



Research article

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Associations and a new species of the genus *Apatidelia* (Trichoptera, Apataniidae) from China

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Abstract. Nine individuals of *Apatidelia* from Zhejiang Province, China were examined and their barcode sequences were generated and analyzed. A new species, *A. morsei* Xu & Sun sp. nov., is described and illustrated. The larva, male and female of *A. acuminata* Leng & Yang, 1998 and the male and female of *A. morsei* Xu & Sun sp. nov. are associated by mtCOI gene sequences. The male of *A. acuminata* Leng & Yang, 1998 is re-described and re-illustrated, and the female and the larva of the same species are also described and illustrated. Females and larvae of the genus are here reported for the first time.

Keywords. Taxonomy, caddisflies, larval-adult association, DNA barcoding, China.

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Introduction

The genus *Apatidelia* Mosely, 1942 was erected by Mosely for his new species, *A. martynovi*, from Fujian, China (Mosely 1942). The second species, *A. gansuensis*, was described by Mey from Gansu Province (Mey 1997). Leng & Yang (1998) recognized the third species, *A. acuminata*, from Zhejiang Province. In addition, based on the abdominal segment V with a short process on each side, Leng & Yang (1998) moved *Apatania mirabilis* Martynov, 1909 to the genus *Apatidelia*. *Apatidelia mirabilis* was originally reported from Kham in eastern Tibet (Martynov 1909), which has now been split into 50 counties belonging to Yunnan, Sichuan, Tibet and Qinghai Provinces (Wikipedia 2016). Thus, Yang *et al.* (2005) considered *Apatidelia mirabilis* to be present in Qinghai, Sichuan and Tibet. The fifth species, *A. egibiel* was described by Malicky from Shaanxi Province (Malicky 2012). All the known species of the genus are endemic to China, two of which (*A. gansuensis*, *A. egibiel*) are distributed in

Palaearctic China and two (*A. martynovi*, *A. acuminata*) in Oriental China, whereas *A. mirabilis* is found in both Palaearctic and Oriental China. Morphologically, these species are well identified by the male genitalia, but females of these species remained unknown for *A. martynovi* and *A. gansuensis*, or were either listed as paratypes only without any description or illustration for *A. acuminata* and *A. egibiel*, or only briefly described and illustrated in the case of *A. mirabilis*.

In this study, nine individuals of *Apatidelia*, collected from Zhejiang Province, China, were examined and their mtCOI gene sequences were generated and analyzed. One species, *A. morsei* Xu & Sun sp. nov., is found to be new to the caddisfly fauna; two females are associated with the male of this new species using molecular analysis and both the male and female are described and illustrated. One female and four larvae of *A. acuminata* are also associated with the male in the same way, and are described and illustrated; its male is re-described and re-illustrated. These contributions bring the number of species within the genus *Apatidelia* to six. Females of two species and the larva of one species are reported for the first time.

Material and methods

Sampling of specimens

Adults were preserved in 100% ethanol using pan traps with 15-W ultraviolet light bulbs. Larvae were collected using a D-frame aquatic net or by handpicking specimens off stones along streams. Adult and larval specimens were then sorted and stored in 100% alcohol.

Morphological study

Adults

The methods of genitalia preparation follow Xu *et al.* (2015), original pencil drawings were scanned to Adobe Photoshop® (v. 6.2 Adobe Systems, Inc.) and placed as a template in Adobe Photoshop®, then inked digitally on a new layer with a WACOM tablet and pen (CTL-671/KO-F) to produce illustrations.

Larvae

Photos for larval characters were taken with a Nikon Eclipse 80i microscope and Nis-Element D® software (v. 3.22.14). A series of photos at different focal distances was taken, which were then stacked using Zerene Stacker® (v. 1.02) into one image with a greater depth of field. Plates were arranged using Adobe Photoshop®.

Terminology

Terminology follows that of Schmid (1969) for wing venation and Schmid (1954) for the male genitalia, Oláh & Johanson (2007) for the cephalic setal warts, Nielsen (1943) and Schmid (1969) for female genitalia, and Wiggins (1977) for the larvae, respectively.

DNA analysis

Right hind legs of nine individuals (males, females and larvae) were taken from bodies for DNA extractions (Table 1). The extractions follow the animal tissue protocol of the DNeasy DNA extraction kit (Sangon Biotech). The reaction follows that of Ruiter *et al.* (2013) in 25 µl volume. The primers (LCO1490/HCO2198; C1-J1709/HCO2198) are listed in Table 2. MtDNA COI sequences were analyzed with Sequencher v. 4.5 (Gene Codes Corporation, Ann Arbor, Michigan, USA). Neighbor-joining (NJ) trees (Fig. 1) were constructed using Mega® v. 6.0 (Tamura *et al.* 2013). Calculation parameters were set as follows: Kimura 2-parameter substitution model, pairwise gap deletion and others as defaults.

Abbreviations

aed. = aedeagus
ana. ope. = anal opening

Table 1. Specimens used in larva-female-male associations of *Apatidelia*, with GenBank accession numbers for mtCOI sequences.

Sample ID	Species	GenBank accession	Life stage	Collection Site
ZJ494	<i>A. acuminata</i> Leng & Yang, 1998	KX158850	♂	Mt. Dashan, Gaohong town, Lin'an, Zhejiang
ZJ495	<i>A. morsei</i> Xu & Sun sp. nov.	KX158856	♂	Mt. Dashan, Gaohong town, Lin'an, Zhejiang
ZJ496	<i>A. morsei</i> Xu & Sun sp. nov.	KX158857	♂	Mt. Dashan, Gaohong town, Lin'an, Zhejiang
ZJ498	<i>A. morsei</i> Xu & Sun sp. nov.	KX158858	♀	Mt. Dashan, Gaohong town, Lin'an, Zhejiang
ZJ499	<i>A. acuminata</i> Leng & Yang, 1998	KX158851	♀	Mt. Dashan, Gaohong town, Lin'an, Zhejiang
ZJ579	<i>A. acuminata</i> Leng & Yang, 1998	KX158852	Larva	Huangjiawan, Xing town, Huzhou, Zhejiang
ZJ580	<i>A. acuminata</i> Leng & Yang, 1998	KX158853	Larva	Huangjiawan, Xing town, Huzhou, Zhejiang
ZJ581	<i>A. acuminata</i> Leng & Yang, 1998	KX158854	Larva	Huangjiawan, Xing town, Huzhou, Zhejiang
ZJ582	<i>A. acuminata</i> Leng & Yang, 1998	KX158855	Larva	Huangjiawan, Xing town, Huzhou, Zhejiang

- ant. lob. IX = anterior lobe of abdominal segment IX
 bas. seg. = basal segments of inferior appendages
 dis. seg. = distal segments of inferior appendages
 ext. bra. = external branches
 FI, FII, FIII, FV = fork I, fork II, fork III and fork V, respectively
 fro. apo. = frontoclypeal apotome
 inf. app. = inferior appendages
 int. bra. = internal branches
 lat. lob. IX = lateral lobes of abdominal segment IX
 l.o. = lateral ocellus

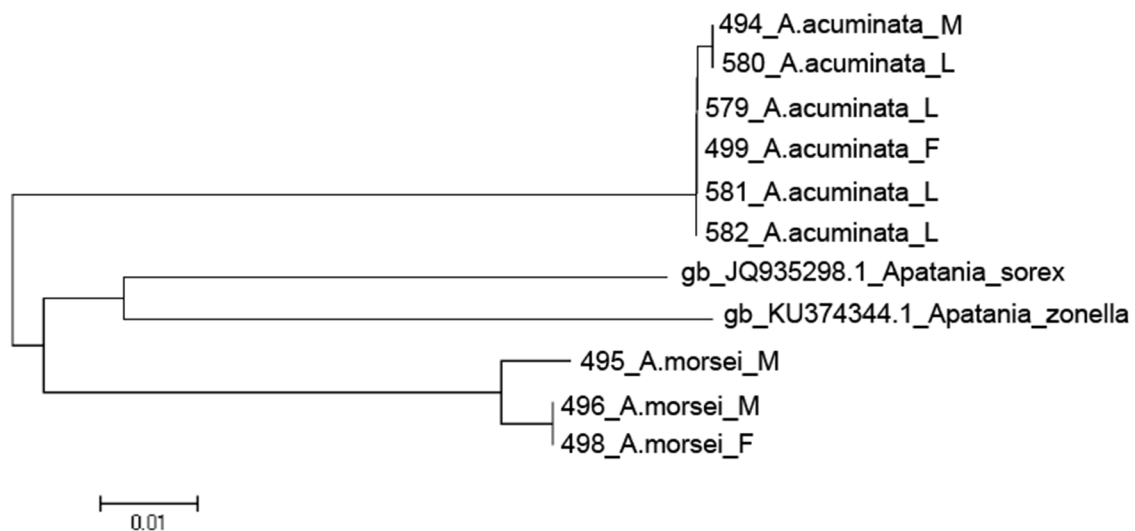
**Fig. 1.** COI neighbour-joining diagram used to determine larval-female-male associations of species of *Apatidelia* in China. M = ♂; F = ♀; L = larva.

Table 2. Polymerase chain reaction primers used to sequence mtCOI genes of *Apatidelia* spp.

Primer	Sequence (5' to 3')	Reference
LCO1490	GGTCAACAAATCATAAAGATATTGG	Folmer <i>et al.</i> (1994)
HCO2198	TAAACTTCAGGGTGACCAAAAAATCA	Folmer <i>et al.</i> (1994)
C1-J1709	AATTGGWGGWTTYGGAAAYTG	Simon <i>et al.</i> (2006)

low. lob. IX	= lower lobe of abdominal segment IX
o.S.W.	= occipital setal warts
pos. lob. IX	= posterior lobe of abdominal segment IX
par.	= parameres
pre. app.	= preanal appendages
pro. spe.	= processus spermathecae
sa1, 2, 3	= setal area 1, 2, 3
spe. scl.	= spermathecal sclerites
v.l.c.S.W.	= vertexal lateroantennal compact setal warts
v.l.f.S.W.	= vertexal lateroantennal fragmented setal warts
v.m.c.S.W.	= vertexal medioantennal compact setal warts
vul. sca.	= vulvar scales

Institutional acronyms

BMNH	= Natural History Museum, London
HUST	= Huazhong University of Science and Technology, Wuhan, China
MNB	= Museum für Naturkunde, Berlin
MNHB	= Museum für Naturkunde der Humboldt-Universität, Berlin
NJAU	= Nanjing Agricultural University, Nanjing, China

Results

Class Hexapoda Blainville, 1816
 Order Trichoptera Kirby, 1813
 Suborder Integripalpia Martynov, 1924
 Superfamily Limnephioidea Kolenati, 1848
 Family Apataniidae Wallengren, 1886
 Subfamily Apataniinae Wallengren, 1886
 Tribe Apataniini Wallengren, 1886

 Genus *Apatidelia* Mosely, 1942

Apatidelia Mosely, 1942: 343 (type species: *Apatidelia martynovi* Mosely, 1942, by original designation).

Diagnosis

Adult

Body size moderately small, length about 5.0–9.0 mm; body color dark-brown. Cephalic setal warts similar to those of *Apatania*, with a pair of lateral ocelli. Fore wings transparent, with a patch of dense hairs near the apex of vein Sc; vein R with a row of close, short, black hairs from the apex to the sub-base (Mosely 1942); FI–III and FV presented in both fore and hind wings; discoidal cells in the fore wings are closed but are open in the hind wings. Spurs 1, 2, 4. Abdominal sternum V with a lateral process on each side in male, by which males are easily separated from any other genus of the tribe Apataniini. However,

due to the absence of such structures, females of the genus must be identified by a short apical vulvar lobe of sternum VIII and a roof-shaped, slightly sclerotized segment X. The vulvar lobes of sternum VIII in female *Apatania* Kolenati, 1848 are usually slender, thumb-like or slender, rectangular.

Apatidelia morsei Xu & Sun sp. nov.

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Figs 2–5

Diagnosis

Male

The new species is very similar to *A. acuminata* in male genitalia, but differs from the latter in that (1) paired internal branches are finger-like, much shorter than those of *A. acuminata*; (2) each external branch is sinuate in dorsal view with its apex acute in the new species, but is arc-shaped with the apex obtuse in *A. acuminata*; (3) each inferior appendage is stout in ventral view in *A. morsei* sp. nov., but is slender in *A. acuminata*; (4) FI is sessile in *A. morsei*, but is petiolate in *A. acuminata*. The new species can be separated from *A. martynovi* by the external branches being sinuate with the apex acute in dorsal view, as in *A. martynovi* it is arc-shaped with the apex bulging. It can easily be separated from *A. gansuensis* by the distal segments of inferior appendages, which are acute apically, but bifurcate in the latter. It differs from *A. egibiel* in the overall shape of the phallic apparatus. In addition, the new species can be separated from *A. mirabilis* by sickle-shaped external branches in lateral view, by short internal branches, and by each distal segment being about twice the length of the basal segment.

Female

The female of the new species is similar to *Apatidelia acuminata*, but differs in that (1) the lateral margin of segment IX is depressed at mid-length in lateral view, but is straight in *A. acuminata*; (2) apicodorsal sclerites of the posterior lobe of IX are close to each other in dorsal view, but widely separated in *A. acuminata*; (3) lateral lobes of IX in ventral view are somewhat elliptical, but rectangular in *A. acuminata*.

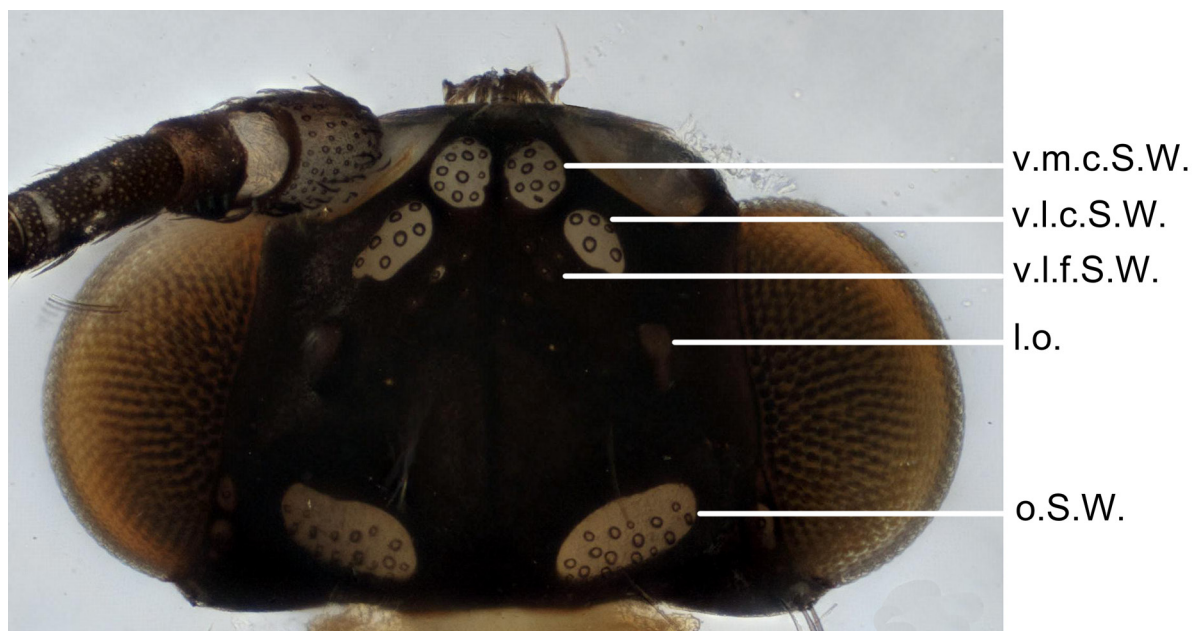


Fig. 2. *Apatidelia morsei* Xu & Sun sp. nov., in alcohol. Head (dorsal view). Scale bar = 0.5 mm.

Etymology

The species is named in honor of Dr John C. Morse from Clemson University, USA, for his contributions to the study of the world's Trichoptera.

Type material

Holotype

CHINA: ♂, Mt. Dashan, Gaohong Town, Lin'an, Zhejiang Province, 119.62° E, 30.39° N, alt. 507 m, 11 May 2015, Jihua Xu and Yue Xie leg. (NJAU).

Paratypes

CHINA: 1 ♂, 2 ♀♀, Cheshuiwu, Lin'an, Zhejiang Province, 119.45° E, 30.36° N, alt. 538 m, 21 Oct. 2015, Jihua Xu, Yue Xie, Xiangjuan Wu, Lei Zhang and Zhen Liu leg. (NJAU).

Description

Male (Figs 2–4)

BODY LENGTH. 6.5 mm. Length of fore wing: 7.5 mm.

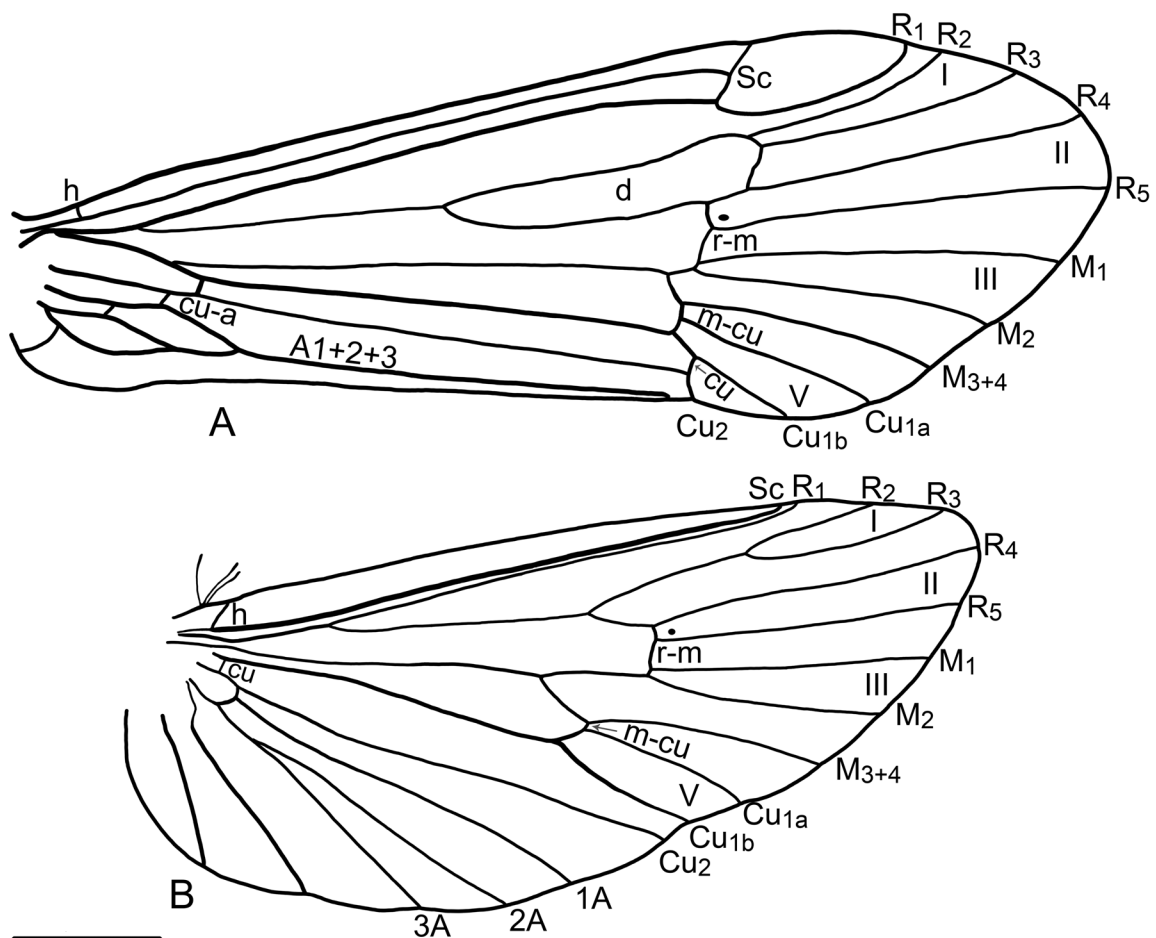


Fig. 3. *Apatidelia morsei* Xu & Sun sp. nov. **A.** Fore wing venation. **B.** Hind wing venation. Scale bar = 0.5 mm.

BODY. Head black; eyes grey, ocelli white; cephalic setal warts white; vertexal medioantennal compact setal warts irregular, length equal to width; vertexal lateroantennal compact setal warts widely separated, length greater than width; vertexal lateroantennal fragmented setal warts small, numbers varying; occipital setal warts large, elliptical (Fig. 2). Prothorax and pterothorax black, with setal warts white. Fore wings brown, with numerous hairs; venation typical of the genus described by Mosely (1942), but without crossvein *r* in each fore wing (Fig. 3A); hind wings pale, with 3 rod-like frenular setae at base of frenulum, each about 0.35 mm long (Fig. 3B). Abdomen dark brown; abdominal sternum V with a short, finger-like lateral process on each side.

MALE GENITALIA. Segment IX annular; in lateral view ventral margin more than 2 times as long as dorsal margin, anterior margins arc-shaped, posterior margins somewhat straight, with posteroventral angle produced apically (Fig. 4A). Segment X membranous. Each preanal appendages short and rod-like, setose. External branches sickle-shaped in lateral view, tapering from base to acute apex; paired internal branches thin and short dorsally, about $\frac{1}{3}$ as long as preanal appendages (Fig. 4B). Inferior appendages stout; basal segments of inferior appendages cylindrical in ventral view, each with base strongly sclerotized, bearing strong bristles; distal segments of inferior appendages lanceolar in lateral view and knife-like in ventral view, about 2 times as long as basal segments of inferior appendages, densely bristled on inner surfaces (Fig. 4C). Aedeagus in ventral view with base bulging and apex divaricate, in ventral view middle portion slightly curved upwards, distal portion swollen; paired parameres in lateral view each divided into 2 branches at middle, dorsal branches slightly sclerotized, straight, sparsely setose, ventral branches shorter than dorsal ones, strongly sclerotized, slightly curved upwards (Fig. 4D–E).

Female (Fig. 5)

BODY LENGTH. 6.0 mm. Length of each fore wing: 6.0 mm.

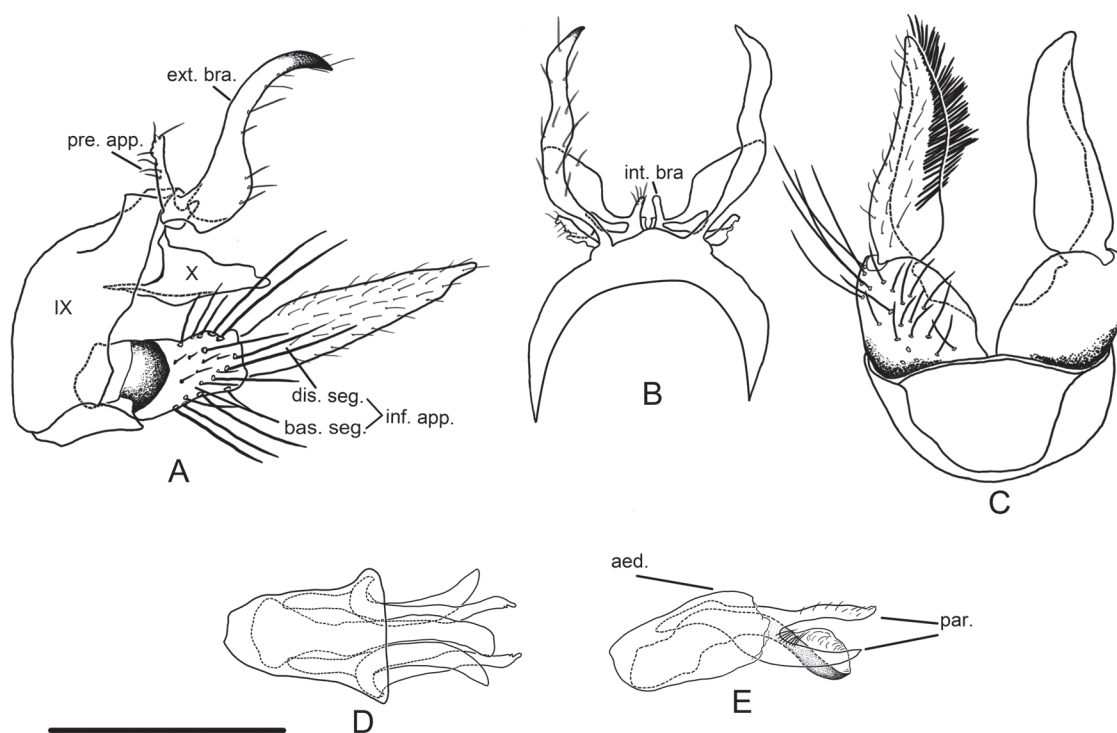


Fig. 4. Male genitalia of *Apatidelia morsei* Xu & Sun sp. nov. **A.** Lateral view. **B.** Dorsal view. **C.** Ventral view. **Aedeagus.** **D.** Dorsal view. **E.** Lateral view. Scale bar = 0.5 mm refers to all figures.

BODY. Color resembles that of male, somewhat yellowish brown. Abdominal sternum V normal, without a lateral process on each side.

FEMALE GENITALIA. Sternum of segment VIII with a short vulvar lobe, somewhat finger-like in lateral view (Fig. 5A) and triangular in ventral view (Fig. 5C). Segment IX in dorsal view triangular, posterior lobe of IX with apex shallowly incised mesally, subapically with 2 rectangular sclerites; lateral lobes of IX developed, subrectangular in lateral view and elliptical in ventral view; lower lobe of IX in lateral view semicircular, in ventral view incised deeply. Segment X visible in lateral and ventral views, slightly sclerotized, roof-shaped in lateral view, rectangular in ventral view. Processus spermathecae triangular in ventral and lateral views, paired spermathecal sclerites hook-like, connected by an arc-shaped sclerite subapically (Fig. 5B–C).

Larva

Unknown.

Distribution

China (Zhejiang).

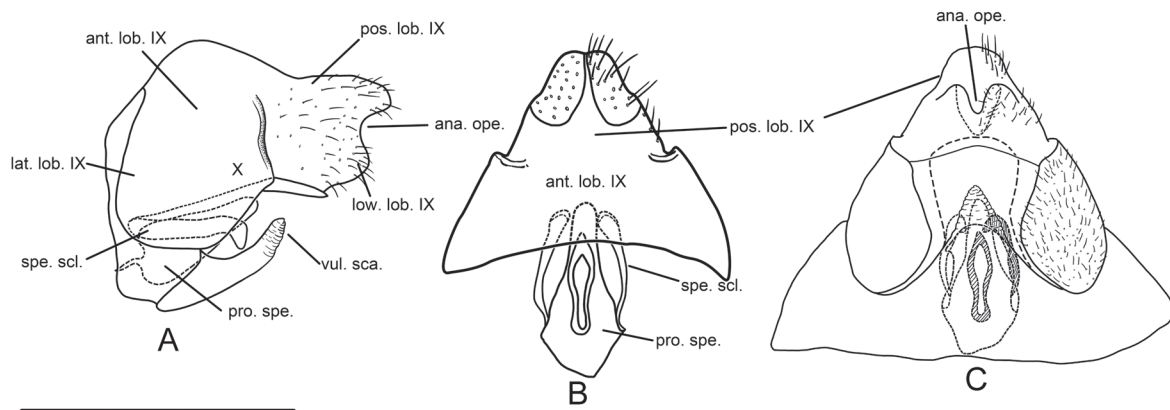


Fig. 5. Female genitalia of *Apatidelia morsei* Xu & Sun sp. nov. **A.** Lateral view. **B.** Dorsal view. **C.** Ventral view. Scale bar = 0.5 mm.

Apatidelia acuminata Leng & Yang, 1998
Figs 6–13, Table 3

Apatidelia acuminata Leng & Yang, 1998: 26, fig. 8 (males and females, deposited in NJAU).

Material examined

Holotype

CHINA: ♂, Mt. Longwang, Anji County, Zhejiang Province, alt. 360–490 m, 16–20 Oct. 1995, Beixin Wang leg. (NJAU).

Other material

CHINA: 14 ♂♂, 13 ♀♀, same collection data as holotype; 1 ♂, 1 ♀, Mt. Dashan, Gaohong Town, Lin'an, Zhejiang Province, 119.62° E, 30.39° N, alt. 507 m, 11 May 2015, Jihua Xu, Yue Xie, Xiangjuan Wu, Lei Zhang and Zhen Liu leg.; 94 larvae, Huangjiawan, Xing Town, Huzhou, Zhejiang Province, 119.88° E, 30.77° N, alt. 64 m., 12 May 2015, Jihua Xu, Siwen He and Shuzhao Gao leg. (NJAU).

Description**Male** (Fig. 6)

BODY LENGTH. 6.0 mm. Length of fore wing 7.0 mm.

BODY. Head black; eyes grey, ocelli white; cephalic setal warts white; vertexal medioantennal compact setal warts irregular, length equal to width; vertexal lateroantennal compact setal warts widely separated, length greater than width; vertexal lateroantennal fragmented setal warts small, numbers varying; occipital setal warts large, elliptical. Prothorax and pterothorax black, with setal warts white. Fore wings transparent, with numerous hairs; FI and FIII with a short petiolate; R₂ interconnect with R₃ after disc cell; base of FIII far away from joint vein r-m. Hind wings transparent and weak, each with 3 rod-like frenular setae at base of frenulum, each seta about 0.3 mm long. Sternum of segment V with a short, finger-like lateral process on each side.

MALE GENITALIA. Segment IX annular; in lateral view ventral margin about 2 times as long as dorsal margin; preanal appendages short and rod-like, lateral margins each rough, with a small stout projection near base. External branches (ext. bra.) sickle-shaped on segment X, in lateral view tapering from base to apex (Fig. 6A); paired internal branches (int. bra.) thin and long, about as long as preanal appendages, with a pair of basal processes (Fig. 6B). Inferior appendages very elongate, basal segments of inferior appendages cylindrical in lateral view, covered with 5 strong bristles and some spine-like setae; distal segments of inferior appendages each knife-like, 3 times as long as basal segments of inferior appendages, with setae on outer surfaces and densely bristled on distal half of inner surfaces (Fig. 6C). Aedeagus tubular, strongly narrowed in middle, with distal margins much broader than basal margins;

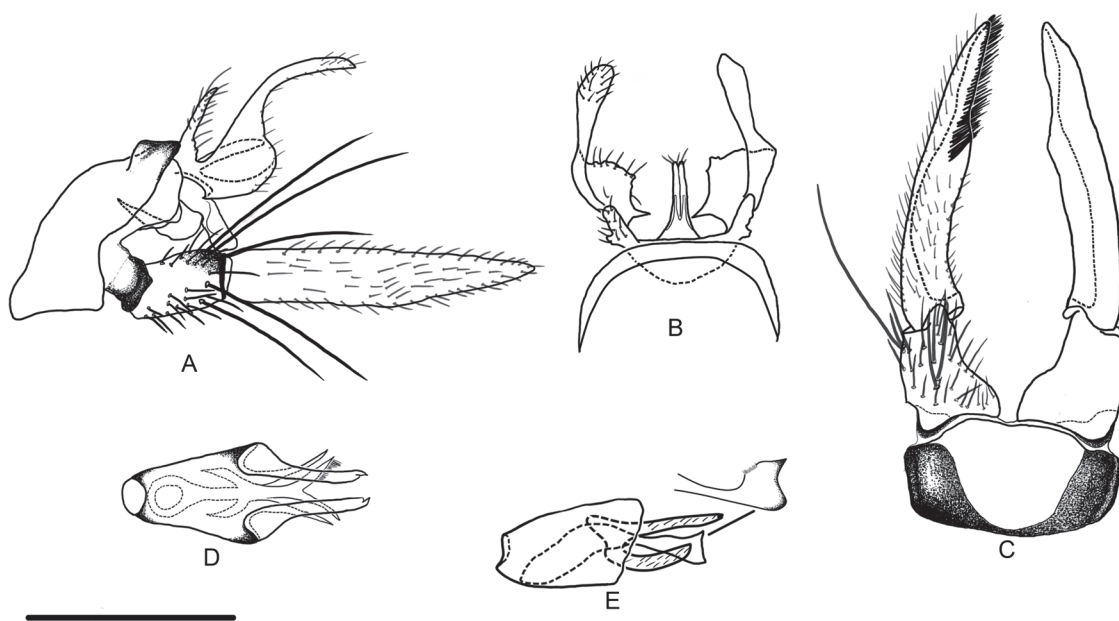


Fig. 6. Male genitalia of *Apatidelia acuminata* Leng & Yang, 1998. **A.** Lateral view. **B.** Dorsal view. **C.** Ventral view. Aedeagus. **D.** Dorsal view. **E.** Lateral view. Scale bar = 0.5 mm refers to all figures.

apex of aedeagus expanded in lateral view, with a row of hairs at anterior margin. Paired parameres each divided in 2 branches at middle; dorsal branches straight with some hairs; ventral branches shorter than dorsal ones, slightly sclerotized, curved upwards (Fig. 6D–E).

Female (Fig. 7)

BODY LENGTH. 9.0 mm. Length of each fore wing 7.5 mm. Body yellowish brown. Abdominal sternum V normal, without a lateral process on each side.

FEMALE GENITALIA. Sternum of segment VIII with a short vulvar lobe, somewhat rectangular in lateral view (Fig. 7A) and triangular in ventral view (Fig. 7C). Segment IX slightly sclerotized, smooth; posterior lobe of IX with apex shallowly incised mesally, subapically with 2 rectangular sclerites; lateral lobes of IX developed, subrectangular in lateral view and in ventral view; low. lob IX in lateral view arc-shaped, in ventral view slightly incised. Segment X visible in lateral and ventral views, slightly sclerotized, roof-shaped in lateral view, rectangular in ventral view. Processus spermathecae triangular in ventral and lateral view, paired spermathecal sclerites hook-like, connected by an arc-shaped sclerite subapically (Fig. 7B).

Final instar larva (Figs 8–13)

MEASUREMENTS. Body length 5.0–7.0 mm (Fig. 13A–C); maximum head width 0.7 mm.

HEAD. Head capsule oval in dorsal view (Fig. 9A–B), distinctly granulated with dense spinules. Overall coloration varying among individuals, from yellowish brown to dark brown, with dark brown stripes along dorsal ecdysial lines, and a transverse dark brown stripe near frontoclypeal corners; in some individuals with a transverse dark brown stripe at #14 seta; parietal with a dark brown band along lower margin on each side; along posterior margin and foramen occipitale with dark brown stripes, some individuals with subtriangular spots at postgena (Fig. 9C). Eyes each oval, black, with a paler ring. Frontoclypeal apotome somewhat omega-shaped, with anterior margin straight. Antenna lies halfway between eye and anterior head margin, cylindrical, with a dark brown ring (Fig. 9C). Ventral apotome brown, posterior margin black, somewhat triangular, length larger than width. Ventral ecdysial line (0.195 mm) less than 25% of apotome length (0.050 mm). Labrum brown, with anterior margin straight or slightly concave, and a setal brush at each anterolateral corner. Mandible scraper black, in lateral view triangular, smooth, with a long lateral seta at end of basal third; only right mandible with stiff hairs at middle of inner margin (Fig. 9D). Cardio sub-rectangular, black.

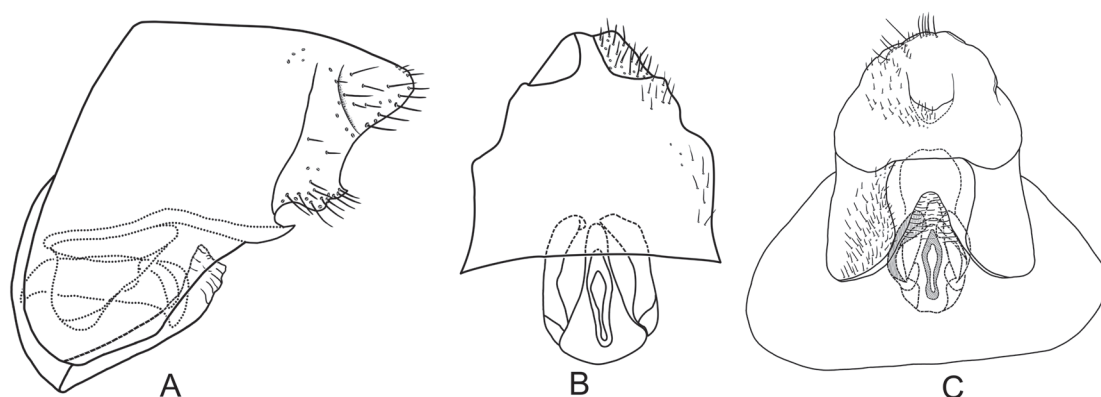


Fig. 7. Female genitalia of *Apatidelia acuminata* Leng & Yang, 1998. **A.** Lateral view. **B.** Dorsal view. **C.** Ventral view. Scale bar = 0.5 mm.

THORAX. Pronotum rectangular, light brown to dark brown, varying among individuals, but posterior ridge always black; covered with white fine hairs and also 20–34 strong setae (Fig. 10A). Mid-dorsal ecdysial line twisted; in lateral view trapezoidal, each side with a black area just above each epimeron. Propleura small: each episternum elongate rectangular, and epimeron rounded, with only one central seta; each trochantin triangular, with sharp apex (Fig. 10D). Prosternal horn present. Mesonotum consists of 2 brown sclerites, their anterior, lateral margins strongly sclerotized, posterior margin paler (Fig. 10B). Setae scattered over mesonotal surface; each sclerite with about 20–30 setae. Mesopleura larger than propleura; each episternum triangular and sclerotized, with about 12–20 setae; each epimeron consists of a triangular sclerite with 11 setae and a membranous area covered with spinules. Metanotum membranous (Fig. 10C), paired *sa1* combined into a large trapezoidal area, with a row of 12–20 setae; *sa2* with a long black seta and 2 short setae; each *sa3* sclerotized, with about 9–12 setae. Metapleura equal to mesopleura in size (Fig. 10E), each episternum triangular and sclerotized, with about 17–20 setae, each epimeron consists of a membranous upper portion and a lower sclerotized portion with about 14–21 setae.

LEGS. Yellowish to light brown (Fig. 11A–C). Fore legs shorter and smaller than mid- and hind legs. Coxae cylindrical, with middle portion slightly bulging, basal and apical margins slightly edged. Trochanters triangular and 2-segmented, basal segment triangular and shorter than triangular apical segment; trochanteral brush present in fore legs, with about 7–10 hairs. Femora as long as coxae, cylindrical, upper and lower margins with hairs. Each tibia and tarsus slender. Tarsus claw curved upwards, with sharp apex, basal seta present.

ABDOMEN. Segment I with 1 fleshy hump dorsally and ventrally and 2 lateral fleshy humps (Fig. 12A–C); setal areas *sa1* distinctly separated by dorsal hump, each with about 8 setae; *sa2* absent; *sa3* with 2 setae; on abdominal sternum I *sa1* fused, creating continuous band of more than 30 setae, *sa3* with 1 seta. Dorsal surface of segments II–VII each with a pair of setae laterally. Venter of segments I–IX each with a pair of setae separated by chloride epithelia. Dorsum of segment VIII with 4–6 setae. Dorsum of segment IX with a median brown arc-shaped sclerite (Fig. 12D); posterior margin of dorsal sclerite

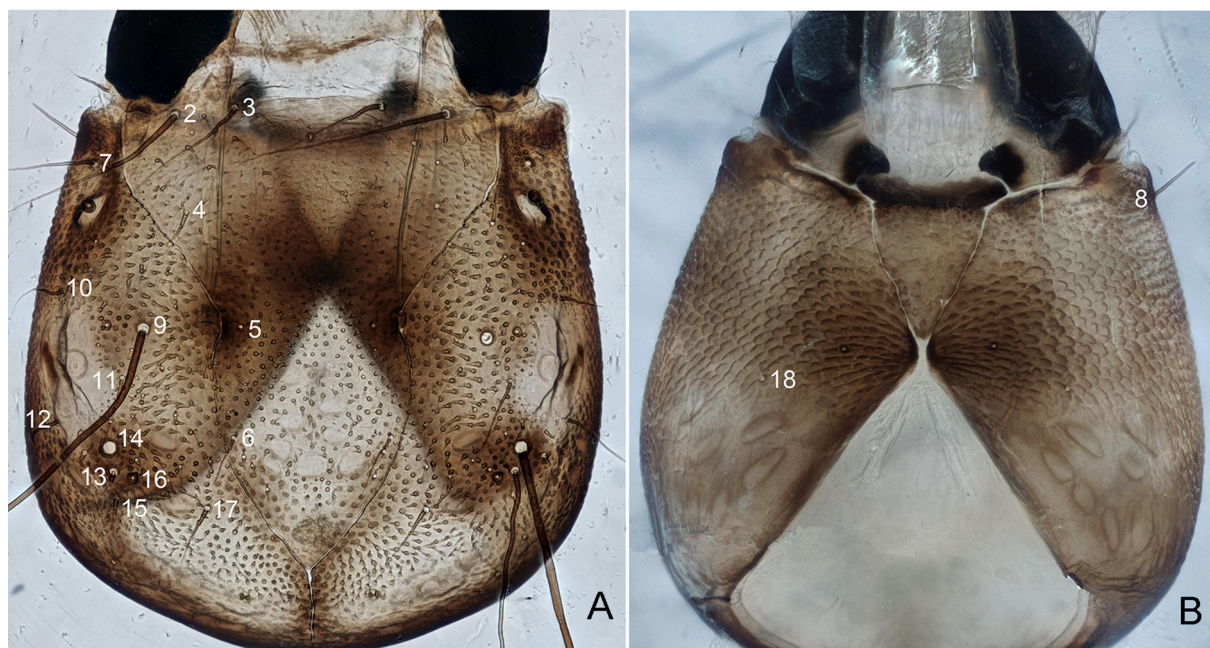


Fig. 8. Head setae of *Apatidelia acuminata* Leng & Yang, 1998, larva. **A.** Dorsal view. **B.** Ventral view. Scale bar = 0.5 mm.

with more than 30 setae; dorsum each with a seta separated by sclerite (Table 3). Lateral sclerites of segment X rectangular in dorsal view, with 8–10 hairs, and 5 spines near posterior margin; ventral sole plate triangular; anal claws brown, without accessory hook. Lateral fringe from mid-segment II to VII. Chloride epithelia present on segment II–VII, those of segment III largest, those of segment IV second largest and others almost equal in size.

CASE. Cases of 5th instar larvae 5.5–7.5 mm long (n=7), slightly dorsoventrally curved, tapering posteriorly, consisting of coarse mineral fragments, sometimes mixed with much larger particles which are mostly attached laterally (Fig. 13D).

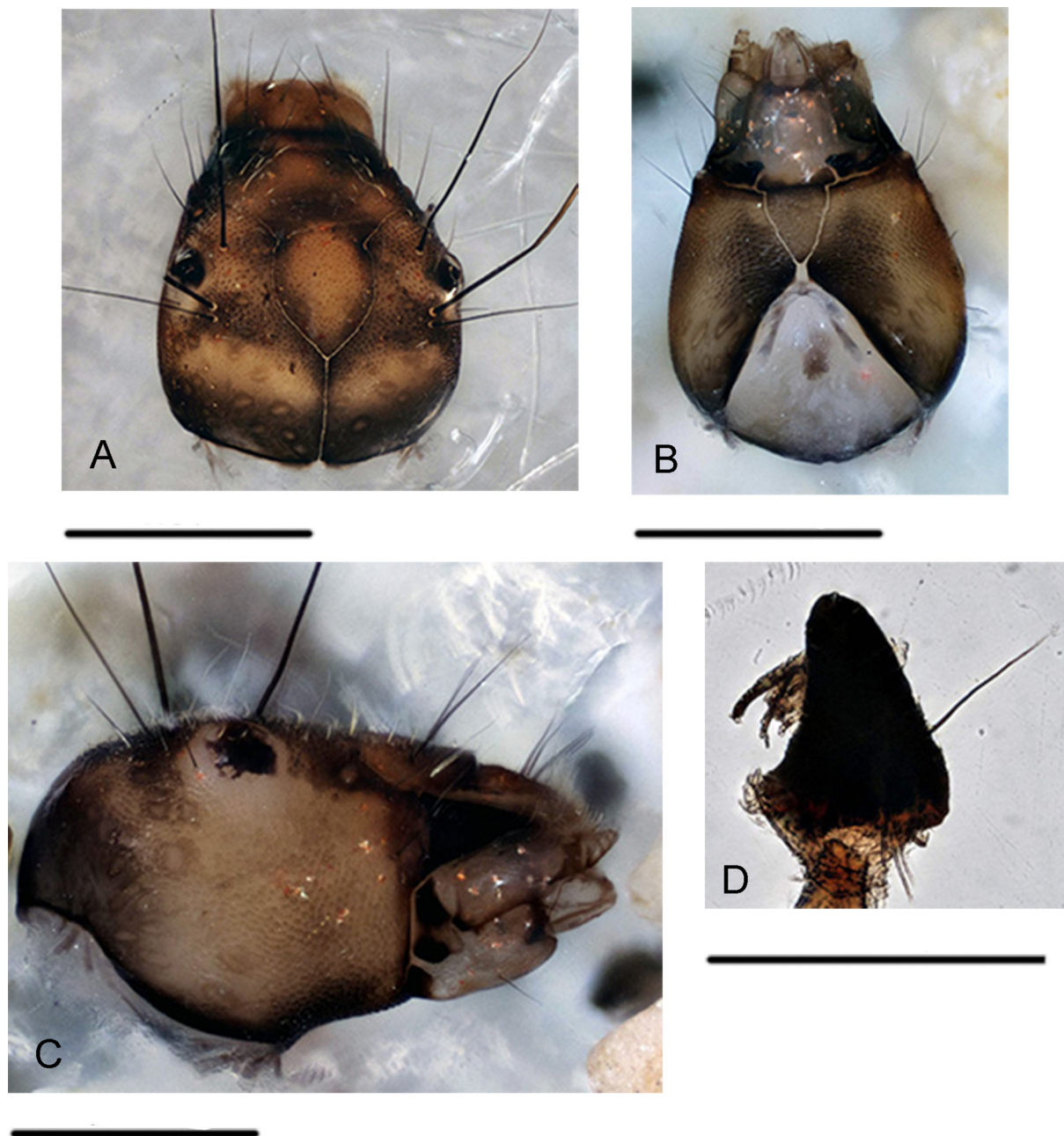


Fig. 9. Head of *Apatidelia acuminata* Leng & Yang, 1998, larva. **A.** Dorsal view. **B.** Ventral view. **C.** Lateral view. **D.** Right mandible (lateral view). Scale bars: A–C = 0.5 mm; D = 0.25 mm.

Distribution

China (Zhejiang).

Discussion

The tribe Apataniini Wallengren, 1886 comprises four extant genera and one fossil genus so far. Mey (1991) discussed the relationships among the four extant genera. *Apataniana* Mosely, 1936 and *Talgara* Mey, 1991 were considered as sister taxa, as were *Apatania* and *Apatidelia*.

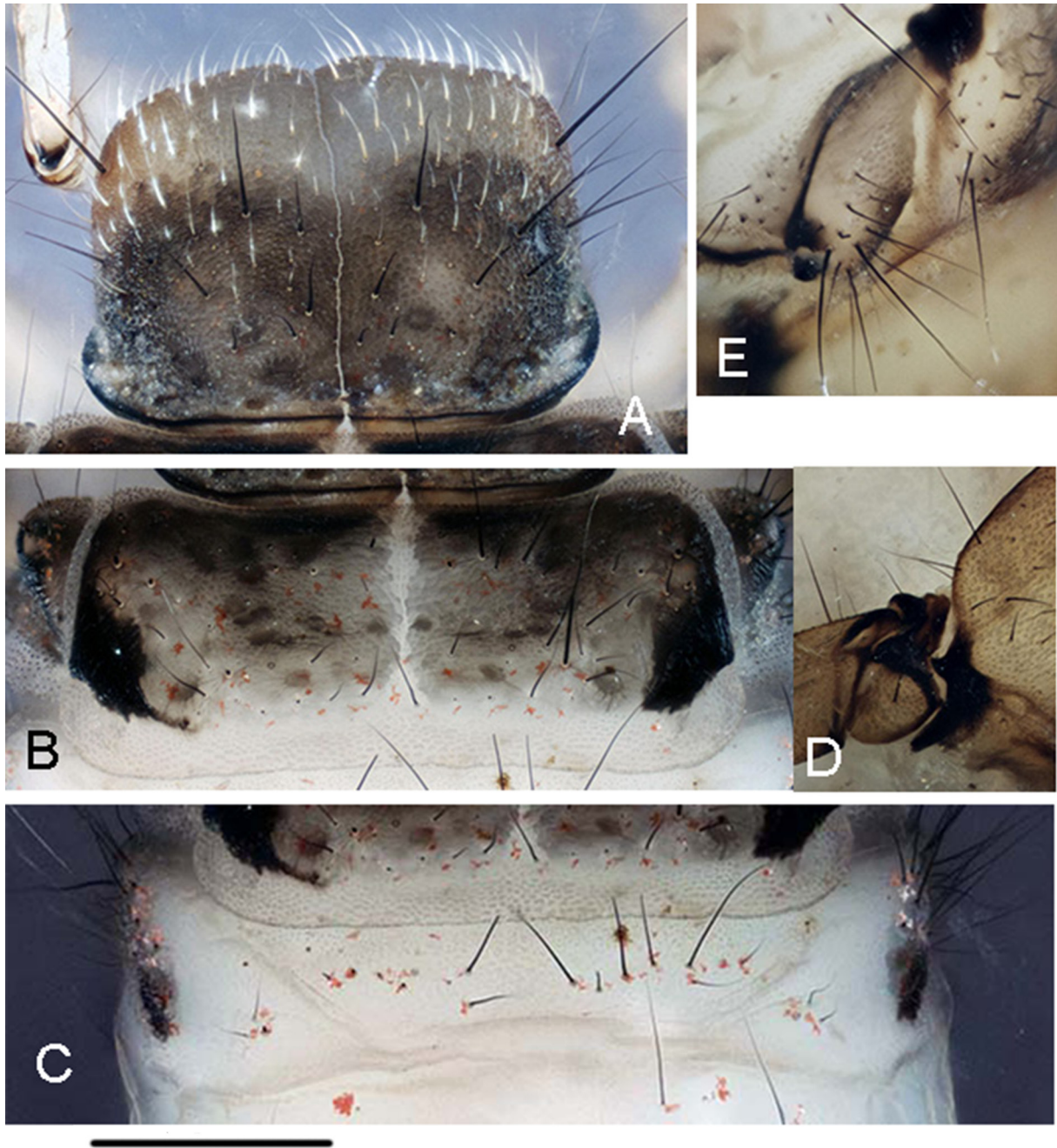


Fig. 10. Thorax of *Apatidelia acuminata* Leng & Yang, 1998, larva. **A.** Pronotum (dorsal view). **B.** Mesonotum (dorsal view). **C.** Metanotum (dorsal view). **D.** Foretrochantin (lateral view). **E.** Mesopleura (lateral view). Scale bar = 0.5 mm.

Table 3. Number of single tracheal gills, setae and chloride epithelia on abdominal segments I–IX (Y: character present; –: character absent).

	No. of gills		No. of setae		Chloride epithelia
	Dorsal Anterior/posterior	Ventral Anterior/posterior	Dorsal	Ventral	Only venter
I	0/1	0/0	≥ 10	≥ 30	–
II	2/1	0/1	2	2	Y
III	2/1	0/1	2	2	Y
IV	0/1	0/1	2	2	Y
V	0/0	0/1	2	2	Y
VI	0/0	0/1	2	2	Y
VII	–	–	2	2	Y
VIII	–	–	4–6	2	Y
IX	–	–	≥ 30	2	Y

Adults of *Apatidelia* are nearly identical to those of *Apatania* morphologically, especially in body size and cephalic and thoracic setal warts. Although they show some tiny variations in fore and hind wing venation, males of the two genera can easily be separated by the presence of a lateral process on each side of sternum V in *Apatidelia* that is absent from *Apatania* (Mosely 1942). Male genitalia structures can also help to diagnose the two genera, but it is difficult to distinguish females of the two genera, except by molecular methods, because they resemble each other in genitalia and in lacking the lateral processes on each side of segment V. We compared the females of *Apatidelia morsei* Xu & Sun sp. nov. and *Apatidelia acuminata* with those of *Apatania* from the eastern Palearctic region (Chuluunbat 2008) and Europe (Malicky 2004). The vulvar scale of sternum VIII is short and triangular, wider than long within females of *Apatidelia* (Figs 5C, 7C), whereas it is longer than wide, usually slender, thumb-like or elongate rectangular in most of the females of *Apatania*, such as *Apatania mongolica* Martynov, 1914 from the East Palearctic Region, *Apatania zonella* (Zetterstedt, 1840) from the Palearctic and Nearctic Regions and *Apatania devisaraspali* Schmid, 1968 from the Oriental Region. In *Apatania crymophila* McLachlan, 1880, from the Palearctic and Nearctic Regions, the vulvar scale of sternum VIII is shorter than in other females and somewhat subrectangular, but it is obviously longer than wide. It seems that females of *Apatidelia* are characterized by the short and triangular vulvar scale of sternum VIII, but more studies on females of the two genera are needed to ascertain the diagnostic characters for female *Apatidelia*.

We compared larvae of *Apatidelia acuminata* with those of *Apatania incerta* (Banks, 1897) (described as *Apatania praevolans* (Morse, 1971) in Chen (1992)), *A. arizona* Wiggins, 1973 (described in Wiggins 1977), *A. helvetica* Schmid, 1954 (described in Waringer *et al.* 2015), *A. wallengreni* McLachlan, 1871, *A. subtilis* Martynov, 1909, *A. crymophila* McLachlan, 1880, *A. stigmatella* (Zetterstedt, 1840), *A. zonella* (Zetterstedt, 1840), *A. majuscula* McLachlan, 1872, *A. copiosa* (McLachlan, 1875), *A. muliebris* McLachlan, 1866 and *A. auricula* (Forsslund, 1930) (all described in Lepneva 1966). The diagnostic characters for *Apatidelia acuminata* may be the combination of the following: (1) labrum with anterior margin straight or only slightly concave (strongly incised in larvae of *Apatania*); (2) lateral margin of the mandible with strong seta at the terminal end of the basal third (with two strong setae at the very base in larvae of *Apatania*); (3) each *sa*₂ of metanotum consists of a long black seta and two short setae (as in

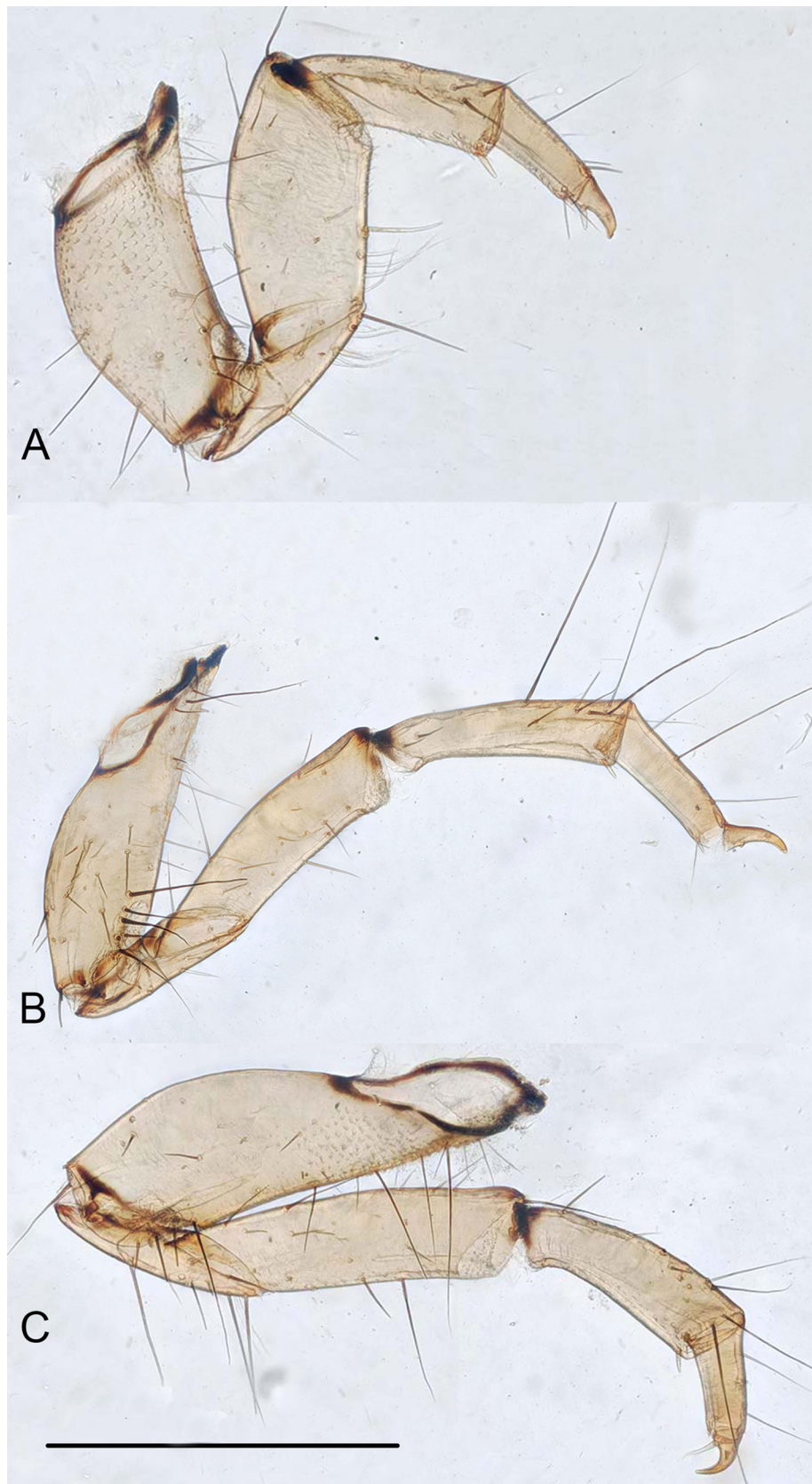


Fig. 11. Legs of *Apatidelia acuminata* Leng & Yang, 1998, larva. **A.** Foreleg (posterior face). **B.** Mid-leg (posterior face). **C.** Hind leg (posterior face). Scale bar = 0.5 mm.

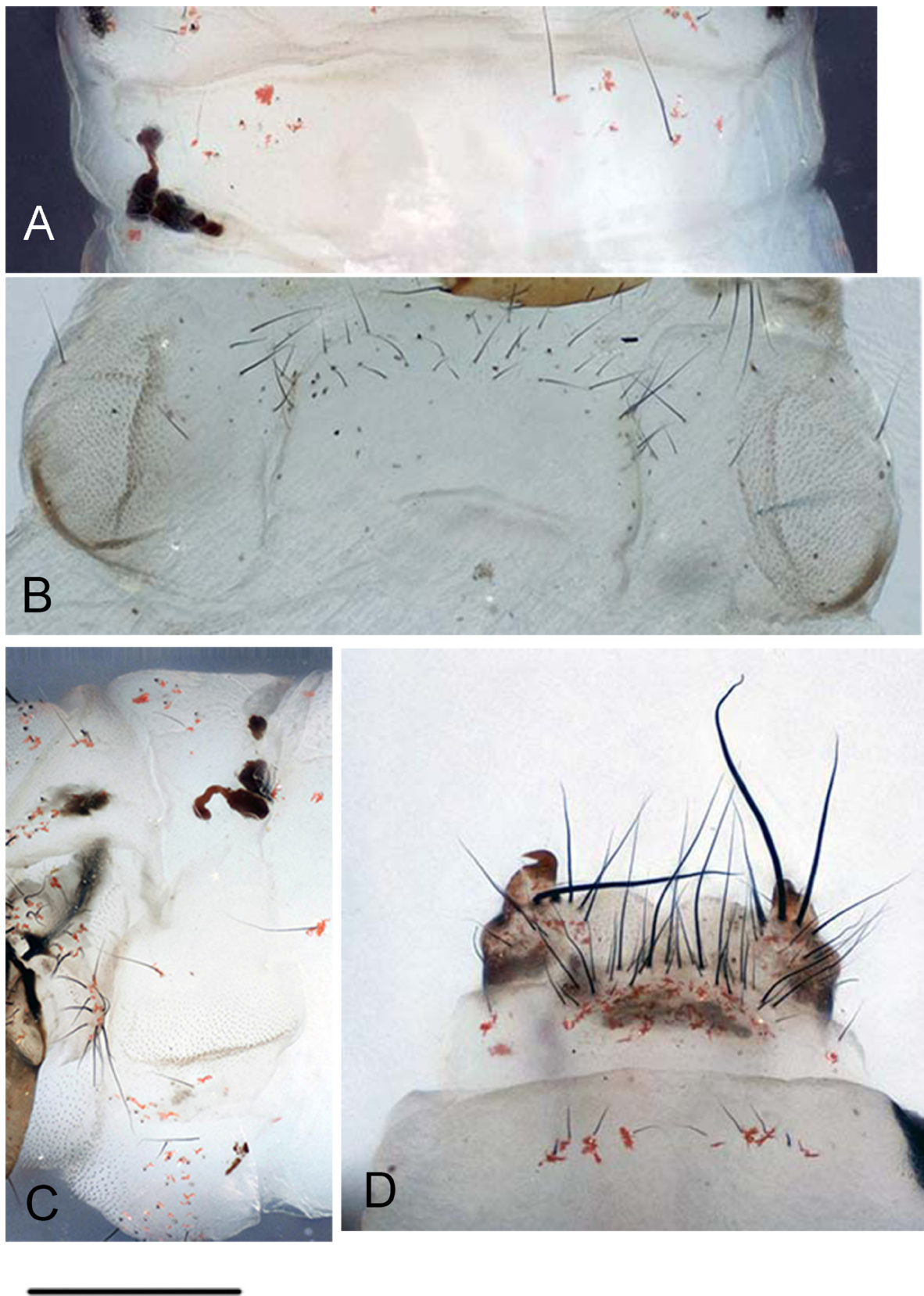


Fig. 12. Abdomen of *Apatidelia acuminata* Leng & Yang, 1998, larva. **A–C.** Segment I. **A.** Dorsal view. **B.** Ventral view. **C.** Lateral view. **D.** Segments IX–X and anal claw (dorsal view). Scale bar = 0.5 mm.

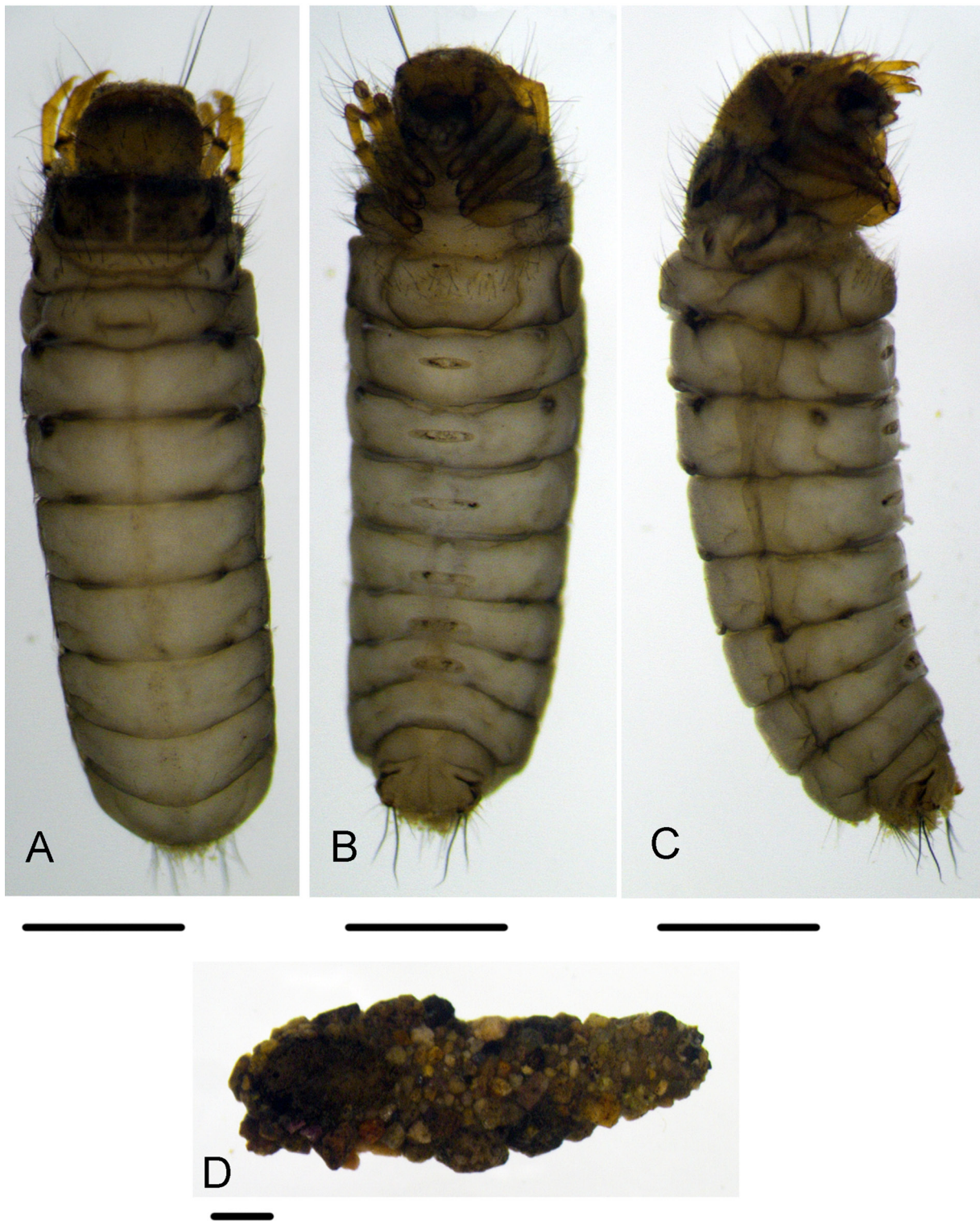


Fig. 13. Habitus of *Apatidelia acuminata* Leng & Yang, 1998, larva. **A.** Dorsal view. **B.** Ventral view. **C.** Lateral view. **D.** Case (ventral view). Scale bars = 1.0 mm.

Apatania incerta, but each with a tuft of more than eight setae in *A. arizona* and *A. helvetica*); (4) each *sa1* on abdominal tergum I is distinctly separated by the dorsal hump, each area with about eight setae (more than 20 setae in *Apatania arizona* and *A. helvetica*); (5) *sa3* on abdominal sternum I with only one seta on each side (with more than 10 setae in *Apatania arizona* and *A. helvetica*). We did not summarize the traits characterizing the larval stages of *Apatidelia*, because the larval stage of *Apatidelia acuminata* we report in this paper is the only larva known for the genus; as for females of *Apatidelia*, more studies are needed.

Geographically, of four extant genera of the tribe Apataniini, the monospecific *Talgara* Mey, 1991 was reported from Kazakhstan (western Tianshan Mountains, Mey 1991), *Apatania* is Holarctic in distribution, *Apataniana* is widespread in both the Palearctic and Oriental regions, whereas the known species of *Apatidelia* are all from China, distributed in Tibet, and in the Gansu, Qinghai (Palearctic China), Sichuan, Fujian, Zhejiang (Yang *et al.* 2016) and Hubei (Qiu personal communication) Provinces (Oriental China). The distribution of *Apatidelia* is highly overlapping with that of *Apatania*, but the genus is absent from Yunnan, Xinjiang, Beijing and Taiwan. More samples are needed to demonstrate the real distribution pattern of *Apatidelia*.

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