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A taxonomic study of the family Micropterigidae (Lepidoptera, Micropterigoidea) of Japan, with the phylogenetic relationships among the Northern Hemisphere genera

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ABSTRACT—The Japanese micropterigid moths are revised. Seventeen species in five genera are recognized from Japan, described or redescribed with the male and female genital figures. Of these, two genera, *Issikiomartyria* HASHIMOTO and *Kurokopteryx* HASHIMOTO, and seven species, *Issikiomartyria akemiae* HASHIMOTO, *Issikiomartyria plicata* HASHIMOTO, *Issikiomartyria distincta* HASHIMOTO, *Issikiomartyria bisegmentata* HASHIMOTO, *Kurokopteryx dolichocerata* HASHIMOTO, *Neomicropteryx kiwana* HASHIMOTO, and *Neomicropteryx redacta* HASHIMOTO, are new to science. A new combination is given: *Issikiomartyria nudata* (ISSIKI). Biology and immature structures of the Japanese species are also described together with the keys to genera and to species provided on the basis of the adult characters. Phylogenetic relationships among the Northern Hemisphere genera are analyzed by the cladistic analysis using PAUP* (SWOFFORD, 2002) based on the morphological characters of adults. A monophyly of the Northern Hemisphere genera except for *Micropterix* is supported by nine apomorphies, but their immediate sister taxon remains unresolved.

KEY WORDS: Micropterigidae, Northern Hemisphere genera, generic phylogeny, classification, two new genera, seven new species, Japan.

INTRODUCTION

The Micropterigidae, the most archaic family of Lepidoptera, consist of about 120 described species in ten extant genera from all zoogeographical regions and constitute the superfamily Micropterigoidea itself (MINET, 1985; KRISTENSEN, 1999). The family previously had been placed in a proper ordinal rank as Zeugloptera (CHAPMAN, 1917; HINTON, 1946, 1958), but now there is no doubt that this family is a member of the Lepidoptera (KRISTENSEN, 1984c).

WHALLEY (1978) classified the family into two groups, the Micropterigoid-group and the Sabatincoid-group, by the bifrucation of forewing R1 and the post apical position of forewing R5. The former group consisted of *Micropterix* HÜBNER, *Epimartyria* WALSINGHAM, *Paramartyria* ISSIKI and *Neomicropteryx* ISSIKI, and the latter of *Sabatinca* WALKER (s. lat.), *Agrionympha* MEYRICK, *Palaeomicroides* ISSIKI (as a printing error of *Paramartyria* in the original article (ISSIKI, 1931); see KRISTENSEN & NIELSEN, 1979, footnote 6 of p. 121) and two fossil genera. However, KRISTENSEN & NIELSEN (1979) indicated that these characters are plesiomorphous, attributed to only the latter group, and therefore do not support the monophylies of two groups. They also divided Micropterigidae (as Micropteriginae) into two groups of genera, *Micropterix* group and *Sabatinca*-group, and this division is in curent use (KRISTENSEN & NIELSEN, 1982; KALTENBACH & SPEIDEL, 1982; MINET, 1985; KRISTENSEN, 1999; HASHIMOTO & MEY, 2000). The *Micropterix*-group consists of only one genus *Micropterix*, known from the Palaearctic region and mainly from the Mediterranean sub-region. The *Sabatinca*-group is composed of the remaining genera: *Sabatinca, Epimartyria, Agrionympha, Paramartyria, Palaeomicroides, Neomicropteryx, Hypomartyria* KRISTENSEN & NIELSEN, *Squamicornia* KRISTENSEN & NIELSEN, and *Vietomartyria* HASHIMOTO & MEY. This group is sporadically distributed in the humid forest localities of the world (NIELSEN, 1985). In the *Sabatinca*-group, four Northern Hemisphere genera, *Epimartyria, Neomicropteryx, Paramartyria,* and *Palaeomicroides,* have been strongly supported as a monophyletic entity (KRISTENSEN, 1984a, 1984b; KRISTENSEN & NIELSEN, 1982), but their relationships have not been studied so far.

ISSIKI (1931) presented the family Micropterigidae for the first time from Japan with a study on the external morphology. He described thirteen new species in three new genera from Japan and Taiwan, of which four species in two genera occur in Japan. Subsequently ISSIKI (1953) added a genus and five species including four new species to the Japanese fauna. Since then few taxonomic studies have been done (HASHIMOTO, 1992), although several important studies on the embryonic and postembryonic stages have been contributed to the family in Japan (ANDO & KOBAYASHI, 1978; HASHIMOTO, 2001; KOBAYASHI & ANDO, 1981, 1982, 1983, 1984; MUTUURA, 1956; YASUDA, 1962; YASUDA & HASHIMOTO, 1989).

In the present paper, the Japanese micropterigid moths are revised based on the adult and larval characters, biology and distribution of the species examined are presented, and the phylogenetic relationships of the Northern Hemisphere genera are summarized in a cladistic analysis using PAUP* (SWOFFORD, 2002).

MATERIALS AND METHODS

The present study is based on about 1,300 specimens including 110 immature stages. Dried and alcoholic specimens are used in this study. In addition to the Japanese micropterigid moths, the following species were examined for the purpose of comparison. Micropterigidae: *Epimartyria auricrinella* WALSINGHAM, *E. pardella* (WALSINGHAM), *Micropterix calthella* (LINNAEUS), *Palaeomicroides marginella* ISSIKI, *Pal. obscurella* ISSIKI, *Paramartyria anmashana* HASHIMOTO, *P. maculatella* ISSIKI, *Sabatinca chalcophanes* (MEYRICK), *S. demissa* PHILPOTT, *S. doroxena* (MEYRICK), *S. kristenseni* MINET, *S. porphyrodes* TURNER, *S. sterops* TURNER, *S. zonodoxa* MEYRICK, *Vietomartyria expeditionis* (MEY), *V.* sp1, *V.* sp2. Eriocraniidae: *Eriocrania semipurpurella* (STEPHENS). Trichoptera, Rhyacophilidae: *Rhyacophila clemens* TSUDA, *R.* sp.

For study of the external structures, each component detached was macerated in hot 10% KOH except antennae and wings. KOH-treated materials were washed and dissected in alcohol, then sometimes stained with acetocarmine, and were mounted in xylol balsam. The antennae and wings were detached and transferred into 75 % Et-OH in a small petri dish, then brushed to remove the scales with a fine brush, and were mounted in xylol balsam. Observations and drawings were done under both binocular stereoscope and compound light microscope. Dried and alcoholic materials were used for examination by a scanning electron microscope (SEM). Before coating with a gold, the materials preserved in 75 % Et-OH were dehydrated with 2-methyl-2-propanol and freeze-dried.

The terminology of adult structures used here mainly follows those of KRISTENSEN & NIELSEN (1979) and of KRISTENSEN (1984a, 1984b). The nomenclature of larval setae is that of HINTON (1946) for the body and that of STEHR (1987) for the head.

Collection abbreviations are as follows: KMNH Kitakyushu Museum of Natural History and Human History; OPU Entomological Laboratory, Osaka Prefecture University, Osaka, Japan.

Holotypes and some paratypes of the species described here will be deposited in the Kitakyushu Museum of Natural History and Human History and some paratypes in the National Science Museum, Tokyo. Other paratypes and specimens are preserved in my personal collection.

MORPHOLOGY

1. Adult

General appearance: Moths are very small, between 10 mm and 15 mm in wingspan (KRISTENSEN, 1999). The forewing shows variable maculation with metallic luster, but the hindwing is uniformly grayish brown or pale fuscous with purple luster (Figs. 1-2).

Head: The compound eye is usually of medium size, but may be large in some species. For describing the head proportion two indices, interocular index (IOI) and supraocular index (SOI), have been defined by DAVIS (1975) and KRISTENSEN & NIELSEN (1979) respectively. In the present paper, the modified interocular index (MIOI = vertical eye diameter / minimum distance between the compound eyes) is used for simplicity of measurement instead of IOI. MIOI is close to the eye size index presented by HIROWATARI (1997). SOI is 0.3 to 0.4, but in the most species examined here is about 0.4. MIOI varies from 0.5 to 0.8. The ocellus is present in the extant genera, but absent in the fossil genus *Parasabatinca* WHALLEY. Base of the ocellus is well elevated, especially on the dorsal side. The cranial sulci are relatively well preserved in the family (Fig. 3), but vary in length and condition both within the family and between the individuals. The epicranial (coronal) sulcus is present on the median longitudinal axis of the head and running from the lower medial part of occiput to the anterior part of vertex. The postinterocellar and interocellar sulci (sensu ISSIKI, 1931) each extend between the ocelli. The former is situated at the hind border of vertex and the latter at the middle of vertex. The epistomal (frontclypeal) sulcus is very distinct and recognized as a deep groove connecting the anterior tentorial pits. On the posterior cranial surface the occipital sulcus is distinct and separates the occipital arch from vertex dorsally and from gena latero-ventrally. The temporal sulcus (sensu KRISTENSEN, 1968; postoccipital suture of HANNEMANN, 1956; a groove separating occiput and postgena of ISSIKI, 1931) is recognized as a short connection between the occipital foramen and the occipital sulcus on the dorso-lateral corner. The head capsule is covered with microtrichia on frons and vertex, but often lacks microtrichia (Fig. 4A) along the frontal margin of compound eye (KRISTENSEN & NIELSEN, 1982). The antenna (Fig. 4B-J) is usually longer than half the length of the forewing. The scape is largest, rounded, and concave at middle of inner surface. The pedicel is secondarily large and globular. The flagellum is filiform (Fig. 4D), submoniliform (Fig. 4E) or moniliform (Fig. 4C, 4F-J) and usually covered with piliform scales. The number of flagellomeres varies from about 20 to more than 65 and is much more in the males than in the females. However, in reared specimens the flagellomeres tend to be reduced in number. Each flagellomere (Fig. 4C) has antennal ascoids (KRISTENSEN & NIELSEN, 1979), but lacks sensilla auricillica (DAVIS, 1978). The mouthparts of the family have been studied in detail by TILLYARD (1923), HANNEMANN (1956), ISSIKI (1931), and KRISTENSEN & NIELSEN (1979). The labrum (Fig. 4K-P) is almost pentagonal and has a broad membranous area on the middle. The epipharynx shows an asymmetrical structure (Fig. 4K, 4M), but in some Northern Hemisphere genera of the *Sabatinca*-group this structure (Fig. 4L, 4N-P) is secondarily reduced or absent (KRISTENSEN & NIELSEN, 1979). The mandibles (Fig. 4Q) are asymmetrical and the incisor casps of the left mandible are present at its apex. The maxilla (Fig. 4R) has an unmodified galea and a 5-segmented palpus folded between segments 1 and 2 and between 3 and 4. Segments 1 and 2 of the maxillary palpus are short and of almost equal length; segment 3 slightly shorter than 4; segment 4 flexible, and segment 5 shorter than 3, rounded near base and tapering to the terminal end. According to KRISTENSEN & NIELSEN (1979), the labium (Figs. 3B, 3D-G, 4S-X) consists of the postlabium (submentum of HANNEMANN and ISSIKI), the proximal prelabium (mentum of HANNEMANN, ISSIKI and TILLYARD), and the distal prelabium (prementum of HANNEMANN; basal segment of labial palpus of ISSIKI and TILLYARD). The distal prelabium bears the paraglossae (a process of basal segment of labial palpus in ISSIKI and TILLYARD), the fused glossae (ligula of KRISTENSEN & NIELSEN; part of hypopharynx in ISSIKI and TILLYARD) and the labial palpi. The labial palpus is very short and 1- to 3-segmented. As shown by HANNEMANN (1956) and KRISTENSEN & NIELSEN (1979), the fused glossae and the hypopharynx unite each other to form a complex structure. The hypopharynx (Fig. 4S) has a chamber (infrabuccal pouch), which has been referred to a triturating basket, with many rows of numerous minute spines at posterior part.

Thorax: The thoracic skeletal structure is well discussed by KRISTENSEN & NIELSEN (1979) in comparison with the family Heterobathmiidae (as the subfamily of Micropterigidae). According to their study, there are some differences in the condition of the antero-lateral process of pronotum (Fig. 5A-D) and a proprioceptive hair plate behind the metasubalare (Fig. 4L-N) at the species or generic levels. A pair of pronotal antero-lateral processes articulates with the propleura (MATSUDA, 1970) and is regarded as the ground plan of the Micropterigidae (KRISTENSEN, 1984c). The fore tibial epiphysis is usually present (Fig. 4E-G), but secondarily lost (Fig. 4H-I). The fore (Fig. 4E-H) and mid tibiae (Fig. 4I) have no spurs and the hind tibia (Fig. 4K) has two pairs of spurs. Each tibia has several spines around its terminal end.

Wing venation: The forewing (Figs. 5O-P, 6A-B, 6G-J) lacks a pterostigma. A humeral vein (h) is usually present. Sc is deeply bifurcate. R1 is also deeply forked in the Southern Hemisphere genera (Fig. 5O-P), but is usually simple in the Northern Hemisphere genera (Fig. 6A-B, 6G-J). Sc-R crossvein is present; another crossvein, which is also recognized in some specimens of *Eriocrania semipurpurella* (Eriocraniidae), is rarely present near base (Fig. 6B, 6G). The Rs veins are dichotomously branched and form a radial cell with a inter Rs crossvein, but in some Northern Hemisphere genera R3 is stalked with R4+5. R4 and R5 are usually long stalked, sometimes free. M is three branched. M-Cu crossvein is present (M4 of PHILPOTT, 1923; ISSIKI, 1931). The anal veins sometimes constitute a double Y formation with a crossvein between 1A and 2A, but 2A and 3A are frequently reduced or absent (COMMON, 1990).

The hindwing venation (Figs. 5O-P, 6) is similar to the forewing venation except for Sc and R1 region, but M-Cu crossvein and 3A are usually absent. The main stem of R1 is complete in *Micropterix* (Fig. 6A) and in some species (Fig. 5O) of the *Sabatinca*-group, but may be reduced to a crossvein like basal piece or as a recurrent vein. In the New Zealand *Sabatinca* species, a distal part of R1 always anastomoses with Sc2 (PHILPOTT, 1923). Therefore, when R1 is complete or retained as a recurrent vein (Fig. 5P) in *Sabatinca* s. lat., a subdistal oblique vein connecting Sc and R1 has been interpreted as the basal portion of Sc2 (TILLYARD, 1919a; PHILPOTT, 1923; see KRISTENSEN & NIELSEN, 1982: 514). In *Micropterix* it remains unclear whether a subdistal short vein between Sc and R1 is a crossvein or a basal part of Sc2 (KRISTENSEN & NIELSEN, 1982), although TILLYARD (1919a) and ISSIKI (1931) identified this as the crossvein Sc-R. However, this condition in *Micropterix* is not so, because in *Sabatinca porphyrodes* the Sc and R1 configuration (Fig. 5O) is very similar to that of *Micropterix* (KRISTENSEN & NIELSEN, 1982). The present paper shows two intraspecific variations of the hindwing Sc and R1 region in the Japanese species. 1) A basal free R1 is retained in some specimens of *Issikiomartyria nudata* (Fig. 6E-G). This might suggest that the

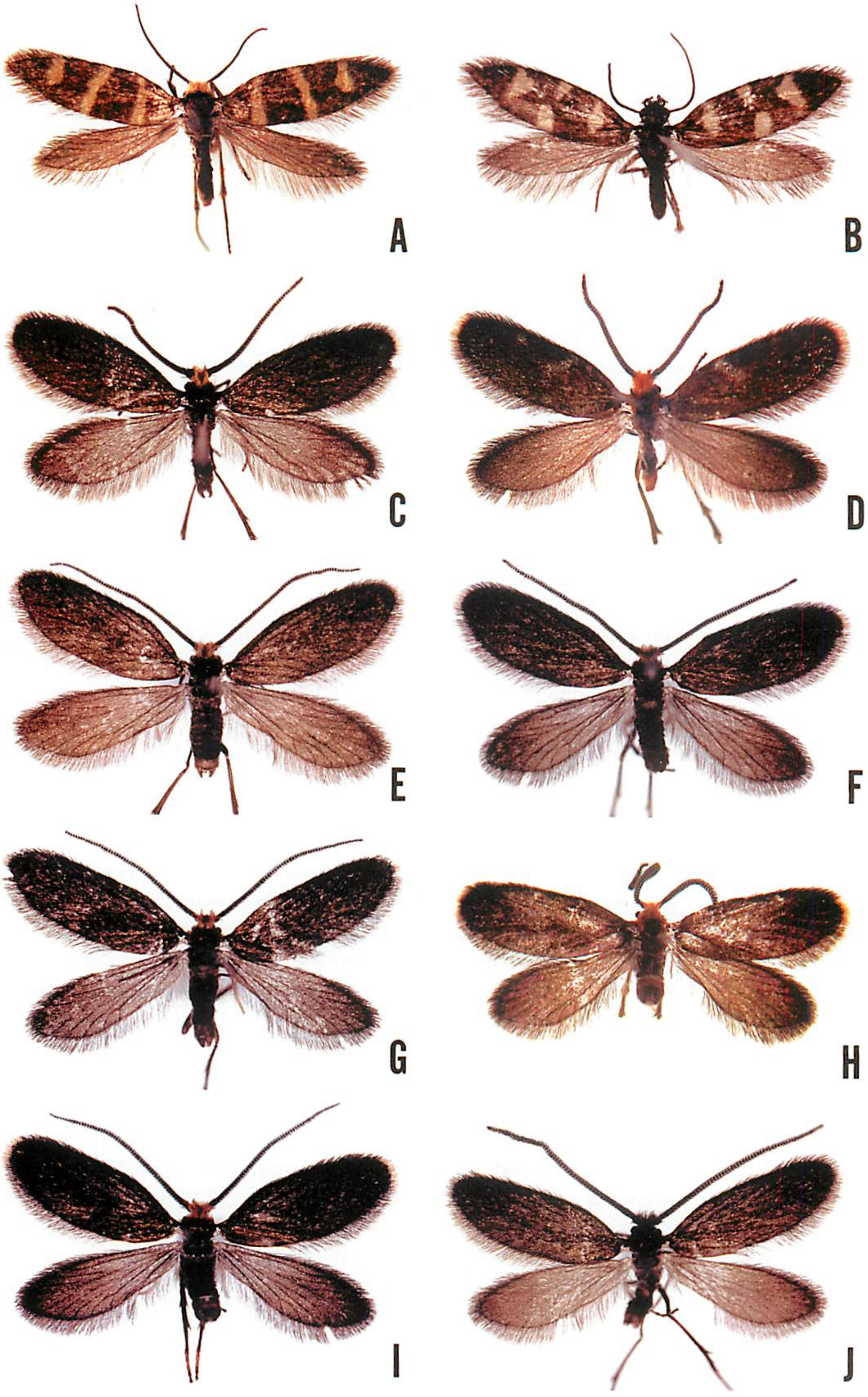

Fig. 1. Adults. A: *Micropterix aureatella,* ♀ (Hokkaido), B: ditto, ♀ (Honshu), C: *Paramartyria immaculatella,* ♂, D: *P. semifasciella,* ♂, E: *Issikiomartyria nudata,* ♂, F: *I. akemiae,* holotype ♂, G: *I. plicata,* holotype ♂, H: *I. distincta,* holotype ♂, I: *I. bisegmentata,* holotype ♂, J. *Kurokopteryx dolichocerata,* holotype ♂.

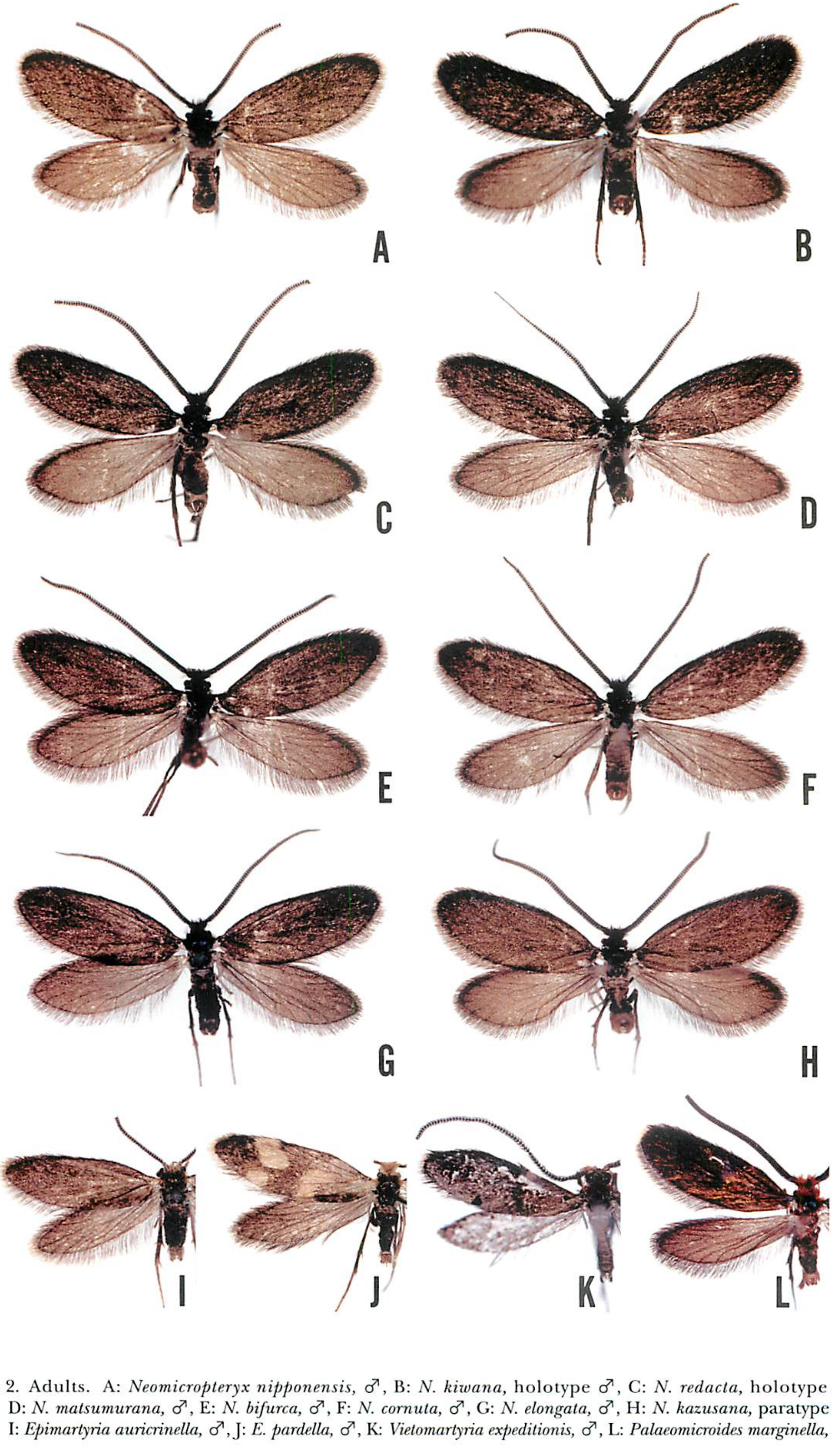

Fig. 2. Adults. A: *Neomicropteryx nipponensis*, ♂, B: *N. kiwana*, holotype ♂, C: *N. redacta*, holotype ♂, D: *N. matsumurana*, ♂, E: *N. bifurca*, ♂, F: *N. cornuta*, ♂, G: *N. elongata*, ♂, H: *N. kazusana*, paratype ♂, I: *Epimartyria auricrinella*, ♂, J: *E. pardella*, ♂, K: *Vietomartyria expeditionis*, ♂, L: *Palaeomicroides marginella*, ♂.

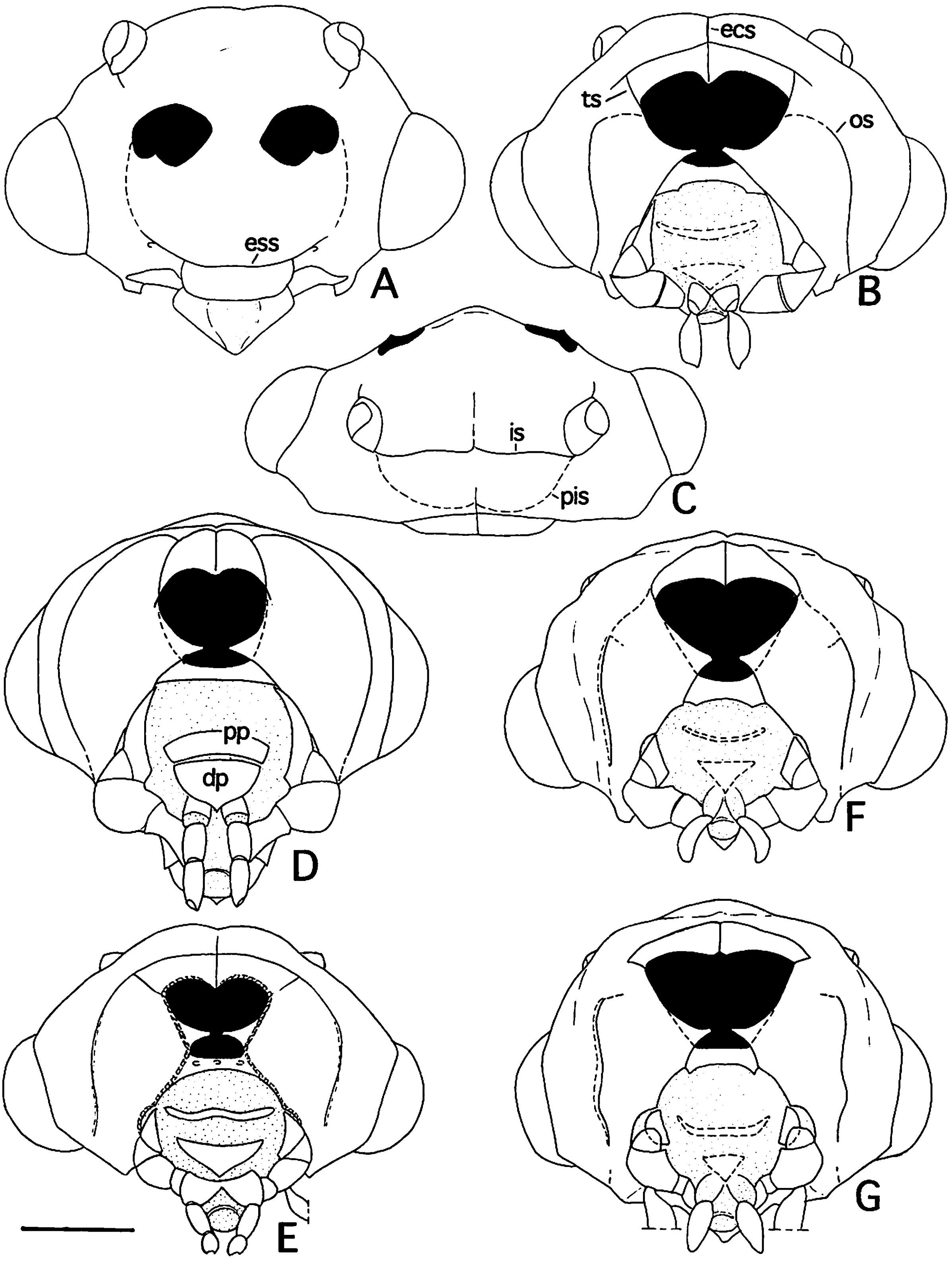

Fig. 3. Head structures. A: *Neomicropteryx nipponensis*, frontal view, B: ditto, posterior view, C: ditto, dorsal view, D: *Micropterix aureatella*, posterior view, E: *Paramartyria immaculatella*, posterior view, F: *Issikiomartyria nudata*, posterior view, G: *Kurokopteryx dolichocerata*, posterior view. dp: distal prelabium, ecs: epicranial sulcus, ess: epistomal sulcus, is: interocellar sulcus, os: occipital sulcus, pis: postinterocellar sulcus, pp: proximal prelabium, ts: temporal sulcus. Scale = 0.2 mm.

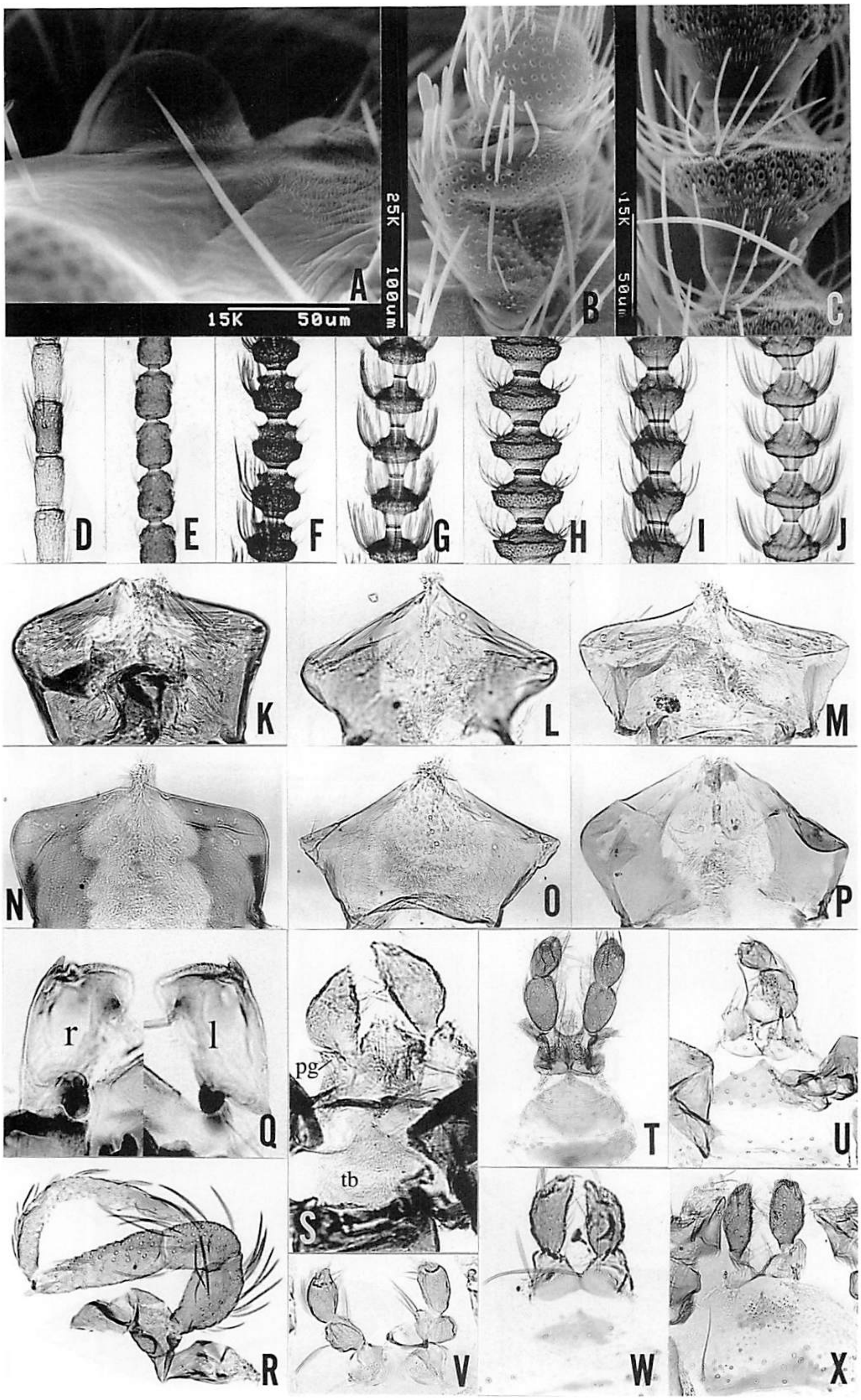

Fig. 4. Head structures. A: epicranium, postero-lateral view, B: scape and pedicel, C: antennal ascoids, D-J: flagellomeres, K-P: labrum, ventral view, Q: mandibles, ventral view, R: right maxilla, S: labium, dorsal view, T-X: labial palpi, ventral view. A, P, S, X: *Neomicropteryx nipponensis*, B-C: *N. matsumurana*, D: *Sabatinca chalcophanes*, E, K, T: *Micropterix aureatella*, F: *Paramartyria semifasciella*, G: *Vietomartyria expeditionis*, H, M: *Palaeomicroides marginella*, I, N: *Issikiomartyria nudata*, J, O, Q-R, W: *Kurokopteryx dolichocerata*, L, U: *Paramartyria immaculatella*, V: *Issikiomartyria bisegmentata*. l: left mandible, pg: paraglossa, r: right mandible, tb: triturating basket.

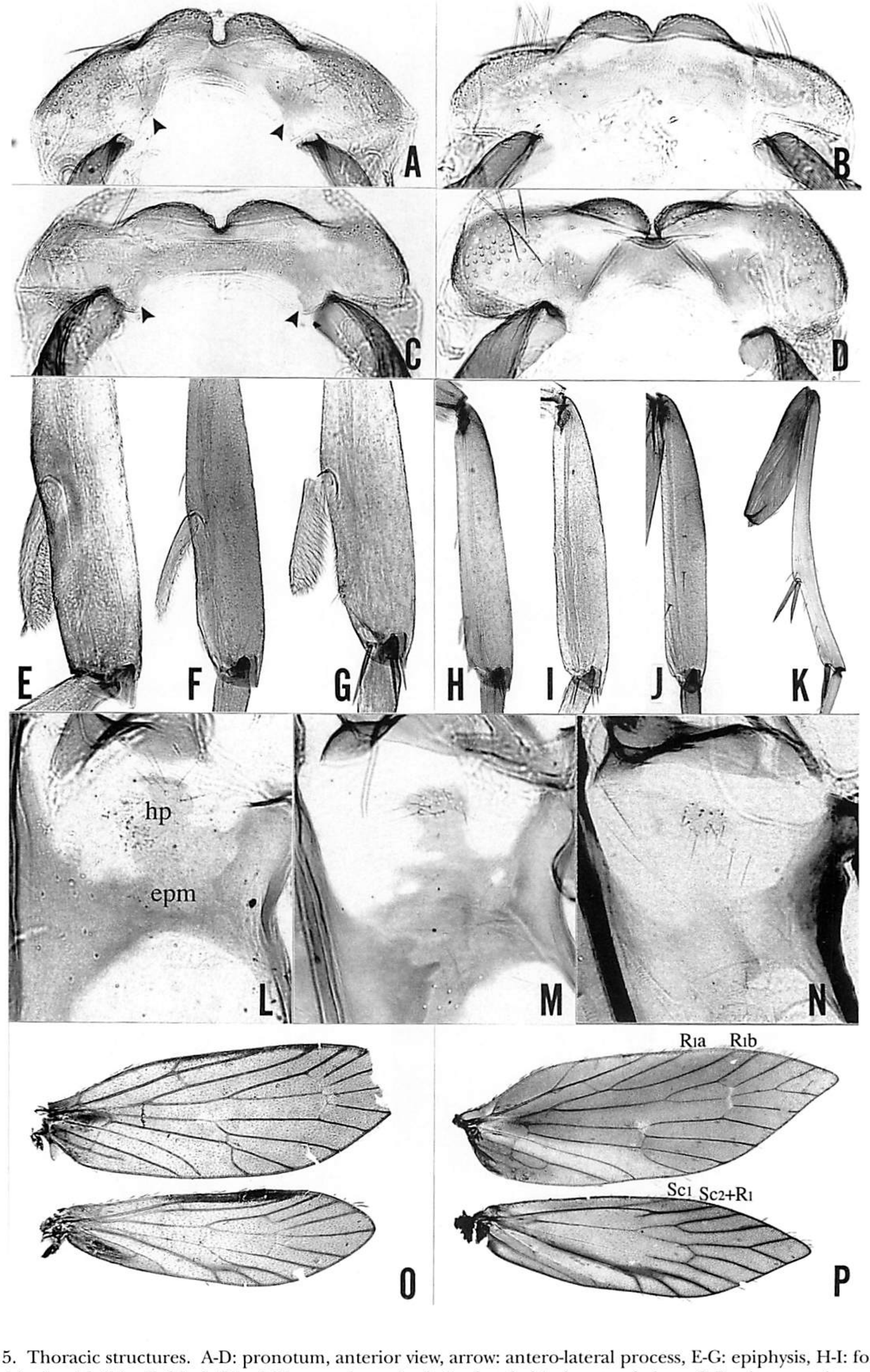

Fig. 5. Thoracic structures. A-D: pronotum, anterior view, arrow: antero-lateral process, E-G: epiphysis, H-I: fore tibia, J: mid tibia, K: hind tibia, L-N: proprioceptive hair plate behind metasubalare, O-P: wing venation. A, F: *Paramartyria immaculatella,* B: *Issikiomartyria nudata,* C, H: *Kurokopteryx dolichocerata,* D, M: *Neomicropteryx elongata,* E: *Micropterix aureatella,* G, L: *Paramartyria semifasciella,* I-K: *Neomicropteryx nipponensis,* N: *N. kazusana,* O: *Sabatinca porphyrodes,* ♂ with specialized scales on costal margin and basal part of media of forewing, and on costal margin and basal part of anal veins of hindwing, P: *S. chalcophanes.* epm: epimeron, hp: hair plate.

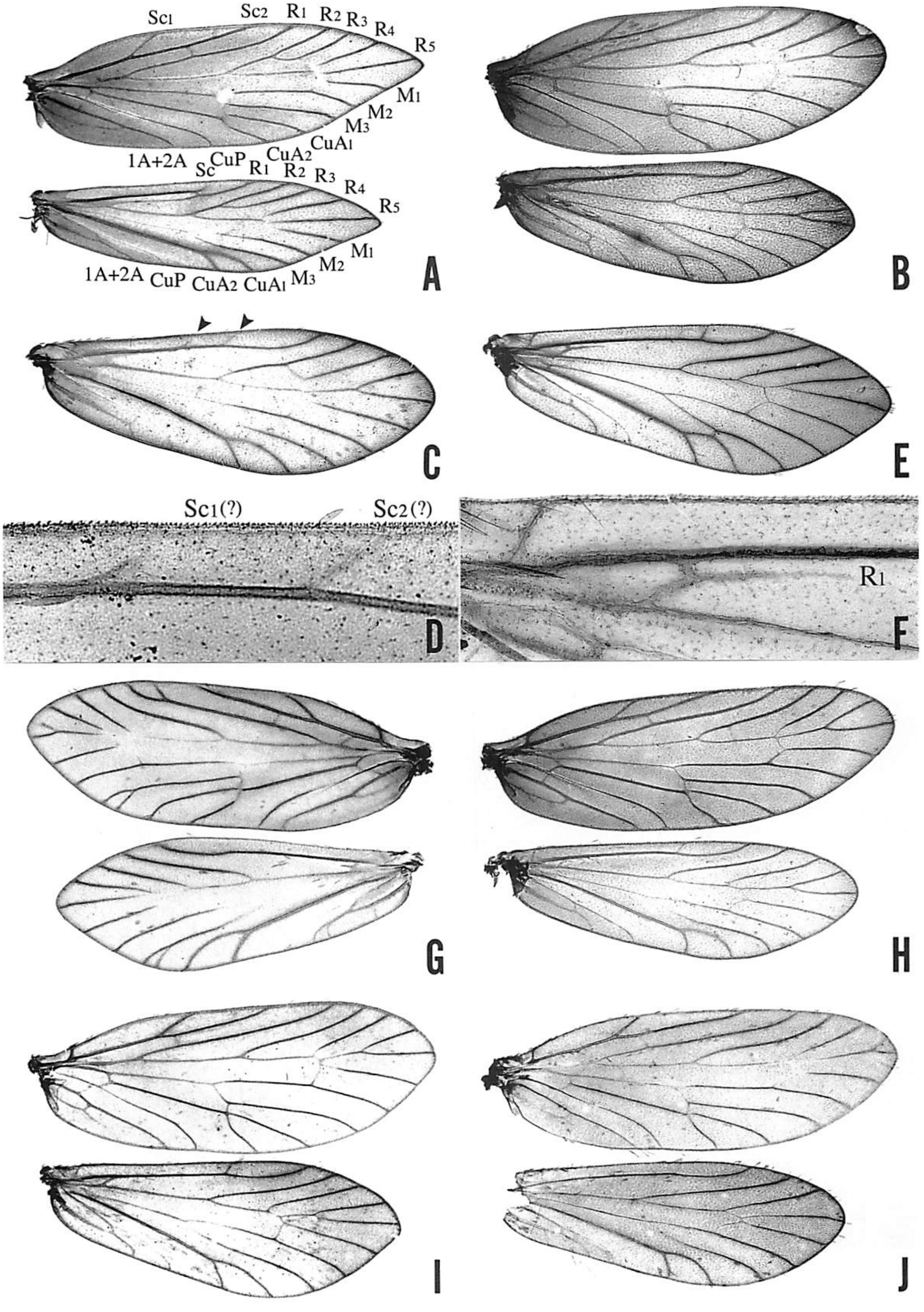

Fig 6. Wing venation. A: *Micropterix aureatella*, B: *Paramartyria immaculatella*, C: *P. semifasciella*, hind wing, arrows: Sc veins (?), D: ditto, middle anterior margin, E: *Issikiomartyria nudata*, hind wing, F: ditto, anterior basal part, G: *I. nudata*, H: *Kurokopteryx dolichocerata*, I: *Neomicropteryx nipponensis*, J: *N. redacta*.

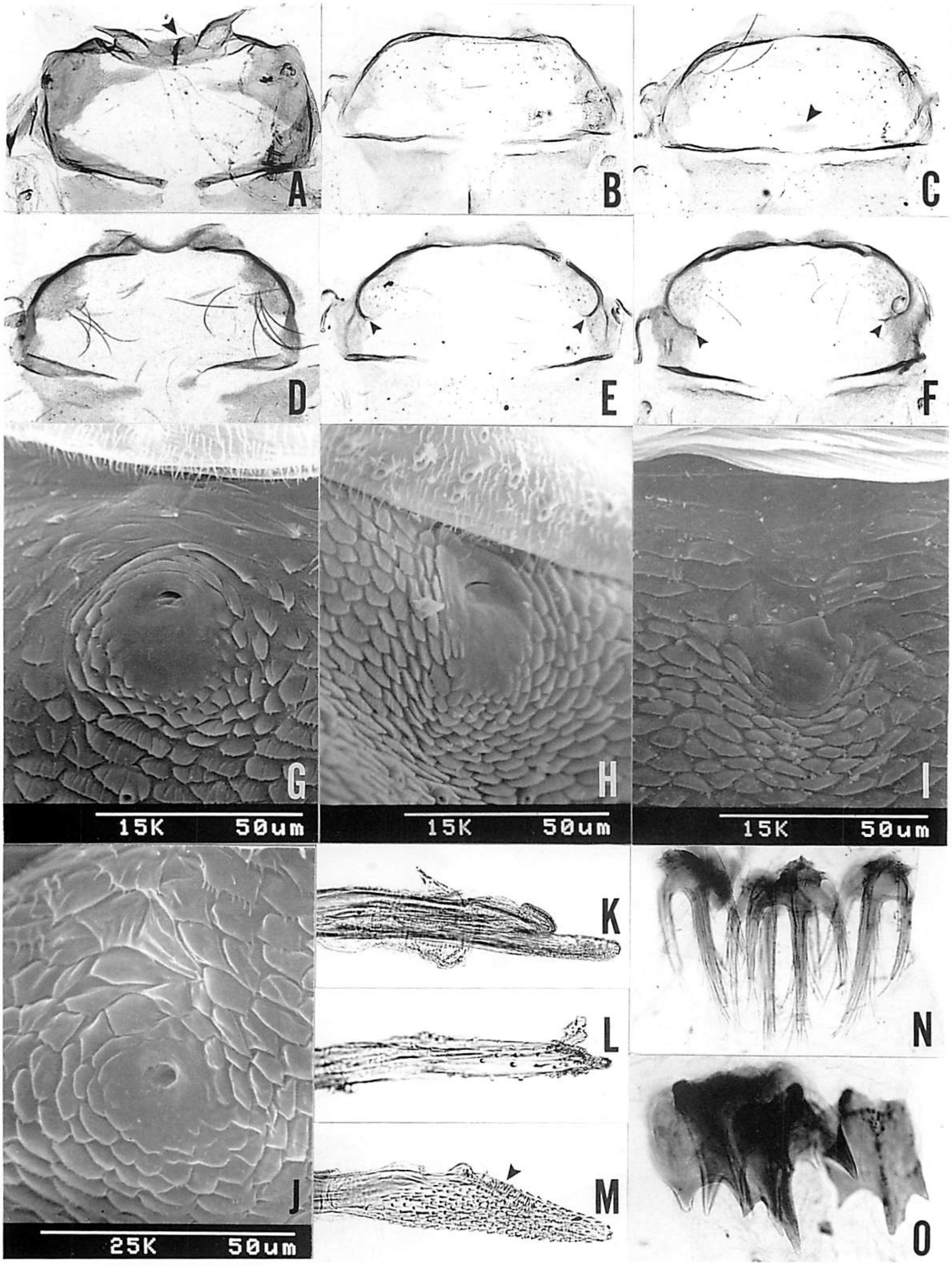

Fig. 7. Abdominal structures. A-F: tergum I, arrows: median longitudinal costa in Fig. A; median sclerite in Fig. C; lateral short ridge in Figs. E-F, G-J: sternum V gland, K-M: aedeagus, lateral view, N-O: signa (tridentaform sclerites). A: *Micropterix aureatella,* B-C: *Paramartyria immaculatella,* D: *Issikiomartyria bisegmentata,* E, I: *Kurokopteryx dolichocerata,* F: *Neomicropteryx matsumurana,* G, L, N: *Paramartyria semifasciella,* H, O: *Issikiomartyria nudata,* J: *Neomicropteryx nipponensis,* K: *Epimartyria auricrinella,* M: *Vietomartyria expeditionis.*

main free stem of R1 disappears in the Northern Hemisphere *Sabatinca*-group. 2) The most anterior vein is three branched near the wing margin in a specimen of *Paramartyria semifasciella* (Fig. 6C-D). When the basal two are interpreted as Sc1 and Sc2 respectively, the distal one is not coalescence of Sc2 and R1, but only the crossvein + distal part of R1. If these variations represent primitive conditions in the Northern Hemisphere genera, as already interpreted by ISSIKI (1931), his interpretation (2) may be correct that similarity between them and the *rosicoma*-section of New Zealand *Sabatinca* is convergent, and that the short vein connecting Sc and R1 in *Micropterix* and *Sabatinca porphyrodes* is a crossvein Sc-R.

Abdomen: KRISTENSEN (1984b) studied the skeltomuscular structure of pregenital abdomen of the family and listed fourteen characters subject to notable variability. In the Japanese micropterigid moths, tergum I shows some variability (Fig. 7A-F). A pair of abdominal glands is usually present on sternum V in both sexes. According to KRISTENSEN (1984b), the gland orifice area is quite different between the Northern and the Southern Hemisphere genera except for *Micropterix* and *Hypomartyria* in which the sternum V gland is secondarily absent. In the former genera the orifice is a narrow slit in a hyaline sternal area (Fig. 7G-J), but in the latter it is present near the tip of the protuberance with the piliform scales. Sternum VIII is reduced as a pair of slender sclerites (Fig. 12B) or completely membranous in the male. The segment VIII spiracle is rudimentary in the female (KRISTENSEN, 1976)

Male genitalia: Abdominal segment IX comprises a synsclerotized ring with an anterior expansion ventrally, but in the Southern Hemisphere species frequently there is less sclerotization dorsally (PHILPOTT, 1924). The valva varies in shape, and its ventral antero-medial part (Figs. 12F, 15D) is firmly connected to an opposite one by a median plate (horizontal plate of PHILPOTT, 1924; juxta of ISSIKI, 1931; Zwischenstück of HANNEMANN, 1957) at the ventral inner surface. Tergum X is generally bilobed, which is recognized as a ground plan of the family (KRISTENSEN, 1984a). Below the proximo-lateral sides of the tergum X there is a more or less sclerotized plate (anal plates in PHILPOTT, 1923; lateral walls in KRISTENSEN & NIELSEN, 1979; anal cone sclerotization in MINET, 1985) morphologically interpreted as venter X sclerotization (sX) by BIRKET-SMITH (1974) and KRISTENSEN (1976, 1984a). This plate (as the venter X plate in this study) is variable in shape and usually separate with tergum X (Fig. 15H), but frequently connected with tergum X (Figs. 17H, 26I, 28H). The phallus is composed of the phallobase and the aedeagus with radial folds around gonopore (Fig. 7K-M). The male genital musculature has been well studied for the genus *Micropterix* (HANNEMANN, 1957; BIRKET-SMITH, 1975; STEKOLNIKOV, 1967; STEKOLNIKOV & KUZNETZOV, 1986), but not in the *Sabatinca*-group (KRISTENSEN, 1984a for *Epimartyria*). Although the musculature is not treated in this paper, *Neomicropteryx* and *Paramartyria* are basically similar to *Epimartyria* in the male genital musculature.

Female genitalia: Abdominal segment IX usually forms a complete ring (PHILPOTT, 1927; MUTUURA, 1972), but when telescoped into segment VIII it is less sclerotized or membranous on the dorsum (CHAPMAN, 1917). Segment X consists of a pair of lateral sclerites and is usually telescoped into the segment IX, but in some Northern Hemisphere genera less so. When segments IX and X are telescoped into the preceding segments, the intersegmental membranes between VIII and IX and between IX and X are relatively long (Fig. 13B). Both apophyses are absent. The corpus bursa is membranous, variable in shape, and sometimes has signa (Figs. 7N-O, 16E, 19A, 24A, 24D, 46A-B, 46G-H) consisting of four tridentaform sclerites (MINET, 1985; PHILPOTT, 1927). The genital chamber is a multi-layered cloaca with a circumcloacal chamber (DUGDALE, 1974), variable in the shape, and often has a variably shaped sclerite (Figs. 19C, 24C, 27C, 29C-D).

2. Immature stages

Egg: Micropterigid eggs are almost ovoid (Fig. 11K-L), about 0.38 × 0.24 mm to about 0.53 × 0.43 mm in *Micropterix* (HEATH, 1962) and about 0.32 × 0.35 mm in *Neomicropteryx* (KOBAYASHI & ANDO, 1982). The egg surface is covered with hygroscopic gelatinous material, which absorbs water to form club like structures (CHAUVIN & CHAUVIN, 1980) or bubble like structures (KOBAYASHI & ANDO, 1982) after oviposition.

Larva: The last instar larvae (Figs. 10, 11A-C) are about 5 mm in length. The head is nearly prognathous, retractable well into the prothorax, has 3-segmented long antenna (Fig. 9M) and 5 to 6 stemmata, but lacks the adfrontal suture and spinneret (MARTINOVA, 1950; LORENZ, 1961; YASUDA, 1962; DAVIS, 1987). The cranial setae are very short, reduced in number, concentrated to the anterior part of head. A single median seta (M1) on the frontoclypeus is unique for Lepidoptera (MARTINOVA, 1950; YASUDA, 1962; DAVIS, 1987; HASHIMOTO, 2001). This seta is considered to be homologous with a campaniform sensillum in the trichopterous larvae (KRISTENSEN, 1999). The thorax and abdomen are hexagonal in cross-section. The thoracic legs are 4-segmented (KRISTENSEN & NIELSEN, 1983: consisting of coxa, trochanter + femur, tibia + tarsus, and pretarsus), but the basal segment (coxa) is unrecognizable (Fig. 9N) as a melanized plate in *Epimartyria* (DAVIS, 1987), *Paramartyria* (YASUDA & HASHIMOTO, 1989), and *Neomicropteryx* (YASUDA, 1962). Abdominal prolegs are present on abdominal segments I-VIII, but lack both muscles (DAVIS, 1987) and

Table 1. Names of larval setae on thorax and abdomen according to different authors.

	Hinton's system			
	Davis, 1982	Hashimoto, 2001	This study	Mutuura, 1956
Prothorax	D1	D1	D1	Unnamed
	XD1	D2	D2	Unnamed
	XD2	L2	L1	PN1
	D2	L3	L2	PN2
	SD1	L1	L3	PN3
	SV1	SV1	SV1	C1
	L1	SV2	SV2	C2
Meso- and metathorax	D1	D1	D1	Unnamed
	D2	D2	D2	Unnamed
	SD1	L1	L1	PN1
	L1	L2	L2	PN2
	*	*, L3	*, L3	*, PN3
	SV1	SV1	SV1	C1
	SV2	SV2	SV2	C2
Abdomen, 1-8	D1	D1	D1	Unnamed
	D2	D2	D2	Unnamed
	SD1	L1	L1	PN1
	L1	L2	L2	PN2
	SV1	SV1	SV1	C1
	V1	SV2	SV2	Coxal process
Abdomen, 9	Unnamed	D1	D1	Unnamed
	Unnamed	L1	L1	PN1
	Unnamed	SV1	SV1	C1
Abdomen, 10	Unnamed	D1	D1	Unnamed
	Unnamed	L1	L1	-

*: L3 is absent in *Epimartyria* and *Paramartyria*.

-: A corresponding seta was not indicated.

crochets. Thoracic and abdominal setae are also reduced in number, but variable in number and shape among the genera. SD and V setae of the body region are absent (Hashimoto, 2001). Hashimoto (2001) compared the setal names according to Davis (1987) and Mutuura (1956), but his setal notation is partly mistaken. Therefore in the present paper the revised setal notation is provided in Table 1 and in Fig. 8A-C. The prothorax has 4 pairs of minute setae arranged in an anterior vertical row in *Epimartyria* (Davis, 1987), *Paramartyria*, and *Neomicropteryx* (Hashimoto, 2001). On the thorax and abdominal segments I-IX, some sclerites, which are the attachments of the muscles internally, are present at the dorsal and lateral parts of each segment (Yasuda, 1962; Yasuda & Hashimoto, 1989). The dorsal sclerite is nearly circular and situated near the caudal margin on the median longitudinal line except on the prothorax and abdominal segments VIII-IX. On the prothorax two dorsal sclerites are present near the anterior margin and between the D1 setae; on abdominal segments VIII-IX it is situated near the anterior margin. The lateral sclerite is smaller than the dorsal one and is situated slightly behind the middle of each segment above the L setal group. The remaining sclerites consist of small dots and are divided into two groups; the upper one is below the level of the D2 setae and the lower one at the level of the lateral sclerite, at the anterior margin of metathorax and abdominal segments I-VIII, and situated in a longitudinal concavity including the spiracle. These sclerites are the attachments of the dorsal longitudinal muscles internally, and therefore, may be homologous with the antecosta of the segment. The larval tracheal system is peripneustic (Davis, 1987). The spiracles are dome-like (Fig. 9O) in the first instar larva, conical and surrounding with filamentous walls (Fig. 9P) in the mature larva (Davis, 1987), and situated at the anterior margin of abdominal segments I-VIII near the level of L1 seta, but on the prothorax near the posterior margin.

Pupa: The pupae are about 2.5 to 4 mm in length and are the decticous type (Fig. 11J) with functional acute, slender mandibles. Abdominal segments I-VII are movable.

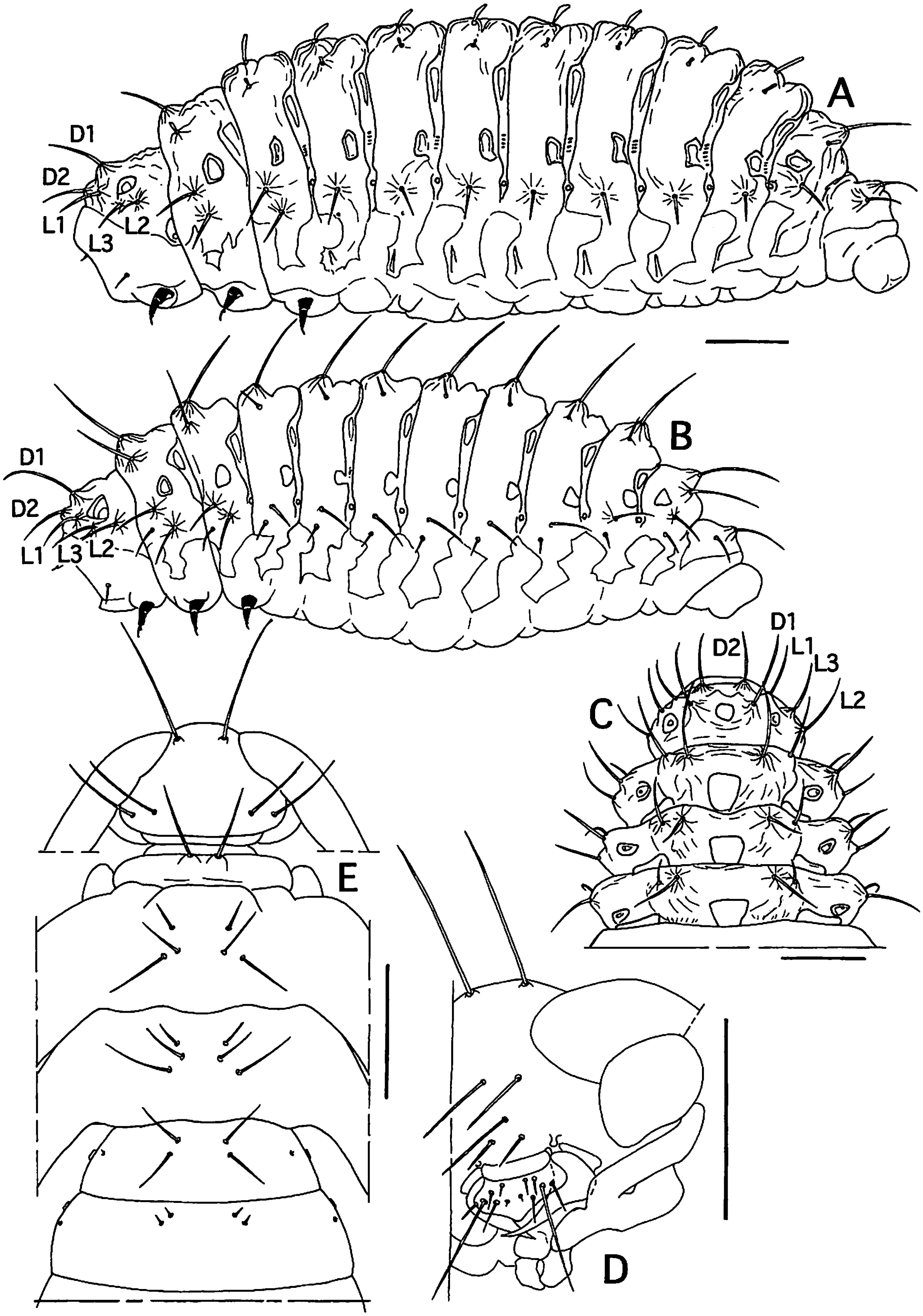

Fig. 8. Last instar larvae and pupa. A-B: last instar larva, lateral, C: last instar larva, anterior dorsal part, D: pupa, head, antero-dorsal view, E: pupa, anterior dorsal part. A: *Issikiomartyria nudata*, B-C: *Kurokopteryx dolichocerata*, D-E: *Neomicropteryx matsumurana*. Scales = 0.5 mm.

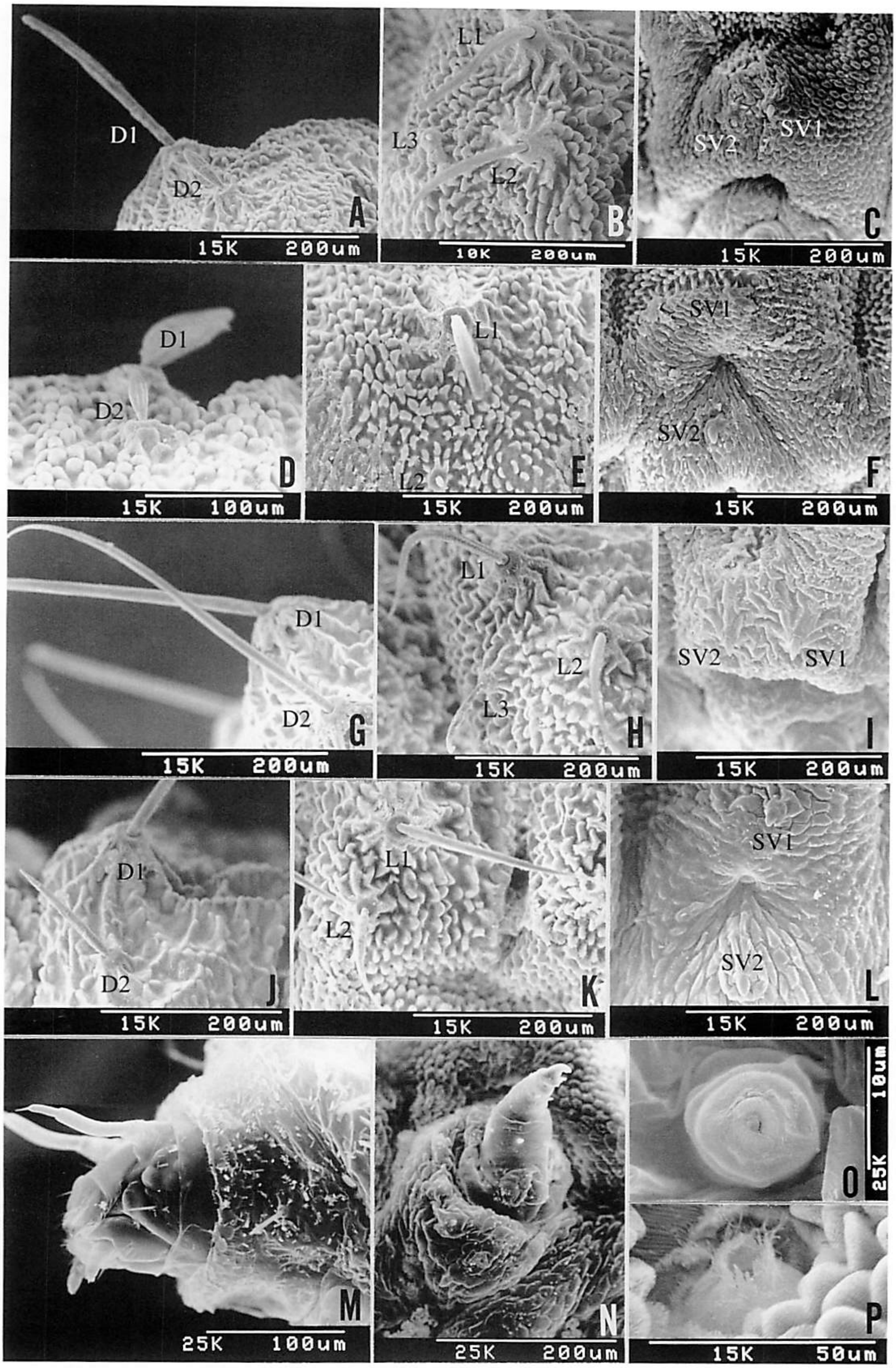

Fig. 9. Larval structures. A, H: mesothorax, D setal group, B, H: ditto, L setal group, C, I: ditto, SV setal group, D: abdominal segment IV, D setal group, E: ditto, L setal group, F: ditto, SV setal group, J: abdominal segment II, D setal group, K: ditto, L setal group, L: ditto, SV setal group, M: 1st instar larva, head, lateral, N: 1st instar larva, metathoracic leg, ventral view, O: 1st instar larva, spiracle, P: last instar larva, spiracle. A-F: *Issikiomartyria nudata*, G-L: *Kurokopteryx dolichocerata*, M-P: *Neomicropteryx matsumurana*.

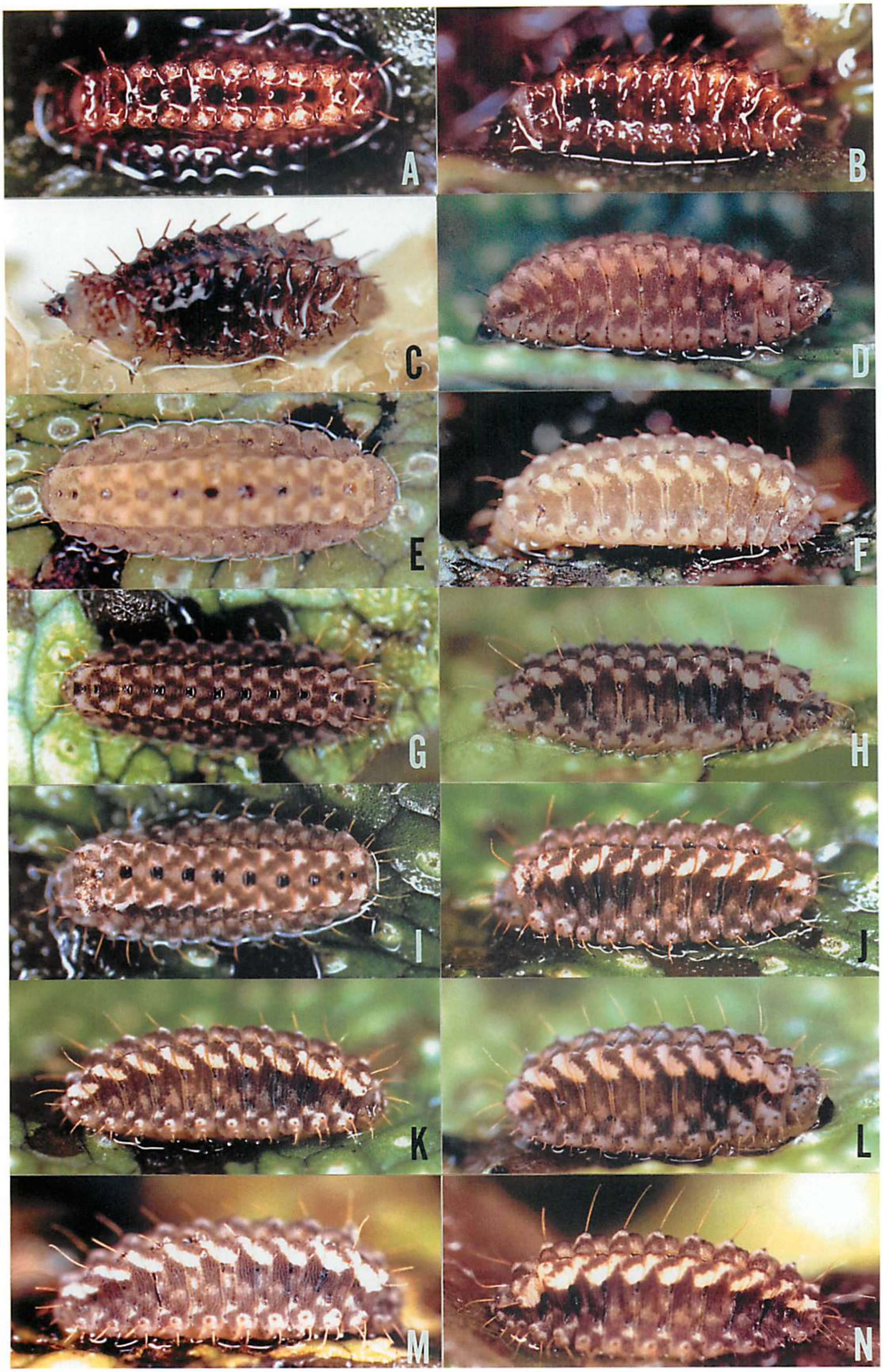

Fig. 10. Last instar larvae. A: *Paramartyria immaculatella,* dorsal, B: ditto, lateral, C: *P. semifasciella,* lateral, D: *Issikiomartyria nudata,* lateral, E: *I. bisegmentata,* dorsal, F: ditto, lateral, G: *Kurokopteryx dolichocerata,* dorsal, H: ditto, lateral, I: *Neomicropteryx nipponensis,* dorsal, J: ditto, lateral, K: *N. kiwana,* lateral, L: *N. redacta,* lateral, M: *N. matsumurana,* lateral, N: *N. bifurca,* lateral.

Fig. 11. Immature stages and biology. A-C: last instar larvae, lateral, D-F: host plants, G-I: pupal case, J: pupa, lateral, K-L: eggs, M-O: perching posture, P: habitat of *Neomicropteryx matsumurana*. A: *Neomicropteryx cornuta*, B: *N. elongata*, C: *N. kazusana*, D: *Paramartyria* larva on *Makinoa crispata*, E: *Heteroscyphus coalitus*, F: *Neomicropteryx* larvae on *Conocephalum conicum*, G: *Paramartyria semifasciella*, H: *Issikiomartyria bisegmentata*, I: *Kurokopteryx dolichocerata*, J, L, N: *Neomicropteryx matsumurana*, K: *Paramartyria immaculatella*, M: *Issikiomartyria nudata*, O: *Micropterix aureatella* (photo by Dr. H. YOSHITOMI).

The body cuticle is almost transparent except for the pale brown mandibles and the peritreme of the spiracles. The number of setae is fewer than that of the larva and the setal arrangements are also rather different. The following descriptions are based on *Neomicropteryx* pupae. Spiracles are present on the prothorax and on abdominal segments I-VIII. The prothoracic spiracle is the largest. Of the abdominal spiracles, the spiracle on segment I is the largest and present at the middle of the segment; other abdominal spiracles are present near the anterior margin of each segment. The spiracle on segment VIII is the smallest. The number of setae is frequently variable on both sides of the body. The labrum (Fig. 8D) has 6 pairs of setae. The frons (Fig. 8D) has two pairs of setae and one median seta considered to be homologous with the one present in the larva (M1). A pair of long setae (Fig. 8D-E) is present behind the vertex and two pairs (Fig. 8E) are present on the occipital region. On the prothorax (Fig. 8E) a pair of long setae is present on the dorsal region. Three pairs of long setae are usually present on the meso- and metathorax. Of these thoracic setae one or two pairs are probably homologous with D setal group of the larva. Two dorsal and two lateral pairs of setae (Fig. 8E) are present on the abdominal segments I-VIII. The dorsal setae of segment I are long and prominent, but the lateral ones of segments I-VIII and the dorsal ones of segments II-VIII are short or minute. Of the two lateral setae, the dorsal one is dorso-caudal and ventral one is ventro-caudal to the spiracle on each segment except segment I on which the dorsal one is directly dorsal to the spiracle. The dorsal pairs may be homologous with the D setal group and the lateral ones L setal group of the larva respectively. There are three pairs of setae on the segment IX, the D1, L1 and SV1. On segment X no setae are visible. The long setae of head and thorax are furcate in *Micropterix* (LORENZ, 1961; CARTER & DUGDALE, 1982), but not furcate in the *Sabatinca*-group (TILLYARD, 1923; YASUDA, 1962).

BIOLOGY

The biology of the family is only partially known. Adult females lay the eggs singly or in small groups in two to 45 on moss or on the under surface of liverwort thalli (LORENZ, 1961; TUSKES & SMITH, 1984; YASUDA, 1962). The larval food substrate is variable among the species, especially in *Micropterix*. It has been observed that the *Micropterix* larvae can be reared on decayed plants (LORENZ, 1961) and on fresh photosynthetic angiosperm tissue (CARTER & DUGDALE, 1982). The larvae of the *Sabatinca*-group (North American *Epimartyria*, Japanese *Neomicropteryx* and *Paramartyria*, and New Zealand *Sabatinca*), feed on liverworts (TILLYARD, 1922; TUSKES & SMITH, 1984; YASUDA, 1962; YASUDA & HASHIMOTO, 1989). The larvae require three instars before pupation in *Epimartyria* (TUSKES & SMITH, 1984), four instars in *Micropterix* (KLAUSNITZER *et al.*, 2002), and four instars in *Kurokopteryx* and *Neomicropteryx* (my observation). Pupation occurs within the ellipsoidal cocoon, which is tightly woven from silk only or from silk and soil granules, on the ground or near the host substrate (Fig. 11G-I). When the adult emerges, the pupa cuts the cocoon with their acute mandibles. Adult moths are typically diurnal (Fig. 11M-O), but it has been observed that some Australian species are attracted to mercury vapor lights in night (COMMON, 1990). The adults of *Micropterix* visit flowers to feed on pollen (HEATH, 1960). The life cycle is apparently completed in a year, but the North American species probably has a two-year life cycle (DAVIS, 1987; TUSKES & SMITH, 1984).

TAXONOMY

Family Micropterigidae HERRICH-SCHÄFFER, 1855

Micropterigina HERRICH-SCHÄFFER, 1855: 389. Type-genus: *Micropterix* HÜBNER, [1825] 1816: 426.

Diagnosis. Micropterigidae are a unique family with functional mandibles and are characterized by antennal ascoids, desclerotization of the abdominal sternum VIII in male, and absence of the apophyses in the post-abdominal segments in female. From the primitive families with the functional mandibles, Agathiphagidae and Heterobathmiidae, Micropterigidae are easily distinguished by the following characters: ocelli absent and spur formula of the legs of 1, 4, 4 in Agathiphagidae (ocelli usually present and spur formula of 0, 0, 4 in Micropterigidae and Heterobathmiidae); Sc vein of the forewing unforked and pterostigma present in Heterobathmiidae (Sc forked and pterostigma absent in Micropterigidae).

Remarks. Fifteen external and two internal characters have been proposed as the probable autapomorphies of the family Micropterigidae (KRISTENSEN, 1999: 41). Of these, twelve characters pertain to the adult. In addition, the loss of crossvein M-Cu in the hindwing is proposed here as one of apomorphies of the family, but it also occurs in some lineages of Lepidoptera. In the Micropterigidae, crossvein M-Cu is rarely present as an individual variation (Fig. 6E).

Micropterigidae are currently divided into two generic groups; namely, the *Micropterix*-group and *Sabatinca*-group (KRISTENSEN & NIELSEN, 1979, 1982). Although KALTENBACH & SPEIDEL (1982) provided tribal status to each generic group, recent studies on the phylogeny of the micropterigid moths based on mitochondrial DNA (KOBAYASHI *et al.*, 2000; KOBAYASHI *et al.*, in prep.) have suggested the possibility that the Northern Hemisphere genera including *Micropterix* constitute a monophyletic entity.

Key to the Northern Hemisphere genera based on adult

1. Forewing with R1 vein deeply bifurcate (Fig. 5P), except for *Sabatinca porphyrodes* (Fig. 5O)...Southern Hemisphere genera
— Forewing with R1 vein unforked (rarely shallowly bifurcate as an individual variation)...(Northern Hemisphere genera) 2
2. Fore- and hindwings with an acute apex; hindwing usually with a complete stem vein of R1......*Micropterix*
— Fore- and hindwings with an obtusely round apex; hindwing with an incomplete stem vein of R1.........3
3. Head covered with yellow or orange piliform scales ...4
— Head covered with black piliform scal 8
4. Foretibia with epiphysis 5
— Foretibia without epiphysis..6
5. Fore- and hindwings with a radial cell; aedeagus with about 20 to 50 minute serrate projections; female abdominal segment X without a dorsal sclerite.........*Paramartyria*
— Fore- and hindwings without a radial cell; aedeagus with a few minute serrate projections; female abdominal segment X with a dorsal sclerite.......*Palaeomicroides*
6. Fore- and hindwings without a radial cell .... *Issikiomartyria* gen. nov.
— Fore- and hindwings with a radial cell 7
7. A basal stalk of each flagellomere distinct; aedeagus divided into dorsal and ventral branches; corpus bursae large, with 4 distinct tridentaform signa ...... *Epimartyria*
— A basal stalk of each flagellomere distinct; aedeagus not divided; corpus bursae small, with or without 4 minute signa .... *Vietomartyria*
8. Forewing slender; valva with a costal long projection curved ventro-mesally; aedeagus without dorsal and ventral longitudinal ridges; female abdominal segment X without a dorsal sclerotized plate...*Kurokopteryx* gen. nov.
— Forewing rather broad and oval; valva without such a long projection; aedeagus with dorsal and ventral longitudinal ridges; female abdominal segment X with a dorsal sclerotized plate....................... *Neomicropteryx*

Genus *Micropterix* HÜBNER, [1825] 1816

Micropterix HÜBNER, [1825] 1816: 426. Type-species: *Tinea podevinella* HÜBNER, [1813]: pl. 50, fig. 342, by subsequent designation by MEYRICK, 1912: 6.

Micropterix ZELLER, 1839: 185, an unjustified emendation.

Eriocephala CURTIS, 1839: folio 751. Type-species: *Phalaena* (*Tinea*) *calthella* LINNAEUS, 1761: 367, by monotypy.

Microptericina ZAGULAJEV, 1983: 113. Type-species: *Micropteryx amasiella* STAUDINGER, 1880: 421, by original designation.

Diagnosis. *Micropterix* is a very unique genus with a pair of slender sclerites of sternum VIII and dorso-medial and dorso-lateral processes of segment IX ring in male, and without sclerotization of dorsum IX in female. Absence of sternum V gland and retention of the main stem of hindwing R1 are shared with the South American genus *Hypomartyria*, from which it differs in an unforked R1 vein of the forewing and an acute apex in the fore- and hindwings (KRISTENSEN & NIELSEN, 1982).

Adult

The description is based on *Micropterix aureatella* (SCOPOLI) and *M. calthella* (LINNAEUS), and on the following studies: ISSIKI (1931), KOZLOV (1988), KRISTENSEN (1984b), KRISTENSEN & NIELSEN (1979, 1982), and LANGOHR & KUCHLEIN (1998).

Head: Head capsule densely covered with microtrichia and therefore seemingly dull; frons and vertex covered with yellow to orange piliform scales in most species, black in a few species. Antenna submoniliform, long, but not reaching an apex of forewing, longer in male; scape the largest segment, longer than borad; pedicel bulbous; flagellomeres about 45 in male, about 35 in female; basal two flagellomeres nearly cylindrical. SOI about 0.4. MIOI about 0.6. Interocellar sulcus interrupted in middle. Postinterocellar sulcus distinct. Epicranial sulcus distinct, extending from occipital foramen to near posterior margin of head. Temporal sulcus distinct. Occipital sulcus complete. Occiput semicircular. Epipharyngeal armature well developed. Labial palpus 2-segmented. Proximal prelabium and post labium distinct.

Thorax: Foretibial epiphysis present; antero-lateral processes of pronotum distinct; proprioceptive hair plate behind metasubalare free. Fore- and hindwings with an acute apex; forewing variable in ground color, usually bronzy golden or purple, with or without golden or silvery markings; forewing R1 unforked; all Rs branches terminated at costal region before apex in fore- and hindwings; an interradial crossvein joining R3 and R4 present in forewing (therefore forming a radial cell), present or absent in hindwing; R4 and R5 free in fore- and hindwings; R1 free, connected with Sc by a subdistal short vein in hindwing.

Abdomen: Tergum I broadly membranous except for both sides, with a median longitudinal, short costa at anterior rim in male (Fig. 7A, arrow). Sternum V gland absent. Tergum VIII smaller than the preceding segments in male, larger in female. Sternum VIII with a pair of slender sclerites in male.

Male genitalia: Segment IX with a dorso-medial and a pair of dorso-lateral processes; antero-ventral portion extending slightly anteriorly. Valva very slender, variable in shape; a median plate small. Phallus nearly straight; phallobase cylindrical; aedeagus slightly divided into dorsal and ventral portions near the terminal end. Tergum X consisting of a pair of setose dorso-lateral processes, weakly sclerotized.

Female genitalia: Segments IX and X completely telescoped in segment VIII. Tergum IX desclerotized. Sternum IX sclerotized, variable in shape. Intersegmental membranes between segment VIII and IX and between IX and X rather long, with many granules. Ductus spermathecae arising from membranous cupuliform papilla. Corpus bursae oblong, without any signa.

Immature stages

Of about 70 described species of the genus *Micropterix*, only the morphology of the immature stages of *M. calthella* has been well studied (CHAUVIN & CHAUVIN, 1980 for egg; HAMON & CHAUVIN, 1995 for larva; LORENZ, 1961 for larva and pupa; MARTINOVA, 1950 for larva) with a few exceptions (CARTER & DUGDALE, 1982; KLAUSNITZER *et al.*, 2002). Larval and pupal descriptions are based on the above authors.

Egg: Ovoid, covered with club like structures.

Last instar larva: Body length 2.5-4.5 mm. Body elongate or barrel-shaped, whitish gray to dark gray. Abdominal segments I-VIII with acute ventral prolegs; segment X trilobated. Setae of thorax and abdomen leaf-shaped or club-shaped, but number of setae on each segment not consistent among the authors.

Pupa: Body length about 2.5 mm. Mandibles usually conspicuous. Head and thorax with long bifurcate setae.

Biology. There is a single generation a year. Adults (Fig. 11O) are diurnal and visit the flowers where they feed on pollen using their functional mandibles (LORENZ, 1961). In the European species, it is observed that the moths are found on the flowers of oak (*Quercus*), sycamore (*Acer*), hawthorn (*Crataegus*), sedges (*Carex*) and many herbaceous plants, and are also found on tree trunks (HEATH, 1960; LANGOHR & KUCHLEIN, 1998). In contrast with the biological information on the adults, little is available on the early stages. Eggs are laid on the soil surface amongst vegetation. Larvae of *M. aruncella* (SCOPOLI, 1763) and *M. calthella* feed on fresh photosynthetic tissue of angiosperms (CARTER & DUGDALE, 1982), but as for other species of *Micropterix*, the larval habits are unknown or little known. It is also reported that the two species mentioned above hibernate in the larval stage (CARTER & DUGDALE, 1982).

Remarks. *Micropterix* is the largest genus in the family and consists of about 70 described species from the Palaearctic region (KRISTENSEN, 1999). Monophyly of the genus *Micropterix* has been supported by the following five characters (KRISTENSEN & NIELSEN 1979, 1982), viz., (1) All Rs veins reaching to costa in the forewing, (2) anterior rim of tergum I with a median longitudinal costa in male, (3) sternum V gland lost, (4) abdominal segment IX ring with dorso-medial and dorso-lateral processes in male, and (5) dorsal area of abdominal segment IX unsclerotized in female. Although an unforked R1 vein of forewing has also been regarded as a derived condition of *Micropterix*, this trait is common to the Northern Hemisphere *Sabatinca*-group genera

Micropterix aureatella (SCOPOLI, 1763)

(Figs. 1A-B, 3D, 4E, 4K, 4T, 5E, 6A, 7A, 11O, 12, 13)

Phalaena aureatella SCOPOLI, 1763: 254.

Micropteryx aureatella: ISSIKI, 1953: 133; ISSIKI, 1971: 5, pl. 1: 1; MORIUTI, 1982: 42, pl. 1: 1, pl. 235: 1, pl. 245: 1.

Micropterix aureatella shikotanica: KOZLOV, 1988: 12.

Redescription

Adult (Figs. 1A-B, 11O). Forewing length 4.0-5.0 mm (mean 4.5 mm, n = 16) in males, 3.9-4.8 mm (mean 4.4 mm, n = 20) in females.

Head capsule dull, fuscous, naked on genal area, covered with pale orange piliform scales on greater part of clypeus, frons and vertex. Antenna long, about 5/6 of forewing length in male, about 2/3 in female; scape, pedicel and basal 1/3 of flagellum covered with fuscous lamellar scales; other flagellomeres surrounded with fuscous piliform scales curved apically; flagellum with 46-48 segments (mean 47.0, n = 10) in males, 32-38 segments (mean 35.0, n = 21) in females; 1st flagellomere nearly cylindrical, longest; other flagellomeres longer than broad. Maxillary palpus covered with light brown scales.

Thorax blackish brown or light brown, covered with brownish purple lamellar scales on dorsum, slightly mixed with blue metallic on tegula; metascutum and metascutellum naked except hind margin of metascutum and a medial part of metascutellum, on which fuscous piliform scales are scattered; pleura covered with glossy and brownish yellow lamellar scales. Legs covered with blackish brown scales, more glossy on inner surface; hind tibial spurs naked, light brown; hind tibia with blackish brown bristles around mid spurs and terminal end. Forewing with parallel margins from basal 1/5 to 2/3, with an acute apex, purple metallic, with three golden fasciae; proximal one being at about basal 1/3 on costa, extending from costa to hind margin and occasionally not reaching hind margin; 2nd being before 1/2, extending outwardly from costa to the middle and then vertically or rather inwardly running to hind margin, but divided into anterior and posterior spots in Tohoku and Chubu specimens examined here; 3rd one on terminal 1/4, usually distinct as a costal large spot, variable in shape and size. Cilia and ventral surface glossy grayish brown. Hindwing more slender than forewing, with an acute apex, glossy blackish brown tinged with purple; cilia glossy grayish

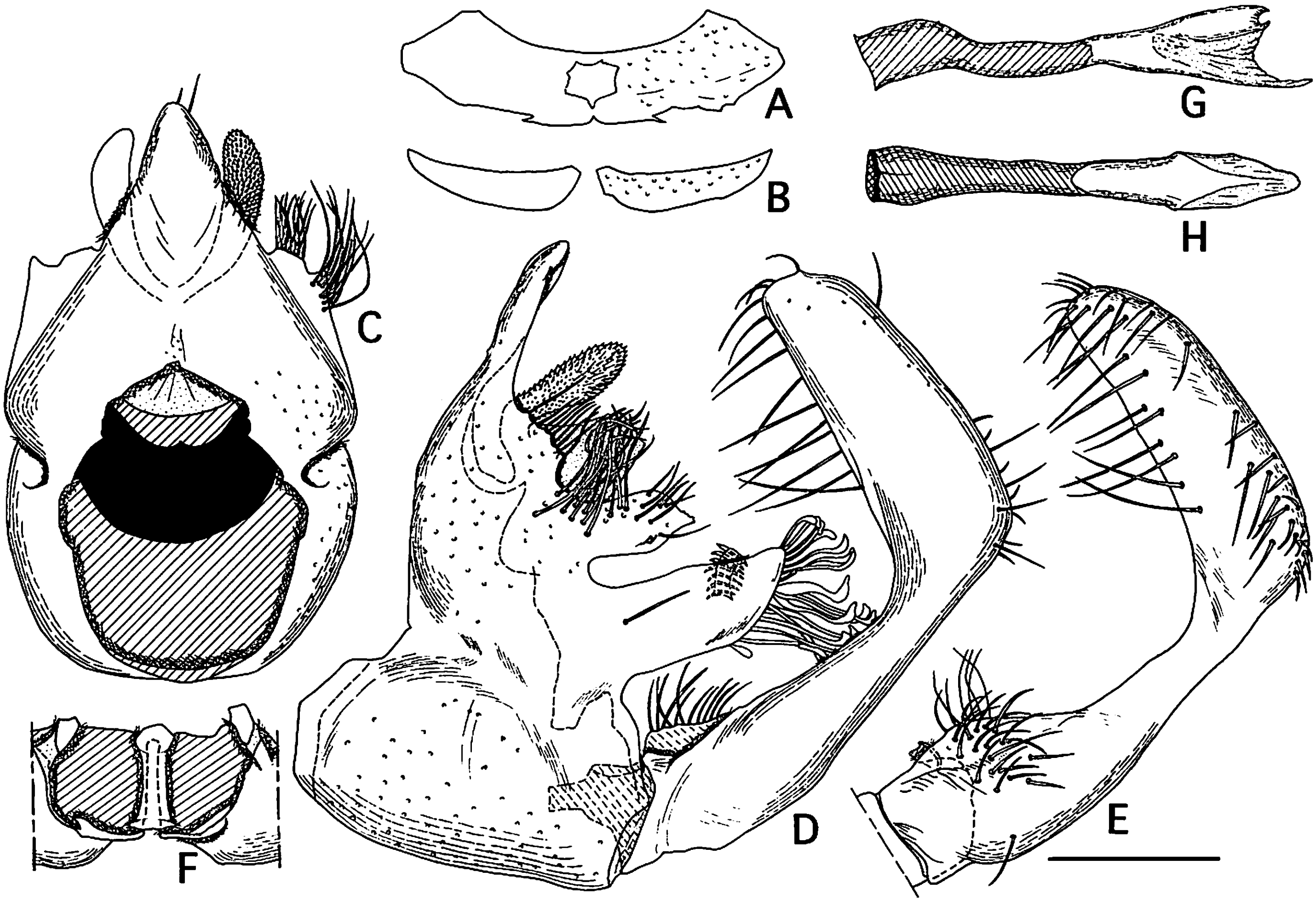

Fig. 12. Abdominal segment VIII and male genitalia of *Micropterix aureatella*. A: tergum VIII, B: sternum VIII, C: antero-dorsal view, phallus and valvae removed, D: lateral view, phallus removed, E: right valva, inner view, F: median plate and basal part of valvae, caudal view, G: phallus, lateral view, H: ditto, ventral view. Scale = 0.2 mm.

brown; ventral surface same as dorsal surface.

Abdomen grayish brown, covered with glossy grayish brown piliform and lamellar scales, tinged with purple, scattered with light orange piliform scales on venter and genital segments in male.

Male genitalia (Fig. 12C-H): Segment IX ring with three pairs of dorso-lateral processes on posterior margin; most dorsal one being ventro-laterally to a dorsal median process, very short, with stout hairs along margin; second one rather long, with a small protrusion at an obtuse apex, with flattened long hairs on outer surface; third one longest, with flattened and rather sclerotized long hairs on terminal inner margin, which are curved near apex and have an obtuse apex, and with a short plate at before 1/4 of terminal end, which has 7 or 8 hornlike projections on each side. Valva slender, curved nearly at right angle at middle. Phallus slender; phallobase as long as aedeagus, almost cylindrical, slightly curved before middle; aedeagus with minute serrate spines on each side at middle, expanded dorso-ventrally towards apex, poorly sclerotized ventrally at apical half, protruded ventro-caudally; gonopore opening at terminal end of dorsal cylindrical part of aedeagus. Tergum X bilobed, less sclerotized, covered with serrate protrusions and small hairs.

Female genitalia (Fig. 13): Abdominal segments IX and X usually telescoped in segment VIII. Sternum IX slightly extending antero-laterally. Segment X shorter than high. Corpus bursae membranous, slender. Arising part of ductus spermathecae concave, circular, surrounded with thicken fold.

Immature stage. Unknown in Japan.

Specimens examined. Hokkaido- 4♂, Mt. Asahidake, 9. vii. 1958 (H. KUROKO) (OPU); 1♀, Shibetsugawa, Kushiro, 27. vi. 2001 (H. YOSHITOMI); 1♀, Mitsumata, Kamishihoro, 22. vii. 1993 (T. HIROWATARI) (OPU); 1♀, Yamada spa, Tokachi, 9. vii. 1980 (S. HASHIMOTO) (OPU); 1♀, Nukabira, Tokachi, 21. vi. 1979 (A. SHINOHARA); 8♀, Osoushi spa,

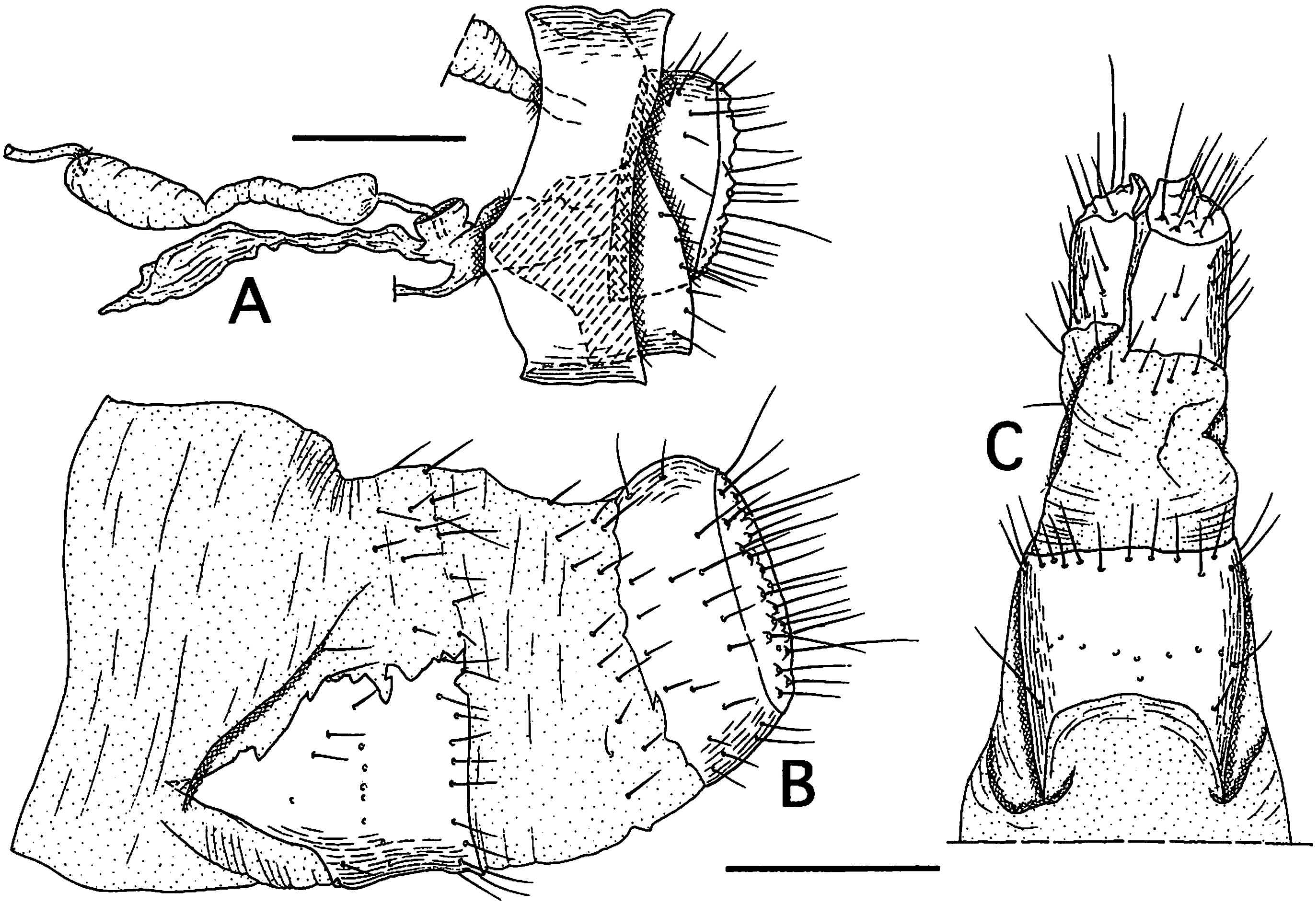

Fig. 13. Female genitalia of *Micropterix aureatella*. A: lateral view, B: segment IX and X, lateral view; C: ditto, ventral view. Scales = 0.2 mm.

Tokachi, 23. vi. 1986 (I. KANAZAWA & F. KOMAI); 1♀, Hokeikyo, Sapporo-shi, 25. vi. 2000 (H. YOSHITOMI). Honshu- 1♀, near Hachimantai (*ca.* 1000-1300 m), Ashiro-cho, Iwate Pref., 10-13. vii. 1995 (H. YOSHITOMI); 4♂, Okutateshina (1800-2000 m), Nagano Pref., 16. vii. 1992 (S. MORIUTI) (OPU); 2♂, same locality (1900-2000 m), 6. vii. 1993 (S. MORIUTI). (OPU); 6♂, 2♀, same locality (*ca.* 1950 m), 12. vii. 1996 (S. MORIUTI & Y. MORIUTI) (OPU); 1♂, Mts. Yatsugadake, Nagano Pref., 24. vii. 1994 (T. HIROWATARI) (OPU); 1♂, Kuroyuridaira, Chino-shi, Nagano Pref., 24. vii. 1994 (T. UEDA)(OPU); 1♂, 1♀ in 75% Et-OH, Mt. Ontake (*ca.* 2000 m), Gifu Pref., 22. vii. 1997 (H. YOSHITOMI).

Distribution. Europe, Russian Far East and Japan (Hokkaido and the mountainous areas of Northern and Central Honshu; Fig. 14).

Biology. The larvae of European population are known as a litter-dwelling species and found in oak (*Quercus*), beech (*Fagus*), and bilberry (*Vaccinium*) litter with a high incidence of mycorrhizal roots (CARTER & DUGDALE, 1982). Adult moths are day-fliers and frequently observed visiting flowers (Fig. 11O).

Remarks. KOZLOV (1988) divided this species into two subspecies, namely *M. aureatella aureatella* for the European population and *M. aureatella shikotanica* for the Russian Far East one, based on the wingspan and length of a dorsal process of the male abdominal segment IX ring. He(1989) also classified the Japanese population into *M. aureatella shikotanica*. According to the original description of the subspecies *M. aureatella shikotanica*, the forewing length (wingspan 7-8.5 mm and forewing length 3.2-3.8 mm) and the dorsal process of male IX ring are shorter

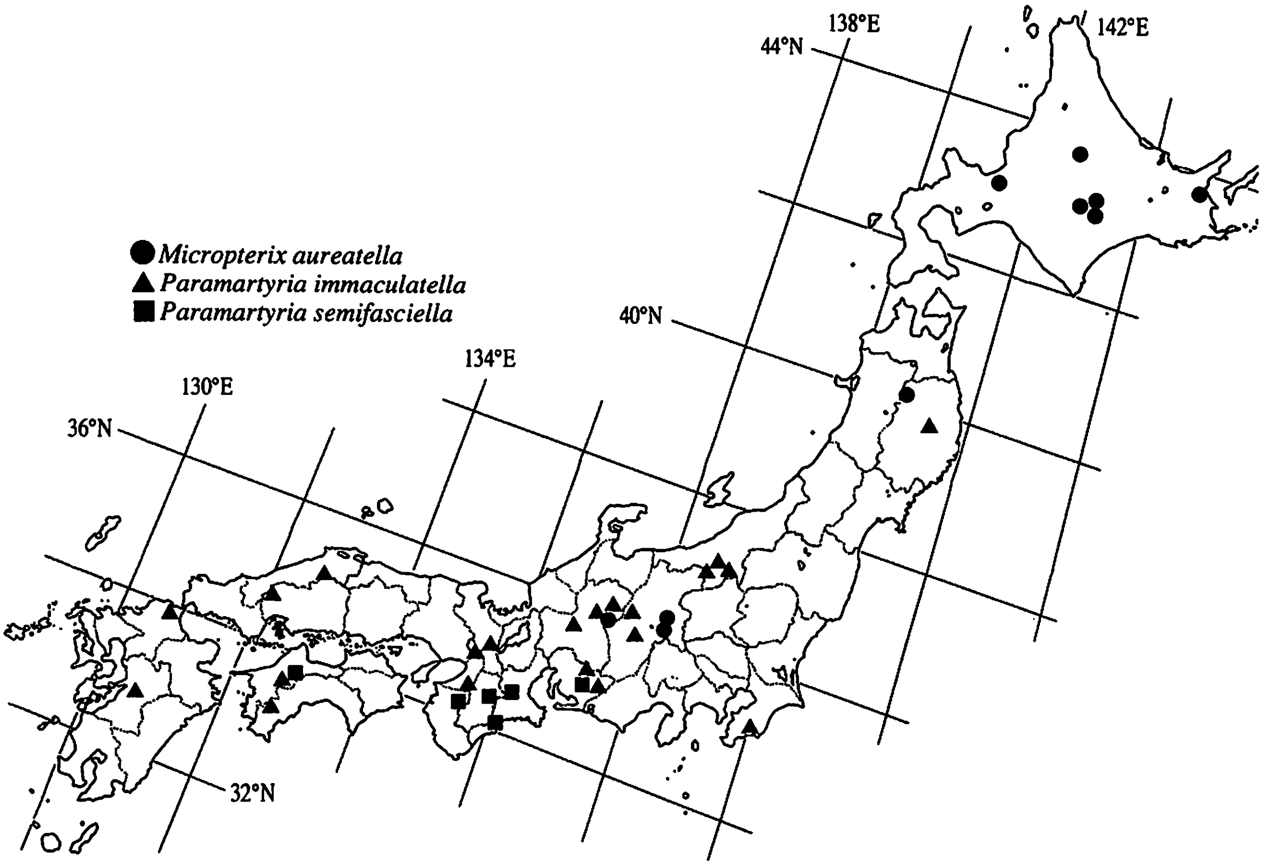

Fig. 14. Distribution map of Japanese *Micropterix* and *Paramartyria* species.

than those of the nominotypical subspecies. However, the Japanese specimens examined here show the rather long forewing (wingspan 8.3-10.1 mm and forewing length 3.8-4.8 mm) and dorsal process similar to those of the nominotypical subspecies. On the other hand, as indicated in the above description, the forewing maculation is different between the Hokkaido and the Honshu populations. However, the number of specimens and localities examined here are too few to classify the Japanese population into subspecies. Therefore, the present paper does not treat the Japanese population as either subspecies.

This species is closely related to *M. sikhotealinensis* PONOMARENKO and BELJAEV (2000) distributed in the continental Russian Far East, but is distinguishable from it by wing maculation (slender fasciae in *M. aureatella*, but broad fasciae in *M. sikhotealinensis*) and the male genitalia (dorsal process of the segment IX ring rather narrow at base in *M. aureatella*, but broad in *M. sikhotealinensis*).

Genus *Paramartyria* ISSIKI, 1931

Paramartyria ISSIKI, 1931: 1000. Type-species: *Paramartyria immaculatella* ISSIKI, 1931: 1002, figs. 1, 2a, 3, 28a, 29b, by original designation.

Diagnosis. *Paramartyria* is characterized by the aedeagus with about 20 to 50 minute serrate projections and the complicated venter X plate in the male, and by the combination of following characters: antenna moniliform, labial palpus 2-segmented, epipharyngeal armature completely reduced, foreleg epiphysis present, forewing R1 simple, a radial cell present in fore- and hindwings, a free stem vein of R1 absent in hindwing, orifice of abdominal V gland reduced as a slit, and valva slender.

Adult

The generic description is based on *Paramartyria immaculatella* ISSIKI, *P. semifasciella* ISSIKI, *P. maculatella* ISSIKI and *P. anmashana* HASHIMOTO, and the following studies: ISSIKI (1931, 1953), KALTENBACH & SPEIDEL (1982) and YANG (1980).

Head: Head capsule densely covered with microtrichia, but naked and shining on genal area; most of clypeus, frons, and vertex covered with orange, piliform scales. Antenna moniliform, long, but not reaching apex of forewing, longer in male; flagellomeres about 45 in male, about 35 in female; basal one or two flagellomeres cylindrical; each node of flagellomere more narrow. SOI about 0.4. MIOI about 0.5. Interocellar sulcus almost complete. Postinterocellar sulcus distinct as a darker line. Epicranial sulcus distinct only at occiput. Occipital sulcus nearly complete, but slightly indistinct on dorso-lateral corner. Temporal sulcus as a darker line. Occiput oblong, fan-shaped. Epipharyngeal armature completely reduced. Labial palpus 2-segmented. Proximal prelabium and post labium distinct as sclerotized plates.

Thorax: Fortibial epiphysis present; antero-lateral processes of pronotum recognizable, but weekly sclerotized; proprioceptive hair plate behind metasubalare connected with epimeron. Fore- and hindwings obtuse at apex; forewing reddish or brownish purple with golden luster at base, with or without golden markings; forewing R1 unforked; an interradial crossvein joining R3 and R4+5 present in fore- and hindwings; R4 and R5 stalked in fore- and hindwings; a main stem of R1 unrecognizable in hindwing; the most anterior vein of hindwing usually simple, but rarely forked near terminal end.

Abdomen: Tergum I usually broadly membranous except laterally. Sternum V gland present, orifice a narrow slit. Sternum VIII completely membranous in male.

Male genitalia: Segment IX a complete ring, well sclerotized, with an anterior expansion ventrally; postero-lateral margin straight or shallowly curved. Valva slender, with a middle or ventro-proximal process on inner surface, usually with inwardly acute tips at dorsal and ventral ends; median plate small, variable in shape. Phallobase slightly arched; aedeagus with minute serrate projections near gonopore. Tergum X bilobed. Venter X plates well developed at latero-ventral sides of tergum X, complex, sometimes fused to each other proximo-ventrally.

Female genitalia: Abdominal segment IX forming a complete ring, sclerotized; anterior margin gradually expanded anteriorly from dorsum to venter. Segment X consisting of a pair of lateral sclerites, without a dorsal sclerite; lateral sclerite semi-cylindrical, with digitate projections having an apical seta at terminal inner margin of lateral sclerite. Corpus bursae oblong, with or without signa. Ductus spermathecae arising from a trapezoidal concavity. Genital chamber with a variably shaped sclerite.

Immature stages

The description is based on *P. immaculatella* and *P. semifasciella*, and based on YASUDA & HASHIMOTO (1989) and HASHIMOTO (2001).

Egg: Almost globular, pale yellow, covered with ciliated structures (Fig. 11K).

Last instar larva: Body length 3.5-4 mm. Head fuscous, with 6 stemmata. Body dark greenish brown with inconspicuous fuscous markings. Dorsal and lateral sclerites on each segment fuscous. Thoracic legs fuscous. Abdominal prolegs semispherical projections. The larval chaetotaxy is shown in HASHIMOTO (2001).

Pupa: Body length about 3 mm. Very similar to the *Neomicropteryx* pupa; body cuticle transparent except for brownish mandibles.

Biology. There is a single generation. The larvae and adults inhabit moist roadsides along rivers in small valleys and in coniferous woods of montane areas, dominated by ferns and bryophytes. Adults of the Japanese species can be observed visiting sedge flowers, but it is unknown whether they feed on the pollen or not. The egg is deposited singly or in a small cluster on the surfaces of thalli, or on rhizoids or stems of bryophytes in laboratory conditions. The larvae usually hide among or under the bryophytes, and when they are disturbed, they make round themselves (YASUDA & HASHIMOTO, 1989). The last instar larva overwinters. Pupation occurs within the ellipsoidal cocoon, which is tightly woven with silk and soil granules (Fig. 11G), on the ground or near the host substrate. The following liverwort species (Fig. 11D-E) are known as the larval host plants: *Heteroscyphus coalitus* (HOOK.) SCHIFFN. (Geocalycaceae) and *Makinoa crispata* (STEPH.) MIYAKE (Makinoaceae).

Remarks. The complete reduction of epipharyngeal armature, the minute serrate aedeagal projections around the gonopore, and the venter X complex plate of the male genitalia are probable synapomorphies of the genus, but it is possible that the reduced epipharyngeal armature has occurred more than twice in the family. This genus may be allied to the North American genus *Epimartyria* in possessing a basal inner process on the valva and in possessing similar larval coloration and chaetotaxy, but *Paramartyria* is easily distinguishable from *Epimartyria* by the complete reduction of the epipharyngeal armature and the presence of the epiphysis. *Paramartyria* is distributed in Continental China, Taiwan and Japan, and comprises ten described species (HASHIMOTO 2000; ISSIKI, 1931; KALTENBACH & SPEIDEL, 1982; YANG, 1980, 1995). However, judging from shape of the valva, it is possible that two Chinese species, *P. jinggangana* YANG, 1980 and *P. baishanzuna* YANG, 1995, belong to the genus *Vietomartyria* HASHIMOTO & MEY.

Key to the Japanese species based on adult characters

1. Head covered with yellow piliform scales; tegula with

black piliform scales; forewing more brownish, without golden costal spots; a medio-proximal process of valva very long; corpus bursae without signum...*immaculatella*

— Head covered with orange piliform scales; tegula with orange piliform scales; forewing more purple, with golden costal spots on basal 1/3 and sometimes with on apical 1/3 (these spots are easily lost); a medio-proximal process of valva short; corpus bursae with signa ....*semifasciella*

Paramartyria immaculatella **ISSIKI, 1931**

(Figs. 1C, 3E, 4L, 4U, 5A, 5F, 6B, 7B-C, 10A-B, 11K, 15, 16A-D)

Paramartyria immaculatella ISSIKI, 1931: 1002, figs 1, 2a, 3, 28a, 29b.

Paramartyria immaculatella: ISSIKI, 1953: 134, fig. 2; ISSIKI, 1971: 5, pl. 1: 3; KRISTENSEN, 1976: 28; MORIUTI, 1982: 42, pl. 1: 2, pl. 235: 2, pl. 245: 3; HASHIMOTO, 1992: 653, figs. 1-2.

Redescription

Adult (Fig. 1C). Forewing length 4.1-4.9 mm (mean 4.6 mm, n = 50) in males, 4.3-4.9 mm (mean 4.6 mm, n = 10) in females.

Head capsule black, naked and lustrous on both sides, covered with yellow piliform scales, frequently mixed with black scales on dorso-medial part between ocelli and on dorso-lateral hind margin. Antenna about 2/3 of forewing length in male, slightly more than half the length of fore-wing in female, densely covered with black piliform scales, especially on scape and pedicel, rarely scattered with blue metallic scales; flagellum 41-50 segments (mean 43.8, n = 94) in males, 33-37 segments (mean 34.8, n = 25) in females.

Thorax grayish brown, covered with purple and brown metallic scales on prothorax, rarely scattered with blue metallic scales, with black piliform scales on tegula and antero-lateral part of prothorax. Legs covered with glossy blackish brown scales, paler on terminal margin of each tarsomere and on spurs. Forewing with purple to brownish purple luster, scattered with golden metallic scales, densely covered with golden luster on basal part and on dorsum near base, sometimes scattered with bluish metallic scales on costa near apex; cilia grayish brown, pale yellow on apex; ventral surface pale brownish purple. Hindwing covered with piliform grayish brown scales on basal half, covered with glossy brownish purple scales on apical half; cilia glossy grayish brown; ventral surface same as forewing.

Abdomen pale grayish brown, sparsely covered with glossy brown to blackish brown piliform scales; tergum I with or without a short medial sclerite near posterior margin (Fig. 7B-C).

Male genitalia (Fig. 15): The male genital structure was redescribed in detail by KRISTENSEN (1976) and variation of the valva (as gonopod) shown by HASHIMOTO (1992). Mid-dorsal length of segment IX about 1/8 of ventral length. Valva with a long process (ventral valve process in KRISTENSEN) at proximal inner surface. Phallobase weekly curved, longer than aedeagus; aedeagus rounded latero-proximally, with minute serrate projections near end and a slender medial incision at dorsal end. Venter X plate well developed below tergum X, with a digitate projection expanding laterally.

Female genitalia (Fig. 16A-D): Mid-dorsal length of segment IX about 1/2 of ventral length; postero-dorsal margin shallowly curved. Lateral sclerite of segment X broader than long. Spermatheca with many fringes at anterior margin. Corpus bursae membranous, elongate, without any signum.

Last instar larva (Fig. 10A-B). Body length 3.5-4 mm. See generic description.

Pupa. Unexamined.

Specimens examined. Honshu- 1♂, Kuzakai, Iwate Pref., 19. vi. 1979 (T. SAITO); 2♂, same locality, 20. vi. 1979 (T. SAITO); 2♂, Shimizu-toge, Tokamachi-shi, Niigata Pref., 2. vi. 1998 (S. HASHIMOTO); 1♂, 1♀, Akakura, Tokamachi-shi, Niigata Pref., 2. vi. 1998 (S. HASHIMOTO); 1♂, 1♀, same locality, 3. vi. 1998 (S. HASHIMOTO); 1♂, Shionomata, Tokamachi-shi, Niigata Pref., 4. vi. 1998 (S. HASHIMOTO); 1♂, Sagurigawa-dam, Muikamachi, Niigata Pref., 3. vi. 1998 (S. HASHIMOTO); 10♂, Ketto, Tsunan-cho, Niigata Pref., 13. vi. 2004 (S. SAKURAI); 4♂, Orikisawa, Kimitsu-shi, Chiba Pref., 27. iv. 1992 (S. HASHIMOTO); 6♂ (2♂ in 75% Et-OH), same locality, 8. v. 1992 (S. HASHIMOTO); 5♂, 6♀ (2♂, 2♀ in 75% Et-OH), Yomogi, Amatsukominato-cho, Chiba Pref., 10. v. 1990 (S. HASHIMOTO); 2♂, 2♀, Shimashima-tani, Azumi-mura, Nagano Pref., 7. vi. 1997 (S. HASHIMOTO); 1♂, Kisokomagatake (*ca.* 1400 m), Nagano Pref., 4. vii. 1994 (H. YOSHITOMI); 1♀, Tsubosaki (600 m), Asahi-cho, Aichi Pref., 4. v. 1998 (T. MANO); 1♂, Uradani, Shitara-cho, Aichi Pref., 16. vi. 1993 (H. YOSHITOMI); 1♂, same locality, 8. vi. 2000 (S. HASHIMOTO); 25♂, same locality, 7. vi. 1994 (S. HASHIMOTO); 14♂, 2♀ in 75% Et-OH, same locality, 14. vi. 1994 (S. HASHIMOTO); 1♂, Hikagedaira, Gifu Pref., 11. vi. 1980 (S. HASHIMOTO); 1♂, Sengendaru, Hiwada-mura, Gifu Pref., 28. vi. 1994 (H. YOSHITOMI); 2♂ in 75% Et-OH, Entani, Itadori-mura, Gifu Pref., 7. v. 1998 (H. NAKANO); 1 ♂ in 75% Et-OH, Azodani, Kifune, Kyoto Pref., 12. vi. 1989 (R. B. KURANISHI); 3♂, 1♀, Kodaizisan, Osaka Pref., 11. v. 1997 (T. SAITO); 2♂, 2♀, same locality, 15. v. 1999 (T. SAITO); 1♀, Minoo, Osaka Pref., 22. v. 1981 (T. SAITO); 1♂, Amami, Kawachinagano-shi, Osaka Pref., 16. v. 1979 (S. HASHIMOTO); 2♂, 1♀, same locality, 14. v. 1983 (S. HASHIMOTO); 4♂, same locality, 15. v. 1993 (S. HASHIMOTO); 1♂, Mt. Izumikatsuragi, Kaizuka-shi, Osaka Pref., 18. v. 1983 (S. HASHIMOTO); 8♂, Kumomidaki, Shimane Pref., 18. v. 1993

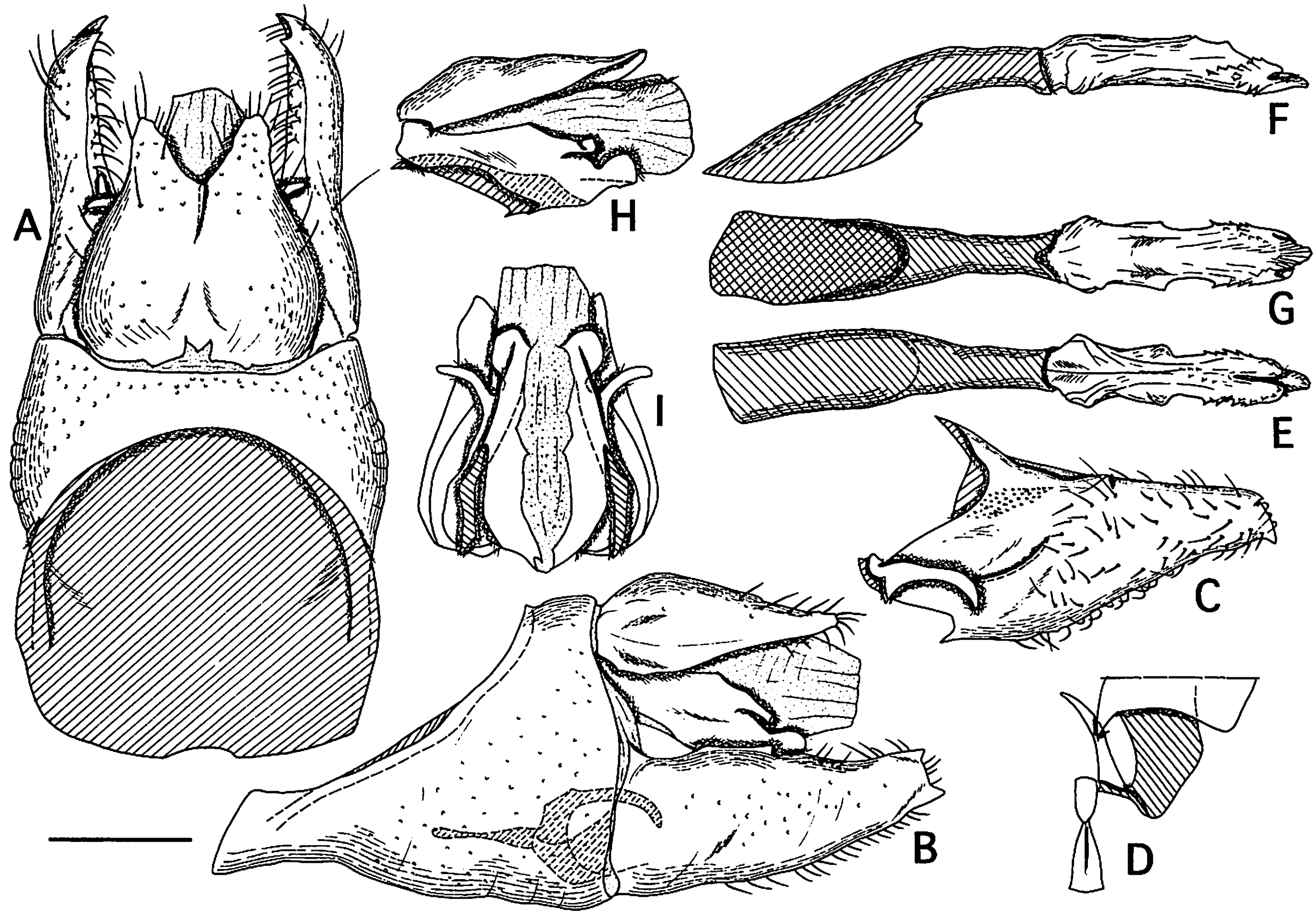

Fig. 15. Male genitalia of *Paramartyria immaculatella*. A: dorsal view, phallus removed, B: lateral view, phallus removed, C: right valva, inner view, D: median plate and basal part of valva, ventral view, E: phallus, dorsal view, F: ditto, lateral view, G: ditto, ventral view, H: tergum X and venter X plate, lateral view, I: ditto, ventral view. Scale = 0.2 mm.

(S. HASHIMOTO); 8♂, 2♀, Sandankyo, Togochi-cho, Hiroshima Pref., 4. vi. 1995 (S. HASHIMOTO). Shikoku- 1♂, Yokoyama, Mikawa-mura, Ehime Pref., 26. v. 1995 (S. HASHIMOTO); 1 ♂ in 75% Et-OH, Nakaba, Nishitosa-mura, Kochi Pref., emerged 20. iv. 2000 (H. YOSHITOMI). Kyushu- 1♂, Yobuno, Kitakyushu, Fukuoka Pref., 18. v. 1996 (K. UEDA) (KMNH); 1♂, Mt. Hakuchozan (labeled as Mt. Shiratori), Kumamoto Pref., 9-10. vi. 1990 (T. HIROWATARI) (OPU); 1♂, Mt. Hakuchozan, Izumi-mura, Kumamoto Pref., 10. vi. 1994 (T. HIROWATARI) (OPU). Other materials- 1 larva, Amatsukominato-cho, Chiba Pref., 21. xi. 1997 (H. YOSHITOMI); 1 larva, Hirase, Shimoyama-mura, Aichi Pref., 20. i. 1996 (H. NAKANO & H. YOSHITOMI); 2 larvae, Sandankyo, Togochi-cho, Hiroshima Pref., 7. xi. 1997 (S. HASHIMOTO).

Distribution. Japan (Honshu, Shikoku, Kyushu) (Fig. 14).

Biology. See biology of genus. *Makinoa crispata* (STEPH.) MIYAKE (Makinoaceae) is recorded here as the larval host plant for the first time (Fig. 11D).

Remarks. This species is distinct among the species of *Paramartyria* in the following characters: forewing without golden costal spots, valva with a long basal process, large venter X plate with a digitate process, and corpus bursae without signum.

Paramartyria semifasciella ISSIKI, 1931

(Figs. 1D, 4F, 5G, 5L, 6C-D, 7G, 7L, 7N, 10C, 11G, 16E-H, 17)

Paramartyria semifasciella ISSIKI, 1931: 1004, fig. 7.
Paramartyria semifasciella: ISSIKI, 1953: 134, figs. 3-4; ISSIKI, 1971: 5, pl. 1: 2; MORIUTI, 1982: 42, pl. 1: 3, pl. 245: 2.

Redescription

This species is similar to *P. immaculatella* in general

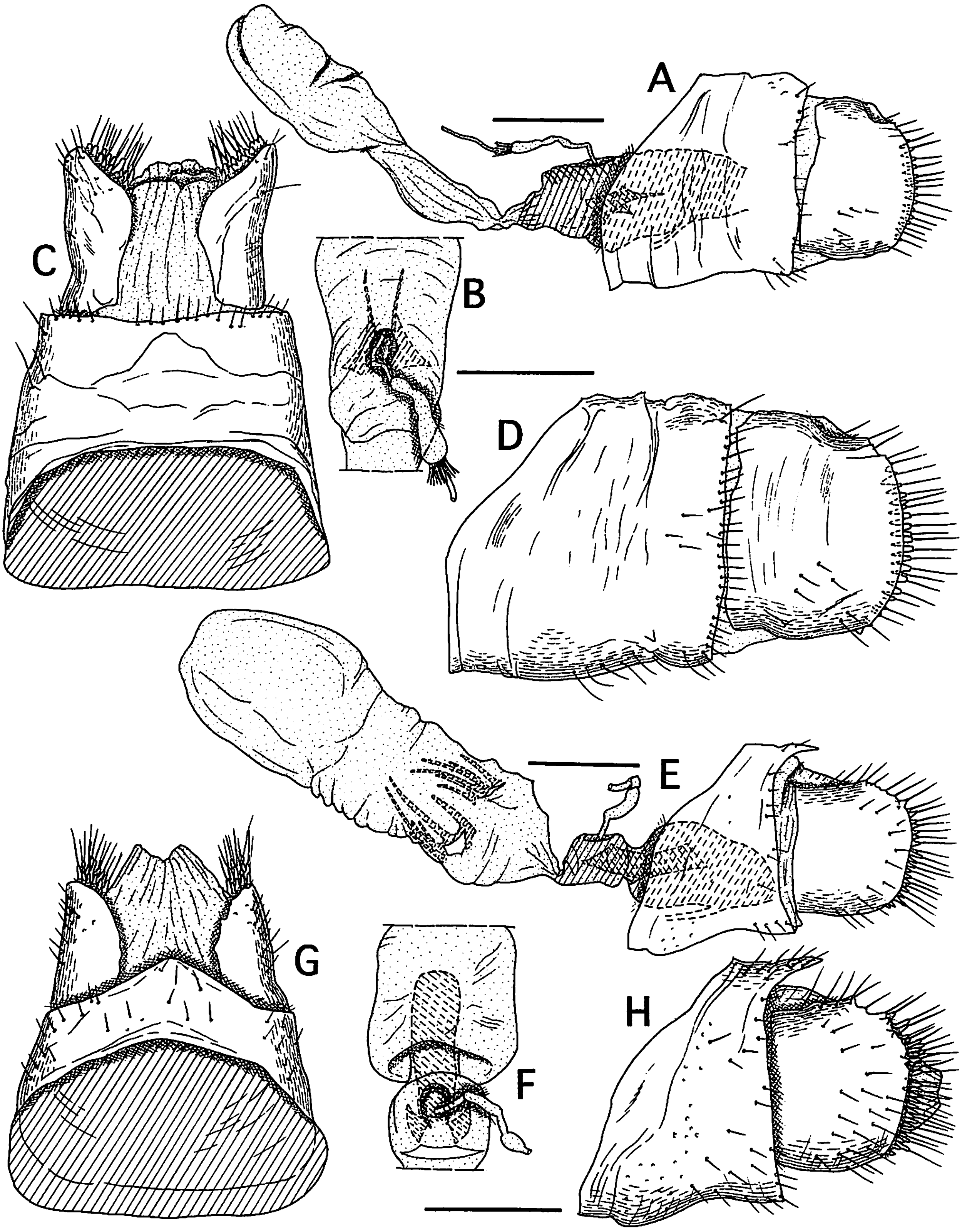

Fig. 16. Female genitalia of *Paramartyria* species. A, E: lateral view, B, F: arising part of ductus spermathecae, dorsal view, C, G: segments IX and X, dorsal view, D, H: ditto, lateral view. A-D: *Paramartyria immaculatella*, E-H: *P. semifasciella*. Scales = 0.2 mm.

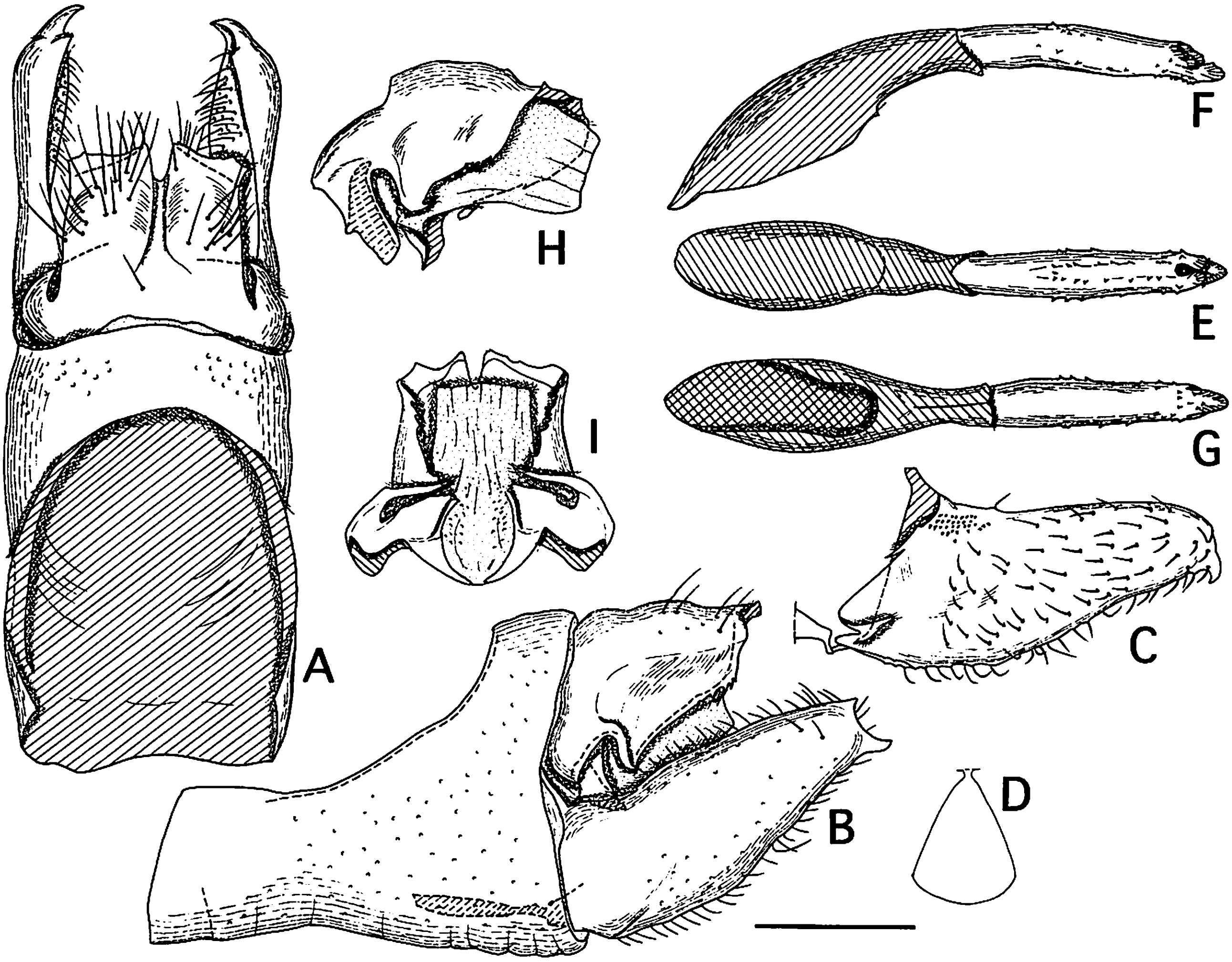

Fig. 17. Male genitalia of *Paramartyria semifasciella*. A: dorsal view, phallus removed, B: lateral view, phallus removed, C: right valva, inner view, D: median plate, ventral view, E: phallus, dorsal view, F: ditto, lateral view, G: ditto, ventral view, H: tergum X and venter X plates, latero-ventral view, I: ditto, ventral view. Scale = 0.2 mm.

appearance. Distinction between them is given in the key.

Adult (Fig. 1D). Forewing length 4.1-4.8 mm (mean 4.4 mm, n = 23) in males, 4.4-4.8 mm (mean 4.6 mm, n = 10) in females. Antennal flagellum 41-46 segments (mean 43.2, n = 27) in males, 34-38 segments (mean 35.9, n = 18) in females. Abdominal tergum I without a short medial sclerite.

Male genitalia (Figs. 7L, 17). Mid-dorsal length of segment IX ring short, about 1/5 of ventral mid length. Valva similar to that of *P. immaculatella*, but proximo-medial process small. Median plate as in Fig. 17D. Phallobase curved, longer than aedeagus; aedeagus slender, with small serrate projections at caudal 2/3 and a round incision at dorsal end. Tergum X rounded latero-basally, with a small caudo-medial incision; posterior margin of terminal lobes shallowly curved. Venter X plate completely fused with ventro-proximal side of tergum X, expanding antero-medially as a slender plate.

Female genitalia (Figs. 7N, 16E-H). Dorso-caudal margin of abdominal segment IX protruded at middle; mid-dorsal length about 2/5 of ventral length. Lateral sclerite of segment X broader than long. Corpus bursae membranous, elongate, with signa composed of 4 tridentaform sclerites. Genital chamber with cylindrical sclerite.

Variation. Usually the piliform scales on the tegula are orange, but in only one specimen were these black such as in *P. immaculatella*.

Last instar larva (Fig. 10C). Body length about 3.5 mm. Similar to *P. immaculatella*, but differs from the latter in the following characters: body coloration slightly paler, D1 and L1 setae on mesothorax to abdominal segment VIII more slender, SV setae on prothorax shorter, and SV1 seta on abdomen rather slender.

Pupa. See generic description.

Specimens examined. Honshu- 1♂, 1♀, Uradani, Shitara-cho, Aichi Pref., 7. vi. 1994 (S. HASHIMOTO); 9♂, 6 ♀ (2♂, 2♀ in 75% Et-OH), same locality, 9. vi. 1995 (S. HASHIMOTO); 1♀, Isegami-toge, Asuke-cho, Aichi Pref., emerged 6. v. 1995 (S. HASHIMOTO); 1♂ in 75% Et-OH, same locality, 19. vi. 1996 (H. YOSHITOMI); 1♂, same locality, 7. vi. 1997 (S. HASHIMOTO); 1♂, 1♀, Hirakura, Misugi-mura, Mie Pref., 17. vi. 1993 (K. FUKUZUMI); 1♂, Yakiyama, Owase-shi, Mie Pref., emerged 14. iv. 1997 (S. HASHIMOTO, H. NAKANO & H. YOSHITOMI), 1♂, 1♀, Kitamatagawa, Kawakami-mura, Nara Pref., 15. vi. 1993 (T. HIROWATARI) (OPU); 4♂, 1♀, Wasamatayama, Kawakami-mura, Nara Pref., 10. vi. 2001 (B. W. LEE) (OPU); 3♂, 1♀, Mt. Koya-san, Wakayama Pref., 6. vi. 1987 (S. HASHIMOTO); 24♂, 4♀ (6 ♂, 2♀ in 75% Et-OH), same locality, 4. vi. 1994 (S. HASHIMOTO). Shikoku- 1♂, Yokoyama, Mikawa-mura, Ehime Pref., 26. v. 1995 (S. HASHIMOTO). Other materials- 1 larva, Isegami-toge, Asuke-cho, Aichi Pref., 4. iv. 1995 (S. HASHIMOTO); 1 larva and 1 pupa reared from larva, Yakiyama, Owase-shi, Mie Pref., 18. ii. 1997 (S. HASHIMOTO, H. NAKANO & H. YOSHITOMI); 1 larva, Omogo, Omogo-mura, Ehime Pref., 6. xi. 1997 (S. HASHIMOTO).

Distribution. Japan (Central Honshu, Shikoku) (Fig. 14).

Biology. The habitat of this species is moister than that of *P. immaculatella*. Two liverworts species (Figs. 11D-E), *Heteroscyphus coalitus* (HOOK.) SCHIFFN. (Geocalycaceae) and *Makinoa crispata* (STEPH.) MIYAKE (Makinoaceae), are known as the larval host plants, with one (*M. crispata*) being newly recorded.

Remarks. According to YANG (1980) this species is allied to *P. cipingana* YANG, but differs in the shape of the bilobed tergum X (gradually more slender toward caudal end in *P. cipingana*).

Genus *Issikiomartyria* gen. nov.

Type-species: *Neomicropteryx nudata* ISSIKI, 1953: 138,
figs. 11, 12, by present designation.

Diagnosis. *Issikiomartyria* is distinct in possessing two pairs of aedeagal basal projections in the male genitalia and the large bulbous corpus bursae in the female genitalia.

Adult

The generic description is based on *Issikiomartyria nudata* (ISSIKI), *I. akemiae, I. plicata, I. distincta,* and *I. bisegmentata,* and on the following study: ISSIKI (1953).

Head: Head capsule densely covered with microtrichia, but naked and glossy on genal area; most of clypeus, frons and vertex covered with brownish yellow piliform scales. Antenna moniliform, long, but not reaching the apex of forewing, longer in male; flagellar segments about 60 in male, about 45 in female; basal one or two flagellomeres cylindrical. SOI about 0.4. MIOI about 0.5. Interocellar sulcus almost complete. Postinterocellar sulcus as a darker line. Epicranial sulcus distinct between occipital foramen and postinterocellar sulcus and being as a short distance anterior to interocellar sulcus. Occipital sulcus almost complete, but slightly indistinct on dorso-lateral corner. Temporal sulcus a darker line. Occiput oblong fan-shaped. Epipharyngeal armature partially reduced, but showing individual variation. Mandibular teeth more or less reduced. Labial palpus 1- or 2-segmented. Proximal prelabium obscure, weakly sclerotized. Post labium variable in sclerotization.

Thorax: Fortibial epiphysis absent. Antero-lateral processes of pronotum recognizable, but weekly sclerotized. Proprioceptive hair plate behind metasubalare connected with epimeron, but occasionally separate as an intraspecific variation. Fore- and hindwings obtuse at apex; forewing with purple to brownish purple luster, without any distinct maculation; forewing R1 usually unforked; R3 stalked with R4+5 in fore- and hindwings; a main stem of R1 usually absent in hindwing; most anterior vein of hindwing forked near terminal end (Sc1 and Sc2 + R1 or Sc and R1).

Abdomen: Tergum I broadly membranous, well sclerotized at antero-lateral corners. Sternum V gland present; orifice of gland a narrow slit. Sternum VIII membranous in male.

Male genitalia: Abdominal segment IX a complete ring, well sclerotized, with an anterior expansion ventrally; posterior margin gradually expanded from dorsum to venter. Valva relatively short, triangular, broadly membranous at proximal inner surface, with a round apex, with or without a mid-dorsal protrusion and with a proximo-ventral projection whose anterior portion is fused with median plate; median plate large, roughly circular. Phallobase strongly arched, with or without longitudinal ventral ridges on or along midline; aedeagus with two pairs of basal hornlike projections, a pair of triangular plates expanding horizontally near middle or posteriorly; dorsal and ventral terminal ends obtuse; gonopore opening horizontally; vesica with serrated minute projections. Tergum X rather short, broader than long, swollen on proximo-dorsal sides, with a pair of hornlike terminal processes curving ventrad and a pair of long ventral plates (venter X plates) extending antero-ventrally at base of terminal processes.

Female genitalia: Segment IX forming a complete ring, well sclerotized; anterior margin gradually expanded anteriorly from dorsum to venter. Segment X consisting of lateral sclerites and a dorsal sclerotized plate; lateral sclerites simple, broader than long, with digitate projections having an apical seta at terminal inner margin. Corpus bursae large, globular, membranous, with signa composed of 4 sclerites near caudal end. Ductus spermathecae arising from a hexagonal concavity. Genital chamber with a small sclerite.

Immature stages

The description is based on *I. nudata and I. bisegmentata.*

Egg: Ovoid, pale yellow, covered with bubble like structures.

Last instar larvae: Body length 4.5-5.0 mm. Head fuscous, with 6 stemmata. Body pale greenish gray to dark gray tinged with purple, but becoming brown to reddish brown before pupation, with creamy white markings situated around the base of D and L setae, around dorsal sclerite (dorsal plate) except for the prothorax and abdominal segments VIII-IX, from the basal part of D2 to the dorso-caudal margin except for the prothorax and abdominal segments IX and X, and at the caudo-ventral part of lateral sclerite; anterior part of prothorax, abdominal segment X and venter creamy white. Thoracic legs 3-segmented, fuscous. Dorsal and lateral sclerites on each segment fuscous. Abdominal prolegs semispherical projections. Setal arrangement and number of setae similar to those of the *Neomicropteryx* larvae, but chaetotaxy differs from them in the following characters; D1 on metathorax to abdominal segment VII short, with a blunt tip; D2 seta on mesothorax to abdominal segment VII short, with a blunt tip.

Pupa: Very similar to the *Neomicropteryx* and *Kurokopteryx* pupae. Length about 4 mm. Cuticle is transparent except for brownish mandibles. The chaetotaxy is identical with that of *Neomicropteryx.*

Biology. There is a single generation per year. The habitat is almost similar to those of other Japanese genera except for *Micropterix*; consequently, *Issikiomartyria* species are often found with *Paramartyria immaculatella.* The larval host plant (Fig. 11F) is *Conocephalum conicum* (L.) DUM. (Conocephalaceae). The larvae feed on the surface of the thallus and are easily observed on the thalli surfaces. Pupation occurs within the ellipsoidal cocoon, which is tightly woven of silk only, near the host substrate or in the rhizoids.

Etymology. *Issikiomartyria* is named in honor of the late Professor Syuti ISSIKI, who was a pioneer of the taxonomic study of the East Asian micropterigid moths. Gender is feminine.

Remarks. The two pairs of hornlike aedeagal projections in the male and the large bulbous female corpus bursae are regarded as synapomorphies of the genus. However, the latter character does not examined in *I. akemiae, I. plicata,* and *I. distincta,* whose females are unknown. *Issikiomartyria* superficially resembles *Paramartyria, Kurokopteryx* and *Neomicropteryx,* but is easily distinguishable from *Paramartyria* by the large size and the genital structures, and from the latter two genera by the following characters: head covered with orange piliform scales, aedeagus with two pairs of basal projections in the male genitalia, and large bulbous corpus bursae with signa in the female genitalia.

This genus is composed of five species, but the phylogenetic relationships among them are not presented in this study, because the morphological characters available are too scarce to construct the phylogenetic tree and are too similar among the *Issikiomartyria* species to determine polarities. The female specimens and immature stages of *I. akemiae, I. plicata,* and *I. distincta* still have been unknown, so their discoveries will throw light on this problem in the future.

Key to the species based on genitalia

1. Valva with a mid-dorsal protrusion; aedeagus with triangular plates at or near middle; signa composed of 4 reduced sclerites in corpus bursae (female unknown in *akemiae* n. sp., *plicata* n. sp., and *distincta* n. sp.)....................2

— Valva without a mid-dorsal protrusion; aedeagus with triangular plates near terminal end; signa composed of 4 tridentaform sclerites in corpus bursae.........*bisegmentata* sp. nov.

2. Dorso-basal margin of valva strongly expanded posteriorly; a mid-dorsal protrusion of valva a thin plate expanding ventro-mesally; dorso- and latero-basal hornlike aedeagal projections rather broadly separated from each other; triangular plate of aedeagus small..*distincta* sp.nov.

— Dorso-basal margin of valva not expanded; a mid-dorsal protrusion of valva either hornlike or a rather thick plate; dorso- and latero-basal hornlike aedeagal projections closer to each other; triangular plate of aedeagus relatively large.. 3

3. A mid-dorsal protrusion of valva a thick plate, rounded; phallobase without a longitudinal ventral ridge; proximo-lateral projections of aedeagus short, rather stout; medial part of tergum X broadly concave .... *nudata*

— A mid-dorsal projection of valva hornlike, acute ventrally; phallobase with longitudinal ventral ridges; proximo-lateral projections of aedeagus slender; medial part of tergum X not concave.. 4

4. Phallobase with two longitudinal short ridges running parallel; proximo-lateral projections of aedeagus extending antero-dorsally; terminal processes of tergum X broadly separate... *akemiae* sp. nov.

— Phallobase with a longitudinal ridge; proximo-lateral projections extending horizontally; terminal processes of tergum X narrowly separate..............*plicata* sp. nov.

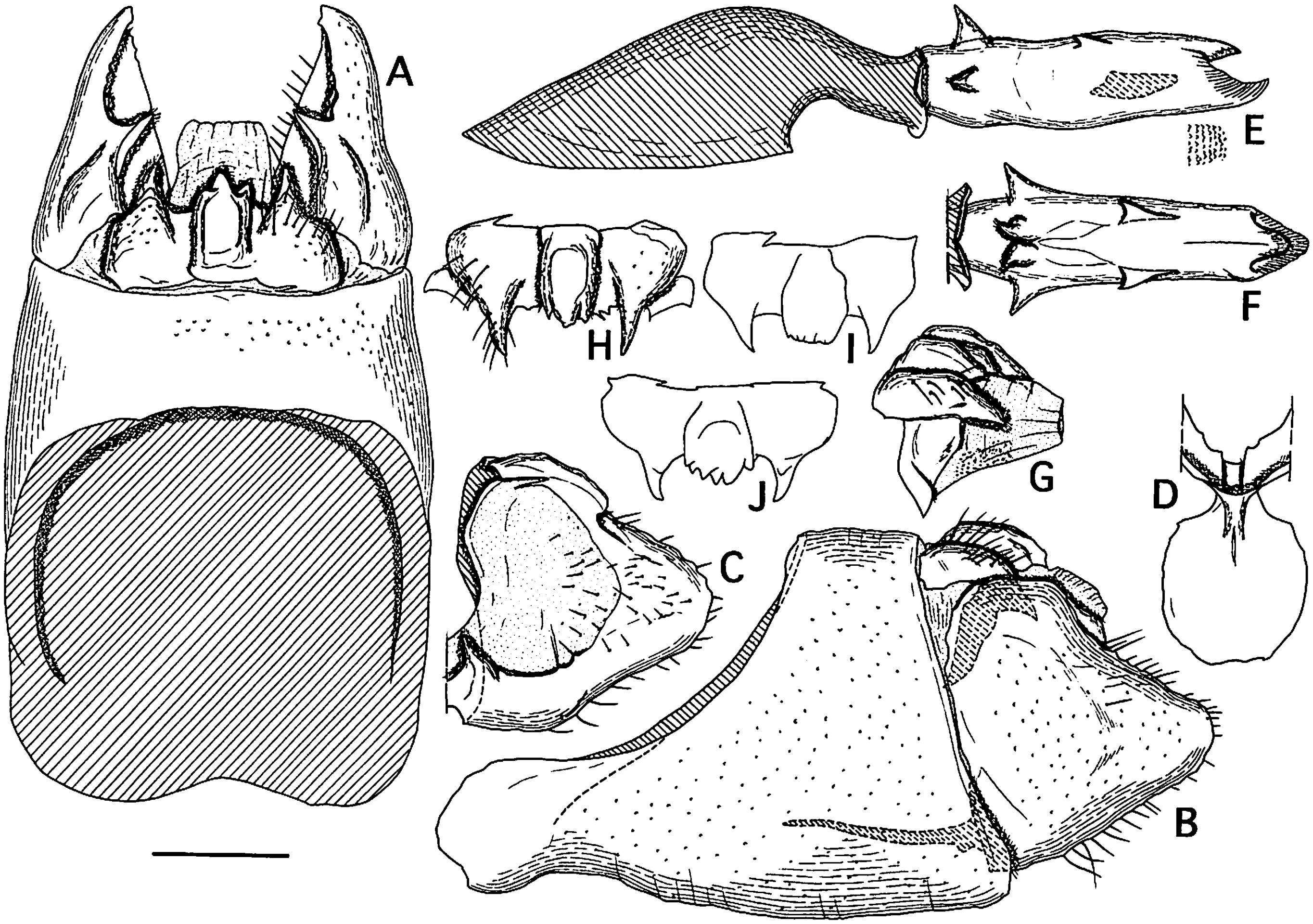

Fig. 18. Male genitalia of *Issikiomartyria nudata*. A: dorsal view, phallus removed, B: lateral view, phallus removed, C: right valva, inner view, D: median plate, dorsal view, E: phallus, lateral view, F: aedeagus, dorsal view, G: tergum X and venter X plate, latero-dorsal view, H-J: tergum X, dorso-caudal view. Scale = 0.2 mm.

Issikiomartyria nudata (ISSIKI, 1953) comb. nov.

(Figs. 1E, 3F, 4I, 4N, 5B, 6E-G, 7H, 7O, 8A, 9A-F, 10D, 11M, 18, 19)

Neomicropteryx nudata ISSIKI, 1953: 138, figs 11,12.
Neomicropteryx nudata: MORIUTI, 1982: 43, pl. 1: 8, pl. 235: 3, pl. 246: 1.

Redescription

Adult (Figs. 1E, 11M). Forewing length 4.4-5.1 mm (mean 4.9 mm, n = 20) in males, 4.8-5.1 mm (5.0 mm, n = 4) in females.

Head capsule fuscous, naked and glossy on both sides, sparsely covered with yellow piliform scales with dark yellow scales on vertex. Antenna about 4/5 length of forewing in male, about 2/3 in female; densely covered with fuscous piliform scales on scape and pedicel; flagellum 53-67 segments (mean 59.1, n = 35) in males, 43-46 segments (mean 44.4, n = 10) in females; labial palpus 1-segmented.

Thorax grayish brown, sparsely covered with purple and brownish gold scales on prothorax with blue metallic scales, with dark yellow piliform scales on tegula. Legs covered with glossy fuscous scales. Forewing with purple and brownish purple luster, scattered with golden metallic scales, densely covered with golden luster over basal half of dorsum; cilia grayish brown, pale yellow on apex; ventral surface glossy grayish purple. Hindwing glossy brownish purple scattered with piliform scales on basal half; cilia grayish brown; ventral surface same as forewing.

Abdomen sparsely covered with grayish brown piliform scales; segment IX of male dark yellow.

Male genitalia (Fig. 18): Mid-dorsal length of segment IX ring about 1/4 of ventral length; postero-dorsal margin almost straight. Dorso-middle protrusion of valva rounded. Phallobase without a ventral longitudinal ridge; two pairs of proximal projections of aedeagus relatively short, stout basally, of these, lateral one is extended horizontally and

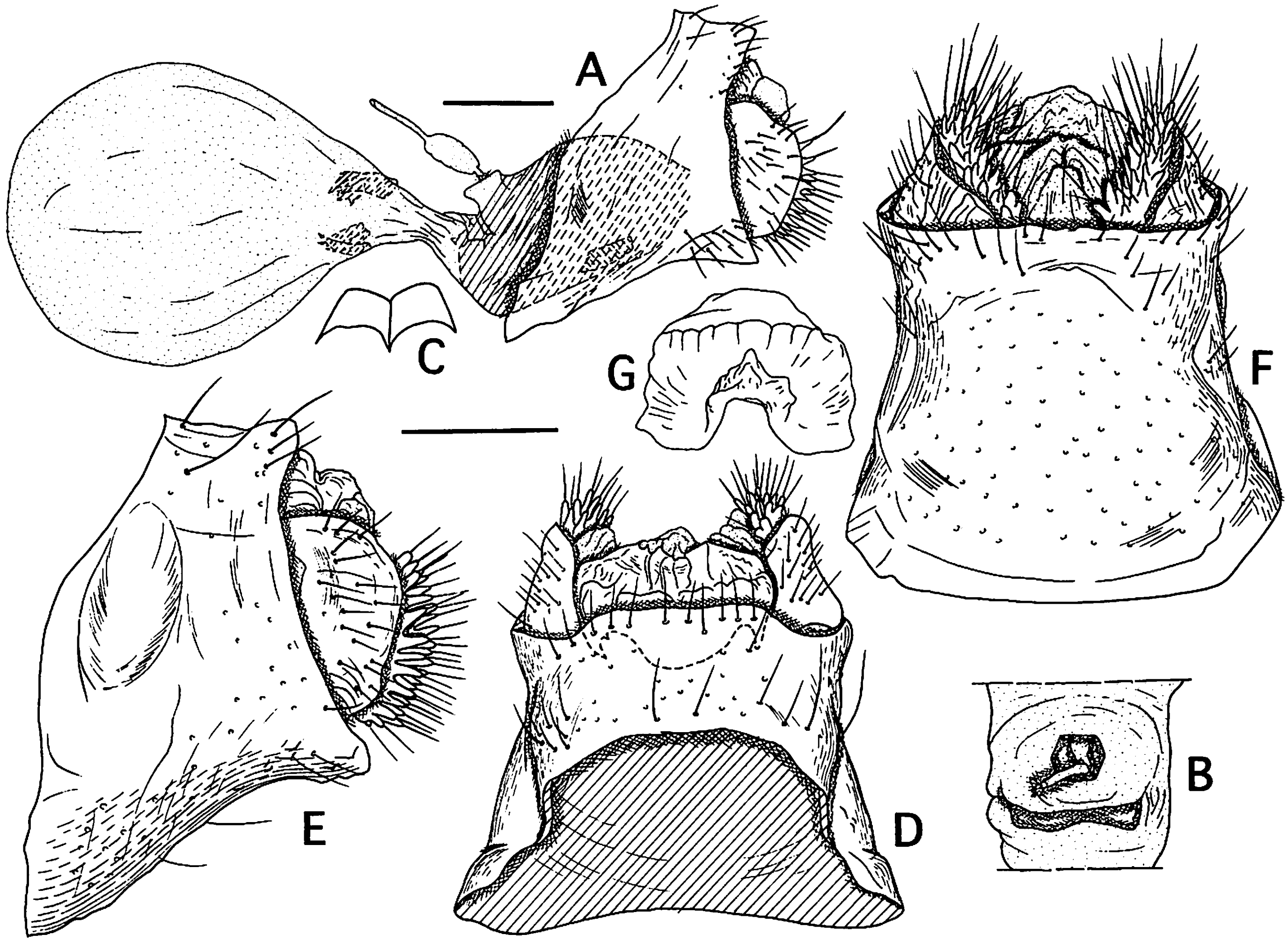

Fig. 19. Female genitalia of *Issikiomartyria nudata*. A: lateral view, B: arising part of ductus spermathecae, dorsal view, C: sclerite in genital chamber, ventral view, D: segments IX and X, dorsal view, E: ditto, lateral view, F: ditto, ventral view, G: dorsal sclerite of segment X, dorso-caudal view. Scales = 0.2 mm.

dorsal one almost vertically. Medial part of tergum X swollen, rectangular, middle portion of which is broadly concave, variably notched at posterior margin (Fig. 18H-J).

Female genitalia (Figs. 70, 19): Segment IX ring strongly sclerotized, concave laterally; mid-dorsal length about 1/3 of ventral length. Dorsal plate between segment X sclerites large, well sclerotized, as in Fig. 19G. Corpus bursae membranous, almost bulbous; signa consisting of 4 reduced sclerites. Genital chamber with a small sclerite.

Variation (Fig. 6E-G). As already indicated by Issiki (1953), this species frequently shows an apical bifurcation of Sc, R1, Rs and M veins of the forewing and Rs and M veins of the hindwing. Short length of a stem vein of R1 rarely appears in the hindwing.

Last instar larva (Figs. 8A, 9A-F, 10D). See generic description. Distinguishable from *I. bisegmentata* by the following characters: SV1 seta on thorax minute (short and distinct in *I. bisegmentata*); L3 on meso- and metathorax minute (relatively long in *I. bisegmentata*); L2 on abdominal segments I-VIII minute (short and distinct in *I. bisegmentata*).

Pupa. Not examined.

Specimens examined. Honshu- 42♂, 4♀ (7♂ in 75% Et-OH), Kitamata, Hakuba-mura, Nagano Pref., 14. vii. 1994 (S. Hashimoto); 14♂ (4♂ in 75% Et-OH), same locality, 22. vii. 1996 (S. Hashimoto). Other materials- 7 larvae, Kitamata, Hakuba-mura, Nagano Pref., 7. v. 1994 (H. Yoshitomi); 2 larvae, same locality, 17. v. 1997 (S. Hashimoto).

Distribution Japan (Central Honshu: Nagano Pref.) (Fig. 25).

Biology. See biology of genus. The larval host plant is *Conocephalum conicum* (L.) Dum. (Conocephalaceae).

Remarks. This species is allied to the following two species,

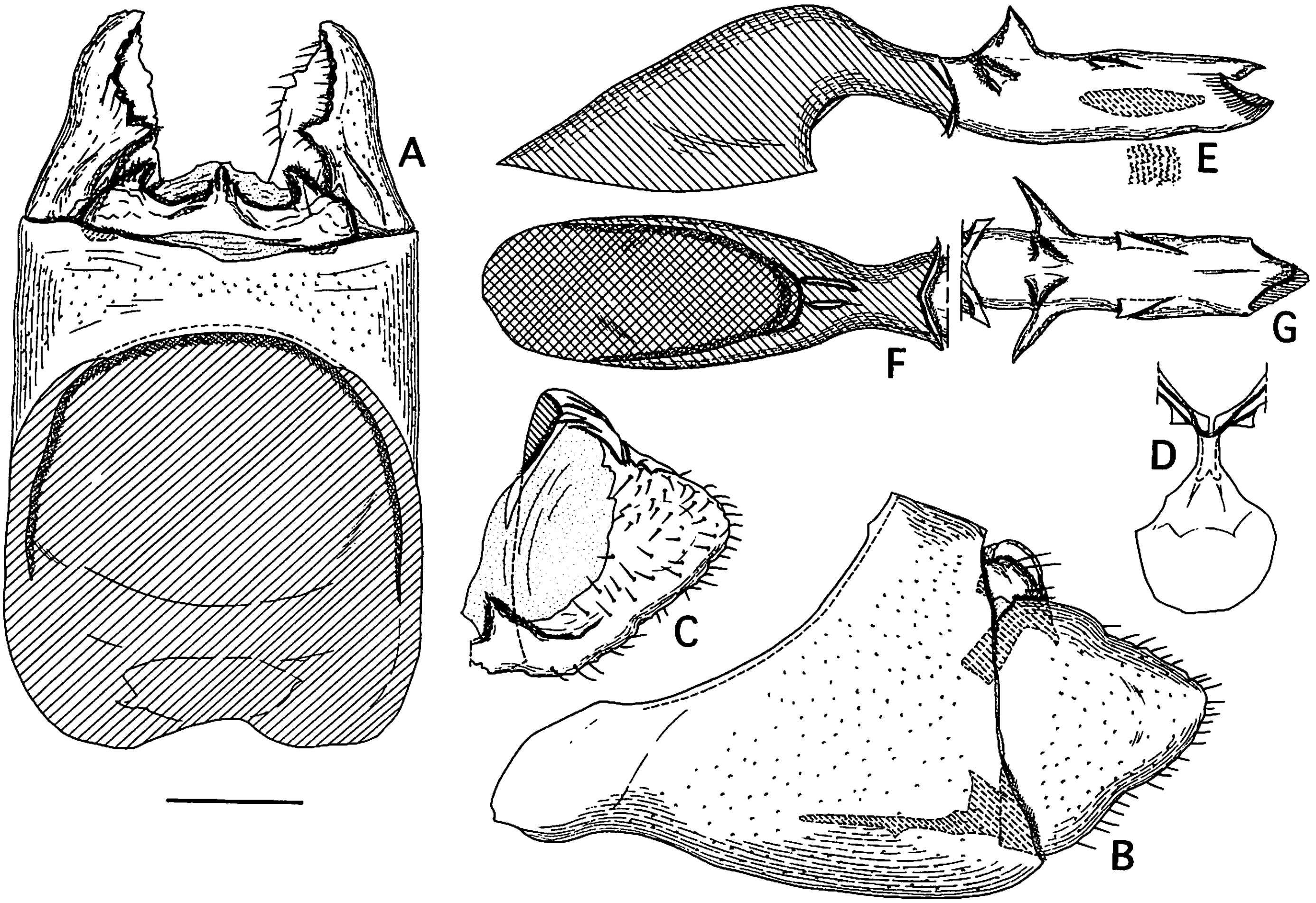

Fig. 20. Male genitalia of *Issikiomartyria akemiae*, paratype. A: dorsal view, phallus removed, B: lateral view, phallus removed, C: right valva, inner view, D: median plate, dorsal view, E: phallus, lateral view, F: phallobase, ventral view, G: aedeagus, dorsal view. Scale = 0.2 mm.

I. akemiae and *I. plicata*, on the basis of the male genitalia, and their distinguishing characters are given in the key.

Issikiomartyria akemiae sp. nov.

(Figs. 1F, 20)

Adult (Fig. 1F). Very similar to *I. nudata* in general appearance and distinguishable only by the genital structures given in the key.

Forewing length 5.0 mm in holotype, 4.7-5.0 mm (mean 4.9 mm, n = 3) in males. Antennal flagellum 56-57 segments (mean 56.3, n = 3) in males.

Male genitalia (Fig. 20): Mid-dorsal length of segment IX ring about 1/7 of ventral length; postero-dorsal margin shallowly curved at middle. Mid-dorsal protrusion of valva acute. Phallobase with two short ventral ridges extending parallel; dorsal hornlike projections of aedeagus relatively short, stout basally, extending almost vertically; lateral ones slender, extending antero-dorsally. Tergum X relatively broad, reduced in length; terminal projections broadly separate; medial part slightly swollen, tapering towards apical end.

Female genitalia. Unknown.

Immature stages. Unknown.

Specimens examined. Holotype- ♂, Tazawa, Nakasato-mura, Niigata Pref., Honshu, Japan, 3. vi. 1998 (S. HASHIMOTO) (KMNHIR200,223). Paratypes- 2♂, same data as the holotype.

Distribution. Japan (Central Honshu: Niigata Pref.) (Fig. 25).

Biology. See biology of genus. Although the host plant is unknown, judging from the habitat of the adult it seems likely that the liverwort species, *Conocephalum conicum* (L.) DUM. (Conocephalaceae), is the larval host plant.

Etymology. This new species is named after my wife Mrs. Akemi HASHIMOTO.

Remarks. Based on similar morphology of the male genitalia,

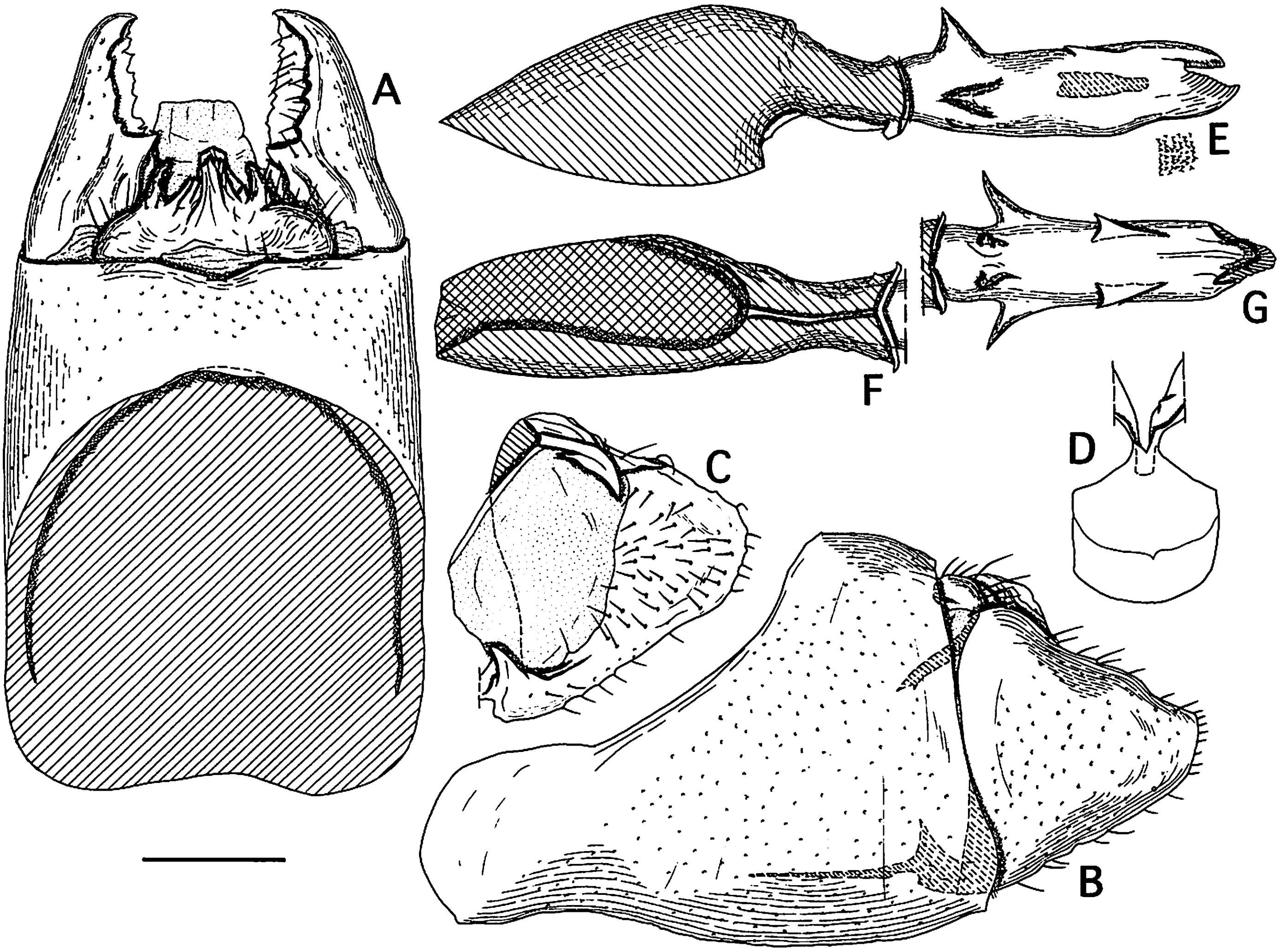

Fig. 21. Male genitalia of *Issikiomartyria plicata*, paratype. A: dorsal view, phallus removed, B: lateral view, phallus removed, C: right valva, inner view, D: median plate, dorsal view, E: phallus, lateral view, F: phallobase, ventral view, G: aedeagus, dorsal view. Scale = 0.2 mm.

this species is allied to *I. plicata*, and their difference is given in the key.

Issikiomartyria plicata sp. nov.

(Figs. 1G, 21)

Adult (Fig. 1G). Very similar to *I. nudata* in general appearance and distinguishable only by the genital structures given in the key.

Forewing length 4.9 mm in holotype, 4.9-5.0 mm (mean 4.9 mm, n = 3) in males. Antennal flagellum 57-58 segments (mean 57.5, n = 2) in males.

Male genitalia (Fig. 21): Mid-dorsal length of segment IX ring about 1/6 of ventral length; postero-dorsal margin shallowly curved at middle. Mid-dorsal protrusion of valva acute. Phallobase with a long ridge throughout ventral mid line; dorsal hornlike projections of aedeagus stout basally, extending almost vertically; lateral ones slender, extending horizontally. Tergum X relatively broad; medial portion between terminal projections weekly swollen, protruded caudally, crumpled.

Female genitalia. Unknown.

Immature stages. Unknown.

Specimens examined. Holotype- ♂, Sagurigawa-dam, Muika-machi, Niigata Pref., Honshu, Japan, 3. vi. 1998 (S. HASHIMOTO) (KMNHIR200,224). Paratypes- 2♂, same data as the holotype. Other materials- 2♂ in 75% Et-OH, same data as the holotype.

Distribution. Japan (Central Honshu: Niigata Pref.) (Fig. 25).

Biology. See biology of genus. Although the host plant is unknown, judging from the habitat of the adult, it seems likely that the liverwort species, *Conocephalum conicum* (L.)

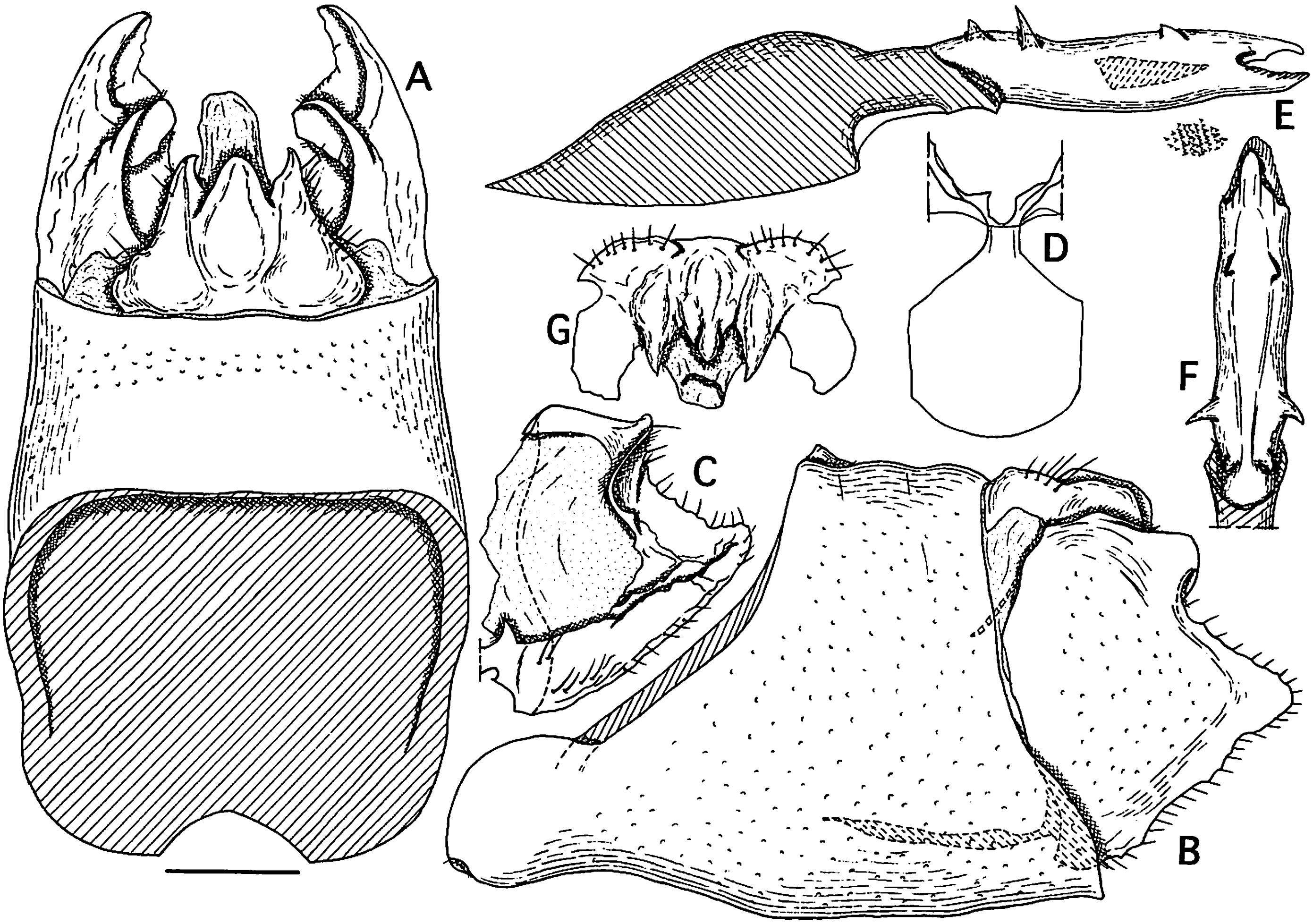

Fig. 22. Male genitalia of *Issikiomartyria distincta*, paratype. A: dorsal view, phallus removed, B: lateral view, phallus removed, C: right valva, inner view, D: median plate, dorsal view, E: phallus, lateral view, F: aedeagus, dorsal view, G: tergum X and venter X plates, dorsocaudal view. Scale = 0.2 mm.

DUM. (Conocephalaceae), is the larval host plant.

Etymology. The specific name is based on the folded condition of the posterior margin of male tergum X.

Remarks. Based on similar male genitalia, this species is closely related to *I. akemiae* and their difference is shown in the key.

Issikiomartyria distincta sp. nov.

(Figs. 1H, 22)

Adult (Fig. 1H). Very similar to other *Issikiomartyria* species in general appearance, but distinguishable from them by the rather small size and the genital structures given in the key.

Forewing length 4.5 mm in holotype, 4.5 mm (mean 4.5 mm, n = 3) in males. Antennal flagellum 59-64 segments (mean 60.7, n = 3) in males.

Male genitalia (Fig. 22): Mid-dorsal length of segment IX ring about 1/3 of ventral length; postero-dorsal margin shallowly curved. Valva with a well-developed mid-dorsal plate expanding ventro-mesally, and with an inner basal projection. Phallobase with a longitudinal ventral ridge; aedeagus with two pairs of hornlike proximal projections relatively small, extending antero-dorsally, well separated from each other; of these, the dorsal projection is short and the lateral one slender; aedeagus with a pair of small triangular plates near middle. Tergum X relatively long, with a developed medial part flattened dorsally between terminal projections.

Female genitalia. Unknown.

Immature stages. Unknown.

Specimens examined. Holotype- ♂, Ôishi-dam, Sekikawa-mura Niigata Pref., Honshu, Japan, 7. vi. 2004 (S. SAKURAI) (KMNHIR200,225). Paratypes- 3♂, same data as the holotype.

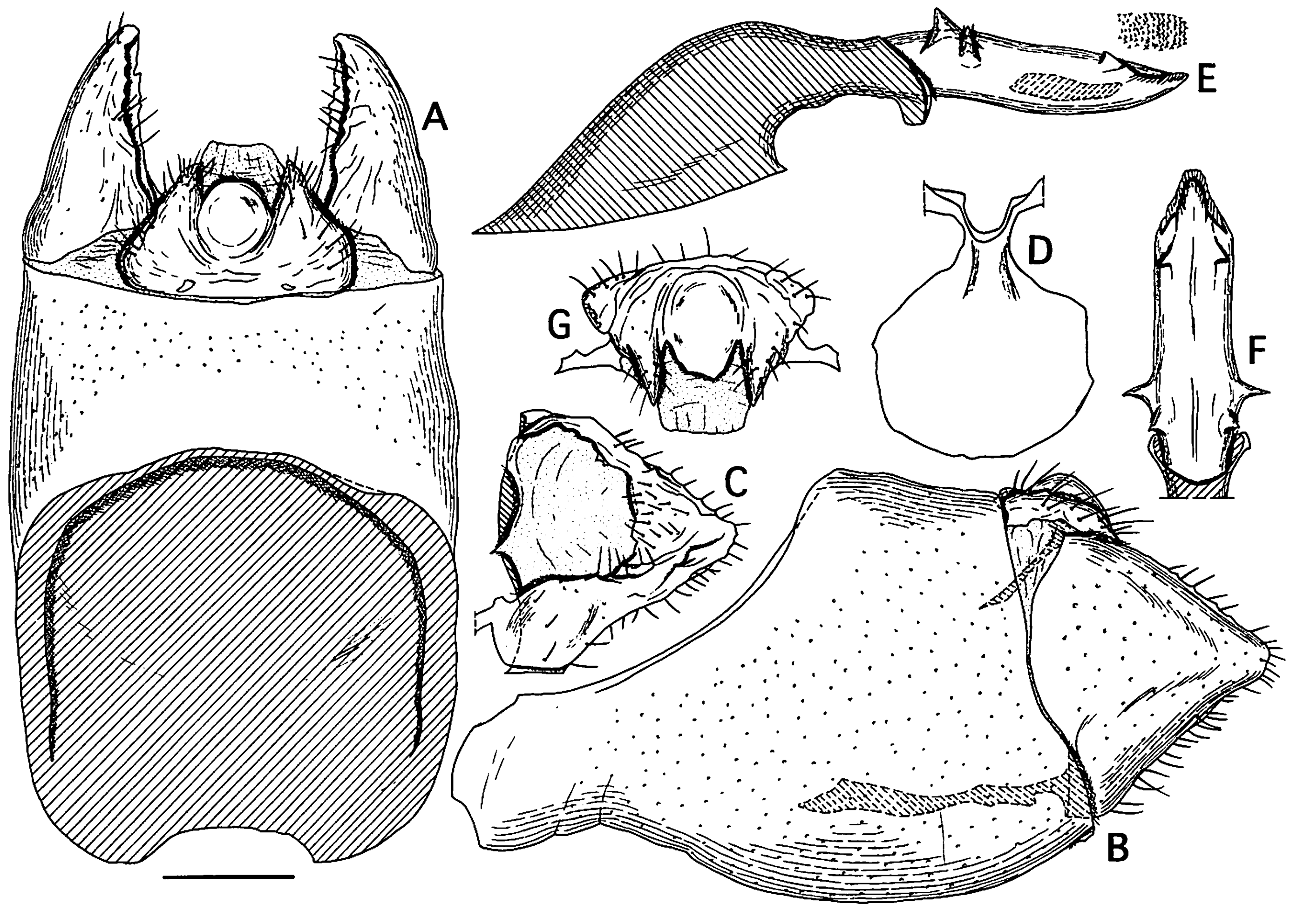

Fig. 23. Male genitalia of *Issikiomartyria bisegmentata*, paratype. A: dorsal view, phallus removed, B: lateral view, phallus removed, C: right valva, inner view, D: median plate, dorsal view, E: phallus, lateral view, F: aedeagus, dorsal view, G: tergum X and venter X plates, dorso-caudal view. Scale = 0.2 mm.

Distribution. Japan (Central Honshu: Niigata Pref.) (Fig. 25).

Biology. See biology of genus. Although the host plant is unknown, judging from the habitat of the adult, it seems likely that the liverwort species, *Conocephalum conicum* (L.) DUM. (Conocephalaceae), is the larval host plant.

Etymology. The species epithet is based on the distinct valva.

Remarks. This species is very similar to other *Issikiomartyria* species and their difference is given in the key. The male tergum X of this species is similar but longer than that of the next species.

Issikiomartyria bisegmentata sp. nov.

(Figs. 1I, 4V, 7D, 10E-F, 11H, 23, 24)

Adult (Fig. 1I). Similar to the above four species in general appearance, but differing from them in possessing a 2-segmented labial palpus (very rarely 1-segmented, but in that case the opposite palpus is usually 2-segmented) and in the coloration of the tarsomeres.

Forewing length 5.1 mm in holotype, 4.6-5.3 mm (mean 5.0 mm, n = 22) in males, 5.1-5.5 mm (mean 5.2 mm, n = 10) in females. Antennal flagellum 56-66 segments (mean 58.9, n = 46) in males, 44-46 (mean 45, n = 3) in females. Labial palpus 2-segmented, but rarely 1-segmented. Apical part of basal tarsomere, and second and third tarsomeres glossy pale yellow. Abdominal segment IX dark yellow.

Male genitalia (Fig. 23): Mid-dorsal length of segment IX ring about 1/4 of ventral length; postero-dorsal margin

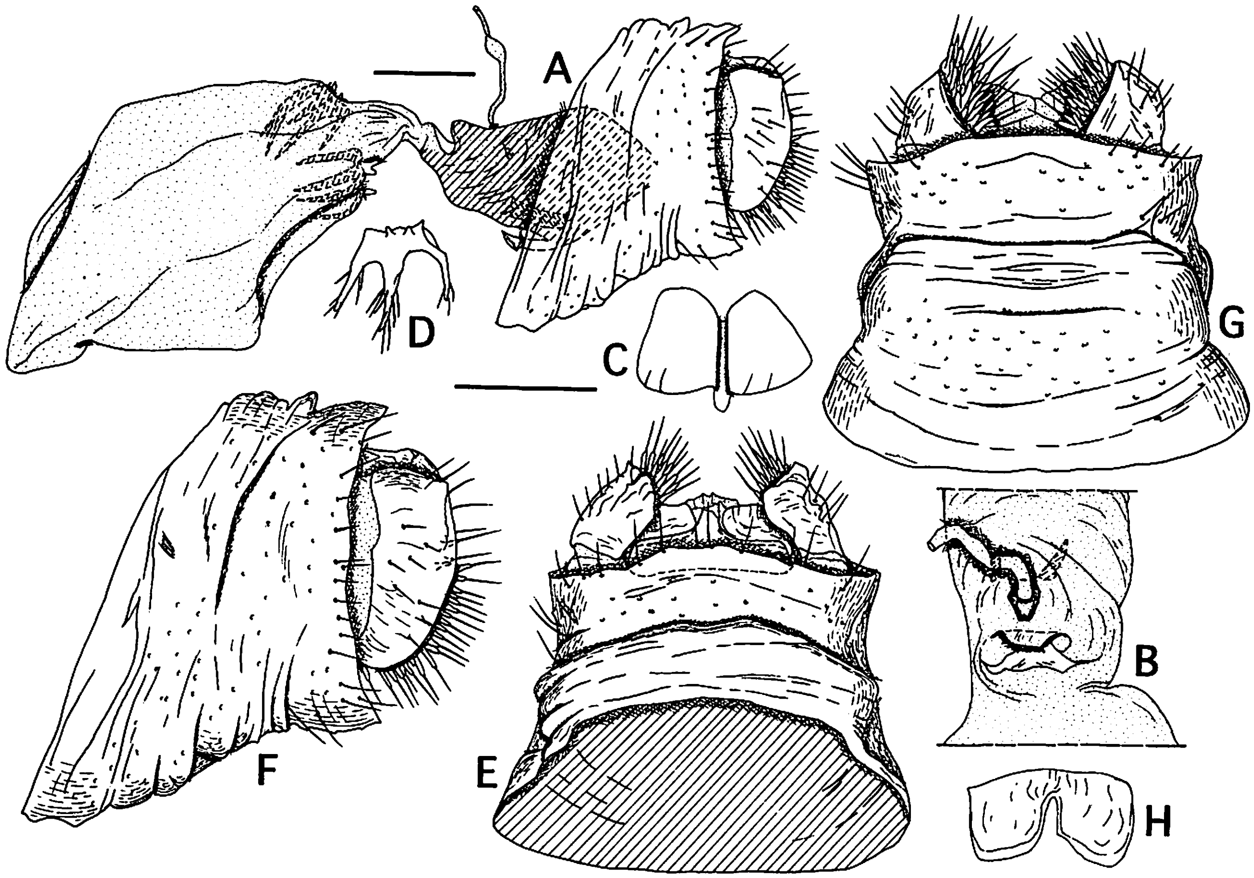

Fig. 24. Female genitalia of *Issikiomartyria bisegmentata*, paratype. A: lateral view, B: arising part of ductus spermathecae, dorsal view, C: sclerite in genital chamber, ventral view, D: signum (tridentaform sclerite), E: segments IX and X, dorsal view, F: ditto, lateral view, G: ditto, ventral view, H: dorsal sclerite of segment X, dorso-caudal view. Scales = 0.2 mm.

shallowly curved. Valva without mid-dorsal protrusion, with a very small proximo-ventral obtuse projection; inner ventral margin broad, slightly concave; apical end obtuse. Phallobase without a ventral ridge; two pairs of hornlike proximal projections of aedeagus relatively short, extending latero-dorsally; aedeagus with a pair of small triangular plate near apex. Tergum X with medial part strongly swollen, semi-globular between terminal projections.

Female genitalia (Fig. 24): Segment IX ring strongly sclerotized, crumpled on dorsum and venter; mid-dorsal length about 3/7 of ventral length. Dorsal plate between segment X sclerites large, well sclerotized, as in Fig. 24H. Corpus bursae membranous, almost bulbous; signa consisting of 4 tridentaform sclerites. Genital chamber with a small sclerite.

Last instar larva (Fig. 10E-F). See generic description. Difference between this species and *I. nudata* is given in the description of *I. nudata*.

Pupa. See generic description.

Specimens examined. Holotype- ♂, Shionomata, Tokamachi-shi, Niigata Pref., Honshu, Japan, 4. vi. 1998 (S. Hashimoto) (KMNHIR200,226). Paratypes- 5♂, 2♀, Koshizawa, Sanpoku-cho, Niigata Pref., emerged 6-10. v. 1999 (H. Yoshitomi); 7♂, 1♀, Utogi, Tokamachi-shi, Niigata Pref., 7. vi. 1997 (S. Sakurai); 3♂, 1♀, same locality, 1-2. vi. 1998 (S. Hashimoto) (KMNHIR200, 227- KMNHIR200,230); 3♂, Hakka, Tokamachi-shi, Niigata Pref., 1. vi. 1998 (S. Hashimoto); 15♂, 1 ♀, Nagasato, Tokamachi-shi, Niigata Pref., 1. vi. 1998 (S. Hashimoto); 14♂, 4♀, Akakura, Tokamachi-shi, Niigata Pref., 2-3. vi. 1998 (S. Hashimoto); 3♂, 1♀, Ochinomizu, Tokamachi-shi, Niigata Pref., 2. vi. 1998 (S.Hashimoto) (KMNHIR200,231-KMNHIR200,234); 1♂, Amaike, Tokamachi-shi, Niigata Pref., 2. vi. 1998 (S. Hashimoto) (KMNHIR200,235); 2♂, Tatsunodaira, Tokamachi-shi, Niigata Pref. 3. vi. 1998 (S. Hashimoto); 2♂, Futatsuya, Tokamachi-shi, Niigata Pref., 3. vi. 1998 (S. Hashimoto); 1♂, Nonaka, Tokamachi-shi, Niigata Pref., 3.vi.1998 (S. Hashimoto) (KMNHIR200,236); 8♂, 2♀, same data as the holotype; 1♂, Iwanosawa, Muika-machi, Niigata Pref., 2. vi. 1998 (S. Hashimoto); 1♀, Shimizu-toge, Muika-machi, Niigata

Pref., 2. vi. 1998 (S. HASHIMOTO). Other materials- 1♀ in 75% Et-OH, Koshizawa, Sanpoku-cho, Niigata Pref., emerged 9. v. 1999 (H. YOSHITOMI); 7♂, 1♀ in 75% Et-OH, Nagasato, Tokamachi-shi, Niigata Pref., 1. vi. 1998 (S. HASHIMOTO); 7♂ in 75% Et-OH, same data as the holotype; 9 ♂ in 75% Et-OH, Utogi, Tokamachi-shi, Niigata Pref., 1. vi. 1998 (S. HASHIMOTO); 2 larvae, Koshizawa, Sanpoku-cho, Niigata Pref., 23. iii. 1999 (H. YOSHITOMI); 5 larvae, Utogi, Tokamachi-shi, Niigata Pref., 16. iv. 1998 (S. HASHIMOTO); 3 larvae, Oike, Tokamachi-shi, Niigata Pref., 17. iv. 1998 (S. HASHIMOTO); 1 pupa reared from larva, Nonaka, Tokamachi-shi, Niigata Pref., 18. iv. 1998 (S. HASHIMOTO).

Distribution. Japan (Central Honshu: Niigata Pref.) (Fig. 25).

Biology. See biology of genus. Larval host plant is *Conocephalum conicum* (L.) DUM. (Conocephalaceae).

Etymology. The specific name is based on the 2-segmented labial palpus.

Remarks. It is probable that this species is the most primitive in the genus in having 2-segmented labial palpus (Fig. 4V) and 4 conspicuous tridentaform sclerites in the female corpus bursae.

Genus *Kurokopteryx* gen. nov.

Type-species. *Kurokopteryx dolichocerata* sp. nov.,
by monotypy.

Diagnosis. *Kurokopteryx* is unique within the family in having the conspicuous valva with a dorsal long protrusion in the male genitalia. The dorsal expansion of segment X sclerite in the female genitalia is shared with *Neomicropteryx*, from which differs in the absence of the dorsal sclerite of segment X.

Adult

The generic description is based on *Kurokopteryx dolichocerata*.

Head: Head capsule densely covered with microtrichia, but naked and glossy on genal area; most of clypeus, frons and vertex covered with black piliform scales. Antenna moniliform, long, approximately as long as forewing or slightly beyond the forewing in male, shorter in female; flagellar segments about 68 in male, about 45 in female; basal one or two flagellomeres cylindrical. SOI about 0.4. MIOI about 0.5. Interocellar sulcus almost complete. Postinterocellar sulcus distinct as a darker line. Epicranial sulcus indistinct. Occipital sulcus interrupted at dorso-lateral corner. Temporal sulcus as a darker line. Occiput oblong, fan-shaped. Epipharyngeal armature reduced. Labial palpus 1-segmented. Proximal margin of prelabium indistinct, weakly sclerotized. Post labium variable in sclerotization.

Thorax: Fortibial epiphysis absent. Antero-lateral processes of pronotum recognizable, but weakly sclerotized. Proprioceptive hair plate behind metasubalare connected with epimeron. Fore- and hindwings obtuse at apex; forewing with purple and brownish purple luster, without any distinct maculation; forewing R1 unforked; R3 stalked with R4 + 5 in fore- and hindwings; a main stem of R1 unrecognizable in hindwing; most anterior vein of hindwing forked near terminal end.

Abdomen: Tergum I broadly membranous, sclerotized triangularly at antero-lateral corners, with a short ridge at middle laterally. Sternum V gland present; its orifice a narrow slit. Sternum VIII completely membranous in male.

Male genitalia: Abdominal segment IX a complete ring, well sclerotized, with an anterior expansion ventrally; postero-lateral margin sinuate. Valva conspicuous, membranous at proximal inner surface, tapering at apical half, with a proximo-dorsal, long sword-like protrusion curved medioventrally; valva proximo-ventrally expanded medially, with a hornlike process extending medially at apical part of ventral expansion, and with a hooked process at ventral proximomedial corner whose anterior part connects with a circular median plate. Phallobase strongly arched; aedeagus with a pair of triangular plates expanding horizontally at middle and with dorsal and ventral terminal ends rather acute; gonopore opening horizontally; vesica with serrate minute projections. Tergum X as long as broad, with a pair of dorsoproximal digitate projections; a pair of hornlike terminal processes curved ventrally, and a pair of long ventral plates (venter X plates) extending antero-ventrally at base of terminal processes.

Female genitalia: Segment IX forming a complete ring, well sclerotized; anterior margin expanded anteriorly from dorsum to venter; postero-dorsal margin protruded; postero-lateral margin sinuate. Segment X consisting of lateral sclerites, without any dorsal sclerite; lateral sclerite expanded dorso-medially, folded dorso-laterally, with digitate projections having an apical seta at terminal inner margin; postero-lateral margin semicircular. Corpus bursae small, oblong, membranous, without signa. Ductus spermathecae arising from a pentagonal concavity. Genital chamber with a small sclerite.

Immature stages

The description is based on *K. dolichocerata*.

Egg: Ovoid, pale yellow, covered with bubble-like structures, as in *Neomicropteryx* eggs.

Last instar larva (Figs. 8B-C, 9G-L, 10G-H). Body length about 4.0 mm. Head fuscous, with 6 stemmata. Body coloration, maculation and chaetotaxy similar to those of *Issikiomartyria* and *Neomicropteryx* larvae (see generic

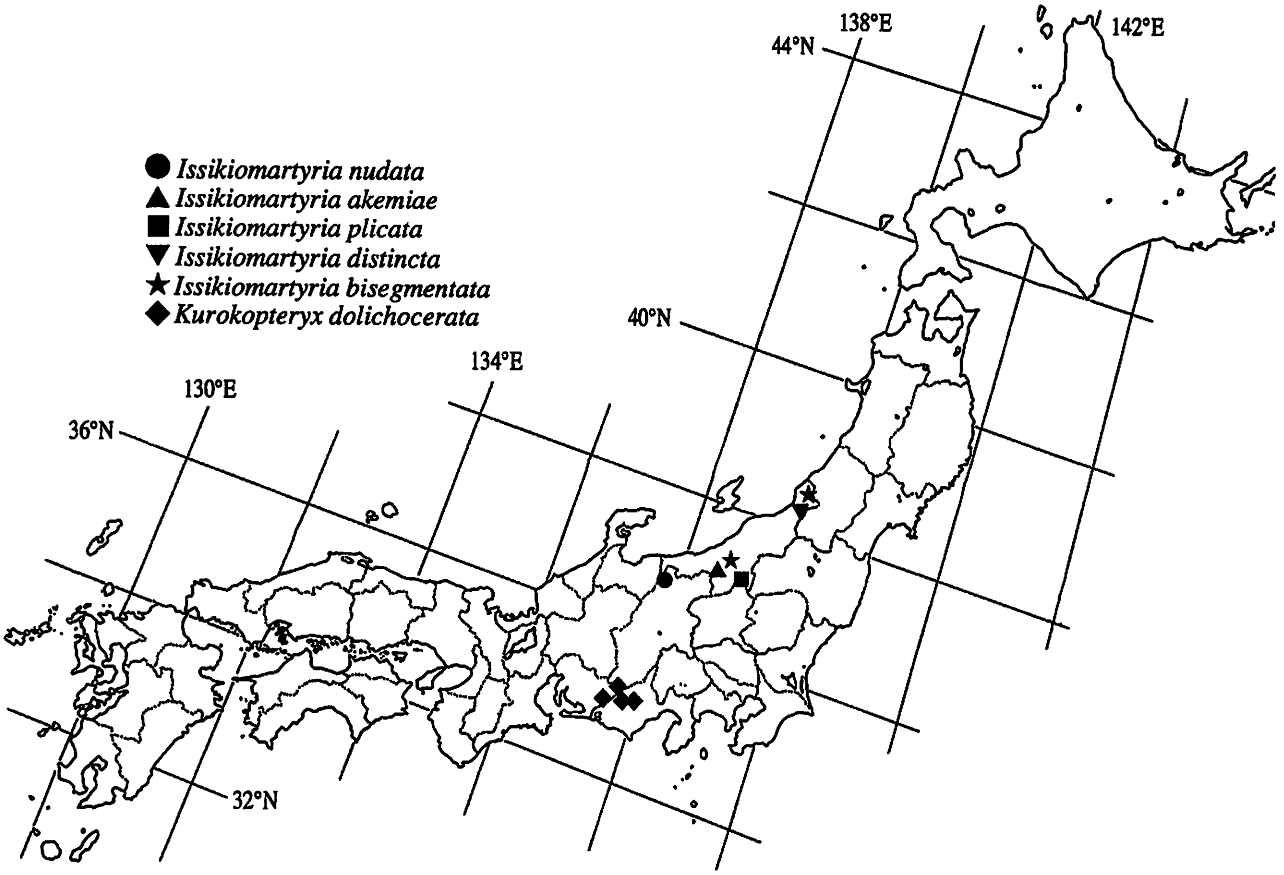

Fig. 25. Distribution map of *Issikiomartyria* and *Kurokopteryx* species.

description of *Issikiomartyria*), but *Kurokopteryx* is distinguishable from the former by the long, acute D1 setae on the metathorax and on abdominal segments I-VII and by the slightly long, acute D2 setae on the mesothorax and on abdominal segment I-VII, and from the latter genus by the minute SV1 seta on thorax.

Pupa. Body length about 3.5 mm. Very similar to the *Issikiomartyria* and *Neomicropteryx* pupae.

Biology. Very similar to those of the *Issikiomartyria* and *Neomicropteryx* species. The larval host plant (Fig. 11F) is *Conocephalum conicum* (L.) DUM. (Conocephalaceae).

Etymology. The generic name is dedicated to Professor Dr. Hiroshi KUROKO, formerly of the Osaka Prefecture University, who is one of the famous taxonomists on Microlepidoptera. Gender is feminine.

Remarks. Apomorphies of *Kurokopteryx* are the distinct male valva, especially a long curved dorsal protrusion and a hornlike ventral projection, and absence of the segment X dorsal sclerite in the female genitalia. Absence of the female segment X dorsal sclerite is usual in the family, but it is probable that this characteristic secondarily occurred in *Kurokopteryx*. This genus is very similar to *Neomicropteryx* from which it differs in the small body size, the slender forewing, the conspicuous male genitalia, and the loss of female abdominal segment X dorsal sclerite.

***Kurokopteryx dolichocerata* sp. nov.**

(Figs. 1J, 3G, 4J, 4O, 4Q-R, 4W, 5C, 5H, 6H,
7E, 7I, 8B-C, 9G-L, 10G-H, 11I, 26, 27)

Neomicropteryx sp.: TANAKA *et al.*, 1991: 108.

Adult (Fig. 1J). Forewing length 4.7 mm in holotype, 4.2-4.9 mm (mean 4.6 mm, n= 36) in males, 4.1-4.8 mm (mean 4.4 mm, n = 20) in females.

Head capsule black, naked and glossy on both sides, covered with black piliform scales. Antenna slightly greater than forewing length in male, about 2/3 in females, densely covered with black piliform scales on scape and pedicel, rarely scattered with blue metallic scales near base; flagellum 62-74 segments (mean 67.6, n = 34) in males, 41-49 (mean

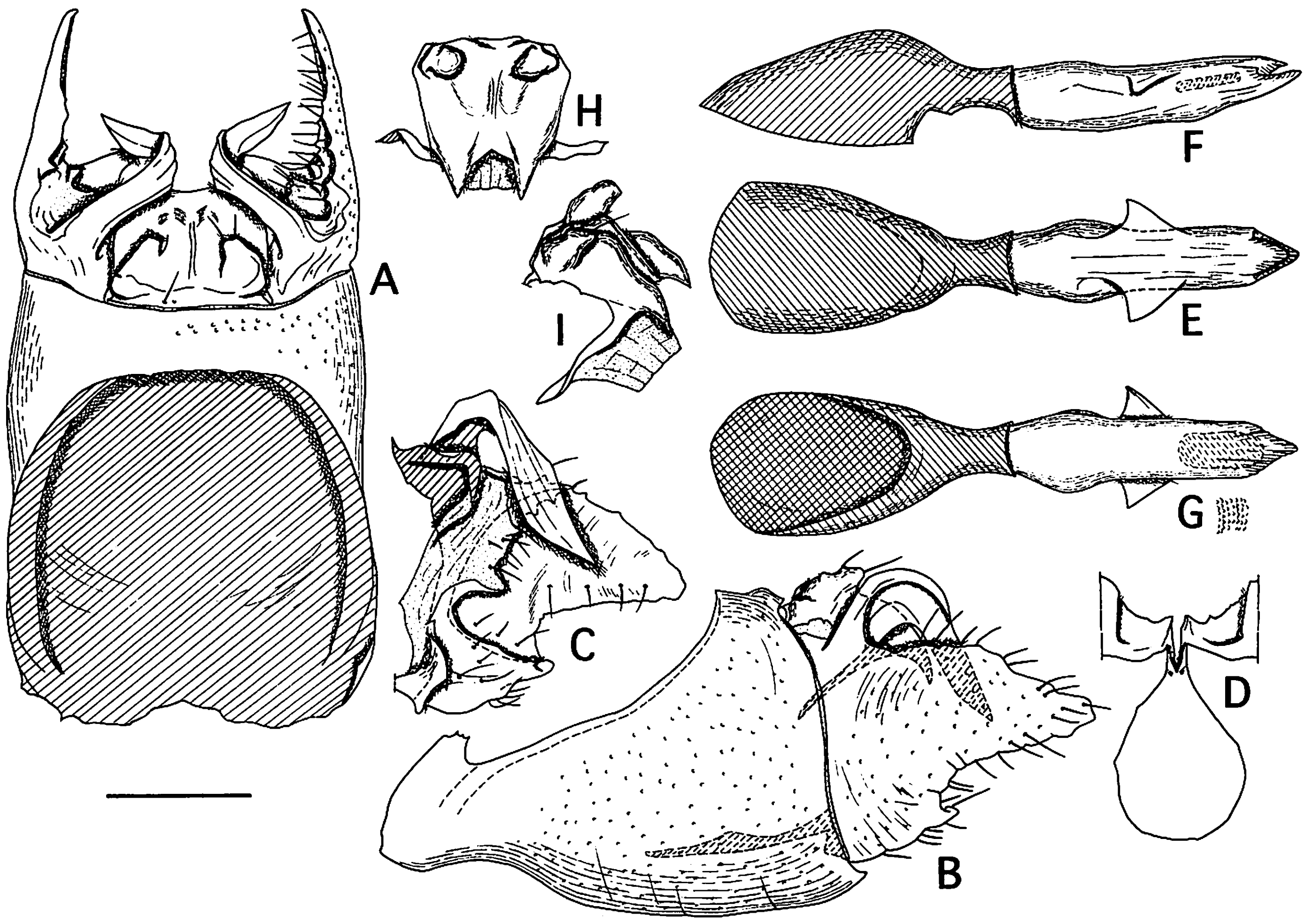

Fig. 26. Male genitalia of *Kurokopteryx dolichocerata*, paratype. A: dorsal view, phallus removed, B: lateral view, phallus removed, C: right valva, inner view, D: median plate, dorsal view, E: phallus, dorsal view, F: ditto, lateral view, G: ditto, ventral view, H: tergum X and venter X plates, dorso-caudal view, I: ditto, latero-dorsal view. Scale = 0.2 mm.

44.7, n = 32) in females.

Thorax fuscous, covered with purple and fuscous metallic scales on prothorax, with sparse bluish metallic luster, with black piliform scales on tegula. Legs covered with glossy fuscous scales. Forewing with purple and brownish purple luster and scattered with golden metallic scales densely near base, sparsely covered with blue metallic scales near base; cilia grayish brown, slightly paler on apex; ventral surface glossy grayish purple. Hindwing glossy grayish purple, with grayish piliform scales on basal half; cilia grayish brown; ventral surface same as forewing.

Abdomen pale yellowish gray, sparsely with fuscous piliform scales, densely on sides of dorsum VII and VIII.

Male genitalia (Fig. 26): Mid-dorsal length of segment IX ring about 1/8 of ventral length; postero-dorsal margin shallowly curved. Proximo-dorsal projection of valva flat, acute at terminal end; dorsal and ventral margins of caudal half roughly notched. Phallobase as long as aedeagus; triangular plate relatively large.

Female genitalia (Fig. 27): Mid-dorsal length of segment IX ring about 3/7 of ventral length; dorso-posterior margin protruded and acute at middle; postero-lateral margin slightly sinuate. Lateral sclerite of segment X crumpled dorso-laterally.

Immature stage. See generic description.

Specimens examined. Holotype- ♂, Matsushima, Toyo-ne-mura, Aichi Pref., Honshu, Japan, 25. iv. 1994 (S.Hashimoto) (KMNHIR200,237). Paratypes- 2♂, 1♀, Nishiyama, Sakuma-cho, Shizuoka Pref., emerged 13-15. iv. 1994 (S. Hashimoto, N. Koda, H. Nakano & H. Yoshitomi) (KMNHIR200,238-KMNHIR200, 240); 31♂, 3♀, same locality, 25. iv. 1994 (S. Hashimoto); 31♂, 13♀, same locality, emerged 10-17. iv. 1995 (S. Hashimoto); 1♂, 1♀, same locality, emerged 15. iv. 1996 (S. Hashimoto) (KMNHIR200,241-

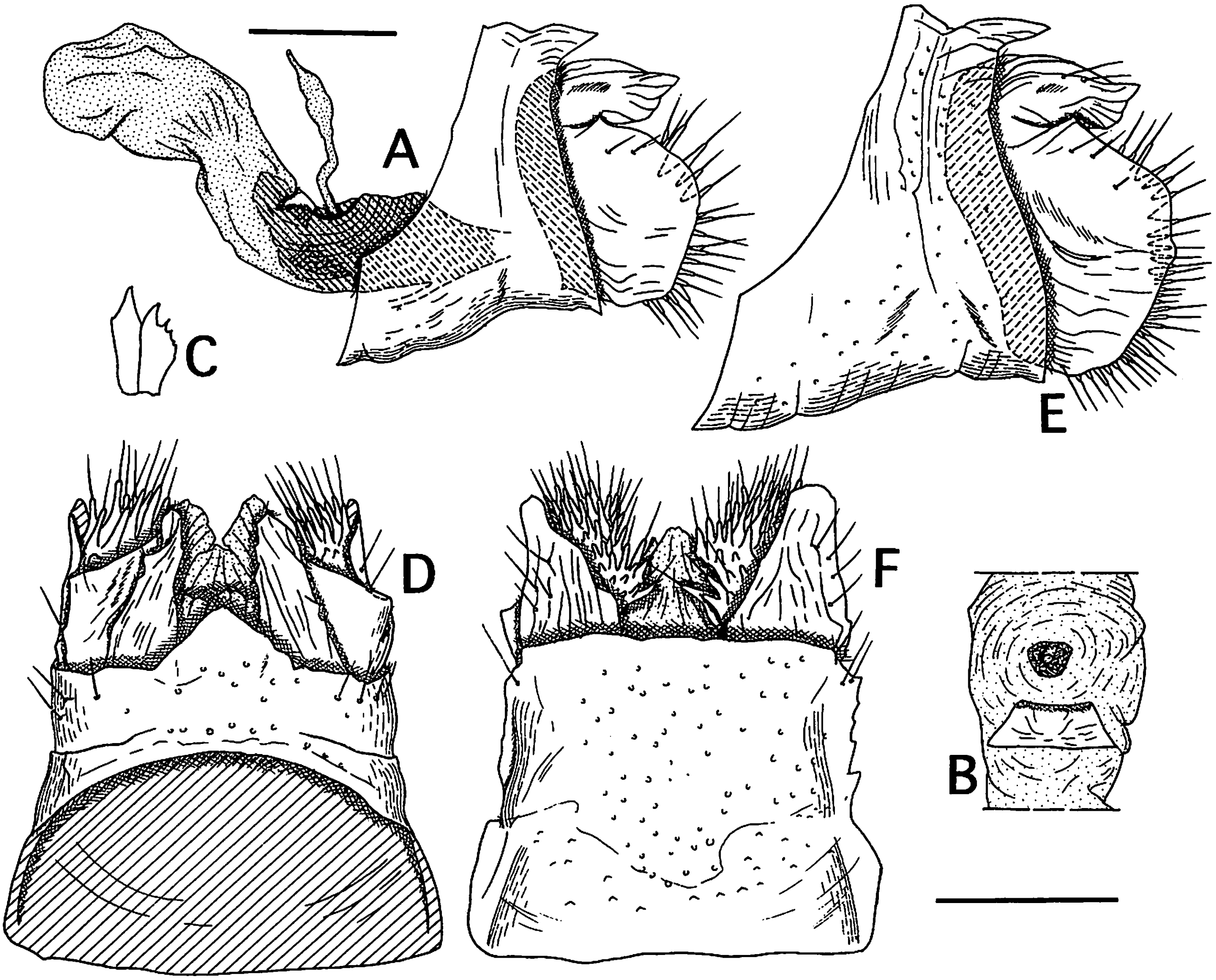

Fig. 27. Female genitalia of *Kurokopteryx dolichocerata*, paratype. A: lateral view, B: arising part of ductus spermathecae, dorsal view, C: sclerite in genital chamber, ventral view, D: segments IX and X, dorsal view, E: ditto, lateral view, F: ditto, ventral view. Scales = 0.2 mm.

KMNHIR200, 242); 35♂, 20♀, same locality, emerged 31. iii. - 7. iv. 1997 (S. Hashimoto, H. Nakano & H. Yoshitomi); 3♂, 1♀, Toriisawa, Mori-machi, Shizuoka Pref., emerged 3-7. iv. 1997 (H. Nakano) (KMNHIR200,243-KMNHIR200,246); 7♂, 3♀, Omatakyomaru, Haruno-cho, Shizuoka Pref., emerged 4-9. iv. 1997 (H. Nakano); 1♂, 5 ♀, Ohtani, Tomiyama-mura, Aichi Pref., emerged 19-20. iv. 1994 (S. Hashimoto, N. Koda, H. Nakano & H. Yoshitomi); 7♂, 6♀, Ashizawa, Tomiyama-mura, Aichi Pref., emerged 19-21. iv. 1994 (S. Hashimoto, N. Koda, H. Nakano & H. Yoshitomi) (KMNHIR200,247-KMNHIR200,259); 23♂, 4♀, same data as the holotype; 5♀, Horaiko, Horai-cho, Aichi Pref., emerged 9-17. iv. 1997 (S. Hashimoto, H. Nakano & H. Yoshitomi). Other materials- 6♂, 1♀ in 75% Et-OH, Nishiyama, 25. iv 1994 (S. Hashimoto); 27 younger larvae reared from eggs oviposited by the captured females, Nishiyama, Sakuma-cho, Shizuoka Pref., 25. iv. 1994 (S. Hashimoto), 1 pupa reared from larva, Nishiyama, Sakuma-cho, Shizuoka Pref., 7. iii. 1995 (S. Hashimoto); 4 larvae and 1 pupa reared from larva, same locality, 4. iii. 1996 (S. Hashimoto); 1 larva, Toriisawa, Mori-machi, Shizuoka Pref., 6. iii. 1997 (H. Nakano); 1 larva, Omatakyomaru, Haruno-cho, Shizuoka Pref., 27. ii. 1997 (H. Nakano); 1 pupa reared from larva, Ohtani, Tomiyama-mura, Aichi Pref., 22. iii. 1994 (S. Hashimoto, N. Koda, H. Nakano & H. Yoshitomi).

Distribution. Japan (Central Honshu: Shizuoka Pref. and Aichi Pref.) (Fig. 25).

Biology. See biology of genus.

Etymology. The specific name is based on the long dorsal projection of the male valva.

Remarks. This species is similar to *Paramartyria immaculatella* and the *Neomicropteryx* species in appearance, but differs from the former in the black piliform scales on the head and from the latter in the small size and the slender forewing.

Genus Neomicropteryx Issiki, 1931

Neomicropteryx Issiki, 1931: 1011. Type-species: *Neomicropteryx nipponensis* Issiki, 1931: 1012, figs 15, 16b, 16c, 17, by original designation.

Diagnosis. *Neomicropteryx* is characterized by the large fan-shaped median plate, the dorsal and ventral longitudinal median ridges of aedeagus, and the rather slender flat terminal processes of tergum X in the male genitalia, and by the lateral concavities of segment IX in the female genitalia.

Adult

The generic description is based on six previously known and two newly described species, and on the following studies: Issiki (1931, 1953) and Hashimoto (1992).

Head: Head capsule densely covered with microtrichia, but naked and glossy on genal area; most of clypeus, frons and vertex covered with black piliform scales. Antenna moniliform, long, approximately as long as forewing in male, shorter in female; flagellar segments about 67 in male, about 51 in female; basal one or two flagellomeres cylindrical. SOI about 0.4. MIOI about 0.5. Interocellar sulcus almost complete. Postinterocellar sulcus distinct as a dark line. Epicranial sulcus present between occipital foramen and postinterocellar sulcus and located a short distance anterior to interocellar sulcus. Occipital sulcus interrupted at dorso-lateral corner. Temporal sulcus a dark line. Occiput oblong, fan-shaped. Epipharyngeal armature reduced, individually variable. Labial palpus 1-segmented. Proximal prelabium indistinct, weakly sclerotized. Post labium variable in sclerotization.

Thorax: Fortibial epiphysis absent. Antero-lateral processes of pronotum present, but weekly sclerotized. Proprioceptive hair plates behind metasubalare usually connected with epimeron, but variable and sometimes separate. Fore- and hindwings obtuse at apex; forewing with purple and brownish purple luster, without any distinct maculation; forewing R1 usually unforked; R3 stalked with R4+5 in fore- and hindwings; main stem of R1 undeveloped in hindwing; most anterior vein of hindwing usually forked near terminal end, rarely simple.

Abdomen: Tergum I broadly membranous, with triangular sclerotization at antero-lateral corners, with a short ridge midway along sides. Sternum V gland present; its orifice a narrow slit or a small hole. Sternum VIII completely membranous in male.

Male genitalia: Abdominal segment IX a complete ring, widening toward caudal end, strongly sclerotized, with an anterior expansion ventrally; postero-lateral margin sinuate. Valva relatively short, triangular, broadly membranous at proximal inner surface, proximo-medial margin with a ventral hooked protrusion that extends anteriorly to connect with median plate; median plate fan-shaped, large. Phallobase strongly curved, as long as aedeagus; aedeagus slightly sinuate laterally, with dorsal and ventral longitudinal median ridges; a small tooth present latero-ventrally at middle, and a pair of triangular plates near terminal end; dorsal end of aedeagus somewhat acute and ventral one rounded, longer than dorsal one; gonopore opening horizontally; vesica with serrate minute projections. Tergum X medium sized, more or less protruded proximo-medially, with a pair of dorso-proximal digitate projections, a pair of slightly flat terminal processes, and a pair of long venter X plates extending antero-ventrally at proximo-ventral sides.

Female genitalia: Segment IX forming a complete ring, strongly sclerotized; anterior margin expanded anteriorly from dorsum to venter; concave laterally and corresponding to male valva in copula. Segment X consisting of lateral and dorsal sclerites; lateral sclerite expanded dorsally, with digitate projections having an apical seta at terminal inner margin; postero-lateral margin slightly curved or sinuate. Internal genitalia uniform in the genus; corpus bursae small, oblong, membranous, without signa; ductus spermathecae arising from a pentagonal concavity; genital chamber with a sclerite.

Immature stages

The description is based on all the known species of the genus and on the following studies: Yasuda (1962), Kobayashi & Ando (1982) and Hashimoto (2001).

Egg: Ovoid, pale yellow, covered with bubble like structures (Fig. 11L).

Last instar larva: Body length approximately 4.5 mm, but sometimes near 5 mm. Similar to the *Issikiomartyria* and *Kurokopteryx* larvae in coloration and maculation. Difference among them is provided in the generic descriptions of *Issikiomartyria* and *Kurokopteryx*. The larval chaetotaxy is shown in Hashimoto (2001), but the names of L setal group are erroneously presented in his figs. 3 & 4G (see Table 1). *Neomicropteryx* larvae are very similar to one another so that identification of the species based on the larval characters is impossible.

Pupa: Body length about 4 mm. The pupal description is given in the general morphology of the family.

Biology. There is a single generation per year. The habitat (Fig. 11P) is very similar to those of the preceding genera. Larvae of all the known species feed on the liverwort species *Conocephalum conicum* (L.) DUM. (Conocephalaceae) (Fig. 11F). Pupation occurs within an ellipsoidal cocoon, which is tightly woven by silk only, near the host substrate or in the rhizoid. All species of the genera *Neomicropteryx*, *Issikiomartyria*, and *Kurokopteryx* occupy the same ecological niche, including life cycle and larval host plant; consequently, their distributions never overlap.

Remarks. Apomorphies of *Neomicropteryx* are the dorsal and ventral longitudinal median keels of the aedeagus, the rather slender, flat terminal projections (tergum X lobes) of male tergum X, and the concave sides of the female abdominal segment IX. The large fan-shaped median plate is also unique in the family, but the median plate varies in shape and size among the species in other genera. This genus is closely related to the genus *Kurokopteryx*. Distinction between them is provided in the key to genera and in the remarks of *Kurokopteryx*.

Adult *Neomicropteryx* species are too similar to one another in general appearance for identification. As already noted by ISSIKI (1953), only the genitalia of both sexes provide good characters for species identification. Although phylogenetic relationships among the species are not presented in this study nor in the genus *Issikiomartyria*, the phylogenetic analysis based on mitochondrial DNA has been studied by KOBAYASHI *et al.* (in prep.).has been studied by KOBAYASHI *et al.* (in prep.).

Key to the species based on male genitalia

1. Width between tergum X terminal processes narrower than tergum X basal width 2
— Width between terminal processes as long as broad or broader than tergum X basal width 3
2. Tergum X long, slender; proximo-dorsal projections of tergum X small .... *elongata*
— Tergum X short; proximo-dorsal projections well-devel oped .... *kazusana*
3. Caudal margin of tergum X almost V-shaped 4
— Caudal margin of tergum X broadly U-shaped 5
4. Valva with a long curved ridge at ventral inner surface; phallobase with a pair of long dorso-caudal ridges; terminal processes of tergum X notched near apex .... *bifurca*
— Valva without an inner ridge; phallobase with a pair of short lateral plates caudally; terminal processes smooth .... *matsumurana*
5. Proximo-dorsal projections of tergum X reduced; tergum X terminal projections shortly divided dorso-ventrally, acute .... *redacta* sp. nov.
— Proximo-dorsal projections developed; terminal projections not divided apically 6
6. Ventro-proximal portion of valva expanded ventrally; terminal processes of tergum X long, slender .... *cornuta*
— Ventro-proximal portion of valva slightly expanded ventrally; terminal processes short or medium, relatively broad 7
7. Proximo-dorsal margin of valva expanding medially as a narrow plate; outer margins of terminal processes of tergum X strongly curved dorsally............ *kiwana* sp. nov.
— Proximo-dorsal margin of valva not expanding; outer margins of terminal processes slightly curved dorsally... *nipponensis*

Key to the species based on female genitalia

1. Dorso-lateral sides of segment IX almost straight.........2
— Dorso-lateral sides rounded..3
2. Segment IX dorsum narrower than venter; dorso-caudal margin of segment IX strongly protruded at middle; dorsal part of lateral sclerite of segment X expanded caudally..*redacta* sp. nov.
— Dorsum slightly narrower than venter; dorso-caudal margin slightly protruded; dorsal part of lateral sclerite not expanded caudally................................ *elongata*
3. Dorsum of segment IX obviously broader than caudal part of venter; dorsal plate between lateral sclerites of segment X weakly sclerotized 4
— Dorsum slightly broader than caudal part of venter; dorsal plate strongly sclerotized 5
4. Lateral concavities of segment IX deeply extending obliquely from antero-dorsal to postero-ventral margins; ventral sides of segment IX becoming narrow gradually at caudal half; width of dorsal plate of segment X about 3 X as long as median length............*nipponensis*
— Lateral concavities shallowly extending shortly; ventral sides becoming narrow gradually from anterior to posterior margins; width of dorsal plate of segment X about 5 X as long as median length......*kiwana* sp. nov.
5. Dorsal part of lateral sclerite of segment X strongly crumpled 6
— Dorsal part weakly crumpled................................. 7
6. Ventral margin of lateral concavity of segment IX strongly oblique; dorsal expansion of lateral sclerite of segment X slightly expanded caudally; segment X dorsal plate obtusely angled caudo-laterally, shallowly emarginated at middle of caudal margin .... *matsumurana*

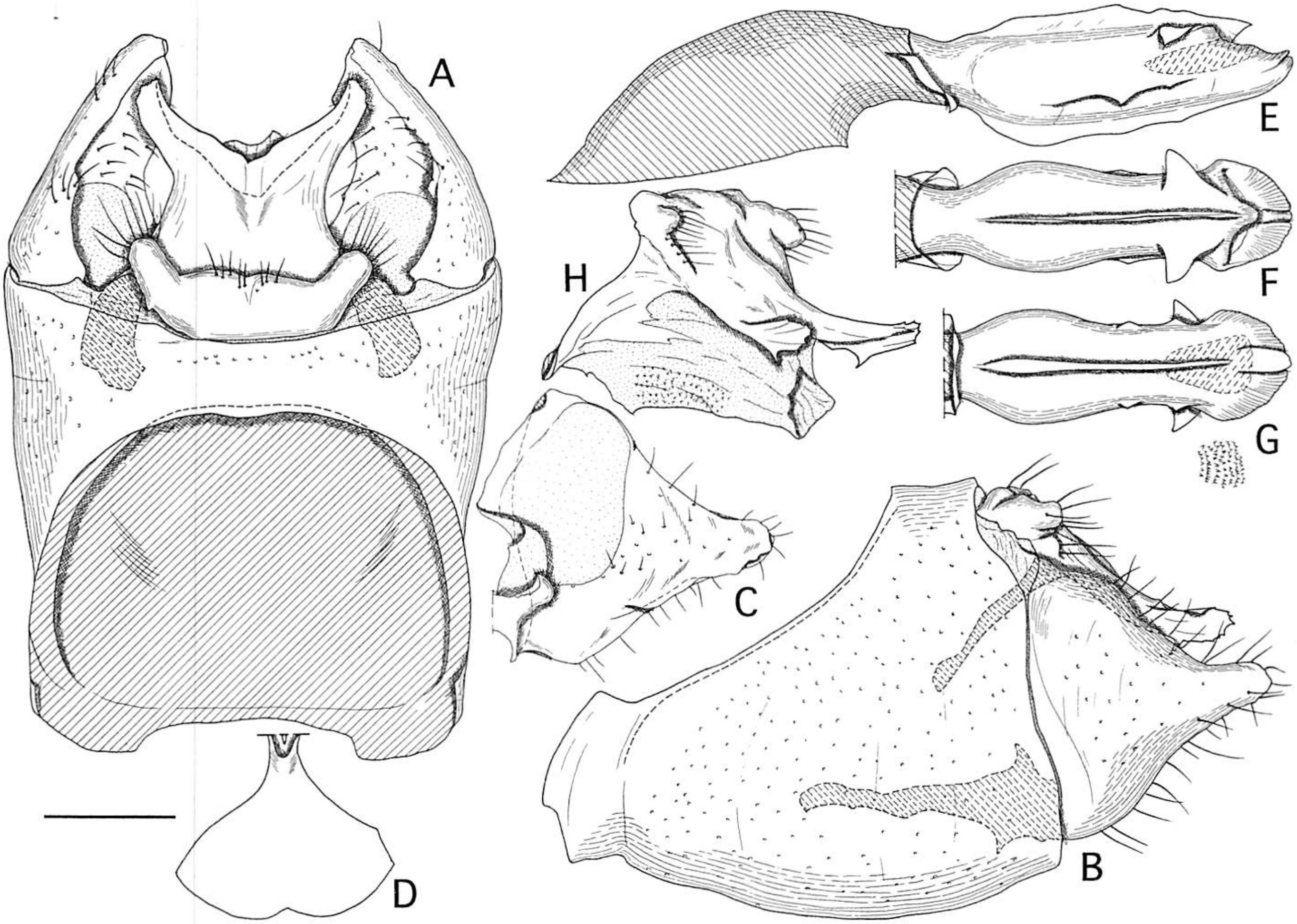

Fig. 28. Male genitalia of *Neomicropteryx nipponensis*. A: dorsal view, phallus removed, B: lateral view, phallus removed, C: right valva, inner view, D: median plate, dorsal view, E: phallus, lateral view, F: aedeagus, dorsal view, G: ditto, ventral view, H: tergum X and venter X plate, latero-caudal view. Scale = 0.2 mm.

— Ventral margin of lateral concavity gently oblique; dorsal expansion extending caudally; dorsal plate rounded caudo-laterally, strongly emarginated at middle of caudal margin...*bifurca*

7\. Ventro-caudal margin of segment IX notched at middle; segment X dorsal plate rectangular, shallowly curved at middle of caudal margin..............................*cornuta*

— Ventro-caudal margin subtruncate; dorsal plate deeply emarginated at middle of caudal margin ..... *kazusana*

Neomicropteryx nipponensis Issiki, 1931

(Figs. 2A, 3A-C, 4A, 4P, 4S, 4X, 5I-K, 6I, 7J, 10I-J, 28, 29)

Neomicropteryx nipponensis Issiki, 1931: 1012, figs 15, 16b, 16c, 17.

Neomicropteryx nipponensis: Issiki, 1953: 136, fig. 5; Issiki, 1971: 6, pl. 1: 4, fig. 3; Moriuti, 1982: 43, pl. 1: 4, pl. 235: 3, pl. 245: 4.

Redescription

Adult (Fig. 2A). Forewing length 5.1-5.9 mm (mean 5.6 mm, n = 24) in males, 4.9-5.9 mm (mean 5.4 mm, n = 7) in females.

Head capsule black, naked and glossy on both sides, covered with black piliform scales. Antenna as long as forewing in males, about 3/4 in females, covered with black piliform scales, densely on scape and pedicel, sparsely with blue metallic scales near base; flagellum 63-70 segments (mean 66.8, n = 22) in males, 49-51 (mean 50.3, n = 6) in females.

Thorax fuscous, covered with fuscous scales, scattered with blue and purple metallic scales on prothorax, with black piliform scales on tegula. Legs covered with fuscous scales. Forewing with purple and brownish purple luster, with scattered golden metallic scales, densely on dorsum near base; cilia grayish brown, slightly paler on apex; ventral

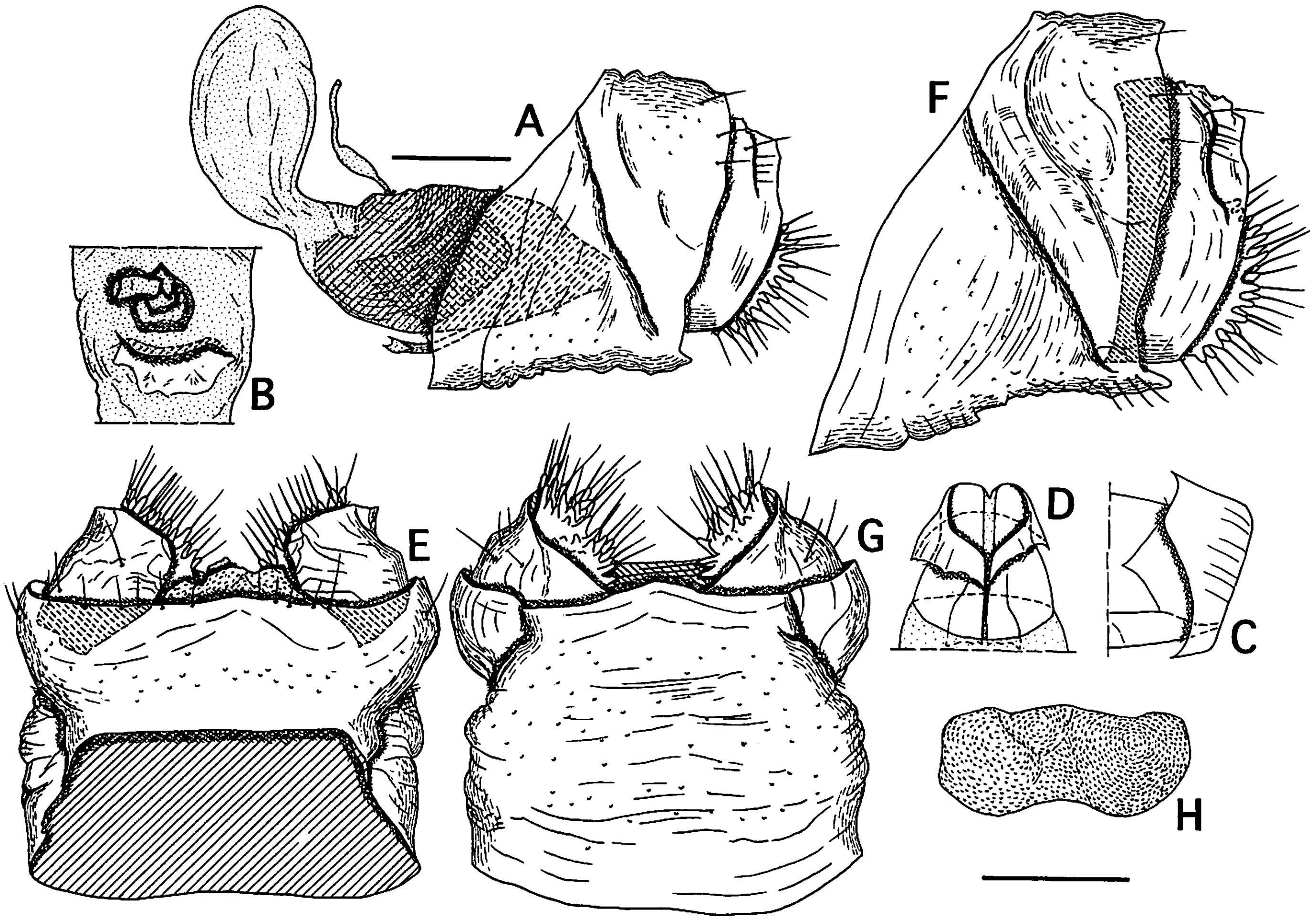

Fig. 29. Female genitalia of *Neomicropteryx nipponensis*. A: lateral view, B: arising part of ductus spermathecae, dorsal view, C: sclerite in genital chamber, lateral view, D: ditto, ventral view, E: segments IX and X, dorsal view, F: ditto, lateral view, G: ditto, ventral view, H: dorsal sclerite of segment X, dorso-caudal view. Scales = 0.2 mm.

surface glossy grayish purple. Hindwing glossy brownish purple; cilia grayish brown; ventral surface same as forewing.

Abdomen grayish brown, with scattered fuscous piliform scales.

Male genitalia (Fig. 28): Mid-dorsal length of segment IX about 1/6 of ventral length. Valva with an obtuse apex; dorsal margin slightly sinuate; apical half sometimes more slender. Latero-ventral margin of caudal end of phallobase expanded outwardly as a narrow, slender plate. Tergum X broad than long, slightly protruded proximo-medially; basal projections well developed, digitiform; terminal projections flattened, with minute serrations near apex, slightly curved dorsally at apical outer margin.

Female genitalia (Fig. 29): Mid-dorsal length of segment IX about 1/3 to 1/2 of ventral length; dorsum broader than caudal part of venter, rounded laterally; both sides of venter becoming narrow toward posterior end ofcaudal half; lateral concavity deeply extending obliquely; caudo-lateral margin slightly curved, but rarely protruded at middle. Dorsal expansion of segment X slightly crumpled; dorsal plate less sclerotized, covered with minute projections, broader than long (about 3 X as long as median length).

Variation. This species shows some variation in the shape of genital structures; especially in the male valva, the male tergum X and the female segment IX.

Last instar larva (Fig. 10I-J). See generic description. Body length about 4.5 mm.

Pupa. See general morphology of the family.

Specimens examined. Honshu- 1♂, Eigenji-cho, Shiga Pref., 19. v. 1991 (N. TERAMOTO); 7♂, 4♀, Reisen, Iga-cho, Mie Pref., emerged 30. iii. - 4. iv. 1998 (H. NAKANO); 1♂, Hirakura, Misugi-mura, Mie Pref., 23. v. 1993 (H. YOSHITOMI); 2♂, 2♀, Akamedani, Nabari-shi, Mie Pref., 19. v. 1994 (S. MORIUTI & Y. MORIUTI) (OPU); 2♂, same locality, 23. v. 1995 (S. MORIUTI & Y. MORIUTI) (OPU); 1♂, 1♀, Ochiai, Nabari-shi, Mie Pref., 23. v. 1995 (S. MORIUTI & Y. MORIUTI)

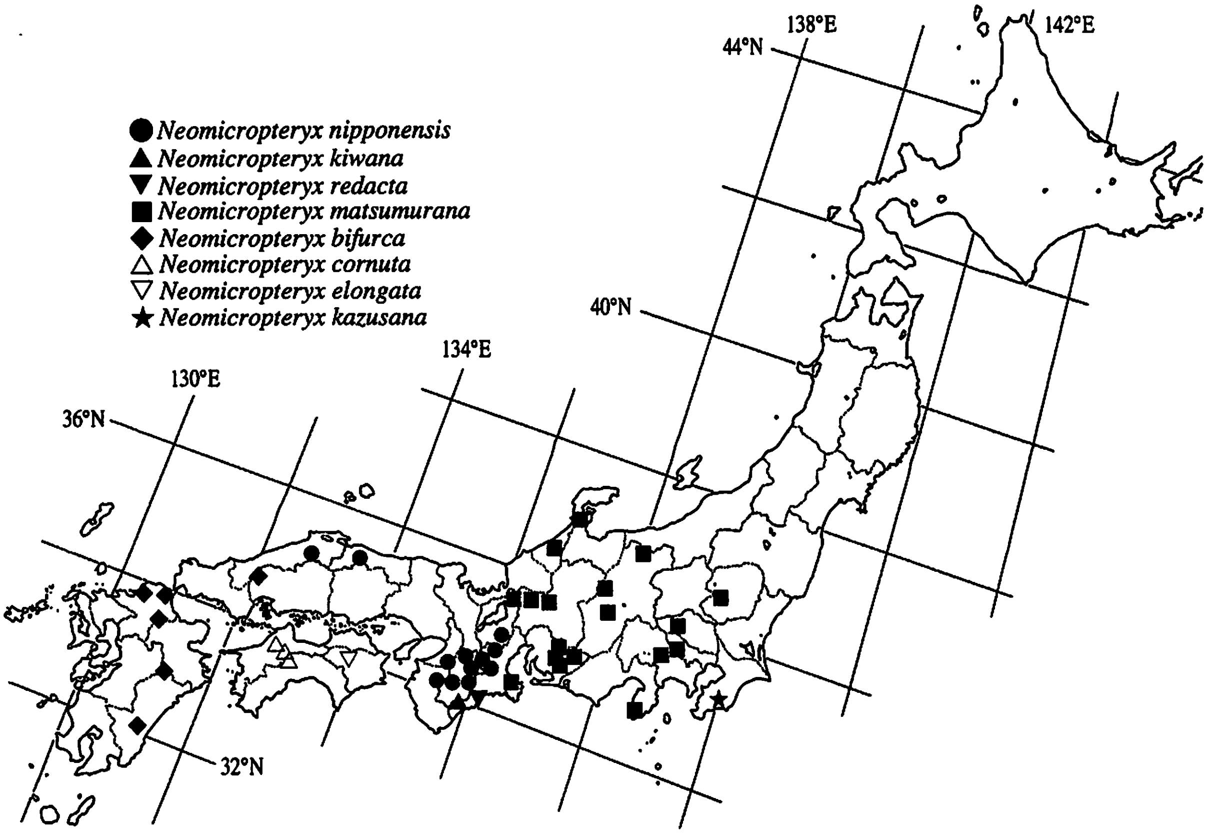

Fig. 30. Distribution map of *Neomicropteryx* species.

(OPU); 2♂, Kasugayama (*ca.* 250 m), Nara Pref., 3. v. 1994 (S. MORIUTI & Y. MORIUTI) (OPU); 2♂, Yoshinoyama (*ca.* 250 m), Nara Pref., 21. v. 1990 (S. MORIUTI) (OPU); 4 ♂, 1♀, Odaiguchi, Kawakami-mura, Nara Pref., emerged 24-30. iv. 1998 (S. HASHIMOTO & H. NAKANO); 8♂, 1♀, Otosan, Oto-mura, Nara Pref., 12. v. 2001 (T. HIROWATARI & B. W. LEE) (OPU); 6♂ (4♂ in 75% Et-OH), Amami, Kawachinagano-shi, Osaka Pref., 16. v. 1979 (S. HASHIMOTO); 2 ♂, 2♀, same locality, emerged 20. iv. 1981 (S. HASHIMOTO); 1♂, 1♀, same locality, 14. v. 1983 (S. HASHIMOTO); 25 ♂, 3♀, same locality, 15. v. 1993 (S. HASHIMOTO); 1♂, Iwawaki-san, Kawachinagano-shi, Osaka Pref., 16. v. 1979 (S. HASHIMOTO); 3♂, same locality, 16. v. 1983 (H. HARA); 1♂, Izumi-Katsuragi, Osaka Pref., 17. v. 1993 (N. HASHIMOTO, M. ISHII & T. HIROWATARI) (OPU); 9♂, 1♀, Kiyokawa, Koya-cho, Wakayama Pref., 17. v. 1995 (T. HIROWATARI) (OPU); 1♂, Koya-san, Koya-cho, Wakayama Pref., 5. vi. 1980 (S. HASHIMOTO); 1♂, same locality, 6. vi. 1987 (S. HASHIMOTO); 2♂ in 75% Et-OH, Kagamiganaru, Tottori Pref., 29. v. 1990 (R. B. KURANISHI); 2♂, Ohyamada, Yoshida-mura, Shimane Pref., 17. v. 1993 (S. HASHIMOTO). Other materials- 1 larva, Kasugayama, Nara-shi, Nara Pref., 10. xii. 1995 (H. YOSHITOMI); 1 larva and 1 pupa reared from larva, Obamine-toge, Kawakami-mura, Nara Pref., 5. iv. 1998 (S. HASHIMOTO & H. NAKANO); 1 pupa, Amami, Kawachinagano-shi, Osaka Pref., 3. iv. 1994 (S. HASHIMOTO); 4 larvae, same locality, 25. x. 1997 (S. HASHIMOTO).

Distribution. Japan (Honshu: Kinki and Chugoku districts) (Fig. 30).

Biology. See biology of genus.

Remarks. This species is closely allied to *N. kiwana*, in the male and female genitalia; their distinction is given in the keys.

Neomicropteryx kiwana sp. nov.

(Figs. 2B, 10K, 31, 32)

Adult (Fig. 2B). Very similar to *N. nipponensis* in general appearance and distinguishable only by the genital structures given in the keys.

Forewing length 5.5 mm in holotype, 5.3-5.8 mm (mean 5.5 mm, n = 6) in males, 5.3-5.5 mm (mean 5.4 mm, n = 9) in females. Antennal flagellum 62-71 (mean

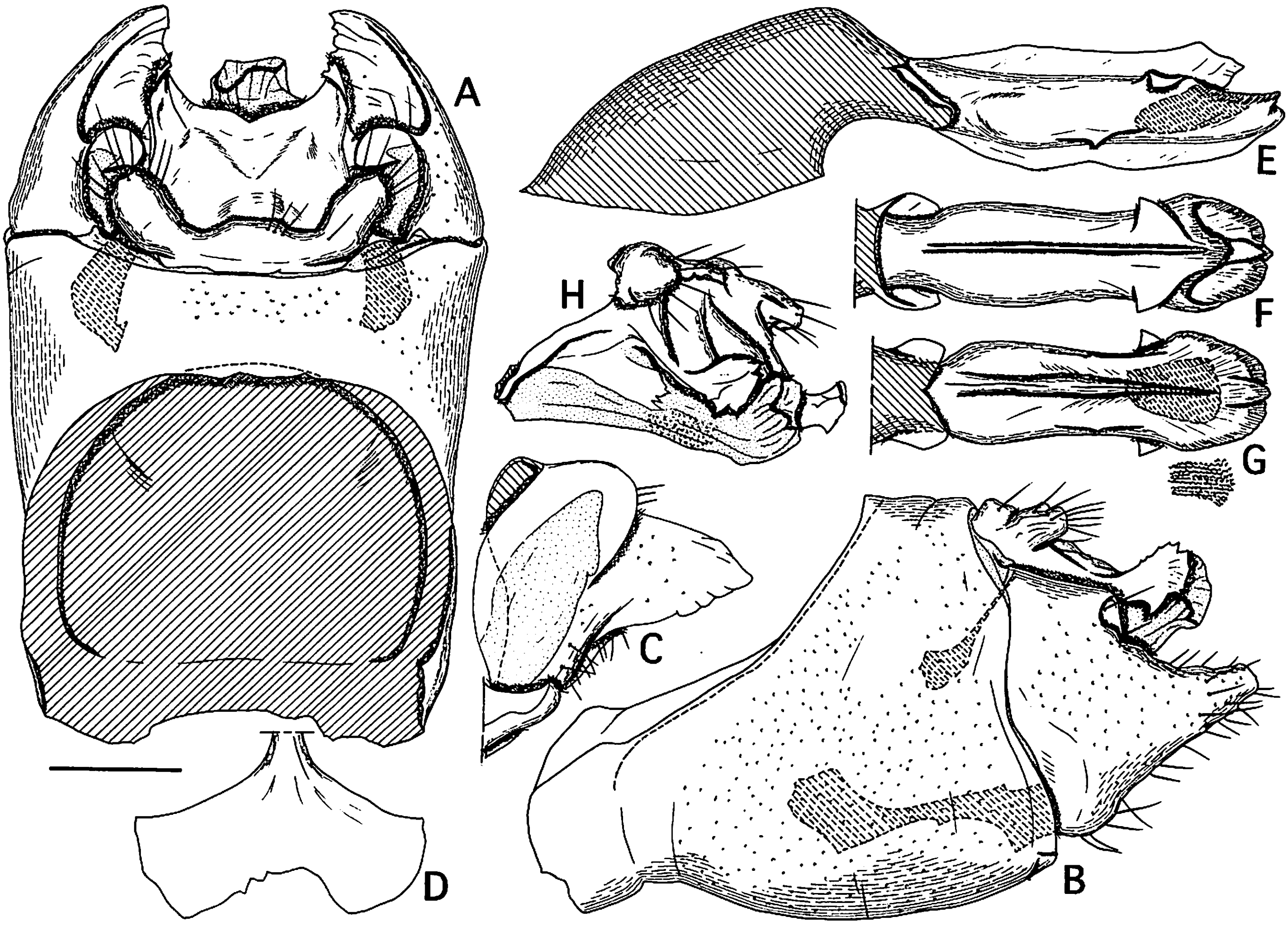

Fig. 31. Male genitalia of *Neomicropteryx kiwana*, paratype. A: dorsal view, phallus removed, B: lateral view, phallus removed, C: right valva, inner view, D: median plate, dorsal view, E: phallus, lateral view, F: aedeagus, dorsal view, G: ditto, ventral view, H: tergum X and venter X plate, latero-caudal view. Scale = 0.2 mm.

65.5, n = 15) in males, 47-52 (mean 50.2, n = 17) in females.

Male genitalia (Fig. 31): Mid-dorsal length of segment IX about 1/5 of venter. Valva with an obtuse apex; dorso-proximal edge expanding mesally as a narrow, thin plate; ventral margin sinuate. Lateral margin of caudal end of phallobase collared, expanded outwardly as a narrow, thin plate. Tergum X broader than long, slightly protruded proximo-medially; basal projections well developed; terminal projections flattened, with minute serrations near apex, strongly curved dorsally at outer margin.

Female genitalia (Fig. 32): Mid-dorsal length of segment IX about 2/5 of venter; dorsum broader than caudal part of venter, rounded laterally; sides of venter gradually narrowing toward posterior end; sides concave obliquely; caudo-lateral margin protruded at middle. Dorsal expansion of segment X slightly crumpled; dorsal plate less sclerotized, covered with minute projections, broader than long (about 5 X as long as median length).

Last instar larva (Fig. 10K). See generic description. Body length 4.5-4.8 mm.

Pupa. Not examined.

Specimens examined. Holotype- ♂, Otani, Kiwa-cho, Mie Pref., Honshu, Japan, 18. ii. 1997 (Larva coll.), emerged 3. iv. 1997 (S. HASHIMOTO, H. NAKANO & H. YOSHITOMI) (KMNHIR200,260). Paratypes- 6♂, 2♀, Ohkochi, Kiwa-cho, Mie Pref., emerged 19-21. iv. 1995 (E. NISHIDA); 4♂, 1♀, same locality as the holotype, emerged 25-26. iv. 1995 (E. NISHIDA) (1♀, KMNHIR200,261); 8♂, 8♀, same locality, emerged 31. iii. - 9. iv. 1997 (S. HASHIMOTO, H. NAKANO & H. YOSHITOMI); 1♂, same locality, emerged 2. iv. 1998 (S. HASHIMOTO, H. NAKANO & H. YOSHITOMI) (KMNHIR200,262); 1 ♂, Asari, Kiho-cho, Mie Pref., emerged 19. iv. 1995 (E. NISHIDA). Other materials- 2♂, 1♀ in 75% Et-OH, Ohkochi, Kiwa-cho,

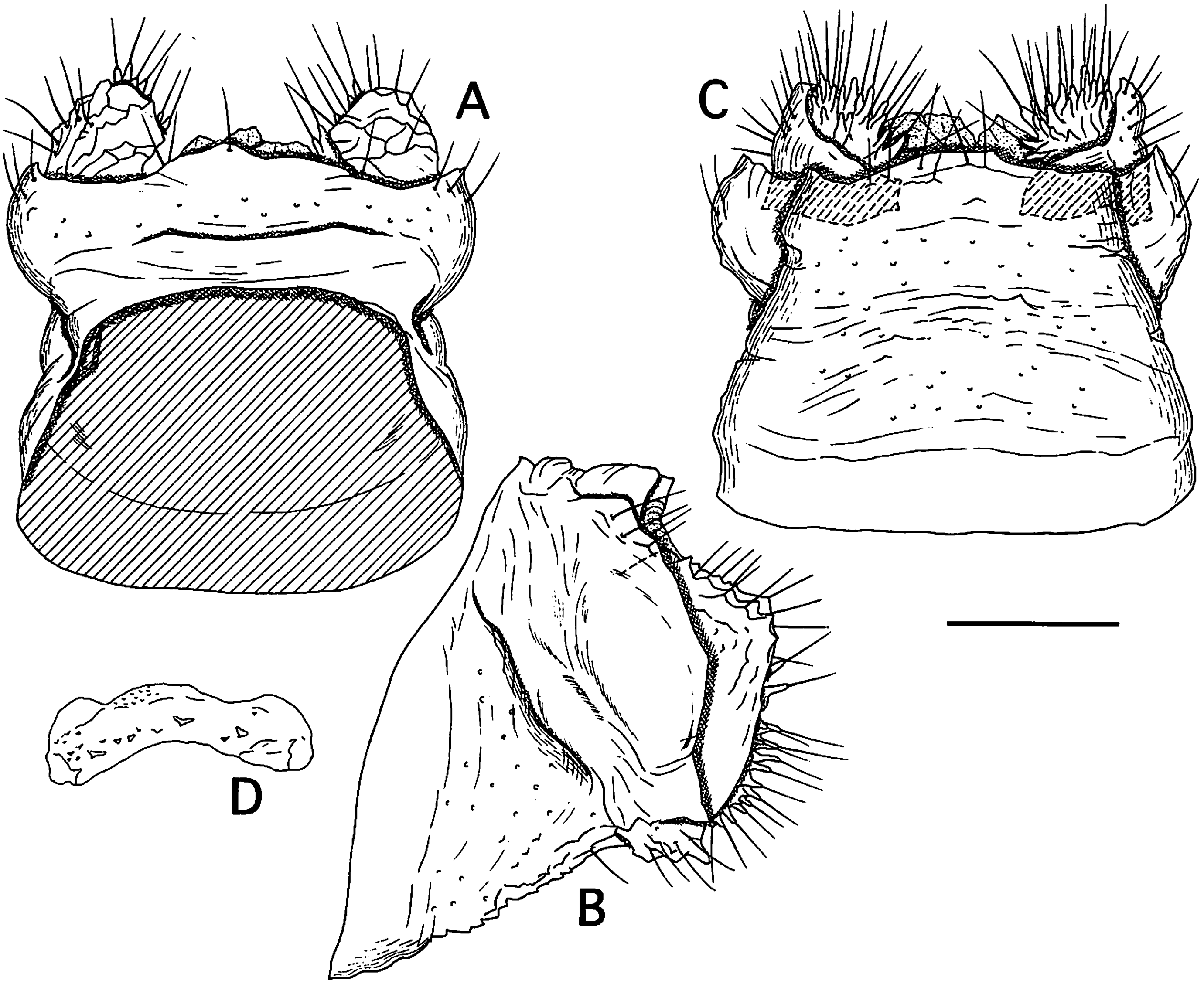

Fig. 32. Female genitalia of *Neomicropteryx kiwana*, paratype. A: segments IX and X, dorsal view, B: ditto, lateral view, C: ditto, ventral view, D: dorsal sclerite of segment X, dorso-caudal view. Scale = 0.2 mm.

Mie Pref., emerged 19-21. iv. 1995 (E. Nishida); 3 larvae, Otani, Kiwa-cho, Mie Pref., 18. ii. 1997 (S. Hashimoto, H. Nakano & H. Yoshitomi).

Distribution. Japan (Honshu: Mie Pref.) (Fig. 30).

Biology. See biology of genus.

Etymology. The specific name is based on the type locality.

Remarks. This species is closely related to *N. nipponensis*. The two species can be distinguished by the keys.

Neomicropteryx redacta sp. nov.

(Figs. 2C, 6J, 10L, 33, 34)

Adult (Fig. 2C). Very similar to *N. nipponensis* in general appearance and distinguishable only by the genital structures given in the keys.

Forewing length 5.5 mm in holotype, 5.3-5.8 mm (mean 5.5 mm, n = 6) in males, 5.3-5.5 mm (mean 5.4 mm, n = 9) in females. Antennal flagellum 63-69 (mean 65.6, n = 7) in males, 49-51 (mean 50.4, n = 8) in females.

Male genitalia (Fig. 33): Mid-dorsal length of segment IX about 1/6 of ventral length. Valva with an obtuse apex; dorsal margin slightly arched at proximal half; ventral margin shallowly curved from mesal view. Latero-ventral margin

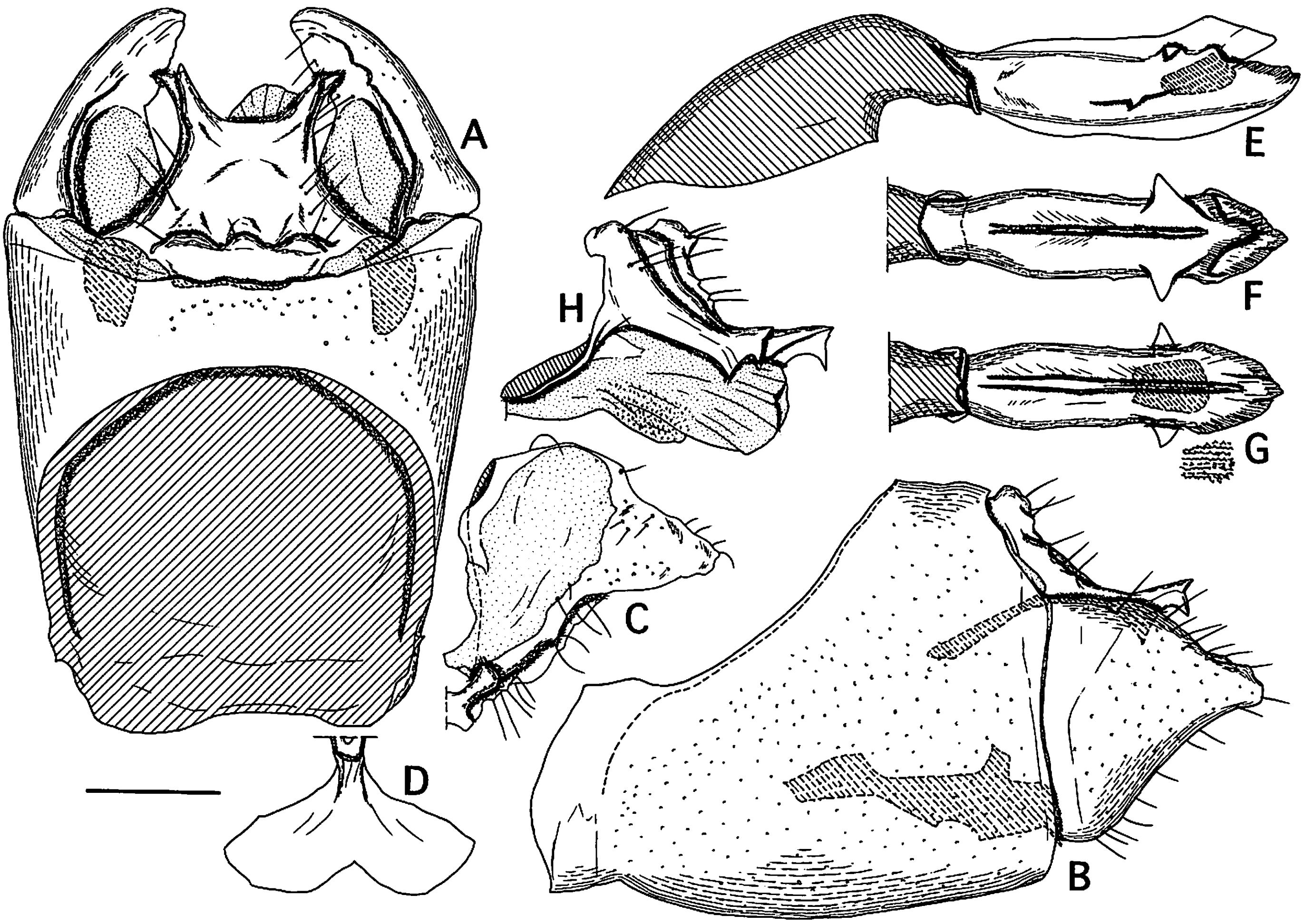

Fig. 33. Male genitalia of *Neomicropteryx redacta*, paratype. A: dorsal view, phallus removed, B: lateral view, phallus removed, C: right valva, inner view, D: median plate, dorsal view, E: phallus, lateral view, F: aedeagus, dorsal view, G: ditto, ventral view, H: tergum X and venter X plate, latero-caudal view. Scale = 0.2 mm.

of caudal end of phallobase expanded outwardly as a narrow thin plate. Tergum X broader than long, with a small proximo-medial projection; basal projections reduced; terminal projections relatively short, divided and dorso-ventrally acute.

Female genitalia (Fig. 34): Mid-dorsal length of segment IX about 1/2 of ventral length; dorsum narrower than venter, gradually narrowing toward anterior margin laterally; caudo-posterior margin broadly protruded medially; venter parallel sided; ventral margin of lateral concavity slightly curved. Dorsal expansion of lateral sclerite of segment X extending caudally; dorsal plate well sclerotized, trapezoidal.

Last instar larva (Fig. 10L). See generic description. Body length about 4.5 mm

Pupa. Not examined.

Specimens examined. Holotype- ♂, Yakiyama, Owase-shi, Mie Pref., Honshu, Japan, 18. ii. 1997 (Larva coll.), emerged 2. iv. 1997 (S. Hashimoto, H. Nakano & H. Yoshitomi) (KMNHIR200,263). Paratypes- 1♂, 1♀, same locality as the holotype, emerged 5-7. iv. 1997 (S. Hashimoto, H. Nakano & H. Yoshitomi) (KMNHIR200,264-KMNHIR200, 265); 6♂, 9♀, same locality, emerged 31. iii. - 10. iv. 1998 (S. Hashimoto & H. Nakano). Other materials- 2♂, 1♀ in 75% Et-OH, Yakiyama, Owase-shi, Mie Pref., emerged 2-7. iv. 1998 (S. Hashimoto & H. Nakano); 2 larvae, Yakiyama, Owase-shi, Mie Pref., 18. ii. 1997 (S. Hashimoto, H. Nakano & H. Yoshitomi).

Distribution. Japan (Honshu: Mie Pref.) (Fig. 30).

Biology. See biology of genus.

Etymology. The specific name is based on the reduced basal projections of male tergum X.

Remarks. This species is easily distinguishable from other

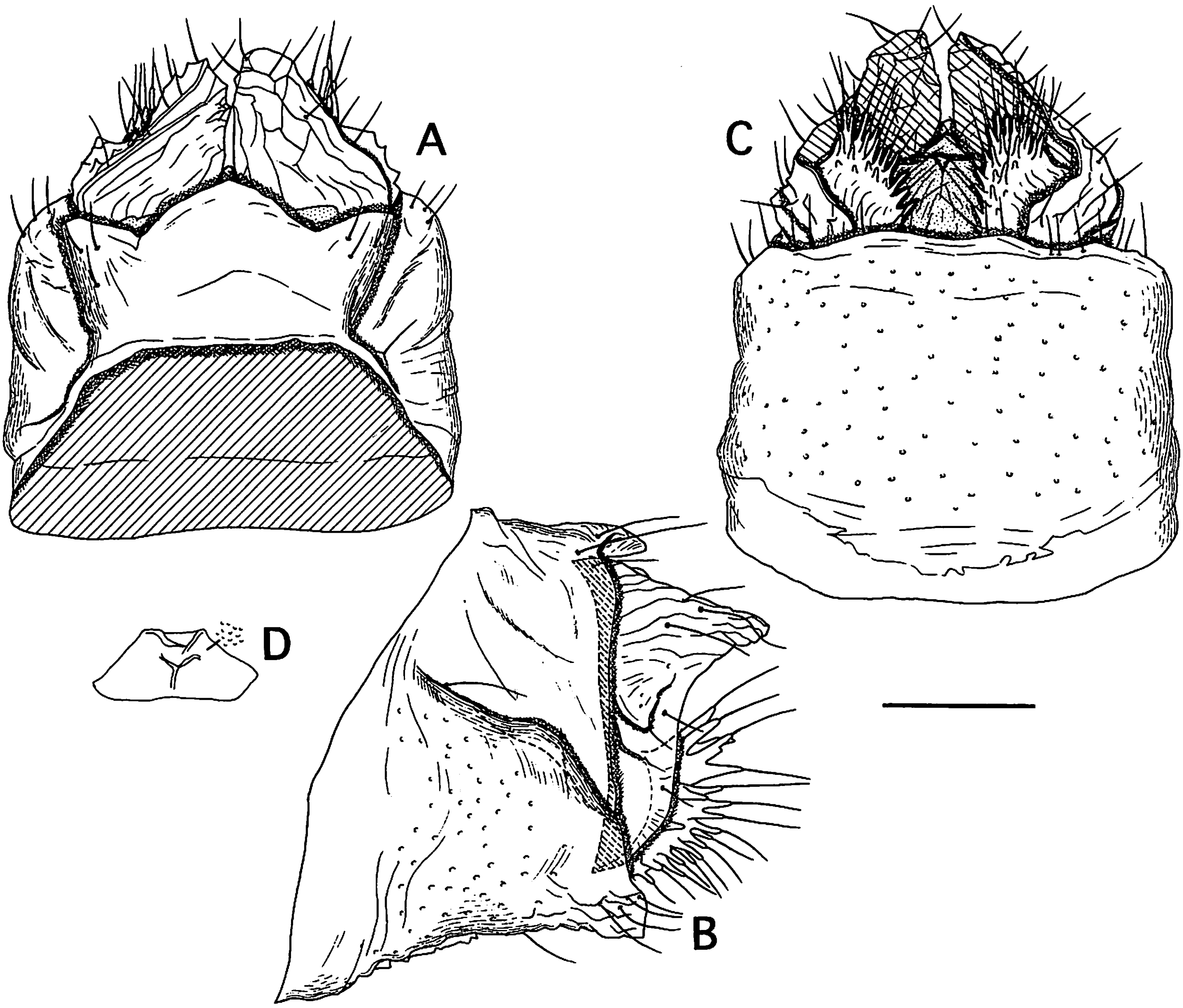

Fig. 34. Female genitalia of *Neomicropteryx redacta*, paratype. A: segments IX and X, dorsal view, B: ditto, lateral view, C: ditto, ventral view, D: dorsal sclerite of segment X, dorso-caudal view. Scale = 0.2 mm.

Neomicropteryx species by the reduced basal projections of male tergum X and the narrow dorsum of female segment IX.

Veins R4 and R5 rarely have a long stalk in the forewing and are completely fused in the hindwing (Fig. 6J). The latter condition partly resembles the hindwing venation of the genus *Squamicornia*.

Neomicropteryx matsumurana **Issiki, 1931**

(Figs. 2D, 4B-C, 7F, 8D-E, 9M-P,
10M, 11J, 11L, 11N, 35, 36)

Neomicropteryx matsumurana Issiki, 1931: 1013, figs 16a, 18.
Neomicropteryx matsumurana: Issiki, 1971: 6, fig. 6A-B; Moriuti, 1982: 43, pl. 1: 5, pl. 245: 5.
Neomicropteryx nipponensis: Tanaka *et al.*, 1991: 108; Bae, 1994: 76.

Redescription

Adult (Figs. 2D, 11N). Very similar to *N. nipponensis* in general appearance and distinguishable only by the genital structures given in the keys.

Forewing length 5.1-5.9 mm (mean 5.4 mm, n = 28) in males, 4.7-5.7 mm (mean 5.2 mm, n = 9) in females. Antennal flagellum 64-73 (mean 67.6, n = 28) in males, 48-58 (mean 52.0, n = 22) in females.

Male genitalia (Fig. 35): Mid-dorsal length of segment

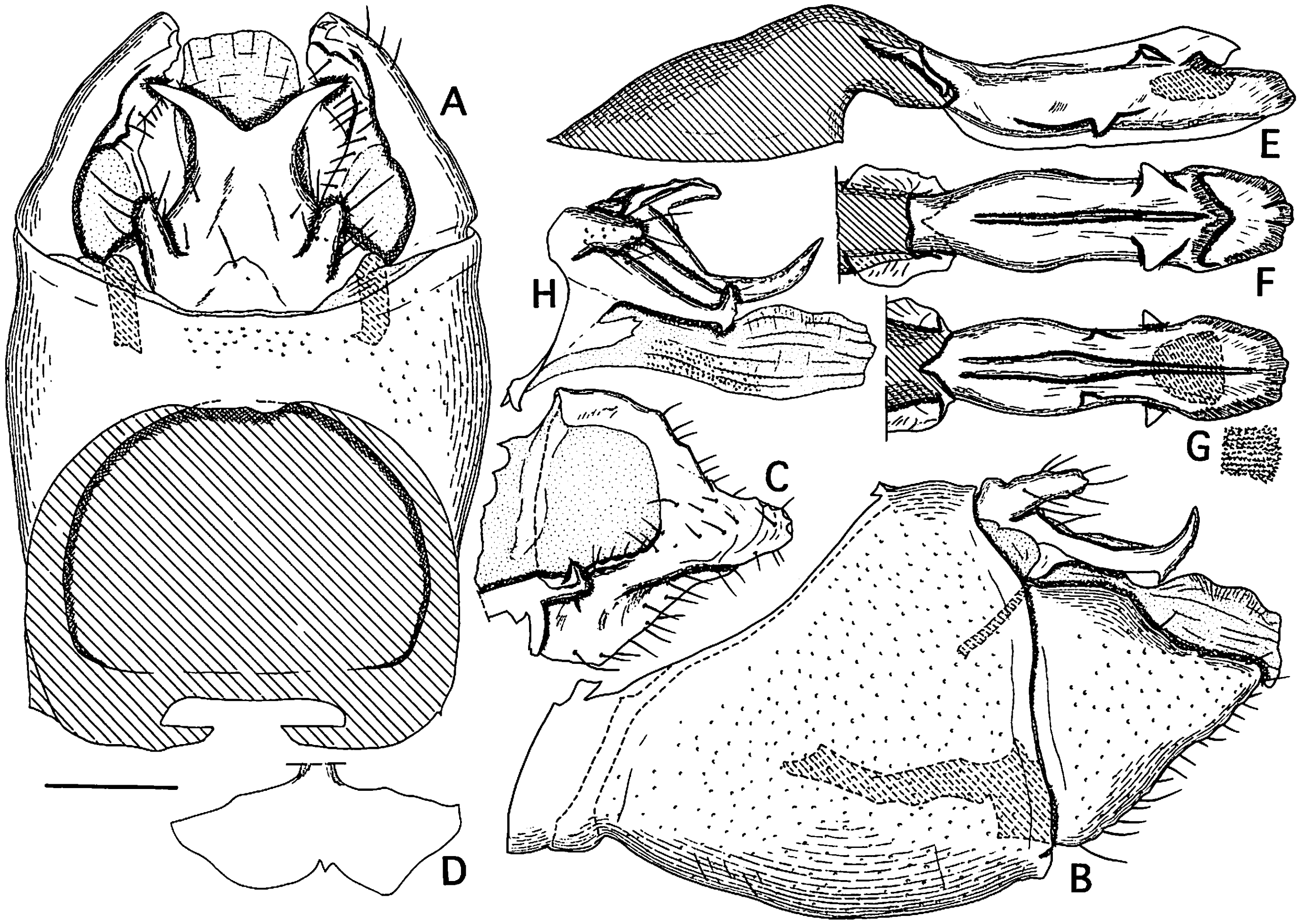

Fig. 35. Male genitalia of *Neomicropteryx matsumurana*. A: dorsal view, phallus removed, B: lateral view, phallus removed, C: right valva, inner view, D: median plate, dorsal view, E: phallus, lateral view, F: aedeagus, dorsal view, G: ditto, ventral view, H: tergum X and venter X plate, latero-caudal view. Scale = 0.2 mm.

IX about 1/5 of ventral length. Valva with an obtuse apex; dorso-proximal margin arched; ventro-proximal margin rather expanded ventrally from mesal view. Lateral margin of caudal end of phallobase expanded outwardly as a thin narrow plate. Tergum X longer than broad, with a small proximo-medial protrusion; basal projections well developed, digitiform; terminal projections slender, obtusely acute, gently curved outwardly.

Female genitalia (Fig. 36): Mid-dorsal length of segment IX about 1/3 of ventral length; dorsum rounded laterally; dorso-caudal margin broadly protruded; both sides of venter gradually narrowing toward caudal end; lateral concavity conspicuous, gently curved, its ventral margin strongly oblique. Dorsal expansion of lateral sclerite of segment X strongly crumpled; dorsal plate well sclerotized, obtusely angled caudo-laterally, shallowly emarginated at middle of caudal margin, somewhat variable in shape.

Variation. This species shows a few variations in the shape of genital structures; especially in the male valva, the male tergum X, and the female segment IX.

Last instar larva (Figs. 9P, 10M). See generic description. Body length 4.5-5.0 mm

Pupa (Figs. 8D-E, 10J). See general morphology of the family.

Specimens examined. Honshu- 3♂, 7♀, Yoshu, Awano-cho, Tochigi Pref., emerged 12-14. iv. 1998 (H. YOSHITOMI); 3♂, 2♀ in 75% Et-OH, Ohwa, Chichibu-shi, Saitama Pref., 16. v. 1999 (Y. KOBAYASHI); 2♂, Mt. Takao, Hachioji-shi, Tokyo, 12. v. 1991 (A. SHINOHARA); 1♂, same locality, emerged 4. v. 1993 (S. HASHIMOTO); 3♂ in 99% Et-OH, same locality, 14. v. 2003 (Y. KOBAYASHI & U. JINBO); 1♂, 3♀, Komotsuriyama, Doshi-cho, Yamanashi Pref., emerged 14. iv. - 5. v. 1999 (H. YOSHITOMI); 6♂, 2♀, Hebiishi-toge, Minamiizu-cho, Shizuoka Pref., emerged 13. iv. - 5. v. 1999

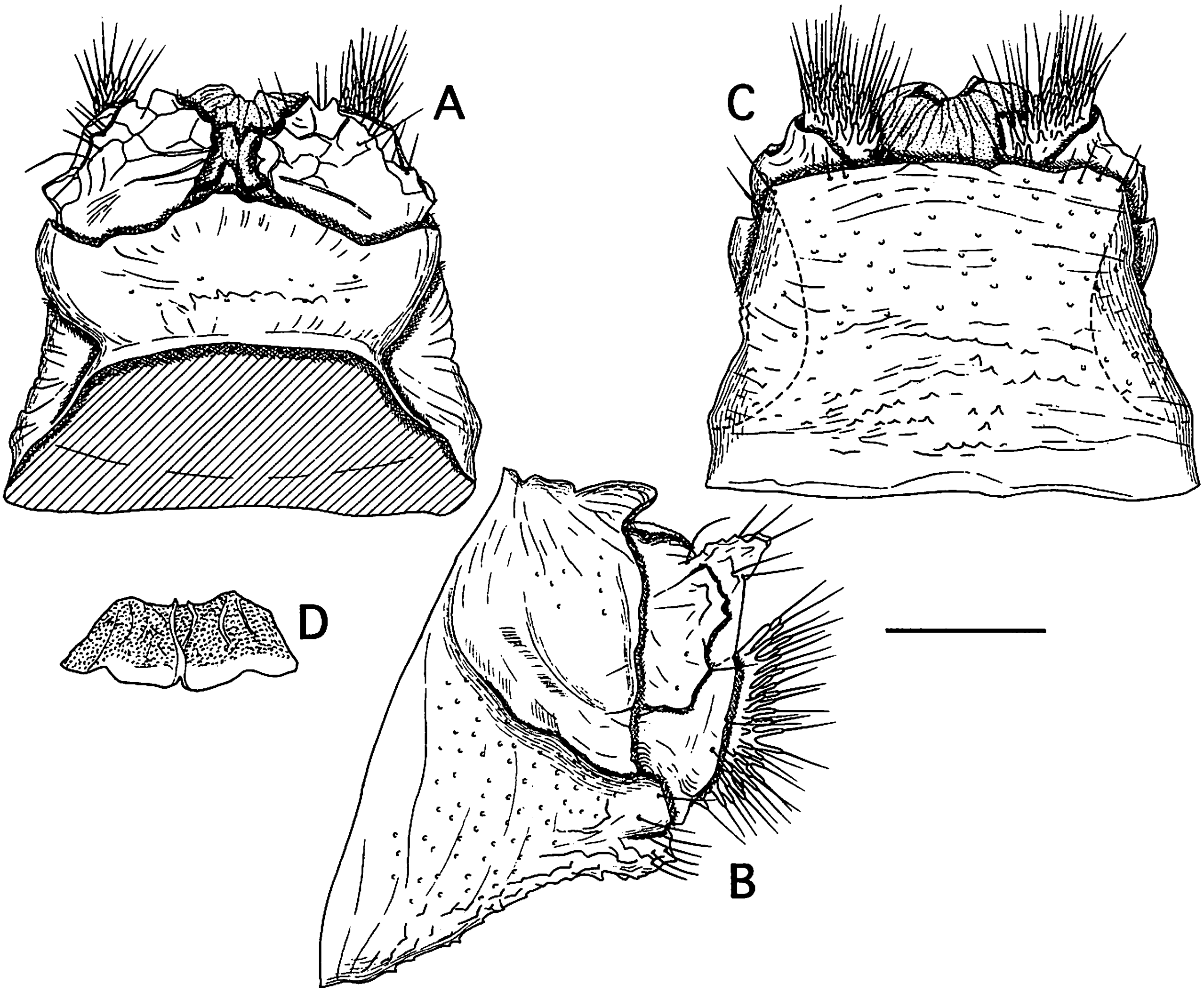

Fig. 36. Female genitalia of *Neomicropteryx matsumurana*. A: segments IX and X, dorsal view, B: ditto, lateral view, C: ditto, ventral view, D: dorsal sclerite of segment X, dorso-caudal view. Scale = 0.2 mm.

(H. Yoshitomi); 5♂ (3♂ in 75% Et-OH), Kurohimeyama, Togakushi-mura, Nagano Pref., 16. v. 1997 (H. Yoshitomi); 12♂, Shimashimatani, Azumi-mura, Nagano Pref., 7. vi. 1997 (S. Hashimoto); 1♂, Kisokomagatake (*ca.* 1400 m), Kisofukushima-cho, Nagano Pref., 4. vii. 1994 (H. Yoshitomi); 2♂, Tochimoto, Kisofukushima-cho, Nagano Pref., emerged 30. v. 1994 (H. Yoshitomi); 1♂ in 75% Et-OH, Kashima-cho, Ishikawa Pref., 16. v. 2000 (H. Kawase); 3♂ in 75% Et-OH, Kawachi-mura, Ishikawa Pref., 22. v. 1999 (H. Kawase); 4♀, Mennoki, Inabu-cho, Aichi Pref., emerged 8. v. 1995 (S. Hashimoto); 2♂, Uradani, Shitara-cho, Aichi Pref., 7. vi. 1994 (S. Hashimoto); 8♂, 3♀, Komagahara, Shitara-cho, Aichi Pref., emerged 28. iv. - 20. v. 1994 (S. Hashimoto); 23♂, 5♀, Takadagi, Shitara-cho, Aichi Pref., emerged 25. iv. - 8. v. 1995 (S. Hashimoto); 2♀ in 75% Et-OH, Tsubosaki, Asahi-machi, Aichi Pref., emerged 1. v. 1998 (H. Nakano); 7♂, 5♀, Isegami, Asuke-cho, Aichi Pref., emerged 27. iv. - 8. v. 1995 (S. Hashimoto); 2♂, same locality, 7. vi. 1996 (S. Hashimoto); 1♂, same locality, 8. vi. 2000 (S. Hashimoto); 2♂, Hirase, Shimoyama-mura, Aichi Pref., emerged 19. iv. 1996 (H. Nakano & H. Yoshitomi); 5♂, 1♀ in 75% Et-OH, Entani, Itadori-mura, Gifu Pref., 7. v. 1998 (H. Nakano); 29♂, 12♀ (9♂, 7♀ in 75% Et-OH), Kishodani, Fujihashi-mura, Gifu Pref., 21. v. 1994 (S. Hashimoto); 2♂, 1♀, same locality, emerged 10-11. v. 1994 (H. Nakano); 2♂, 2♀, Ohgidani, Fujihashi-mura, Gifu Pref., emerged 11-12. v. 1994 (H. Nakano); 1♀, same locality, emerged 2. v. 1996 (S. Hashimoto); 1♂, 1♀, Tsurumi, Fujihashi-mura, Gifu Pref., emerged 7. v. 1994 (H. Nakano); 7♂, Yokoyama-dam, Fujihashi-mura, Gifu Pref., 17. v. 1996 (S. Hashimoto); 6♂, 1♀, Kanzanji, Yogo-cho, Shiga Pref., 18-20. v. 1993 (Y. S.

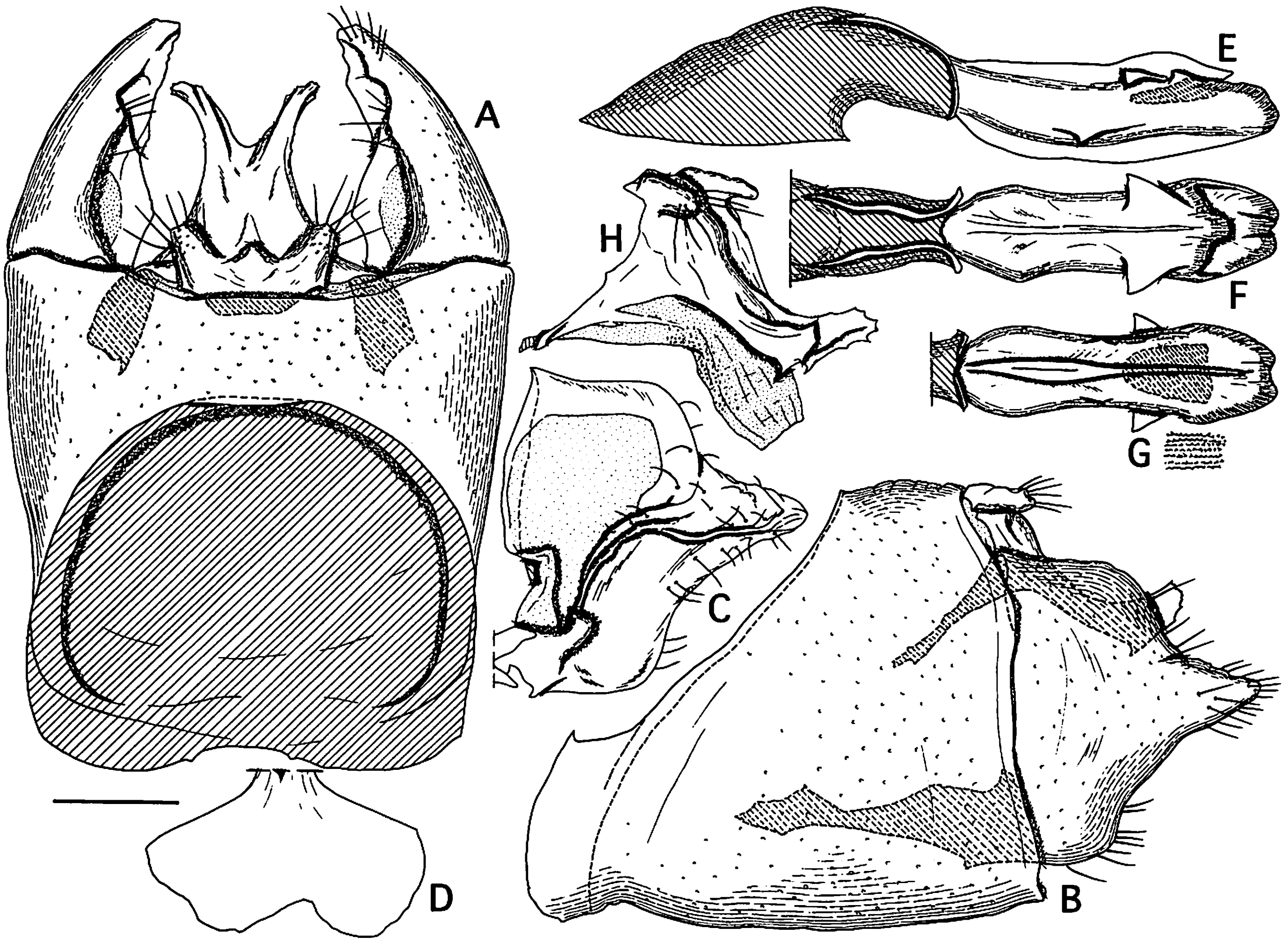

Fig. 37. Male genitalia of *Neomicropteryx bifurca*. A: dorsal view, phallus removed, B: lateral view, phallus removed, C: right valva, inner view, D: median plate, dorsal view, E: phallus, lateral view, F: aedeagus, dorsal view, G: ditto, ventral view, H: tergum X and venter X plate, latero-caudal view. Scale = 0.2 mm.

BAE) (OPU); 1♂, Takihara, Ise-shi, Mie Pref., 5. v. 1984 (A. SHINOHARA); 2♂, 3♀, Kochi, Toba-shi, Mie Pref., emerged 9-11. iv. 2001 (H. OHGANE); 4♂ in 75% Et-OH, Chayahiro, Watarai-cho, Mie Pref., 4. v. 2001 (H. MORITA). Other materials- 3 larvae, Mt. Takao, Hachioji-shi, Tokyo, 10. x. 1992 (S. HASHIMOTO); 1 larva and 1 pupa reared from larva, Shitara-cho, Aichi Pref., 1. iv. 1994 (S. HASHIMOTO); 2 larvae, Mennoki, Shitara-cho, Aichi Pref., 4. iv. 1995 (S. HASHIMOTO); 9 larvae, Tsubosaki, Asahi-machi, Aichi Pref., 9. xi. 1997 (H. NAKANO); 7 larvae, Hirase, Shimoyama-mura, Aichi Pref., 20. i. 1996 (H. NAKANO & H. YOSHITOMI); 1 pupa reared from larva, Isegami, Asuke-cho, Aichi Pref., 4. iv. 1995 (S. HASHIMOTO); 3 larvae, Ohgidani, Fujihashi-mura, Gifu Pref., 4. xii. 1995 (S. HASHIMOTO); 4 larvae, Yokoyama-dam, Fujihashi-mura, Gifu Pref., 16. xi. 1996 (S. HASHIMOTO); 1 pupa reared from larva, Kochi, Toba-shi, Mie Pref., 2. ii. 2001 (H. OHGANE).

Distribution. Japan (central Honshu; mainly Chubu and Kanto districts) (Fig. 30).

Biology. See biology of genus. Biology of this species was already summarized by HASHIMOTO and ARITA (1987).

Remarks. This species is similar to *N. bifurca* in the male genitalia. The two species can be separated by the keys.

Neomicropteryx bifurca ISSIKI, 1953
(Figs. 2E, 10N, 37, 38)

Neomicropteryx bifurca ISSIKI, 1953: 136, figs 6, 7.
Neomicropteryx bifurca: MORIUTI, 1982: 43, pl. 1: 6, pl. 245: 6.

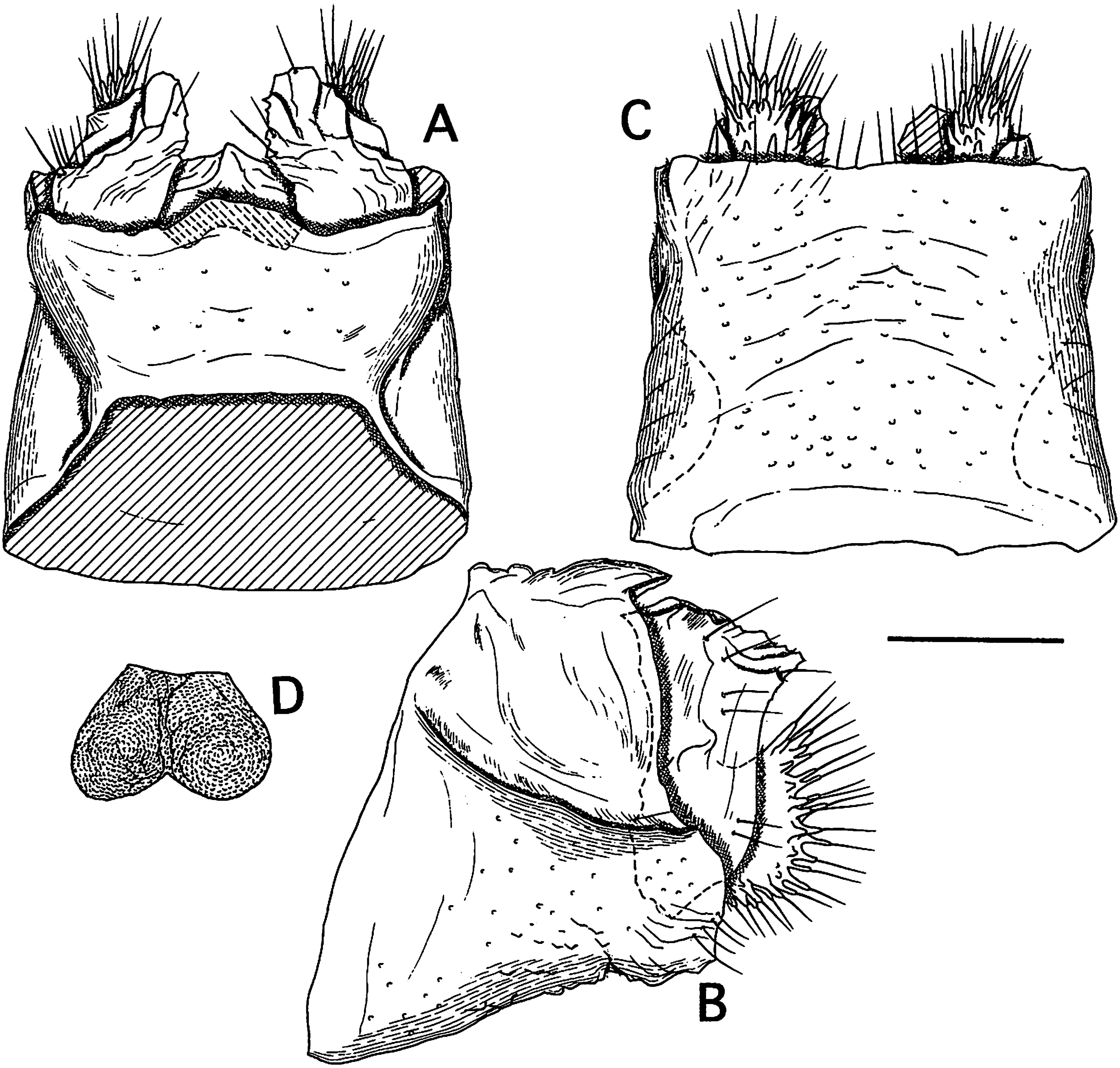

Fig. 38. Female genitalia of *Neomicropteryx bifurca*. A: segments IX and X, dorsal view, B: ditto, lateral view, C: ditto, ventral view, D: dorsal sclerite of segment X, dorso-caudal view. Scale = 0.2 mm.

Neomicropteryx matsumurana: Issiki, 1971: figs. 6C-D.

Redescription

Adult (Fig. 2E). Very similar to *N. nipponensis* in general appearance and distinguishable only by the genital structures given in the keys.

Forewing length 5.0-5.8 mm (mean 5.5 mm, n = 22) in males, 5.1-5.5 mm (mean 5.3 mm, n = 3) in females. Antennal flagellum 66-72 (mean 68.3, n = 17) in males, 47-51 (mean 48.8, n = 8) in females.

Male genitalia (Fig. 37): Mid-dorsal length of segment IX about 1/5 of ventral length. Valva with an obtuse apex, with a long curved ridge at inner surface; dorso- and ventro-proximal margins strongly arched. Latero-ventral margin of caudal end of phallobase expanded outwardly as a thin narrow plate whose dorsal part extends anteriorly as a long

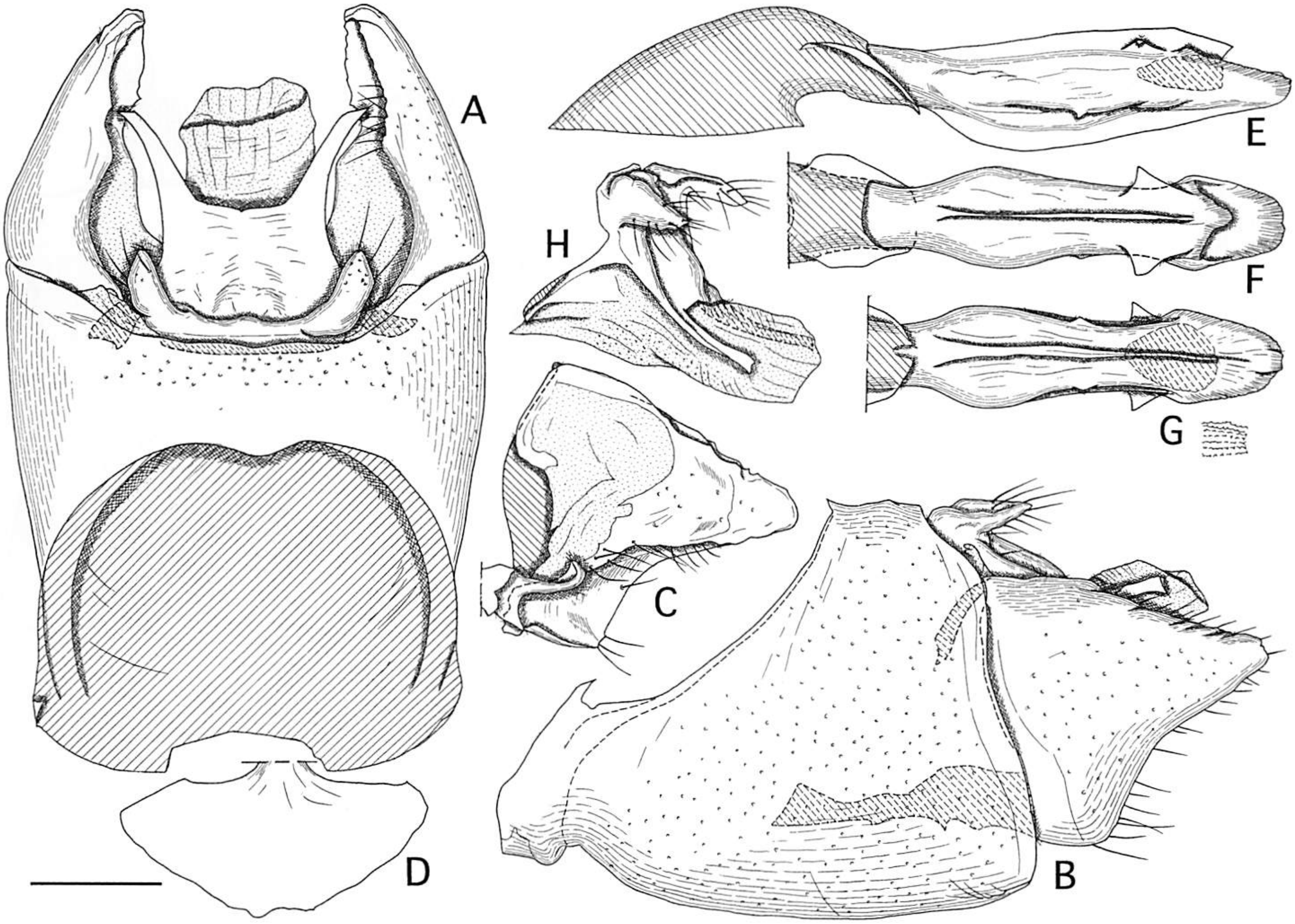

Fig. 39. Male genitalia of *Neomicropteryx cornuta*. A: dorsal view, phallus removed, B: lateral view, phallus removed, C: right valva, inner view, D: median plate, dorsal view, E: phallus, lateral view, F: aedeagus, dorsal view, G: ditto, ventral view, H: tergum X and venter X plate, latero-caudal view. Scale = 0.2 mm.

keel. Tergum X broader than long, with a small proximo-medial protrusion; basal projections developed, digitiform; terminal projections relatively long, slender, gently curved outwardly, notched near apex, with some ridges.

Female genitalia (Fig. 38): Mid-dorsal length of segment IX about 1/2 of ventral length; rounded laterally; postero-caudal margin slightly protruded at middle; venter almost parallel sided; ventral margin of lateral concavity gently oblique. Dorsal expansion of lateral sclerite of segment X extended caudally; dorsal plate well sclerotized, rounded caudo-laterally, emarginated at middle of caudal margin.

Last instar larva (Fig. 10N). See generic description. Body length 4.5-4.8 mm

Pupa. Not examined.

Specimens examined. Honshu- 31♂, 3♀ (9♂ in 75% Et-OH), Sandankyo, Togochi-cho, Hiroshima Pref., 4. vi. 1995 (S. HASHIMOTO); 1♂, same locality, emerged 21. iv. 1998 (S. HASHIMOTO & H. NAKANO). Kyushu- 2♂, Yobuno, Kitakyushu, Fukuoka Pref., 6. v. 1996 (K. UEDA) (KMNH); 1♂, same locality, 18. v. 1996 (K. UEDA) (KMNH); 1♂, Inunaki Toge, Fukuoka Pref., 13. v. 1995 (K. UEDA) (KMNH); 7♂, 1♀ in 75% Et-OH, Mt. Hiko-san, Fukuoka Pref., 12. v. 1986 (A. SHINOHARA); 1♀, Mt. Sobo, Oita Pref., emerged 21. iv. 1998 (H. YOSHITOMI); 1♂, Ohmoridake-rindo-shita, Aya-machi, Miyazaki Pref., 28. iv. 2003 (A. NAGAI). Other materials- 2 larvae, Sandankyo, Togochi-cho, Hiroshima Pref., 7. xi. 1997 (S. HASHIMOTO).

Distribution. Japan (Western Honshu, Kyushu) (Fig. 30).

Biology. See biology of genus.

Remarks. Though ISSIKI (1971) indicated the possibility that this species was synonymous with *N. matsumurana*,

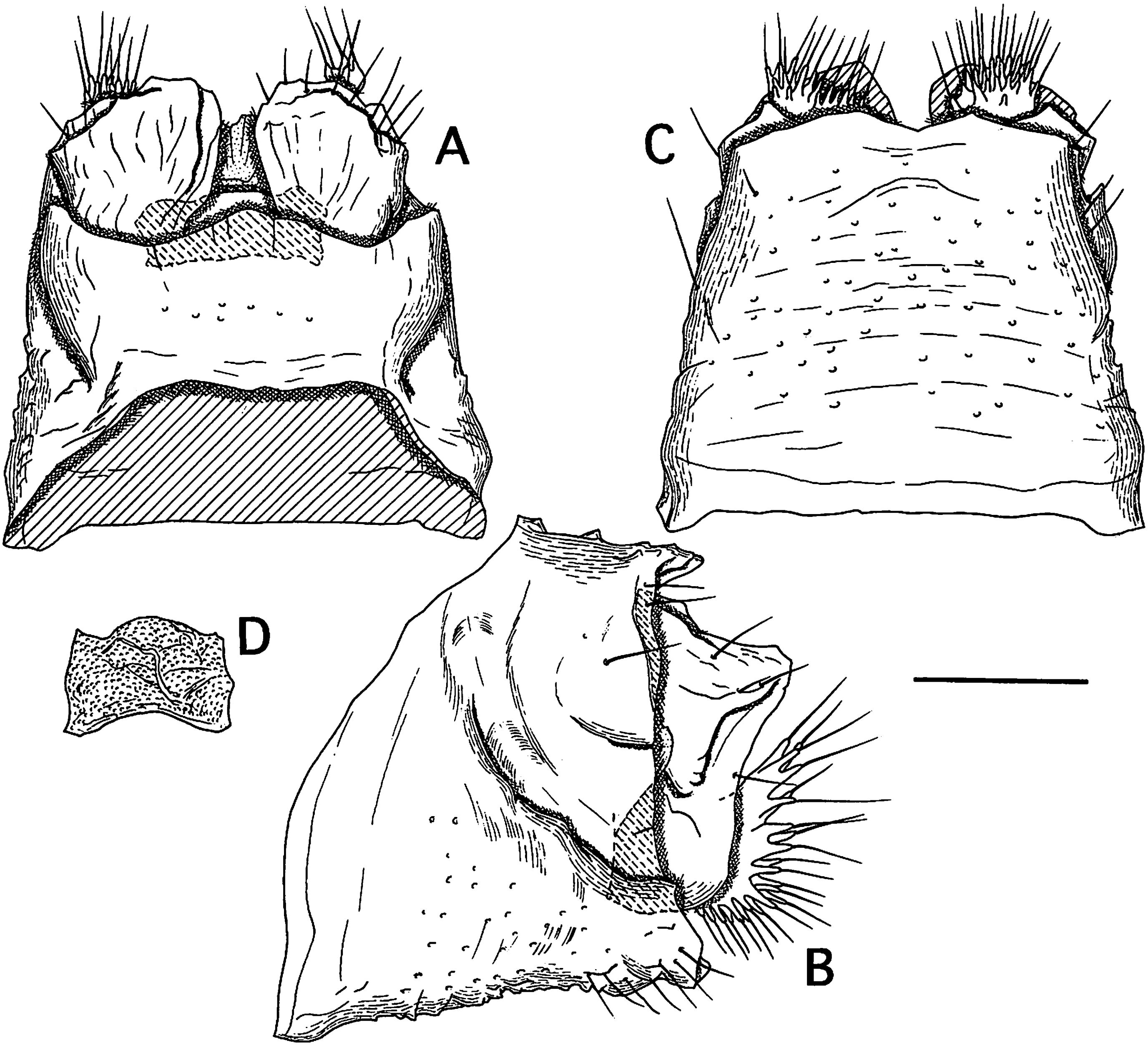

Fig. 40. Female genitalia of *Neomicropteryx cornuta*. A: segments IX and X, dorsal view, B: ditto, lateral view, C: ditto, ventral view, D: dorsal sclerite of segment X, dorso-caudal view. Scale = 0.2 mm.

these two species are easily distinguishable by the genital structures given in the keys.

Neomicropteryx cornuta Issiki, 1953

(Figs. 2F, 11A, 39, 40)

Neomicropteryx cornuta Issiki, 1953: 138, fig 10.
Neomicropteryx cornuta: Issiki, 1971: 6, fig. 5; Moriuti, 1982: 43, pl. 245: 8.

Redescription

Adult (Fig. 2F). Very similar to *N. nipponensis* in general appearance and distinguishable only by the genital structures given in the keys.

Forewing length 5.3-6.1 mm (mean 5.6 mm, n = 17) in males, 5.4-5.8 mm (mean 5.7 mm, n = 4) in females. Antennal flagellum 65-72 (mean 68.8, n = 21) in males, 51-53 (mean 52.0, n = 7) in females.

Male genitalia (Fig. 39): Mid-dorsal length of segment IX about 1/5 of ventral length. Valva with an obtuse apex;

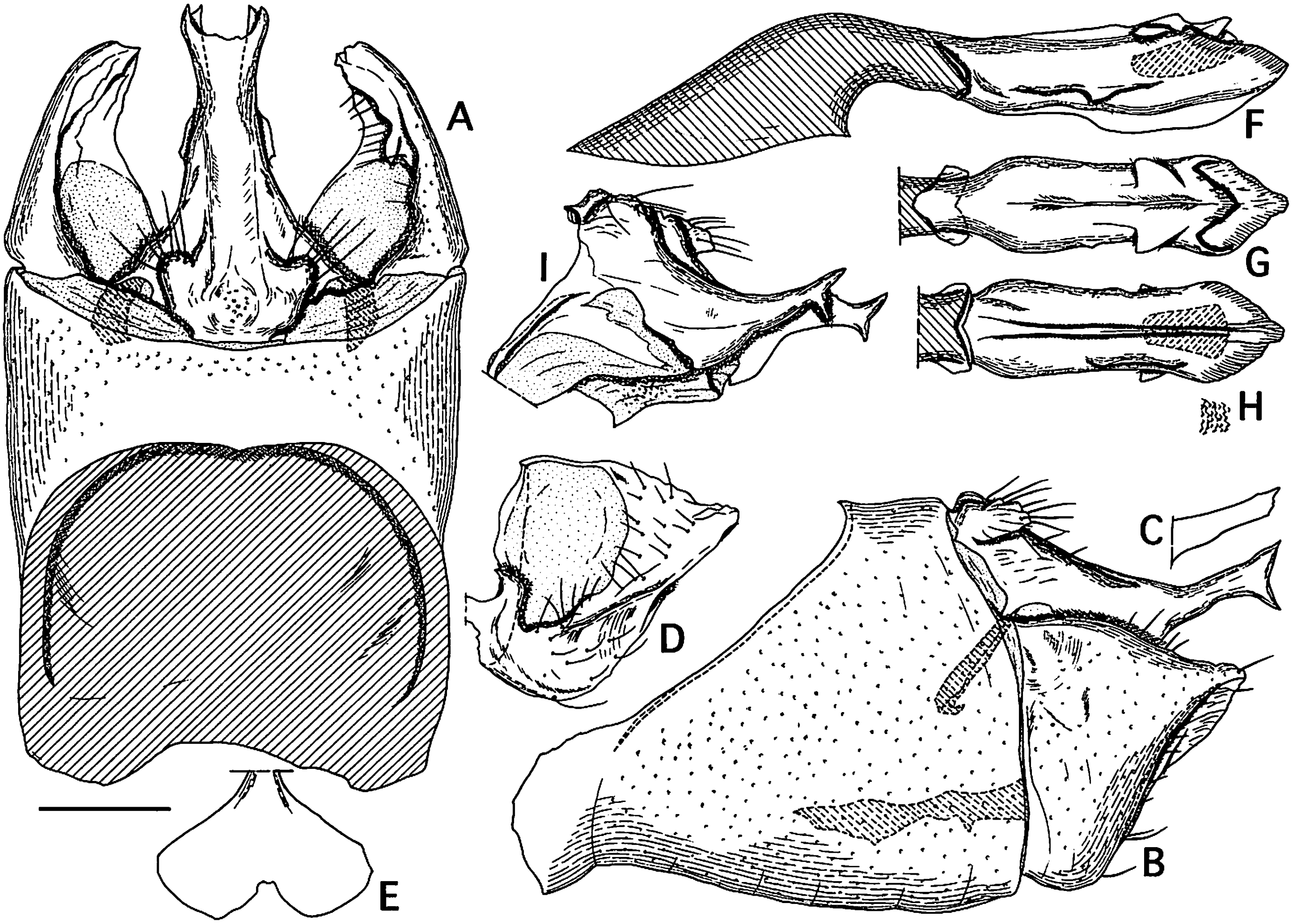

Fig. 41. Male genitalia of *Neomicropteryx elongata*. A: dorsal view, phallus removed, B: lateral view, phallus removed, C: tergum X lobe, lateral view, D: right valva, inner view, E: median plate, dorsal view, F: phallus, lateral view, G: aedeagus, dorsal view, H: ditto, ventral view, I: tergum X and venter X plate, latero-caudal view. Scale = 0.2 mm.

dorsal margin almost straight; ventro-proximal margin strongly expanded ventrally from mesal view. Latero-ventral margin of caudal end of phallobase expanded outwardly as a thin narrow plate. Tergum X as long as broad, slightly protruded proximo-dorsally, broadly U-shaped at caudal margin; basal projections well developed, digitiform; terminal projections long, slender, gently curved outwardly.

Female genitalia (Fig. 40): Mid-dorsal length of segment IX about 2/5 of ventral length; dorsum rounded laterally; dorso-caudal margin protruded at middle; venter gradually narrowing toward caudal margin at both sides; ventro-caudal margin notched at middle; ventral margin of lateral concavity strongly oblique and gently curved. Dorsal expansion of lateral sclerite of segment X weakly crumpled, slightly extended caudally; dorsal plate well sclerotized, rectangular, shallowly curved at middle of caudal margin

Last instar larva (Fig. 11A). See generic description. Body length about 4.5 mm.

Pupa. Not examined.

Specimens examined. Shikoku- 13♂, 3♀ (7♂, 1♀ in 75% Et-OH), Saragamine, Shigenobu-cho, Ehime Pref., 26. v. 1995 (S. HASHIMOTO); 6♂, 1♀, Omogo, Omogo-mura, Ehime Pref., 26. v. 1995 (S. HASHIMOTO); 4♂, 1♀, same locality, emerged 11-18. iv. 1998 (S. HASHIMOTO & H. NAKANO); 5♂, 4♀, Doi, Ikegawa-cho, Kochi Pref., emerged 30. iii. - 5. iv. 1998 (S. HASHIMOTO & H. NAKANO). Other materials- 2 larvae, Omogo, Omogo-mura, Ehime Pref., 6. xi. 1997 (S. HASHIMOTO & H. NAKANO); 2 larvae, Akayabu, Ikegawa-cho, Kochi Pref., 6. xi. 1997 (S. HASHIMOTO & H. NAKANO).

Distribution. Japan (western part of Shikoku) (Fig. 30).

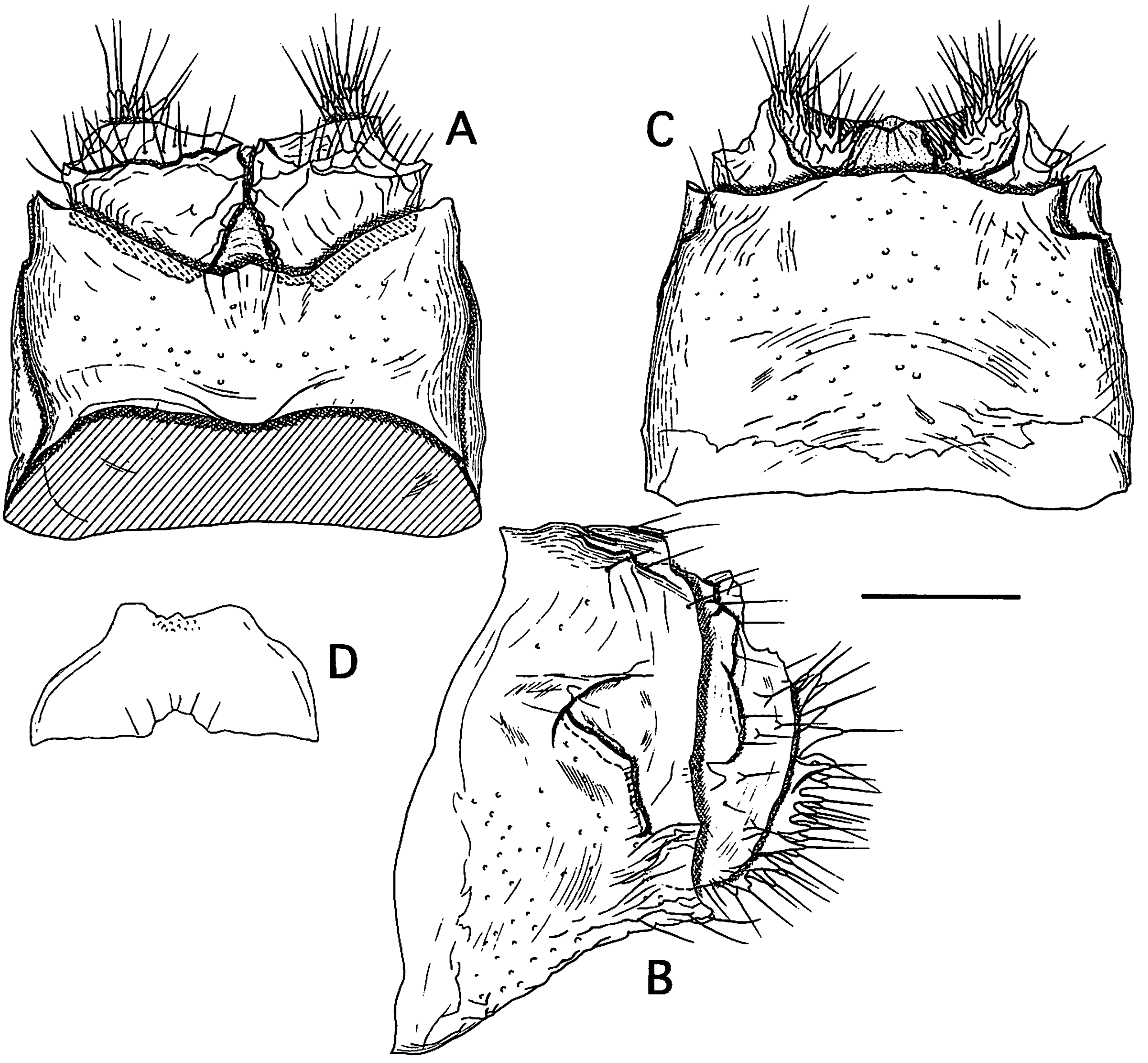

Fig. 42. Female genitalia of *Neomicropteryx elongata*. A: segments IX and X, dorsal view, B: ditto, lateral view, C: ditto, ventral view, D: dorsal sclerite of segment X, dorso-caudal view. Scale = 0.2 mm.

Biology. See biology of genus.

Remarks. This species is easily distinguishable from other *Neomicropteryx* species by the broadly U-shaped caudal margin and the slender terminal projections of male tergum X, and by the caudo-ventral margin with a small middle notch in female tergum IX.

Neomicropteryx elongata Issiki, 1953
(Figs. 2G, 5D, 5M, 11B, 41, 42)

Neomicropteryx elongata Issiki, 1953: 137, figs 8, 9.

Neomicropteryx elongata: Issiki, 1971: 6, fig. 4; Moriuti, 1982: 43, pl. 1: 7, pl. 245: 7.

Redescription

Adult (Fig. 2G). Very similar to *N. nipponensis* in general appearance and distinguishable only by the genital structures given in the keys.

Forewing length 5.5-6.1 mm (mean 5.8 mm, n = 22) in males, 5.4-5.5 mm (mean 5.5 mm, n = 4) in females. Antennal flagellum 64-72 (mean 67.8, n = 19) in males, 50-52 (mean 50.6, n = 5) in females.

Male genitalia (Fig. 41): Mid-dorsal length of segment

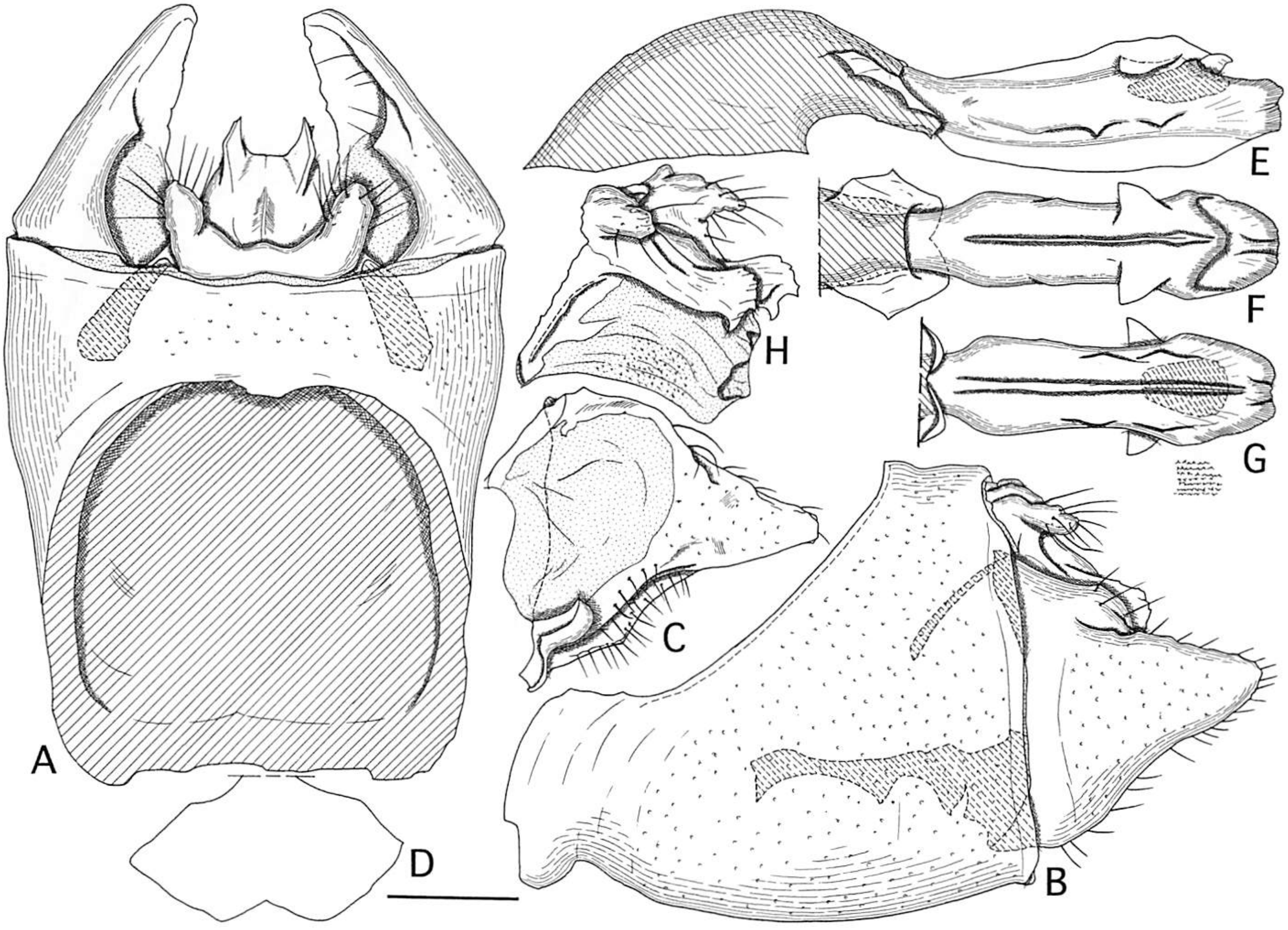

Fig. 43. Male genitalia of *Neomicropteryx kazusana*, paratype. A: dorsal view, phallus removed, B: lateral view, phallus removed, C: right valva, inner view, D: median plate, dorsal view, E: phallus, lateral view, F: aedeagus, dorsal view, G: ditto, ventral view, H: tergum X and venter X plate, latero-caudal view. Scale = 0.2 mm.

IX about 1/5 of ventral length. Valva relatively short, relatively acute at apex; dorsal margin slightly arched; ventro-proximal margin strongly arched. Latero-ventral margin of caudal end of phallobase expanded outwardly as a thin narrow plate. Tergum X longer than broad, slender toward caudal end, with a small proximo-medial protrusion; basal projections small; terminal projections short, divided and dorso-ventrally acute, but rarely reduced at tip as in fig. 41C.

Female genitalia (Fig. 42): Mid-dorsal length of segment IX about 1/2 of ventral length; dorsum as broad as venter, almost parallel sided; postero-dorsal margin broadly concave, but slightly protruded at middle; lateral concavity conspicuously edged medially; caudo-lateral margin nearly straight. Lateral sclerite of segment X with a ridge running from dorso-caudal corner to latero-medial part; dorsal plate less sclerotized.

Last instar larva (Fig. 11B). See generic description. Body length about 4.5 mm

Pupa. Not examined.

Specimens examined. Shikoku- 30♂, 3♀ (7♂1♀ in 75% Et-OH), Kuwadaira, Ichiu-mura, Tokushima Pref., 24. v. 1995 (S. HASHIMOTO); 6♂, 2♀, same locality, 25. v. 1995 (S. HASHIMOTO). Other materials- 4 larvae, Kuwadaira, Ichiu-mura, Tokushima Pref., 5. xi. 1998 (S. HASHIMOTO).

Distribution. Japan (eastern part of Shikoku) (Fig. 30).

Biology. See biology of genus.

Remarks. This species is easily distinguishable from other *Neomicropteryx* species by the slender male tergum X and the parallel-sided female tergum IX.

Neomicropteryx kazusana HASHIMOTO, 1992

(Figs. 2H, 5N, 11C, 43, 44)

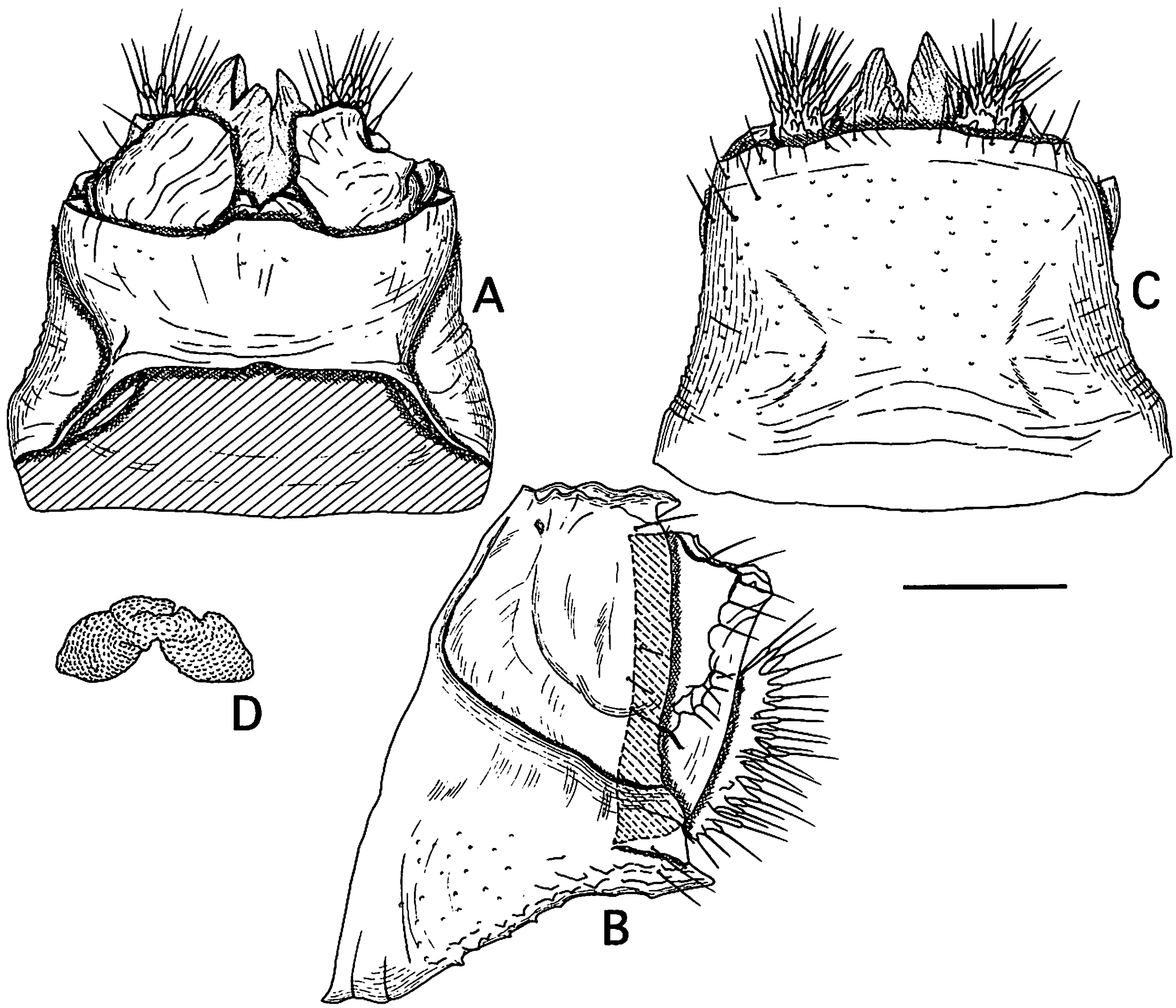

Fig. 44. Female genitalia of *Neomicropteryx kazusana*, paratype. A: segments IX and X, dorsal view, B: ditto, lateral view, C: ditto, ventral view, D: dorsal sclerite of segment X, dorso-caudal view. Scale = 0.2 mm.

Neomicropteryx kazusana HASHIMOTO, 1992: 654, figs. 3-17.

Redescription

Adult (Fig. 2H). Very similar to *N. nipponensis* in general appearance and distinguishable only by the genital structures given in the keys.

Forewing length 5.4-5.9 mm (mean 5.6 mm, n = 10) in males, 5.3-5.9 mm (mean 5.5 mm, n = 4) in females. Antennal flagellum 64-71 segments (mean 67.6, n = 9) in males, 50-55 segments (mean 52.2, n = 6) in females.

Male genitalia (Fig. 43): Mid-dorsal length of segment IX about 1/5 of ventral length. Valva with an obtuse apex; dorso- and ventro-proximal margins slightly arched. Latero-ventral margin of caudal end of phallobase expanded outwardly as a thin narrow plate. Tergum X broader than long, gradually narrowing toward apex in dorsal view, slightly protruded proximo-dorsally; basal projections developed, digitiform; terminal projections short, as a vertical plate, with some minute serrations near apex and with a slender apical hook ventrally.

Female genitalia (Fig. 44): Mid-dorsal length of segment IX about 1/3 of ventral length; dorsum rounded laterally; dorso-caudal margin nearly straight; both sides of venter gradually narrowing toward caudal end; lateral concavity deep, slightly oblique. Dorsal expansion of lateral sclerite of segment X weakly crumpled, slightly extending caudally; dorsal plate sclerotized, deeply emarginated at middle of caudal margin.

Last instar larva (Fig. 11C). See generic description. Body length 4.4-4.8 mm

Table 2. Character matrix of Northern Hemisphere genera and *Sabatinca* s. str.

Character Genus	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
Sabatinca s. str.	0	0/1	0	0	0	0	0	0	0/1	0	0	0	0	0	0	0	0	0	0	0/1	1	0	0	0	0	0	1	1
Micropterix	0/1	1	0	1	1	1	0	0	1	0	0	0	0	0	1	0	1	1	1	0	0/1	0	1	1	0	2	0	0
Epimartyria	0	2	0	1	1	2	1	1	1	0	1	1	1	1	1	0	0	0	1	1	0	0	0	0	0	1	0	1
Paramartyria	0	2	0	1	1	2	1	1	1	0	1	0	1	1	1	0	0	0	1	1	0	0	0	0	0	1	0	1
Vietomartyria	0	3	1	2/3	2	2	1	1	1	0	1	1	1	1	1	0	0	0	1	1	0	0	0	0	0	1	0	1
Palaeomicroides	0	3	0	2	2	2	1	0	1	0	1	0	1	1	1	1	0	0	1	1	0	1	0	0	0	1	0	1
Issikiomartyria	0	3	0	2	2	2	1	1	1/2	1	1	1	1	1	1	1	0	0	1	1	0	1	0	0	0	1	0	1
Kurokopteryx	1	3	0	3	2	2	2	1	2	1	1	1	1	1	1	1	0	0	1	1	0	1	0	0	1	1	0	1
Neomicropteryx	1	3	0	3	3	2	2	1	2	1	1	1	1	1	1	1	0	0	1	1	0	1	0	0	1	1	0	1

Character Genus	29	30	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
Sabatinca s. str.	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	0	0
Micropterix	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	0	0	0	0	0	1
Epimartyria	0	0	0	0	3	1	1	0	0	0	1	0	0	0	1	0	0/1	1	0	0	1	0	1	0	0	0	0
Paramartyria	0	0	0	0	1/3	1	0	0	0	0	0	0	1	0	0	0	0	0	1	0	1	0	1	0	0	0	0/1
Vietomartyria	0	0	0	0	1	1	0	0	0	0	0	0	2	1	0	0	0	0	0	0	1	0	1	1	0	0	0/1
Palaeomicroides	0	0	0	1	2	1	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0	1	0	1	0	0
Issikiomartyria	0	1	0	0	1	1	0	0	1	1	0	0	0	0	0	0	1	0	0	1	1	0	1	0	1	1	0
Kurokopteryx	0	1	1	0	1	1	0	0	0	1	0	0	0	0	0	1	1	0	0	1	1	0	1	2	0	0	1
Neomicropteryx	0	1	0	0	1	1	0	1	0	1	0	0	0	0	0	1	2	0	0	1	1	1	1	2	1	0	1

Pupa. See general morphology of the family.

Specimens examined. 5♂, 3♀ (paratypes), Amagakura (labeled as Megakura), Ichihara-shi, Chiba Pref., 12. v. 1991 (S. HASHIMOTO); 27♂, 2♀ (paratypes), Orikisawa, Kimitsu-shi, Chiba Pref., 27. iv. 1992 (S. HASHIMOTO); 7♂, 1♀ (paratypes), same locality, 8. v. 1992 (S. HASHIMOTO). Other materials- 11♂, 3♀ in 75% Et-OH, Orikisawa, Kimitsu-shi, Chiba Pref., 27. iv. 1992 (S. HASHIMOTO); 1 larva and 1 pupa reared from larva, same locality, 11. xii. 1992 (S. HASHIMOTO); 1 larva, Ozaki, Kimitsu-shi, Chiba Pref., 7. xi. 1990 (S. HASHIMOTO), 1 larva, Tashiro, Kimitsu-shi, Chiba Pref., 7. xi. 1991 (S. HASHIMOTO); 4 larvae, Amatsukominato-cho, Chiba Pref., 21. xi. 1997 (H. YOSHITOMI).

Distribution. Japan (Honshu: Chiba Pref.) (Fig. 30).

Biology. See biology of genus.

Remarks. This species is easily distinguishable from other *Neomicropteryx* species by the genital characters given in the keys.

PHYLOGENETIC CONSIDERATIONS OF NORTHERN HEMISPHERE GENERA

Eight genera including two genera of Micropterigidae described in the present paper have been recorded from the Northern Hemisphere: *Micropterix, Epimartyria, Paramartyria, Palaeomicroides, Neomicropteryx, Vietomartyria, Issikiomartyria* and *Kurokopteryx*. Of these, *Epimartyria, Paramartyria, Palaeomicroides* and *Neomicropteryx* have been regarded as a monophyletic group based on non-elevation of the sternum V gland area and on the gland opening in the form of a slit (KRISTENSEN, 1984a, 1984b; KRISTENSEN & NIELSEN, 1982), but their relationships remain unresolved. *Vietomartyria, Issikiomartyria* and *Kurokopteryx* also share the above character states. Therefore, it is apparent that these seven genera (hereafter referred to as the *Neomicropteryx*-group) are monophyletic. In the Northern Hemisphere genera, only *Micropterix* does not possess the above character states. However, molecular phylogeny based on mitochondrial DNA (KOBAYASHI *et al.*, 2000) suggests that *Micropterix* is an immediate sister taxon of the *Neomicropteryx*-group. On the other hand, MINET (1985) indicated that *Sabatinca* s. str. (sensu MINET), *Epimartyria* and *Paramartyria* constitute a monophyletic entity in having the tridentaform organ in the female corpus bursae, which was considered to be a synapomorphy for them (MINET, 1985). The tridentaform sclerites are also found in *Vietomartyria, Palaeomicroides* and *Issikiomartyria,* but not in *Kurokopteryx* and *Neomicropteryx.* In this section, monophyly and relationship of the *Neomicropteryx*-group are analyzed and discussed.

Methods for phylogenetic analysis

The phylogenetic relationship of the *Neomicropteryx*-group was analyzed by an exhaustive search by using PAUP* 4.0b10 (SWOFFORD, 2002). MacClade 3.05 (MADDISON & MADDISON, 1992) was also used for searching character evolution of the phylogenetic trees obtained. *Sabatinca* s. str. and *Micropterix* were adopted as outgroups because of the above reason. To evaluate validity of Sabatinca s. str. and Micropterix as outgroups, the phylogenetic analyses excluding either or both of them were also performed. When two more most parsimonious trees were obtained, successive approximations weighting (CARPENTER, 1994) was applied using the rescaled consistency index (FARRIS, 1989) to select the most acceptable tree.

Characters

The characters used for the analysis are based on adult morphology, numbered and discussed, and the coding used for each character is described. The numbers correspond to those of the character matrix (Table 2) and the cladogram (Fig. 47). All characters are treated as unordered in this paper, though polarities of most characters could be decided by the outgroup comparisons.

Head

1. Head scales. Yellow or yellowish orange (0); fuscous or black (1)

   Yellow or yellowish orange piliform scales on the head are common in the family, while fuscous or black piliform scales are found in *Kurokopteryx* and *Neomicropteryx* and in a few species of *Micropterix* (LANGOHR & KUCHLEIN, 1998).
2. Antennal flagellum. Filiform (0); submoniliform (1); moniliform, each flagellomre longer than broad (2); moniliform, each flagellomere broader than long (3)

   The filiform antennal flagellum (Fig. 4D) is the ground plan of the Amphiesmenoptera (KRISTENSEN & NIELSEN, 1979). It is probable that the antennal flagellum has evolved from filiform to distinctly moniliform in Micropterigidae. In the *Neomicropteryx*-group the flagellum is moniliform (Fig. 4F) to conspicuously moniliform (Fig. 4C, 4G-J).
3. Basal stalk of each flagellomere. Indistinct (0); distinct (1)

   In the genus *Vietomartyria* each flagellomere (Fig. 4G) has a distinct, long basal stalk (HASHIMOTO & MEY, 2000), but in other genera of the family the basal stalk is indistinct.
4. Number of male flagellomeres. Less than 40 (0); about 45 (1); about 60 (2); above 65 (3)

   An increasing number of the flagellomeres is one of the evolutionary trends of the *Neomicropteryx*-group (HASHIMOTO & MEY, 2000).
5. Number of female flagellomeres. Less than 25 (0); about 35 (1); about 45 (2); about 50 (3)

   See the above character. In Micropterigidae the numbe of flagellomeres is fewer in females than in males.
6. Modified interocular index (MIOI). About 0.7 to 0.8 (0); about 0.6 (1); about 0.5 (2)

   The head of the *Neomicropteryx*-group becomes broad so that the modified interocular index show relatively low values compared with those of other micropterigid genera and the lower Lepidoptera (DAVIS, 1978; KRISTENSEN & NIELSEN, 1979). It is considered that this character is strongly associated with the following character.
7. Occipital sulcus. Complete and distinct (0); complete but indistinct at dorso-lateral corners (1); interrupted at dorso-lateral corners (2)

   As already noted by ISSIKI (1931), the occipital salcus is indistinct or reduced on dorso-lateral corners in the *Neomicropteryx*-group (Fig. 3B, 3F, 3G).
8. Epipharyngeal armature. Developed (0); reduced or absent (1)

   The asymmetrical epipharyngeal armature (Fig. 4K, 4M) is found in Micropterigidae and Heterobathmiidae in the Lepidoptera, and simplicity or absence of the asymmetrical sclerites is regarded as secondary in the family (KRISTENSEN & NIELSEN, 1979). Except for *Micropterix* and *Palaeomicroides*, in the Northern Hemisphere genera this structure is usually reduced or absent (Fig. 4L, 4N-P), but variable at the intraspecific level.

9. Labial palpus. 3-segmented (0); 2-segmented (1); 1-segmented (2)

Three-segmented, elongate labial palpi are the ground plan of the Amphiesmenoptera, but in Micropterigidae they become shortened and reduced in number (KRISTENSEN & NIELSEN, 1979).

10. Proximal prelabium. Sclerotized (0); less sclerotized (1)

The proximal prelabium is normally well sclerotized and distinct (Fig. 4T-U) in the family, but in *Issikiomartyria, Kurokopteryx* and *Neomicropteryx* it is less sclerotized and indistinct (Fig. 4W-X; ISSIKI, 1931). The postlabium is often less sclerotized in the Northern Hemisphere *Sabatinca*-group, with some intraspecific variation.

Thorax

11. Antero-lateral processes of pronotum. Distinct, melanized (0); indistinct, less melanized (1)

The distinctly melanized antero-lateral processes of the pronotum are the ground plan of Micropterigidae, with reduction (Fig. 5A-D) believed to be secondary in the Northern Hemisphere genera except for *Micropterix* (KRISTENSEN & NIELSEN, 1979).

12. Foretibial epiphysis. Present (0); absent (1)

The foretibial epiphysis is one of the apomorphies of the Lepidoptera, but the epiphysis is secondarily lost (Fig. 5H-I) in some genera of Micropterigidae (ISSIKI, 1931; KRISTENSEN, 1984c).

13. Proprioceptive hair plate behind metasubalare. Free from metepimeron (0); connected with metepimeron (1)

The descrete proprioceptive hair plate, a ground plan of the Amphiesmenoptera, is typical in Micropterigidae as well as in the lower Lepidoptera (*e.g.* Agathiphagidae and Eriocraniidae) (KRISTENSEN & NIELSEN, 1979). As indicated by KRISTENSEN & NIELSEN, in the *Neomicropteryx*-group the proprioceptive hair plate is connected with the metepimeron (Fig. 5L-M), but rarely free at the intraspecific level (Fig. 5N).

14. Apex of wings. More or less acute (0); obtuse (1)

The wing apexes are usually more or less acute in Micropterigidae, but obtuse in the *Neomicropteryx*-group. The obtuse apices are also found in the South American genus *Hypomartyria* (KRISTENSEN & NIELSEN, 1982).

15. Forewing R1. Forked (0); unforked (1)

The forked condition of R1 (Fig. 5P) is considered to be plesiomorphous within the Amphiesmenoptera and the ground plan of Micropterigidae (KRISTENSEN & NIELSEN,1979). R1 is simple in the Northern Hemisphere genera. As already indicated by ISSIKI (1931, 1953), the forked condition occurs as an intraspecific variation (Fig. 6G) in the *Neomicropteryx*-group.

16. Forewing Rs. Dichotomously branched (0); unilaterally branched (1)

The dichotomously branched Rs (Figs. 5O-P, 6A-B) is a primitive condition in the Amphiesmenoptera (TILLYARD, 1919b) and is typical in Micropterigidae (ISSIKI, 1931; KRISTENSEN & NIELSEN, 1979; PHILPOTT, 1923). In the *Neomicropteryx*-group, *Palaeomicroides, Issikiomartyria, Kurokopteryx* and *Neomicropteryx* show the unilaterally branched Rs (Fig. 6G-J). ISSIKI (1931) interpreted the unilateral condition in this group as the result that a basal portion of R3 is secondarily lost and the interradial crossvein replaces R3 in arising from the stem of R4 + 5. Although the South African genus *Agrionympha* also shows the unilaterally branched Rs (JANSE, 1942), it is probable that the unilateral condition of Rs has occurred parallel in *Agrionympha* and the *Neomicropteryx*-group.

17. Forewing R4 & R5. Stalked or connate (0); separate (1)

KRISTENSEN & NIELSEN (1979) regarded that the stalked or connate condition of R4 and R5 is primitive in the family and the separate condition is paralleled in *Micropterix* (Fig. 6A) and in some species (Fig. 5O) of *Sabatinca* s. lat.

18. Forewing R5. R5 reaching apex or termen (0); all Rs reaching costa (1)

The condition of R5 reaching apex or termen is regarded to be plesiomorphous in the Amphiesmenoptera (KRISTENSEN & NIELSEN, 1979). *Micropterix* and *Squamicornia* possess all Rs reaching the costa (KRISTENSEN & NIELSEN, 1979, 1982). In the Northern Hemisphere *Sabatinca* genera, R5 is rarely reaching the costa as an intraspecific variation.

19. Forewing 3A. Present (0); absent (1)

Although the double-Y configuration of the anal veins is the ground plan of the Amphiesmenoptera (TILLYARD, 1919b; KRISTENSEN, 1984c), in Micropterigidae 3A is frequently reduced in parallel.

20. Hindwing R1. Free (0); not free (1)

The completely free R1 is primitive in the Amphiesmenoptera (TILLYARD, 1919b; KRISTENSEN & NIELSEN, 1979), but in most species of Micropterigidae (except for *Micropterix* and a few species of the *Sabatinca*-group) R1 is not present as a complete free vein.

21. Interradial crossvein of hindwing. Present (0); absent (1)

The interradial crossvein of hindwing is normally present in the non-glossatan Lepidoptera (DUMBLETON, 1952; KRISTENSEN & NIELSEN, 1979), but secondary loss is paralleled at Micropterigidae (at the species level of *Sabatinca* s. lat. and *Micropterix*).

22. Hindwing Rs. Dichotomously branched (0); unilaterally

branched (1)

See character number 16.

23. Hindwing R4 and R5. Stalked or connate (0); separate (1)

See character number 17.

Pregenital abdomen

24. Median longitudinal costa on anterior rim of male tergum I. Absent (0); present (1)

The median, longitudinal, short costa (Fig. 7A; arrow) is unique in the family and found in only male *Micropterix* (Kristensen & Nielsen, 1979; Kristensen, 1984b).

25. Short ridge present mid-laterally on tergum I. Absent (0); present (1)

A short ridge at the middle of the sides on tergum I (Fig. 7E-F; arrows) is characteristic of *Kurokopteryx* and *Neomicropteryx*. A similar character is not found in other genera.

26. Sternum V gland. Present on protuberance (0); present on shallow concavity (1); absent (2)

The sternum V gland is one of autapomorphies of Amphiesmenoptera (Kristensen & Nielsen, 1979; Kristensen, 1984b & c) and normally is present on a protuberance in the lower Lepidoptera (Davis, 1978; Kristensen & Nielsen, 1979). In Micropterigidae the gland is lost in parallel in *Hypomartyria* (Kristensen & Nielsen, 1982) and *Micropterix* (Kristensen & Nielsen, 1979). The shallowly concave gland area is believed to be a synapomorphy of the *Neomicropteryx*-group (Kristensen, 1984b).

27. Piliform scales on sternum V gland area. Absent (0); present (1)

According to Kristensen (1984b), presence of the piliform scales on the sternum V gland area is a synapomorphy of the Southern Hemisphere genera, i. e. *Sabatinca* s. lat., *Agrionympha* and *Squamicornia*.

28. Male sternum VIII. A pair of slender sclerites (0); membranous (1)

Kristensen & Nielsen (1979, 1982) reported that the male sternum VIII retains a pair of slender sclerites in *Micropterix* and that the completely membranous sternum VIII is a synapomorphy of the *Sabatinca*-group. However, as already shown by Issiki (1931) it is possible that the slender sclerite in *Micropterix* is secondary. Molecular phylogeny based on mitochondrial DNA suggests that the Northern Hemisphere genera including *Micropterix* are monophyletic (Kobayashi, *et al.*, 2000).

Male genitalia

29. Dorso-median and dorso-lateral processes of male tergum IX. Absent (0); present (1)

This structure is regarded as one of autapomorphies of the genus *Micropterix* (Kristensen & Nielsen, 1979, 1982).

30. Inner proximal part of valva. Sclerotized (0); membranous (1)

A membranous inner proximal part of the valva is characteristic of *Issikiomartyria, Kurokopteryx* and *Neomicropteryx*. In other genera the valva is a partially sclerotized lobe (Issiki, 1931; Janse, 1942; Kozlov, 1989; Kristensen, 1976; Kristensen & Nielsen, 1982; Philpott, 1924)

31. Proximo-dorsal long and medio-ventrally curved sword-like protrusion and mid-ventral hornlike process of valva. Absent (0); present (1)

Although the shape of valva varies in Micropterigidae (Issiki, 1931; Janse, 1942; Kozlov, 1989; Kristensen, 1976; Kristensen & Nielsen, 1982; Philpott, 1924), the remarkable valva (Fig. 26C) with a long curved dorsal protrusion and a hornlike ventral projection of *Kurokopteryx* is very specialized in the family.

32. Three projections along inner proximal margin of valva. Absent (0); present (1)

These structures (Fig. 45I) are characteristic of *Palaeomicroides* (Issiki, 1931) and similar specializations are not found in other micropterigid genera.

33. Inner basal projection of valva. Absent (0); present and short (1); present and long (2)

This projection (Figs. 15I, 17C, 18C, 26C, 28C, 45D, 45I) is found only in the *Neomicropteryx*-group. Although the projection shows considerable diversity in shape, position and size, it is believed that this character is homologous in the *Neomicropteryx*-group because the proximal inner part of the projection is always connected with a median plate (Kristensen, 1984a; my observation).

34. Phallobase. Nearly straight and cylindrical (0); curved (1)

The nearly straight and cylindrical phallobase (Fig. 12) is common in the family (Janse, 1942; Kozlov, 1989; Kristensen, 1976; Kristensen & Nielsen, 1982; Philpott, 1924), but in the *Neomicropteryx*-group the phallobase is curved and broadly opened ventrally (Issiki, 1931; Kristensen, 1984a).

35. Ventral branch of aedeagus. Absent (0); present (1)

The ventral branch of the aedeagus (Figs. 7K, 45B-C, 45E-F) is very uncommon in the family and present in only *Epimartyria* (Kristensen, 1984a; Philpott, 1924). Kristensen (1984a) suggested the probability that presence of the aedeagal ventral branch is an underlying synapomorphy at the superordinal level (Amphiesmenoptera), because this character is also found in the family Eriocraniidae (Davis, 1978) and in some trichopterous families such as Rhyacophilidae and Glossosomatidae (Nielsen, 1957). However, this seems unlikely,

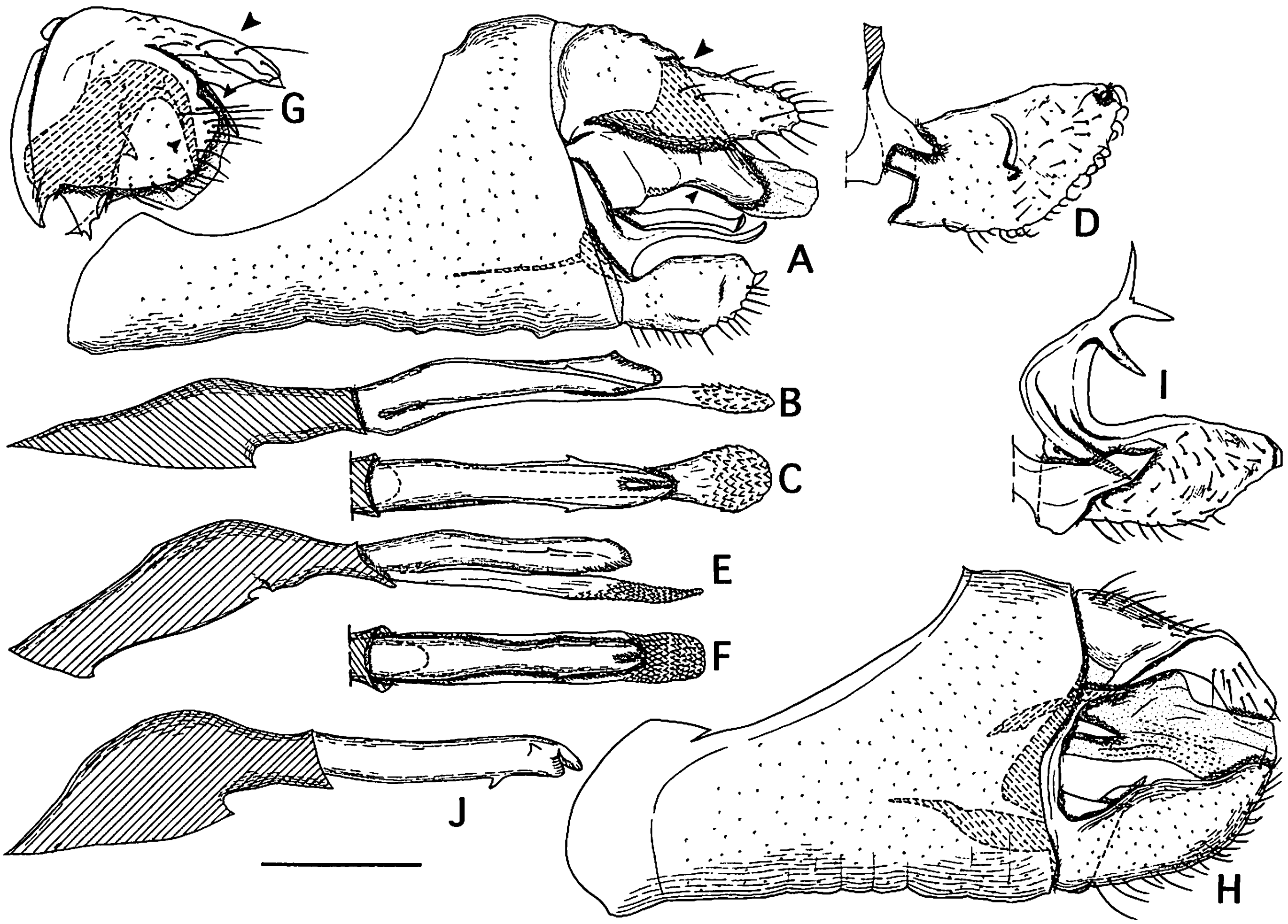

Fig. 45. Male genitalia. A, H: lateral view, phallus removed, B, E, J: phallus, lateral view, C, F: aedeagus, dorsal view, D, I: right valva, inner view, G: tergum X, dorso-lateral view. A-C: *Epimartyria pardella*, D-G: *E. auricrinella*, H-J: *Palaeomicroides marginella*. Arrows: dorsal (large arrow) and ventral (small arrow) processes. Scale = 0.2 mm.

because it assumes that the loss of ventral branch has occurred in many lineages in the Amphiesmenoptera, and also because structure of the ventral branch differs considerably among the groups mentioned.

36. Dorsal and ventral mid longitudinal ridges of aedeagus. Absent (0); present (1)

This structure is unique in the family and is one of characteristics of *Neomicropteryx* (ISSIKI, 1931).

37. Two pairs of hornlike projections of aedeagal base. Absent (0); present (1)

This is one of characteristics of *Issikiomartyria* and similar projections are not found in other micropterigid genera.

38. A pair of triangular plates at middle or posterior part of aedeagus. Absent (0); present (1)

A pair of triangular plates on the aedeagus is common in *Issikiomartyria, Kurokopteryx* and *Neomicropteryx*. Similar characters are not found in other genera.

39. A pair of small lateral projections near apical 1/3 of aedeagus. Absent (0), present (1)

A pair of small lateral projections (Fig. 45C, 45F) is unique to the genus *Epimartyria*. This projection is present on the longitudinal, slender sclerite of the aedeagus (KRISTENSEN, 1984a; my observation).

40. One or two small projections near middle or apex of aedeagus. Absent (0); present (1)

One or two small projections of the aedeagus (Fig. 45J), which are variable in position, are characteristic in the genus *Palaeomicroides* (ISSIKI, 1931); similar projections are also found in some species of *Sabatinca* s. lat. (PHILPOTT, 1924). However, it is possible that this structure is not homologous between them, because in *Sabatinca* s. lat. the projections are strongly sclerotized and larger.

41. Minute, serrate projections near gonopore of aedeagus. Absent (0); less than 50 (1); more than 100 (2)

Presence of minute serrations on the aedeagus is unique in the family and occurs in *Paramartyria* and *Vietomartyria*. In *Paramartyria* (Fig. 7L) less than 50 serrations are present around the gonopore and in the latter genus (Fig. 4M) more than 100. Although a similar character is also present on the ventral branch of the aedeagus in *Epimartyria* (KRISTENSEN, 1984a), it was not treated here as a homologous character because the gonopore does not open on the ventral branch.

42. Gonopore. Horizontal opening at apex (0); vertical opening at apex (1); dorsal longitudinal opening before apex (2)

The gonopore usually opens horizontally at the apex of the aedeagus in the family, but in *Epimartyria* it opens vertically (Fig. 45C, 45F) and in *Vietomartyria* dorsally it opens longitudinally (Fig. 7M; arrow). The latter two characteristics are unique within the family, but it is believed that these had evolved independently because of their differences in shape and position. A dorsal longitudinal opening is one of apomorphies of *Vietomartyria* (HASHIMOTO & MEY, 2000).

43. Tergum X divided into dorsal and ventral processes. Not divided (0); divided (1)

The male tergum X consisting of two pairs of dorsal and ventral processes (Fig. 45A, 45G: arrows) is very unique in the family and found in only *Epimartyria* (PHILPOTT, 1924; KRISTENSEN, 1984a). KRISTENSEN (1984a) interpreted that the dorsal protrusions (flat plates) are the true tergum X lobes and the ventral ones are the anal cone sclerotization. According to him, the latter consist of the segment X (dorsal proximal part) and the segment XI (lateral lobes: paraproct). However this conclusion is problematical, because it must be assumed that the loss of segment XI sclerotization (paraproct) has occurred several times within the family.

44. A pair of basal small projections of tergum X. Absent (0); present (1)

The paired basal projections of male tergum X are one of characteristics of *Neomicropteryx* (ISSIKI, 1931), and *Kurokopteryx* also shows the same character state. KRISTENSEN (1984a) suggested that the basal small projections of *Neomicropteryx* are counterpart of the dorsal protrusions of *Epimartyria* and consequently the apical projections (uncus in ISSIKI, 1931) are the anal cone sclerotization. However, judging from the location of the venter X plates in the genera *Neomicropteryx*, *Kurokopteryx*, *Issikiomartyria* and *Palaeomicroides*, in which the latter two genera do not possess the basal small projections (Fig. 45H), the basal projections are regarded here as a specialization in the former two genera. Therefore the apical projections (Figs. 18, 20-23, 45H) are considered to be the true tergum X lobes in *Neomicropteryx* and *Kurokopteryx*.

45. Tergum X lobe. Lobed (0); hornlike (1); slender (2)

The lobed condition is usual in the family and is considered to be the lepidopterous grand plan (KRISTENSEN, 1984a). The hornlike condition is found in *Epimartyria auricrinella* (Fig. 45G) and in the genera *Issikiomartyria* and *Kurokopteryx*, but it is probable that this occurred in parallel between *Epimartyria auricrinella* and the latter genera, because another *Epimartyria* species, *Epimartyria pardella*, shows the lobed condition. The slender condition is restricted to *Neomicropteryx*.

46. Venter X plate. Distinct (sclerotized) (0); indistinct (less sclerotized) (1)

A distinct (sclerotized) venter X plate is common in the family (PHILPOTT, 1924; my observation), but in *Epimartyria* (KRISTENSEN, 1984a) and *Micropterix* (BIRKET-SMITH, 1974) the venter X plate is less sclerotized. KRISTENSEN (1984a) regarded the simple and inconspicuous venter X as plesiomorphous, but it is possible that an unsclerotized condition is derived and parallel in *Epimartyria* and *Micropterix*.

47. Shape of venter X plate. Nearly flat and simple (0); complex and inflexed (1)

The complex and inflexed venter X plate is a characteristic of *Paramartyria*. When the venter X plate is distinct in the family, this plate is generally simple and flat, but rarely has a distinct projection in *Paramartyria immaculatella*, *Vietomartyria expeditionis* and the monotypic genus *Hypomartyria* (KRISTENSEN, 1976; KRISTENSEN & NIELSEN, 1979; MEY, 1997).

48. Location of venter X plate. Horizontal to anal cone (0); almost vertical (1)

The venter X plate is normally located horizontally to the anal cone in Micropterigidae, but in *Kurokopteryx*, *Issikiomartyria*, *Neomicropteryx* and *Palaeomicroides* it becomes nearly vertically.

Female genitalia

49. Segment IX. Complete ring, dorsum equal to venter in length (0); complete or almost complete ring, dorsum shorter than venter (1); broadly membranous on dorsum (2)

Segment IX forms usually a complete or almost complete ring as in the male segment IX in Micropterigidae (KRISTENSEN & NIELSEN, 1982; PHILPOTT, 1924). The *Neomicropteryx*-group and some species of *Sabatinca* s. lat show a markedly short dorsal part of the segment IX ring, but *Agrionympha*, *Squamicornia* and other *Sabatinca* species possess equal dorsal and ventral lengths for the

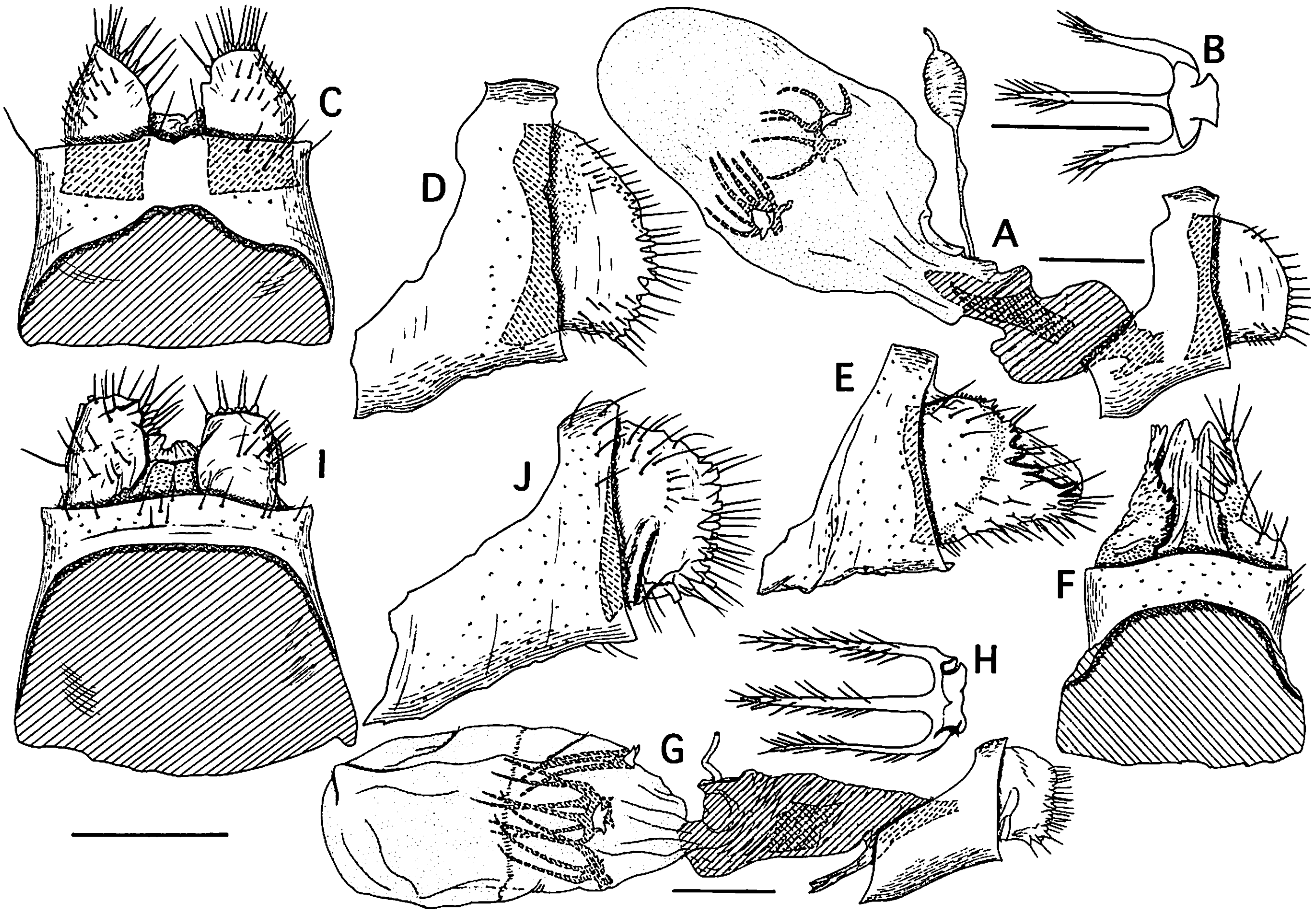

Fig. 46. Female genitalia. A, G: lateral view, B, H: signum (tridentaform sclerite), C, F, I: segments IX and X, dorsal view, D, E, J: ditto, lateral view. A-D: *Epimartyria auricrinella*, E-F: *Vietomartyria expeditionis* (after HASHIMOTO & MEY, 2000), G-J: *Palaeomicroides marginella*. Scales = 0.2 mm.

segment IX ring (KRISTENSEN & NIELSEN, 1982). The broadly membranous dorsal part of segment IX is one of autapomorphies of *Micropterix* (KRISTENSEN & NIELSEN, 1982).

50. Lateral oblique concavity of segment IX. Absent (0); present (1)

The lateral oblique concavity of segment IX is unique in the family, found in *Neomicropteryx*, and probably associated with the shape of the ventral edge of the male valva.

51. Intersegmental membrane between segments IX and X. Long (0); short (1)

The intersegmental membrane between the female segments IX and X is rather long so that segment X is telescoped into the segment IX or VIII in the family (CHAPMAN, 1916; KRISTENSEN & NIELSEN, 1979; PHILPOTT, 1927). However, in the *Neomicropteryx*-group the intersegmental membrane is short and segment X is not completely telescoped into IX.

52. Segment X lateral sclerite. Simple (0); tapering ventro-caudally (1); expanding dorso-medially (2)

The segment X lateral sclerite is usually a semi-cylindrical, simple plate with an arched caudal margin within the family (CHAPMAN, 1916; KRISTENSEN & NIELSEN, 1979; PHILPOTT, 1927). In *Vietomartyria* the lateral sclerite tapers ventro-caudally (Fig. 46E-F), whereas in *Kurokopteryx* and *Neomicropteryx* the lateral sclerite expands dorso-medially.

53. Dorsal sclerite of segment X. Absent (0); present (1)

A dorsal part of the female segment X is usually membranous in the family (CHAPMAN, 1916; KRISTENSEN & NIELSEN, 1979; PHILPOTT, 1927), but this becomes more or less sclerotized in the genera *Palaeomicroides*, *Issikiomartyria* and *Neomicropteryx*.

54. Corpus bursae. Oblong (0); globular (1)

The corpus bursae are oblong in most genera of the

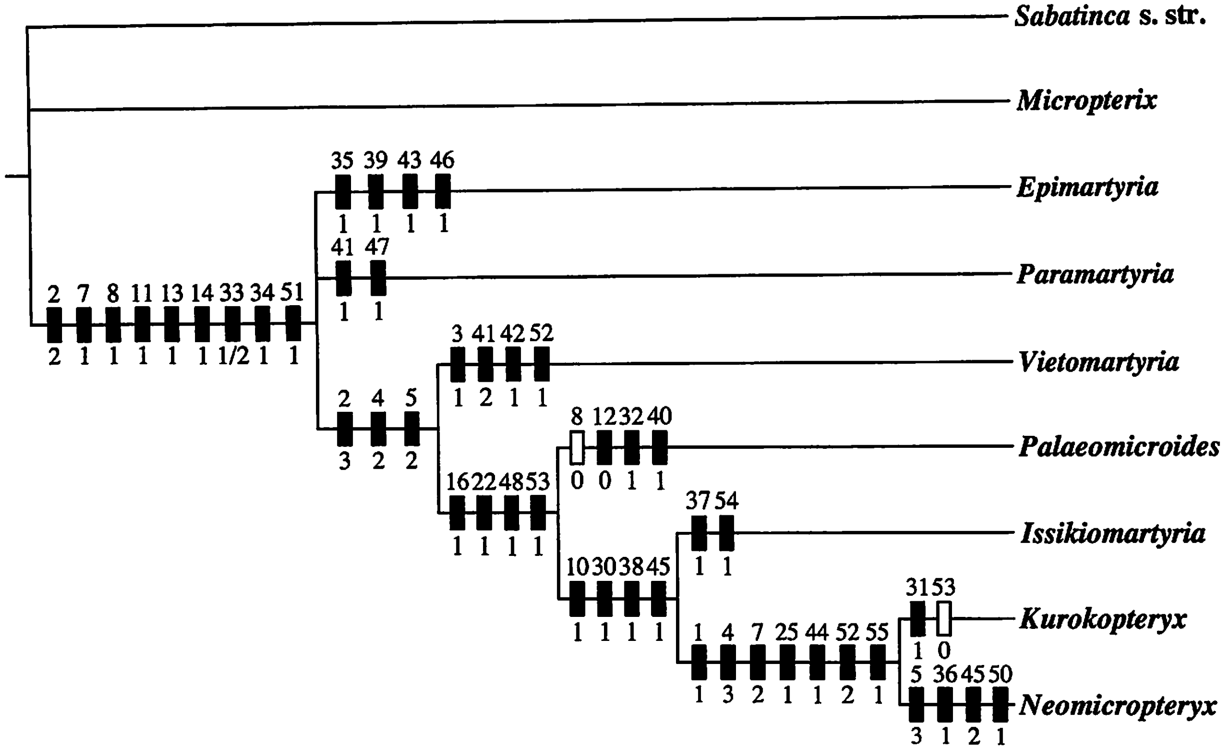

Fig. 47. Recommended cladogram of the *Neomicropteryx*-group with apomorphies of each clade. Numbers above bars correspond to character numbers and those below bars to character states. White bars represent reversals.

family (KRISTENSEN & NIELSEN, 1979; PHILPOTT, 1927), but globular in *Issikiomartyria*.

55. Signa. Present (0); absent (1)

MINET (1985) suggested that the tridentaform signa are an autapomorphy of *Sabatinca* s. str., *Epimartyria* and *Paramartyria*, but it remains unclear whether the absence of signa is primary or not in other genera. However, it is probable that the signa have been reduced or lost several times in the *Neomicropteryx*-group.

Results of cladistic analysis and discussion

Phylogenetic analysis including *Sabatinca* s. str. and *Micropterix* as outgroups resulted in only one most parsimonious tree (tree length 85, consistency index (CI) = 0.93, retention index (RI) = 0.87, rescaled consistency index (RC) = 0.81). In this tree the *Neomicropteryx*-group constituted a simple nested set: *Paramartyria* + (*Epimartyria* + (*Vietomartyria* + (*Palaeomicroides* + (*Issikiomartyria* + (*Kurokopteryx* + *Neomicropteryx*))))).

When only *Sabatinca* s. str. was treated as outgroup, one most parsimonious tree (tree length 71, CI = 0.94, RI = 0.88, RC = 0.83) was also obtained. This tree was identical in the tree topology with the above-unweighted tree including *Sabatinca* s. str. and *Micropterix* as outgroups.

When only *Micropterix* was used as outgroup, two most parsimonious trees (tree length 73, CI = 0.92, RI = 0.84, RC = 0.77) were obtained. One of these also presented the same tree topology as the unweighted tree including *Sabatinca* s. str. and *Micropterix*. The other tree differed in the placement of *Epimartyria* and *Paramartyria*, where their placement was the reverse to the former tree. A successive approximation weighting resulted in one parsimonious tree (tree length 53.00, CI = 0.98, RI = 0.97, RC = 0.95), which was identical with the latter unweighted tree.

Analysis of ingroup led to one most parsimonious tree (tree length 50, CI = 0.94, RI = 0.89, RC = 0.84), in which the *Neomicropteryx*-group was divided into three clades (*Epimartyria*, *Paramartyria* and the other genera), but their relationships remained unresolved as a trichotomy. This tree had the same tree topology as the strict consensus tree of the unweighted trees including *Micropterix* as outgroup.

Monophyly of the *Neomicropteryx*-group was confirmed by nine apomorphies. All the trees supported monophyly of the clade *Vietomartyria* + (*Palaeomicroides* + (*Issikiomartyria* + (*Kurokopteryx* + *Neomicropteryx*))). However the phylogenetic positions of *Epimartyria* and Paramartyria were not definite. Taking the character evolution and the uncertainty in the relationships of *Epimartyria* and *Paramartyria* into consideration, the recommended tree is shown in Fig.

47 with the apomorphies of each clade. This tree corresponds to the strict consensus tree of the unweighted trees including *Micropterix* as outgroup, but differed in the relationships of *Epimartyria, Paramartyria* and *Vietomartyria* from the molecular phylogenetic tree based on mitochondrial DNA (KOBAYASHI *et al.*, 2000; KOBAYASHI *et al.*, in prep.), in which these genera constituted a monophyletic group. The molecular analysis also suggested that *Micropterix* is an immediate sister taxon of the *Neomicropteryx*-group, but this study could not determine whether *Micropterix* is an immediate sister taxon or not. For resolving the basal trichotomy and for determining an immediate sister taxon of the *Neomicropteryx*-group it will be necessary to examine other morphological characters such as the antennal sensorium, the head capsule structure, the wing maculation, the male genital musculature and the larval structures, which could not be treated here. Furthermore it would be desirable that the morphological and the molecular relationships be verified reciprocally for constructing a more reliable phylogenetic tree.

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