

Systematic status of true katydids *Sathrophyllia* (Orthoptera, Tettigoniodea, Pseudophyllinae) from Pakistan, with description of two new species

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Abstract

The genus *Sathrophyllia* Stål, 1874 from Pakistan is reviewed with four species recorded. The diagnostic characters are given and two new species *Sathrophyllia saeedi* sp. n. and *Sathrophyllia irshadi* sp. n. are described. In addition to that *Sathrophyllia* nr. *rugosa* (Linnaeus, 1758) and *Sathrophyllia femorata* (Fabricius, 1787) are re-described. Further information on the distribution and ecology of the species is given and a key to studied to Pakistan species of *Sathrophyllia* is presented. *Sathrophyllia femorata* (Fabricius, 1787) and *S. rugosa* (Linnaeus, 1758) are recorded from Rawalakot (KPK) and Tharparker (Sindh), Pakistan for first the time.

Keywords

Sathrophyllia, new record, systematics, identification, new species, Pakistan

Introduction

Bushcrickets or katydids belonging to the Tettigoniodea consume a wide variety of agricultural crops including forests, fruit orchards, and berry shrubs, and many species are ecologically associated with forest biocenoses, damaging trees and shrubs in addition to herbaceous plants (Riffat and Wagan 2012).

Sathrophyllia was erected by Stål in 1874 with type species *Sathrophyllia fuliginosa*. This genus consists of six species Barman (2003). Previously, many authors Stål 1874; Brunner 1893, 1895; Kirby 1906; Karny 1923, 1924; Beier 1954, 1962, 1963; Otte 1997) carried out work on the morphology and taxonomic status of *Sathrophyllia* (true katydids) from tropical Asia and southern Arabia including the Indian subcontinent; after this there are no updated records available on this genus.

The present study fills some gaps in the existing knowledge. Furthermore, the addition of two new species proved to be a contribution to the biodiversity of *Sathrophyllia* fauna. Additionally, the findings of the present study will be useful in making predictions about the relationship between the species and for accurate identification in the future.

Material and methods

The adult *Sathrophyllia* were collected from meadow grass, bushes, with mixed vegetation (herbs, shrubs and grasses) and tress with the help of traditional insect hand-nets (8.89 cm in width and 50.8 cm in length). For killing and preservation of specimens, the standard entomological methods described by Vickery and Kevan (1983) and Riffat and Wagan (2012) were adopted for all collected species. Identification of specimens was carried out under a stereoscopic dissecting binocular microscope (OLYMPUS SZX7, SZ2-ILST) with the help of keys and descriptions available in the scientific literature. The diagrams were all drawn with the help of an “Ocular Square Reticule” fitted in one eyepiece of the binocular microscope. All measurements are given in millimeters and were made with scales, dividers, and ocular square reticules. All the material is deposited in the Sindh Entomological Museum (SEM) Department of Zoology, University of Sindh, Jamshoro, Pakistan.

Results and discussion

Checklist of *Sathrophyllia* species

Sathrophyllia arabica Krauss, 1902 Arabian Peninsula
Sathrophyllia cristata Beier, 1954 Indo-China, Thailand
Sathrophyllia femorata (Fabricius, 1787) Pakistan **new record**
Sathrophyllia fuliginosa Stål, 1874 Indian Subcontinent, Nepal
Sathrophyllia rugosa (Linnaeus, 1758) Pakistan **new record**
Sathrophyllia acutipennis Beier, 1954 Malesia, Borneo
Sathrophyllia saeedi **sp. n.**
Sathrophyllia irshadi **sp. n.**

Key to species of *Sathrophyllia* Stål, 1874 occurring in Pakistan

- 1 Pronotum with one pointed tooth at anterior side, 6.3 mm in length (Fig. 1 a, b) **2**
- Pronotum without pointed tooth at anterior side, 9 mm in length (Fig. 2a, h) **femorata**
- 2 Ovipositor 10.3 mm long, with small tooth on its apex (Fig. 1e) **nr. rugosa**
- Ovipositor 18 mm long, without small tooth on its apex (Fig. 4 e) **3**
- 3 Pronotum with tubercles, brown from dorsal side, 9.5 mm in length (Fig. 4c, d) **irshadi sp. n.**
- Pronotum without tubercles, paler from dorsal side, 10 mm in length (Fig. 3a, b) **saeedi sp. n.**

Tribe Cymatomerini

Figs 1–4

Diagnosis. Size medium to large, head usually short and rounded in appearance, face not slanting or flattened, head finely punctuated, forehead usually pale in color. Pronotum strong with or without tubercle on its apex. Ovipositor with or without spines on its apex.

Sathrophyllia* Stål, 1874Dehaania* Koningsberger, 1902.

Diagnosis. Pronotum with or without tubercle on it, size medium or large (sometimes very large), head usually short and rounded, face not slanting or flattened; antennae longer than body, inserted between eyes. The fore margin of the tegmina is not or only very faintly undulate. In this character it differs from *Olcinia* Stål where the fore margin shows distinct lobes. In most species of *Sathrophyllia* the tegmina are tapering towards the apical part, not broadly rounded as in the genera *Tegra* Walker and in many species of the genus *Olcinia* Stål.

***Sathrophyllia* nr. *rugosa* (Linnaeus, 1758)**

Fig. 1a–e

Diagnostic features. Dark brown tegmina with distinct dots (Fig. 1a, b, c). Pronotum has one pointed tooth on anterior side and several on posterior end; in the centre two transverse sulci are located just behind the middle (Fig. 1a–d). Centre of fore, mid,

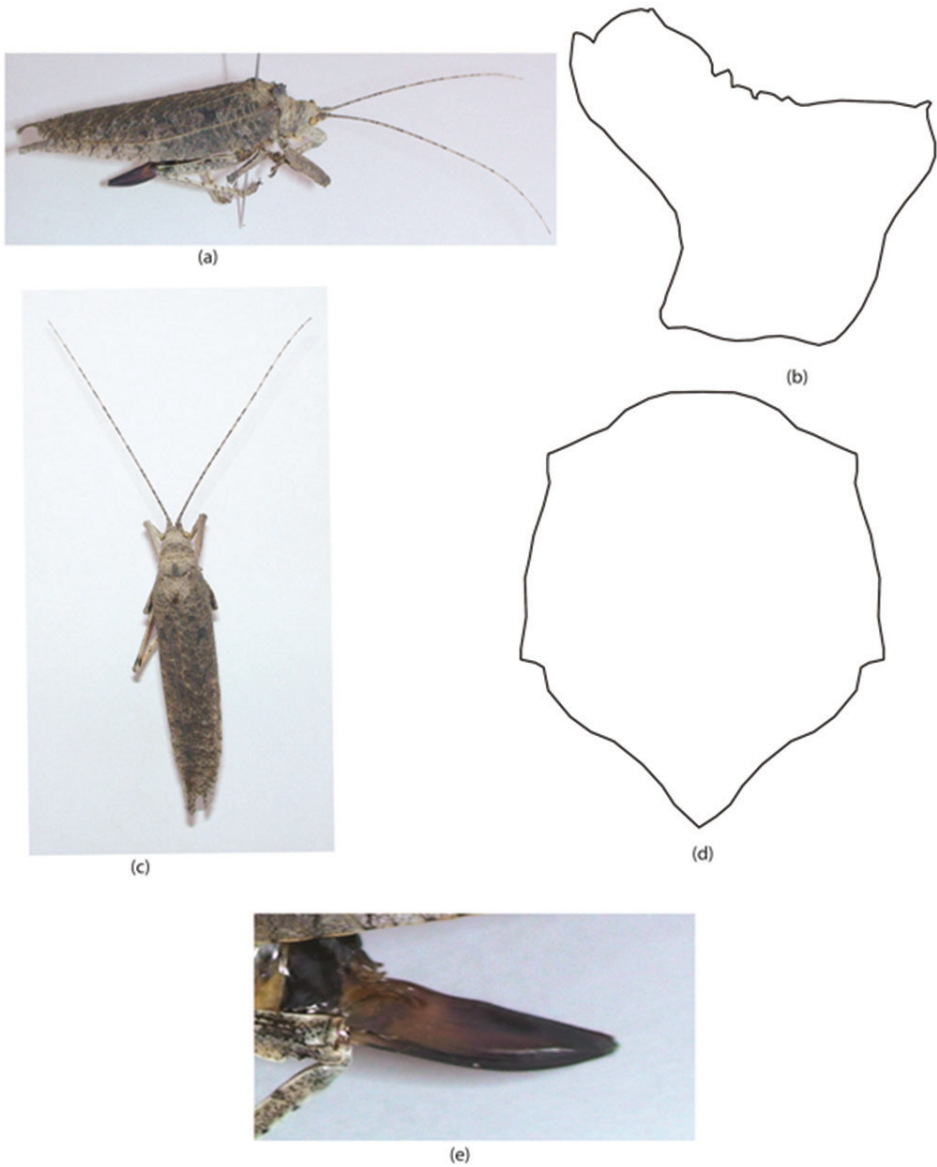


Figure 1. *Sathrophyllia* nr. *rugosa* Female; **a** adult LV **b** pronotum LV **c** adult DV **d** pronotum DV **e** ovipositor LV. Key: LV = lateral view, DV = dorsal view, VV = ventral view.

and hind femur with rounded dots on its lower side. Tegmina slightly shorter than wings. Ovipositor with small teeth on its apex (Fig. 1e).

Length measurements. ♀: pronotum, 6.3 mm; tegmina, 42 mm; femur, 10.3 mm; tibia, 8.7 mm; ovipositor, 10.3 mm; total body length, 25.9 mm.

Material examined. Pakistan, Sindh, Tharparkar, Mithi, 1♀, 10.viii.2013, 24.7400°N, 69.8000°E (leg. Riffat S & Waheed AP).

Remarks. This species is very closely related to *S. rugosa* (Linnaeus, 1758) but it differs due to following morphological analysis: it is smaller in size, the presence of serration on the ovipositor, coloration and width (4.2 mm). Furthermore, *S. rugosa* was described from Himalayas and the high altitudes and colder areas but the present specimen is coming from the desert area of Tharparkar, Sindh. Despite is uncertain placement, it is a new record for the area. The present investigation confirms the statement of the great Sir Uvarov (1924) that “The desert of Sindh harbours striking Orthoptera”. We agree on Sir Uvarov’s statement.

Ecology. *Sathrophyllia* nr. *rugosa* has been collected from flat habitats. These habitats are usually surrounded by sand dunes comprising of sandy loam soils supporting a large number of taxa. The community formation of tree species such as *Prosopis cineraria* and *Tamarix aphylla* is present. Furthermore, katydids were also noted to have a close association with *Citrillus colycynthis*, *Dactyloctenium scindicum* and *Poa tenella* in the survey areas.

Sathrophyllia femorata (Fabricius, 1787)

Fig. 2a–h

Sathrophyllia orientalis (Rehn, 1909), p. 200: figs 22, 23.

Sathrophyllia punctifrons Karny, 1927, p. 8.

Diagnostic features. Generally brown in color, suffused with drab at tegmina at the base of costal field and to a lesser degree on the distal half (Fig. 2a, b); nodes on the veins of the distal half of tegmina brown; eyes brown, antennae annulate with dark brown, median limbs irregularly spotted and caudal tibiae incompletely annulate with brown coloration; genicular part of caudal femora brown; abdomen blackish brown (Fig. 2 c, d, e). Size medium, with a slightly depressed form; head smooth, depressed with dorsal length nearly two thirds of the pronotum. Pronotum strongly tuberculate (Fig. 2b, h); occiput slightly descending to very broad intraocular region. Fastigium of vertex sharply and considerably produced, moderately tapering, proximal width slightly exceeding half the width of the compound eyes; dorsum of fastigium deplinate, with a slight medial longitudinal sulcus. Lateral carina indicated by pair of rows of tubercles. Tegmina of peculiar texture, with low nodes of short cross-veins. Wings extended to tip of closed tegmina; mesosternum strongly transverse. Ovipositor without tooth on its apex. Cerci nearly reaching tip of subgenital plate, straight, robust, tapering at proximal two thirds. Subgenital plate produced into pair of depressed styliform processes of plate, slightly broader, apices bluntly acute (Fig. 2f–g).

Length measurements. ♂ pronotum, 9 mm ; tegmina, 41 mm; femur, 16 mm; tibia, 15 mm; total body length, 30 mm. ♀, pronotum, 11 mm; tegmina, 46 mm; femur, 18 mm; tibia, 16 mm; ovipositor, 20 mm; total body length, 32 mm.

Material examined. Rawalakot 1 ♂ & 1 ♀, 11.ix.2013, 33.51°N, 73.45°E (leg. Riffat S & Waheed AP).

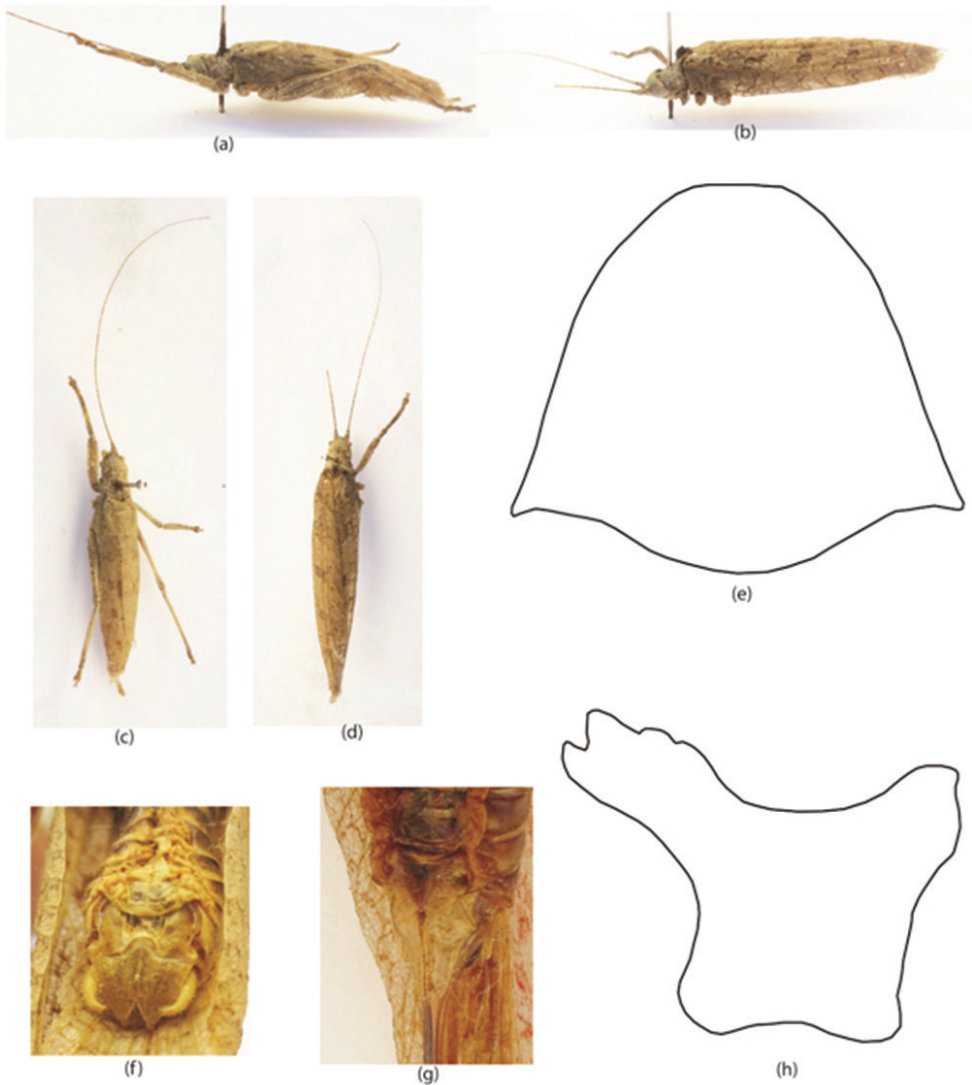


Figure 2. *Sathrophyllia femorata* **a–h** Male & Female **a** adult male LV **b** adult female LV **c** adult male DV **d** adult female DV **e** pronotum male DV **f** male subgenital plate **g** female subgenital plate **h** pronotum male LV.

Remarks. Earlier, Brunner (1893) provided a revision of the genus *Sathrophyllia* from Italy and reported that *Sathrophyllia femorata* occurs in maximum numbers in Genova. At present we have reported 1♂ & 1♀ of this species from Pakistan, which are also new records for Rawalakot. The present study recommends that more detail surveys are needed to explore areas in order to improve the knowledge of this genus.

Ecology. During the field surveys, it was observed that *Sathrophyllia femorata* fed exclusively in the cultivated field habitats occurring near valleys. These valleys were dominated by the grasses *Cynodon dactylon* and *Desmostachya-Brachiaria*. Present study suggests that most probably they feed on these grasses but our later study with more specimens will confirm this fact. Marini et al. (2010) also stated that as grasses having favorable of moisture level that attract species for their essential activities e.g breeding, feeding and overwintering. Possibly the grasses accumulate more visiting species to these habitats by providing appropriate environment for foraging and reproduction.

***Sathrophyllia saeedi* sp. n.**

<http://zoobank.org/9733C527-13B3-429F-ACB4-EB8C814367F3>

Fig. 3a–c

Diagnosis. This new species is closely related to *Sathrophyllia femorata* but differs in coloration and body size and in having a unique light brownish coloration. It is also smaller in size than *femorata* by approximately 3 mm. Body medium size; pronotum with tubercles and tegmina wider in the middle slightly tapering at apex. Ovipositor small in size, thick at its basal part and serrated at apex (Fig. 3e).

Description. Head short, rounded, slightly ovoid at apex; pronotum with tubercles (Fig. 3b, d); size medium; antennae longer than the body length (Fig. 3a, c). Fastigium of frons with brownish spots. Pronotum paler in color dorsally, brown at posterior part. Eyes ovoid, brownish in color. Body light brown in color; antennae yellowish at scapus and with brownish spots; fastigium with brownish spots; abdomen brownish in color. Tegmina have brownish or dark brownish patches in a lunar shape. Ovipositor small, thick at its basal part, and serrated at apex (Fig. 3e). Ovipositor brown at base and over-all yellowish in color.

Length measurements. ♀: pronotum 10 mm, tegmina 47 mm, femur 19 mm, tibia 16 mm, ovipositor 18 mm, total body length 29 mm.

Material examined. Rawalakot, 1♀, 11.ix.2013, 33.51°N, 73.45°E (leg. Riffat S & Waheed AP).

Remarks. This new species is closely related to *Sathrophyllia femorata* but differ in the tegmina. The tegmina of *femorata* is of a peculiar texture with low nodes of short cross veins, whilst the tegmina in new species is brownish and has dark brownish patches on it producing a lunar shape.

Ecology. *Sathrophyllia saeedi* apparently has been found in the agricultural/cultivated field habitats between dunes in valleys where *Desmostachya-Brachiaria cynodon* was dominant. Moreover, the valleys were comprised of different plant communities such as *Achyranthus aspera*, *Alhagi maurorum*, *Dactyloctenium aegypticum*, *Cenchrus ciliaris*, and *Cynodon dactylon*. The present study suggests that few grasshopper species were probably able to utilize these resources of such a habitat for promoting their breeding and feeding activities.

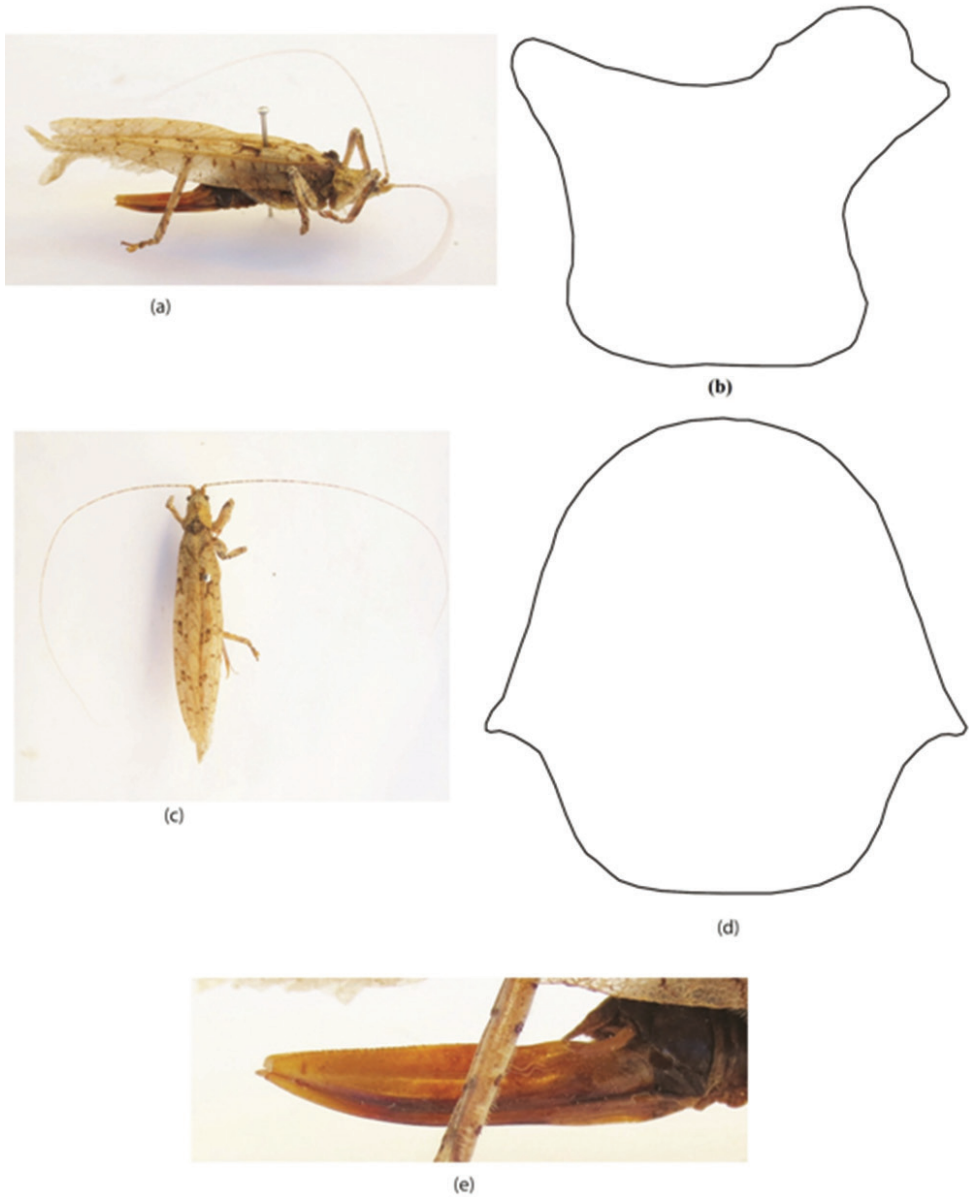


Figure 3. *Sathrophyllia saeedi* sp. n. female **a** adult LV **b** pronotum LV **c** adult DV **d** pronotum DV **e** ovipositor LV.

Derivatio nominis. This new species is named in honor of Prof. Dr. Muhammed Saeed Wagan, a renowned taxonomist and ex-chairperson, Department of Zoology, University of Sindh, and the person who opened the door of entomology to us.

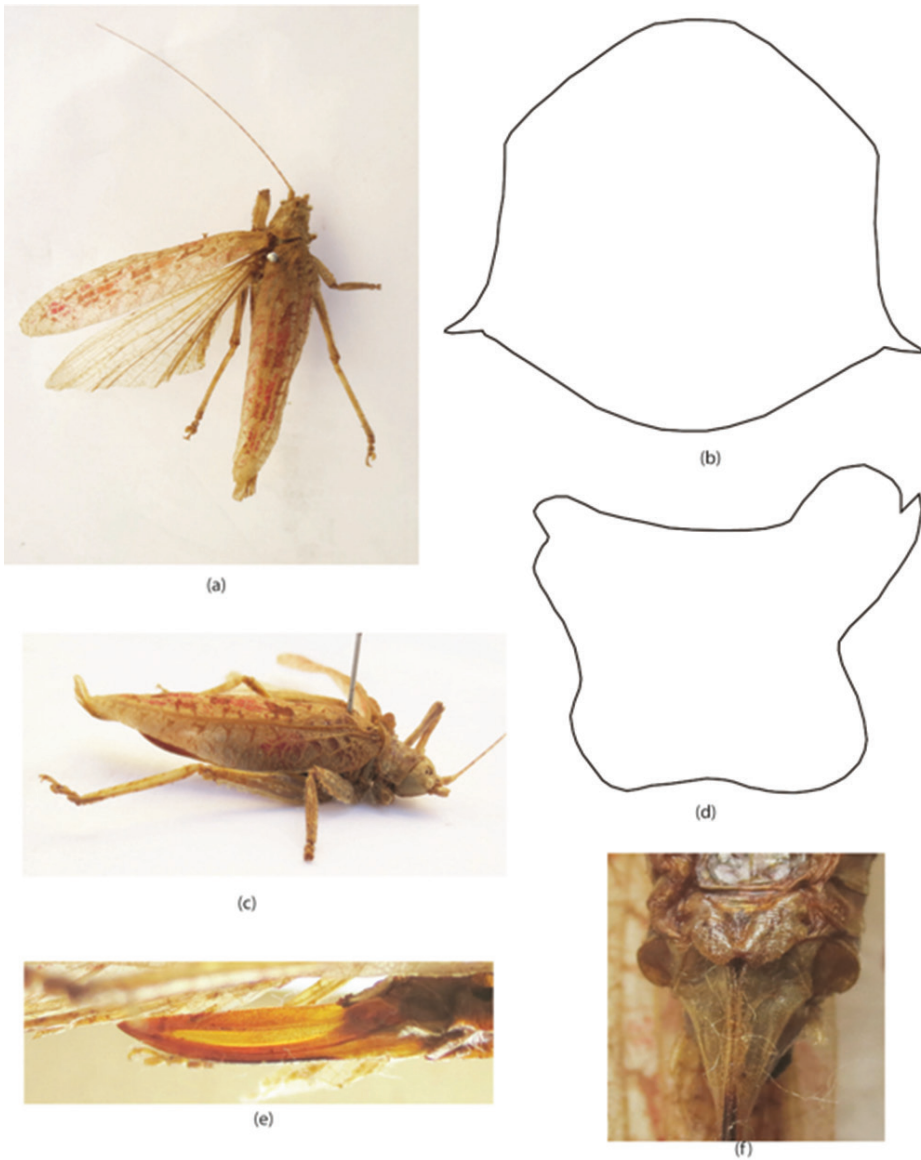


Figure 4. *Sathrophyllia irshadi* sp. n. female **a** adult DV **b** pronotum DV **c** adult LV **d** pronotum LV **e** ovipositor LV **f** subgenital plate VV.

***Sathrophyllia irshadi* sp. n.**

<http://zoobank.org/60683DF8-542B-4249-893E-CF04E0496E63>

Fig. 4a–f

Diagnosis. This new species is closely related to *Sathrophyllia rugosa* but differs in coloration and body size: it has a brownish coloration and is also larger by 12.5 mm

than *rugosa*. Furthermore, the tegmina of *Sathrophyllia irshadi* is of a peculiar texture with reddish patches on its surface. Body large in size; pronotum with numerous tubercles and tegmina well developed and much longer than the body length with reddish patches. Ovipositor wide, slightly tapering at apices thick at its basal part and but not serrated at apex (Fig. 4e).

Description. Head rounded, ovoid at apices; pronotum with numerous tubercles (Fig. 4c, d); size large; antennae longer than the body length (Fig. 4a). Fastigium with brownish spots. Pronotum brown in color dorsally at anterior and posterior parts (Fig. 4a, b). Eyes ovoid, brownish in color. Body light brown in color; antennae yellowish at scapus with brownish spots; fastigium with brown spots; abdomen usually brown in color. Tegmina and wings fully developed; tegmina much longer than the total body length with reddish patches. Ovipositor wide, slightly tapers at apices thick at its basal part and but not serrated at apex (Fig. 4e, f). Ovipositor yellowish over-all and brownish at base.

Length measurements. ♀: pronotum 9.5 mm, tegmina 50 mm, femur 21.5 mm, tibia 16.5 mm, ovipositor 18 mm, total body length 38 mm.

Material examined. Rawalakot, 1♀, 4.vi.2013, 33.51°N, 73.45°E (leg Riffat S & Waheed AP).

Remarks. The new species is like that of *S. rugosa* but differ in body size and coloration. Furthermore, the specimen has been collected from Rawalakot which occurs above sea level whilst *S. rugosa* was collected from low altitude (24.7400° N, 69.8000° E) from Tharparker.

Ecology. This species inhabits especially nutrient-rich grasslands. The surrounding plantations were covered by *Desmostachya-Brachiaria cynodon*, which were found to be dominant over this habitat. Moreover, the valleys were comprised of different plant communities i.e., *Achyranthus aspera*, *Alhagi maurorum*, *Dactyloctenium aegypticum*, *Cenchrus ciliaris* and *Cynodon dactylon*.

Derivatio nominis. This new species is named in the honor of Muhammad Irshad Entomologist, NARC Islamabad, for his great contributions in the field of entomology.

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Contribution to the knowledge of seed-beetles (Coleoptera, Chrysomelidae, Bruchinae) in Xinjiang, China

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Abstract

Nineteen species of seed-beetles belonging to the subfamily Bruchinae (Coleoptera, Chrysomelidae) were collected in Xinjiang, China. Of these, the following four were new records for China: *Bruchus affinis* Frolich, 1799, *B. atomarius* L., 1761, *B. loti* Paykull, 1800 and *Kytorhinus kergoati* Delobel & Legalov, 2009. We provide an annotated checklist, illustrations and a key to the 19 species.

Keywords

New record, checklist, taxonomy, Palearctic region

Introduction

Xinjiang Uygur Autonomous Region (hereafter referred to as Xinjiang, also known as Sinkiang) is a provincial region in the northwest of the People's Republic of China. It is the largest Chinese administrative division and it spans over 1.6 million km². The

region is bordered by eight countries: Russia, Mongolia, Kazakhstan, Kyrgyzstan, Tajikistan, Afghanistan, Pakistan and India.

Four tribes of the Chrysomelidae subfamily Bruchinae have been recorded in Xinjiang: Amblycerini, Bruchini, Kytorhinini and Rhaebini (Anton 2010, Tan and Yu 1980) and six tribes according to Bouchard et al. (2011): Amblycerini, Bruchini, Eubaptini, Kytorhinini, Pachymerini and Rhaebini. Kytorhinini and Rhaebini are monotypic and restricted to Central Asia and the temperate Holarctic region, respectively (Borowiec 1987, Delobel and Legalov 2009). The majority of Bruchinae species, commonly called bean weevils or seed-beetles, feed on grain legumes and seeds of leguminous trees and shrubs. Many species have a significant economic impact because they can consume valuable protein-rich crops that would otherwise be eaten by humans (Southgate 1979). Despite this, little is currently known about the seed-beetles of Xinjiang. Fifteen species have been documented (Hoffmann 1965, Tan and Yu 1980, Zhang et al. 1987, Xu 1991, Anton 2010, Sui et al. 2011), but most of the records lack detailed information about their distribution.

Methods

We checked all seed-beetles specimens from Xinjiang (most collected from 1956 to 1978) in National Zoological Museum of China (NZMC), Institute of Zoology, Chinese Academy of Science (IZCAS), in Beijing, China. In order to increase the material currently available in the NZMC collection, we collected twice in Xinjiang in July 2009 and August 2013. Seed-beetles were obtained in the field by sweeping with a sweep net and by collecting seeds of host plants in day time. We also tried to collect at night, but no seed-beetles were found. The identification of some of the specimens were confirmed by Chinese Chrysomelidae specialist Tan Juanjie and Yu Peiyu of IZCAS twenty years ago. All the specimens were identified by comparing the external morphological features and the male genitalia morphological characters with some published articles again (Lukjanovitsch and Ter-Minassian 1957, Tan and Yu 1980, Borowiec 1987, 1991, Kingsolver 2004, Delobel and Legalov 2009).

Photographs of all the seed-beetles were taken with a Cannon 5D digital camera and images were processed in Adobe Photoshop CS5. Drawings were created using Adobe Illustrator CS4. All specimens were deposited in the NZMC, where most of them were assigned unique numbers corresponding to the Institute of Zoology collection code entry IOZ(E).

Results

In this study, 19 species of Bruchinae beetles were collected in Xinjiang. They were annotated with updated detailed distribution in the following checklist. The following key is illustrated with photographs of morphological characters used in it.

Checklist of Bruchinae from Xinjiang, China

Tribe Amblycerini Bridwell, 1932

Subtribe Spermophagina Borowiec, 1987

Genus *Spermophagus* Schoenherr, 1833

Spermophagus sericeus (Geoffroy, 1785)

Figs 1–2

Material. 2♂, Akqi, Kizilsu, Xinjiang, 40.98°N, 78.70°E, alt. ca 1970 m, 2005.VI.14, H.Y. Hu leg.; 1♀6♂, Aksu, Xinjiang, 40.94°N, 80.11°E, alt. ca 1180 m, 1978.VI.19, Y.H. Han leg.; IOZ(E)1016347–1016583; 1♀, Qinggil, Altay, Xinjiang, 46.69°N, 90.39°E, alt. ca 1390 m, 1956.VIII.1, W.Y. Yang leg., IOZ(E)632314; 1♀1♂, Turpan, Xinjiang, 42.93°N, 89.27°E, alt. ca 140 m, 1958.V.20, C.Q. Li and G. Wang leg., IOZ(E)632431, IOZ(E)632433; 3♀3♂, Baicheng, Aksu, 41.78°N, 81.92°E, alt. ca 1310 m, 1959.VII.22, A.F. Tian leg., IOZ(E)115170–115176; 1♀3♂, Yuli, Mila, Bayingol, Xinjiang, 41.77°N, 84.24°E, alt. ca 1000 m, 1958.VII.13, C.Q. Li leg., IOZ(E)115143–115146; 1♀1♂, Urumqi, Xinjiang, 43.83°N, 87.55°E, alt. ca 820 m, 1955.VII.25, S.J. Ma, K.L. Xia and Y.L. Chen leg., IOZ(E)115133–115134; 2♀2♂, Usu, Qoqek, Xinjiang, 45.02°N, 84.78°E, alt. ca 290 m, 1957.VI.16, G. Wang leg., IOZ(E)115106–115109; 10♀16♂, Shihezi, Xinjiang, 44.28°N, 86.27°E, alt. ca 500 m, 1957.VI.7, G. Wang and C.P. Hong leg., IOZ(E)115080–115106; 1♀6♂, Shawan, Qoqek, Xinjiang, 44.46°N, 85.66°E, alt. ca 420 m, 1957.VI.11, G. Wang and C.P. Hong leg., IOZ(E)115063–115169; 1♀, Jeminay, Altay, Xinjiang, 47.43°N, 85.87°E, alt. ca 970 m, 1956.IX.17, W.Y. Yang leg., IOZ(E)115054.

Distribution. Widely distributed around the Palaearctic region.

Tribe Bruchini Latreille, 1802

Subtribe Acanthoscelidina Bridwell, 1946

Genus *Acanthoscelides* Schilsky, 1905

Acanthoscelides pallidipennis (Motschulsky, 1874)

Figs 3–4, 49

Distribution. Armenia, Austria, Azerbaijan, Bulgaria, China, Croatia, Czech Republic, France, Germany, Greece, Hungary, Italy, Japan, Macedonia, North America, North Korea, Russia, Slovakia, Switzerland, Serbia and Montenegro, Tajikistan.

Remarks. We did not find any specimens of *A. pallidipennis* in Xinjiang in our study, however Tan and Yu (1980) recorded it in Xinjiang. According to Tan and Yu (1980), the North American bruchid *A. pallidipennis* was introduced to China with its natural host *Amorpha fruticosa* L. a number of years ago. It has been a major pest of *A. fruticosa* seeds in China.

Genus *Bruchidius* Schilsky, 1905

Bruchidius apicipennis Heyden, 1892

Figs 5–6

Material. 2♀5♂, Korla, Bayingol, Xinjiang, 41.61°N, 86.22°E, alt. ca 1060 m 1958.VIII.11–17, C.Q. Li, IOZ(E)109480–109482, 109484, 109486, 109488–109489; 1♂, Aksu, Xinjiang, 41.18°N, 80.19°E, alt. ca 1210 m, 1958.IX.9, C.Q. Li, IOZ(E)109517; 1♂, Karakax, Hetian, Xinjiang, 37.79°N, 80.52°E, alt. ca 1250 m, 1958.V.8, C.Q. Li, IOZ(E)109516; 12♂13♀, Halajunxiang, Artux, Kizilsu, Xinjiang, 40.02°N, 76.81°E, alt. ca 1610 m, 1959.VI.22, S.Y. Wang leg., IOZ(E)109490–109514; 1♂, Yanqi, Bayingol, 41.80°N, 85.82°E, alt. ca 950 m, 1958.VIII.26, C.Q. Li, IOZ(E)109515; 1♀, Hetian, Xinjiang, 37.02°N, 79.98°E, 1955.V.20, S.J. Ma, K.L. Xia and Y.L. Chen leg., IOZ(E)109657; 2♀, Jinghe, Bortala, Xinjiang, 44.36°N, 83.15°E, alt. ca 1730 m, 1955.VIII.24, S.J. Ma, K.L. Xia and Y.L. Chen leg., IOZ(E)109518–109519; 1♀, Manas, Changji, Xinjiang, 44.54°N, 86.22°E, alt. ca 400 m, 1957.VI.9, G. Wang, IOZ(E)109521; 4♂3♀, Milan, Ruoqiang, Bayingol, Xinjiang, 39.27°N, 89.10°E, alt. ca 900 m 1960.IV.30, S.Y. Wang leg., IOZ(E)109649–109655; 2♀, Xiao Artux, Artux, Kizilsu, Xinjiang, 39.68°N, 75.67°E, alt. ca 2100 m, 1959.VI.17, S.Y. Wang leg., IOZ(E)109658–109659; 1♀, Shihutang, Manas, Changji, Xinjiang, 44.60°N, 86.09°E, alt. ca 370, 1957.VII.4, C.P. Hong leg., IOZ(E)109660; 1♂2♀, Wensu, Aksu, Xinjiang, 41.29°N, 80.21°E, alt. ca 1190, 1955.VI.9, S.J. Ma, K.L. Xia and Y.L. Chen leg., IOZ(E)109841–109843.

Distribution. China, Iran, Kazakhstan, Mongolia, Russia, South Africa, Turkey, Turkmenistan.

Bruchidius tuberculicauda Lukjanovitsch & Ter-Minassian, 1954

Figs 7–8, 64–65

Material. 1♀1♂, Nilka, Ila, Xinjiang, 43.79°N, 82.50°E, 1124m, 1994.VI.20, X.F. Huang leg.; 2♀1♂, Takeshikenzhen, Qinggil, Altay, Xinjiang, 46.18°N, 90.81°E, alt. ca 1110 m, 2013.VII.28, Y. Li leg..

Distribution. China, Kyrgyzstan, Kazakhstan, Mongolia, Russia.

Genus *Callosobruchus* Pic, 1902

Callosobruchus chinensis (L., 1755)

Figs 9–10

Material. 1♀, Xinhe, Xinjiang, 41.51°N, 82.50°E, alt. ca 980 m, 2000.VI.30, R.H. Lin leg.



Figures 1–12. Bruchinae in Xinjiang, dorsal and lateral view. 1–2 *Spermothagus sericeus* 3–4 *Acanthoscelides pallidipennis* 5–6 *Bruchidius apicipennis* 7–8 *B. tuberculicauda* 9–10 *Callosobruchus chinensis* 11–12 *C. maculatus*; black bar = 1 mm.

Distribution. Almost worldwide.

Remarks. In this study, we found only one specimen of *C. chinensis* in Xinjiang. Zhang et al. (1987) and Xu (1991), however, recorded *Vigna radiata* and *V. angularis* extensively infested by *C. chinensis* in Kumul and Shihezi, Xinjiang.

***Callosobruchus maculatus* (Fabricius, 1975)**

Figs 11–12, 50–51

Distribution. Almost worldwide.**Remarks.** Although we did not collect any *C. maculatus* specimens from Xinjiang in this study, Sui et al. (2001) previously recorded *Cicer arietinum* infested by *C. maculatus* in Kashgar City, Xinjiang.**Genus *Megabruchidius* Borowiec, 1984*****Megabruchidius dorsalis* (Fabraeus, 1839)**

Figs 13–14, 66–67

Material. 10♀5♂, Ili Forestry Science Research Institute, Gulja, Ili, Xinjiang, 43.94°N, 81.33°E, alt. ca 660 m, 1973.VII.5, IOZ(E)109814–109818, 632556–632565.**Distribution.** Bulgaria, China, France, Greece, Hong Kong, Hungary, India, Italy, Japan, Mongolia, Papua New Guinea, Switzerland, Turkmenistan.**Subtribe Bruchina Latreille, 1802****Genus *Bruchus* L., 1767*****Bruchus affinis* Frolich, 1799**

Figs 15–16, 52, 59, 68

Material. 7♀3♂, Xinyuan, Ili, Xinjiang, 43.42°N, 82.26°E, alt. ca 1200 m, 1972.VII, IOZ(E)1016073–1016075, 108162–108163, 108157–108160, 108155.**Distribution.** China, Afghanistan, Kyrgyzstan, Kazakhstan, Lebanon, Mongolia, North Korea, Russia, Syria, Tajikistan, Europe.***Bruchus atomarius* (L., 1761)**

Figs 17–18, 53, 63, 68

Material. 5♀2♂, Xinyuan, Ili, Xinjiang, 43.42°N, 82.26°E, alt. ca 1200 m, 1972.VII, IOZ(E)1016068–1016072, 108161, 108156; 1♀, Kanasi, Buerjin County, Altay, Xinjiang, 49.01°N, 87.35°E, alt. ca 1550 m, 2009.VII.25, Z.L. Wang leg..**Distribution.** New record for China, Europe, Iran, Kyrgyzstan, Kazakhstan, Lebanon, Mongolia, North Korea, Russia, Syria.



Figures 13–26. Bruchinae in Xinjiang, dorsal and lateral view. **13–14** *Megabruchidius dorsalis* **15–16** *Bruchus affinis* **17–18** *Bruchus atomarius* **19–20** *Bruchus dentipes* **21–22** *Bruchus loti* **23–24** *Bruchus pisorum* **25–26** *Bruchus rufimanus*; black bar = 1 mm.

***Bruchus dentipes* Baudi, 1886**

Figs 19–20, 54

Distribution. Afghanistan, Algeria, Azerbaijan, Armenia, Belgium, China, Croatia, Cyprus, Egypt, England, France, Greece, Italy, Iran, Iraq, Israel, Jordan, Kazakhstan, Lebanon, Russia, Spain, Switzerland, Syria, Tajikistan, Turkmenistan, Turkey, Uzbekistan.

Remarks. We did not collect any *B. dentipes* specimens in Xinjiang in this study, but Tan and Yu (1980) previously recorded *B. dentipes* as occurring in Xinjiang.

***Bruchus loti* Paykull, 1800**

Figs 21–22, 55, 68

Material. 3♀, Xinyuan, Ili, Xinjiang, 43.42°N, 82.26°E, alt. ca 1200 m, 1972.VII, IOZ(E)1016065–1016067.

Distribution. Algeria, **New record for China**, Eurasia, Japan, Morocco, Russia, Turkey, Ukraine.

***Bruchus pisorum* (L., 1758)**

Figs 23–24, 56, 60

Distribution. Worldwide.

Remarks. In this study, we did not find any *B. pisorum* specimens in Xinjiang, but Yixin (1991) previously recorded *B. pisorum* as occurring in Xinjiang.

***Bruchus rufimanus* Boheman, 1833**

Figs 25–26, 46, 57, 62

Distribution. Worldwide except Australia.

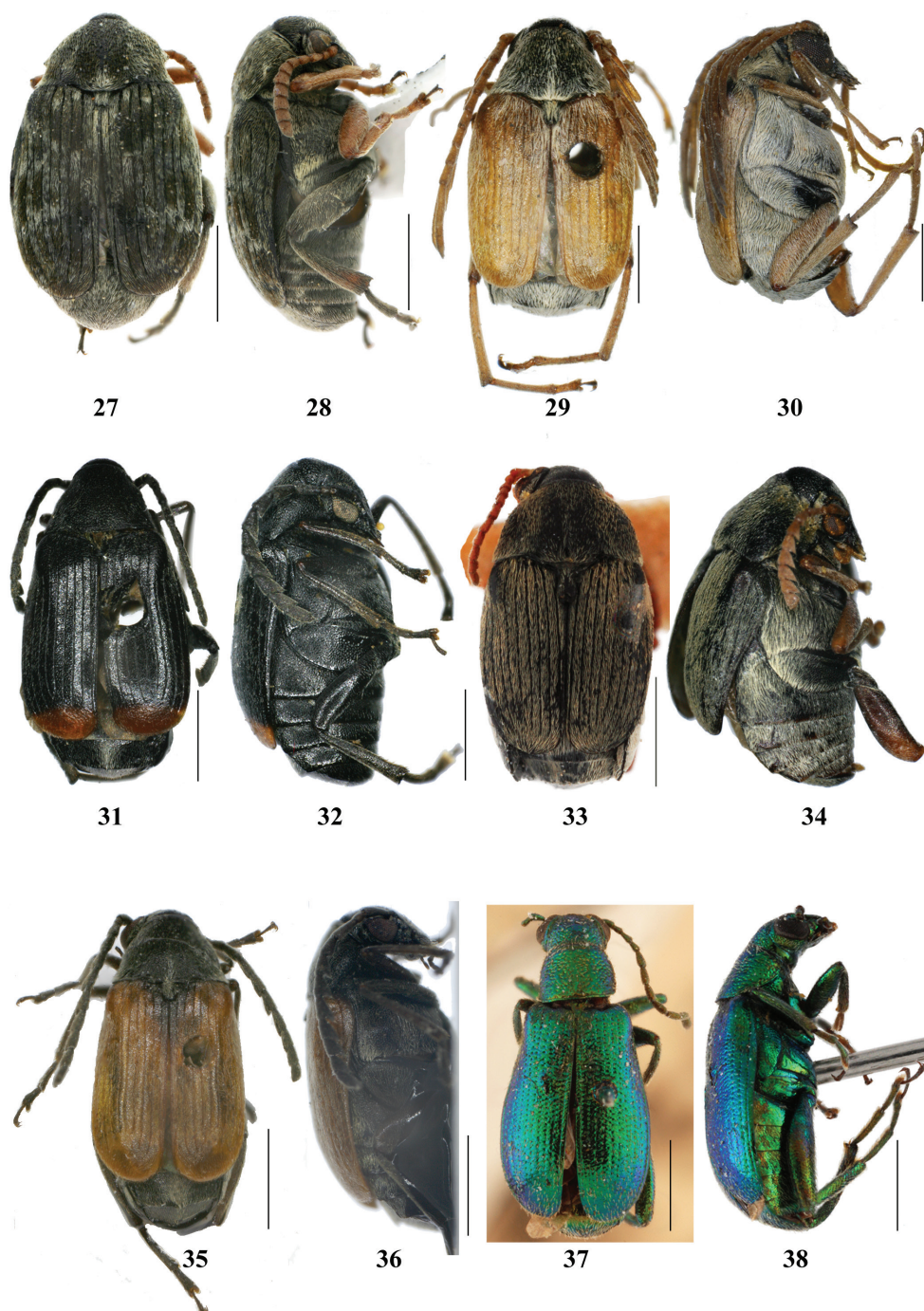
Remarks. We did not find any *B. rufimanus* specimens in Xinjiang; however it was previously recorded as occurring there (Tan and Yu 1980).

***Bruchus sibiricus* Germar, 1824**

Figs 27–28, 58, 61

Material. 1♀1♂, North of Tianshan Mountain, Wuku Road, Urumqi, Xinjiang, 43.56°N, 87.19°E, alt. ca 1600 m, 1960.VI.11, S.Y. Wang leg., IOZ(E)1045200–1045201.

Distribution. Azerbaijan, Armenia, China, Kyrgyzstan, Kazakhstan, Mongolia, Russia, Tajikistan, Turkey, Uzbekistan.



Figures 27–38. Bruchinae in Xinjiang, dorsal and lateral view. **27–28** *Bruchus sibiricus* **29–30** *Kytorhinus immixtus* **31–32** *Kytorhinus karasini* **33–34** *Kytorhinus thermopsis* **35–36** *Kytorhinus kergoati* **37–38** *Rhaebus solskyi*; black bar = 1 mm.

Tribe Kytorhinini Bridwell, 1932**Genus *Kytorhinus* Fischer von Waldheim, 1809*****Kytorhinus immixtus* Motschulsky, 1874**

Figs 29–30, 43

Material. 1♂, Pochengzi, Wensu, Aksu, Xinjiang, 41.77°N, 80.99°E, alt. ca 2000 m, 1978.VI.15.

Distribution. China, Kyrgyzstan, Russia.

***Kytorhinus karasini* Fischer, 1809**

Figs 31–32

Material. 1♀, Tianshan Mountain, Fukang, Changji, Xinjiang, 43.95°N, 88.15°E, alt. ca 2150 m, 1957.VII.14, G. Wang leg., IOZ(E)115178; 1♀, Tianshan Mountain, Fukang, Changji, Xinjiang, 43.95°N, 88.40°E, alt. ca 2250 m, 1957.VII.14, G. Wang leg., IOZ(E)107522; 1♀, Zhao Su Xian, Yili, Xinjiang, 42.66°N, 80.18°E, alt. ca 2200 m, 1978.VIII.7, Y.H. Han leg., IOZ(E)1045574; 1♀, Takeshikenzhen, Qinggil, Altay, Xinjiang, 46.18°N, 90.81°E, alt. ca 1110 m, 2013.VII.28, Y. Li leg.

Distribution. China, Russia.

***Kytorhinus kergoati* Delobel & Legalov, 2009**

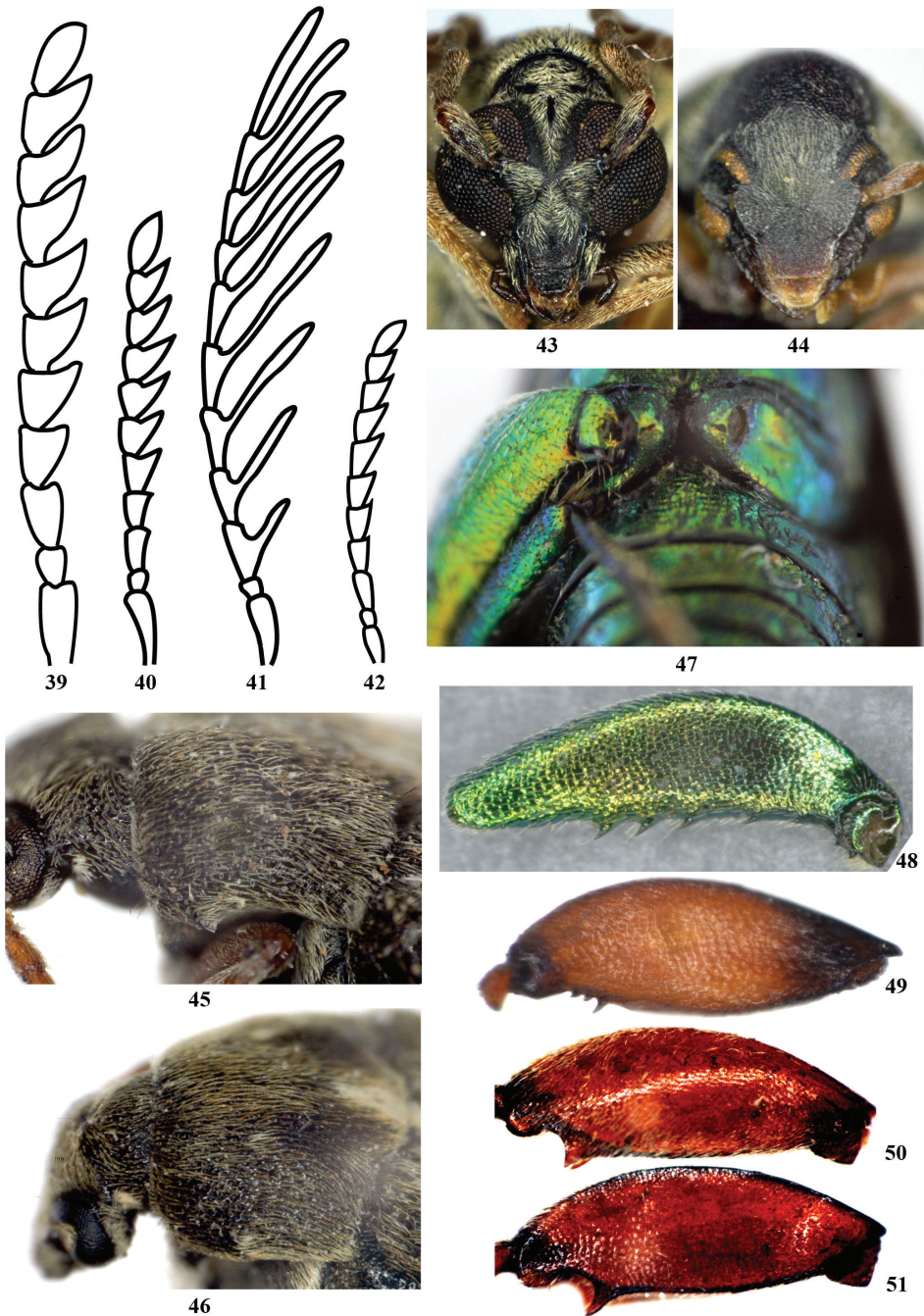
Figs 35–36, 41–42, 68

Material. 1♀, Pochengzi, Wensu, Aksu, Xinjiang, 41.77°N, 80.91°E, alt. ca 1930 m, 1978.VI.3, X.Z. Zhang leg., IOZ(E)1045598; 1♀1♂, Tomur peak, Wensu, Aksu, Xinjiang, 41.74°N, 80.58°E, alt. ca 2400 m, 1977.VI.19, C.J. Li leg., IOZ(E)632265–632266; 1♂, Tomur peak, Wensu, Aksu, Xinjiang, 41.81°N, 80.59°E, alt. ca 3200 m, 1977.VII.11, Y.H. Han leg., IOZ(E)632264; 1♂, Tomur peak, Wensu, Aksu, Xinjiang, 41.81°N, 80.59°E, alt. ca 3200 m, 1977.VII.14, C.J. Li leg., IOZ(E)632263; 1♂, Yangbajingzhen, Damxung, Lhasa, Tibet, China, 30.02°N, 90.39°E, alt. ca 4310 m, 1960.VI.2, C.G. Wang leg., IOZ(E)1016165.

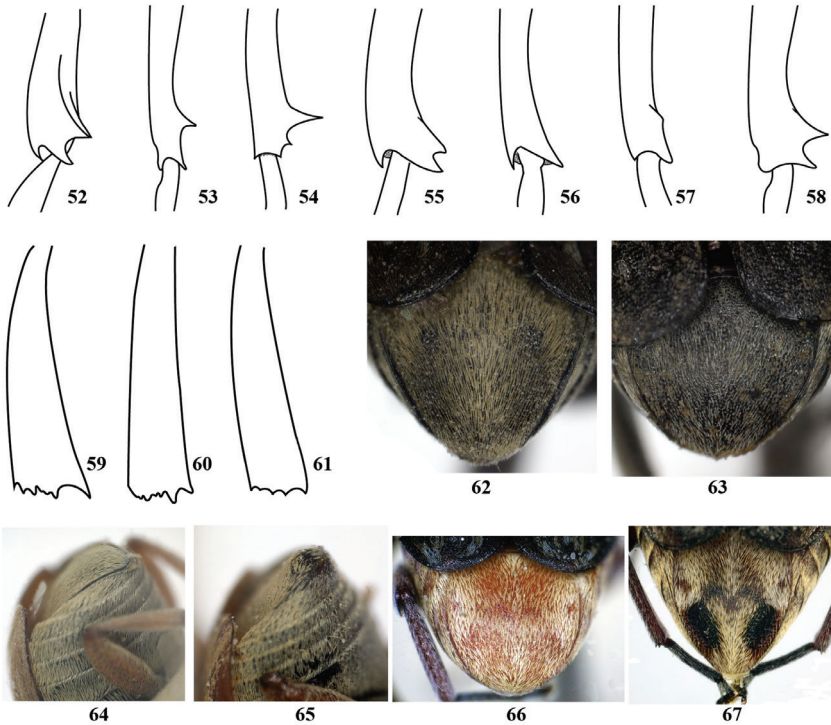
Distribution. New record for China, Tajikistan (Gorno-Badakhshan autonomous province).

Host. Unknown.

Remarks. Delobel and Legalov (2009) described this species based on a single male. We examined a female specimen and found that its antennae are serrated and are slightly longer than half of the body length (Fig. 35, 41, 42). Additionally, the elytra of the female are almost yellow, with the exception of a black, elongate triangular area, which extends from the base to one-third of the elytral suture (Fig. 35) corresponding to main distinguishing characters of a single known male of *K. kergoati*.



Figures 39–42. Antennae. **39** *Kytorhinus thermopsis* male **40** *K. thermopsis* female **41** *Kytorhinus kergoati* male **42** *Kytorhinus kergoati* female **43–44** Head **43** *Kytorhinus immixtus* **44** *Kytorhinus thermopsis* **45–46** Lateral pronotal margin. **45** *Bruchus affinis* **46** *Bruchus rufimanus* **47** Hind trochanters **47** *Rhaebus solskyi* **48–51** Hind femur. **48** *Rhaebus solskyi* male **49** *Acanthoscelides pallidipennis* **50** *Callosobruchus maculatus* outside view **51** *Callosobruchus maculatus* inside view.



Figures 52–68. Tibia apical portion of *Bruchus* spp. male mid legs. **52** *Bruchus affinis* **53** *Bruchus atomarius* **54** *Bruchus dentipes* **55** *Bruchus loti* **56** *Bruchus pisorum* **57** *Bruchus rufimanus* **58** *Bruchus sibiricus* **59–61** Tibia apical portion of *Bruchus* spp. hind legs **59** *Bruchus affinis* **60** *Bruchus pisorum* **61** *Bruchus sibiricus* **62–67** Pygidium. **62** *Bruchus rufimanus* **63** *Bruchus atomarius* **64** *Bruchidius tuberculicauda* male **65** *Bruchidius tuberculicauda* female **66** *Megabruchidius dorsalis* male **67** *Megabruchidius dorsalis* female.

Kytorhinus thermopsis Motschulsky, 1874

Figs 33–34, 39, 40

Material. 1♀, Xinjiang, IOZ(E)115177 ; 1♀, 6 km northwest of Fuyun, Altay, Xinjiang, 47.14°N, 87.55°E, alt. ca 650 m, 2009.VII.13, X.L. Huang leg.

Distribution. China, Kazakhstan, Mongolia, Russia.

Tribe Rhaebini Blanchard, 1845

Genus *Rhaebus* Fischer von Waldheim, 1824

Rhaebus solskyi Kraatz, 1879

Figs 37–38, 47–48

Material. 2♀1♂, Haiziwan Reservo, Shawan, Qoqek, Xinjiang, 44.56°N, 85.78°E, alt. ca 390 m, 1957.VI.9, C.P. Hong leg., IOZ(E)107501–107503; 1♀, Takeshikenzhen, Qinggil, Altay, Xinjiang, 46.18°N, 90.81°E, alt.1110 m, 2013.VII.28, Y. Li leg.

Distribution. China, Kazakhstan, Mongolia, Russia.

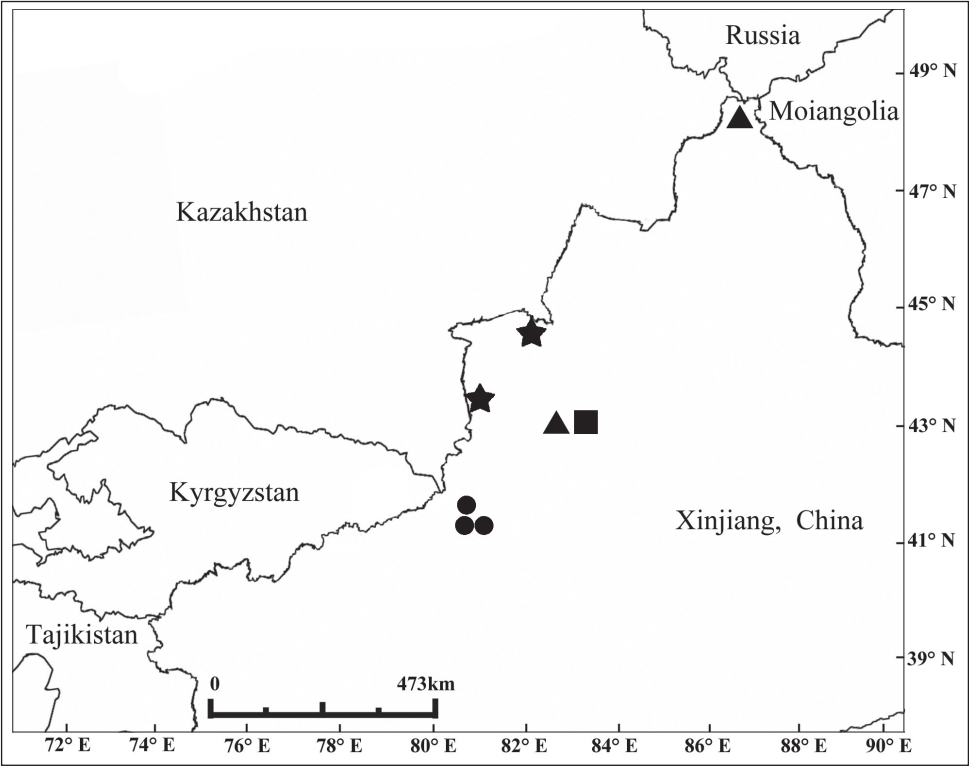


Figure 68. Map of northwestern China, illustrating localities for Bruchinae species. *Bruchus affinis* and *Bruchus loti* = squares. *Bruchus atomarius* = triangles. *Kytorhinus kergoati* = dots. Only new records reported here are shown.

Key to species of Bruchinae in Xinjiang

- 1 Body completely metallic in color (Fig. 37); hind trochanters extremely enlarged (Fig. 47); hind femur with 3–8 small, evenly spaced spines on ventral side (Fig. 48).....*Rhaebus solskyi*
- Body not metallic in color; hind trochanters small; hind femur without 3–8 small, evenly spaced spines on ventral side2
- 2 Antennae sexually dimorphic, male antennae strongly serrate (Fig. 39) or pectinate (Fig. 41), female antennae moderately serrate (Figs 40, 42); 3 last abdominal tergites (including pygidium) exposed behind the elytra (Figs 29, 31, 33, 35)3
- Antennae not sexually dimorphic, sometimes male and female antennae with different color; only pygidium exposed behind the elytra (Figs 62–67)6
- 3 Elytra integument with single color (Figs 29, 33).....4
- Elytra integument with two colors (Figs 31, 35)5
- 4 Antennae, legs and elytra integument yellow (Fig. 29); eyes large and separated by 0.2 times head width including eyes (Fig. 43) *Kytorhinus immixtus*

- Antennae and legs reddish brown, elytra integument black (Fig. 33); eyes medium-sized and separated by 0.4 times head width including eyes (Fig. 44) ***Kytorhinus thermopsis***
- 5 Antennae and legs black, elytra integument almost yellow except by black basal area elongated, triangular (Fig. 35) ***Kytorhinus kergoati***
- Body almost black, only apex of elytra red (Fig. 31)..... ***Kytorhinus karasini***
- 6 Lateral pronotal margins with tubercle (maybe obscured by setae) (Figs 45, 46); mesotibia at apex in male with apical spines or plates (Figs 52–58).....7
- Lateral pronotal margins smooth without tubercle; mesotibia at apex in male without apical spines or plates..... **13**
- 7 Elytra without white or brown setae; body almost black, only 4 basal antennal segments and fore legs reddish orange ***Bruchus loti***
- Elytra with white or brown setae (Figs 15–28); body not almost black **8**
- 8 Metatibia with mucro longer than lateral denticle (Figs 60, 61) **9**
- Metatibia with mucro shorter than lateral denticle (Fig. 59) **10**
- 9 Four basal antennomeres, protibia and tarsi, part or all of mesotibia, and tarsi reddish orange; hind femur with long external tooth near apex; mesotibia at apex in male as Fig. 56..... ***Bruchus pisorum***
- Five basal antennomeres reddish orange and rest black in female, antenna all reddish orange in male; hind femur with blunt external tooth near apex; mesotibia at apex in male as Fig. 58..... ***Bruchus sibiricus***
- 10 Pygidium with white or brown, dense and long setae, with 2 subapical black spots (sometimes subapical spots indistinct as in *Bruchus rufimanus*) (Fig. 62); mesotibia at apex in male as Fig. 52, 54 or 57 **11**
- Pygidium with gray, sparse and short setae, without subapical spot (Fig. 63); mesotibia at apex in male as Fig. 53..... ***Bruchus atomarius***
- 11 Lateral pronotal margin with denticle at midpoint (Fig. 46); mesotibia at apex in male as Fig. 54 or 57 **12**
- Lateral pronotal margin with denticle at 1/3 near apex (Fig. 45); mesotibia at apex in male as Fig. 52..... ***Bruchus affinis***
- 12 Lateral pronotal margin with prominent and sharp denticle; elytra with 3 rows of white stripes; pygidium with 2 distinct black subapical spots; mesotibia at apex in male as Fig. 54 ***Bruchus dentipes***
- Lateral pronotal margin with blunt denticle; elytra varying from pattern of white spots on black background with short, yellowish brown stripes to variably distributed white spots; pygidium with 2 indistinct black subapical spots (Fig. 62); mesotibia at apex in male as Fig. 57 ***Bruchus rufimanus***
- 13 Body ovate; metatibia with 2 conspicuous apical spurs (Fig. 2); pronotum lateral margins complete ***Spermophagus sericeus***
- Body suboval; metatibia without apical spur; pronotum lateral margins absent in apical half at least **14**

- 14 Hind femur with teeth both on inner and outer margins of ventral sulci (Figs 50, 51), sometimes denticle on distal margin blunt; posterior margin of pronotum bilobed at junction with scutellum and feebly gibbose there (Figs 9, 11) **15**
- Hind femur with outer margin of ventral sulci edentate; posterior margin of pronotum without feeble gibbose there..... **16**
- 15 Elytral striae 3 and 4 each with prominent subbasal denticles on slight gibbose, antennae serrate in male..... ***Callosobruchus chinensis***
- Elytral striae extending to basal margin without prominent denticles or gibbose, antennae smooth linear in male ***Callosobruchus maculatus***
- 16 Hind femur ventrally with 3 distinct preapical teeth on inner margins of ventral sulci, proximal tooth much larger than others (Fig. 49) ***Acanthoscelides pallidipennis***
- Hind femur ventrally edentate or with 1 preapical tooth in internal margins of ventral sulci **17**
- 17 Pygidium immaculate in male (Fig. 66) and with a pair of dark patches in female (Fig. 67) ***Megabruchidius dorsalis***
- Pygidium without patches **18**
- 18 Pronotum covered with orange pubescence (Fig. 7); pygidium tuberculate in female and smooth in male (Figs 64, 65) ***Bruchidius tuberculicauda***
- Pronotum covered with white pubescence (Fig. 5); pygidium not tuberculate..... ***Bruchidius apicipennis***

Discussion

Chinese literature on Bruchinae is out-of-date because of the recent changes in generic and tribal classification and description of new species (Borowiec 1987, Bouchard et al. 2011, Delobel and Legalov 2009). The majority of seed-beetle species in Xinjiang belong to the genera *Bruchus* and *Kytorhinus*. Of these, four species in this study are new records for China. These are *Bruchus affinis*, *B. atomarius*, *B. loti* and *Kytorhinus kergoati*. The first three have a wide distribution in the Palearctic Region. Only *K. kergoati* has been recorded in Tajikistan. Most of the new Bruchinae distribution records are found near the border. *Acanthoscelides pallidipennis*, *Callosobruchus chinensis* and *C. maculatus* are adventive species, so the extended human activity in Xinjiang is probably responsible for the beetle's extended distribution in this area too. *Bruchidius apicipennis*, *B. tuberculicauda*, *Megabruchidius dorsalis*, *Rhaebus solskyi* and *Spermophagus sericeus* appear to be eurytopic species found in a wide variety of habitats of the Palearctic Region.

The Bruchinae of Xinjiang remain relatively poorly investigated and it is likely that many additional species can still be found in the region. Further fieldwork is required to ascertain if the paucity of data is due to a genuinely small number of species, or the result of insufficient collection efforts.

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The new genus *Pheude* (Coleoptera, Curculionidae, Cossoninae) with description of a new species from mainland China

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Abstract

A new weevil, *Pheude punctatus* **gen. et sp. n.**, of the tribe Dryotribini in Cossoninae, is described from Guangdong Province, South China. It differs from the related genera *Dryotribus* Horn and *Microtribodes* Morimoto in having antennae with seven articles and a distinct scutellum, and from *Ochronanus* Pascoe and *Stenomimus* Wollaston in having long antennae, a rostrum with a medio-longitudinal furrow beginning at the posterior margin of the eyes and extending approximately midway on the rostrum, and a moderately elevated, medio-longitudinal carina extending the full length of the pronotum. Other diagnostic characters and illustrations are provided. A key to the genera of Dryotribini known from China is given.

Keywords

Dryotribini, new species, *Pheude punctatus*, China, key to genera

Introduction

Cossoninae are small to medium-sized, primarily wood-associated weevils with a worldwide distribution. They are represented in China by six tribes, 32 genera, and 72 species (YMO unpublished data based on collection at Institute of Zoology, Chinese Academy of Sciences, Beijing). All native genera are widely distributed in China except for the monotypic *Muschanella* Folwaczny, 1964 (Folwaczny 1964) and *Microtribodes* Morimoto, 1973 (Morimoto 1973) which are known only from Zhejiang Province (East China) and Taiwan, respectively. In this study, we describe a new genus and species of Dryotribini LeConte, 1876 from Guangdong Province (South China). Species in this tribe are coarsely sculptured, have an elongate, apically subcylindrical rostrum, funicle with five, six or seven articles, head small with slight post-ocular constriction, dorso-lateral eyes, visible or obscure scutellum, and slender tibiae (LeConte 1876; Voss 1955; Konishi 1962; Decelle and Voss 1972; Folwaczny 1973); the new genus is exceptional in that the elytra narrow slightly from base to apex, whereas they do not narrow apically in the other genera. Dryotribini contain 49 genera in the Palearctic, Neotropical, Afrotropical, Oriental, Neoguinean and Neozelandic Regions (Alonso-Zarazaga and Lyal 1999, regional nomenclature from Cox 2001). In China, Dryotribini are represented by *Dryotribus* Horn, 1873, *Microtribodes*, *Ochronanus* Pascoe, 1885 and *Stenomimus* Wollaston, 1873 (Csiki 1936; Zhang 1992; Alonso-Zarazaga and Lyal 1999; Kojima and Morimoto 2004).

Materials and methods

The type specimens are deposited in the Institute of Zoology, Chinese Academy of Sciences, Beijing, China. Observations were made with a Zeiss Semi SV 11 stereomicroscope. Habitus photographs were taken by Micropublisher 5.0 RTV digital camera model: MP5.0-RTV-CLR-10A-color 10 BIT, attached to a Zeiss Stereomicroscope Discovery V12. SEM images were captured using a LEO 1550 FESEM.

Measurements were taken using an ocular micrometer and are defined using the following abbreviations: **ACL** – antennal club length; **ACW** – antennal club width; **AFL** – antennal funicle length; **AL** – antennal length; **ASL** – antennal scape length; **BL** – body length; **EL** – elytral length; **EWB** – elytral width at base; **EWW** – elytral width at widest part; **PL** – pronotal length; **PW** – pronotal width (widest part); **RL** – rostral length (excluding mandibles); **RWA** – rostral width at apex; **RWB** – rostral width at base.

Measurements were taken as follows: antennal club width measured at the widest part of the club; body length measured in lateral view from the apex of the elytra to the anterior end of the rostrum; elytral length measured in lateral view starting from the base to the apex; pronotal length measured along the median line; rostral length measured in lateral view from the anterior edge of the eyes to the apex. Funicular articles are enumerated beginning with the pedicel and including all articles before the club. On

the elytra, intervals and striae are numbered beginning from the suture and extending laterally. Hind wing terminology follows Zherikhin and Gratshev (1995).

The new genus was compared to the following available identified genera in the National Zoological Museum in the Institute of Zoology, Chinese Academy of Sciences, Beijing, China: *Dryotribus*: 8 ♀ (25 VII 1957) Shandong province; 1 ♀ (17 X 1977) Guangdong province; *Stenomimus*: 1 ♂ (20 V 1938), 2 ♀ (5 III 1952), 6 ♀ (7 III 1952) Guangxi Province; *Ochronanus*: 1 ♂ (20 V 1938) Guangxi Province, China.

Taxonomic treatment

Pheude Omar & Zhang, gen. n.

<http://zoobank.org/9AD0B374-A96F-4246-B200-4F15EA9111EF>

Figs 1–38

Type species. *Pheude punctatus* Omar & Zhang, here designated.

Diagnosis. Rostrum nearly parallel-sided, rostrum without any keel ventrally, longer than wide (more than $2 \times$ width), with longitudinal furrow dorsally; antenna inserted at basal one-third of rostrum; scape extending beyond hind margin of eye, funicle with seven articles; pronotum longer than wide, base bisinuate, with longitudinal median crest from base to apex; scutellum visible; apical margin of elytra expanded and lower than level of venter, elytral apical margin gently rounded and flattened; third tarsomere entire.

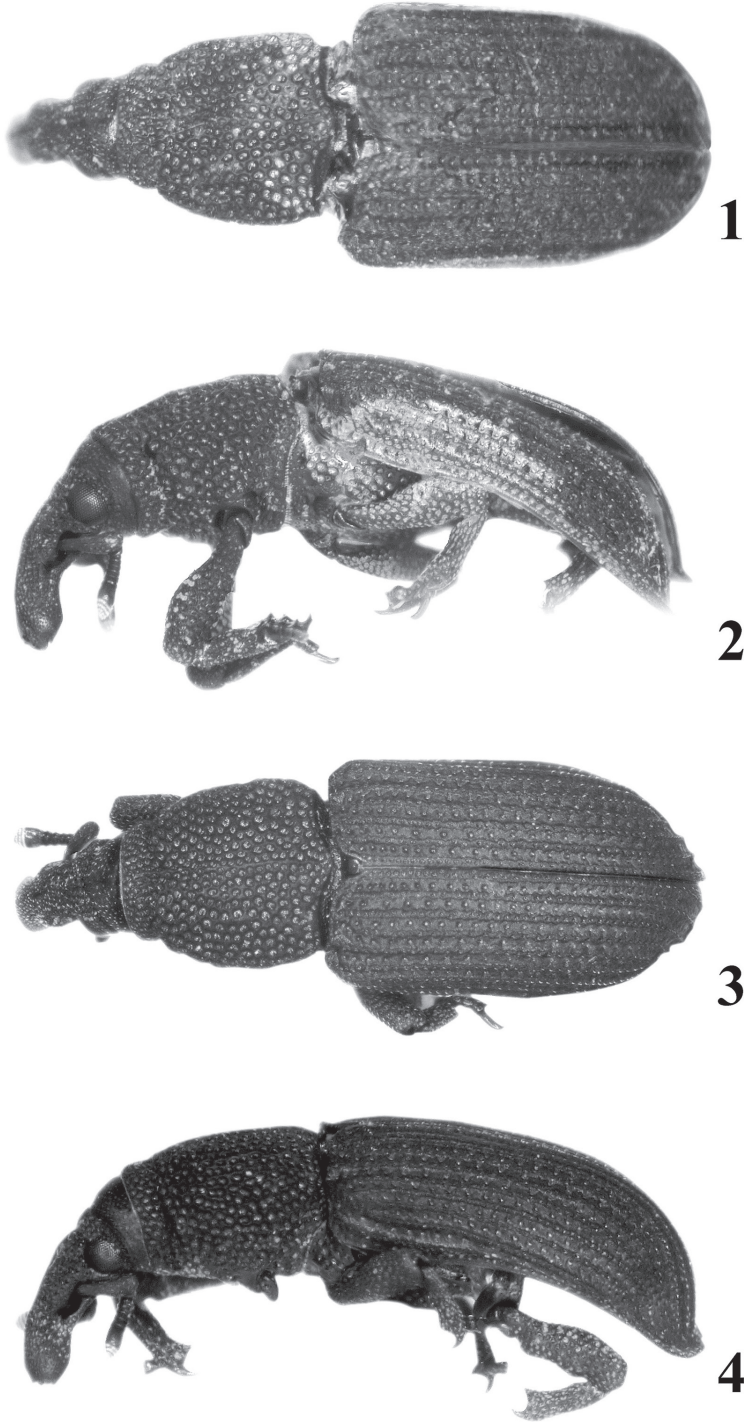
Description. *Form* slightly arched, widest approximately at elytral humeri, slightly tapered both apicad and caudad.

Mouthparts. Maxilla (Fig. 14) with 3-segmented palpus, basal two segments each with a single lateral seta; stipes and palpiger each with a single lateral, large seta; galeolacinial complex with large, paddle-shaped setae along mesal margin; elongate, slender setae along antero-mesal margin of lacinia. Labium (Fig. 15) with 2-segmented palpus; basal segment with one lateral seta; prementum with two lateral setae on both sides; postmentum with two setae before latero-distal margin on ventral side. Mandibles falcate, left mandible (Fig. 16) with one tooth and molar region, right mandible (Fig. 17) with two teeth and molar region.

Proventriculus as in Figure 18.

Rostrum longer than broad, punctures with minute suberect setae, with large, deep, longitudinal furrow beginning behind eyes and extending to point of antennal insertion, forming slight cleft in rostrum; point of antennal insertion at basal $1/3$ of rostrum; scrobe well-defined, deep, dorsal margin directed towards middle of eye but not touching eye, subsequently extending ventrally below eye.

Antennae long, stout; scape: clavate, extending slightly beyond hind margin of eyes; funicle with seven articles; article one (pedicel) longer than others, as well as longer than own width; article two small, shorter than others and shorter than own width; club with three articles, appearing to have four with apical constriction, shorter than funicle.



Figures 1–4. *Pheude punctatus*. **1** Female, dorsal view **2** Female, lateral view **3** Male, dorsal view **4** Male, lateral view.

Head small, strongly constricted behind eyes; frons as broad as base of rostrum, with long longitudinal furrow extending midway on rostrum. Eyes oval, strongly convex.

Pronotum longer than wide, constricted behind apex.

Scutellum visible, deeply sunken, subcircular, finely punctured.

Elytra wider than pronotum, transversely concave immediately after antero-dorsal margin; basal margin forming transverse keel from sutural interval to humeri. Humeri umbonate, truncate. Intervals elevated from base to apex; striae wider than intervals, with deep circular punctures, distance between punctures ca. $1.5\text{--}2.0 \times$ puncture diameter; apex of elytra (from declivity to apex) expanded laterally and extending slightly below level of abdomen; apices gently rounded and slightly upturned.

Hindwings (Fig. 23) slender, lacking jugal area (anal lobe); Rr slender, abbreviated, not reaching rcm; rc absent; 1rs triangular and larger than 2rs; R3 present, forming a very thin, sclerotized stripe; Cu₁ not reaching posterior margin of wing; r-m absent; A simple, other anal veins absent.

Mesothorax (Fig. 20). Mesonotum typical of other cossonines; axillary cord enlarged, lateral margins rounded.

Metathorax (Fig. 21). Metanotum with metascutum reaching posterior margin of notum; scutellar groove reaching posterior margin of notum; allocrista angular at antero-mesal angle.

Thoracic sterna punctured throughout, distance separating punctures $\sim 1.0\text{--}2.0 \times$ puncture diameter; mesoventrite relatively small, coxae separated by distance of $0.5 \times$ diameter of coxa, with short, straight intercoxal projection; metaventrite long; coxae separated by distance approximately equal to diameter of metacoxa, coxae with medio-transverse furrow (Fig. 35). Metendosternite (Fig. 22): with long, narrow hemiductus; furcal arm narrow, apex bifid; anterior tendons inserted near base of furcal arms.

Legs. Femur strong, longer than tibia, entirely punctured; tibiae parallel-sided; protibia with distal comb of setae along inner margin; tarsus with five articles, articles one and two equal, three entire, feebly longer and wider than one and two combined; five slightly curved, glossy.

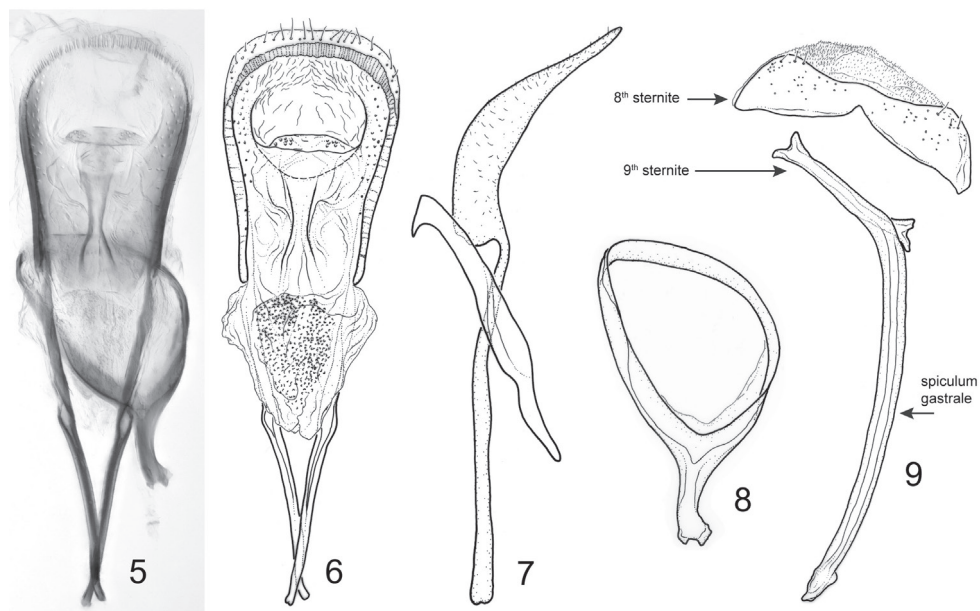
Etymology. The name of the new genus honors Pierre Heude (1836–1902), a French Jesuit and zoologist who came to China in 1868. Heude was a cofounder of the first natural history museum in China, and the oldest insect specimens housed in the CAS Institute of Zoology are from this museum, often collected by Octavie Piel. The gender is masculine.

***Pheude punctatus* Omar & Zhang, sp. n.**

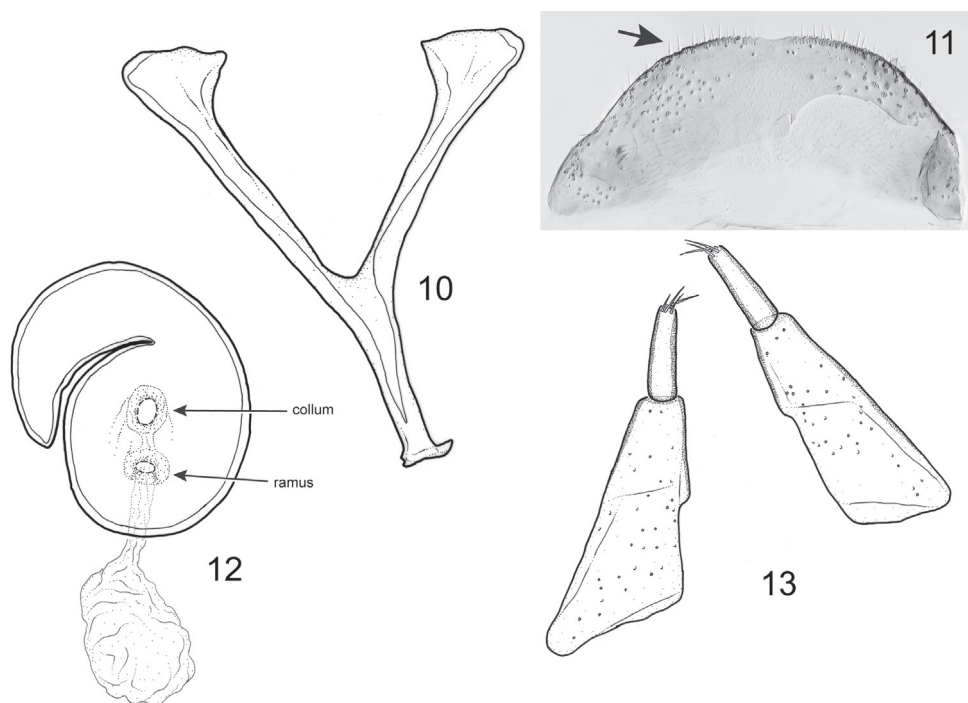
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Figs 1–38

Description. *Male measurements.* BL: 3.52–4.60 mm; EL: 2.09–2.56 mm; EWB: 1.33–1.65 mm; EWW: 1.38–1.73 mm; PN L: 1.04–1.38 mm; PNW: 1.00–1.25 mm; RL: 0.74–0.89 mm; RWA: 0.34–0.42 mm; RWB: 0.34–0.42 mm; AL: 0.85–1.03 mm;



Figures 5–9. *P. punctatus*. Male terminalia. **5–6** aedeagus, dorsal view **7** aedeagus, lateral view. **8** tegmen, ventral view **9** 8th and 9th sternites, dorsal view.



Figures 10–13. *P. punctatus*. Female terminalia and associated tergites. **10** sternite 8 **11** tergite 8 showing short simple setae **12** spermatheca **13** coxites and styli.

ASL: 0.38–0.44 mm; AFL: 0.34–0.38 mm; ACL: 0.21–0.25 mm; ACW: 0.15–0.19 mm. *Female measurements.* BL: 4.10 mm; EL: 2.00 mm; EWB: 1.52 mm; EWW: 1.55 mm; PN L: 1.14 mm; PNW: 1.12 mm; RL: 0.93 mm; RWA: 0.34 mm; RWB: 0.34 mm; AL: 0.94 mm; ASL: 0.36 mm; AFL: 0.32 mm; ACL: 0.26 mm; ACW: 0.13 mm.

Integument. Body densely, deeply punctured throughout (Fig. 24); Color brown to dark brown, opaque, one specimen rusty colored, dull (Figs 1–4).

Rostrum long, more than $2 \times$ longer than wide, uneven dorsally, curved from point of antennal insertion to anterior (apical) fourth of rostrum, apical fourth becoming more linear; dense, elongate, deep punctures throughout, punctures occasionally longitudinally confluent, coarse. Scrobe well-defined, wide, located along basal half of rostrum (Figs 25, 26).

Antenna moderately robust, wide; scape with elongate punctures; long, gently widening from base to apex, shorter than funicle and club combined; funicle slightly glossy, chestnut brown, compact, robust, articles three to five approximately equal in size; articles six and seven approximately equal in size, wider than long (Fig. 26); club glossy, chestnut brown (Figs 26, 27); club article 1 longer than others combined and glabrous; club articles 2 and 3 with yellowish, erect setae (Fig. 27), strongly compact, ovate.

Head oval, coarse, punctures nearly confluent in various circular and oblong shapes. Eyes dark brown to black, with coarse, convex facets (Fig. 25), widely separated dorsally, located laterally at base of rostrum. Temples swelling.

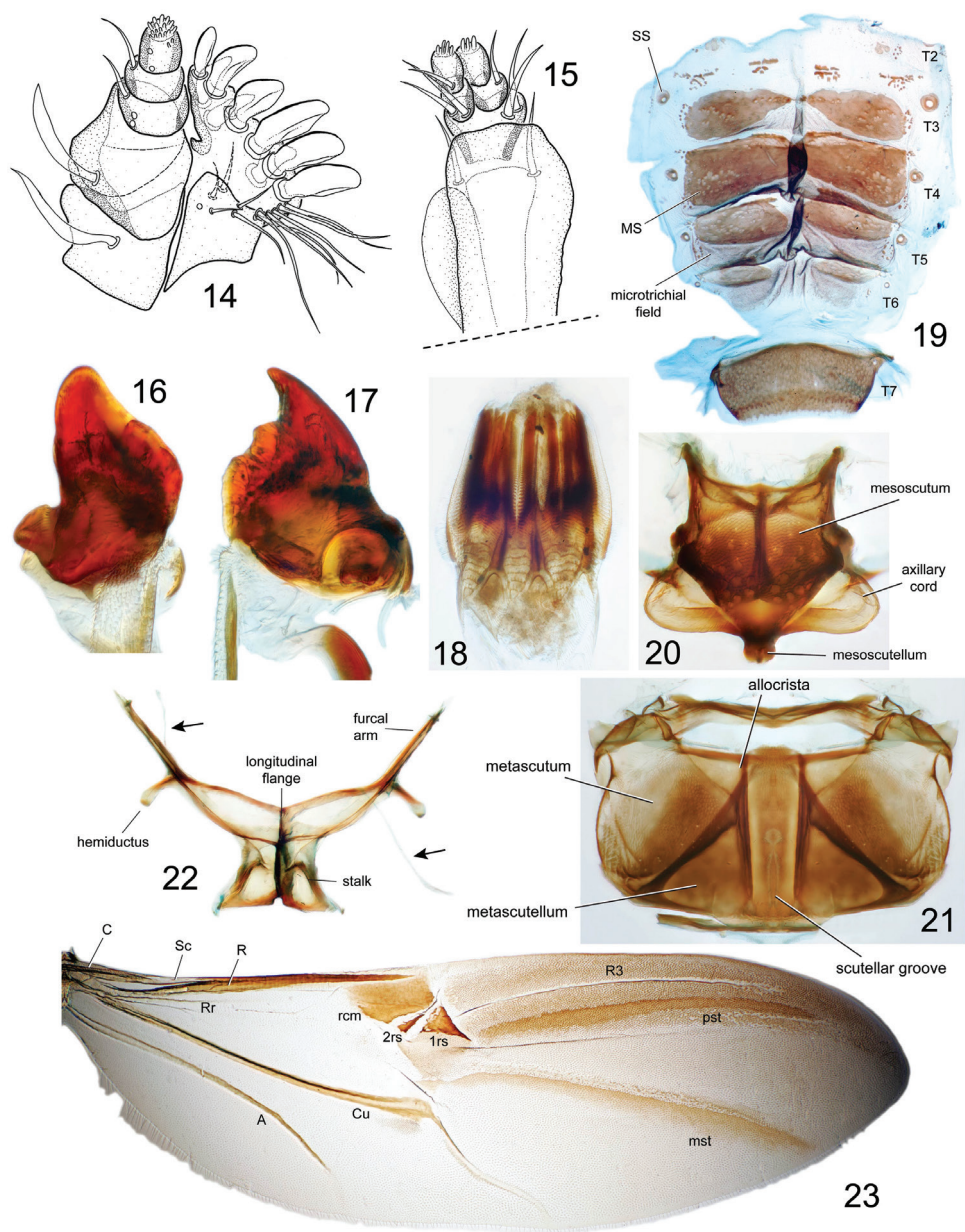
Pronotum with moderately elevated longitudinal carina from base to apex; laterally curved, dorsally convex, with deep, circular punctures, occasionally confluent, unevenly distributed with distance $0.5\text{--}1.0 \times$ puncture diameter; each puncture with minute seta off-centered near margin (Fig. 28); basal pronotal margin bisinuate.

Scutellum fuscous, glossy, large.

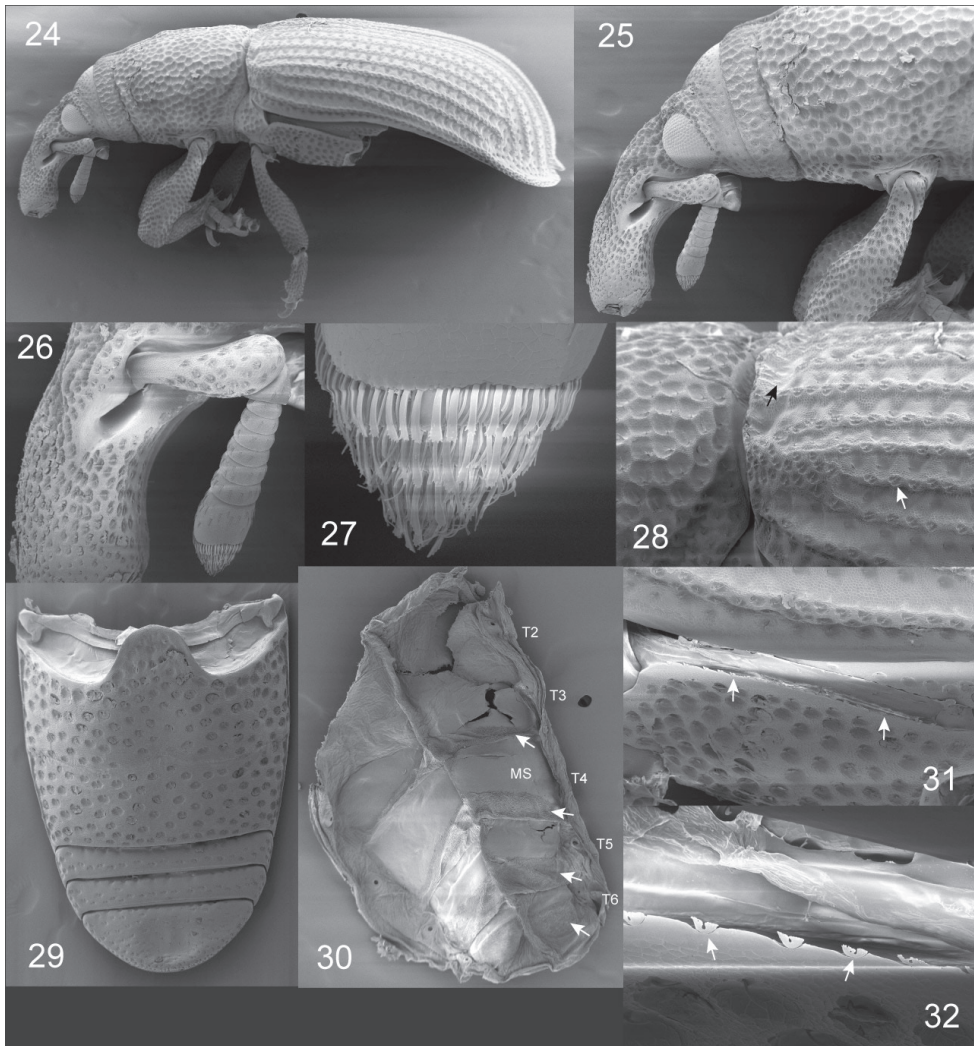
Elytra arcuate, basal margin slightly concave, apex gently rounded and emarginate laterally; striae with deep circular punctures, diameter longer than distance between punctures; intervals: with evenly shaped and distributed punctures; punctures with median keel dividing each puncture and with minute setae slightly off-center on keel (Fig. 28); first interval dilated behind declivity to apex, with fine punctures and appressed, minute setae from declivity to apex; intervals four and six connate and fused at declivity (Fig. 24); humeri convex, limited by striae six to eight and intervals six to nine. Sclerolepidia along dorsal margin of metaventricle appearing closer to digitate type 2A (Figs 31, 32), in which sclerolepidia are divided into two distinct lobes, with each lobe divided into several short digits (Lyal et al. 2006).

Abdominal terga. Median sclerites developed on T3–6 (Figs 19, 30), small, round spiracular sclerites on all tergites; numerous small sclerites laterally, between median and spiracular sclerites, and scattered medially from T1–2; microtrichial fields present along T3–6 posterior to median sclerites.

Legs coarse, femora robust, widening along apical $3/4$; tibiae strong, with elliptical, deep punctures; unci large, curved, originating at outer apical angle and small premucro on inner apical angle (Figs 33–36); tarsus article 3 cylindrical, subglabrous; article 5 long, slightly curved (Fig. 38); tarsal claws (pretarsal ungues) simple, joined basally, small (Fig. 37).

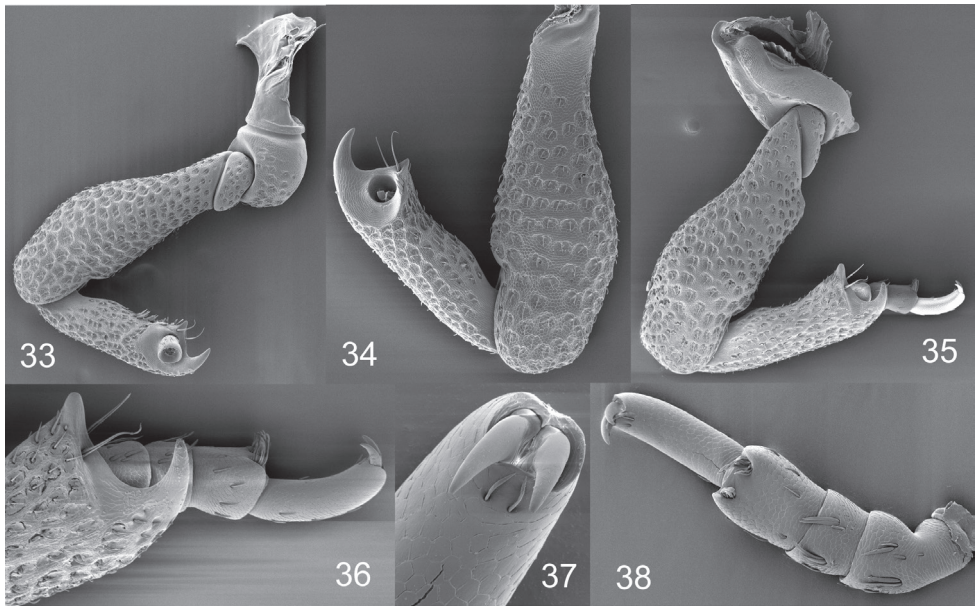


Figures 14–23. *P. punctatus*. **14** maxilla **15** labium **16** left mandible **17** right mandible **18** proventriculus **19** tergum: MS=median sclerite SS=spiracular sclerite **20** mesonotum **21** metanotum **22** metendos-ternite showing anterior tendons **23** hind wing: C=Costa Sc=Subcosta Rr=radial recurrent vein R=Radius rcm=margin of radial cell 2rs, 1rs=radial sclerites R3=3rd radial vein pst=postradial stripe mst=medial stripe Cu=Cubital A=Anal.



Figures 24–32. *P. punctatus*; SEM micrographs. **24** body, lateral view **25** enlargement of head and anterior portion of prothorax, lateral view **26** enlargement of left antenna and apex of rostrum **27** enlargement of apex of antennal club **28** enlargement of posterior of prothorax and anterior of left elytron, lateral view, showing punctures on elytral intervals and cleft immediately behind antero-dorsal margin of elytron **29** abdominal venter **30** tergum showing microtrichial patches along tergites, posterior to median sclerites: MS=median sclerite **31** metathorax, lateral view showing type 2A sclerolepidia (*sensu* Lyal et al. 2006) **32** enlargement of sclerolepidia.

Ventral areas. Prosternum densely, deeply punctured; distance between procoxae approximately $0.5 \times$ diameter of coxa; procoxal cavities closed, procoxae separated by distance ca. one third of diameter of coxa, positioned close to posterior margin of prosternum; mesoventrite with sparse, deep, circular punctures. Ventrites with sparse, deep, circular punctures, ventrites 1 and 2 slightly elevated, with circular punctures separated by $1\text{--}3 \times$



Figures 33–38. *P. punctatus*. **33** fore leg **34** middle leg **35** hind leg **36** distal end of metatibia and metatarsus **37** tarsal claws (pretarsal ungues), ventral view **38** tarsus, ventral view.

puncture diameter, more convex than other ventrites, posterior margin of ventrite 1 convex medially; 2 slightly narrower than 1; 3 and 4 subequal in width, narrow, sparsely and shallowly punctured; 5 sparsely and shallowly punctured, with large, oval convexity medially.

Male terminalia and genitalia (Figs 5–9). Spiculum gastrale broadly curved, with narrow apex; base slender. Eighth sternite not divided, bearing a few setae near postero-lateral margins. Tegmen complete; manubrium short, slightly less than $0.5 \times$ length of tegmen. Penis with median struts slightly longer than median lobe; apical margin of median lobe bearing sparse setae; endophallus (internal sac) bearing numerous minute setae/microtrichia near apex.

Female terminalia and genitalia (Figs 10–13). Gonocoxites of typical form; coxites oblong, somewhat quadrate; styli elongate, narrow. Spermatheca with globular base; apex strongly curved. Eighth tergite with slight rounded concavity along margin at middle and row of small setae along apical margin. Eighth sternite with base strongly bifurcate; spiculum short, approximately $0.5 \times$ length of base.

Material examined. Holotype. ♂, China: Guangdong Province: Xiancun, Guangzhou; Col. Unknown; VIII 1974; collected from *Aleurites moluccana* (L.) Willdenow; **Paratypes.** 7♂ and 1♀, same data as holotype.

Distribution. Guangdong Province, southern China.

Host plant. The type series was collected from the tree *Aleurites moluccana* (L.) Willdenow (Euphorbiaceae), but it is not known if this is a larval host of the weevil.

Etymology. The specific epithet is a Latin past participle and used to refer to the punctate body of the species.

Sexual dimorphism. No strong differences are apparent between sexes other than the slightly longer and narrower rostrum of the female and the concave first and second ventrites in the male.

Discussion

Pheude is the third monotypic cossonine genus described from China and differs from other oriental cossonine genera, which have been studied by Morimoto (1973), and other Dryotribini genera (e.g. *Lixomimus* Voss; *Cotasteroloebelia* Osella) distributed in adjacent countries (India, Nepal, and Japan) in having the following characters: rostrum nearly parallel-sided, rostrum without any keel ventrally, longer than wide (more than $2 \times$ width), with a longitudinal furrow dorsally; head small; antenna inserted on basal one-third of rostrum; scape extending beyond hind margin of eye, funicle with seven articles; pronotum longer than wide, base bisinuate, with a longitudinal median crest from base to apex; scutellum visible; apical margin of elytra expanded and lower than level of venter, elytral apical margin gently rounded and flattened; third tarsomere entire. Also, *Pheude* differs from the Chinese genera *Muschanella* and *Microtribodes* by the following: *Muschanella* has a wider head, the rostrum widened towards apex, and the antennae inserted slightly before middle of rostrum. *Microtribodes* has an antennal funicle of five articles, the basal half of rostrum with a ventral keel, the antennae inserted before middle of rostrum, and tarsomere 3 bilobed.

The tribe Dryotribini is represented in China by five genera. All these genera are distributed in China and adjacent countries except *Stenomimus*, which is completely Nearctic and Neotropical in distribution, so is presumably introduced into China.

The available distribution of these genera can give an idea that the Chinese cossonine fauna still have so many genera beyond our thinking either to be recorded or to be discovered, so that much more efforts are required for collecting specimens and identification.

Key to the genera of Dryotribini from China

- 1 Funicle with five articles; scutellum minute or indistinct **2**
- Funicle with seven articles; scutellum distinct **3**
- 2 Rostrum constricted basally, underside without median keel; antenna inserted at middle of rostrum; head strongly constricted behind eyes; scape exceeding hind margin of eye; scutellum indistinct; third tarsomere feebly emarginate ***Dryotribus***
- Rostrum without constriction, underside with median keel on basal half; antenna inserted before middle of rostrum; head without constriction behind eyes; scape not exceeding hind margin of eye; scutellum small, flat; third tarsomere bilobed ***Microtribodes***

- 3 Antenna short, scape not reaching eye; rostrum long, curved, without any furrow; pronotum slightly constricted at anterior margin, without median carina.....4
- Antenna long, scape extending slightly beyond posterior margin of eye; rostrum with longitudinal median furrow beginning at posterior margin of eyes and extending approximately midway on rostrum, furrow becoming shallower in anterior third; pronotum clearly constricted slightly before anterior margin, with moderately elevated, median longitudinal carina extending from anterior to posterior margin *Pheude*
- 4 Eyes oval, not visible in dorsal view; scrobe oblique, running ventrally at base of rostrum; prothorax oblong, with shallow subapical constriction not extending across dorsum; procoxae separated by distance less than one fourth of the diameter of coxa *Ochrananus*
- Eyes more rounded, prominent; scrobe with dorsal margin directed to middle of eye; prothorax more triangular, with deep subapical constriction; procoxae separated by approximately half the diameter of coxa *Stenomimus*

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A new parasitoid of *Bazaria turensis* (Lepidoptera, Pyralidae): *Campoplex bazariae* sp. n. (Hymenoptera, Ichneumonidae)

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Abstract

A new solitary endoparasitoid of the larva of *Bazaria turensis* Ragonot, 1887 (Lepidoptera, Pyralidae) in Qinghai province, China, *Campoplex bazariae* Sheng, **sp. n.**, belonging to the subfamily Campopleginae (Hymenoptera, Ichneumonidae), is reported. Illustrations of the new species are provided.

Keywords

Campopleginae, new species, taxonomy, host, *Bazaria turensis*, Lepidoptera, host plant

Introduction

Campoplex Gravenhorst, 1829, belonging to the subfamily Campopleginae (Hymenoptera: Ichneumonidae), comprises 209 species (Yu et al. 2012), of which 15 are from the Eastern Palaearctic Region (Momoi 1977, Uchida 1932, 1936, 1956, Yu et al. 2012), 123 from the Western Palaearctic (six of them are found across the Palaearctic) (Horstmann 1985, 1993, 2008, Meyer 1935, Yu et al. 2012), 33 are from the Nearctic Region (Yu et al. 2012), 30 from the Oriental (Gupta and Maheshwary 1977), 11 from the Neotropical, two from the Afrotropical (Townes and Townes

1973). Eleven species of *Campoplex* Gravenhorst have been known from China (Gupta and Maheshwary 1977, Kokujev 1915, Sheng and Sun 2014, Sonan 1930, Uchida 1932). The diagnostic characters of the genus were elucidated by Townes (1970) and expanded upon by Gupta and Maheshwary (1977).

The hosts of *Campoplex* Gravenhorst mainly belong to Coleophoridae, Gelechiidae, Pyralidae, Tortricidae, Yponomeutidae, etc. (Aubert 1983, Horstmann 1980, 1985, Kusigemati 1987, Shaw and Aeschlimann 1994, Yu et al. 2012).

In the last five years the authors have been exploring Qinghai Province, Ningxia Hui Autonomous Region and Inner Mongolia Autonomous Region, situated in northwestern China, and have collected large numbers of ichneumonids. In this article, one new species of *Campoplex* is reported, reared from the larva of *Bazaria turensis* Ragonot, 1887 (Lepidoptera, Pyralidae), from Qinghai Province, P.R. China.

Materials and methods

Mature larvae of the host, *Bazaria turensis*, were collected on 28 August 2013 by Mao-Ling Sheng. Cocoons of the host were collected on 21 May 2014 by Yan-Ling Zhang, from a forest where there had been an outbreak lasting at least three years, and brought to the laboratory. The forest is located in Dulan County, Qinghai Province. The forest is a shrubbery composed of *Nitraria tangutorum* Bobrov, *Lycium chinense* Miller var. *potaninii* (Pojarkova) A.M. Lu and *Kalidium foliatum* (Pallas) Moquin-Tandon. Mature larvae were maintained in a nylon cage at room temperature. The pupae were stored individually in glass tubes with a piece of filter paper dipped in distilled water to maintain moisture and plugged tightly with absorbent cotton. Glass tubes are 60 mm long and 6 mm diameter. After the emergence of moths and parasitoids was complete, all remaining pupae were dissected to record their condition (i.e. status of moths, and parasitism).

Specimens were compared with material from the Natural History Museum (NHM), London, UK. Morphological terminology is mostly based on Gauld (1991).

Images of whole insects were taken using a CANON Power Shot A650 IS. Other images were taken using a Cool SNAP MPS Color attached to a Zeiss Discovery V8 Stereomicroscope and captured with QCapture Pro 7.

Type specimens are deposited in the Insect Museum, General Station of Forest Pest Management (GSFPM), State Forestry Administration, People's Republic of China.

Results

Campoplex Gravenhorst, 1829

Campoplex Gravenhorst, 1829. Ichneumonologia Europaea, 3: 453. Type-species: *Ichneumon difformis* Gmelin, 1790. Designated by Westwood 1840.

Diagnosis. Eye slightly or not at all emarginate opposite antennal socket. Occipital carina joining hypostomal carina above base of mandible, or reaching directly to base of mandible. Area superomedia and area petiolaris confluent, junction between them usually discernible, combined area moderately wide. Area dentipara completely bordered by carinae. Apex of propodeum usually not reaching middle of hind coxa. Areolet usually present. 2m-cu inclivous. Basal portion of first tergite subcylindric and less than $3.0\times$ as long as deep, suture between tergite and sternite approximately at or a little below mid-height. Apex of male gonosquama rounded above or with a very shallow emargination. Ovipositor sheath about $3\text{--}4\times$ as long as apical depth of metasoma.

***Campoplex bazariae* Sheng, sp. n.**

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Figs 1–10

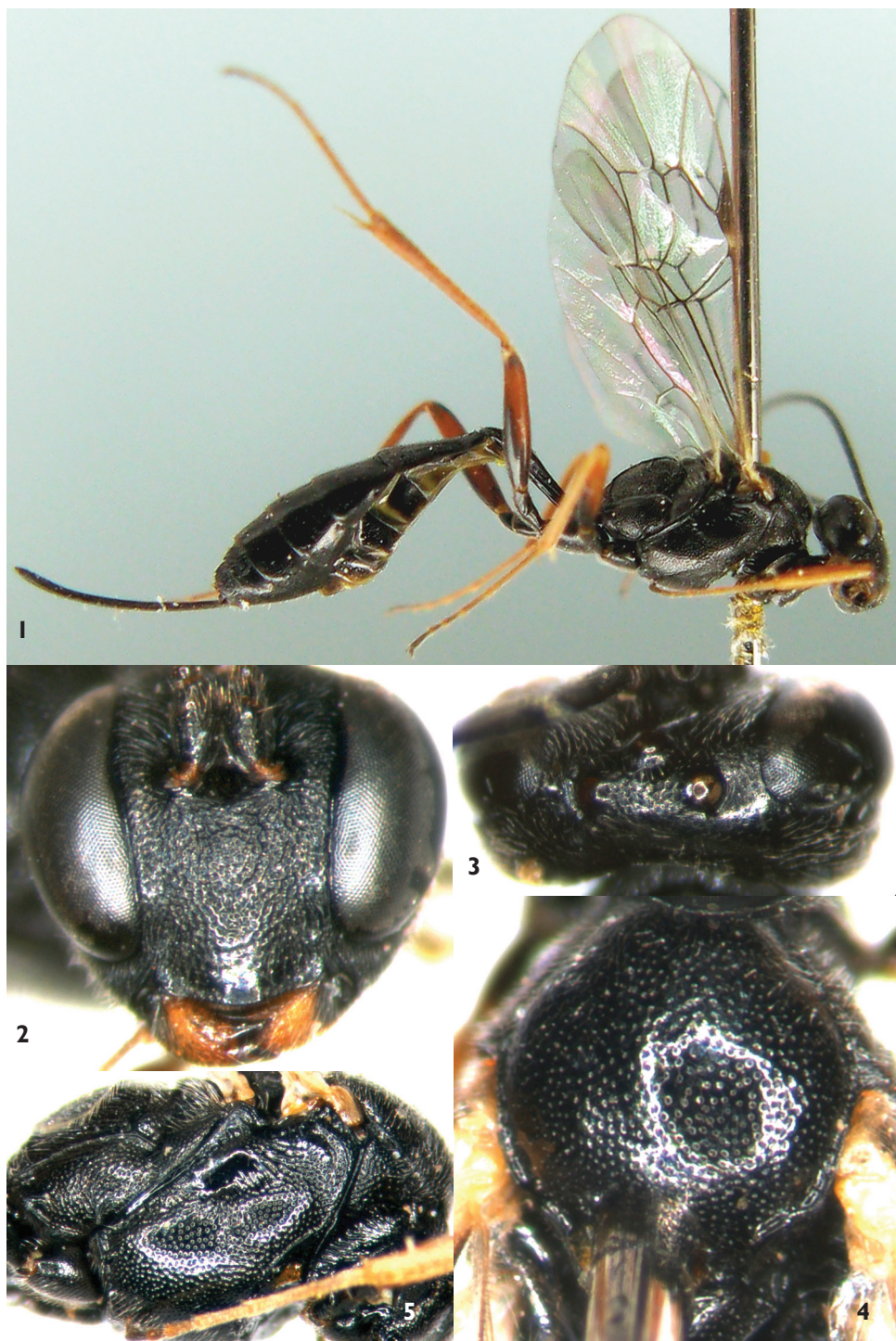
Etymology. The specific name is derived from the host's name.

Material examined. Holotype, female emerged from cocoon of *Bazaria turensis* on 20 July 2014 reared by Yan-Ling Zhang, CHINA: Balong, 2860m, Dulan County, Qinghai Province. Paratypes: 2 females, same data as holotype. 1 male, same data as holotype except 15 September 2014. 1 female, 1 male, CHINA: Nuomuhong, 2690m, Dulan County, Qinghai Province, 28 August 2013, Mao-Ling Sheng.

Diagnosis. Face finely coriaceous, with dense punctures. Interocellar area with distinct punctures. Postocellar line $1.6\text{--}1.7\times$ as long as ocular-ocellar line. Postscutellum with fine dense distinct punctures. First tergite from base to apex strongly evenly convex, smooth, shiny. Second and subsequent tergites finely coriaceous. Apical margins of tergites 6 and 7 with deep median triangular emarginations. Ovipositor slightly, evenly curved upwards. Head except mandibles and maxillary and labial palpi, mesosoma and all tergites entirely black.

Description. Female. Body length 7.5–8.0 mm. Fore wing length 5.5–5.8 mm. Ovipositor sheath length 2.7–2.9 mm.

Head. Inner margins of eyes slightly convergent ventrally. Narrowest width of face (Fig. 2) approximately $0.9\times$ height of face plus clypeus, slightly convex, finely coriaceous, with dense punctures. Clypeus shiny, with sparse punctures; apical margin slightly elevated and arched forwards. Mandible short, with large punctures, upper tooth as long as lower tooth. Malar area slightly concave, indistinctly granulose. Malar space approximately $0.30\text{--}0.34\times$ as long as basal width of mandible. Gena in dorsal view approximately $0.6\times$ as long as width of eye, almost smooth, with sparse, fine punctures, posterior portion obviously convergent posteriorly. Vertex (Fig. 3) finely granulose, with indistinct, fine, shallow punctures. Interocellar area with distinct punctures. Postocellar line $1.6\text{--}1.7\times$ as long as ocular-ocellar line. Ocular-ocellar line $1.0\text{--}1.2\times$ diameter of posterior ocellus. Frons almost flat, rough, with dense, indistinct punctures. Antenna with 37 flagellomeres. Ratio of length from first to fifth flagel-

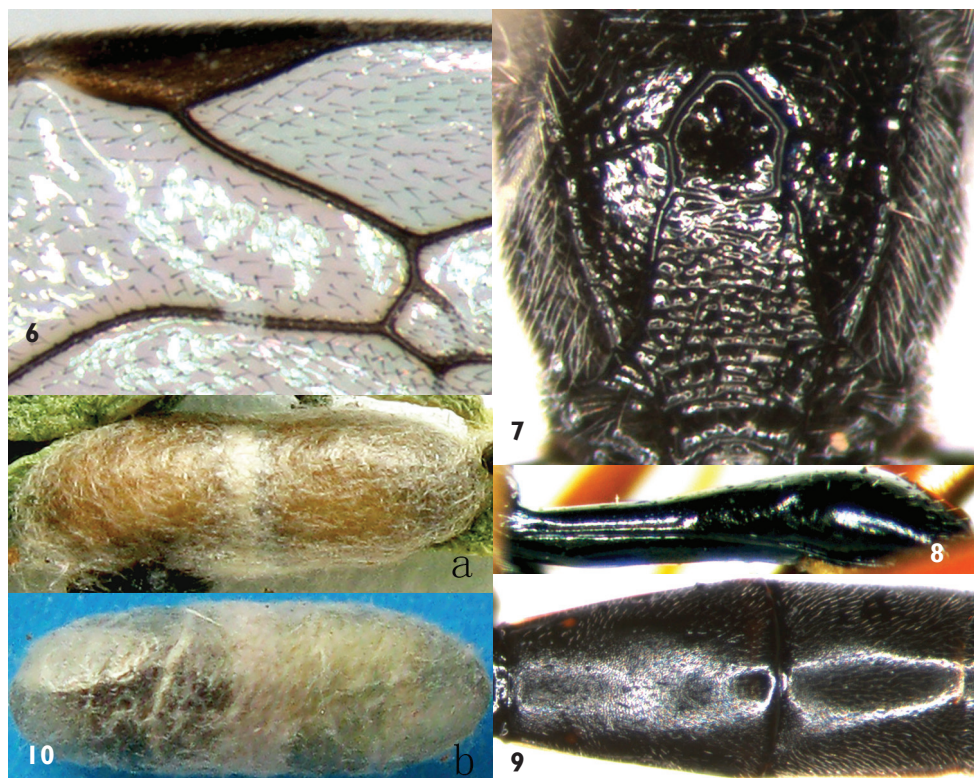


Figures 1–5. *Campoplex bazariae* sp. n. Holotype. Female **1** Habitus, lateral view **2** Head, anterior view **3** Head, dorsal view **4** Mesoscutum **5** Mesopleuron.

lomeres: 4.0:3.0:2.9:2.8:2.6. Occipital carina complete, upper median portion evenly up-curved, lower end reaching base of mandible.

Mesosoma. Lateral concavity of pronotum with dense oblique wrinkles, upper-posterior portion with dense coarse irregular punctures, distance between punctures $0.2\text{--}0.5\times$ diameter of puncture, upper posterior margin with dense fine punctures. Epomia distinct. Mesoscutum (Fig. 4) evenly convex, with distinct punctures, distance between punctures $0.2\text{--}2.5\times$ diameter of puncture. Notaulus vestigial. Scutellum evenly, strongly convex, with dense distinct punctures, distance between punctures $0.2\text{--}0.5\times$ diameter of puncture. Postscutellum trapezoidally convex, with fine, dense, distinct punctures, anteriorly transversely concave. Mesopleuron (Fig. 5) with distinct punctures, distance between punctures approximately $0.2\text{--}2.5\times$ diameter of puncture, in lower-front portion of speculum with dense oblique wrinkles. Speculum approximately transverse-quadrate, smooth, shiny. Upper end of epicnemial carina reaching about 0.5 level of posterior margin of pronotum. Mesopleural fovea consisting of short, shallow horizontal groove. Mesosternum with punctures as that of mesopleuron, posterior transverse carina complete, strong. Metapleuron slightly convex, with punctures as, or slightly denser than that of mesopleuron. Submetapleuron carina complete, strong. Wings slightly brownish, hyaline. Fore wing with vein 1cu-a distinctly distal of 1-M. Areolet (Fig. 6) obliquely quadrangular, its petiole $0.7\text{--}0.9\times$ as long as 2rs-m, receiving vein 2m-cu approximately $0.7\times$ distance from vein 2rs-m to 3rs-m. 2m-cu slightly inclivous. 2-Cu approximately as long as 2cu-a. Hind wing vein 1-cu almost vertical, about $3.0\times$ as long as cu-a. Ratio of lengths of hind femur, tibia and tarsus 7.5:10:12.5. Ratio of length of hind tarsomeres 1:2:3:4:5 is 10.0:4.0:2.6:1.7:2.0. Claws thin. Base of fore claw with sparse pectination. Base of hind claw with dense pectination. Area spiracularis of propodeum (Fig. 7) combined with area lateralis. Areas basalis small, strongly convergent posteriorly, longer than its maximum width, smooth, shiny. Area superomedia and area petiolaris confluent, junction point between them discernible. Area superomedia smooth, shiny, costula connecting approximately at its middle or slightly behind middle. Area petiolaris almost flat (indistinctly longitudinally concave), with dense distinct transverse wrinkles. Area externa smooth, distinctly punctate. Area dentipara slightly coarse, with indistinct, irregular wrinkles. Area posteroexterna with oblique transverse wrinkles. Areas spiracularis and lateralis with dense indistinct fine punctures. Propodeal spiracle small, elongate-oval, connecting with pleural carina by a distinct carina, space between them shorter than its longest diameter, distance to lateral longitudinal carina longer than its longest diameter. Apex of propodeum reaching 0.25 of hind coxa.

Metasoma. First tergite (Fig. 8) approximately 2.9 times as long as apical width, basal portion subcylindric, suture separating from sternite lying at mid height of segment; from base to apex strongly, evenly convex; smooth, shiny. Spiracle located about at apical 0.4 of first tergite. Second and subsequent tergites finely coriaceous. Second tergite (Fig. 9) $1.25\text{--}1.43\times$ as long as apical width. Third and following tergites compressed. Apical margins of tergites 6 and 7 with deep median triangular emarginations. Ovipositor sheath approximately $1.25\times$ as long as hind tibia, $0.65\text{--}0.75\times$ as long as total length of posterior seven tergites. Ovipositor slightly curved upwards, with distinct subapical dorsal notch.



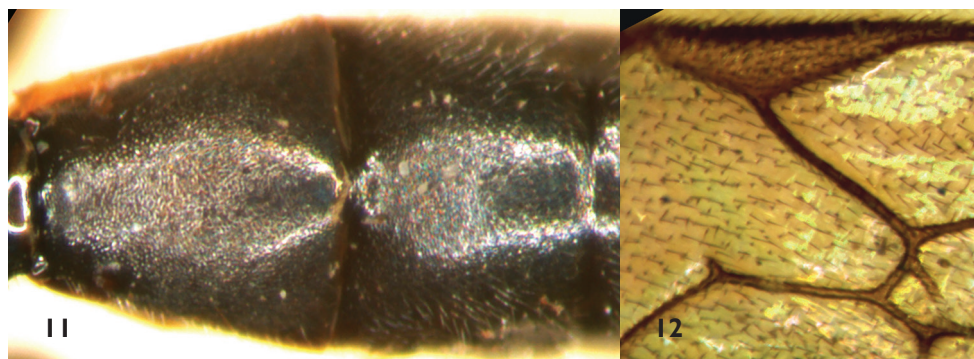
Figures 6–10. *Campoplex bazariae* Sheng, sp. n. Holotype. Female **6** Areolet and pterostigma **7** Propodeum **8** First tergite, lateral view **9** Tergites 2–3 **10 a, b** Cocoon.

Color (Fig. 1). Black, except the following. Maxillary and labial palpi blackish brown. Median portions of mandibles dark brown, or upper-median margins yellowish brown. Tegula stramineous. All coxae and trochanters, except brownish apical margins of fore trochanter, black. Fore femur, dorsal profiles and ventral apical portions of mid and hind femora reddish brown. Basal ventral halves or more of mid and hind femora, apical portion of hind femur black. Fore and mid tibiae, except outsides slightly yellowish, and tarsi brown to dark brown. Ventral side of hind tibia reddish brown, dorsal side and tarsus dark brown. Second, lateral margin of third and apical margins of fourth to sixth sternites grayish yellow to off-white. Median portion of pterostigma dark brown. Veins brownish black.

Male. Body length 8.0–8.2 mm. Fore wing length approximately 6.0 mm. Median portion of frons with dense transverse wrinkles. Apex of gonosquama more or less horny. Median portion of mandible reddish brown. Tegula yellow, median portion asymmetrically blackish brown. Mid and hind tarsi dark brown.

Cocoon (Fig. 10). Length about 7.5 mm. Diameter about 2.5 mm. Apices vaulted. Whitish grey.

Host. *Bazaria turensis* Ragonot, 1887 (Lepidoptera, Pyralidae).



Figures 11–12. *Campoplex ovatus* (Brischke, 1880) (NHM) Female **11** Tergites 2–3 **12** Areolet and pterostigma.

Host plants. *Nitraria tangutorum* Bobrov (Zygophyllaceae), *Kalidium foliatum* (Pallas) Moquin-Tandon (Amaranthaceae).

Biology. *Campoplex bazariae* Sheng is a solitary endoparasitoid of the larva of *Bazaria turensis*, spinning its cocoon in deciduous leaves (Fig. 10a) or near the surface of soil (Fig. 10b); also in the cocoon of *B. turensis*, collected and reared by the local colleague, Yan-Ling Zhang (Director of Forestry Pest Control and Quarantine Station of Dulan, Qinghai, China).

Remarks. This new species is similar to *C. ovatus* (Brischke, 1880) and can be distinguished from the latter by the following combination of characters: petiole of areolet (Fig. 6) 0.7–0.9× as long as 2rs-m; area superomedia smooth, shiny, flat, costula connecting at its middle; area petiolaris almost flat; second tergite approximately 1.25–1.43× as long as apical width; posterior portions of tergites 6 and 7 with deep median triangular emarginations; apical portions and basal ventral halves or more of hind femora black; ventral profiles of hind tibiae reddish brown, dorsal profiles darkish brown; median portion of pterostigma darkish brown. *Campoplex ovatus* (Figs 11, 12) (NHM): petiole of areolet approximately 0.5× as long as 2rs-m; area superomedia rough, costula connecting at its anterior 0.3; confluent areas superomedia and petiolaris distinctly longitudinally concave; second tergite as long as or slightly longer than apical width; posterior margins of tergites 6 and 7 truncate; hind femora and tibiae entirely reddish brown; pterostigma brown.

Acknowledgements

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A taxonomic study of the genus *Panesthia* (Blattodea, Blaberidae, Panesthiinae) from China with descriptions of one new species, one new subspecies and the male of *Panesthia antennata*

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Abstract

One new species *Panesthia guizhouensis* **sp. n.** and one new subspecies *Panesthia stellata concava* **ssp. n.** are described and illustrated. The male of *Panesthia antennata* Brunner von Wattenwyl, 1893 and its brachypterous form are described and illustrated for the first time. *Panesthia strelkovi* Bey-Bienko, 1969 is redescribed and illustrated. Three known species, *Panesthia birmanica* Brunner von Wattenwyl, 1893, *Panesthia sinuata* Saussure, 1839 and *Panesthia angustipennis cognata* Bey-Bienko, 1969 are illustrated. In addition, a key to all species of the genus *Panesthia* from China is presented.

Keywords

Wing polymorphism, brachypterism, illustration, key, *Salganea*

Introduction

The wood-feeding cockroach genus *Panesthia* was established by Serville (1831), belonging to the subfamily Panesthiinae of the family Blaberidae. Brunner von Wattenwyl (1893) presented 16 species and Saussure (1895) recorded 33 species in this genus. Bey-Bienko (1969) described three species of this genus from China. More recently, Roth (1977, 1979) recognized 55 species and nine subspecies of *Panesthia* worldwide, of which 15 species and two subspecies were reported for the first time. In this latter work, Roth also stated that *P. angustipennis spadica* by Bey-Bienko (1950) from mainland China should be *P. angustipennis cognata*. From then on, no new valid taxon in this genus was published. Asahina (1988) established the subspecies *P. angustipennis yayeyamensis*, which was split from the subspecies *P. angustipennis spadica*; but Maekawa et al. (1999) disagreed with his view based on molecular data. Feng and Woo (1990) reported two species from China, i.e., *P. concinna* Feng & Woo, 1990 and *P. guangxiensis* Feng & Woo, 1990; the former had been synonymized with *Salganea taiwanensis* Roth, 1979, while the latter was transferred to *Salganea* (Wang et al., 2014). At the same time, they also recorded *P. birmanica*, *P. sinuata* and *P. stellata* as distributed in China. Up to now, there were 55 species and nine subspecies of *Panesthia* reported worldwide, including eight species and two subspecies from China.

In this paper, we report one new species and one new subspecies, and also provide a key including nine species and three subspecies of the *Panesthia* from China. We also take this opportunity to report the male and the brachypterous form of *P. antennata* for the first time.

Materials and methods

The terminology of the head, body and male genitalia used in this paper mainly follows Roth (1977, 1979, 2003). Measurements are based on materials examined. Measurement of body length is without the tegmen. The genital segments of the examined specimens were macerated in 10% NaOH and observed in glycerin jelly using a Motic K400 stereomicroscope. All drawings were made with the aid of a Motic K400 stereomicroscope. Photographs of the specimens were made using a Canon 50D plus a Canon EF 100mm f/2.8L IS USM Macro lens with the aid of Helicon Focus software. We considered adults and nymphs collected from the same colony with similar external characters to be one species. Nymphs were identified mainly based on markings on the mesonotum and metanotum as well as their holes in terga, lateral margin of terga and hind margin of supra-anal plate. Type specimens are deposited in the Institute of Entomology, Southwest University, Beibei, Chongqing, China (SWU) and the Museum of Hebei University, Baoding, Hebei Province, China (HBU). We also borrowed specimens from the Museum of Southwest Forestry University, Kunming, Yunnan Province, China (SWFU) and Dali University, Dali, Yunnan Province, China (DLU) as indicated.

Taxonomy

Family Blaberidae Brunner von Wattenwyl, 1865

Subfamily Panesthiinae Kirby, 1904

Genus *Panesthia* Serville, 1831

Panesthia Serville, 1831: 38; Princis 1965: 309; Roth 1977: 12, 1979: 3. Type species: *Panesthia angustipennis* (Illiger, 1801).

Proterodia Costa, 1866: 5. Type species: *Proterodia punctatissima* Costa, 1866. Synonymized by Princis 1965: 309.

Dicellonotus Butler, 1882: 387. Type species: *Dicellonotus lucanoides* Butler, 1882. Synonymized by Roth 1977: 12.

Diagnosis (mainly following Roth 1977, 1979). Coloration dark reddish brown or black. Size ranging from 15 mm to over 50 mm. Body strongly sclerotized with a coarse surface, densely covered with punctations. Vertex foveolar or not, slightly exposed. Pronotum transversal ovate, anterior margin slightly convex, with a variable excision in the midline, or entire. If excised, the corners of the concavity protruding or not. Lateral margins of pronotum arched and the hind margin almost straight or slightly concave. The surface of the pronotum granular on variably depressed anterior half with a pair of oblique grooves and often with two disc tubercles on the posteriorly punctate half. Tegmina and wings unicoloured or not, fully developed (sometimes mutilated terminally or only leaving the basal portion of the tegmina and wings), or reduced, or tegmina reduced but wings absent, or both tegmina and wings absent. The tarsi of legs with five segments, pulvilli are present on segments 1–4. The hind metatarsus is shorter than the remaining segments combined. Claws symmetrical, without arolia. Abdominal terga with punctate surface, and the hind margins without spines, tubercles or teeth.

Anterolateral corners of terga rarely with holes and without setae, or just tergum six (*T6*) and tergum seven (*T7*) with holes. Lateral margins of *T6* smooth, and latero-caudal angles not produced, or with a spine and directed caudally. Lateral margins of *T7* straight and not crenulate, latero-caudal angles sometimes produced and usually directed caudally. Lateral margins of sternite seven (*S7*) with a feeble and short ridge or without ridge. In the male, the hind margin of the last sternite is truncate or concave, and the subgenital plate is slightly exposed. In the female, the hind margin of the last sternite is convex and rounded. Both sexes are without styli. Supra-anal plate punctate, with uneven or rounded hind margin, and cerci are short and broad basally. Paraprocts are asymmetrical, the left one in ventral view with a finger-like projection lacking in the right one. Anterior margin and lateral margins of subgenital plate concave and the hind margin is rounded. Four genital phallomeres as follow: first sclerite of the left phallomere (*L1*) plated; second ventromedial sclerite of left phallomere (*L2vm*) rod-like; second dorsal sclerite of the left phallomere (*L2d*) variable; second sclerite of the



Figures 1–16. 1–2 *Panesthia antennata* Brunner von Wattenwyl, 1893, male: 1 dorsal view 2 ventral view 3–4 *Panesthia antennata* Brunner von Wattenwyl, 1893, nymph: 3 dorsal view 4 ventral view 5–6 brachypterous form of *Panesthia antennata* Brunner von Wattenwyl, 1893, male: 5 dorsal view 6 ventral view 7–8 brachypterous form of *Panesthia antennata* Brunner von Wattenwyl, 1893, nymph: 7 dorsal view 8 ventral view 9–10 *Panesthia stellata concava* ssp. n., male: 9 holotype, dorsal view 10 same, ventral view 11–12 *Panesthia stellata concava* ssp. n., nymph: 11 paratype, dorsal view 12 same, ventral view 13–14 *Panesthia guizhouensis* sp. n., male: 13 holotype, dorsal view 14 same, ventral view 15–16 *Panesthia guizhouensis* sp. n., nymph: 15 paratype, dorsal view 16 same, ventral view. Scale bars = 1.0 cm.



Figures 17–26. 17–18 *Panesthia strelkovi* Bey-Bienko, 1969, male: 17 dorsal view 18 ventral view 19–20 *Panesthia birmanica* Brunner von Wattenwyl, 1893, male: 19 dorsal view 20 ventral view 21–22 *Panesthia sinuata* Saussure, 1895, male: 21 dorsal view 22 ventral view 23–24 *Panesthia angustipennis cognata* Bey-Bienko, 1969, female: 23 dorsal view 24 ventral view 25–26 *Panesthia angustipennis cognata* Bey-Bienko, 1969, nymph: 25 dorsal view 26 ventral view. Scale bars = 1.0 cm.

right phallomere (*R2*) well developed or reduced, if developed, it is often hook-like and curved to right side in dorsal view.

Remarks. The genus *Panesthia* is recognized by both *T6* and *T7* having smooth lateral margins, their hind margins without tubercles; the hind angles of *T7* spine-like, but *T6* not. Some species in this genus may have individuals with mixed characters resembling the genus *Salganea* Stål, 1877, *Ancaudellia* Shaw, 1925 or *Miopanesthia* Saussure, 1895 (Roth 1982: 71). The first two genera can be distinguished from *Panesthia* by the anterolateral angles of terga usually with holes or grooves with associated setae, but species of *Panesthia* often lack holes, or if with holes in *T6* and *T7*, the holes without setae. The last genus *Miopanesthia*, has a hind metatarsus that is usually close to or longer than the combined length of the remaining tarsal segments; however, the hind metatarsus is shorter than the remaining segments in *Panesthia*.

Distribution. Oriental Region, Australian Region, a few locations in the Palearctic Region (China, Japan).

Key to species of *Panesthia* from China

- 1 Tegmina and wings absent.....*P. larvata*
- Tegmina and wings present, or tegmina present and wings absent.....2

- 2 Tegmina reduced (Fig. 17) and wings absent *P. strelkovi*
 – Tegmina and wings well developed or reduced 3
 3 Tegmina with more than one colour in the form of spots *P. transversa*
 – Tegmina unicoloured without spots 4
 4 Laterocaudal angles of *T6* acute and posteriorly directed *P. birmanica*
 – Laterocaudal angles of *T6* not acute 5
 5 Anterior margin of pronotum broadly excavated and with a projection mesally in male, slightly concave and without projection in female 6
 – Anterior margin of pronotum slightly concave and without middle projection in both sexes 8
 6 Body length < 30 mm, anteroventral margin of front femur with 0–1 spine .
 *P. sinuata*
 – Body length > 30 mm, anteroventral margin of front femur with two spines or more (*P. angustipennis* complex) 7
 7 Hind margin of supra-anal plate entire dorsally or weakly undulate; median phallomere *L2d* elongate, tapering to a round apex (Roth 1979: Figs 19J, 20C–G) *P. angustipennis spadica*
 – Hind margin of supra-anal plate undulate dorsally; median phallomere *L2d* short with variable apex (Fig. 92; Roth 1979: Figs 21H, 22E, 23A–X)
 *P. angustipennis cognata*
 8 Hind margin of supra-anal plate slightly crenate in ventral view (Fig. 89) and entire in dorsal view *P. guizhouensis* sp. n.
 – Hind margin of supra-anal plate crenulate in ventral and dorsal view 9
 9 Vertex with a foveola in dorsal view (Fig. 27), and teeth on supra-anal plate with smooth border (Fig. 32) *P. antennata*
 – Vertex without foveola (Fig. 39), and teeth on supra-anal plate with uneven border (Fig. 44) *P. stellata concava* ssp. n.

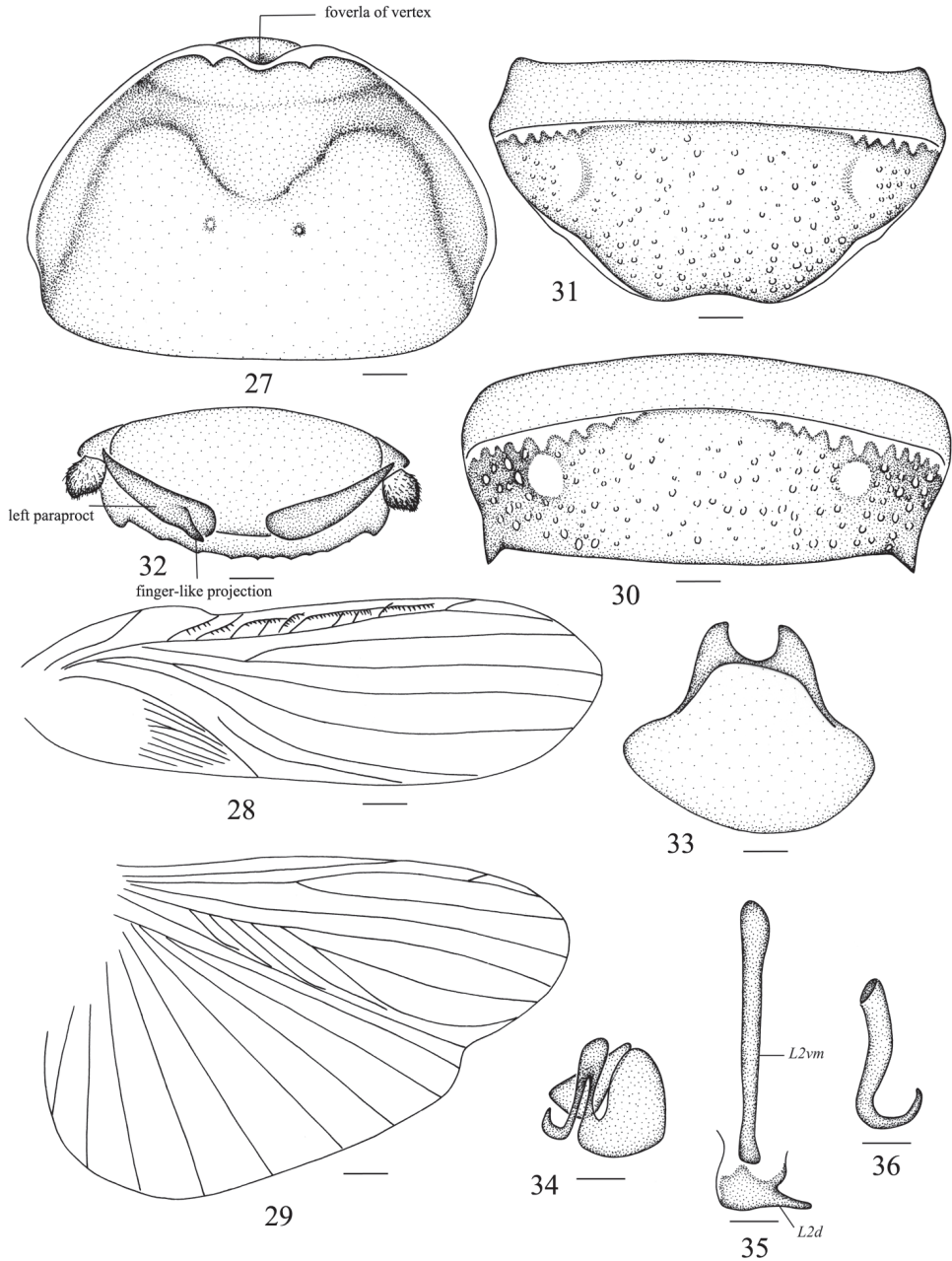
***Panesthia antennata* Brunner von Wattenwyl, 1893**

Figs 1–8, 27–38

Panesthia antennata Brunner von Wattenwyl, 1893: 50; Roth 1979: 61.

Description. Male. Body black or dark brown (Figs 1, 5). Face black with brown eyes, ocelli and upper lip yellowish brown. Antennae black, with apical segments pale yellow. Sternites and legs reddish brown or black, tarsal pulvilli pale (Figs 2, 6).

Vertex punctate, with a small foveola in dorsal view, which is exposed to the excision of pronotum in anterior margin (Fig. 27). Face punctulate, ocelli distinct. Pronotum transverse, anterior margin with a U-shaped excision in the middle, lateral corners of the indentation incrassate and upturned; lateral margins convex and the widest point below the middle; hind margin straight; anterior 1/3 of pronotum weakly depressed and the floor granular, with two rounded grooves, remaining surface punctate and with two tu-



Figures 27–36. *Panesthia antennata* Brunner von Wattenwyl, 1893 **27** vertex and pronotum **28** tegmen **29** hind wing **30** abdominal tergum 7, dorsal view **31** abdominal sternite 7, ventral view **32** supra-anal plate and paraprocts, ventral view **33** subgenital plate, dorsal view **34** left phallomere (L1) **35** median phallomere (L2vm and L2d) **36** right phallomere (R2). Scale bars = 1.0 mm (Figs **27**, **30–33**), 2.0 mm (Figs **28–29**), 0.5 mm (Figs **34–36**).

bercles medially (Fig. 27). Tegmina and wings fully developed (Figs 28–29) and reaching or extending beyond the end of abdomen (Fig. 1), sometimes mutilated. In brachypterous form, tegmina and wings reduced (Figs 37–38) with tip just reaching the hind margin of segment two to segment four of abdomen (Fig. 5), sometimes mutilated terminally. Caudal edge of the hind wing wave-shaped (Fig. 38). Anterior ventral margin of front femur with 0–2 spines and distal spine absent, hind margin with a large distal spine. Abdominal tergites densely punctate, the punctations denser caudally, anterolateral corners without holes. Caudal angles of *T6* rounded; lateral margins of *T7* smooth, posteriolateral angles extended caudally and with subacute apex (Fig. 30). Abdominal sternites densely punctate, hind margin of *S7* concave (Fig. 31) and subgenital plate slightly exposed. Supra-anal plate densely punctate, the surface coarser than on abdominal tergites; hind margin crenulate, with 7–10 small teeth in middle, caudal angles small, similar to or slightly bigger than the largest one between them (Fig. 32). Cercus fin-shaped, setaceous ventrally, dorsal surface without setae (Fig. 32). Posterior part of subgenital plate flabellate (Fig. 33).

Male genitalia. Genital phallomere *L1* well developed but slightly sclerotized (Fig. 34); *L2vm* rod-like, *L2d* with an elongate projection at the apex (Fig. 35); *R2* developed and hook-shaped (Fig. 36).

Female. Similar to male, but hind margin of *S7* rounded. In all specimens observed, the anterior margin of pronotum with an excision. In brachypterous form, tegmina and wings also reduced similar to males.

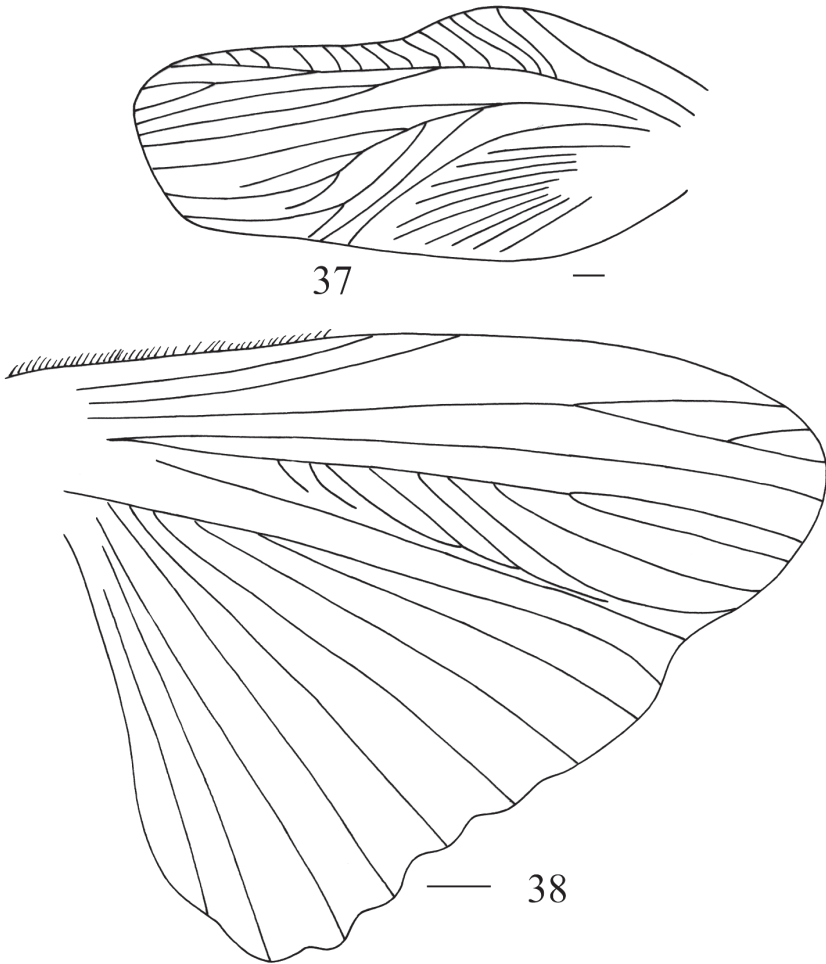
Nymph. Body black and punctate, with two yellowish brown marks on the mesonotum and metanotum without marks (Figs 3–4, 7–8).

Measurements. Male, body length: 29.1–32.0 mm; pronotum: length/width: 6.5–6.9/9.6–10.5 mm; width of excision of anterior margin of pronotum: 1.7–2.0 mm; distance between disc tubercles: 1.5–2.0 mm; tegmen: 22.7–26.4 mm. In brachypterous form, body length: 28.5–35.5 mm; pronotum: length/width: 6.8–7.1/9.8–11.3 mm; width of excision of anterior margin of pronotum: 2.0–2.5 mm; distance between disc tubercles: 1.9–2.5 mm; tegmen: 13.5–16.7 mm.

Female, body length: 29.7–32.6 mm; pronotum: length/width: 6.5–7.0/10.1–10.3 mm; width of excision of anterior margin of pronotum: 1.7–2.0 mm; distance between disc tubercles: 1.9–2.0 mm; tegmen: 23.0–26.8 mm. In brachypterous form, body length: 32.0–32.5 mm; pronotum: length/width: 6.1–7.1/9.6–11.1 mm; width of excision of anterior margin of pronotum: 1.6–2.5 mm; distance between disc tubercles: 2.0–2.4 mm; tegmen: 12.6–16.0 mm.

Material examined. Two males, two females and one nymph, China: Yunnan Prov., Tengchong County, Mt. Gaoligong, 9 August 2005, coll. Benyong Mao (HBU); 13 males, six females and 32 nymphs, Yunnan Prov., Tengchong County, Lingjiapu, 13–14 August 2006, coll. Biao Liu (SWFU).

In brachypterous form, one male and one female, China: Yunnan Prov., Tengchong County, Mt. Gaoligong, Baihualing, 30 July 2012, coll. Jishan Xu and Lingxiao Chang (HBU); two males, two females and one nymph, Yunnan Prov., Longling County, Longxin Village, Mt. Hei, 2300m, 23–25 July 2008, coll. Jishan Xu and Zhenhua Gao (HBU); one male and one female, China: Yunnan Prov., Nanjian Coun-



Figures 37–38. brachypterous form of *Panesthia antennata* Brunner von Wattenwyl, 1893 **37** tegmen **38** hind wing. Scale bars = 1.0 mm.

ty, Mt. Wuliang, 8–9 July 2006, coll. Benyong Mao and Juntong Lang (HBU); one male and one nymph, China: Yunnan Prov., Nanjian County, Mt. Wuliang, 17 July 2003, coll. Benyong Mao (HBU); three males and five nymphs, China: Yunnan Prov., Longchuan County, Mt. Ping, 1800m, 6 November 2003, coll. Jinxin Song (SWFU); one male, China: Yunnan Prov., Lijiang, Snow Mt. Yulong, Yuanbinping, 3228m, 31 October 2007, coll. Biao Liu (SWFU); one male and one female, China: Yunnan Prov., Tengchong County, Dahaoping, 2000m, 3 May 2002, coll. Jinxin Song and Yingxian Situ (SWFU); one male, China: Yunnan Prov., Baoshan City, Baihualing, 1980m, 12 April 2002, coll. Yingxian Situ (SWFU); one male and one nymph, Yunnan Prov., Mt. Wuliang, 2000m, 17 July 2003, coll. Benyong Mao (DLU).

Distribution. China (Yunnan); Myanmar.

***Panesthia stellata concava* ssp. n.**

Figs 9–12, 39–48

Description. Male. Body black (Fig. 9). Eyes, ocelli and upper lip yellowish brown. Antennae black, with terminal segments yellow. Legs black, tarsal pulvilli pale yellowish (Fig. 10).

Vertex and face punctate, the former exposed and without foveola (Fig. 39). Ocelli small with indefinite borders. Pronotum transverse, anterior margin concave, thickened and with a V- or U-shaped excision in the middle, the corners of the excavation slightly incrassate and upturned; lateral margins rounded with the widest point behind the midline; hind margin almost straight; anterior 1/3 of pronotum depressed with two arched grooves, the surface granular; posterior half densely punctate, with two middle tubercles (Fig. 39). Tegmina and wings well developed (Figs 40–41), extending to or beyond the end of the abdomen (Fig. 9). Anterior ventral margin of front femur with zero, two or four spines (most commonly two) and a small distal spine, hind margin with a large distal spine. Abdominal tergites densely punctate, the anterolateral corners of tergites without hole; caudal angles of *T6* rounded; lateral margins of *T7* smooth, caudal angles oblique and subacute (Fig. 42). Abdominal sternites densely punctate, hind margin of *S7* truncate and rear edge of subgenital plate exposed (Fig. 43). Supra-anal plate roughened and densely punctate, coarser than abdominal tergites; hind margin with 8–10 subobsolete teeth and with margin uneven; lateral angles larger than the medial tooth (Fig. 44). Cercus without setae dorsally, ventral surface convex with dense hairs (Fig. 44). Anterior margin of subgenital plate concave, anterolateral corners rounded; lateral margins concave (Fig. 45).

Male genitalia. Genital phallomere *L1* well developed (Fig. 46); *L2vm* rod-like, *L2d* short and apex round (Fig. 47); *R2* well developed and hook-shaped (Fig. 48).

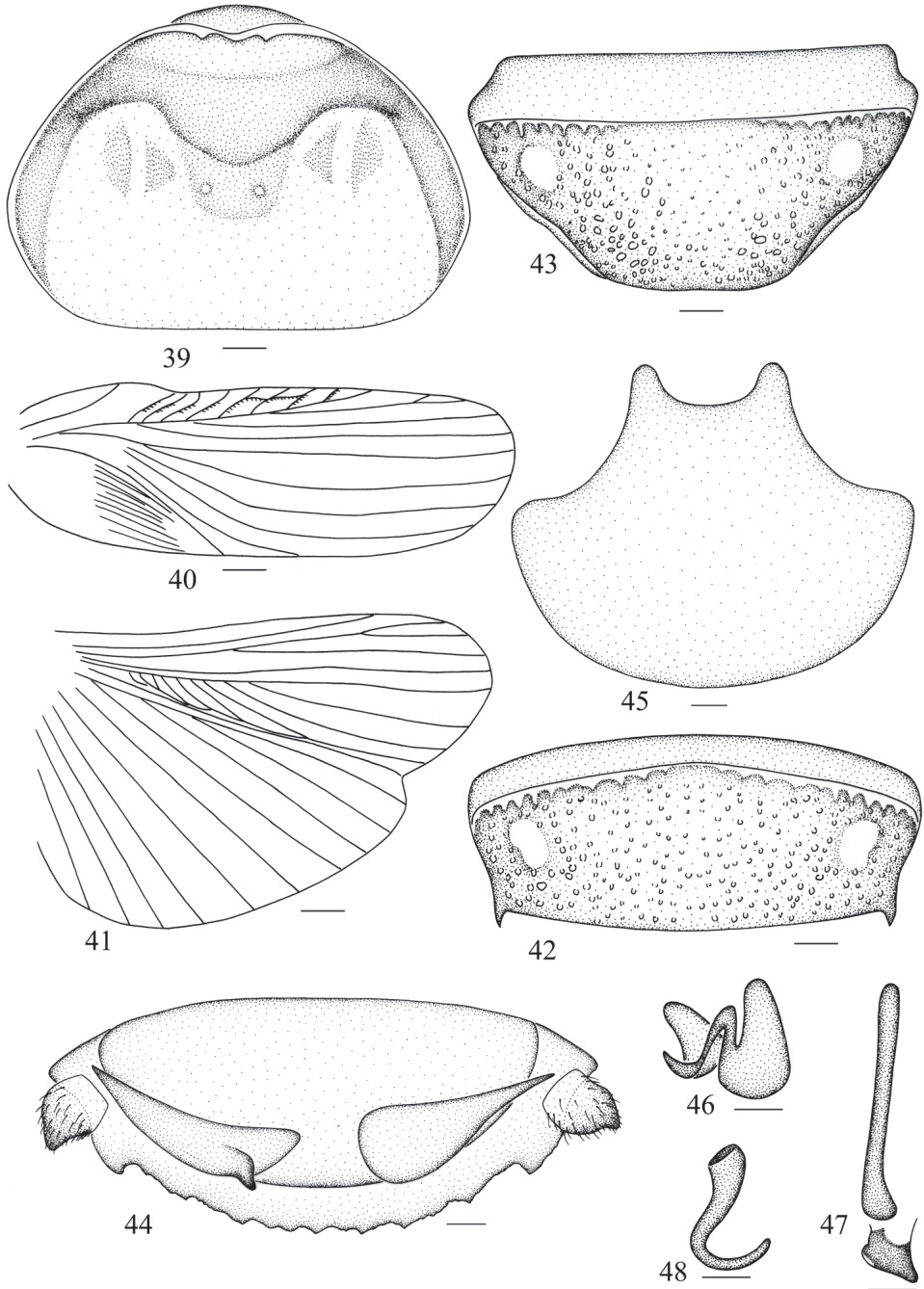
Female. Essentially similar to male, differs with the anterior margin of pronotum weakly concave as well as *S7* with rounded hind margin.

Nymph. Body black and punctate, with a broad yellow band on the mesonotum which extends to the middle of the metanotum, hind border of the mark concave (Figs 11–12).

Measurements. Male, body length: 27.0–32.5 mm; pronotum: length/width: 5.9–7.3/9.4–11.2 mm; width of excision of anterior margin of pronotum: 1.3–2.0 mm; distance between disc tubercles: 1.6–2.1 mm; tegmen: 22.1–26.7 mm.

Female, body length: 28.5–32.5 mm; pronotum: length/width: 6.5–7.1/10.3–11.0 mm; width of excision of anterior margin of pronotum: 1.0–1.3 mm; distance between disc tubercles: 1.5–2.0 mm; tegmen: 23.8 mm.

Material examined. *Holotype*, male, China: Xizang Prov., Chayu County, Shangchayu Town, 8 August 2013, coll. Xinglong Bai and Junsheng Wang (HBU). *Paratypes*, four males, one female and four nymphs, same data as holotype (HBU); one male, two females and two nymphs, Sichuan Prov., Dege County, Gengqing Town, 3270m, 19 July 2009, coll. Guodong Ren (HBU); one female, China: Xizang Prov., Chayu, 2000m, 24 August 1973, coll. Fusheng Huang (SWU).



Figures 39–48. *Panesthia stellata concava* ssp. n. **39** vertex and pronotum **40** tegmen **41** hind wing **42** abdominal tergum 7, dorsal view **43** abdominal sternite 7, ventral view **44** supra-anal plate and paraprocts, ventral view **45** subgenital plate, dorsal view **46** left phallomere (L1) **47** median phallomere (L2vm and L2d) **48** right phallomere (R2). Scale bars = 1.0 mm (Figs 39, 42–45), 2.0 mm (Figs 40–41), 0.5 mm (Figs 46–48).

Remarks. This subspecies is close to *P. stellata stellata* Saussure, 1895, but can be distinguished by the following characteristics: 1) nymph with broad yellowish band on mesonotum and metanotum, nymph of *P. stellata stellata* with two yellowish markings on mesonotum and without markings on metanotum; 2) anterior margin of pronotum with an excision in both sexes and the corners of the excision upturned in male; anterior margin of pronotum entire or slightly concave in both sexes of *P. stellata stellata*. Feng and Woo (1990) identified the material collected by Fusheng Huang as *P. stellata* Saussure, 1895. But after our critical examination, it should be treated as a new subspecies.

Etymology. The subspecific epithet is derived from the Latin word “*concavus*” which refers to the hind margin of the yellowish mark on nymphs being concave.

***Panesthia guizhouensis* sp. n.**

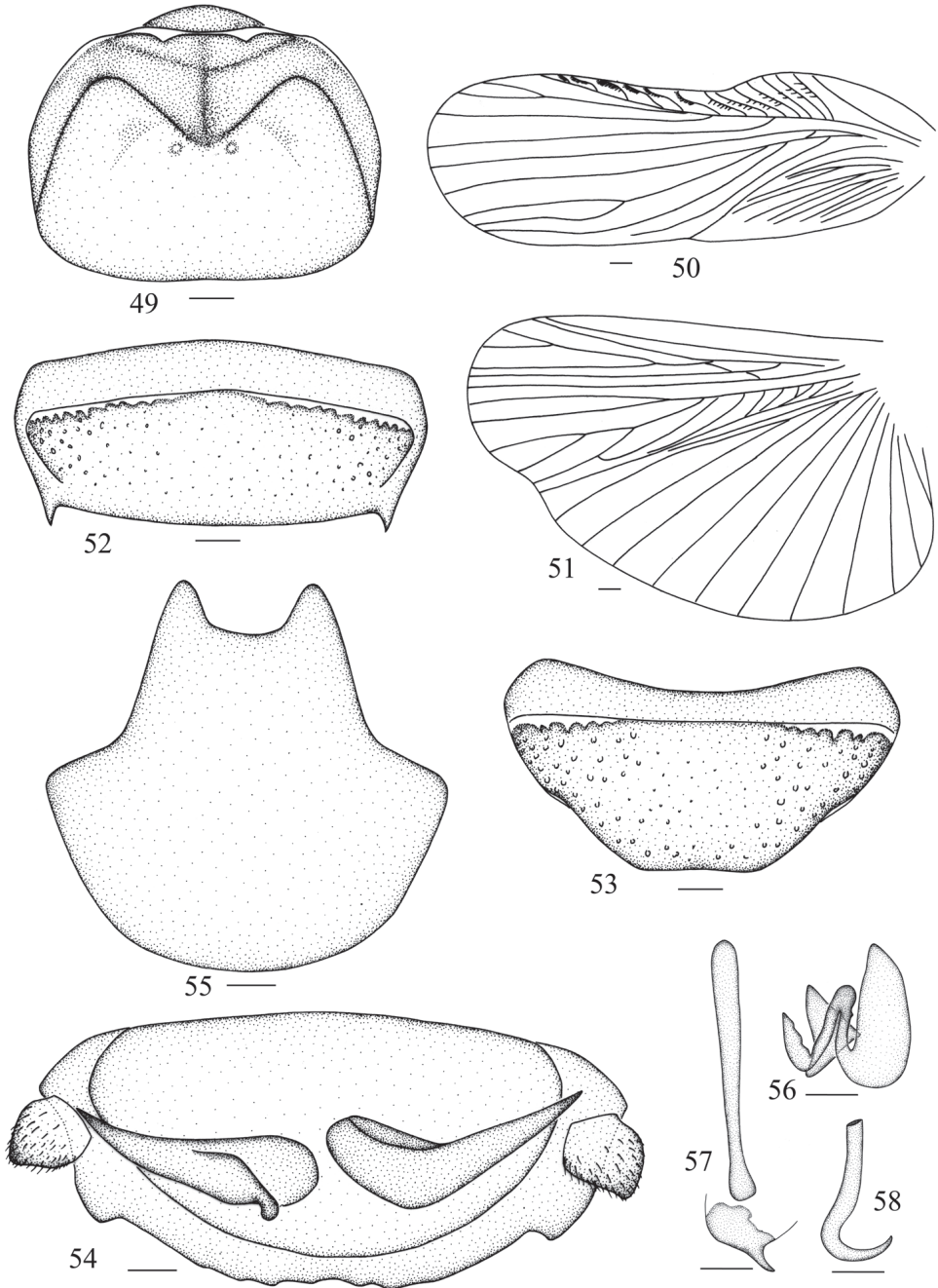
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Figs 13–16, 49–58

Description. Male. Body dark brown or black (Fig. 13). Face black, eyes brown or black, ocelli pale yellowish and upper lip yellowish brown. Antennae black, terminal segments light brown. Abdominal sternites reddish brown with the middle of anterior three sternites brown (Fig. 14). Legs reddish brown with coxae and trochanter brown, tarsal pulvilli pale (Fig. 14).

Vertex slightly punctate, exposed (Fig. 49). Face punctulate, ocelli small, round. Pronotum transverse ovate and flat; anterior margin convex or straight, center weakly concave, lateral corners of the indentation slightly incrassate and upturned; lateral margins convex and widest at or before the midline; hind margin straight; anterior 1/3 of pronotum shallowly depressed and delineated by two grooves, the surface sparsely granular; posterior half flattened and punctate densely, with two small disc tubercles (Fig. 49). Tegmina and wings well developed (Figs 50–51), extending to or surpassing the tip of abdomen (Fig. 13), few reaching to the hind margin of 6th tergite, sometimes mutilated terminally. Anterior ventral margin of front femur with 0–1 spine and with a small distal spine, hind margin with a large distal spine. Abdominal tergites punctate, with punctations denser caudally, anterolateral corners without holes. Caudal angles of 6th tergite weakly extended; lateral margins of 7th tergite smooth, caudal angles acute and directed caudally (Fig. 52). Abdominal sternites punctate, hind margin of the 7th sternite weakly concave and subgenital plate exposed (Fig. 53). Supra-anal plate punctate densely, hairless, hind margin smooth or slightly concave in the middle in dorsal view, with 5–7 small teeth medially or smooth in ventral view, caudal angles small (Fig. 55). Cercus fin-shaped with acute apex, dorsal surface without setae and hairy ventrally (Fig. 54). Hind margin of subgenital plate rounded (Fig. 55).

Male genitalia. Genital phallomere well developed, *L1* well sclerotized (Fig. 56); *L2vm* rod-like, *L2d* elongate (Fig. 57); *R2* hook-shaped (Fig. 58).



Figures 49–58. *Panesthia guizhouensis* sp. n. **49** vertex and pronotum **50** tegmen **51** hind wing **52** abdominal tergum 7, dorsal view **53** abdominal sternite 7, ventral view **54** supra-anal plate and paraprocts, ventral view **55** subgenital plate, dorsal view **56** left phallomere (L1) **57** median phallomere (L2vm and L2d) **58** right phallomere (R2). Scale bars = 1.0 mm (Figs 49–55), 0.5 mm (Figs 56–58).

Female. Differs from male as follows: the anterior margin of pronotum weakly concave and the corners not upturned; the tubercles on surface smaller than in male. Hind margin of *S7* rounded.

Nymph. Body black and punctuate, with two yellowish brown marks on the mesonotum and metanotum without marks (Figs 15–16).

Measurements. Male, body length: 24.5–27.0 mm; pronotum: length/width: 4.2–5.2/ 7.9–9.0 mm; width of excision of anterior margin of pronotum: 1.5–1.8 mm; distance between disc tubercles: 1.1–1.5 mm; tegmen: 22.0–25.6 mm.

Female, body length: 26.8–31.5 mm; pronotum: length/width: 4.5–5.0/8.5–9.0 mm; width of excision of anterior margin of pronotum: 1.1–1.3 mm; distance between disc tubercles: 1.3–1.5 mm; tegmen: 21.2–23.2 mm.

Material examined. *Holotype*, male, China: Guizhou Prov., Zunyi City, Suiyang County, Kuankuoshui Natural Reserve, 14 August 2010, coll. Keliang Wu (SWU). *Paratypes*, five males, two females and five nymphs, same data as holotype (SWU); four males, 12 females and 13 nymphs, Guizhou Prov., Zunyi City, Suiyang County, Kuankuoshui Natural Reserve, 1–2 August 2013, coll. Xiudan Wang and Yuhong Zheng (SWU).

Remarks. This species is similar to *P. angustipennis spadica*, but can be distinguished by the following characteristics: 1) anterior margin of pronotum weakly concave in male, and without mesal elevation, male of latter with anterior margin broadly excised and with mesal elevation; 2) body length < 30 mm in most, or few surpassing 30 mm, body length of *P. angustipennis spadica* > 30 mm.

Etymology. The specific epithet is named after the locality of the holotype, Guizhou Province.

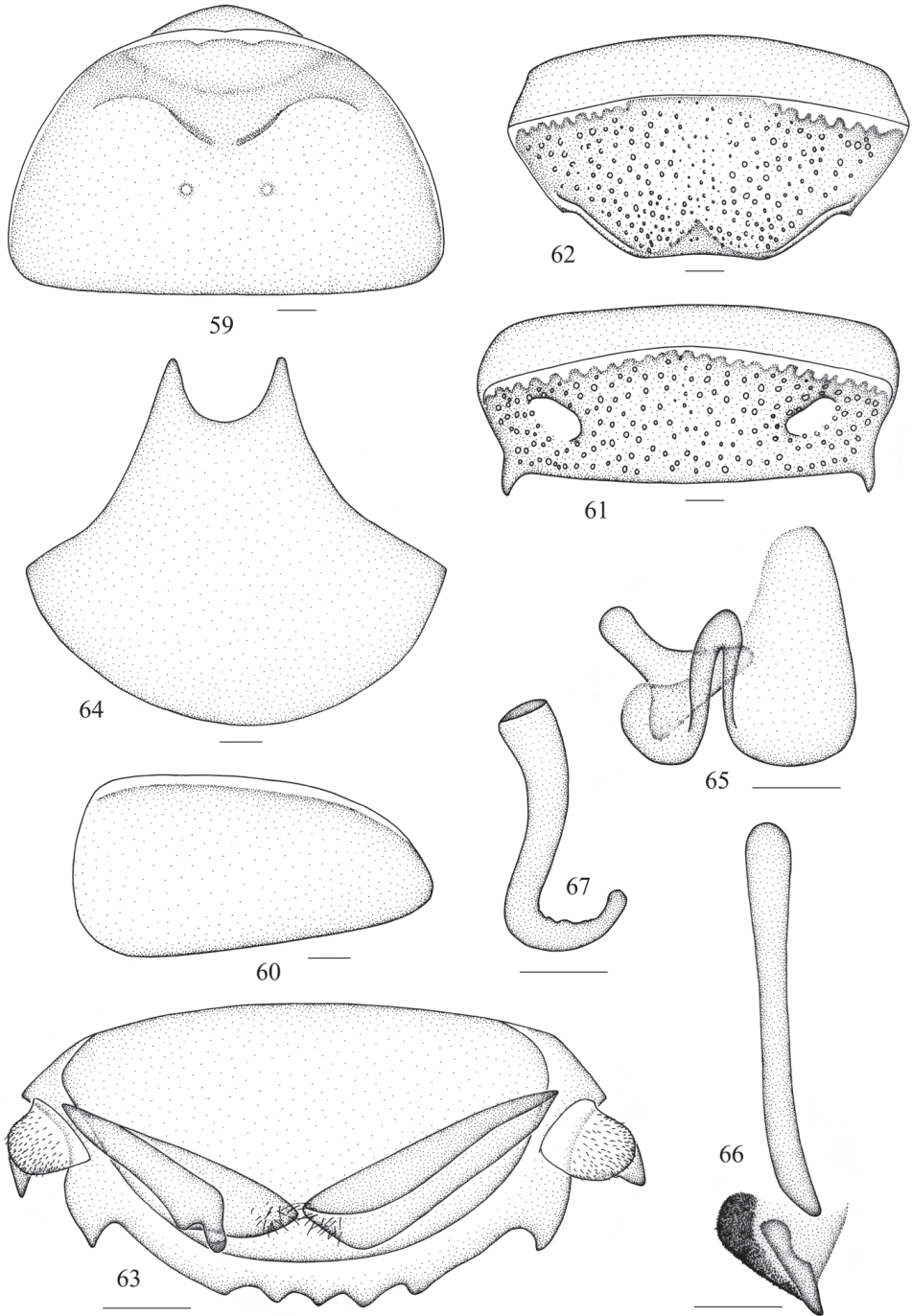
***Panesthia strelkovi* Bey-Bienko, 1969**

Figs 17–18, 59–67

Panesthia strelkovi Bey-Bienko, 1969: 834; Roth 1979: 104; Feng and Woo 1990: 216.

Description. Male. Body black (Fig. 17). Face black, eyes and ocelli brown, upper lip yellowish brown, antennae black with brownish apex. Legs dark brown, coxae and trochanter reddish brown (Fig. 18).

Face punctulate, with weak ocelli; vertex slightly exposed (Fig. 59). Pronotum nearly semicircular, the widest near the truncate hind margin (Fig. 59). Anterior margin convex and incrassate, slightly concave in the middle, with two upturned tubercles (Fig. 59). Anterior half of pronotum depressed, the surface granular; posterior part punctate and elevated, with two tubercles on disc (Fig. 59). Tegmina reduced to sclerotized blades (Fig. 60) which are far separated on the lateral sides of the mesonotum respectively, with apex slightly surpassing hind margin of mesonotum; wings absent (Fig. 17). Anterior ventral margin of front femur with 2–3 spines and with one small distal spine, hind margin with one large distal spine. Abdominal tergites densely punctate, with punctures denser and larger caudally; lateral margins smooth; anterolateral corners without holes. *T6* with



Figures 59–67. *Panesthia strelkovi* Bey-Bienko, 1969 **59** vertex and pronotum **60** tegmen **61** abdominal tergum 7, dorsal view **62** abdominal sternite 7, ventral view **63** supra-anal plate and paraprocts, ventral view **64** subgenital plate, dorsal view **65** left phallomere (*L1*) **66** median phallomere (*L2vm* and *L2d*) **67** right phallomere (*R2*). Scale bars = 1.0 mm (Figs 59, 61–62), 0.5 mm (Figs 60, 63–67).

small spine in the each hind angle, *T7* with relatively large posteriolateral angles, with apexes acute and directed to the terminus (Fig. 61). Abdominal sternites equally punctate. Lateral margins of *S7* oblique and protruded medially; hind margin straight (Fig. 62) and subgenital plate marginally exposed. The surface of supra-anal plate uniformly covered with large round punctations; hind margin with 5–7 small subacute teeth medially; the lateral teeth with acute apexes are larger than the teeth between them (Fig. 63). Cercus fin-shaped and pointed apically, swollen and hirsute in venter, but hairless dorsally (Fig. 63). Anterior angles of subgenital plate tapering to subacute apexes (Fig. 64).

Male genitalia. *L1* well developed (Fig. 65); *L2vm* stick-like and *L2d* slightly sclerotized, which is hairy in left side of dorsal view (Fig. 66); *R2* hook-shaped with apex rounded (Fig. 67).

Measurements. Male, body length: 29.0–37.0 mm; pronotum: length/width: 7.2–8.2/10.0–13.0 mm; width of excision of anterior margin of pronotum: 1.0–1.7 mm; distance between disc tubercles: 2.0–2.5 mm; tegmen: 3.6–5.5 mm.

Material examined. Two males, China: Hainan Prov., Mt. Diaoluo, 12 May 1965, coll. Sikong Liu; one male, China: Hainan Prov., Mt. Jianfengling, 17 April 1982, coll. Zhiqin Chen. (SWU)

Distribution. China (Hainan).

***Panesthia birmanica* Brunner von Wattenwyl, 1893**

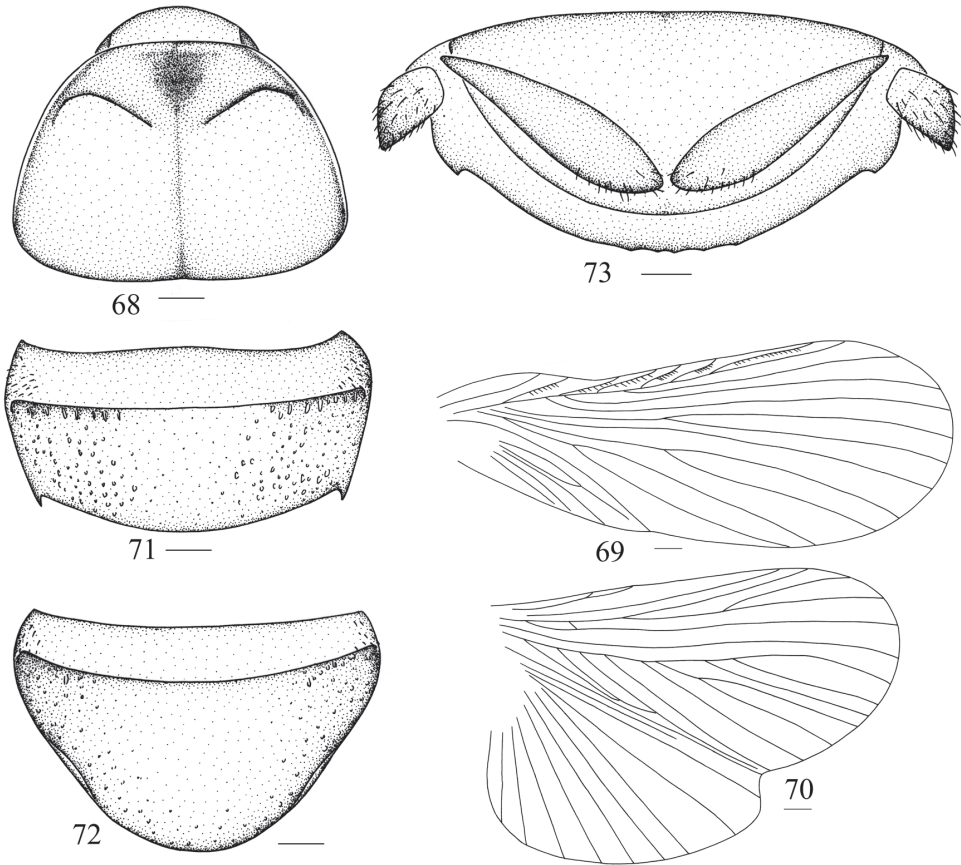
Figs 19–20, 68–73

Panesthia birmanica Brunner, 1893: 54; Roth 1979: 67; Feng and Woo 1990: 213.

Remarks. This species is distinguished from other species by its small body length, ranging from 22.5 mm to 28 mm; and also by pronotum virtually flattened, anterior margin slightly thickened, entire or weakly indented in male, entire and not thickened in female (Fig. 68); as well as the caudal angles of *T7* acute and posteriorly directed (Fig. 71); hind margin of supra-anal plate smooth or slightly crenulate, with the lateral teeth acute in apexes (Fig. 73); anterior ventral margin of front femur with 0–3 spines and with small distal spine, and posterior ventral margin with a large distal spine. The caudal angles of *T6* sometimes with an acute spine separately may confuse this species with species in the genus *Miopanesthia*, but can be distinguished by the shorter hind metatarsus, as stated in the genus remarks. Roth (1979) determined that the tegmina and wings were polymorphic in this species since the specimens he examined had both the macropterous and brachypterous forms. The tegmina and wings are fully developed (Figs 19, 69–70) or mutilated on all material of this species we examined.

Material examined. One female, China: Hainan Prov., Mt. Jianfengling, Tianchi, 6 July 1981, collector unknown; one female, China: Hainan Prov., Changjiang, Mt. Bawangling, 8–13 July 2006, coll. Jiliang Wang and Chao Gao; three females, China: Yunnan Prov., Xishuangbanna, Dadugang, 27 April 2014, Xinran Li. (SWU).

Distribution. China (Hainan, Yunnan); India; Myanmar; Vietnam; Thailand.



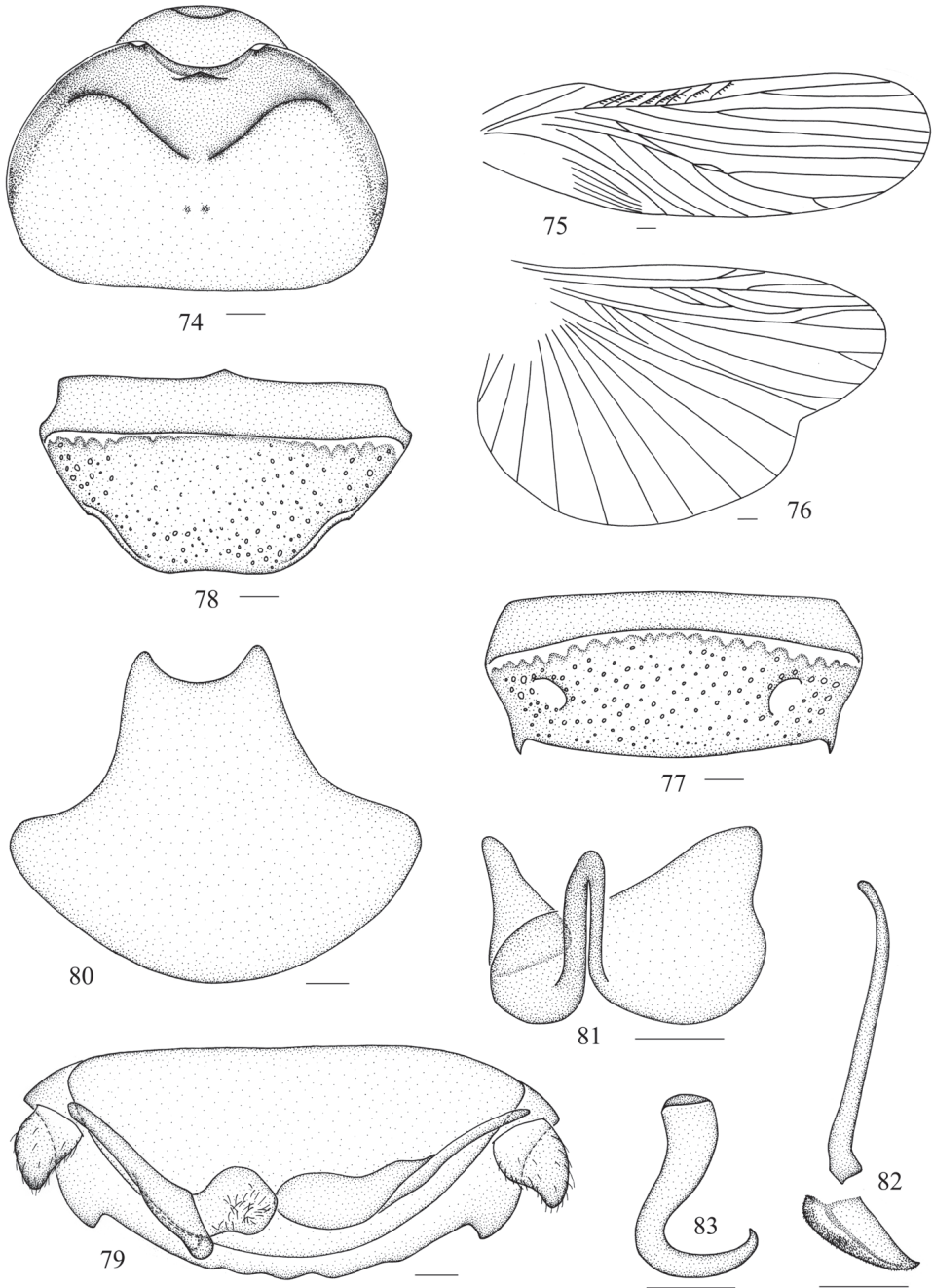
Figures 68–73. *Panesthia birmanica* Brunner von Wattenwyl, 1893, female **68** vertex and pronotum **69** tegmen **70** abdominal tergum 7, dorsal view **71** hind wing **72** abdominal sternite 7, ventral view **73** supra-anal plate and paraprocts, ventral view. Scale bars = 1.0 mm (Figs 68–72), 0.5 mm (Fig. 73).

Panesthia sinuata Saussure, 1895

Figs 21–22, 74–83

Panesthia sinuata Saussure, 1895: 318; Roth 1979: 55; Feng and Woo 1990: 216.

Remarks. This species is similar to *P. angustipennis spadica*, but can be distinguished by body length (19–29 mm), which is commonly smaller than the latter (34–42 mm). In male of *P. sinuata*, the anterior margin of pronotum is broadly concave and the corners of the indentation upturned (Fig. 74), while the latter is merely concave and without corners in small individuals about 34 mm. The anteroventral margin of front femur often bears 0–1 spine in *P. sinuata*, but more than two spines in *P. angustipennis spadica*. Roth (1979) described this species as similar to *P. antennata*, but the male of the latter had no mesal elevation of the anterior margin of pronotum.



Figures 74–83. *Panesthia sinuata* Saussure, 1895 **74** vertex and pronotum **75** tegmen **76** hind wing **77** abdominal tergum 7, dorsal view **78** abdominal sternite 7, ventral view **79** supra-anal plate and paraprocts, ventral view **80** subgenital plate, dorsal view **81** left phallomere (L1) **82** median phallomere (L2vm and L2d) **83** right phallomere (R2). Scale bars = 1.0 mm (Figs 74–78), 0.5 mm (Figs 79–83).

Material examined. Two males and one female, China: Yunnan Prov., Xishuangbanna, Menghai, 1200–1600m, 26 July 1958, coll. Shuyong Wang; one male, China: Yunnan Prov., Xishuangbanna, 1050–1080m, 9 June 1958, coll. Fuji Pu. (SWU)

Distribution. China (Yunnan, Guangdong); Vietnam; Laos; Malaysia.

***Panesthia angustipennis cognata* Bey-Bienko, 1969**

Figs 23–26, 84–93

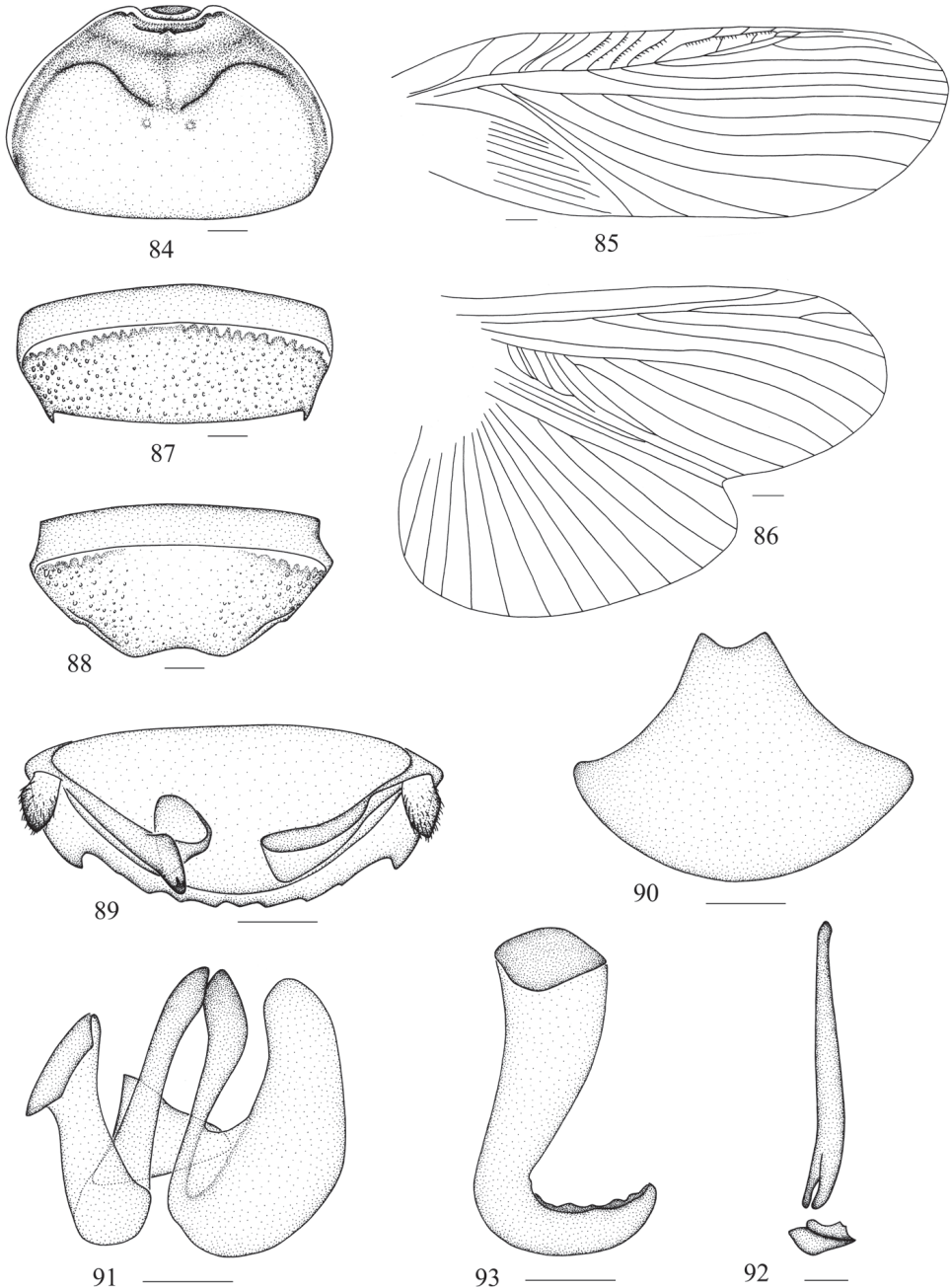
Panesthia cognata Bey-Bienko, 1969: 833; Feng and Woo 1990: 216.

Panesthia angustipennis cognata, Roth 1979: 42.

Remarks. This subspecies resembles *P. angustipennis spadica*, and it is difficult to distinguish adults. Roth (1979) stated *P. angustipennis spadica* had a deflexed hind margin of the supra-anal plate and appeared to be entire dorsally, not deflexed and with teeth visible dorsally in *P. angustipennis cognata*. Despite this character being variable, some of the populations were sufficiently different, and distinct on average. It is significant that *L2d* of median phallomere in *P. angustipennis cognata* is short with variable apex, but elongate and tapering to a round apex in *P. angustipennis spadica*. Nymphs of *P. angustipennis cognata* have a broadly yellowish marking on mesonotum and metanotum (Fig. 25) while *P. angustipennis spadica* is with or without two markings on mesonotum, and without any markings on metanotum.

Material examined. One nymph, China: Hainan Prov., Mt. Jianfengling, 29 June 1981, coll. Kegang Hu; one nymph, China: Hainan Prov., Ledong County, 25 December 1963, coll. Yuliang Luo; one nymph, China: Hainan Prov., Mt. Jianfengling, Tianchi, 24 February 1982, Ruilin Pan; one female, China: Hainan Prov., Mt. Jianfengling, 24 November 1981, Ruilin Pan; one nymph, China: Hainan Prov., Mt. Jianfengling, 8 July 1981, collector unknown; one nymph, China: Hainan Prov., Mt. Jianfengling, Tianchi, 8–10 May 1964, coll. Hui Ren; one nymph, China: Hainan Prov., Mt. Jianfengling, 11 May 1981, collector unknown; one female, China: Hainan Prov., Ledong County, Mt. Jianfengling, 1050m, 6–7 December 2007, coll. Weiwei Zhang; one female, China: Hainan Prov., Mt. Jianfengling, Tianchi, 26 July 1983, coll. Lishen Hua; one nymph, China: Hainan Prov., Wanning City, Xinglong, 23 February 1964, coll. Sikong Liu; one female, China: Hainan Prov., Mt. Jianfengling, 9 May 1964, coll. Sikong Liu; one nymph, China: Yunnan Prov., Menglun, 1 August 2009, coll. Zongqing Wang; one nymph, China: Yunnan Prov., Yingjiang County, Tongbiguan, 1450m, 30 July 2009, coll. Benyong Mao; one male, China: Guizhou Prov., Liping County, Mt. Taiping, 27 July 2009, coll. Yang; two males, one female and one nymph, China: Xizang Prov., Motuo, 1100m, 5 January 1983, coll. Yinheng Han; one female, China: Xizang Prov., Motuo, 700–1050m, 23 June 1983, coll. Yinheng Han; one male, China: Xizang Prov., Chayu County, Songgu, 23 July 1972, coll. Fusheng Huang. (SWU). One male, one female and one nymph, China: Guangxi Prov., Hechi City, Tian'e County, 14–19 September 2002, coll. Ming Bai. (HBU)

Distribution. China (Hainan, Guangxi, Guizhou, Yunnan, Xizang); India; Sikim; Myanmar; Vietnam; Laos; Thailand.



Figures 84–93. *Panesthia angustipennis cognata* Bey-Bienko, 1969 **84** vertex and pronotum **85** tegmen **86** hind wing **87** abdominal tergum 7, dorsal view **88** abdominal sternite 7, ventral view **89** supra-anal plate and paraprocts, ventral view **90** subgenital plate, dorsal view **91** left phallomere (L1) **92** median phallomere (L2vm and L2d) **93** right phallomere (R2). Scale bars = 2.0 mm (Figs 84–90), 0.5 mm (Figs 91–93).

Discussion

Gregarious, xylophagous cockroaches of the blaberid genus *Panesthia* exhibit little variation in morphology. They have dark, hard, rigid and pitted exoskeletons. Body sizes range from 15 mm to over 50 mm. They usually live in decaying wood, fallen leaves, rubbish, cracks in rocks, or in some kind of debris, and feed on wood (Feng and Woo 1990). Members of *Panesthia cribrata* live not only inside decaying logs but also under logs (Rugg and Rose 1989). During our collection in Guizhou Province in August, 2013, we obtained a colony of *P. guizhouensis* sp. n. from rotten wood near a large pool, comprised of 52 adults and at least 60 nymphs of different instars. When the wood was split, all of them fled away quickly (Wang X.D., pers. obs.).

Nymphs of *P. angustipennis spadica* have two morphs. One has a pair of large reddish spots on mesonotum (Roth 1979: Fig. 20B) and is from Taiwan, China and Yayeyama Island, Japan. The other is uniformly colored without spots on mesonotum (Roth 1979: Fig. 20A) and is from Taiwan and Japan except Yayeyama Island. Asahina (1988) separated *P. angustipennis yayeyamensis* from *P. angustipennis spadica* in view of the nymph having a reddish marked mesonotum. Maekawa et al. (1999) analyzed the molecular phylogenetic relationships of *Salganea* and *Panesthia* based on the COII gene. *P. angustipennis yayeyamensis* formed a monophyletic clade, which was embedded in the clade of *P. angustipennis spadica*; this suggests *P. angustipennis yayeyamensis* should be returned to *P. angustipennis spadica*. After examination of a large quantity of nymphs of *P. angustipennis*, we think it is not reasonable and adequate to accurately distinguish subspecies only according to the difference in marks of the nymph. For example, there are also different nymph morphs in *P. angustipennis angustipennis* (Roth 1979: Figs 2B–K). Therefore, we hereby agree with the decision by Maekawa et al. (1999) that *P. angustipennis yayeyamensis* should be treated as the synonym of *P. angustipennis spadica*.

Panesthia is the only genus of the subfamily Panesthiinae in which several species and subspecies have tegmina and wings which are fully developed or variably reduced (Roth 1982), i.e., include wing polymorphic species. There are five species and four subspecies of *Panesthia* with variable reduction of tegmina and wings in both sexes (Roth 1982). From a *P. antennata*, which was recorded with mutilated tegmina and wings, Roth (1979) inferred that a developed winged morph may have existed. But after checking specimens collected from Yunnan Province, we have identified and discovered 15 males and eight females of *P. antennata* with tegmina and wings about or beyond the end of abdomen, and 11 males and five females with tegmina and wings apparently short, only reaching between the second segment and the fourth segment of the abdomen. Given the above, *P. antennata* can also be treated as a wing polymorphic species.

The reason for wing polymorphism in cockroaches is still unknown. Roth (1977, 1979) observed that some species of *Panesthia* with reduced-wing forms were not commonly collected. We record 16 adult specimens of *P. antennata* in brachypterous form collected (39 specimens in all). To be unambiguous, this brachypterous form does not

just occur by accident or gene mutation in rare specimens, but rather in large numbers. Species with both macropterous and brachypterous forms possess a higher fitness (Roff, 1986) and this seems reasonable in *Panesthia* as well. However further investigation will be required to confirm this reasoning.

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Four new species of hangingflies (Insecta, Mecoptera, Bittacidae) from the Middle Jurassic of northeastern China

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Abstract

Two new species of *Mongolbittacus* Petrulevičius, Huang & Ren, 2007, *M. speciosus* **sp. n.** and *M. oligophlebius* **sp. n.**, and two new species of *Exilibittacus* Yang, Ren & Shih, 2012, *E. foliaceus* **sp. n.** and *E. plagioneurus* **sp. n.**, in the family Bittacidae, are described and illustrated based on five well-preserved fossil specimens. These specimens were collected from the late Middle Jurassic Jiulongshan Formation of Daohugou, Inner Mongolia, China. These new findings enhance our understanding of the morphological characters of early hangingflies and highlight the diversity of bittacids in the Mid Mesozoic ecosystems.

Keywords

Mongolbittacus, *Exilibittacus*, Jiulongshan Formation, Daohugou, Insect fossil

Introduction

Bittacidae, a large family of Mecoptera commonly called hangingflies, live mainly in the temperate or warm tropical climates. The fifth tarsomere of bittacids can be folded against the fourth with the only one claw at pretarsus (Petrulevičius et al. 2007). Since this special tarsi structure is shared by a sister group of Cimbrophlebiidae (Archibald 2009; Yang et al. 2012a), it is suggested that this morphological character may be

an apomorphy. So far, there are 16 extant genera with about 270 described extant species (Krzemiński 2007; Yang et al. 2012b). For fossil records, there are 28 genera comprising 52 species as summarized by Li and Ren (2009b). Since then, two genera, *Decoribittacus* Li & Ren, 2009 and *Exilibittacus* Yang, Ren & Shih, 2012, with three species have been described (Li et al. 2009a, Yang et al. 2012b). In addition, up to date, about 20 genera have been described from the Jurassic (Handlirsch 1906, 1939; Ansonge 1993; Tillyard 1933; Ren 1993, 1997; Novokshonov 1993a, 1993b, 1997; Petrulėvičius et al. 2007; Li et al. 2008, 2009a; Yang et al. 2012a, 2012b). The age distribution for these fossil genera suggests that the broadest diversity of Bittacidae occurred during the Jurassic, and the earliest fossil record of Bittacidae is *Archebittacus exilis* Riek, 1955 from the Upper Triassic of Mt. Crosby, Australia (Riek 1955).

Until now, 11 fossil genera of Bittacidae from the late Middle Jurassic to the Early Cretaceous have been recorded in China: *Liaobittacus* Ren, 1993 from the Haifanggou Formation; *Megabittacus* Ren, 1997 and *Sibirobittacus* Sukatcheva, 1990 from the Yixian Formation; *Neorthopplebia* Handlirsch, 1906 from the Tuodian Formation; *Preanabittacus* Novokshonov, 1993, *Mongolbittacus* Petrulėvičius, Huang & Ren, 2007, *Formosibittacus* Li, Ren & Shih, 2008, *Jurahylobittacus* Li, Ren & Shih, 2008, *Decoribittacus* Li & Ren, 2009, *Karattacus* Novokshonov, 1997, and *Exilibittacus* Yang, Ren & Shih, 2012, all from the Jiulongshan Formation. A list of 14 species in 11 genera is summarized in Table 1.

Herein we describe four new species of Bittacidae, based on five recently collected fossil specimens from the Jiulongshan Formation of Daohugou, Ningcheng County, Inner Mongolia, China. The section at Daohugou Village is composed of grey tuffaceous sandstone and sandy mudstone (Ren et al. 2002). This formation has yielded abundant and diverse insect fossils (Ren et al. 2010), such as Lepidoptera (Zhang et al. 2013), Mecoptera (Ren et al. 2009; Wang et al. 2012; Wang et al. 2014), Hymenoptera (Shih et al. 2010; Li et al. 2013; Wang et al. 2014), Diptera (Liu et al. 2012), Neuroptera (Wang et al. 2010) and many others insects (Gao et al. 2012).

Material and methods

The fossil specimens were examined with a Leica M165C dissecting microscope and illustrated with the aid of a camera lucida attached to the microscope; drawings were scanned into a computer by EPSON5100 and were edited with Adobe Photoshop® CS3. Photographs of the specimens and magnified images of the details were taken with a digital camera system attached to the Leica M165C. Specimens were at times treated with ethanol (95%) on the surface to enhance the clarity and contrast. All type specimens are deposited in the Key Lab of Insect Evolution and Environmental Changes, the College of Life Sciences, Capital Normal University, Beijing, China (CNUB, Ren Dong, Curator). The wing venation nomenclature follows Byers (1979). The term of ‘bittacid cross’ is defined as the crossveins of $[R_{4+5}-M_{1+2}, M_{1+2}-M_3]$ (Bechly and Schweigert 2000).

Table 1. A list of Bittacidae fossils described from China.

Genus	Species	Locality	Horizon/Age
<i>Megabittacus</i> Ren, 1997	<i>M. beipiaoensis</i> Ren, 1997	Beipiao, Liaoning	Yixian Fm.,K1
	<i>M. colosseus</i> Ren, 1997	Beipiao, Liaoning	Yixian Fm.,K1
	<i>M. spatiosus</i> Yang, Shih & Ren, 2012	Beipiao, Liaoning	Yixian Fm.,K1
<i>Sibirobittacus</i> Novokshonov, 1993	<i>S. atalus</i> Ren, 1997	Beipiao, Liaoning	Yixian Fm., K1
<i>Neorthopblebia</i> Handlirsch, 1906	<i>N. yunnanensis</i> Zhang & Hong, 2003	Tuodian, Yunnan	Tuodian Fm., J3
<i>Decoribittacus</i> Li & Ren, 2009	<i>D. euneurus</i> Li & Ren, 2009	Ningcheng, Inner Mongolia	Jiulongshan Fm., J2
	<i>D. stictus</i> Li & Ren, 2009	Ningcheng, Inner Mongolia	Jiulongshan Fm., J2
<i>Exilibittacus</i> Yang, Shih & Ren, 2012	<i>E. lii</i> Yang, Shih & Ren, 2012	Ningcheng, Inner Mongolia	Jiulongshan Fm., J2
	<i>E. plagioneurus</i> sp. n.	Ningcheng, Inner Mongolia	Jiulongshan Fm., J2
	<i>E. foliaceus</i> sp. n.	Ningcheng, Inner Mongolia	Jiulongshan Fm., J2
<i>Formosibittacus</i> Li, Ren & Shih, 2008	<i>F. macularis</i> Li, Ren & Shih, 2008	Ningcheng, Inner Mongolia	Jiulongshan Fm., J2
<i>Jurahylobittacus</i> Li, Ren & Shih, 2008	<i>J. astictus</i> Li, Ren & Shih, 2008	Ningcheng, Inner Mongolia	Jiulongshan Fm., J2
<i>Karattacus</i> Novokshonov, 1997	<i>K. longialatus</i> Li & Ren, 2009	Ningcheng, Inner Mongolia	Jiulongshan Fm., J2
<i>Liaobittacus</i> Ren, 1993	<i>L. longantennatus</i> Ren, 1993	Beipiao, Liaoning	Haifanggou Fm., J2
<i>Preanabittacus</i> Novokshonov, 1993	<i>P. validus</i> Yang, Shih & Ren, 2012	Ningcheng, Inner Mongolia	Jiulongshan Fm., J2
<i>Mongolbittacus</i> Petrulevičius, Huang & Ren, 2007	<i>M. daohugoensis</i> Petrulevičius, Huang & Ren, 2007	Ningcheng, Inner Mongolia	Jiulongshan Fm., J2
	<i>M. speciosus</i> sp. n.	Ningcheng, Inner Mongolia	Jiulongshan Fm., J2
	<i>M. oligophlebius</i> sp. n.	Ningcheng, Inner Mongolia	Jiulongshan Fm., J2

Systematic paleontology

Order Mecoptera Packard, 1886
Infraorder Raptipeda Willmann, 1977
Family Bittacidae Handlirsch, 1906

Genus *Mongolbittacus* Petrulevičius, Huang & Ren, 2007

Type species. *Mongolbittacus daohugoensis* Petrulevičius, Huang & Ren, 2007
Included species. Type species, *Mongolbittacus speciosus* sp. n., and *Mongolbittacus oligophlebius* sp. n.

***Mongolbittacus speciosus* sp. n.**
<http://zoobank.org/442F8176-318C-4671-8BA1-83B449A8F4C7>
Figs 1–4

Etymology. The specific epithet is derived from a Latin word of *speciosus* (showy), highlighting the well-preserved wings in the holotype.

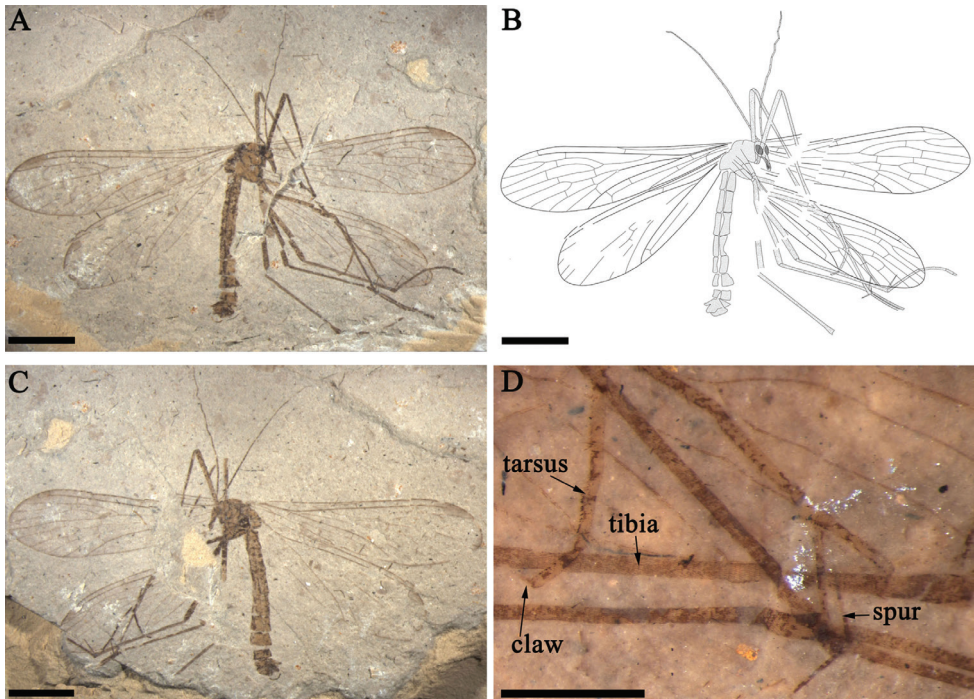


Figure 1. *Mongolbittacus speciosus* sp. n., holotype, CNU-MEC-NN2013008 P/C. **A** photo of part **B** line drawing of part **C** photo of counterpart **D** photo of legs, under alcohol. Scale bars represent 3 mm in **A–C**, 0.5 mm in **D**.

Holotype. A male specimen well-preserved, CNU-MEC-NN2013008 P/C, part and counterpart. Body 8.8 mm long; forewing 11.3 mm long with a maximal width of 3.0 mm; hind wing 9.1 mm long with a maximal width of 3.0 mm.

Horizon and locality. Jiulongshan Formation, late Middle Jurassic, Daohugou Village, Shantou Township, Ningcheng County, Inner Mongolia, China.

Diagnosis. In forewing, Sc reaching the anterior margin proximad of the forking of Rs; one crossvein between C and R_1 ; 1A and 2A fusing at base; and 2A sharply curving to the posterior margin.

Description. A male specimen in lateral view. The head oviform with robust and slender chewing mouthparts. Compound eyes large and oval. Antennae almost complete, filiform, about 6.9 mm long, comprising about twenty antennomeres; the lengths of basal antennomeres almost the same, but several apical antennomeres shorter than the basal ones. Thorax divided into pronotum, mesonotum and metanotum from the lateral view (Figs 1A–C, 4B, F).

Legs. Long and slender in lateral view, densely covered with short setae. But all legs fragmented due to poor preservation. Mesocoxa, metacoxa, trochanter visible in lateral view. Mid tibia 4.4 mm; tibial spurs long and sharp. Tarsus with 5 tarsomeres and a single pretarsal claw, but the fifth tarsomere not folded against the fourth as

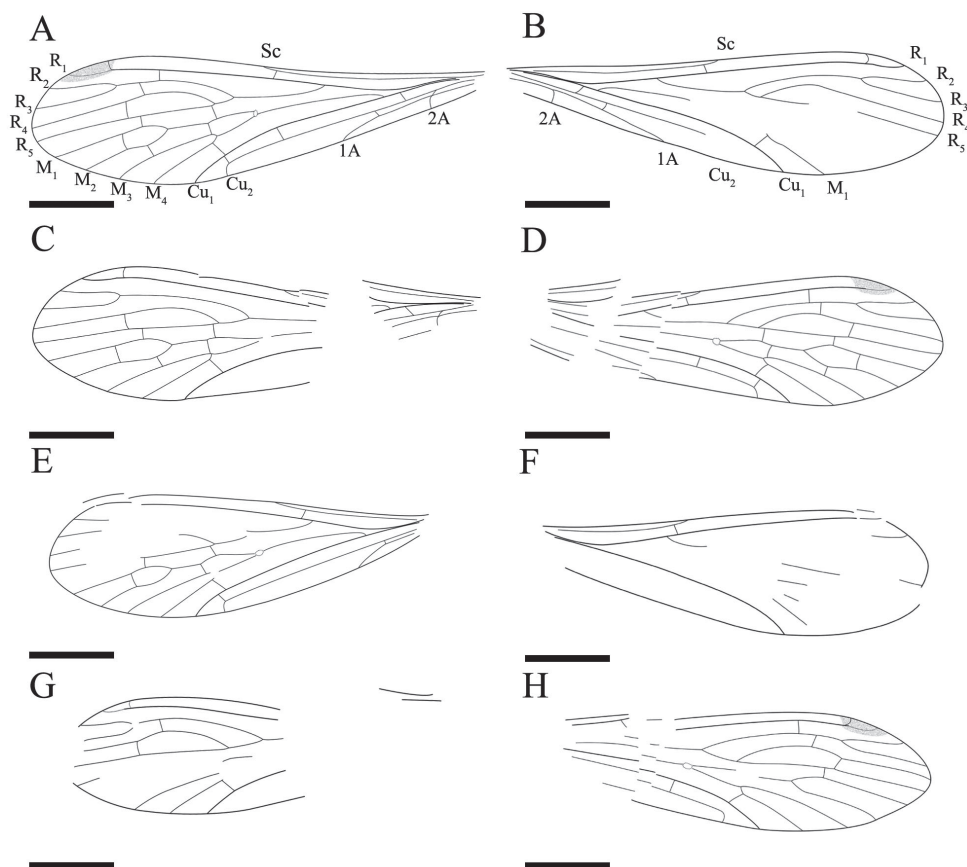


Figure 2. *Mongolbittacus speciosus* sp. n., holotype, CNU-MEC-NN2013008 P/C. Line drawings of part. **A** left forewing **D** right forewing **E** left hind wing **H** right hind wing. Line drawings of counterpart **B** right forewing **C** left forewing **F** right hind wing **G** left hind wing. Scale bars represent 1 mm in **A–H**.

preserved. In addition, the second and third tarsomeres covered with a few small spines (Fig. 1A–D).

Forewing. No maculation, base of wing narrow. Sc short, one oblique subcostal crossvein (Scv) between Sc and R_1 ; one crossvein between R_1 and C; R_1 smooth and reaching the dark pterostigmal area; Rs originating from R_1 at an acute angle; one crossvein between R_1 and R_{2+3} , one crossvein between R_{2+3} and R_4 and one crossvein between R_4 and R_5 ; the ‘bittacid cross’ not aligned, Z-shaped (in side view), and posterior part of ‘the ‘bittacid cross’ distad of the forking of M_{3+4} ; M with four branches and bifurcating proximad of the forking of Rs; one crossvein between R_5 and M_1 , one between M_1 and M_2 and one between M_2 and M_3 ; M_4 simple, one long and oblique crossvein between M_4 and Cu_1 ; Cu_1 and M overlapping at base for a short distance; Cu_2 curving sharply with a 90° angle, reaching the posterior margin; Cu_1 and Cu_2 almost parallel, with three crossveins between them, the first oblique crossvein located

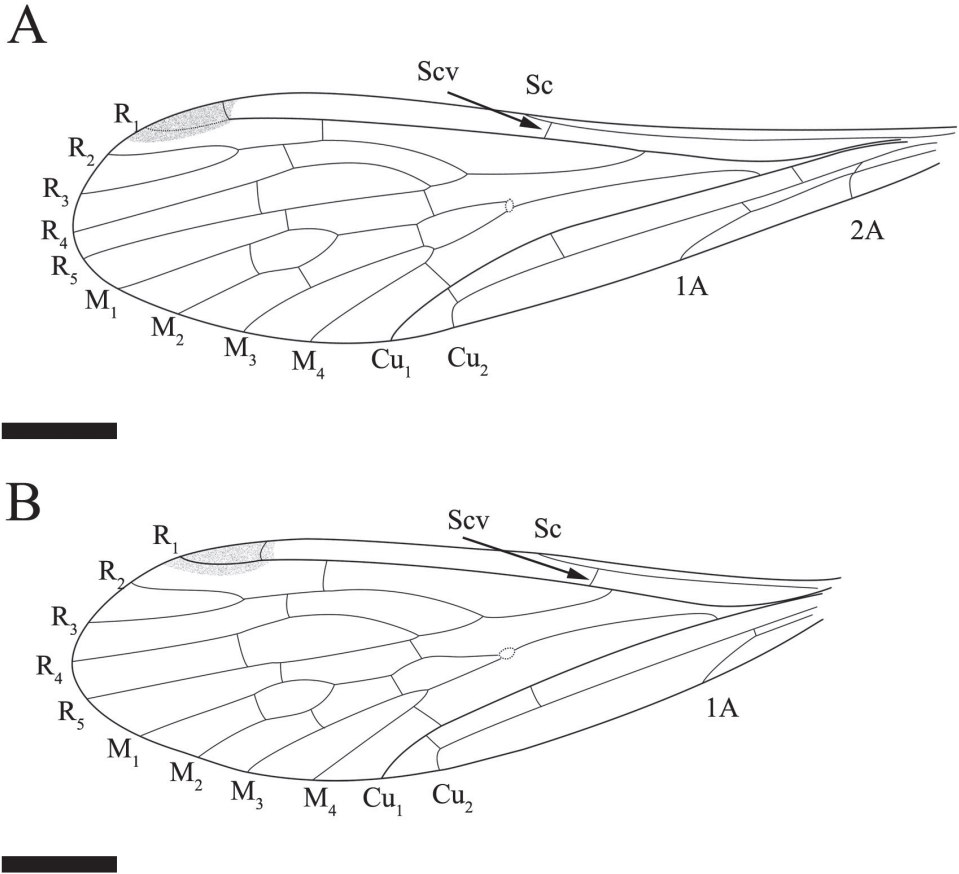


Figure 3. *Mongolbittacus speciosus* sp. n., holotype. **A** line drawing of forewing, composite of right and left forewings of part and counterpart **B** line drawing of hind wing, composite of right and left hind wings of part and counterpart. Scale bars represent 1 mm in **A–B**.

at the base of the wing, the second at the level of Scv, and the third near the sharp bending of Cu_2 . Veins 1A and 2A fusing at base, 1A reaching the posterior margin proximad of the origination of Rs from R_1 ; two crossveins between 1A and Cu_2 (Figs 2A–D, 3A).

Hind wing. Sc short, reaching the anterior margin proximad of the forking of Rs; one crossvein between R_1 and C; One subcostal crossvein (Scv) between Sc and R_1 , one crossvein between R_1 and R_{2+3} , and one short crossvein between R_{2+3} and R_4 ; R_4 sharply bending upwards, then parallel with R_5 , one crossvein between them; the ‘bittacid cross’ not aligned, Z-shaped; M forking proximad of the bifurcation of Rs; one crossvein between R_5 and M_1 , one between M_1 and M_2 , one between M_2 and M_3 and one oblique crossvein between M_4 and Cu_1 ; Cu_1 and Cu_2 almost parallel with two crossveins between them; Cu_2 bending sharply with an 90° angle at the level slightly proximad of the forking of M_{3+4} ; one crossvein between Cu_2 and 1A (Figs 2E–H, 3B).

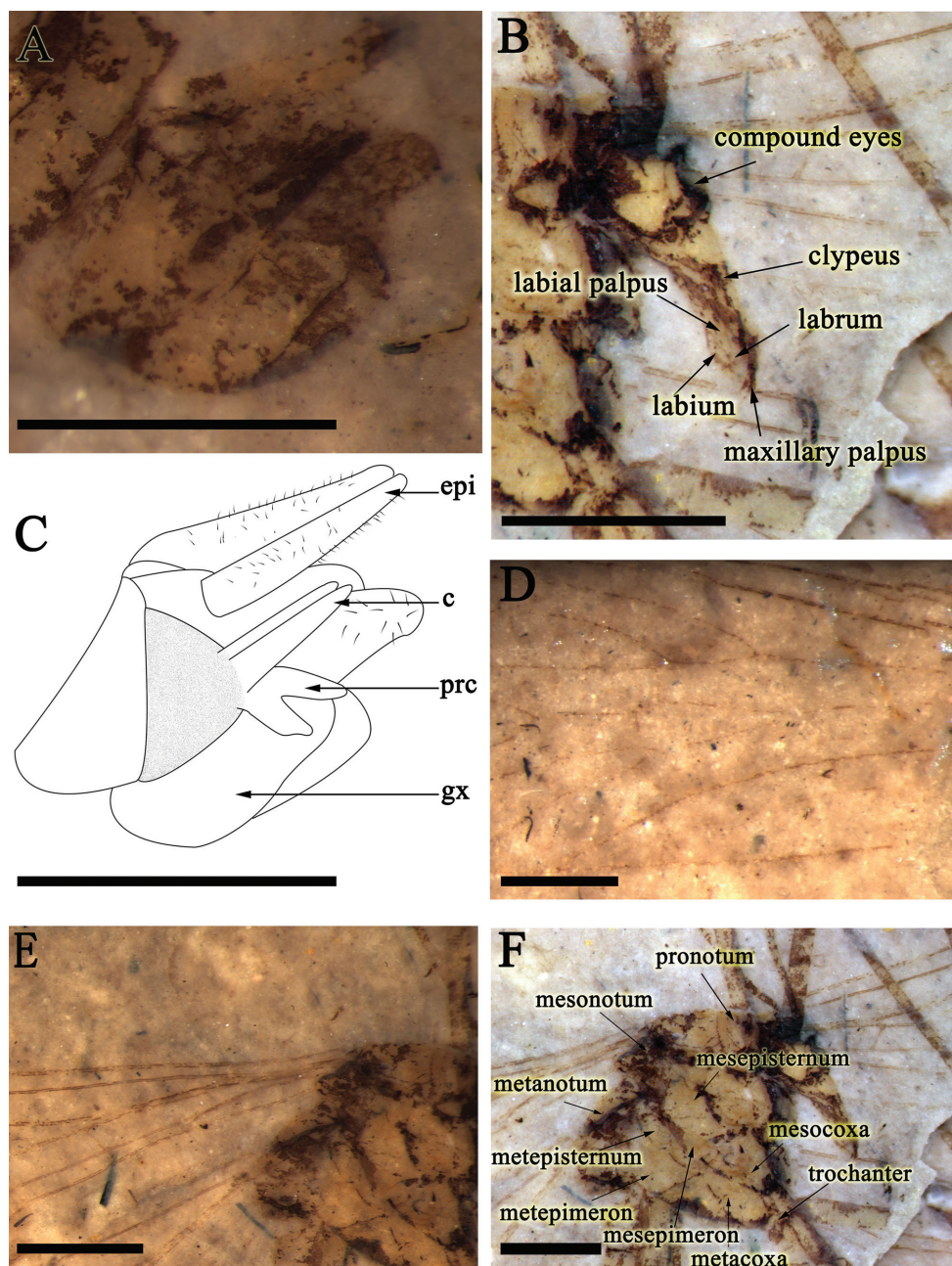


Figure 4. *Mongolbittacus speciosus* sp. n., holotype, photos under alcohol and a line drawing. **A** genitalia in lateral view **B** head **C** line drawing of genitalia in lateral view **D** vein M forking proximal to Rs forking in left forewing **E** anal field of left forewing; **F** thorax; Scale bars represent 0.5 mm in **A**, **C**, 1 mm in **B**, **D–F**. Abbreviations: c, cercus; epi, epiandrium; gx, gonocoxite; prc, procitiger.

Abdomen. Abdomen 6.5 mm long, with 9 visible segments. The ninth tergum (T9) connecting gonocoxite with dense short setae at the apex, epiandrium well-preserved with long setae on the surface; procitiger and cercus present in lateral view (Figs 1A–C, 4A, C).

Remarks. *Mongolbittacus speciosus* sp. n. (Figs 1–4) is assigned to the genus *Mongolbittacus* based on the following generic diagnostic characters: R_{4+5} plus R_4 distinctively curved; M_4 simple; the ‘bittacid cross’ not aligned; wide posterior anal field; and the forking of M proximad of the R s forking. *M. speciosus* sp. n. is distinguished from the other two species of *Mongolbittacus* by veins of 1A and 2A fusing at base, and 2A sharply curving to the posterior margin, as shown in the key below.

***Mongolbittacus oligophlebius* sp. n.**

<http://zoobank.org/D4B8FBAC-45F0-4A31-B805-108FB33AC7B1>

Figs 5, 6

Etymology. The specific name *oligophlebius* denotes the wing venation is simple with only a few crossveins.

Holotype. CNU-MEC-NN-2013009 P/C, part and counterpart. Forewing 12 mm long with a maximal width of 3.5 mm.

Paratype. CNU-MEC-NN-2013014.

Horizon and locality. Jiulongshan Formation, late Middle Jurassic, Daohugou Village, Ningcheng County, Inner Mongolia, China.

Diagnosis. The posterior part of the ‘bittacid cross’ coinciding with the forking of M_{3+4} ; one oblique crossvein between R_{2+3} and R_4 at the bifurcation of R_{2+3} ; and length of R_3 0.9 times as long as R_{2+3} .

Description. Poorly preserved with only one complete forewing and the basal part of one hind wing. But the mid-tibia with two long spurs and five tarsomeres well-preserved, covered by dense short setae (Fig. 5A, B, D).

Forewing. Sc reaching the anterior margin proximad of the forking of R s, one crossvein between C and R_1 ; one subcostal crossvein (Scv) between Sc and R_1 ; R s bifurcating into four branches, one crossvein between R_1 and R_{2+3} and one oblique crossvein between R_{2+3} and R_4 ; R s arising from R_1 at an acute angle; length of R_3 0.9 times as long as R_{2+3} ; one crossvein between R_4 and R_5 ; M with four branches and bifurcating proximad of the forking of R s; the ‘bittacid cross’ not aligned; the posterior part of the ‘bittacid cross’ coinciding with the forking of M_{3+4} ; one crossvein between R_5 and M_1 , one between M_1 and M_2 and one between M_2 and M_3 ; one crossvein between Cu_1 and M_4 , Cu_1 and Cu_2 parallel with two crossveins between them; one crossvein between Cu_2 and 1A; 1A reaching the posterior margin distad of the origination of R s from R_1 ; 2A bending sharply and reaching the posterior margin, a short crossvein between 1A and 2A (Figs 5C, E, 6C).

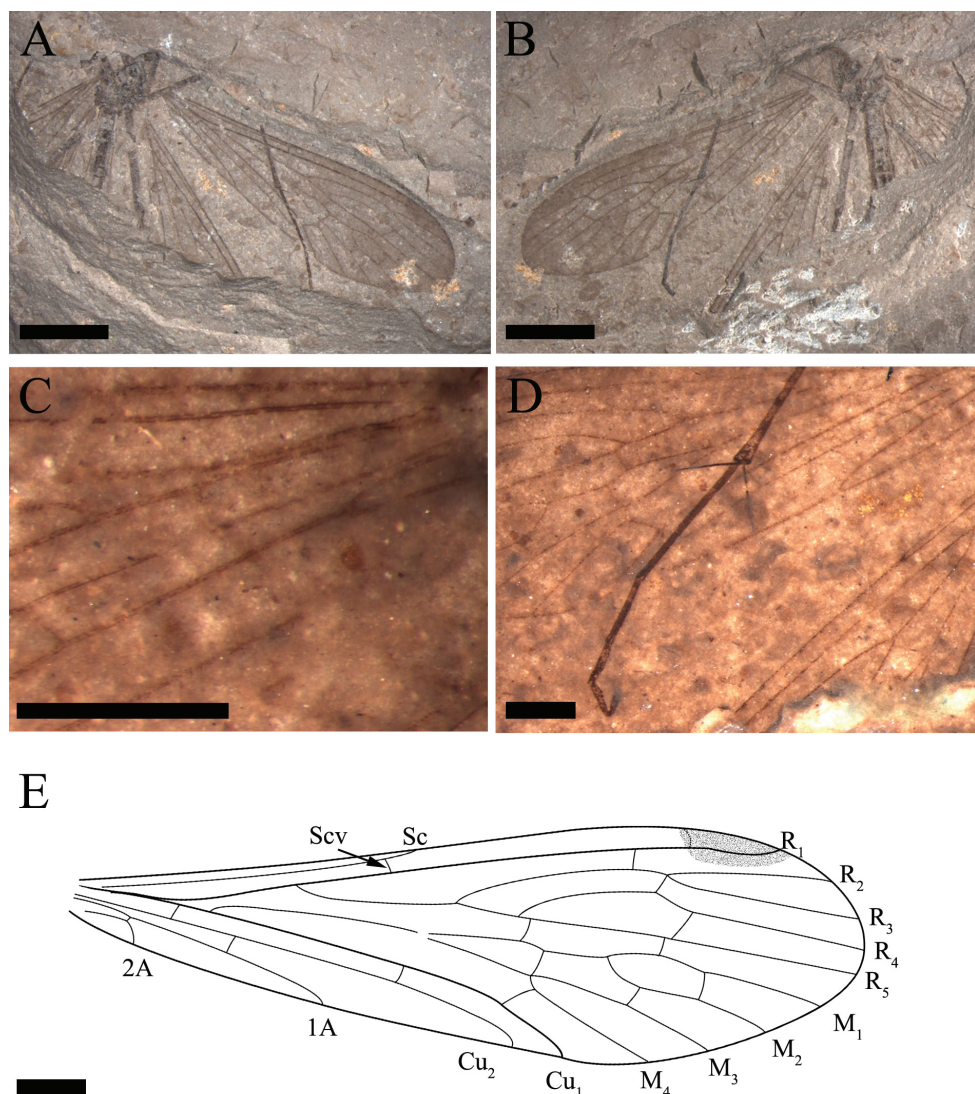


Figure 5. *Mongolbittacus oligophlebius* sp. n., holotype, CNU-MEC-NN-2013009 P/C. **A** photo of part **B** photo of counterpart **C** anal field of left forewing, under alcohol **D** photo of a leg, under alcohol **E** line drawing of right forewing of part. Scale bars represent 3 mm in **A–B**, 1 mm in **C–E**.

Remarks. *Mongolbittacus oligophlebius* sp. n. (Figs 5, 6) is assigned to the genus *Mongolbittacus* based on the following generic diagnostic characters: R_{4+5} plus R_4 distinctively curved; M_4 simple; the ‘bittacid cross’ not aligned; posterior anal field broad; and 2A bending sharply and reaching the posterior margin. This new species is differentiated from *M. daohugoensis* and *M. speciosus* sp. n. by characters as shown in the key below.

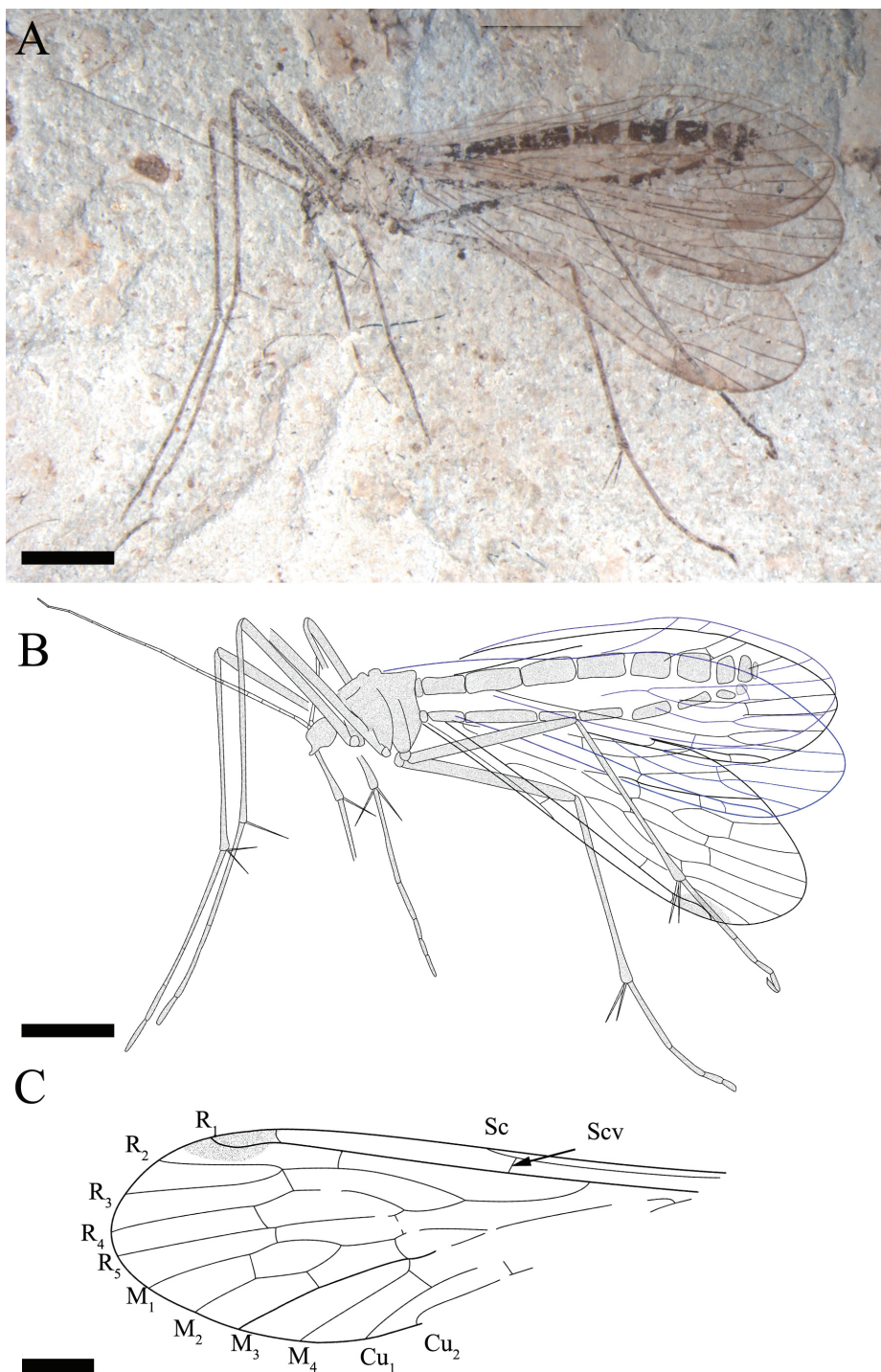


Figure 6. *Mongolbittacus oligophlebius* sp. n., paratype, CNU-MEC-NN-2013014. **A** photo **B** line drawing of part **C** line drawing of left forewing of part; Scale bars represent 2 mm in **A–B**, 1 mm in **C**.

Sc reaching the anterior margin proximad of the forking of Rs (Figs 3A, 5E).... **2**
 Sc reaching the anterior margin distad of the forking of Rs.....
 ***M. daobugoensis* Petrulevičius, Huang & Ren, 2007**
 1A and 2A fusing at base (Fig. 3A) ***M. speciosus* sp. n.**
 A short crossvein between 1A and 2A (Fig. 5E) ***M. oligophlebius* sp. n.**

Emended diagnosis. Forewing: Sc reaching the anterior margin at the same level or proximad of the forking of R_{4+5} ; the ‘bittacid cross’ aligned, the posterior of the ‘bittacid cross’ distad of the bifurcation of M_{3+4} ; 1A terminating at the posterior margin at the same level or distad of the origination of Rs from R_1 . Hind wing: Rs with three or four branches, M with three branches and 2A absent.

Forewing. The base of wings narrow, pterostigma slightly dark. Sc terminating at the anterior margin proximad of the R_{4+5} forking; one subcostal crossvein (Scv) between Sc and R_1 ; R_1 running straight through pterostigma, without sagging; one crossvein between R_1 and R_{2+3} ; Rs with four branches, R_4 slightly curved at beginning and then parallel with R_5 ; one crossvein between R_{2+3} and R_4 and one crossvein between R_4 and R_5 ; M with four branches, M_{3+4} forking far proximad of the bifurcation of

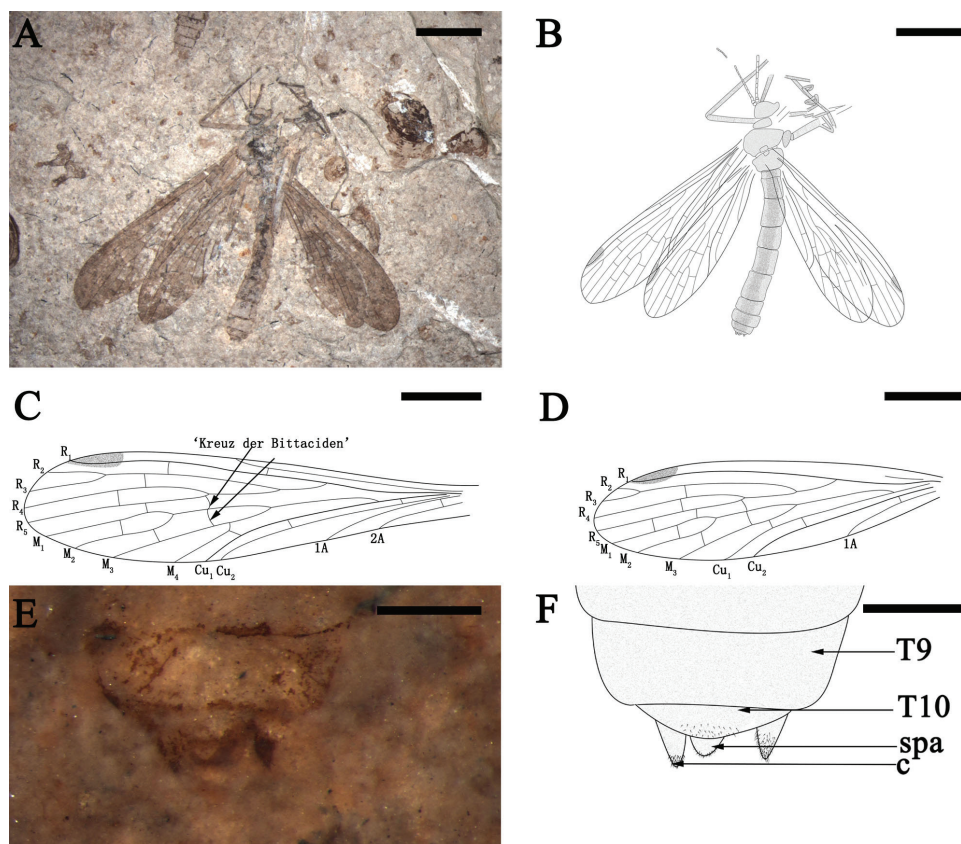


Figure 7. *Exilibittacus foliaceus* sp. n., holotype, CNU-MEC-NN2013010. **A** photo **B** line drawing **C** line drawing of left forewing **D** line drawing of left hind wing **E** photo of genitalia in dorsal view, under alcohol **F** line drawing of genitalia in dorsal view. Scale bars represent 3 mm in **A**, **B**, 2 mm in **C**, **D**, 0.5 mm in **E**, **F**. Abbreviations: T9, the ninth tergum; T10, the tenth tergum; c, cercus; spa, supraanale.

M_{1+2} ; the ‘bittacid cross’ aligned and gently curved, posterior part of the ‘bittacid cross’ reaching M_3 distad of the M_{3+4} forking point; one crossvein between R_5 and M_1 , one between M_1 and M_2 and one between M_2 and M_3 ; Cu_1 and Cu_2 almost parallel with two crossveins between them, one crossvein between M_4 and Cu_1 ; 1A and 2A simple and one crossvein between them; 1A reaching the posterior margin at the same level of the origination of Rs from R_1 ; 2A reaching the posterior margin at the same level of the origination point of M (Fig. 7C).

Hind wing. With the same shape as the forewing. R_1 running smoothly through pterostigma; pterostigmal crossveins (Pcv) absent; Rs with four branches; one crossvein between R_{2+3} and R_4 and one between R_4 and R_5 ; the ‘bittacid cross’ aligned; M divided into three branches; two crossveins between R_5 and M_1 , one between M_1 and M_2 , one between M_2 and M_3 and one between M_3 and Cu_1 ; Cu_1 and

Cu_2 parallel and with one crossvein between them. Vein 1A reaching the posterior margin at the level slightly proximad of the R_s originating from R_1 , one crossvein between Cu_2 and 1A (Fig. 7D).

Abdomen. Abdomen 9.1 mm long, with ten visible segments. Female genital structure well-preserved from the dorsal view. Supraanale and cercus covered with small and short setae (Fig. 7A, B, E, F).

Remarks. *Exilibittacus foliaceus* sp. n. (Fig. 7) is assigned to the genus *Exilibittacus* Yang, Ren & Shih, 2012 based on the following generic diagnostic characters: in forewing, Sc reaching the anterior margin proximad of the forking of R_{4+5} and the 'bittacid cross' aligned; and in hind wing, R_s with four branches while M with three branches. *Exilibittacus foliaceus* sp. n. is distinguished from the other two species as shown by the key below.

***Exilibittacus plagioneurus* sp. n.**

<http://zoobank.org/CCEF6E6E-B54D-43CB-8E24-F289597FB4C1>

Figs 8, 9

Etymology. From Greek "*plagios*" (oblique) and "*neuron*" (vein), referring to oblique crossveins of the wings.

Holotype. Female, CNU-MEC-NN2013013 P/C, in dorsal view. Abdomen length 8.3 mm, forewing length 9.3 mm with a maximal width of 2.3 mm; hind wing length 8.4 mm with a maximal width of 2.2 mm.

Horizon and locality. Jiulongshan Formation, late Middle Jurassic, Daohugou Village, Shantou Township, Ningcheng County, Inner Mongolia, China.

Diagnosis. Forewing Sc terminating at the anterior margin at the same level of the R_{4+5} forking; Vein 1A terminating at the posterior margin distad of the origination of R_s from R_1 .

Description. Female, small-sized, head not preserved but mesothorax and metathorax preserved. Legs partially preserved, one hind leg with five tarsomeres present but the pretarsal claw not preserved, the fifth tarsomere folded against the fourth; the first and second tarsomeres with several spines. (Fig. 8A–D)

Forewing. Wing narrow basally with obviously dark pterostigma. Sc long, reaching the anterior margin at the same level of the R_{4+5} forking; R_1 not forking, one subcostal crossvein (Scv) between Sc and R_1 , Scv about 1/6 as long as the Sc length between Scv and the apex of Sc; one pterostigmal crossvein (Pcv) and one crossvein between R_1 and R_{2+3} ; R_s with four branches, one crossvein between R_3 and R_4 , one between R_{2+3} and R_4 and one between R_4 and R_5 ; M with four branches, M_4 base bending sharply; the 'bittacid cross' aligned, the posterior part of the 'bittacid cross' reaching M_3 distad of the M_{3+4} forking point; two crossveins between R_5 and M_1 , one between M_1 and M_2 and one between M_2 and M_3 ; Cu_1 ending before the forking of R_{4+5} , one crossvein between M_4 and Cu_1 , one between Cu_1 and Cu_2 ; one short

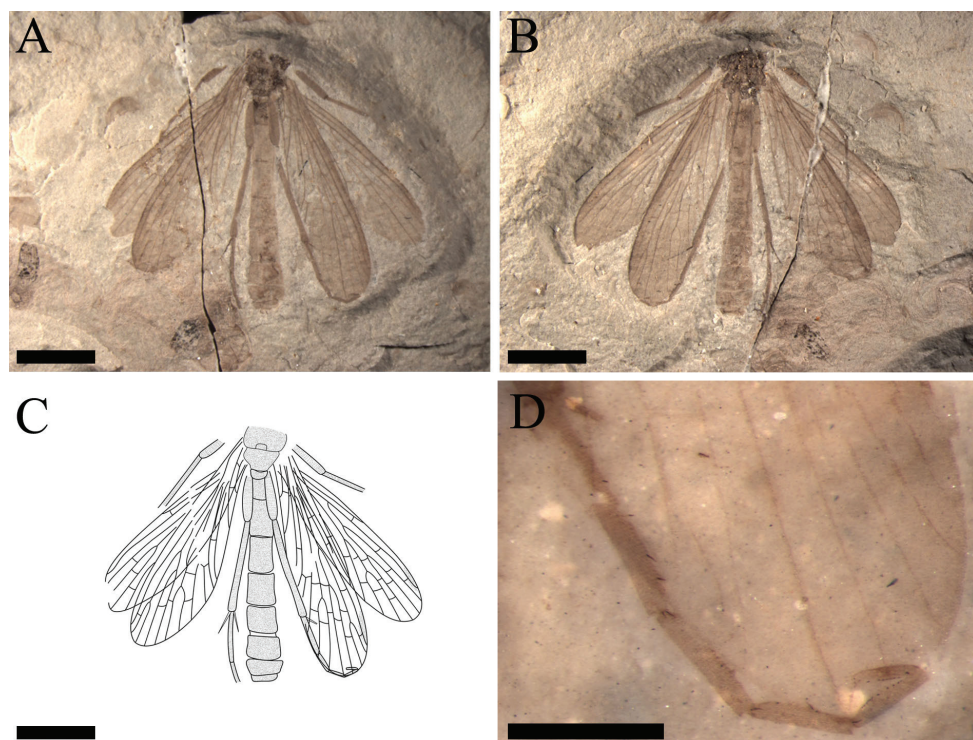


Figure 8. *Exilibittacus plagioneurus* sp. n., holotype, CNU-MEC-NN2013013 P/C, dorsal view. **A** photo of part **B** photo of counterpart **C** line drawing of part **D** photo of a hind leg, under alcohol. Scale bars represent 3 mm in **A–C**, 1 mm in **D**.

crossvein between Cu_2 and $1A$; $1A$ terminating at the posterior margin distad of the origination of R_s ; $2A$ ending proximad of the originations of R_s and M , one crossvein between $1A$ and $2A$ (Fig. 9A, C).

Hind wing. Sc short, reaching the anterior margin before the forking of R_{4+5} ; one crossvein (Scv) between Sc and R_1 ; R_1 smooth and not sagging through the pterostigmal area; one pterostigmal crossvein (Pcv) present. R_s with three branches; one crossvein between R_1 and R_2 , one between R_2 and R_3 and one between R_3 and R_4 ; M with three branches; two crossveins between R_4 and M_1 , one between M_1 and M_2 and one between M_2 and M_3 ; the ‘bittacid cross’ not aligned; one between M_3 and Cu_1 and one between Cu_1 and Cu_2 . Vein $1A$ terminating at the posterior margin distad of the origination of R_s , one crossvein between Cu_2 and $1A$ (Fig. 9B, D).

Abdomen. Ten segments visible, genital segments not preserved (Fig. 8A–C).

Remarks. *Exilibittacus plagioneurus* sp. n. (Figs 8, 9) is assigned to *Exilibittacus* Yang, Ren & Shih, 2012 based on the following generic diagnostic characters: in forewing, Sc reaching the anterior margin at the same level of the forking of R_{4+5} and the ‘bittacid cross’ aligned, and in hind wing, M with three branches. The new species is differentiated from *E. lii* and *E. foliaceus* sp. n. by characters shown in the key below.

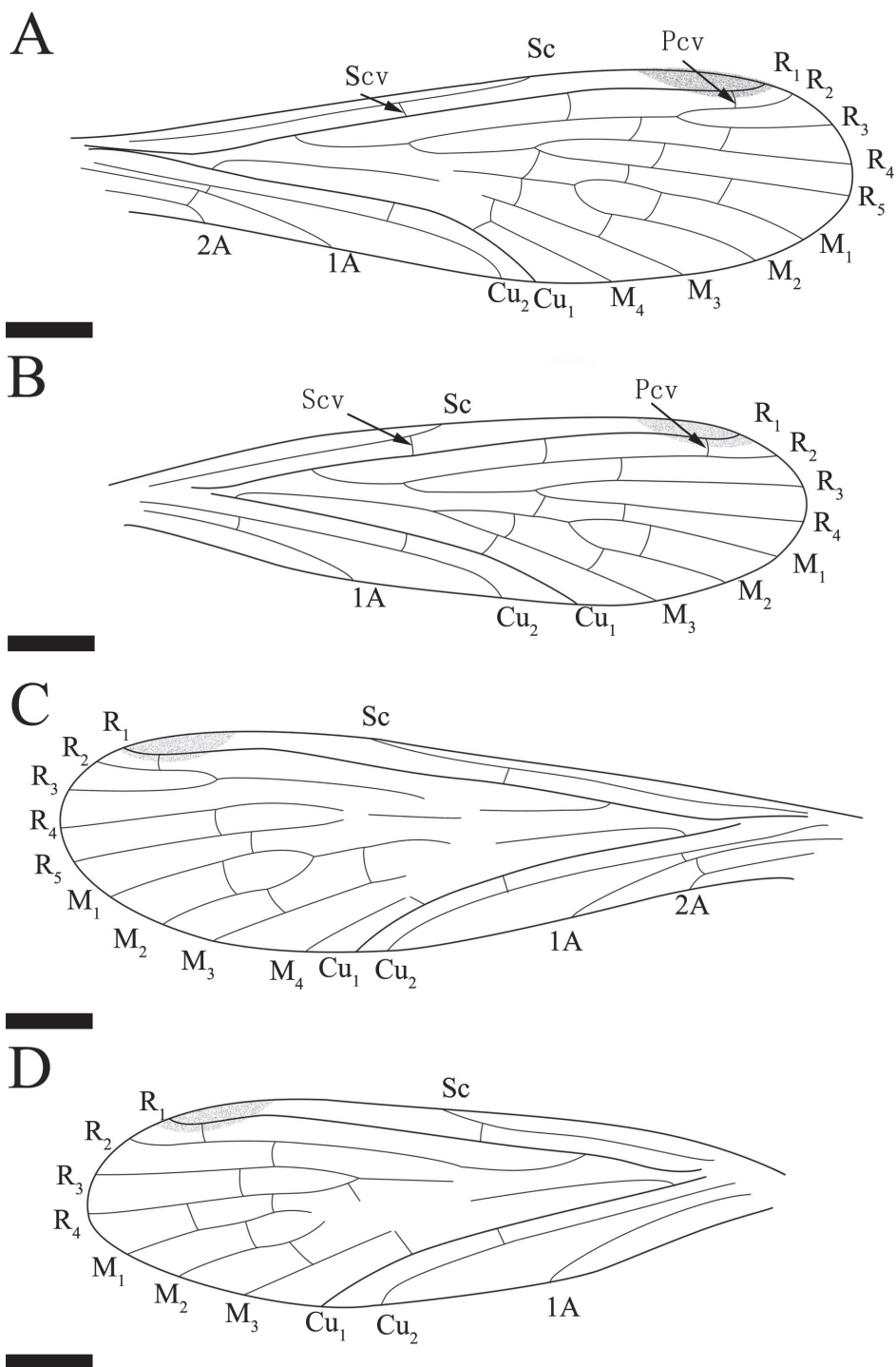


Figure 9. *Exilibittacus plagioneurus* sp. n., holotype. Line drawings of part **A** right forewing of part **B** right hind wing of part **C** left forewing of part **D** left hind wing of part. Scale bars represent 1 mm in **A–D**.

Key to species of *Exilibittacus* based on characters of both fore- and hind-wings

- 1 Rs with four branches in hind wing (Fig. 7D).....*E. foliaceus* sp. n.
- Rs with three branches in hind wing.....2
- 2 1A terminating at the posterior margin of the forewing distad of the origination of Rs (Fig. 9A).....*E. plagioneurus* sp. n.
- 1A terminating at the posterior margin of the forewing proximad of the origination of R *E. lii* Yang, Ren & Shih, 2012

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A new species of the leafhopper genus *Calodia* Nielson, 1982 (Hemiptera, Cicadellidae, Coelidiinae) from China, with a key to Chinese species

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Abstract

This paper describes and illustrates a new *Calodia* leafhopper species from China (Oriental Region), namely *Calodia dentispina* Fan, Li & Chen, **sp. n.** (Cicadellidae: Coelidiinae: Coelidiini) and provides a distribution map for the new species. A key to the Chinese coelidiine genera and species of *Calodia* is also provided.

Keywords

Leafhopper, morphology, taxonomy, distribution

Introduction

The Oriental leafhopper genus *Calodia* (Cicadellidae: Coelidiinae: Coelidiini) was erected by Nielson (1982) based on *C. multipectinata* as its type species from Malaysia. The genus encompasses 60 known species at present, of which 22 species are found in China (Nielson 1982, 1991, 1996; Li 1989; Zhang 1990, 1994; Li and Wang 1991; Cai and Kuoh 1993; Xu and Kuoh 1999). Recently, we discovered one new *Calodia* species from China, which is described, illustrated and mapped in the present paper. A key to the Chinese coelidiine genera and species of *Calodia* is also provided.

Material and methods

The morphological terminology adopted herein follows Nielson (1982). Photos of external morphology were obtained by Keyence VHX-1000 system. Illustrations of male genitalia were drawn using an Olympus CX41 stereomicroscope, then enhanced by Adobe Illustrator CS6. All pictures were labelled and plates composition in Adobe Photoshop CS5. The type specimens are deposited in the Institute of Entomology, Guizhou University, Guiyang, China (GUGC).

Taxonomy

Key to tribes and genera of Coelidiinae from China

(modified from Zhang 1994)

- 1 Ventral side of aedeagus with paraphysis; aedeagus simple, without process, gonopore apical (Thagriini)..... **Thagria Melichar**
- Ventral side of aedeagus without paraphysis; aedeagus with distinct processes or apically with small teeth, gonopore subapical (Coelidiini) **2**
- 2 Aedeagus without distinct process, only dorsal side of apical portion of shaft with many small teeth or spines **Tabarana Nielson**
- Aedeagus with distinct processes, occasionally dorsal side of apical portion of shaft with small teeth **3**
- 3 Apical or subapical part of aedeagal shaft with one distinct process **Olidiana McKamey**
- Apical or subapical part of aedeagal shaft with two or more distinct processes **Calodia Nielson**

Genus *Calodia* Nielson

Calodia Nielson 1982: 140

Type species. *Calodia multipectinata* Nielson, 1982

Diagnosis. This genus can be separated from the other Chinese coelidiine genera mainly by the asymmetrical aedeagus without ventral paraphysis and with two or more apical or subapical processes (see key to genera).

Distribution. Oriental Region.

Key to species (male) of the genus *Calodia* from China

(modified from Zhang 1994)

- 1 Pygofer side extended into a long lateral caudodorsal process (Nielson 1982: 174, fig. 560) **2**

- Pygofer side not extended into a lateral caudodorsal process, posterior margin with a membranous process (Fig. 7)..... **4**
- 2 Subgenital plate with one apical spine; aedeagal shaft with one row of right lateral spines subapically **3**
- Subgenital plate without spine apically; aedeagal shaft with one spine-like process near apex and one row of left lateral setae-like spines slightly distad of midlength ***C. webbi* (Nielson)**
- 3 Pygofer side with a long straight sharply pointed caudodorsal process, dorsal margin with one toothed subapical spine; aedeagus with subapical spines widely spaced ***C. warei* Nielson**
- Pygofer side with a long S-shaped and gradually narrowed caudodorsal process, dorsal margin without subapical spine; aedeagus with subapical spines close together ***C. yunnanensis* Zhang**
- 4 Subgenital plate apex tapered or if not tapered with spines (Nielson 1982: 145 fig. 458; 164 fig. 527) **5**
- Subgenital plate apex not tapered and without spine (Fig. 8) **12**
- 5 Subgenital plate with subapical spines **6**
- Subgenital plate without subapical spine **9**
- 6 Aedeagus with two long spines closely appressed to midlength of shaft **7**
- Aedeagus with row of short spines on each lateral margin, directed laterally **8**
- 7 Forewing with three broad yellowish brown bands and two broad fawn bands transversely ***C. patricia* (Jacobi)**
- Forewing only with two broad, infusate transverse bands ***C. flavinota* Cai & Kuoh**
- 8 Pygofer caudoventral margin with a small digitate process ***C. centata* Zhang**
- Pygofer caudoventral margin without digitate process... ***C. bispinosa* Nielson**
- 9 Aedeagus with one apical spine and one or two subapical spines **10**
- Aedeagus with several uniseriate spines on each lateral margin **11**
- 10 Aedeagus with one apical spine and one subapical spine ***C. obliquasimilaris* Zhang**
- Aedeagus with one apical spine and two subapical spines ***C. obliqua* Nielson**
- 11 Aedeagal processes long, distinctly separated basally ***C. spinifera* Zhang**
- Aedeagal processes short, close basally ***C. setulosa* Zhang**
- 12 Aedeagus with many processes, without secondary spine (Nielson 1982: 195 fig. 642) **13**
- Aedeagus with two processes, with or without secondary spines (Fig. 12) **16**
- 13 Aedeagal shaft constricted and narrowed at midlength, flattened at apical half, spines mostly on dorsal surface **14**
- Aedeagal shaft narrow throughout, apical half tubular, spines on both lateral margins **15**
- 14 Style constricted at midlength and apex, expanded subapically, not bifurcate ... ***C. robusta* Nielson**

- Style base broad, narrowed distally, subapically bifurcate *C. bifurcata* Xu & Kuoh
- 15 Aedeagal shaft with two short left lateral spines and four long right lateral spines; gonopore lateral *C. barnesi* Nielson
- Aedeagal shaft with many spines of equal length on each side; gonopore dorsal *C. yayeyamae* (Matsumura)
- 16 Aedeagal shaft with two processes without secondary spine (Nielson 1982: 148 fig. 469) 17
- Aedeagus with one or two processes with secondary spines (Fig. 12) 18
- 17 Forewing with a narrow flavous band along costa; both aedeagal processes subapical on shaft *C. ostenta* (Distant)
- Forewing without band along costa; both aedeagal processes at midlength of shaft *C. longispina* Li & Wang
- 18 Style much longer than connective (Zhang 1994: 126 fig. 124J) 19
- Style slightly shorter than connective (Figs 9, 10) 20
- 19 Both aedeagal processes at apex of shaft *C. apicalis* Li
- Both aedeagal processes at midlength of shaft *C. harpagota* Zhang
- 20 Aedeagal processes arising on same side of shaft (Fig. 11) 21
- Aedeagal processes arising on different sides of shaft (Zhang 1994: 122 fig. 120L) 22
- 21 Pygofer with internal digitate caudoventral processes; aedeagus with lower process about twice as long as upper process (Figs 11–13) *C. dentispina* sp. n.
- Pygofer without internal caudoventral process; aedeagus with processes of near equal length *C. guttivena* (Walker)
- 22 Pygofer side with one digitate caudoventral process; both aedeagus processes with secondary lateral spines (Zhang 1994: 122 figs 120F, 120L) *C. lii* Zhang
- Pygofer side without caudoventral process; aedeagus with one spine with and one without secondary processes (Nielson 1982: 156 figs 498, 501) *C. fusca* (Melichar)

***Calodia dentispina* Fan, Li & Chen, sp. n.**

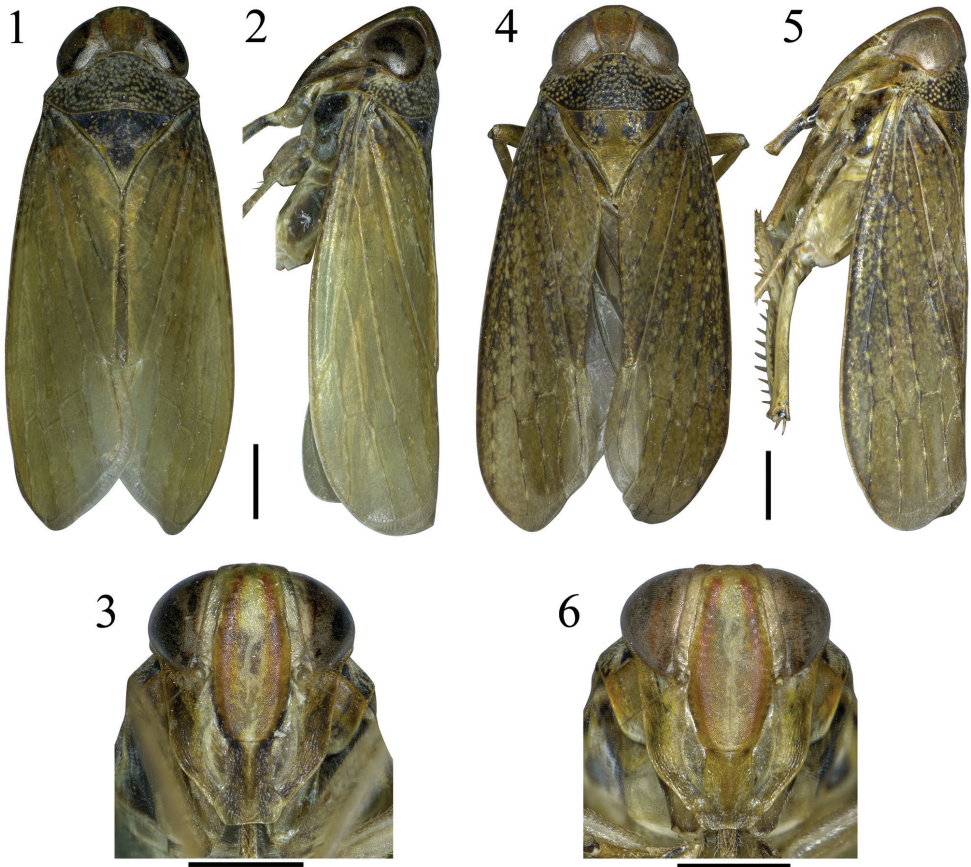
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Figs 1–13

Description. Length (including wings in repose): ♂ 8.1–8.5 mm, ♀ unknwn.

Crown brown, with a variable red broad band medially, about 1/3rd as wide as midline of crown, ocelli and eyes brown (Figs 1, 4). Face yellow to brown, with a red longitudinal stripe on each lateral margin of clypeus (Figs 3, 6). Pronotum dark brown, with yellow markings (Figs 1, 4). Mesonotum dark brown with yellow spots (Fig. 1) or brown with black spots (Fig. 4). Forewing light brown to brown, with or without yellow patches, venation brown or black (Figs 1, 2, 4, 5).

Head narrower than pronotum; crown longer in middle than next to eyes, length beyond eyes about 1/6th median length, coronal suture extending to level of ocelli,

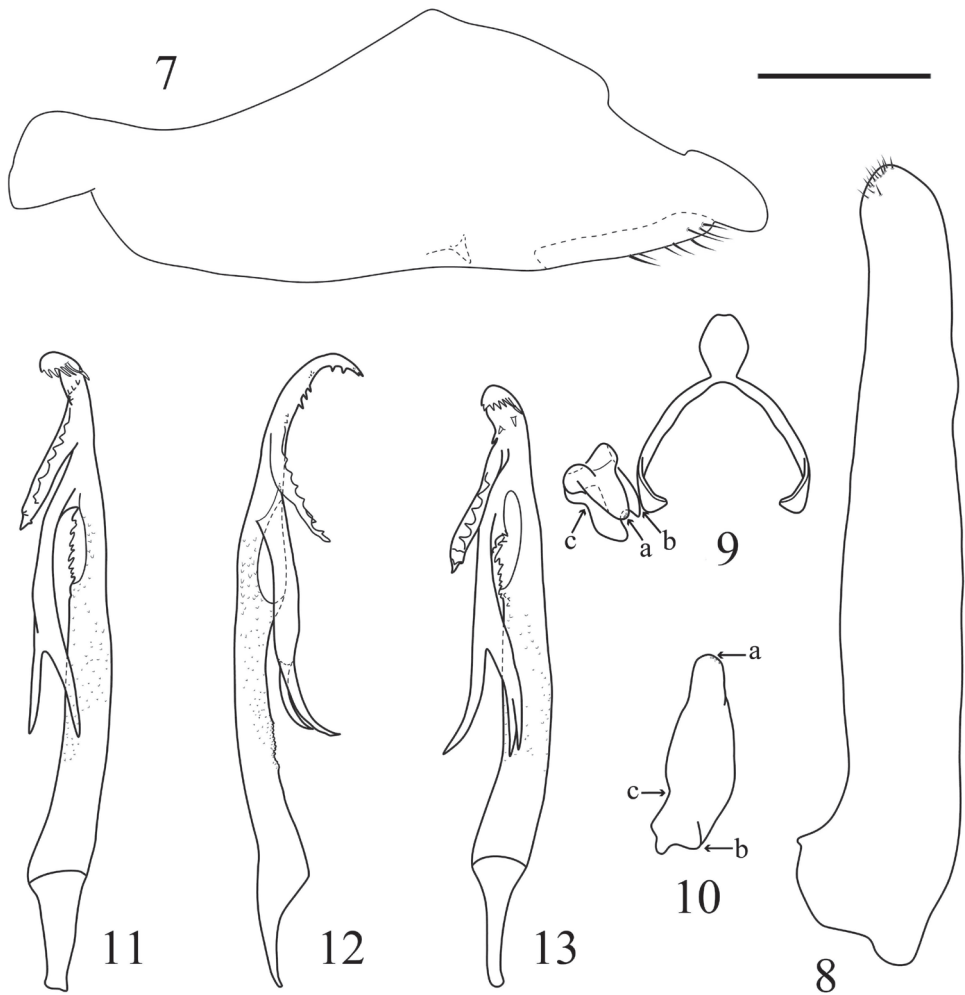


Figures 1–6. *Calodia dentispina* sp. n. 1–3 Holotype 4–6 Paratype 1, 4 Habitus, dorsal view 2, 5 Habitus, lateral view 3, 6 Facial view. Scale bars = 1 mm.

ocelli on anterior margin of crown (Figs 1, 2, 4, 5). Face with clypeus flat, laterally expanded under antennal sockets, apex constricted, clypellus narrow, base inflated longitudinally, apically with lateral margins expanded (Figs 3, 6). Crown, pronotum and mesonotum with ratio along midline about 1:1.3:2 (Fig. 1) or 1:1.1:1.5 (Fig. 4).

Male genitalia. Pygofer with caudal lobe broadly triangular in lateral view, caudoventral margin inturned with a small internal digitate process (Fig. 7). Segment X without process. Subgenital plate long, apex with short fine setae (Fig. 8). Connective Y-shaped with stem very short (Fig. 9). Style short and simple, apophysis folded at midlength, narrowed distally to rounded apex (Figs 9, 10). Aedeagal shaft asymmetrical, elongate, distally upturned and tapered to acute apex in lateral view with numerous small spines and fine teeth, with two large subapical processes arising on same side, lower process about twice length of other bifurcate apically with inner branch also bifurcate, upper process with margin serrate in lateral view; gonopore large, subapical, situated laterally (Figs 11–13).

Distribution. China (Guangxi).



Figures 7–13. *Calodia dentispina* sp. n., male genitalia. **7–12** Holotype: **7** Pygofer, lateral view **8** Subgenital plate, ventral view **9** Connective and style, dorsal view (letters a–c refer to corresponding areas on Fig. 10) **10** Style, dorsolateral view (letters a–c refer to corresponding areas on Fig. 9) **11** Aedeagus, dorsal view **12** Aedeagus, lateral view **13** Paratype: Aedeagus, dorsal view. Scale bar = 0.5 mm.

Type material. Holotype, ♂, CHINA: Guangxi, Chongzuo City, Longzhou County, Nonggang Preserve, 8 May 2012, coll. Fan Zhihua (GUGC). Paratype, 1♂, same data as holotype, except coll. Li Hu (GUGC).

Etymology. The species name *dentispina*, refers to the dentate margin of the shorter aedeagal process.

Remarks. This new species differs from other members of this genus by the shape and configuration of the aedeagal processes.

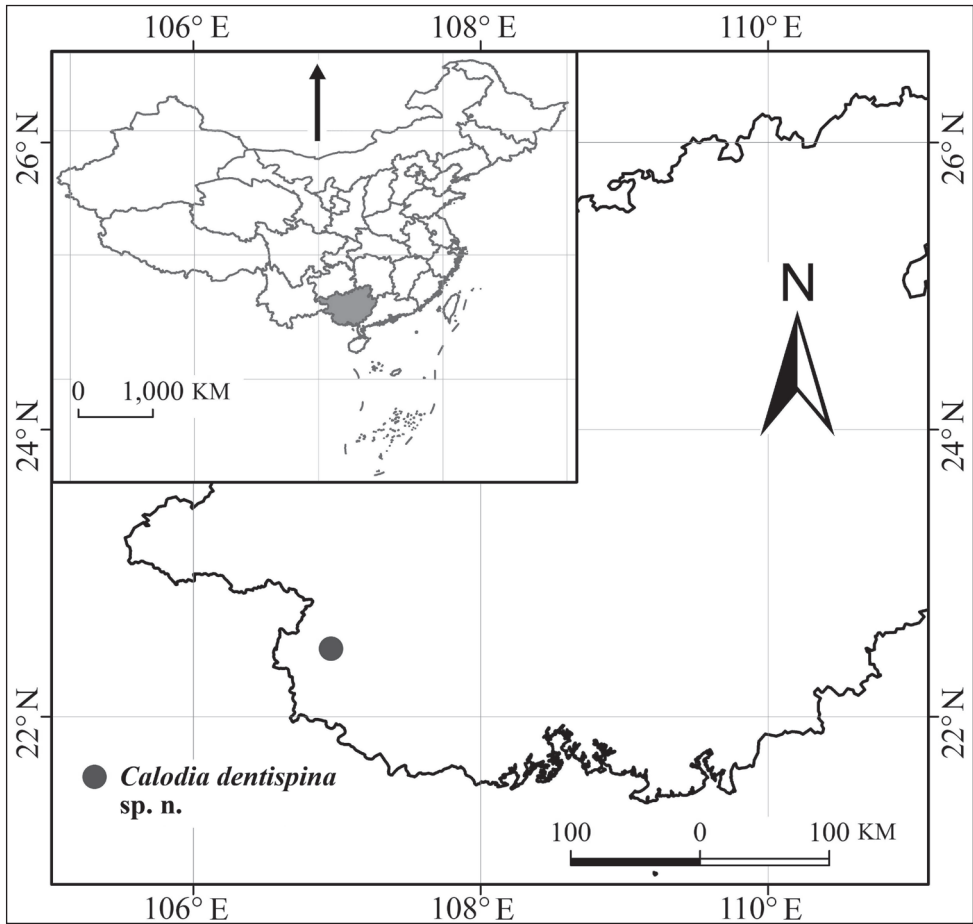


Figure 14. Geographic distribution of *Calodia* new species in China.

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A Dataset of Deep-Sea Fishes Surveyed by Research Vessels in the Waters around Taiwan

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Abstract

The study of deep-sea fish fauna is hampered by a lack of data due to the difficulty and high cost incurred in its surveys and collections. Taiwan is situated along the edge of the Eurasia plate, at the junction of three Large Marine Ecosystems or Ecoregions of the East China Sea, South China Sea and the Philippines. As nearly two-thirds of its surrounding marine ecosystems are deep-sea environments, Taiwan is expected to hold a rich diversity of deep-sea fish. However, in the past, no research vessels were employed to collect fish data on site. Only specimens, caught by bottom trawl fishing in the waters hundreds of meters deep and missing precise locality information, were collected from Dasi and Donggang fishing harbors. Began in 2001, with the support of National Science Council, research vessels were made available to take on the task of systematically collecting deep-sea fish specimens and occurrence records in the waters surrounding Taiwan. By the end of 2006, a total of 3,653 specimens, belonging to 26 orders, 88 families, 198 genera and 366 species, were collected in addition to data such as sampling site geographical coordinates and water depth, and fish body length and weight. The information, all accessible from the “Database of Taiwan’s Deep-Sea Fauna and Its Distribution (<http://deepsea.biodiv.tw/>)” as part of the “Fish Database of Taiwan,” can benefit the study of temporal and spatial changes in distribution and abundance of fish fauna in the context of global deep-sea biodiversity.

Keywords

Deep-Sea Fish Fauna, Otter Trawl, Beam Trawl, IKMT, Catalog of Life, Barcode of Life, Encyclopedia of Life

Data resources

The data underpinning the analyses reported in this paper are deposited in the GBIF, the Global Biodiversity Information Facility, <http://taibif.tw/ipt/resource.do?r=deep-sea-fishes>.

Taxonomic coverage

“Fishes of the World” (Nelson 2006) was used as a taxonomic reference for this work.

General taxonomic coverage description: The coverage of this dataset includes Class Actinopterygii (3,496/3,653), Class Chondrichthyes (156/3,653) and Class Myxini (1/3,653). The top 10 orders are Gadiformes, Myctophiformes, Anguilliformes, Stomiiformes, Ophidiiformes, Pleuronectiformes, Argentiniformes, Perciformes, Beryciformes and Squaliformes (Figure 1). The top 10 families are Macrouridae, Myctophidae, Ophidiidae, Sternoptychidae, Cynoglossidae, Synaphobranchidae, Muraenesocidae, Gonostomatidae, Alepocephalidae and Neoscopelidae (Figure 2).

Taxonomic ranks

Kingdom: Animalia

Phylum: Chordata

Class: Actinopterygii, Chondrichthyes, Myxini

Order: Albuliformes, Anguilliformes, Argentiniformes, Aulopiformes, Beryciformes, Carcharhiniformes, Chimaeriformes, Gadiformes, Gasterosteiformes, Gonorhynchiformes, Lamniformes, Lophiiformes, Myctophiformes, Myliobatiformes, Myxiniformes, Ophidiiformes, Perciformes, Pleuronectiformes, Rajiformes, Saccopharyngiformes, Scorpaeniformes, Squaliformes, Stephanoberyciformes, Stomiiformes, Tetraodontiformes, Torpediniformes

Family: Acropomatidae, Alepocephalidae, Aphyonidae, Aploactinidae, Bathyclupeidae, Bathylaconidae, Bothidae, Bramidae, Bregmacerotidae, Bythitidae, Callionymidae, Caristiidae, Centrophoridae, Cepolidae, Ceratiidae, Champsodontidae, Chaunacidae, Chiasmodontidae, Chimaeridae, Chlorophthalmidae, Colocongridae, Congridae, Cottidae, Cynoglossidae, Dalatiidae, Diretmidae, Ereuniidae, Etmopteridae, Eurypharyngidae, Gempylidae, Gonorynchidae, Gonostomatidae, Halosauridae, Himantolophidae, Hoplichthyidae, Ipnopidae, Linophrynidae, Lophiidae, Macrouridae, Melamphaidae, Melanocetidae, Melanonidae, Microstomatidae, Moridae, Muraenesocidae, Muraenidae, Myctophidae, Myxinidae, Nemichthyidae, Neoscopelidae, Nettastomatidae, Nomeidae, Notacanthidae, Ogcocephalidae, Oneirodidae, Ophichthidae, Ophidiidae, Ostracoberycidae, Paralepididae, Paralichthyidae, Percichthyidae, Percophidae, Peristediidae,

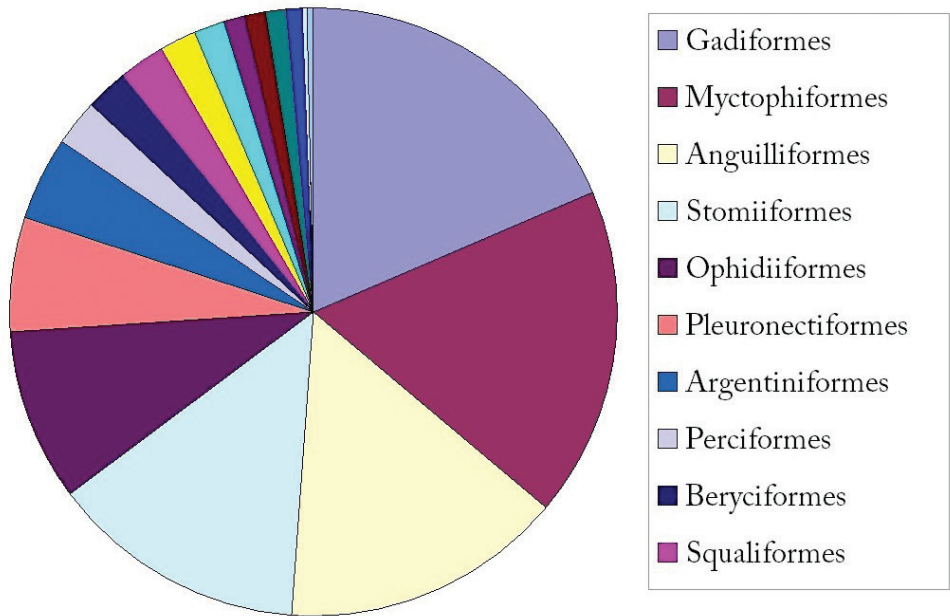


Figure 1. Taxonomic coverage (by order).

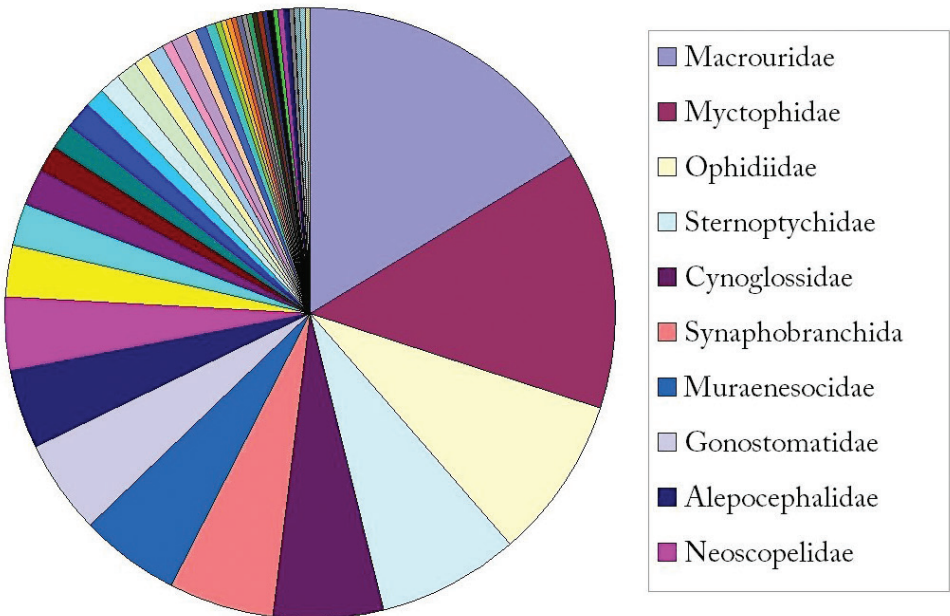


Figure 2. Taxonomic coverage (by family).

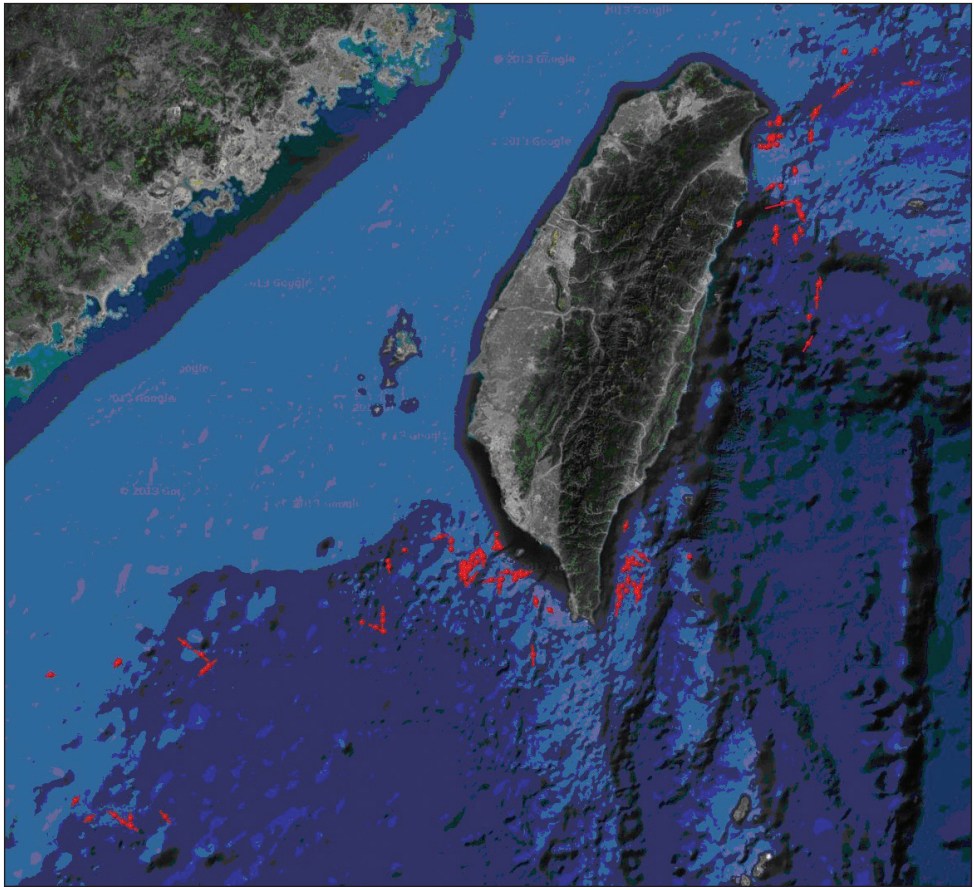


Figure 3. Spatial coverage (sampling routes).

Phosichthyidae, Poecilopsettidae, Priacanthidae, Pseudocarchariidae, Rajidae, Rondeletiidae, Scopelarchidae, Scorpaenidae, Scyliorhinidae, Serrivomeridae, Sparidae, Squalidae, Sternoptychidae, Stomiidae, Synaphobranchidae, Syngnathidae, Synodontidae, Tetraodontidae, Torpedinidae, Trachichthyidae, Triacanthodidae, Trichiuridae, Triglidae, Urolophidae, Zoarcidae

Spatial coverage

General spatial coverage: Seas around Taiwan (Figure 3)

Coordinates: 20°38'52.8"N and 25°23'2.4"N Latitude; 117°17'42"E and 123°0'43.2"E Longitude

Temporal coverage: May 20, 2001–August 27, 2006

Methods

Study extent description: The surveys were carried out from 2001 to 2006 in waters off northeastern Taiwan (Okinawa Trough), eastern Taiwan, southeastern Taiwan (Western Pacific) and southwestern Taiwan (South China Sea).

Sampling description: The research vessels used were “R/V Fishery Researcher I,” “R/V Ocean Researcher I” and “R/V Ocean researcher III.” Constrained by limited cable length, the maximum depth sampled was 4,460 meters. Major equipment used were otter trawl, French type beam trawl of 4 m span, ORE type beam trawl of 3 m span and Isaacs-Kidd midwater trawl (IKMT). Once the nets reached the sea bottom, they were towed for one hour at a ground speed of 1.5–2.5 knot for otter trawls and 1.0–1.5 knot for others.

Quality control description: All the scientific names of fish samples were validated by the updated fish checklist in the “Fish Database of Taiwan” or TaiCOL (<http://col.taibif.tw>; formerly TaiBNET, <http://taibnet.sinica.edu.tw>) before they were entered into database. Afterward, they were validated again by matching against FishBase and Catalog of Fishes, California Academy of Sciences for further correction. If a specimen was rare or it might belong to an undescribed or new species, it was photographed in fresh and then both the specimen and its tissue sample were catalogued and deposited at the Biodiversity Research Museum of Biodiversity Research Center, Academia Sinica (ASIZP of BRCAS). The latitude and longitude of trawling routes were plotted on Google Maps and outlier detection was conducted.

Step description:

- Step1: Sampling locality and water depth were recorded.
- Step2: Specimens were roughly classified and counted either right on board or when they reached the shore.
- Step3: Specimens were shipped back to the lab for species identification, body length and weight measurement, and picture taking.
- Step4: Specimens were fixed in 10% Neutral Buffered Formalin for one month. Next, they were cleaned with water and preserved in 70% alcohol.

Project details

Project title: Survey of Deep-Sea Fish Diversity by Research Vessels in Taiwan Waters.

Personnel: Kwang-Tsao Shao (Project Director), Jack Lin (Software Engineer and Database Manager), Hsin-Ming Yeh, Mao-Yin Lee, Hsuan-Ching Ho, Yun-Chih Liao, Hen-Wei Lin (field work, fish identification, data collection and analysis).

Funding: Ministry of Science and Technology (previously National Science Council), Executive Yuan, R.O.C. (Taiwan).

Study area descriptions/descriptor: Taiwan is located on the eastern edge of Asian continental shelf. To the west of Taiwan is the shallow Taiwan Strait, to the northeast is the Okinawa Trough (maximum depth 2,716 m), to the east is the complex and diverse Philippine Sea (with deep oceanic trenches), and to the south is the South China Sea (maximum depth 5,016 m). These deep-water environments were where the surveys were carried out.

Design description: This study focused on Taiwan's deep-sea fish fauna, which so far hasn't been investigated much, and hoped to learn if the fauna varies depending on the sea area, current and water depth. All the specimens caught went through taxonomic identification and had their collection time, water depth and coordinates recorded. A geographic information system (GIS) on their distributions was established in order to provide references for future academic researches as well as resource development, management and assessment. One or several specimens per fish species were selected to have their photos taken in color. Keeping to the Barcode of Life tissue preservation techniques, a small piece of tissue was excised, preserved in 90–95% alcohol and stored at BRCAS in liquid nitrogen canisters. Backup tissue samples were also stored at Livestock Research Institute, COA to facilitate the study of molecular biology and genetics later. The voucher specimens and whole fish specimens were deposited at BRCAS. The specimen information was entered into the Fish Database of Taiwan and is freely accessible to all.

Datasets

Dataset description: The dataset includes station number, locality name, water depth, collection date, latitude, longitude, family name, species name and Chinese common name. Since the number of individuals and the weight and length of each specimen are also included, the data can be used to calculate biodiversity indices, K-dominance (A-B-C) curve and community structure analysis by applying various clustering or ordination methods. They can form a good baseline for the time period of 2001–2006. If more data can be collected in the future, comparisons can be performed and the question of whether deep-sea fish diversity is declining under anthropogenic and climate change impacts can be assessed. The collected specimens (voucher and tissue sample) deposited at BRCAS are open to all users for taxonomic and ecological researches so that studies on new species, phylogeny and zoogeography of deep-sea fishes can be published. Some images and morphological data can also be used by the global databases of FishBase, OBIS, GBIF and EOL. Additionally, detailed analyses on the body size of certain species can generate valuable information on the fish's early life history and its inshore or offshore migration and recruitment.

Object name: Darwin Core Archive A Dataset of Deep-Sea Fishes Surveyed in the Waters around Taiwan

Character encoding: UTF-8

Format name: Darwin Core Archive format

Format version: 1.0

Distribution: <http://taibif.tw/ipt/archive.do?r=deep-sea-fishes>

Publication date of data: 2014-08-26

Language: English

Metadata language: English

Date of metadata creation: 2014-08-26

Hierarchy level: Dataset

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