Zootaxa 3619 (2): 101–129
www.mapress.com/zootaxa/

Article

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

http://dx.doi.org/10.11646/zootaxa.3619.2.1
http://zoobank.org/urn:lsid:zoobank.org:pub:CD8D33DF-DF33-437F-B0C9-5AC26EC36C11

Four new species of Gracillariidae (Lepidoptera) from China and Japan, and description of the pupal morphology of the genera *Corythoxestis, Eumetriochroa, Guttigera,* and *Metriochroa*

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Abstract

Four new leaf mining Oecophyllembiinae (Gracillariidae) species are described from China and Japan: *Metriochroa symplocosella* sp. nov. (host plants: *Symplocos anomala, S. sumuntia,* Symplocaceae) from China, *Guttigera schefflerella* sp. nov. (host plant: *Schefflera octophylla,* Araliaceae), *Eumetriochroa araliella* sp. nov. (host plants: *Dendropanax trifidus, Evodiopanax innovans, Eleutherococcus sciadophylloides* and *Fatsia japonica,* Araliaceae) and *Corythoxestis tricalysiella* sp. nov. (host plant: *Tricalysia dubia,* Rubiaceae) from Japan. *Corythoxestis sunosei* (Kumata, 1998) is recorded from new host plants: *Adina pilulifera* and *Mussaenda parviflora,* Rubiaceae, from Japan. The female adult and pupal morphologies, life history and host plant of the genus *Guttigera* are described for the first time. Pupae of seven species of four genera: *Corythoxestis, Eumetriochroa, Guttigera,* and *Metriochroa,* are described for the first time. We provide morphological diagnostic differences between species and genera of Oecophyllembiinae and *Phyllocnistis*. Our preliminary data suggest that Oecophyllembiinae species have three valuable pupal diagnostic characters: 1) cocoon cutter with unique lateral processes or setae on the clypeus, 2) tergal spines with only a pair of dorsal setae, and 3) cremaster with more than two pairs of caudal processes, while *Phyllocnistis* species possess 1) cocoon cutter without lateral processes or setae on clypeus, 2) tergal spines with a pair of dorsal setae and dorsal hooks, and 3) cremaster with only a pair of caudal processes.

Key words: Araliaceae, *Corythoxestis sunosei*, Leafminer, Oecophyllembiinae, *Phyllocnistis*, Rubiaceae, Symplocaceae

Introduction

Adult Oecophyllembiinae are some of the smallest of the leaf-mining gracillariid subfamilies, with a wing expanse of only 5–10 mm. Vári *et al.* (2002) treated Oecophyllembiinae as a synonym of Phyllocnistinae. De Prins & De Prins (2005, 2012) discussed the various opinions about the subfamily classification of the Gracillariidae and the placement of the seven genera that they recognized in the Phyllocnistinae: *Angelabella* Vargas & Parra, 2005, *Corythoxestis* Meyrick, 1921, *Eumetriochroa* Kumata, 1998, *Guttigera* Diakonoff, 1955, *Metriochroa* Busck, 1900, *Phyllocnistis* Zeller, 1848, and *Prophyllocnistis* Davis, 1994.

Recently, Kawahara *et al*. (2011) sequenced 21 genes (14,793 bp) for 57 taxa of Gracillarioidea and outgroups. In their analyses, the grouping of Oecophyllembiinae (*sensu* Kumata) + Phyllocnistinae, was supported weakly or not at all, but a sister-group relationship could not be rejected. Because the phylogenetic position of the sister-group remains unclear, we followed Kumata (1998) in recognizing six genera in the Oecophyllembiinae, with *Phyllocnistis* as the sole member of the Phyllocnistinae.

In China, five *Phyllocnistis* species have been recorded: *P. citrella* Stainton, 1856; *P. saligna* (Zeller, 1839); *P. wampella* Liu & Zeng, 1985; *P breynilla* Liu & Zeng, 1989; and *P. embeliella* Liu & Zeng, 1989 (Liu & Zeng 1985, 1989). Kobayashi *et al.* (2011a) recorded two Oecophyllembiinae species: *Corythoxestis sunosei* (Kumata, 1998) and

Accepted by J.-F. Landry: 10 Jan. 2013; published: 27 Feb. 2013

Eumetriochroa hederae Kumata, 1998 and pupae of the genera *Corythoxestis* and *Eumetriochroa* were described for the first time. We found three diagnostic differences of these genera from other genera of Oecophyllembiinae and *Phyllocnistis*. In Japan, three genera and eight species of Oecophyllembiinae have been recorded: *Eumetriochroa hederae* Kumata, 1998; *E. miyatai* Kumata, 1998; *E. kalopanacis* Kumata, 1998; *E. hiranoi* Kumata, 1998; *Metriochroa fraxinella* Kumata, 1998; *M. syringae* Kumata, 1998; *Corythoxestis sunosei* (Kumata, 1998); *C. yaeyamensis* (Kumata, 1998) (Kumata 1998). As a result of our field work in China and Japan, we discovered four new leaf-mining Oecophyllembiinae species, a *Metriochroa* species feeding on Symplocaceae, a *Eumetriochroa* species and a *Guttigera* species feeding on Araliaceae, and a *Corythoxestis* species feeding on Rubiaceae.

In this paper, four new species of Oecophyllembiinae species are described with reports of their life histories, and the female adult and pupal morphologies, life history and host plant of the genus *Guttigera* are described for the first time. Pupae of six species of the genera *Eumetriochroa*, *Metriochroa* and *Corythoxestis* are described for the first time. We also report life histories and new host plants of *Corythoxestis sunosei* from Japan.

Material and methods

Chinese specimens were collected in the Tianpingshan Mountain, Badagongshan NNR (28°32.848'N, 111°25.310'E, asl 400 m; Fig. 1A), Sangzhi County, Hunan Province in China in March 2011. Japanese specimens were collected from March to November in 2008–2011 and from March to June in 2012 in the following prefectures: Mie (Nabari: Yuriga–oka (34°36'12"N, 136°05'47"E, asl 240 m), Shōrenji (34°35'06N, 136°06'57"E, asl 300 m)), Nara (Soni (34°30'N, 136°07'E, asl 400–1000 m; Fig. 1E)), Kagoshima (Amami–Ohshima: Sumiyō (28°18'43"N, 129°24'25"E, asl 140 m), Yamato (28°22'26"N, 129°24'52"E, asl 120 m; Fig. 1C), Yuwan (28°17'53"N, 129°20'2"E, asl 490 m; Fig. 10D), Okinawa (Ishigaki Is.: Takeda (24°24'27"N, 124°11'10"E, asl 100–150 m, Maesato (24°25'36"N, 124°11'49"E, asl 100 m; Fig. 1G, K)). Adult specimens are preserved in the Institute of Entomology, Hunan Agricultural University, China (HUNAU) and the Entomological Laboratory, Osaka Prefecture University (OPU). Those collected by Dr. H. Kuroko (Kishiwada) were also examined.

Larvae and cocoons were collected from leaves of host plants and were reared in plastic cups (420 ml: 129 mm in top diameter and 60 mm in depth) containing wet cotton at 20±5 ˚C under a photoperiod of 13~16-h light: 8~12-h dark in the laboratory. For the leafminer species, the morphology of each instar and pupa was recorded. Some leafmines were scanned using an EPSON GT7400 flatbed scanner. Some pupae were dried and sputter-coated with a 60:40 mixture of gold-palladium for examination with a scanning electron microscope (SEM). SEM photographs were taken using a HITACHI SU1510 with a lanthanum hexaboride (LaB6) source at an accelerating voltage of 15 kV. For preparation of the male and female genitalia, the abdomen was removed and boiled for 3–4 min in 10% aqueous KOH. They were stained with acetocarmine.

Scientific names of plants follow the Missouri Botanical Garden *Tropicos* database (2012). Terms for genitalia follow Kumata (1998).

Descriptions

Key to the genera of Oecophyllembiinae and Phyllocnistis based on pupal morphology

1	Dorsum of abdominal segments 2–10 with a pair of dorsal hooks (Fig. 21H–J)	*Phyllocnistis*
-	Dorsum of abdominal segments 2–10 with a pair of dorsal setae (e.g. Figs 14I, 16H, 17G, 20H)	2
2	Frontal process of cocoon cutter flanked by two lateral processes or setae (Fig. 16B, 20B)	3
-	Frontal process of cocoon cutter not flanked lateral processes or setae (e.g. Fig. 14B)	5
3	Frontal process of cocoon cutter flanked by two lateral processes (Fig. 16B, 20B)	4
-	Frontal process of cocoon cutter not flanked lateral setae	**Angelabella*
4	Lateral processes of cocoon cutter with a pair of setae; clypeus without setae (Fig. 20A–B, D–E)	*Corythoxestis*
-	Lateral processes of cocoon cutter without a pair of setae; clypeus with a pair of setae (Fig. 16B, E)	*Guttigera*
5	Clypeus with a pair of setae (Figs 17B, 18B, 19B); cremaster without ventral processes (Figs 17I, 18I)	6
-	Clypeus without a pair of setae (Figs14A, 15A); cremaster with ventral (perianal) processes (Figs 14J, 15K)	*Metriochroa*
6	Clavate setae of clypeus; tubercule-shaped dorsal process of cremaster	**Prophyllocnistis*
-	Tapering setae of clypeus; basally flat-shaped dorsal process of cremaster)	*Eumetriochroa*

**Angelabella* and *Prophyllocnistis* are not treated in this paper, see Vargas & Parra (2005, figs. 4, 7) and Davis (1994, figs 11–12, 37–45)

FIGURE 1. Habitats and hostplants of Oecophyllembiinae species. A. Type locality of *Metriochroa symplocosella* sp. nov., Tianpingshan, Badagongshan NNR, Hunan, China, asl 400 m. B. The shoot of *Symplocos sumuntia* at the type locality. C. Type locality of *Guttigera schefflerella* sp. nov., Kuninao, Amami–Oshima, Kagoshima Pref., Japan, asl 100 m. D. The leaves and flowers of *Schefflera octophylla* at the type locality. E. Type locality of *Eumetriochroa araliella* sp. nov., Kumawata, Soni, Nara Pref., Japan, asl 700 m. F. The leaves of *Evodiopanax innovans* at the type locality. G. Type locality of *Corythoxestis tricalysiella* sp. nov., Maesato, Ishigaki Is., Okinawa Pref., Japan, asl 100 m. H. The shoot of *Tricalysia dubia* at the type locality. I. Habitat of *Corythoxestis sunosei*, Takeda, Ishigaki Is., Okinawa, Japan, asl 150 m. J. The leaves and flower of *Mussaenda parviflora* in the habitat. K. Habitat of *Cryphiomystis yaeyamensis*, Maesato, Ishigaki Is., Okinawa, Japan, asl 100 m. L. The leaves of *Saurauia tristyla* in the habitat.

***Metriochroa symplocosella* Kobayashi, Huang & Hirowatari sp. nov.**
Figs. 2A–B, 3, 7, 14

Diagnosis. All *Metriochroa* species possess a forewing without veins R_1 and CuA_2 (Fig. 4A). The forewings of most species are ochreous white with brown scales (Fig. 2A, B). This species is superficially very similar to *M. pergulariae* Vári, but it is distinguished from the latter by the following characters:

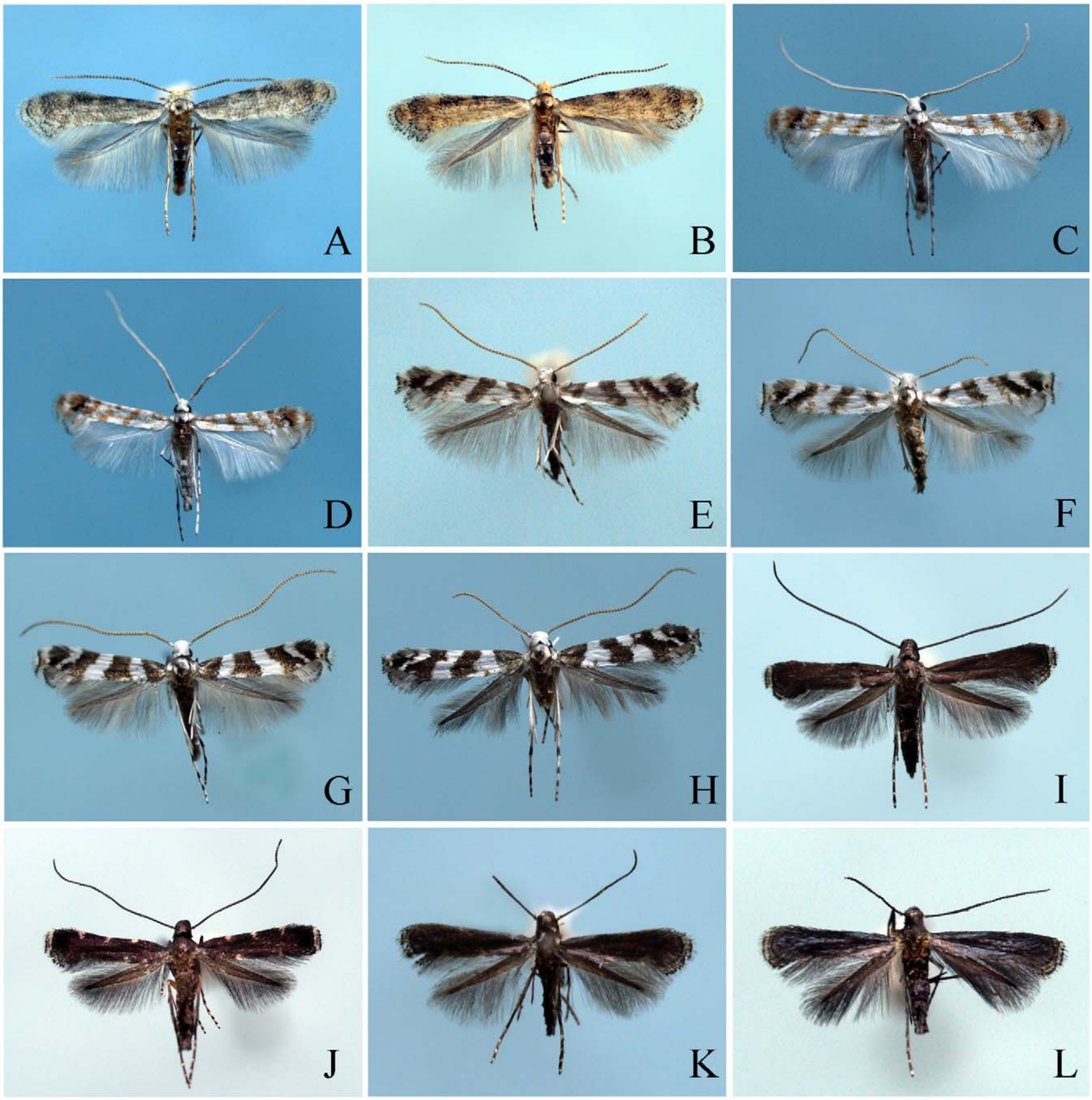


FIGURE 2. Adult of Oecophyllembiinae species from China and Japan. A. *Metriochroa symplocosella* sp. nov., holotype ♂. B. Paratype ♀. C. *Guttigera schefflerella* sp. nov., holotype ♂. D. Paratype ♀. E. *Eumetriochroa araliella* sp. nov., holotype ♂. F. Paratype ♀ mining *Evodiopanax innovans*. G. Paratype ♂ mining *Dendropanax trifidus*. H. Paratype ♂ mining *Fatsia japonica*. I. *Corythoxestis tricalysiella* sp. nov., holotype ♂. J. Paratype ♀. K. *Corythoxestis sunosei* (Kumata, 1998) ♂ in Japan. L. *Corythoxestis yaeyamensis* (Kumata, 1998).

Male genitalia with tubular aedeagus without juxta (Fig. 3E). Female genitalia without a signum on the corpus bursae (Fig. 3F).

Adult. (Fig. 2A, B) Wing expanse 8.0 mm in holotype, 6.2–8.0 mm (7.32 mm in average of 19 specimens) in paratypes. Head smooth; frons and vertex lustrous ochreous white mixed with brown scales centrally and laterally. Maxillary palpus pale ochreous; labial palpus pale ochreous to whitish brown, with blackish brown apically. Antennae 9/10 of forewing, lustrous white annulated with dark brown. Thorax ochreous white. Abdomen ochreous to dark grey. Anal tuft whitish brown to grey. Forewing: white to ochreous white scattered with brown scales and with dark brown obscure patches; one obscure line from base to 1/4, one patch at costal 2/5, another at costal 3/5, apical patches at 7/10 of wing. dorsal area white scattered with brown or dark brown scales. Hindwing whitish grey or grey; cilia white. Wing venation (Fig. 3A, B).

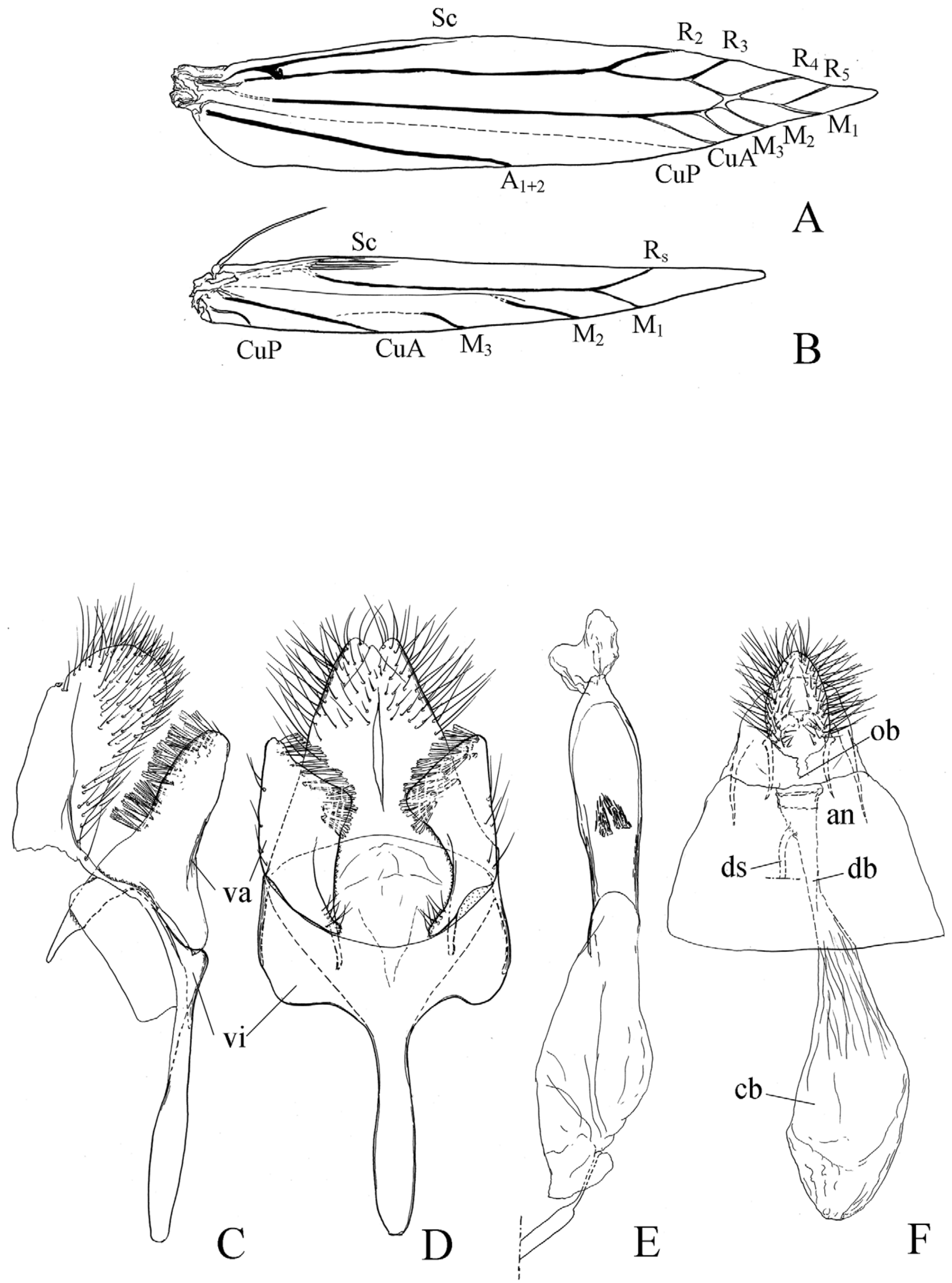
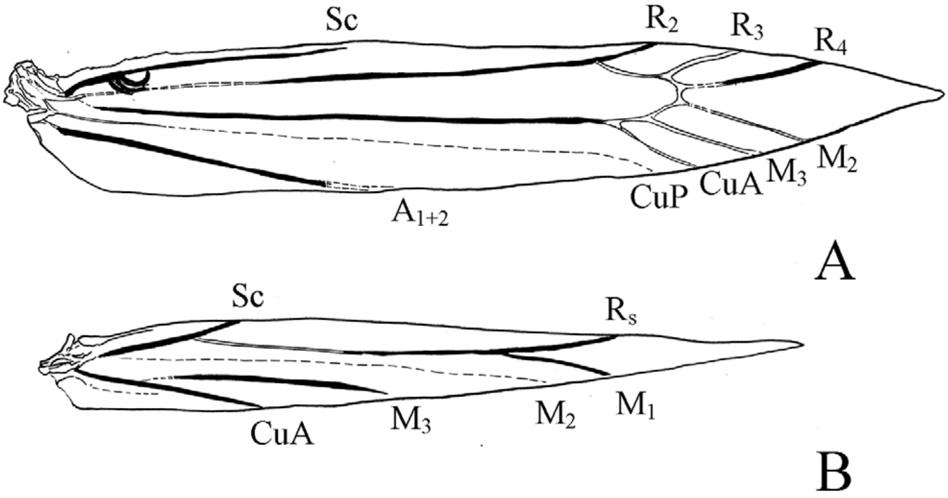


FIGURE 3. The wing venation and genitalia of *Metriochroa symplocosella* sp. nov.. A. Forewing ♀. B. Hindwing ♀. C. Male genitalia, lateral view. D. Ventral view. E. Aedeagus, ventral view. F. Female genitalia, ventral view. va: valva; vi: vinculum; ae, aedeagus; ob: ostium bursae; an: apophysis posterioris; ds: ductus bursae; db: ductus bursae; cb: corpus bursae.



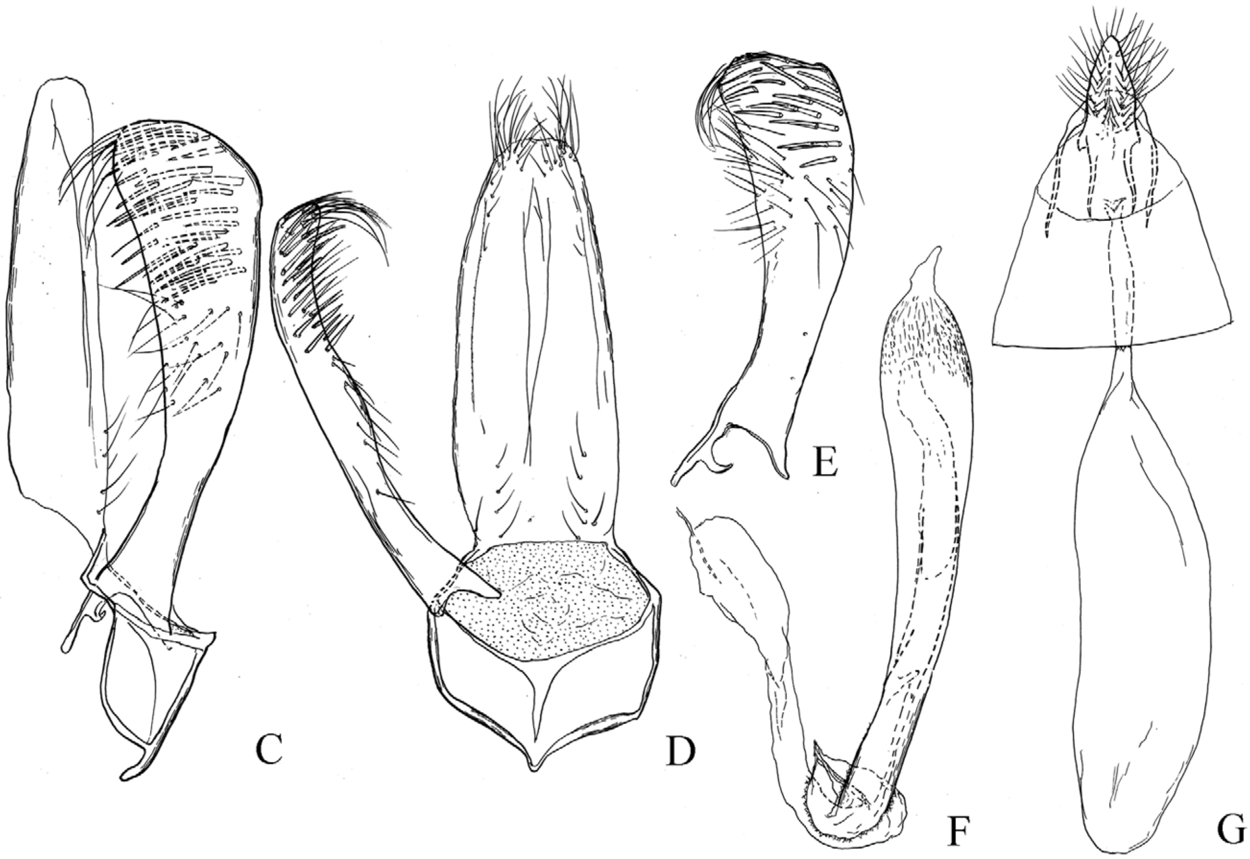


FIGURE 4. The wing venation and genitalia of *Guttigera schefflerella* sp. nov.. A. Forewing ♀. B. Hindwing ♀. C. Male genitalia, lateral view. D. Ventral view. E. Left valva, lateral view. F. Aedeagus, ventral view. G. Female genitalia, ventral view.

Male genitalia (Fig. 3C–E). Tegumen round apically. Vinculum Y-shaped, round laterally, with saccus oblong clavate. Valva about 3/4 in length, clavate in lateral view with an apex obliquely curved toward middle; a group of partite scales occurring along apex. Aedeagus (Fig. 3E) tubular, slightly longer than valva in length; vesica with several small spines densely concentrated at middle.

Female genitalia (Fig. 3F). Apophyses anterioris and apophyses posterioris slender. Ostium bursae membranous; antrum very short, ring-shaped; ductus bursae short, tubular; inception of ductus seminalis on the posterior part of ductus bursae. Corpus bursae pyriform, without a signum, posterior part wrinkled.

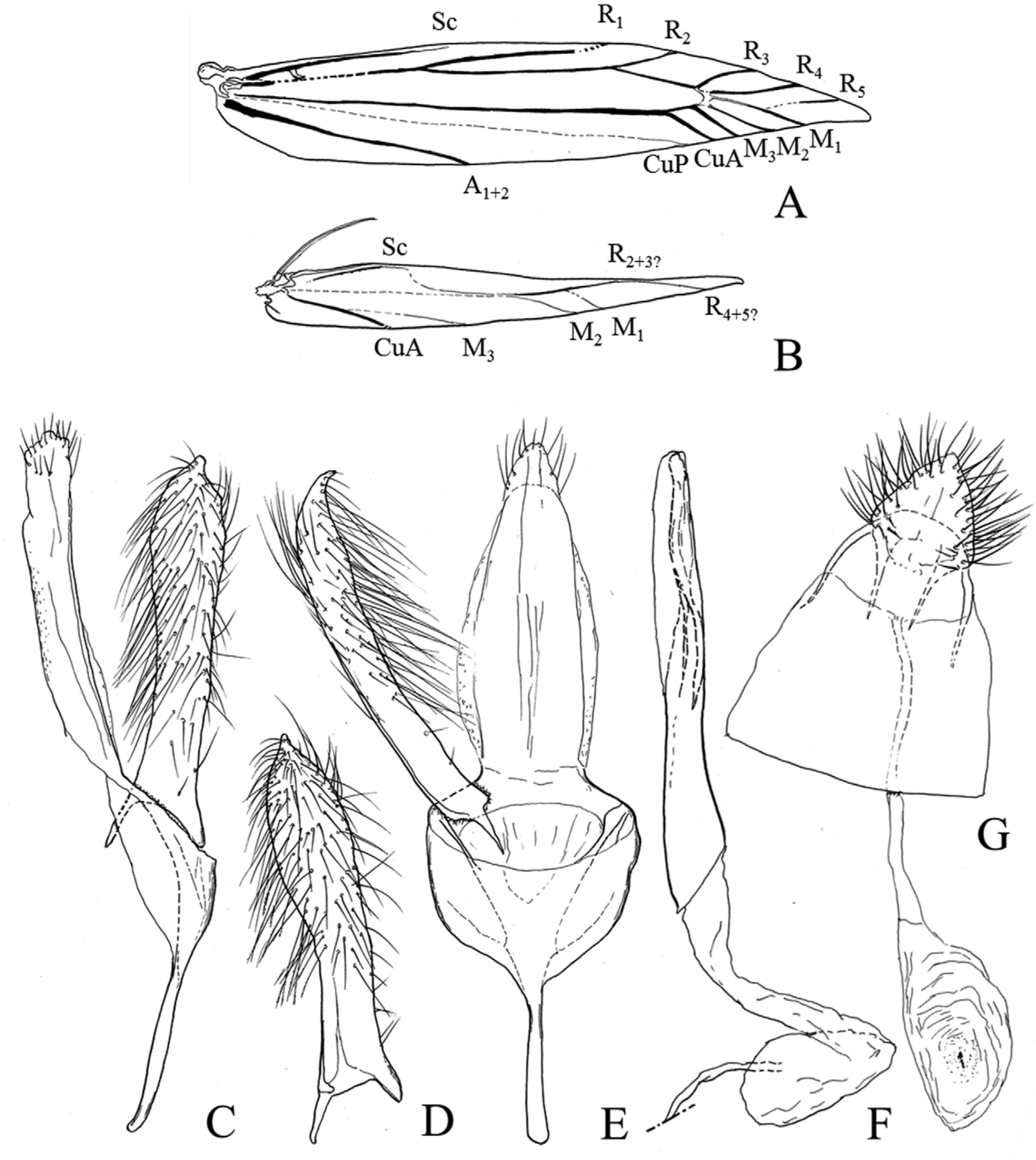


FIGURE 5. The wing venation and genitalia of *Eumetriochroa araliella* sp. nov.. A. Forewing ♀. B. Hindwing ♀. C. Male genitalia, lateral view. D. Left valva, lateral view. E. Male genitalia, ventral view.. F. Aedeagus, lateral view. G. Female genitalia, ventral view.

Pupa. (Figs. 7G–I, 14). Dark brown, 3.5–3.6 mm in length, 0.5–0.6 mm in diameter (Fig. 7G–I). Vertex with a stout, spade-like frontal process (cocoon cutter) (Fig. 14B, E). Dorsum of A2–A8 with a pair of long, lateral setae, and a concentration of small spines (Fig. 14F, I); A9–10 prominently furcated with a pair of perianal, dorsal and caudal processes (Fig. 14J–L); one pair of very small spines from anal area; second pair of digital processes from caudal apex with small processes at apex; third pair of anterior curved, small caudal processes dorsally.

Distribution. China (Hunan).

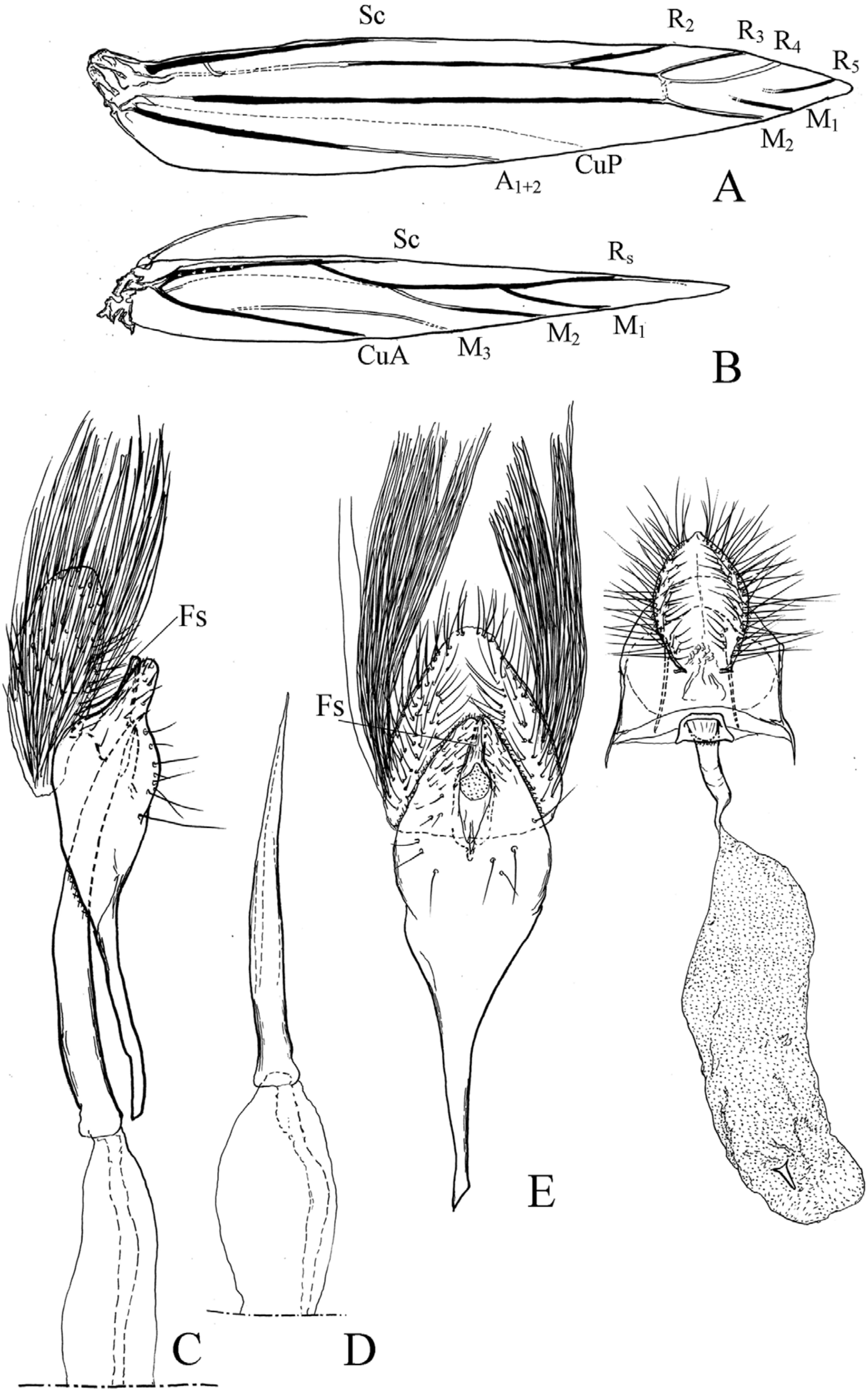


FIGURE 6. The wing venation and genitalia of *Corythoxestis tricalysiella* sp. nov.. A. Forewing ♂. B. Hindwing ♂. C. Male genitalia, lateral view. D. Aedeagus, lateral view. E. Male genitalia, ventral view. F. Female genitalia, ventral view. Fs: Fultura superior.

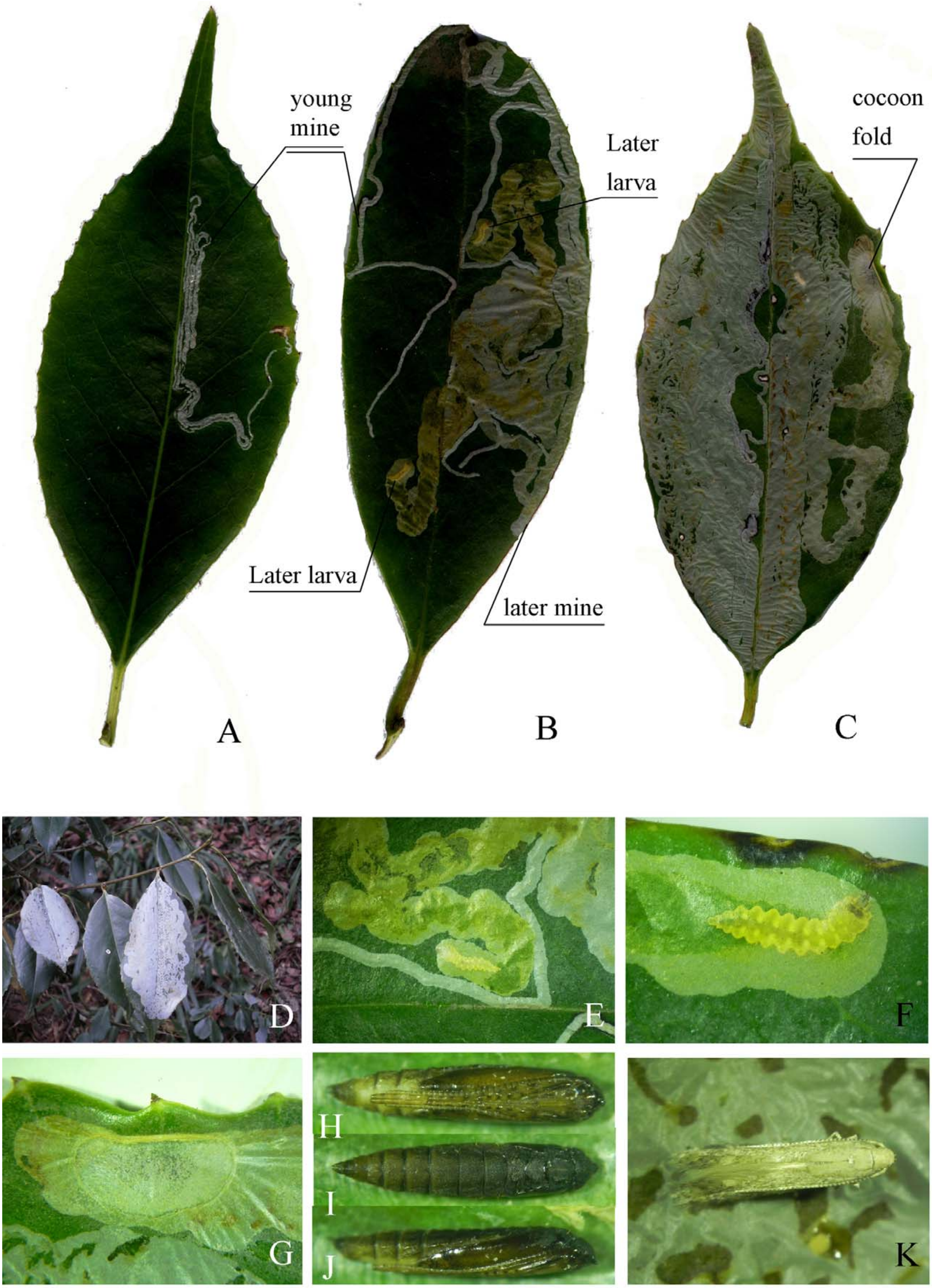


FIGURE 7. Biology of *Metriochroa symplocosella* sp. nov. and the hostplants. A, C, D–K. *Symplocos. sumuntia*. B. *S. anomala*. A–C. Mines on the adaxial epidermis of the leaf. A, E. Mine by young larva. B. Mines by later instar larvae. C, D. Cocoon fold and old mine. F. Later instar larva on adaxial epidermis. G. Cocoon fold. H. Pupa, ventral view. I. Dorsal view. J. Lateral view. K. Resting posture of the adult, dorsal view.

Host plant. *Symplocos anomala* Brand, *S. sumuntia* Buch.-Ham. ex D. Don, (Symplocaceae).

Specimens examined

Type material. 25 (13♂ 12♀)

Adults: Holotype ♂, China: Tianpingshan, Badagongshan NNR, Sangzhi, Hunan, 20.iv.2011 em., T. Hirowatari & Guo-Hua Huang, Host: *Symplocos sumuntia*, 28–29. iii. 2011 (ex larva) in OPU. Paratypes 12♂ 12♀. Same locality as holotype, 18–27.iv.2011 em., Host: *Symplocos anomala* and *S. sumuntia*, 28–29.iii.2011 (ex larva), (genitalia slide no. OPU-SK340–346) in HUNAU and OPU.

Pupae: 12 exs, Same locality and data of type series, 19.iv.2011.

Etymology. The specific epithet, *symplocosella*, is derived from the generic name of the host plant, *Symplocos*.

Biology. The larvae mine the adaxial epidermis of the leaf forming a narrow, long serpentine mine; about 30~ cm in length, yellowish green in coloration, with old mines becoming white. The mines (Fig. 7A–C) were usually 1–2 mines per leaf. The late instar larva is 3.0–4.0 mm long and yellow in coloration (Fig. 7E). The pupal cocoon fold is bean-shaped, situated at the end of the mine, usually along the leaf margins (Fig. 7F). The species overwintered in the larval stage in the leaf mine.

Remarks. In the original description of the genus, the length of antennae was described as “a little longer than forewing”. However, the antennae are a little shorter than the forewings in the new species and *M. fraxinella*, and the same length in *M. syringae* (Kumata 1998). Vári (1961) did not mention the length of antennae of his new *Metriochroa* species. At least, that of *M. pergulariae* is shorter than the forewing judging from the photographs of adult specimens. In addition, the new species and *M. fraxinella* possess a forewing with vein M_3 and distinct CuA, while the type species *M. psychotriella* and *M. syringae* possess a forewing without vein M_3 (Vári 1961; Kumata 1998).

Metriochroa fraxinella Kumata, 1998

Fig. 15.

Metriochroa fraxinella Kumata, 1998: 100–103, figs 8, 13(A, B), 15(A), 26(A, B). Type locality: Japan (Nagano).

Pupa. (Fig. 15). Yellow, 3.4–4.1 mm in length, 0.5–0.6 mm in diameter. Vertex with a small triangular frontal process (Fig. 15B, E, H). Dorsum of A2–A10 with a pair of short setae (Fig. 15F, I). A10 furcated with a pair of short stick-shaped processes from caudal apex, rolled dorsal side (Fig. 15M); second pair of anteriorly curved, small conical, caudal processes from dorsal side (Fig. 15N–O); third pair of laterally curved, short, stout caudal processes ventrally (Fig. 15K).

Host plant. *Fraxinus* spp., *Fraxinus sieboldiana* Blume, *Ligustrum japonicum* Thunb., *L. micranthum* Zucc. in Japan, Oleaceae (Kumata 1998).

Distribution. Japan (Honshu, Kyushu, Ogasawara Is.) (Kumata 1998).

Specimens examined. 2 exs.

Adults: [Host: *L. japonicum*]: 1 ex, Owada, Saitama, 24.iii.2012 em., R. Osada, 11.iii.2012 (ex pupa); 1 ex, Mikata, Mitsushima, Tsushima Is., Nagasaki, 20.iv.2012 em., S. Kobayashi, 27.iii.2012 (ex larva).

Pupae: 3 exs.

1 ex, Owada, Saitama, 24.iii.2012, R. Osada, 11.iii.2012 (ex pupa); 2 exs, Mikata, Mitsushima, Tsushima Is., Nagasaki, S. Kobayashi, 27.iii.2012 (ex larva).

Biology. Kumata (1998) recorded the biology of this species. In the present study, we newly recorded the length and/or width of mines, larvae, and cocoon folds. We observed larvae on *Ligustrum japonicum* forming a serpentine mine on the adaxial epidermis; whitish, 0.4–2.0 mm in width; frass line: ~0.5–1.0 mm in width; usually 1–2 mines per leaf. The late instar larva is 5.5 mm long and yellow in coloration. A pupal cocoon fold (yellow to brown, 8.0–10.0 mm in length, 1.9–2.6 mm in width) is situated at the end of the mine, usually along a leaf margin.

Guttigera schefflerella Kobayashi, Huang & Hirowatari sp. nov.

Figs. 2C–D, 4, 8, 16.

Diagnosis. All *Guttigera* species possess a forewing with three radial veins R_2–R_4 on costa and without R_5 and M_1; hindwing with vein M_3 stalked with CuA (Fig. 4A, B). The genus was represented by only two species from New Guinea (Diakonoff 1955), and each species was described based on only one male specimen: *G. rhythmica* Diakonoff, 1955 has a blackish-purple forewing and three-ribbed pyramid shaped valva with a group of brush-like bristles; *G. albicaput* Diakonoff, 1955 has a whitish forewing irrorated with fuscous scales and the genital structure is unknown (Diakonoff 1955). The new species is easily distinguished from the other two species by white with ochreous oblique streaks of forewing and male genitalia with elongate valva broaden to apex; a group of brush-like scales occurring on interior part of apex (Fig. 4E), and distinguished from *Eumetriochroa* species in having similar forewing parttern (e.g. *E. hiranoi*, *E. kalopanacis* and *E. miyatai*) by a black patch at near apex of forewing and large flap of scape in antennae (Fig. 2C, D). The resting posture of the adult moth in extending the antennae anteriorly is unique in the genera of Oecophyllembiinae and *Phyllocnistis* species.

Adult. (Fig. 2C, D). Wing expanse 8.1 mm in holotype, 6.1–8.1 mm (7.4 mm in average of seven specimens) in paratypes. Head smooth, frons lustrous white mixed with ochreous scales. Labial palpus whitish, second segment tufted ochreous scales bellow. Maxillary palpus absent. Antennae about 1.1–1.2 x longer than forewing, lustrous white annulated with ochreous; scape lustrous white, slightly thickened, with ochreous to brown with a large flap of scales below. Thorax white with ochreous. Abdomen ochreous in anterior part, grey to dark silver in posterior part. Anal tuft whitish brown with blackish brown at apex. Legs white to pale ochreous, all tarsi with narrowly black-ringed; outer spurs pale ochreous; anterior tibia with a blackish brown line; median tibia smooth; posterior tibia with white hairs above. Forewing white with ochreous oblique streaks with dark brown scales; an obscure patch base to 1/6; first streak at costal 1/3, second line at costal 1/2, third line at costal 3/4; a large apical patch at 5/6 of wing, another at apex; a black patch from middle to dorsum at 5/6. Cilia white and ochreous in costal area; a small blackish apical spot at apex with blackish scales at apex; terminal cilia white with fuscous fringe line near termen. Hindwing white; cilia white.

Wing venation (Fig. 4A, B). Forewing lanceolate, with nine veins. Sc along costal fold, ending at one-third of costa; R_1 absent; R_2, R_3 and R_4 from end of cell to costa; R_5 and M_1 absent; M_2, M_3 and Cu from end of cell to dorsum; CuP weak, from base and reaching dorsal area; A_{1+2} from base to one-third of dorsum. Hindwing lanceolate, with six veins; Sc along anterior margin, ending at two-sevenths of costa; R_S to costa near apex; branched M_1; M_2 weak, from base ending at two-thirds of dorsum. Cu from base ending at two-sevenths of dorsum; branched M_3.

Male genitalia (Fig. 4C–F). Tegumen as long as valva in length. Vinculum short acute in anterior part. Valva elongate, broaden to apex; a group of brush-like scales occuring on interior part of apex. Aedeagus tubular; vesica without spines.

Female genitalia (Fig. 4G). Apophysis anterioris and apophysis posterioris slender. Ostium bursae slightly cup-shape; ductus bursae short, tubular. Corpus bursae large, elongate, without signum.

Remarks. The female adult moth of the genus is recorded for the first time. In the original description of the genus, the maxillary palpus were characterized as “very short porrect, pointed”. However, we could not observe the maxillary palpus in this new species. The type species possesses a hindwing with M_2 connate with costal vein (perhaps R_S), whereas the new species possesses a hindwing with independent M_2. In spite of these mismatched characters, we placed the new species in the genus based on the following characters: fore- and hindwing veins, flap of antennae, valva with brush-like scales on apex in the male genitalia. We did not observe generic characters of the female genitalia that distinguish it from other Gracillariidae.

Pupa. (Fig. 16). Pale blackish brown, 4.7 mm in length, 0.7 mm in diameter. Vertex with a triangular frontal process flanked by a pair of horn-shaped processes (Fig. 16B, E). Clypeus with a pair of long setae, about 1.5x length of frontal process, with stout base (Fig. 16A–B, D–E). Dorsum of A2–A10 with a concentration of small spines in anterior portion with a pair of long setae from dorsal side (Fig. 16G); A4–A10 with two pairs of long setae from lateral side (Fig. 16H, K, L). A10 furcated with a pair of Y-shaped processes from caudal apex, rolled dorsal side (Fig. 16I, M, O); two pairs of processes from mid-dorsal side: one pair of small needle-shaped ones; another pair of small stout ones rolled dorsally (Fig. 16J, N).

Host plant. *Schefflera octophylla* (Lour.) Harms (Araliaceae).

Distribution. Japan (Kagoshima (Amami–Oshima) and Okinawa (Ishigaki Is.) Prefectures).

Specimens examined

Type material. 10 (2♂ 5♀ 3exs).

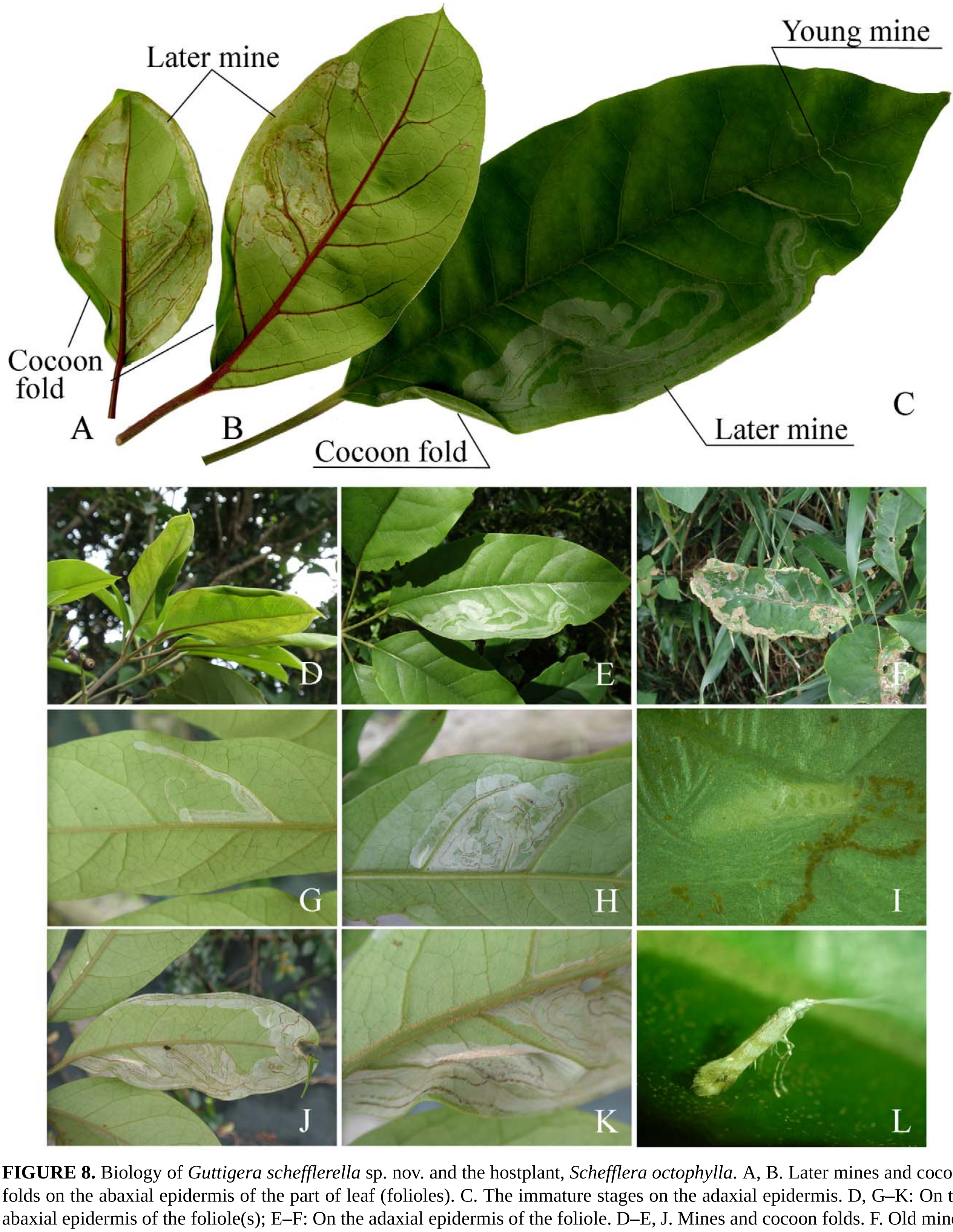


FIGURE 8. Biology of *Guttigera schefflerella* sp. nov. and the hostplant, *Schefflera octophylla*. A, B. Later mines and cocoon folds on the abaxial epidermis of the part of leaf (folioles). C. The immature stages on the adaxial epidermis. D, G–K: On the abaxial epidermis of the foliole(s); E–F: On the adaxial epidermis of the foliole. D–E, J. Mines and cocoon folds. F. Old mines. G. Mine by young larva. H. Mine by later instar larva. I. Last instar larva. K. Cocoon fold. L. Resting posture of the adult.

Adults: Holotype ♂, Japan: Kuninao, Yamato, Amami–Oshima, Kagoshima, 20–22.iii.2012 em., S. Kobayashi leg., Host: *Schefflera octophylla*, 6.iii.2012 (ex larva) (genitalia slide no. OPU-SK395) in OPU. Paratypes 1♂ 5♀ 3exs. Same host plants as holotype, Kagoshima Pref.: 1♂ 2♀, Anbo, Yakushima Is., 27.x.1959, H. Kuroko;

[Amami–Oshima, Kobayashi leg.]: 1♀ 1ex, Kise, Kasari, 8&20–22.iii.2012 em., S., 5.iii.2012 (ex larva); 1♀ 2exs, same locality as holotype, 20–22.iii.2012 em., 6.iii.2012 (ex larva). 1♀, Takeda, Omoto, Ishigaki Is., Okinawa, 10–13.xi.2011 em., S. Kobayashi, 30.x.2011 (larva) in OPU.

Pupae: 1 ex. Kise, Kasari, Amami–Oshima, Kagoshima, 24.iii.2012., S. Kobayashi leg., Host: *Schefflera octophylla,* 5.iii.2012 (ex larva)

Etymology. The specific epithet, *schefflerella*, is derived from host plant genus name, *Schefflera.*

Biology. The biology and hostplant of the genus is recorded for the first time. This species has a few generations per year. The larvae emerge in early spring and autum. The larvae mine leaves (each foliole) of *Schefflera octophylla* forming broad, long serpentine mines, about 40–50~ cm in length, clear to white, 0.5–4.0 mm in width; frass line: ~1.0 mm in width, pale brown to blackish brown; old mine are brown in coloration, with the epidermis cell removed and curling or becoming wrinkled from foliolate margin (Fig. 8F). The mines ((Fig. 8A–E) were found on both sides of the leaves, and were entirely subepidermal, usually 1–2 mines per foliole. The late instar larva is pale yellow in coloration (Fig. 8H). A pupal cocoon fold (white to cream white, 15.0 mm in length, 3.0 mm in width) is situated at the end of the mine, and usually found along the foliolate margins; sometimes a rolled 1/4 foliole (Fig. 8C, D, K). When resting, adult moths raise the anterior part of the body at a steep angle with the fore and mid legs stepped ventro-laterally and the hind legs posteriorly in parallel with the abdomen; the antennae are extended anteriorly (Fig. 8L).

Eumetriochroa araliella Kobayashi, Huang & Hirowatari sp. nov.

Figs. 2E–H, 5, 9, 10, 17.

Diagnosis. All *Eumetriochroa* species possess a forewing with vein R_1 (Fig. 5A). The forewing pattern of this species is easily distinguished from other species by the three dark greyish-brown oblique streaks (Fig. 2E–H). The genital structure of this species is similar to *E. hederae* Kumata and *E. miyatai* Kumata, but it is distinguished from them by the bowl-shaped vinculum with saccus long virgulate in the male genitalia (Fig. 5D, E) and very small signum in the female genitalia (Fig. 5G).

Adult. (Fig. 2E–H). Wing expanse 6.0 mm in holotype, 5.0–8.1 mm (6.9 mm in average of eleven paratype specimens) in paratypes. Vertex and frons lustrous white; vertex with lustrous white scales appressed on occiput. Labial palpus whitish, porrect, slightly upcurved, with pale blackish brown scales in the base. Maxillary palpus absent. Antennae as long as forewing, lustrous white annulated with whitish brown. Thorax white to pale brown. Abdomen dark grey. Anal tuft grey. Forewing. White with dark greyish-brown oblique streaks; first triangular patch from base to 1/5, second broad, at costal 1/3, third linear at costal 1/2, obscure and narrow from middle to dorsum, apical patches at 9/10 of wing. Cilia white and dark grey at costal area with one apical dark grey transverse strigula; sometimes a blackish apical spot at apex; terminal cilia white with fuscous fringe line near termen. Hindwing whitish grey or grey; cilia white. Wing venation (Fig. 5A, B).

Male genitalia (Fig. 5C–F). Tegumen as long as valva. Vinculum bowl-shaped, with saccus long virgulate. Valva slender, acute at apex, with plumose setae occuring on interior part of apex. Aedeagus tubular, as long as valva; vesica without spines.

Female genitalia (Fig. 5G). Apophysis anterioris and apophysis posterioris slender. Ostium bursae membranous; ductus bursae long, tubular. Corpus bursae small, with very small signum on central part.

Pupa. (Fig. 17). Pale yellow to ochreous, 2.8–3.0 mm in length, 0.3–0.4 mm in diameter. Vertex with a short, triangular frontal process (Fig. 17B, C, E). Clypeus with a pair of short setae (Fig. 17A, B, F). Dorsum of A2–A10 with a concentration of small spines in anterior portion (Fig. 17G, H). A10 furcated with a pair of beak-shaped processes from caudal apex, rolled dorsally (Fig. 17I, J–L).

Host plant. *Dendropanax trifidus* (Thunb.) Makino ex Hara, *Evodiopanax innovans* (Siebold & Zucc.) Nakai, *Eleutherococcus sciadophylloides* (Franch. & Sav.) H. Ohashi and *Fatsia japonica* (Thunb.) Decne. & Planch. (Araliaceae).

Distribution. Japan (Mie, Nara, Fukuoka, Kagoshima (Amami Is.) Prefectures).

Specimens examined

Type material. 15 (5♂ 4♀ 6 exs).

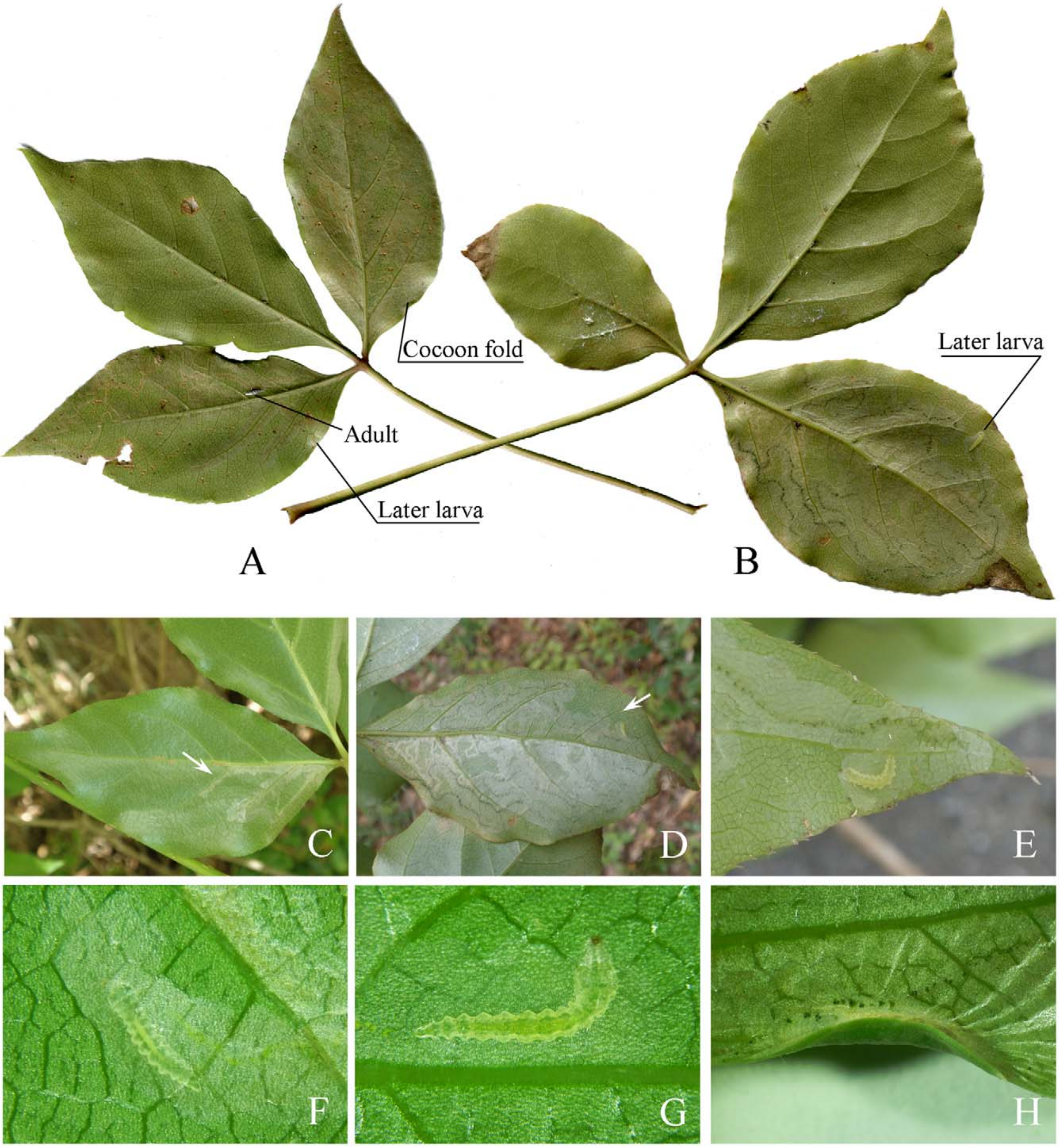


FIGURE 9. Biology of *Eumetriochroa araliella* sp. nov. on the abaxial epidermis of the leaves of hostplant, *Evodiopanax innovans*. A, B. The immature stages oh the leaves. C. Mine by young larva. D. Mine by later instar larva. E. Last instar larva. F. Young larva. G. Later instar larva. H. Cocoon fold.

Adults: Holotype ♂, Japan: Kumawata, Soni, Uda, Nara, 12.x.2011 em., S. Kobayashi, Host: *Evodiopanax innovans*, 9.x.2011 (ex pupa) (genitalia slide no. OPU-SK366) in OPU. Paratypes 2♂3♀5exs. Same host plants as holotype, [Nishi–rokuban–cho, Yuri–gaoka, Nabari, Mie]: 1♀, 23.xi.2009 em., S. Kobayashi & S. Teramura, 8.xi.2009 (ex larva); 1♂ 1♀ 1 ex, 23.x.2010 em., S. Kobayashi, 16.x.2010 (ex larva). [Hikosan, Fukuoka, H. Kuroko leg.]: 2 exs, 10 & 14.xi.1954; 1♂ 1♀, 4 & 22.x.1955. 1 ex, 11.ix.1959, Host: *Eleutherococcus sciadophylloides*. 1 ex, 3.v.1957 in OPU. [Kuninao, Yamato, Amami, Kagoshima, S. Kobayashi leg., 6.iii.2012 (ex pupa)]: 1♂ 1♀ 1ex, 9–14.iii.2012 em., Host: *Dendropanax trifidus*,; 1♂, 20–22.iii.2012 em., Host: *Fatsia japonica* Pupae: 5 exs.

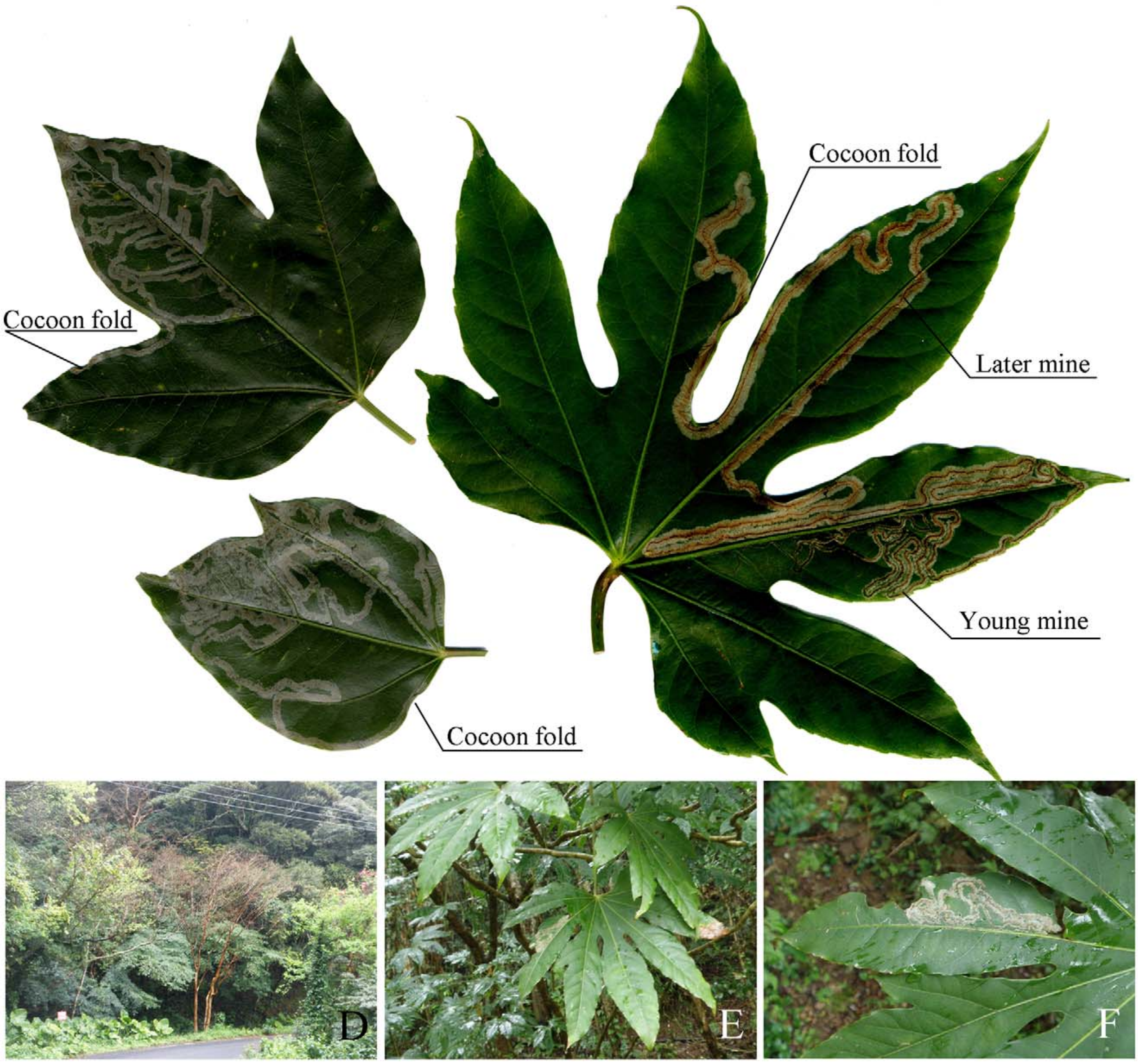


FIGURE 10. Biology of *Eumetriochroa araliella* sp. nov. on the abaxial epidermis of the leaves of hostplants. A, B. Mines and cocoon folds on *Dendropanax trifidus*. C. Mines and cocoon folds on *Fatsia japonica*. D. Habitat of *Fatsia japonica*, Yuwan, Amami–Oshima, Kagoshima Pref. asl 490 m. E, F. Mines and leaves of *Fatsia japonica*.

[Host: *Evodiopanax innovans*, S. Kobayashi leg.]: [Nishi–rokuban–cho, Yuri–gaoka, Nabari]: 1 ex, 23.x.2010, 16.x.2010 (larva); 4 exs, 12 & 26.ix.2011, 10.ix.2011 (ex larva).

Etymology. The specific epithet, *araliella*, is derived from the family name of the host plant, Araliaceae.

Biology. This species has 2–3 generations per year. The larvae emerged from July to November in Nara and Mie Prefectures. We observed larvae on *Evodiopanax innovans* forming a narrow, long serpentine mine; about 30~ cm in length, clear and colorless. The mines (Fig. 9A–D) were only found on the abaxial epidermis of leaves, usually 1–3 mines per leaf. The late instar larva is 3.0–4.0 mm long and pale greenish yellow in coloration (Fig. 9E–G). A pupal cocoon fold (white to creamy white, 4.5–5.0 mm in length, 0.8–1.0 mm in width) situated at the end of the mine, usually found along leaf margins (Fig. 9H). We also observed the mined leaf of *Fatsia japonica* to be a narrow, long linear mine (whitish, about 20~ cm in length; 0.6–5 mm in width; brownish frass line: ~1.0 mm in width) (Fig. 10C, E, F). A pupal cocoon fold (white, 9.0 mm in length, 2.0 mm in width) situated along leaf margins.

Biotope. The Kumawata valley (type locality of *E. araliella*) is part of Tokai Nature Trail connecting Soni Vilage and Uda City (Murō Vil.), Nara Prefecture with a planted forest of Japanese cedar and cypress mixed with fagaceous trees and with few host plants (Fig. 1E).

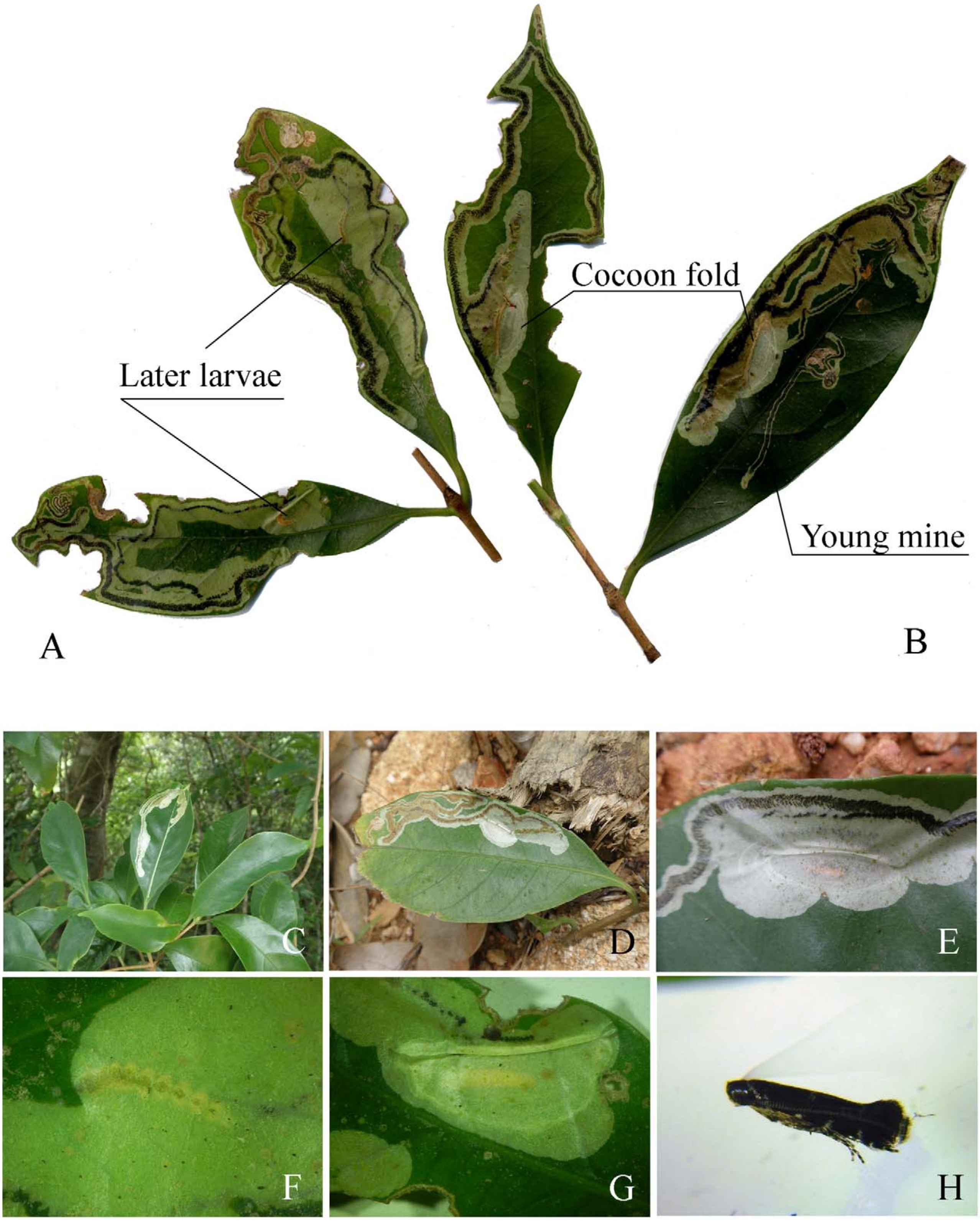


FIGURE 11. Biology of *Corythoxestis tricalysiella* sp. nov. on the adaxial epidermis of the leaves of hostplant, *Tricalysia dubia*. A. Mines by later instar larvae. B. Young mine and cocoon folds. C, D. Mine and cocoon fold on the leaves. E, G. Cocoon fold. F. Later instar larva. H. Resting posture of the adult.

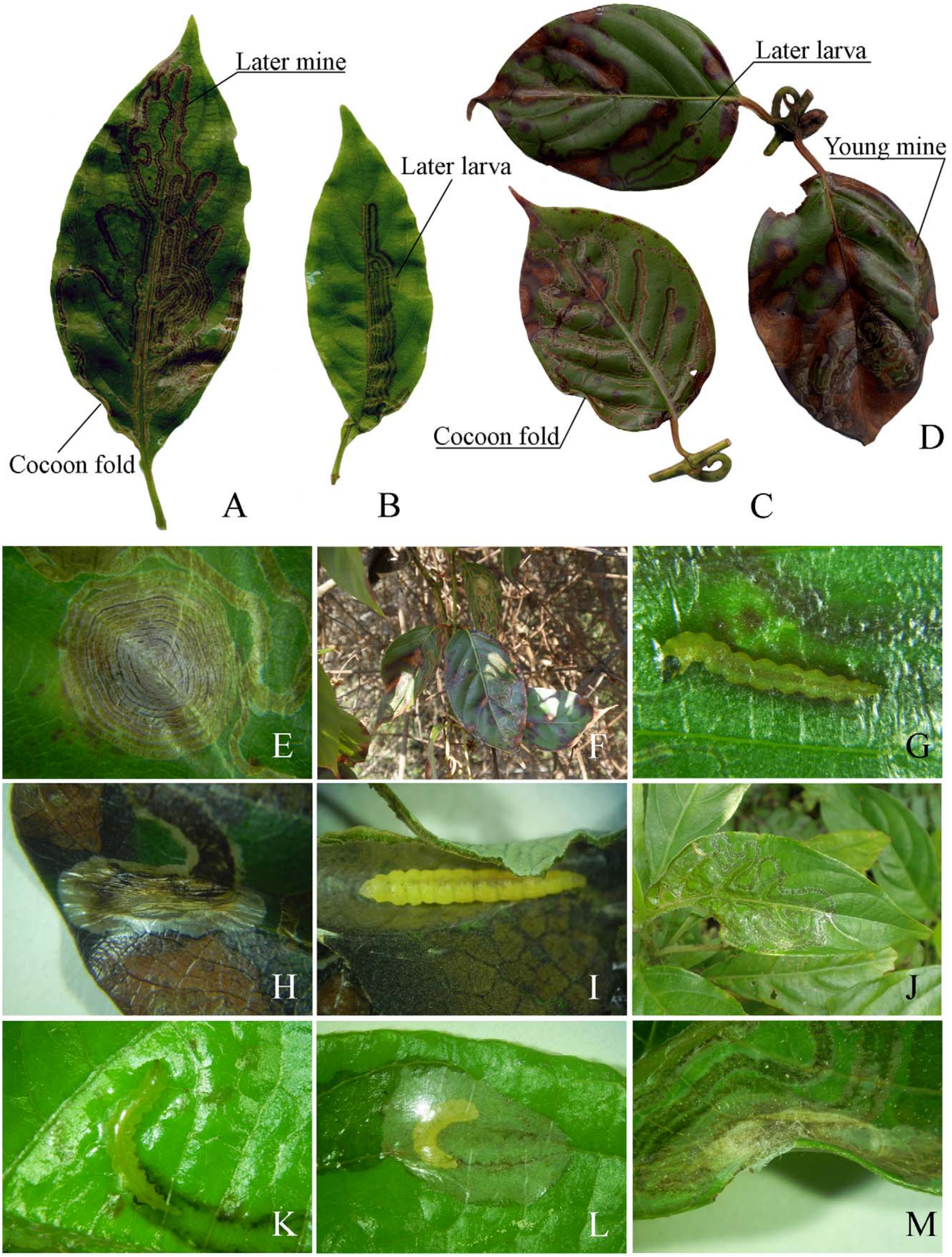


FIGURE 12. Biology of *Corythoxestis sunosei* (Kumata, 1998) on the adaxial epidermis of the leaves of hostplants. A, B, J–M. *Mussaenda parviflora*. C–I. *Uncaria rhynchophylla*. A, B, J. Mines by later instar larva and cocoon folds. C. Mine and cocoon fold. D. Young mine and later instar larva. E. Tigtly coild mine by young larva. F, J. Leaves and mines of hosstplants. G, K. Later instar larva. H, M. Cocoon fold. I, L. Final instar larva.

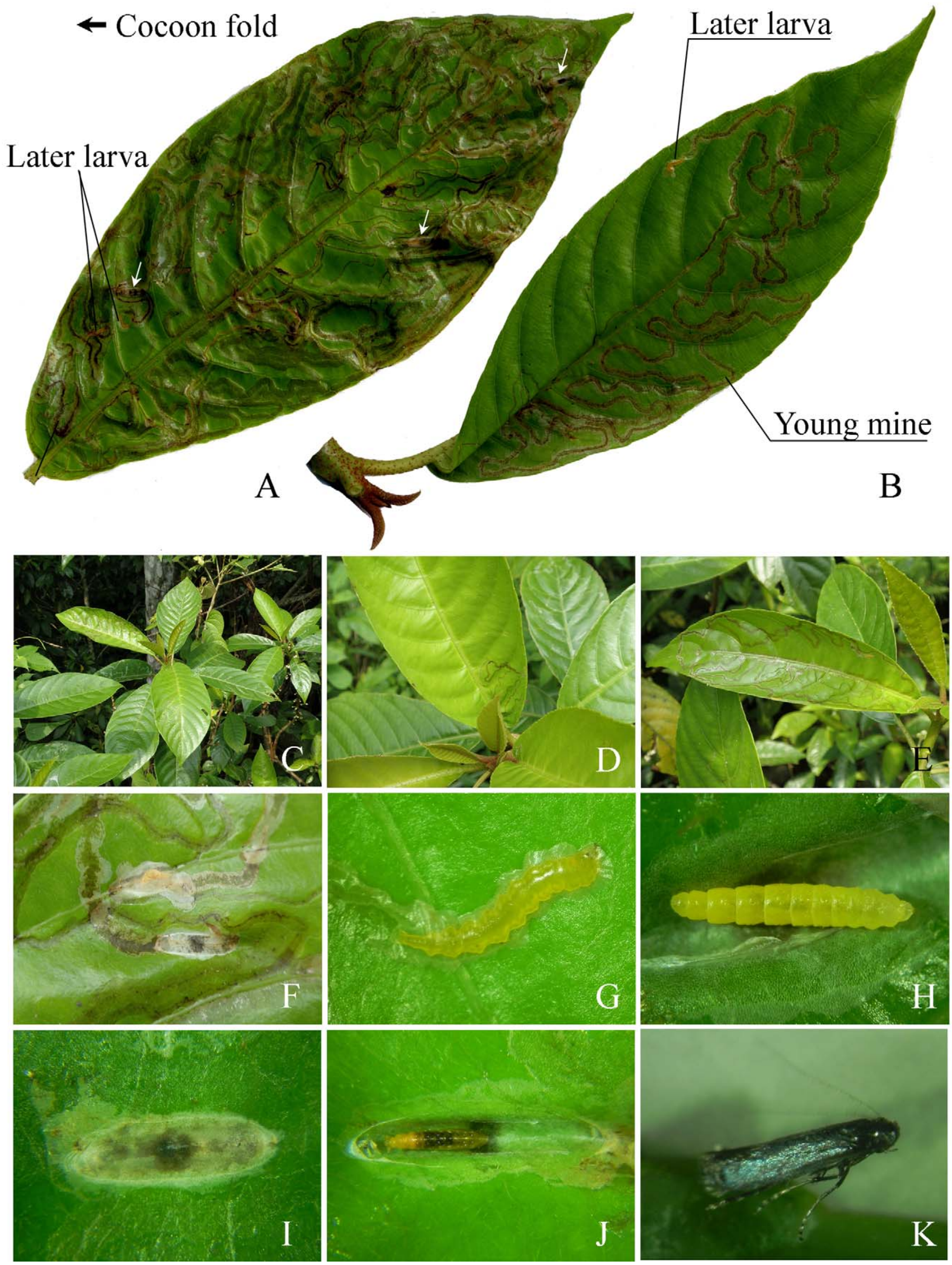


FIGURE 13. Biology of *Corythoxestis yaeyamensis* (Kumata, 1998) on the adaxial epidermis of the leaves of hostplant, *Saurauia tristyla*. A, B. biology of the imature stages on the leaf. C. The shoot of the hostplant and leaf mines. D. Mine by young larva. E. Mine by later instar larva. F, I. Cocoon fold. G. Later instar larva. H. Final instar larva. J. Pupa on the cocoon. K. Resting posture of the adult.

***Eumetriochroa miyatai* Kumata, 1998**
Fig. 18.

Eumetriochroa miyatai Kumata, 1998: 89–92, figs 2(B), 3, 12(C, D), 14(B), 22(B), 24(C–E); Sato & Kumata 2011, 573. Type locality: Japan (Fukuoka).

Pupa. (Fig. 18). Sato and Kumata (2011; fig. III-4) described the pupal morphology of this species. In the present study, the pupa was found to be yellow, about 4.0 mm in length, 0.5–0.6 mm in diameter. Additional description: Clypeus with a pair of setae, divided at 2/3, another one about 1/6 shorter divided at apex (Fig. 18B, E).

Host plant. *Ilex crenata* Thunb., *I. pedunculosa* Miq. and *I. rotunda* Thunb. in Japan, Aquifoliaceae (Sato & Kumata 2011).

Distribution. Japan (Hokkaido, Honshu, Shikoku, Kyushu) (Kumata 1998).

Specimens examined. 20 exs (2 ♂).

Adults: [Host: *I. pedunculosa*]: 3 exs, Kōchi–bashi, Shorenji, Nabari, Mie, 6–7.vii.2010 em., S. Kobayashi, 4.vii.2010 (pupa); 2 exs, Kaimondake, Kagoshima, 26.xi. & 12.xii.1955, H. Kuroko. [Host: *I. crenata*]: 2 exs, Shijonawate, Osaka, 2.vi.1975., H. Kuroko; [Hikosan, Fukuoka, H. Kuroko leg.]: 1 ex, 22.vii.1954.; 2 exs, 17.iv. & 8.vi.1955; 4 exs, Amami–Ohshima, Kagoshima, 22–25.x.2010 em., S. Kobayashi & T. Fujisawa, Host: *Ilex crenata*, 5.x.2010 (ex larva) in OPU. [Host: *I. rotunda,* S. Kobayashi leg.]: 1 ♂ 3 exs, Adachi Park, Kokura, Fukuoka, 8.iii.2012 em., 20.ii.2012 (ex larva); 1 ♂ 1 ex, Mikata, Mitsushima, Tsushima Is., Nagasaki, 4&9.iv.2012 em., 27.iii.2012 (ex larva) in OPU.

Pupae: 3 exs.

[Nabari, Mie Pref., S. Kobayashi leg.]: 1 ex, Nishi–rokuban–cho, Yuri–gaoka, 25.iii.2010., Host: *I. crenata*, 14.iii.2010 (ex larva); 2 exs, Kōchi–bashi, Shorenji, 14.ii.2011, Host: *I. pedunculosa*, 5.ii.2010 (ex larva).

Biology. Kumata (1998), Sato and Kumata (2011) detailed the biology of this species. In the present study, we newly recorded the length and/or width of mines, larvae, and cocoon folds. We observed the larvae on the above three hostplants forming serpentine mines on the adaxial epidermis; whitish to ocherous, 20~ cm in length, ~0.7–4.0 mm in width; frass line: ocherous to blackish, ~0.5–1.0 mm in width; usually 1–2 mines per leaf. The mines on *Ilex crenata* often covered all of the adaxial epidermis of the leaf. The late instar larva is 5.4–6.0 mm long and yellow in coloration. A pupal cocoon fold (white to brown, 7.0 mm in length, 1.3–2.6 mm in width) is situated at the end of the mine, and usually along leaf margins.

***Eumetriochroa hiranoi* Kumata, 1998**
Fig. 19.

Eumetriochroa hiranoi Kumata, 1998: 96–99, figs 5(C), 12(G, H), 14(E), 25(C, D). Type locality: Japan (Okinawa).

Pupa. (Fig. 19). Ochreous to brown, 2.3–2.7 mm in length, 0.3–0.4 mm in diameter. Vertex with a triangular frontal process (Fig. 19B, E, F). Clypeus with a pair of long setae, about twice length of frontal process (Fig. 19A, B, D). Dorsum of A2–A8 with a concentration of small spines in anterior portion (Fig. 19G, H). Plate-like A10 furcated with a pair of short processes from caudal apex, with small acute processes at apex (Fig. 19I–L). another pair of short acute caudal ones laterally (Fig. 19I, K).

Host plant. *Styrax japonicus* Siebold & Zucc. in Japan, Styraceae (Kumata 1998).

Distribution. Japan (Honshu, Kagoshima (Amami Is.) and Okinawa Prefectures) (Kumata 1998).

Specimens examined. 16 exs.

Adults: Host: *Styrax japonicus*]: 1 ex, Konagao, Soni, Uda, Nara, 18–26.x.2009 em., S. Kobayashi, 26.ix.2009 (ex larva); [Hikosan, Fukuoka, H. Kuroko leg.]: 4 exs, 28.vi.1954.; 2 ex, Same locality, 18.iv.& 24.iv.1955., H. Kuroko; 4 exs, Nagakumo–toge, Amami–Ohshima, Kagoshima, 18–19.x.2010 em., S. Kobayashi & T. Fujisawa, 5.x.2010 (ex larva); 3 exs, Takeda, Ishigaki Is., Okinawa, 25, 28, 31.iii.2011., S. Kobayashi, 16–17.iii.2011 (ex larva).

Pupae: 6exs.

[Host: *Styrax japonicus*]: 2 exs, Amami–Ohshima, Kagoshima, 23.x.2010 em., S. Kobayashi & T. Fujisawa, 4.x.2010 (ex larva); 2 exs, Takeda, Ishigaki Is., Okinawa, 25.iii.2011., S. Kobayashi, 17.iii.2011 (ex larva), 2 exs, Mt. Sumitsuka, Konagao, Soni, Nara, 20–21.vii.2011., S. Kobayashi, 17.vii.2011 in OPU.

Biology. Kumata (1998) reported the biology of this species. In the present study, we newly recorded the length and/or width of mines and larvae. We observed the larvae on *Styrax japonicus* forming long linear, irregularly curved mines on the adaxial epidermis; whitish, 15~ cm in length, 2.0~ mm in width; frass line: pale yellow to brown, ~1.0–2.0 mm in width; usually one mine per leaf. The late instar larva is 3.0–5.0 mm long and yellow in coloration.

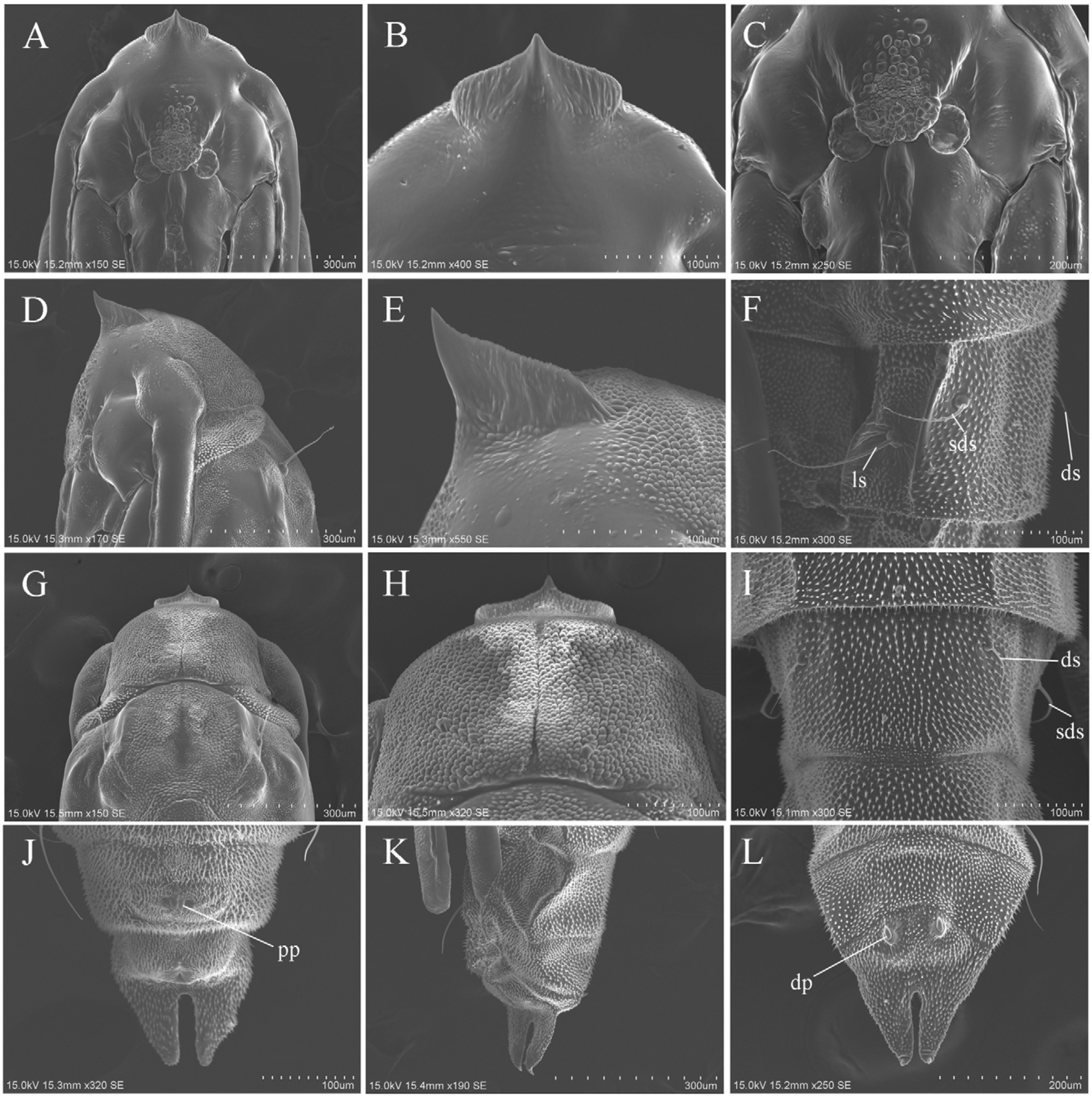


FIGURE 14. Pupa of *Metriochroa symplocosella* sp. nov.. A. Head, ventral view. B. Cocoon cutter, ventral view. C. Frons. D. Head, lateral view. E. Cocoon cutter, lateral view. F. Spines on 6th abdominal tergum, lateral view. G. Head, dorsal view. H. Cocoon cutter, dorsal view. I. Spines on 7th abdominal tergum. J. A8–A10, ventral view. K. lateral view. L. dorsal view. ds: dorsal seta; sds: subdorsal seta; ls: lateral seta; dp: dorsal process of cremaster; pp: perianal process.

Corythoxestis tricalysiella Kobayashi, Huang & Hirowatari sp. nov.

Figs. 2I–J, 6, 11.

Diagnosis. All *Corythoxestis* species possess a forewing without vein M_3, CuA_1 and CuA_2 (Fig. 6A). The forewing pattern of fresh specimens of this species is easily distinguished from other species by the costal and dorsal whitish spots and lustrous white apical line (Fig. 2J). However, in damaged specimens, this can be difficult to distinguish from other species with dark fuscous forewings. The genital structure of this species is similar to that of *C. cyanolampra* Vári, but it is distinguished from the latter by slender short valva and needle-shaped aedeagus in the male genitalia (Fig. 6C, D) and a small spinal signum on the corpus bursae in the female genitalia (Fig. 6F).

Adult. (Fig. 2I, J) Wing expanse 6.6 mm in holotype, 6.8, 7.0 mm in paratypes. Frons and vertex dark fuscous to grey-purple. Palpi ochreous to blackish brown; labial palpus mixed with blackish scales; maxillary palpus ochreous. Antennae about 9/8 of forewing, dark fuscous annulated with fuscous to whitish grey. Thorax dark fuscous to grey-purple. Abdomen and anal tuft dark fuscous. Forewing: dark fuscous to greyish-purple with whitish spots; three triangular costal spots: first at 1/4, second at 1/2, third at 3/4; two triangular dorsal spots: one at 1/3, another at 2/3;. cilia dark fuscous to black; lustrous white apical line mixed with fuscous scales. Hindwing dark grey; cilia dark grey to black. Wing venation (Fig. 6A, B).

Male genitalia (Fig. 6C–E). Tegumen membranous pyriform, about twice length of valva, without lateral arms connected with vinculum, with a concentration of very long setae laterally on both sides. Vinculum tightly united with valvae and a well developed saccus; Fultura superior horn-shaped, strongly sclerotized, slightly curved to caudal apex; basally united valvae short, slender, basally broadened, with fine setae on apical area; saccus about 1/2 length of aedeagus, tapering apically. Aedeagus needle-shaped, sharpened apically and thickened basally, slightly curved. Eight abdominal segment weakly sclerotized, glabrous, without any lobe at ventrum.

Female genitalia (Fig. 6F). Apophysis anterioris slender, as long as apophysis posterioris. Ostium bursae crescent-shaped, surrounded by a circular genital plate. Antrum sclerotized, tubular, slightly curved. Corpus bursae oblong, membranous, with a small, well screlotized, spinal signum at anterior part.

Pupa. Not examined.

Host plant. *Tricalysia dubia* (Lindl.) Ohwi (Rubiaceae).

Distribution. Japan (Okinawa Prefecture (Ishigaki Is.)).

Specimens examined

Type material. 3 (2♂ 1♀).

Adults: Holotype ♂, Japan: Maesato, Ishigaki Is., Okinawa, 16.v.2012 em., S. Kobayashi, K. Nakatsuka, T. Yoshida & T. Hirowatari leg., Host: *Tricalysia dubia*, 11.v.2012 (ex pupa) (genitalia slide no. OPU-SK400) in OPU. Paratypes 1♂ 1♀. Same locality and host plants as holotype, 13&18.v.2012 em., 11.v.2012 (exs pupa and larva) (SK399 and SK401) in OPU

Etymology. The specific epithet, *tricalysiella*, is derived from the scientifc name of the host plant, *Tricalysia*.

Biology. The number of generations and the overwintering stage have not yet been established, because we have only one series of bred specimens. The larvae mine leaves of *Tricalysia dubia* forming a long serpentine and linear mine; white, about 180~ cm in length, 1–6 mm in width, with brownish to blackish frass line; 0.5–1.5 mm in width. The mines (Fig. 11A–D) were only found on the adaxial epidermis of leaves on relatively young trees (~1–2 m in tree-height), usually 1–3 mines per leaf. The later instar larva is ~6.5 mm long and yellow in coloration (Fig. 11F). The final instar is 5.2 mm long and yellow in coloration. A pupal cocoon fold (white to cream white, 12–15 mm in length, 5–6 mm in width) is situated at the end of the mine, usually along the leaf margins (Fig. 11G).

Corythoxestis sunosei (Kumata, 1998)

Figs. 2K, 12.

Cryphiomystis sunosei Kumata, 1998: 107–109, figs 10, 13(E, F), 15(C), 23(B), 27(A, B).
Corythoxestis sunosei: Kobayashi *et al*., 2011, 26–27, figs 1A–B, 2A–L, 3, 4. Type locality: Japan (Kagoshima).

Pupa. Creamy yellow, 3 mm in length, 0.5 mm in diameter. Vertex with a stout, triangular frontal process flanked by a pair of long spatulate, about 2 x longer processes with a hair on inner 2/3. Dorsum of A2–A10 with a pair of long setae, and anterior part with a concentration of small spines; A10 prominently furcated with a pair of slender, long, slightly curved acute processes from caudal apex; another pair of laterally curved, half as long as caudal ones, claw-shaped processes from dorsal side. (Kobayashi *et al.* 2011a, fig. 3).

Distribution. China (Kobayshi *et al.* 2011a), Japan (Nara and Okinawa Prefectures (new record), Kyushu (Kumata 1998)).

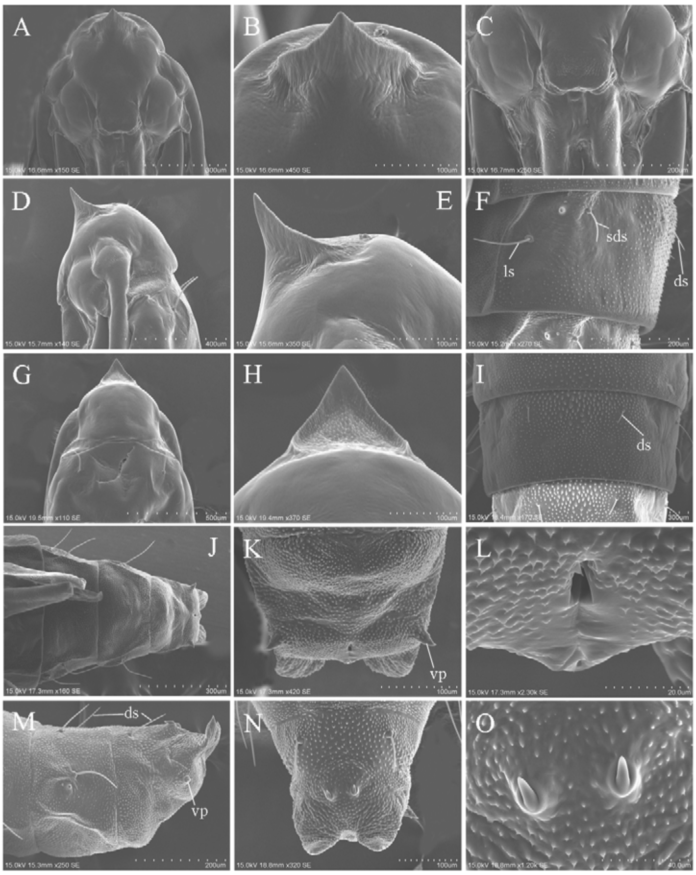


FIGURE 15. Pupa of *Metriochroa fraxinella* Kumata, 1998. A. Head, ventral view. B. Cocoon cutter, ventral view. C. Frons. D. Head, lateral view. E. Cocoon cutter, lateral view. F. Spines on 7th abdominal tergum, lateral view. G. Head, dorsal view. H. Cocoon cutter, dorsal view. I. Spines on 7th abdominal tergum. J. A7–A10, ventral view. K. Cremaster, ventral view. L. Anus. M. A8–A10, lateral view. N. Dorsal view. O. Caudal processes on A10, dorsal view. ds: dorsal seta; sds: subdorsal seta; ls: lateral seta; vp: ventral process of cremaster.

Host plant. *Adina pilulifera* (Lam.) Franch. ex Drake (new record), *Mussaenda esquirolii* H. Lév. (Kobayshi *et al.* 2011), *M. parviflora* Miq. (new record) and *Uncaria rhynchophylla* (Miq.) Miq. (Kumata 1998) (Rubiaceae).

Specimens examined. 25 exs.

Adults: Japan: [Host: *U. rhynchophylla*]: 3 exs, Kasuga–yama, Nara, 23.vii.1965 em., H. Kuroko, , 19.vii.1965; 1 ex, Mikata, Mitsushima, Tsushima Is., Nagasaki, 9.iv.2012 em., 27.iii.2012 (ex larva). 10 exs, Hyuga–line, Miyazaki, 6&16–22. x. 1964 em., H. Kuroko, Host: *Adina pilulifera*. [Host: *M. parviflora*]: 1 ex, Yona, Okinawa, 2.x.1989 em., H. Kuroko; 6 exs, Takeda, Ishigaki Is., Okinawa, 28.iii & 6–7.iv.2011 em., S. Kobayashi, 17.iii.2011 (ex larva); 4 exs, Yuwan, Uken, Amami, Kagoshima, 17–22.iii.2012 em., 6.iii.2012 (ex larva).

Biology. Kumata (1998) and Kobayshi *et al.* (2011) recorded the biology of this species on *Uncaria rhynchophylla* and *Mussaenda esquirolii*, respectively. In the present study, we observed the larvae on a new host plant, *M. parviflora* forming a narrow, serpentine mine; white to ocherous, about 20~ cm in length, 0.1~1.0–1.3 mm in width (Fig. 12A, B, J). A pupal cocoon fold (whitish, 5 mm in length, 1.0–1.5 mm in width) is situated at the end of the mine, usually along the leaf margins (Fig. 12M).

Corythoxestis yaeyamensis **(Kumata, 1998)**

Figs. 2L, 20.

Cryphiomystis yaeyamensis Kumata, 1998: 109–110, figs 11, 13(G, H), 15(D), 27(C, D). Type locality: Japan (Okinawa).

Pupa. (Fig. 13J, 20). Creamy yellow to darker yellow, 2.7 mm in length, 0.5 mm in diameter. Vertex with a triangular, laciniate, small frontal process (cocoon cutter) flanked by a pair of spatulate processes with a hair on inner apex (Fig. 20B, E). Dorsum of A2–A10 with a pair of thick setae, and with a concentration of small spines in patches; A3–A9 with two pairs of long, lateral setae (Fig. 20F, H, I). A10 with a pair of flat, digitiform, slightly curved processes projecting from lateral side (Fig. 20J, M); another pair of laterally curved, uncinate processes from dorsal side of lateral ones (Fig. 20O); a pair of short setae, as long as dorsal process from anterodorsal side of lateral ones (Fig. 20L, O).

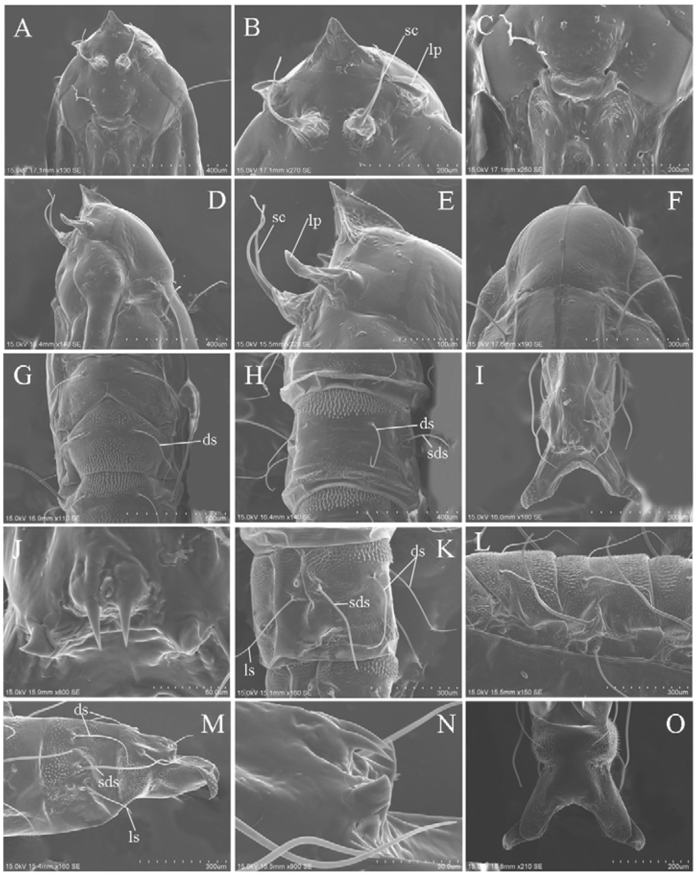


FIGURE 16. Pupa of *Guttigera schefflerella* sp. nov.. A. Head, ventral view. B. Cocoon cutter, ventral view. C. Frons. D. Head, lateral view. E. Cocoon cutter, lateral view. F. Head, dorsal view. G. Spines on 2nd abdominal tergum, dosal view. H. Spines on 6th abdominal tergum, tergum view. I. A7–A10, dorsal view. J. Caudal processes on A10, dorsal view. K. Spines on 6th abdominal tergum, dosal view. L. Spines on 2nd–3rd abdominal tergum, lateral view. M. A8–A10, lateral view. N. Caudal processes on A10, lateral view. O. A8–A10, ventral view. lp: lateral process of cocoon cutter; sc: seta of clypeus; ds: dorsal seta; sds: subdorsal seta; ls: lateral seta.

Distribution. Japan (Okinawa (Iriomote Is. (Kumata 1998), Ishigaki Is.).

Host plant. *Saurauia tristyla* DC. in Japan, Actinidiaceae (Kumata 1998).

Specimens examined. 7exs.

Adults: Japan: 7 exs, Maesato, Ishigaki Is., Okinawa, 13–17.v.2012 em., S. Kobayashi, K. Nakatsuka, T. Yoshida & T. Hirowatari leg. Host: *Saurauia tristyla*, 8.v.2012(pupa & larva).

Pupae: 5 exs, Maesato, Ishigaki Is., Okinawa, 19.v.2012., S. Kobayashi, K. Nakatsuka, T. Yoshida & T. Hirowatari, 8, 11.v.2012(pupa) in OPU.

Biology. Kumata (1998) recorded the biology of this species. In the present study, we newly recorded the length and/or width of the mine, larva, and cocoon fold. We observed the larvae on *Saurauia tristyla* forming a long serpentine mine on the adaxial epidermis; about 70~ cm in length, 0.3–1.2~ mm in width. The mines (Fig. 13A–E) are usually found at a density of 1–6 mines per leaf. The larva is 2.7–6.0 mm long and yellow in coloration (Fig. 13G). The final instar larva is 3.3~ mm long and yellow in coloration (Fig. 13H). A pupal cocoon fold (whitish and blackish in the middle, 6.5–7.0 mm in length, 1.2–2.0 mm in width) is situated at the end of the mine (Fig. 13I).

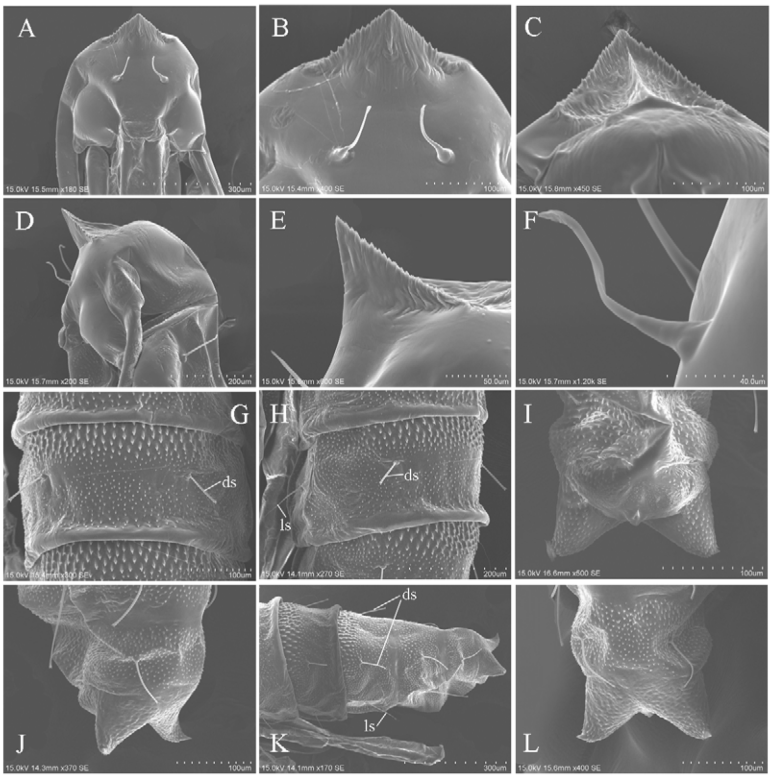


FIGURE 17. Pupa of *Eumetriochroa araliella* sp. nov.. A. Head, ventral view. B. Cocoon cutter, ventral view. C. Cocoon cutter, dorsal view. D. Head, lateral view. E. Cocoon cutter, lateral view. F. Seta of clypeus. G. Spines on 6th abdominal tergum. H. Lateral view. I. A8–A10, ventral view. J. lateral view. K. A6–A10, lateral view. L. A8–A10, dorsal view. ds: dorsal seta; ls: lateral seta.

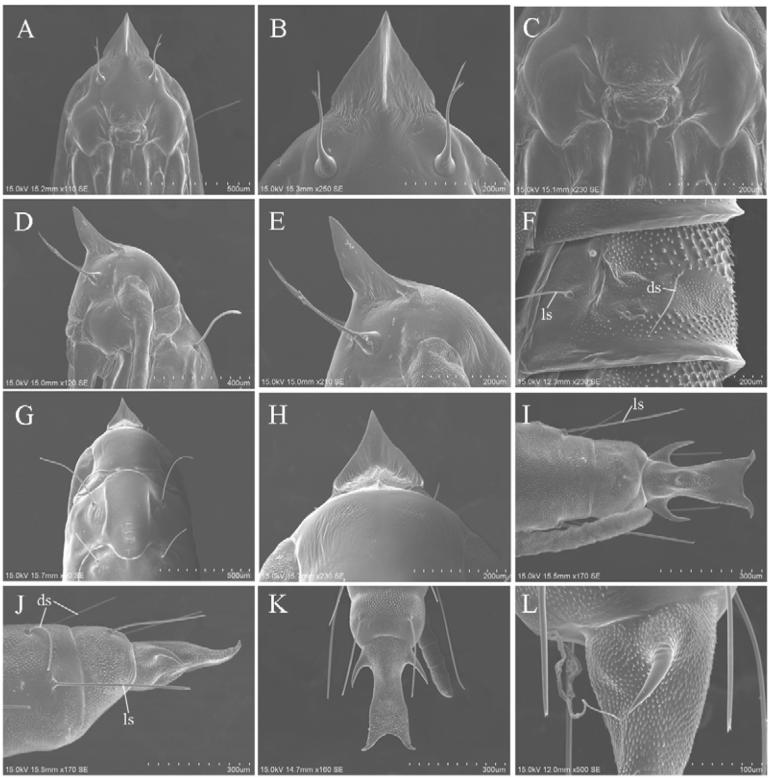


FIGURE 18. Pupa of *Eumetriochroa miyatai* Kumata, 1998. A. Head, ventral view. B. Cocoon cutter, ventral view. C. Frons. D. Head, lateral view. E. Cocoon cutter, lateral view. F. Spines on 5th abdominal tergum, lateral view. G. Head, dorsal view. H. Cocoon cutter, dorsal view. I. A7–A10, ventral view. J. lateral view. K. Dorsal view. L. Dorsal process of cremaster, lateral view. ds: dorsal seta; ls: lateral seta.

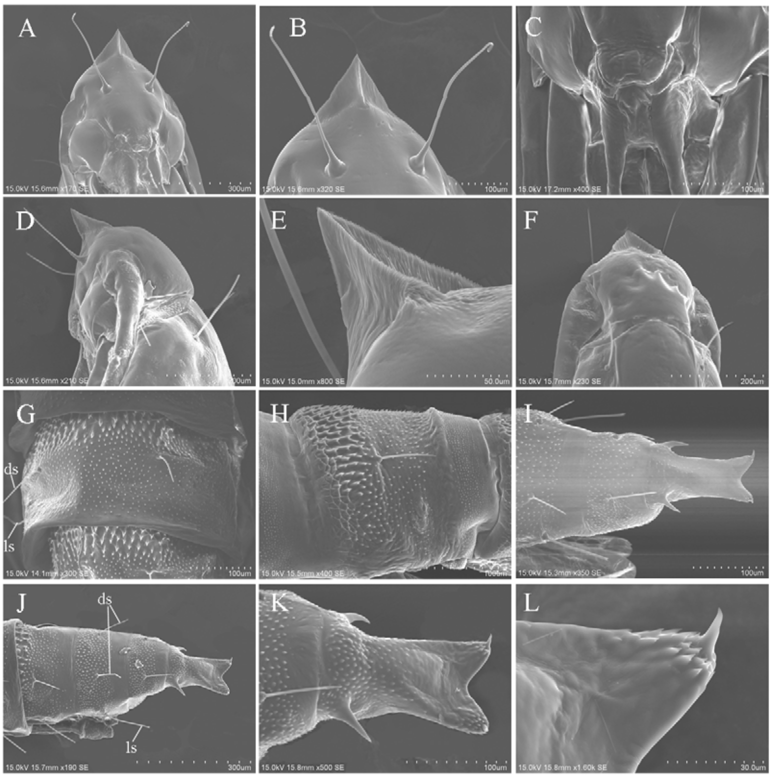


FIGURE 19. Pupa of *Eumetriochroa hiranoi* Kumata, 1998. A. Head, ventral view. B. Cocoon cutter and pair of setae of clypeus, ventral view. C. Frons. D. Head, lateral view. E. Cocoon cutter, lateral view. F. Head, dorsal view. G. Spines on 6th abdominal tergum. H. lateral view. I. A8–A10, ventral view. J. lateral view. K. Dorsal view. L. Acute process of cremaster. ds: dorsal seta; ls: lateral seta.

Discussion

Kobayashi *et al.* (2011a) noted that three pupal characters, 1) frontal process (cocoon cutter); 2) tergal spines; and 3) cremaster, might provide a useful diagnosis among species of *Corythoxestis*, *Eumetriochroa* and other genera in the Oecophyllembiinae and *Phyllocnistis*.

The pupal morphology of *Guttigera* Diakonoff has not been described and that of five genera of Oecophyllembiinae have been described only from one species in each genus (*Angelabella*: Vargas & Parra 2005; *Prophyllocnistis*: Davis 1994; *Metriochroa*: Patočka & Turčáni 2005; *Eumetriochroa* and *Corythoxestis*: Kobayashi *et al*. 2011a). Several authors have described pupal morphologies of twelve *Phyllocnistis* species with scanning electron micrographs (Liu & Zeng 1985, 1989; Kawahara *et al.* 2009; Davis & Wagner 2011; Kobayashi *et al*. 2011b; Kobayashi & Hirowatari 2011).

In the present study, we add information on pupal characters of seven species: two *Metriochroa,* one *Guttigera,* three *Eumetriochroa* and one *Corythoxestis* species. Below we provide diagnostic differences of Oecophyllembiinae species (Table 1) and compare pupal characters among six genera of Oecophyllembiinae and the genus *Phyllocnistis*.

1) Oecophyllembiinae species except for *Metriochroa symplocosella* and *M. fraxinella*, have the frontal process (cocoon cutter) flanked by two lateral processes or with paired setae on the clypeus. *Guttigera schefflerella* and two *Corythoxestis* species have the frontal process flanked by two lateral processes (Fig. 16E, 20B, E; Kobayashi *et al*. 2011a, fig. 3B, E). *Angelabella tecomae* (Vargas & Parra 2005, figs. 7B, C) has two long strong setae at the same position. Additionally, *Corythoxestis* species have a pair of setae on the lateral processes. *Metriochroa* and *Eumetriochroa* species have a simple triangular cocoon cutter without lateral processes. Three *Eumetriochroa* species and *E. hederae* (Kobayashi *et al.* 2011) have a pair of setae arising from the clypeus. *Prophyllocnistis epidrimys* (Davis 1994, fig. 37, 38) has two long clavate setae at the same position. *Metriochroa*

latifoliella (Patočka & Turčáni 2005, fig. 25(27, 29)) and *Guttigera schefflerella* also have paired setae on the clypeus. *Phyllocnistis* species have a simple triangular cocoon cutter without lateral processes or setae on the clypeus (e.g. Kobayashi *et al*. 2011b, fig 8C, K).

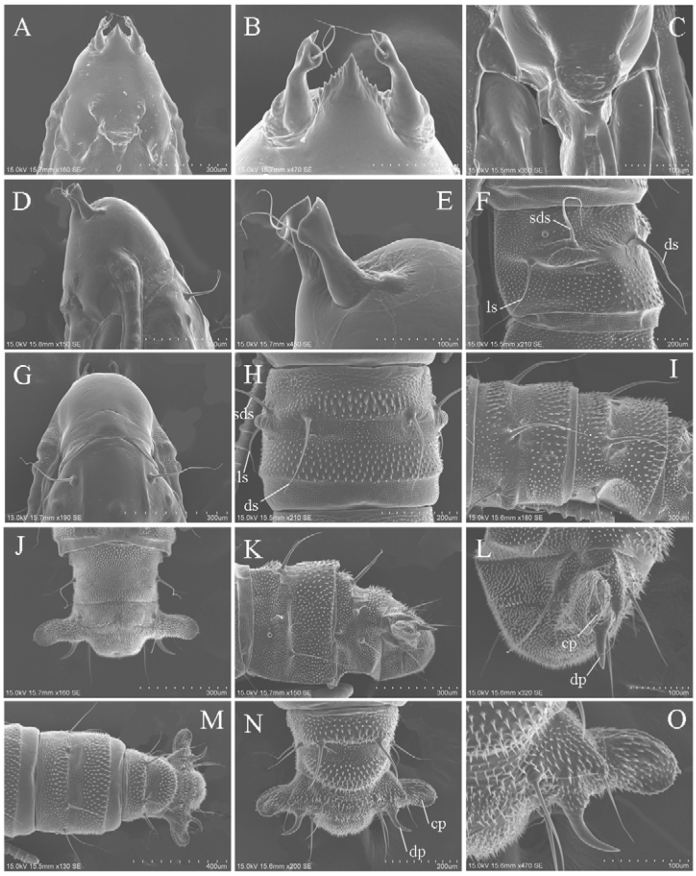


FIGURE 20. Pupa of *Corythoxestis yaeyamensis* (Kumata, 1998). A. Head, ventral view. B. Cocoon cutter, ventral view. C. Frons. D. Head, lateral view. E. Cocoon cutter, lateral view. F. Spines on 6th abdominal tergum, lateral view. G. Head, dorsal view. H. Spines on 6th abdominal tergum, dorsal view. I. Spines on 6–7th abdominal tergum, lateradorsal view. J. A7–A10, ventral view. K. Lateral view. L. A10, lateral view. M. A7–A10, dorsal view. N. A10, dorsal view. O. Caudal processes on A10. cp: caudal process of cremaster; dp: dorsal process of cremaster. ds: dorsal seta; sds: subdorsal seta; ls: lateral seta.

2) All species of the genera of Oecophyllembiinae have tergal spines with only a pair of dorsal setae on the abdominal segments (e.g. figs 14I, 16G–H, K, M, 19G, J, 20F, H) while *Phyllocnistis* species have not only a pair of short setae but also a pair of spines (fig. 21G, I–J; e.g. Kobayashi & Hirowatari 2011, figs. 7G, 8G; Davis & Wagner 2011, figs. 6C, 12D, 14C).

3) All species of the genera of Oecophyllembiinae have a cremaster with more than two pairs of caudal processes (ventral processes: figs 14J, 15K; dorsal processes: figs 14L, 15N, 16I–J, 18K, 19K, 20N). The characters of the processes on the dorsal side are valuable for defining or identifying each genus or species. *Metriochroa* species have two pairs of caudal processes in addition to ventral (perianal) processes. *Phyllocnistis* species have a cremaster with only a pair of caudal processes (e.g. Kobayashi & Hirowatari 2011, figs. 7K, 8K).

In conclusion, the pupal characters described above, particularly the cocoon cutter and cremaster, are shown to be one of the most useful morphological sources of diagnostic characters among species and genera in the Oecophyllembiinae and *Phyllocnistis.* Our preliminary data suggest Oecophyllembiinae species have three valuable diagnostic pupal characters: 1) cocoon cutter with unique lateral processes or setae on the clypeus, 2) tergal spines with only a pair of setae, and 3) cremaster with more than two pairs of caudal processes, while *Phyllocnistis* species possess 1) a cocoon cutter without processes or setae, 2) tergal spines with a pair of setae and hooks, and 3) a cremaster with only a pair of processes.

TABLE 1. Pupal diagnostic features of Oecophyllembiinae and *Phyllocnistis* species

		Head		Abdominal segments 2-7			Cremaster		
Species name	Host plant	Frontal processes of cocoon cutter	Paired setae of clypeus	Paird dorsal setae	Paird dorsal hooks	Arrangement of concentration of small spines	Paired caudal processes	Paired dorsal processes	Paired ventral processes
Metriochroa symplocosella sp. nov.	*Symplocos anomala, S. sumuntia,* (Symplocaceae)	stout spade-like	absent	shrot	absent	allover	digitiform	small, conical anteriorly curved	very small, perianal
M. fraxinella	*Fraxinus* spp., *Fraxinus sieboldiana, Ligustrum japonicum, L. micranthum,* (Oleaceae)	small trianguler	absent	very short	absent	allover	short stick-shaped	small, conical anteriorly curved	short, stout, laterally curved
Guttigera schefflerella sp. nov.	*Schefflera octophylla* (Araliaceae)	triangular, flanked by a pair of horn-shaped processes	long, about 1.5x length of frontal process, with stout base	long	absent	anterior portion	Y-shaped	small, needle-shaped flanked by a pair of small stout processes	absent
Eumetriochroa araliaella sp. nov.	*Dendropanax trifidus, Evodiopanax innovans, Eleutherococcus sciadophylloides, Fatsia japonica* (Araliaceae)	short, triangular	short	short	absent	anterior portion	beak-shaped	absent	absent
E. hederae†	*Hedera rhombea, H. nepalensis* var. *sinensis* (Araliaceae)	spade-like	short, on the under part	short	absent	allover	digitiform	small, conical anteriorly curved,	absent
E. miyatai	*Ilex crenata, I. pedunculosa, I. rotunda* (Aquifoliaceae)	steepled*	same length of frontal process, branched 2/3	short, long on A7	absent	anterior portion	plate-like A-10 with short claw-shaped one	laterally, long*, half-crescent-shaped	absent
E. hiranoi	*Styrax japonicus* (Styraceae)	triangular	long, about 2x length of frontal process	short	absent	anterior portion	plate-like A-10 with short processes	laterally, short, acute	absent
Corythoxestis sunosei†	*Adina pilulifera, Mussaenda esquirolii, M. parviflora, Uncaria rhynchophylla* (Rubiaceae)	stout, triangular, flanked by two processes with a pair of setae	absent	very long, stout base	absent	anterior portion	Slender, long, slightly curved acute	Claw-shaped, laterally curved, half as long as caudal ones	absent
C. yaeyamensis	*Saurauia tristyla* (Actinidiaceae)	small, triangular, laciniate, flanked by two processes with a pair of setae	absent	long, thick	absent	streaky	flat, digitiform, projecting to lateral side	laterally curved, uncinate	absent
*Angelabella tecomae***	*Tecoma fulva* (Cav.) G. Don and *T. stans* (L.) Juss. ex Kunth (Bignoniaceae)	subpyramidal, serrated lateral margins, flanked by two strong setae, 1.5x length of frontal process	absent	short	absent	anterior portion	long, conical acute at apex	present, but no figure or illustraition	absent
Prophyllocnistis epidrimys‡	*Drimys winteri* fo. *andina* and *D. winteri* var. *chilensis* (Winteraceae)	stout, elongate, acute	long, clavate	short, long on A9	absent	allover, with largest spines anteriorly	prominently furcate	small, tubercule-shaped	absent
Metriochroa latifoliella§	*Olea europaea, Phillyrea angustifolia, P. latifolia, Phillyrea* sp. (Oleaceae)	oblong, acute, steepled	same length of frontal process	long	absent	allover	slender, digitiform	small, anteriorly curved	developed, laterally curved
Phyllocnistis unipunctella¶	*Populus* spp. (Salicaceae)	developed, curved, spine-like	absent	very short	In 2 rows, with a paired laterally curved hooks	centrally	short, conical	absent	absent
P. citrella	*Aegle marmelos, Citrus* spp. *Fortunella* spp., *Murraya koenigii* and *Poncirus trifoliata* (Rutaceae)	slightly dorsally curved, spine like with projected lateral margins	absent	very short	In 2 rows, only on A6–7 with a paired laterally curved hooks	small omly on A2–4	short, bulbiform	absent	absent

*Sato & Kumata (2011); †*E. hederae* and *C. sunosei* after Kobayashi *et al.* (2011); **Vargas & Parra (2005); ‡(Davis 1994); §Patočka & Turčáni (2005); ¶Lűders (1900), *P. unipunctella* is type species of the genus.

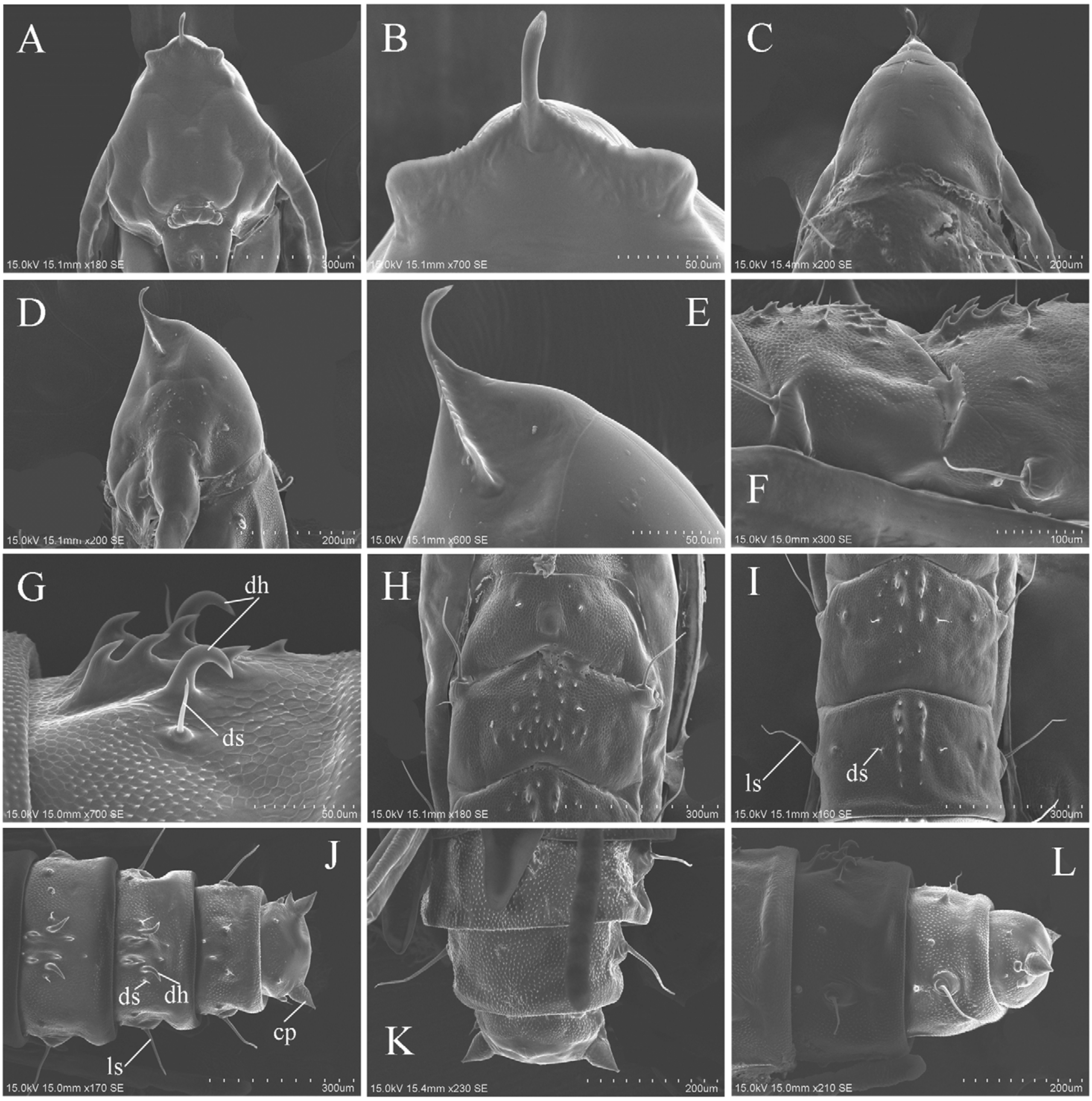


FIGURE 21. Pupa of *Phyllocnistis citrella* Stainton, 1856. A. Head, ventral view. B. Cocoon cutter, ventral view. C. Head, dorsal view. D. Head, lateral view. E. Cocoon cutter, lateral view. F. Spines on second to 3th abdominal tergum, lateral view. G. Spines on 7th abdominal tergum, lateral view. H. A1–2, dorsal view. I. A3–4, dorsal view. J. A6–A10, dorsal view. K. A7–A10, ventral view. L. A7–A10, lateral view. dh: dorsal hook; ds: dorsal seta; ls: lateral seta; cp: caudal process of cremaster.

Acknowledgements

We express our special thanks to Dr. J. De Prins (Royal Museum for Central Africa, Belgium), and an anonymous reviewer for their critical reading of the manuscript. We also express our special thanks to Dr H. Kuroko (Kishiwada, Osaka) for his valuable material and kind assistance. We also thank Mr. Qi Gu and Zhi-Rong Gu (Badagongshan National Nature Reserve, China) for providing help in the field and for identifying host plants. We wish to express cordial thanks to Prof. M. Ishii and Dr N. Hirai (Entomological Laboratory, OPU) for their valuable suggestions. Sir Anthony Galsworthy kindly corrected the language of the manuscript. This research was supported by the China Postdoctoral Science Special Foundation (2012T50695) and partly by the Research Fellowships of the Japan Society for the Promotion of Science (JSPS) for Young Scientists (DC1, 1081000108).

The first author (Kobayashi) wishes to express his cordial thanks to Mr. R. Osada (OPU) for providing material and the members of the Entomological Laboratory (OPU) for their kind advice and help. He also thanks Mr. Y. Kobayashi (Soni, Nara) and Mr. S. Yamaguchi (Nabari, Mie), Mrs M. Kobayashi (Soni, Nara), Mrs N. & H. Sugimoto and T. Miyata (Nabari, Mie), and his family for providing habitat information on host plants and/or facilities for his fieldwork.

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