EUROPEAN JOURNAL OF ENTOMOLOGY
ISSN (online): 1802-8829
http://www.eje.cz
Eur. J. Entomol. **121**: 146–172, 2024
doi: 10.14411/eje.2024.017
ORIGINAL ARTICLE

A taxonomic review of *Ptilomera* from China, with descriptions of two new species (Hemiptera: Heteroptera: Gerridae)

Zhaoqi LENG, Beichen ZHANG and Zhen YE*

Institute of Entomology, College of Life Sciences, Nankai University, Tianjin, 300071, China;
e-mails: zhaoqileng0712@gmail.com, 2111284@mail.nankai.edu.cn, yezhen1987331@nankai.edu.cn

Key words. Gerromorpha, morphology, key, distribution, Ptilomerinae, water strider, Yunnan

Abstract. The species of *Ptilomera* Amyot & Serville, 1843 from China are reviewed. Two new species, *Ptilomera acutidentata* sp. n. and *Ptilomera valida* sp. n., are described from Yunnan, China. Diagnoses and new distribution records are provided for four previously recorded species, i.e., *Ptilomera burmana* D. Polhemus, 2001, *Ptilomera hemmingseni* Andersen, 1967, *Ptilomera hylactor* Breddin, 1903, and *Ptilomera tigrina* Uhler, 1860. Photographs and line drawings of the habitus, diagnostic characteristics of both sexes, habitat and in-situ photographs are presented. A distribution map of *Ptilomera* in China is also provided.

ZooBank Article Registration: https://zoobank.org/urn:lsid:zoobank.org:pub:CF35ECAE-EE40-4A3A-ACF5-FE6EB085FE0D

INTRODUCTION

The gerrid subfamily Ptilomerinae Bianchi, 1896 consists of 16 genera with over 120 extant species (Chen et al., 2005; Polhemus & Polhemus, 2008; Zettel, 2009; Jehamalar et al., 2014, 2018; Raruanysong et al., 2014; Leng et al., 2023), usually inhabiting waterways, such as fast-flowing streams and rivers. To adapt to this environment, all Ptilomerinae species are equipped with a row of short, dense setae on their middle tibiae, providing them with a greater impetus when striding against the flowing water.

Ptilomera Amyot & Serville, 1843, the type genus of Ptilomerinae, is the largest genus in the subfamily, comprising 59 known species with a widespread distribution from Sri Lanka to New Guinea and adjacent islands (Hungerford & Matsuda, 1965; Andersen, 1967; Zettel & Chen, 1996; Polhemus, 2001, 2017; Polhemus & Polhemus, 2001; Vitheepradit & Sites, 2007; Gupta & Chaturvedi, 2008; Cheng et al., 2006; Raruanysong et al., 2014; Jehamalar et al., 2018). On the Southeast Asian mainland, nine species have been recorded (Hungerford & Matsuda, 1965; Andersen, 1967; Zettel & Chen, 1996; Polhemus, 2001; Vitheepradit & Sites, 2007). In China, there were five species recorded prior to this study, mostly distributed in the southern area of the country (including Hainan Island), which is also the northeastern-most edge of its range (Hungerford & Matsuda, 1965; Cheng et al., 2006).

Based on specimens collected in recent years, the present paper provides a taxonomic review of *Ptilomera* in China. Here we describe two new species – *P. acutidentata* sp. n. and *P. valida* sp. n. – and provide details and photographs of diagnostic characters for all known species (except *P. assamensis* Hungerford & Matsuda, 1965). We also provide a key, new distribution data, in-situ photographs, and a distribution map for *Ptilomera* species that occur in China.

MATERIAL AND METHODS

All measurements are given in millimeters (mm), and represent the average values of the measurements taken from the type specimens. Measurements, observations, and dissections were made using a Zeiss Discovery V8 stereo microscope. Male genitalia were macerated in cold 5% potassium hydroxide solution (KOH) at room temperature. Photographs of male genitalic structures (pygophore, paramere, and proctiger) were taken with a Canon 90D equipped with a macro lens. All other photographs except male genitalic structures were taken with a Nikon D500 camera equipped with a macro lens and a telephoto lens. The map was prepared using ArcMap ver. 10.8 software. Morphological terminology largely follows Hungerford & Matsuda (1965) and Chen (2005), as is shown in Figs 1 and 6.

Dried and alcohol-preserved specimens examined in this study were deposited in the following museums and collections: IZAS – Institute of Zoology, Chinese Academy of Sciences, Beijing, China; NKUM – Institute of Entomology, College of Life Sciences, Nankai University, Tianjin, China.

* Corresponding author; e-mail: yezhen1987331@nankai.edu.cn

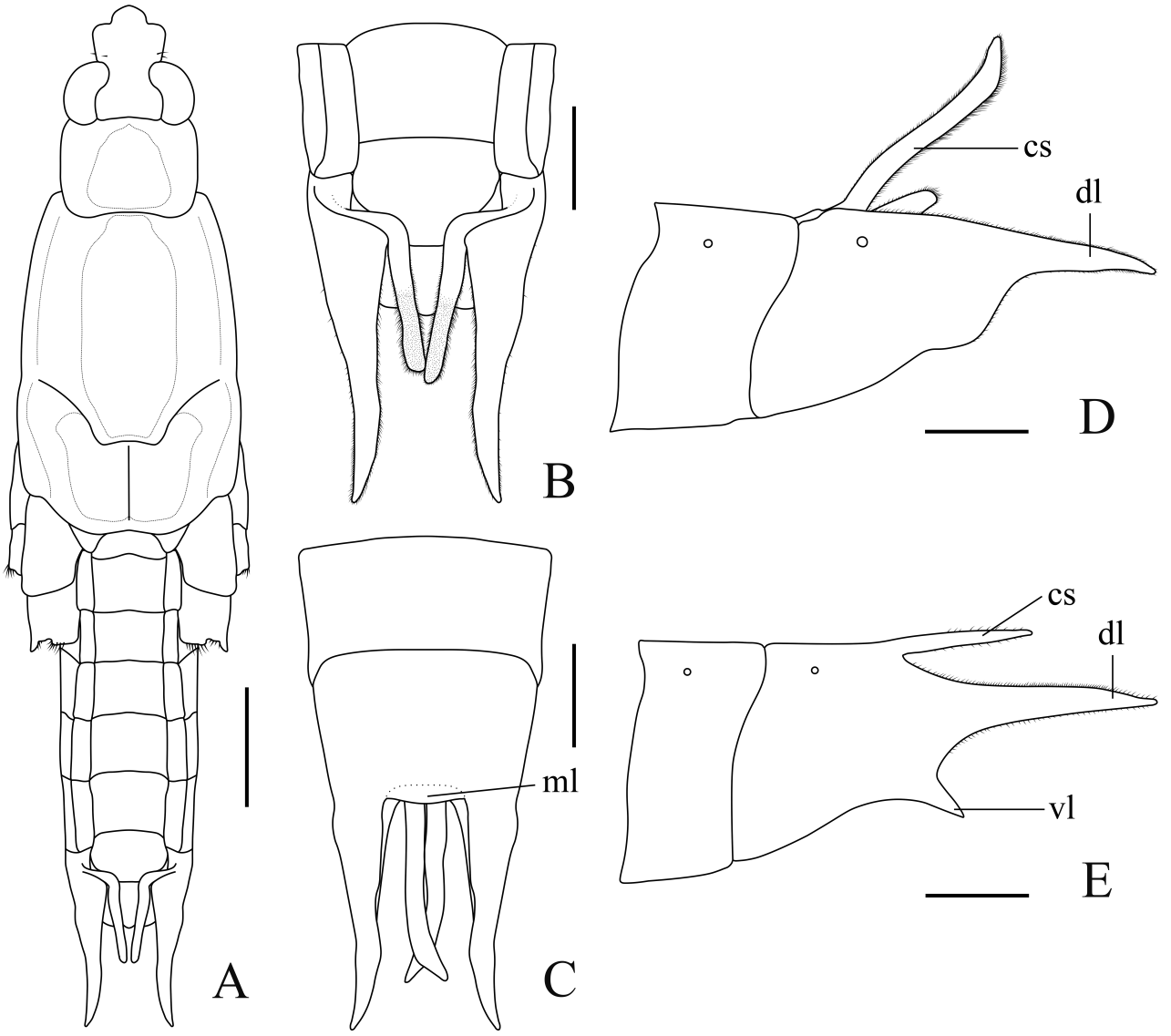

Fig. 1. Morphological features of *Ptilomera* spp., apterous female. A–D – *P. acutidentata* sp. n.: A – body in dorsal view; B – abdominal end, dorsal view; C – abdominal end, ventral view; D – abdominal end, lateral view; E – *P. hylactor*, abdominal end, lateral view. cs – connexival spine, dl – dorsolateral lobe, vl – ventrolateral lobe, ml – median ventral lobe. Scale bars: A = 2 mm; B–E = 1 mm.

Genus *Ptilomera* Amyot & Serville, 1843

(Figs 1–23)

Ptilomera Amyot & Serville, 1843: 413 (type species by monotypy: *Gerris laticaudata* Hardwicke, 1825, Nepal).

Diagnosis. Body relatively large, abdomen elongate (Figs 1A, 2). Antennal tubercles pronounced, angularly produced in dorsal view; antennal segment I longer than segments II–IV combined, segment II shorter than segment III (Fig. 2). Pronotum, mesonotum, and metanotum with median brownish-yellow marks (Fig. 3); mesonotum without tubercle (Figs 3–4). Hind coxa with apical spine in both sexes (Fig. 3). In females, connexival segment VI without process, with spines and processes on connexival segment VII and laterosternite VII (Figs 3–5); mediosternite VII commonly with a median lobe (Figs 1C, 5). In males, genital segment relatively long (Fig. 6A–C); apical half of middle femur with dense, erect setae (Fig. 7); abdominal segment VIII with large median ventroapical carina, dorsal side with pair of longitudinal elongate sublateral setal patches, which surround spiracle VIII (Fig. 8); pygophore with pointed or blunt lateral processes (Fig. 9), sometimes nearly absent (Fig. 9C, D); proctiger with wings laterally, and a median process on posterior margin (Fig. 10); paramere strongly developed, subapically with long black setae, extending out of the proctiger, usually visible in dorsal view (Fig. 11) (Hungerford & Matsuda, 1965; Chen et al., 2005).

Key to species of *Ptilomera* of China

Note: *Ptilomera assamensis* Hungerford & Matsuda, 1965 was included on literature data (male characters only, no female differences could be found). Its presence in China requires verification (see Discussion).

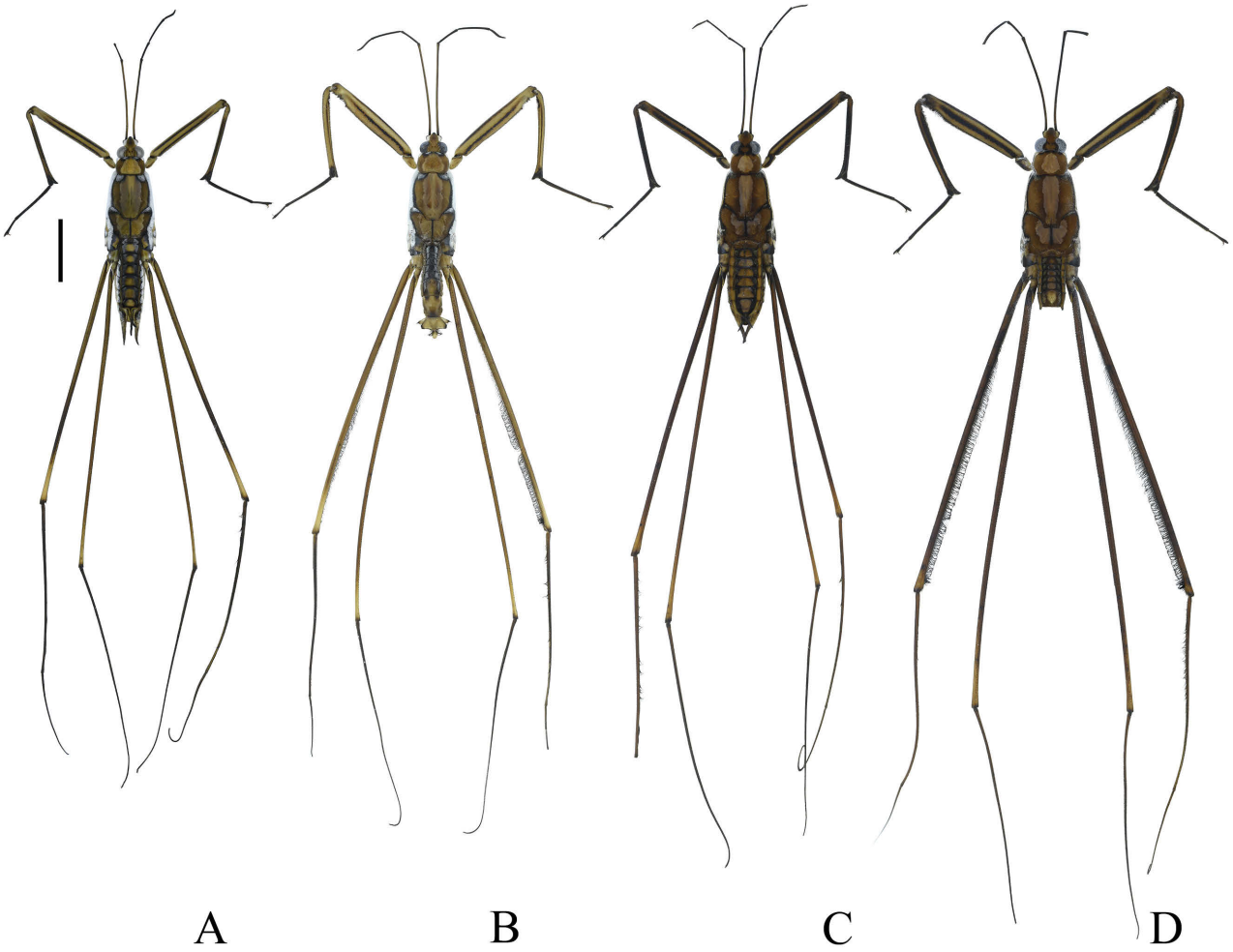

Fig. 2. A, B – habitus of *Ptilomera acutidentata* sp. n. in dorsal view: A – paratype, apterous female; B – holotype, apterous male; C, D – habitus of *Ptilomera valida* sp. n. in dorsal view: C – holotype, apterous female; D – paratype, excluding genitalia segments, apterous male. Scale bar = 5 mm.

1 Female: connexival spines arising from the median part of connexival segment VII, abdominal segment VII without ventrolateral lobe (Fig. 4C, D). Male: middle trochanter with few tiny spines (Fig. 7C–E); lateral projection of pygophore blunt, nearly absent (Fig. 9C, D); lateral wings of proctiger not expanded to a subtrapezoidal shape, median lobe of proctiger elongate (Fig. 10C, D); paramere with relatively short and sparse setae and is not strongly curved nor with distinct process apically (Fig. 11C, D) 2

– Female: connexival spines arising from the median part of connexival segment VII, abdominal segment VII with a distinct ventrolateral lobe (Fig. 4E, F); or connexival spines arising from the anterior margin of connexival segment VII, abdominal segment VII without a distinct ventrolateral lobe (Fig. 4A, B). Male: middle trochanter with many tiny spines (Fig. 7A, B, F, G); lateral projection of pygophore angular, elongate and well developed (Fig. 9A, B, E, F); lateral wings of proctiger expanded to a subtrapezoidal shape, median lobe of proctiger short (Fig. 10A, B, E, F); paramere with relatively long and dense setae and is strongly curved or with a distinct process apically (Fig. 11A, B, E, F)..... 3

2 Both sexes: abdominal mediotergite I with dense dark-brownish setae (Figs 12A, B, 13B, 14B). Female: abdominal segment VII relatively long (Fig. 4C), dorsolateral lobe relatively long and robust, directed upwards (Fig. 13F). Male: lateral wings of proctiger blunt, directed laterad, anterior part of proctiger elongated (Fig. 10C); paramere strongly curved on the basal and middle part (Fig. 11C)..... *Ptilomera valida* sp. n.

– Both sexes: abdominal mediotergite I with sparse dark-brownish setae or without dark-brownish setae (Fig. 12C, E, F). Female: abdominal segment VII relatively short, dorsolateral lobe relatively short and slender, directed downwards (Fig. 4D). Male: lateral wings of proctiger blunt, directed downwards, anterior part of proctiger not elongated (Fig. 10D); paramere moderately curved on the basal and middle part (Fig. 11D) ..... *Ptilomera hemmingseni*

3 Female: connexival spines arising from the median part of connexival segment VII (Fig. 4E, F). Male: lateral projection of pygophore sharp apically (Fig 9E, F)..... 4

– Female: connexival spines arising from the anterior margin of connexival segment VII (Fig. 4A, B). Male: lateral projection of pygophore blunt apically (Fig. 9A, B; also see Fig. 2C in Jehamalar et al., 2018)..... 5

4 Female: dorsolateral lobe relatively long; ventrolateral lobe sharply angular (Figs 1E, 4E), not covering the median ventral lobe nor converging inwards in ventral view (Fig. 5E). Male: middle femur relatively long, with long, dense, blackish setae on the distal 2/3 (Fig. 7F); pygophore without distinct longitudinal ridge ventrally, lateral projections with dis-

tinct group of blackish setae apically (Fig. 9E); abdominal segment VIII relatively long (Figs 16B, 17A); lateral wings of proctiger not surpassing the median lobe caudally (Fig. 10E); paramere relatively short (Fig. 11E) ..... *Ptilomera hylactor*

– Female: dorsolateral lobe relatively short; ventrolateral lobe expanded and without sharp angle (Fig. 4F), partly covering the median ventral lobe in ventral view, converging inwards (Fig. 5F). Male: middle femur relatively short, with long, dense, blackish setae on the distal ½ (Fig. 7G); pygophore with distinct longitudinal ridge ventrally, lateral projections without distinct group of blackish setae apically (Fig. 9F); abdominal segment VIII relatively short (Fig. 17C); lateral wings of proctiger distinctly surpassing the median lobe caudally (Fig. 10F); paramere relatively long (Fig. 11F)..... *Ptilomera tigrina*

5 Male: lateral projection of pygophore without dense black setae, paramere without a distinct process (see Fig. 2J in Jehamalar et al., 2018) ..... *Ptilomera assamensis*

– Male: lateral projection of pygophore with dense black setae, paramere with a distinct process (Fig. 11A, B) 6

6 Male: the process on paramere with a relatively sharp apical angle, less than 90°; width of the paramere nearly equal from basal part to distal process (Fig. 11A) ..... *Ptilomera acutidentata* sp. n.

– Male: the process on paramere forming a relatively blunt arc not less than 90°; width of the paramere narrowed at the base of distal process (Fig. 11B)..... *Ptilomera burmana*

Ptilomera acutidentata sp. n.

(Figs 1A–D, 2A, B, 3A, B, 4A, 5A, 6, 7A, 8A, B, 9A, 10A, 11A)

ZooBank taxon LSID:
DFC28DCA-8467-47F6-A228-C34B113C3FE7

Diagnosis. Body length of female 13.91–15.25, of male 14.32–15.99. In both sexes, the black stripe on the mesopleuron not bifurcated (Fig. 4A). In females, abdominal segment VII elongated, nearly as long as the three preceding segments combined (Fig. 4A); connexival spines arising from the anterior margin of connexival segment VII, the transverse bases of the connexival spines hidden beneath infolded dorsal margins of the dorsolateral lobes of abdominal segment VII on either side, apical half directed upwards; dorsolateral lobe elongated; ventrolateral lobe not distinct, showing a blunt curve (Fig. 1D). In males, middle trochanter with many dense tiny spines, middle femur with dense, blackish, elongate setae on the distal half (Fig. 7A); pygophore large, front and posterior margins of the lateral projections relatively parallel, mostly exposed in dorsal view, distal part of the lateral projections with group of blackish setae (Figs 6C, 9A); paramere relatively long and simply curved, with a distinct process on the sub-apical part, and bearing relatively long and dense setae on the apical part (Figs 6E, 11A).

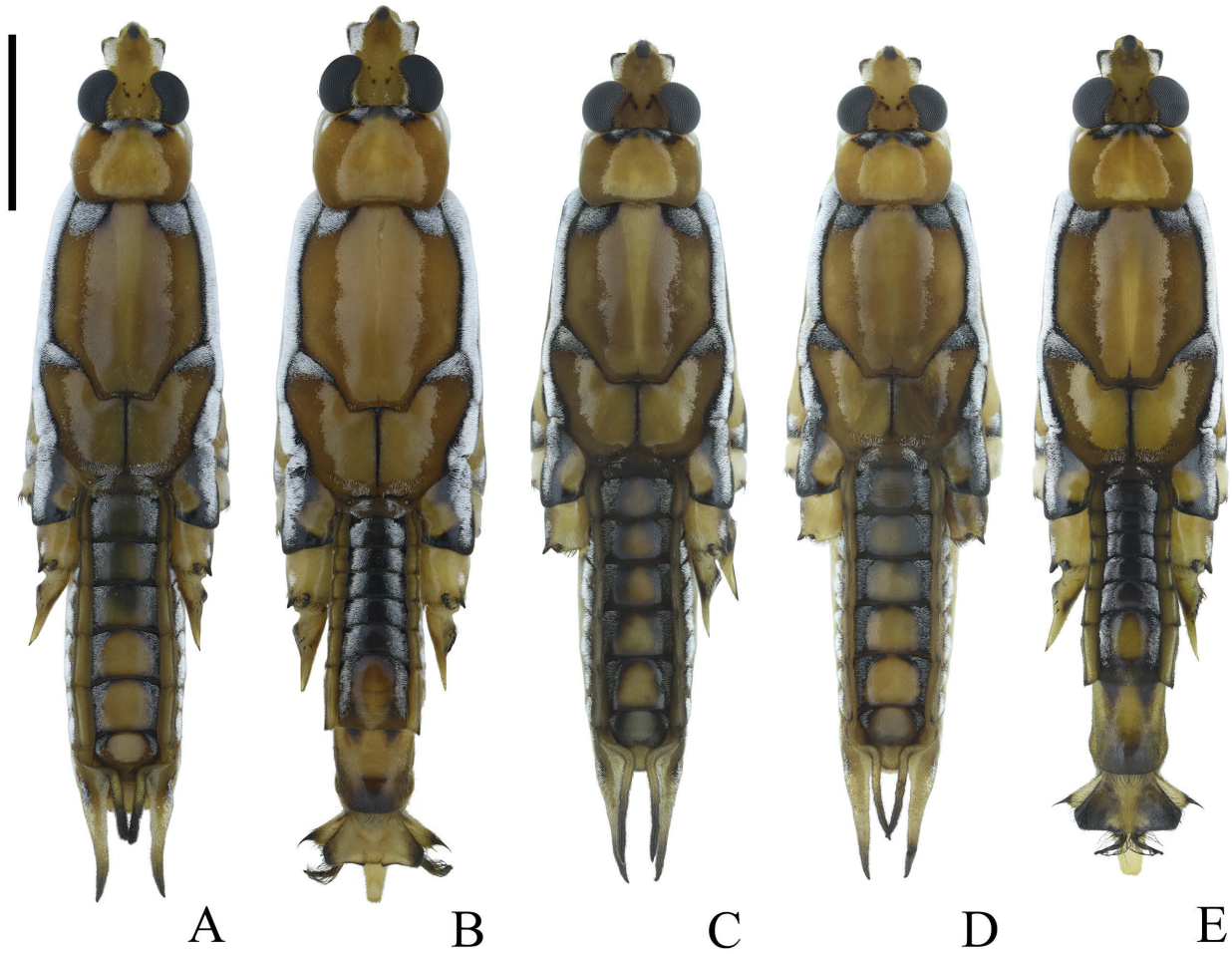

Fig. 3. Photographs of bodies of *Ptilomera* spp. in dorsal view. A, B – *P. acutidentata* sp. n.: A – paratype, apterous female; B – holotype, apterous male; C–E – *P. burmana*: C, D – apterous female; E – apterous male. Scale bar = 3 mm.

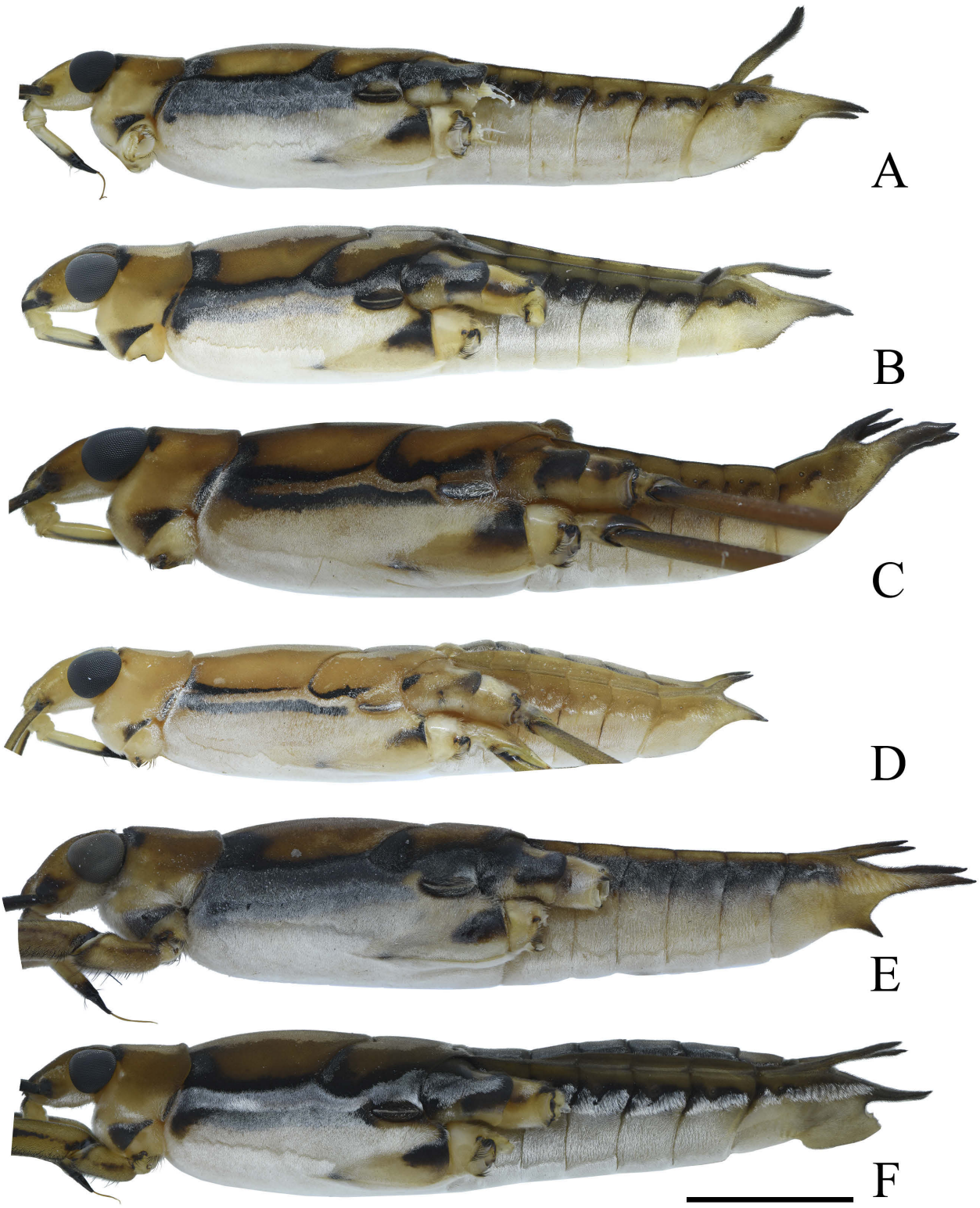

Fig. 4. Photographs of bodies of *Ptilomera* spp. in lateral view, apterous female. A – *P. acutidentata* sp. n.; B – *P. burmana*; C – *P. valida* sp. n.; D – *P. hemmingseni*; E – *P. hylactor*; F – *P. tigrina*. Scale bar = 3 mm.

Description. Apterous female. Coloration. Head brownish with two pairs of obvious blackish spots. Pronotum, mesonotum, and metanotum chiefly light-brownish with median dark-yellowish marks (Figs 1A, 2A, 3A). The black stripe on the mesopleuron not bifurcated (Fig. 4A). Abdominal mediotergite I–IV brownish, abdominal mediotergites V–VII dark-brownish laterally, with a median yellowish spot on each mediotergite (Fig. 3A). **Structure.** Abdomen relatively long, almost straight (Fig. 4A). Abdominal mediotergite I medially with few dark brownish setae (Fig. 3A). Abdominal segment VII elongated, nearly as long as the three preceding abdominal segments combined (Fig. 4A); connexival spines arising from the anterior margin of the connexival segment VII (Figs 1B–D,

Fig. 5. Photographs of bodies of *Ptilomera* spp., excluding head and prothorax, in ventral view, apterous female. A – *P. acutidentata* sp. n.; B – *P. burmana*; C – *P. valida* sp. n.; D – *P. hemmingseni*; E – *P. hylactor*; F – *P. tigrina*. Scale bar = 3 mm.

3A), the transverse bases of the connexival spines hidden beneath infolded dorsal margins of the dorsolateral lobes of abdominal segment VII on either side, apical halves directed upwards (Figs 1B, D, 4A); dorsolateral lobe is relatively long, nearly straight on the dorsal margin (Figs 1D, 4A); ventrolateral lobe not distinct, showing a blunt curve (Figs 1D, 4A); median ventral lobe sub-rectangular (Figs 1C, 5A).

Apterous male. Coloration. Head brownish with two pairs of obvious blackish spots. Pronotum, mesonotum, and metanotum chiefly light-brownish with median dark-yellowish marks (Figs 2B, 3B, 6A). The black stripe on the mesopleuron not bifurcated. Abdominal mediotergite I brownish, abdominal mediotergites II–VII dark-brownish (Figs 2B, 3B). Abdominal mediotergite VIII chiefly brownish on the anterior part, with a pair of blackish spots; dark brownish on posterior part (Fig. 8A). Proctiger chiefly yellowish with blackish margins. **Structure.** Middle trochanter with many tiny spines, middle femur bears long, dense, blackish setae on the distal half (Figs 2B, 7A). Abdominal segment VIII relatively long (Figs 6B, C, 8A, B). Pygophore relatively large; front and posterior margins of the lateral projections relatively parallel (Fig. 9A), mostly exposed in dorsal view (Fig. 8A); distal part of the lateral projection with a group of blackish setae (Fig. 9A); posterior tip bluntly pointed. The median lobe of proctiger relatively broad and short, not as long as the distal width of a lateral wing, surpassing the latter caudally (Figs 6D, 10A). Paramere relatively long and simply curved, with a distinct and angular process, bearing long and dense setae on the apical part (Figs 6E, 11A).

Measurements. Apterous female. Body length 13.91–15.25, width 3.64–3.74, head width 1.87–2.02, interocular width 0.56–0.58, eye length (dorsal view) 0.87–0.88; relative lengths of antennal segments I–IV: 5.52–5.98: 0.93–1.28: 1.74–1.92: 1.14–1.15; pronotum: length 1.29–1.35, width 1.91–2.12; mesonotum: length 3.17–3.26, width 3.64–3.74; metanotum: length 1.08–1.35, width 3.42–3.56; abdomen length (ventral view) 7.25–8.63; abdominal sternum VII: length 2.74–3.51, width 1.88–2.29; relative lengths of leg segments: fore leg (femur: tibia: tarsal segment I: tarsal segment II): 6.07–6.83: 4.32–5.96: 2.91–3.65: 1.25–1.52, middle leg (femur: tibia: tarsal segment I: tarsal segment II): 16.02–18.75: 9.49–13.23: 4.82–7.69: 0.51–0.74, hind leg (femur: tibia: tarsal segment I+II): 18.73–21.63: 11.02–17.17: 0.44–0.49. **Apterous male.** Body length 14.32–15.99, width 3.47–3.83, head width 1.94–2.17, interocular width 0.56–0.65, eye length (dorsal view) 0.84–0.99; relative lengths of antennal segments I–IV: 6.32–7.01: 1.27–5.82: 1.91–3.62: 1.31–1.41; pronotum: length 1.31–1.58, width 2.09–2.53; mesonotum: length 3.34–3.76, width 3.47–3.83; metanotum: length 1.19–1.64, width 3.41–3.78; abdomen length (ventral view) 6.81–6.81; relative lengths of leg segments: fore leg (femur: tibia: tarsal segment I: tarsal segment II): 6.74–7.61: 5.88–6.36: 3.69–3.89: 1.5–1.59, middle leg (femur: tibia: tarsal segment I: tarsal segment II): 18.25–21.68: 11.03–13.38: 5.31–7.75: 0.56–0.83, hind leg (femur: tibia: tarsal segment I+II): 22.65–26.57: 18.31–19.32: 0.43–0.48.

Type material. China: Holotype 1♂ (apterous): Yunnan Province, Pu-er City, Meng-lian County, Meng-ma Town, Meng-ma Waterfall // 22°14′7.0″N, 99°23′5.6″E // 981 m a.s.l. // 22 Aug. 2016 // Run-xi Wang leg. (NKUM). **Paratypes** 1♂, 2♀ (apterous): same collection data as for holotype (NKUM); 1♂, 1♀ (apterous): Yunnan Province, Pu-er City, Jing-dong County, Wen-long Town // 24°38′31.6″N, 100°43′39.7″E // 1277 m a.s.l. // 1 Mar. 2023 // Hao Xun leg. (NKUM); 1♀ (apterous): Yunnan Province, Xishuang-ban-na Autonomous Prefecture, Jing-hong City, Meng-la County, Bu-lang-shan Township // 21°35′22.9″N, 100°25′29.5″E

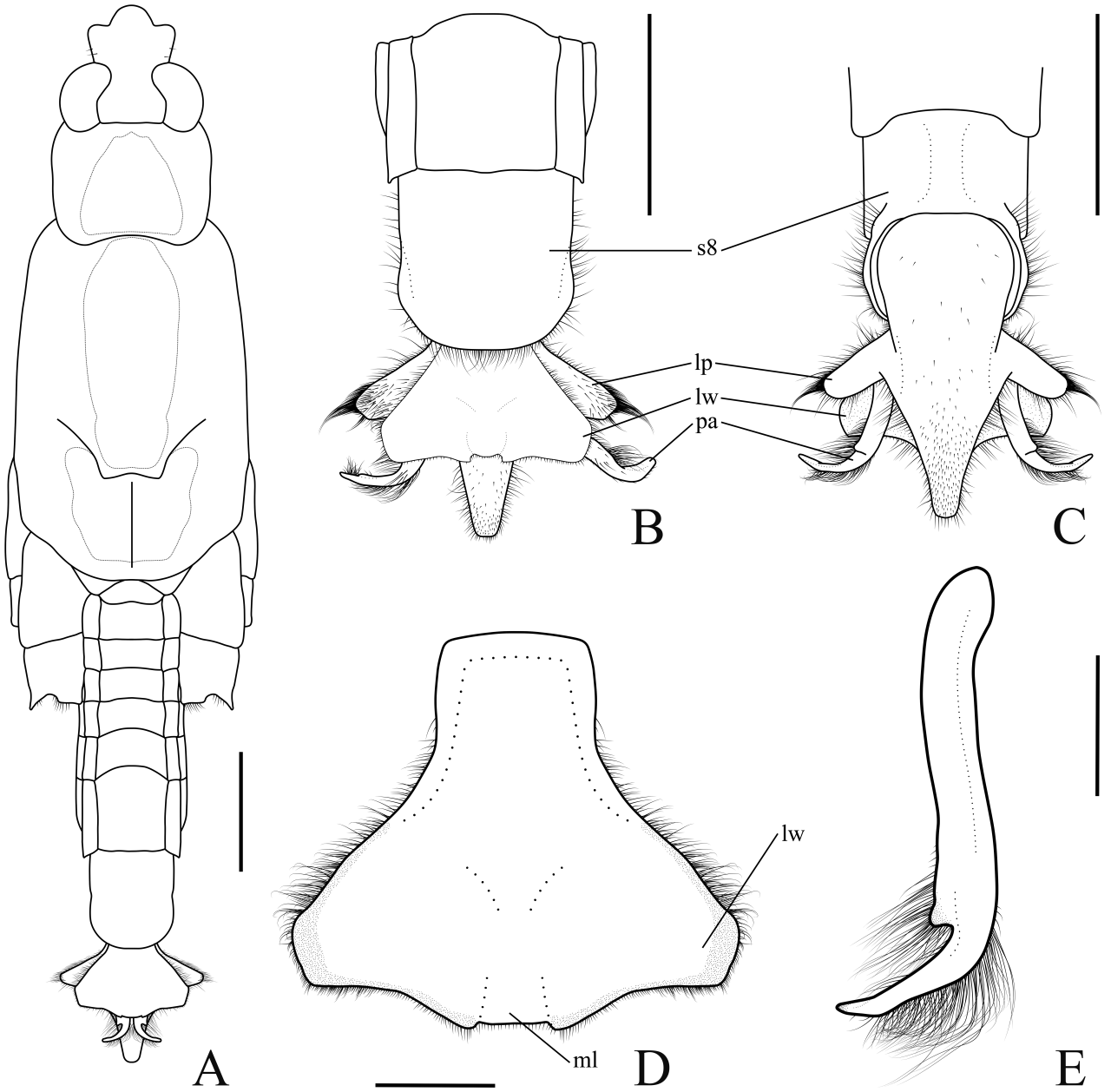

Fig. 6. Morphological features of *Ptilomera acutidentata* sp. n., apterous male. A – body in dorsal view; B – abdominal end, dorsal view; C – abdominal end, ventral view; D – proctiger, dorsal view; E – left paramere, dorsal view. s8 – abdominal segment VIII, lp – lateral projection of pygophore, lw – lateral wing of proctiger, ml – median ventral lobe of proctiger, pa – paramere. Scale bars: A = 2 mm; B, C = 1 mm; D, E = 0.5 mm.

// 31 May 2014 // Zhen Ye leg. (NKUM); 1♂, 1♀ (apterous): Yunnan Province, Pu-er City, Meng-lian County, Meng-ma Town, Mang-yun Waterfall // 22°14′19.3″N, 99°21′12.1″E // 981 m a.s.l. // 20 Jul. 2016 // Zhen Ye leg. (NKUM); 1♂ (apterous): Yunnan Province, Pu-er City, Lan-cang County, Long-tan // 800 m a.s.l. // 27 Nov. 2011 // Wei-bing Zhu leg. (NKUM).

Type locality. China, Yunnan, Puer.

Etymology. The species epithet is derived from the Latin adjective "acutidentatus", which means "having pointed teeth" and refers to the obvious process on the paramere of this species.

Distribution. China: Yunnan.

Comparative notes. *Ptilomera acutidentata* sp. n. is most similar to four species (i.e., *P. assamensis*, *P. burmana*, *P. fang*, and *P. laticaudata*) among all the congeneric species. Females of these five species share the following characteristics of abdominal segment VII: connexival spines arising from the anterior margin of connexival segment VII, the dorsolateral lobe elongated, and the ventrolateral lobe is either absent or indistinct (Fig. 1D). Among all these five species, only *P. acutidentata* sp. n. and *P. burmana* have a distinct process on the paramere (Figs 6E, 11A, B). *Ptilomera acutidentata* sp. n. and *P. burmana* can be separated by the following characters: (1) In the female of *P. acutidentata* sp. n., the black stripe on the mesopleuron is not bifurcated (Fig. 4A), whereas in the female of *P. burmana*, the black stripe on the mesopleuron is bifurcated (Fig. 4B); (2) in the male of *P. acutidentata* sp. n., the process on the paramere has a relatively sharp apex angle, being less than 90°, with the width of the para-

Fig. 7. Photographs of mid right trochanter and femur of *Ptilomera* spp. in ventral view (apterous males). A – *P. acutidentata* sp. n.; B – *P. burmana*; C – *P. valida* sp. n.; D, E – *P. hemmingseni*; F – *P. hylactor*; G – *P. tigrina*. Scale bar = 5 mm.

mere being nearly equal from the basal part to the process (Fig. 11A); whereas in the male of *P. burmana*, the process on the paramere has a relatively blunt apex angle, not less than 90°, and the paramere is narrowed at the base of the process (Fig. 11B).

Ptilomera valida sp. n.

(Figs 2C, D, 4C, 5C, 7C, 9C, 10C, 11C, 12A, B, 13, 14, 15A–C)

ZooBank taxon LSID:
D9BC5D4C-DABD-462D-A28D-335BEDFB0A03

Diagnosis. Body length of female 16.19–16.96, of male 15.69. In both sexes, the black stripe on the mesopleuron posteriorly bifurcated. In females, abdominal mediotergite I bears dense dark brownish setae medially (Figs 12A, 13B); abdominal segment VII elongated, nearly as long as the four preceding abdominal segments combined (Fig. 4C); connexival spines produced from the median part of connexival segment VII; dorsolateral lobe relatively long and robust, much longer than the connexival spine, and raise upwards; ventrolateral lobe absent (Figs 4C, 12A, B). In males, middle trochanter bears only a few tiny spines, middle femur bears long, dense, blackish setae on the distal 2/3 (Figs 2D, 7C); pygophore large, with blunt, indistinct lateral projections, with the posterior margin sharp apically but not elongated into a finger-like shape (Figs 9C,14D); proctiger with a pair of short lateral lobes showing a blunt curve on the margin, and the median lobe of the hind margin distinctly elongate (Figs 10C, 14F); paramere relatively long and distinctly curved on the basal and middle part, bearing relatively short and sparse setae on the apical part. (Fig. 11C).

Description. Apterous female. Coloration. Head brownish with two pairs of blackish spots, indistinctly connected with a pair of black stripes. Pronotum, mesonotum, and metanotum chiefly dark-brownish with median brownish spots (Figs 2C, 12A, 13C). Black stripe on mesopleuron posteriorly bifurcated (Figs 4C, 13A). Abdominal mediotergite I brownish, abdominal mediotergites II–VII dark-brownish laterally, each with a median dark-yellowish spot (Fig. 12A). **Structure.** Abdomen relatively long, with segment VII moderately curved upwards into an oblique position (Figs 4C, 13A). Abdominal mediotergite I with dense dark brownish setae medially (Figs 12A, 13B). Abdominal segment VII elongated, nearly as long as the four preceding abdominal segments combined (Fig. 4C); connexival spines produced from the median part of connexival segment VII, crossing each other (Fig. 13C, D); dorsolateral lobe relatively long and robust, much longer than the connexival spine, raising upwards (Figs 4C, 13D–F); ventrolateral lobe absent (Fig. 13F); median ventral lobe sub-rectangular (Figs 5C, 13E).

Apterous male. Coloration. Head brownish with two pairs of blackish spots. Pronotum, mesonotum, and metanotum chiefly blackish with median dark yellowish spots (Figs 2D, 12B, 14A). The black stripe on the mesopleuron posteriorly bifurcate. Abdominal mediotergite I brownish, abdominal mediotergites II–VII dark-brownish laterally, with dark-yellowish spots medially (Fig. 12B). Abdominal mediotergite VIII chiefly brownish on the anterior part, with a pair of blackish spots, dark brownish on posterior part (Fig. 15A). Proctiger dark-brownish laterally, light brownish medially (Fig. 10C). **Structure.** Abdomen relatively long and wide. Abdominal mediotergite I with dark brownish setae medially, but sparser than in females (Figs 12B, 14B). Middle trochanter bears only a few tiny spines, middle femur bears long, dense, blackish setae

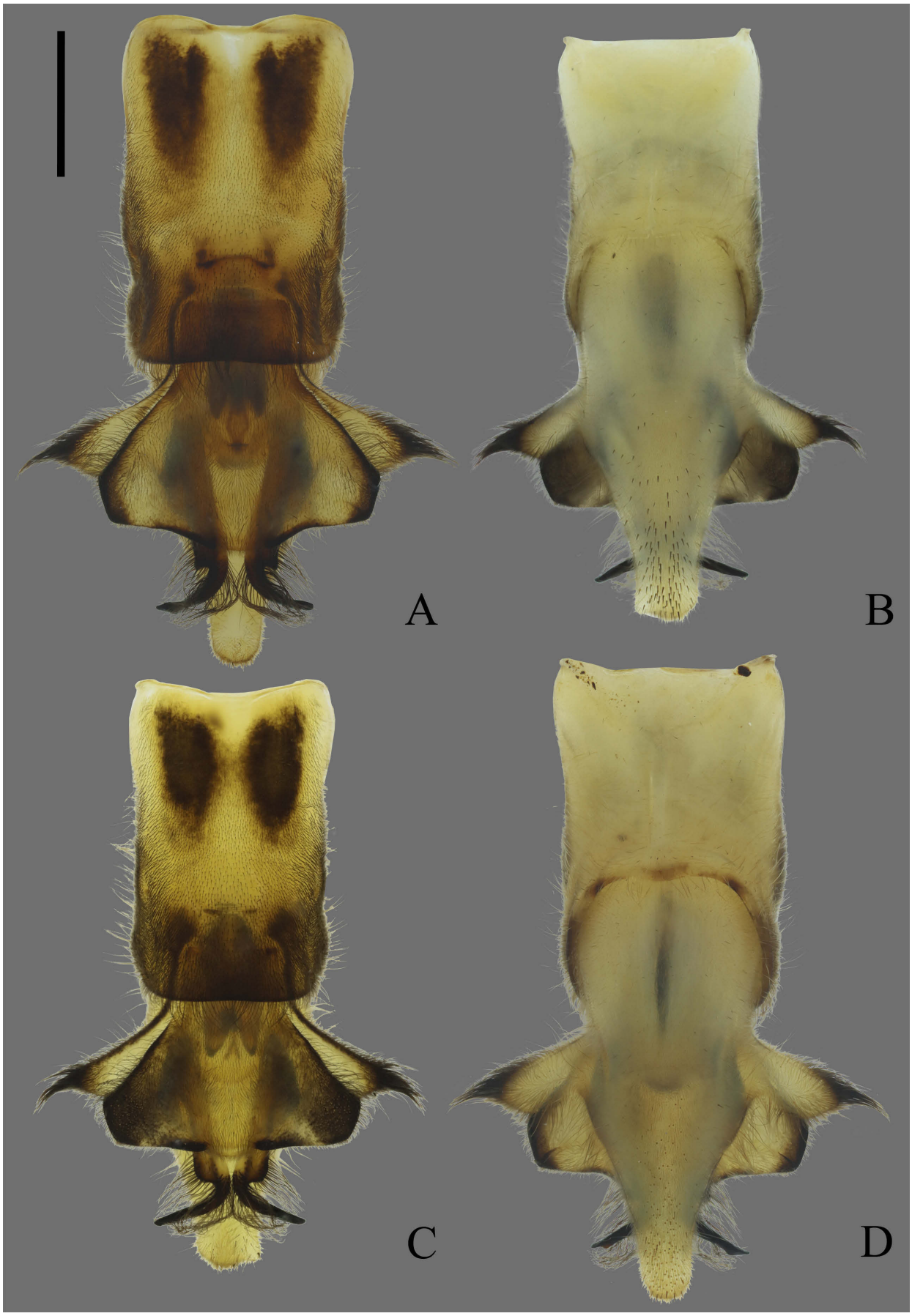

Fig. 8. Photographs of male genitalia segments of *Ptilomera* spp. A, B – *P. acutidentata* sp. n.: A – dorsal view; B – ventral view; C, D – *P. burmana*: C – dorsal view; D – ventral view. Scale bar = 1 mm.

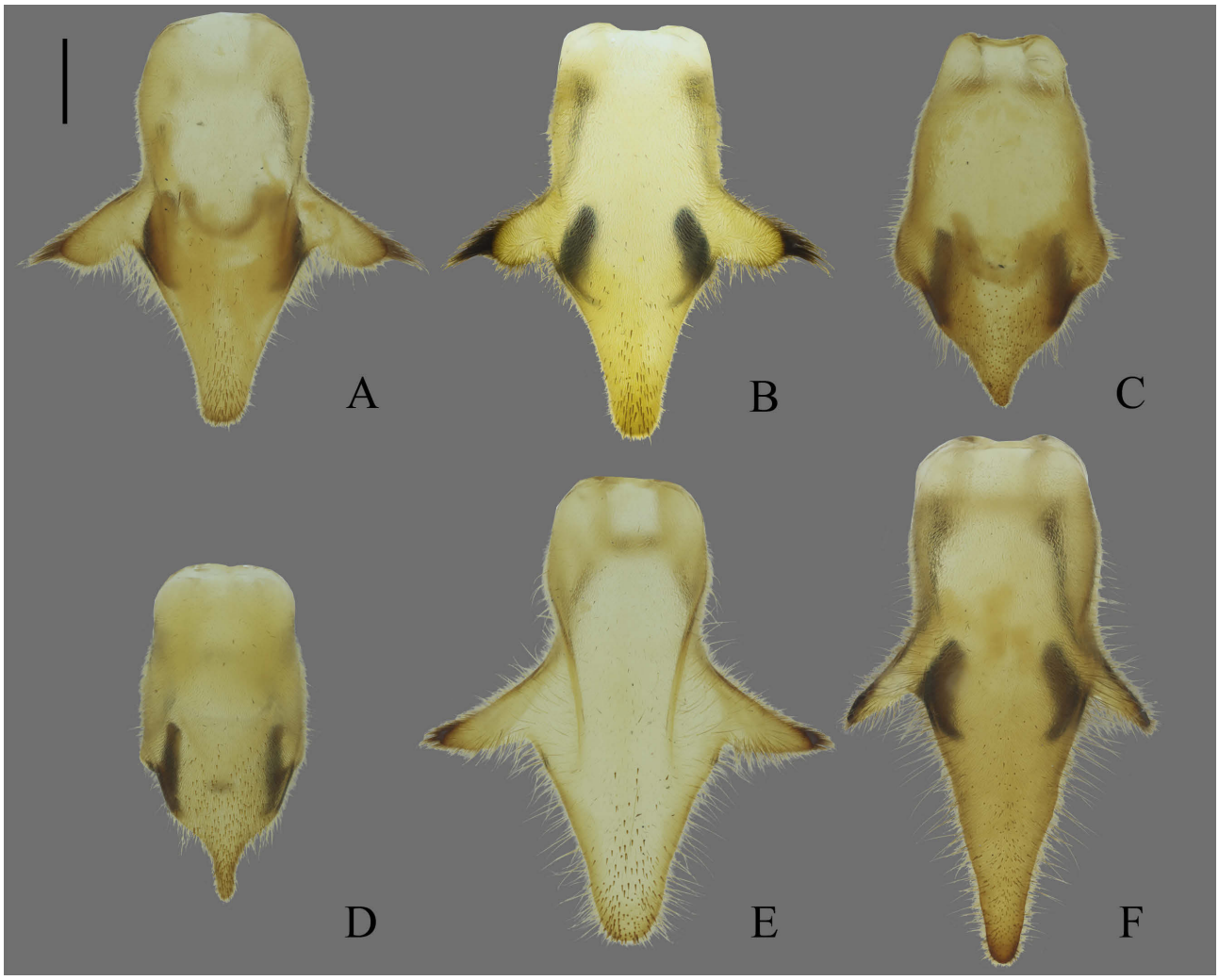

Fig. 9. Photographs of male pygophores of *Ptilomera* spp., ventral view. A – *P. acutidentata* sp. n.; B – *P. burmana*; C – *P. valida* sp. n.; D – *P. hemmingseni*; E – *P. hylactor*; F – *P. tigrina*. Scale bar = 0.5 mm.

on the distal 2/3 (Figs 2D, 7C). Abdominal segment VIII not elongate, covering anterior half of the pygophore (Figs 14C–E, 15A–C). Pygophore large, with blunt, indistinct lateral projections, these lateral projections posteriorly covered by the proctiger in dorsal view (Figs 14C–E, 15A–C), with posterior margin angular apically but not elongate to a finger-like shape (Figs 14D, 15B). Proctiger with a pair of short lateral lobes showing a blunt curve on the lateral margins, median lobe of hind margin distinctly elongate (Figs 10C, 14F). Paramere relatively long and distinctly curved on the basal and middle parts, bearing relatively short and sparse setae on the apical part. (Figs 11C, 14G).

Measurements. Apterous female. Body length 16.19–16.96, width 4.41–4.83, head width 2.29–2.37, interocular width 0.66–0.75, eye length (dorsal view) 1.03–1.06; relative lengths of antennal segments I–IV: 6.51–6.87: 1.55–1.56: 2.17–2.23: 1.29–1.37; pronotum: length 1.62–1.64, width 2.24–2.46; mesonotum: length 3.42–3.76, width 4.41–4.83; metanotum: length 1.51–1.65, width 4.08–4.29; abdomen length (ventral view) 8.11–8.69; abdominal sternum VII: length 3.51–3.97, width 2.27–2.57; relative lengths of leg segments: fore leg (femur: tibia: tarsal segment I: tarsal segment II): 7.38–7.83: 6.22–6.74: 3.96–4.17: 1.45–1.69, middle leg (femur: tibia: tarsal segment I: tarsal segment II): 19.79–21.65: 12.87–14.95: 6.37–7.21: 0.63–0.66, hind leg (femur: tibia: tarsal segment I+II): 22.44–27.42: 1.64–1.83: 0.46–0.56. **Apterous male.** Body length 15.69, width 4.71, head width 2.51, interocular width 0.73, eye length (dorsal view) 1.16; relative lengths of antennal segments I–IV: 7.73: 1.65: 2.59: ; pronotum: length 1.87, width 2.72; mesonotum: length 4.06, width 4.71; metanotum: length 1.76, width 4.56; abdomen length (ventral view) 6.97; relative lengths of leg segments: fore leg (femur: tibia: tarsal segment I: tarsal segment II): 9.34: 8.22: 5.06: 1.81, middle leg (femur: tibia): 26.31: 16.43, hind leg (femur: tibia: tarsal segment I+II): 26.28: 21.22: 0.37.

Type material. China: Holotype ♀ (apterous): Yunnan Province, Hong-he Autonomous Prefecture, He-kou County, Da-wei Mountain // 22°39′50″N, 103°51′28″E // 436 m a.s.l. // 11 Aug. 2016 // Xiao-ya Sun leg. (NKUM). **Paratypes** 1♂, 2♀ (apterous): same collection data as for holotype (NKUM).

Type locality. China, Yunnan, Honghe.

Etymology. The species epithet is derived from the Latin adjective “validus”, meaning “strong” and refers to the extremely robust body of both sexes.

Distribution. China: Yunnan.

Comparative notes. *Ptilomera valida* sp. n. is most closely related to *P. hemmingseni* by the combination of the following shared characteristics: (1) In both sexes, the

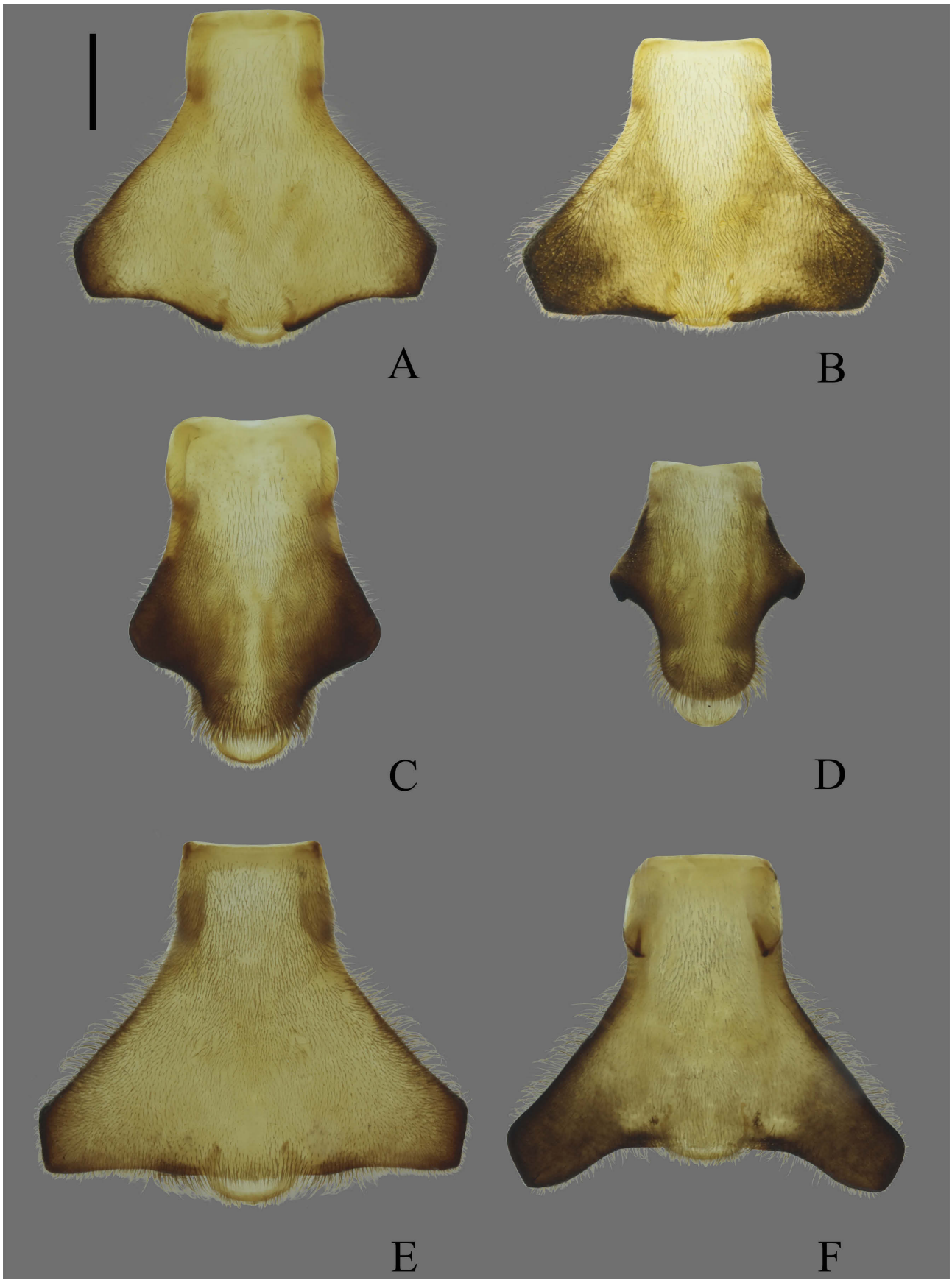

Fig. 10. Photographs of male proctigers of *Ptilomera* spp., dorsal view. A – *P. acutidentata* sp. n.; B – *P. burmana*; C – *P. valida* sp. n.; D – *P. hemmingseni*; E – *P. hylactor*; F – *P. tigrina*. Scale bar = 0.5 mm.

Fig. 11. Photographs of male left paramere of *Ptilomera* spp., dorsal view. A – *P. acutidentata* sp. n.; B – *P. burmana*; C – *P. valida* sp. n.; D – *P. hemmingseni*; E – *P. hylactor*; F – *P. tigrina*. Scale bar = 0.5 mm.

black stripe on the mesopleuron posteriorly bifurcated (Fig. 4C, D); (2) in females, abdominal segment VII lacks a ventrolateral lobe, and the connexival spines are produced form the median part of connexival segment VII (Figs 4C, D, 13F); (3) in males, the middle trochanter bears only a few tiny spines (Fig. 7C–E); the pygophore lacks a distinctly elongate lateral projections, being blunt on both lateral sides (Fig. 9C, D); the proctiger has short lateral wings directed downwards, with the median lobe elongate (Fig. 10C, D); the paramere is strongly curved on the middle part, without long setae on the apical part (Fig. 11C, D). These two species can be distinguished by the following characteristics: (1) In the female of *P. valida* sp. n., abdominal mediotergite I bears dense dark brownish setae medially (Figs 12A, 13B), which are lacking in *P. hemmingseni* (Fig. 12C); in *P. valida* sp. n., the connexival spines and dorsolateral lobe of abdominal segment VII are elongate (Figs 4C, 13F), while they are relatively short in *P. hemmingseni* (Fig. 4D); (2) in the male of *P. valida* sp. n., the posterior tip of the pygophore is relatively blunt (Fig. 9C) and not elongated into a finger-like shape, whereas in *P. hemmingseni*, the tip of the pygophore is relatively sharp and elongated into a finger-like shape (Fig. 9D); in *P. valida* sp. n., the lateral wings of the proctiger arise from a relatively posterior position (Fig. 10C), while in *P. hemmingseni*, they arise from the middle part of the proctiger (Fig. 10D); in *P. valida* sp. n., the hind margin of the lateral wing appears as a blunt curve (Figs 10C, 14F), while in *P. hemmingseni*, it has an angular shape (Fig. 10D).

Ptilomera burmana D. Polhemus, 2001

(Figs 3C–E, 4B, 5B, 7B, 8C, D, 9B, 10B, 11B)

Ptilomera burmana D. Polhemus, 2001: 218.

Diagnosis. In both sexes, the black stripe on the mesopleuron posteriorly bifurcated (Fig. 4B). In females, abdominal segment VII elongated, being nearly as long as the three preceding segments combined (Fig. 4B); connexival spines arising from the anterior margin of connexival segment VII (Figs 3C, D, 4B); dorsolateral lobe elongated and horizontally directed; ventrolateral lobe indistinct, being bluntly curved (Fig. 4B); median ventral lobe sub-rectangular (Fig. 5B). In males, middle trochanter bears many dense tiny spines, middle femur bears long, dense, blackish setae on the distal half (Fig. 7B); pygophore large, with the front and hind margins of the lateral projections relatively parallel (Figs 8D, 9B), and mostly exposed in dorsal view (Fig. 8C, D), with distal part of the lateral projections bearing a tuft of blackish setae; proctiger chiefly yellowish with blackish areas laterally, and with the median lobe not elongate posteriorly (Fig. 10B); paramere relatively long and simply curved, with a blunt process on the sub-apical part, forming a arc-shaped margin, also with relatively long and dense setae on the apical part (Fig. 11B).

Material examined. China: 13♂, 17♀ (apterous): Yunnan Province, De-hong Autonomous Prefecture, Na-bang Village // 24°42′05.8″N, 97°34′25.0″E // 335 m a.s.l. // 15 Apr. 2023 // Ze-zhong Jin and Zi-he Li leg. (NKUM).

Distribution. China: Yunnan; Myanmar.

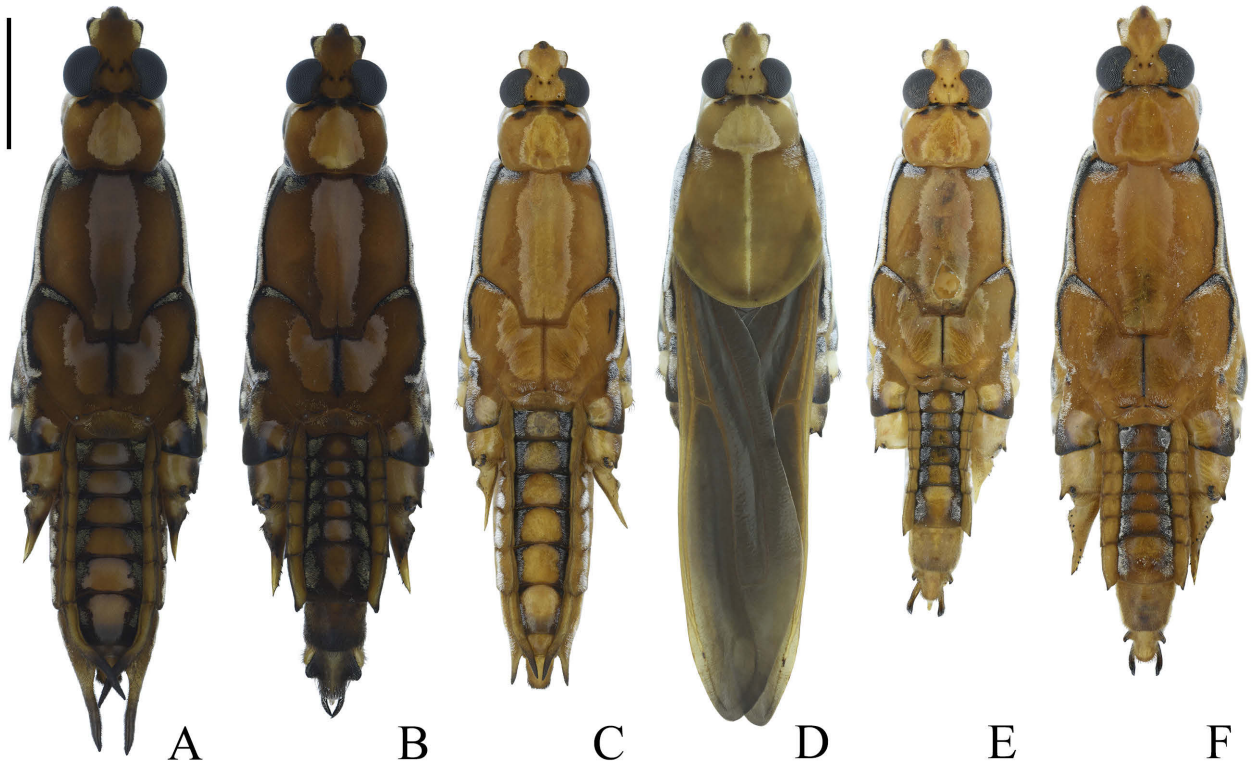

Fig. 12. Photographs of bodies of *Ptilomera* spp. in dorsal view. A, B – *P. valida* sp. n.: A – holotype, apterous female; B – paratype, apterous male; C–F – *P. hemmingseni*: C – apterous female; D – macropterous female; E, F – apterous male. Scale bar = 3 mm

Comparative notes. *Ptilomera burmana* is most similar to *P. acutidentata* sp. n.; see the comparative notes under *P. acutidentata* sp. n.

Remarks. *Ptilomera burmana* was originally described by Polhemus (2001) based on a pair of apterous specimens from Myanmar. In the discussion of Polhemus (2001), it was noticed that in the female (the paratype) of *P. burmana*, the bases of the connexival spines are not covered by the infolded dorsal margins of the dorsolateral lobes on abdominal segment VII. Our material is collected from Tongbi-guan Village, Yunnan, China, which is located near the border between China and Myanmar and is not far from the type locality. However, in the specimens we collected, there are two forms of morphological patterns for the connexival spines: the first pattern is same as in the type specimen, with the basal parts of the connexival spines exposed (Fig. 3C); in the other pattern, the basal parts of the connexival spines are partly covered by the dorsal margins of the dorsolateral lobes laterally (Fig. 3D). As a result, this is not a consistently reliable characteristic for distinguishing this species from the other four similar species occurring in the region (i.e., *P. acutidentata* sp. n., *P. assamensis*, *P. fang*, and *P. laticaudata*).

Ptilomera hemmingseni Andersen, 1967

(Figs 4D, 5D, 7D, E, 9D, 10D, 11D, 12C–F, 15D–F, 19)

Ptilomera hemmingseni Andersen, 1967: 309.

Diagnosis. In both sexes, body color light brownish (Fig. 12C–F), with the black stripe on the mesopleuron posteriorly bifurcate. In females, abdominal mediotergite I lacks median dark brownish setae (Fig. 12C); abdominal mediotergites I–VII blackish laterally with a brownish-yellow spot medially (Fig. 4D); abdominal segment VII elongated, being nearly as long as the two preceding segments combined; connexival spines produced from the median part of the dorsal margin (Fig. 4D); dorsolateral lobe relatively short; ventrolateral lobe absent; median ventral lobe subsemicircular (Fig. 5D). In males, abdominal mediotergites I–VI blackish laterally with a brownish-yellow spot medially (Fig. 12E, F); middle trochanter bears a few tiny spines, and middle femur possess setae only on the apical part (Fig. 7D) or with dense blackish setae on the distal 2/3 (Fig. 7E); abdominal segment VIII not distinctly elongate (Fig. 15D–F); pygophore relatively small, with indistinct lateral projections that are nearly completely covered by the proctiger in dorsal view, and with the posterior tip of the pygophore produced into a finger-like shape (Fig. 9D); proctiger chiefly brownish-yellow, with a pair of dark brownish angular lateral wings directed slightly downwards, and with a distinct median lobe on the hind margin (Fig. 10D); paramere relatively long and simply curved, with relatively short and sparse setae on the apical part (Fig. 11D).

Material examined. China: 1♂ (apterous): Guangxi Province, Bai-se City, Na-po County, Bai-he Village // 8 Apr. 1998 // Min Wu leg. (NKUM); 1♂, 2♀ (apterous): Yunnan Province, Pu-er City, Meng-lian County, Meng-ma Town, Meng-ma Waterfall // 22°14′7.0″N, 99°23′5.6″E // 981 m a.s.l. // 21 Aug. 2016 // Run-xi Wang leg. (NKUM); 14♂, 17♀ (apterous): Yunnan Province, Xi-shuang-ban-na Autonomous Prefecture, Jing-hong City, Meng-la County, Man-he-hui Waterfall // 21°53′49.9″N,

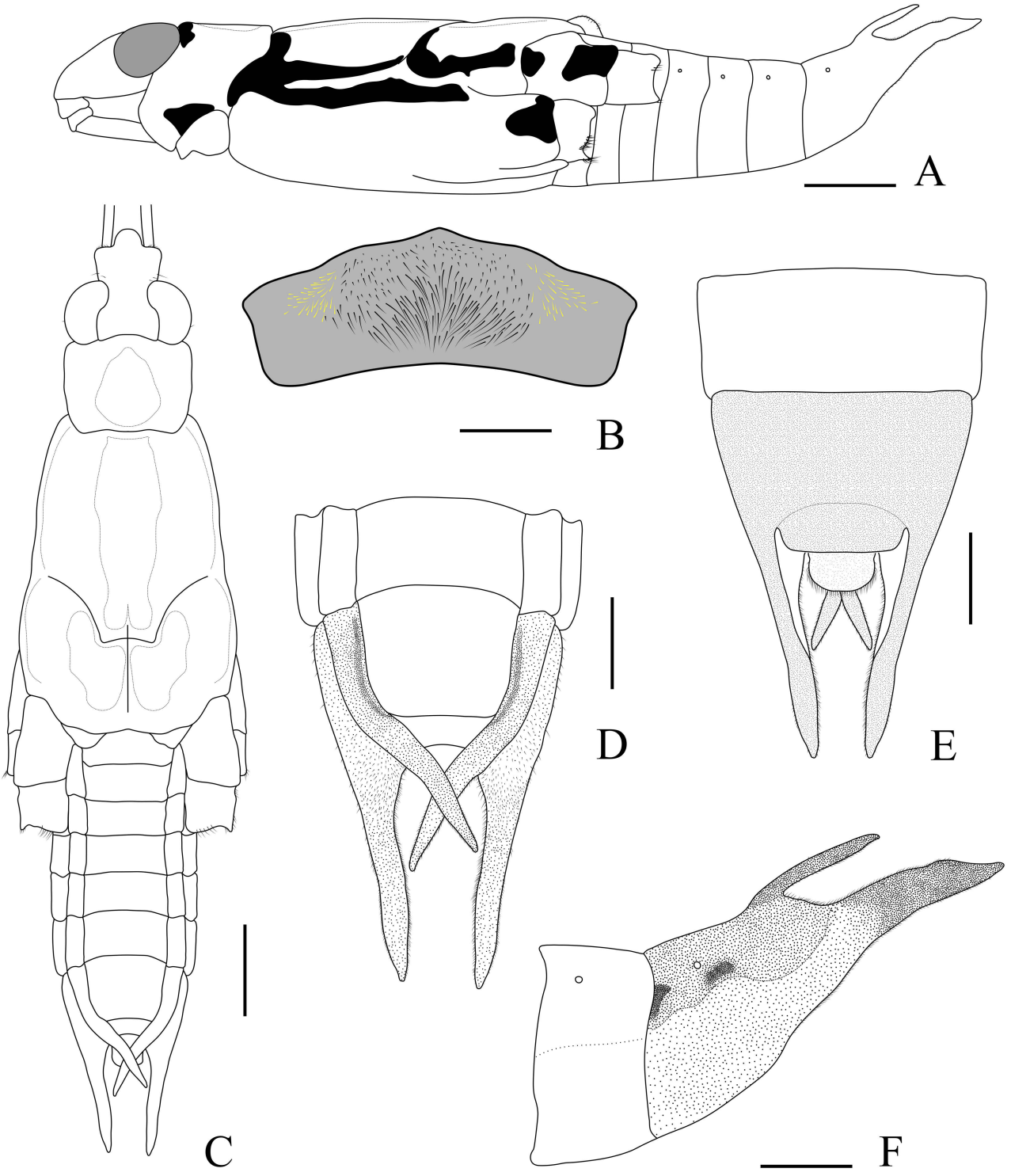

Fig. 13. Morphological features of *Ptilomera valida* sp. n., apterous female. A – body in lateral view; B – abdominal mediotergite I, dorsal view; C – body in dorsal view; D – abdominal end, dorsal view; E – abdominal end, ventral view; F – abdominal end, lateral view. Scale bars: A, C = 2 mm; B = 0.5 mm; D–F = 1 mm.

100°46′01.6″E // 628 m a.s.l. // 18 Apr. 2023 // Zhao-qi Leng and Ze-zhong Jin leg. (NKUM); 5♂, 3♀ (macropterous): Yunnan Province, Xi-shuang-ban-na Autonomous Prefecture, Jing-hong City, Meng-la County, Man-he-hui Waterfall // 21°53′49.9″N, 100°46′01.6″E // 628 m a.s.l. // 18 Apr. 2023 // Zhao-qi Leng and Ze-zhong Jin leg. (NKUM); 3♀ (apterous): Yunnan Province, Xi-shuang-ban-na Autonomous Prefecture, Jing-hong City, Meng-la County, Meng-lun Town, Ba-ka-xiao-zhai // 21°57′39.0″N, 101°12′46.0″E // 631 m a.s.l. // 9 Aug. 2012 // Yan-hui Wang leg. (NKUM); 1♂, 1♀ (apterous): Yunnan Province, Xi-shuang-ban-na Autonomous Prefecture, Jing-hong City, Meng-la County, Meng-lun Town, Ba-ka-xiao-zhai // 21°58′0.0″N, 101°12′5.0″E E // 709 m a.s.l. // 10 Jan. 2023 // Zhao-qi Leng leg. (NKUM); 1♂, 3♀ (apterous): Yunnan Province, Xi-shuang-ban-na Autonomous Prefecture, Jing-hong City, Meng-la County, Meng-lun Town, Ba-ka-xiao-zhai // 21°57′23.4″N, 101°12′27.6″E // 630 m a.s.l. // 8 Aug. 2012 // Yan-hui Wang leg. (NKUM); 1♀ (apterous): Yunnan Province, Xi-shuang-ban-na Autonomous Prefecture, Jing-

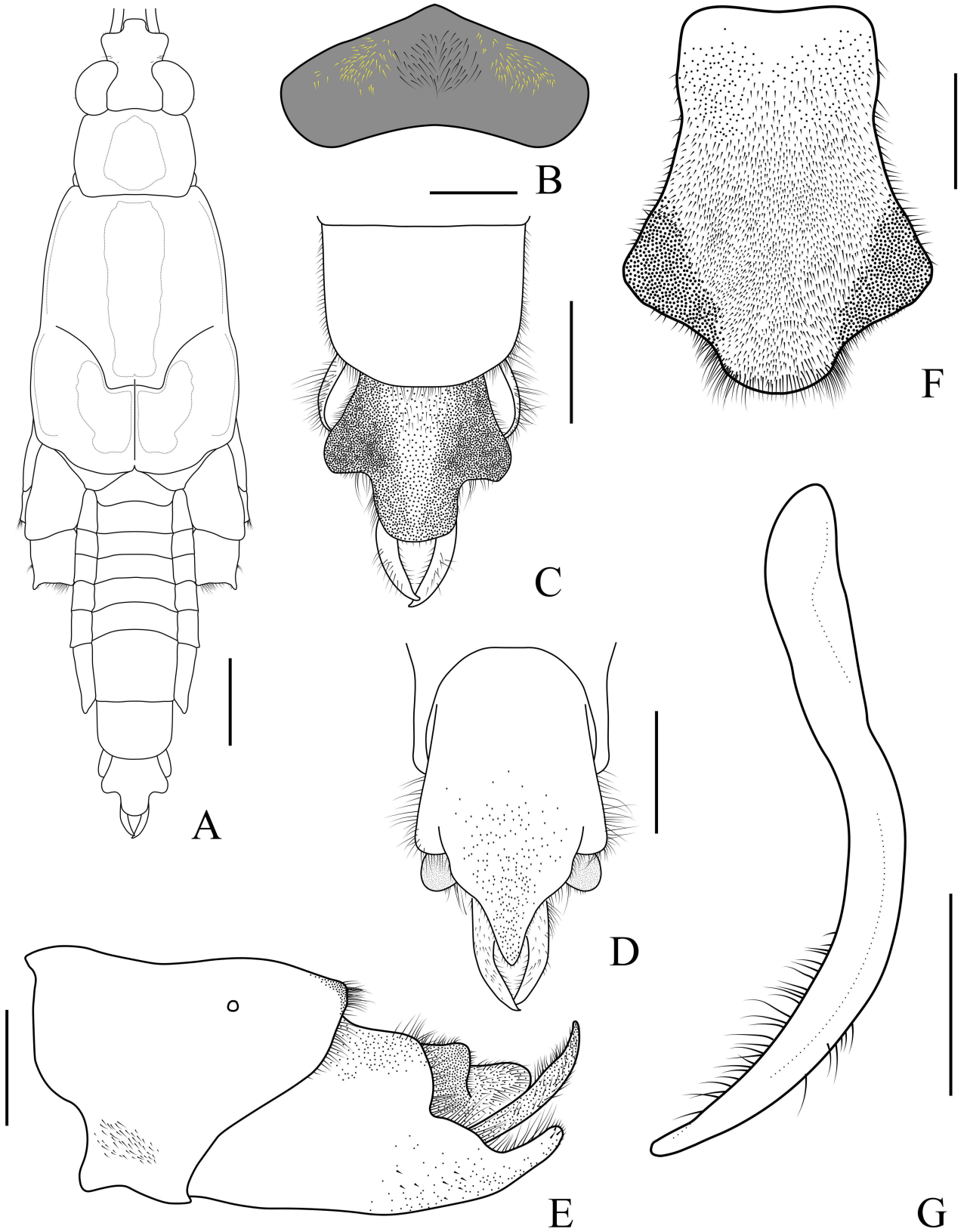

Fig. 14. Morphological features of *Ptilomera valida* sp. n., apterous male. A – body in dorsal view; B – abdominal mediotergite I, dorsal view; C – abdominal end, dorsal view; D – abdominal end, ventral view; E – abdominal end, lateral view; F – proctiger, dorsal view; G – left paramere, lateral view. Scale bars: A = 2 mm; C, D = 1 mm; B, E, F, G = 0.5 mm.

hong City, Meng-la County, Meng-man Town // 21°18′01.7″N, 101°18′30.5″E // 1 May 2011 // Rui Wang leg. (NKUM).

Distribution. China: Yunnan; Laos; Thailand.

Comparative notes. *Ptilomera hemmingseni* is most similar to *P. valida* sp. n.; see the comparative note under *P. valida* sp. n.

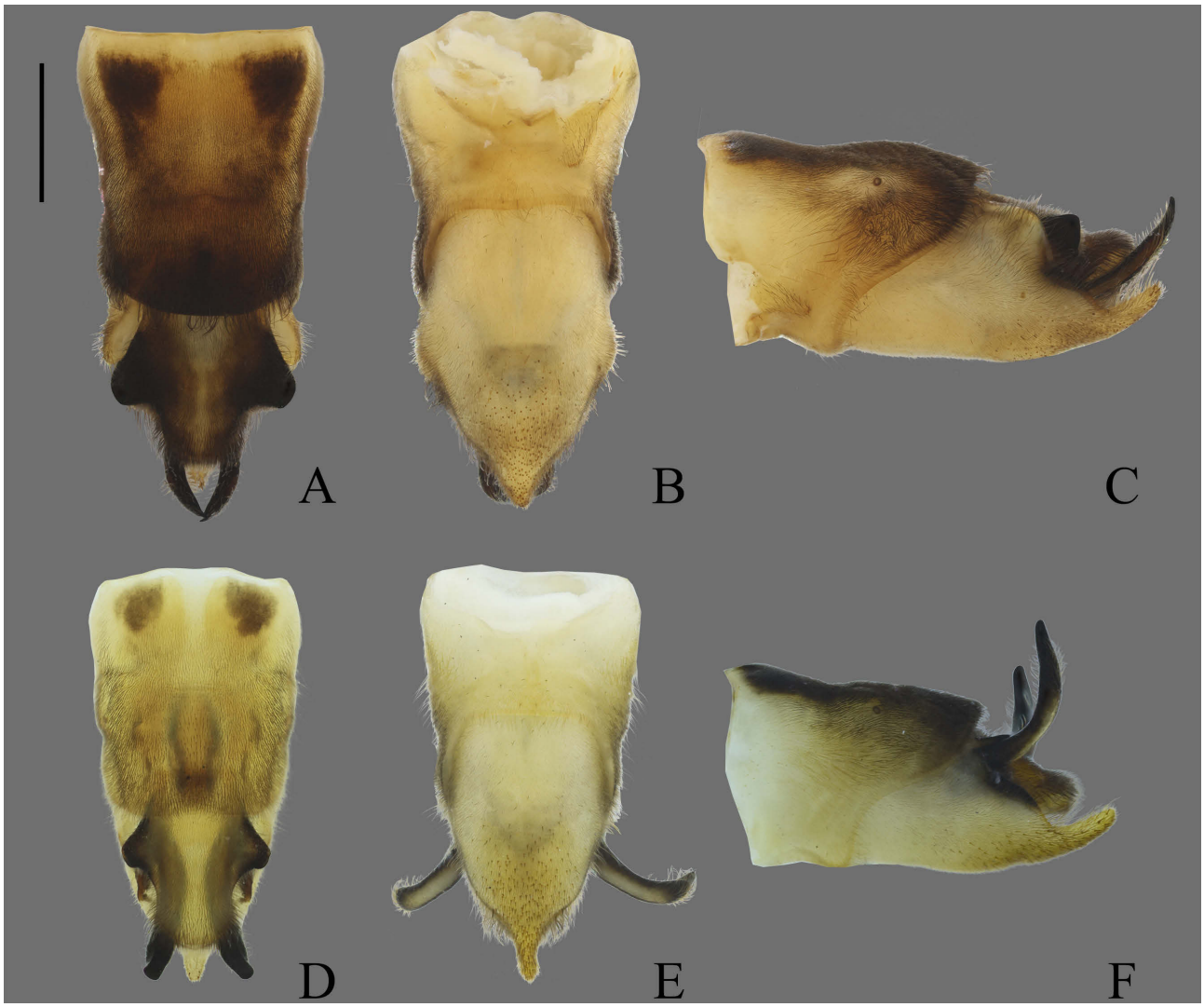

Fig. 15. Photographs of male genitalia segments of *Ptilomera* spp. A–C – *P. valida* sp. n.: A – dorsal view; B – ventral view; C – lateral view; D–F – *P. hemmingseni*: D – dorsal view; E – ventral view; F – lateral view. Scale bar = 1 mm.

Remarks. We observed two different morphological forms of males in the same population of *Ptilomera hemmingseni*. The first form is relatively smaller and slender (Fig. 12E) and has the middle femur relatively short, with only few long setae at the distal end (Fig. 7D). The second form is relatively larger and more robust (Fig. 12F), with the middle femur relatively long, and bearing long and dense setae on distal 2/3 part (Fig. 7E). As the genitalic structures are identical, the two types are clearly the same species. We have found this phenomenon in several populations from China and have conjectured that it is a common phenomenon in this species, however, we have not found this phenomenon in other species of *Ptilomera*.

In both sexes and both apterous and macropterous forms of *Ptilomera hemmingseni*, the dorsum of the body is light-brownish in color (Fig 12C–F, 19B, C), which is more light-colored compared to other widespread species like *P. hylactor* and *P. tigrina* (Fig. 16). Through our observations, we found that *P. hemmingseni* commonly inhabits streams with argillaceous sediment that renders a lighter background color (Fig. 19A), indicating the light-brownish body color might be an adaption to the pale benthic substrate (Fig. 19B, C).

Ptilomera hylactor Breddin, 1903

(Figs 1E, 4E, 5E, 7F, 9E, 10E, 11E, 16A, B, 17A, B, 20A, 21, 22)

Ptilomera hylactor Breddin, 1903: 148.

Diagnosis. In both sexes, the black stripe on the mesopleuron broadened and not bifurcated (Fig. 4E). In females, abdominal mediotergite I lacks dark brownish setae medially (Fig. 16A); abdominal mediotergites I–VI are dark-blackish, mediotergite VII brownish (Fig. 16A); abdominal segment VII elongated, being nearly as long as the three preceding segments combined, with connexiva erect, lying perpendicular to the mediotergites; connexival spines produced from the median part of dorsal margin (Fig. 1E, 4E); dorsolateral lobe relatively long and slender; ventrolateral lobe angular; median ventral lobe sub-semicircular and not folded inwards to the ventral midline (Fig. 5E). In males, abdominal mediotergites I–VI dark-blackish (Fig. 16B); middle trochanter bears dense spines, middle

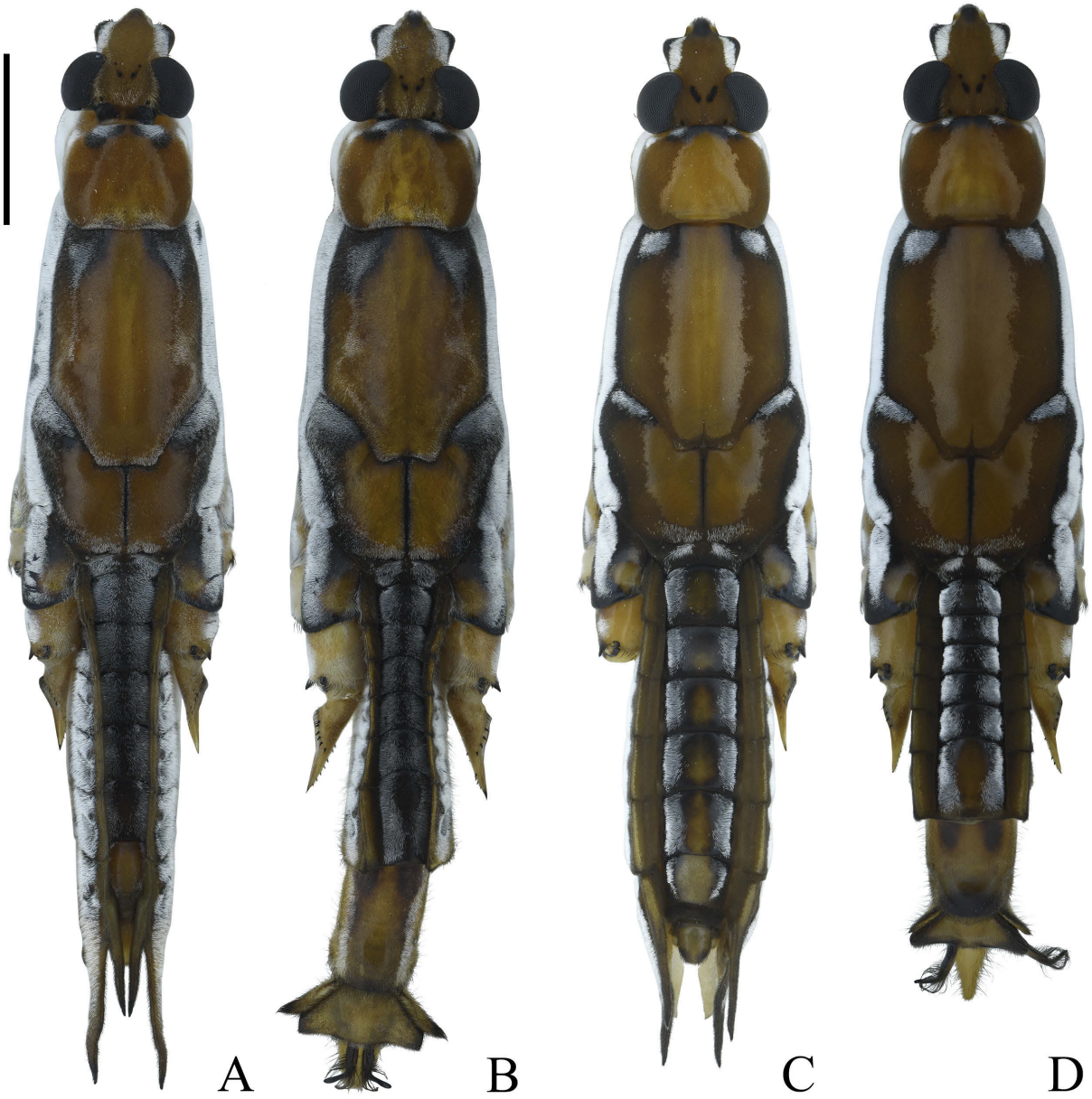

Fig. 16. Photographs of bodies of *Ptilomera* spp. in dorsal view. A, B – *P. hylactor*: A – apterous female; B – apterous male; C, D – *P. tigrina*: C – apterous female; D – apterous male. Scale bar = 3 mm.

femur relatively long, with long, dense, blackish setae on the distal 2/3 (Fig. 7F); abdominal segment VIII elongated (Figs 16B, 17A, B); pygophore large, with distinct lateral projections mostly exposed in dorsal view and a distinct longitudinal ridge ventrally, and the lateral projections bear tufts of blackish setae apically (Fig. 9E); proctiger chiefly brownish-yellow (Fig. 10E), with posterior margin almost flush; paramere elongated and simply curved, with relatively dense long setae on the apical part (Fig. 11E).

Material examined. China: 2♂, 3♀ (apterous): Yunnan Province, Xi-shuang-ban-na Autonomous Prefecture, Jing-hong City, Meng-la County // 21°29′30.0″N, 101°32′0.1″E // 640 m a.s.l. // 2 Aug. 2012 // Sha-sha Yu leg. (NKUM); 1♂, 2♀ (apterous): Yunnan Province, Hong-he Autonomous Prefecture, He-kou County, Hua-yu-dong // 22°30′50.0″N, 103°57′21.0″E // 85 m a.s.l. // 6 Jan. 2023 // Zhao-qi Leng leg. (NKUM); 4♂, 1♀ (apterous): Yunnan Province, Xi-shuang-ban-na Autonomous Prefecture, Jing-hong City, Meng-la County, Meng-kuan River // 21°42′56.2″N, 100°7′58.2″E // 590 m a.s.l. // 18 Aug. 2010 // Kai Dang leg. (NKUM); 7♂, 6♀ (apterous): Yunnan Province, Xi-shuang-ban-na Autonomous Prefecture, Jing-hong City, Meng-la County, Meng-lun Town, Man-zhang Village // 22°7′19.2″N, 100°51′4.7″E // 534 m a.s.l. // 4 Aug. 2010 // Qing Zhao, Rui Wang & Jing Wang leg. (NKUM); 1♀ (apterous): Yunnan Province, Xi-shuang-ban-na Autonomous Prefecture, Jing-hong City, Pu-wen Town // 22°45′2.8″N, 101°3′6.7″E // 885 m a.s.l. // 25 Apr. 2011 // Rui Wang leg. (NKUM); 4♂, 5♀ (apterous): Yunnan Province, Hong-he Autonomous Prefecture, Yuan-yang County, Yuan-yang Forest Park // 23°12′46.0″N, 102°50′12.0″E // 207 m a.s.l. // 6 Jan. 2023 // Zhao-qi Leng leg. (NKUM).

Distribution. China: Yunnan; Cambodia; Laos; Thailand; Vietnam.

Remarks. *Ptilomera hylactor* Breddin, 1903 is a widespread species in Indochina. We found this species in the

Fig. 17. Photographs of male genitalia segments of *Ptilomera* spp. A, B – *P. hylactor*: A – dorsal view; B – ventral view; C, D – *P. tigrina*: C – dorsal view; D – ventral view. Scale bar = 1 mm.

mountain streams of Yunnan (Fig. 18A), usually occuring in large numbers (Fig. 21A, B). Both females and males have a relatively large body size (Figs 16A, B, 22A–C). We sometimes found them not only feeding on prey that had fallen into the water, but also actively catching live insects resting on rocks in the streams (Fig. 22A).

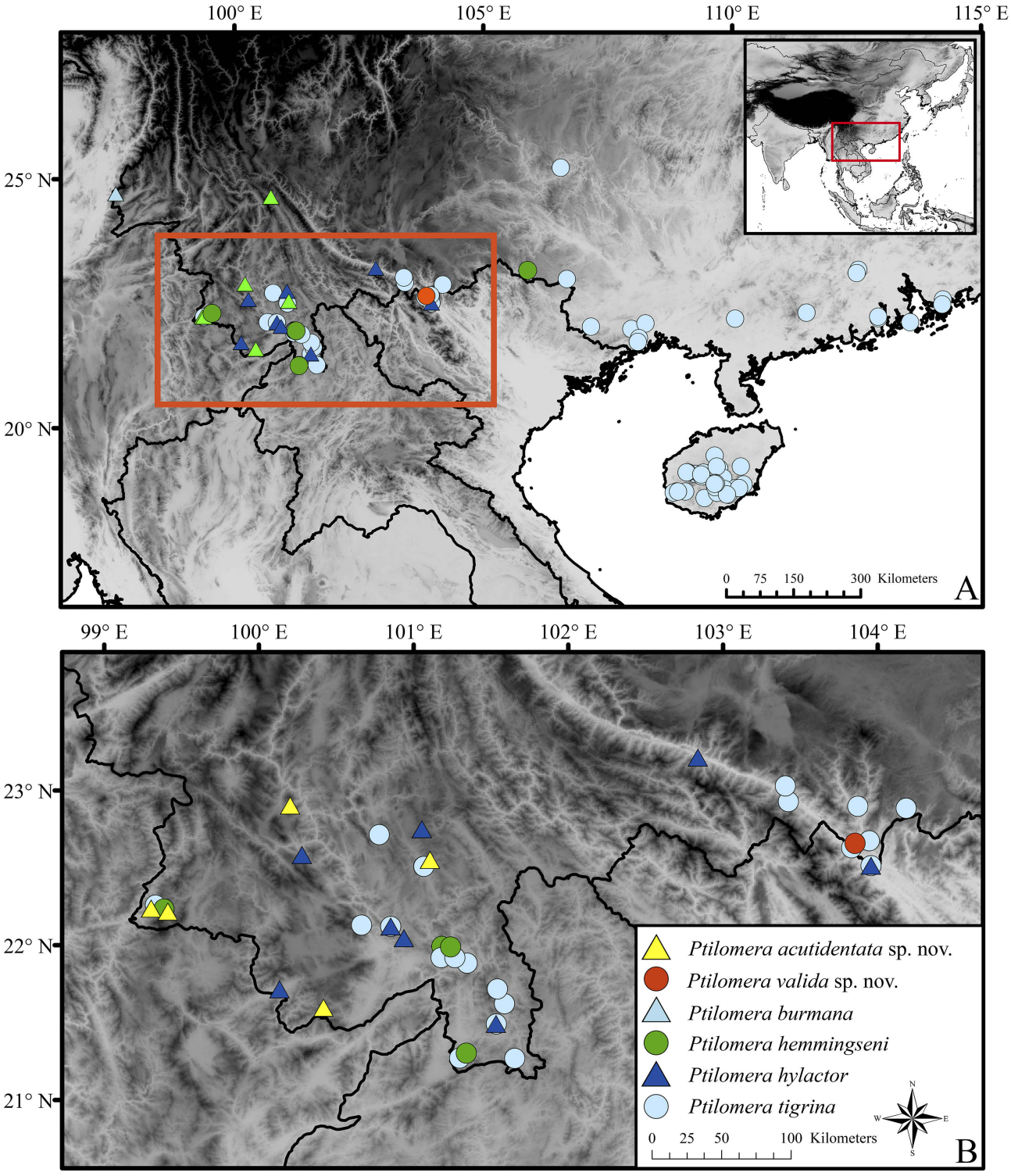

Fig. 18. Distribution map of *Ptilomera* spp. in China. A – distribution map of all species in China; B – local zoom-in distribution map in southern Yunnan, China, corresponding to the red frame in Fig. 18A.

Ptilomera tigrina Uhler, 1860

(Figs 4F, 5F, 7G, 9F, 10F, 11F, 16C, D, 17C, D, 20, 23)

Ptilomera tigrina Uhler, 1860: 230.
Ptilomera harpyia Schmidt, 1926: 65 (synonymized by Polhemus, 1991: 439).

Diagnosis. In females, the black stripe on the mesopleuron not bifurcated (Fig. 4F); abdominal mediotergite I dark-brownish, and lacking dark brownish setae medially (Fig. 16C); abdominal mediotergites II–VII mainly dark-brownish with a yellowish-brownish mark medially (Fig. 16C); abdominal segment VII elongated, nearly as long as the two preceding segments combined; connexival spines produced from the median part of dorsal margin (Fig. 4F); dorsolateral lobe relatively long; ventrolateral lobe expanded but without an angular shape (Figs 4F, 5F); median

Fig. 19. *Ptilomera hemmingseni*, habitat (A) and live habitus in situ (B, C). A – an argillaceous stream in the mountain of Meng-la, Yunnan, China; B – apterous male standing on slow-flowing water; C – macropterous female striding on fast-flowing water. Images not to scale.

Fig. 20. Habitat of *Ptilomera spp*. A – habitat of *P. hylactor* and *P. tigrina*, a rocky mountain stream in He-kou, Yunnan, China; B – habitat of *P. tigrina*, an argillaceous stream near the farmland in He-kou, Yunnan, China; C – habitat of *P. tigrina*, a rocky stream in Meng-la, Yunnan, China; D – habitat of *P. tigrina*, a rocky stream in Hong Kong, China (photographed by Michael Z. Lee). Images not to scale.

ventral lobe sub-semicircular, and covered by the ventrolateral lobe laterally in ventral view (Fig. 5F). In males, abdominal mediotergites I–V dark-brownish, with abdominal mediotergite VI bearing a yellowish-brownish mark medially (Fig. 16D); the black stripe on the mesopleuron posteriorly bifurcated; middle trochanter with dense tiny spines, middle femur bears long, dense, blackish setae on the distal 1/2 (Fig. 7G); abdominal segment VIII relatively long (Fig. 17C, D); the lateral projections of the pygophore lack distinct tufts of setae, directed downwards (Fig. 9F); the anterior margins of the lateral projections nearly paralleled to the anterior margins of the lateral wings of the proctiger (Fig. 17C); proctiger chiefly dark brownish, with the lateral wings directed distinctly downwards (Fig. 9F), surpassing the median lobe caudally; paramere elongated and simply curved, with relatively dense long setae on the apical part (Fig. 10F).

Material examined. China: 3♂, 4♀ (apterous): Guangdong Province, Tai-shan City, Bei-feng-shan Forest Park // 22°12′46.4″N, 112°56′17.2″E // 316 m a.s.l. // 1 Aug. 2022 // Xue-dong & Yao-yao Zhang leg. (NKUM); 3♂, 5♀ (apterous): Guangdong Province, Xin-yi City, He-shui Town // 22°19′22.1″N, 111°29′30.8″E // 430 m a.s.l. // 17 Jul. 2019 // Mu Qiao & Ze-zhong Jin leg. (NKUM); 4♂, 2♀ (apterous): Guangdong Province, Guangzhou City, Ding-hu Mountain // 23°10′52.0″N, 112°31′57.7″E // 318 m a.s.l. // 19 Jul. 2019 // Zhen Ye leg. (NKUM); 5♂, 13♀ (apterous): Guangdong Province, Guangzhou City, Ding-hu Mountain // 20 Apr. 1987 // Ping-ping Chen leg. (NKUM); 4♂, 3♀ (apterous): Guangdong Province, Guangzhou City, Ding-hu Mountain // 19 Sep. 1962 // Le-yi Zheng & Han-hua Cheng leg. (NKUM); 2♂, 1♀ (apterous): Guangdong Province, Zhao-qing City, Ding-hu District, Bei-ling-shan Forest Park // 23°7′1.6″N, 112°30′3.6″E // 63 m a.s.l. // 19 Jul. 2022 // Zi-he Li leg. (NKUM); 1♂, 1♀ (apterous): Guangdong Province, Tai-shan City, Si-jiu Town, Gu-dou-shan // 21 Jul. 2009 // Ying Cui leg. (NKUM); 12♂, 12♀ (apterous): Guangxi Province, Chong-

Fig. 21. *Ptilomera hylactor*, a group of adults striding on a surface area sheltered from rapids, live habitus in situ. A – dorsal view; B – dorsolateral view. Images not to scale.

Fig. 22. *Ptilomera hylactor*, live habitus in situ. A – apterous female striding on the surface of water and feeding on its prey; B – apterous female standing on water surface, lateral view; C – apterous male standing on water surface. Images not to scale.

zuo City, Ning-ming County, Pai-yang-shan Forest Park // 22°2′35.2″N, 107°9′33.8″E // 175 m a.s.l. // 12 Aug. 2022 // Mu Qiao leg. (NKUM); 2♀ (apterous): Guangxi Province, Fang-cheng-gang City, Da-lu Town, Shan-zhong-cun // 21°48′39.2″N, 108°7′29.9″E // 40 m a.s.l. // 18 Mar. 2021 // Hao Meng leg. (IZAS); 3♂, 1♀ (apterous): Guangxi Province, Fang-cheng-gang City, Na-suo Town, Na-suo Village, Bai-ma-shan-zhuang // 21°44′13.4″N, 108°6′7.5″E // 60 m a.s.l. // 9 Dec. 2020 // Kui-yan Zhang leg. (IZAS); 2♂, 1♀ (apterous): Guangxi Province, Qin-zhou City, Ba-zhai-gou // 22°6′21.2″N, 108°15′13.0″E // 76 m a.s.l. // 30 Jul. 2019 // Si-ying Fu leg. (NKUM); 2♂, 2 ♀ (macropterous): Guangxi Province, Qin-zhou City, Ba-zhai-gou // 22°6′21.2″N, 108°15′13.0″E // 76 m a.s.l. // 30 Jul. 2019 // Si-ying Fu leg. (NKUM); 3♂, 9♀ (apterous): Guangxi Province, Yu-lin City, Bo-bai County, Tian-chii-da-xia-gu // 22°12′7.9″N, 110°3′25.9″E // 176 m a.s.l. // 28 Jul. 2019 // Ze-zhong Jin & Zhen Ye leg. (NKUM); 5♂, 8♀ (apterous): Guangxi Province, Yu-lin City, Bo-bai County, Tian-chii-da-xia-gu // 22°12′7.9″N, 110°3′25.9″E // 176 m a.s.l. // 29 Jul. 2019 // Mu Qiao & Si-ying Fu leg. (NKUM); 6♂, 3♀ (apterous): Guangxi Province, Yu-lin City, Bo-bai County, Tian-chii-da-xia-gu // 22°12′7.9″N, 110°3′25.9″E // 176 m a.s.l. // 28 Jul. 2019 // Si-qi Wang leg. (NKUM); 1♀ (apterous): Guizhou Province, Qian-nan Autonomous Prefecture, Luo-dian County, Wan-li Village // 25°14′4.2″N, 106°33′14.0″E // 421 m a.s.l. // 24 Jul. 2021 // Shu-jing Wang leg. (NKUM); 4♂, 6♀ (apterous): Hainan Province, Bai-sha County,

Fig. 23. *Ptilomera tigrina*, habitat and live habitus in situ. A – a rocky stream in Le-dong, Hainan, China (photographed by Peng-xu Mu); B – a group of adults striding on surface of water at Le-dong, Hainan, China (photographed by Peng-xu Mu); C, D – adults from Shen-zhen, Guangdong, China (photographed by Qian-le Lu): C – apterous male standing on water; D – apterous female striding on water. Images not to scale.

Luo-shuai Village, Xian-nv-xi // 19°5′58.4″N, 109°32′46.2″E // 324 m a.s.l. // 26 Jul. 2017 // Zhen Ye & Juan-juan Yuan leg. (NKUM); 2♂, 1♀ (apterous): Hainan Province, Bai-sha County, Nan-kai Township // 19°6′26.0″N, 109°25′10.7″E // 221 m a.s.l. // 27 Jul. 2011 // Si-ying Fu leg. (NKUM); 3♂, 2♀ (apterous): Hainan Province, Bai-sha County, Nankai Township, Guangyuan Village, Ying-ge-ling Nature Reserve // 19°3′19.0″N, 109°26′17.0″E // 370 m a.s.l. // 21 Jul. 2013 // Sha-sha Yu leg. (NKUM); 1♂, 6♀ (apterous): Hainan Province, Bai-sha County, Shicai Village, Ying-ge-ling Nature Reserve, Nan-kai Branch Station // 19°4′23.0″N, 109°22′34.0″E // 310 m a.s.l. // 20 Jul. 2013 // Yan-hui Wang & Qiang Xie leg. (NKUM); 5♀ (apterous): Hainan Province, Bao-ting County, Nan-lin Village // 18°35′57.1″N, 109°26′36.2″E // 525 m a.s.l. // 7 Aug. 2017 // Zhen Ye leg. (NKUM); 1♀ (apterous): Hainan Province, Bao-ting County, Qi-xian-ling National Forest Park // 18°42′12.4″N, 109°41′44.7″E // 318 m a.s.l. // 4 Aug. 2017 // Zhen Ye & Juan-juan Yuan leg. (NKUM); 2♀ (apterous): Hainan Province, Chang-jiang County, Ba-wang-ling Nature Reserve // 19°7′0.0″N, 109°6′0.0″E // 630 m a.s.l. // 31 Jul. 2013 // Sha-sha Yu leg. (NKUM); 4♂, 2♀ (apterous): Hainan Province, Chang-jiang County, Ba-wang-ling Nature Reserve // 22 Apr. 2009 // Geng-ping Zhu leg. (NKUM); 1♀ (apterous): Hainan Province, Chang-jiang County, Ba-wang-ling Nature Reserve // 19°7′0.0″N, 109°5′0.0″E // 130 m a.s.l. // 27 Jul. 2013 // Yan-hui Wang leg. (NKUM); 2♂, 4♀ (apterous): Hainan Province, Chang-jiang County, Ba-wang-ling Nature Reserve, under the No. 1 Bridge // 19°7′0.0″N, 109°5′0.0″E // 130 m a.s.l. // 28 Jul. 2013 // Qiang Xie & Yan-hui Wang leg. (NKUM); 1♂, 3♀ (apterous): Hainan Province, Chang-jiang County, Qing-song Village, Ba-wang-ling Nature Reserve, Nan-sha River // 19°5′0.2″N, 109°15′58.1″E // 457 m a.s.l. // 26 Jul. 2017 // Zhen Ye & Juan-juan Yuan leg. (NKUM); 2♂, 4♀ (apterous): Hainan Province, Dan-zhou City, Lan-yang Town, Lian-hua-ling // 19°27′6.8″N, 109°38′48.5″E // 213 m a.s.l. // 21 Jul. 2017 // Zhen Ye leg. (NKUM); 3♂, 2♀ (apterous): Hainan Province, Dan-zhou City, Lu-mu-wan Waterfall // 19°13′54.6″N, 109°41′16.5″E // 202 m a.s.l. // 22 Jul. 2017 // Zhen Ye & Juan-juan Yuan leg. (NKUM); 1♂, 6♀ (apterous): Hainan Province, Le-dong County, Jian-feng-ling, Wu-fen-he Pool 3 // 18°43′58.0″N, 108°53′9.6″E // 859 m a.s.l. // 15 Aug. 2017 // Kun Jiang leg. (NKUM); 3♀ (apterous): Hainan Province, Ling-shui County, Da-xing Waterfall // 18°43′54.9″N, 109°57′1.0″E // 170 m a.s.l. // 8 Aug. 2017 // Si-ying Fu & Kun Jiang leg. (NKUM); 7♂, 8♀ (apterous): Hainan Province, Ling-shui County, Diao-luo-shan Forest Park // 18°40′14.2″N, 109°53′42.2″E // 252 m a.s.l. // 24 Aug. 2015 // Chen-guang Zheng leg. (NKUM); 7♂, 1♀ (macropterous): Hainan Province, Ling-shui County, Diao-luo-shan Forest Park // 18°40′14.2″N, 109°53′42.2″E // 252 m a.s.l. // 24 Aug. 2015 // Chen-guang Zheng leg. (NKUM); 6♂, 6♀ (apterous): Hainan Province, Ling-shui County, Diao-luo-shan Forest Park // 720 m a.s.l. // 18 May 2008 // Geng-ping Zhu leg. (NKUM); 6♂, 2♀ (macropterous): Hainan Province, Ling-shui County, Diao-luo-shan Forest Park // 720 m a.s.l. // 18 May 2008 // Geng-ping Zhu leg. (NKUM); 1♀ (apterous): Hainan Province, Qiong-zhong County, Bai-hu-shan Forest Park // 19°0′20.9″N, 109°49′6.2″E // 393 m a.s.l. // 23 Jul. 2017 // Zhen Ye leg. (NKUM); 5♂, 8♀ (apterous): Hainan Province, Qiong-zhong County, Beng-ling Village // 18°46′42.7″N, 109°50′29.3″E // 253 m a.s.l. // 8 Aug. 2017 // Zhen Ye, Juan-juan Yuan & Kun Jiang leg. (NKUM); 1♂ (apterous): Hainan Province, Qiong-zhong County, Li-mu Mountain // 19°11′11.1″N, 109°44′21.4″E // 631 m a.s.l. // 25 Jul. 2017 // Zhen Ye leg. (NKUM); 4♂, 4♀ (apterous): Hainan Province, Qiong-zhong County, Chang-xing Village // 18°48′4.2″N, 110°4′38.2″E // 158 m a.s.l. // 11 Aug. 2017 // Zhen Ye leg. (NKUM); 5♂, 4♀ (apterous): Hainan Province, Tun-chang County, Nan-lv-ling // 19°13′49.0″N, 110°10′20.8″E // 172 m a.s.l. // 24 Jul. 2017 // Kun Jiang leg. (NKUM); 1♂, 4♀ (apterous): Hainan Province, Wan-ning City, Jian-feng-ling Nature Reserve // 18°43′49.7″N, 108°54′33.0″E // 800–900 m a.s.l. // 6 Dec. 2009 // Kai Dang leg. (NKUM); 5♀ (apterous): Hainan Province, Wan-ning City, Jian-feng-ling Nature Reserve // 18°43′49.7″N, 108°54′33.0″E // 14 Dec. 2010 // Zhen Ye leg. (NKUM); 4♂, 3♀ (apterous): Hainan Province, Wan-ning City, Jian-feng-ling Nature Reserve // 350 m a.s.l. // 29 Jul. 2008 // Cui-qing Gao leg. (NKUM); 8♂, 4♀ (apterous): Hainan Province, Wan-ning City, Jian-feng-ling Nature Reserve, Bai-shui-ling // 18°52′21.5″N, 110°13′32.2″E // 86 m a.s.l. // 9 Aug. 2017 // Si-ying Fu & Kun Jiang leg. (NKUM); 4♂, 4♀ (apterous): Hainan Province, Wan-ning City, Jian-feng-ling Nature Reserve, Bai-shui-ling // 18°52′21.5″N, 110°13′32.2″E // 86 m a.s.l. // 9 Aug. 2017 // Zhen Ye & Juan-juan Yuan leg. (NKUM); 4♂, 1♀ (macropterous): Hainan Province, Wan-ning City, Jian-feng-ling Nature Reserve, Bai-shui-ling // 18°52′21.5″N, 110°13′32.2″E // 86 m a.s.l. // 9 Aug. 2017 // Zhen Ye & Juan-juan Yuan leg. (NKUM); 2♂, 9♀ (apterous): Hainan Province, Wan-ning City, Jian-feng-ling Nature Reserve, Yu-lin-gu // 18°42′30.9″N, 108°49′20.2″E // 1 Aug. 2017 // Juan-juan Yuan leg. (NKUM); 5♂, 7♀ (apterous): Hainan Province, Wan-ning City, Xing-long County, Ai-qing-gu // 18°47′54.3″N, 110°8′19.8″E // 148 m a.s.l. // 11 Aug. 2017 // Zhen Ye leg. (NKUM); 5♂, 7♀ (apterous): Hainan Province, Wan-ning City, Xing-long County // 100 m a.s.l. // 1 Aug. 2008 // Cui-qing Gao leg. (NKUM); 4♀ (apterous): Hainan Province, Wu-zhi-shan City, Shui-man Township // 18°53′21.0″N, 109°40′9.8″E // 600–750 m a.s.l. // 17 May 2007 // Ji-meng Hua leg. (NKUM); 14♂, 11♀ (apterous): Hainan Province, Wu-zhi-shan City, Shui-man Township // 650–700 m a.s.l. // 19 May 2007 // Xu Zhang & Ji-meng Hua leg. (NKUM); 4♂, 4♀ (apterous): Hainan Province, Wu-zhi-shan City, Shui-man Township // 740 m a.s.l. // 14 Apr. 2009 // Yi-ran Mu leg. (NKUM); 8♂, 5♀ (apterous): Hainan Province, Wu-zhi-shan City, Xin-min Village // 18°49′6.7″N, 109°39′25.0″E // 579 m a.s.l. // 6 Aug. 2017 // Zhen Ye & Juan-juan Yuan leg. (NKUM); 2♂, 6♀ (apterous): Hainan Province, Bai-sha County, Ying-ge-ling Nature Reserve, Ying-ge-ling Management Station // 10 Dec. 2009 // Qing Zhao leg. (NKUM); 7♂, 7♀ (apterous): Yunnan Province, Pu-er City, Lan-cang County, Long-tan // 800 m a.s.l. // 27 Nov. 2011 // Wei-bing Zhu leg. (NKUM); 3♂, 3♀ (apterous): Yunnan Province, Hong-he Autonomous Prefecture, Old City, Lv-xiao-he // 23°1′43.0″N, 103°24′9.4″E // 467 m a.s.l. // 31 Jul. 2020 // Xue Dong leg. (NKUM); 1♀ (apterous): Yunnan Province, Hong-he Autonomous Prefecture, He-kou County, Nan-xi Town, Hua-yu-dong // 22°40′31.4″N, 103°56′44.6″E // 14 Apr. 2011 // Zhen Ye leg. (NKUM); 4♂, 4♀ (apterous): Yunnan Province, Hong-he Autonomous Prefecture, He-kou County, Nan-xi Town, Hua-yu-dong // 22°30′50.0″N, 103°57′21.0″E // 84 m a.s.l. // 5 Jan. 2023 // Zhao-qi Leng leg. (NKUM); 1♀ (apterous): Yunnan Province, Pu-er City, Meng-lian County, Meng-ma Town, Meng-ma Waterfall // 22°14′7.0″N, 99°23′5.6″E // 981 m a.s.l. // 22 Aug. 2016 // Run-xi Wang leg. (NKUM); 22♂ (apterous): Yunnan Province, Xi-shuang-ban-na Autonomous Prefecture, Jing-hong City, Meng-la County // 24 Sep. 1979 // Le-yi Zheng & Guo-qing Liu leg. (NKUM); 4♂ (apterous): Yunnan Province, Xi-shuang-ban-na Autonomous Prefecture, Jing-hong City, Meng-la County // 18 Sep. 1979 // Huan-guang Zou leg. (NKUM); 4♂, 5♀ (apterous): Yunnan Province, Xi-shuang-ban-na Autonomous Prefecture, Jing-hong City, Meng-la County, Meng-lun Town, Ba-ka-xiao-zhai // 21°57′57.0″N, 101°12′16.2″E // 747 m a.s.l. // 5 Jul. 2018 // Juan-juan Yuan & Yan-fei Li leg. (NKUM); 3♂, 9♀ (apterous): Yunnan Province, Xi-shuang-ban-na Autonomous Prefecture,

Jing-hong City, Meng-la County, Meng-lun Town, Ba-ka-xiao-zhai // 21°57′39.0″N, 101°12′46.0″E // 630 m a.s.l. // 8 Aug. 2012 // Yan-hui Wang leg. (NKUM); 6♂, 6♀ (apterous): Yunnan Province, Xi-shuang-ban-na Autonomous Prefecture, Jing-hong City, Meng-la County, Meng-lun Town, Ba-ka-xiao-zhai // 21°57′45.4″N, 101°12′6.1″E // 747 m a.s.l. // 9 Jul. 2021 // Run-qi Zhu leg. (NKUM); 5♂, 1♀ (apterous): Yunnan Province, Xi-shuang-ban-na Autonomous Prefecture, Jing-hong City, Meng-la County, Meng-lun Town, 213 National Highway 2879 km // 21°57′39.0″N, 101°12′46.0″E // 630 m a.s.l. // 8 Aug. 2012 // Hua-xi Liu leg. (NKUM); 4♂, 2♀ (apterous): Yunnan Province, Xi-shuang-ban-na Autonomous Prefecture, Jing-hong City, Meng-la County, Meng-lun Town, Man-zhang Village // 22°7′19.2″N, 100°51′4.7″E // 534 m a.s.l. // 3 Aug. 2010 // Qing Zhao & Rui Wang leg. (NKUM); 28♂, 27♀ (apterous): Yunnan Province, Xi-shuang-ban-na Autonomous Prefecture, Jing-hong City, Meng-la County, Meng-lun Town, Man-zhang Village // 4 Aug. 2010 // Qing Zhao & Rui Wang leg. (NKUM); 12♂, 11♀ (apterous): Yunnan Province, Xi-shuang-ban-na Autonomous Prefecture, Jing-hong City, Meng-la County, Meng-lun Town, Man-zhang Village // 4 Aug. 2010 // Jing Wang & Kai Dang leg. (NKUM); 3♂, 8♀ (apterous): Yunnan Province, Xi-shuang-ban-na Autonomous Prefecture, Jing-hong City, Meng-la County, Mo-han Town // 21°16′10.9″N, 101°39′9.0″E // 804 m a.s.l. // 12 Jan. 2023 // Zhao-qi Leng leg. (NKUM); 5♂, 3♀ (apterous): Hong Kong, Bo-fu-lin Park // 22°15′59.7″N, 114°8′25.1″E // 162 m a.s.l. // 28 Jun. 2023 // Michael Z. Lee leg. (NKUM).

Distribution. China: Guangdong, Guangxi, Guizhou, Hainan, Hongkong, Yunnan, Macao; Cambodia; Laos; Thailand; India; Malaysia; Indonesia: Sumatra.

Remarks. *Ptilomera tigrina* Uhler, 1860 is a widespread species that ranges from subtropical to tropical regions. This species was originally described by Uhler (1860) based on type specimens from Hong Kong, China. We found specimens of this species from Guangdong, Guangxi, Hainan and Hong Kong, China (Fig. 16C, D) that completely fit the original description.

We observed *P. tigrina* inhabiting all kinds of streams (Figs 20A–D, 23A), even those obviously affected by human activities, such as streams passing through farmland (Fig. 18B), showing that this species has a great ability to adapt to disturbed environments. Both males and females of *P. tigrina* have a dark-brownish body color (Fig. 23B–D), which could help them blend into the dark background (Fig. 23B) of such streams.

DISCUSSION

Distribution, ecology and behavior

Polhemus (2001) and Cheng et al. (2006) reported specimens of both sexes identified as *Ptilomera assamensis* Hungerford & Matsuda, 1965 from Menghai, Xishuangbanna, Yunnan, China. We have not seen those specimens, nor did our extensive collecting in that region yield this species and, furthermore, we could not find any such specimens in museums. We include *P. assamensis* in the above key based only on the literature, but we do not present diagnosis of this species and therefore its presence in China requires verification; the above reports from Yunnan might be based on specimens of the morphologically similar and distributionally compatible *P. acutidentata* sp. n. There are still some insufficiently investigated areas that *Ptilomera* species might inhabit (such as the western areas of Guangxi and Yunnan and low altitude areas on the margins of the Tibetan Plateau). Further surveys in these areas may uncover additional species.

Ptilomera has an extremely wide distribution pattern, mostly concentrated in the tropics near the equatorial region (Hungerford & Matsuda, 1965; Polhemus & Polhemus, 2001; Jehamalar et al., 2018). However, the present study shows that five or possibly six species of *Ptilomera* (should the occurrence of *P. assamensis* be confirmed) co-exist in Xishuangbanna, Yunnan (Fig. 18B). In contrast, only one species (*P. tigrina*) is found in Guangxi and Hainan (Fig. 18A).

Ptilomera species are usually observed in small or moderately sized streams (Figs 19A, 20, 23A), with the nymphs preferring relatively still water sections and the adults preferring somewhat faster flowing waters with a single smooth direction of flow (Raruanysong et al., 2014), where they can glide against the current without being swept away by turbulent flow (Fig. 21A, B). This is essentially the same pattern of behavior as seen in another genus, *Potamometra*, and the two genera are similar in size, but with no distributional overlap between them. Mating behavior in *Ptilomera* has rarely been observed, although night mating was reported to the authors by some insect collectors in *Ptilomera tigrina*, the most widespread species in the genus.

Morphological forms of *Ptilomera tigrina*

Ptilomera tigrina was described by Uhler (1860) based on the type specimens collected from Hongkong, China. Hungerford & Matsuda (1965) hypothesized that another species, *P. harpyia* Schmidt, 1926 (collected from Cambodia and Laos), might be same as *P. tigrina* and required further comparison with the male of *P. tigrina*. Polhemus (1991) placed *P. harpyia* as a synonym of *P. tigrina* based on the similarity of genitalic structures of the males. However, distinct morphological differences have been observed in specimens of *P. tigrina* from other sites. Based on specimens in our collection (i.e., material from China, Laos, Thailand, Vietnam, and western Malaysia), there are at least two morphological forms of "*P. tigrina*": (1) The classical form of *P. tigrina*, which agrees with the original description of this species, and was only found in China (Guangdong, Guangxi, Hainan and Hongkong). For the classical form, the ventrolateral lobes are distinctly expanded in females, and the sizes of abdominal segment VIII, pygophore, proctiger, and paramere are relatively larger in males, with the lateral wings of proctiger elongated. (2) The typical "*P. harpyia*" form, widespread from Yunnan, China to Indochina and Peninsular Malaysia. In this form, the ventrolateral lobes are moderately expanded in females, and the sizes of abdominal segment VIII, pygophore, proctiger, and paramere are relatively smaller in males, with the proctiger having less extended lateral wings. Whether different morphological forms within *P. tigrina* constitute cryptic species remains to be further investigated in the future based on molecular data.

ACKNOWLEDGEMENTS. We thank the members of our lab for collecting the specimens. We express our gratitude to the three reviewers who participated in the peer-review process and provided constructive suggestions for improvement. We are also grateful to Q.-L. Lu and P.-X. Mu for providing the photographs of the habitus and habitat of *Ptilomera tigrina*; to C.-Y. Jiang for loan of the material at the Institute of Zoology, Chinese Academy of Sciences, Beijing, China; to M.Z. Lee for providing the specimens and photographs of the habitat of *P. tigrina* from Hong Kong, China; to H.-Y Li, L. Liang and H. Xun for providing the specimens of *P. tigrina* from Hainan and Yunnan. This project is supported by Natural Science Foundation of China (No. 32322012), National Science & Technology Fundamental Resources Investigation Program of China (No. 2019FY100402) and Fundamental Research Funds for the Central Universities, Nankai University (No. 20JCQNJC01420).

REFERENCES

Andersen N.M. 1967: The genus *Ptilomera* Amyot & Serville in Thailand, with a new species from the north (Hemiptera: Gerridae). — *Entomol. Meddel.* **35**: 309–314.

Chen P.P., Nieser N. & Zettel H. 2005: *The Aquatic and Semiaquatic Bugs (Heteroptera: Nepomorpha and Gerromorpha) of Malesia. Fauna Malesiana Handbook 5.* Brill, Leiden, Boston, 546 pp.

Cheng L., Yang C., Li D. & Liu H. 2006: Aquatic Heteroptera (Insecta: Gerromorpha and Nepomorpha) from Xishuangbanna, Yunnan, China. — *Raffles Bull. Zool.* **54**: 203–214.

Gupta Y.C. & Chaturvedi D.K. 2008: On a new species of water skater, *Ptilomera* Amyot and Serville, 1843 from India (Hemiptera: Heteroptera, Gerridae). — *Asian J. Exp. Sci*. **22**: 165–170.

Hungerford H.B. & Matsuda R. 1965: The genus *Ptilomera* Amyot and Serville (Gerridae: Hemiptera). — *Univ. Kansas Sci. Bull.* **45**: 397–515.

Jehamalar E.E., Chandra K., Zettel H., Basu S., Barman B., Gupta S. & Subramanian K.A. 2014: Two new species of *Pleciobates* (Hemiptera: Gerromorpha: Gerridae) from India, with a key to the species of *Pleciobates*. — *Zootaxa* **3866**: 435–445.

Jehamalar E.E., Chandra K., Basu S. & Selvakumar C. 2018: Review of *Ptilomera* (*Ptilomera*) (Hemiptera: Heteroptera: Gerridae) from India, with description of a new species. — *Zootaxa* **4370**: 501–518.

Leng Z., Tran A.D. & Ye Z. 2023: Taxonomic review of *Rhyacobates* Esaki, 1923, with descriptions of three new species (Hemiptera: Heteroptera: Gerridae). — *Eur. J. Taxon.* **893**: 1–73.

Polhemus D.A. 2001: A review of the genus *Ptilomera* (Heteroptera: Gerridae) in Indochina, with descriptions of two new species. — *J. N. Y. Entomol. Soc.* **109**: 214–234.

Polhemus D.A. 2017: An initial survey of aquatic and semiaquatic Heteroptera (Insecta) from the Cardamom Mountains and adjacent uplands of southwestern Cambodia, with descriptions of four new species. — *Tijdschr. Entomol.* **160**: 89–138.

Polhemus D.A. & Polhemus J.T. 2001: A revision of the genus *Ptilomera* (Heteroptera: Gerridae) on New Guinea and nearby islands. — *J. N. Y. Entomol. Soc.* **109**: 81–166.

Polhemus J.T. 1991: Nomenclatural notes on aquatic and semiaquatic Heteroptera. — *J. Kansas Entomol. Soc.* **64**: 438–443.

Polhemus J.T. & Polhemus D.A. 2008: A new genus of ptilomerine Gerridae (Hemiptera: Heteroptera) from Flores, Lesser Sunda Islands. — *Proc. Entomol. Soc. Wash.* **110**: 1042–1049.

Raruanysong S., Vitheepradit A. & Sites R.W. 2014: Key to the species of Ptilomerinae (Hemiptera: Heteroptera: Gerridae) of Thailand and review of the fauna of the Tennaserim Mountain Range. — *Zootaxa* **3852**: 101–117.

Uhler P.R. 1860: Hemiptera of the North Pacific exploring expedition under Com'rs Rodgers and Riaggold. — *Proc. Acad. Nat. Sci. Philadelphia* **12**: 230–231.

Vitheepradit A. & Sites R.W. 2007: A review of *Ptilomera* (Heteroptera: Gerridae) of Thailand with descriptions of three new species. — *Ann. Entomol. Soc. Am.* **100**: 139–151.

Zettel H. 2009: Three new genera of Ptilomerinae (Hemiptera: Heteroptera: Gerridae) from Southeast Asia. — *Zootaxa* **2046**: 26–42.

Zettel H. & Chen P.P. 1996: Beitrag zur Taxonomie und Faunistik der Gerridae Vietnams mit Neubeschreibungen der Gattung *Andersenius* gen. nov. aus der Unterfamilie Ptilomerinae und weiterer Arten (Insecta: Heteroptera: Gerridae). — *Entomol. Abh. Staatl. Mus. Tierk. Dresden* **57**: 149–182.

Received November 11, 2023; revised and accepted March 7, 2024
Published online April 10, 2024