. A morphological review of tribes in Larentiinae (Lepidoptera: Geometridae). *Zootaxa*, **3136**: 1–44.
- Walker, F., 1860. *Catalogue of Lepidoptera Heterocera*. Fifth series. *List of Specimens lepidopterous Insects in the Collection of the British Museum*, **21**: 1–498.
- Walker, F., 1861. *Catalogue of Lepidoptera Heterocera*. Fifth series. *List of Specimens lepidopterous Insects in the Collection of the British Museum*, **23**: 757–1020.
- Walker, F., 1862. *Catalogue of Lepidoptera Heterocera*. Fifth series. *List of the Specimens of lepidopterous Insects in the Collection of the British Museum*, **24**: 1021–1280.
- Walker, F., [1863] 1862. *Catalogue of Lepidoptera Heterocera*. Fifth series. *List of the Specimens of lepidopterous Insects in the Collection of the British Museum*, **26**: 1479–1796.
- Warren, W., 1893. On new and species of moths of the family Geometridae from India, in the collection of H. J. Elwes. *Proceedings of the zoological Society of London*, **1893**: 341–434, pls. 32–34.
- Warren, W., 1894. New genera and species of Geometridae. *Novitates zoologicae*, **1**: 366–466.
- Warren, W., 1895. New species and genera of Geometridae in Tring Museum. *Novitates zoologicae*, **2**: 82–159.
- Warren, W., 1896a. New Geometridae in the Tring Museum. *Novitates zoologicae*, **3**: 99–140.
- Warren, W., 1896b. New species of Drepanulidae, Thyrididae, Uraniidae, Epiplemidae, and Geometridae in the Tring Museum. *Novitates zoologicae*, **3**: 335–419.
- Warren, W., 1897. New genera and species of moths from the old-world regions in the Tring Museum. *Novitates zoologicae*, **4**:

- 12–178.
- Warren, W., 1899a. New species and genera of the Families Drepanulidae, Thyrididae, Uraniidae, Epiplemidæ and Geometridæ from the Old-world regions. *Novitates zoologicae*, **6**: 1–66.
- Warren, W., 1899b. New Drepanulidae, Thyrididae, Epiplemidæ, Uraniidae, and Geometridæ from the Oriental and Palaearctic Regions. *Novitates zoologicae*, **6**: 313–358.
- Warren, W., 1905. New Thyrididae, Epiplemidæ, Uraniidae, and Geometridæ from the Oriental region. *Novitates zoologicae*, **12**: 6–15.
- Wehrli, E., 1931. Neue Geometriden-Arten und Rassen aus China und Tibet. *Neue Beiträge zur systematische Insektenkunde*, **5**: 2–31.
- Wehrli, E., 1932. Ein neues Genus, ein neues Subgenus und 4 neue Arten von Geometriden aus meiner Sammlung. *Entomologische Rundschau*, **49**: 220–221, figs. 1–2.
- Wehrli, E. & O. Bang-Hass, 1927. IV. Geometridae. In Bang-Haas, O., *Horae Macrolepidoptera Regionis palaearticae*, **1**: 91–98, pl. 11.
- Wileman, A. E., 1911. New and unrecorded species of Lepidoptera Heterocera from Japan. *Transactions of the entomological Society of London*, **1911**: 189–407, pls. 30–31.
- Wileman, A. E., 1914. New species of Geometridae from Formosa. *Entomologist*, **47**: 290–293.
- Wootton, R. J., 1979. Function, homology and terminology in insect wings. *Systematic Entomology*, **4**: 81–93.
- Xue, D., 1992. A study on the tribe Trichopterygini Warren of China (Lepidoptera: Geometridae, Larentiinae). *Sinozoologia*, **9**: 267–296, 2 pls. [In Chinese with English summary.]
- Xue, D. & F. Meng, 1995. Tree new species of Larentiinae from Gansu and Qinghai, China (Lepidoptera: Geometridae). *Acta Entomologica Sinica*, **38** (2): 222–227, pl. 1.
- Xue, D. & H. Zhu, 1999. Lepidoptera, Geometridae, Larentiinae. *Fauna Sinica, Insecta*, **15**. xxxii + 1090 pp., 25 pls. Science Press, Beijing. [In Chinese.]
- Xue, D., C. Wu, & H. Han, 2008. *Tricalcaria* Han gen. nov., a remarkable new genus with three hind-tibial spurs belonging to the tribe Trichopterygini, with description of a new species from China (Lepidoptera: Geometridae: Larentiinae). *Entomological Science*, **11**: 409–411.
- Yamamoto, S. & T. Sota, 2007. Phylogeny of the Geometridae and the evolution of winter moths inferred from a simultaneous analysis of mitochondrial and nuclear genes. *Molecular Phylogenetics and Evolution*, **44**: 711–723.
- Yazaki, K., 1972. Notes on the larvae of three species of Geometridae. *Japan Heterocerists' Journal*, (72): 206–207. [In Japanese.]
- Yazaki, K., 1974. [Notes on the larvae of the genus *Trichopteryx* (1)]. *Yugato*, (55): 6. [In Japanese.]
- Yazaki, K., 1975. [Notes on the larvae of the genus *Trichopteryx* (2)]. *Yugato*, (60): 44. [In Japanese.]
- Yazaki, K., 1978. A new species of *Trichopteryx* from Japan (Lepidoptera: Geometridae). *Transactions of the lepidopterological Society of Japan*, **29**: 111–113.
- Yazaki, K., 1986a. A new species of *Esakiopteryx* (Geometridae) from Taiwan. *Japan Heterocerists' Journal*, (134): 132–133. [In Japanese with English summary.]
- Yazaki, K., 1986b. A new species of *Epilobophora* from Taiwan and notes on two species of *Tanaorhinus* (Geometridae). *Japan Heterocerists' Journal*, (138): 197–199. [In Japanese with English summary.]
- Yazaki, K., M. Wang, & G-H. Huang, 2004. Notes on geometrid moths (Lepidoptera: Geometridae) from Nanling Mts, S. China (II). *Tinea*, **18**: 56–64.
- Yazaki, K. & M. Wang, 2018. Notes of geometrid moths (Lepidoptera, Geometridae) from Nanling Mts, S. China (IV). *Tinea*, **24**: 164–186.

9. Appendices

Appendix 1. Characters used in the phylogenetic analysis

Head

1. Antennal flagellomeres (male): 0, filiform; 1, compressed filiform (Fig. 5K–L); 2, dentate (Fig. 5B); 3, laminate (Fig. 91A); 4, fasciculate (Fig. 91C); 5, bipectinate (Fig. 91B); 6, very shortly bipectinate.
2. Antennal flagellomeres (female): 0, filiform; 1, compressed filiform; 2, bipectinate
3. Frons: 0, slightly or well rounded, except for swelling of scales (Fig. 6A–F); 1, protruded antero-ventrally (Fig. 6G).
4. Labial palpus (male): 0, very short, less than 1.0 times as long as eye diameter; 1, short to medium, 1.0 to 2.5 times as long as eye diameter (Fig. 6A, D–E); 2, long, more than 2.5 times as long as eye diameter (Fig. 6F).
5. Labial palpus (female): 0, very short, less than 1.0 times as long as eye diameter; 1, short to medium, 1.0 to 2.5 times as long as eye diameter; 2, long, more than 2.5 times as long as eye diameter.

Thorax

6. Apical claw of foretibia: 0, absent; 1, present (Fig. 99A).
7. Metepimeron (male): 0, not swollen (Figs. 92A, 100A–B); 1, not swollen, but with a short inner ridge ventrally (Fig. 8G); 2, swollen, divided into anterior and posterior parts by an inner longitudinal ridge (Figs. 8A, C–E, 9A).
8. Metepimeron (female): 0, not swollen; 1, swollen, divided into anterior and posterior parts by inner longitudinal ridge (Fig. 8B).
9. Metamerion (male): 0, not modified; 1, broad towards trochanter; 2, posterior margin arched (Figs. 8A, C–E, 92A).
10. Eucoxa of metathorax (male): 0, not modified; 1, broad, with a short inner ridge near trochanter; 2, elongate (Fig. 8D).
11. Hind tibial hair-pencil (male): 0, absent; 1, present on outer surface near femoro-tibial joint (Fig. 99B); 2, present on inner surface near femoro-tibial joint (Fig. 7C–F, 9B–C, 92B, 100C).
12. Hind tibial spurs (male): 0, four (two pairs of spurs: Figs. 7D, 92B, 100C); 1, three (one mid spur and a pair of apical spurs); 2, two, but very short, externally invisible by scales (a pair of apical spurs: Fig. 7E); 3, two, distinct (a pair of apical spurs: Fig. 7C); 4, no spurs (Fig. 7F).
13. Hind tibial spurs (female): 0, four (two pairs of spurs); 1, three (one mid spur and a pair of apical spurs); 2, two (a pair of apical spurs).
14. Male hind tibia: 0, not modified; 1, incrassate (Fig. 81C–G).
15. Male hind tarsus: 0, not modified; 1, reduced (Fig. 81D–G).
16. Forewing pattern: 0, usually distinguishable, consisting of several adjacent lines (basal, postbasal, antemedial, postmedial, subterminal, adterminal lines, and a row of terminal dots), but some of them occasionally indistinct (Figs. 61, 80, 101A, I); 1, several adjacent lines distinct, of which antemedial line is strongly protruded outwardly between CuA1 and 1A+2A and connected with postmedial line (Fig. 101C); 2, consisting of a few row of dots (Fig. 90C); 3, consisting of two or three costal dots, and ante- and postmedial lines (Fig. 90B); 4, consisting

of ante- and postmedial lines (Fig. 101H); 5, consisting of two lines, one is running from apex to middle on dorsum and another from apex to subterminal on dorsum (Fig. 90D).

17. Forewing apex: 0, rather rounded (Figs. 61, 80, 101C–D); 1, pointed (Fig. 90A–B, D, 101A, B, E, H).
18. Number of areoles: 0, two (Fig. 11A, 94A); 1, one (Fig. 11D, 93A, D).
19. Arising part of Rs3 + Rs4, or arising part of Rs3 + Rs4 + M1: 0, from more basal (Fig. 93D); 1, near or from end of discal cell (Fig. 11A, 93A, 94A).
20. M1 vein of forewing: 0, connate with Rs (Figs. 21A, 39D) or arising from outer margin of discal cell (Figs. 21D, 93D, 94A); 1, from areole (Figs. 11A, 27A, 33A, 93A).
21. Specialized hairs on undersurface between 1A+2A vein and inner margin in male: 0, absent; 1, present (Fig. 99C).
22. Frenulum: 0, present (Fig. 102A, C); 1, absent (Fig. 102B).
23. Outer marginal fold of hindwing (male): 0, absent; 1, present (Figs. 76I–J, 79E–F).
24. Anal margin of hindwing (male): 0, not modified (Figs. 27B, 93E, 94E, 102A–B); 1, modified as a small or large anal fold (Figs. 11B, E, 21B, E, 27D, 93B, 102C); 2, modified as a narrow anal fold (Fig. 94B, D).
25. Incision between anal fold and anal margin: 0, absent; 1, shallowly incised (Figs. 11B, E, 33B, E); 2, deeply incised (Fig. 21B, E).
26. Sc and R+Rs veins (male): 0, Sc fused with R+Rs for most length of discal cell or a short length at middle of discal cell (Figs. 21B, 27B, 76F, 102C); 1, Sc connecting with R+Rs at a point or very short length near base and then sharply diverging as Sc+R1 (Fig. 102A); 2, Sc separate from R+Rs and connecting with a short vein of R before or near middle of discal cell (Figs. 93B, E, 94B, D–E, 102B); 3, Sc separate from R+Rs and connecting with R near end of discal cell (Figs. 11B, 21E, 27D).
27. Sc and R+Rs veins (female): 0, Sc fused with an upper vein (R+Rs) of discal cell from near base to near upper angle of discal cell or a short length at middle of discal cell (Figs. 11C, 27E, 33C, F, 39C, F); 1, Sc connecting with R+Rs at a point or very short length near base and then sharply diverging as Sc+R1; 2, Sc separate from R+Rs and connecting with R before or near middle of discal cell (Figs. 93C, F, 94C).
28. Distal part of Sc+R: 0, not separate; 1, separate (Fig. 102B).
29. Rs and M1 veins (male): 0, stalked (Figs. 93B, 102); 1, connate or separate (Figs. 11B, 27B, D 93E, 94B, D, E); 2, completely fused (Fig. 76F, I–J).
30. Rs and M1 veins (female): 0, stalked; 1, long stalked, separate near termen; 2, connate or separate.
31. M3 and CuA1 veins (male): 0, connate or separate; 1, short stalked (Fig. 94B, D); 2, completely fused (Fig. 76B, D, F, I, 94E).
32. M3 and CuA1 veins (female): 0, connate or separate (Fig. 76C, G); 1, stalked (Figs. 76K, 94C).
33. CuA1 vein (male): 0, almost same length with M3 (Fig. 21B, E); 1, shorter than M3 (Fig. 11B).
34. CuA2 vein (male): 0, longer or almost same length with CuA1 or M3+CuA1 (Figs. 27B, 94B, E, 102A, B); 1, slightly shorter than CuA1 (Figs. 52B, 94D); 2, clearly short, less than 1/2 length of CuA1 or M3+CuA1 (Figs.

- 11B, 21B, E, 102C).
35. 1A+2A vein (male): 0, long, same length with that of female (Fig. 27B); 1, shorter than female (Fig. 94B, D); 2, clearly short, being in anal fold (Figs. 11B, 27D).
36. 3A vein: 0, present; 1, absent.
- Pregenital abdomen
37. Sternum II triangularly sclerotized, with a circular concave accompanied with specialized scales (male): 0, absent; 1, present (Fig. 99D).
38. Sternum II with a pair of slender short projections laterally (male): 0, without projections; 1, with projections (Fig. 99D).
39. Male abdominal sternum II pouch: 0, absent; 1, small to medium, occasionally externally invisible (Figs. 8A, 9D); 2, large, well beyond 2nd abdominal segment (Fig. 12A–B); 3, vestigial (Figs. 9F, 12C).
40. Sternum II with a pair of triangular expansions (male): 0, reduced or absent; 1, present (Figs. 8A, 9D, 12B).
41. A pair of scale tufts on each of sterna II and IV to VII: 0, absent; 1, present, but only on sternum V; 2, present on each of sterna II and IV to VII (Fig. 9F).
42. Posterior part of 7th segment (female): 0, not modified; 1, posterior 1/3 to 2/5 completely sclerotized circularly (Fig. 12E–F).
43. Length of sternum VII (female): 0, almost same length with tergum VII; 1, longer than tergum (Fig. 31I).
44. Sternum VII (female): 0, not modified; 1, posterior margin sclerotized, incurved; 2, modified as sterigma.
45. Intersegmental membrane between segments VII and VIII (female): 0, almost same as preceding ones; 1, reduced (Fig. 31I).
46. Ventral intersegmental membrane between segments VII and VIII covered with hairy setae (female): 0, absent; 1, present (Fig. 47G).
- Male genitalia
47. Sternite VIII (male): 0, almost same as preceding segments; 1, variable in shape among species (Fig. 99E).
48. Coremmata between 8th segment and ring (male): 0, absent; 1, present.
49. Tegumen: 0, posterior margin rounded (Figs. 22B, 23B); 1, rounded, but posterior part concave (Fig. 42B); 2, more or less pointed (Fig. 103I); 3, posterior margin wide, slightly rounded (Fig. 95B); 4, posterior margin wide, slightly incurved (Figs. 82C, 83B)).
50. Saccus: 0, thick, anterior margin rounded (Figs. 40C, 42C); 1, thick, anterior margin wide, slightly rounded or incurved (Figs. 82D, 83C); 2, narrow, anterior margin wide, slightly rounded or incurved (Figs. 77D, 95C, 98D); 3, triangular, with obtuse apex (Fig. 31C); 4, pointed (Fig. 60C).
51. Apical part of uncus: 0, single, pointed (Fig. 14A–B); 1, single, spatulate; 2, single, rather wide tip (Fig. 98G, I); 3, bifid, flat, rather long, dull tip (Fig. 103B–C); 4, bifid, thick, dull tip; 5, bifid, narrow, sharply pointed (Figs. 77B, 78B); 6, trifid, pointed; 7, obsolete (Fig. 95B).
52. Socius: 0, obsolete; 1, a setose swelling at latero-basal sides of uncus (Fig. 14A); 2, developed, digitiform; 3, well developed, thick, with long hairy setae along inner margin (Figs. 82B–C, 83A–B).
53. Gnathos: 0, both gnathii extending ventrally and fused with each other or very close each other (Figs. 95A, 96B); 1 both gnathii (socii of Inoue, 1982) expanding posteriorly along anal cone; 2, slender, separate from uncus-socius complex by narrow membrane (Fig. 14A); 3, slender, fused with uncus-socius complex (Figs. 42A, 43A); 4, slender, anterior parts of both gnathii extending antero-medially and fused with anterior part of subscaphium (Fig. 103I); 5, very thick, completely fused with uncus-socius complex (Figs. 82B–C, 83A–B).
54. Diaphragmal pouch: 0, absent; 1, present (Fig. 82A).
55. Costal arm with cucullus: 0, absent (Figs. 28D, 30D, 77E, 82E); 1, long, slender, wholly sclerotized (Figs. 22D, 23D, 25D); 2, long, slender, sclerotized on dorsal margin (Figs. 34E, 35D); 3, short to medium, slender, sclerotized on dorsal margin (Fig. 40D, J); 4, short to medium, rather broad, sclerotized on dorsal margin (Figs. 53D, 66D); 5, medium in length, broad, wholly sclerotized (Figs. 48D, 49D).
56. Dorsal margin of costa with some spines or a serrate sclerite near middle: 0, without such spines or sclerite; 1, with such spines or sclerite (Figs. 40D, J, 42D, 43D).
57. Costa with a setose swelling expanding ventrally near base: 0, without such swelling; 1, with such swelling (Figs. 34E, 35D).
58. Dorsal margin of costa with a protuberance near posterior 2/3: 0, without a protuberance; 1, with a protuberance.
59. Costa with a serrate digitiform process expanding ventrally near middle: 0, without such process; 1, with such process (Fig. 98E).
60. Posterior end of costa: 0, not pointed; 1, sharply pointed (Fig. 103E); 2, protruded.
61. Cucullus: 0, indistinguishable from valvula, rarely rather densely covered with hairy setae (Figs. 28D, 31D); 1, hairy slightly swelling on dorsal end of valve (Fig. 96D); 2, hairy oblong lobe on dorsal end of valve (Figs. 82E, 83D); 3, hairy oblong lobe on posterior end of costal arm (Figs. 53D, 54A); 4, hairy narrow sclerite on posterior end of costal arm, indistinguishable from costal arm (Figs. 22D, 23D, 25D); 5, semispherical sclerite with spines and hairy setae (Fig. 95D–E).
62. Transtilla: 0, developed, as a setose or non-setose sclerite (Figs. 55D, 72D); 1, reduced, as a non-setose narrow plate (Figs. 77E, 78E); 2, absent (Fig. 95D).
63. Both transtillae: 0, separate; 1, completely fused with each other medially (Figs. 36E, 42E, 43E).
64. Transtillae with labides: 0, without labides; 1, with semicircular hairy processes surrounding dorsal part of phallus (Figs. 22D–E, 23D, 25D); 2, with setose semidisc-like or arched processes (Fig. 96D); 3, with stout spinose sclerites (Fig. 98E); 4, with fine hairy falcate processes (Fig. 103K–L).
65. Sacculus: 0, not vertically pleated; 1, vertically pleated (Figs. 82E, 83D).
66. Basal process of sacculus: 0, absent; 1, present, digitiform, extending posteriorly (Fig. 95E).
67. Distal process of sacculus: 0, usually absent (Figs. 77E, 82E); 1, short, sclerotized, extending dorsally (Fig. 47D); 2, narrow, short, sclerotized, extending posteriorly (Figs. 46D, 48D); 3, digitiform, short, weakly sclerotized, extending posteriorly (Fig. 95D–E); 4, broad, long, sclerotized, extending posteriorly (Fig. 34D); 5, bifurcate, flattened, sclerotized, extending dorsally and posteriorly (Fig. 28D).
68. Dorsally expanding process on distal 1/3 to 1/4 of

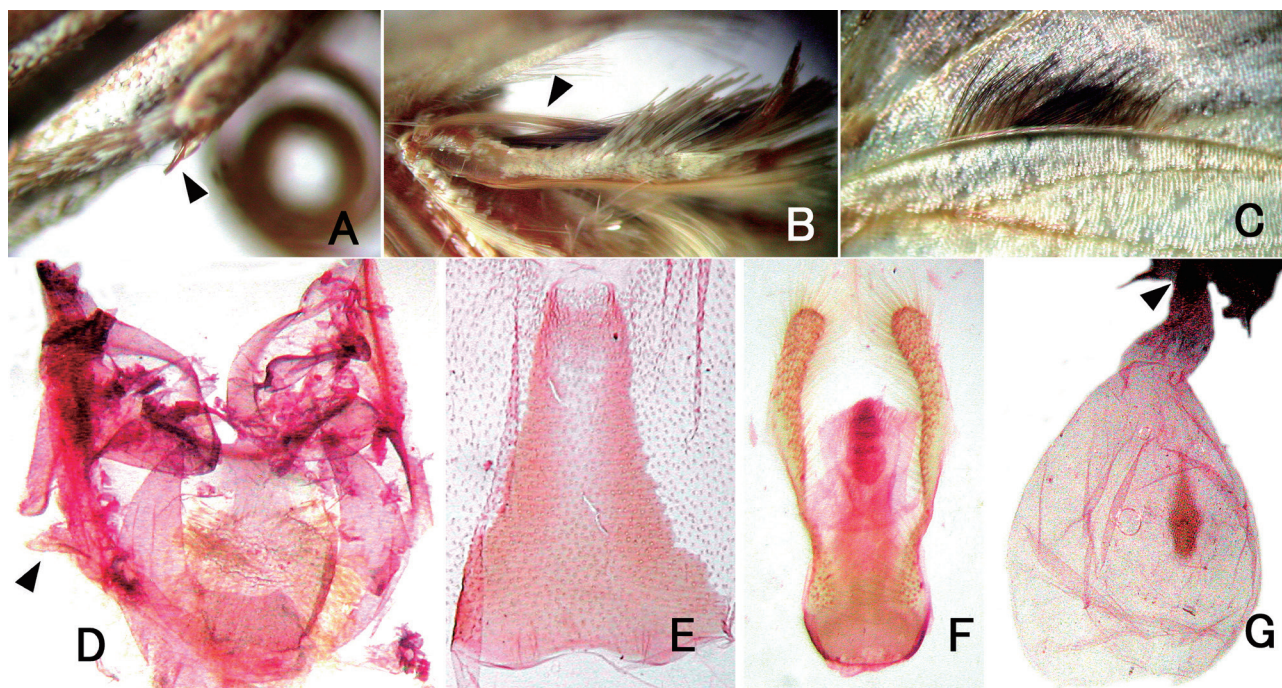


Fig. 99. Thoracic and abdominal structures, *Aplocera perelegans perelegans* (Warren) (A), *Idaea biselata biselata* (Hufnagel) (B, D), *Eustroma japonica* Inoue (C, F, G), *Eupithecia daemionata daemionata* Dietze (E). A, apical claw of foretibia; B, male hindleg with hair-pencil; C, specialized hairs between 1A + 2A vein and inner margin on undersurface of male forewing; D, sternum II; E, sternite VIII; F, juxta; G, female genitalia.

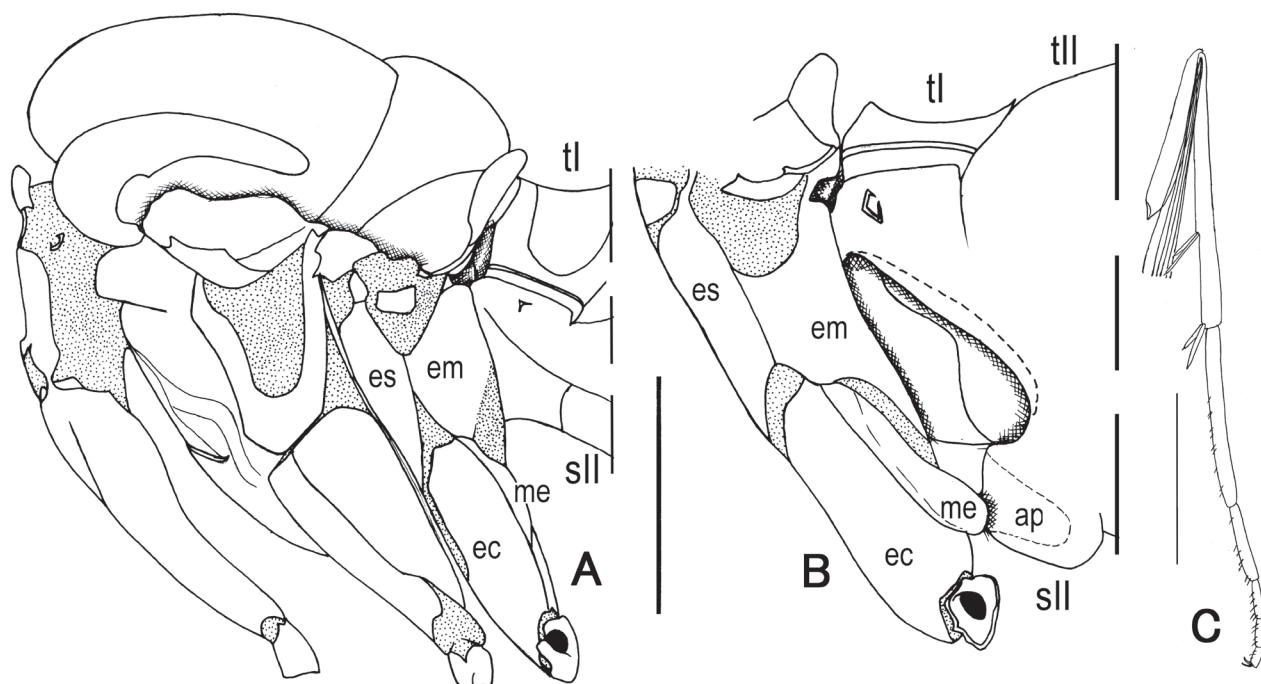


Fig. 100. Male thorax and anterior abdomen. A, *Eupithecia daemionata daemionata* Dietze, lateral; B, *Aplocera perelegans perelegans* (Warren), metathorax and anterior abdomen, lateral; C, ditto, hindleg. ap, abdominal pouch; ec, eucoxa; em, epimeron; es, epsisternum; me, meron. Scales = 1.0 mm (AB), 3.0 mm (C).

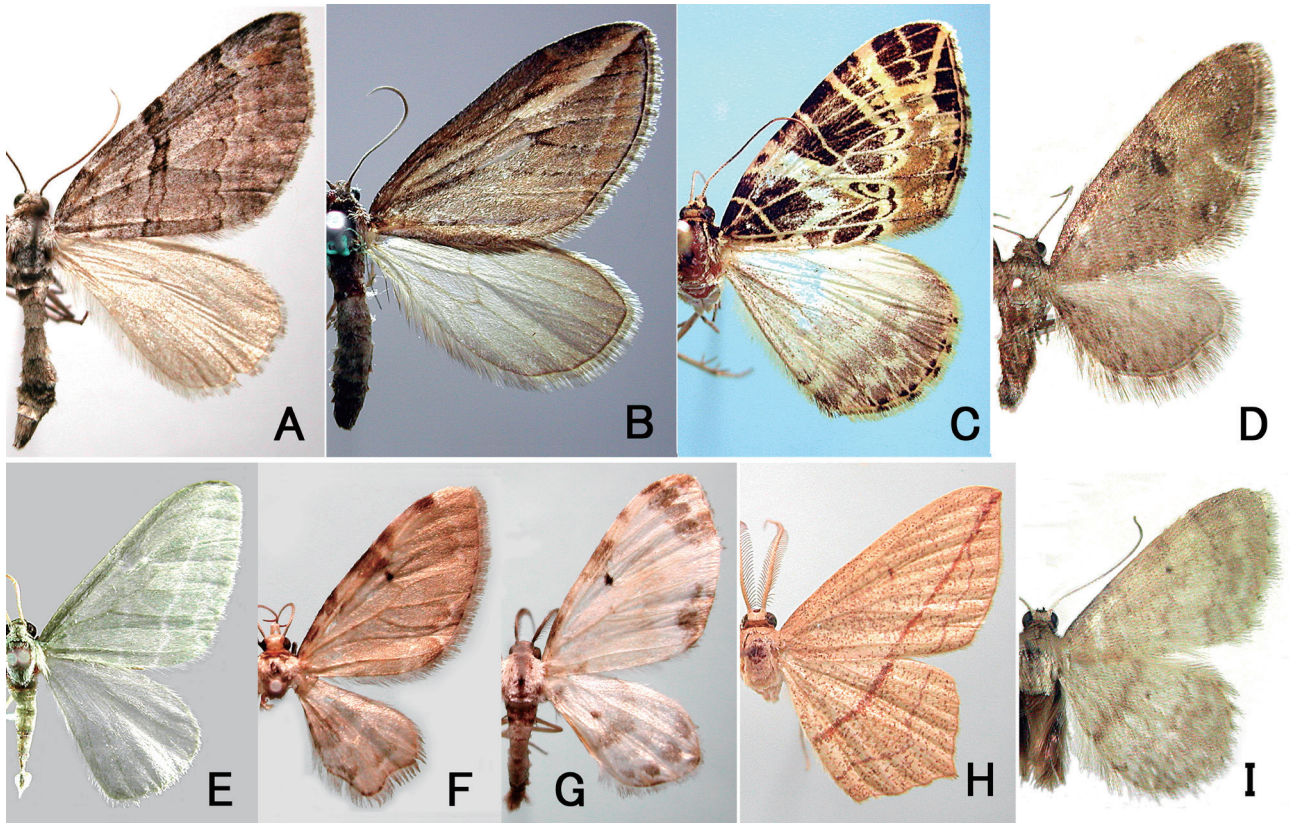


Fig. 101. Adults. A, *Aplocera perelegans perelegans* (Warren), ♀; B, *Chesias legatella legatella* ([Denis & Schiffermüller]), ♀ (Czech); C, *Eustroma japonica* Inoue, ♀; D, *Eupithecia signigera* Butler, ♂; E, *Leptostegna tenerata* Christoph, ♂; F, *Brabira artemidora artemidora* (Oberthür), ♀; G, *Tyloptera bella bella* (Butler), ♀; H, *Timandra apicirosea* (Prout), ♂; I, *Idaea biselata biselata* (Hufnagel), ♂.

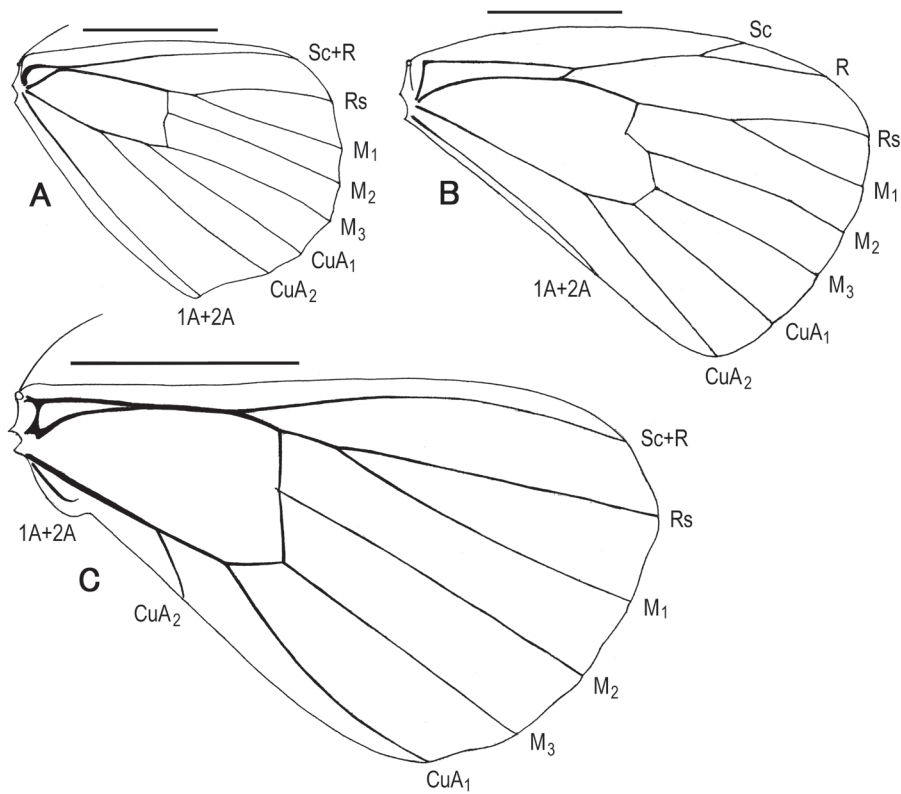


Fig. 102. Male hindwing venation. A, *Idaea biselata biselata* (Hufnagel); B, *Leptostegna tenerata* Christoph; C, *Aplocera perelegans perelegans* (Warren).

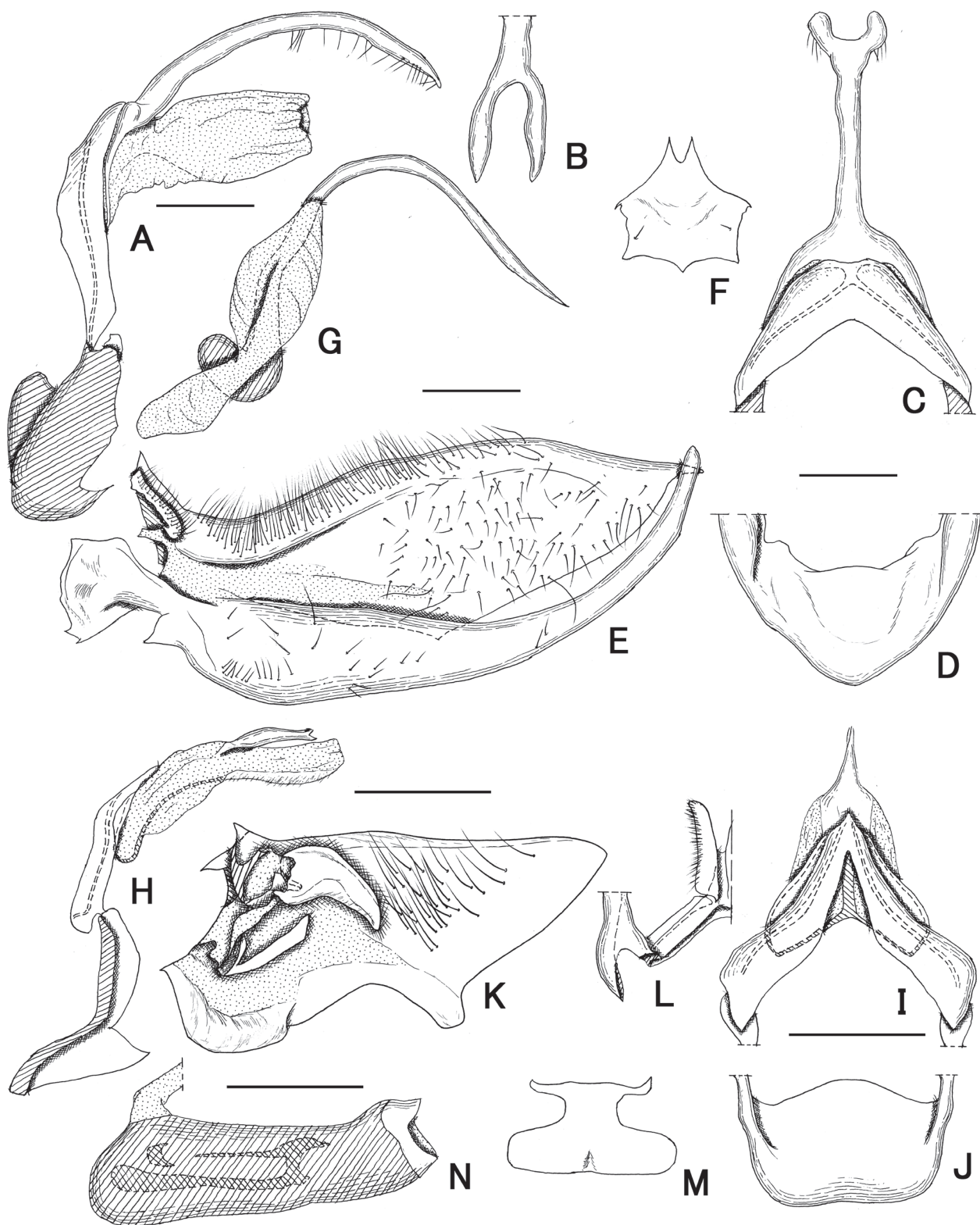


Fig. 103. Male genitalia, *Aplocera perelegans perelegans* (Warren) (A–G), *Eupithecia daemionata daemionata* Dietze (H–N). A, H, lateral; B, apical part of uncus, caudal; C, I, tegumen, dorsal; D, J, saccus, dorsal; E, K, right valve, inner; L, right labis, dorsal; F, M, juxta, ventral; G, N, phallus, lateral. Scales = 0.5 mm.

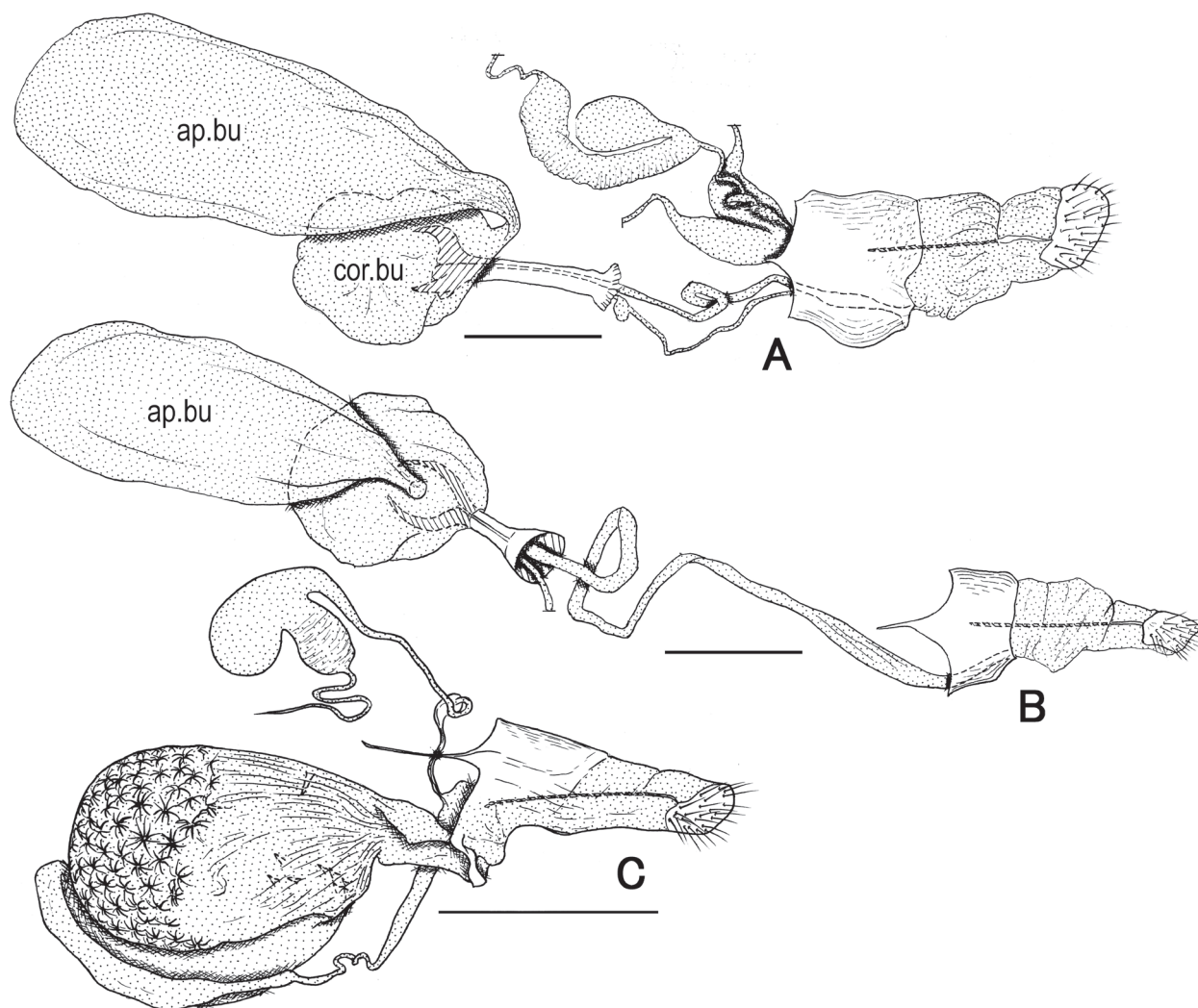


Fig. 104. Female genitalia, lateral. A, *Aplocera perelegans perelegans* (Warren); B, *Aplocera plagiata plagiata* (Linnaeus) (Czech); C, *Eupithecia daemionata daemionata* Dietze. ap. bu, appendix bursae; cor. bu, corpus bursae. Scales = 1.0 mm.

- sacculus: 0, absent; 1, present (Figs. 53D, 54A, 55D, 57D).
69. Long sclerotized spines arising from posterior inner surface of saccular process: 0, absent; 1, present (Fig. 36D).
70. Harpe: 0, indistinct, weakly sclerotized, indistinguishable from valvula (Figs. 96D, 103E, K); 1, indistinct, well sclerotized, indistinguishable from valvula (Figs. 22D, 23D, 25D); 2, disitnct, oval or rectangular sclerite, distinguishable from valvula (Figs. 14E, 46D, 47D, 48D, 53D, 60D); 3, disitnct, narrow rectangular sclerite, distinguishable from valvula (Fig. 31D); 4, distinct, ventral hairy process on posterior 1/4 on valve (Fig. 95D–E); 5, indistinct, completely fused with basal part of saccular process (Figs. 34E, 35D).
71. Harpe with a proximo-dorsal sclerotized setose lobe: 0, without such lobe; 1, with such lobe (Figs. 36D, 40D, J, 42D, 43D).
72. Harpe with a median flap expanding basally: 0, without such flap; 1, with such flap (Figs. 77E, 78E).
73. Valvula: 0, broad, distinguishable from costa and sacculus, widely rounded on posterior margin (Figs. 36D, 42D, 43D, 77E, 82E); 1, broad, distinguishable from costa and sacculus, serrate on posterior margin (Figs. 30A, 31D); 2, triangular, with an obtuse apex (Figs. 14E, 46D, 53D, 60D); 3, triangular, with a dull pointed apex (Fig. 23D); 4, slender, with a sharply pointed apex (Figs. 22D, 25D); 5, slender, with an obtuse apex (Fig. 96D); 6, slender, expanded on posterior end; 7, narrow, digitiform (Fig. 95D–E).
74. Sclerotization of valvula: 0, weakly sclerotized; 1, wholly sclerotized (Figs. 22D, 23D, 25D).
75. Posterior margin of valvula: 0, not marginated; 1, broadly marginated (Figs. 82E, 83D).
76. Valvula with long hairy tufts (brushes) along posterior margin: 0, without such tufts; 1, with such tufts, but less than 1/2 length of valve (Figs. 83D, 84D); 2, with such tufts, more than twice length of valve (fig. 82A).
77. Shape of phallus: 0, almost straight or gently curved; 1, strongly curved on coecum and on posterior 1/3 (Fig. 95F); 2, weakly sigmoid; 3, helicoid (Fig. 103G).
78. Posterior end of phallus aciculate: 0, not aciculate; 1, aciculate (Fig. 103G).
79. Posterior part of phallus covered with small spines or granules: 0, generally without any ornamentation (rarely with a few small spines laterally in the species level);

- 1, with several small spines laterally (Fig. 36H); 2, circularly covered with spines or granules (Figs. 14A–B, 60F, 66F).
80. Posterior end of phallus tapering or with a few flat sclerites: 0, without such structure; 1, tapering; 2, with a few flat sclerites (Fig. 28F–H).
81. Cornuti: 0, usually absent (rarely present in the species level); 1, vesica with or without an irregular sclerite; 2, vesica with or without several stout spines (Figs. 31H, 49G); 3, circularly covered with many fine spines (Figs. 77G, 84F); 4, with many small spines (Figs. 40I, 43G–H); 5, a long band of many small or needle-like spines (Figs. 22G, 23G, 25F, 96G, J); 6, several needle-like spines near posterior end of phallus (Fig. 98H, J); 7, with many granules (Figs. 53F, 55F–G, 57F–G); 8, with four sets consisting of sclerites and spines (Fig. 103N).
82. Coecum laterally expanded: 0, not expanded; 1, expanded (Figs. 40G, 42 H).
83. Juxta and phallus: 0, separate by membrane; 1, completely fused (Fig. 95F).
84. Juxta with a pair of posterior setose lobes: 0, without such lobes; 1, with such lobes (Figs. 28E, 99F).
85. Juxta with a pair of triangular projections near middle: 0, without such projections; 1, with such projections (Fig. 31E).
86. Juxta with canaliculus (a dorsally grooved narrow pointed projection composed of a pair of processes expanding from posterior sides of juxta): 0, without canaliculus; 1, with canaliculus.
87. Juxta strongly constricted, consisting of anterior rounded sclerites and posterior narrow arms: 0, not constricted; 1, constricted (Fig. 103M).
88. Ventral part of anellus with a pair of narrow sclerites behind juxta: 0, without such sclerites; 1, with sclerites (Fig. 23E).
- Female genitalia**
89. Shape of corpus bursae: 0, subglobular or pear-shaped; 1, globular; 2, disc-shaped (Fig. 99G); 3, oval or flattened oval (Fig. 86H–I); 4, oblong, occasionally constricted (Figs. 54E, 58, 98N); 5, cylindrical oblong (Figs. 22H, 24, 25G); 6, small, narrowly oblong.
90. Corpus bursae with one or two small rather oval scobinate sclerites (signum or signa): 0, without such sclerite; 1, with such sclerite (Fig. 99G).
91. Corpus bursae with a invaginate ridge (signum): 0, without such ridge; 1, with such ridge.
92. Corpus bursae with a bifurcate or forked sclerite continuing from sclerotized ductus bursae (signum): 0, without such sclerite; 1, with such sclerite (Fig. 104A–B).
93. Corpus bursae circularly covered with several invaginate triangular sclerites or invaginate long sclerotized ridges (signa): 0, without such sclerites; 1, with sclerites (Figs. 95G, 97, 98K, N).
94. Corpus bursae covered with many small or minute spines (signa): 0, without such spines (Figs. 48G, 49H); 1, wholly or partly covered with spines forming star-shaped base on outer surface (Figs. 15D, 37A, 77H, 104C); 2, partly covered with spines forming star-shaped base on outer surface and a row of spines in lateral sides (Figs. 54E, 58); 3, covered with a row of spines dorsally and ventrally (Fig. 53G); 4, circularly covered with small needle-like spines near anterior end of corpus bursae (Figs. 41A, D, 43I); 5, covered with two large ovate patches consisting of minute spines (Figs. 22H, 24, 25G).
95. Posterior part of corpus bursae: 0, not sclerotized; 1, sclerotized.
96. Cephalic part of ductus bursae: 0, not modified; 1, thickly sclerotized (Fig. 104A–B).
97. Middle of ductus bursae: 0, not modified; 1, slightly swollen and wrinkled (Figs. 77H, 78H, 82H; cestum of Dugdale, 1980).
98. Ductus bursae with spines: 0, without any spines; 1, broadly covered with many minute spines, frequently forming star-shaped base on outer surface (Figs. 29A, 47G); 2, covered with small spines (sometimes forming star-shaped base) near anterior end of ductus bursae (Figs. 48H, 49I); 3, scarcely covered with small spines and with a comb-like spinous ridge or a row of spines (Figs. 34I, 35G); 4, with a comb-like spinous ridge or a row of spines (Figs. 15D, 70G); 5, circularly covered with several invaginate long sclerite ridges (Fig. 98K).
99. Colliculum: 0, absent; 1, present, less than 1/4 length of ductus bursae (Figs. 97B, 99G; arrow).
100. Appendix bursae: 0, absent; 1, present near anterior end of corpus bursae, globular (Figs. 34I, 37A, 41A, D, 43I); 2, present near or posterior end of corpus bursae, globular (Figs. 77H, 86H–I); 3, present near posterior end of corpus bursae, oblong (Fig. 104A–B).
101. Arising point of ductus seminalis: 0, arising near antrum or ostium; 1, from near anterior end of a wrinkled swollen part of ductus bursae (Figs. 77H, 82H); 2, from near (or rarely on) corpus bursae, almost opposite to arising part of appendix bursae (Figs. 88I); 3, from corpus bursae (Fig. 104C); 4, from near corpus bursae (Figs. 22H, 24, 25G); 5, from posterior end of thickened sclerite tube of ductus bursae (Fig. 104A–B).
102. Basal part of ductus seminalis: 0, usually narrow; 1, thick (Figs. 53G–H, 104C).
103. Lagna of spermatheca: 0, present (Figs. 15D, 34I); 1, absent (Figs. 15A, 37A).
104. Antrum: 0, rather distinct, cup-shaped, wider than long (Figs. 53H, 55I); 1, distinct, cup-shaped, longer than wide (Figs. 77I, 82I); 2, distinct, parallel sided, narrow (Fig. 43K); 3, indistinct, membranous (Figs. 46I, 104A–B).
105. Anterior margin of segment VIII: 0, almost vertically straight; 1, oblique postero-ventrally (Figs. 30B, 31I–J).
106. Tergum VIII: 0, not divided; 1, longitudinally divided by narrow membrane (Figs. 15B, 43J, 47H, 48I).
107. Ostium bursae: 0, opening on sternum VIII; 1, on sternum VII.
108. Sternum VIII: 0, almost membranous except for anterior margin; 1, sclerotized, semicylindrical, connected with 8th tergum at base of apophysis anterioris (Figs. 29A–B, 98N); 2, sclerotized, completely fused with 8th tergum (Figs. 15C, 98K, 104A–B).
109. Sternum VIII with a pair of scale tufts at antero-lateral sides: 0, without such scale tufts; 1, with such scale tufts (Figs. 77H, 83G).
110. Sternum VIII triangularly expanded postero-laterally, deeply incised on posterior margin: 0, without such structure; 1, with such structure (Fig. 37A–B).
111. Apophysis anterioris: 0, almost reduced or absent (Figs.

- 30B, 31J, 37A); 1, short, less than 1/4 length of apophysis posterioris (Fig. 15A, C, 41A, 104A–B); 2, about 1/2 to 1/3 length of posterioris (Figs. 15D, 35G, 46H); 3, slightly longer than 1/2 length of posterioris (Fig. 98N); 4, almost same or slightly shorter than posterioris (Figs. 29A–B, 77H, 82H, 97A–C).
112. Intersegmental membrane between 8th segment and papillae anales: 0, slightly longer than preceding one; 1, very long, more than twice length of preceding one (Fig. 29B).
113. Papillae anales: 0, almost oval, weakly sclerotized, higher than long or almost same length; 1, slightly rounded, sclerotized, longer than height (Fig. 43I); 2, slender, longer than height, strongly sclerotized, with a pointed apex (Fig. 29B).
114. Papillae anales covered with crumpled membrane dorsally: 0, without such structure; 1, with such structure (Fig. 46H).
115. Ventral sclerite (sternite IX) between papillae anales: 0, slender (Fig. 15C–D); 1, rectangular, weakly sclerotized (Figs. 97F, 98M); 2, nearly trapezoid, strongly sclerotized (Fig. 43K); 3, absent.

Appendix 2. Characters matrix

The character matrix and the indices of the weighted characters are shown in the Tables 6 and 7, respectively. The numbers of character matrix and of the weighted characters correspond to the character numbers mentioned above (Appendix 1). Unknown character states were coded as “?”. Because the multiple character states were recognized in the following taxa and characters, against them were treated as mentioned above (see 2.3. Cladistic analysis): male antennal flagellomeres of *Lobophora* (character state 0 for character number 1 in Appendix 1); male metamer of *Cladara* A (2 for 9); male hind tibial hair-pencil of *Cladara* A and *Lobophora* (2 for 11); forewing areole of *Eupithecia* and *Naxidia* B (1 for 18); gnathos of *Trichopteryx* (2 for 53); ornamentation of phallus of *Esakiopteryx* and *Lobophorodes* (0 for 79); cornutus of *Trichopteryx* (0 for 81). For more information, see their generic descriptions.

Table 6. Character matrix (1/4).

Taxa\Chracters No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
<i>Acasis</i>	0	0	0	1	1	0	2	1	2	0	2	3	2	0	0	0	0	0	1	1	0	0	0	1	1	0	0	0	1	0
<i>Aplocera</i> A	0	0	1	1	1	1	0	0	2	0	2	0	0	0	0	0	1	0	1	1	0	0	0	1	1	0	0	0	0	0
<i>Aplocera</i> B	0	0	1	1	1	1	0	0	2	0	2	0	0	0	0	0	1	0	1	1	0	0	0	1	1	0	0	0	0	0
<i>Archaeocasis</i>	0	0	0	1	1	0	2	1	2	0	2	3	2	0	0	0	0	0	1	1	0	0	0	1	1	0	0	0	0	0
<i>Brabira</i>	5	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	0	0	0	0	2	1
<i>Carige</i>	5	2	0	1	1	0	0	0	2	0	2	0	0	0	0	4	1	1	1	1	0	0	0	1	1	2	2	0	0	0
<i>Chesias</i>	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0
<i>Cladara</i> A	0	0	0	1	1	0	2	1	2	0	2	3	2	0	0	0	0	0	1	1	0	0	0	1	1	0	0	0	1	2
<i>Cladara</i> B	0	0	0	1	1	0	2	1	2	0	2	3	2	0	0	0	0	0	1	1	0	0	0	1	1	0	0	0	1	2
<i>Episteira</i> A	1	1	0	2	2	0	0	0	0	0	0	4	2	0	0	0	0	1	1	1	0	0	0	1	1	3	0	0	1	0
<i>Episteira</i> B	1	1	0	2	2	0	2	0	2	0	2	4	2	0	0	0	0	1	1	1	0	0	0	1	1	3	0	0	1	0
<i>Esakiopteryx</i>	0	0	0	1	1	0	2	1	2	0	2	3	2	0	0	0	0	1	1	1	0	0	0	1	1	3	0	0	0	0
<i>Eupithecia</i>	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0
<i>Eustroma</i>	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	0	0	0	0	0	0	0	0	0
<i>Heterophleps</i> A	4	0	0	1	1	0	0	0	2	0	2	0	0	0	0	3	1	0	1	0	0	0	0	0	0	2	2	0	1	0
<i>Heterophleps</i> B	5	0	0	1	1	0	0	0	2	0	2	0	0	0	0	3	1	0	1	0	0	0	0	2	0	2	2	0	1	0
<i>Heterophleps</i> C	4	0	0	1	1	0	0	0	2	0	2	0	0	0	0	3	1	0	1	0	0	0	0	2	0	2	2	0	1	0
<i>Leptostegna</i>	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	1	0	0	1	0	0	0	2	2	1	0	0
<i>Lobophora</i>	0	0	0	1	1	0	2	1	2	0	2	0	0	0	0	0	0	0	1	0	0	0	0	1	2	0	0	0	1	0
<i>Lobophorodes</i>	0	0	0	1	1	0	2	1	2	0	2	3	2	0	0	0	0	0	1	1	0	0	0	1	1	3	0	0	1	2
<i>Neophacrophilla</i>	2	0	0	1	1	0	2	1	2	0	2	0	0	0	0	0	0	0	1	0	0	0	0	1	2	3	0	0	1	0
<i>Nothocasis</i>	0	0	0	1	1	0	2	1	2	0	2	3	2	0	0	0	0	0	1	1	0	0	0	1	1	0	0	0	0	0
<i>Naxidia</i> A	3	0	0	1	1	0	0	0	2	0	2	0	0	0	0	2	0	1	0	0	0	0	0	0	0	2	2	0	1	2
<i>Naxidia</i> B	3	0	0	1	1	0	0	0	2	0	2	0	0	0	0	2	0	1	0	0	0	0	0	0	0	2	2	0	1	2
<i>Otoplecta</i>	0	0	0	1	1	0	2	1	2	0	2	3	2	0	0	0	0	1	1	0	0	0	0	1	1	0	0	0	1	2
<i>Palaeomystis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	1	0	1	0	0	0	0	0	0	2	2	0	1	2
<i>Paralobophora</i>	0	0	0	1	1	0	2	1	2	0	2	3	2	0	0	0	0	0	1	1	0	0	0	1	1	0	0	0	1	2
<i>Phthonoloba</i> A	0	0	0	1	1	0	2	1	2	2	2	2	2	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	1	2
<i>Phthonoloba</i> B	0	0	0	1	1	0	2	1	2	2	2	2	2	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	1	2
<i>Paratrichopteryx</i>	0	0	0	1	1	0	2	1	0	0	0	3	2	0	0	0	0	0	1	1	0	0	0	1	1	3	0	0	0	0
<i>Pseudacasis</i>	0	0	0	1	1	0	2	1	2	0	2	3	2	0	0	0	0	0	1	1	0	0	0	1	1	0	0	0	1	0
<i>Pterapherapteryx</i>	0	0	0	1	1	0	2	1	2	0	2	0	0	0	0	0	0	1	1	0	0	0	0	1	2	3	0	0	1	0
<i>Sauris</i> A	1	1	0	2	2	0	1	0	0	0	0	4	2	0	0	0	0	1	1	1	0	0	0	1	1	0	0	0	2	0
<i>Sauris</i> B	1	1	0	2	2	0	0	0	0	0	0	4	2	0	0	0	0	1	1	1	0	0	0	1	1	3	0	0	2	0
<i>Sauris</i> C	1	1	0	2	2	0	0	0	0	0	0	4	2	1	1	0	0	1	1	1	0	0	1	1	1	3	0	0	2	0
<i>Sauris</i> D	1	1	0	2	2	0	0	0	0	0	0	4	2	1	1	0	0	1	1	1	0	0	1	1	1	3	0	0	2	0
<i>Tatosoma</i>	0	0	0	1	2	0	2	1	2	0	2	1	1	0	0	0	0	0	1	1	0	0	0	1	1	3	0	0	1	0
<i>Trichopterigia</i>	0	0	0	1	1	0	2	1	2	0	2	3	2	0	0	0	0	1	1	1	0	0	0	1	1	0	0	0	0	0
<i>Trichopteryx</i>	0	0	0	1	1	0	2	1	2	0	2	3	2	0	0	0	0	0	1	1	0	0	0	1	1	3	0	0	1	0
<i>Tristeirometa</i>	0	0	0	2	2	0	2	1	2	0	2	3	2	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	0
<i>Tyloptera</i>	5	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	2	0	0	0	0	2	0
<i>Tympanota</i> A	1	1	0	2	2	0	2	0	2	0	2	4	2	0	0	0	0	1	1	1	0	0	0	1	1	3	0	0	0	0
<i>Tympanota</i> B	1	1	0	2	2	0	?	0	2	0	2	4	2	0	0	0	0	1	1	1	0	0	0	1	1	3	0	0	1	0
<i>Idaea</i> (<i>Ptychopoda</i>)	0	0	0	1	1	0	0	0	1	1	1	4	2	1	1	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0
<i>Timandra</i>	5	0	0	1	1	0	0	0	0	0	0	0	0	0	0	5	1	1	0	0	0	0	0	0	0	1	1	0	0	0

Table 6. Character matrix (2/4).

Taxa\Chracters No.	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
<i>Acasis</i>	0	0	0	2	2	1	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0	1	3	0	3	1	0	0	0	0
<i>Aplocera</i> A	0	0	0	2	2	1	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	1	3	0	0	0	0	0	0	1
<i>Aplocera</i> B	0	0	0	2	2	1	0	0	1	0	0	0	0	0	0	0	0	0	1	0	3	1	3	0	0	0	0	0	0	1
<i>Archaeocasis</i>	0	0	0	2	2	1	0	0	2	1	0	0	0	0	0	0	0	0	3	0	0	1	3	0	0	0	0	0	0	0
<i>Brabira</i>	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	0	0	0	0	0	0	0
<i>Carige</i>	0	0	0	0	2	1	0	0	1	0	0	0	0	0	0	0	0	0	3	2	7	1	0	0	0	0	0	0	0	0
<i>Chesias</i>	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	4	1	1	3	0	0	0	0	0	0	0
<i>Cladara</i> A	0	0	0	1	2	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	2	0	4	0	0	0	0	0
<i>Cladara</i> B	0	0	0	1	2	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	2	0	4	0	0	0	0	0
<i>Episteira</i> A	2	0	0	2	2	1	0	0	1	0	0	0	0	0	0	0	0	0	1	2	5	1	3	0	0	0	0	0	0	0
<i>Episteira</i> B	2	0	0	2	2	1	0	0	2	1	0	0	0	0	0	0	0	0	1	2	5	1	3	0	0	0	0	0	0	0
<i>Esakiopteryx</i>	0	0	0	2	2	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	3	0	4	0	0	0	0	0
<i>Eupithecia</i>	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	2	1	0	1	4	0	0	0	0	0	0	0
<i>Eustroma</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	2	0	0	0	0	0	0	0
<i>Heterophleps</i> A	2	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
<i>Heterophleps</i> B	1	1	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
<i>Heterophleps</i> C	1	0	0	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
<i>Leptostegna</i>	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0
<i>Lobophora</i>	0	0	0	2	2	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	3	0	1	0	0	0	0	0
<i>Lobophorodes</i>	0	0	0	2	2	1	0	0	1	1	0	0	1	0	1	0	0	0	0	3	0	1	3	0	0	0	0	0	0	0
<i>Neophacrophilla</i>	0	0	0	2	2	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	3	0	1	0	0	0	0	0
<i>Nothocasis</i>	0	0	0	0	2	1	0	0	2	1	0	0	0	0	0	1	0	0	0	0	0	1	2	0	4	0	0	0	0	0
<i>Naxidia</i> A	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	3	2	2	1	0	0	0	0	0	0	1	0
<i>Naxidia</i> B	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	3	2	2	1	0	0	0	0	0	0	1	0
<i>Otopecta</i>	0	0	0	0	2	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	3	0	0	1	0	0	0	0
<i>Palaeomystis</i>	0	0	0	1	1	1	0	0	?	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	2
<i>Paralobophora</i>	0	0	0	1	2	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	2	0	5	0	0	0	0	0
<i>Phthonoloba</i> A	0	0	0	0	0	1	0	0	2	1	0	0	0	0	0	0	0	0	0	0	4	1	3	0	0	0	0	0	0	0
<i>Phthonoloba</i> B	0	0	0	0	0	1	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	1	3	0	0	0	0	0	0	0
<i>Paratrachopteryx</i>	0	0	0	2	2	1	0	0	3	0	0	0	0	0	0	0	0	0	2	4	0	1	2	0	4	0	0	0	0	0
<i>Pseudacasis</i>	0	0	0	1	2	1	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0	1	3	0	4	0	0	0	0	0
<i>Pterapherapteryx</i>	0	0	0	2	2	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	3	0	1	0	0	0	0	0
<i>Sauris</i> A	2	0	0	1	2	1	0	0	1	1	0	0	0	0	0	0	0	0	4	1	0	3	5	1	0	0	0	0	0	0
<i>Sauris</i> B	2	1	0	2	2	1	0	0	3	0	0	0	0	0	0	0	0	0	4	1	0	3	5	0	0	0	0	0	0	0
<i>Sauris</i> C	2	1	0	2	2	1	0	0	3	0	1	0	0	0	0	0	0	0	4	1	0	3	5	0	0	0	0	0	0	0
<i>Sauris</i> D	2	1	0	2	2	1	0	0	3	0	2	0	0	0	0	0	0	0	4	1	0	3	5	1	0	0	0	0	0	0
<i>Tatosoma</i>	2	1	0	1	2	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	3	0	0	0	0	0	0	0
<i>Trichopterigia</i>	0	0	0	1	2	1	0	0	1	1	0	1	0	0	0	0	0	0	0	1	0	1	3	0	2	0	1	0	0	0
<i>Trichopteryx</i>	0	0	1	2	2	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	2	0	4	0	0	0	0	0
<i>Tristeiometa</i>	0	0	0	0	0	1	0	0	2	1	0	0	0	0	0	0	0	0	0	1	6	1	3	0	0	0	0	0	0	0
<i>Tyloptera</i>	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
<i>Tympanota</i> A	2	0	0	0	2	1	0	0	1	1	0	0	0	0	0	0	0	1	1	2	0	1	3	0	0	0	0	0	0	0
<i>Tympanota</i> B	2	0	0	0	2	1	0	0	1	0	0	0	0	0	0	0	0	1	1	2	0	1	3	0	0	0	0	0	0	0
<i>Idaea (Ptychopoda)</i>	0	0	0	0	0	1	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Timandra</i>	0	0	0	0	0	1	0	0	0	0	0	0	0	2	0	0	0	0	0	1	2	0	1	0	0	0	0	1	0	2

Table 6. Character matrix (3/4).

Taxa\Chracters No.	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
<i>Acasis</i>	3	0	1	0	0	0	4	0	0	2	1	0	0	0	0	0	0	0	0	0	4	1	0	0	0	0	0	0	0	0
<i>Aplocera</i> A	0	0	0	0	0	0	4	0	0	0	0	0	5	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0	1	0
<i>Aplocera</i> B	0	0	0	0	0	0	1	0	0	0	0	0	5	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0	1	0
<i>Archaeocasis</i>	2	0	1	0	0	0	4	0	1	2	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0
<i>Brabira</i>	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0
<i>Carige</i>	5	2	0	0	0	1	3	0	0	4	0	0	7	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1	0
<i>Chesias</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	1	0
<i>Cladara</i> A	3	0	0	0	0	0	2	1	0	2	0	0	2	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	5	0
<i>Cladara</i> B	3	0	0	0	0	0	2	1	0	2	0	0	2	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	4	0
<i>Episteira</i> A	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0
<i>Episteira</i> B	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	4	0
<i>Esakiopteryx</i>	3	0	0	0	0	0	2	0	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Eupithecia</i>	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	1	0	0	0
<i>Eustroma</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	1
<i>Heterophleps</i> A	1	0	0	2	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Heterophleps</i> B	1	0	0	2	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	5	0
<i>Heterophleps</i> C	1	0	0	2	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	5	0
<i>Leptostegna</i>	1	0	0	1	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Lobophora</i>	4	0	0	1	0	0	0	0	0	1	0	0	4	1	0	0	0	0	0	0	5	0	0	0	0	0	0	0	5	0
<i>Lobophorodes</i>	0	0	0	0	0	0	0	0	0	3	0	0	1	0	0	0	0	0	0	0	2	0	0	0	1	0	0	0	0	0
<i>Neophacrophilla</i>	4	0	0	1	0	0	0	0	0	1	0	0	3	1	0	0	0	0	0	0	5	0	0	0	0	0	0	1	5	0
<i>Nothocasis</i>	3	0	0	0	0	0	1	0	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Naxidia</i> A	1	0	0	3	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	1	0
<i>Naxidia</i> B	1	0	0	2	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	4	0
<i>Otoplecta</i>	2	0	1	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0
<i>Palaeomystis</i>	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0
<i>Paralobophora</i>	3	0	0	0	0	0	2	0	0	2	0	0	2	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	1	0
<i>Phthonoloba</i> A	0	1	0	0	0	0	5	0	0	2	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
<i>Phthonoloba</i> B	0	1	0	0	0	0	5	0	0	2	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	0	0	0	0	0
<i>Paratrachopteryx</i>	3	0	0	0	0	0	2	0	0	2	0	0	2	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
<i>Pseudacasis</i>	3	0	1	0	0	0	4	0	1	2	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
<i>Pterapherapteryx</i>	4	0	0	1	0	0	0	0	0	1	0	0	4	1	0	0	0	0	0	0	5	0	0	0	0	0	0	0	5	0
<i>Sauris</i> A	2	0	0	0	1	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	3	0	0	0	0	0	0	0	0	0
<i>Sauris</i> B	2	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	3	0	0	0	0	0	0	0	1	0
<i>Sauris</i> C	2	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	3	0	0	0	0	0	0	0	1	0
<i>Sauris</i> D	2	0	0	0	1	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	3	0	0	0	0	0	0	0	3	0
<i>Tatosoma</i>	2	0	0	0	0	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0
<i>Trichopterigia</i>	3	0	0	0	0	0	4	0	0	5	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Trichopteryx</i>	3	0	0	0	0	0	2	0	0	2	0	0	2	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	1	0
<i>Tristeirometa</i>	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0
<i>Tyloptera</i>	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0
<i>Tympanota</i> A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0
<i>Tympanota</i> B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	1	0
<i>Idaea (Ptychopoda)</i>	0	1	0	0	0	0	0	0	0	0	0	0	6	0	0	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0
<i>Timandra</i>	2	1	0	0	0	1	4	0	0	0	0	0	6	0	0	0	2	0	0	0	1	0	0	0	0	0	0	0	4	0

Table 6. Character matrix (4/4).

Taxa\Chracters No.	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115
<i>Acasis</i>	0	0	0	4	0	0	0	0	0	1	0	0	1	2	0	1	0	2	0	0	1	0	0	0	0
<i>Aplocera</i> A	0	1	0	0	0	1	0	0	0	3	5	0	0	3	0	0	0	2	0	0	1	0	0	0	0
<i>Aplocera</i> B	0	1	0	0	0	1	0	0	0	3	5	0	0	3	0	0	0	2	0	0	1	0	0	0	0
<i>Archaeocasis</i>	0	0	0	4	0	0	0	0	0	1	0	0	?	2	0	0	0	2	0	0	0	0	0	0	0
<i>Brabira</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0
<i>Carige</i>	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	1	0	0	0	0
<i>Chesias</i>	0	0	0	1	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	1	0	0	0	0
<i>Cladara</i> A	0	0	0	3	0	0	0	4	0	0	0	1	0	0	0	0	0	0	0	0	2	0	0	0	0
<i>Cladara</i> B	0	0	0	2	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
<i>Episteira</i> A	0	0	0	1	0	0	1	0	0	2	1	0	0	1	0	0	0	0	1	0	4	0	0	0	0
<i>Episteira</i> B	0	0	0	1	0	0	1	0	0	2	1	0	0	1	0	0	0	0	1	0	4	0	0	0	0
<i>Esakiopteryx</i>	0	0	0	1	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	2	0	0	1	0
<i>Eupithecia</i>	0	0	0	1	0	0	0	0	1	0	3	1	0	0	0	0	0	0	0	0	2	0	0	0	0
<i>Eustroma</i>	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	3
<i>Heterophleps</i> A	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0
<i>Heterophleps</i> B	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	1
<i>Heterophleps</i> C	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0
<i>Leptostegna</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0
<i>Lobophora</i>	0	0	0	5	0	0	0	0	0	0	4	0	0	1	0	0	0	0	0	0	2	0	0	0	0
<i>Lobophorodes</i>	0	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
<i>Neophacrophilla</i>	0	0	0	5	0	0	0	0	0	0	4	0	0	1	0	0	0	0	0	0	2	0	0	0	0
<i>Nothocasis</i>	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0
<i>Naxidia</i> A	0	0	0	0	0	0	0	5	0	0	0	0	0	3	0	0	0	2	0	0	4	0	0	0	1
<i>Naxidia</i> B	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	3	0	0	0	1
<i>Otoplecta</i>	0	0	0	4	0	0	0	0	0	1	0	0	1	2	0	1	0	0	0	0	2	0	1	0	2
<i>Palaeomystis</i>	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
<i>Paralobophora</i>	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	1	0	0	0	0	2	0	0	0	0
<i>Phthonoloba</i> A	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	4	1	2	0	0
<i>Phthonoloba</i> B	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	4	1	2	0	0
<i>Paratrachopteryx</i>	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0	0	0	0
<i>Pseudacasis</i>	0	0	0	1	0	0	0	0	0	1	0	0	1	2	0	0	0	2	0	1	0	0	0	0	0
<i>Pterapherapteryx</i>	0	0	0	5	0	0	0	0	0	0	4	0	0	1	0	0	0	0	0	0	2	0	0	0	0
<i>Sauris</i> A	0	0	0	1	0	0	1	0	0	0	1	0	0	1	0	0	0	0	1	0	4	0	0	0	0
<i>Sauris</i> B	0	0	0	1	0	0	0	0	0	2	2	0	0	1	0	0	0	0	1	0	4	0	0	0	0
<i>Sauris</i> C	0	0	0	1	0	0	0	0	0	2	2	0	0	1	0	0	0	0	1	0	4	0	0	0	0
<i>Sauris</i> D	0	0	0	1	0	0	0	0	0	2	2	0	0	1	0	0	0	0	1	0	4	0	0	0	0
<i>Tatosoma</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0
<i>Trichopterigia</i>	0	0	0	1	0	0	0	3	0	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
<i>Trichopteryx</i>	0	0	0	1	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
<i>Tristeirometa</i>	0	0	0	1	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	4	0	0	0	0
<i>Tyloptera</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	3	0	0	0	3
<i>Tympanota</i> A	0	0	0	1	0	0	1	0	0	2	1	0	0	1	0	0	0	0	1	0	4	0	0	0	0
<i>Tympanota</i> B	0	0	0	1	0	0	1	0	0	2	1	0	0	1	0	0	0	0	1	0	4	0	0	0	0
<i>Idaea (Ptychopoda)</i>	0	0	0	0	1	0	0	0	0	3	4	0	0	0	0	0	0	0	0	0	2	0	0	0	0
<i>Timandra</i>	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	1	0	0	0	2	0	0	0	0

Table 7. Character weighting matrix.

Characters	Weight indices	Characters	Weight indices	Characters	Weight indices	Characters	Weight indices
1	0.51282054	31	0.60000002	61	0.39583334	91	1
2	0.58333331	32	0.1	62	0.30000001	92	1
3	1	33	1	63	1	93	0.40000001
4	0.28	34	0.11067194	64	0.6857143	94	0.32467532
5	0.29090908	35	0.24444444	65	1	95	1
6	1	36	1	66	0	96	1
7	0.63333333	37	1	67	0.30769232	97	0.375
8	0.47368622	38	1	68	1	98	0.35714287
9	0.23076923	39	0.2	69	1	99	0.0625
10	1	40	0.16190477	70	0.63025212	100	0.5
11	0.23076903	41	1	71	0.25	101	0.75
12	0.60606062	42	1	72	1	102	0
13	0.44444445	43	1	73	0.56875002	103	1
14	0.25	44	1	74	1	104	0.17355372
15	0.25	45	1	75	1	105	1
16	1	46	1	76	0.33333334	106	0.11111111
17	0.15625	47	1	77	1	107	1
18	0.06878307	48	1	78	1	108	0.25
19	0.33333334	49	0.35714287	79	1	109	1
20	0.14666666	50	0.19393939	80	1	110	1
21	1	51	0.65625	81	0.7157895	111	0.19692308
22	1	52	1	82	1	112	1
23	1	53	0.63492066	83	1	113	1
24	0.31999999	54	0	84	0.25	114	1
25	0.44444445	55	0.72916669	85	1	115	0.30000001
26	0.42857143	56	1	86	1		
27	1	57	1	87	1		
28	1	58	1	88	1		
29	0.21052632	59	1	89	0.17763157		
30	0.18518518	60	0.33333334	90	1		

JAPANESE JOURNAL OF SYSTEMATIC ENTOMOLOGY

Monographic Series, No. 6

JAPANESE JOURNAL OF SYSTEMATIC ENTOMOLOGY

Monographic Series, No. 6

April 2021