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A new genus of anthophilous drosophilids, *Impatiophila* (Diptera, Drosophilidae): morphology, DNA barcoding and molecular phylogeny, with descriptions of thirty-nine new species

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Table of contents

Abstract

Breeding habits of essential dependence on flowers for larval food resources have evolved repeatedly in separate lineages of the Drosophilidae. However, flowers of *Impatiens* L. have never been recognized as hosts for drosophilid flies until recently: two *Hirtodrosophila* species, *H. actinia* (Okada) and *H. yapingi* Gao, were found feeding and breeding on *Impatiens* flowers. During our recent field surveys in central and southern China, a great number of drosophilid flies morphologically resembling the two species were collected, almost exclusively from flowers of *Impatiens* (family Balsaminaceae) and the family Gesneriaceae. In the present study, these specimens were identified on the basis of morphological characters and/or partial DNA sequences of the mitochondrial *COI* (cytochrome *c* oxidase subunit I gene, used as a barcoding marker). As a result, 39 new species were recognized. We then reconstructed the phylogenetic relationships among most of them, based on concatenated DNA sequences (3047 nucleotide sites) of two mitochondrial (*COI* and *COII*, i.e., cytochrome *c* oxidase subunits I and II, respectively) and three nuclear genes (*ATPsyn-alpha*, *alphaTub84B* and *Hsc70cb*, i.e., ATP synthase alpha, alpha-Tubulin at 84B and Hsc70Cb isoform H, respectively). In the resulting Bayesian and ML (maximum likelihood) trees, three well-supported clades were recognized, with a few species having remained uncertain for their phylogenetic positions. We also conducted a cladistic analysis with data of adult morphological characters to investigate the phylogenetic positions of a few species of which DNA sequence data were not available, and to investigate the classification of species groups with definition of their diagnoses. In consequence, we established a new genus, *Impatiophila*, for the species visiting flowers of *Impatiens* and Gesneriaceae, described all the new species, and revised the taxonomy of some known species.

Key words: China; Gesneriaceae; Grafting analysis; *Impatiens*; Species group; Taxonomy

Introduction

The family Drosophilidae has repeatedly evolved to use various kinds of flowers as breeding resources (Brncic, 1983). Studies on flower-breeding drosophilids help investigators to integrate microenvironmental factors in the flowers with genetic ones in the flies. Adaptations to such restricted ecological niches have evolved in a number of species from quite different lineages in the Drosophilidae (Brncic 1983; Grimaldi *et al.* 2003). However, it had never been known until recently that flowers of *Impatiens* L. (Balsaminnaceae) were used as hosts for some drosophilids.

Gao (2011) described the flower-visiting species *Hirtodrosophila yapingi*, and reported its feeding and breeding habits on living flowers of *Impatiens tayemonii* Hayata. Toda (unpublished data; see the "Taxonomic account" section for details) observed similar behavior of *Hirtodrosophila actinia* (Okada, 1991) on flowers of *Impatiens uniflora* Hayata even earlier, in Taiwan, China. These species morphologically resemble

Hirtodrosophila limbicostata described from East Nepal by Okada (1966). Okada (1966) assigned it to the fungivorous *Hirtodrosophila* Duda (a subgenus of *Drosophila* Fallén at that time), because it has only one ventral branch of arista and resembles *H. hirticornis* de Meijere in the cheek width and the wing color pattern. Okada (1991) and Gao (2011) followed this classification, assigning the two species that breed on *Impatiens* flowers to *Hirtodrosophila*. However, Okada (1966) remarked the morphological peculiarity of *H. limbicostata* in "having strong costal bristles ending before end of R_{2+3}" among species of the Drosophilidae. In addition, the type specimen of *H. limbicostata* was collected from "mixed plants by damp cliff in deep river gorge". Such a habitat is typical for *Impatiens* host plants of *H. yapingi* and *H. actinia*.

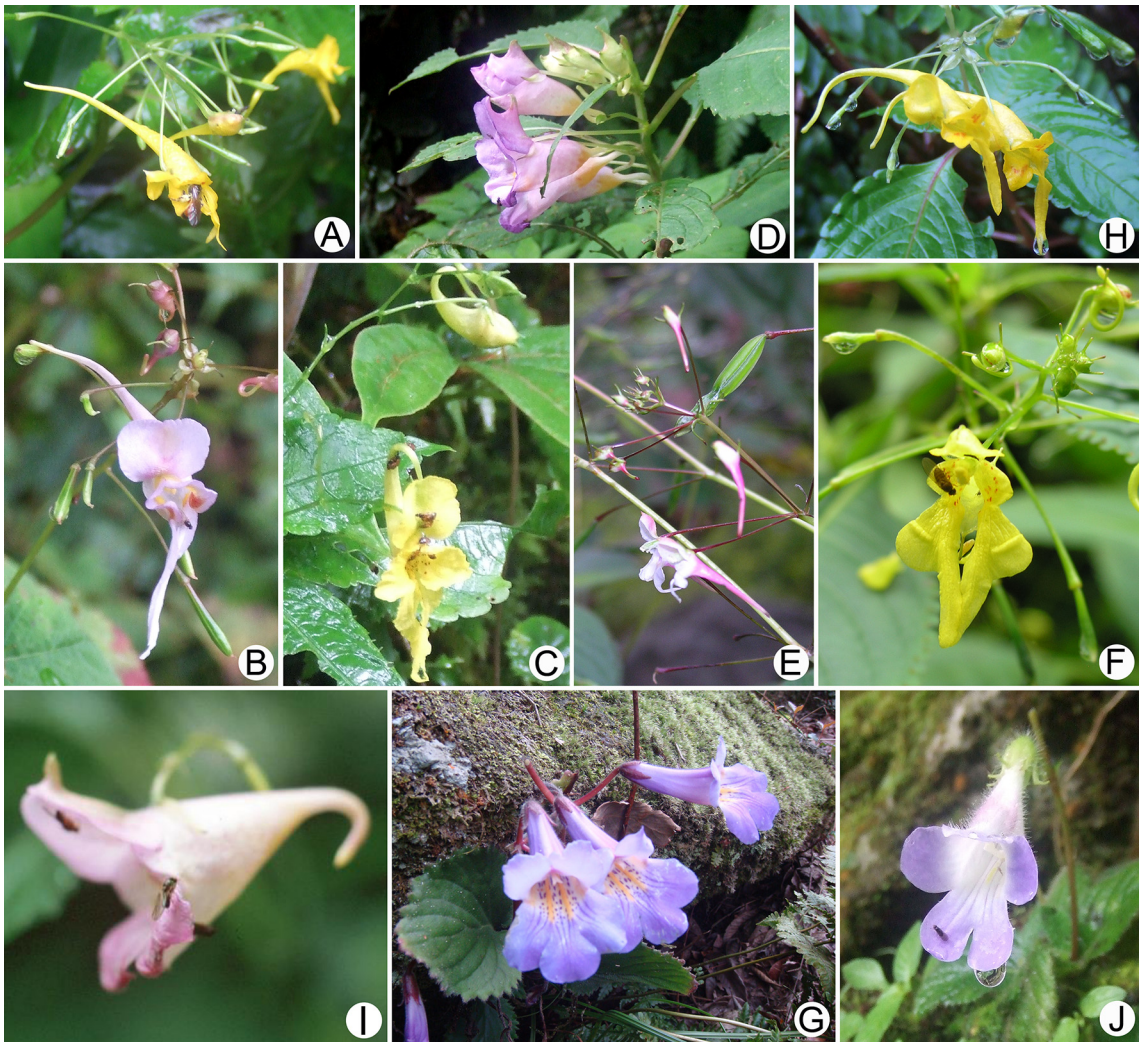

FIGURE 1. Flowers from which some of the BVD (*Impatiophila* gen. nov.) flies employed in the present study were collected. Sites of photographing are given in parentheses (see Fig. 2 for detailed information about each site). A, *Impatiens siculifer* Hook. f. (site 3); B, *Impatiens* sp. aff. *bahanensis* Hand.-Mazz (site 2); C, *Impatient desmantha* Hook. f. (site 1), D, *Impatiens arguta* Hook. f. et. Thoms. (site 4); E, *Impatiens radiata* Hook. f. (site 10); F, *Impatiens racemosa* (site 17); G, Gesneriaceae sp.1 (site 22); H, *Impatiens siculifer* Hook. f. (site 6); I, *Impatiens uniflora* Hayata (site 23); J, Gesneriaceae sp.2 (site 6).

During our field surveys in the recent years in central and southern China, we paid careful attention to flowering plants of *Impatiens*, and found much more drosophilid species morphologically similar to *H. limbicostata*, *H. actinia* and *H. yapingi*. Most of these flies were found aggregating on *Impatiens* flowers, or flowers of the family Gesneriaceae (Fig. 1). In addition, a small fraction of specimens were recently collected from flowers of the family Acanthaceae, but they were not included in this study. Furthermore, by surveying the taxonomic literature of the Old World (especially the Oriental Region) drosophilids, three species described from India by Gupta & Singh (1981) and Gupta & Gupta (1991) were found to be similar to these species: *Drosophila paralongifera* Gupta & Singh, *D. ovilongata* Gupta & Gupta and *D. sikkimensis* Gupta & Gupta. Gupta & Gupta (1991) mentioned that the last two species were associated with flowers of the family Leguminosae.

All the above-mentioned flies are morphologically similar to each other, but distinct from any known genera/

subgenera in the Drosophilidae. Their close association with flowers, especially of *Impatiens*, has never been observed in other drosophilids. These suggest that the flies represent a distinct group (tentatively named "balsamine-visiting drosophilids", or "BVDs" in abbreviation) in the Drosophilidae. In a molecular phylogenetic study of the Drosophilidae, Yassin (2013) included one BVD species collected from Guangxi, China, which was misidentified as *H. actinia* (correctly *Impatiophila pipa* sp. nov. to be described in the present paper). This species was placed as the sister to *Lissocephala* Malloch in the basal clade, the tribe Colocasiomyini Okada revised by Yassin (2013) as comprising the genera *Lissocephala*, *Scaptodrosophila* Duda, *Phorticella* Duda, *Chymomyza* Czerny, *Colocasiomyia* de Meijere and *Neotanygastrella* Duda, of the subfamily Drosophilinae.

In this study, we determine species delimitation for the BVD species collected by us from China and the above-mentioned, related, known species, based on morphological characters and/or partial DNA sequences of the mitochondrial *COI* (cytochrome *c* oxidase subunit I) gene, and reconstruct their phylogeny by integrating morphological data and DNA sequence data of two mitochondrial and three nuclear genes. Based on the inferred phylogeny, we establish a new genus, *Impatiophila*, and three species groups for the BVDs, and describe all new species and revise taxonomic positions of the known species under this new classification framework.

Materials and Methods

Materials

All the fly samples/specimens employed in the present study are shown in Table 1. The specimens were mostly collected by directly aspirating from flowers of *Impatiens* and Gesneriaceae plants growing in forests, on forest edges, along streamside, on damp, shaded cliffs, or low-lying sites along forest-roads. Some of the specimens were captured incidentally by net sweeping, apparently due to the existence of host flowers nearby. Fig. 2 shows the collection sites of samples/specimens. The specimens were immediately preserved in 70% ethanol after collection.

TABLE 1. Specimens used for DNA sequencing in the present study.

Species*	Voucher #/collection site**				
	COI	*COII*	*ATPsyn-alpha*	*alphaTub 84B*	*Hsc70Cb*
I. acutivalva	00282/7, 00283/7, 00298/7, 00374/7, 00375/7, 00495/7, 00496/7, 00497/7, 00498/7, 00516/1, **00517**/7, 00518/7, 00549/7, 00550/7	00282/7	00517/7	00517/7	00517/7
I. aspidosternata	**00185**/22, 00186/22, 00193/22, 00195/22	00185/22	00185/22	00185/22	00185/22
I. bifurcata	**01127**/14, 01149/12, 02582/16	01127/14	01127/14	01127/14	01127/14
I. chiasmosternata	00090/9, 00092/9, 00100/9, 00101/9, **00102**/9, 00103/9, 00106/9, 01399/9, 01540/8, 01546/8, 01550/8, 01555/8	00090/9	000102/9	000102/9	01546/8
I. convergens	**00311**/2, 00540/2	00311/2	-	-	00311/2
I. curvivalva	00089/9, 00094/9, 00095/9, 00096/9, 00097/9, 00098/9, 00099/9, 00104/9, 00105/9, 00107/9, 00108/9, 00109/9, 00514/10, 01148/15, 01398/9, 01542/8, 01543/8, 01544/10, **01545**/10, 01547–9/8, 01551/8, 01552/8, 01554/8, 01556/8, 01557/13, 03720/17, 3721/17, 3723–6/17	000097/9	01554/8	01554/8	01554/8
I. epubescens	**00278**–81/7, 00548/7, 00553/7, 01387/7	00278/7	00278/7	00278/7	00278/7
I. eretmosternata	00310/1, **00515**/1	00515/1	00515/1	-	00515/1
I. forcipivalva	00309/1, 00542/1, **00312**/2, 03716/17	00312/2	00312/2	00312/2	00312/2
I. furcatosternata	**00272**/5, 00275/5, 00306/4, 00687/4	00272/5	00272/5	00272/5	00272/5
I. hutiaoxiana	**01541**/8	01541/8	01541/8	01541/8	01541/8
I. latipennata	00378/4, **00604**/3, 00608/3, 01200/6, 01524/6	00604/3	00604/3	00604/3	00604/3

...Continued on next page

TABLE 1. (Continued)

Species*	Voucher #/collection site**				
	COI	*COII*	*ATPsyn-alpha*	*alphaTub 84B*	*Hsc70Cb*
I. linzhiensis	**00543**/1	00543/1	00543/1	00543/1	00543/1
I. longifolia	**00321**/15, 00508/15, 00509/15, 00572/15, 01151/12, 01403/15, 01405/12	00321/15	00321/15	-	00572/15
I. magnimaculata	00544/11, 01147/13, 01553/8, **01569**–72/11	01569/11	01569/11	01569/11	01569/11
I. maoershanensis	**00176**/22, 00181/22, 01146/12, 02580/16	00176/22	00176/22	00176/22	00176/22
I. medivittata	**01558**/14	01558/14	01558/14	01558/14	01558/14
I. menba	00307/6, 00308/6, 00372/5, 00473/6, 00475/6, **00483**/4	00308//6	00483/4	00475/6	00483/4
I. menghaiensis	00397/14, 00398/14, 01124/14, 01125/14, 01402/14, 01438/14, 01440/14, 01441/14, 01559/14, **01562**/14, 01563/14	00397/14	00397/14	01562/14	00397/14
I. motuoensis	**00273**/5, 00274/5, 00373/5	00273/5	00273/5	00274/5	00273/5
I. pulla	01126/14	01126/14	01126/14	01126/14	01126/14
I. parvula	00270/3, 00271/3, **00300**/5, 00304/5, 00370/3, 00377/4, 00609/3, 01401/5	00270/3	00300/5	00377/4	00300/5
I. pipa	00113/15, **00202**/22, 00395/13, 01407/12, 01699/20, 03577/17	00202/22	01699/20	00202/22	00202/22
I. ptyonosternata	00296/7, 00297/7, **00313**/7	00296/7	00313/7	00313/7	00313/7
I. rhombivalva	**01198**/16, 02579/7, 02581/16, 03703/17	01198/16	01198/16	01198/16	01198/16
I. securiformis	00173/11, 00174/11, 00276/5, 00471/5, 00482/4, 00513/4, 01501/11, 01502/11, 01503/12, 01504/12, 01505/6, 01506/6, **01507**/6, 01564/12, 01565/12	00173/11	01507/6	01507/6	01507/6
I. taibaishanensis	**01700**/20, 02542/20	-	01700/20	01700/20	01700/20
I. tongmaiensis	**00294**/7, 00295/7, 00493/7	00294/7	00294/7	00294/7	00294/7
I. trifurcatosternata	00111/15, 00112/15, **00551**/15, 01388/15	00112/15	00112/15	00551/15	00112/15
I. truncivalva	**00302**/5, 00303/5, 00369/3, 00396/13	00302/5	00302/5	00302/5	00302/5
I. tumidivalva	**00376**/7	00376/7	00376/7	00376/7	00376/7
I. unicolorata	**01439**/14	01439/14	01439/14	01439/14	01439/14
I. viasericaria	**01406**/12, 3576/17, 3579/17, 3671/17, 3699/17, 3701/17, 3702/17, 3705–7/17, 3710–3/17, 3715/17, 3727/17, 3730/17, 3731/17	01406/12	01406/12	01406/12	01406/12
I. xiaoi	**00117**/10, 00125/10, 00126/10	00117/10	00117/10	00117/10	00117/10
I. yangi	**01566**/10, 01567/10, 03575/17, 03581/17, 03582/17	-	01566/10	01566/10	01566/10
I. yapingi	00115/10, **00116**/10, 00411/18, 00784/18	00115/10	00116/10	00116/10	00116/10
S. subtilis	**02548**/23	02548/24	02548/24	02548/24	02548/24
S. bryani	-	-	02543/25	02543/25	02543/25
S. dorsocentralis	**02544**/24	02544/26	02544/26	02544/26	-
L. sabroskyi	-	02546/27	02546/27	-	02546/27

* Species identification based on morphology and *COI* DNA sequences. ** Collection sites: for sites 1–23 in China, see Fig. 2; 24, Iwakura-agura-cho, Kyoto, Japan; 25, Pagat, Guam; 26, Hamamoto, T.F.W., Guam; 27, Bogor, West Java, Indonesia. Numbers underlined: specimens with registered barcodes; numbers in bold: specimens of which *COI* sequences were incorporated into concatenated sequences for molecular phylogenetic construction.

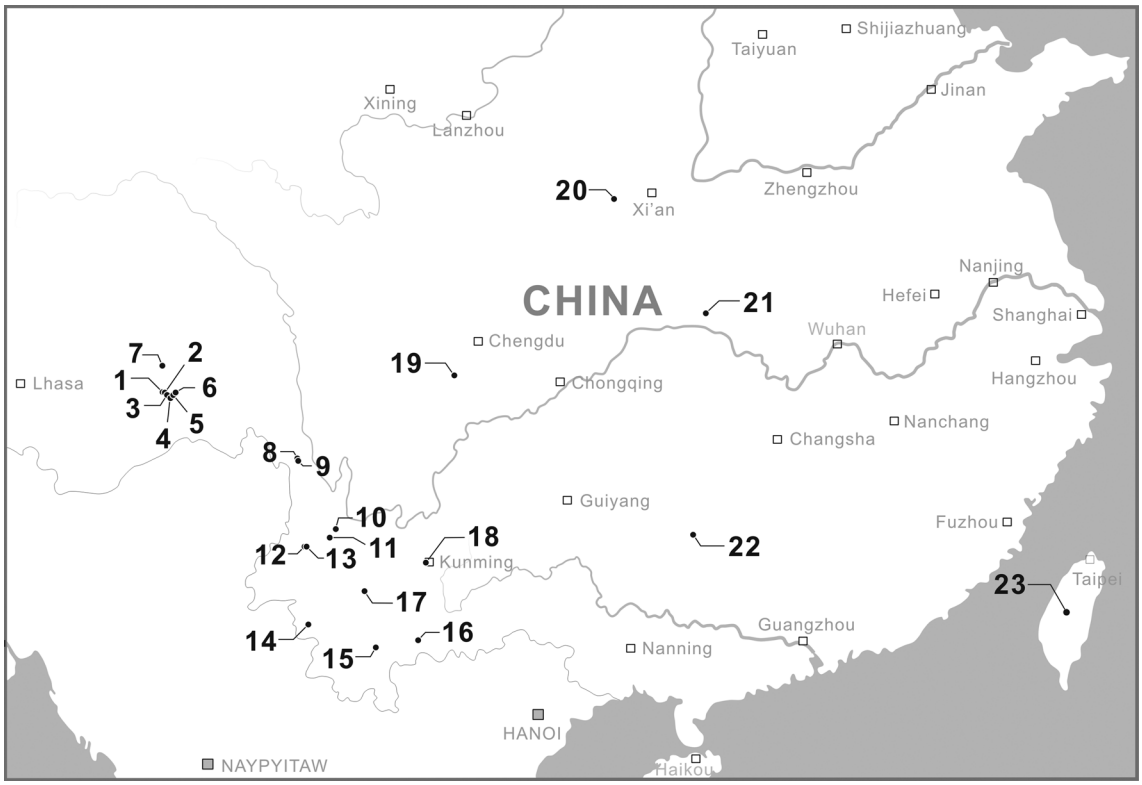

FIGURE 2. Collection sites. 1, along the way from Lage Village, Baiba Town, Linzhi County to Hanmi Village, Beibeng Town, Motuo County, Xizang; 2, Hanmi Village; 3, along the way from Hanmi to the seat of Beibeng Town; 4, the seat of Beibeng Town; 5, from the seat of Beibeng Town to Yarang Village, Motuo Town, Motuo County, Xizang; 6, from Yarang to the seat of Motuo County; 7, Tongmai Village, Yigong Town, Bomi County, Xizang; 8, Hutiaoxia Town, Shangri-la County, Yunnan; 9, Liangjiaren (site 2) in Hutiaoxia Town; 10, Cangshan National Nature Reserve, Dali, Yunnan; 11, Yangbi County, Yunnan; 12, Jiujiezi, Mt. Gaoligong, Baoshan, Yunnan; 13, Baihualing Village, Mangkuan Town, Longyang District; Baoshan, Yunnan; 14, Hesong Village, Xiding Town, Menghai County, Yunnan; 15, Yixiang Town, Simao District, Pu'er, Yunnan; 16, Mt. Huanglianshan, Luchun County, Yunnan; 17, Wenjing Town or Jinping Town, Jingdong County, Yunnan; 18, Qiongzhusi, Kunming, Yunnan; 19, Mt. E'mei, Emeishan City, Sichuan; 20, Haoping, Taibaishan National Nature Reserve, Shaanxi; 21, Shennongjia Forestry District, Shiyan, Hubei; 22, Maoershan National Nature Reserve, Guilin, Guangxi; 23, Chitou, Nantou, Taiwan, China.

Species delimitation based on morphological and DNA sequence data

Specimens were first roughly sorted by observing the external morphology, e.g., body color pattern, chaetotaxy on wing and legs, metric characters, etc., under a binocular stereoscopic microscope installed with an ocular micrometer, taking their geographical origins, habitats and host plants as well into account. Then, detailed structures of the male/female terminalia and the mouth part were examined to identify morpho-species. These organs of representative specimens were detached from their bodies, cleared in 10% KOH solution at 80°C for about 15−20 minutes, dipped into a drop of glycerol on a cavity glass slide, and then observed under a compound light microscope. If necessary, these cleared organs were microphotographed using a DinoLite® Digital Eyepiece Camera. In morphological description, we followed McAlpine (1981) for the terminology and Zhang & Toda (1992) for the definitions of measurements and indices (Table 2).

DNA sequences of *COI* were determined for representative specimens of morpho-species. Genome DNA was extracted using the TIANamp Genomic DNA kit (TIANGEN® Biotech) from the right hindleg in the case of intact specimens, or from small piece(s) of abdominal soft tissues in the case of terminalia-dissected specimens. We used Folmer *et al.*'s (1994) primer pair (Table 3) for PCR and sequencing of the *COI* fragment. The PCR products were separated on 2.0% agarose gels, and then purified using TIANamp Universal DNA purification kit (TIANGEN® Biotech). The purified products were subjected to sequencing on an ABI 3700 sequencer. The *COI* sequences were aligned with the ClustalW method implemented in MEGA5 (Tamura *et al.* 2011). Pairwise genetic distances among *COI* sequences were calculated, and an unrooted neighbor-joining (NJ) tree was constructed with the Kimura two-parameter (K2P) nucleotide substitution model in MEGA5.

Finally, species were delimited by integrating all available information, especially the *COI* phylogeny and morphological characters.

TABLE 2. Morphological measurements and indices applied to the present study, defined by Zhang & Toda (1992).

Measurement/index	Definition
BL (body length)	Straight distance from anterior edge of pedicel to tip of abdomen
ThL (thorax length)	Medial distance from anterior notal margin to apex of scutellum
WL (wing length)	Distance from humeral cross vein to wing apex
WW (wing width)	Maximum wing width
FW/HW	Frontal width / head width
ch/o	Maximum width of gena / maximum diameter of eye
prorb	Proclinate orbital seta / posterior reclinate orbital seta in length
rcorb	Anterior reclinate orbital seta / posterior reclinate orbital seta in length
orbito	Distance between proclinate and posterior reclinate orbital setae / distance between inner vertical and posterior reclinate orbital setae
vb	Subvibrissal seta / vibrissa in length
dcl	Anterior dorsocentral seta / posterior dorsocentral seta in length
presctl	Prescutellar seta / posterior dorsocentral seta in length
sctl	Basal scutellar seta / apical scutellar seta in length
sterno	Anterior katepisternal seta / posterior katepisternal seta in length
m-sterno	Mid katepisternal seta / posterior katepisternal seta in length
dcp	Distance between ipsilateral dorsocentral setae / distance between anterior dorsocentral setae
sctlp	Distance between ipsilateral scutellar setae / distance between apical scutellar setae
C	2nd costal section between subcostal break and R_{2+3} / 3rd costal section between R_{2+3} and R_{4+5}
4c	3rd costal section between R_{2+3} and R_{4+5} / M_1 between r-m and dm-cu
4v	M_1 between dm-cu and wing margin / M_1 between r-m and dm-cu
5x	CuA_1 between dm-cu and wing margin / dm-cu between M_1 and CuA_1
ac	3rd costal section between R_{2+3} and R_{4+5} / distance between distal ends of R_{4+5} and M_1
M	CuA_1 between dm-cu and wing margin / M_1 between r-m and dm-cu
C3F	Length of heavy setation in 3rd costal section / length of 3rd costal section

Molecular phylogenetic reconstruction

Phylogeny of 36 delimited BVD species was analyzed using concatenated sequences of five genes: two mitochondrial (*COI*; *COII*: cytochrome *c* oxidase subunit II) and three nuclear (*ATPsyn-alpha*: ATP synthase alpha; *alphaTub84B*: alpha-Tubulin at 84B; and *Hsc70cb*: Hsc70Cb isoform H). The primers used for PCR amplification and sequencing for these genes are shown in Table 3.

We conducted Bayesian and maximum likelihood (ML) phylogenetic analyses under partitioned models, using the software MrBayes 3.12 (Ronquist & Huelsenbeck 2003) and RAxML HPC (Stamatakis 2006), respectively. We used the index of substitution saturation (I_{ss}) of Xia *et al.* (2003) implemented in the DAMBE software version 5.2.13 (Xia & Xie 2001) to test the nucleotide substitution saturation for each of the data-subsets. The base composition homogeneity in each data-subset was tested using the software Statio (http://homes.bio.psu.edu/people/faculty/Nei/software.htm) that implements the method of Rzhetsky & Nei (1995) accounting for possible phylogenetic correlations.

TABLE 3. Primer sequences for PCR/sequencing

Target region	Primer name	Primer sequence (5'–3')	Reference
COI	LCO1490	GGTCA ACAAA TCATA AAGAT ATTG G	Folmer *et al.* (1994)
	HCO2198	TAAAC TTCAG GGTGA CCAAA AAATC	ditto
COII	COII-1	ATGGCAGATTAGTGCAATGG	O'Grady (1999)
	COII-2	GTTTAAGAGACCAGTACTTG	ditto
ATPsyn-alpha	210fw1	ACGCCCTGATCATCTACGATGATTTGTC	Present study
	210rv1	TCAGGCGCACACCACGGTTCA	ditto
alphaTub84B	227fw1	TGCTGTGGTAGAGCCCTACAACTC	ditto
	227rv2	CCGACTTCCTCGTAATCCTTCTC	ditto
Hsc70cb	251fw1	GTACAACACGAACTCAAGAGCATTCC	ditto
	251rv2	AACTTGGTGCTGTTTGCCGACAT	ditto

Four species, three from the genus *Scaptodrosophila* [*S. dorsocentralis* (Okada), *S. bryani* (Malloch) and *S. subtilis* (Kikkawa & Peng)] and one from the genus *Lissocephala* (*L. sabroskyi* Wheeler & Takada), were used as outgroup taxa, based on the result of molecular phylogenetic reconstruction of the family Drosophilidae by Yassin (2013).

We used the Bayes factor (BF) criterion (Brandley *et al.* 2005) to select optimal data partitioning strategy among six competing strategies chosen a priori: P_1, the whole concatenated data; P_2, 2 partitions each for the mitochondrial (mt) or nuclear (nu) sequences combined; P_3, 3 partitions each for the 1st, 2nd or 3rd codon positions of the whole concatenated data; P_4, 4 partitions each for the (1st+2nd) or 3rd codon positions of mt or nu sequences combined; P_5, 5 partitions each for a gene locus; P_6, 6 partitions each for the 1st, 2nd or 3rd codon positions of the mt or nu sequences combined. In the partitioned Bayesian analyses, nucleotide substitution model was selected for each data partition using Modeltest 3.7 (Posada & Crandall 1998). For each analysis, two parallel runs were performed, with the Markov chains sampled every 100 generations. The runs were performed for 10^7 or more generations until the average standard deviation (STDEV) of split frequencies fell well below 0.01, a status indicating the convergence of the two runs onto stationary distribution. The trace files generated by Bayesian MCMC runs under each partitioning strategy were analyzed (with 20% early samples discarded as burn-in), and BF was calculated for each strategy in Tracer v1.5 (Rambaut A and Drummond AJ, 2003−2009, available from the BEAST site: http://beast.bio.ed.ac.uk/). Alternative strategies were evaluated with the BFs following the method and criterion in Brandley *et al.* (2005). For the Bayesian analysis under the optimal strategy, the samples of parameters and trees were summarized, and the strict consensus tree was adopted as the optimal phylogenetic hypothesis, with branch confidences evaluated by posterior probabilities (PPs). In the partitioned RAxML analysis, 20 distinct ML trees were calculated starting from distinct random trees under the GTRGAMMA model of nucleotide substitution, with the gamma model of rate heterogeneity. Branch confidence values (bootstrap percentages, BPs) were obtained by conducting 1000 replicates of rapid bootstrap analyses, with bipartitions drawn from the 1000 bootstrapped trees onto the best-scoring ML tree.

Morphological grafting analysis

To include some species of which molecular (DNA sequence) data were not available in phylogenetic analyses and to investigate the classification of species groups with definition of their diagnoses, a parsimony analysis was conducted using morphological characters. As ingroup taxa, in addition to 39 BVD species newly found from China, the six known species, viz. *H. limbicostata*, *H. actinia*, *H. yapingi*, *D. paralongifera*, *D. ovilongata* and *D. sikkimensis*, were included: all the ingroup species show close resemblance in morphology and are distributed in the Oriental subtropical regions (mainly highlands). Although *Hirtodrosophila miniserrata* (Okada) recorded from Mt. Kinabalu in Borneo seems to be related to the ingroup species as suggested by Okada (1991), its phylogenetic and taxonomic position will be studied elsewhere, along with some related species recently found also from the tropics of Southeast Asia. *Lissocephala sabroskyi* was selected as an outgroup taxon, based on the result of molecular phylogenetic analysis in the present study.

For character selection, we examined detailed structure of every sclerotized organ of male and female adult bodies. As to *H. limbicostata*, *D. paralongifera*, *D. ovilongata* and *D. sikkimensis*, of which no specimen was available for examining characters, states of some characters were judged from their original descriptions (Okada 1966; Gupta & Singh 1981; Gupta & Gupta 1991). A total of 25 characters were analyzed (see below), with character polarity determined by the outgroup comparison method (Watrous & Wheeler 1981), in which all character states of the outgroup species, *L. sabroskyi*, were coded as 0 (Table 4). All transformation series were assumed to be "unordered".

TABLE 4. Data matrix of 25 morphological characters for 45 *Impatiophila* species (ingroup) and one *Lissocephala* species (outgroup).

Species	Character code																								
	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
Lissocephala sabroskyi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Impatiophila bifurcata	0	0	3	1	1	0	0	1	2	1	1	1	0	0	0	0	2	0	1	1	0	0	1	0	0
I. maoershanensis	0	a	0	2	1	a	0	1	2	1	1	1	0	0	1	0	0	2	2	3	0	0	1	0	0
I. menba	0	0	0	0	1	0	0	0	3	1	1	1	1	0	1	0	0	2	2	3	0	0	1	0	0
I. securiformis	0	0	0	0	1	0	1	0	3	1	1	1	1	0	1	0	0	2	2	3	0	0	1	0	0
I. quadrangulata	0	1	0	0	1	1	1	1	2	1	1	0	0	0	1	0	0	2	2	3	0	0	1	0	0
I. tumidivalva	0	0	3	2	1	0	?	?	?	?	?	?	?	?	1	2	0	1	1	3	0	0	1	0	0
I. xiaoi	0	1	0	0	1	1	1	1	2	0	1	1	0	0	1	2	0	1	1	3	0	0	1	0	0
I. aspidosternata	0	0	2	0	1	0	1	1	2	1	1	1	0	0	1	0	0	0	2	3	1	0	1	0	0
I. yapingi	0	1	0	1	1	1	1	1	2	1	1	1	1	0	1	0	0	0	2	3	0	0	1	0	0
I. viasericaria	0	0	1	1	1	0	0	1	2	1	1	1	0	0	1	0	0	0	2	3	a	0	1	0	0
I. rhombivalva	0	0	1	1	1	0	0	1	2	1	1	1	1	0	1	0	0	0	2	3	0	0	1	0	0
I. hutiaoxiana	0	0	0	0	1	0	?	?	?	?	?	?	?	?	1	0	0	2	2	2	0	0	1	0	0
I. yangi	0	0	3	0	1	0	1	1	2	1	1	1	0	0	0	0	0	1	1	1	0	0	1	0	0
I. forcipivalva	0	1	3	1	1	?	1	1	2	1	1	1	0	0	0	0	0	0	1	1	0	0	1	0	0
I. trifurcatosternata	0	0	3	1	1	0	1	1	3	1	1	1	0	0	1	0	1	2	b	2	1	0	1	0	0
I. latipennata	0	0	2	1	1	0	1	1	2	1	1	1	0	0	1	0	1	2	2	2	0	0	1	0	0
I. ptyonosternata	0	1	0	0	1	1	1	1	2	1	1	1	1	0	1	0	0	1	2	2	1	0	1	0	0
I. medivittata	0	1	0	0	1	1	0	1	2	1	1	1	1	0	?	?	?	?	?	?	?	?	?	?	?
I. taibaishanensis	0	1	0	0	1	1	0	1	2	1	1	1	1	0	1	0	0	2	2	2	0	0	1	0	0
I. longifolia	0	0	2	2	1	0	1	1	2	1	1	1	1	0	1	0	0	2	1	3	0	0	1	0	0
I. linzhiensis	0	1	1	0	1	1	1	?	?	?	?	?	?	?	1	0	0	2	2	2	0	0	1	0	0
I. bifasciata	0	1	0	0	1	1	0	1	3	1	1	1	1	0	1	0	0	2	2	3	0	0	1	0	0
I. eretmosternata	0	1	3	0	1	1	0	1	2	1	1	1	1	0	1	0	0	0	2	3	1	0	1	0	0
I. tongmaiensis	0	1	0	1	1	1	1	1	2	1	1	1	1	0	1	0	0	1	2	3	1	0	1	0	0
I. parvula	0	0	3	0	1	0	0	1	3	1	1	1	1	0	1	0	0	1	2	3	1	0	1	0	0
I. convergens	0	1	3	0	1	?	0	1	3	1	1	1	1	0	1	0	0	0	1	3	0	0	1	0	0
I. limbicostata	?	1	1	?	?	1	?	?	?	?	?	?	?	?	1	0	0	0	1	3	0	0	1	0	?
I. pulla	1	0	0	0	2	0	1	1	2	0	1	0	0	1	?	?	?	?	?	?	?	?	?	?	?
I. unicolorata	1	0	0	0	2	0	?	?	?	?	?	?	?	?	0	1	0	0	0	0	1	1	1	1	1
I. menghaiensis	1	0	0	0	2	0	1	1	2	0	1	0	0	1	0	0	0	0	0	0	2	1	1	1	1

...Continued on next page

TABLE 4. (Continued)

Species	Character code																								
	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
I. truncivalva	1	0	0	0	2	0	1	1	2	0	1	0	0	1	0	1	0	0	0	0	1	1	1	1	1
I. pipa	1	0	0	0	2	0	1	1	2	0	1	0	1	1	0	1	0	0	0	0	1	1	1	1	1
I. curvivalva	1	1	0	0	1	1	1	1	1	0	1	0	0	1	0	0	0	0	0	0	2	1	1	1	1
I. sikkimensis	?	1	0	?	?	1	?	1	?	0	1	0	?	1	0	0	0	0	?	0	1	1	1	1	?
I. actinia	1	1	0	0	2	1	1	1	1	0	1	0	0	1	0	0	0	0	0	0	2	1	1	1	1
I. paralongifera	?	1	0	?	?	1	?	1	?	0	1	0	?	1	0	a	0	0	?	0	2	?	1	?	?
I. pentamaculata	1	1	0	0	2	1	1	1	1	0	1	0	0	1	0	0	0	0	0	0	2	1	1	1	1
I. oblongata	1	1	0	0	1	1	1	1	2	0	1	0	0	1	0	0	0	0	0	0	2	1	1	1	1
I. chiasmosternata	1	1	0	0	1	1	1	1	1	0	1	0	1	1	0	1	0	0	0	0	2	1	2	1	1
I. magnimaculata	1	1	0	0	2	1	1	1	1	0	1	0	0	0	0	1	0	0	0	0	2	1	2	1	1
I. acutivalva	1	0	0	0	1	1	1	1	1	0	1	0	0	1	0	0	0	0	0	0	1	1	1	1	1
I. furcatosternata	1	0	0	0	2	1	1	1	1	0	1	0	0	1	0	0	0	0	0	0	1	1	1	1	1
I. epubescens	1	0	0	0	1	1	1	1	0	0	1	0	0	1	0	1	0	0	0	0	2	1	1	1	1
I. motuoensis	1	0	0	0	1	1	1	1	1	0	1	0	0	1	0	1	0	0	0	0	2	1	2	1	1
I. ovilongata	?	0	0	?	?	1	?	1	?	0	1	0	?	1	0	1	0	0	?	0	2	1	2	?	?

a: 0 or 1; b: 1 or 2

To incorporate molecular phylogenetic information into the morphological analysis, we adopted a method similar to the "morphological grafting" by Yassin *et al.* (2008): a well-resolved topology (Fig. 10) inferred from the molecular phylogenetic analysis was used as backbone constraints for searching most parsimonious trees. The analysis was performed using PAUP v4.0b10 (Swofford 2003). Maximum parsimony cladograms were generated by a heuristic search under the constraints. In the heuristic search, the addition sequences were set at random and tree-bisection reconnection (TBR) branch-swapping was performed. The most parsimonious cladograms were obtained after 1000 replicates of such a search, and then the strict consensus tree was obtained from them. On the strict consensus tree, character optimization was performed by ACCTRAN (accelerated transformation) and DELTRAN (delayed transformation). Branch support was assessed by bootstrap analysis with 1000 replicates.

Characters

Mouthparts

1. *Cibarium*; *anteromost posterior sensillum*: (0) ≥ twice length of posteromost medial sensillum (Fig. 3A); (1) < twice length of posteromost medial sensillum (Fig. 3B).

Thorax

2. *Scutum and scutellum*; *distinct color pattern*: (0) absent (Fig. 3C); (1) present (Fig. 3D).

Wing

3. *Setae of middle row on 2nd costal section*: (0) all heavy, peg-like setae reaching or beyond tip of R_{2+3} (Fig. 3E); (1) mostly heavy, peg-like setae, but not reaching R_{2+3} (Fig. 3F); (2) heavy, peg-like setae interspersed with weak, trichoid ones (Fig. 3G); (3) all weak, trichoid (Fig. 3H).

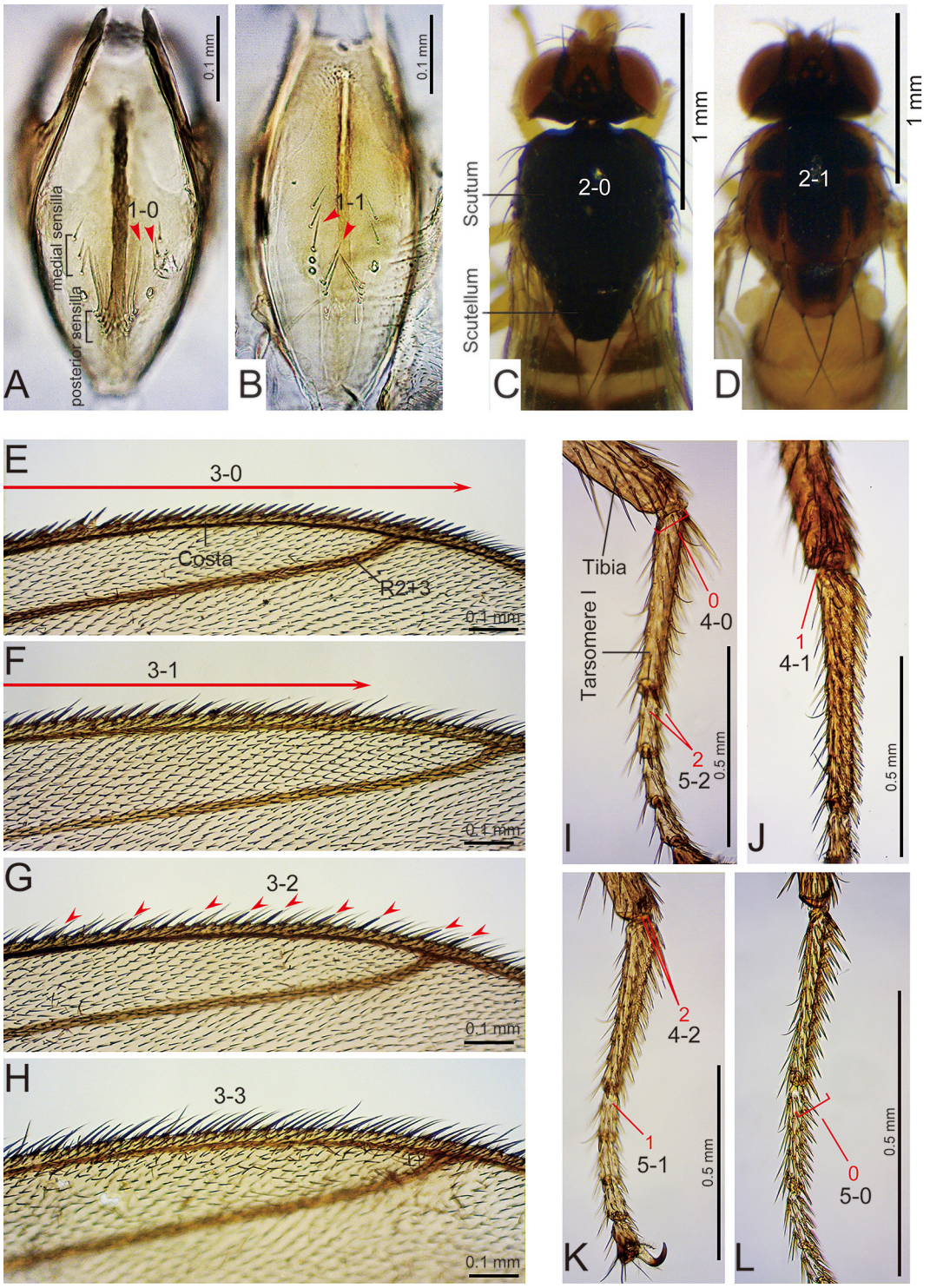

FIGURE 3. Characters 1–5. A, B, cibarium (dorsal view) of *Impatiophila yapingi* (A, #00116) and *I. acutivalva* (B, paratype ♂ #00375); C, D, thorax (dorsal view) of *I. acutivalva* (C, holotype ♂ #00282) and *I. magnimaculata* (D, paratype ♂ #00544); E–H, wing (anterodistal portion) of *I. securiformis* (E, paratype ♂ #01507), *I. linzhiensis* (F, holotype ♀ #00543), *I. longifolia* (G, paratype ♂ #00321) and *I. bifurcata* (H, paratype ♂ #02582); I–L, hindleg of *I. truncivalva* (I, paratype ♂ #01536), *I. yapingi* (J, ♂ #03752), *I. longifolia* (K, paratype ♂ #00321) and *Lissocephala sabroskyi* (L, ♂ from Bogor, West Java, Indonesia).

Legs

4. *Hindleg*; *number of black, apically blunt, stout spines at outer apex on underside of tibia*: (0) 0 (Fig. 3I); (1) 1 (Fig. 3J); (2) 2–4 (Fig. 3K).
5. *Hindleg*; *number of black, apically blunt, stout spines at outer apex on underside of tarsomere I*: (0) 0 (Fig. 3L); (1) 1 (Fig. 3K); (2) 2 (Fig. 3I).

Abdomen

6. *Tergites III to V*; *color*: (0) unicolorously dark brown to black (Fig. 4A); (1) with black, caudal bands (Fig. 4B–D).
7. *Sternites*; *proportion of male VI*: (0) longer than wide (Fig. 4E); (1) not longer than wide (Fig. 4F).

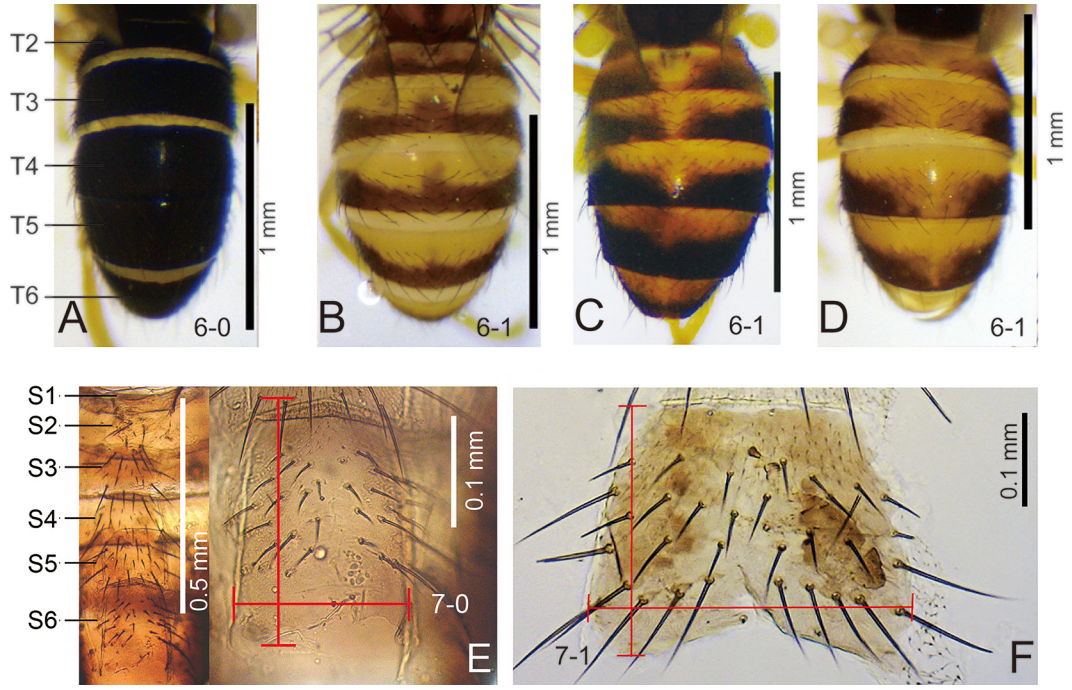

FIGURE 4. Characters 6 and 7: abdomen. A–D, tergites (dorsal view) of *Impatiophila truncivalva* (A, #00302), *I. ptyonosternata* (B, #00296), *I. taibaishanensis* (C, #01700) and *I. curvivalva* (D, #00089); E, F, male sternite IV (ventral view) of *I. viasericaria* (E, paratype #03580) and *I. trifurcatosternata* (F, paratype #01622).

Male genitalia

8. *Epandrium*; *patch of dense, small setae or stout setulae on caudoventral portion*: (0) absent (Fig. 5A); (1) present (Fig. 5B).
9. *Epandrium*; *pubescence*: (0) absent (Fig. 5D); (1) covering only small patch on dorsolateral portion (Fig. 5C); (2) covering less than half (Fig. 5B); (3) covering more than half, except for anterior and ventral portions (Fig. 5A).
10. *Surstylus*; *distal margin*: (0) not deeply concave (Fig. 5D); (1) deeply concave in ventral 2/3 (Fig. 5B).
11. *Surstylus*; *dorsal, stout prensiseta(e) more or less separated from others*: (0) absent (Fig. 5F); (1) present (Fig. 5E).
12. *Paramere*; *apical portion in lateral view*: (0) more or less angled at apicodorsal corner (Fig. 5G); (1) more or less roundish on apical margin (Fig. 5I).
13. *Paramere*; *proportion in lateral view*: (0) not longer than twice of width (Fig. 5G); (1) longer than twice of width (Fig. 5I).
14. *Aedeagal basal process*; *length*: (0) longer than 1/2 of paramere (Fig. 5J); (1) not longer than 1/2 of paramere (Fig. 5H).

Female genitalia

15. *Oviscapt valve*; *apical portion*: (0) narrowing (Fig. 6B); (1) horizontally expanded (Fig. 6D).
16. *Oviscapt valve*; *dorsosubapical margin in lateral view*: (0) gently curved (Fig. 6C, I); (1) obliquely truncate (Fig. 6A, G); (2) more or less convex (Fig. 6J).
17. *Oviscapt valve*; *dorsomedial portion in lateral view*: (0) not or less expanded (Fig. 6C); (1) strongly expanded (Fig. 6E); (2) narrowly extended anteriad (Fig. 6K).

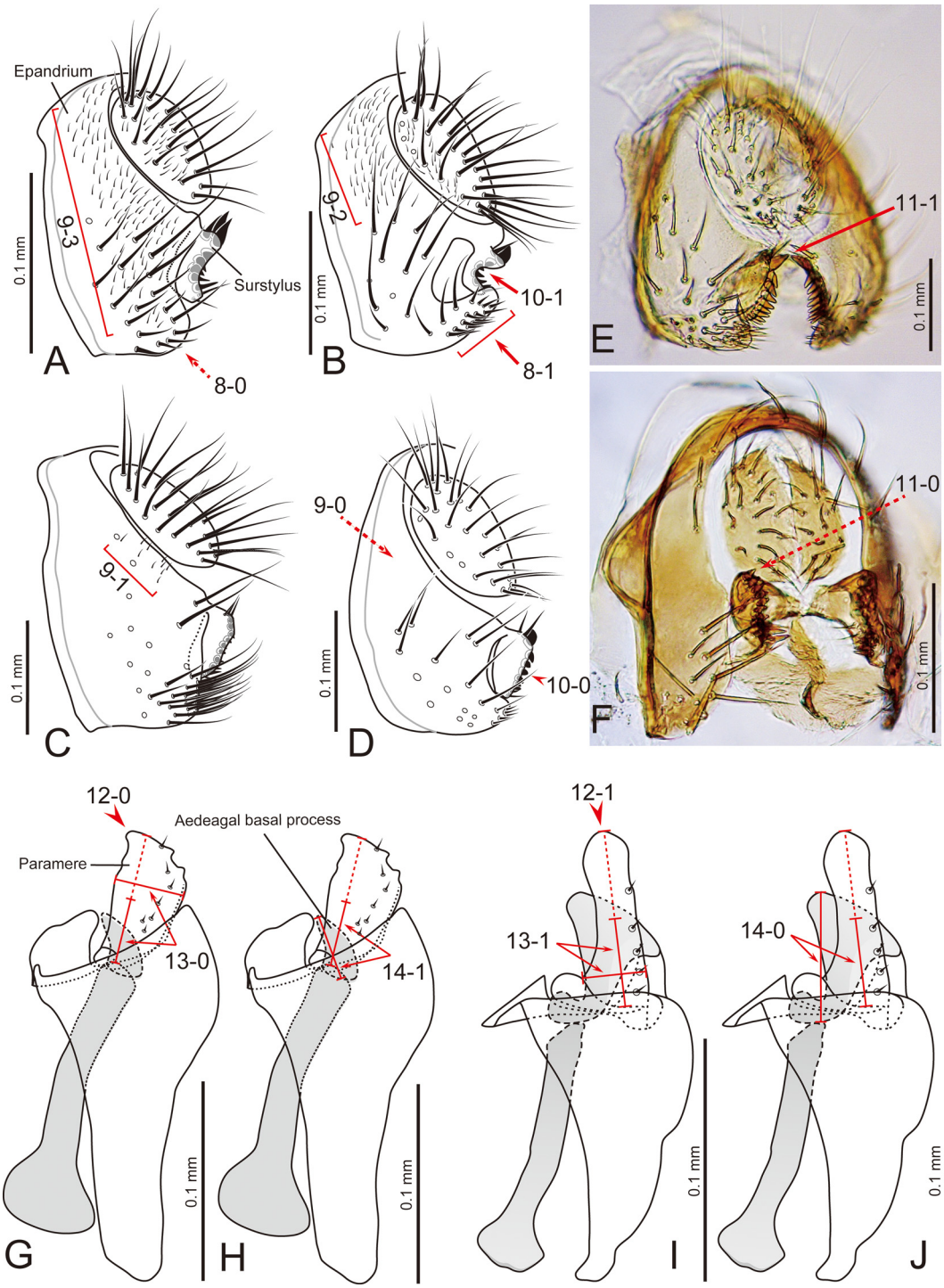

FIGURE 5. Characters 8–14: male terminalia. A–F, periphallic organs (caudolateral view) of *Impatiophila securiformis* (A, #01501), *I. longifolia* (B, #00508), *I. motuoensis* (C, #00273), *I. epubescens* (D, #00280), *I. pentamaculata* (E, ♂ from Jizushan, Dali, Yunnan, China) and *Lissocephala sabroskyi* (F, ♂ from Bogor, West Java, Indonesia); G–J, phallic organs (lateral view) of *I. curvivalva* (G, H; #00089) and *I. menba* (I, J; #00307).

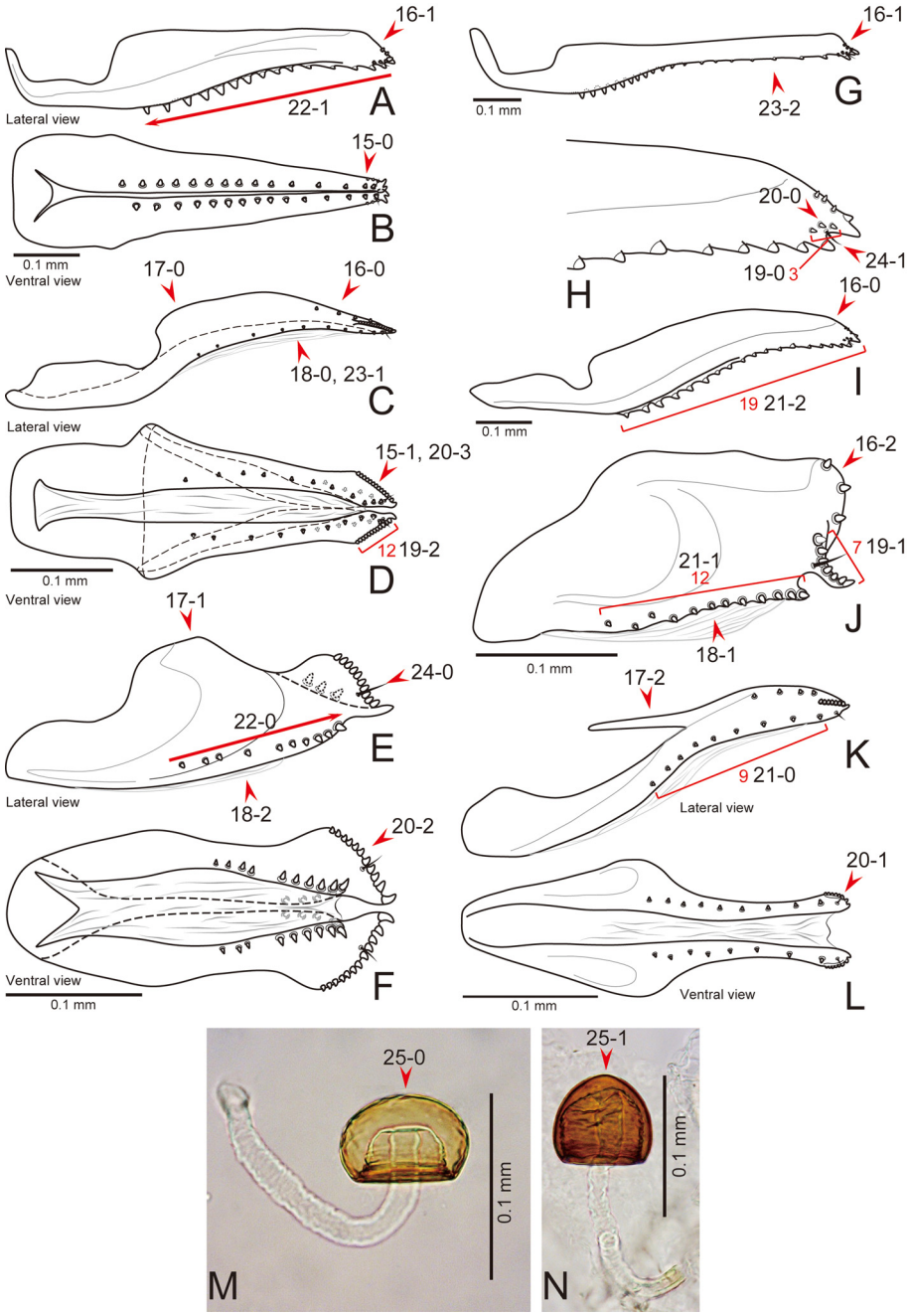

FIGURE 6. Characters 15–25: female terminalia. A–L, oviscapt valve of *Impatiophila unicolorata* (A, lateral view; B, ventral view; #01439), *I. viasericaria* (C, lateral view; D, ventral view; #01406), *I. latipennata* (E, lateral view; F, ventral view; #00303), *I. magnimaculata* (G, lateral view; #01572), *I. curvivalva* (H, enlarged apical portion in lateral view; I, lateral view; #00097), *I. tumidivalva* (J, lateral view; #00376) and *I. bifurcata* (K, lateral view; L, ventral view; #01127); M, N, spermatheca (lateral view) of *I. yapingi* (M, ♀ from Kunming, Yunnan, China) and *I. actinia* (N, ♀ from Chitou, Taiwan).

18. *Oviscapt valve*; *ventral margin in lateral view*: (0) distally concave (Fig. 6C); (1) nearly straight (Fig. 6J); (2) more or less convex (Fig. 6E).
19. *Oviscapt valve*; *number of lateral ovisensilla*: (0) 3 or 4 (Fig. 6H); (1) 6 to 10 (Fig. 6J); (2) 11 or more (Fig. 6D).
20. *Oviscapt valve*; *arrangement of lateral ovisensilla*: (0) not tightly arranged on subapicolateral portion (Fig. 6H); (1) tightly arranged in a slightly convex (in ventral view) row on apicolateral portion (Fig. 6L); (2) tightly arranged in a slightly convex (in ventral view) row on margin of apicolateral flap (Fig. 6F); (3) tightly arranged in a nearly straight (in ventral view) row on margin of apicolateral flap (Fig. 6D).

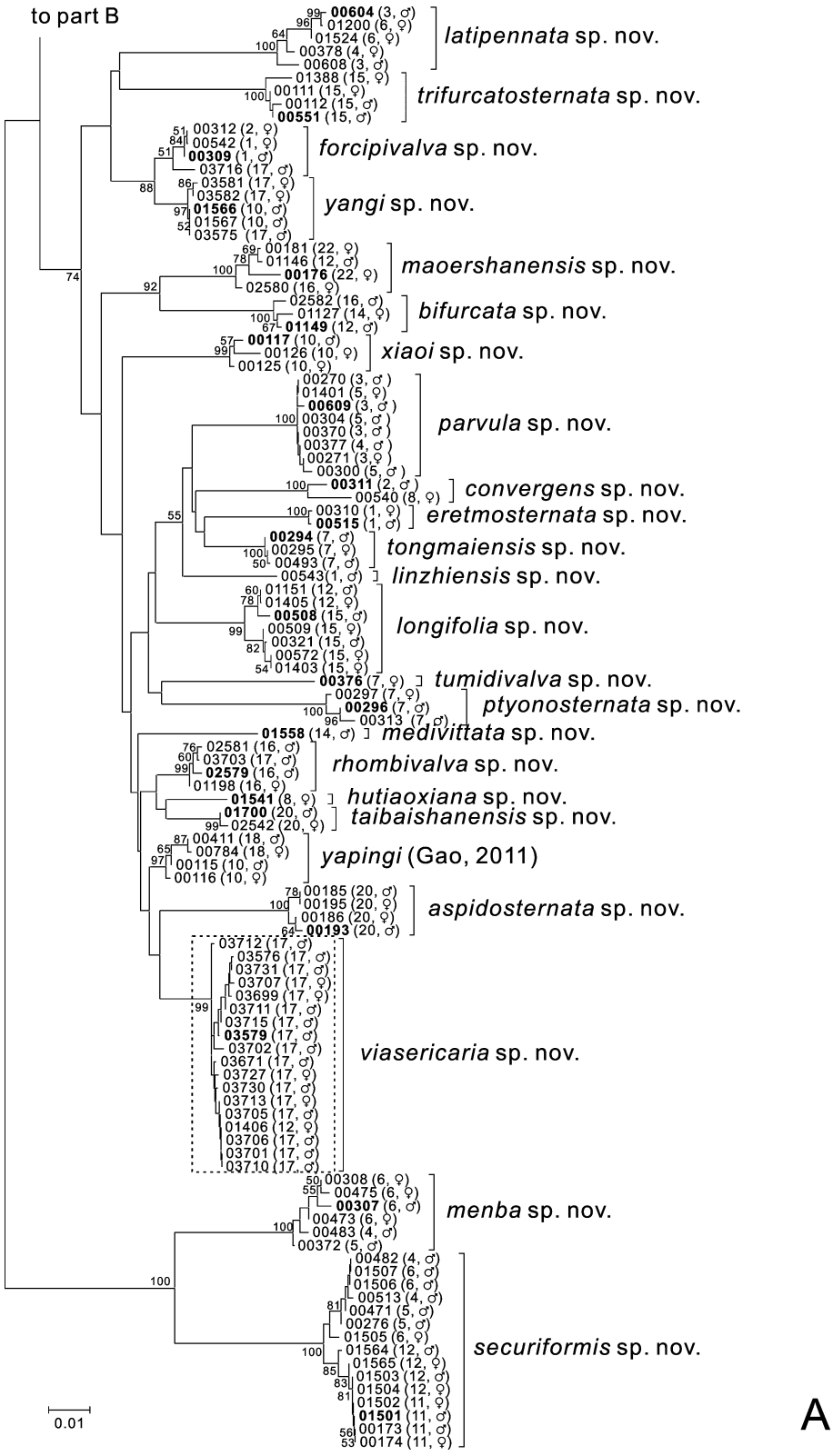

FIGURE 7. Neighbor-joining tree of the *COI* DNA sequences of BVDs. Label of each operational taxonomic unit (OUT) is given in the format of "voucher number (collection site code, sex)" (see Table 1 and Fig. 2 for the details of the code of each collection site). Two new species, *I. viasericaria* and *I. chiasmosternata* spp. nov., are framed with dashed line in the parts A and B of the tree, respectively. Numbers beside nodes are bootstrap percentages.

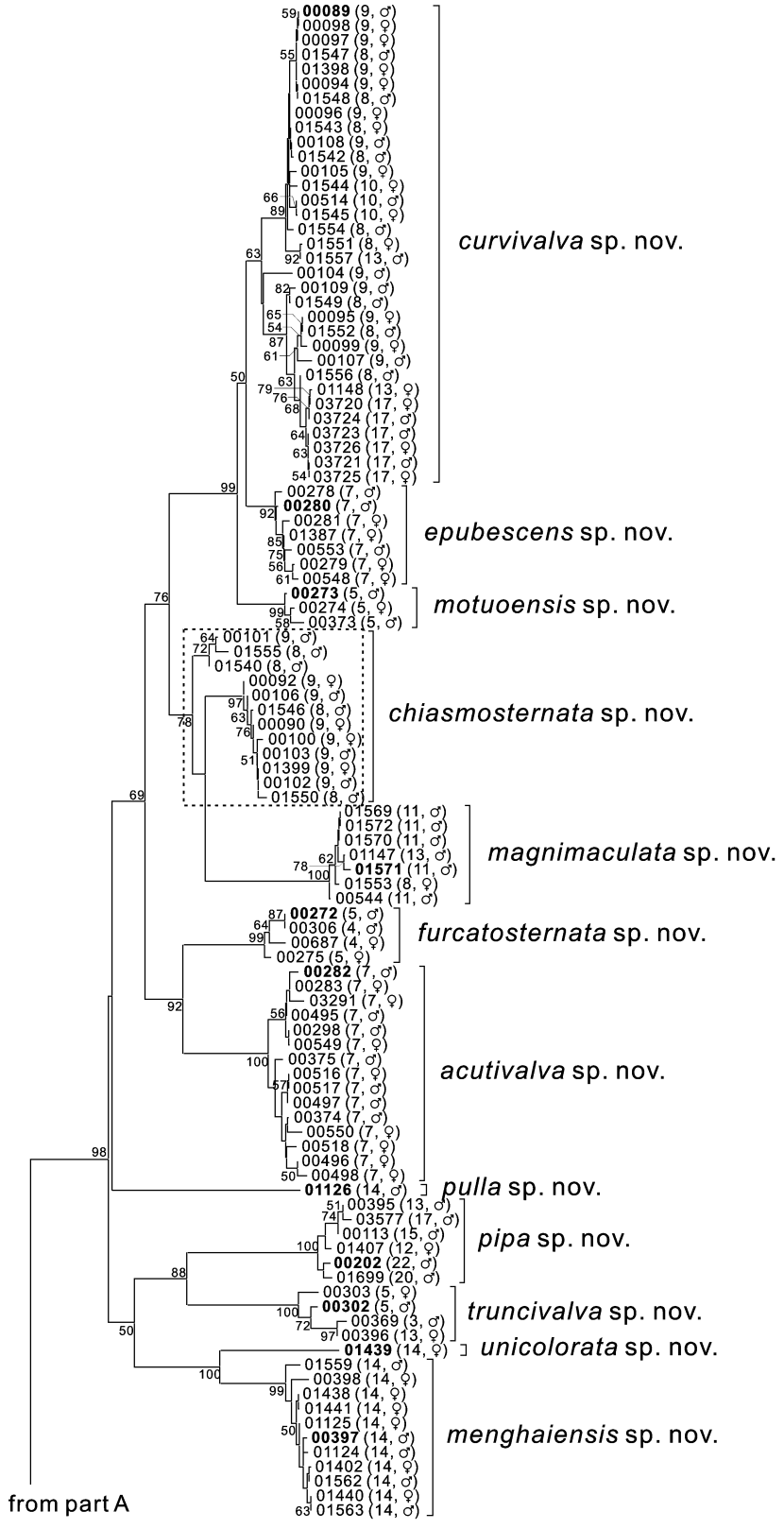

FIGURE 7. (Continued) Neighbor-joining tree of the *COI* DNA sequences of BVDs. Label of each operational taxonomic unit (OUT) is given in the format of "voucher number (collection site code, sex)" (see Table 1 and Fig. 2 for the details of the code of each collection site). Two new species, *I. viasericaria* and *I. chiasmosternata* spp. nov., are framed with dashed line in the parts A and B of the tree, respectively. Numbers beside nodes are bootstrap percentages.

21. *Oviscapt valve*; *number of ovisensilla on ventral margin*: (0) 10 or less (Fig. 6K); (1) 11 to 16 (Fig. 6J); (2) 18 or more (Fig. 6I).
22. *Oviscapt valve*; *size of ovisensilla on ventral margin*: (0) increasing distally or nearly constant (Fig. 6E); (1) decreasing distally (Fig. 6A).
23. *Oviscapt valve*; *arrangement of ovisensilla on ventral margin*: (0) more widely spaced in proximal portion; (1) entirely arranged at nearly equal intervals (Fig. 6C); (2) more widely spaced in subdistal portion (Fig. 6G).
24. *Oviscapt valve*; *subapical trichoid ovisensillum*: (0) stout, longer than apical, peg-like ovisensillum (Fig. 6E); (1) weak, as long as apical, peg-like ovisensillum (Fig. 6G).
25. *Spermathecal capsule in lateral view*: (0) apically somewhat round or flat (Fig. 6M); (1) apically somewhat pointed (Fig. 6N).

Results

Species delimitation

The GenBank accession numbers for the newly determined DNA sequences of the *COI* gene are KU600449–KU600662. Fig. 7 shows the neighbor-joining tree of 214 *COI* sequences of BVD flies. In this tree, distinct lineages each represented by one or more *COI* sequences were recognized. The sequences were accordingly pre-assigned into 36 species, including *H. yapingi* and 35 putatively new species. All these 36 species (the 35 new ones indicated with names given in the TAXONOMIC ACCOUNT section) were well supported by the congruence between morphological and molecular (*COI* sequence) data, with the following two exceptions:

1) For *Impatiophila viasericaria* sp. nov., 17 specimens collected from Yunnan (sites 12 and 17) were employed for *COI* sequencing; these specimens were rather homogeneous in the structures of male or female genitalia and external morphology, except for the continuously varying abdominal pigmentation pattern among the specimens (Fig. 8). The clustering of these *COI* sequences was strongly supported (Fig. 7A; BP = 99%), with very low divergence among them (pairwise K2P distances ≤ 0.0065, mean = 0.0020).

FIGURE 8. Abdominal color pattern in *Impatiophila viasericaria* sp. nov. A, paratype ♂ #03710; B, paratype ♂ #03705; C, paratype ♂ #03576; D, holotype ♂ #03579. Scale lines (dashed) = 0.5 mm.

2) *I. chiasmosternata* sp. nov. was suggested to be paraphyletic with respect to *I. magnimaculata* sp. nov. (Fig. 7B), but this relationship was only weakly supported. The specimens used for *COI* sequencing were morphologically homogeneous, and the genetic divergence among them (pairwise K2P distances ≤ 0.0167, mean = 0.0066) was much smaller than their distances to *I. magnimaculata* sp. nov.

In each of these exceptional cases, taking into account that there is essential divergence in neither morphology nor *COI* sequence among the specimens, we regarded the specimens as conspecific.

Molecular phylogeny

The GenBank accession numbers are KU600663–KU600699 for the *COII* gene, KU600700–KU600735 for the *alphaTub84B* gene, KU600736–KU600774 for the *ATPsyn-alpha* gene, and KU600775–KU600813 for the *Hsc70cb* gene. The alignment of the concatenated DNA sequences was 3047 nucleotides in length, among which 809 were variable and 508 were parsimony informative (Table 5). Results of the tests for substitution saturation and

base composition homogeneity are shown in Table 6. The DAMBE tests suggested that, assuming a symmetrical true tree, there was no substitution saturation in any of the data partitions. When a very asymmetrical true tree was assumed (but very unlikely; Xia & Lemey 2009), only the partition of the 3rd codon position of *COII* exhibited essential saturation (P_{Asym} = 0.535). In the compositional homogeneity test, the null hypothesis was rejected for the partitions of the 3rd codon positions of *COI* and *COII* (P = 0.00).

TABLE 5. Summary of the alignment of the concatenated sequences.

Genetic marker	Summary of sequences		
	Length (sites)	Variable sites	Parsimony informative sites
COI	658	216	176
COII	672	217	151
ATPsyn-alpha	437	65	36
alphaTub84B	724	150	76
Hsc70cb	556	161	69
Total	3047	809	508

The result of substitution model selection is shown in Table 7. Table 8 gives the mean and 95% HPD of –ln$L$ for each partitioning strategy. Increasing the numbers of partitions from 1 to 4 gradually improved the mean –ln$L$ in turn. The strategy P_4 making distinction between the source of sequences (nuclear *vs.* mitochondrial genomes) and codon position (i.e., the 1st+2nd *vs.* 3rd codon position) has the largest effect on the mean –ln$L$. The strategy P_5 received a mean –ln$L$ even worse than the strategy P_3, indicating that gene loci was less important than the source of sequences and codon position for data partitioning in our case. The mean –ln$L$ of the strategy P_6 was larger than that of P_4, implying that it was not necessary to make distinction between the 1st and 2nd codon positions in the sequences. Using the criterion of 2ln Bayes factor ≥ 10 as strong support against the alternative strategy (Kass & Raftery 1995), we determined the strategy P_4 as the best to be applied to our molecular phylogenetic analyses (Table 9).

Fig. 9 shows the Bayesian tree constructed based on the concatenated DNA sequences of five genes under the data partitioning strategy P_4. The ML tree (not shown) was essentially identical, though including some minor variations, in topology with the Bayesian tree. For comparison, branch confidences estimated in the ML phylogenetic analysis were also shown in Fig. 9. The ingroup BVDs formed a well-supported (PP = 1.00, BP = 82%) clade, which is to be established as the new genus *Impatiophila* on *H. yapingi* as the type species in the present paper. Among the outgroup taxa, *Lissocephala sabroskyi* was placed as the sister to this clade (PP = 1.00, BP = 74%). Within the ingroup clade (*Impatiophila*), three well-supported subclades were recognized. The first one contained *I. yapingi* comb. nov. and 19 allied new species, and is to be established as the *I. yapingi* species group. Its monophyly was well supported (PP = 1.00, BP = 72%), but the relationships among the component species were poorly resolved. The second and the third subclades were recognized as the sister groups to each other (PP = 1.00, BP = 80%). The second subclade highly supported (PP = 1.00, BP = 99%) and to be established as the *I. acutivalva* species group contained 12 new species. The relationships among these species were rather well resolved. They were largely divided into two clusters: one comprising *I. pulla*, *I. pipa*, *I. truncivalva*, *I. menghaiensis* and *I. unicolorata* spp. nov. (PP = 1.00, BP = 89%), and the other comprising *I. magnimaculata*, *I. chiasmosternata*, *I. furcatosternata*, *I. acutivalva*, *I. curvivalva*, *I. motuoensis* and *I. epubescens* spp. nov. (PP = 1.00, BP = 87%). The third subclade (PP = 1.00, BP = 100%) to be established as the *I. menba* species group contained only two species: *I. menba* and *I. securiformis* spp. nov.

Of the 36 ingroup species, two were not included in any of the three subclades. *Impatiophila bifurcata* sp. nov. was placed as a branch of the basal crown, while *I. maoershanensis* sp. nov. was placed as the sister to the lineage comprising the second and the third subclades (PP = 1.00, BP = 56).

TABLE 6. Results of substitution saturation and base composition homogeneity tests.

Indices	*COI*			*COII*			*ATPsyn-alpha*			*alphaTub84B*			*Hsc70cb*		
	1st CP	2nd CP	3rd CP	1st CP	2nd CP	3rd CP	1st CP	2nd CP	3rd CP	1st CP	2nd CP	3rd CP	1st CP	2nd CP	3rd CP
Test of substitution saturation															
I_{ss} [a]	0.070	0.003	0.465	0.049	0.136	0.391	0.122	0.001	0.108	0.095	0.060	0.137	0.133	0.085	0.106
$I_{ss.cSym}$ [b]	0.699	0.698	0.700	0.688	0.688	0.688	0.743	0.743	0.759	0.694	0.708	0.699	0.706	0.705	0.709
P_{sym} [c]	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
$I_{ss.cAsym}$ [d]	0.393	0.392	0.396	0.371	0.371	0.371	0.475	0.475	0.506	0.383	0.380	0.393	0.407	0.406	0.413
P_{Asym} [e]	0.000	0.000	0.039	0.000	0.011	0.535	0.013	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000
Test of base composition homogeneity															
df	114	114	76	108	108	108	114	114	114	102	102	102	111	111	114
I	43.16	3.13	247.01	59.30	9.59	1158.31	4.36	1.05	42.96	8.71	0.00	120.35	16.20	6.27	108.72
P	1.0000	1.0000	0.0000	1.0000	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.1037	1.0000	1.0000	0.5434

[a] Index of substitution saturation (I_{ss});

[b] Critical I_{ss} value assuming a symmetrical true tree;

[c] Probability of significant difference between I_{ss} and $I_{ss.cSym}$ (two-tailed test);

[d] Critical I_{ss} value assuming an asymmetrical true tree;

[e] Probability of significant difference between I_{ss} and $I_{ss.cAsym}$ (two-tailed test)

TABLE 7. Result of selection of nucleotide substitution models (using the hLRTs criterion).

Data set	Model selected	Base frequency				Rate of different substitution types						I^a	Γ^b
		A	C	G	T	A-C	A-G	A-T	C-G	C-T	G-T		
COI	GTR+I+Γ	0.3371	0.1130	0.1282	0.4218	1.8068	47.0641	7.4708	3.9706	67.9162	1.0000	0.6157	0.9368
COII	GTR+I+Γ	0.3761	0.0864	0.0895	0.4480	0.9180	18.8991	1.4254	2.6111	34.7335	1.0000	0.5679	0.5578
ATPsyn-alpha	TrN+Γ	0.1636	0.3138	0.2697	0.2528	1.0000	4.1741	1.0000	1.0000	9.3921	1.0000	0	0.0951
alphaTub84B	TrN+I+Γ	0.1899	0.3147	0.2663	0.2291	1.0000	3.1374	1.0000	1.0000	6.9397	1.0000	0.5457	0.7652
Hsc70cb	TrNef+Γ	-	-	-	-	1.0000	2.2450	1.0000	1.0000	5.3441	1.0000	0	0.2920
mt	GTR+I+Γ	0.3545	0.0975	0.1055	0.4424	1.1373	23.9010	2.7309	2.2824	39.7229	1.0000	0.5990	0.7400
mt-CP_1	TrNef+I+Γ	-	-	-	-	1.0000	9.6291	1.0000	1.0000	22.2348	1.0000	0.6665	0.9695
mt-CP_2	F81+I+Γ	0.2026	0.2200	0.1589	0.4184	-	-	-	-	-	-	0.9058	0.8728
mt-CP_3	GTR+I+Γ	0.4564	0.0534	0.0347	0.4555	0.2839	17.6441	0.2270	1.0205	13.8748	1.0000	0.0961	0.8238
mt-CP_{12}	TrN+I+Γ	0.2457	0.1833	0.2092	0.3618	1.0000	7.9719	1.0000	1.0000	17.4709	1.0000	0.7959	0.5811
nu	TrN+I+Γ	0.1976	0.2943	0.2728	0.2353	1.0000	3.1187	1.0000	1.0000	6.4433	1.0000	0.5336	0.7316
nu-CP_1	TrN+Γ	0.2443	0.2128	0.3512	0.1917	1.0000	0.5858	1.0000	1.0000	13.4641	1.0000	0	0.0154
nu-CP_2	F81+Γ	0.3040	0.2592	0.1501	0.2867	-	-	-	-	-	-	0	0.0139
nu-CP_3	TrN+Γ	0.0763	0.3901	0.2996	0.2340	1.0000	8.8469	1.0000	1.0000	5.3992	1.0000	0	0.9207
nu-CP_{12}	TrNef+I+Γ	-	-	-	-	1.0000	1.1305	1.0000	1.0000	5.3453	1.0000	0.8650	1.0278
All	GTR+I+Γ	0.2469	0.2208	0.2207	0.3116	0.9751	8.9617	3.8800	2.0208	14.2790	1.0000	0.5837	0.5647
All-CP_1	TrNef+I+Γ	-	-	-	-	1.0000	5.4360	1.0000	1.0000	17.6900	1.0000	0.7606	1.0020
All-CP_2	F81+I+Γ	0.2581	0.2429	0.1550	0.3441	-	-	-	-	-	-	0.9314	0.9603
All-CP_3	TVM+Γ	0.2278	0.2441	0.1925	0.3356	0.9915	13.6417	5.2514	2.7169	13.6417	1.0000	0	0.5476

[a] Proportion of invariable sites; [b] Gamma distribution shape parameter

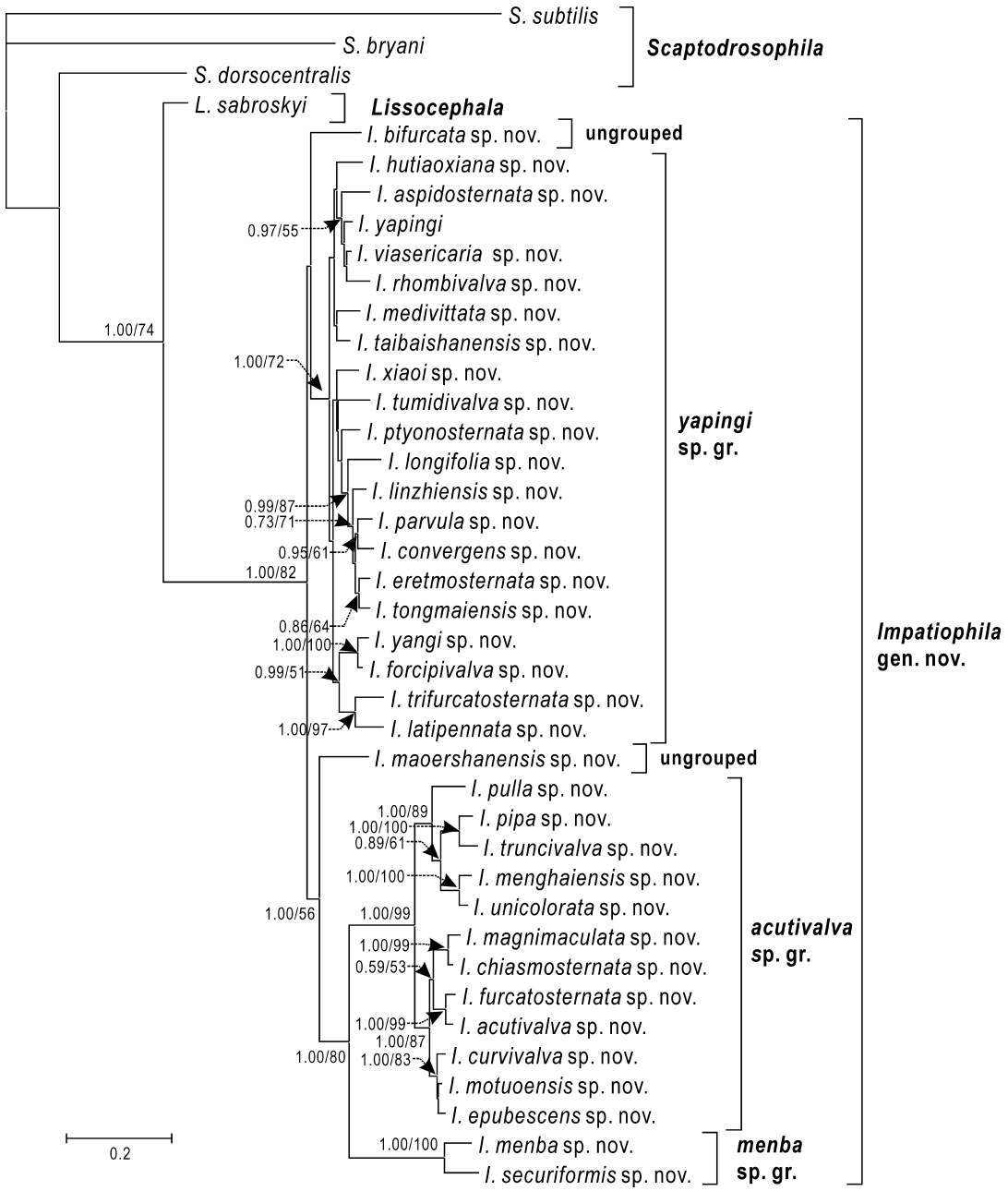

FIGURE 9. Bayesian tree of *Impatiophila.* Bayesian posterior probabilities and ML bootstrap percentages (BP) are shown (separated by a slash) for branches supported by BPs ≥ 50%.

TABLE 8. Mean –ln*L* and 95% credible interval of each partitioning strategy.

Strategy	–ln*L*			
	ESS[a]	Mean	95% HPD[b] lower	95% HPD[b] upper
P_1	8831.74	15629.392	15644.919	15614.830
P_2	3115.48	15088.867	15105.207	15072.807
P_3	4266.41	15011.394	15027.910	14995.558
P_4	3169.04	14191.762	14209.161	14171.885
P_5	3764.73	15051.329	15069.625	15033.540
P_6	2521.73	14257.298	14275.553	14239.607

[a] Effective sample size; [b] 95% highest posterior density.

TABLE 9. 2ln BFs of comparisons between partitioning strategies (1 vs. 2). A positive value indicates evidence against the strategy 2.

Strategy 2	Strategy 1				
	P_6	P_5	P_4	P_3	P_2
P_1	2737.118	1149.396	2870.514	1232.718	1077.948
P_2	1659.170	71.448	1792.566	154.770	
P_3	1504.400	–83.322	1637.796		
P_4	–133.396	–1721.118			
P_5	1587.722				

Morphological grafting analysis

The parsimony analysis of the morphological data matrix (Table 4) resulted in 1382 most parsimonious cladograms under the constraints of partial topology (Fig. 10), with a length of 120 steps and the following statistics: CI (consistency index) = 0.3250, HI (homoplasy index) = 0.6750, RI (characters retention index) = 0.7515, and RC (rescaled consistency index) = 0.2442. The strict consensus of these cladograms was rooted by the outgroup rooting. In the resulting rooted tree (Fig. 11), apomorphies were indicated on each branch according to the estimation by ACCTRAN. The results of character optimization were inconsistent for some transformation series between ACCTRAN and DELTRAN. Synapomorphies not identified by both ACCTRAN and DELTRAN are excluded from the following description.

The monophyly of the genus *Impatiophila* to be newly established was supported by three autapomorphies: the presence of one or two apically blunt, stout spine(s) at outer apex on underside of hindleg tarsomere I (ch. 5-1, 2; Fig. 3I, K), the presence of dorsal, stout, upturned prensiseta(e) more or less separated from others on the surstylus (ch. 11-1; Fig. 5E) and the ovisensilla on ventral margin of oviscapt valve not more widely spaced in proximal portion than in other portions (ch. 23-1, 2; Fig. 6C, G). Thus, all the known species included in this analysis and so far assigned to the genus *Hirtodrosophila* or *Drosophila* should be transferred to the genus *Impatiophila*. Within *Impatiophila*, *I. bifurcata* sp. nov. was placed as the most basal branch. Of the three subclades (species groups) detected within the ingroup *Impatiophila* by the molecular phylogenetic analysis, the *menba* and the *acutivalva* groups were recovered as clades with high confidences (BP = 97% and 99%, respectively) in the morphological analysis as well. The *menba* group was characterized by the absence of dense, small setae or stout setulae on the caudoventral portion of epandrium (ch. 8-0, regarded as a secondary loss within the genus *Impatiophila*; Fig. 5A). The monophyly of the *acutivalva* group was strongly supported by four autapomorphies: the anteromost posterior sensillum of cibarium shorter than twice length of posteromost medial sensillum (ch. 1-1; Fig. 3B), ovisensilla on the ventral margin of oviscapt valve distally decreasing in size (ch. 22-1; Fig. 6A), the subapical trichoid ovisensillum of oviscapt valve weak, as long as apical, peg-like ovisensillum (ch. 24-1; Fig. 6H) and the spermathecal capsule apically somewhat pointed in lateral view (ch. 25-1; Fig. 6N). *Impatiophila sikkimensis* comb. nov., *I. actinia* comb. nov., *I. paralongifera* comb. nov., *I. ovilongata* comb. nov., *I. pentamaculata* sp. nov. and *I. oblongata* sp. nov., of which DNA sequence data were unavailable, were grafted on to this species group. The *yapingi* group, with grafted *I. limbicostata* comb. nov., *I. quadrangulata* sp. nov. and *I. bifasciata* sp. nov., was poorly supported morphologically: no synapomorphy was detected for this clade. And, the relationships among the three species groups and an ungrouped species, *I. maoershanensis* sp. nov., were almost unresolved morphologically.

Taxonomic account

Integrating the results of molecular and morphological phylogenetic analyses, the new genus *Impatiophila* is established here, and three species groups are recognized within it. However, two species, *I. bifurcata* sp. nov. and *I. maoershanensis* sp. nov., are left unassigned to any species group. The morphological diagnoses for the genus and the species groups are given on the basis of synapomorphies detected for the corresponding clades in the morphological analysis. As for the *I. yapingi* species group, however, its diagnosis is defined by a combination of synplesiomorphies.

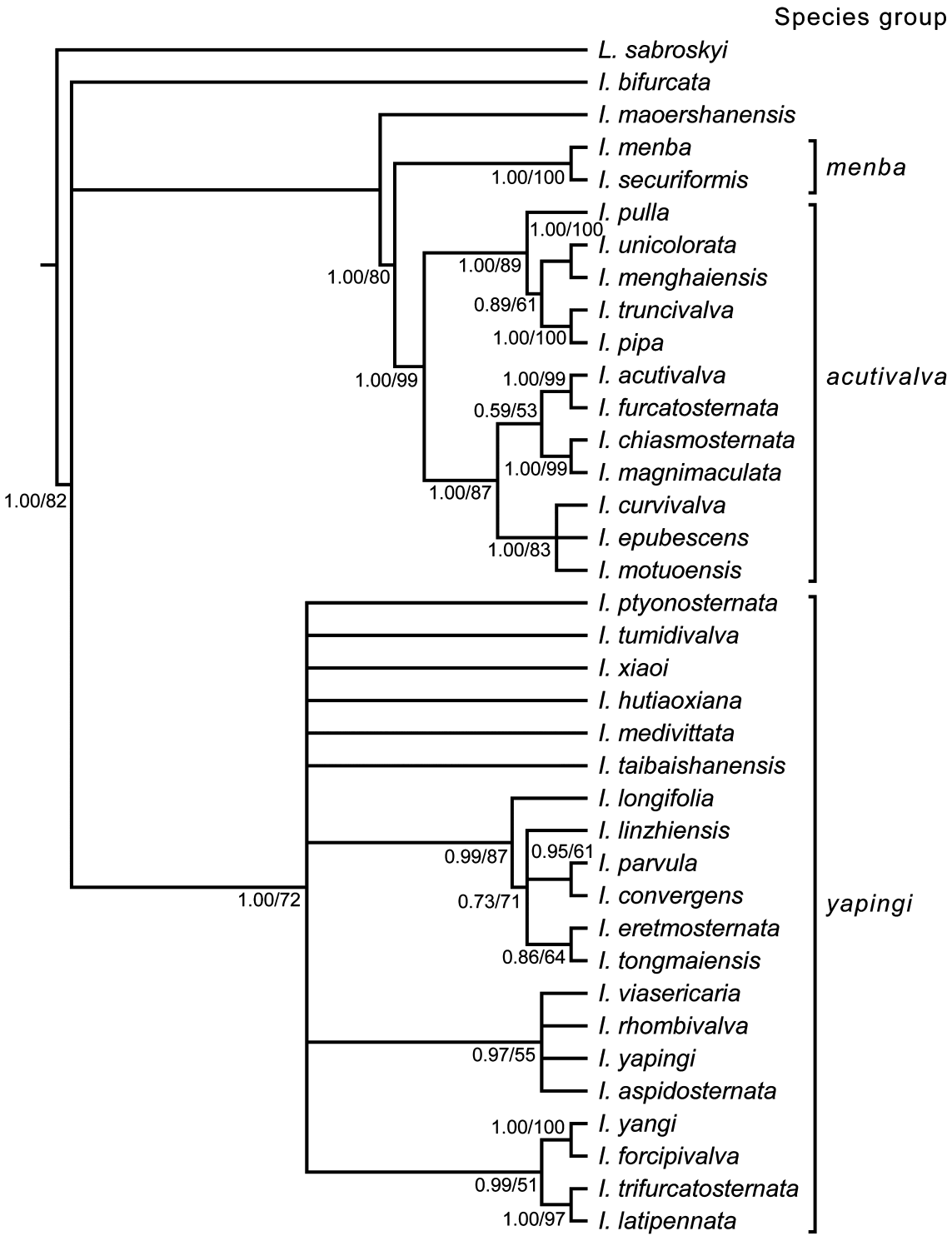

FIGURE 10. A backbone constraint topology. Branches with ≥ 50% ML bootstrap percentages in the molecular phylogeny (Fig. 9) were retained. This constraint was used for searching of parsimony trees in a grafting analysis with morphological characters. Numbers beside each node are posterior probability and bootstrap percentage (separated by a slash).

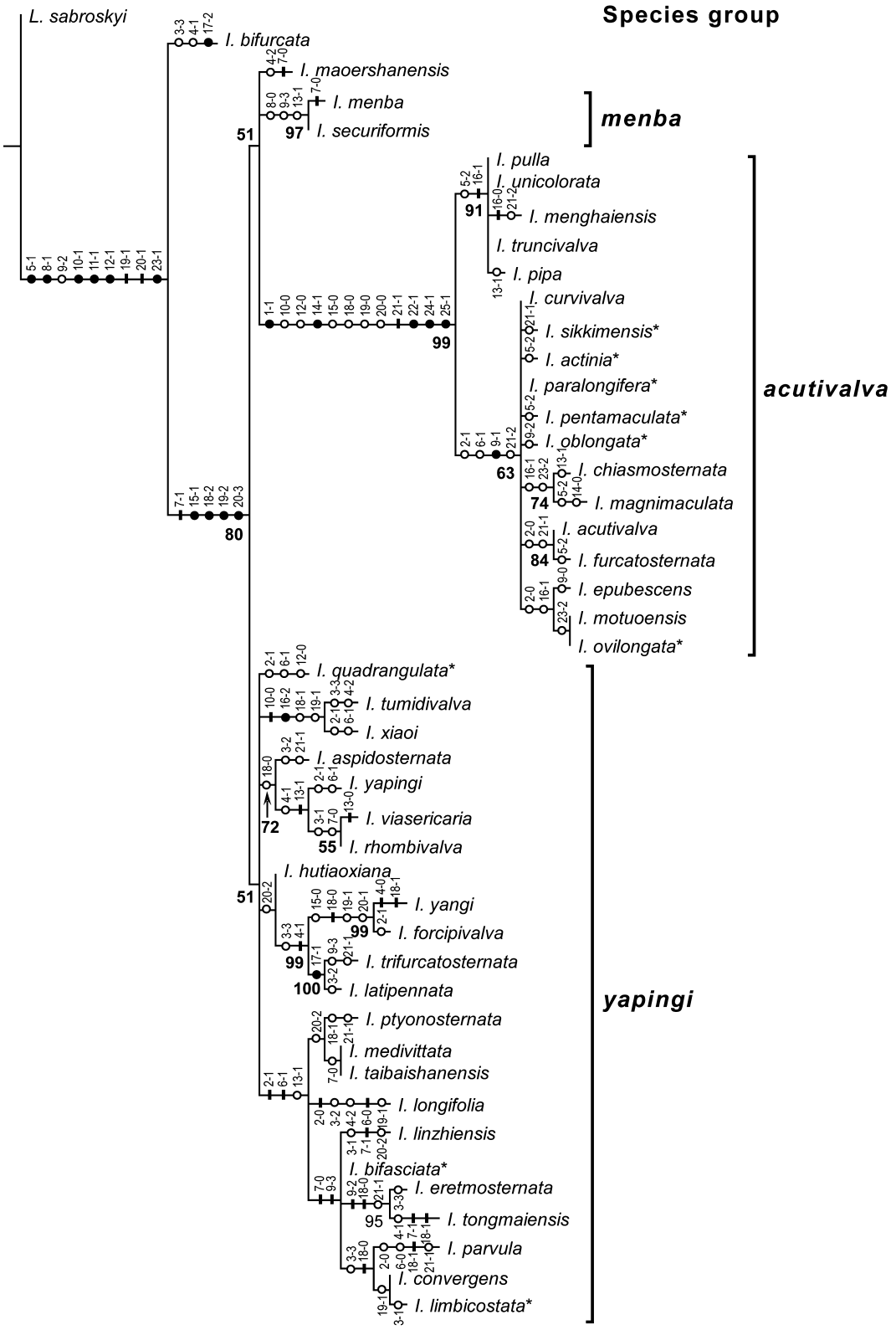

FIGURE 11. The strict consensus tree of 1382 most parsimonious cladograms. This tree was obtained under the constraints of tree topology shown in Fig. 10 by a grafting analysis with 25 morphological characters. Synapomorphies inferred from ACCTRAN character optimization are indicated on each branch: solid circle, non-homoplastic change; open circle, homoplastic (parallel and/or reversal) change; bar, change inconsistent with DELTRAN inference (not shown). Bootstrap value (more than 50%) is indicated beside each branch. * Morphologically grafted species.

***Impatiophila* Fu & Gao, gen. nov.**

Diagnosis. One or two apically blunt, stout spine(s) present at outer apex on underside of hindleg tarsomeres I to IV (Fig. 3I, K). Dorsal, stout, upturned prensiseta(e) of surstylus more or less separated from others (Fig. 5E). Ovisensilla on ventral margin of oviscapt valve not more widely spaced in proximal portion than in other portions (Fig. 6C, G).

Common characters. Eyes red to reddish purple, with thick interfacetal setulae. Frons brown to blackish brown, nearly parallel-sided; ocellar triangle and fronto-orbital plates glossary black. Antennal pedicel cylindrically conical, yellow to brown, blackish brown laterally, with 2 prominent and a few small setae; first flagellomere yellow. Face yellowish brown; carina narrow, relatively flat. Gena narrow, yellowish brown; postgena and occiput black. Palpus apically roundish, with 1 prominent seta apically and several short ones apically to ventrally. Cibarium protruded at anterolateral corners, with 4 anterior sensilla arranged in somewhat irregular quadrangle and 2 pair of sensilla campaniformia. Acrostichal setulae in 8 regular rows. Postpronotal setae 2 (4 in *I. actinia* comb. nov.), subequal. Prescutellar setae absent. Basal scutellar setae usually diverged from each other; apical scutellar setae cruciate. Mid katepisternal seta as long as or slightly longer than anterior katepisternal one; katepisternum without setulae beside prominent seta near caudoventral corner. Wing apically round, relatively long and narrow, extending much beyond abdominal tip; C_1 setae 2; R_{2+3} slightly curved to costa; R_{4+5} and M nearly parallel distally. Preapical dorsal setae present on tibiae of all legs; apicals only on tibiae of midlegs; tarsomere Vs of all legs dark, with large claws. Female abdominal tergite VII separated into 2 lateral plates, blackish brown. Epandrium usually truncate ventrally. Surstylus with a row of prensisetae like canine teeth along caudal margin. Cercus separated from epandrium. Hypandrium without paramedian setae, posteriorly fused with gonopods. Gonopods flap-shaped, apically narrowing, close to each other, forming clamp-like structure. Paramere postolaterally fused with gonopod, with sensilla arranged in longitudinal row from subapical to subbasal portion (except *I. quadrangulata* sp. nov.: in chevroned row). Aedeagus membranous; basal process well developed, sclerotized; apodeme rod-shaped, anteriorly expanded in lateral view.

Type species. Hirtodrosophila yapingi Gao, 2011.

Etymology. Referring to the preference (Latin: *-philus*) to the genus of their main host plants (*Impatiens*). Gender: feminine.

Key. The multiple-entry key "*Impatiophila* (Diptera: Drosophilidae)" to all species of this genus has been constructed based on a database of morphological characters, and is available from the website "Biological Classification and Identification System (BioCIS: http://biokey.museum.hokudai.ac.jp/Classification/index.jsp)".

1. *Impatiophila yapingi* species group, new

Diagnosis. Anteromost, posterior sensillum of cibarium not shorter than twice length of posteromost, medial sensillum (Fig. 3A). Patch of dense, small setae or stout setulae present on caudoventral portion of epandrium (Fig. 5B). Ovisensilla on ventral margin of oviscapt valve distally increasing or nearly constant in size (Fig. 6E). Subapical, trichoid ovisensillum of oviscapt valve stout, longer than apical, peg-like ovisensillum (Fig. 6E). Spermathecal capsule wider than long, apically somewhat round or flat in lateral view (Fig. 6M).

Common characters. Cibarial, posterior sensilla slightly curved anteriad. Labellum with 6 pseudotracheae per side (small variation seen in *I. trifurcatosternata*). Hindleg tarsomeres I–IV each with 1 black, apically blunt, stout spine at outer apex on underside (Figs. 3K, 12A; unknown for *I. limbicostata*). Distal margin of surstylus deeply concave in ventral 2/3 (except for *I. quadrangulata*: moderately concave). Paramere more or less roundish on apical margin (except for *I. quadrangulata*: quadrangular as a whole) in lateral view. Aedeagal basal process longer than 1/2 of paramere. Oviscapt valve horizontally expanded at apical portion (except for *I. yangi* and *I. forcipivalva*: not distinctly expanded); lateral ovisensilla tightly arranged in a nearly straight (in ventral view) row on margin of apicolateral flap (except for *I. yangi* and *I. forcipivalva*); ovisensilla on ventral margin of valve entirely arranged at nearly equal intervals.

1) *Impatiophila limbicostata* (Okada, 1966), comb. nov.

Drosophila (*Hirtodrosophila*) *limbicostata* Okada, 1966: 79.

Diagnosis. Abdomen tergites III−V each with caudal band medially narrowly constricted. Setae of middle row on 2nd costal section mostly heavy, peg-like setae, but not reaching R_{2+3}.

Distribution. Nepal (Taplejung).

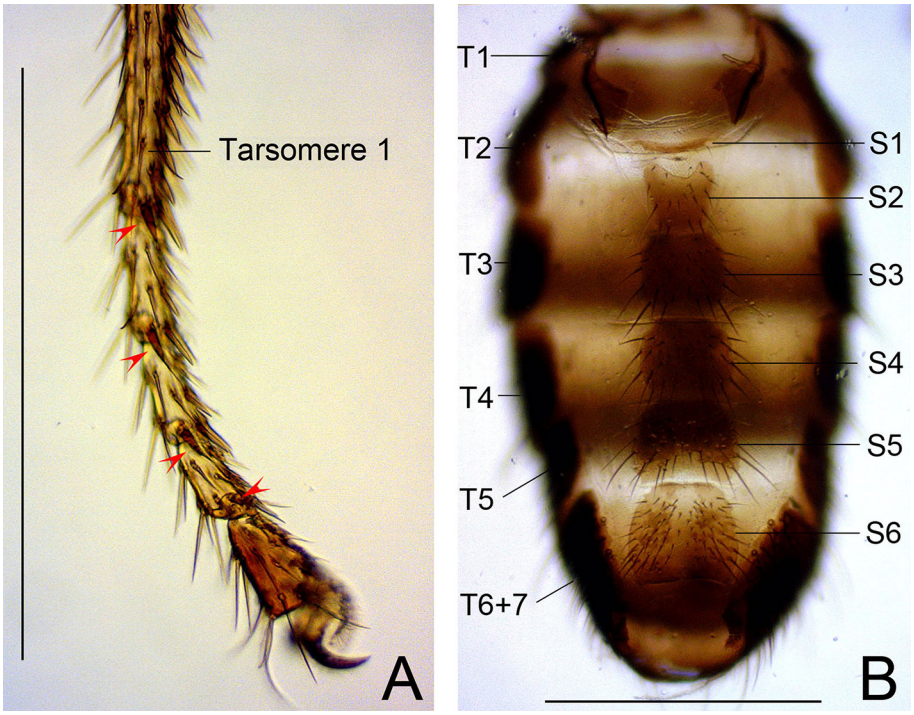

FIGURE 12. ***Impatiophila yapingi*** **(Gao, 2011), comb. nov.** Hindleg tarsus (#03752) and abdominal sternites (#03752). Abbreviations: T, tergite; S, sternite. Scale lines = 0.5 mm.

2) *Impatiophila yapingi* (Gao, 2011), comb. nov.
(Figs. 3A, J, 12; Pl. 1A; Pl. 6A)

Hirtodrosophila yapingi Gao, 2011: 74.

Diagnosis. Abdominal tergites III−V each with broad, black caudal band protruded medially (Pl. 1A). Setae of middle row on 2nd costal section all heavy, peg-like setae, present beyond tip of R_{2+3} ["Fig. 17" of Gao (2011)]. Hindleg tibia with 1 black, apically blunt, stout spine at outer apex on underside (Fig. 3J).

Supplementary and revised description (♂, ♀). Head ["Fig. 5" of Gao (2011)]: Arista with 2−3 dorsal and 1 ventral branches. Cibarium with 2−3 medial and 5−6 posterior sensilla per side (Fig. 3A).

Thorax: Mid katepisternal seta longer than anterior katepisternal seta.

Abdomen (Pl. 1A): Male sternite VI somewhat quadrate, slightly wider than long, nearly straight or slightly concave on posterior margin (Fig. 12B).

Male terminalia: Epandrium pubescent patchily less than half but not on mid-dorsal portion ["Fig. 18" of Gao (2011)]. Tenth sternite medially slightly projected ["Fig. 11" of Gao (2011)]. Paramere longer than twice of width in lateral view ["Fig. 10" of Gao (2011)].

Female terminalia: Oviscapt valve gently curved on dorsosubapical margin and less expanded dorsomedially in lateral view, with 4 dorsal, 11−12 lateral ovisensilla and 9−10 nearly constant in size on distally concave, ventral margin ["Figs. 21, 22" of Gao (2011)].

Specimens examined. CHINA: 1♂ (KIZ: #01678), Bamboo Temple, Kunming, Yunnan, 28.vii.2011, *ex Impatiens tayemonii* Hayata, J.J. Gao; 4♂, 5♀ (KIZ: #00115, #00116, #00118–24), same except for 25.viii.2011; 1♂, 1♀ (KIZ: #03752, #03753), same except for 21.viii.2014, M.J. Toda; 1♀, same except for 28.ii.1987, W.X. Zhang (SEHU).

Distribution. China (Yunnan).

3) *Impatiophila parvula* Fu & Gao, sp. nov.
(Fig. 13; Pl. 1B; Pl. 6B)

Diagnosis. Abdominal tergites III−V unicolorously black (Pl. 1B). Paramere somewhat pointed apically in lateral view (Fig. 13F). Tenth sternite somewhat triangularly convex on dorsal margin, broadened ventrally (Fig. 13D). Oviscapt valve with 6−7 ovisensilla on dorsal margin (Fig. 13G).

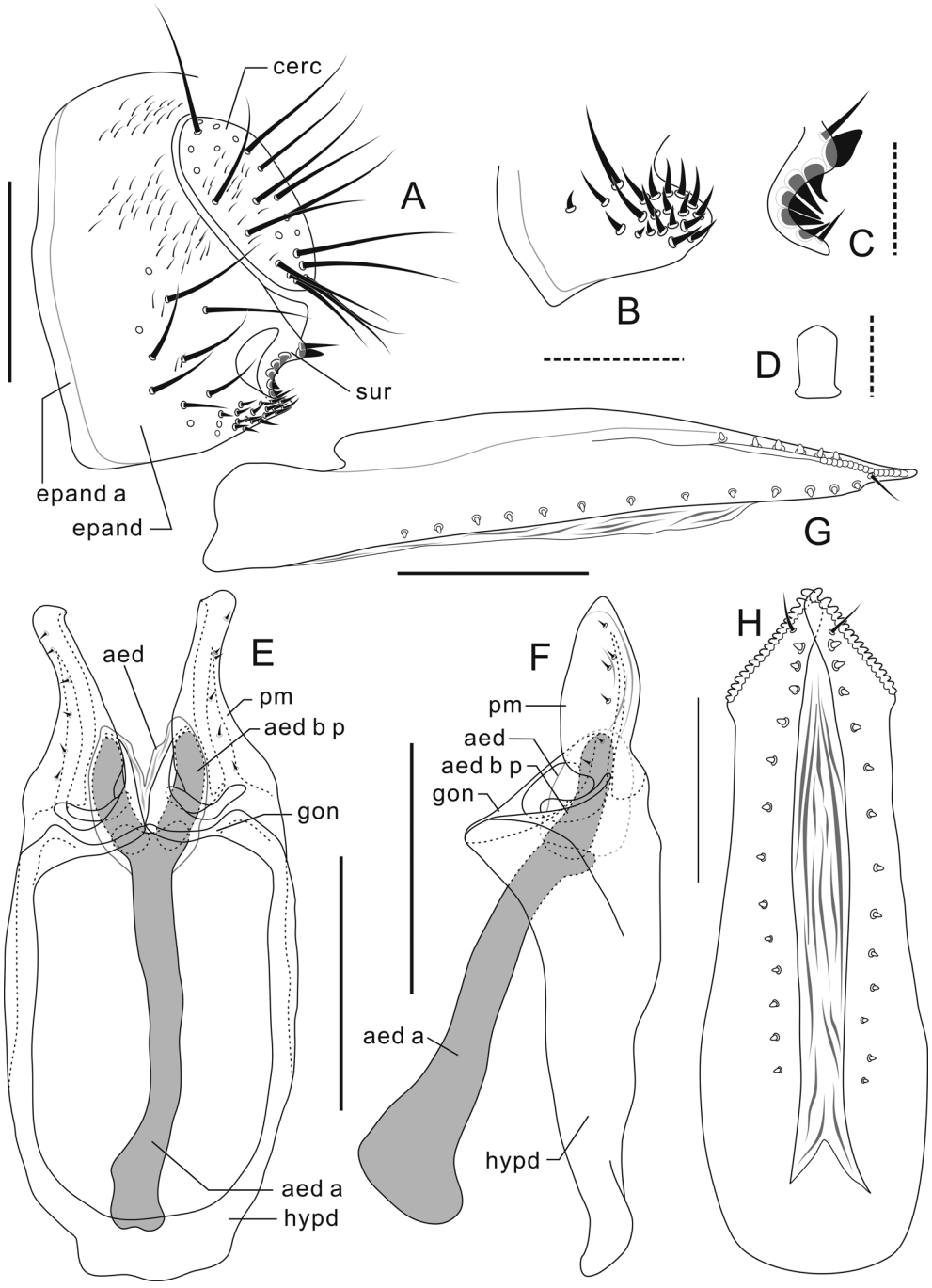

FIGURE 13. *Impatiophila parvula* Fu & Gao, sp. nov. Adult male (paratype, #00270) and female (paratype, #00612): A, periphallic organs (caudolateral view); B, caudoventral part of epandrium; C, surstylus (caudal view); D, tenth sternite; E, phallic organs (dorsal view); F, phallic organs (lateral view); G, oviscapt (lateral view); H, oviscapt (ventral view). Abbreviations: aed = aedeagus, aed a = aedeagal apodeme, aed b p = aedeagal basal process, cerc = cercus, epand = epandrium, epand a = epandrial apodeme, gon = gonopod, hypd = hypandrium, pm = paramere, sur = surstylus. Scale lines = 0.1 (solid lines) or 0.05 mm (dashed lines).

Description (♂, ♀). Head: Cibarium with 2−3 medial and 5 posterior sensilla per side.

Thorax (Pl. 1B): Postpronotum, scutum and scutellum black; pleura blackish brown.

Wing (Pl. 1B) pale brown; veins dark brown. C_1 setae subequal. Setae of middle row on 2nd costal section all weak, trichoid. Haltere brown.

Legs (Pl. 1B) yellowish brown. Hindleg tibia without black, apically blunt, stout spine at outer apex on underside.

Abdomen: Sternites grayish yellow; male VI somewhat quadrate, slightly longer than wide, nearly straight or slightly concave on posterior margin.

Male terminalia (Fig. 13A–F): Epandrium pubescent largely more than half, except for mid-dorsal, anterior and ventral portions, ventrally with 9 long setae; caudoventral portion broad, with a patch of ca. 19 short, stout setulae. Surstylus with 1 long seta in addition to stout, upturned prensiseta at caudodorsal corner, 5 apically converging prensisetae along distal margin and long seta near ventral apex. Cercus sparsely pubescent, with ca. 23 long setae. Hypandrium nearly parallel-sided on medial to posterior portion of lateral margins, with broad apodeme anteriorly. Gonopod apically narrowing in lateral view, connected to aedeagal basal process by narrow, membraneous tissue. Paramere longer than twice of width in lateral view, with 6 sensilla. Aedeagal basal process slightly longer than 1/2 of paramere.

Female terminalia (Fig. 13G, H; Pl. 6B): Oviscapt valve gently curved on dorsosubapical margin and less expanded dorsomedially in lateral view, with 17−19 lateral ovisensilla and ca. 13 distally increasing in size on nearly straight, ventral margin. Spermathecal capsule brown; introvert depth of duct about 1/2 of capsule height.

Measurements: BL = 1.87 in the holotype (5♂ paratypes: 1.87−2.08; 5♀ paratypes: 1.81−2.05) mm, ThL = 0.85 (0.72−0.88; 0.72−0.93) mm, WL = 1.80 (1.55−1.80; 1.59−1.90) mm, WW = 0.77 (0.69−0.77; 0.67−0.81) mm.

Indices: arb = 2/1 (5♂, 5♀: 2−3/0−2), FW/HW = 0.47 (0.45−0.50), ch/o = 0.11 (0.07−0.15), prorb = 1.00 (0.88−1.26), rcorb = 0.73 (0.53−0.84), orbito = 1.17 (0.91−1.31), vb = 0.39 (0.31−0.46), dcl = 0.55 (0.45−0.62), dcp = 0.36 (0.35−0.45), sterno = 0.65 (0.51−0.75), m-sterno = 0.66 (0.64−0.79), sctl = 0.92 (0.90−1.11), sctlp = 1.00 (0.85−1.14), C = 2.37 (2.22−2.53), 4c = 0.90 (0.82−0.98), 4v = 1.61 (1.48−1.79), 5x = 1.71 (1.63−1.92), ac = 2.72 (2.17−2.60), M = 0.43 (0.44−0.53).

Holotype. ♂ (#00609), along the way from the Hanmi Village to the seat of Beibeng Town, Motuo County, Linzhi, Xizang (Tibet), China, 27.ix.2010, *ex Impatiens siculifer* Hook. f. (Fig. 1A), J.J. Gao (KIZ).

Paratypes. CHINA: 5♂, 5♀ (#00270, #00271, #00603, #00605−7, #00610−12, #00614), same data as holotype; 2♂, 1♀ (#00300, #00304, #01401), by net sweeping, along the way from Beibeng to the seat of Motuo County, Linzhi, Xizang, 1.x.2010, J.J. Gao (KIZ, SEHU).

Distribution. China (Xizang).

Etymology. Referring to the small (*parvus*) body size.

4) *Impatiophila convergens* Fu & Gao, sp. nov.

(Fig. 14; Pl. 1C; Pl. 6C)

Diagnosis. Setae of middle row on 2nd costal section all weak, trichoid. Hindleg tibia without black, apically blunt, stout spine at outer apex on underside. Tenth sternite somewhat triangularly convex on dorsal margin (Fig. 14D). Oviscapt valve distally concave on ventral margin in lateral view, with 9–10 lateral ovisensilla (Fig. 14G, H).

Description (♂, ♀). Head: Cibarium with 2 medial and 4−7 posterior sensilla per side.

Thorax (Pl. 1C): Postpronotum brown; scutum blackish brown, paler along transverse suture, medially with narrow, pale brown, longitudinal stripe; scutellum dark brown; pleura brown to blackish brown.

Wing (Pl. 1C) hyaline; veins yellow. C_1 setae 2; ventral one thinner and shorter. Haltere pale yellow.

Legs (Pl. 1C) yellow.

Abdomen (Pl. 1C): Tergites each with broad, pale brown, caudal band. Sternites pale yellow; male VI somewhat quadrate, slightly longer than wide, nearly straight or slightly concave on posterior margin.

Male terminalia (Fig. 14A−F): Epandrium posteriorly pubescent on dorsal 2/3, ventrally with 8 long setae; caudoventral portion broad, roundish distally, with a patch of ca. 20 short, stout setulae. Surstylus with 2 long setae in addition to 2 stout, upturned prensiseta around caudodorsal corner, 4 apically converging prensisetae along distal margin and 2 long setae near ventral apex. Cercus sparsely pubescent on large area, with ca. 20 long setae. Hypandrium somewhat trapezoid in ventral view. Gonopod apically oval in lateral view. Paramere slightly curved

dorsad subapically, longer than twice of width in lateral view, with 6 sensilla. Aedeagal basal process about 3/5 length of paramere.

Female terminalia (Fig. 14G, H; Pl. 6C): Oviscapt valve gently curved on dorsosubapical margin and less expanded dorsomedially in lateral view, with 4 dorsal ovisensilla and 9−10 ventral ones distally increasing in size. Spermathecal capsule brown; introvert depth of duct about 1/3 of capsule height.

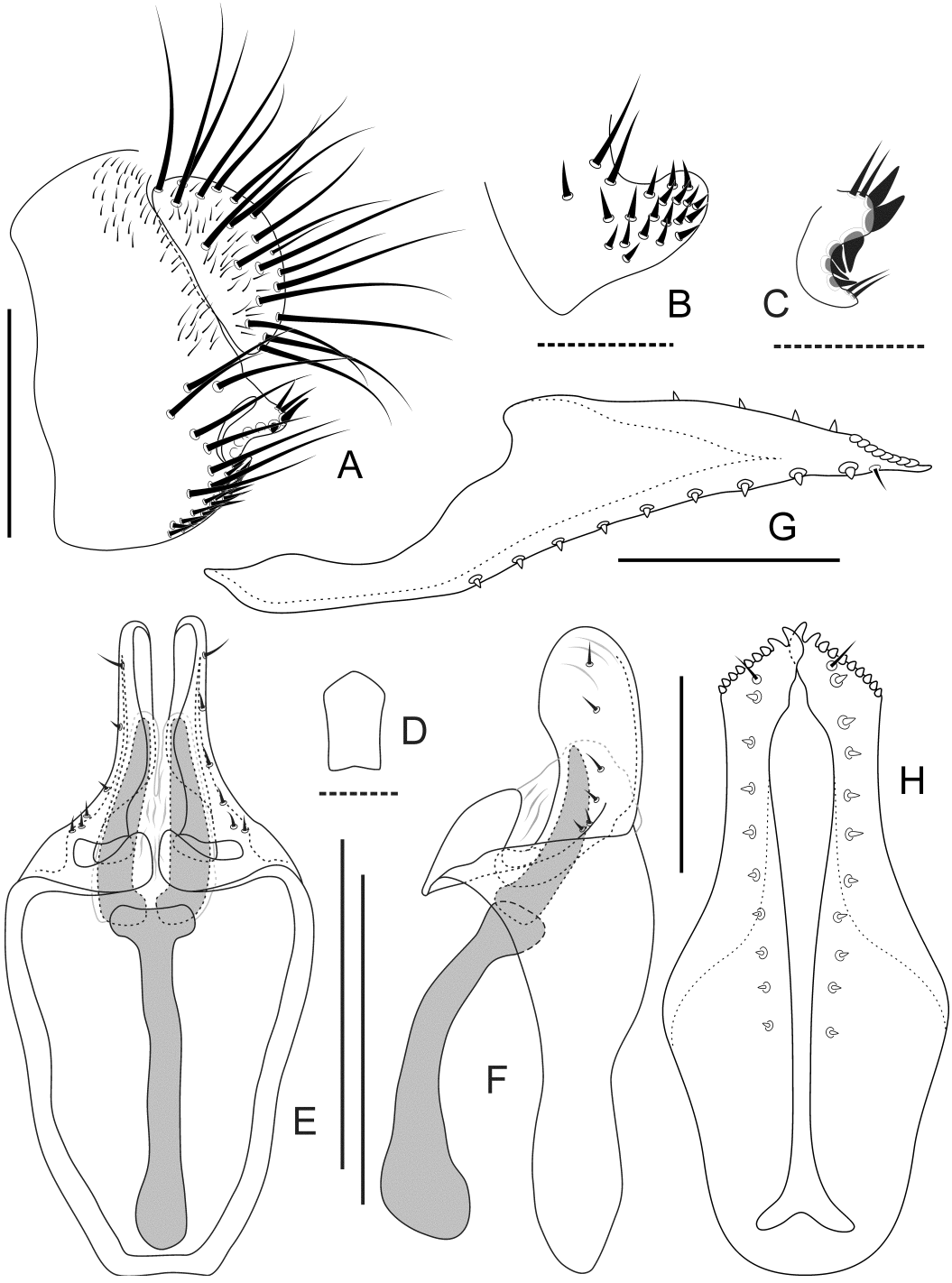

FIGURE 14. ***Impatiophila convergens*** **Fu & Gao, sp. nov.** Adult male (holotype, #00311) and female (paratype, #00540): A, periphallic organs (caudolateral view); B, caudoventral part of epandrium; C, surstylus (caudal view); D, tenth sternite; E, phallic organs (dorsal view); F, phallic organs (lateral view); G, oviscapt (lateral view); H, oviscapt (ventral view).

Measurements: BL = 2.08 (1♀ paratype: 2.09) mm, ThL = 0.91 (0.96) mm, WL = 2.16 (2.17) mm, WW = 0.99 (1.02) mm.

Indices: arb = 2/1 (1♀ paratype: 2–3/1), FW/HW = 0.51 (0.52), ch/o = 0.21 (0.16), prorb = 0.93 (0.92), rcorb = 0.67 (0.70), orbito = 1.25 (1.20), vb = 0.45 (0.41), dcl = 0.50 (0.54), dcp = 0.38 (0.42), sterno = 0.64 (0.63), m-sterno = 0.72 (0.74), sctl = 1.05 (0.99), sctlp = 1.06 (1.07), C = 2.21 (2.45), 4c = 0.96 (0.82), 4v = 1.65 (1.49), 5x = 1.42 (1.46), ac = 2.50 (2.50), M = 0.46 (0.45).

Holotype. ♂ (#00311), Hanmi Village, Beibeng Town, Motuo County, Linzhi District, Xizang, China, 29°22′00″N, 95°07′39″E, ca. 2130 m, 26.ix.2010, *ex Impatiens* sp. aff. *bahanensis* Hand.-Mazz. (Fig. 1B), J.J. Gao (KIZ).

Paratype. CHINA: ♀ (#00540), same data as holotype (KIZ).

Distribution. China (Xizang).

Etymology. Referring to the converging (*convergens*) prensisetae on the distal margin of surstylus.

5) *Impatiophila eretmosternata* Fu & Gao, sp. nov.

(Fig. 15; Pl. 1D; Pl. 6D)

Diagnosis. Scutum and scutellum with distinct color pattern (Pl. 1D). Setae of middle row on 2nd costal section all weak, trichoid. Hindleg tibia without black, apically blunt, stout spine at outer apex on underside. Epandrium posteriorly pubescent in patches on dorsal 1/2 (Fig. 15A). Oviscapt valve distally concave on ventral margin in lateral view, with 12–13 lateral ovisensilla (Fig. 15G, H).

Description (♂, ♀). Head: Cibarium with 1–3 medial and 4–6 posterior sensilla per side.

Thorax (Pl. 1D): Postpronotum pale brown; scutum blackish brown, pale along transverse suture and along lines running through ipsilateral, dorsocentral setae; scutellum brown, pale laterally; pleura pale brown.

Wing (Pl. 1D) hyaline; veins yellow. C_1 setae 2; ventral one thinner and shorter. Haltere pale yellow.

Legs (Pl. 1D) yellow. Hindleg tibia without black, apically blunt, stout spines at outer apex on underside.

Abdomen (Pl. 1D): Tergites each with broad, blurred, pale brown, caudal band; bands on II–IV medially more or less notched or interrupted, laterally narrowed. Sternites pale yellow; male VI somewhat quadrate, slightly longer than wide, nearly straight or slightly concave on posterior margin.

Male terminalia (Fig. 15A–F): Epandrium ventrally with ca. 16 long setae; caudoventral portion somewhat triangular, with a patch of ca. 15 short, stout setulae. Surstylus with 1 long seta in addition to 1 stout, upturned prensiseta at caudodorsal corner, 5 apically converging prensisetae along distal margin and 1 long seta near ventral apex. Tenth sternite roundly convex on both dorsal and ventral margins, longer than twice of width. Cercus sparsely pubescent, with ca. 21 long setae. Hypandrium slightly dilated posteriorly, roundish on anterior margin. Paramere nearly straight in lateral view, longer than twice of width in lateral view, with 7 sensilla. Gonopod apically triangular in lateral view. Aedeagal basal process slightly longer than 1/2 length of paramere.

Female terminalia (Fig. 15G, H; Pl. 6D): Oviscapt valve gently curved on dorsosubapical margin and less expanded dorsomedially in lateral view, with 6–8 dorsal ovisensilla and 11–13 ventral ones nearly constant in size. Spermathecal capsule brown; introvert depth of duct about 1/3 of capsule height.

Measurements: BL = 2.21 (1♀ paratype: 2.38) mm, ThL = 1.08 (1.06) mm, WL = 2.59 (2.57) mm, WW = 1.15 (1.16) mm.

Indices: arb = 2–3/1 (1♀ paratype: 2–3/1), FW/HW = 0.44 (0.45), ch/o = 0.14 (0.12), prorb = 1.07 (1.10), rcorb = 0.77 (0.75), orbito = 1.16 (1.06), vb = 0.46 (0.41), dcl = 0.56 (0.52), dcp = 0.42 (0.33), sterno = 0.68 (0.60), m-sterno = 0.74 (0.72), sctl = 1.04 (1.00), sctlp = 1.15 (1.10), C = 2.28 (2.65), 4c = 0.93 (0.86), 4v = 1.63 (1.67), 5x = 1.40 (1.48), ac = 2.70 (2.63), M = 0.44 (0.49).

Holotype. ♂ (#00515), along the way from the Lage Village, Baiba Town, Linzhi County to the Hanmi Village, Beibeng Town, Motuo County, Linzhi District, Xizang, China, 25.ix.2010, *ex Impatient desmantha* Hook. f. (Fig. 1C), J.J. Gao (KIZ).

Paratype. CHINA: 1♀ (#00310), same data as holotype (KIZ).

Distribution. China (Xizang).

Etymology. Referring to the remiform (*eretmo*-) tenth sternite (*sternum*).

Remarks. The dark pigmentation on the scutum, scutellum, thoracic pleura and abdominal tergites is weaker in the holotype (#00515) than in the paratype (#00310); moreover, in the holotype, an additional, blurred central stripe is present on the scutum (lacking in the paratype), and the lateral stripes run through the notum (slightly extending to the anterior dorsocentral setae in the paratype). These differences are probably due to the difference in

age between the two specimens; the holotype seems to be younger than the paratype. The two specimens were collected from the same plant at the same locality, and their *COI* K2P genetic distance was very low (0.0016). Therefore, we regarded them as conspecific.

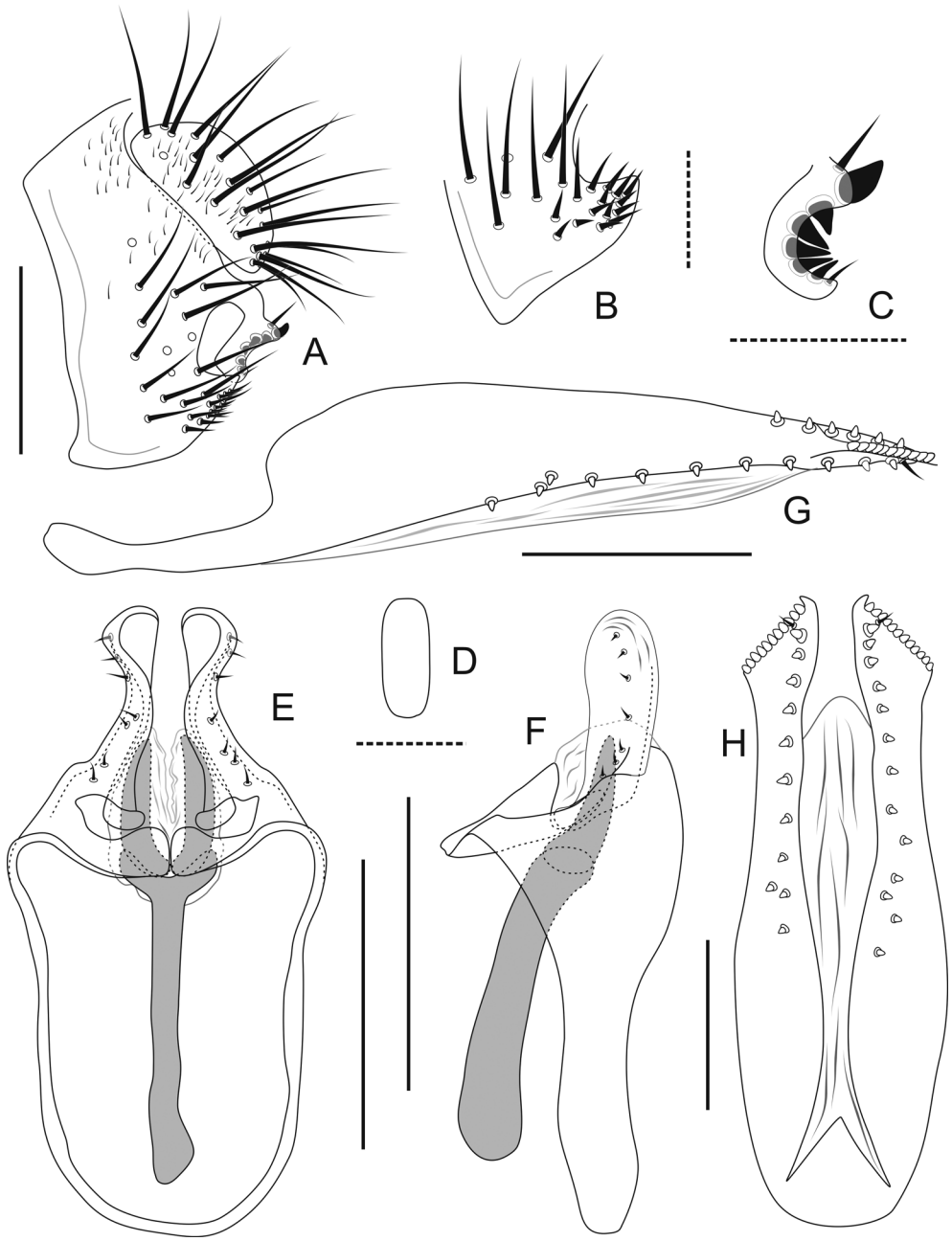

FIGURE 15. ***Impatiophila eretmosternata*** **Fu & Gao, sp. nov.** Adult male (holotype, #00515) and female (paratype, #00310): A, periphallic organs (caudolateral view); B, caudoventral part of epandrium; C, surstylus (caudal view); D, tenth sternite; E, phallic organs (dorsal view); F, phallic organs (lateral view); G, oviscapt (lateral view); H, oviscapt (ventral view).

6) *Impatiophila tongmaiensis* Fu & Gao, sp. nov.

(Fig. 16; Pl. 1E; Pl. 6E)

Diagnosis. Setae of middle row on 2nd costal section all heavy, peg-like, present beyond tip of R_{2+3}. Abdominal tergite V with caudal, black band medially neither interrupted/constricted nor protruded (Pl. 1E). Hindleg tibia with 1 black, apically blunt, stout spine at outer apex on underside.

Description (♂, ♀). Head (Pl. 1E): Eyes brownish. Cibarium with 2or 3 medial and 4–6 posterior sensilla per side.

Thorax (Pl. 1E): Postpronotum yellowish brown to brown; scutum black, pale along transverse suture, notopleural line and lines running through ipsilateral, dorsocentral setae and extending to notum; scutellum black, pale laterally; pleura brown to blackish brown.

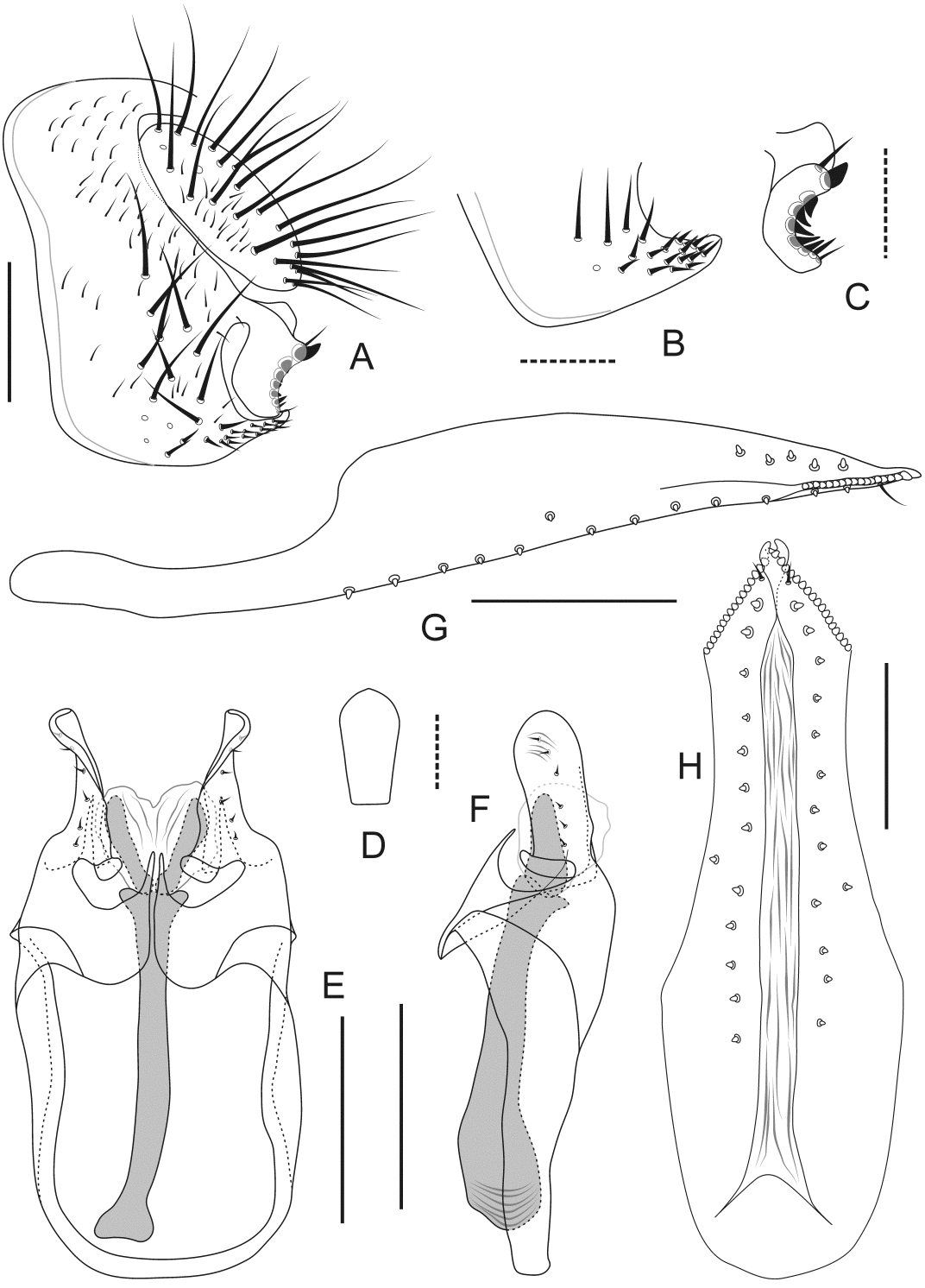

FIGURE 16. ***Impatiophila tongmaiensis*** **Fu & Gao, sp. nov.** Adult male (holotype, #00294) and female (paratype, #00295): A, periphallic organs (caudolateral view); B, caudoventral part of epandrium; C, surstylus (caudal view); D, tenth sternite; E, phallic organs (dorsal view); F, phallic organs (lateral view); G, oviscapt (lateral view); H, oviscapt (ventral view).

Wing (Pl. 1E) hyaline; veins yellowish brown. C_1 setae 2; ventral one thinner and shorter. Haltere pale yellow.

Abdomen (Pl. 1E): Tergites each with broad, blackish brown to black, caudal band; bands on II−IV medially with narrow, deep notches. Sternites grayish brown; male VI posteriorly wider, concave on posterior margin.

Male terminalia (Fig. 16A−F): Epandrium sparsely and patchily pubescent except for anterior and ventral portions, ventrally with ca. 12 long setae; caudoventral portion narrow, somewhat pointed apically, with a patch of ca. 18 setulae. Surstylus with 1 seta in addition to 1 stout, upturned prensiseta at caudodorsal corner, 6 apically converging prensisetae along distal margin and 1 seta near ventral apex. Tenth sternite dorsally broader, slightly pointed at apex of convex, dorsal margin. Cercus anteromedially pubescent in patch, with ca. 28 long setae. Hypandrium somewhat quadrate, 3/4 as wide as long. Gonopod apically very sharp, curved ventrad. Paramere nearly straight in lateral view, longer than twice of width in lateral view, with 6 sensilla. Aedeagal basal process slightly longer than 1/2 length of paramere.

Female terminalia (Fig. 16G, H; Pl. 6E): Oviscapt valve gently curved on dorsosubapical margin and less expanded dorsomedially in lateral view, with 5 dorsal and 18−19 lateral ovisensilla and 13 distally increasing in size on nearly straight, ventral margin. Spermathecal capsule brown; introvert depth of duct about 1/2 of capsule height.

Measurements: BL = 2.48 (4♂ paratypes: 2.37−2.83, 5♀ paratypes: 2.62−2.83) mm, ThL = 1.18 (1.03−1.24, 1.07−1.32) mm, WL = 2.91 (2.55−2.93, 2.60−3.12) mm, WW = 1.30 (1.14−1.28, 1.10−1.37) mm.

Indices: arb = 3/1 (4♂, 5♀ paratypes: 4−2/1−2), FW/HW = 0.45 (0.44−0.51), ch/o = 0.14 (0.07−0.14), prorb = 0.91 (0.94−1.12), rcorb = 0.62 (0.59−0.72), orbito = 1.04 (0.96−1.15), vb = 0.35 (0.33−0.44), dcl = 0.46 (0.47−0.63), dcp = 0.33 (0.32−0.40), sterno = 0.67 (0.62−0.75), m-sterno = 0.82 (0.61−0.91), sctl = 1.04 (0.93−1.05), sctlp = 1.17 (1.04−1.34), C = 2.61 (2.44−2.70), 4c = 0.80 (0.78−0.94), 4v = 1.48 (1.51−1.81), 5x = 1.46 (1.35−1.63), ac = 2.55 (2.41−2.92), M = 0.46 (0.42−0.49), C3F = 0.20 (0.06−0.20).

Holotype. ♂ (#00294), Tongmai Village, Yigong Town, Bomi County, Linzhi District, Xizang, China, 30°06′10″N, 95°04′49″E, 2080 m, 9.x.2010, *ex Impatiens* ?*arguta* Hook. f. et. Thoms. (Fig. 1D), J.J. Gao (KIZ).

Paratypes. CHINA: 4♂, 5♀ (#00295, #00493, #00494, #00638, #00640−43, #00681), same data as holotype (KIZ, SEHU).

Distribution. China (Xizang).

Etymology. Pertaining to the type locality.

7) *Impatiophila linzhiensis* Fu & Gao, sp. nov.

(Fig. 17; Pl. 1F; Pl. 6F)

Diagnosis. Setae of middle row on 2nd costal section mostly heavy, peg-like setae, but not reaching R_{2+3} (Fig. 3F). Abdominal tergites III–V each with black, medially widely interrupted, caudal band (Pl. 1F).

Description (♀). Head (Pl. 1F): Eyes dark brownish. Cibarium with 3 medial and 4 posterior sensilla per side.

Thorax (Pl. 1F): Postpronotum yellowish brown; scutum blackish brown to black, pale posteriorly, along transverse suture and throughout median line and lines of ipsilateral dorsocentral setae; scutellum brown, pale laterally; pleura brown to blackish brown.

Wing (Pl. 1F) hyaline; veins yellowish brown. C_1 setea 2; ventral one shorter and thinner. Haltere pale yellow.

Legs: (P1. 1F): Hindleg tibia without black, apically blunt, stout spine at outer apex on underside.

Abdomen: Sternites grayish yellow.

Female terminalia (Fig. 17A, B; Pl. 6F): Oviscapt valve gently curved on dorsosubapical margin and less expanded dorsomedially in lateral view, with 5–6 ovisensilla on dorsosubapical margin, ca. 12 on slightly convex (in ventral view) margin of somewhat triangular, apicolateral flap and 9–13 distally increasing in size on slightly convex, ventral margin. Spermathecal capsule pale brown; introvert depth of duct about 1/3 of capsule height.

Measurements: BL = 2.48 mm, ThL = 1.13 mm, WL = 2.55 mm, WW = 1.12 mm.

Indices: arb = 2/1, FW/HW = 0.47, ch/o = 0.14, prorb = 1.00, rcorb = 0.67, orbito = 1.32, vb = 0.40, dcl = 0.55, dcp = 0.38, sterno = 0.60, m-sterno = 0.71, sctl = 1.08, sctlp = 1.18, C = 2.71, 4c = 0.81, 4v = 1.60, 5x = 1.73, ac = 2.55, M = 0.49.

Holotype. ♀ (#00543), along the way from Lage Village, Baiba Town, Linzhi County to Hanmi Village, Beibeng Town, Motuo County, Linzhi District, Xizang, China, 25.ix.2010, *ex Impatiens desmantha* Hook. f. (Fig. 1C), J.J. Gao (KIZ).

Distribution. China (Xizang).

Etymology. Pertaining to the type locality.

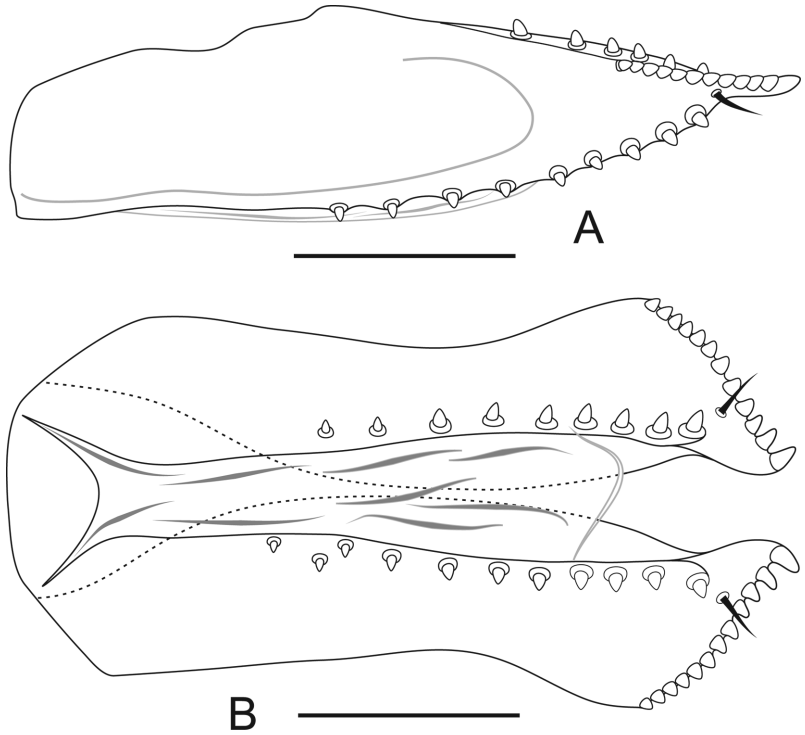

FIGURE 17. ***Impatiophila linzhiensis*** **Fu & Gao, sp. nov.** Adult female (holotype, #00543): A, oviscapt (lateral view); B, oviscapt (ventral view).

8) ***Impatiophila longifolia*** **Fu & Gao, sp. nov.**
(Fig. 18; Pl. 1G; Pl. 6G)

Diagnosis. Heavy, peg-like setae of middle row on 2nd costal section interspersed with weak, trichoid ones (Fig. 3G). Abdominal tergites entirely black (Pl. 1G). Hindleg tibia with 2 black, apically blunt, stout spines at outer apex on underside (Fig. 3K). Paramere like tip of golf shaft in lateral view (Fig. 18F).

Description (♂, ♀). Head: Cibarium with 2−3 medial and 4–6 posterior sensilla per side.

Thorax (Pl. 1G): Postpronotum blackish brown to black; scutum and scutellum black; pleura brown to blackish brown.

Wing (Pl. 1G) pale brown; veins brown. C_1 setae 2, subequal. Haltere pale yellow.

Abdomen: Sternites grayish brown; male VI posteriorly wider, nearly straight or slightly concave on posterior margin.

Male terminalia (Fig. 18A–F): Epandrium pubescent medially to posteriorly on dorsal 1/2, ventrally with ca. 14 long setae; caudoventral portion broad, apically somewhat truncate, with ca. 15 short, stout setulae. Surstylus with 1 seta in addition to 1 stout, upturned prensiseta at caudodorsal corner, 6 apically converging prensisetae along distal margin and 1 short seta near ventral apex. Tenth sternite warhead-shaped, slightly constrict basolaterally. Cercus pubescent near anterior margin, with ca. 25 long setae. Hypandrium long, largely parallel-sided, anteriorly with distinct apodeme. Gonopod short, apically blunt in lateral view. Paramere longer than twice of width in lateral view, with 6 sensilla. Aedeagal basal process slightly longer than 1/2 length of paramere.

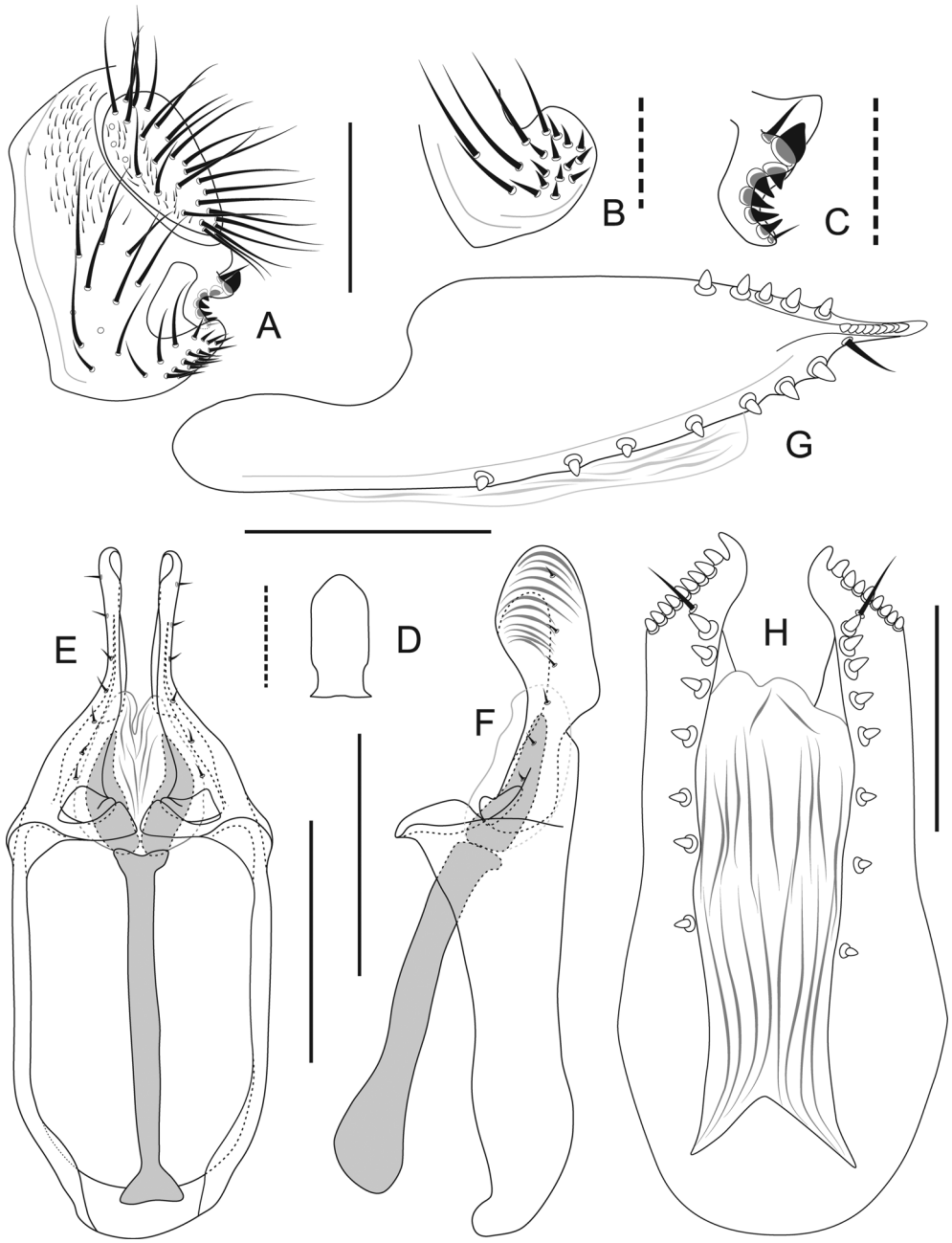

FIGURE 18. ***Impatiophila longifolia*** **Fu & Gao, sp. nov.** Adult male (holotype, #00508) and female (paratype, #00572): A, periphallic organs (caudolateral view); B, caudoventral part of epandrium; C, surstylus (caudal view); D, tenth sternite; E, phallic organs (dorsal view); F, phallic organs (lateral view); G, oviscapt (lateral view); H, oviscapt (ventral view).

Female terminalia (Fig. 18G, H; Pl. 6G): Oviscapt valve gently curved on dorsosubapical margin and less expanded dorsomedially in lateral view, with 5 dorsal ovisensilla, 9−10 ones on margin of narrow, apicolateral flap and 7−8 ones distally increasing in size on slightly convex, ventral margin. Spermathecal capsule brown; introvert depth of duct about 1/2 of capsule height.

Measurements: BL = 1.94 (5♂ paratypes: 1.53−2.27, 5♀ paratypes: 1.90−2.51) mm, ThL = 0.86 (0.70−0.95, 0.72−1.00) mm, WL = 1.92 (1.53−2.04, 1.81−2.17) mm, WW = 0.83 (0.67−0.93, 0.73−0.90) mm.

Indices: arb = 3/1 (5♂, 5♀ paratypes: 2−3/1), FW/HW = 0.45 (0.40−0.47), ch/o = 0.08 (0.06−0.09), prorb = 0.91 (0.93−1.09), rcorb = 0.82 (0.64−0.76), orbito = 0.89 (1.00−1.41), vb = 0.42 (0.27−0.44), dcl = 0.57 (0.36−0.58), dcp = 0.36 (0.32−0.46), sterno = 0.69 (0.55−0.76), m-sterno = 0.77 (0.53−0.80), sctl = 1.04 (0.97−1.08), sctlp = 1.22 (0.97−1.30), C = 2.35 (2.03−2.57), 4c = 0.85 (0.77−0.95), 4v = 1.49 (1.41−1.77), 5x = 1.62 (1.53−2.00), ac = 2.56 (2.28−3.09), M = 0.42 (0.39−0.50).

Holotype. ♂ (#00508), Banpo, Yixiang, Simao, Pu'er, Yunnan, China, 2.x.2011, *ex Impatiens* sp.5 (with yellow flowers), J.J. Gao (KIZ).

Paratypes. CHINA: 4♂, 4♀ (#00321, #00569, #00571, #00572, #01403, #01596, #01617, #01618), same data as holotype; 1♂, 1♀ (#01151, #01405), Jiujiezi, Baihualing Village, Mangkuan Town, Longyang County, Yunnan, 1900 m, 24.ix.2012, *ex Impatiens* sp.6 (with yellow flowers), J. J. Gao (KIZ, SEHU).

Distribution. China (Yunnan).

Etymology. Referring to the long (*longus*), foliate (*-foliatus*) paramere.

9) *Impatiophila ptyonosternata* Fu & Gao, sp. nov.

(Fig. 19; Pl. 1H; Pl. 6H)

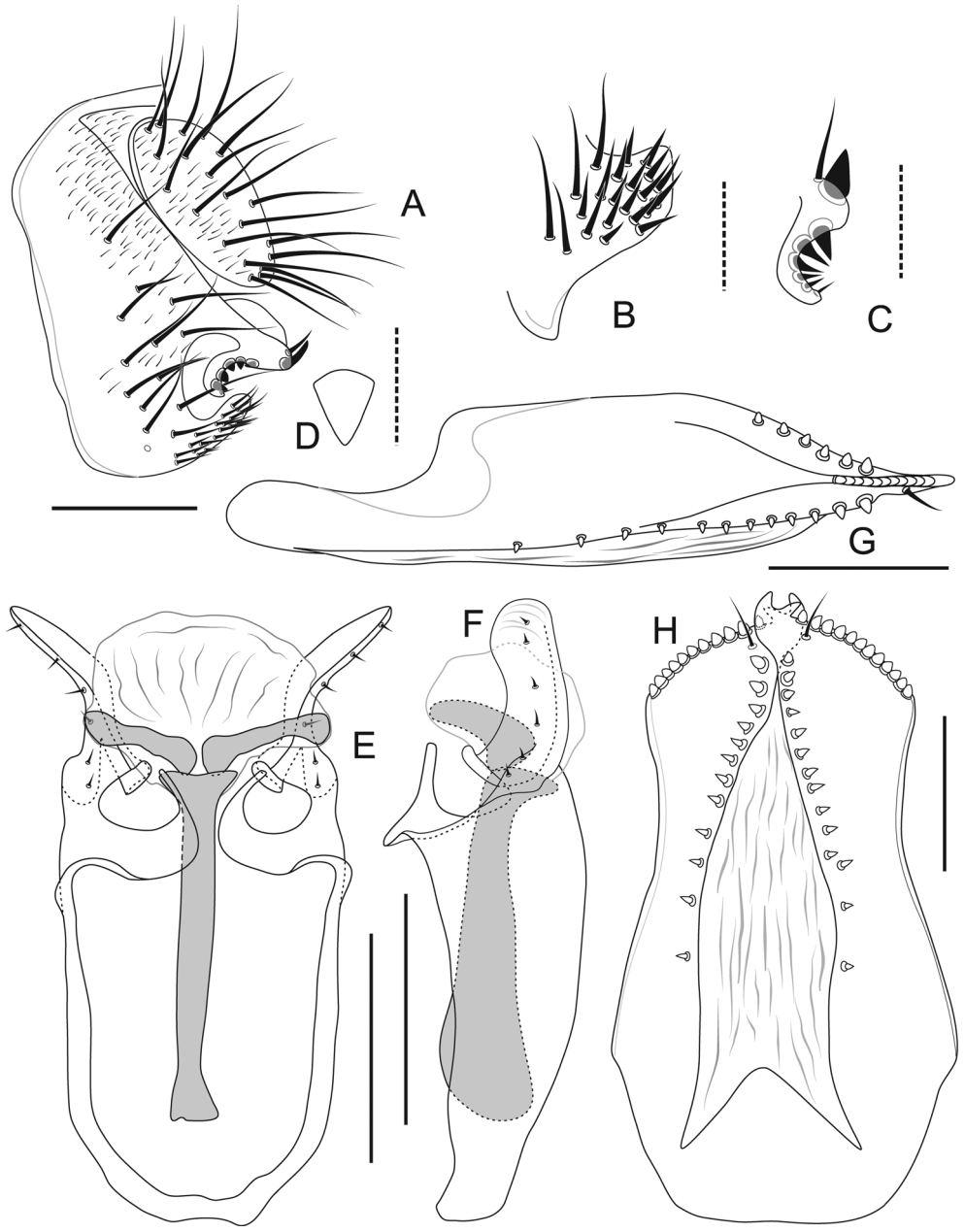

FIGURE 19. *Impatiophila ptyonosternata* Fu & Gao, sp. nov. Adult male (holotype, #00296) and female (paratype, #00297): A, periphallic organs (caudolateral view); B, caudoventral part of epandrium; C, surstylus (caudal view); D, tenth sternite; E, phallic organs (dorsal view); F, phallic organs (lateral view); G, oviscapt (lateral view); H, oviscapt (ventral view).

Diagnosis. Setae of middle row on 2nd costal section all heavy, peg-like, present beyond tip of R_{2+3}. Abdominal tergites III–V each with caudal, black band medially protruded (Pl. 1H). Hindleg tibia without black, apically blunt, stout spine at outer apex on underside. Male abdominal sternite VI wider than long. Tenth sternite somewhat triangular, roundly convex on dorsal margin (Fig. 19D); gonopod apically narrowing, finger-shaped in lateral view (Fig. 19F).

Description (♂, ♀). Head: Cibarium with 3−4 medial and 4−5 posterior sensilla per side.

Thorax (Pl. 1H): Postpronotum yellow to yellowish brown; scutum black to blackish brown, pale along transverse suture and throughout lines of ipsilateral dorsocentral setae; scutellum blackish brown, pale laterally; pleura yellowish brown to brown.

Wing (Pl. 1H) hyaline; veins yellowish brown. C_1 setae 2, subequal. Haltere pale yellow.

Abdomen (Pl. 1H): Tergites yellow, with black caudal bands broadened laterally. Sternites grayish brown; male VI posteriorly wider, concave on posterior margin.

Male terminalia (Fig. 19A–F): Epandrium pubescent except for anterial and ventral portions, ventrally with 12 long setae; caudoventral portion broad, obliquely truncate apically, with ca. 19 short, stout setulae. Surstylus with 1 seta in addition to 1 stout, upturned prensiseta at caudodorsal corner, 6 apically converging prensisetae along distal margin and 1 short seta near ventral apex. Cercus pubescent on anterior half, with ca. 26 long setae. Hypandrium long, largely parallel-sided. Paramere curved dorsad and longer than twice of width in lateral view, with 6 sensilla. Aedeagal basal process slightly longer than 1/2 length of paramere.

Female terminalia (Fig. 19G, H; Pl. 6H): Oviscapt valve gently curved on dorsosubapical margin and less expanded dorsomedially in lateral view, with 6 dorsal ovisensilla, 13−14 lateral ones on slightly convex margin of broad apicolateral flap and 12−14 distally increasing in size on nearly straight, ventral margin. Spermathecal capsule brown; introvert depth of duct about 1/2 of capsule height.

Measurements: BL = 2.63 (2♂ paratypes: 2.78−2.83, 3♀ paratypes: 2.41−2.81) mm, ThL = 1.10 (1.16−1.16, 1.06−1.20) mm, WL = 2.62 (2.73−2.75, 2.53−2.91) mm, WW = 1.14 (1.17−1.20, 1.16−1.30) mm.

Indices: arb = 3/1 (2♂, 3♀ paratypes: 3/1), FW/HW = 0.46 (0.46−0.48), ch/o = 0.13 (0.10−0.15), prorb = 0.97 (0.97−1.05), rcorb = 0.53 (0.58−0.66), orbito = 1.19 (0.81−1.20), vb = 0.31 (0.26−0.38), dcl = 0.47 (0.52−0.63), dcp = 0.40 (0.35−0.39), sterno = 0.68 (0.62−0.69), m-sterno = 0.82 (0.76−0.81), sctl = 1.06 (0.99−1.06), sctlp = 1.01 (1.02−1.13), C = 2.58 (2.46−3.08), 4c = 0.78 (0.68−0.84), 4v = 1.50 (1.47−1.65), 5x = 1.50 (1.50−1.64), ac = 2.83 (2.51−2.92), M = 0.41 (0.42−0.46), C3F = 0.12 (0.00−0.20).

Holotype. ♂ (#00296), Tongmai Village, Yigong Town, Bomi County, Linzhi District, Xizang, China, 30°06′10″N, 95°04′49″E, ca. 2080 m, 9.x.2010, *ex Impatiens* ?*arguta* Hook. f. et. Thoms. (Fig. 1D), J.J. Gao (KIZ).

Paratypes. CHINA: 1♂, 3♀ (#00297, #00313, #00463, #00464), same data as holotype; 1♂ (#00538), along the way from Beibeng Town to Yarang Village, Motuo Town, Motuo County, Linzhi District, Xizang, 1.x.2010, *ex Impatiens* ?*arguta* Hook. f. et. Thoms. (Fig. 1D), J.J. Gao (KIZ, SEHU).

Distribution. China (Xizang).

Etymology. Referring to the tenth sternite (*sternum*) shaped like fan (*ptyon*).

10) *Impatiophila tumidivalva* Fu & Gao, sp. nov.

(Fig. 20; Pl. 2A; Pl. 6I)

Diagnosis. Abdominal tergite dark brown to glossily black (Pl. 2A). Oviscapt valve strongly inflated in lateral view, strongly convex dorsosubapically (Fig. 20A).

Description (♀). Head: Cibarium with 2−3 medial and 5 posterior sensilla per side.

Thorax (Pl. 2A): Postpronotum and pleura blackish brown; scutum and scutellum black.

Wing (Pl. 2A) hyaline; veins brown. C_1 setae 2; ventral one shorter and thinner. Setae of middle row on 2nd costal section all weak, trichoid. Haltere pale yellow.

Legs (Pl. 2A) yellowish brown. Hindleg tibia with 2 black, apically blunt, stout spines at outer apex on underside.

Abdomen: Sternites grayish brown.

Female terminalia (Fig. 20A, B; Pl. 6I): Oviscapt valve less expanded dorsomedially in lateral view, with 3−4 dorsal ovisensilla on strongly convex, dorsosubapical margin, 7 lateral ones and 9−12 distally increasing in size on nearly straight, ventral margin. Spermathecal capsule brown; introvert depth of duct about 1/2 of capsule height.

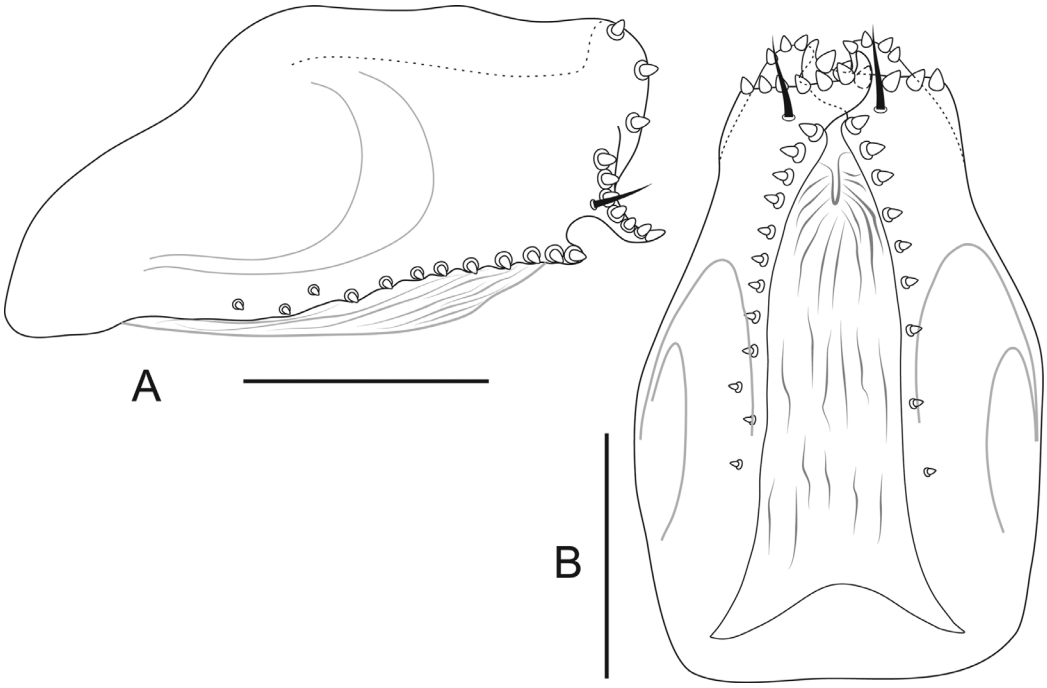

FIGURE 20. ***Impatiophila tumidivalva*** **Fu & Gao, sp. nov.** Adult female (holotype, #00376): A, oviscapt (lateral view); B, oviscapt (ventral view).

Measurements: BL = 2.52 mm, ThL = 1.15 mm, WL = 2.34 mm, WW = 1.05 mm.

Indices: arb = 2/1, FW/HW = 0.48, ch/o = 0.11, prorb = 0.98, rcorb = 0.68, orbito = 0.94, vb = 0.44, dcl = 0.59, dcp = 0.37, sterno = 0.71, m-sterno = 0.77, sctl = 1.05, sctlp = 1.00, C = 2.48, 4c = 0.91, 4v = 1.69, 5x = 1.68, ac = 2.29, M = 0.50.

Holotype. ♀ (#00376): Hanmi Village, Beibeng Town, Motuo County, Linzhi District, Xizang, China, 29°22′00″N, 95°07′39″E, ca. 2130 m, 26.ix.2010, *ex Impatiens* ?*arguta* Hook.f. & Thoms. (Fig. 1D) J.J. Gao (KIZ).

Distribution. China (Xizang).

Etymology. Referring to the strongly inflated (*tumidus*) oviscapt valve (*valva*).

11) *Impatiophila xiaoi* Fu & Gao, sp. nov.

(Fig. 21; Pl. 2B; Pl. 6J)

Diagnosis. Scutum pale brown, with 4 blackish brown to black, longitudinal stripes; two median ones faded and converged with each other posteriorly; scutellum with blackish brown stripe medially, pale brown laterally (Pl. 2B). Abdominal tergites III–V each with black, medially widely interrupted, caudal band (Pl. 2B). Setae of middle row on 2nd costal section all heavy, peg-like, present beyond tip of R_{2+3}. Tenth sternite somewhat obovate, with small notch medially on dorsal margin (Fig. 21D). Oviscapt valve moderately convex dorsosubapically in lateral view (Fig. 21G).

Description (♂, ♀). Head: Cibarium with 2–3 medial and 4–7 posterior sensilla per side.

Thorax (Pl. 2B): Postpronotum yellowish brown; pleura blackish brown to black.

Wing (Pl. 2B) pale brown; veins brown. C_1 bristle 2, subequal. Haltere pale yellow.

Legs: (P1. 2B)Hindleg tibia without black, apically blunt, stout spines at outer apex on underside.

Abdomen: Sternites grayish yellow; male VI somewhat quadrate, slightly wider than long.

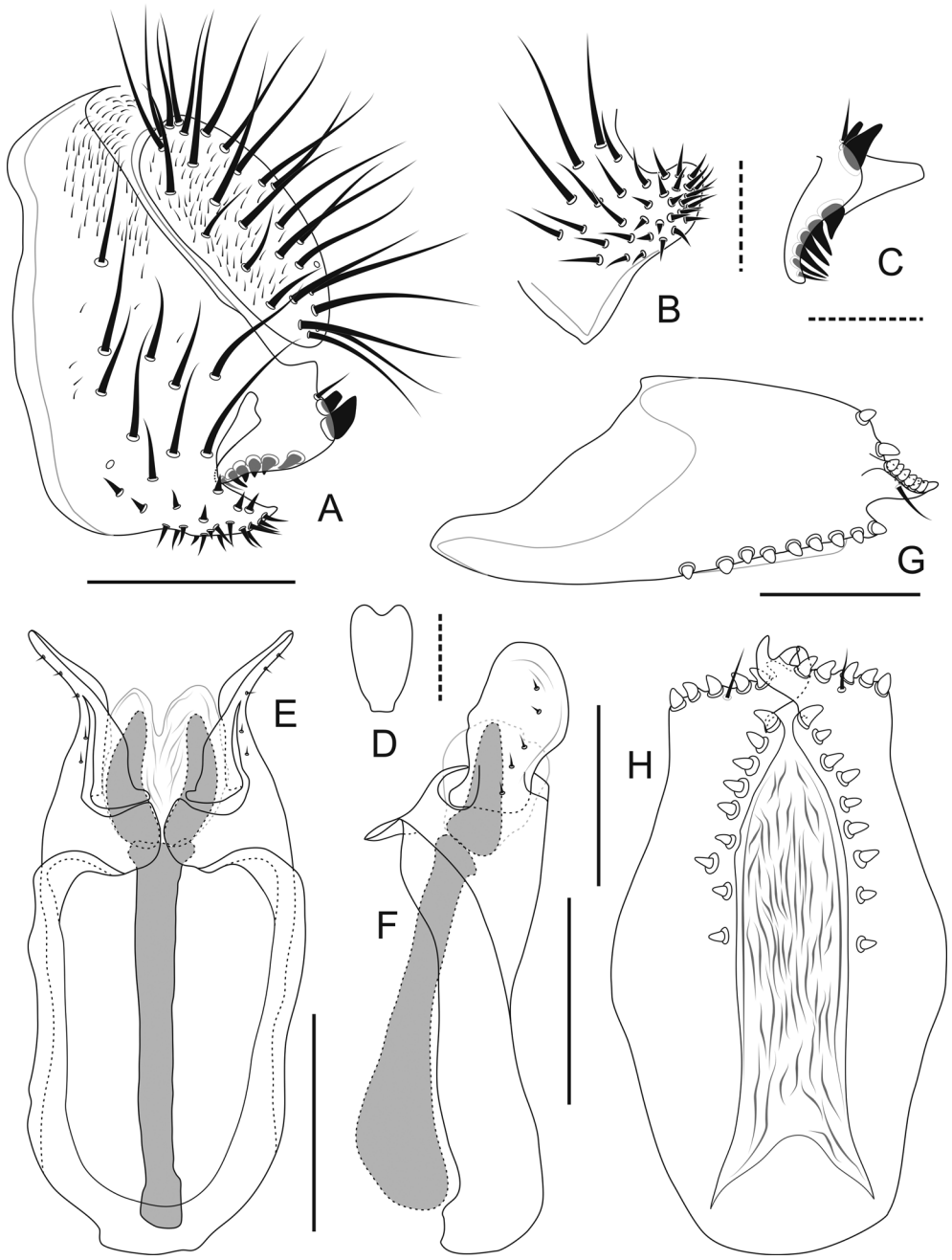

FIGURE 21. ***Impatiophila xiaoi*** **Fu & Gao, sp. nov.** Adult male (holotype, #00117) and female (paratype, #00125): A, periphallic organs (caudolateral view); B, caudoventral part of epandrium; C, surstylus (caudal view); D, tenth sternite; E, phallic organs (dorsal view); F, phallic organs (lateral view); G, oviscapt (lateral view); H, oviscapt (ventral view).

Male terminalia (Fig. 21A–F): Epandrium pubescent posteriorly on dorsal 1/3 and sparsely on median portion, ventrally with 11 long setae; caudoventral portion somewhat rounded apically, with ca. 30 short, stout setulae. Surstylus with 1 seta in addition to 2 stout, upturned prensisetae around caudodorsal corner, 7 apically converging prensisetae along distal margin and 1 short seta near ventral apex. Cercus largely pubescent except for posterior to ventral portion, with 28–30 long setae. Hypandrium long, largely parallel-sided, with apodeme on anterior margin. Gonopod apically curved ventrad, hook-like in lateral view. Paramere auricular, slightly convex at dorsomedian edge, not longer than twice of width, with 5 sensilla. Aedeagal basal process slightly longer than 1/2 length of paramere.

Female terminalia (Fig. 21G, H; Pl. 6J): Oviscapt valve slightly wider than 1/2 of its length, less expanded dorsomedially in lateral view, with 2 dorsal ovisensilla on convex, dorsosubapical margin, 7 lateral ones and 9

distally increasing in size on nearly straight, ventral margin. Spermathecal capsule brown; introvert depth of duct about 1/2 of capsule height.

Measurements: BL = 2.45 (4♀ paratypes: 2.59−3.16) mm, ThL = 1.32 (1.30−1.35) mm, WL = 2.73 (2.76−2.82) mm, WW = 1.22 (1.22−1.29) mm.

Indices: arb = 2/1 (4♀ paratypes: 2/1), FW/HW = 0.45 (0.45−0.46), ch/o = 0.13 (0.11−0.16), prorb = 0.85 (0.95−1.11), rcorb = 0.63 (0.55−0.78), orbito = 1.00 (0.92−1.10), vb = 0.41 (0.39−0.45), dcl = 0.46 (0.51−0.54), dcp = 0.34 (0.40−0.42), sterno = 0.63 (0.60−0.70), m-sterno = 0.78 (0.71−0.81), sctl = 1.00 (1.00−1.06), sctlp = 1.11 (0.87−1.02), C = 2.53 (2.58−2.64), 4c = 0.83 (0.77−0.84), 4v = 1.55 (1.41−1.69), 5x = 1.28 (1.29−1.52), ac = 2.52 (2.21−2.68), M = 0.42 (0.39−0.49), C3F = 0.17 (0.20−0.27).

Holotype. ♂ (#00117), Cangshan National Nature Reserve, Dali, Yunnan, China, ca. 2000 m, 25.viii.2011, *ex Impatiens radiate* Hook. f. (Fig. 1E), J.J. Gao (KIZ).

Paratypes. CHINA: 4♀ (#00125−8), same data as holotype (KIZ, SEHU).

Distribution. China (Yunnan).

Etymology. Patronym, in honor of Dr. Wen Xiao, Dali University, who helped us in collecting the specimens of the new species.

12) *Impatiophila viasericaria* Fu & Gao, sp. nov.

(Fig. 22; Pl. 2C; Pl. 6K)

Diagnosis. Setae of middle row on 2nd costal section mostly heavy, peg-like setae, but not reaching R_{2+3}. Hindleg tibia with 1 black, apically blunt, stout spine at outer apex on underside. Tenth sternite ventrally narrowing, notched medially on dorsal margin (Fig. 22D).

Description (♂, ♀). Head: Cibarium with 3 medial and 4−5 posterior sensilla per side.

Thorax (Pl. 2C): Scutum black; scutellum blackish brown to black, paler laterally; pleura yellowish brown except blackish brown mesopleuron.

Wing (Pl. 2C) slightly fuscous, pale brown; veins brown; C_1 setea 2, ventral one shorter and thinner. Haltere whitish yellow.

Legs (Pl. 2C) pale yellowish brown.

Abdomen: Tergites variable in pigmentation pattern: nearly entirely black except for blackish brown I in some specimens including the holotype (Fig. 8D, Pl. 2C), while III−V each with caudal band medially protruded in some others (Fig. 8A−C). Sternites grayish yellow; male VI longer than wide.

Male terminalia (Fig. 22A−F): Epandrium pubescent near posterior margin of dorsal 1/2, ventrally with 11 long setae; caudoventral portion rounded apically, with ca. 14 short, stout setulae. Surstylus with 1 seta in addition to 1 stout, upturned prensiseta around caudodorsal corner, 6 apically converging prensisetae along distal margin and 2 short setae near ventral apex. Cercus pubescent near anterior margin, with ca. 21 long setae. Hypandrium slightly narrowing anteriorly. Gonopod short, apically slightly curved ventrad, blunt hook-like in lateral view. Paramere auricular, with somewhat irregularly waved dorsal margin in lateral view, not longer than twice of width, with 6 sensilla. Aedeagal basal process 2/3 as long as paramere.

Female terminalia (Fig. 22G, H; P1. 6K): Oviscapt valve gently curved on dorsosubapical margin and less expanded dorsomedially in lateral view, with 4 dorsal ovisensilla, 13−14 lateral ones on margin of relatively narrow, apicolateral flap and 9−11 distally increasing in size on distally concave, ventral margin. Spermathecal capsule dark brown; introvert depth of duct about 1/2 of capsule height.

Measurements: BL = 2.10 (5♂ paratypes: 1.98−2.41; 5♀ paratypes: 2.13−2.50) mm, ThL = 0.97 (0.95−1.08; 0.88−1.16) mm, WL = 2.28 (2.07−2.35; 2.16−2.52) mm, WW = 0.99 (0.93−1.00; 0.90−1.07) mm.

Indices: arb = 2/1 (5♂, 5♀ paratypes: 2−3/1−2), FW/HW = 0.44 (0.42−0.45), ch/o = 0.05 (0.08−0.12), prorb = 1.06 (0.87−1.18), rcorb = 0.56 (0.51−0.68), orbito = 0.96 (0.88−1.23), vb = 0.31 (0.31−0.46), dcl = 0.54 (0.49−0.63), dcp = 0.44 (0.34−0.43), sterno = 0.68 (0.50−0.70), m-sterno = 0.76 (0.71−0.83), sctl = 1.02 (1.01−1.10), sctlp = 1.01 (0.96−1.18), C = 2.47 (2.38−2.76), 4c = 0.86 (0.74−0.87), 4v = 1.57 (1.39−1.60), 5x = 1.46 (1.44−2.04), ac = 2.04 (2.39−3.08), M = 0.45 (0.42−0.50).

Holotype. ♂ (#03579), Huangcaoling, Jinping Town, Jingdong County, Pu'er District, Yunnan, China, 24°22.501′N, 100°46.141′E, ca. 2100 m, 1.ix.2014, *ex Impatiens racemosa* DC. (Fig. 1F), J.J. Gao, M.J. Toda (KIZ).

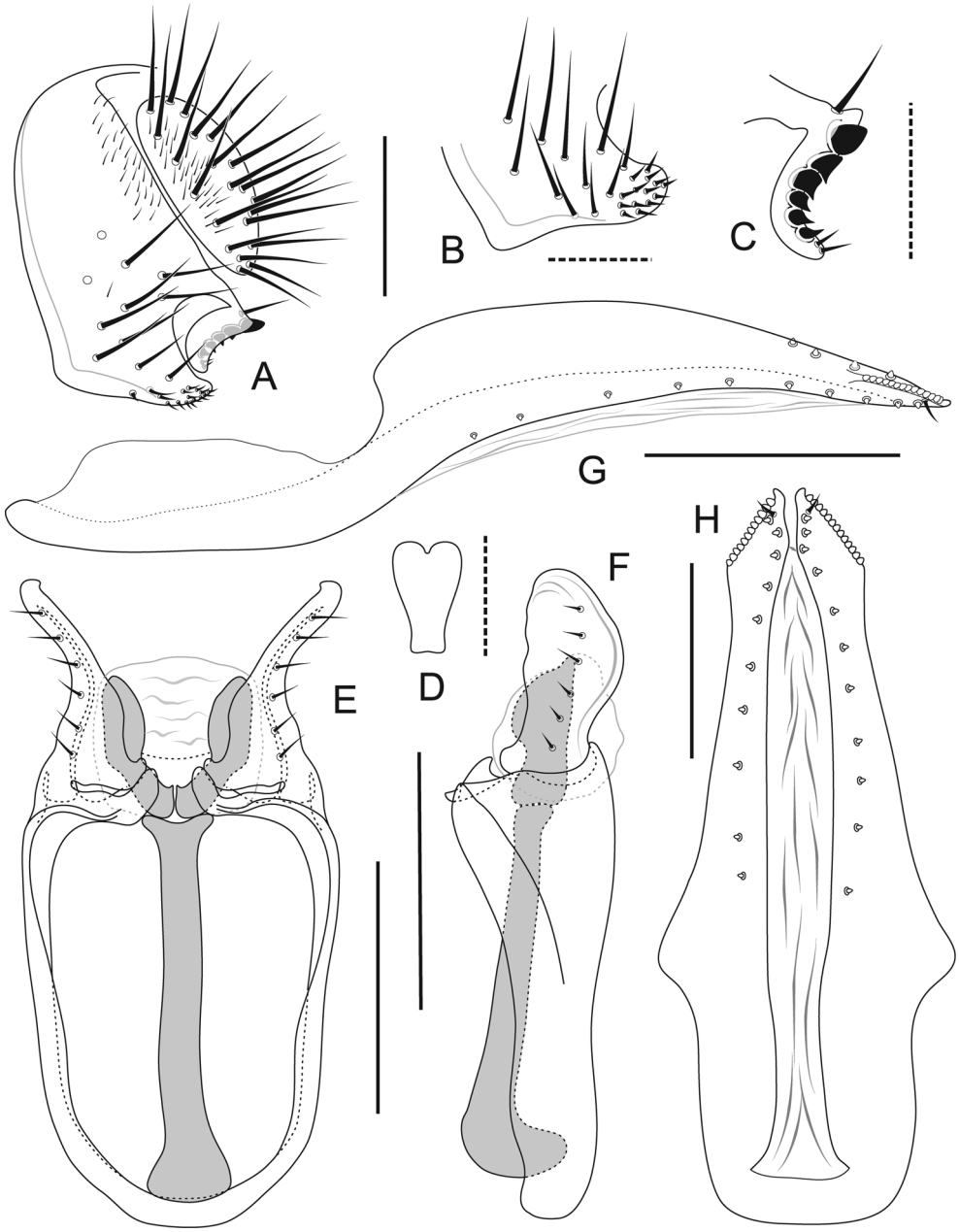

FIGURE 22. ***Impatiophila viasericaria*** **Fu & Gao, sp. nov.** Adult male (holotype, #03579) and female (paratype, #01406): A, periphallic organs (caudolateral view); B, caudoventral part of epandrium; C, surstylus (caudal view); D, tenth sternite; E, phallic organs (dorsal view); F, phallic organs (lateral view); G, oviscapt (lateral view); H, oviscapt (ventral view).

Paratypes. CHINA: 1♀ (#01406), Jiujiezi, Baihualing Village, Mangkuan Town, Longyang County, Yunnan, ca. 1900 m, 24.ix.2012, J.J. Gao (KIZ); 5♂, 2♀ (#03576, #03580, #03702, #03705−7, #03713), same data as holotype; 2♀ (#03729, #03733), Bingbi, Wenjing Town, Jingdong County, Yunnan, ca. 3000 m, 30.viii.2014, *ex Impatiens racemosa* DC. (Fig. 1F), J.J. Gao (KIZ).

Distribution. China (Yunnan).

Etymology. Pertaining to the distribution area located along the ancient Southern Silk (*sericus*) Road (*via*).

13) *Impatiophila rhombivalva* Fu & Gao, sp. nov.

(Fig. 23; Pl. 2D; Pl. 6L)

*Diagnosis***.** Setae of middle row on 2nd costal section mostly heavy, peg-like setae, but not reaching R_{2+3}. Hindleg tibia with 1 black, apically blunt, stout spine at outer apex on underside. Tenth sternite somewhat trapezoid, slightly

constrict subbasally, slightly concave on dorsal margin (Fig. 23D). Oviscapt anteriorly narrowing and round on margin in ventral view (Fig. 23H).

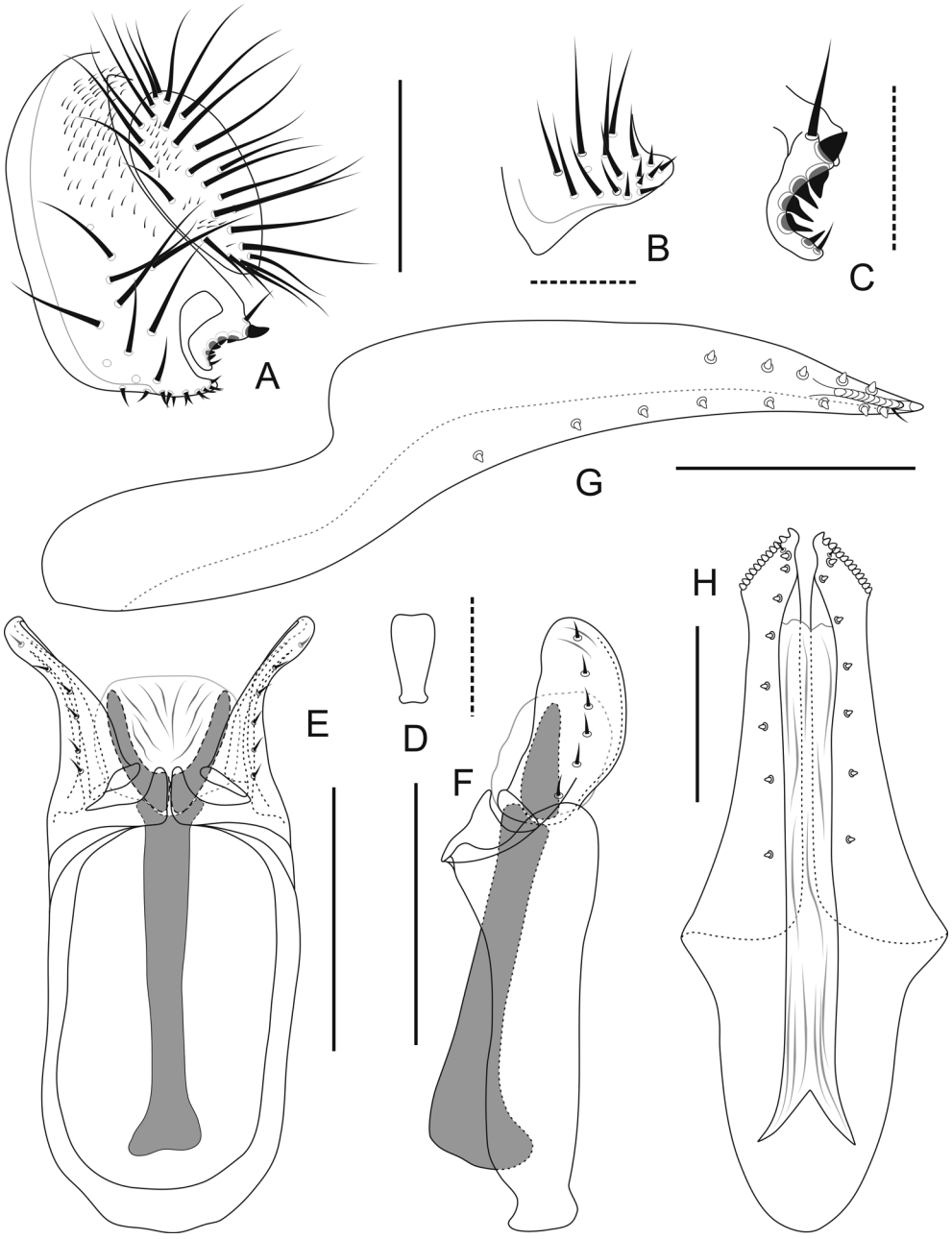

FIGURE 23. ***Impatiophila rhombivalva*** **Fu & Gao, sp. nov.** Adult male (holotype, #02579) and female (paratype, #02581): A, periphallic organs (caudolateral view); B, caudoventral part of epandrium; C, surstylus (caudal view); D, tenth sternite; E, phallic organs (dorsal view); F, phallic organs (lateral view); G, oviscapt (lateral view); H, oviscapt (ventral view).

Description (♂, ♀). Head: Cibarium with 2 medial and 6–7 posterior sensilla per side.

Thorax (Pl. 2D): Postpronotum yellowish brown; scutum and scutellum glossy black, blackish brown laterally; pleura blackish brown to black.

Wing (Pl. 2D) pale brown; veins brown. C_1 setae 2, ventral one shorter and thinner. Haltere pale yellow.

Abdomen (Pl. 2D): Tergite I dark brown; II blackish brown; III–VI with faded, blackish brown, laterally extended caudal bands; bands medially protruded on III and IV, but medially more or less constricted on V and VI. Sternites pale grayish brown; male VI somewhat quadrate, slightly longer than wide, nearly straight or slightly concave on posterior margin.

Male terminalia (Fig. 23A–F): Epandrium pubescent on posterior portion of dorsal 1/2, ventrally with ca. 9 long setae; caudoventral portion apically more or less triangular, with ca. 14 short setae. Surstylus with 1 long seta in addition to 1 stout, upturned prensiseta above caudodorsal corner, 5 apically converging prensisetae along distal margin and 1 short seta near ventral apex. Cercus pubescent near anterior margin, with ca. 26 long setae. Hypandrium somewhat rectangular in ventral view. Gonopod somewhat triangular, slightly curved ventrad apically in lateral view. Paramere auricular, with slightly waved dorsal margin in lateral view, longer than twice of width, with 6 sensilla. Aedeagal basal process slightly longer than 1/2 length of paramere.

Female terminalia (Fig. 23G, H; Pl. 6L): Oviscapt valve with 4−5 dorsal ovisensilla, 12−13 lateral ones on margin of relatively narrow, apicolateral flap and 6–8 distally increasing in size on distally concave, ventral margin. Spermathecal capsule brown; introvert depth of duct about 1/2 of capsule height.

Measurements: BL = 1.93 (2♀ paratypes: 1.83−2.38) mm, ThL = 0.95 (0.82−1.11) mm, WL = 2.02 (1.83−2.38) mm, WW = 0.90 (0.75−1.04) mm.

Indices: arb = 2/1 (2♀ paratypes: 2/1), FW/HW = 0.42 (0.41−0.46), ch/o = 0.07 (0.12−0.12), prorb = 1.14 (0.97−1.00), rcorb = 0.68 (0.60−0.63), orbito = 0.84 (0.83−1.00), vb = 0.44 (0.46−0.48), dcl = 0.64 (0.54−0.62), dcp = 0.40 (0.32−0.39), sterno = 0.78 (0.62−0.77), m-sterno = 0.85 (0.72−0.75), sctl = 0.95 (1.06−1.09), sctlp = 1.17 (0.92−1.24), C = 2.38 (2.26−2.38), 4c = 0.76 (0.82−0.88), 4v = 1.34 (1.44−1.60), 5x = 1.50 (1.65−1.79), ac = 2.63 (2.58−2.90), M = 0.35 (0.42−0.44).

Holotype. ♂ (#02579), Huanglianshan Nature Reserve, Luchun County, Honghe District, Yunnan, China, 26.iv.2010, by net sweeping, Y.R. Su *et al.* (KIZ).

Paratypes. CHINA: 2♀ (#01198, #02581), same data as holotype (KIZ).

Distribution. China (Yunnan).

Etymology. Referring to the rhombic (*rhombus*) oviscapt valve (*valva*) in ventral view.

14) *Impatiophila aspidosternata* Fu & Gao, sp. nov.

(Fig. 24; Pl. 2E; Pl. 6M)

Diagnosis. Heavy, peg-like setae of middle row on 2nd costal section interspersed with weak, trichoid ones. Hindleg tibia without black, apically blunt, stout spine at outer apex on underside. Tenth sternite ventrally tapering, slightly concave on dorsal margin (Fig. 24D). Hypandrium twice as long as wide (Fig. 24E). Paramere somewhat angled at postero-dorsal and –ventral corners in lateral view, shorter than twice of width, with 5 sensilla (Fig. 24E, F). Oviscapt valve less expended submedially in ventral view (Fig. 24H).

Description (♂, ♀). Head: Cibarium with 3 medial and 4–6 posterior sensilla per side.

Thorax (Pl. 2E): Postpronotum brown; scutum and scutellum glossy black; pleura grayish brown to blackish black.

Wing (Pl. 2E) hyaline, slightly infuscate; veins pale brown. C_1 setae 2, subequal. Haltere pale yellowish brown.

Abdomen (Pl. 2E): Tergites brown. Sternites grayish brown; male VI somewhat quadrate, slightly wider than long, nearly straight on posterior margin.

Male terminalia (Fig. 24A−F): Epandrium very sparsely pubescent on dorsal 1/3, ventrally with ca. 12 long setae; caudoventral portion rounded apically, with ca. 19 short setulae. Surstylus with 2 setae in addition to 1 stout, upturned prensiseta above caudodorsal corner, 6 apically converging prensisetae along distal margin and 3 short setae near ventral apex. Cercus pubescent on anterior portion, with ca. 23 long setae. Hypandrium somewhat narrowing anteriorly in ventral view, with distinct apodeme on anterior margin. Gonopod somewhat triangular in lateral view. Aedeagal basal process longer than 1/2 length of paramere.

Female terminalia (Fig. 24G, H; Pl. 6M): Oviscapt valve gently curved on dorsosubapical margin and less expanded dorsomedially in lateral view, with 4 dorsal ovisensilla, 13−14 lateral ones on margin of relatively narrow, apicolateral flap and 11 distally slightly increasing in size on distally slightly concave, ventral margin. Spermathecal capsule brown; introvert depth of duct about 2/3 of capsule height.

Measurements: BL = 2.23 (5♂ paratypes: 2.00−2.47, 5♀ paratypes: 2.03−2.47) mm, ThL = 0.97 (0.87−1.00, 0.97−1.03) mm, WL = 2.10 (1.93−2.10, 2.03−2.20) mm, WW = 0.93 (0.87−0.93, 0.87−0.97) mm.

Indices: arb = 2/1 (5♂, 5♀ paratypes: 2−3/0−1), FW/HW = 0.39 (0.38−0.45), ch/o = 0.13 (0.07−0.11), prorb = 1.06 (0.97−1.19), rcorb = 0.76 (0.64−0.79), orbito = 1.40 (1.14−1.40), vb = 0.50 (0.36−0.46), dcl = 0.57 (0.52−0.60), dcp = 0.33 (0.29−0.41), sterno = 0.62 (0.58−0.83), m-sterno = 0.77 (0.65−0.81), sctl = 0.98

(0.93−1.05), sctlp = 0.93 (0.93−1.33), C = 2.57 (2.16−2.74), 4c = 0.84 (0.79−1.00), 4v = 1.60 (1.54−1.79), 5x = 1.79 (1.53−1.88), ac = 2.50 (2.38−3.24), M = 0.49 (0.40−0.52).

Holotype. ♂ (#00193), Maoershan National Nature Reserve, Xing'an, Guilin, Guangxi, China, 17−19.iii.2009, *ex* flowers of Gesneriaceae sp.1 (Fig. 1G), J.J. Gao (KIZ).

Paratypes. CHINA: 5♂, 5♀ (#00185−7, #00189, #00192, #00194, #00195, #00197, #00198, #00201), same data as holotype (KIZ); 1♂, 2♀, Yangjiangping, Tianpingshan, Hunan, 1−6.ix.2000, Y.G. Hu (SEHU).

Distribution. China (Hunan, Guangxi).

Etymology. Referring to the scutellate (*aspido*-) tenth sternite (*sternum*).

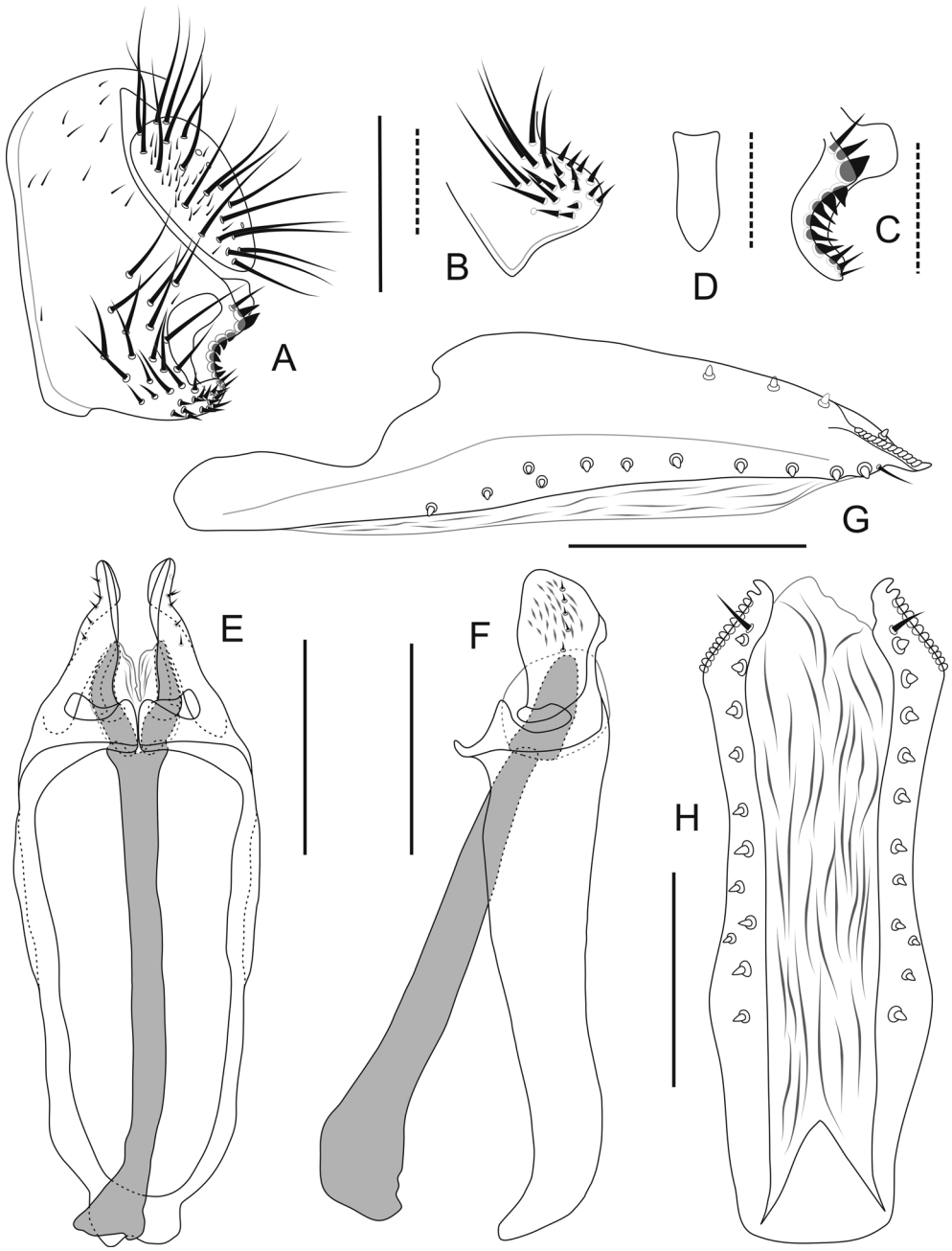

FIGURE 24. ***Impatiophila aspidosternata*** **Fu & Gao, sp. nov.** Adult male (holotype, #00193) and female (paratype, #00185): A, periphallic organs (caudolateral view); B, caudoventral part of epandrium; C, surstylus (caudal view); D, tenth sternite; E, phallic organs (dorsal view); F, phallic organs (lateral view); G, oviscapt (lateral view); H, oviscapt (ventral view).

15) *Impatiophila hutiaoxiana* Fu & Gao, sp. nov.
(Fig. 25; Pl. 2F; Pl. 6N)

Diagnosis. Abdominal tergites III−V unicolorously dark brown to black (Pl. 2F). Setae of middle row on 2nd costal section all heavy, peg-like setae, present beyond tip of R_{2+3}.

Description (♀). Head: Cibarium with 2 medial and 5−6 posterior sensilla per side.

Thorax (Pl. 2F): Postpronotum grayish yellow; scutum black, slightly paler along transverse suture and longitudinal lines on ipsilateral dorsocentral setae; scutellum black, paler laterally; pleura grayish brown to blackish black.

Wing (Pl. 2F) yellowish; veins yellowish brown. C_1 setae 2, ventral one shorter and thinner. Haltere whitish yellow.

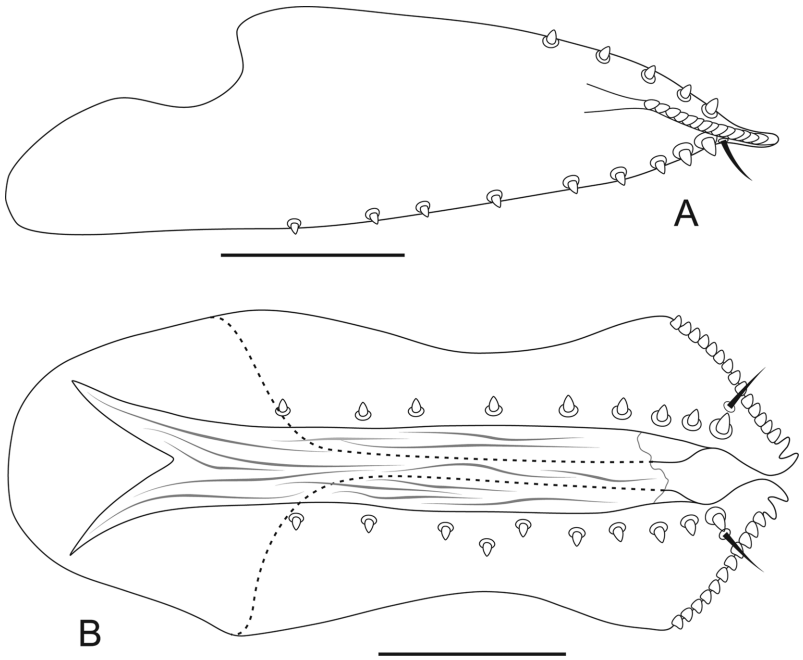

FIGURE 25. *Impatiophila hutiaoxiana* Fu & Gao, sp. nov. Adult female (holotype, #01541): A, oviscapt (lateral view); B, oviscapt (ventral view).

Legs: (PL. 2F): Hindleg tibia without black, apically blunt, stout spine at outer apex on underside.

Abdomen: Sternites pale grayish brown.

Female terminalia (Fig. 25; Pl. 6N): Oviscapt valve gently curved on dorsosubapical margin and less expanded dorsomedially in lateral view, with 5 dorsal ovisensilla, 13−16 lateral ones on slightly convex (in ventral view) margin of well-developed apicolateral flap and 9−10 distally slightly increasing in size on slightly convex, ventral margin. Spermathecal brown; introvert depth of duct about 1/2 of capsule height.

Measurements: BL = 2.72 mm, ThL = 1.23 mm, WL = 2.69 mm, WW = 1.19 mm.

Indices: arb = 3/1, FW/HW = 0.47, ch/o = 0.11, prorb = 1.00, rcorb = 0.61, orbito = 1.00, vb = 0.43, dcl = 0.58, dcp = 0.33, sterno = 0.76, m-sterno = 0.82, sctl = 1.02, sctlp = 1.08, C = 2.35, 4c = 0.87, 4v = 1.59, 5x = 1.66, ac = 2.76, M = 0.47, C3F = 0.21.

Holotype. ♀ (#01541), Liangjiaren Village, Hutiaoxia Town, Shangri-la County, Diqing District, Yunnan, China, 23.viii.2011, by net sweeping, J.J. Gao (KIZ).

Distribution. China (Yunnan).

Etymology. Pertaining to the type locality.

16) *Impatiophila medivittata* Fu & Gao, sp. nov.
(Fig. 26; Pl. 2G)

Diagnosis. Abdominal tergites III−V each with broad, black caudal band protruded medially (Pl. 2G). Setae of middle row on 2nd costal section all heavy, peg-like setae, present beyond tip of R_{2+3}. Hindleg tibia without black,

apically blunt, stout spine at outer apex on underside. Male abdominal sternite VI somewhat quadrate, slightly longer than wide, nearly straight or slightly concave on posterior margin. Paramere with 6 sensilla arranged more sparsely distally (Fig. 26E, F).

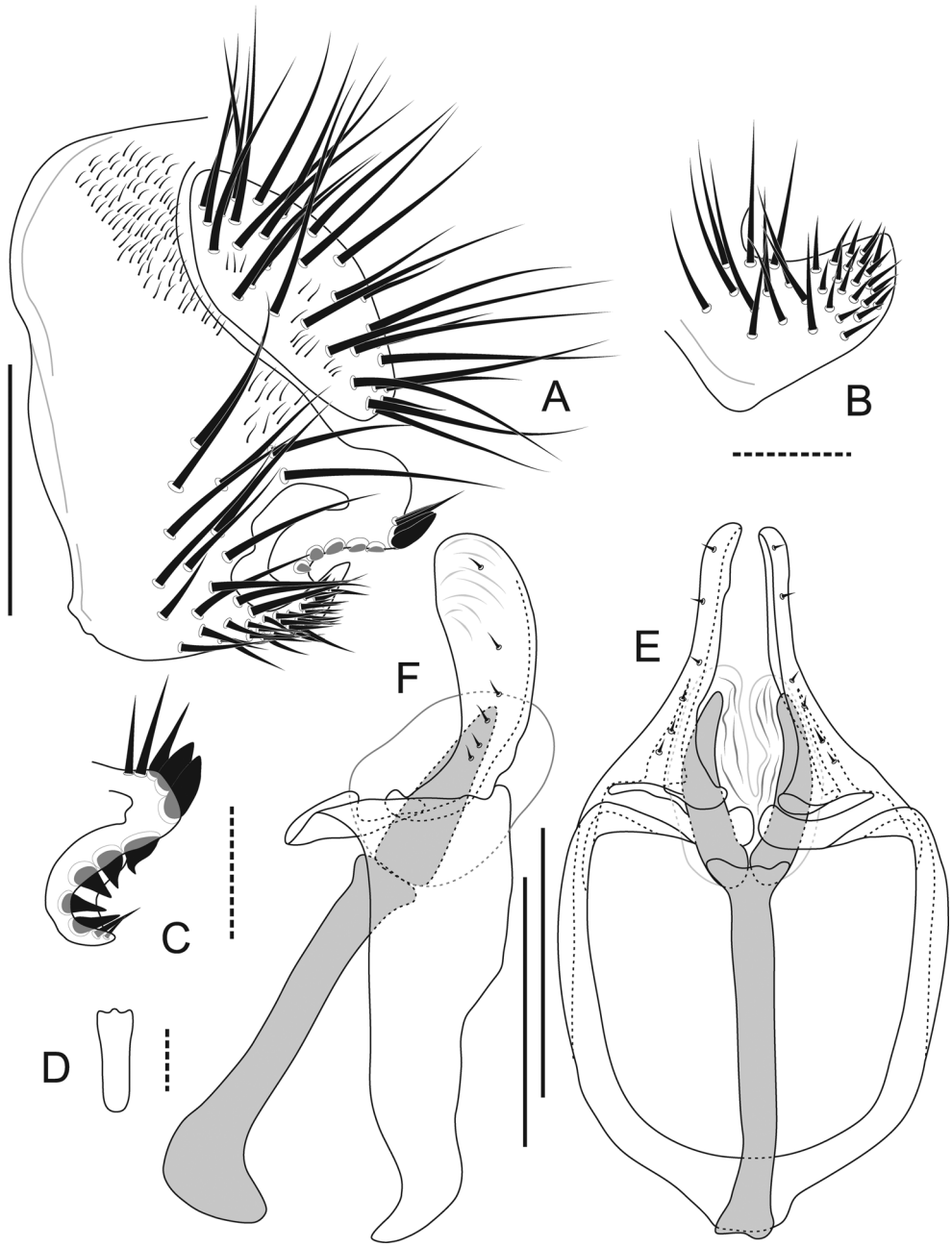

FIGURE 26. ***Impatiophila medivittata*** **Fu & Gao, sp. nov.** Adult male (holotype, #01558): A, periphallic organs (caudolateral view); B, caudoventral part of epandrium; C, surstylus (caudal view); D, tenth sternite; E, phallic organs (dorsal view); F, phallic organs (lateral view).

Description (♂). Head: Cibarium with 3 medial and 5−6 posterior sensilla per side.

Thorax (Pl. 2G): Postpronotum yellowish brown; scutum and scutellum glossy black; pleura yellowish brown to dark brown.

Wing (Pl. 2G) pale brown, paler proximally; veins dark brown. C_1 setae 2, ventral one shorter and thinner. Haltere whitish yellow.

Abdomen: Sternites grayish yellow.

Male terminalia (Fig. 26A−F): Epandrium posteriorly pubescent on dorsal 1/2, ventrally with ca. 14 long setae; caudoventral lobe prominent, somewhat pointed apically, with ca. 20 setae. Surstylus with 3 thick, long setae in

addition to 2 stout, upturned prensiseta around to above caudodorsal corner, 5 apically converging prensisetae along distal margin and 2 short setae near ventral apex. Tenth sternite narrow, medially slightly projected on dorsal margin. Cercus pubescent in small patches on anterior portion, with ca. 25 long setae. Hypandrium slightly narrower than long, with distinct hypandrial apodeme on anteromedial margin. Gonopod somewhat triangular in lateral view. Paramere much longer than twice of width. Aedeagal basal process longer than 1/2 length of paramere.

Measurements: BL = 2.60 mm, ThL = 1.28 mm, WL = 2.65 mm, WW = 1.12 mm.

Indices: arb = 2−3/1, FW/HW = 0.44, ch/o = 0.12, prorb = 1.00, rcorb = 0.65, orbito = 0.93, vb = 0.41, dcl = 0.61, dcp = 0.47, sterno = 0.71, m-sterno = 0.82, sctl = 1.02, sctlp = 1.08, C = 2.89, 4c = 0.70, 4v = 1.40, 5x = 1.47, ac = 2.32, M = 0.38, C3F = 0.32.

Holotype. ♂ (#01558), Hesong Village, Xiding Town, Menghai County, Xishuangbanna District, Yunnan, China, 21°49′57″N, 100°06′09″E, 17.iv.2010, by sweeping above fallen trunks along waterside, J.J. Gao (KIZ).

Distribution. China (Yunnan).

Etymology. Referring to the dorsomedian (*medius*), dark, longitudinal vitta (*vittatus*) on abdominal tergites.

17) *Impatiophila taibaishanensis* Fu & Gao, sp. nov.

(Fig. 27; Pl. 2H; Pl. 6O)

Diagnosis. Abdominal tergites III−V each with broad, blackish brown to black, caudal band medially narrowly interrupted or notched (Pl. 2H). Setae of middle row on 2nd costal section all heavy, peg-like setae, present beyond tip of R_{2+3}. Tenth sternite medially slightly convex on dorsal margin, dorsally dilated (Fig. 27D). Oviscapt valve with 13 lateral ovisensilla on slightly convex (in ventral view) margin of apicolateral flap (Fig. 27H).

Description (♂, ♀). Head: Cibarium with 3 medial and 5 posterior sensilla per side.

Thorax (Pl. 2H): Postpronotum yellowish brown; scutum black; scutellum black, laterally brown; pleura dark brown to blackish brown.

Wing (Pl. 2H) pale brown; veins yellowish brown. C_1 setae 2, ventral one shorter and thinner. Haltere whitish yellow.

Legs: (PL. 2H): Hindleg tibia without black, apically blunt, stout spine at outer apex on underside.

Abdomen (Pl. 2H): Tergite I dark brown; II yellowish brown, with broad, black caudal band medially interrupted. Sternites pale grayish brown; male VI posteriorly wider, concave on posterior margin.

Male terminalia (Fig. 27A−F): Epandrium posteriorly pubescent on dorsal 1/2, ventrally with ca. 8 long setae; caudoventral portion broad, somewhat angular dorso-apically, with ca. 20 short spines. Surstylus with 2 thick setae in addition to 1 stout, upturned prensiseta around caudodorsal corner, 4 apically converging prensisetae along distal margin and 3 short setae near ventral apex. Cercus pubescent in patches nearly overall, with ca. 31 long setae. Hypandrium 2/3 as wide as long, nearly parallel-sided. Gonopod somewhat triangular, pointed apically in lateral view. Paramere much longer than twice of width, gently curved dorsad, with 6 sensilla. Aedeagal basal process nearly 1/2 length of paramere.

Female terminalia (Fig. 27G, H; Pl. 6O): Oviscapt valve brown, gently curved on dorsosubapical margin and less expanded dorsomedially in lateral view, with 4 dorsal ovisensilla and 9 distally slightly increasing in size on slightly convex, ventral margin. Spermathecal capsule brown; introvert depth of duct about 3/5 of capsule height.

Measurements: BL = 2.57 (1♂ paratype: 2.57, 1♀ paratype: 2.83) mm, ThL = 1.22 (1.15, 1.21) mm, WL = 2.63 (2.55, 2.63) mm, WW = 1.18 (1.14, 1.017) mm.

Indices: arb = 2−3/1 (1♂, 1♀ paratypes: 3/1), FW/HW = 0.41 (0.41−0.42), ch/o = 0.08 (0.06−0.08), prorb = 1.01 (1.00−1.00), rcorb = 0.69 (0.67−0.69), orbito = 1.01 (1.05−1.10), vb = 0.39 (0.32−0.36), dcl = 0.55 (0.59), dcp = 0.38 (0.37−0.39), sterno = 0.68 (0.66−0.76), m-sterno = 0.48 (1♀ paratype: 0.79), sctl = 1.07 (1♂ paratype: 1.05), sctlp = 1.20 (1.19−1.33), C = 2.67 (2.29−2.60), 4c = 0.84 (0.82−0.93), 4v = 1.71 (1.62−1.72), 5x = 1.69 (1.58−1.63), ac = 2.76 (2.92−3.33), M = 0.47 (0.44−0.46), C3F = 0.25 (0.21−0.24).

Holotype. ♂ (#01700), Haoping, Mt. Taibai, Taibaishan National Nature Reserve, Baoji District, Shaanxi, China, 16.viii.2013, *ex Impatiens* sp.8 (with yellow flowers), J.J. Gao (KIZ).

Paratypes. CHINA: 1♂, 1♀ (#02541, #02542), same data as holotype (KIZ).

Distribution. China (Shaanxi).

Etymology. Pertaining to the type locality.

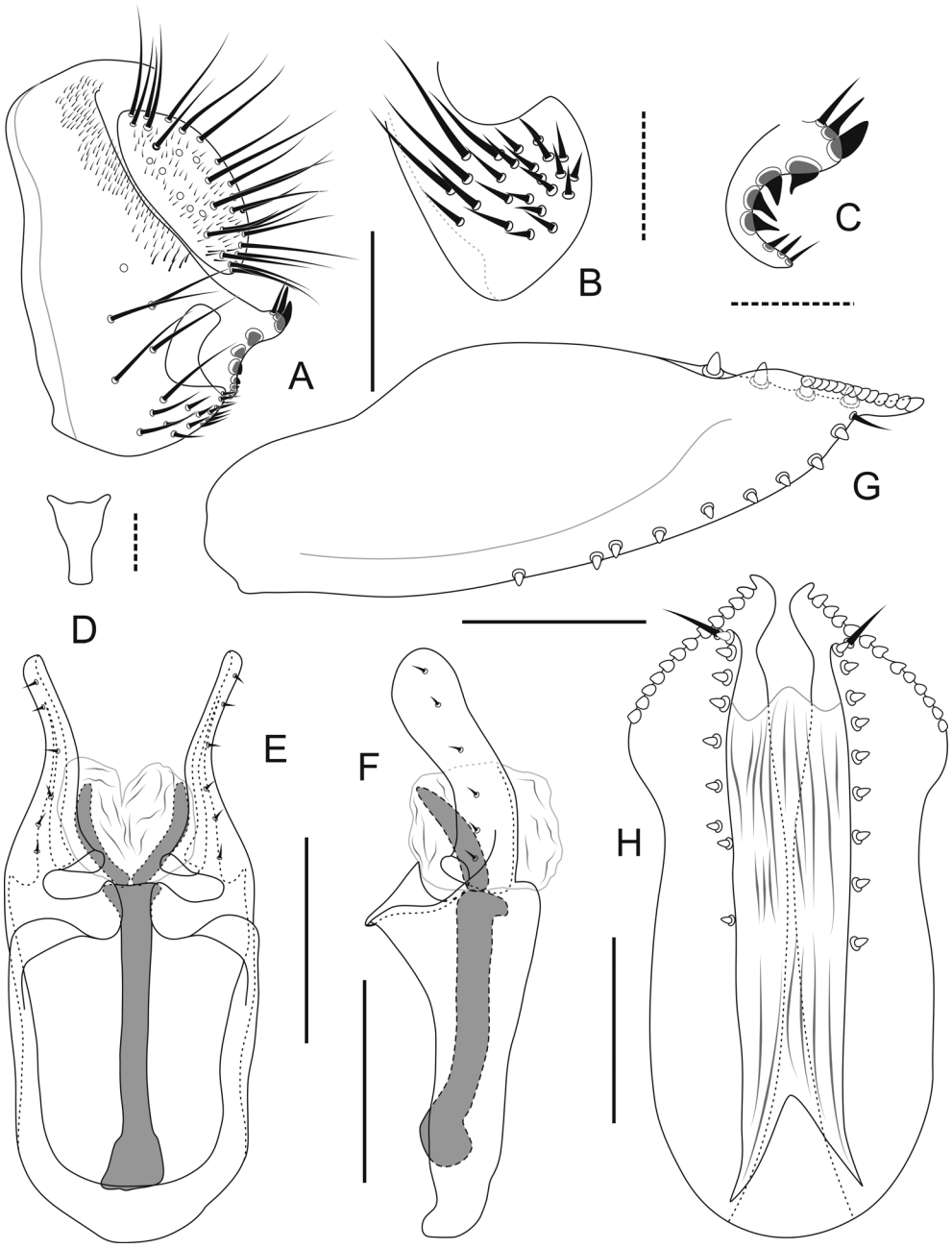

FIGURE 27. ***Impatiophila taibaishanensis*** **Fu & Gao, sp. nov.** Adult male (holotype, #01700) and female (paratype, #02542): A, periphallic organs (caudolateral view); B, caudoventral part of epandrium; C, surstylus (caudal view); D, tenth sternite; E, phallic organs (dorsal view); F, phallic organs (lateral view); G, oviscapt (lateral view); H, oviscapt (ventral view).

18) ***Impatiophila yangi*** **Fu & Gao, sp. nov.**
(Fig. 28; Pl. 3A; Pl. 6P)

Diagnosis. Setae of middle row on 2nd costal section all weak, trichoid. Hindleg tibia without black, apically blunt, stout spine at outer apex on underside. Male abdominal sternite VI large, somewhat quadrate, slightly wider than long, concave on posterior margin. Tenth sternite 2/5 as wide as long, concave on lateral margins, medially projected on dorsal margin (Fig. 28D). Oviscapt valve distally slightly narrowing in ventral view: apicolateral flap less developed (Fig. 28H).

Description (♂, ♀). Head: Cibarium with 2−3 medial and 4 posterior sensilla per side.

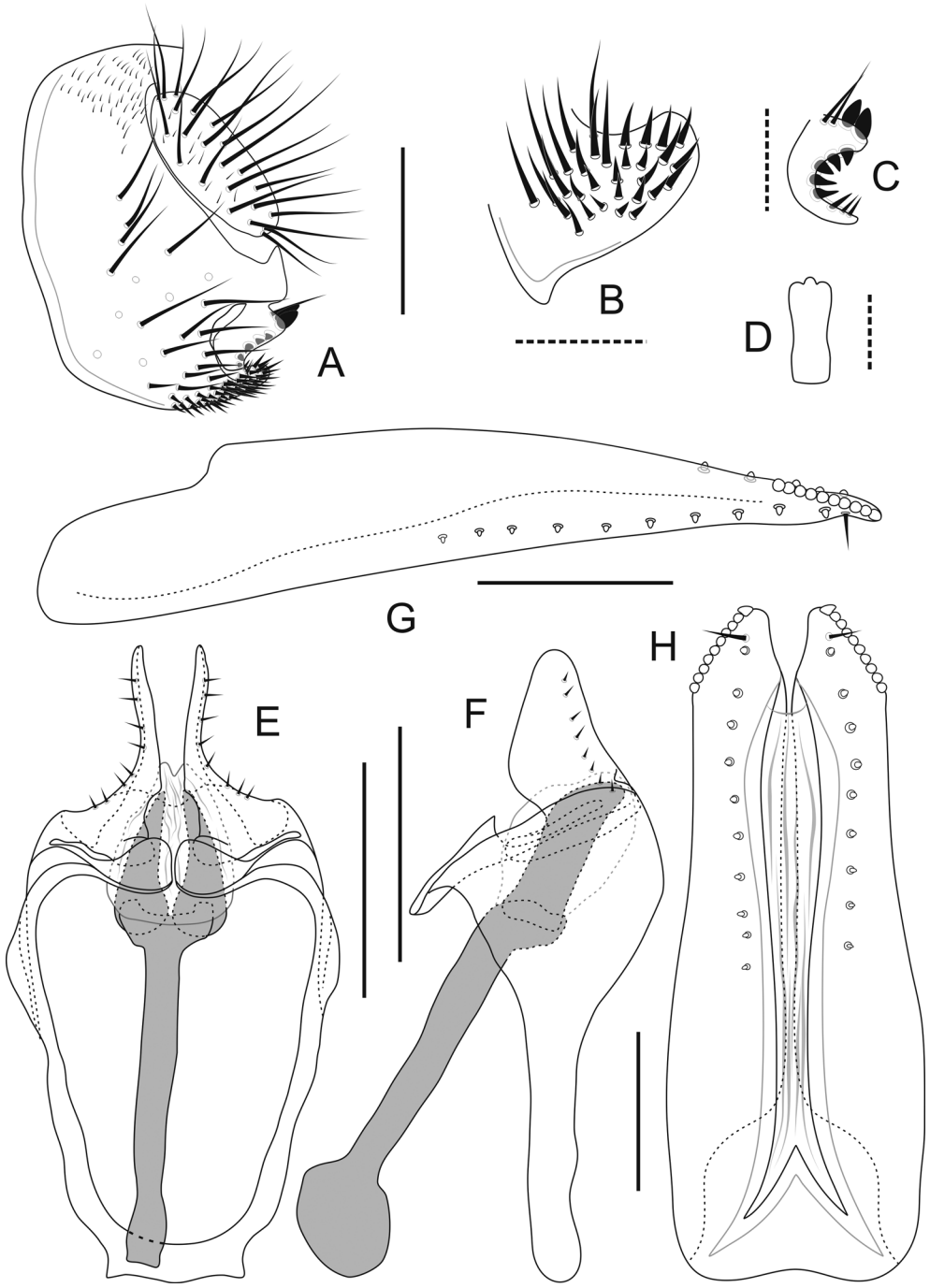

FIGURE 28. ***Impatiophila yangi*** **Fu & Gao, sp. nov.** Adult male (holotype, #01566) and female (paratype, #03581): A, periphallic organs (caudolateral view); B, caudoventral part of epandrium; C, surstylus (caudal view); D, tenth sternite; E, phallic organs (dorsal view); F, phallic organs (lateral view); G, oviscapt (lateral view); H, oviscapt (ventral view).

Thorax (Pl. 3A): Postpronotum dark brown; scutum and scutellum glossy black; pleura dark brown to blackish brown.

Wing (Pl. 3A) pale brown; veins brown. C_1 setae 2, subequal. Haltere pale yellow.

Legs (Pl. 3A) yellowish brown.

Abdomen (Pl. 3A): Tergites glossy black. Sternites grayish yellow.

Male terminalia (Fig. 28A–F): Epandrium pubescent on dorsal portion, ventrally with ca. 15 long setae; caudoventral portion apically roundish, with ca. 30 short, stout setulae. Surstylus with 2 setae in addition to 2 stout, upturned prensiseta around to above caudodorsal corner, 5 apically converging prensisetae along distal margin and 3 short setae near ventral apex. Cercus sparsely pubescent on anterior portion, with ca. 22 long setae. Hypandrium

somewhat trapeziform, wider posteriorly. Gonopod somewhat triangular, pointed apically in lateral view. Paramere distally somewhat triangular in lateral view, not longer than twice of width, with 8 sensilla. Aedeagal basal process slightly longer than 1/2 length of paramere.

Female terminalia (Fig. 28G, H; Pl. 6P): Oviscapt valve gently curved on dorsosubapical margin and less expanded dorsomedially in lateral view, with 5 dorsal ovisensilla, 10 lateral ones in a slightly convex (in ventral view) row on apicolateral portion and 9−10 distally slightly increasing in size on nearly straight, ventral margin. Spermathecal capsule brown; introvert depth of duct about 3/5 of capsule height.

Measurements: BL = 2.08 (2♂ paratypes: 1.97−2.02; 1♀ paratype: 2.50) mm, ThL = 1.03 (0.98−0.98; 1.01) mm, WL = 2.39 (2.32−2.32; 2.25) mm, WW = 1.02 (0.91−0.97; 0.90) mm.

Indices: arb = 2/1 (2♂, 1♀ paratypes: 2−3/1), FW/HW = 0.46 (0.41−0.45), ch/o = 0.13 (0.11−0.15), prorb = 0.94 (0.90−1.00), rcorb = 0.75 (0.63−0.68), orbito = 1.08 (1.10−1.29), vb = 0.34 (0.33−0.40), dcl = 0.37 (2♂ paratypes: 0.53−0.56), dcp = 0.37 (0.34−0.39), sterno = 0.60 (0.56−0.67), m-sterno = 0.87 (0.69−0.85), sctl = 1.03 (1.00−1.07), sctlp = 1.03 (0.91−1.17), C = 2.48 (2.08−2.50), 4c = 0.87 (0.84−0.97), 4v = 1.63 (1.57−1.59), 5x = 1.60 (1.38−1.87), ac = 2.54 (2.92−3.13), M = 0.46 (0.38−0.49).

Holotype. ♂ (#01566), Cangshan National Nature Reserve, Dali, Yunnan, China, ca. 2200 m, 25.viii.2011, *ex Impatiens radiate* Hook. f. (Fig. 1E), J.J. Gao (KIZ).

Paratypes. CHINA: 1♂ (#01567), same data as holotype; 1♂, 1♀ (#03581, #03718), Huangcaoling, Jinping Town, Jingdong County, Yunnan, N24º22.501′, E100º46.141′, ca. 2100 m, *ex Impatiens racemos* DC. (Fig. 1F), J.J. Gao, M.J. Toda (KIZ).

Distribution. China (Yunnan).

Etymology. Patronym, in honor of Dr. Zi-Zhong Yang for his help in field collection.

19) *Impatiophila forcipivalva* Fu & Gao, sp. nov.
(Fig. 29; Pl. 3B; Pl. 6Q)

Diagnosis. Setae of middle row on 2nd costal section all weak, trichoid. Hindleg tibia with 1 black, apically blunt, stout spine at outer apex on underside. Tenth sternite 1/2 as wide as long, slightly wider dorsally, slightly concave on lateral margins, medially projected on dorsal margin (Fig. 29D). Oviscapt valve distally narrowing in ventral view, without distinct lateral flap (Fig. 29H). Spermathecal capsule with small warts on outer surface (Pl. 6Q).

Description (♂, ♀). Head: Cibarium with 2−3 medial and 3−4 posterior sensilla per side.

Thorax (Pl. 3B): Postpronotum yellowish brown; scutum blackish brown, dorsocentrally with 4 blurry, pale, longitudinal stripes; scutellum blackish brown, with 1 pair of yellowish brown, longitudinal stripes near lateral margins; pleura pale brown.

Wing (Pl. 3B) hyaline; veins yellowish brown. C_1 setae 2, subequal. Haltere pale yellow.

Legs (Pl. 3B) yellow.

Abdomen (Pl. 3B): Tergites each with broad, pale brown caudal band. Sternites pale yellow; male VI somewhat quadrate, slightly wider than long, nearly straight on posterior margin.

Male terminalia (Fig. 29A−F): Epandrium pubescent on dorsal 1/4 only, ventrally with ca. 15 long setae; caudoventral portion apically somewhat pointed, with ca. 23 short, stout setulae. Surstylus with 3 setae in addition to 2 stout, upturned prensiseta at and above caudodorsal corner, 5 apically converging prensisetae along distal margin and 2 short setae near ventral apex. Cercus sparsely pubescent in small patch on anteromedial portion, with ca. 17 long setae. Hypandrium somewhat triangular, 2/3 as wide as long. Gonopod apically somewhat triangular, moderately protruded. Paramere distally somewhat triangular in lateral view, shorter than twice of width, with 7 sensilla. Aedeagal basal process 2/3 as long as paramere.

Female terminalia (Fig. 29G, H; Pl. 6Q): Oviscapt valve gently curved on dorsosubapical margin and less expanded dorsomedially in lateral view, with 5−6 dorsal ovisensilla, 10 lateral ones in slightly convex (in ventral view) row on apicolateral portion and 8−9 distally slightly increasing in size on distally concave, ventral margin. Spermathecal capsule brown; introvert depth of duct about 1/2 of capsule height.

Measurements: BL = 2.20 (1♂ paratype: 2.04; 2♀ paratypes: 2.07−2.31) mm, ThL = 1.06 (1.01; 1.08−1.11) mm, WL = 2.45 (2.42; 2.50−2.55) mm, WW = 1.08 (1.04; 1.11−1.12) mm.

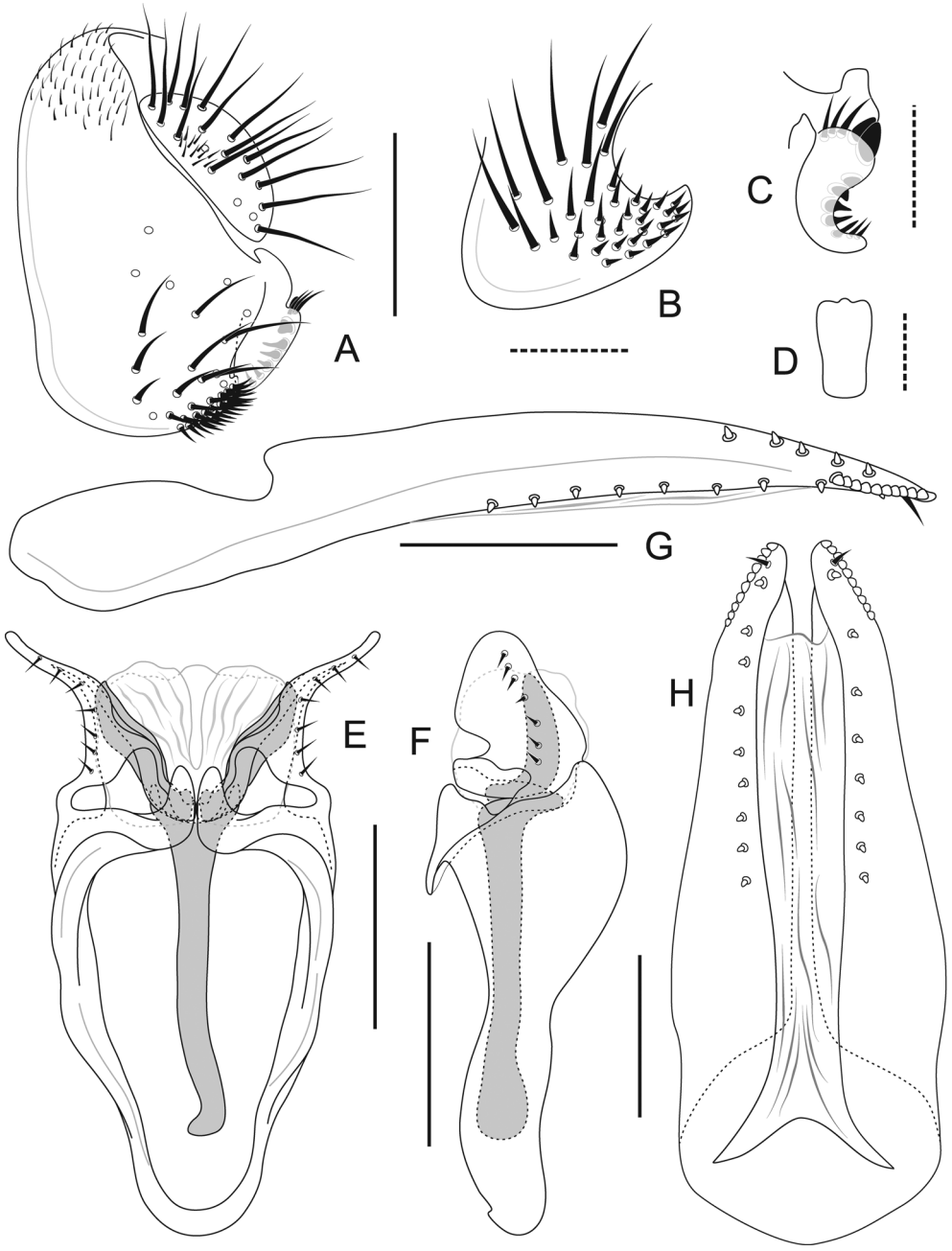

FIGURE 29. ***Impatiophila forcipivalva*** **Fu & Gao, sp. nov.** Adult male (holotype, #00309) and female (paratype, #00312): A, periphallic organs (caudolateral view); B, caudoventral part of epandrium; C, surstylus (caudal view); D, tenth sternite; E, phallic organs (dorsal view); F, phallic organs (lateral view); G, oviscapt (lateral view); H, oviscapt (ventral view).

Indices: arb = 2/1 (1♂, 2♀ paratypes: 2/1), FW/HW = 0.43 (0.44−0.46), ch/o = 0.13 (0.10−0.15), prorb = 0.94 (0.84−0.93), rcorb = 0.63 (0.61−0.68), orbito = 1.00 (0.94−1.02), vb = 0.40 (0.38−0.44), dcl = 0.53 (0.51−0.59), dcp = 0.35 (0.33−0.40), sterno = 0.67 (0.62−0.66), m-sterno = 0.76 (0.74−0.79), sctl = 1.01 (0.97−1.10), sctlp = 1.21 (0.97−1.22), C = 2.57 (2.27−2.60), 4c = 0.87 (0.82−0.91), 4v = 1.68 (1.56−1.62), 5x = 1.74 (1.57−1.74), ac = 2.71 (2.58−2.84), M = 0.50 (0.46−0.51).

Holotype. ♂ (#00309), along the way from Lage Village, Baiba Town, Linzhi County to Hanmi Village, Beibeng Town, Motuo County, Linzhi District, Xizang, China, 25.ix.2010, *ex Impatient desmantha* Hook. f. (Fig. 1C), J.J. Gao (KIZ).

Paratypes. CHINA: 1♀ (#00542), same data as holotype; 1♀ (#00312), Hanmi, Beibeng, Motuo, Xizang, 26.ix.2011, *ex Impatiens* sp. aff. *bahanensis* Hand.-Mazz. (Fig. 1B), J.J. Gao; 1♂ (#03716). Huangcaoling, Jinping

Town, Jingdong County, Yunnan, 24º22.501′N, 100º46.141′E, ca. 2100 m, 1.ix.2014, *ex Impatiens racemosa* DC. (Fig. 1F), J.J. Gao, M.J. Toda (KIZ).

Distribution. China (Yunnan, Xizang).

Etymology. Referring to the distally forceps-like (*forceps*) oviscapt valve (*valva*).

20) *Impatiophila trifurcatosternata* Fu & Gao, sp. nov.
(Fig. 30; Pl. 3C; Pl. 6R)

Diagnosis. Setae of middle row on 2nd costal section all weak, trichoid. Hindleg tibia with 1 black, apically blunt, stout spine at outer apex on underside. Tenth sternite 3/5 as wide as long, narrowing ventrally, with W-shaped notch medially on dorsal margin (Fig. 30D). Oviscapt valve with 4−5 dorsal ovisensilla (Fig. 30H).

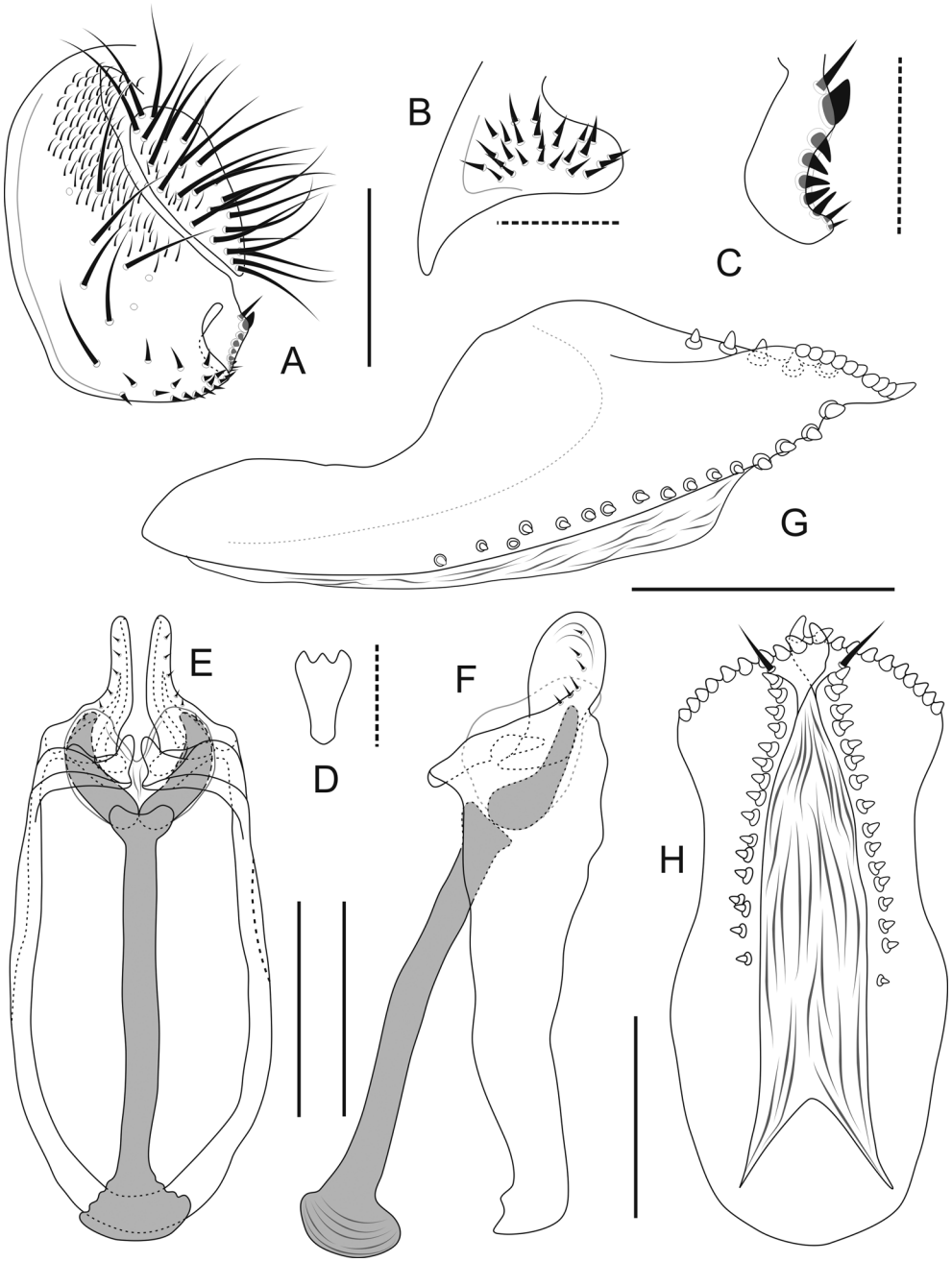

FIGURE 30. *Impatiophila trifurcatosternata* Fu & Gao, sp. nov. Adult male (holotype, #00551) and female (paratype, #00111): A, periphallic organs (caudolateral view); B, caudoventral part of epandrium; C, surstylus (caudal view); D, tenth sternite; E, phallic organs (dorsal view); F, phallic organs (lateral view); G, oviscapt (lateral view); H, oviscapt (ventral view).

Description (♂, ♀). Head: Cibarium with 3 medial and 4 posterior sensilla per side. Labellum with 5–6 pseudotracheae per side.

Thorax (Pl. 3C): Postpronotum, scutum and scutellum black; pleura blackish brown to black.

Wing (Pl. 3C) pale brown; veins dark brown. C_1 setae 2, subequal. Haltere pale yellow.

Legs (Pl. 3C) yellowish brown.

Abdomen (Pl. 3C): Tergites blackish brown. Sternites grayish yellow; male VI somewhat quadrate, slightly wider than long, nearly straight on posterior margin.

Male terminalia (Fig. 30A−F): Epandrium pubescent posteriorly on dorsal 1/2, ventrally with ca. 10 long setae; caudoventral portion round apically, with ca. 30 short setulae. Surstylus with 1 thick seta in addition to 1 stout, upturned prensiseta around caudodorsal corner, 5 apically converging prensisetae along distal margin and 2 short setae near ventral apex. Cercus sparsely pubescent on anteromedial portion, with ca. 25 long setae. Hypandrium twice as long as wide, slightly narrowing posteriorly, round on anterior margin. Gonopod apically moderately protruded. Paramere not longer than twice of width, with 6 sensilla. Aedeagal basal process about 3/5 length of paramere.

Female terminalia (Fig. 30G, H; Pl. 6R): Oviscapt valve brown, gently curved on dorsosubapical margin and strongly expanded dorsomedially in lateral view, with 4−5 dorsal ovisensilla, 10−12 lateral ones on slightly convex (in ventral view) margin of apicolateral flap and 16 distally slightly increasing in size on convex, ventral margin. Spermathecal capsule brown; introvert depth of duct about 1/2 of capsule height.

Measurements: BL = 2.07 (5♂ paratypes: 1.87−2.22, 5♀ paratypes: 2.20−2.55) mm, ThL = 0.98 (0.83−0.93, 0.89−0.97) mm, WL = 1.80 (1.73−1.92, 1.81−1.99) mm, WW = 0.79 (0.73−0.83, 0.77−0.87) mm.

Indices: arb = 3/1 (5♂, 5♀ paratypes: 2−3/1), FW/HW = 0.42 (0.39−0.45), ch/o = 0.10 (0.07−0.10), prorb = 0.91 (0.95−1.17), rcorb = 0.66 (0.68−0.86), orbito = 0.89 (0.82−1.24), vb = 0.42 (0.37−0.52), dcl = 0.57 (0.51−0.57), dcp = 0.35 (0.28−0.44), sterno = 0.70 (0.70−0.81), m-sterno = 0.74 (0.66−0.95), sctl = 0.99 (0.93−1.03), sctlp = 1.04 (0.96−1.22), C = 2.37 (2.15−2.60), 4c = 0.85 (0.77−0.95), 4v = 1.51 (1.42−1.69), 5x = 1.57 (1.44−1.81), ac = 2.69 (2.54−2.98), M = 0.40 (0.38−0.47).

Holotype. ♂ (#00551), Banpo, Yixiang Town, Simao County, Pu'er District, Yunnan, China, 2.x.2011, *ex Impatiens* sp.5, J.J. Gao (KIZ).

Paratypes. CHINA: 5♂, 5♀ (#00111, #00112, #01619−26), same data as holotype (KIZ, SEHU).

Distribution. China (Yunnan).

Etymology. Referring to the tenth sternite (*sternum*) apically looked like trifurcated (*trifurcatus*).

21) *Impatiophila latipennata* Fu & Gao, sp. nov.

(Fig. 31; Pl. 3D; Pl. 6S)

Diagnosis. Heavy, peg-like setae of middle row on 2nd costal section interspersed with weak, trichoid ones. Hindleg tibia with 1 black, apically blunt, stout spine at outer apex on underside. Epandrium deeply concaved on lower caudal margin, resulting in prominent caudoventral lobe (Fig. 31A). Tenth sternite somewhat cordiform, with deep, narrow, V-shaped, median notch on dorsal margin (Fig. 31D).

Description (♂, ♀). Head: Cibarium with 2 medial and 6 posterior sensilla per side.

Thorax (Pl. 3D): Postpronotum, scutum and scutellum glossy black; pleura blackish brown to black.

Wing (Pl. 3D) pale brown; veins dark brown. C_1 setae 2, ventral one shorter and thinner. Haltere grayish yellow.

Legs (Pl. 3D) yellowish brown.

Abdomen (Pl. 3D): Tergites glossy black. Sternites grayish brown; male VI posteriorly wider, concave on posterior margin.

Male terminalia (Fig. 31A−F): Epandrium pubescent posteriorly on dorsal 1/2, ventrally with ca. 10 setae; caudoventral lobe with ca. 13 setae. Surstylus with 2 setae in addition to 1 stout, upturned prensiseta around caudodorsal corner, 7 apically converging prensisetae along distal margin and 3 short setae near ventral apex. Cercus sparsely pubescent on anteromedial portion, with ca. 20 long setae. Hypandrium nearly parallel-sided, roundish on anterior margin. Gonopod apically somewhat acutely projected. Paramere not longer than twice of width, with 7sensilla. Aedeagal basal process about 2/3 length of paramere.

Female terminalia (Fig. 31G, H; Pl. 6S): Oviscapt valve brown, gently curved on dorsosubapical margin and

strongly expanded dorsomedially in lateral view, with 3−4 dorsal ovisensilla, 11−12 lateral ones on slightly convex (in ventral view) margin of apicolateral flap and 9−11 distally slightly increasing in size on convex, ventral margin; apicolateral flap well developed, turnup in lateral view. Spermathecal capsule brown; introvert depth of duct about 1/2 of capsule height.

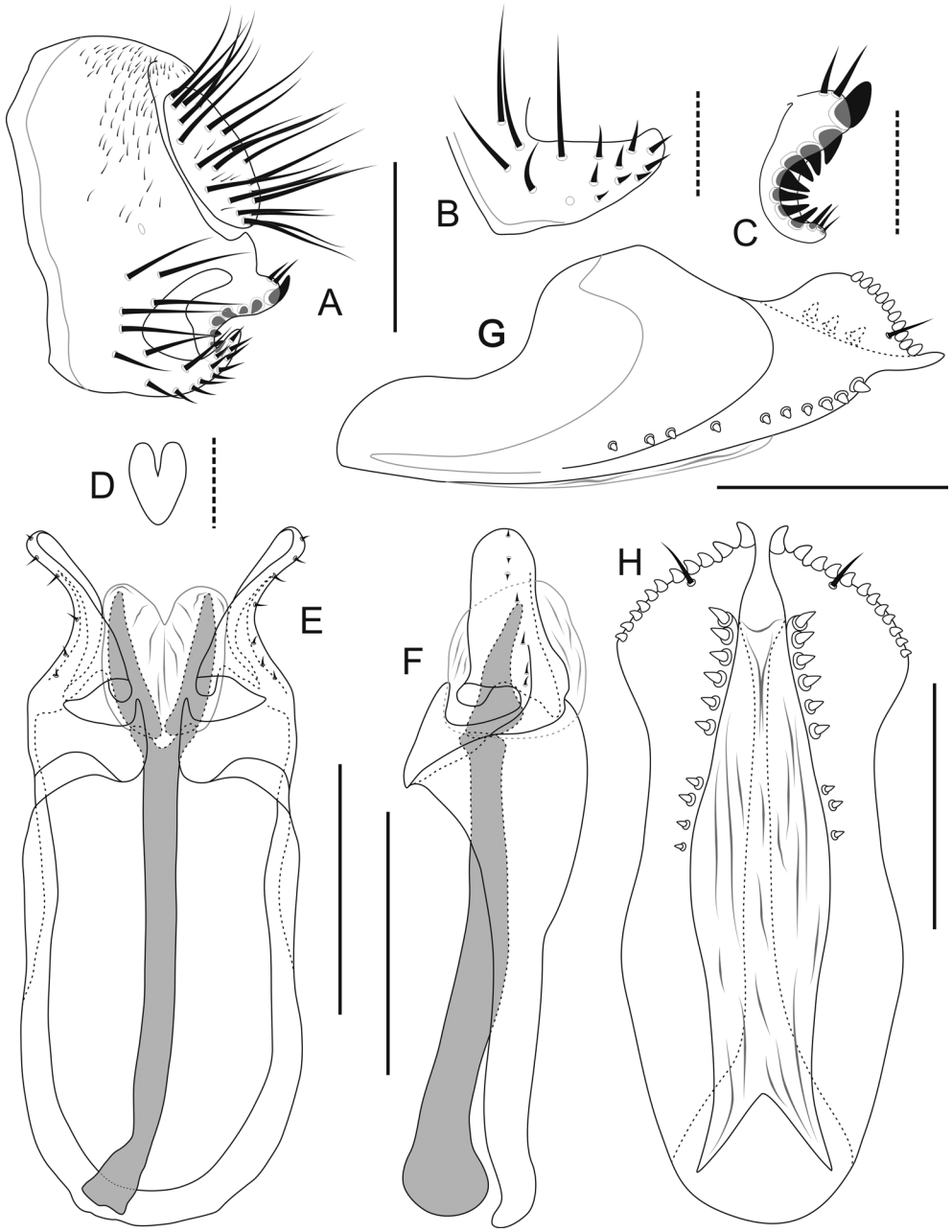

FIGURE 31. ***Impatiophila latipennata*** **Fu & Gao, sp. nov.** Adult male (paratype, #00608) and female (paratype, #00378): A, periphallic organs (caudolateral view); B, caudoventral part of epandrium; C, surstylus (caudal view); D, tenth sternite; E, phallic organs (dorsal view); F, phallic organs (lateral view); G, oviscapt (lateral view); H, oviscapt (ventral view).

Measurements: BL = 2.21 (1♂ paratype: 1.80, 3♀ paratypes: 1.77−2.45) mm, ThL = 0.87 (0.80, 0.68−1.10) mm, WL = 1.93 (1.80, 1.58−2.26) mm, WW = 0.88 (0.83, 0.70−0.98) mm.

Indices: arb = 2/1 (1♂, 3♀ paratypes: 2−3/1), FW/HW = 0.49 (0.44−0.52), ch/o = 0.10 (0.07−0.14), prorb = 0.90 (0.92−1.11), rcorb = 0.65 (0.68−0.78), orbito = 0.85 (0.91−1.08), vb = 0.39 (0.40−0.46), dcl = 0.57 (0.37−0.60), dcp = 0.38 (0.34−0.42), sterno = 0.70 (0.64−0.73), m-sterno = 0.79 (0.55−0.77), sctl = 1.00 (1.02−1.17), sctlp = 0.92 (0.92−1.15), C = 2.47 (2.06−2.73), 4c = 0.83 (0.82−1.00), 4v = 1.52 (1.61−1.70), 5x = 1.53 (1.42−1.79), ac = 2.55 (2.35−2.99), M = 0.44 (0.45−0.53).

Holotype. ♂ (#00604), Beibeng Town, Motuo County, Linzhi District, Xizang, China, 27.IX.2010, *ex Impatiens* sp.9 (with yellow flowers), J.J. Gao (KIZ).

Paratypes. CHINA: 1♂, 1♀ (#00378, #00608), same data as holotype; 2♀ (#01200, #01524), along the way from Yarang, Motuo Town to the county seat of Motuo County, 1.x.2010, *ex Impatiens siculifer* Hook. f. (Fig. 1H), J.J. Gao (KIZ).

Distribution. China (Xizang).

Etymology. Referring to the broad (*latus*), pinnate (*pennatus*), apicolateral flap of oviscapt valve.

22) *Impatiophila bifasciata* Fu & Gao, sp. nov.

(Fig. 32; Pl. 3E; Pl. 6T)

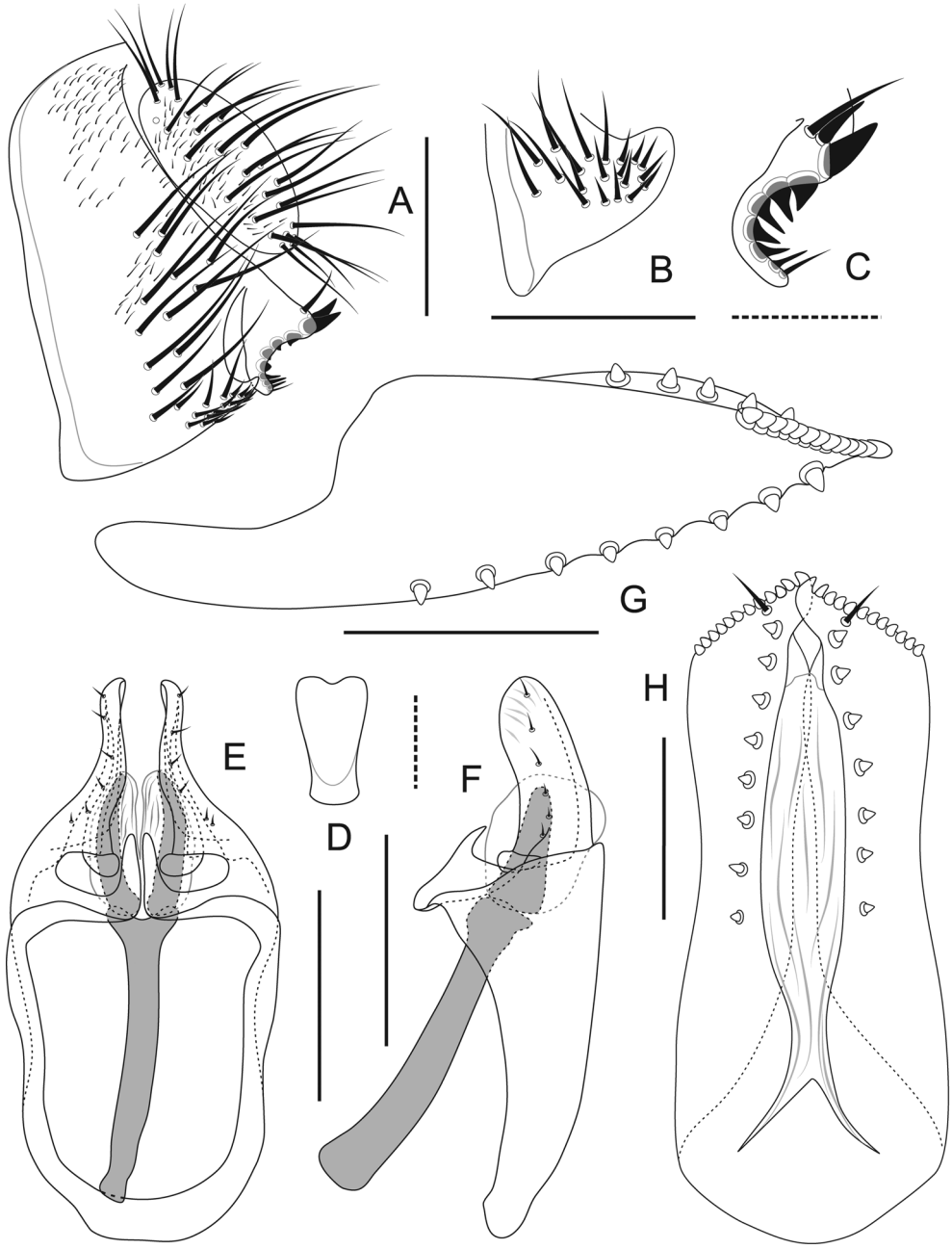

FIGURE 32. ***Impatiophila bifasciata*** **Fu & Gao, sp. nov.** Adult male (holotype, #02572) and female (paratype, #02573): A, periphallic organs (caudolateral view); B, caudoventral part of epandrium; C, surstylus (caudal view); D, tenth sternite; E, phallic organs (dorsal view); F, phallic organs (lateral view); G, oviscapt (lateral view); H, oviscapt (ventral view).

Diagnosis. Abdominal tergites III and IV each with broad, blackish brown to black, caudal band medially narrowly notched (Pl. 3E). Setae of middle row on 2nd costal section all heavy, peg-like setae, present beyond tip of R_{2+3}. Hindleg tibia without black, apically blunt, stout spine at outer apex on underside. Tenth sternite medially concaved on dorsal margin, dorsally somewhat dilated (Fig. 32D). Oviscapt valve with 12 lateral ovisensilla on nearly straight (in ventral view) margin of apicolateral flap (Fig. 32H).

Description (♂, ♀). Head: Cibarium with 2–3 medial and 5–6 posterior sensilla per side.

Thorax (Pl. 3E): Postpronotum yellowish brown; scutum dark brown, pale along transverse suture, central line and lateral lines passing ipsilateral, dorsocentral setae; scutellum dark brown, laterally with yellowish, longitudinal stripes; pleura grayish brown to blackish brown.

Wing (Pl. 3E) yellowish hyaline; veins yellowish brown. C_1 setae 2, subequal. Haltere pale yellow.

Legs (Pl. 3E) yellowish brown.

Abdomen (Pl. 3E): Tergites yellow, each with broad, brown, caudal band slightly broadened dorsally; band medially interrupted on II. Sternite grayish yellow; male VI somewhat quadrate, slightly longer than wide, nearly straight on posterior margin.

Male terminalia (Fig. 32A−F): Epandrium pubescent in patches posteriorly on dorsal 2/3, ventrally with ca. 17 long setae; caudoventral portion with 14 shorter setae. Surstylus with 1 long, stout seta in addition to 2 stout, upturned prensisetae around caudodorsal corner, 5 apically converging prensisetae along distal margin and 2 short setae near ventral apex. Cercus pubescent on anterior half, with ca. 27 long setae. Hypandrium slightly narrowing anteriorly, narrower than long. Gonopod apically acutely protruded, curved ventrad. Paramere slightly bent dorsad in lateral view, longer than twice of width, with 6 sensilla. Aedeagal basal process about 2/3 length of paramere.

Female terminalia (Fig. 32G, H; Pl. 6T): Oviscapt valve brown, gently curved on dorsosubapical margin and less expanded dorsomedially in lateral view, with 5 dorsal ovisensilla, 12 lateral ones on nearly straight (in ventral view) margin of apicolateral flap and 7−8 distally slightly increasing in size on convex, ventral margin. Spermathecal capsule brown; introvert depth of duct about 1/3 of capsule height.

Measurements: BL = 2.60 (5♂ paratypes: 2.40−2.67, 5♀ paratypes: 2.37−2.77) mm, ThL = 1.13 (1.11−1.19, 1.08−1.25) mm, WL = 2.60 (2.60−2.63, 2.50−2.77) mm, WW = 1.18 (1.10−1.17, 1.07−1.20) mm.

Indices: arb = 2/1 (5♂, 5♀ paratypes: 2/1), FW/HW = 0.40 (0.38−0.41), ch/o = 0.07 (0.06−0.07), prorb = 1.00 (0.99−1.03), rcorb = 0.63 (0.59−0.72), orbito = 1.13 (1.00−1.18), vb = 0.49 (0.38−0.44), dcl = 0.54 (0.51−0.57), dcp = 0.37 (0.35−0.39), sterno = 0.66 (0.60−0.69), m-sterno = 0.66 (0.65−0.71), sctl = 1.05 (0.98−1.13), sctlp = 1.03 (0.97−1.16), C = 2.57 (2.43−2.72), 4c = 0.84 (0.81−0.86), 4v = 1.63 (1.56−1.73), 5x = 1.49 (1.46−1.71), ac = 2.79 (2.84−3.42), M = 0.46 (0.43−0.48), C3F = 0.20 (0.16−0.29).

Holotype. ♂ (#02572), Mt. E'mei, Emeishan, Sichuan, China, 19.vii.1992, *ex* shelter, M.J. Toda (KIZ).

Paratypes. CHINA: 5♂, 5♀ (#02573, #02893−901), same data as holotype (KIZ); 5♂, 3♀, same data as holotype (SEHU); 3♂, 2♀, Shennongjia, Hubei, 1520 m alt., 26.vii.1992, M.J. Toda (SEHU).

Distribution. China (Hubei, Sichuan).

Etymology. Referring to the two (*bi*-) dark, longitudinal stripes (*fasciatus*) on the scutum.

23) *Impatiophila quadrangulata* Fu & Gao, sp. nov.

(Fig. 33; Pl. 3F; Pl. 7A)

Diagnosis. Abdominal tergites III and IV each with broad, blackish brown, caudal band medially somewhat protruded; V with caudal band medially neither interrupted/constricted nor protruded (Pl. 3E). Setae of middle row on 2nd costal section all heavy, peg-like setae, present beyond tip of R_{2+3}. Paramere somewhat quadrangular in lateral view, with apically diverging process ventrosubbasally (at continuum between paramere and hypandrium) and 7 sensilla arranged in chevroned row on lateral surface (Fig. 33F).

Description (♂, ♀). Head: Cibarium with 3–4 medial and 6–7 posterior sensilla per side.

Thorax (Pl. 3F): Postpronotum yellow; scutum blackish brown, with 3 pale, longitudinal stripes and pale posterior margin; scutellum blackish brown, pale anteriorly and laterally; pleura brown to blackish brown.

Wing (Pl. 3F) hyaline, yellowish; veins pale brown. C_1 setae 2, ventral one shorter and thinner. Haltere whitish yellow.

Legs (Pl. 3F) yellowish brown. Hindleg tibia without black, apically blunt, stout spine at outer apex on underside.

Abdomen (Pl. 3F): Tergites yellowish brown; II−VI each with broad, blackish brown, caudal band, notched medially on II. Sternites grayish yellow; male VI somewhat quadrate, much wider than long, nearly straight on posterior margin.

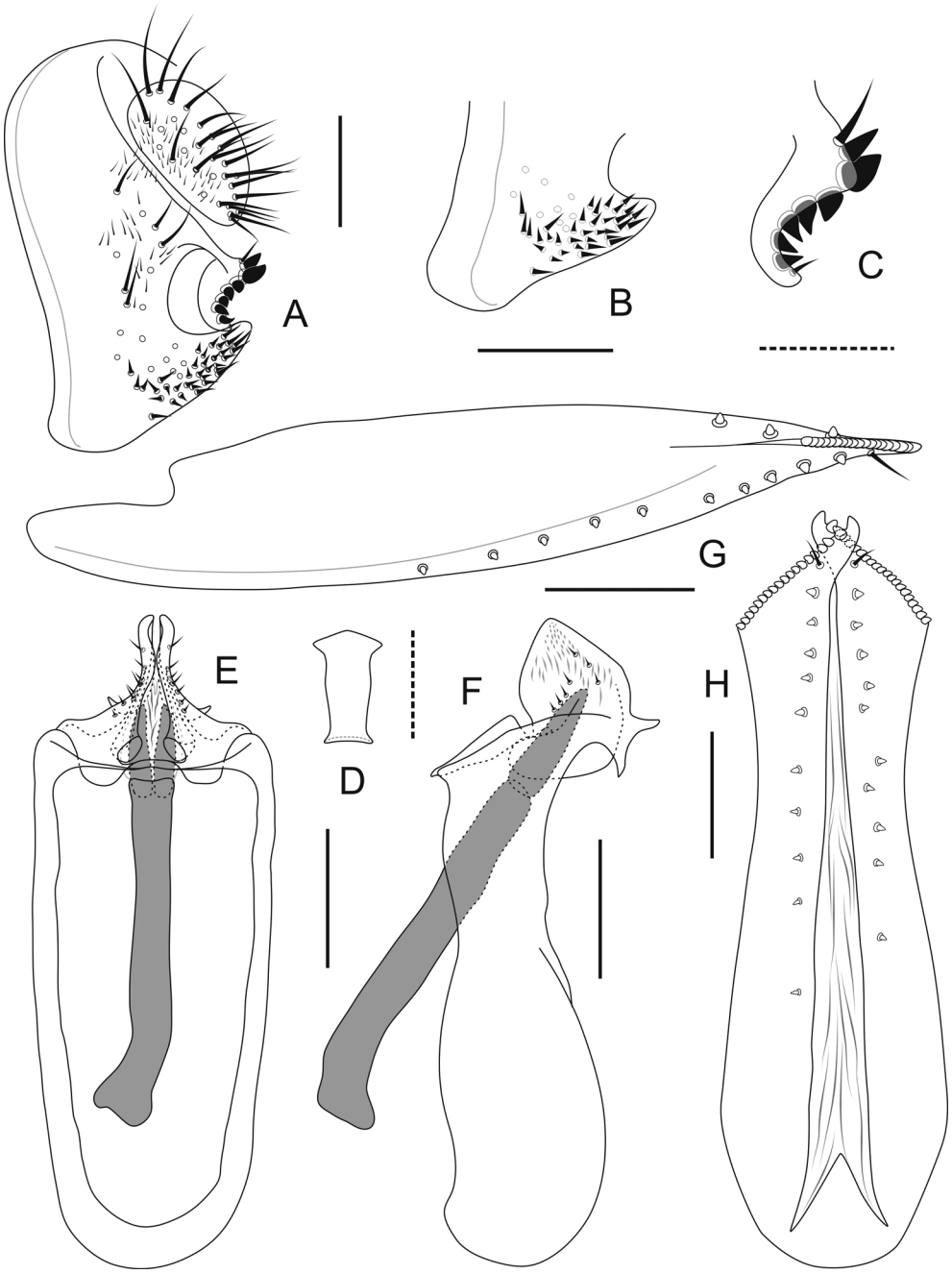

FIGURE 33. ***Impatiophila quadrangulata*** **Fu & Gao, sp. nov.** Adult male (holotype, #02574) and female (paratype, #02575): A, periphallic organs (caudolateral view); B, caudoventral part of epandrium; C, surstylus (caudal view); D, tenth sternite; E, phallic organs (dorsal view); F, phallic organs (lateral view); G, oviscapt (lateral view); H, oviscapt (ventral view).

Male terminalia (Fig. 33A−F): Epandrium pubescent in small patches on posteromedial portion only, obliquely truncate on ventral margin, ventrally with ca. 12 long setae; caudoventral process somewhat triangular, with ca. 40 short spine-like setulae. Surstylus moderately concave in ventral 2/3 of distal margin, with 1 long, thick seta in addition to 2 stout, upturned prensiseta around caudodorsal corner, 5 apically converging prensisetae along distal margin and 1 short seta near ventral apex. Tenth sternite somewhat triangularly expanded on dorsolateral margins, convex on dorsal margin. Cercus pubescent on anteromedial portion, with ca. 28 long setae. Hypandrium slightly narrowing anteriorly, narrower than 1/2 length. Gonopod apically right-angled in lateral view. Paramere only slightly longer than wide. Aedeagal basal process about 3/4 length of paramere.

Female terminalia (Fig. 33G, H; Pl. 7A): Oviscapt valve brown, gently curved on dorsosubapical margin and less expanded dorsomedially in lateral view, with 3 dorsal ovisensilla, 19−21 lateral ones on nearly straight (in ventral view) margin of apicolateral flap and 10 distally increasing in size on slightly convex, ventral margin. Spermathecal capsule brown; introvert depth of duct about 1/4 of capsule height.

Measurements: BL = 2.23 (2♂ paratypes: 2.20−2.47, 2♀ paratypes: 2.63−2.70) mm, ThL = 1.13 (1.10−1.17, 1.13−1.16) mm, WL = 2.48 (2.60−2.60, 2.63−2.83) mm, WW = 1.14 (1.17−1.20, 1.14−1.23) mm.

Indices: arb = 3/1 (2♂, 2♀ paratypes: 2−3/1), FW/HW = 0.44 (0.41−0.44), ch/o = 0.11 (0.08−0.10), prorb = 0.91 (0.91−1.07), rcorb = 0.48 (0.65−0.78), orbito = 0.95 (1.07−1.35), vb = 0.35 (1♂, 2♀ paratypes: 0.39−0.47), dcl = 0.61 (0.55−0.60), dcp = 0.40 (0.32−0.37), sterno = 0.71 (0.69−0.80), m-sterno = 0.75 (0.75−0.83), sctl = 1.06 (0.99−1.05), sctlp = 1.13 (1.00−1.28), C = 2.19 (2.37−2.50), 4c = 0.98 (0.87−0.94), 4v = 1.85 (1.62−1.68), 5x = 1.81 (1.50−1.73), ac = 3.16 (2.87−3.12), M = 0.55 (0.44−0.50), C3F = 0.06 (0.06−0.09).

Holotype. ♂ (#02574), Mt. E'mei, Sichuan, China, ca. 2540 m, 17.vii.1992, by net sweeping, M.J. Toda (KIZ).

Paratypes: CHINA: 1♂, 2♀ (KIZ: #02575, #02883, #02884), 1♂ (SEHU), same data as holotype; 1♂ (KIZ: #02885) Mt. E'mei, Sichuan, 19.vii.1992, by net sweeping, M.J. Toda.

Distribution. China (Sichuan).

Etymology. Referring to the quadrangular (*quadrangulatus*) paramere.

2 *Impatiophila acutivalva* species group, new

Diagnosis. Anteromost, posterior sensillum of cibarium shorter than twice length of posteromost, medial sensillum (Fig. 3B). Ovisensilla on ventral margin of oviscapt valve distally decreasing in size (Fig. 6A). Subapical, trichoid ovisensillum of oviscapt valve weak, as long as apical, peg-like ovisensillum (Fig. 6H). Spermathecal capsule apically somewhat pointed in lateral view (Fig. 6N).

Common characters. Cibarial, posterior sensilla nearly straight. Setae of middle row on 2nd costal section of wing all heavy, peg-like, reaching or beyond tip of R_{2+3}. Hindleg tibia without black, apically blunt, stout spines at outer apex on underside (unknown for *I. paralongifera*, *I. ovilongata* and *I. sikkimensis*). Male sternite VI not longer than wide, posteriorly wider, concave on posterior margin (unknown for *I. paralongifera*, *I. ovilongata*, *I. sikkimensis* and *I. unicolorata*). Epandrium with patch of dense, small setae or stout setulae on caudoventral portion. Distal margin of surstylus not deeply concave. Paramere more or less angled at apicodorsal corner (without exception), not longer than twice of width (except for *I. pipa* and unknown for *I. paralongifera*, *I. ovilongata*, *I. sikkimensis* and *I. unicolorata*). Aedeagal basal process not longer than 1/2 of paramere (except for *I. magnimaculata*). Oviscapt valve slender, not or less expanded in dorsomedial portion, distally concave on ventral margin, with apical portion narrowing in ventral view and 3−4 lateral ovisensilla not tightly arranged on subapicolateral portion. Spermathecal capsule as wide as long.

24) *Impatiophila paralongifera* (Gupta & Singh, 1981), comb. nov.

Drosophila paralongifera Gupta & Singh, 1981: 33.

Diagnosis. Abdominal tergites III–V each with medially "mildly interrupted broad black band" (Gupta & Singh, 1981). Scutum dark brown, much lighter near region of postpronotal lobe; "scutellum brown, lighter at margin" (Gupta & Singh, 1981).

Distribution. India (West Bengal).

25) *Impatiophila ovilongata* (Gupta & Gupta, 1991), comb. nov.

Drosophila ovilongata Gupta & Gupta, 1991: 59.

Diagnosis. Abdominal tergites II and III with "broad dark brown bands widely interrupted medially"; IV with "a narrowly interrupted band" (Gupta & Gupta, 1991). Scutum and scutellum without distinct color pattern: "Mesonotum shining brown to black, scutellum little lighter" (Gupta & Gupta, 1991).

Distribution. India (Sikkim).

26) *Impatiophila sikkimensis* (Gupta & Gupta, 1991), comb. nov.

Drosophila sikkimensis Gupta & Gupta, 1991: 62.

Diagnosis. Abdominal tergites with "light brown bands"; II and III with "medially interrupted bands"; IV and V with "completely bands" (Gupta & Gupta, 1991). Scutum "pale brown to shining dark brown, with a obscure lightly brown longitudinal stripe" (Gupta & Gupta, 1991).

Distribution. India (Sikkim).

27) *Impatiophila actinia* (Okada, 1991), comb. nov.

Drosophila (*Hirtodrosophila*) *actinia* Okada, 1991: 481.

Diagnosis. Abdominal tergite III with caudal band medially narrowly interrupted; IV with caudal band medially narrowly constricted; V with caudal band medially neither interrupted/constricted nor protruded. Scutum "glossy blackish brown, somewhat pruinose, paler along humeral callus and notopleural line"; scutellum "pruinose black, marginally gray" (Okada, 1991). Hindleg tarsomere I with 2 black, apically blunt, stout spines at outer apex on underside. Tenth sternite longer than wide, parallel-sided, with narrow, V-shaped notch medially on dorsal margin.

Supplementary and revised description (♂, ♀). Head: Cibarium with 3 medial and 4 posterior sensilla per side. Labellum with 6 pseudotracheae per side.

Thorax: Mid katepisternal seta longer than anterior katepisternal seta.

Abdomen: Male sternite VI posteriorly wider, concave on posterior margin.

Male terminalia: Epandrium pubescent only in small patch on dorsolateral portion. Paramere not longer than twice of width in lateral view.

Female terminalia: Oviscapt valve gently curved on dorsosubapical margin in lateral view, with 4 dorsal ovisensilla and 21–22 entirely arranged at nearly equal intervals on ventral margin.

Specimens examined. CHINA: 1♂, Chitou, Taiwan, 20.i.1982, *ex* flower of *Impatiens uniflora* Hayata (Fig. 1I), M.J. Toda (SEHU); 1♀, ditto, except for 20.iv.1997 (SEHU).

Distribution. China (Taiwan).

Reproductive ecology. Flower-visiting/breeding habits of this species were investigated on April 21, 1997 in Chitou, Taiwan. One to five male and one to seven female flies (on average 1.7 and 2.0, respectively, $N = 29$; flowers without flies were not sampled; Table 10) were collected per flower of *Impatiens uniflora* (Fig. 1I). Their crop contents, if present, always included liquid substance. Although pollen grains were observed in crop contents of a few individuals, the amount was small. This suggests that adult flies take nectar from the flowers; pollen intake may be unintentional mixing. Small- to large-sized (probably representing 1st to 3rd instars) larvae (one to three per flower) were found from some flowers, but no egg was found. They were reared on the collected flowers, and all adult flies having emerged from them were *I. actinia*.

TABLE 10. Adults and immatures of *Impatiophila actinia* collected from *Impatiens uniflora* flowers on 21.iv.1997 in Chitou, Taiwan, China.

Flower	Adults		Larvae			Conditions of adult
	♀	♂	S	M	L	♀(Stage* or No. of mature egg(s) in left ovary/ditto in right one, egg** in uterus; crop contents***) , ♂(crop contents)
1		1				♂(L)
2	1	2	1		1	♀(I/I,–; –), ♂(–), ♂(L)
3	5	5	1			♀(1/1,+; L), ♀(1/IV,+; L), ♀(2/4,–; L), ♀(II/II,+; L), ♀(1/II,–; L), 5♂(L)
4	1	1	1			♀(2/1,+; L), ♂(–)
5		1				♂(–)
6		1	2		1	♂(L)
7		1	1			♂(L)

...Continued on next page

TABLE 10. (Continued)

Flower	Adults		Larvae			Conditions of adult
	♀	♂	S	M	L	♀(Stage* or No. of mature egg(s) in left ovary/ditto in right one, egg** in uterus; crop contents***) , ♂(crop contents)
8	1		1		1	♀(1/1,+; –)
9	1					♀(II/II,–; –)
10	1					♀(4/4,+; L)
11	4	1	1			♀(2/1,+; L+P), 2♀(II/II,–; L), ♀(I/I,–; L), ♂(–)
12		1				♂(L)
13	1				1	♀(IV/1,–; L)
14	2	5			1	♀(1/1,–; –), ♀(IV/IV,+; –), 3♂(–), 2♂(L)
15	1	1				♀(IV/IV,+; –), ♂(L)
16	2	1			1	♀(II/II,–; –), ♀(II/II,–; L), ♂(L)
17	1		1			♀(2/2,–; L)
18	3	5			1	♀(1/1,+; –), ♀(II/II,–; –),♀(II/1,–; L), 2♂(L), 3♂(–)
19	1	3	1		1	♀(1/II,–; –), ♂(–), ♂(L), ♂(L+P)
20	1	1				♀(II/IV,+; L), ♂(L)
21	1					♀(5/2,+; –)
22	1	2				♀(II/II,–; L), 2♂(L)
23		1	1	1	1	♂(–)
24		1			1	♂(–)
25		1				♂(L+P)
26		1				♂(L)
27	3	7				♀(II/II,–; –),♀(2/1,+; –),♀(II/II,–; L), 2M(–), 5M(L)
28	1	1				♀(IV/IV,–; L), M(L)
29	1	1			1	♀(1/1,–; –), M(L)
Mean	1.7	2.0				

* I: undeveloped, II: developing, III: mature, IV: degenerated (Watabe & Beppu 1977)
** +: present, –: absent
*** L: liquid, P: pollen, –: empty

28) *Impatiophila pulla* Fu & Gao, sp. nov.

(Fig. 34; Pl. 3G)

Diagnosis. Abdominal tergites entirely black (Pl. 3G). Labellum with 6 pseudotracheae per side. Tenth sternite broader than long, nearly parallel-sided, with W-shaped notch medially on dorsal margin (Fig. 34D). Paramere not longer than twice of width in lateral view (Fig. 34E).

Description (♂). Head: Cibarium with 2−3 medial and 3−4 posterior sensilla per side.

Thorax (Pl. 3G): Postpronotum blackish brown; scutum and scutellum black; pleura brown to blackish brown.

Wing (Pl. 3G) pale brown; veins brown. C_1 setae 2, subequal. Haltere pale yellow.

Leg (Pl. 3G) yellowish brown. Hindleg tarsomere I with 2 black, apically blunt, stout spines at outer apex on underside.

Abdomen: Sternites grayish yellow.

Male terminalia (Fig. 34A−F). Epandrium pubescent on posterior portion of dorsal 3/4, ventrally with ca. 18 setae: caudoventral ones shorter and more densely distributed. Surstylus with 1 long, thick setae in addition to 1 stout, upturned prensiseta on dorsal margin and 6 prensisetae along distal margin. Cercus pubescent in patches on

anteromedial portion, with ca. 21 long setae. Hypandrium somewhat obovate. Gonopod rounded on dorsal margin, apically beak-like narrowing in lateral view. Paramere caudoventrally rounded, with 6 sensilla. Aedeagal basal process about 1/2 length of paramere.

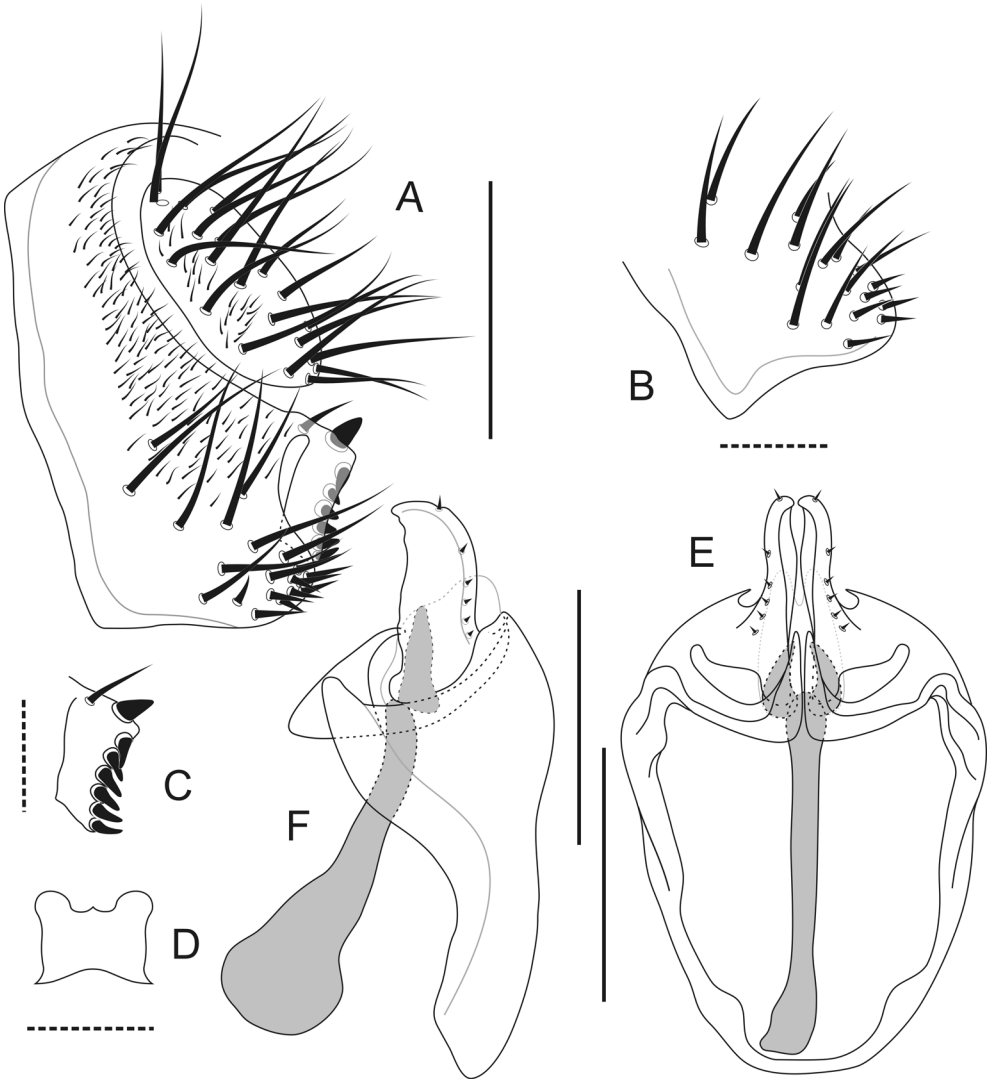

FIGURE 34. ***Impatiophila pulla*** **Fu & Gao, sp. nov.** Adult male (holotype, #01126): A, periphallic organs (caudolateral view); B, caudoventral part of epandrium; C, surstylus (caudal view); D, tenth sternite; E, phallic organs (dorsal view); F, phallic organs (lateral view).

Measurements: BL = 1.91 mm, ThL = 0.88 mm, WL = 1.95 mm, WW = 0.82 mm.

Indices: arb = 2/1, FW/HW = 0.47, ch/o = 0.09, prorb = 1.03, rcorb = 0.47, orbito = 1.07, vb = 0.42, dcl = 0.49, dcp = 0.40, sterno = 0.53, m-sterno = 0.61, sctl = 1.04, sctlp = 0.97, C = 2.28, 4c = 0.94, 4v = 1.71, 5x = 1.46, ac = 2.49, M = 0.43, C3F = 0.39.

Holotype. ♂ (#01126), Hesong Village, Xiding Town, Menghai County, Xishuangbanna District, Yunnan, China, 21°49′57″N, 100°06′09″E, 17.iv.2010, by net sweeping above fallen trunks along waterside, J.J. Gao (KIZ).

Distribution. China (Yunnan).

Etymology. Referring to the blackish (*pullus*) body color.

Remarks. This species known only for male can not be morphologically distinguished from *I. unicolorata* sp. nov. known only for female.

29) *Impatiophila motuoensis* Fu & Gao, sp. nov.
(Fig. 35; Pl. 3H; Pl. 7B)

Diagnosis. Abdominal tergite I grayish yellow; II and III each with black, medially widely interrupted, caudal band; IV with caudal band medially widely constricted; V and VI nearly entirely black (Pl. 3H). Tenth sternite flexuous on lateral margins, with W-shaped notch medially on dorsal margin (Fig. 35D).

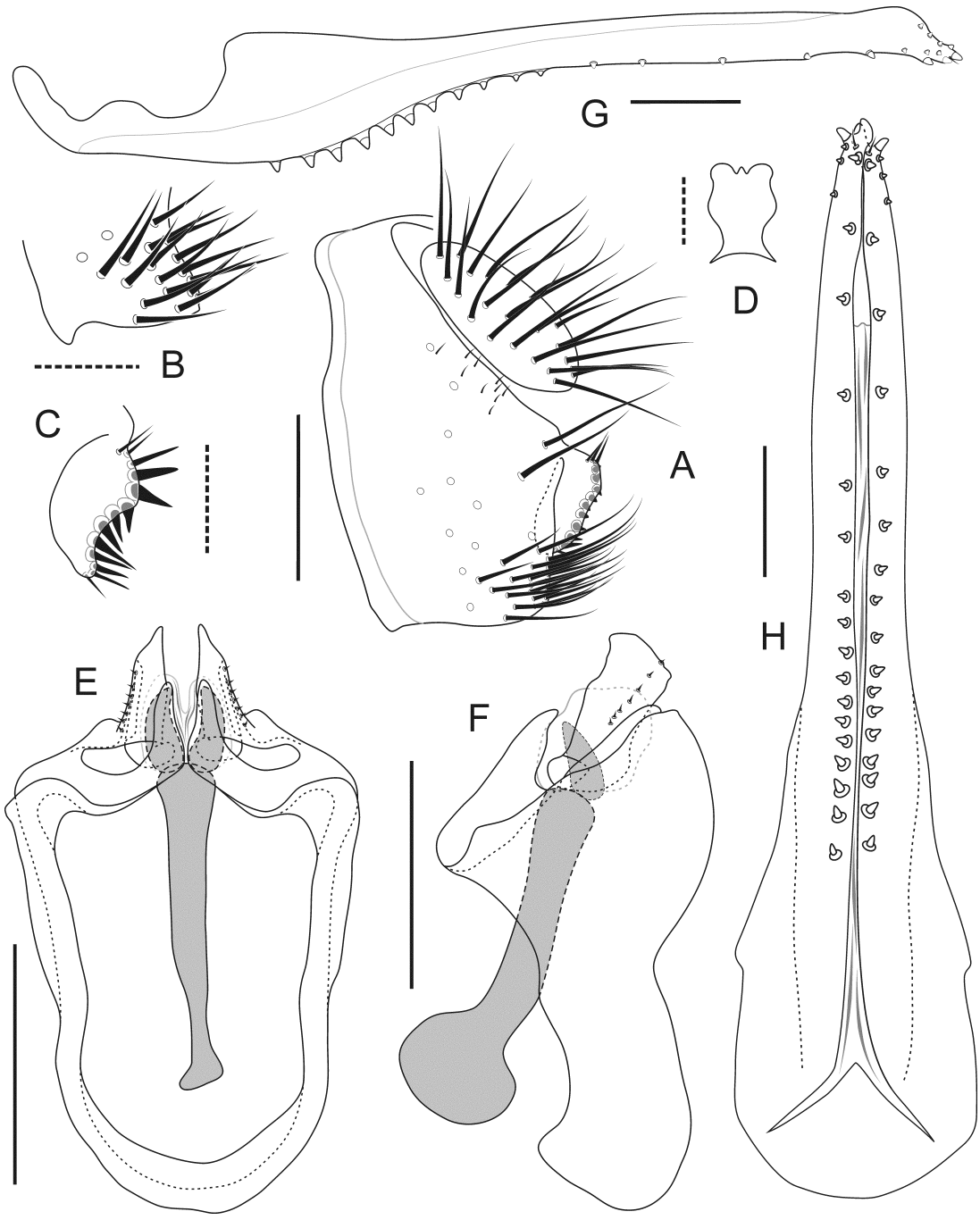

FIGURE 35. *Impatiophila motuoensis* Fu & Gao, sp. nov. Adult male (holotype, #00273) and female (paratype, #00274): A, periphallic organs (caudolateral view); B, caudoventral part of epandrium; C, surstylus (caudal view); D, tenth sternite; E, phallic organs (dorsal view); F, phallic organs (lateral view); G, oviscapt (lateral view); H, oviscapt (ventral view).

Description (♂, ♀). Head: Cibarium with 2−3 medial and 4 posterior sensilla per side. Labellum with 5 pseudotracheae per side.

Thorax (Pl. 3H): Postpronotum dark brown; scutum and scutellum black; pleura brown to blackish brown.

Wing (Pl. 3H) pale brown; veins brown. C_1 setae 2, subequal. Haltere pale yellow.

Legs (Pl. 3H) yellowish brown. Hindleg tarsomere I with 1 black, apically blunt, stout spine at outer apex on underside.

Abdomen: Sternites grayish yellow.

Male terminalia (Fig. 35A−F): Epandrium pubescent in small patch on caudomedial portion, truncate on ventral margin, with ca. 31 long setae on medial to ventral portion: caudoventral ones more densely distributed. Surstylus with 3 setae in addition to 2 stout, upturned prensisetae around and above caudodorsal corner, 6 prensisetae along distal margin and 2 setae at ventral apex. Cercus unpubescent, with ca. 24 long setae. Hypandrium slightly narrowing anteriorly, slightly (in ventral view) and strongly (in lateral view) constricted around anterior 1/3. Gonopod well developed, more or less straight on dorsal margin in lateral view. Paramere apically obliquely truncate, with 7 sensilla. Aedeagal basal process about 1/2 length of paramere.

Female terminalia (Fig. 35G, H; Pl. 7B): Oviscapt valve yellowish brown, obliquely truncate on dorsosubapical margin in lateral view, with 4−5 dorsal ovisensilla and 17−18 ventral ones more widely spaced in subdistal portion. Spermathecal capsule dark brown; introvert depth of duct about 4/5 of capsule height.

Measurements: BL = 2.48 (5♂ paratypes: 2.25−2.65, 3♀ paratypes: 2.72−2.90) mm, ThL = 1.14 (0.98−1.26, 1.25−1.33) mm, WL = 2.36 (2.13−2.48, 2.44−2.57) mm, WW = 0.99 (0.88−1.05, 1.05−1.12) mm.

Indices: arb = 2/1 (5♂, 3♀ paratypes: 2−3/1), FW/HW = 0.39 (0.39−0.44), ch/o = 0.10 (0.07−0.11), prorb = 1.14 (0.94−1.36), rcorb = 0.55 (0.52−0.68), orbito = 0.91 (0.84−1.22), vb = 0.42 (0.32−0.55), dcl = 0.56 (0.51−0.65), dcp = 0.36 (0.36−0.42), sterno = 0.61 (0.57−0.68), m-sterno = 0.67 (0.54−0.76), sctl = 0.91 (0.97−1.08), sctlp = 1.06 (0.87−1.12), C = 3.29 (2.81−3.44), 4c = 0.71 (0.68−0.84), 4v = 1.73 (1.60−1.75), 5x = 1.50 (1.25−1.63), ac = 2.33 (2.28−2.63), M = 0.39 (0.37−0.43), C3F = 0.41 (0.23−0.39).

Holotype. ♂ (#00273), along the way from Beibeng Town to Yarang Village, Motuo Town, Motuo County, Linzhi, Xizang, China, 1.x.2010, *ex Impatiens* ?*arguta* Hook. f. et. Thoms. (Fig. 1D) J.J. Gao (KIZ).

Paratypes. CHINA: 1♂, 1♀ (#00274, #00373), same data as holotype; 3♂, 2♀ (#00701−5), along the way from Yarang Village to the seat of Motuo County, Linzhi, Xizang, 1.x.2010, *ex Impatiens* ?*arguta* Hook. f. et. Thoms. (Fig. 1D) J.J. Gao (KIZ, SEHU).

Distribution: China (Xizang).

Etymology. Pertaining to the type locality.

30) *Impatiophila epubescens* Fu & Gao, sp. nov.

(Fig. 36; Pl. 4A; Pl. 7C)

Diagnosis. Abdominal tergite I grayish yellow; II−VI yellow, each with broad, black, caudal band; bands on II− IV medially narrowly interrupted or constricted; bands on V and VI medially neither interrupted/constricted nor protruded (Pl. 4A). Hindleg tarsomere I with 1 black, apically blunt, stout spine at outer apex on underside. Labellum with 5 pseudotracheae per side. Tenth sternite broader than long, dorsally dilated, with V-shaped notch medially on dorsal margin (Fig. 36D). Paramere slightly serrated on dorsosubacpial margin (Fig. 36F). Hypandrium slightly narrowing posteriorly (Fig. 36E).

Description (♂, ♀). Head: Cibarium with 2−3 medial and 4 posterior sensilla per side.

Thorax (Pl. 4A): Postpronotum yellowish brown; scutum black, narrowly pale along lines passing ipsilateral dorsocentral setae; scutellum black, pale laterally; pleura blackish brown to black.

Wing (Pl. 4A) pale brown; veins brown. C_1 setae 2, subequal. Haltere knob yellow; stem grayish yellow.

Legs (Pl. 4A) yellowish brown.

Abdomen: Sternites grayish yellow.

Male terminalia (Fig. 36A−F): Epandrium unpubescent, with ca. 28 long setae on ventral half: caudoventral ones shorter and more densely distributed. Surstylus with 2 thick setae in addition to 1 stout, upturned prensiseta around caudodorsal corner, 6 prensisetae along distal margin and 2 setae near ventral apex. Cercus unpubescent, with ca. 25 long setae. Hypandrium slightly narrowing posteriorly, slightly concaved on medial portion of ventral surface in lateral view. Gonopod well developed. Paramere with 7 sensilla. Aedeagal basal process about 2/5 length of paramere.

Female terminalia (Fig. 36G, H; Pl. 7C): Oviscapt valve yellowish brown, obliquely truncate on dorsosubapical margin in lateral view, with 4 dorsal ovisensilla and 16−19 ventral ones arranged entirely at nearly equal intervals. Spermathecal capsule brown; introvert depth of duct about 4/5 of capsule height.

Measurements: BL = 3.07 (5♂ paratypes: 2.50−2.67, 5♀ paratypes: 2.37−3.20) mm, ThL = 1.20 (1.10−1.23, 1.05−1.33) mm, WL = 2.64 (2.46−2.72, 2.46−2.87) mm, WW = 1.13 (1.01−1.18, 1.07−1.23) mm.

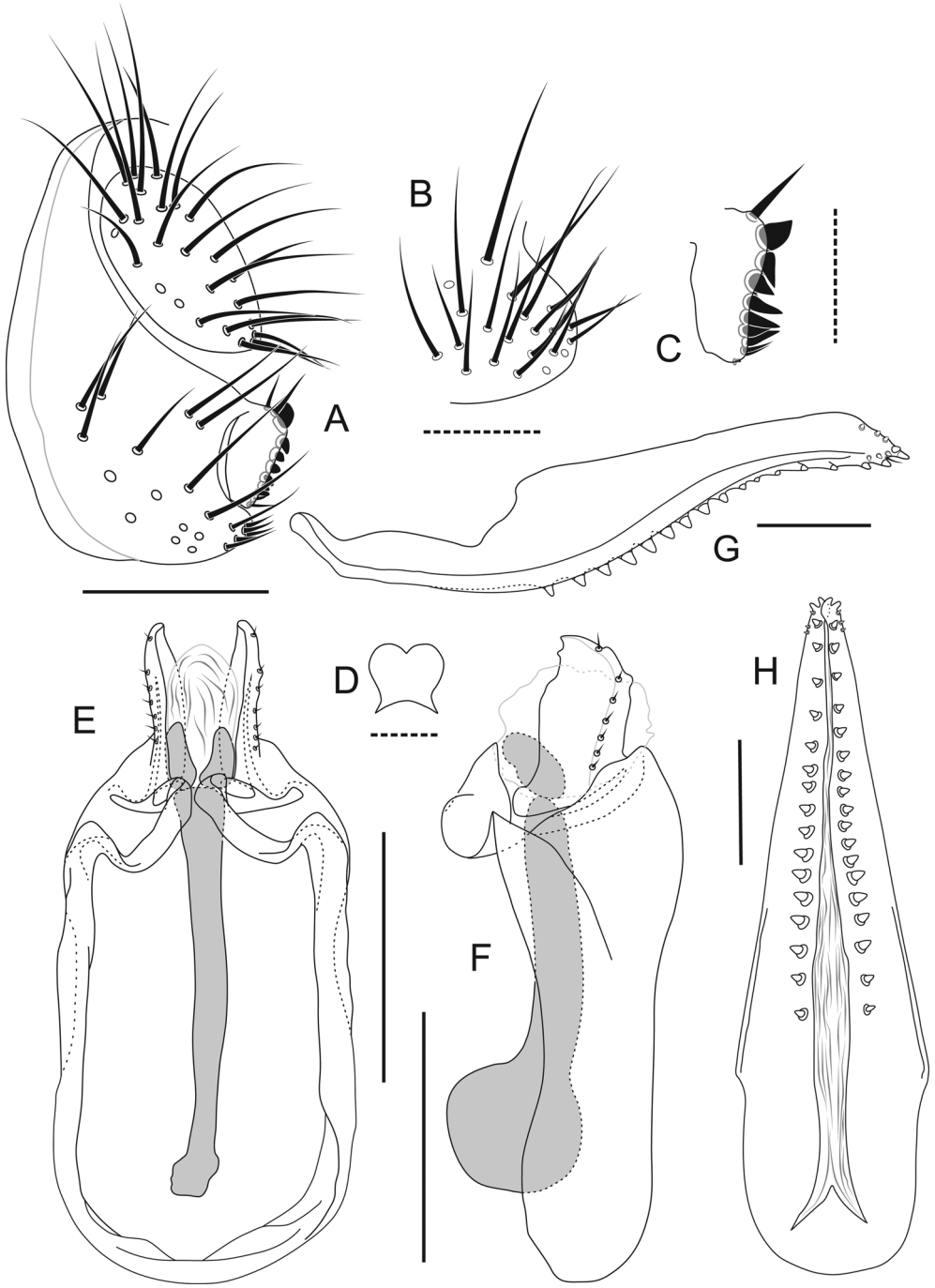

FIGURE 36. ***Impatiophila epubescens*** **Fu & Gao, sp. nov.** Adult male (holotype, #00280) and female (paratype, #00278): A, periphallic organs (caudolateral view); B, caudoventral part of epandrium; C, surstylus (caudal view); D, tenth sternite; E, phallic organs (dorsal view); F, phallic organs (lateral view); G, oviscapt (lateral view); H, oviscapt (ventral view).

Indices: arb = 2/1 (5♂, 5♀ paratypes: 2−3/0−1), FW/HW = 0.46 (0.44−0.47), ch/o = 0.13 (0.09−0.13), prorb = 1.09 (0.98−1.24), rcorb = 0.53 (0.47−0.57), orbito = 1.00 (0.86−1.16), vb = 0.30 (0.29−0.43), dcl = 0.51 (0.48−0.59), dcp = 0.42 (0.34−0.42), sterno = 0.54 (0.54−0.69), m-sterno = 0.79 (5♂, 4♀ paratypes: 0.60−0.81), sctl = 1.02 (0.99−1.09), sctlp = 1.33 (0.93−1.33), C = 2.64 (2.48−2.79), 4c = 0.85 (0.74−0.93), 4v = 1.70 (1.43−1.86), 5x = 1.37 (1.14−1.60), ac = 2.43 (2.15−2.94), M = 0.44 (0.34−0.49), C3F = 0.27 (0.19−0.31).

Holotype. ♂ (#00280), Tongmai, Yigong, Bomi, Linzhi, Xizang, China, 30°06′10″N, 95°04′49″E, ca. 2080 m, 9.x.2010, *ex Impatiens* ?*arguta* Hook. f. et. Thoms. (Fig. 1D) J.J. Gao (KIZ).

Paratypes. CHINA: 5♂, 7♀ (#00278, #00279, #00281, #00545−50, #00552, #00553, #01387), same data as holotype (KIZ, SEHU).

Distribution. China (Xizang).

Etymology. Referring to the unpubescent (*e-pubescens*) epandrium.

31) *Impatiophila curvivalva* Fu & Gao, sp. nov.
(Fig. 37; Pl. 4B; Pl. 7D)

Diagnosis. Abdominal tergites II–VI with broad, black, caudal bands broadened laterally, medially widely interrupted or constricted on II−V (Pl. 4B). Hindleg tarsomere I with 1 black, apically blunt, stout spine at outer apex on underside. Tenth sternite slightly broader than long, dorsally dilated, with U-shaped notch medially on dorsal margin (Fig. 37D).

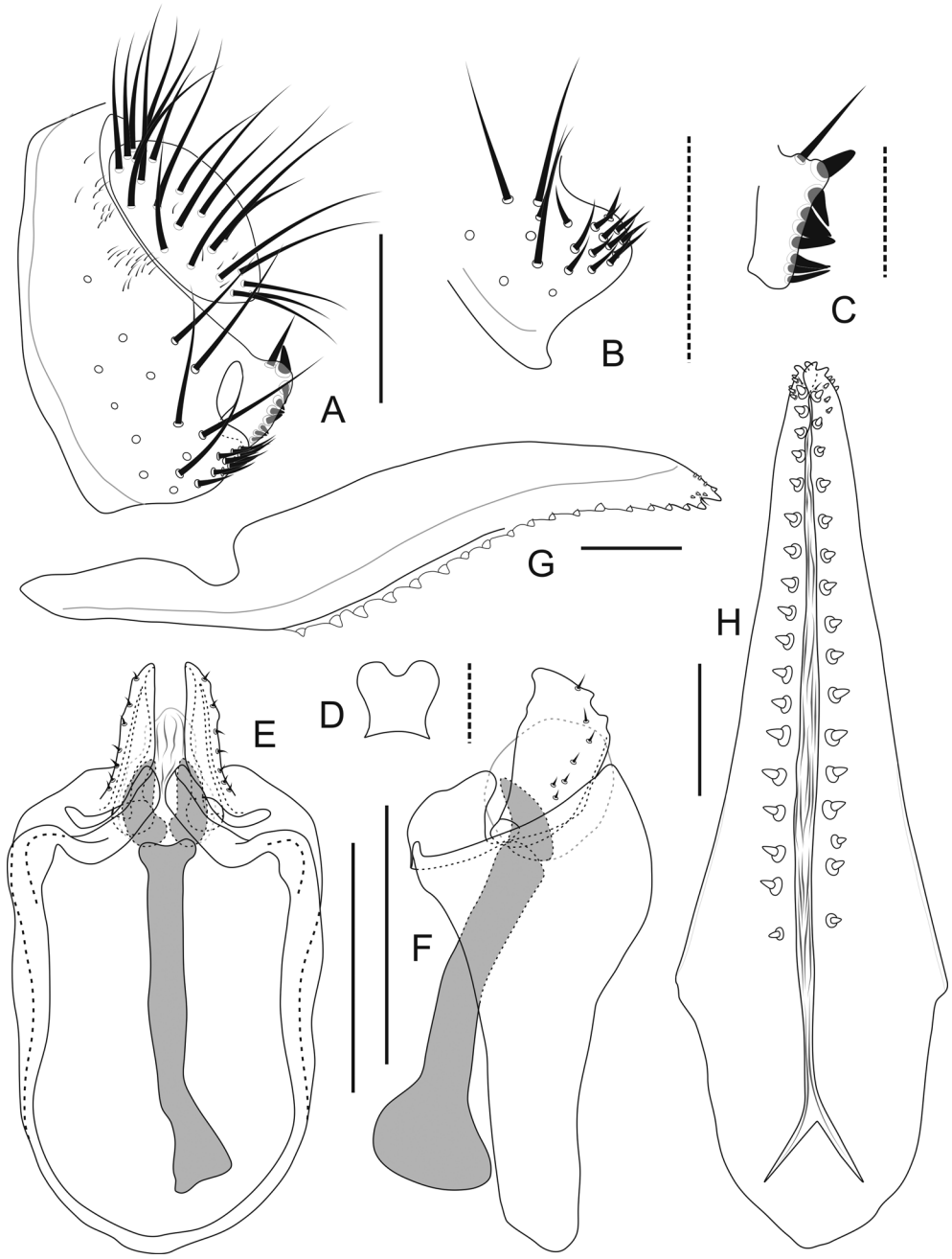

FIGURE 37. *Impatiophila curvivalva* Fu & Gao, sp. nov. Adult male (holotype, #00089) and female (paratype, #00097): A, periphallic organs (caudolateral view); B, caudoventral part of epandrium; C, surstylus (caudal view); D, tenth sternite; E, phallic organs (dorsal view); F, phallic organs (lateral view); G, oviscapt (lateral view); H, oviscapt (ventral view).

Description (♂, ♀). Head: Cibarium with 2−3 medial and 7 posterior sensilla per side. Labellum with 5−6 pseudotracheae per side.

Thorax (Pl. 4B): Postpronotum yellowish brown; scutum black anteriorly, blackish brown posteriorly, pale brown along notopleural line and lines connecting anterior and posterior, dorsocentral setae; scutellum blackish brown, marginally pale brown; pleura yellowish brown to blackish brown.

Wing (Pl. 4B) hyaline; veins yellowish brown. C_1 setae 2, subequal. Haltere knob yellow; stem grayish yellow.

Legs (Pl. 4B) yellowish brown.

Abdomen (Pl. 4B): Tergites yellow. Sternites grayish yellow.

Male terminalia (Fig. 37A−F): Epandrium pubescent in small patches on posterior, subdorsal to medial portion, with 17 long setae on medial to ventral portion and 13 shorter setae on caudoventral portion. Surstylus with 1 long, thick seta on dorsal margin in addition to 1 stout, upturned prensiseta at caudodorsal corner, 6 prensisetae along distal margin and 1 seta near ventral apex. Cercus with sparse pubescence on medial to ventral portion and ca. 25 long setae. Hypandrium nearly parallel-sided, roundish on anterior margin. Gonopod well developed, apically rounded. Paramere slightly waved on dorsosubapical margin, with 7 sensilla arranged in somewhat irregular row. Aedeagal basal process slightly shorter than 1/2 length of paramere.

Female terminalia (Fig. 37G, H; Pl. 7D): Oviscapt valve yellowish brown, gently curved on dorsosubapical margin in lateral view, with 4 dorsal ovisensilla and 16−19 ventral ones arranged entirely at nearly equal intervals. Spermathecal capsule brown; introvert depth of duct about 4/5 of capsule height.

Measurements: BL = 2.67 (5♂ paratypes: 2.28−2.70, 5♀ paratypes: 2.69−2.93) mm, ThL = 1.18 (1.04−1.15, 1.21−1.30) mm, WL = 2.45 (2.30−2.38, 2.52−2.77) mm, WW = 1.02 (0.95−1.02, 1.05−1.14) mm.

Indices: arb = 2/1 (5♂, 5♀ paratypes: 2−3/1), FW/HW = 0.45 (0.44−0.47), ch/o = 0.08 (0.07−0.14), prorb = 1.13 (0.96−1.22), rcorb = 0.60 (0.47−0.61), orbito = 0.82 (0.81−1.04), vb = 0.40 (0.33−0.49), dcl = 0.62 (0.53−0.65), dcp = 0.39 (0.33−0.45), sterno = 0.68 (0.57−0.65), m-sterno = 0.72 (0.64−0.78), sctl = 1.03 (0.96−1.08), sctlp = 1.04 (0.95−1.29), C = 2.60 (2.56−2.96), 4c = 0.83 (0.70−0.85), 4v = 1.66 (1.51−1.76), 5x = 1.38 (1.33−1.61), ac = 2.24 (2.15−2.77), M = 0.41 (0.40−0.47), C3F = 0.37 (0.22−0.38).

Holotype. ♂ (#00089), Liangjiaren, Hutiaoxia, Shangri-la, Diqing, Yunnan, China, 27°08′43″N, 100°33′06″E, ca. 1800 m, 21.viii.2011, *ex Impatiens* sp.11 (with purple flowers), J.J. Gao (KIZ).

Paratypes. CHINA: 5♂, 7♀ (#00094, #00095, #00097−9, #00105, #00108, #01542, #01547, #01548), same data as holotype (KIZ, SEHU).

Distribution. China (Yunnan).

Etymology. Referring to the curved (*curvi*-) oviscapt valve (*valva*) in lateral view.

32) *Impatiophila magnimaculata* Fu & Gao, sp. nov.

(Fig. 38; Pl. 4C; Pl. 7E)

Diagnosis. Abdominal tergites II–VI with blackish brown to black, caudal bands broadened laterally and medially widely interrupted or constricted (Pl. 4C). Hindleg tarsomere I with 2 black, apically blunt, stout spines at outer apex on underside. Tenth sternite longer than wide, dorsally slightly dilated, with shallow, somewhat quadrate notch medially on dorsal margin (Fig. 38D).

Description (♂, ♀). Head: Cibarium with 3−5 medial and 4−5 posterior sensilla per side. Labellum with 6 pseudotracheae per side.

Thorax (Pl. 4C): Postpronotum yellowish brown; scutum yellowish brown along notopleural line, transverse suture, lines connecting anterior and posterior, dorsocentral setae, leaving medial portion as large, black macula: scutellum black, marginally yellowish brown; pleura yellowish brown to blackish brown.

Wing (Pl. 4C) infuscate; veins brown. C_1 setae 2, subequal. Haltere knob pale yellow; stem somewhat pale brown.

Legs (Pl. 4C) yellow.

Abdomen: Sternites grayish yellow.

Male terminalia (Fig. 38A–F): Epandrium pubescent posteriorly on subdorsal to medial portion, with ca. 16 long setae on ventral half and ca. 11 shorter setae on caudoventral portion. Surstylus with 3 long setae in addition to 2 stout, upturned prensisetae around to above caudodorsal corner, 6 prensisetae along distal margin and 2 setae near ventral apex. Cercus unpubescent, with ca. 25 long setae. Hypandrium posteriorly slightly widened in ventral view

and strongly convex in lateral view, roundish on anterior margin. Gonopod long, protruded ventrad apically. Paramere slightly bent ventrad in distal 1/3 portion, with 6 sensilla. Aedeagal basal process slightly longer than 1/2 length of paramere.

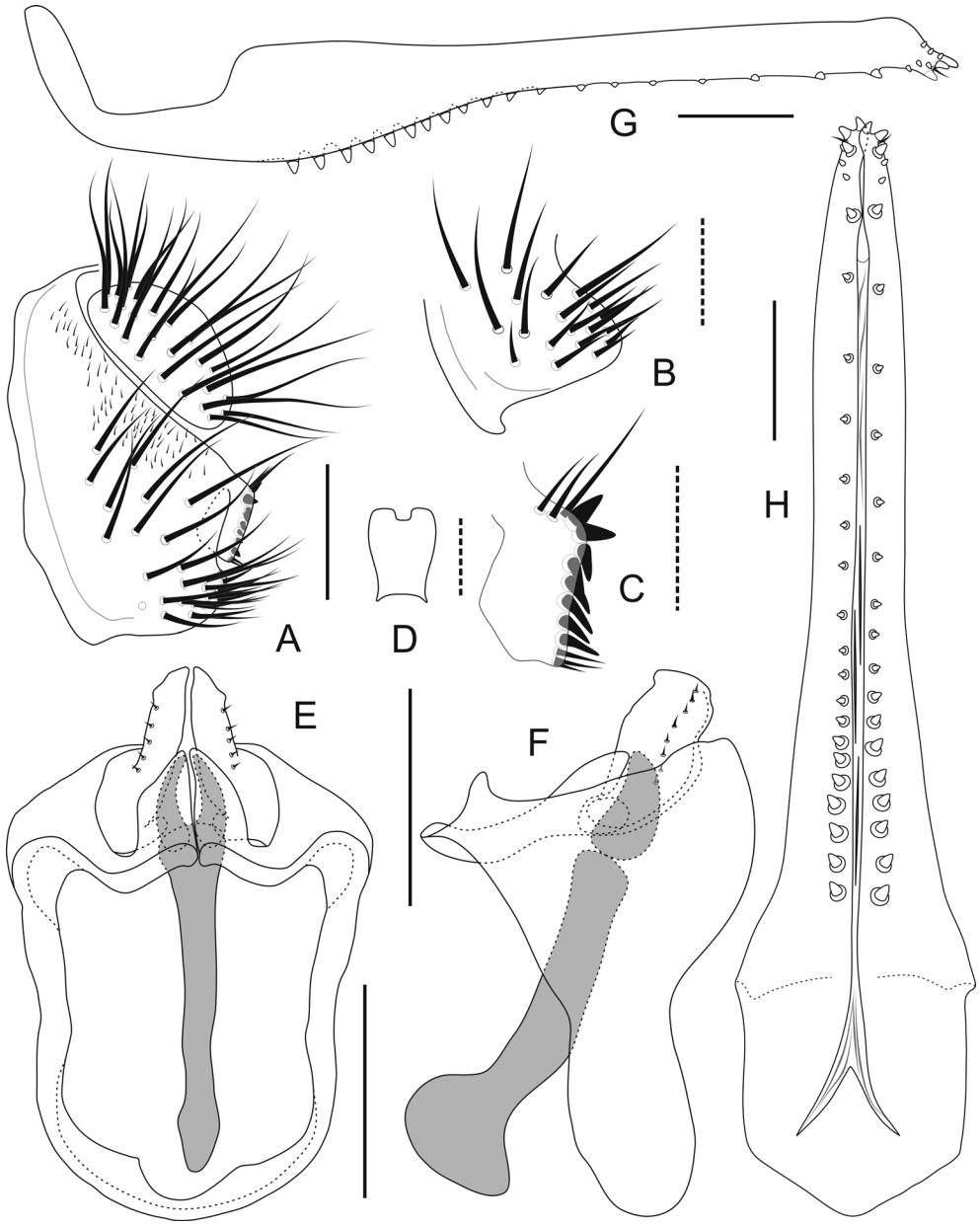

FIGURE 38. ***Impatiophila magnimaculata*** **Fu & Gao, sp. nov.** Adult male (holotype, #01571) and female (paratype, #01553): A, periphallic organs (caudolateral view); B, caudoventral part of epandrium; C, surstylus (caudal view); D, tenth sternite; E, phallic organs (dorsal view); F, phallic organs (lateral view); G, oviscapt (lateral view); H, oviscapt (ventral view).

Female terminalia (Fig. 38G, H; Pl. 7E): Oviscapt valve yellowish brown, obliquely truncate on dorsosubapical margin in lateral view, with 3 dorsal ovisensilla and 18−21 ventral ones more widely spaced in subdistal portion. Spermathecal capsule brown; introvert depth of duct about 7/8 of capsule height.

Measurements: BL = 2.59 (5♂ paratypes: 2.48−2.79, 2♀ paratypes: 2.06−3.10) mm, ThL = 1.25 (1.15−1.30, 1.40−1.42) mm, WL = 2.58 (2.43−2.76, 2.91−2.98) mm, WW = 1.09 (1.02−1.22, 1.22−1.26) mm.

Indices: arb = 2/1 (5♂, 2♀ paratypes: 1−2/1), FW/HW = 0.49 (0.45−0.48), ch/o = 0.12 (0.09−0.14), prorb = 1.03 (0.96−1.12), rcorb = 0.68 (0.51−0.67), orbito = 1.10 (1.00−1.22), vb = 0.38 (0.37−0.47), dcl = 0.56 (0.53−0.64), dcp = 0.36 (0.36−0.43), sterno = 0.65 (0.63−0.69), m-sterno = 0.77 (0.71−0.78), sctl = 0.98 (0.98−1.08), sctlp = 1.14 (0.90−1.40), C = 3.30 (2.72−3.35), 4c = 0.69 (0.70−0.80), 4v = 1.62 (1.51−1.71), 5x = 1.74 (1.29−1.54), ac = 2.05 (2.06−2.57), M = 0.46 (0.39−0.48), C3F = 0.28 (0.24−0.32).

Holotype. ♂ (#01571), Yangbi County, Dali District, Yunnan, China, 26.viii.2011, *ex Impatiens* sp.12 (with purple flowers), J.J. Gao (KIZ).

Paratypes. CHINA: 4♂, 1♀ (#00544, #01568−70, #01572), same data as holotype; 1♂ (#01147), Baihualing Village, Mangkuan Town, Longyang County, Yunnan, 23.ix.2012, *ex Impatiens* sp.13 (with purple flowers), J.J. Gao; 1♀ (#01553), Liangjiaren Village, Hutiaoxia Town, Shangri-la County, Diqing District, Yunnan, 23.viii.2011, by net sweeping, J.J. Gao (KIZ, SEHU).

Distribution. China (Yunnan).

Etymology. Referring to the large (*magni*-) macula (*maculatus*) on scutum.

33) *Impatiophila chiasmosternata* Fu & Gao, sp. nov.

(Fig. 39; Pl. 4D; Pl. 7F)

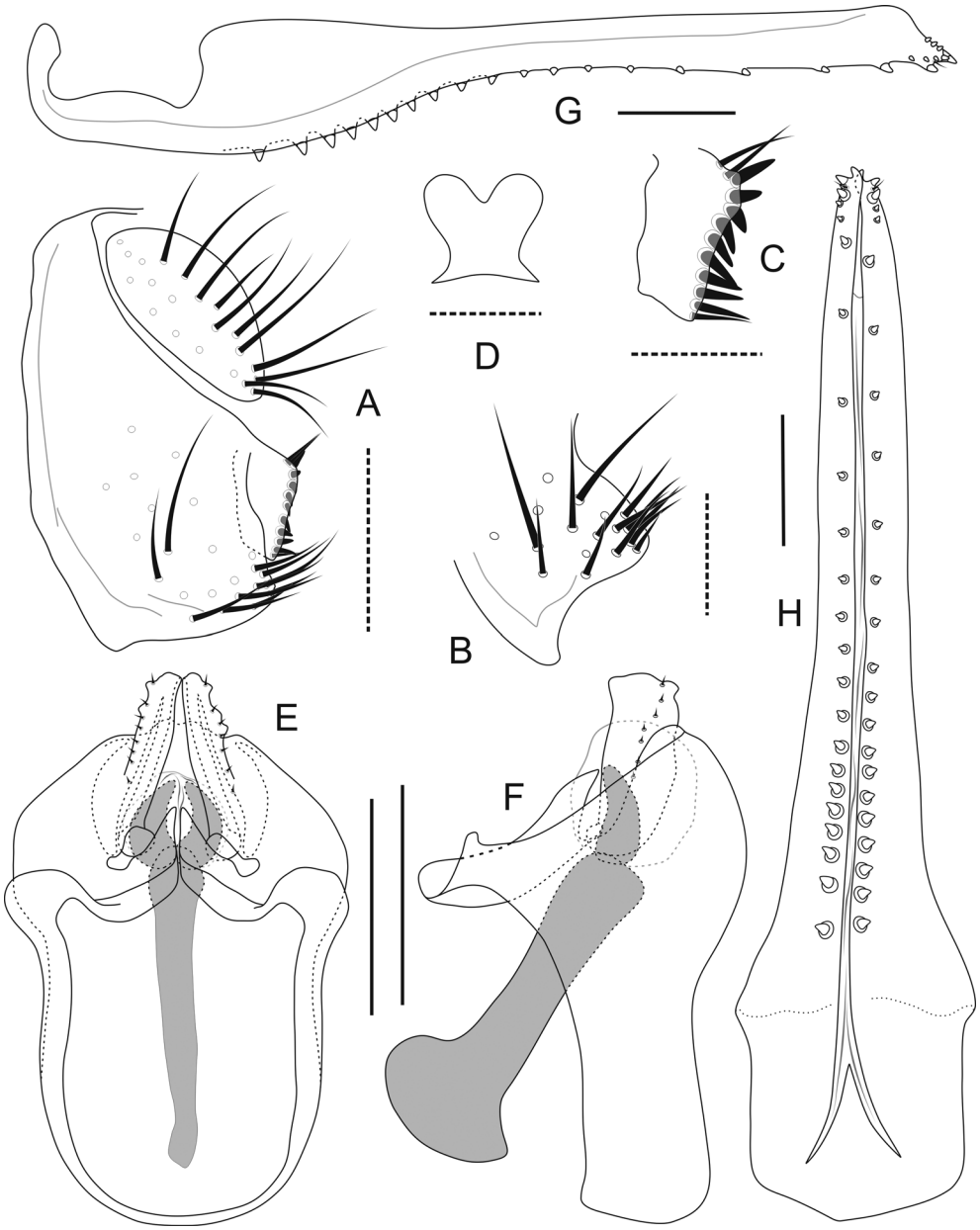

FIGURE 39. *Impatiophila chiasmosternata* Fu & Gao, sp. nov. Adult male (paratype, #00102) and female (paratype, #00103): A, periphallic organs (caudolateral view); B, caudoventral part of epandrium; C, surstylus (caudal view); D, tenth sternite; E, phallic organs (dorsal view); F, phallic organs (lateral view); G, oviscapt (lateral view); H, oviscapt (ventral view).

Diagnosis. Abdominal tergites II−VI with black, laterally broadened caudal bands medially widely interrupted or constricted on II−IV, narrowly notched on V, but more or less convex on VI (Pl. 4D). Tenth sternite as broad as long, dorsally much dilated, with large, V-shaped notch medially on dorsal margin (Fig. 39D).

Description (♂, ♀). Head: Cibarium with 3−4 medial and 6−7 posterior sensilla per side. Labellum with 6 pseudotracheae per side.

Thorax (Pl. 4D): Postpronotum brown; scutum glossy black, pale along lines connecting ipsilateral dorsocentral setae; scutellum blackish brown, grayish brown laterally; pleura brown to blackish brown.

Wing (Pl. 4D) hyaline, slightly infuscate; veins brown. C_1 setae 2, subequal. Haltere pale yellow.

Legs (Pl. 4D) yellowish brown; hindleg tarsomere I with 1 black, apically blunt, stout spine at outer apex on underside.

Abdomen: Sternites pale yellow.

Male terminalia (Fig. 39A−F): Epandrium unpubescent, with ca. 14 long setae on ventral half and ca. 11 shorter setae on caudoventral portion. Surstylus with 2 long setae in addition to 2 stout, more or less upturned prensisetae around caudodorsal corner, 7 prensisetae along distal margin and 1 seta at ventral apex. Cercus unpubescent, with ca. 21 long setae. Hypandrium largely parallel-sided, with dilated, posterolateral corners and roundish anterior margin, posteriorly convex in lateral view. Gonopod long, protruded ventrad apically. Paramere apically somewhat truncate, with 8 sensilla. Aedeagal basal process about 1/2 length of paramere; aedeagal apodeme entirely thick in lateral view.

Female terminalia (Fig. 39G, H; Pl. 7F): Oviscapt valve yellowish brown, obliquely truncate on dorsosubapical margin in lateral view, with 3 dorsal ovisensilla and 19−20 ventral ones more widely spaced in subdistal portion. Spermathecal capsule brown; introvert depth of duct about 5/6 of capsule height.

Measurements: BL = 2.52 (5♂ paratypes: 2.38−2.86, 5♀ paratypes: 2.79−3.13) mm, ThL = 1.20 (0.99−1.29, 1.25−1.35) mm, WL = 2.50 (2.28−2.62, 2.62−2.82) mm, WW = 1.05 (0.95−1.12, 1.09−1.16) mm.

Indices. arb = 2/1 (5♂, 5♀ paratypes: 2/1), FW/HW = 0.45 (0.42−0.47), ch/o = 0.09 (0.08−0.12), prorb = 1.10 (1.04−1.35), rcorb = 0.55 (0.54−0.70), orbito = 0.89 (0.91−1.05), vb = 0.32 (0.35−0.48), dcl = 0.53 (0.50−0.62), dcp = 0.34 (0.36−0.43), sterno = 0.65 (0.62−0.72), m-sterno = 0.74 (0.60−0.78), sctl = 1.01 (0.91−1.07), sctlp = 1.11 (0.92−1.11), C = 3.23 (2.62−3.30), 4c = 0.71 (0.70−0.80), 4v = 1.56 (1.59−1.78), 5x = 1.38 (1.25−1.65), ac = 2.03 (2.12−2.55), M = 0.38 (0.40−0.48), C3F = 0.28 (0.20−0.36).

Holotype. ♂ (#00109), Liangjiaren, Hutiaoxia, Shangri-la, Diqing, Yunnan, China, 27°08′43″N, 100°33′06″E, ca. 1800 m, 21.viii.2011, *ex Impatiens* sp.11 (with purple flowers), J.J. Gao (KIZ).

Paratypes. CHINA: 5♂, 5♀ (#00090−93, #00100, #00102, #00103, #00106, #01546, #01550), same data as holotype (KIZ, SEHU).

Distribution. China (Yunnan).

Etymology. Referring to the somewhat X-shaped (*chiasma*) tenth sternite (*sternum*).

34) *Impatiophila furcatosternata* Fu & Gao, sp. nov.

(Fig. 40; Pl. 4E; Pl. 7G)

Diagnosis. Abdominal tergite IV with caudal, black band medially neither interrupted/constricted nor protruded (Pl. 4E). Scutum and scutellum unicolorously glossy black, without distinct color pattern (Pl. 4E). Hindleg tarsomere I with 2 black, apically blunt, stout spines at outer apex on underside. Tenth sternite slightly broader than long, dorsally dilated, with deep, narrow, V-shaped notch medially on dorsal margin (Fig. 40D). Oviscapt valve with 4–5 dorsal ovisensilla (Fig. 40H).

Description (♂, ♀). Head: Cibarium with 2 medial and 4–5 posterior sensilla per side. Labellum with 6 pseudotracheae per side.

Thorax (Pl. 4E): Postpronotum blackish brown; thoracic pleura blackish brown.

Wing (Pl. 4E) grayish brown; veins brown; C_1 setae 2, subequal. Haltere pale yellow.

Legs (Pl. 4E) yellow.

Abdomen (Pl. 4E): Tergites yellowish brown, with broad, black, laterally broadened, caudal bands on II−V; bands on II and III medially narrowly interrupted; VI entirely blackish brown. Sternites grayish yellow.

Male terminalia (Fig. 40A−F): Epandrium sparsely pubescent on posterior portion of dorsal half, with ca 10 long setae on ventral half and ca. 15 shorter setae on caudoventral portion. Surstylus with 2 long setae in addition to

2 more or less stout, upturned prensisetae at and above caudodorsal corner, 6 prensisetae along distal margin and 1 seta at ventral apex. Cercus slightly pubescent on anterior portion, with ca. 23 long setae. Hypandrium nearly parallel-sided, roundish on anterior margin, posteriorly convex in lateral view. Gonopod broad, apically somewhat triangular and curved ventrad in lateral view. Paramere apically somewhat truncate, with 7 sensilla. Aedeagal basal process about 1/2 length of paramere.

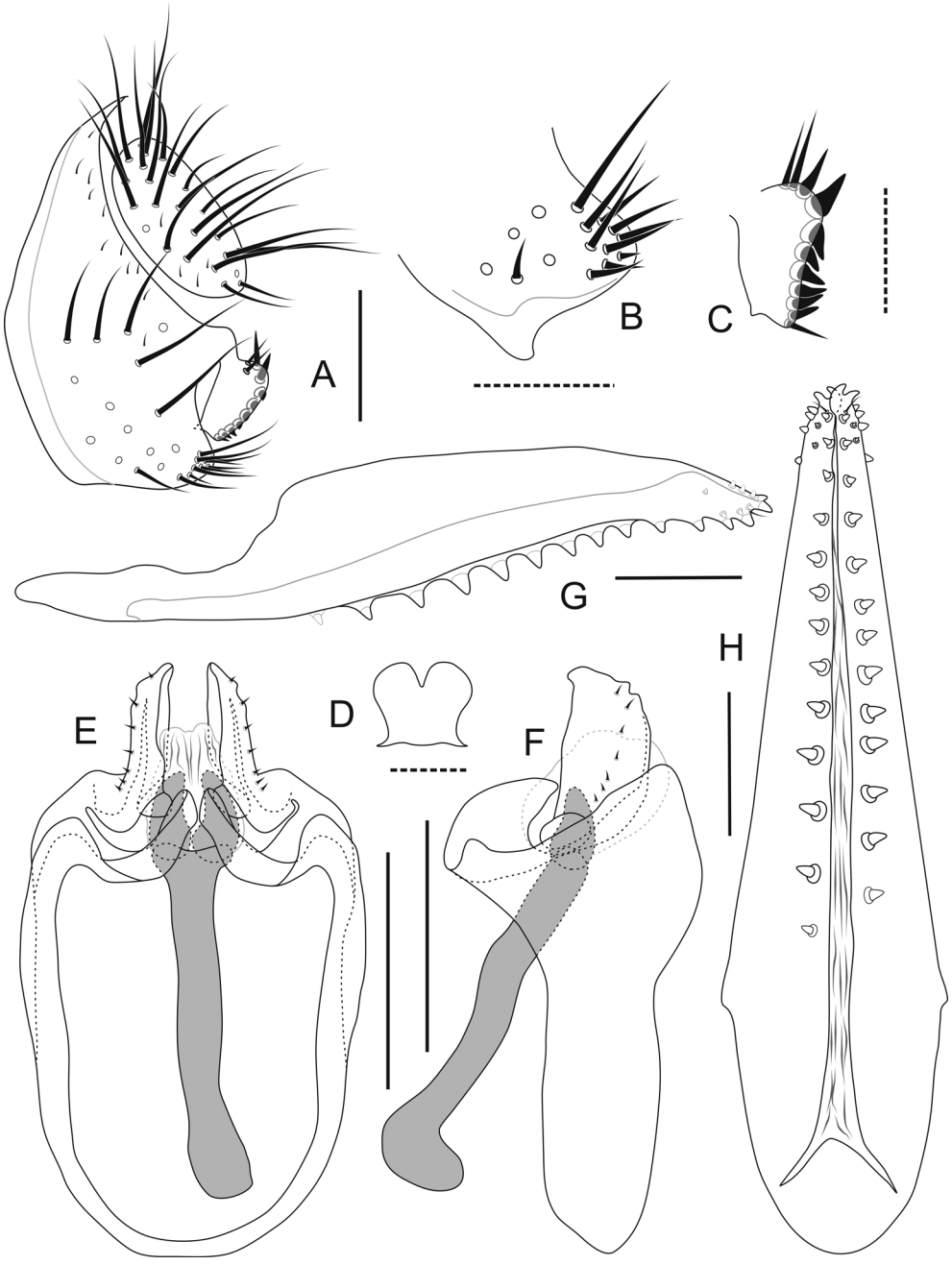

FIGURE 40. ***Impatiophila furcatosternata*** **Fu & Gao, sp. nov.** Adult male (holotype, #00272) and female (paratype, #00275): A, periphallic organs (caudolateral view); B, caudoventral part of epandrium; C, surstylus (caudal view); D, tenth sternite; E, phallic organs (dorsal view); F, phallic organs (lateral view); G, oviscapt (lateral view); H, oviscapt (ventral view).

Female terminalia (Fig. 40G, H; Pl. 7G): Oviscapt valve yellowish brown, gently curved on dorsosubapical margin in lateral view, with 4 lateral ovisensilla and ca. 13 ventral ones arranged entirely at nearly equal intervals. Spermathecal capsule brown; introvert depth of duct about 5/6 of capsule height.

Measurements: BL = 2.25 (4♂ paratypes: 1.90−2.43, 3♀ paratypes: 2.10−2.50) mm, ThL = 1.11 (0.94−1.08, 1.02−1.17) mm, WL = 2.15 (1.92−2.17, 2.10−2.37) mm, WW = 0.94 (0.82−0.97, 1.02−1.17) mm.

Indices: arb = 2/1 (4♂, 3♀ paratypes: 2/1), FW/HW = 0.45 (0.41−0.45), ch/o = 0.09 (0.08−0.11), prorb = 1.08

(0.98−1.33), rcorb = 0.56 (0.48−0.73), orbito = 1.01 (0.75−1.07), vb = 0.39 (0.35−0.54), dcl = 0.58 (4♂, 2♀ paratypes: 0.44−0.60), dcp = 0.36 (0.31−0.39), sterno = 0.62 (0.57−0.63), m-sterno = 0.76 (3♂, 2♀ paratypes: 0.66−0.77), sctl = 1.00 (4♂, 2♀ paratypes: 0.99−1.07), sctlp = 0.80 (0.84−1.13), C = 3.14 (2.83−3.26), 4c = 0.78 (0.67−0.81), 4v = 1.77 (1.50−1.66), 5x = 1.66 (1.42−1.75), ac = 2.22 (2.11−2.33), M = 0.52 (0.40−0.51), C3F = 0.33 (0.28−0.43).

Holotype. ♂ (#00272), along the way from the seat of Beibeng Town, Motuo County to the Yarang Village, Motuo Town, Motuo County, Linzhi, Xizang, China, 1.x.2010, *ex Impatiens* ?*arguta* Hook. f. et. Thoms. (Fig. 1D) J.J. Gao (KIZ).

Paratypes. CHINA: 2♂, 2♀ (#00275, #00682, #00683, #00685), same data as holotype; 2♂, 1♀ (#00306, #00512, #00687), Beibeng, Motuo, Linzhi, Xizang, 29°14′36″N, 95°10′12″E, ca. 780 m, 29.ix.2010, *ex Impatiens arguta* Hook. f. et. Thoms. (Fig. 1D), J.J. Gao (KIZ, SEHU).

Distribution. China (Xizang).

Etymology. Referring to the somewhat bifurcated (*furcatus*) tenth sternite (*sternum*).

35) *Impatiophila acutivalva* Fu & Gao, sp. nov.
(Fig. 41; Pl. 4F; Pl. 7H)

Diagnosis. Abdominal tergite IV with caudal, black band medially neither interrupted/constricted nor protruded (Pl. 4F). Scutum and scutellum unicolorously glossy black, without distinct color pattern (Pl. 4F). Hindleg tarsomere I with 1 black, apically blunt, stout spine at outer apex on underside. Tenth sternite as wide as long, dorsally not dilated, with narrow, U-shaped notch medially on convex, dorsal margin (Fig. 41D). Oviscapt valve with 2 dorsal ovisensilla (Fig. 40G).

Description (♂, ♀). Head: Cibarium with 2−3 medial sensilla and 2−4 posterior sensilla per side. Labellum with 5−6 pseudotracheae per side.

Thorax (Pl. 4F): Postpronotum blackish brown; scutum and scutellum glossy black; pleura blackish brown to black.

Wing (Pl. 4F) pale brown; veins brown. C_1 setae 2, subequal. Haltere pale yellow.

Legs (Pl. 4F) yellow.

Abdomen (Pl. 4F): Tergites II−VI with broad, black, caudal bands; bands on II and III medially narrowly interrupted. Sternites grayish yellow.

Male terminalia (Fig. 41A−F): Epandrium very sparsely pubescent in patches, with ca. 11 long setae on ventral 3/5 and ca. 15 shorter setae on caudoventral portion. Surstylus with 2 long setae in addition to 2 stout, upturned prensisetae at and above caudodorsal corner, 7 prensisetae along distal margin and 1 seta at ventral apex. Cercus very sparsely pubescent in patches, with ca. 25 long setae. Aedeagal basal process about 1/2 the length of paramere. Hypandrium somewhat rectangular, posteriorly less convex in lateral view. Gonopod apically slightly curved ventrad and pointed in lateral view. Paramere with 6 sensilla.

Female terminalia (Fig. 41G, H; Pl. 7H): Oviscapt valve yellowish brown, gently curved on dorsosubapical margin and apically sharp in lateral view, with 4 lateral and ca. 15 ventral ovisensilla arranged entirely at nearly equal intervals. Spermathecal capsule brown: introvert depth of duct about 4/5 of capsule height.

Measurements: BL = 2.67 (5♂ paratypes: 2.40−2.67, 5♀ paratypes: 2.40−2.83) mm, ThL = 1.12 (1.08−1.12, 1.09−1.27) mm, WL = 2.40 (2.30−2.40, 2.40−2.66) mm, WW = 1.00 (1.00−1.03, 1.00−1.13) mm.

Indices: arb = 2/1 (5♂, 5♀ paratypes: 2−3/1), FW/HW = 0.47 (0.41−0.48), ch/o = 0.08 (0.07−0.12), prorb = 1.06 (0.94−1.24), rcorb = 0.50 (0.53−0.68), orbito = 1.14 (0.86−1.26), vb = 0.38 (0.34−0.47), dcl = 0.44 (0.44−0.58), dcp = 0.42 (0.38−0.46), sterno = 0.69 (0.54−0.70), m-sterno = 0.72 (0.61−0.82), sctl = 1.05 (0.98−1.09), sctlp = 1.09 (0.90−1.21), C = 2.97 (2.67−3.16), 4c = 0.75 (0.74−0.82), 4v = 1.59 (1.56−1.86), 5x = 1.45 (1.38−1.70), ac = 2.23 (2.20−2.64), M = 0.40 (0.40−0.48), C3F = 0.25 (0.20−0.36).

Holotype. ♂ (#00282), Tongmai, Yigong, Bomi, Linzhi, Xizang, China, 30°06′10″N, 95°04′49″E, 2080 m, 9.x.2010, *ex Impatiens* ?*arguta* Hook. f. et. Thoms. (Fig. 1D) J.J. Gao (KIZ).

Paratypes. CHINA: 5♂, 5♀ (#00283, #00298, #00299, #00374, #00375, #00497, #00498, #00517, #00549, #00550), same data as holotype (KIZ, SEHU).

Distribution. China (Xizang).

Etymology. Referring to the apically acute (*acutus*) oviscapt valve (*valva*).

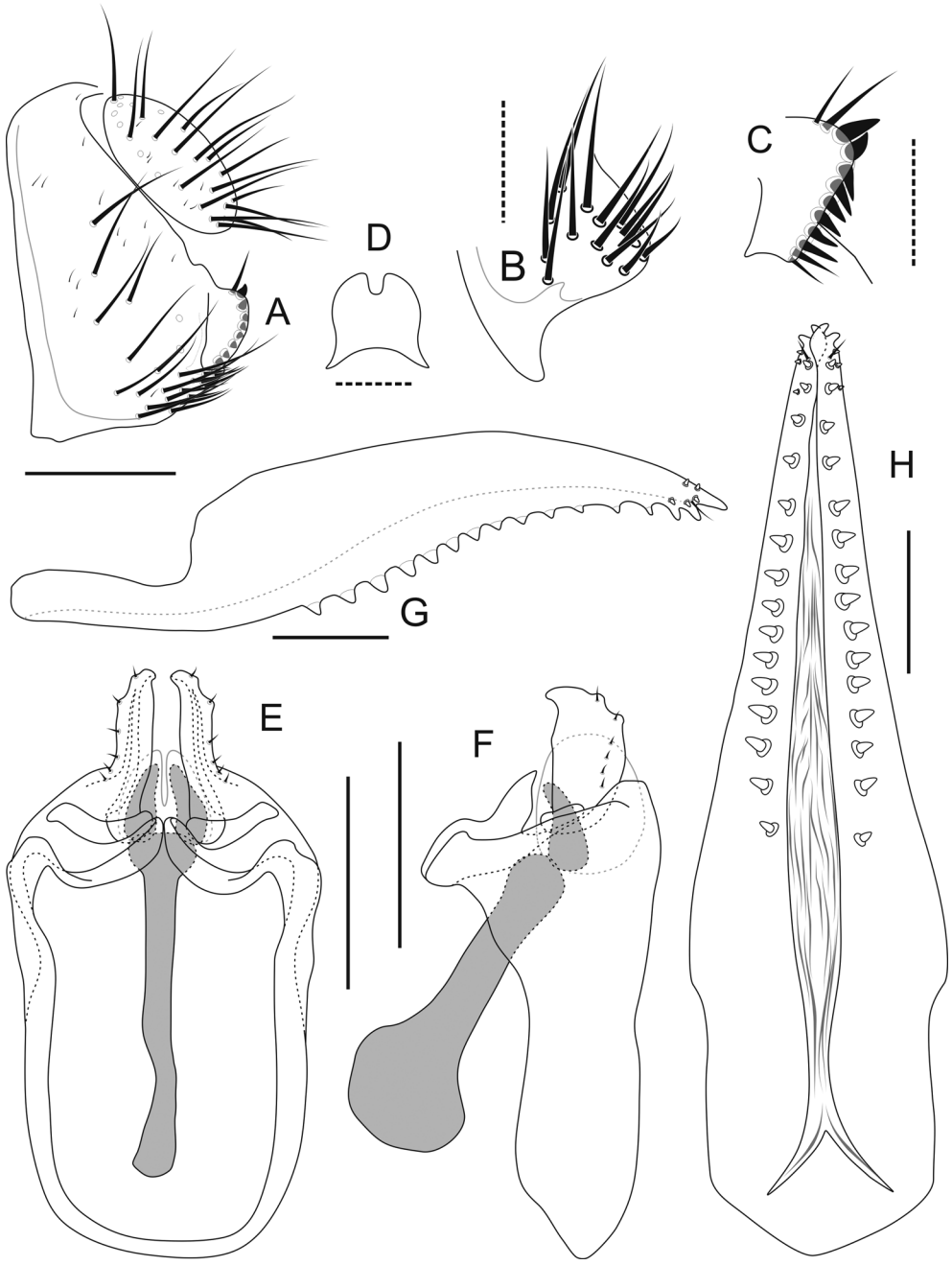

FIGURE 41. ***Impatiophila acutivalva*** **Fu & Gao, sp. nov.** Adult male (holotype, #00282) and female (paratype, #00283): A, periphallic organs (caudolateral view); B, caudoventral part of epandrium; C, surstylus (caudal view); D, tenth sternite; E, phallic organs (dorsal view); F, phallic organs (lateral view); G, oviscapt (lateral view); H, oviscapt (ventral view).

36) *Impatiophila pipa* Fu & Gao, sp. nov.

(Fig. 42; Pl. 4G; Pl. 7I)

Diagnosis. Abdominal tergites unicolorously glossy black (Pl. 4G). Labellum with 6 pseudotracheae per side. Paramere longer than twice of width, smooth on dorsal and ventral margins, with 5 sensilla much more widely spaced distally (Fig. 42F). Tenth sternite as long as wide, nearly parallel-sided (Fig. 42D). Oviscapt valve with 5 dorsal ovisensilla (Fig. 42G).

Description (♂, ♀). Head: Cibarium with 3−4 medial and 3−4 posterior sensilla per side. Labellum with 6 pseudotracheae per side.

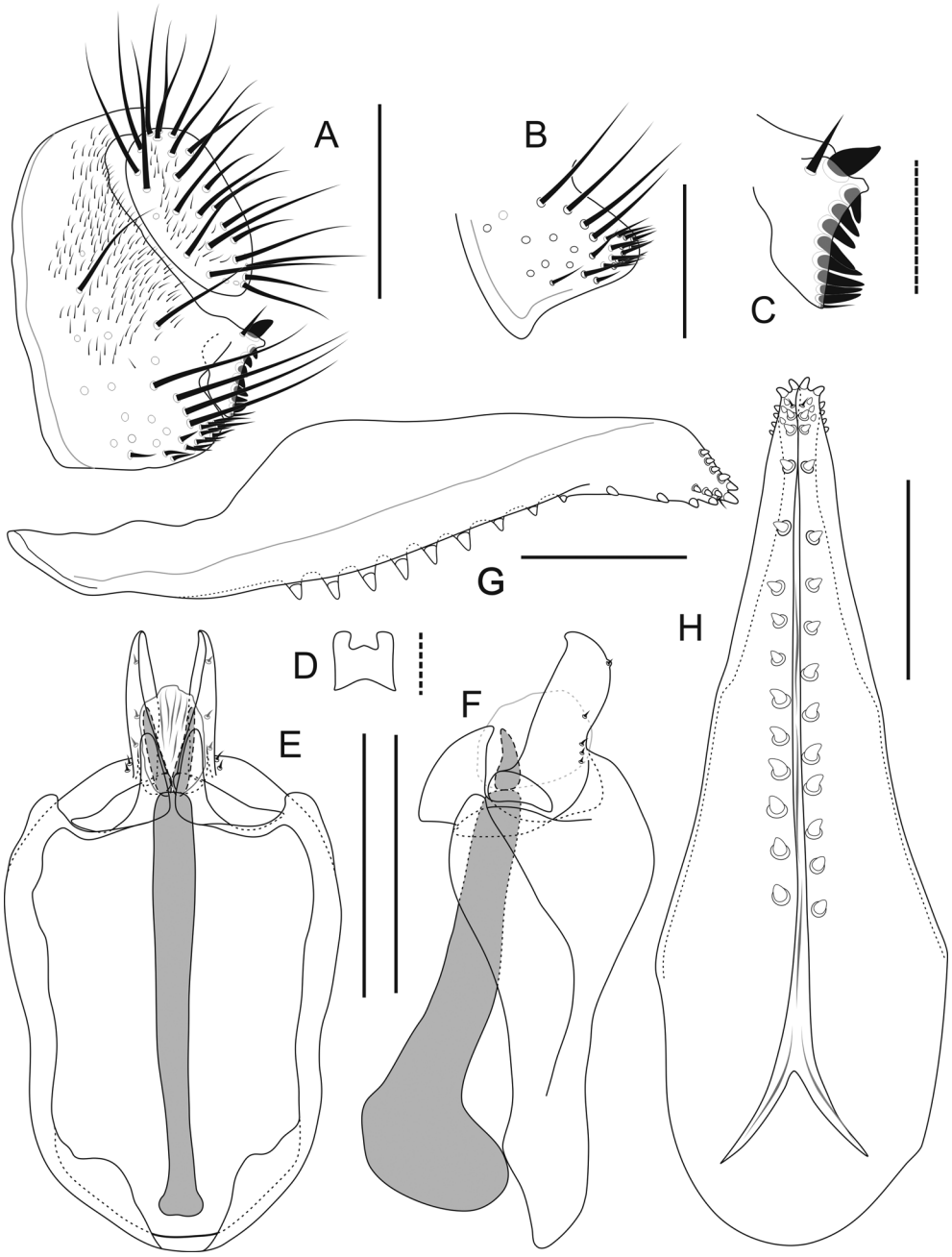

FIGURE 42. ***Impatiophila pipa*** **Fu & Gao, sp. nov.** Adult male (holotype, #00202) and female (paratype, #01407): A, periphallic organs (caudolateral view); B, caudoventral part of epandrium; C, surstylus (caudal view); D, tenth sternite; E, phallic organs (dorsal view); F, phallic organs (lateral view); G, oviscapt (lateral view); H, oviscapt (ventral view).

Thorax (Pl. 4G): Postpronotum blackish brown; scutum and scutellum glossy black; pleura blackish brown to black.

Wing (Pl. 4G) hyaline, slightly infuscate. C_1 setae 2, subequal. Haltere yellow.

Legs (Pl. 4G) yellowish brown. Hindleg tarsomere I with 2 black, apically blunt, stout spines at outer apex on underside.

Abdomen: Sternites grayish brown.

Male terminalia (Fig. 42A–F): Epandrium densely pubescent except for anterior margin and ventral 1/3, with ca 15 long setae on ventral half and ca. 20 shorter setae on caudoventral portion. Surstylus with 1 thick seta in addition to 1 stout, upturned prensiseta above caudodorsal corner, 8 prensisetae along distal margin and 1 seta at ventral apex. Tenth sternite with W-shaped notch medially on dorsal margin. Cercus pubescent on anterior portion,

with ca. 25 long setae. Hypandrium slightly narrowing anteriorly, roundish on anterior margin. Gonopod somewhat fan-shaped and apically more or less acute in lateral view. Aedeagal basal process about 1/2 length of paramere.

Female terminalia (Fig. 42G, H; Pl. 7I): Oviscapt valve yellowish brown, obliquely truncate on dorsosubapical margin in lateral view, with 13–14 ventral ovisensilla arranged entirely at nearly equal intervals. Spermathecal capsule brown; introvert depth of duct about 4/5 of capsule height.

Measurements: BL = 2.69 (6♂ paratypes: 2.11−2.77, 2♀ paratypes: 2.27−2.30) mm, ThL = 1.13 (0.96−1.13, 1.15−1.18) mm, WL = 2.34 (2.03−2.42, 2.42−2.49) mm, WW = 0.97 (0.87−1.04, 1.05−1.06) mm.

Indices: arb = 2/1 (6♂, 2♀ paratypes: 2/1), FW/HW = 0.42 (0.41−0.45), ch/o = 0.06 (0.08−0.12), prorb = 1.03 (5♂, 2♀ paratypes: 1.03−1.17), rcorb = 0.59 (5♂, 2♀ paratypes: 0.50−0.59), orbito = 1.25 (0.82−1.06), vb = 0.41 (0.36−0.59), dcl = 0.52 (0.46−0.63), dcp = 0.37 (0.32−0.46), sterno = 0.65 (0.62−0.67), m-sterno = 0.78 (0.68−0.84), sctl = 0.96 (0.94−1.10), sctlp = 1.36 (0.88−1.35), C = 2.63 (2.44−2.65), 4c = 0.85 (0.79−0.89), 4v = 1.74 (1.55−1.70), 5x = 1.50 (1.42−1.65), ac = 2.34 (2.17−2.47), M = 0.45 (0.41−0.49), C3F = 0.21 (0.14−0.26).

Holotype. ♂ (#00202), Maoershan National Nature Reserve, Xing'an, Guilin, Guangxi, China, 19.iii.2009, *ex* flowers of Gesneriaceae sp.1 (Fig. 1G), J.J. Gao (KIZ).

Paratypes. CHINA: 3♂ (#00204, #00206, #00208), same data as holotype; 1♀ (#01407), Jiujiezi, Mangkuan Town, Longyang County, Baoshan District, Yunnan, ca. 1900 m, 24.ix.2012, *ex Impatiens* flowers, J.J. Gao; 1♂ (#00395); 1♂ (#00113), Banpo, Yixiang Town, Simao County, Pu'er District, Yunnan, 2.x.2011, J.J. Gao; 1♂ (#01699), Haoping, Taibaishan National Nature Reserve, Baoji, Shaanxi, *ex* yellow *Impatiens* flowers, 16.viii.2013, J.J. Gao; 1♂ (#03577), Huangcaoling, Jinping, Jingdong, Yunnan, N24º22.501′, E100º46.141′, ca. 2100 m, 1.ix.2014, *ex Impatiens racemosa* DC. (Fig. 1F), J.J. Gao, M.J. Toda (KIZ, SEHU).

Distribution. China (Guangxi, Yunnan, Shaanxi).

Etymology. "Pipa" means lute in Chinese, referring to the lute-shaped oviscapt in ventral view.

37) *Impatiophila truncivalva* Fu & Gao, sp. nov.
(Fig. 43; Pl. 4H; Pl. 7J)

Diagnosis. Abdominal tergites unicolorously glossy black (Pl. 4H). Labellum with 6 pseudotracheae per side. Tenth sternite longer than wide, dorsally dilated, concave on lateral margins (Fig. 43D). Oviscapt valve with 4 dorsal ovisensilla (Fig. 43G).

Description (♂, ♀). Head: Cibarium with 2−3 medial and 3 posterior sensilla per side.

Thorax (Pl. 4H): Postpronotum blackish brown to black; pleura blackish brown to black.

Wing (Pl. 4H) pale brown; veins brown. C_1 setae 2, subequal. Haltere pale yellow.

Legs (Pl. 4H) yellowish brown. Hindleg tarsomere I with 2 black, apically blunt, stout spines at outer apex on underside.

Abdomen: Sternites grayish brown.

Male terminalia (Fig. 43A−F): Epandrium densely pubescent except for anterior and ventral 1/3 portions, with ca 15 long setae on ventral half and ca. 16 shorter setae on caudoventral portion. Surstylus with 1 seta in addition to 1 stout, upturned prensiseta above caudodorsal corner, 7 prensisetae along distal margin and 1 seta at ventral apex. Tenth sternite with W-shaped notch medially on dorsal margin. Cercus sparsely pubescent on anterior portion, with ca. 26 long setae. Hypandrium somewhat trapeziform, posteriorly broader. Gonopod apically more or less obtuse in lateral view. Paramere smooth on dorsal and ventral margins, with 5 sensilla. Aedeagal basal process slightly shorter than 1/2 length of paramere.

Female terminalia (Fig. 43G, H; Pl. 7J): Oviscapt valve brown, obliquely truncate on dorsosubapical margin in lateral view, with 13 ventral ovisensilla arranged entirely at nearly equal intervals. Spermathecal capsule brown; introvert depth of duct about 4/5 of capsule height.

Measurements: BL = 2.30 (2♂ paratypes: 2.03−2.27, 4♀ paratypes: 2.17−2.30) mm, ThL = 0.92 (0.92−0.98, 0.90−1.02) mm, WL = 2.07 (2.00−2.15, 2.03−2.13) mm, WW = 0.92 (0.87−0.94, 0.87−0.90) mm.

Indices: arb = 2−3/1 (2♂, 4♀ paratypes: 2−3/1), FW/HW = 0.44 (0.39−0.45), ch/o = 0.09 (0.10−0.14), prorb = 1.06 (1.03−1.30), rcorb = 0.65 (0.50−0.65), orbito = 1.18 (0.69−0.92), vb = 0.33 (0.34−0.43), dcl = 0.51 (0.49−0.62), dcp = 0.43 (0.36−0.48), sterno = 0.66 (0.60−0.73), m-sterno = 0.72 (0.63−0.84), sctl = 0.95 (0.87−0.98), sctlp = 1.11 (1.00−1.26), C = 2.92 (2.45−2.72), 4c = 0.71 (0.78−0.93), 4v = 1.50 (1.54−1.80), 5x = 1.43 (1.47−1.63), ac = 2.09 (2.25−2.44), M = 0.40 (0.39−0.48), C3F = 0.00 (0.00−0.18).

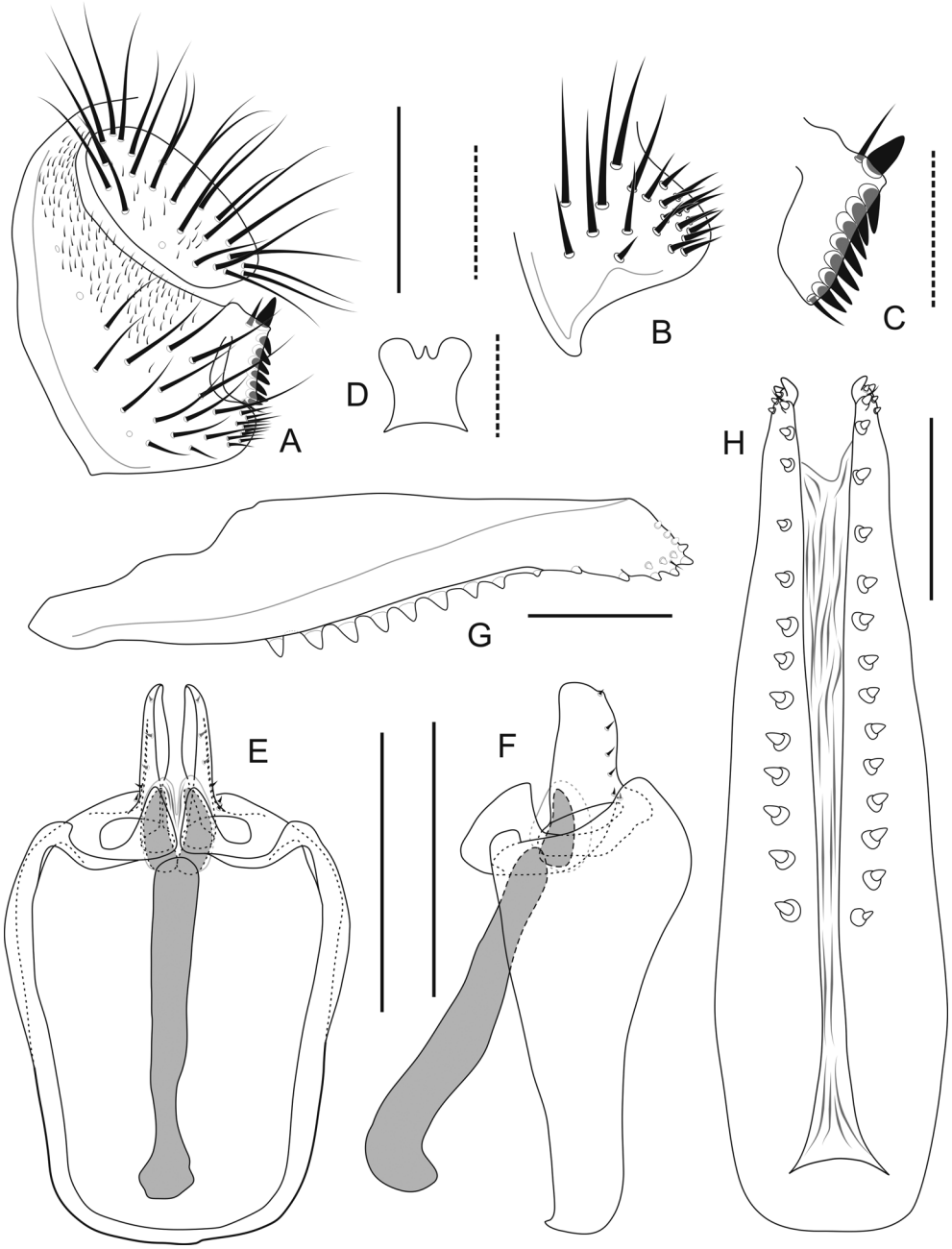

FIGURE 43. ***Impatiophila truncivalva*** **Fu & Gao, sp. nov.** Adult male (holotype, #00302) and female (paratype, #00303): A, periphallic organs (caudolateral view); B, caudoventral part of epandrium; C, surstylus (caudal view); D, tenth sternite; E, phallic organs (dorsal view); F, phallic organs (lateral view); G, oviscapt (lateral view); H, oviscapt (ventral view).

Holotype. ♂ (#00302), along the way from the seat of Beibeng Town, Motuo County to the Yarang Village, Motuo Town, Motuo County, Linzhi, Xizang, China, 1.x.2010, *ex Impatiens siculifer* Hook. f. (Fig. 1H), J.J. Gao (KIZ).

Paratypes. CHINA: 2♂, 2♀ (#00303, #01536, #00500, #00503), same data as holotype; 1♂ (#00369), along the way from the Hanmi Village, Beibeng Town to the seat of the Beibeng Town, Motuo County, Linzhi, Xizang, 27.ix.2010, *ex Impatiens siculifer* Hook. f. (Fig. 1A), J.J. Gao; 1♀ (#00396), Baihualing, Mangkuan, Longyang, Baoshan, Yunnan, 13.vi.2011, *ex Impatiens* sp. (with yellow flowers), J.J. Gao; 1♀ (#00511), along the way from the Yarang Village to the seat of the seat of Motuo County, Linzhi, Xizang, 1.x.2010, *ex Impatiens siculifer* Hook. f. (Fig. 1H), J.J. Gao (KIZ).

Distribution. China (Xizang, Yunnan).

Etymology. Referring to the oviscapt valve (*valva*) apically obliquely truncate (*truncus*).

38) *Impatiophila menghaiensis* Fu & Gao, sp. nov.
(Fig. 44; Pl. 5A; Pl. 7K)

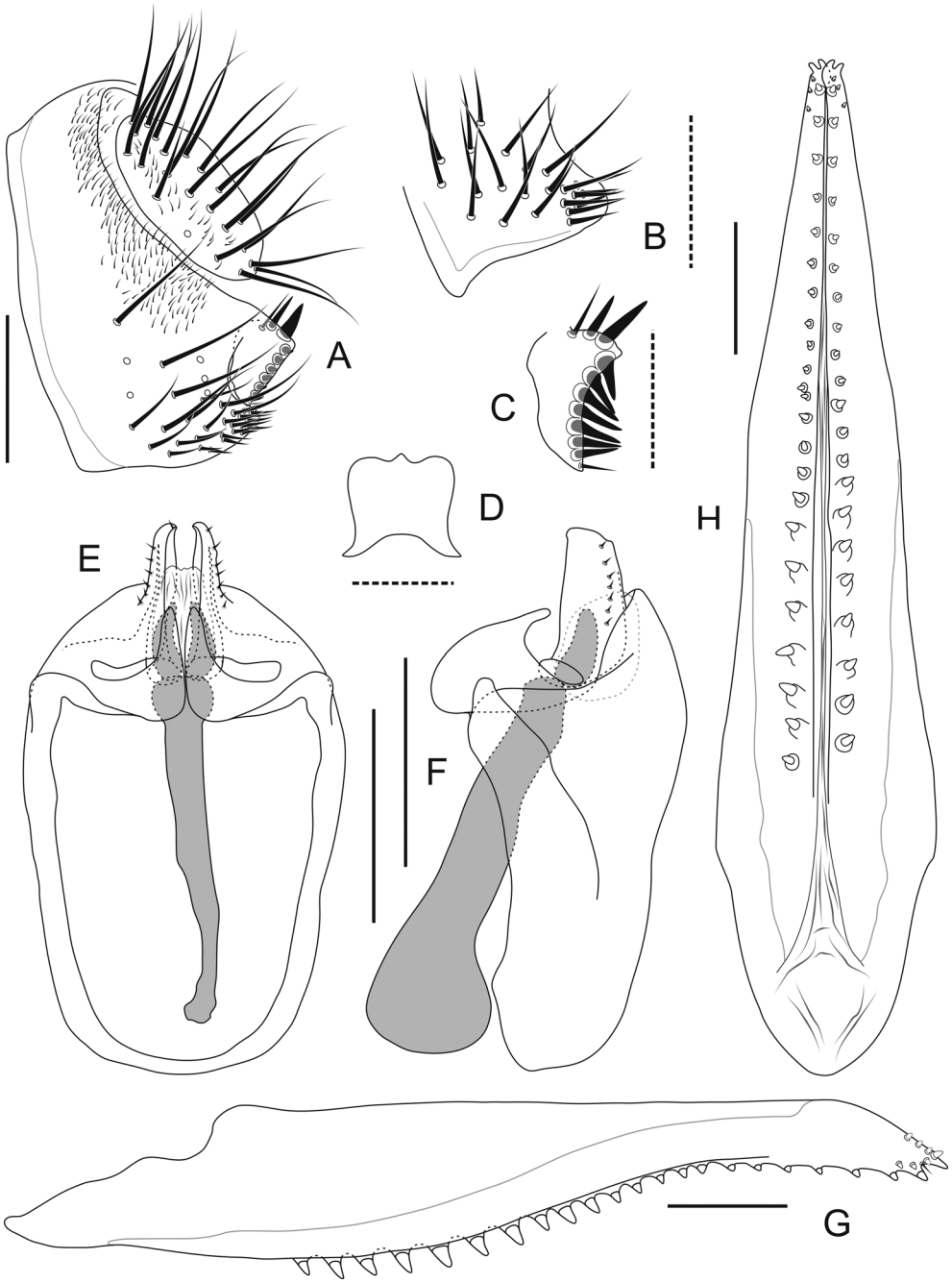

FIGURE 44. ***Impatiophila menghaiensis*** **Fu & Gao, sp. nov.** Adult male (paratype, #00397) and female (paratype, #01440): A, periphallic organs (caudolateral view); B, caudoventral part of epandrium; C, surstylus (caudal view); D, tenth sternite; E, phallic organs (dorsal view); F, phallic organs (lateral view); G, oviscapt (lateral view); H, oviscapt (ventral view).

Diagnosis. Abdominal tergites unicolorously glossy black (Pl. 5A). Labellum with 7 pseudotracheae per side. Tenth sternite with very shallow, W-shaped notch on dorsal margin (Fig. 44D). Paramere distally narrowing, apically somewhat obliquely truncate (Fig. 44F). Gonopod very broad and apically protruded ventrad in lateral view (Fig. 44F). Oviscapt valve relatively long, 1/5 as wide as long in ventral view (Fig. 44G).

Description (♂, ♀). Head: Cibarium with 3 medial and 4 posterior sensilla per side.

Thorax (Pl. 5A): Postpronotum blackish brown; scutum and scutellum glossy black; pleura blackish brown to black.

Wing (Pl. 5A) pale brown. C_1 setae 2, subequal. Haltere pale yellow.

Legs (Pl. 5A) yellowish brown. Hindleg tarsomere I with 2 black, apically blunt, stout spines at outer apex on underside.

Abdomen: Sternites grayish yellow.

Male terminalia (Fig. 44A−F): Epandrium densely pubescent on posterior portion of dorsal 2/3, with ca 15 long setae on ventral half and ca. 15 shorter setae on caudoventral portion. Surstylus with 1 seta in addition to 2 thick, relatively long, upturned prensisetae above caudodorsal corner, 7 prensisetae along distal margin and 1 seta at ventral apex. Tenth sternite slightly wider than long, dorsally slightly dilated. Cercus pubescent on anterior portion, with ca. 26 long setae. Hypandrium somewhat trapeziform, posteriorly broader. Paramere smooth on dorsal and ventral margins, with 7 sensilla. Aedeagal basal process slightly shorter than 1/2 length of paramere.

Female terminalia (Fig. 44G, H; Pl. 7K): Oviscapt valve brown, obliquely truncate on dorsosubapical margin in lateral view, with 4−5 dorsal ovisensilla and 19−23 ventral ones arranged entirely at nearly equal intervals. Spermathecal capsule brown; introvert depth of duct about 4/5 of capsule height.

Measurements: BL = 2.60 (4♂ paratypes: 2.67−2.97, 5♀ paratypes: 2.67−3.07) mm, ThL = 1.23 (1.27−1.33, 1.28−1.37) mm, WL = 2.62 (2.60−2.83, 2.73−2.88) mm, WW = 1.07 (1.10−1.17, 1.13−1.20) mm.

Indices: arb = 2/1 (4♂, 5♀ paratypes: 2−3/1), FW/HW = 0.44 (0.40−0.44), ch/o = 0.12 (0.10−0.13), prorb = 1.10 (1.00−1.25), rcorb = 0.54 (0.55−0.67), orbito = 0.95 (0.69−0.96), vb = 0.41 (0.35−0.46), dcl = 0.63 (0.58−0.64), dcp = 0.32 (0.34−0.43), sterno = 0.72 (0.59−0.82), m-sterno = 0.76 (0.62−0.86), sctl = 0.93 (0.88−1.06), sctlp = 1.18 (1.05−1.30), C = 2.94 (2.68−3.22), 4c = 0.70 (0.64−0.79), 4v = 1.33 (1.46−1.66), 5x = 1.33 (1.23−1.61), ac = 2.30 (2.20−2.50), M = 0.37 (0.37−0.43), C3F = 0.28 (0.26−0.34).

Holotype. ♂ (KIZ: #00397), Hesong Village, Xiding Town, Menghai County, Xishuangbanna District, Yunnan, China, 21°49′57″N, 100°06′09″E, 17.iv.2010, by net sweeping above fallen trunks along waterside, J.J. Gao (KIZ).

Paratypes. CHINA: 5♂, 7♀ (#00397, #00398, #01124, #01125, #01438, #01440, #01441, #01559, #01562, #01563), same data as holotype (KIZ, SEHU).

Distribution. China (Yunnan).

Etymology. Pertaining to the type locality.

39) *Impatiophila unicolorata* Fu & Gao, sp. nov.
(Fig. 45; Pl. 5B; Pl. 7L)

Diagnosis. Abdominal tergites entirely black (Pl. 5B). Labellum with 6 pseudotracheae per side. Oviscapt valve with 3 dorsal ovisensilla (Fig. 45A).

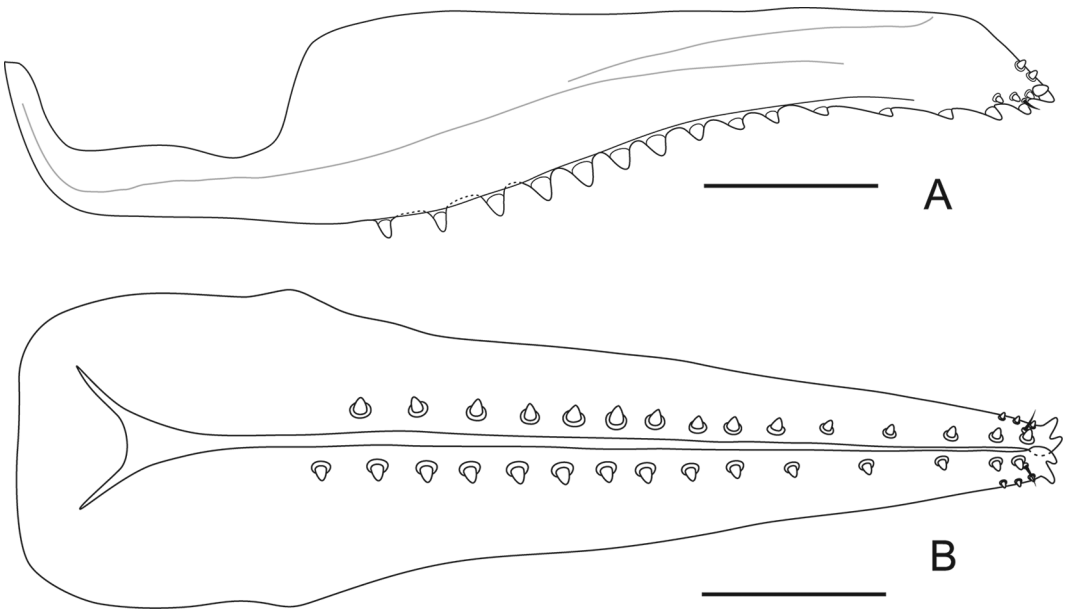

FIGURE 45. *Impatiophila unicolorata* Fu & Gao, sp. nov. Adult female (holotype, #01439): A, oviscapt (lateral view); B, oviscapt (ventral view).

Description (♀). Head: Cibarium with 2 medial and 3 posterior sensilla per side.

Thorax (Pl. 5B): Postpronotum blackish brown to black; scutum and scutellum black; pleura blackish brown to black.

Wing (Pl. 5B) pale brown. C_1 setae 2, subequal. Haltere pale yellow.

Legs (Pl. 5B) yellowish brown. Hindleg tarsomere I with 2 black, apically blunt, stout spines at outer apex on underside.

Abdomen: Sternites grayish yellow.

Female terminalia (Fig. 45; Pl. 7L): Oviscapt valve yellowish brown, obliquely truncate on dorsosubapical margin in lateral view, with 15 ventral ovisensilla arranged entirely at nearly equal intervals. Spermathecal capsule brown; introvert depth of duct about 4/5 of capsule height.

Measurements: BL = 2.38 mm, ThL = 1.08 mm, WL = 2.28 mm, WW = 0.99 mm.

Indices: arb = 2/1, FW/HW = 0.48, ch/o = 0.14, prorb = 1.17, rcorb = 0.53, orbito = 0.73, vb = 0.44, dcl = 0.54, dcp = 0.38, sterno = 0.68, m-sterno = 0.82, sctl = 1.02, sctlp = 0.99, C = 2.52, 4c = 0.91, 4v = 1.72, 5x = 1.30, ac = 2.34, M = 0.43, C3F = 0.36.

Holotype. ♀ (#01439), Hesong Village, Xiding Town, Menghai County, Xishuangbanna District, Yunnan, China, 21°49′57″N, 100°06′09″E, 17.iv.2010, by net sweeping above fallen trunks along waterside, J.J. Gao (KIZ).

Distribution. China (Yunnan).

Etymology. Referring to the unicolorouly (*uni-coloratus*) black thorax.

40) *Impatiophila oblongata* Fu & Gao, sp. nov.

(Fig. 46; Pl. 5C; Pl. 7M)

Diagnosis. Tergites II−VI with broad, black, caudal bands; bands on II−IV medially narrowly interrupted/constricted; band on V medially neither interrupted/constricted nor protruded (Pl. 5C). Scutum black, posteriorly blackish brown, paler along transverse suture, notopleural line and lines connecting ipsilateral dorsocentral setae; scutellum blackish brown, paler marginally (Pl. 5C). Hindleg tarsomere I with 1 black, apically blunt, stout spine at outer apex on underside. Tenth sternite longer than wide, distally bilobed, with deep, somewhat U-shaped, median notch on dorsal margin (Fig. 46D). Hypandrium longer than twice of width (Fig. 46E).

Description (♂, ♀). Head: Cibarium with 2−4 medial and 5−6 posterior sensilla per side. Labellum with 6 pseudotracheae per side.

Thorax (Pl. 5C): Postpronotum brown; pleura brown to blackish brown.

Wing (Pl. 5C) hyaline; veins yellowish brown. C_1 setae 2, subequal. Haltere pale yellow.

Legs (Pl. 5C) yellowish brown.

Abdomen: Sternites pale yellowish brown.

Male terminalia (Fig. 46A−F): Epandrium pubescent in patches on posterior portion of dorsal 2/3, with ca. 13 long setae on ventrally half and with ca. 15 shorter setae on caudoventral portion. Surstylus with 1 thick seta in addition to 1 stout, upturned prensiseta above caudodorsal corner, 7 prensisetae along distal margin and 1 seta at ventral apex. Cercus slightly pubescent on anteromedial portion, with ca. 29 long setae. Hypandrium nearly parallel-sided, roundish on anterior margin. Gonopod narrow, protruded ventrad in lateral view. Paramere smooth dorsal and ventral margins, with 5 sensilla: distalmost one distantly located from others, but proximalmost two very close to each other. Aedeagal basal process about 1/2 length of paramere; aedeagal apodeme entirely thickened in lateral view.

Female terminalia (Fig. 46G, H; Pl. 7M): Oviscapt valve anteriorly triangularly narrowing in ventral view; valve brown, gently curved on dorsosubapical margin in lateral view, with 4−6 dorsal ovisensilla and 17−18 ventral ones arranged entirely at nearly equal intervals. Spermathecal capsule brown; introvert depth of duct about 7/8 of capsule height.

Measurements: BL = 2.87 (3♂ paratypes: 2.40−2.87, 5♀ paratypes: 2.55−3.00) mm, ThL = 1.27 (1.03−1.28, 1.20−1.32) mm, WL = 2.72 (2.43−2.77, 2.57−2.82) mm, WW = 1.18 (1.03−1.23, 1.13−1.23) mm.

Indices: arb = 2/1 (3♂, 5♀ paratypes: 2/1), FW/HW = 0.40 (0.40−0.43), ch/o = 0.11 (0.09−0.11), prorb = 1.00 (2♂, 5♀ paratypes: 1.00−1.17), rcorb = 0.56 (2♂, 5♀ paratypes: 0.45−0.60), orbito = 1.04 (0.71−1.08), vb = 0.41 (0.33−0.40), dcl = 0.59 (0.56−0.62), dcp = 0.36 (0.33−0.47), sterno = 0.71 (0.64−0.74), m-sterno = 0.74 (0.72−0.82), sctl = 1.04 (2♂, 4♀ paratypes: 0.92−1.00), sctlp = 1.19 (1.07−1.24), C = 2.54 (2.58−3.04), 4c = 0.77

(0.71−0.85), 4v = 1.52 (1.63−1.69), 5x = 1.41 (1.32−1.63), ac = 2.37 (2.13−2.71), M = 0.37 (0.41−0.48), C3F = 0.34 (0.23−0.36).

Holotype. ♂ (#02886), Shennongjia Forest Region, Hubei, China, 1520 m, 26.vii.1992, M.J. Toda (KIZ).

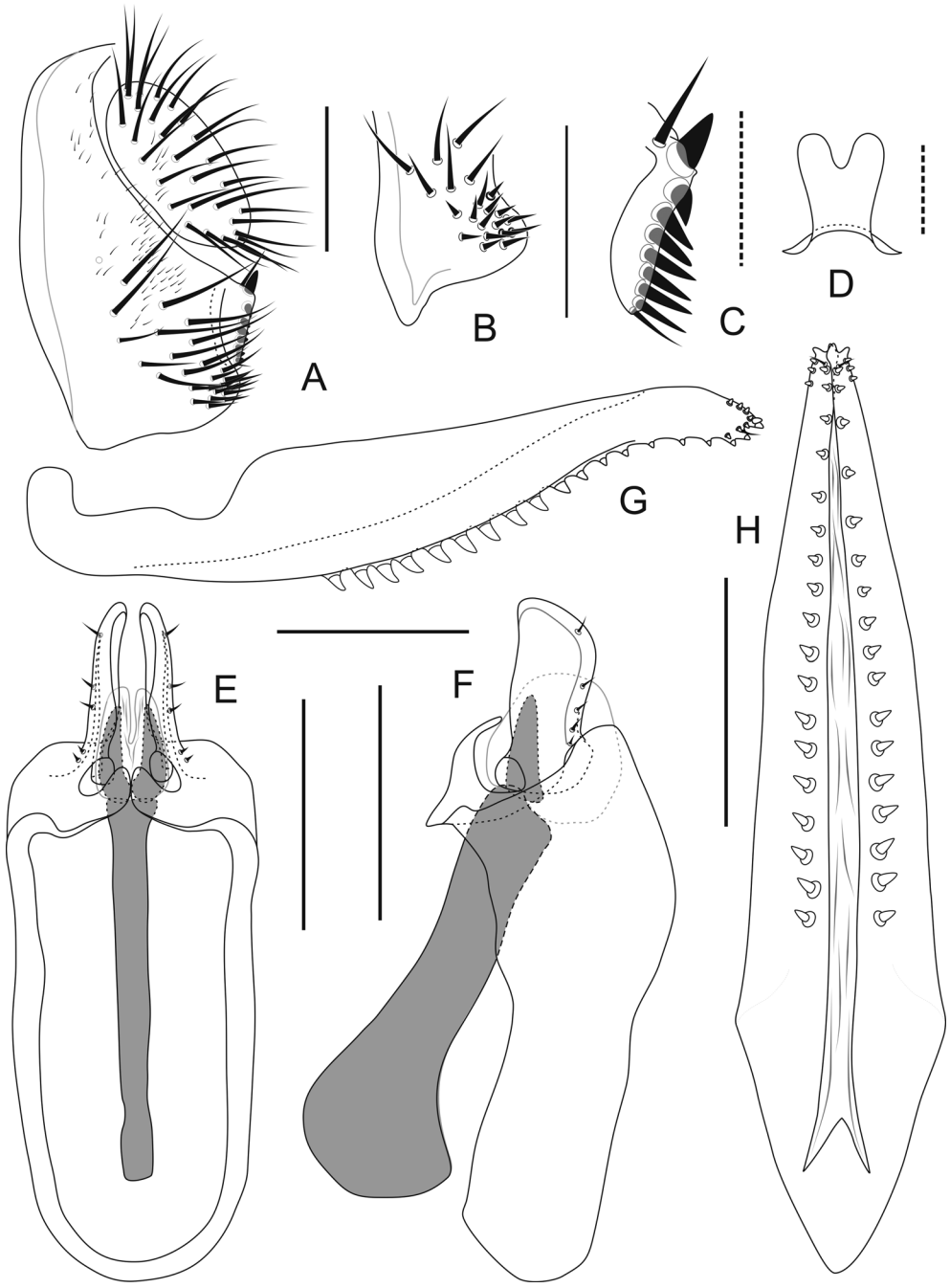

FIGURE 46. ***Impatiophila oblongata*** **Fu & Gao, sp. nov.** Adult male (paratype, #02576) and female (paratype, #02577): A, periphallic organs (caudolateral view); B, caudoventral part of epandrium; C, surstylus (caudal view); D, tenth sternite; E, phallic organs (dorsal view); F, phallic organs (lateral view); G, oviscapt (lateral view); H, oviscapt (ventral view).

Paratypes. CHINA: 1♂ (#02887), same data as holotype; 2♂, 5♀ (KIZ: #02576, #02577, #02888−92), 2♂, 2♀ (SEHU), Mt. E'mei, 19.vii.1992, M.J. Toda.

Distribution. China (Hubei, Sichuan).

Etymology. Referring to the oblong (*oblongatus*) hypandrium.

41) *Impatiophila pentamaculata* Fu & Gao, sp. nov.
(Fig. 47; Pl. 5D; Pl. 7N)

Diagnosis. Tergites II−VI with broad, blackish brown to black, caudal bands; bands on II−IV medially narrowly interrupted/constricted; band on V medially neither interrupted/constricted nor protruded (Pl. 5C). Thorax maculated by central, broader and 2 lateral, narrower dark, longitudinal stripes on pale brown ground: central stripe running through pronotum and scutum, but lateral stripes shorter, interrupted by transverse suture (Pl. 5D). Hindleg tarsomere I with 2 black, apically blunt, stout spines at outer apex on underside. Tenth sternite longer than wide, distally somewhat roundly dilated, with shallow, median notch on dorsal margin (Fig. 47D). Oviscapt valve not dilated subbasally in ventral view, only slightly concave on ventral margin and gently curved on dorsosubapical margin in lateral view, with 4−5 dorsal ovisensilla and 18−19 ventral ones arranged entirely at nearly equal intervals (Fig. 47G, H).

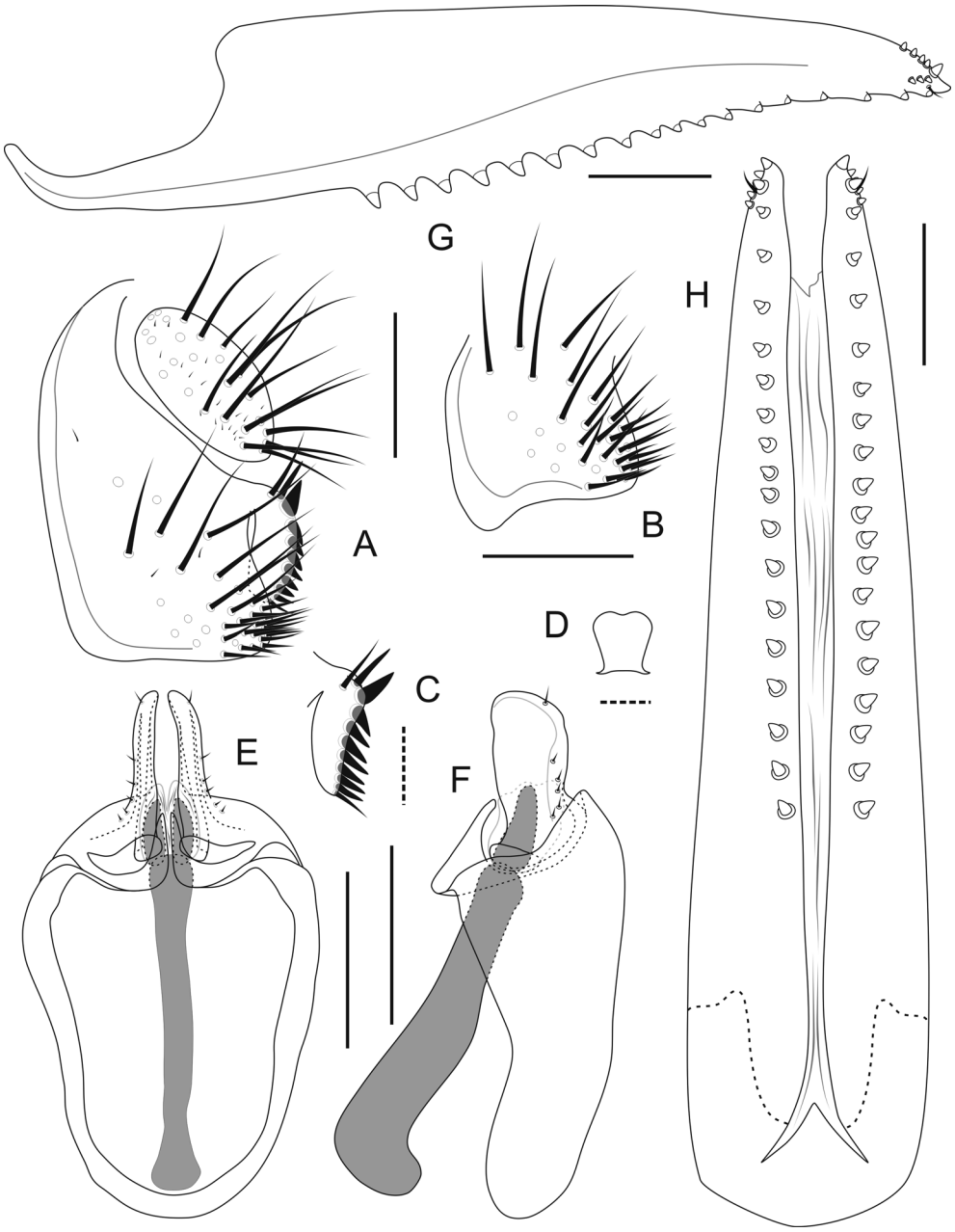

FIGURE 47. ***Impatiophila pentamaculata*** **Fu & Gao, sp. nov.** Adult male (holotype, #02558) and female (paratype, #02559): A, periphallic organs (caudolateral view); B, caudoventral part of epandrium; C, surstylus (caudal view); D, tenth sternite; E, phallic organs (dorsal view); F, phallic organs (lateral view); G, oviscapt (lateral view); H, oviscapt (ventral view).

Description (♂, ♀). Head: Cibarium with 3−4 medial and 5−6 posterior sensilla per side. Labellum with 6 pseudotracheae per side.

Thorax (Pl. 5D): Postpronotum yellowish brown; scutellum medially blackish brown, marginally yellowish brown; pleura brown to blackish brown.

Wing (Pl. 5D) pale brown. C_1 setae 2: ventral one shorter and thinner. Haltere pale yellow.

Legs (Pl. 5D) yellowish brown.

Abdomen: Sternites grayish yellow.

Male terminalia (Fig. 47A−F): Epandrium broad, truncate on ventral margin, only very sparsely pubescent, with ca. 15 long setae on ventral half and ca. 18 shorter setae on caudoventral portion. Surstylus with 1 long, thick seta in addition to 2 stout, upturned prensisetae around caudodorsal corner, 7 prensisetae along distal margin and 1 seta at ventral apex. Cercus very sparsely pubescent, with ca. 25 long setae. Hypandrium obovate. Gonopod narrow, protruded ventrad in lateral view. Paramere with 6 sensilla: distalmost one distantly located from others. Aedeagal basal process about 1/2 length of paramere.

Female terminalia (Fig. 47G, H; Pl. 7N): Spermathecal capsule brown; introvert depth of duct about 4/5 of capsule height.

Measurements: BL = 2.70 (1♀ paratype: 3.03) mm, ThL = 1.20 (1.32) mm, WL = 2.48 (2.73) mm, WW = 1.10 (1.17) mm.

Indices: arb = 2/1 (1♀ paratype: 2/1), FW/HW = 0.46 (0.47), ch/o = 0.10 (0.12), prorb = 1.10 (1.14), rcorb = 0.52 (0.55), orbito = 0.79 (0.86), vb = 0.44 (0.28), dcl = 0.60 (0.64), dcp = 0.44 (0.36), sterno = 0.59, m-sterno = 0.63, sctl = 0.94 (1.02), sctlp = 0.90 (0.95), C = 2.83 (3.00), 4c = 0.79 (0.69), 4v = 1.66 (1.46), 5x = 1.32 (1.29), ac = 2.21 (2.22), M = 0.40 (0.35), C3F = 0.23 (0.30).

Holotype. ♂ (#02558), Jizushan (Mt. Jizu), Dali, Yunnan, China, 17.viii.2010, H. Watabe, J.G. Xiangyu (KIZ).

Paratypes. CHINA: 1♂ (SEHU), 1♀ (KIZ: #02559), same data as holotype; 2♀, Mt. E'mei, Sichuan, 16, 17.vii.1992, H. Watabe (SEHU); 1♀, Yangjiangping, Tianpingshan, Hunan, 1.ix.2000, Y.G. Hu (SEHU).

Distribution. China (Hunan, Sichuan, Yunnan).

Etymology. Referring to the five (*penta*-) dark maculae (*maculatus*) on the thorax.

3 *Impatiophila menba* species group, new

Diagnosis. Patch of dense, small setae or stout setulae absent on caudoventral portion of epandrium (Fig. 5A).

Common characters. Cibarium with 2−3 posterior sensilla slightly curved anteriad per side: anteromost one twice as long as posteromost, medial sensillum. Postpronotum blackish brown to black; scutum and scutellum unicolorously dark brown to black; pleura blackish brown to black (Pl. 5E, F). Wing hyaline, slightly infuscate (Pl. 5E, F); veins dark brown; C_1 setae 2, subequal; setae of middle row on 2nd costal section of wing all heavy, peg-like, reaching or beyond tip of R_{2+3}. Haltere pale yellow. Legs yellowish brown to yellow (Pl. 5E, F); hindleg tibia without black, apically blunt, stout spines at outer apex on underside; hindleg tarsomeres I–IV each with 1 such spine at outer apex on underside. Abdominal tergites unicolorously dark brown to black (Pl. 5E, F); sternites grayish brown. Epandrium largely pubescent (Figs. 48A, 49A). Surstylus deeply concave on ventral 2/3 of distal margin, with 2 setae near ventral apex. (Figs. 48C, 49C). Cercus pubescent on anteromedial portion (Figs. 48A, 49A). Gonopod narrow, apically connecting to aedeagal basal process by narrow, membranous tissue (Figs. 48F, 49F). Paramere more or less roundish on apical margin in lateral view, longer than twice of width (Figs. 48F, 49F). Aedeagal basal process longer than 1/2 length of paramere (Figs. 48E, 49E). Oviscapt valve horizontally expanded at apical portion, less expanded in dorsomedial portion, gently curved on dorsosubapical margin, convex on ventral margin in lateral view, with lateral ovisensilla tightly arranged in nearly straight (in ventral view) row on margin of apicolateral flap and nearly equal-sized, ventral ones arranged entirely at nearly equal intervals; subapical, trichoid ovisensillum stout, longer than apical, peg-like ovisensillum (Figs, 48G, H, 49G, H). Spermathecal capsule wider than long, apically nearly flat (Pl. 7O, P).

42) *Impatiophila menba* Fu & Gao, sp. nov.

(Fig. 48; Pl. 5E; Pl. 7O)

Diagnosis. Male abdominal sternite VI longer than wide. Tenth sternite somewhat rhombic, largely triangularly convex on dorsomedial margin (Fig. 48D). Paramere nearly straight in lateral view (Fig. 48F). Hypandrium somewhat triangular, narrowing anteriorly in dorsal/ventral view (Fig. 48E). Oviscapt valve with 4 dorsal ovisensilla (Fig. 48G).

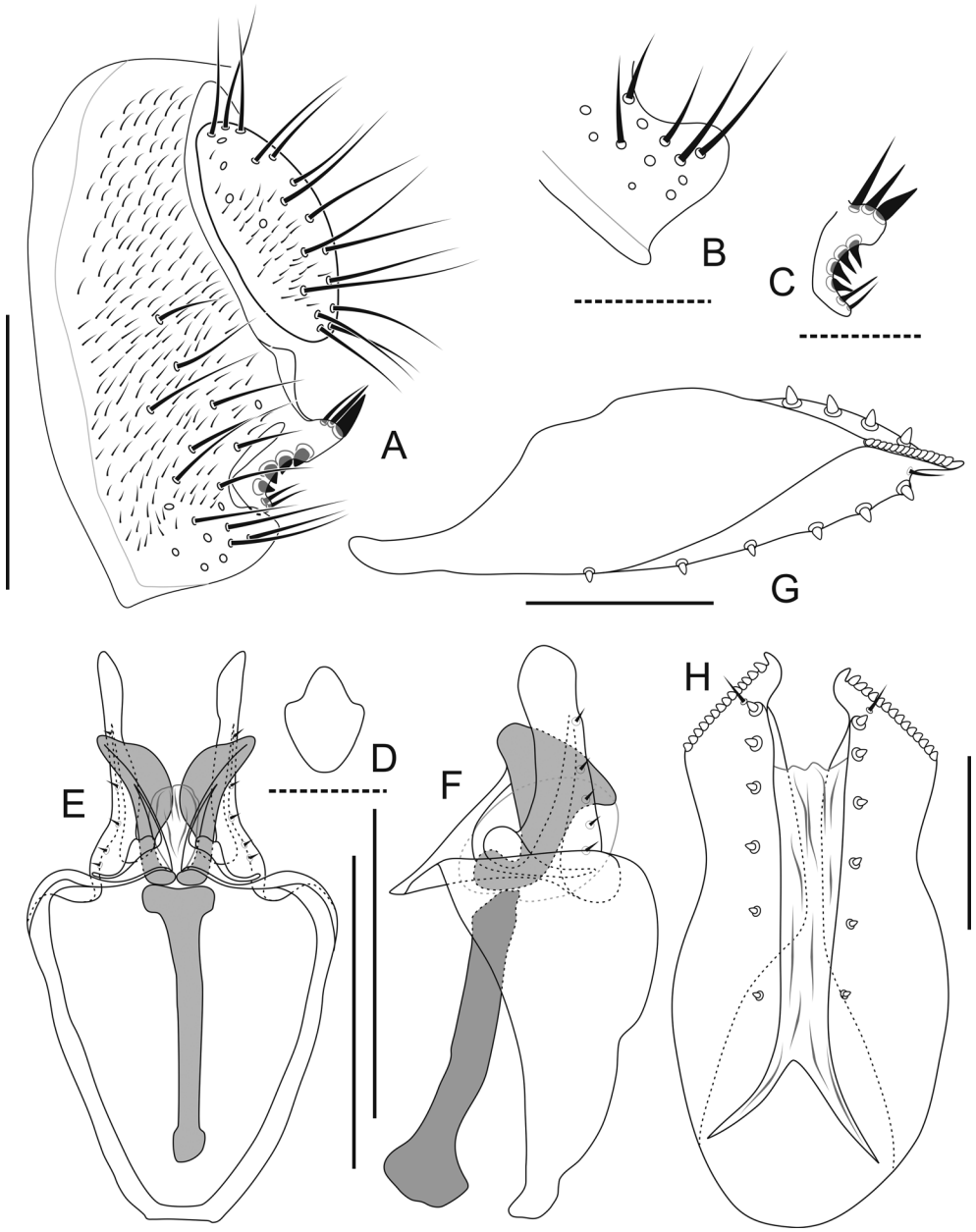

FIGURE 48. ***Impatiophila menba*** **Fu & Gao, sp. nov.** Adult male (holotype, #00307) and female (paratype, #00308): A, periphallic organs (caudolateral view); B, caudoventral part of epandrium; C, surstylus (caudal view); D, tenth sternite; E, phallic organs (dorsal view); F, phallic organs (lateral view); G, oviscapt (lateral view); H, oviscapt (ventral view).

Description (♂, ♀). Head: Cibarium with 3−4 medial sensilla per side (Fig. 48B).

Male terminalia (Fig. 48A−F): Epandrium pubescent except for dorsocentral and ventromarginal portions, with ca. 19 long setae on ventral half. Surstylus with 2 thick setae in addition to 1 stout, upturned prensiseta at and above caudodorsal corner and 4 prensisetae along distal margin. Cercus with ca. 20 long setae. Paramere with 5 sensilla. Aedeagal basal process distally expanded and somewhat fan-shaped in lateral view, about 2/3 length of paramere.

Female terminalia (Fig. 48G, H; Pl. 7O): Oviscapt valve with 14−15 lateral and 6 ventral ovisensilla. Spermatheca capsule pale brown; introvert depth of duct about 1/4 of capsule height.

Measurements: BL = 2.07 (5♂ paratypes: 1.57−2.18, 5♀ paratypes: 1.88−2.13) mm, ThL = 0.87 (0.64−0.92, 0.77−0.85) mm, WL = 1.80 (1.57−1.93, 1.65−1.90) mm, WW = 0.84 (0.64−0.92, 0.77−0.85) mm.

Indices: arb = 3/1 (5♂, 5♀ paratypes: 2−3/1), FW/HW = 0.44 (0.43−0.48), ch/o = 0.10 (0.08−0.15), prorb = 1.06 (0.92−1.10), rcorb = 0.72 (0.57−0.76), orbito = 1.38 (1.06−1.40), vb = 0.29 (0.28−0.42), dcl = 0.56 (0.46−0.63), dcp = 0.59 (0.45−0.62), sterno = 0.58 (0.54−0.63), m-sterno = 0.60 (0.56−0.78), sctl = 1.09 (0.94−1.10), sctlp = 0.98 (0.92−1.25), C = 2.33 (2.16−2.46), 4c = 0.96 (0.92−1.10), 4v = 1.78 (1.69−2.00), 5x = 2.02 (1.59−1.90), ac = 2.38 (2.47−3.11), M = 0.44 (0.46−0.57), C3F = 0.16 (0.00−0.23).

Holotype. ♂ (#00307), along the way form the Yarang Village to the seat of the Motuo County, Linzhi, Xizang, China, 1.x.2010, *ex* flowers of Gesneriaceae sp.2 (Fig. 1J), J.J. Gao (KIZ).

Paratypes. CHINA: 4♂, 5♀ (#00308, #00467, #00468, #00473−00475, #00477−00479), same as holotype; 1♂, 1♀ (#00372, #00481), from the seat of the Beibeng Town to the Yarang Village, Motuo Town, Motuo County, Linzhi, Xizang, 1.x.2010, *ex* flowers of *Impatiophila* sp.4? (Fig. 1D), J.J. Gao; 1♂ (#00483), Beibeng Town, Motuo County, Linzhi, Xizang, 29°14′36″N, 95°10′12″E, ca. 783 m, 30.ix.2010, *ex* flowers of *Impatiophila* sp.4 (Fig. 1D), J.J. Gao (KIZ, SEHU).

Distribution. China (Xizang).

Etymology. Pertaining to the Menba people inhabiting the type locality.

43) *Impatiophila securiformis* Fu & Gao, sp. nov.

(Fig. 49; Pl. 5F; Pl. 7P)

Diagnosis. Male abdominal sternite VI wider than long. Tenth sternite much narrowing ventrally, nearly flat on dorsomedial margin (Fig. 49D). Paramere strongly curved dorsad in lateral view (Fig. 49F). Hypandrium convex on lateral margins and slightly narrowing anteriorly in dorsal/ventral view (Fig. 49E). Oviscapt valve with 5 dorsal ovisensilla (Fig. 49H).

Description (♂, ♀). Head: Cibarium with 2−3 medial sensilla per side.

Male terminalia (Fig. 49A−F): Epandrium pubescent except for dorsocentral, antero- and ventromarginal portions, with ca. 12 long setae on ventral half and with ca. 8 shorter setae on caudoventral portion. Surstylus with 1 thick seta in addition to 2 stout, upturned prensisetae at and above caudodorsal corner and 5 prensisetae along distal margin. Cercus with ca. 10−23 long setae. Paramere with 6 sensilla: distalmost one distantly located. Aedeagal basal process distally less expanded in lateral view, about 3/5 length of paramere.

Female terminalia (Fig. 49G, H; Pl. 7P): Oviscapt valve with 11−13 lateral and 6−7 ventral ovisensilla. Spermatheca capsule pale brown; introvert depth of duct about 1/4 of capsule height.

Measurements: BL = 1.76 (5♂ paratypes: 1.46−1.84, 5♀ paratypes: 1.84−2.28) mm, ThL = 0.76 (0.64−0.77, 0.76−0.82) mm, WL = 1.62 (1.50−1.70, 1.77−1.89) mm, WW = 0.71 (0.65−0.73, 0.75−0.80) mm.

Indices: arb =3/1 (5♂, 5♀ paratypes: 3/1), FW/HW = 0.47 (0.44−0.48), ch/o = 0.10 (0.08−0.12), prorb = 0.98 (0.91−1.10), rcorb = 0.73 (0.63−0.82), orbito = 1.63 (1.22−1.60), vb = 0.38 (0.35−0.40), dcl = 0.57 (0.51−0.62), dcp = 0.54 (0.42−0.60), sterno = 0.58 (0.51−0.62), m-sterno = 0.62 (0.50−0.66), sctl = 1.02 (0.93−1.03), sctlp = 1.00 (0.95−1.17), C = 2.56 (2.40−2.83), 4c = 0.94 (0.87−1.04), 4v = 1.82 (1.83−2.09), 5x = 1.87 (1.87−2.42), ac = 2.37 (2.30−2.75), M = 0.64 (0.53−0.69), C3F = 0.16 (0.16−0.25).

Holotype. ♂ (#01501), Yangbi, Dali, Yunnan, China, 26.VIII.2011, *ex Impatiens* sp.12 (with purple flowers), J.J. Gao (KIZ).

Paratypes. CHINA: 2♂, 2♀ (#00173, #00174, #01400, #01502), same data as holotype; 2♂, 2♀ (#01503, #01504, #01564, #01565), Jiujiezi, Baihualing Village, Mangkuan Town, Longyang County, Baoshan, Yunnan, 24.ix.2012, ca. 1900m, *ex Impatiens* sp.6 (with purple flowers), J.J. Gao; 1♂, 1♀ (#01592, #01593), Laomengshan, Baihualing Village, Mangkuan Town, Longyang County, Baoshan, Yunnan, 23.ix.2012, ca. 1500 m, J.J. Gao; 1♂ (#01507), along the way from Yarang Village to the seat of Motuo County, Linzhi, Xizang, 1.x.2010, *ex Impatiens* ?*arguta* Hook. f. et. Thoms. (Fig. 1D) J.J. Gao; 1♀ (#00277), along the way from the seat of Beibeng Town, Motuo County to the Yarang Village, Motuo Town, Motuo County, Linzhi, Xizang, 1.x.2010, *ex Impatiens* ?*arguta* Hook. f. et. Thoms. (Fig. 1D) J.J. Gao (KIZ, SEHU).

Distribution. China (Yunnan, Xizang).

Etymology. Referring to the securiform (*securis-formis*) tenth sternite.

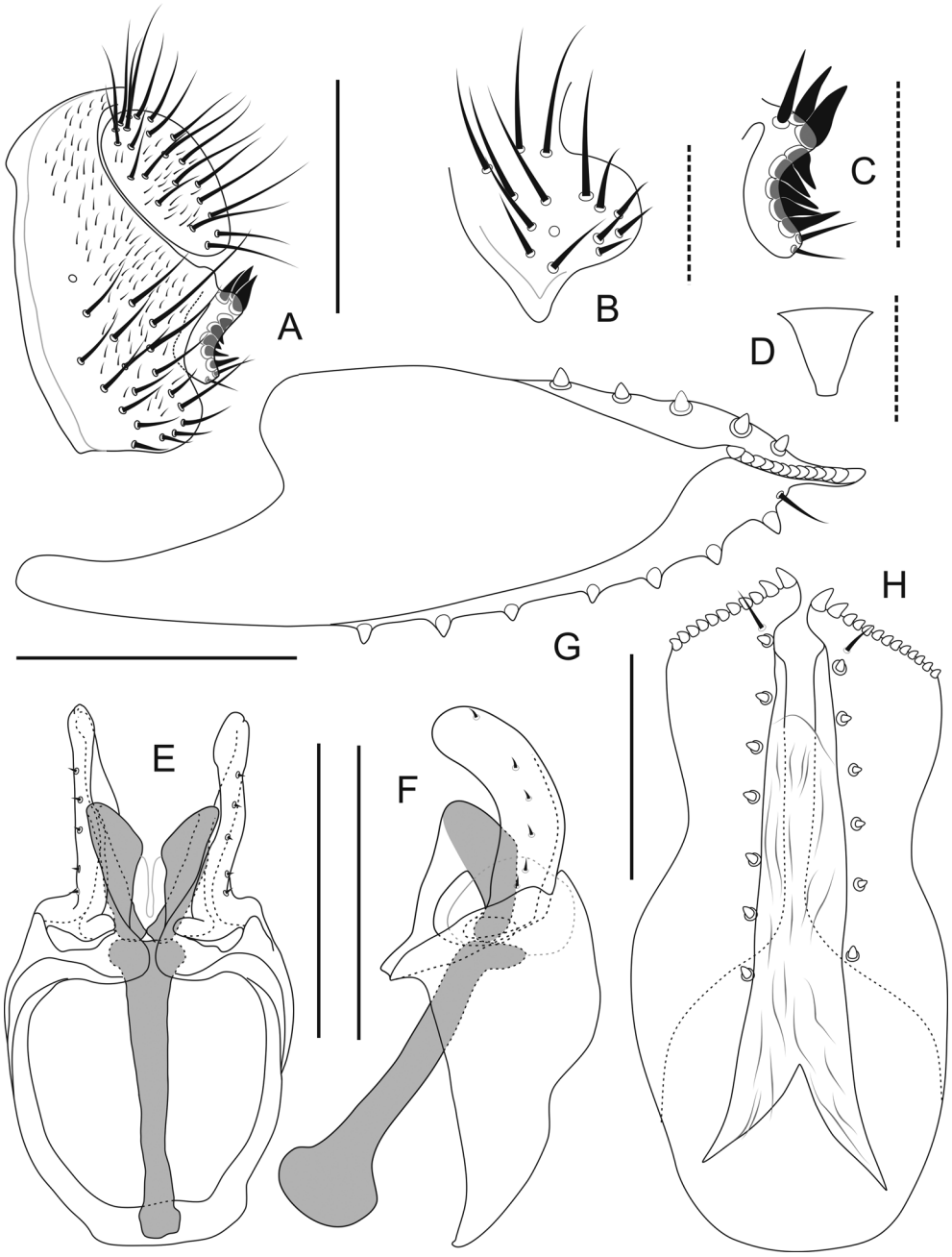

FIGURE 49. ***Impatiophila securiformis*** **Fu & Gao, sp. nov.** Adult male (holotype, #01501) and female (paratype, #00174): A, periphallic organs (caudolateral view); B, caudoventral part of epandrium; C, surstylus (caudal view); D, tenth sternite; E, phallic organs (dorsal view); F, phallic organs (lateral view); G, oviscapt (lateral view); H, oviscapt (ventral view).

4 Ungrouped species

44) *Impatiophila bifurcata* Fu & Gao, sp. nov.

(Fig. 50; Pl. 5G; Pl. 7Q)

Diagnosis. Abdominal tergites unicolorously blackish brown (Pl. 5G). Hindleg tibia with 1 black, apically blunt, stout spine at outer apex on underside. Tenth sternite longer than twice of width, roundly convex on dorsal margin (Fig. 50D). Dorsomedial portion of oviscapt valve narrowly extended anteriad in lateral view (Fig. 50G).

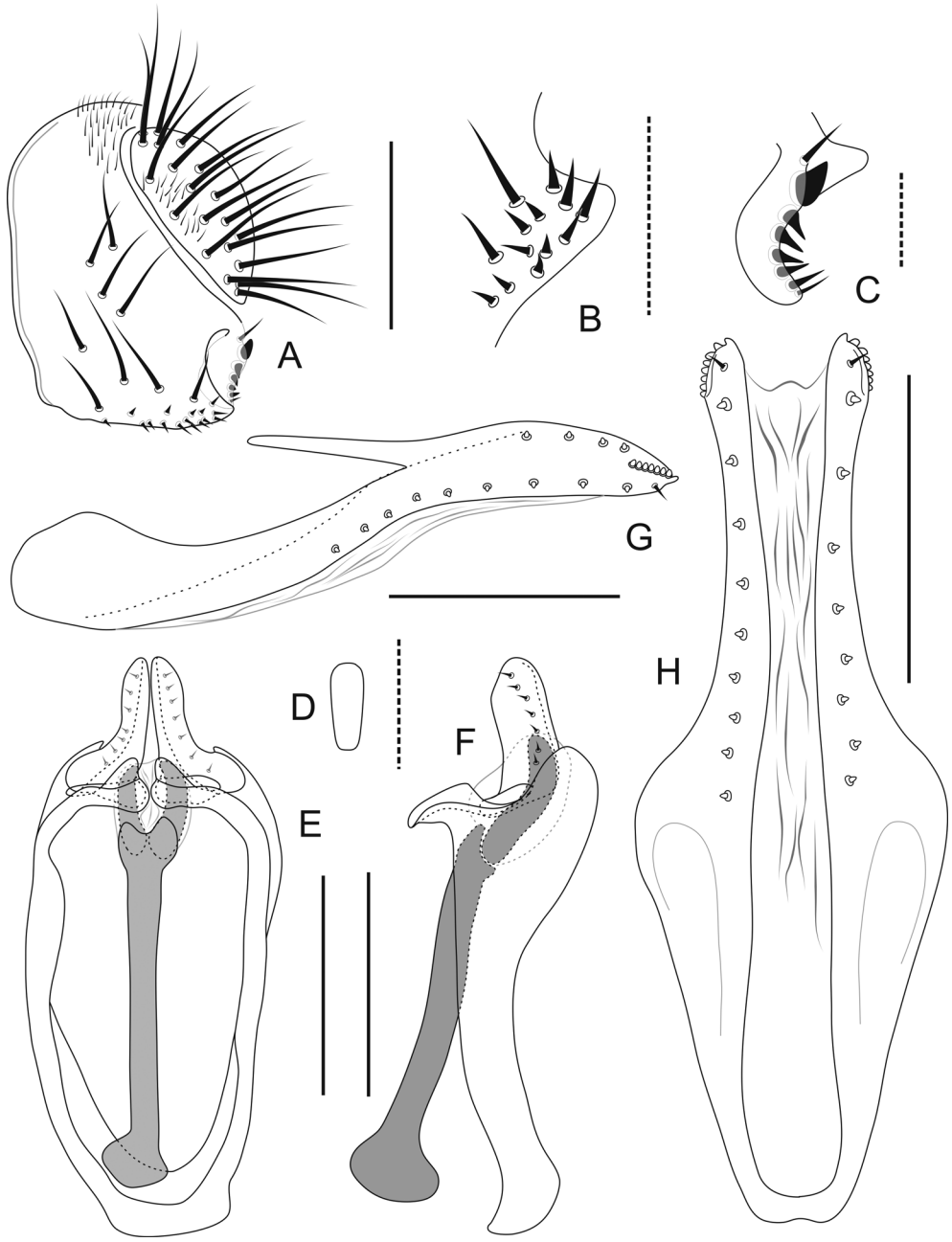

FIGURE 50. ***Impatiophila bifurcata*** **Fu & Gao, sp. nov.** Adult male (holotype, #01149) and female (paratype, #001127): A, periphallic organs (caudolateral view); B, caudoventral part of epandrium; C, surstylus (caudal view); D, tenth sternite; E, phallic organs (dorsal view); F, phallic organs (lateral view); G, oviscapt (lateral view); H, oviscapt (ventral view).

Description (♂, ♀). Head: Cibarium with 3−4 medial and 5 posterior sensilla per side: posterior sensilla slightly curved anteriad and anteromost one twice as long as posteromost, medial sensillum. Labellum with 6−7 pseudotracheae per side.

Thorax (Pl. 5G): Postpronotum dark brown; scutum and scutellum glossy black; pleura dark brown to blackish brown.

Wing (Pl. 5G) hyaline; veins pale brown. C_1 setae 2, subequal. Setae of middle row on 2nd costal section all weak, trichoid. Haltere pale yellow.

Legs (Pl. 5G) yellow. Hindleg tarsomeres I−IV each with 1 black, apically blunt, stout spine at outer apex on underside.

Abdomen: Sternites grayish yellow; male VI somewhat quadrate, slightly longer than wide, nearly straight or slightly concave on posterior margin.

Male terminalia (Fig. 50A−F): Epandrium broad, truncate on ventral margin, pubescent on dorsomedial portion, with ca. 10 long setae on ventral 2/3 and ca. 10 shorter setae on caudoventral portion. Surstylus deeply concave in ventral 2/3 of distal margin, with 1 seta in addition to 1 stout, upturned prensiseta around caudodorsal corner, 5 prensisetae along distal margin and 1 seta at ventral apex. Cercus pubescent on anteromedial portion, with ca. 18 long setae. Hypandrim twice as long as wide, slightly narrowing anteriorly. Gonopod broad, short in lateral view. Paramere somewhat roundish on apical margin, twice as long as wide, with 7 sensilla. Aedeagal basal process about 2/3 length of paramere.

Female terminalia (Fig. 50G, H; Pl. 7Q): Oviscapt valve yellowish brown, apically less expanded in ventral view, without distinct lateral flap, gently curved on dorsosubapical margin, distally concave on ventral margin in lateral view, with 4 dorsal ovisensilla, 8 lateral ones tightly arranged in slightly convex (in ventral view) row on margin of apicolateral portion and 8−9 ventral ones nearly constant in size and entirely arranged at nearly equal intervals; subapical trichoid ovisensillum stout, longer than apical, peg-like ovisensillum. Spermatheca capsule brown, as wide as long, apically slightly concave; introvert depth of duct about 1/3 of capsule height.

Measurements: BL = 2.25 (1♂ paratype: 1.83, 1♀ paratype: 2.45) mm, ThL = 1.06 (1.01, 1.13) mm, WL = 2.20 (2.05, 2.28) mm, WW = 1.00 (0.92, 0.99) mm.

Indices: arb = 2/1 (1♂, 1♀ paratype: 2−3/1), FW/HW = 0.46 (0.46−0.47), ch/o = 0.08 (0.09−0.13), prorb = 1.06 (0.99−1.00), rcorb = 0.94 (0.62), orbito = 1.19 (0.85−1.00), vb = 0.40 (0.35−0.36), dcl = 0.50 (0.52−0.62), dcp = 0.42 (0.39), sterno = 0.58 (0.57−0.64), m-sterno = 0.79 (0.74−0.78), sctl = 1.02 (1.04−1.07), sctlp = 1.12 (0.95−0.97), C = 2.28 (2.08−2.14), 4c = 0.89 (0.94−1.01), 4v = 1.58 (1.55−1.73), 5x = 1.74 (1.58−1.74), ac = 2.66 (2.65−3.00), M = 0.50 (0.43−0.50).

Holotype. ♂ (#01149), Jiujiezi, Baihualing Village, Mangkuan Town, Longyang County, Baoshan, Yunnan, China, ca. 1900 m, 9.x.2010, J.J. Gao (KIZ).

Paratypes. CHINA: 1♂ (#02582), Huanglianshan Nature Reserve, Luchun, Honghe, Yunnan, 26.iv.2010, by net sweeping on herbaceous vegetation, Y.R. Su *et al.*; 1♀ (#01127), Hesong Village, Xiding Town, Menghai County, Xishuangbanna, Yunnan, 21°49′57″N, 100°06′09″E, 17.iv.2010, by net sweeping above fallen trunk along waterside, J.J. Gao (KIZ).

Distribution. China (Yunnan).

Etymology. Referring to the oviscapt valve dorsomedially bifurcated (*bi-furcatus*) with anteriad extending, narrow projection.

45) *Impatiophila maoershanensis* Fu & Gao, sp. nov.

(Fig. 51; Pl. 5H; Pl. 7R)

Diagnosis. Abdominal tergite III unicolorously blackish brown (Pl. 5H). Hindleg tibia with 2−4 black, apically blunt, stout spines at outer apex on underside. Setae of middle row on 2nd costal section of wing all heavy, peg-like, reaching or beyond tip of R_{2+3}. Dorsal 2/3 of surstylus broad, strongly protruded posteriad, with 4−5 setae on dorsal margin and 3−4 stout, upturned prensiseta on distal margin (Fig. 51A).

Description (♂, ♀). Head: Cibarium with 2−3 medial and 3−5 posterior sensilla per side: posterior sensilla slightly curved anteriad and anteromost one twice as long as posteromost, medial sensillum. Labellum with 6 pseudotracheae per side.

Thorax varying in color pattern from unicolorously blackish brown or black one (Pl. 5H) to pale-patterned one.

Wing (Pl. 5H) hyaline, slightly infuscate; veins brown. C_1 setae 2, subequal. Haltere pale yellow.

Legs (Pl. 5H) yellowish brown. Hindleg tarsomeres I−IV each with 1 black, apically blunt, stout spine at outer apex on underside.

Abdomen: Tergites unicolorously dark brown to black (Pl. 5H), but varying on IV and V: some with caudal band medially neither interrupted/constricted nor protruded. Sternites grayish yellow; male VI somewhat quadrate, slightly longer than wide, nearly straight or slightly concave on posterior margin.

Male terminalia (Fig. 51A−F): Epandrium pubescent in small patches on posteromedial portion, with ca 10 long setae on ventral half and ca. 21 short spines on caudoventral portion distally broadly rounded. Surstylus with 7 prensisetae along deeply concave, ventral margin but no seta near ventral apex. Tenth sternite somewhat

trapeziform, narrowing anteriorly, slightly concave on dorsal margin. Cercus pubescent on anteromedial portion, with ca. 19 long setae. Hypandrium trapeziform, longer than wide, posteriorly dilated horizontally and vertically. Gonopod broad, apically widely blunt. Paramere broad, shorter than twice of width, apically round, with 8 sensilla. Aedeagal basal process slightly shorter than 2/3 length of paramere.

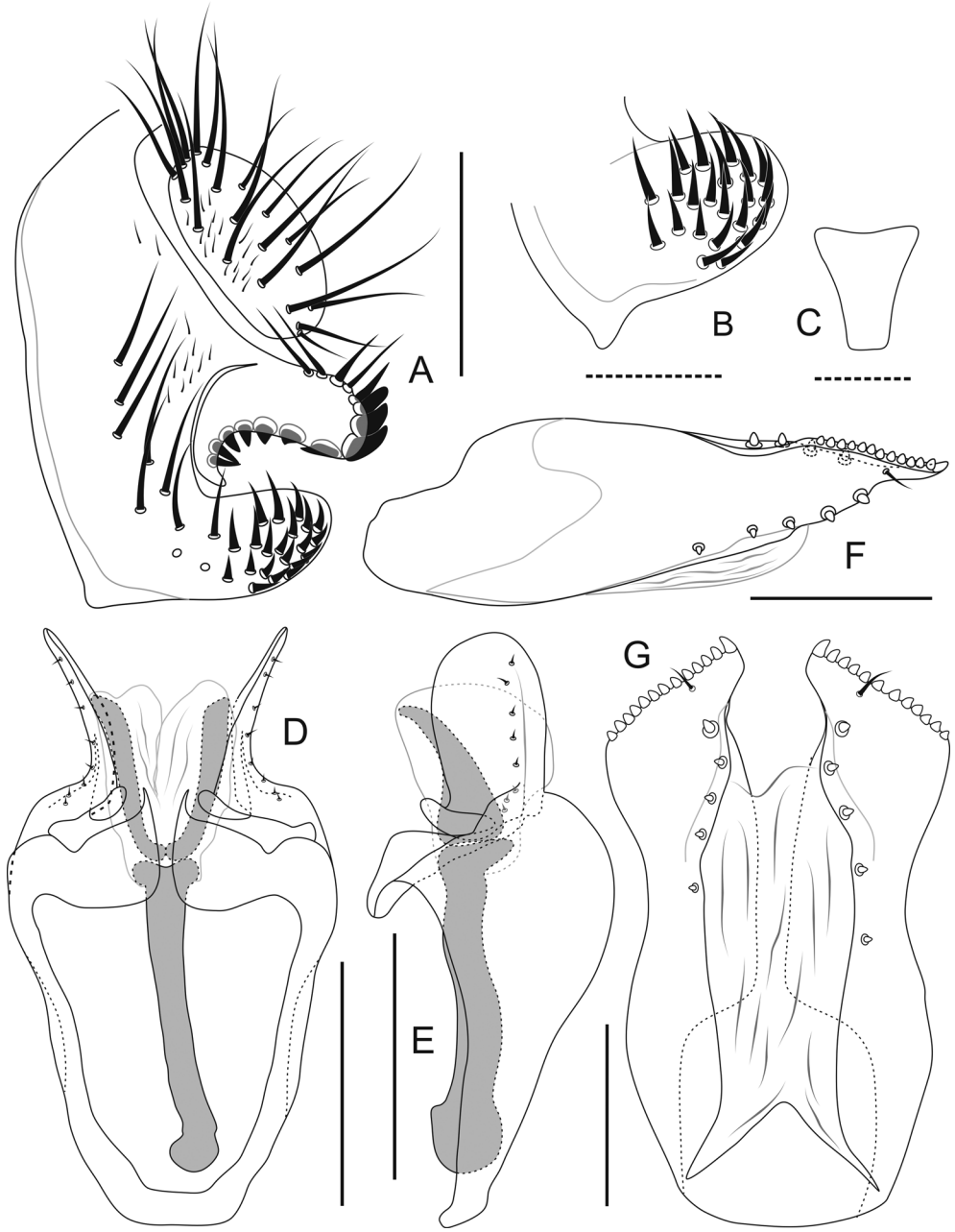

FIGURE 51. ***Impatiophila maoershanensis*** **Fu & Gao, sp. nov.** Adult male (holotype, #00175) and female (paratype, #00176): A, periphallic organs (caudolateral view); B, caudoventral part of epandrium; C, tenth sternite; D, phallic organs (dorsal view); E, phallic organs (lateral view); F, oviscapt (lateral view); G, oviscapt (ventral view).

Female terminalia (Fig. 51G, H; Pl. 7R). Oviscapt valve brown, apically much expanded in ventral view, forming well-developed lateral flap, gently curved on dorsosubapical margin, less expanded dorsomedially, somewhat convex on ventral margin in lateral view, with 4−5 dorsal ovisensilla, 12–13 lateral ones tightly arranged in nearly straight (in ventral view) row on margin of apicolateral flap and 5 ventral ones distally increasing in size and entirely arranged at nearly equal intervals; subapical trichoid ovisensillum stout, longer than apical, peg-like ovisensillum. Spermathecal capsule brown, wider than long, apically somewhat flat in lateral view; introvert depth of duct about 1/2 of capsule height.

Measurements: BL = 2.38 (5♂ paratypes: 2.00−2.38, 2♀ paratypes: 2.30−2.69) mm, ThL = 0.99 (0.96−1.07, 1.06−1.10) mm, WL = 2.11 (2.08−2.18, 2.14−2.19) mm, WW = 0.95 (0.91−0.97, 0.95−0.95) mm.

Indices: arb = 2/1 (5♂, 2♀ paratypes: 2−3/1), FW/HW = 0.44 (0.42−0.45), ch/o = 0.06 (0.07−0.10), prorb = n/a (5♂, 1♀ paratypes: 0.96−1.00), rcorb = 0.77 (0.73−0.87), orbito = 1.36 (1.08−1.39), vb = 0.42 (0.41−0.47), dcl = 0.53 (0.54−0.60), dcp = 0.43 (0.39−0.44), sterno = 0.72 (0.64−0.80), m-sterno = 0.69 (0.71−0.83), sctl = 1.04 (0.95−1.10), sctlp = 0.97 (0.96−1.17), C = 2.15 (2.12−2.66), 4c = 0.83 (0.83−0.94), 4v = 1.47 (1.52−1.74), 5x = 1.63 (1.52−1.75), ac = 2.85 (2.28−2.94), M = 0.45 (0.45−0.51), C3F = 0.17 (0.00−0.14).

Holotype. ♂ (#00175), Maoershan National Nature Reserve, Xing'an, Guilin, Guangxi, China, 19.iii.2009, *ex* flowers of Gesneriaceae sp.1 (Fig. 1G), J.J. Gao (KIZ).

Paratypes. CHINA: 2♂, 2♀ (#00176, #00179−81), same data as holotype; 2♂, 1♀ (#00438, #00439, #02580), Huanglianshan Nature Reserve, Luchun, Honghe, Yunnan, 26.ix.2010, by net sweeping on herbaceous vegetation, Y.R. Su *et al.*; 1♂ (#01146), Jiujiezi, Baihualing, Mangkuan, Longyang, Baoshan, Yunnan, 24.ix.2012, J.J. Gao (KIZ, SEHU).

Distribution. China (Guangxi, Yunnan).

Etymology. Pertaining to the type locality.

Discussion

Breeding habits of essential dependence on flowers for larval food resources have evolved repeatedly in separate lineages of the Drosophilidae (Brncic 1983). The tribe Colocasiomyini Okada in the sense revised by Yassin (2013) is rich in number of obligatory flower-breeding species: all species of *Colocasiomyia* are oligo- or monophagous flower-breeders exclusively depending on inflorescences of Araceae, Arecaceae and Magnoliaceae (Sultana *et al.* 2006); African species of *Lissocephala* are strictly specialized on *Ficus* L. (Moraceae), their larvae feeding inside immature figs (Lachaise 1977, Harry *et al.* 1996); many species of *Scaptodrosophila* are known as strict flower-breeders in tropics of Africa, Micronesia, Australia and Asia (see Brncic 1983 for review). In addition, two Neotropical flower-breeding genera, *Laccodrosophila* Duda and *Zapriothrica* Wheeler, which are currently assigned to the revised tribe Drosophilini Okada (Yassin 2013), show close affinity in morphology to the tribe Colocasiomyini, being placed close to most members of the latter tribe on Grimaldi's (1990) cladogram based on 217 morphological characters. The new genus *Impatiophila* established here is another florivorous genus in Colocasiomyini. Adult flies of this genus have been collected almost exclusively from flowers of the genus *Impatiens* (Balsaminaceae) and the families Gesneriaceae, Zingiberaceae and Acanthaceae as well, but not from any other substrates in nature or bait traps for collecting other drosophilids. And, two species have proved to breed on *Impatiens* flowers: Gao (2011) exactly studied the breeding habits of *Impatiophila yapingi* on its host plant, *Impatiens tayemonii*, and in this paper we gave a brief note on reproductive ecology of *Impatiophila actinia* using flowers of *Impatiens uniflora*.

Some flower-breeding drosophilid species show morphological, physiological and behavioral adaptations to their floral niches. In species of which females oviposit on tough, fleshy, unopened flower buds, their ovipositors are acuminate and equipped with dense and/or stout dentation on distal margins for scraping floral tissue (Pipkin *et al.* 1966). *Impatiophila yapingi* shows similar ovipositing behavior; its female lays an egg on unripen anthers within a flower bud by inserting the ovipositor through a slit opened by it on unopened petals (Gao 2011). Its ovipositor is shaped like a snap-off cutter blade and densely dentate on distal margin ("Fig. 22" in Gao 2011). The ovipositors of this type with apical, horizontal flap bearing dense, peg-like ovisensilla on its margin are seen commonly in most species of the *I. yapingi* species group and an ungrouped species, *I. maoershanensis*. The nearly identical form of ovipositor ("Figs. 155, 156" in Grimaldi 1987) is seen in a flower-breeding species of the genus *Zygothrica* Wiedemann, *Z. florinjecta* Grimaldi, and more or less similar ones in five Neotropical, flower-breeding species of the subgenus *Drosophila* ("FIG. 4" in Pipkin *et al.* 1966). This should be a morphological convergence having independently evolved in distantly related species that have acquired the habit of ovipositing on unopened flower buds. In addition, convergent evolution is seen in another characteristic of flower-breeding drosophilid species: many species deposit their eggs in an advanced stage of embryonic development (see Brncic 1983 for review). This is considered to be an adaptation of minimizing the larval growth period to cope with the short duration of floral food resources. Gao (2011) suggested that *I. yapingi* as well has such an adaptive characteristic.

On the other hand, the *I. acutivalva* species group is quite different in the form of ovipositor from the other species of *Impatiophila*. A number of synapomorphies (including some homoplastic ones) characterizing this species group were recognized from this organ (Fig. 11). The ovipositors of this species group are apically not expanded horizontally but narrowing, distally less dentate, and much longer than those of the *yapingi* group. The elongated ovipositor is another morphological adaptation for some flower-breeding drosophilids to place an egg into an unopened bud from the outside or at a deep place of opened flower (Pipkin *et al.* 1966, Brncic 1983). These derived characteristics in the ovipositor morphology suggest that females of the *acutivalva* group lay their eggs on host plant flowers in a different manner from those of the other *Impatiophila* species. Discovery of no egg from any flower of the host plant *Impatiens uniflora* may imply the ovoviviparity in *Impatiophila actinia*. Thus, the *I. acutivalva* species group may have evolved to exploit a novel microniche within the host plant flowers, and diversified.

In contrast to the differentiation between the species groups, the *yapingi* and the *acutivalva* groups each comprises a number of species rather uniform in morphology and less differentiated genetically in terms of the concatenated DNA sequences of the five studied genes. Seemingly, encompassing of many closely related but distinct (in light of *COI* sequence) species in each species group is a consequence of explosive speciation, which may or may not be associated with selection of species-specific host plants. However, evidence for this hypothesis with regard to the eco-morphological differentiation at the level of species group and the radiation at the level of species in each species group is still very insufficient: so far, reproductive ecology has been studied in only two species, *I. yapingi* and *I. actinia*, representing the *yapingi* and *acutivalva* groups, respectively, but only briefly for the latter species. In the future, selection of host plants in each local population, the mating, feeding and ovipositing behaviors of adult flies, and the life histories at the pre-imaginal stages should be investigated for more species of *Impatiophila*.

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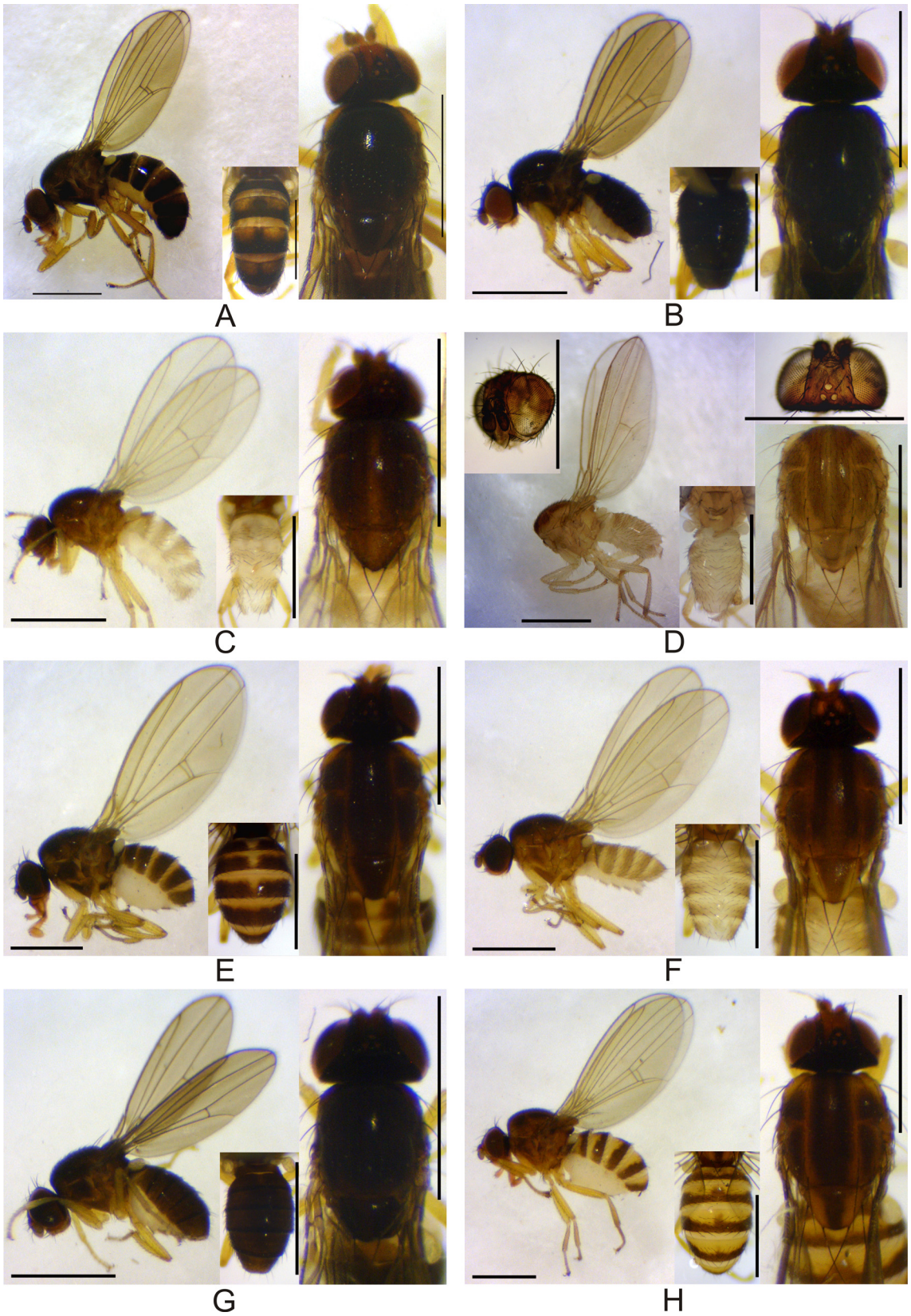

PLATE 1. Photographs of *Impatiophila* species (part 1). A, *yapingi* (♂ #03752); B, *parvula* (paratype ♂, #00270); C, *convergens* (holotype ♂, #00311); D, *eretmosternata* (holotype ♂, #00515); E, *tongmaiensis* (holotype ♂, #00294); F, *linzhiensis* (holotype ♀, #00543); G, *longifolia* (paratype ♂, #00321); H, *ptyonosternata* (holotype ♂, #00296). Scale lines = 1.0 mm.

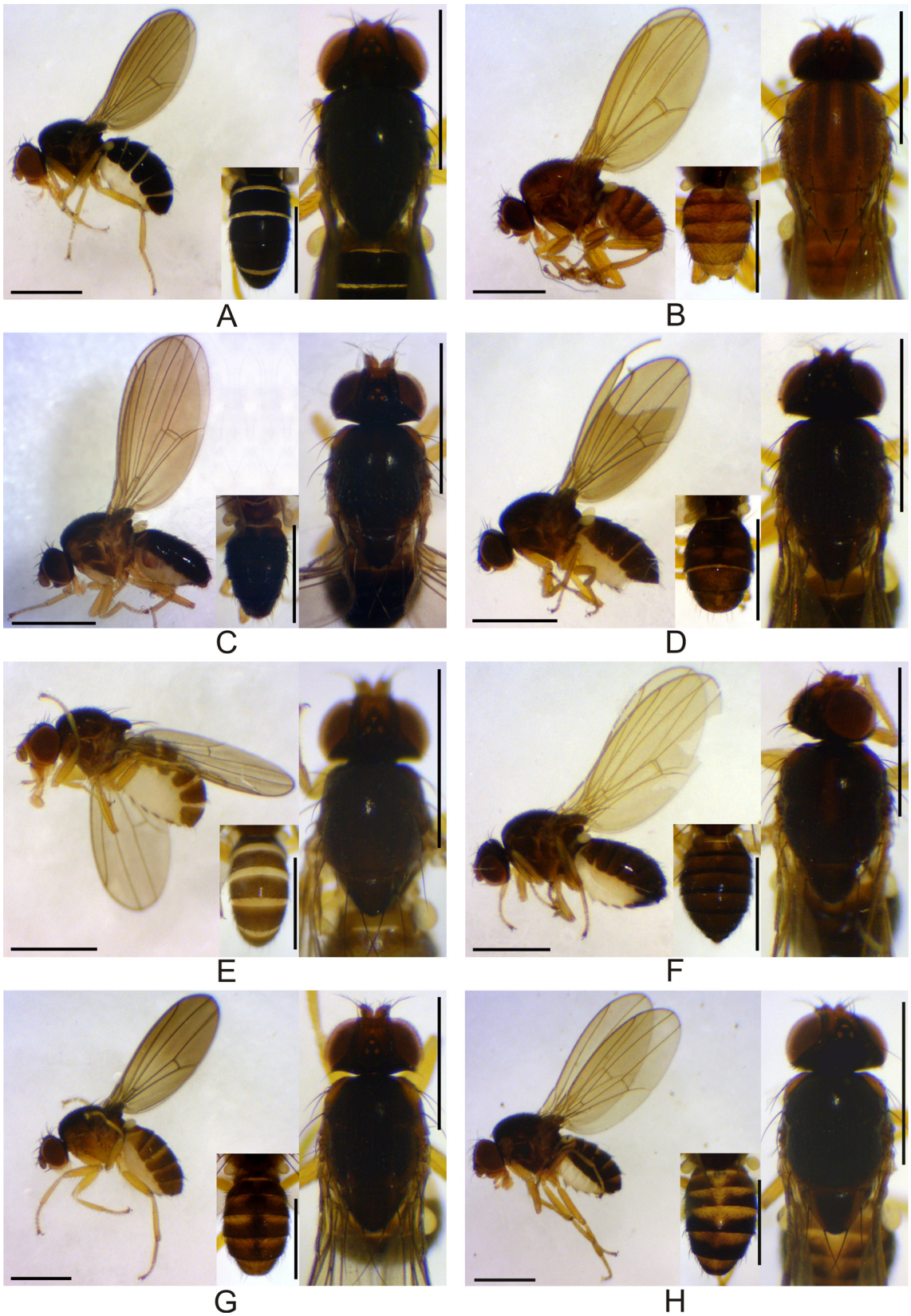

PLATE 2. Photographs of *Impatiophila* species (part 2). A, *tumidivalva* (holotype ♀, #00376); B, *xiaoi* (holotype ♂, #00117); C, *viasericaria* (holotype ♂, #03579); D, *rhombivalva* (paratype ♀, #01198); E, *aspidosternata* (paratype ♂, #00185); F, *hutiaoxiana* (holotype ♀, #01541); G, *medivittata* (holotype ♂, #01558); H, *taibaishanensis* (holotype ♂, #01700).

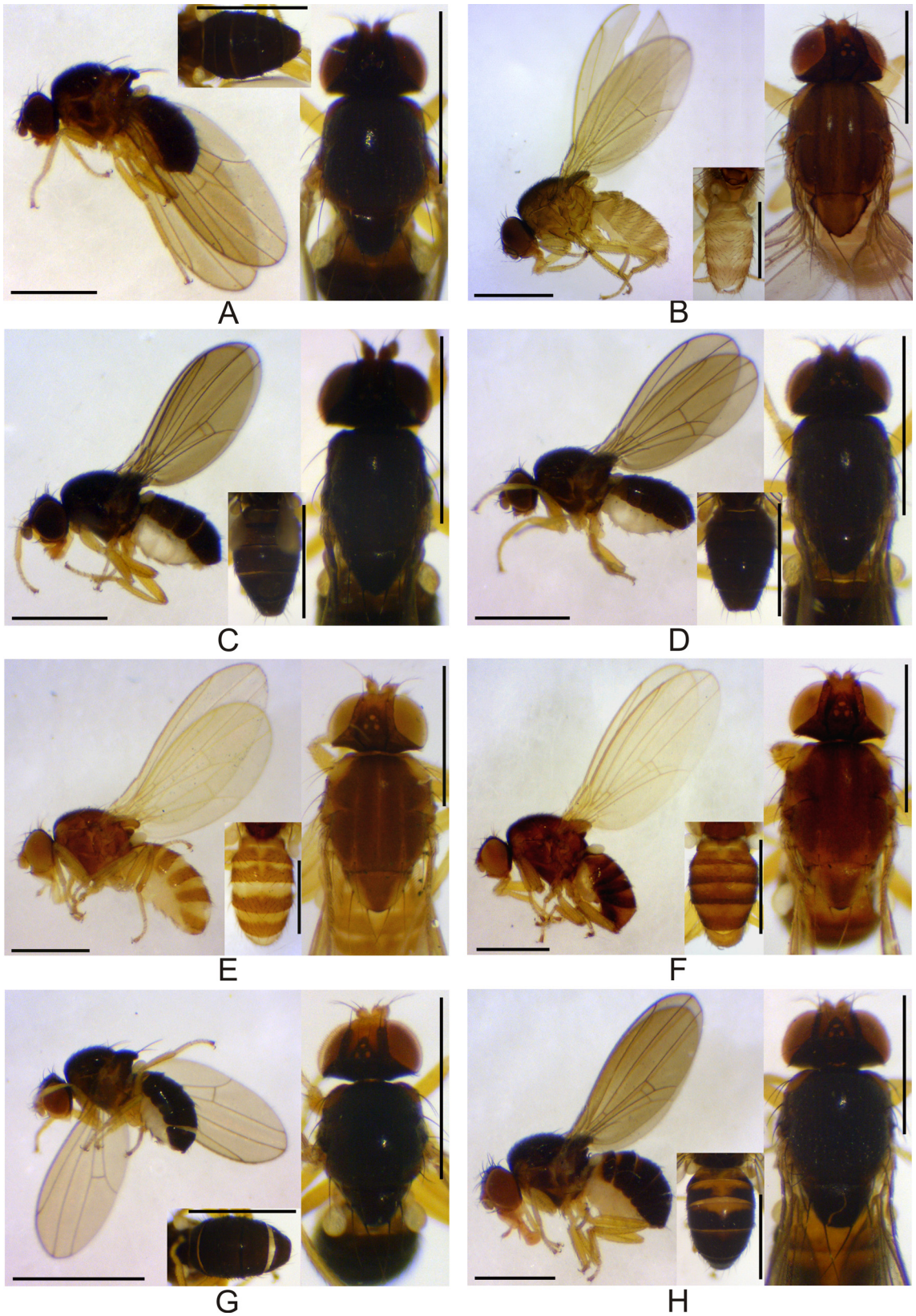

PLATE 3. Photographs of *Impatiophila* species (part 3). A, *yangi* (holotype ♂, #01566); B, *forcipivlava* (holotype ♂, #00309); C, *trifurcatosternata* (holotype ♂, #00551); D, *latipennata* (holotype ♂, #00604); E, *bifasciata* (holotype ♂, #02572); F, *quadrangulata* (holotype ♂, #02574); G, *pulla* (holotype ♂, #01126); H, *motuoensis* (holotype ♂, #00273).

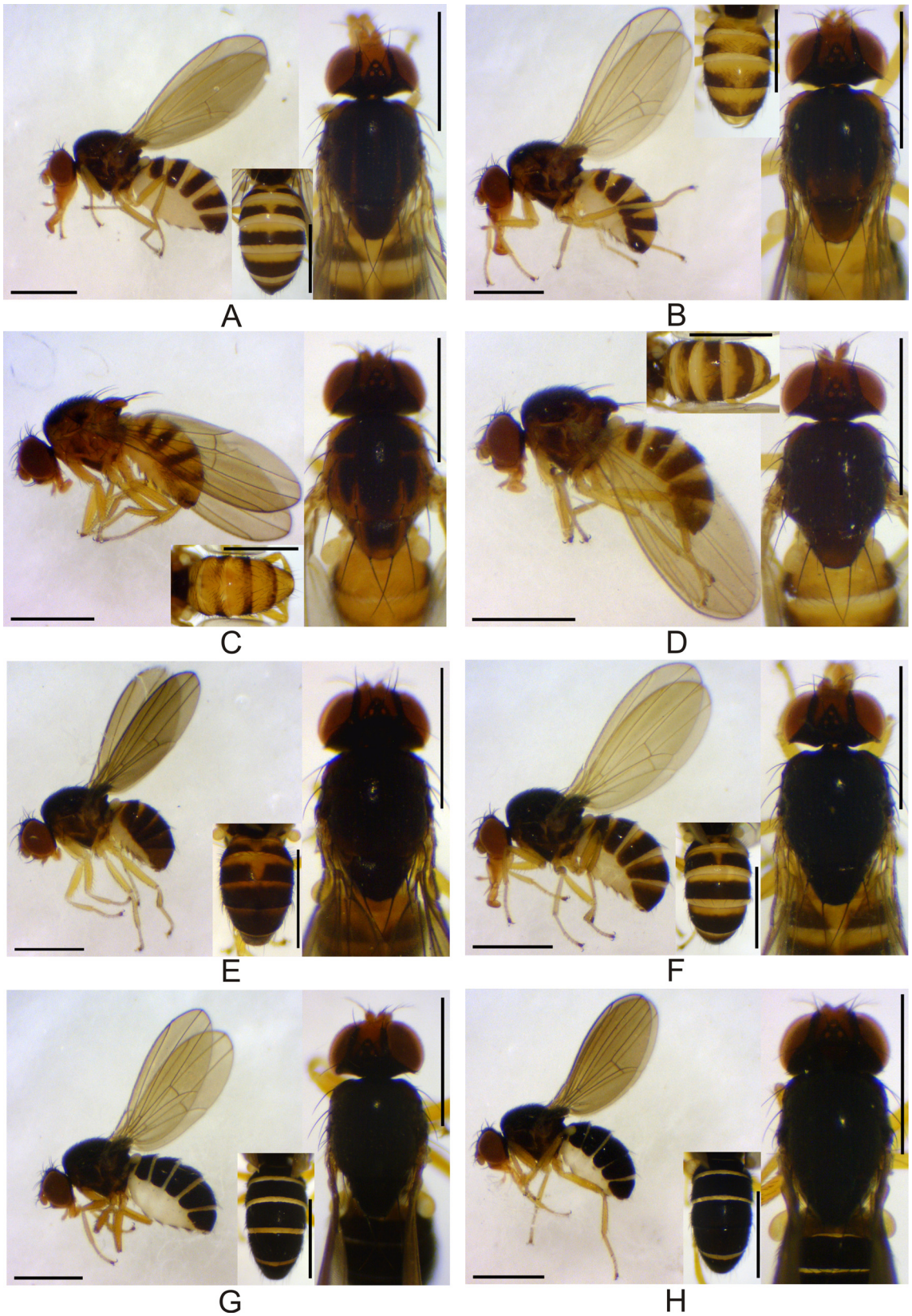

PLATE 4. Photographs of *Impatiophila* species (part 4). A, *epubescens* (holotype ♂, #00280); B, *curvivalva* (holotype ♂, #00089); C, *magnimaculata* (paratype ♂, #00544); D, *chiasmosternata* (paratype ♂, #00106); E, *furcatosternata* (holotype ♂, #00272); F, *acutivalva* (holotype ♂, #00282); G, *pipa* (holotype ♂, #00202); H, *truncivalva* (holotype ♂, #00302).

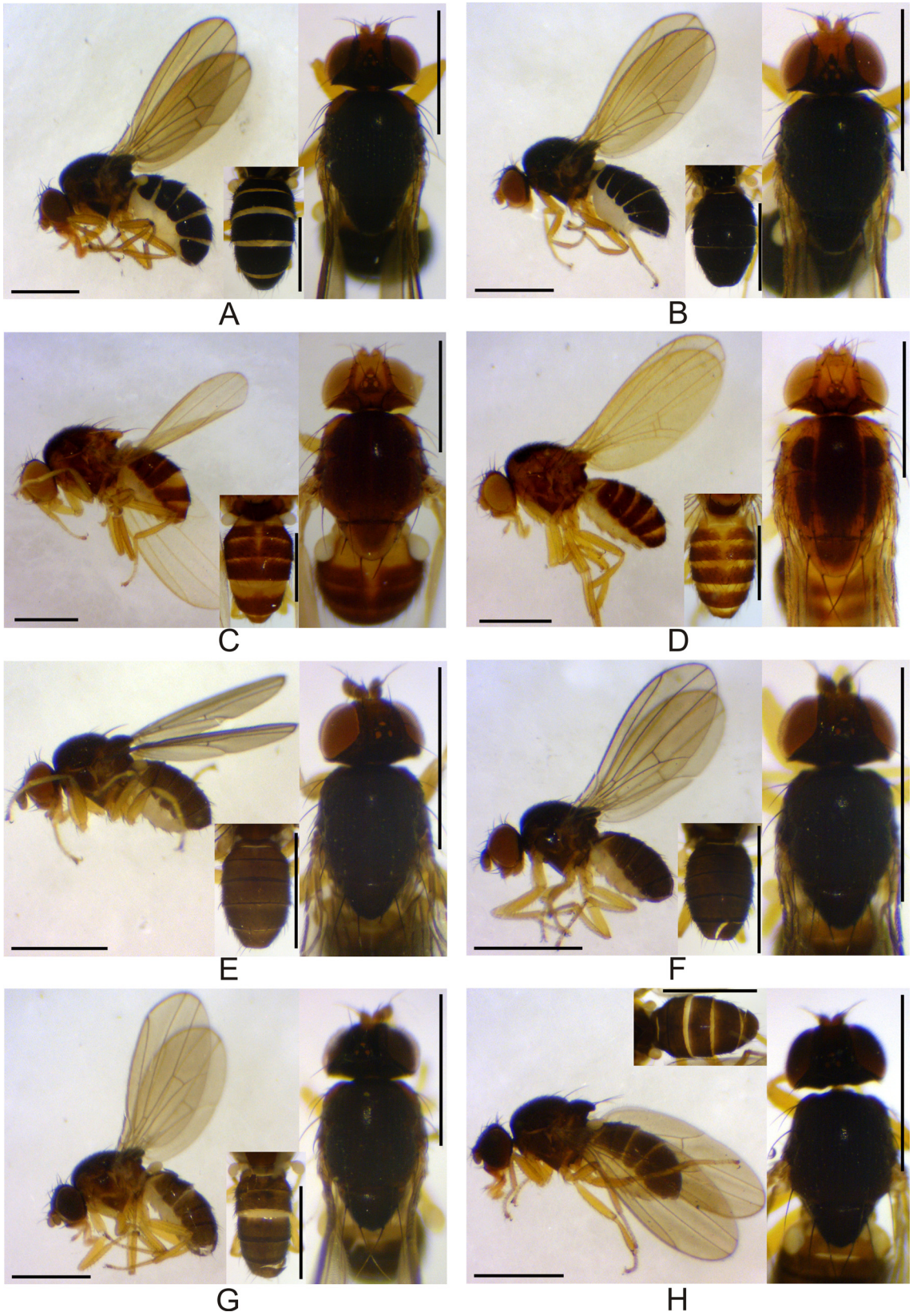

PLATE 5. Photographs of *Impatiophila* species (part 5). A, *menghaiensis* (holotype ♂, #00397); B, *unicolorata* (holotype ♀, #01439); C, *oblongata* (paratype ♂, #02576); D, *pentamaculata* (holotype ♂, #02558); E, *menba* (holotype ♂, #00307); F, *securiformis* (paratype ♂, #00173); G, *bifurcata* (holotype ♂, #01149); H, *maoershanensis* (holotype ♂, #00175).

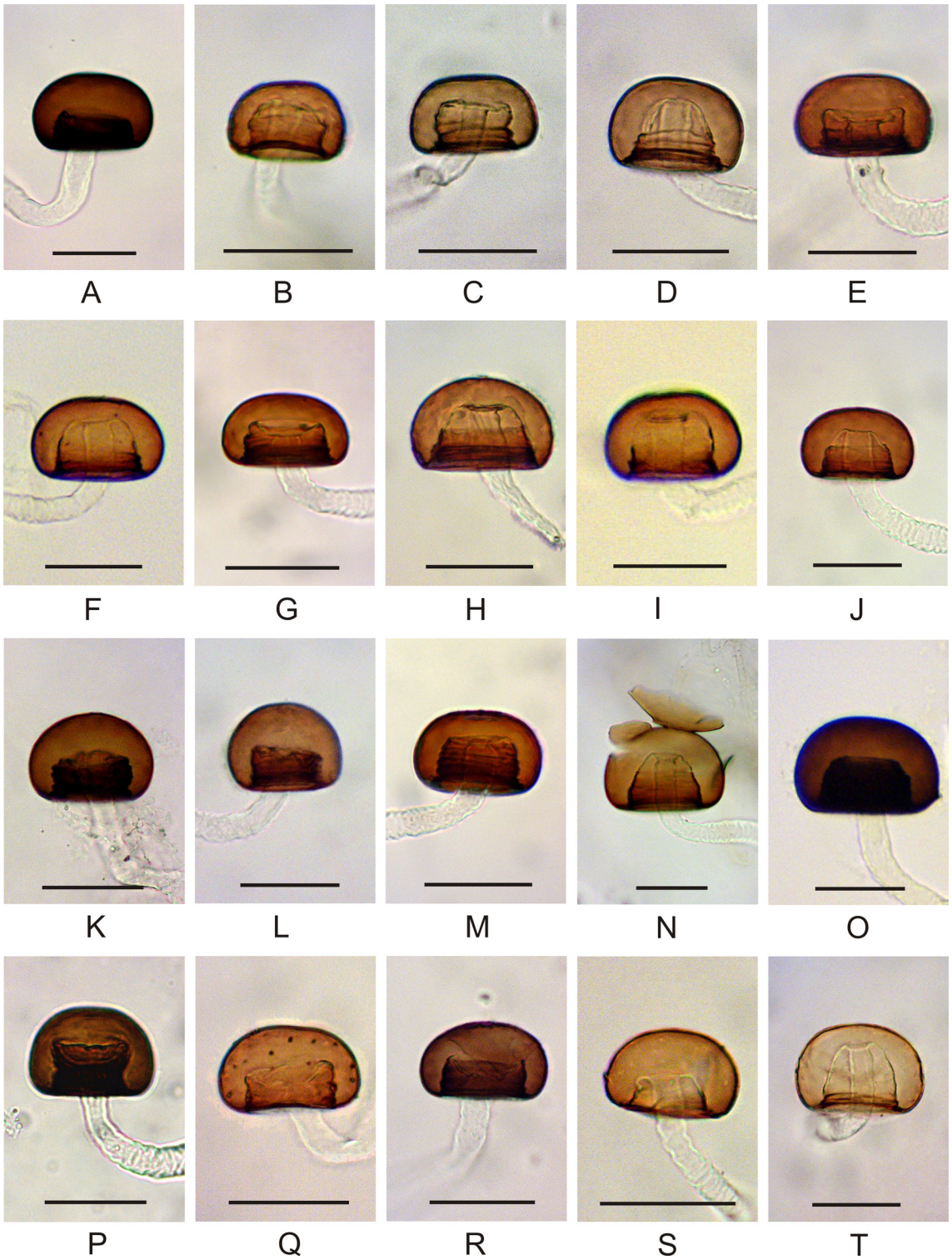

PLATE 6. Spermathecae of *Impatiophila* (part 1). A, *yapingi* (#03753); B, *parvula* (paratype, #00612); C, *convergens* (paratype, #00540); D, *eretmosternata* (paratype, #00310); E, *tongmaiensis* (paratype, #00295); F, *linzhiensis* (holotype, #00543); G, *longifolia* (paratype, #00572); H, *ptyonosternata* (paratype, #00297); I, *tumidivalva* (holotype, #00376); J, *xiaoi* (paratype, #00126); K, *viasericaria* (paratype, #03733); L, *rhombivalva* (paratype, #01198); M, *aspidosternata* (paratype, #00195); N, *hutiaoxiana* (holotype, #01541); O, *taibaishanensis* (paratype, #02542); P, *yangi* (paratype, #03581); Q, *forcipivalva* (paratype, #00312); R, *trifurcatosternata* (paratype, #00111); S, *latipennata* (paratype, #00378); T, *bifasciata* (paratype, #02573).

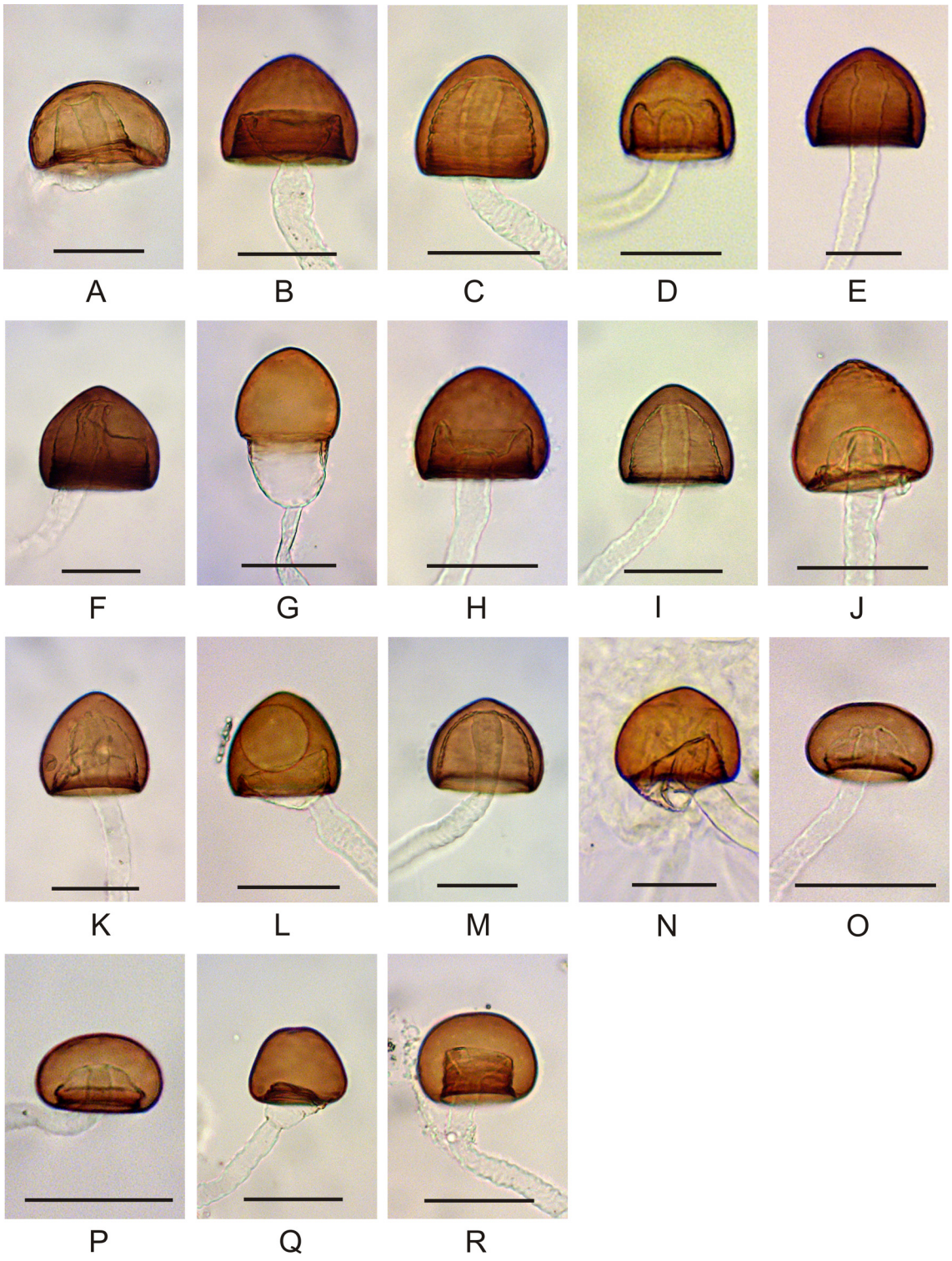

PLATE 7. Spermathecae of *Impatiophila* (part 2). A, *quadrangulata* (paratype, #02575); B, *motuoensis* (paratype, #00274); C, *epubescens* (paratype, #00279); D, *curvivalva* (paratype, #00097); E, *magnimaculata* (paratype, #01553); F, *chiasmosternata* (paratype, #00090); G, *furcatosternata* (paratype, #00275); H, *acutivalva* (paratype, #00549); I, *pipa* (paratype, #01407); J, *truncivalva* (paratype, #00303), K, *menghaiensis* (paratype, #01125); L, *unicolorata* (holotype, #01439); M, *oblongata* (paratype, #02577); N, *pentamaculata* (paratype, #02559); O, *menba* (paratype, #00473); P, *securiformis* (paratype, #00277); Q, *bifurcata* (paratype, #01127); R, *maoershanensis* (paratype, #00176).