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The genus *Bebryce* (Cnidaria, Octocorallia, Plexauridae) at Japan, with descriptions of three new species

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Abstract

Three new deep-water species of *Bebryce* from Japan are described and depicted using Scanning Electron Microscopy: *B. otsuchiensis* **sp. n.**, *B. rotunda* **sp. n.**, and *B. satsumaensis* **sp. n.** *Bebryce studeri* Whitelegge, 1897, was reported from Japanese waters for the first time, bringing the total of Japanese *Bebryce* species to six. Five of these six species seem to be endemic to Japanese waters and all occur in deep water up to 213 m. A key to the *Bebryce* species is presented.

Keywords

Anthozoa, taxonomy, new records, subtropical, temperate, deep water

Introduction

Bebryce Philippi, 1841, is a genus of octocorals, which is distributed in tropical to subtropical waters in the Atlantic and Indo-Pacific Oceans. Two Japanese endemic subtropical deep-water species of *Bebryce* have been reported from the Ogasawara Islands (= Bonin Islands), both with rosettes with warty, rounded, or bristle-like projections: *B. bocki* Aurivillius, 1931 and *B. boninensis* Aurivillius, 1931. These two species have been re-described in a revision by Bayer and Ofwegen (2016), in which they

remained the only *Bebryce* species described from Japanese waters. Meanwhile, other species have been reported from Japan, and *B. bocki* has been reported outside Japan (Bayer and Ofwegen 2016).

Here we present three additional, new species, and report the finding of *B. studeri* Whitelegge, 1897 in Japanese waters, a species previously known from Funafuti, New Caledonia, Indonesia, and the Philippines (Bayer and Ofwegen 2016). *Bebryce bocki* seems to be the most common *Bebryce* species in Japanese waters, whereas *B. boninensis* was never found again.

Material and methods

Material was collected by dredging, trawling or fishing net onboard research vessels *RV Tansei-maru*, University of Tokyo and Japan Agency for Marine-earth Science and Technology, *RV Yayoi*, the University of Tokyo, *RV Shinyo-maru*, Tokyo University of Marine Science and Technology, and the commercial fishing boat *Kiryo-maru* during the years 2003–2009. Depths of each station are converted to depth range in meters from shallow to deep, also when it is towed from deep to shallow if that would be indicated on the sampling label with original provenance data. We also examined historical museum material of the Zoological Museum University of Copenhagen, Denmark (ZMUC); University Museum of University of Tokyo, Japan (UMUT); and type material of *B. bocki* and *B. boninensis* of the Museum of Evolution, Uppsala, Sweden (UUZM) (Figure 1). Specimens were collected from a depth between 67.1 and 213 m.

Of each specimen, a small piece of the distal part of a branch was dissolved in a 4% household bleach solution to isolate sclerites. These sclerites were washed with demineralised water, dried on a hot plate, mounted on SEM stubs, and coated with Pd/Au for SEM imaging. For this, either a JEOL JSM6490LV scanning electron microscope was operated at high vacuum at 10 kV, or a JEOL JSM6510LA scanning electron microscope with a Quick Carbon Coater SC-701C, SANYU ELECTRON was used. For terminology, see Bayer et al. (1983).

Descriptions of old Japanese material collected by Japanese used “hiro” (Japanese fathom) as the depth unit. One Japanese fathom (hiro) is usually 1.43 m, occasionally 1.51 m, whereas, it is 1.818 m for the length unit on land. The old depth unit fathom is also converted to 1.8288 m. When it was not clear whether the collector used fathom or hiro, the converted depth has wider ranges.

All new type material is stored in ethanol and deposited in the Cnidaria collection (RMNH Coel.) of Naturalis Biodiversity Center, Leiden, the Netherlands (NBC).

Abbreviations

AKM Asako K. Matsumoto collection, Planetary Exploration Research Center (PERC), Chiba Institute of Technology (Chitech), Japan

BIK The Biological Institute on Kuroshio, Kochi, Japan
NBC (RMNH) Naturalis Biodiversity Center, formerly Rijksmuseum van Natuurlijke Historie Leiden, The Netherlands
ME (UPSZTY (UUZM)) Museum of Evolution, Uppsala, Sweden
UMUTZ University Museum of the University of Tokyo, Japan
ZMUC Zoological Museum University of Copenhagen, Denmark

Key to the Japanese species of *Bebryce*

1 Rosettes with bristle-like projections **2**
– Rosettes cup-shaped **4**
2 Calycular margins without modified rosettes... ***B. boninensis* Aurivillius, 1931**
– Calycular margins with modified rosettes **3**
3 Calycular margins with asymmetrical rosettes not strongly modified..... ..... ***B. studeri* Whitelegge, 1897**
– Calycular margins with spindles with blade ..... ***B. bocki* Aurivillius, 1931**
4 Coenenchymal sclerites include tuberculate disks with central process..... ..... ***B. rotunda* sp. n.**
– Coenenchymal sclerites 4-6-rayed stellate plates..... **5**
5 Rosettes with slightly serrated rim with spines ..... ***B. satsumaensis* sp. n.**
– Rosettes with slightly serrated rim with blunt processes.... ***B. otsuchiensis* sp. n.**

Systematic part

***Bebryce bocki* Aurivillius, 1931**
Figures 1, 2a

Bebryce brocki Aurivillius, 1931: 194, fig. 38, pl. 4 fig. 4; erroneous original spelling for *bocki*, in honor of Sixten Bock's expedition to the Bonin Islands, Japan.
Bebryce bocki; Matsumoto 2014: Table 1; Bayer and Ofwegen 2016: 308.
Bebryce boninensis; Matsumoto et al. 2007: table 1.

Material examined. Holotype UPSZTY2181 (UUZM84), East of Chichijima I., Ogasawara Is. (Bonin Is.), Japan, depth 120 m (100 m in Aurivillius 1931), coll. Dr. Sixten Bock, 1 August 1914; RMNH Coel. 42080 (AKM 806) Off Takarajima I., Tokara Is., Japan, East China Sea, 29°14.6410'N, 129°07.8392'E, depth 156 m, *RV Tansei-maru*, KT07-2 cruise, st. DT5 (D8), coll. H. Yokose, 2 March 2007; AKM1407, West of Chichijima I., Ogasawara Is. (Bonin Is.), Japan, 27°01.395'N, 142°07.412'E – 27°01.360'N, 142°07.467'E, depth range 139–144 m, *RV Tansei-maru*, KT09-02, st. TW01-01, coll. A.K. Matsumoto, 19 March 2009; AKM1445, same data as AKM1407; AKM 878, off Hachijo Jima I., Izu Is., Japan, 33°20.9082'N, 139°41.1841'E – 33°21.0775'N,

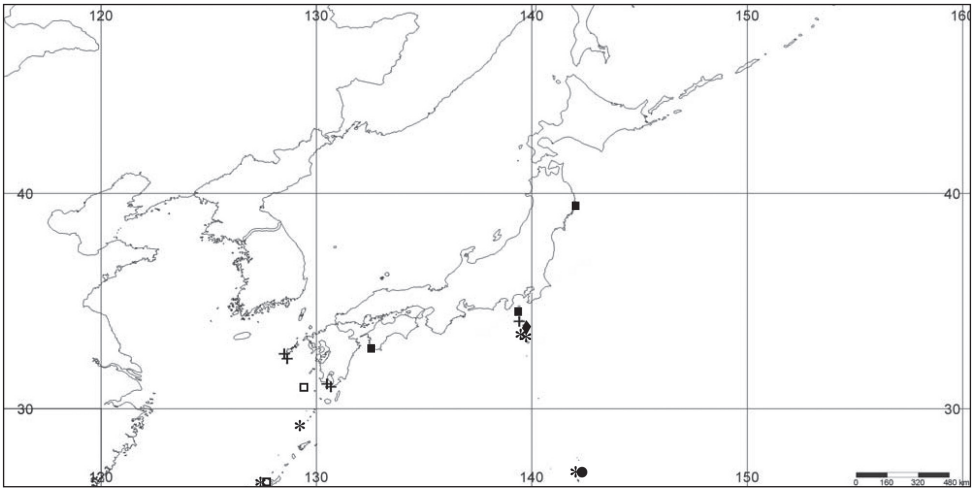

Figure 1. Distribution of *Bebryce bocki* (*), *B. boninensis* (●), *B. otsuchiensis* sp. n.(■), *B. rotunda* sp. n.(♦), *B. satsumaensis* sp. n., (+), and *B. studeri* (□).

139°40.4931'E, depth range 185–213 m, *RV Tansei-maru*, KT07-31, st. 14 (L-7-200), chain bag dredge, coll. A.K. Matsumoto, 26 November 2007; AKM 251(BIK-G878), off Hachijo Jima I., Izu Is., Japan, 33°26.0'N, 139°41.9'E – 33°26.1'N, 139°41.6'E, depth range 160–190 m, *RV Shinyo-maru*, KS03 cruise, st. 17, coll. A.K. Matsumoto, 21 October 2003; AKM 264 (BIK-G00902), off Hachijojima I., Izu Is., Japan, 33°26.3'N, 139°42.3'E – 33°26.5'N, 139°42.0'E, depth range 157–172 m, *RV Shinyo-maru*, KS03 cruise, st. 18, coll. A.K. Matsumoto, 21 October 2003; AKM 294 (BIK-G00907), off Hachijojima I. Izu Is., Japan, 33°26.8'N, 139°42.7'E – 33°27.0'N, 139°42.4'E, depth 170–176 m, *RV Shinyo-maru*, KS03 cruise, st. 19, coll. A.K. Matsumoto, 21 October 2003; AKM 1334, off Kerama Is. Japan, East China Sea, 26°00.55'N, 127°12.87'E – 26°00.66'N, 127°12.61'E, depth range 97–100 m, *RV Tansei-maru*, KT08-33, KR-3, chain bag dredge, coll. A.K. Matsumoto, 18 December 2008.

Diagnosis. *Bebryce* with rosettes with warty, rounded, or bristle-like projections. Those of calycular margin asymmetrically developed, with strong projecting blade. Coenenchymal sclerites are thick, warty disks.

Remarks. Apparently this is the most common *Bebryce* species in sub-tropical to temperate Japanese waters, in a depth range of 97–213 m.

Bebryce boninensis Aurivillius, 1931

Figures 1, 2b

Bebryce boninensis Aurivillius, 1931: 200, fig. 39, pl. 4 fig. 3 (Bonin Is., Japan); Matsumoto 2014: Table 1; Bayer and Ofwegen 2016: 308.

NOT *Bebryce boninensis*; Matsumoto et al. 2007: table 1 = *B. bocki*.

Figure 2. a *Bebryce bocki* Aurivillius, 1931, holotype (UPSZTY2181 (UUZM84)) **b** *B. boninensis* Aurivillius, 1931, holotype (UPSZTY2166 (UUZM69)) **c** *B. otsuchiensis* sp. n., holotype (RMNH Coel. 42072) **d** *B. rotunda* sp. n., holotype (RMNH Coel. 42076) **e** *B. satsumaensis* sp. n., holotype (RMNH Coel. 42077). Scales: 1 cm.

Material examined. Holotype UPSZTY2166 (UUZM69), ENE from Anojima I. (Anijima I. or Anejima I.), Ogasawara Is. (Bonin Is.), Japan, depth 150 m (100 fathoms in Aurivillius 1931), coll. Dr. Sixten Bock, 15 August 1914.

Diagnosis. *Bebryce* with rosettes with warty, rounded, or bristle-like projections. Calycular margins without specialized sclerites. Coenenchymal sclerites are thick, warty disks.

Remarks. It cannot be excluded that this species is synonymous with *B. bocki*. Its sclerites are very similar and it only differs in lacking the asymmetrical rosettes at the calyx margin. These sclerites may perhaps fall off easily, which would explain why the species was never reported again. The distance between Chichijima Island (type locality of *B. bocki*) and Anijima Island (type locality of *B. boninensis*) is ca. 800 m within the Anijima Strait. The recorded depth of *B. boninensis* (150 m) is within the depth range of *B. bocki* (97–213 m). As collecting efforts at the Bonin Islands have been limited, the two species are still considered separate in the present study. Re-examination of the material studied by Matsumoto et al. (2007), proved to be *B. bocki*.

***Bebryce otsuchiensis* sp. n.**
http://zoobank.org/E4DF6D06-CC14-4469-A19D-3428D656E789
Figures 1, 2c, 3–6

Material examined. Holotype RMNH Coel. 42072 (AKM 703), Entrance of Otsuchi Bay, Iwate Prefecture, Japan, 39°21.8052'N, 142°00.0750'E – 39°22.0672'N, 141°59.9619'E, depth 67–81 m, *RV Yayoi*, st. 2, 1 m biological dredge, coll. A.K. Matsumoto, 23 May 2006; paratypes RMNH Coel. 42073 (AKM 531), Otsuki, Tosa, Kochi Prefecture, Japan, 32°34.14'N, 132°48.59'E – 32°34.18'N, 132°47.53'E, depth range 117–125 m, local fishermen's boat *Kiryo-maru*, st. 2, coral net, coll. A.K. Matsumoto, 7 October 2004; RMNH Coel. 42074 (AKM 1628), Otsuki, Tosa, Kochi prefecture, Japan, 32°37.66'N, 132°50.44'E – 32°37.56'N, 132°47.88'E, depth 114 m, local fishermen's boat *Kiryo-maru*, st. 1, coral net, coll. A.K. Matsumoto, 7 October 2004; RMNH Coel. 42075 (AKM 943), Toshima I., Izu Is., Japan, 34°33.1102'N, 139°17.4102'E – 34°33.6524'N, 139°17.6725'E, depth 143 m, *RV Tansei-maru*, KT07-31 cruise (Kuramochi leg), st. 22 (L-3-100), chain bag dredge, coll. A.K. Matsumoto, 27 November 2007.

Description. The holotype RMNH Coel. 42072 consists of two branches, both 4 cm long. (Figure 2c). The calyces are placed spirally all around the slender branches, which are about 1 mm wide. The dome-shaped calyces are about 1 mm wide and high.

The anthocodiae are armed with a crown and points consisting of a transverse crown with curved, rather smooth spindles up to 0.40 mm long (Figure 3a) and eight points formed by spindles 0.35 mm long (Figure 3b) placed in a chevron-like pattern beneath the tentacles. These spindles have simple tubercles and a distal spiny end. The tentacles contain flattened, dragon wing sclerites up to 0.2 mm long (Figure 3c).

Figure 3. *Bebryce otsuchiensis* sp. n., holotype (RMNH Coel. 42072) **a** collaret spindles **b** point spindles **c** tentacle sclerites **d** rosettes of outer surface of coenenchyme **e** asymmetrical rosettes from calyx rim.

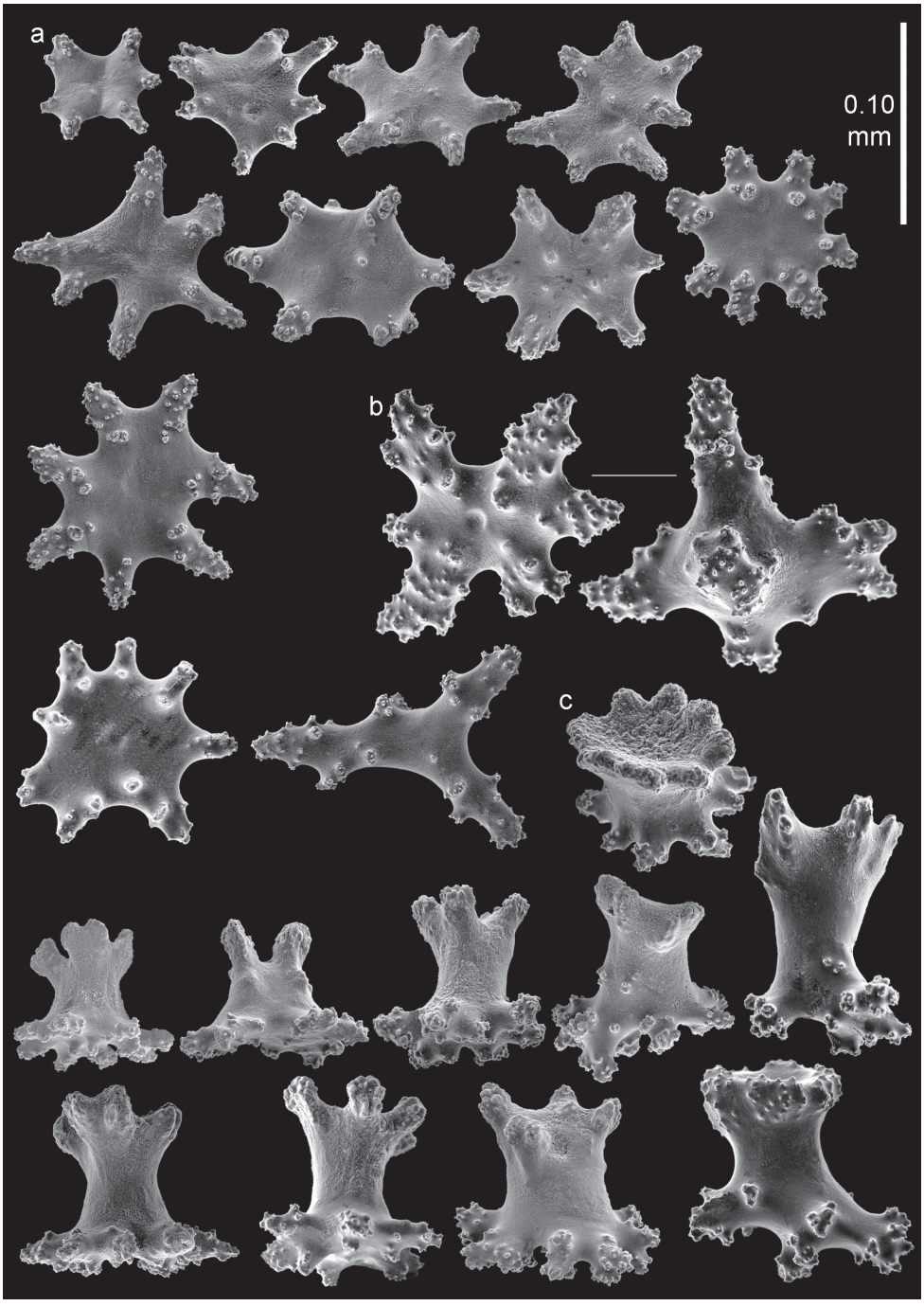

Figure 4. *Bebryce otsuchiensis* sp. n., holotype (RMNH Coel. 42072) **a–b** 3–6 rayed stellate plates of deeper layer of coenenchyme **c** rosettes of outer surface of coenenchyme.

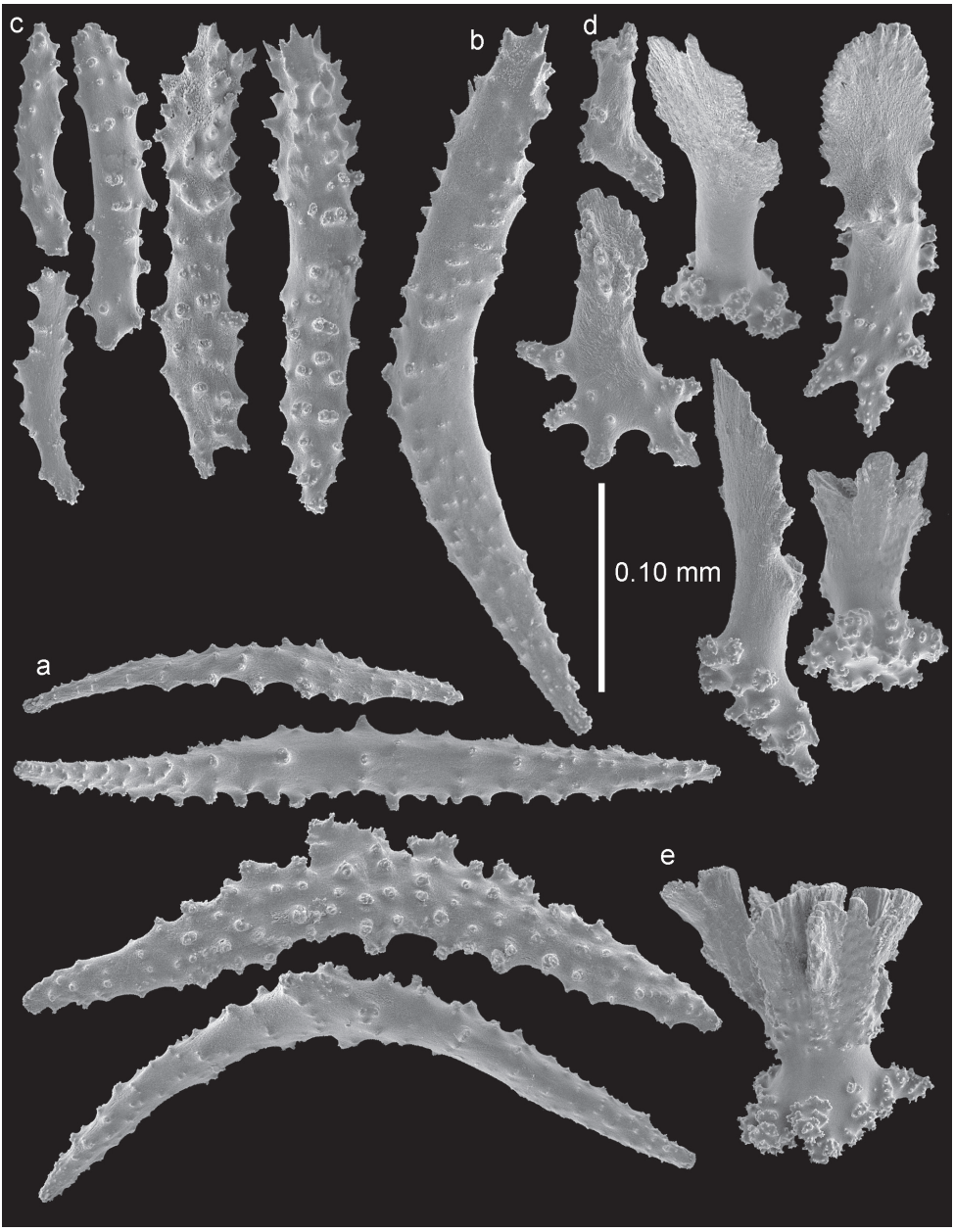

Figure 5. *Bebryce otsuchiensis* sp. n., paratype (RMNH Coel. 42074) **a** collaret spindles **b** point spindle **c** tentacle sclerites **d** asymmetrical rosettes from calyx rim **e** rosette of outer surface of coenenchyme.

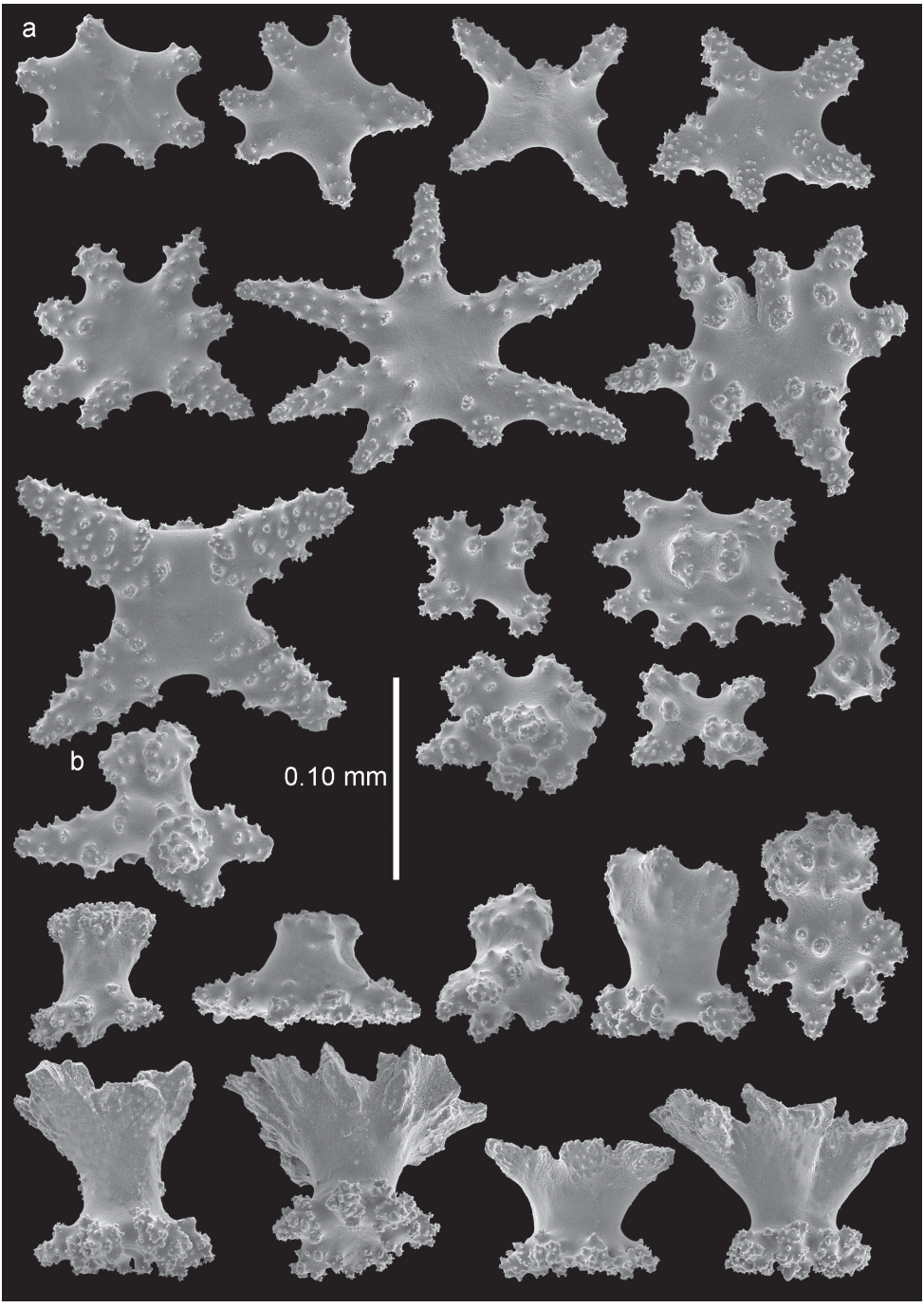

Figure 6. *Bebryce otsuchiensis* sp. n., paratype (RMNH Coel. 42074) **a** 3–6 rayed stellate plates of deeper layer of coenenchyme **b** rosettes of outer surface of coenenchyme.

The sclerites of the outer surface of coenenchyme and calyces are rosettes consisting of a cup-shaped thorny projection arising from a warty base. Several of these are up to 0.10 mm long and have a widely flared calyx part of about 0.10 mm in greatest diameter with slightly serrated rim with a few blunt processes, joined by a smooth, slender stem to a warty base narrower than the calyx (Figure 3d); others do not flare out (Figure 4c). The rosettes become asymmetrical toward the calycular apertures (Figure 3e), with the calyx margin becoming elongated and forming a blade-like process that projects from the surface and surrounds the calycular aperture. These sclerites are up to 0.20 mm long.

The deeper layer of coenenchyme contains stellate plates, 3–6 rayed forms up to 0.15 mm in the greater diameter, with a central process (Figure 4a). Most are weakly tuberculated (Figure 4a) but several are more tuberculated towards the end of the rays (Figure 4b).

Colour. The holotype is light brown.

Etymology. Named after the type locality, Otsuchi Bay.

Variation. RMNH Coel. 42074 (AKM 1628) has slightly wider point sclerites, collaret spindles heavier tuberculate, and more tuberculate stellate plates (Figures 5–6).

Comparisons. The species mostly resembles *B. harpy* Grasshoff, 1999, regarding the blunt processes of the rosettes. It differs in overall having less tuberculate sclerites.

Remarks. This is the northernmost species of *Bebryce*. It has a very wide distribution from North to South Japan, and is only found in the warm Kuroshio Current area, in the depth range 67–143 m. This species also represents the northernmost record of the genus *Bebryce*, and the first from north of 39°N latitude.

***Bebryce rotunda* sp. n.**
http://zoobank.org/57ED4C53-5C51-4089-B26C-230EB84A1C79
Figures 1, 2d, 7–8

Material examined. Holotype RMNH Coel. 42076 (AKM 881), Hachijo I., Izu Is., Japan, 33°20.9082'N, 139°41.1841'E – 33°21.0775'N, 139°40.4931'E, depth range 185–213 m, *RV Tansei-maru*, KT07-31 cruise (Kuramochi leg), st. 14 (L-7-200), chain bag dredge, coll. A.K. Matsumoto, 26 November 2007.

Description. The holotype RMNH Coel. 42076 (AKM 881) is a sparsely branched colony 10 cm long (Figure 2d). The calyces are placed spirally all around the slender branches, which are about 1 mm wide. The stem is 2 cm wide. The dome-shaped calyces are about 2 mm wide and high.

The anthocodiae are armed with a crown and points consisting of a transverse crown with curved spindles up to 0.35 mm long (Figure 7a) and eight points formed by spindles 0.35 mm long (Figure 7b) placed in a chevron-like pattern beneath the tentacles. These spindles have simple tubercles and a distal spiny end. The tentacles contain flattened, dragon wing sclerites up to 0.2 mm long (Figure 7c).

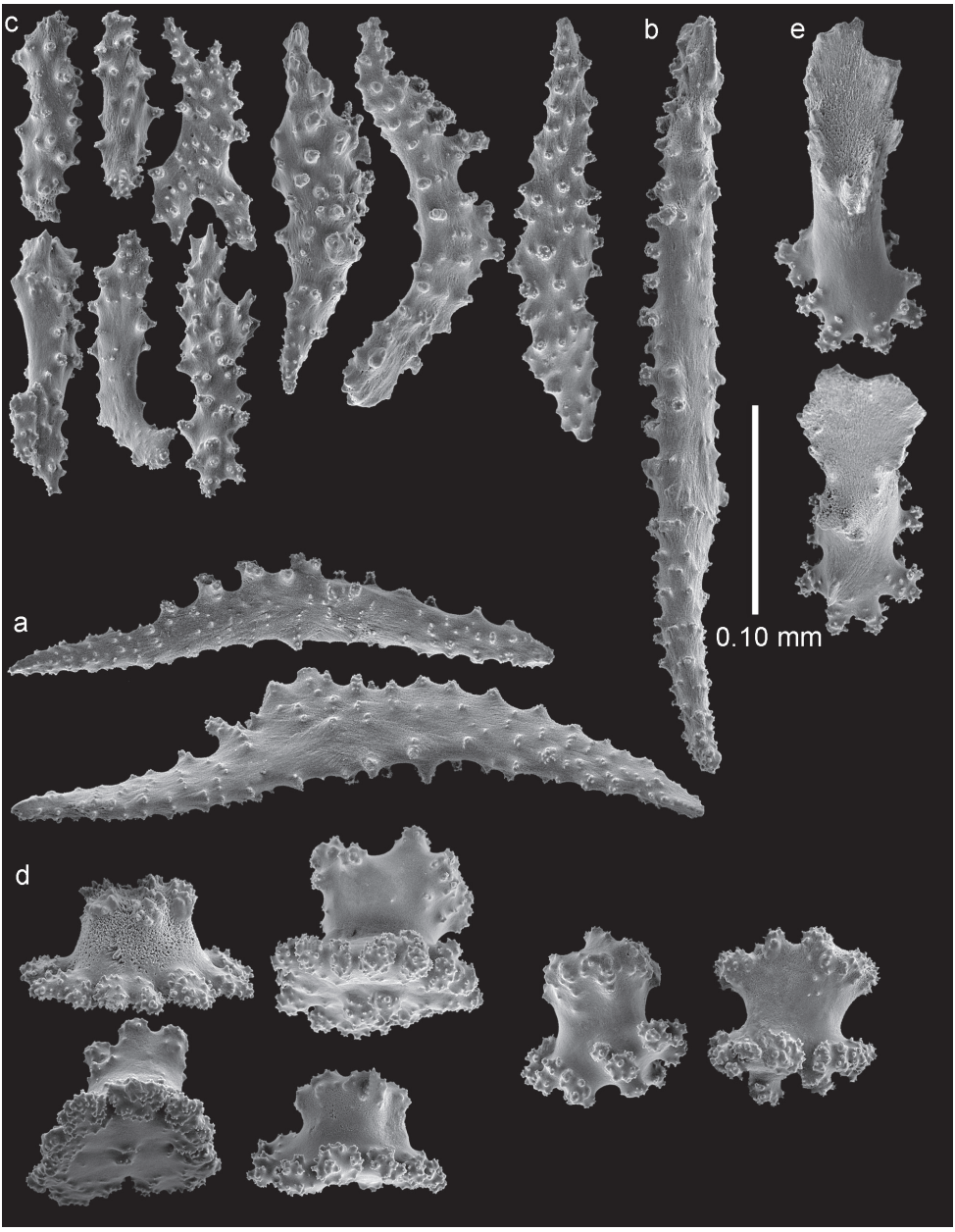

Figure 7. *Bebryce rotunda* sp. n., holotype (RMNH Coel. 42076) **a** collaret spindles **b** point spindle **c** tentacle sclerites **d** rosettes of outer surface of coenenchyme **e** asymmetrical rosettes from calyx rim.

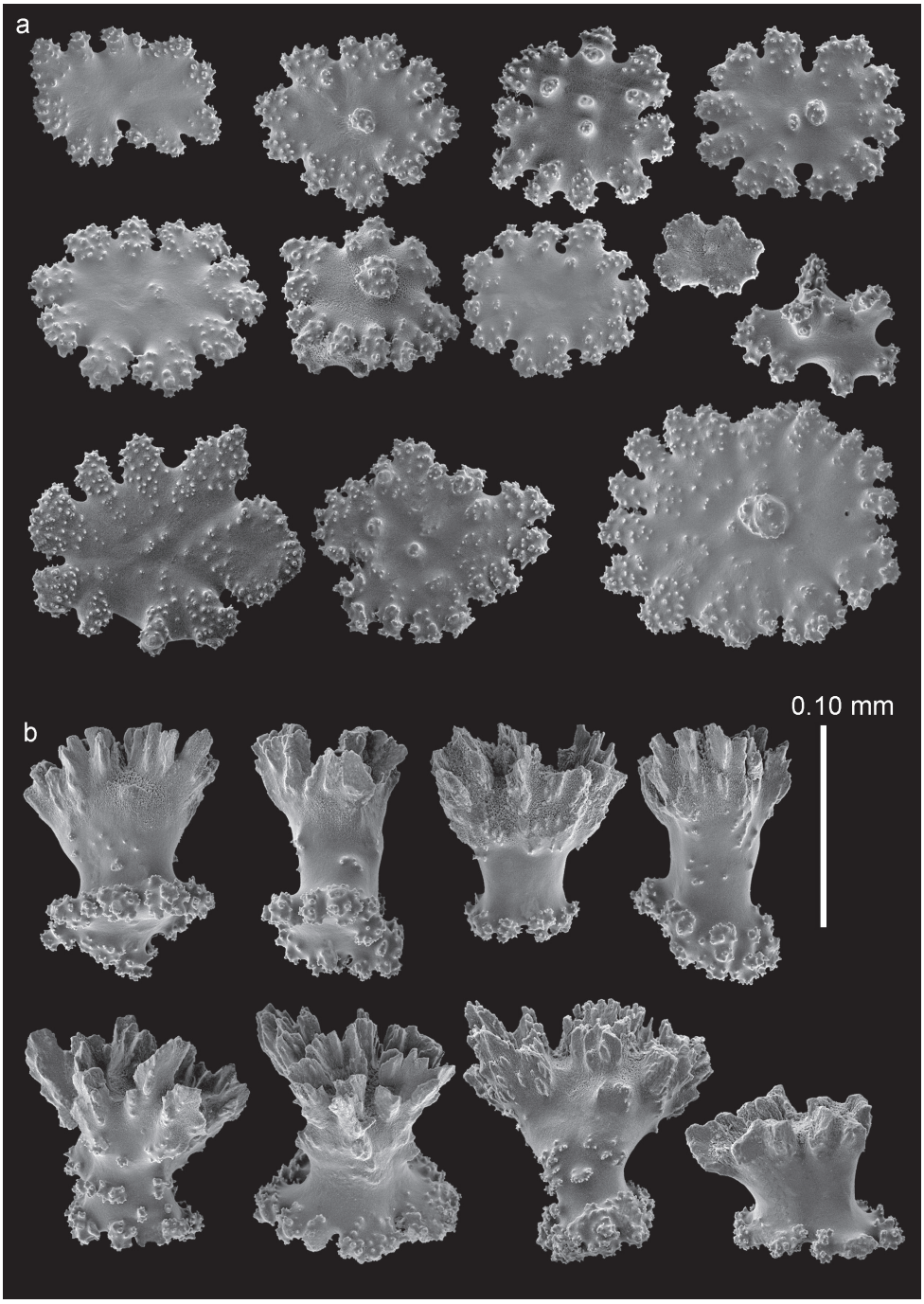

Figure 8. *Bebryce rotunda* sp. n., holotype (RMNH Coel. 42076) **a** tuberculate disks of deeper layer of coenenchyme **b** rosettes of outer surface of coenenchyme.

The sclerites of the outer surface of coenenchyme and calyces are rosettes consisting of a cup-shaped thorny projection arising from a warty base. These rosettes are 0.10 mm tall, have a flared calyx part about 0.10 mm in greatest diameter with blunt processes (Figure 7d) or the rim of the cups is formed several strong, laciniated projections (Figure 8b). Toward the calycular apertures the rosettes become asymmetrical (Figure 7e), with the margin of the calyx becoming much elongated forming a blade-like process that projects from the surface and surrounds the calycular aperture. These sclerites are up to 0.15 mm long.

The plates of the inner coenenchyme are tuberculate disks up to about 0.15 mm in diameter with tuberculate rim and central process on one surface (Figure 8a).

Colour. The holotype is creme.

Etymology. From the Latin *rotundus*, wheel-shaped, round, referring to the round disks of the coenenchyme.

Comparisons. Bayer and Ofwegen (2016) mentioned only two species with tuberculate disks and cup-shaped rosettes, *Bebryce* species A and *B. thomsoni* Nutting, 1910. The present species differs from these two by having disks with a smooth central part and a small process in the middle, while those of *Bebryce* species A and *B. thomsoni* have tubercles all over the disk.

***Bebryce satsumaensis* sp. n.**
http://zoobank.org/C2586676-9927-4B9D-8C9E-B1E509C1EB29
Figures 1, 2e, 9–10

Material examined. Holotype RMNH Coel. 42077 (AKM760), off Sata-misaki Cape, Kagoshima Prefecture, Japan, 30°56.0025'N, 130°44.2299'E – 30°56.2953'N, 130°43.3981'E, depth range 116–120 m, *RV Tansei-maru*, KT07-1 cruise, st. SM-1, chain bag dredge, coll. A.K. Matsumoto, 23 February 2007; paratypes RMNH Coel. 42078 (AKM 1629), off Sata-misaki Cape, Kagoshima Prefecture, Japan, 31°00.50'N, 130°35.09'E – 31°01.3211'N, 130°34.6509'E, depth range 178–189 m, *RV Tansei-maru*, KT07-1 cruise, st. SM-2, coll. A.K. Matsumoto, 23 February 2007; UMUTZ-CnidG-49, off Kozushima I., Izu Is., Sagami Bay, Japan, Ohnoura-maru, 24 August 1893; UMUTZ-CnidG-90, Yamagawa, below Kaimon-dake mt., Kagoshima Bay (Kagoshima Prefecture), Japan, depth 70 Japanese fathoms (100–106 m), Prof. Mitsukuri & Hara Satsuma Exp., long line, coll. S. Azuma, 8 April 1896; UMUTZ-CnidG-91, Odawara, Kanagawa Prefecture, Japan, depth 120 hiro (Japanese fathoms (171–181 m)), coll. I. Ijima, August 1895; ZMUC-ANT-000645 (ZMUC 120604-39), East China Sea, 32º15'N, 128º12'E, depth 90 fms (165 m), hard bottom, gear: Shveber, *Hyateri-maru*, Dr. Th. Mortensen's Pacific Expedition 1914–1915, coll. Dr. Th. Mortensen, 15 May 1914; RMNH Coel. 42079 (AKM 1092), Shin-sone bank, Danjo Is., Japan, East

Figure 9. *Bebryce satsumaensis* sp. n., holotype (RMNH Coel. 42077) **a** collaret spindles **b** point spindles **c** tentacle sclerites **d** asymmetrical rosettes from calyx rim **e** rosette of outer surface of coenenchyme.

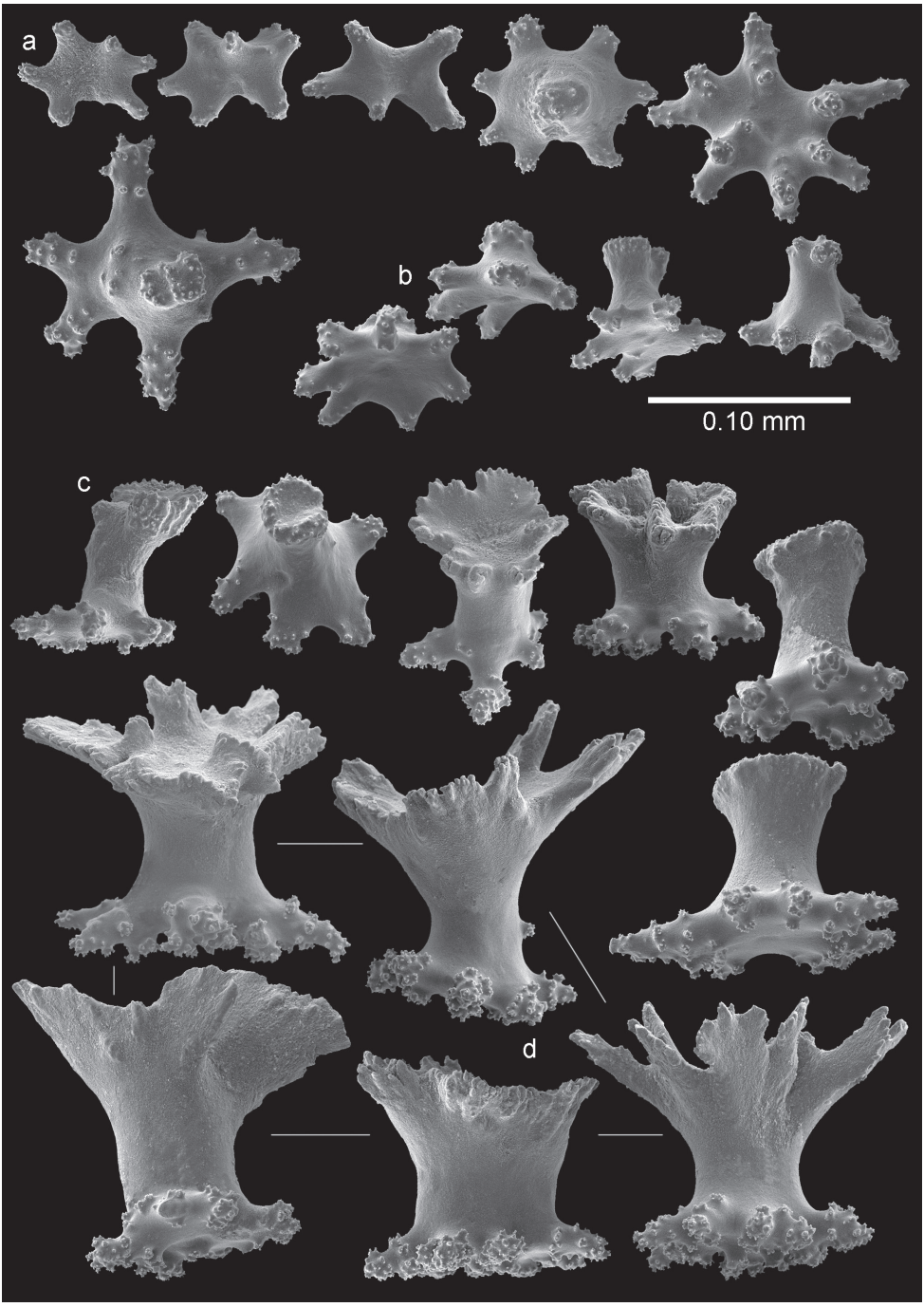

Figure 10. *Bebryce satsumaensis* sp. n., holotype (RMNH Coel. 42077) **a** 3–6 rayed stellate plates of deeper layer of coenenchyme **b–d** rosettes of outer surface of coenenchyme.

China Sea, 31°54.61'N, 128°19.56'N, – 31°54.64'N, 128°19.41'E, depth range 200–210 m , *RV Tanisei-maru*, KT08-3(Oji leg), st. GT02(2), ORI-TI chain bag dredge, coll. A.K. Matsumoto, 7 March 2008.

Description. The holotype RMNH Coel. 42077 consists of a sparsely branched colony about 5 cm long and a few loose branches (Figure 2e). The calyces are placed spirally all around the slender branches, which are about 1 mm wide. The dome-shaped calyces are about 1 mm wide and high.

The anthocodiae are armed with a crown and points consisting of a transverse crown with curved, rather smooth spindles up to 0.45 mm long (Figure 9a) and eight points formed by spindles 0.3 mm long (Figure 9b) placed in a chevron-like pattern beneath the tentacles. These spindles have simple tubercles and a distal spiny end. The tentacles contain flattened, dragon wing sclerites up to 0.2 mm long (Figure 9c).

The sclerites of the outer surface of coenenchyme and calyces are rosettes consisting of a cup-shaped thorny projection arising from a warty base. Several, about 0.15 mm tall, have a widely flared calyx part about 0.15 mm in greatest diameter with slightly serrated rim with some spines, joined by a smooth, slender stem to a warty base narrower than the calyx (Figures 9e, 10d). Others have a less serrated rim which does not flare out (Figure 10c). Toward the calycular apertures the rosettes become asymmetrical (Figure 9d), with the margin of the calyx becoming much elongated, forming a blade-like process that projects from the surface and surrounds the calycular aperture. These sclerites are up to 0.25 mm long.

The deeper layer of coenenchyme contains stellate plates, 4–6 rayed forms up to 0.10 mm in the greater diameter, with a central process (Figure 10a). Stellate sclerites with a prominent, thorny central process, intermediate in form between the cup-shaped outer forms and the stellate plates of the deeper coenenchyme are not uncommon (Figure 10b).

Colour. The holotype is brown.

Etymology. Named after the type locality, Satsuma (old name of Kagoshima prefecture).

Comparisons. The rosettes with weakly serrate rim and few spines are unique for this species within the genus. *B. brunnea* (Nutting, 1908) and *B. cofferi* Bayer and Ofwegen, 2016 resemble this species but have rosettes with more serrate rim.

Remarks. ZMUC-ANT-000645 (ZMUC 120604-39) was listed as ?*Bebryce* sp. in Matsumoto 2014.

The species occurs in South Japan up to Sagami Bay, in the depth range 100–210 m.

Bebryce studeri Whitelegge, 1897

Figures 1, 11

Material examined. AKM1280, off Kerama Is., Okinawa Prefecture, Japan, East China Sea, 26°04.59'N, 127°27.70'E – 26°04.56'N, 127°27.95'E, depth range 153–160 m, *RV Tansei-maru*, KT08-33 cruise (Oji leg), KR-7, chain bag dredge, coll.

Figure 11. *Bebryce studeri* Whitelegge, 1897 **a** AKM1280 **b** UMUTZ-Cnid G103. Scales: 1 cm.

A.K. Matsumoto, 16 December 2008; UMUTZ-Cnid G103, coral ground, Uji Is., Satsuma, Kanogshima Prefecture, Japan, depth ca. 80 fms (114–121 m), coll. K. Kinoshita, June 1908.

Diagnosis. *Bebryce* with rosettes with warty, rounded, or bristle-like projections. Those of calycular margin asymmetrically developed, with weakly developed projecting blade. Coenenchymal sclerites are warty disks.

Remarks. This is the first record of this species for Japan, where it is limited to the South of Japan, East China Sea. The depth record of previous studies is 23–113 m, from Funafuti, New Caledonia, Indonesia, Philippines, and Papua New Guinea (Bayer and Ofwegen 2016). This study recorded a deeper depth range, namely 114–160 m.

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RESEARCH ARTICLE

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A new termite (Isoptera, Termitidae, Syntermitinae, *Macuxitermes*) from Colombia

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Abstract

A new species of termite, *Macuxitermes colombicus* Postle & Scheffrahn is described from soldiers and workers collected from Departamento Magdalena, Colombia. The soldier of *M. colombicus* differs from its lone congener in having no protuberances on the head capsule.

Keywords

Isoptera, Termitidae, Syntermitinae, *Macuxitermes colombicus*, Colombia, new species, taxonomy

Introduction

The Neotropical subfamily Syntermitinae (Isoptera: Termitidae)—"the mandibulate nasutes"—is composed of 18 genera whose distribution ranges from southern Mexico to northern Argentina. The most diagnostic character of the subfamily is, as the name suggests, soldiers that possess a nasus in addition to well-developed mandibles. The component genera vary widely in the length of the nasus, with *Syntermes* spp. and *Labiotermes* spp. having the shortest and some *Rhynchotermes* spp. the longest nasus relative to head capsule proportions (Constantino and Carvalho 2011, Rocha et al. 2011, Fontes 1985), and two genera (*Macuxitermes* and *Rhynchotermes*) have species with major and minor soldiers; nevertheless, the monophyly of the subfamily is retained throughout (Inward et al. 2007, Noirot 2001).

Within the Syntermitinae, the three monotypic genera *Macuxitermes*, *Noirotitermes*, and *Acangaobitermes* form a small monophyletic group (Rocha et al. 2012). Based on original descriptions, this conclusion may seem unlikely. The soldiers of *Macuxitermes* are dimorphic, although the minor soldiers may be quite rare, while those of *Noirotitermes* and *Acangaobitermes* are monomorphic. *Noirotitermes* has prominent spine-like protuberances towards the posterior margin of the head capsule: the head capsules of *Macuxitermes* and *Acangaobitermes* lack such protuberances. *Macuxitermes* and *Acangaobitermes* soldiers possess a relatively long, slender nasus while that of *Noirotitermes* is short and broad. The pronotum of the former two genera is more-or-less saddle-shaped, yet has a clover-like appearance in *Noirotitermes*. Furthermore, the lateral margins of the thoracic nota of both major and minor *Macuxitermes* soldiers are adorned with short dark, stout spines which are absent in *Noirotitermes* and *Acangaobitermes*. Nevertheless, the group is distinguished by having soldiers with characteristic minute granulations on the surface of the head capsule, which are absent in all other Syntermitinae, and slender, sickle-shaped, piercing mandibles with a sharply pointed, marginal tooth.

There are also differences between the workers. The morphology of the mandibles—including the absence of ridges on the molar plates—and relative dimensions of the digestive tube are essentially the same among the three taxa; however, *Macuxitermes* workers are large and robust, while those of the other two genera are small, slender, and elongate. Only *Macuxitermes* workers have notal spines (similar to those of the soldiers). In all three genera, the digestive tube displays the complete dorsal torsion as defined by Noirot (2001), while the components are of very similar disposition and relative proportions. However, although the enteric valves share an almost identical shape, the arrangement and structure of the spines in *Macuxitermes* differs from that of *Noirotitermes* and *Acangaobitermes*.

Genera of Syntermitinae exhibit a wide variety of nest-building behaviour (Constantino 1991, Emerson 1952, Emerson and Banks 1965, Fontes 1985, Redford 1984, Scheffrahn 2010, Snyder 1922). Some build epigeal mounds (*Cornitermes* and *Embiratermes* spp.) or arboreal carton nests in rotten wood or tree stumps (*Labiotermes* spp., *Silvestritermes holmgreni* (Snyder)), while some, including species of *Cyrilliotermes* and *Curvitermes*, live in abandoned nests of other termite species or as inquilines. *Labiotermes longilabius* (Silvestri) builds "underground nests lined with blackish carton" (Silvestri 1903, cited in Emerson and Banks 1965) or "ladder" nests up the sides of trees. Other species construct diffuse underground nests and galleries e.g. *Rhynchotermes bulbinasus* Scheffrahn. The *Macuxitermes* group seems to fall into the latter category, although Rocha et al. (2012) suggest that these may also be mound inquilines of other species.

Material and methods

Specimens of *Macuxitermes colombicus* sp. n. were collected in Departamento Magdalena, Colombia, on 3 JUN 2009. Images of preserved specimens in 85% ethanol were made using an Olympus SZX9 stereomicroscope fitted with a LM Scope camera tube

to an Olympus E-410 digital camera. Specimens were suspended in Purell® Instant Hand Sanitizer for transparent posturing support during photography. Enteric valve slide images were taken with an Olympus BH-2 compound microscope fitted with phase contrast optics. The entire worker P2 region was removed by micro-dissection and external muscle detached. Food particles were removed from enteric valve armature using an ultrasonic cleaner. The cleaned enteric valve was longitudinally cut, splayed open, and mounted on a microscope slide using PVA medium (BioQuip Products Inc.). External morphological terminology follows that of Roonwal (1969) and internal anatomical terminology that of Noirot (2001).

Taxonomic treatment

Macuxitermes Cancello & Bandeira

Description. The genus *Macuxitermes* was erected for a single species, *Macuxitermes triceratops* Cancello & Bandeira, 1992. Their generic description is modified below to include *M. colombicus*.

Soldier. Dimorphic or monomorphic.

Major soldier. Head capsule evenly rounded or with a dorsal elevation and anterior protuberance either side of the midline, entire surface covered with minute granulations. Anterior of head capsule narrows to form a robust conical nasus whose apex extends far beyond tips of mandibles; nasus well separated from mandibles in lateral view, conical, gradually tapering to apex; without setae but terminating in a circular fontanelle, the opening of which is surrounded by numerous short hairs; mandibles curved strongly inwards, apices directed laterally at rest and not upturned, each mandible with a pointed marginal tooth half-way along inner surface; width of labrum greater than length; antennae yellow with 15 articles, I largest and III shortest; rows of dark short, tooth-like spines along the margins of the thoracic nota.

Minor soldier. Known only in *M. triceratops*. See Cancello and Bandeira (1992) for description.

Worker. Detailed description in Cancello and Bandeira (1992) is congruent with *M. colombicus*.

Addenda: left mandible with all three marginal teeth clearly visible, molar plates with no ridges; digestive tube showing complete dorsal torsion and with small crop, long and inflated mixed segment that is proximally narrow and broadly oval distally, very large and voluminous P1 and relatively smaller P3 (with diverticulum), long P4 and large P5; two pairs of Malpighian tubules, each pair joining alimentary canal separately at junction of midgut and hindgut; enteric valve narrow, on the left posterior side of the abdomen, with three finger-like cushions each bearing two rows of regularly spaced long, narrow, straight or slightly curved spines of equal length throughout; ridges separated by pads composed of a single layer of squamous cells, each with a central, slightly raised spine marginally shorter in length than spines on cushion.

***Macuxitermes colombicus* Postle & Scheffrahn, sp. n.**
http://zoobank.org/6F05594E-14EB-4762-9E90-B3A16D7D32B8
Figs 1–8

Material examined. Holotype. Soldier. Labelled "(UF code CO442) Colombia, Depto. Magdalena, Ciénaga de Ortiz, 10.15187 –75.04366, 3JUN2009, col. SBC-MKSN". The holotype is kept in the same vial as the paratypes.

Type locality. COLOMBIA. Elevation 44 m

Paratypes. One soldier and 12 workers. The material examined was hand-collected by John R. Mangold. The type and paratypes are deposited in the University of Florida Termite Collection (Ft. Lauderdale Research and Education Center, Davie, Florida).

Etymology. The species name is derived from the latinization of Colombia, the type country.

Habitat and biology (Fig. 8). Foragers were collected under a tree branch that had recently fallen in a cattle pasture. The wood had not been attacked, suggesting that this termite is probably a soil feeder.

Description. Winged imago. unknown.

Minor soldier. unknown.

Major soldier (Figs 1, 2, 8). Monomorphic. Head capsule with characteristic microsculpture and with a few long, pale setae on posterior margin; in profile, nasus at an angle of 45 degrees to inferior angle of head capsule but slightly convergent with plane of mandibles; fronto-clypeal region slightly inflated, length less than one-third width, distal margin hyaline, postclypeus with transverse rugulae; labrum broader than long, with convex sides and rounded apex, distal margin hyaline; postmentum very short; mandibles not upturned apically, marginal teeth tapering distally to a sharp point which is directed anteriorly; antennae yellow with 15 articles, 1>2>3=4=5.

Pronotum narrower than head, anterior lobe longer than broad, arising very steeply from posterior lobe so that it is positioned like a brace under the posterior margin of the head capsule, posterior lobe more than twice as broad as long, lateral and posterolateral margins with numerous dark short, tooth-like spines; lateral margins of meso- and metanotum with similar spines. Legs slender with irregularly spaced long, pale, fine, erect setae on femora, tibiae and tarsi, fore-coxae ridged but with no projecting keel, fore-tibiae slightly inflated, fore- and mid-coxae with two short, dark, stout distal spines on inner ventral surface near junction with trochanter; tibial spur formula 2: 2: 2. Abdominal tergites and sternites with numerous, closely packed, long and short pale, erect setae.

Measurements – mean and range in mm (n=2): head length with nasus: 2.30 (2.20–2.40), head length to base of mandibles: 0.96 (no range), maximum head width: 1.36 (1.32–1.40), maximum pronotal width: 0.82 (0.80–0.84), length of hind tibia: 1.17 (1.16–1.18).

Worker (Figs 3–8). Monomorphic. Body slightly smaller than that of the soldier. Fig. 8 shows workers and soldier to have exceptionally contrasting coloration between the abdomen (very dark) and thorax (very pale). Head rounded, with scattered long,

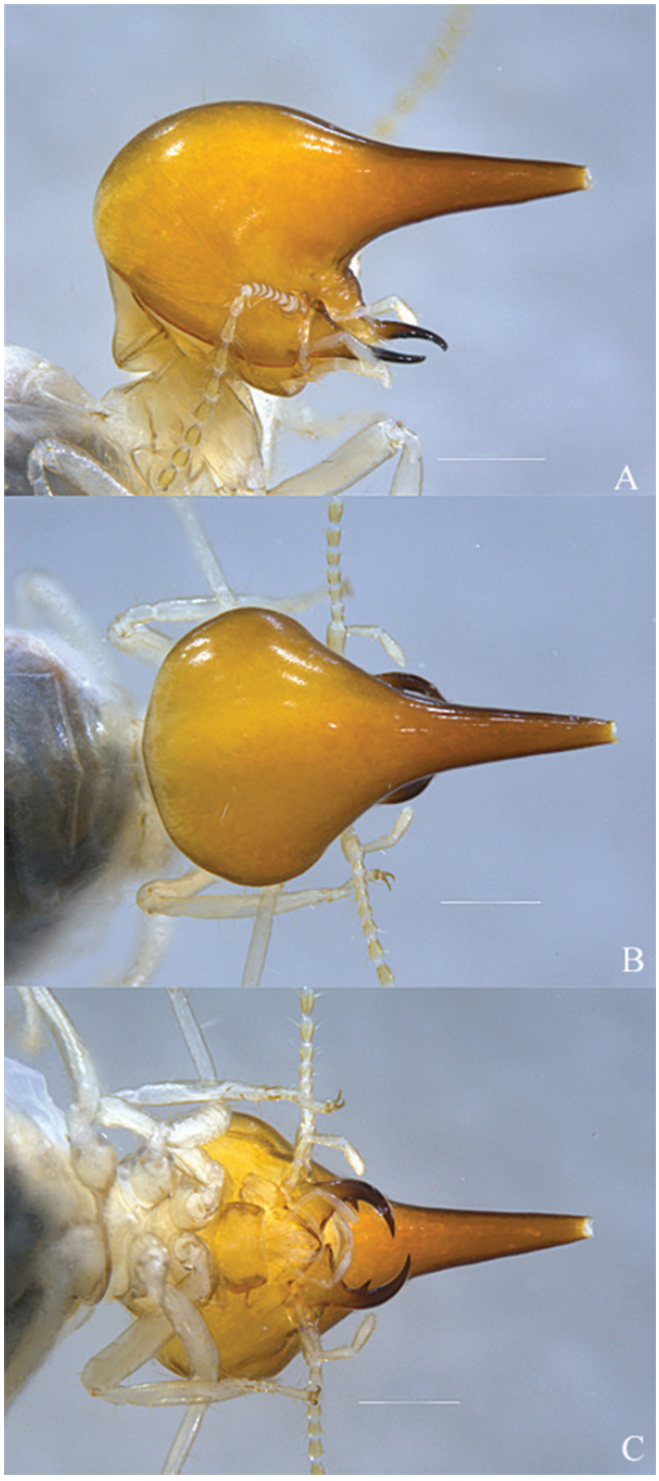

Figure 1. *Macuxitermes colombicus* soldier. **A** lateral **B** dorsal and **C** ventral views of head. Scale: 500 μm.

Figure 2. *Macuxitermes colombicus* soldier. **A** posterolateral and **B** anterolateral views of head capsule showing surface pitting. Scale: 500 μm.

Figure 3. *Macuxitermes colombicus* worker. **A** dorsal **B** lateral (right) **C** ventral, and **D** lateral (left) views. Is, Isthmus; MS, Mixed segment, P1, P2, P3, P4 and P5 proctodeal segments 1-5, respectively. Scale: 1mm.

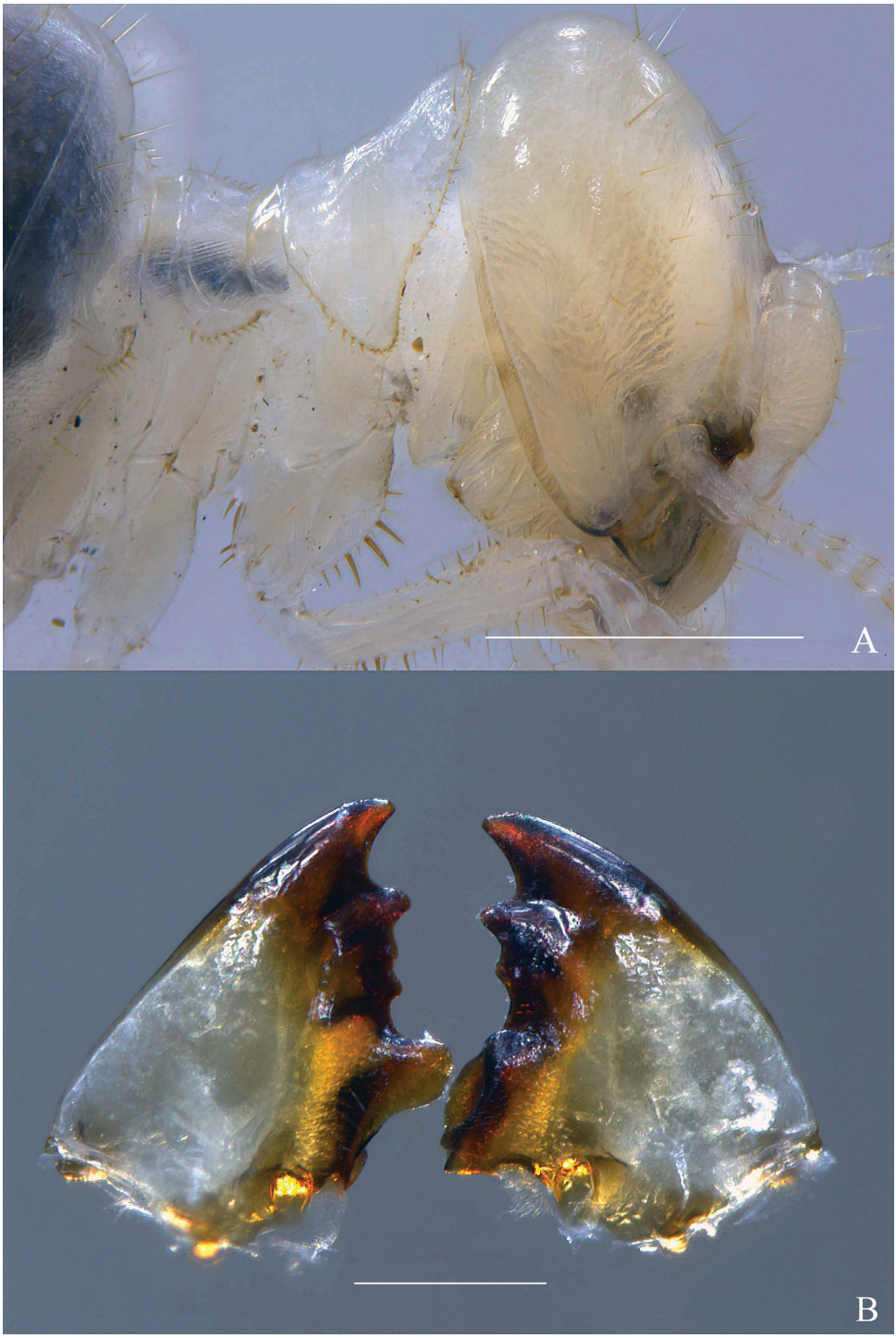

Figure 4. *Macuxitermes colombicus* worker. **A** head and thorax **B** mandibles (somewhat worn). Scale: 500 μm (**A**), 200 μm (**B**).

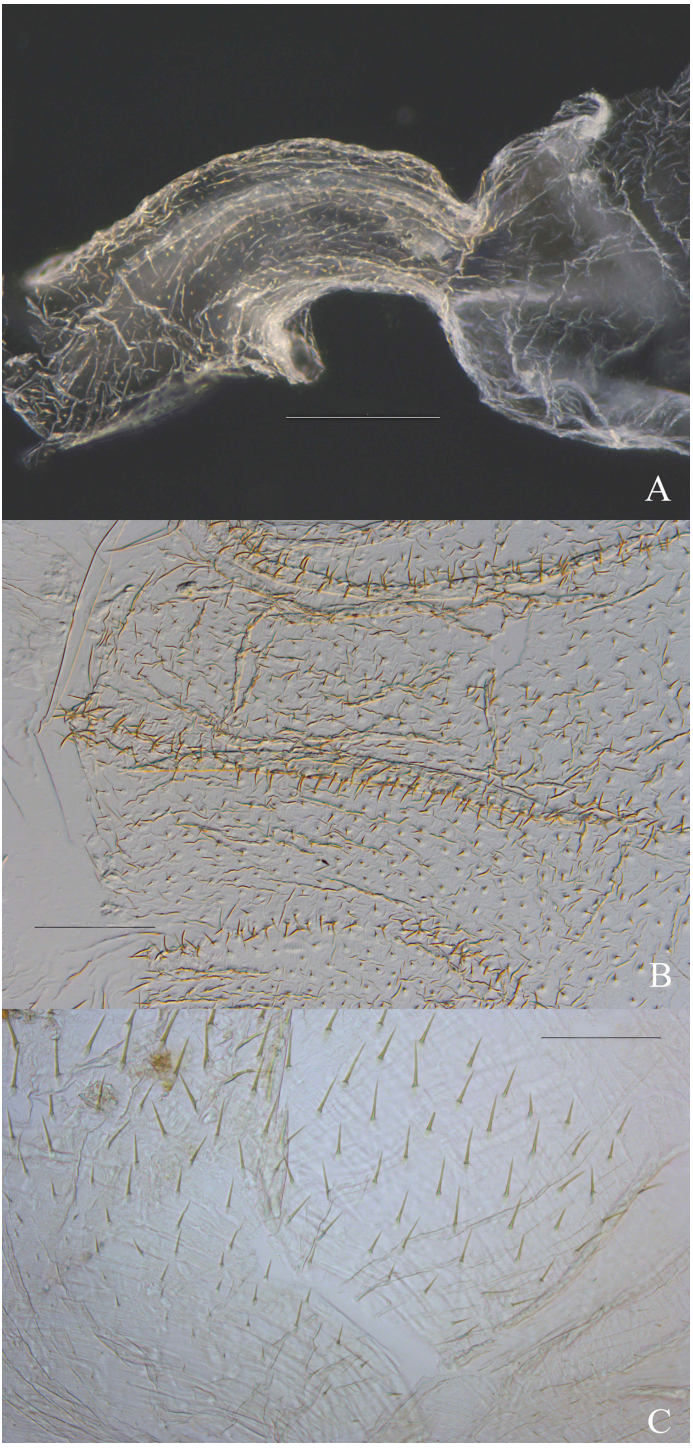

Figure 5. *Macuxitermes colombicus* worker. **A** P2 and connection with P3 **B** enteric valve ridges, and **C** aciculiform spines near junction of P1 and mixed segment. Scale: 200 μm (**A**), 100 μm (**B, C**)

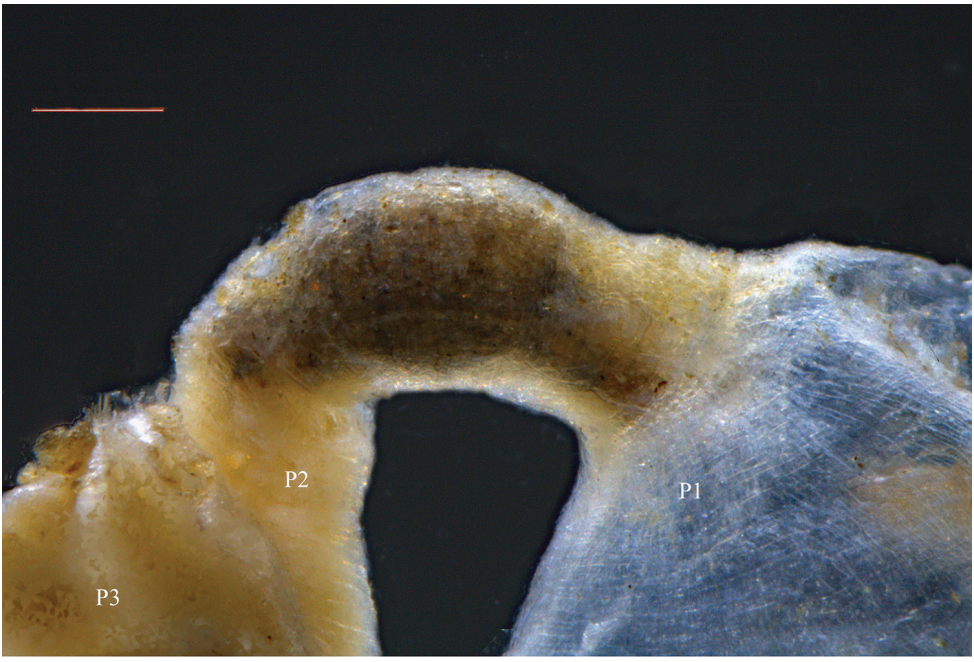

Figure 6. *Macuxitermes colombicus* worker alimentary canal showing P2 at junction of P1 and P3. Scale: 100 μm.

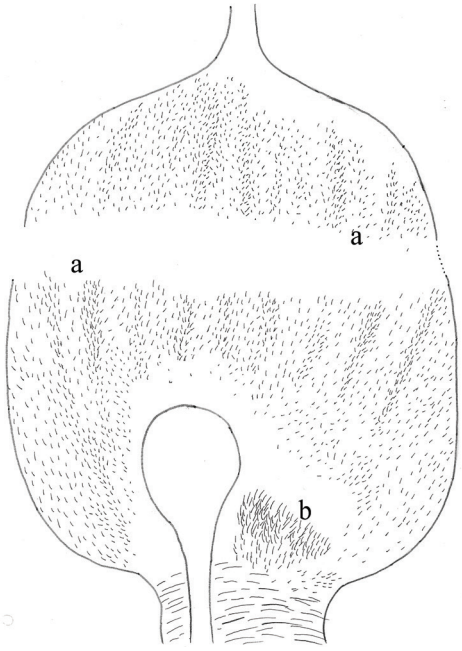

Figure 7. *Macuxitermes colombicus* worker alimentary canal: schematic drawing of P1 showing position and arrangement of **a** short inner-surface spines and **b** aciculiform spines.

Figure 8. *Macuxitermes colombicus* type locality and live workers and soldier habitus (inset).

pale, fine, erect setae; postclypeus strongly inflated, labrum with two long erect setae either side of midline; both mandibles with apical tooth longer than marginal teeth, inner margin of each apical tooth slightly concave and longer than the anterior margin of the first marginal tooth, second marginal tooth small but distinct, molar plates with no obvious ridges; left mandible with posterior margin of first marginal tooth slightly concave, second marginal tooth slightly smaller than and well separated from third marginal tooth, molar plate clearly visible although covered by molar process which projects beyond apex of third marginal tooth; right mandible with second marginal tooth much smaller than first but evident, posterior margin of first marginal tooth concave, posterior margin of second marginal tooth concave to molar plate which is very reduced and anterior to molar process; antennae with 15 articles, basal articles pale yellow, distal five-seven articles darker yellow.

Pronotum narrower than head, anterior lobe as in soldier, much longer than broad and rising at a very steep angle (>80 degrees) from the posterior lobe, about as long as broad; anterior margin with a row of long, pale, erect setae interspersed with smaller setae, posterior lobe short and broad; lateral and postero-lateral margins of pronotum and lateral margins of meso- and metanotum with numerous short, dark, serrations or tooth-like spines. Legs slender with numerous long, pale, erect setae on femora, tibiae and tarsi, a few prominent dark spines on anterior and inner ventral surfaces of fore-

coxae and basal region of fore-femora, shorter, irregularly spaced shorter dark spines elsewhere on these segments, fore-coxae ridged but with no projecting keel, fore-tibiae slightly inflated, a ventral row of longer dark spines, along with a few scattered, much shorter dark spines on distal half; tibial spur formula 2: 2: 2. Tergites and sternites with numerous closely packed, long and short pale, fine, erect setae.

Digestive tube almost identical to that of *M. triceratops* as depicted in Constantino (1997) (See generic description for details). The cross-section of the gizzard resembles very closely that of *Cornitermes cumulans* (Kollar) as illustrated in Noirot (2001), in possessing a well-sclerotized columnar belt and a lightly sclerotized pulvillar belt. The pulvilli appear to lack spines. The internal ornamentation of P1 is similar to that of *M. triceratops* as illustrated by Rocha and Constantini (2015) but the arrangement of the proximal aciculiform spines is different.

Measurements – mean and range in mm (n=12): head length with nasus/mandibles: 1.34 (1.28–1.44), head length to base of mandibles: 0.86 (0.84–0.92), maximum head width: 1.09 (1.04–1.12), maximum pronotal width: 0.62 (0.56–0.64), length of hind tibia: 1.06 (1.04–1.12).

Discussion

The new species was assigned to *Macuxitermes* after careful assessment and consideration of the morphological and anatomical data that have been assembled and reported on the component genera of Syntermitinae. Like *M. triceratops*, the head capsule of the soldier is endowed with fine microsculpture on the surface and the soldier and worker castes have notal spines, while the mandibles, mesenteric tongue and enteric valve of the workers match the descriptions of these structures in this species. However, several of these features are also found in members of the genus *Armitermes s. s.*. Our species does in fact resemble *Armitermes* and differs conspicuously from *M. triceratops* in its appearance. The mandibles in the major soldier are less robust than those of *M. triceratops* and the postmentum, although very short, is not noticeably inflated. The profile of the nasus is straight rather than curved and the head capsule lacks the anterior processes of *M. triceratops* plus the occipital protuberances which are a feature of other members of the *Macuxitermes* group (Rocha et al. 2012). Furthermore, *M. colombicus* might not have minor soldiers.

Nevertheless, this termite does not fit readily into *Armitermes* either. The shape of the head capsule of the soldier differs from those of the three known species of *Armitermes*; nor is the minute pitting that covers its surface a characteristic of the latter. The labrum of *M. colombicus* soldiers is broadly rounded, while the mandibles have a distinctly different configuration from those of *Armitermes* spp.. As stated, *Macuxitermes* does share with *Armitermes s. s.* the presence of notal spines in both soldiers and workers but this is not considered evidence of close relationship (Constantino 1997, Rocha et al. 2012). In addition, the notal spines on the new species are far more numerous and extensive than in *Armitermes* and the bristles of the pro-, meso- and metanotum of

the soldier, reported by Rocha et al. (2012) as definitive of this genus, are lacking. In the worker, there is a greater degree of pilosity and the enteric valve is different from the type diagnostic of *Armitermes* spp.

Rather than create a new genus, the authors therefore place this species in *Macuxitermes* to which it seems to have the greatest affinity. As well as the previously listed similarities, it has the following in common with *M. triceratops*. Although worn down to some degree in all specimens examined, the second marginal tooth in the worker is reduced but distinct on both mandibles. Thus, all three marginal teeth are clearly visible on the left mandible. For consistency, the term "first-plus-second marginal tooth" should perhaps be retained for the left mandible, although the degree of fusion seems much less than in other genera and species of the sub-family.

The enteric valve of the worker very closely resembles that of *M. triceratops*. It is also very similar in appearance and constitution to those of *Noirotitermes*, *Acangaobitermes*, *Embiratermes*, *Ibitermes*, and *Uncitermes* (Constantino 1997, Cancello and Myles 2000, Rocha et al. 2012). However, it differs from these in having spines of equal length on the finger-like ridges, rather than spines that increase in length distally. The ridges in *Ibitermes* are also slightly dilated apically. Thus, the composition of the enteric valve may also be a diagnostic feature of *Macuxitermes*.

The absence of pulvillar spines as a generic feature is yet to be determined. Although pulvilli are described as "lacking armature or ornamentation" in *Acangaobitermes* (Rocha et al., 2011), the presence or absence of such is not reported for *M. triceratops* (Constantino 1997) or *Noirotitermes* (Cancello & Myles, 2000). Because of the apparent close similarity in appearance between the structure of the gizzard in *M. colombicus* and *C. cumulans*, it would be of interest if further studies could reveal the degree of uniformity of the gizzard's musculature and cuticular armature throughout the sub-family, however.

It is possible that DNA analyses may provide greater insight into the relationship of *M. colombicus* with its congener. It is also possible that future field studies may yield further specimens of the species, including minor soldiers, thereby confirming its current taxonomic status. Until then, its placement in the genus *Macuxitermes* is in concordance with the available data.

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An annotated checklist of Microweiseinae and Sticholotidini of Iran (Coleoptera, Coccinellidae)

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Abstract

An updated checklist of the Coccinellidae species of the former subfamily Sticholotidinae recorded from Iran is provided. Eleven species are reported: two species classified presently in the subfamily Microweiseinae (in the genera *Paracoelopterus* Normand, 1936 and *Serangium* Blackburn, 1889), and nine species classified in the tribe Sticholotidini of the subfamily Coccinellinae (in the genera *Coelopterus* Mulsant & Rey, 1852 and *Pharoscymnus* Bedel, 1906). *Pharoscymnus smirnovi* Dobzhansky, 1927 is removed from the list of the Coccinellidae of Iran. Distribution of species in Iranian provinces is presented. Data concerning their host plants along with their prey species are also included when known. Morphological features of two rarely collected and poorly known species of Iranian fauna, *Pharoscymnus brunneosignatus* Mader, 1949 and *P. pharoides* (Marseul, 1868) are diagnosed and illustrated.

Keywords

Coccinelloidea, distribution, host plants, Microweiseinae, prey species, Sticholotidini, updated checklist

Introduction

The family Coccinellidae with approximately 6000 species and 360 genera was classified until recently in the superfamily Cucujoidea (Coleoptera, Polyphaga) and placed in the Cerylonid Series, a derived clade formed by Cerylonidae and eight other families of Cucujoidea (e.g. Crowson 1955; Lord et al. 2010). The most recent molecular research by Robertson et al. (2015) revealed, however, the Cerylonid Series as monophyletic group sister to the remaining Cucujiformia, not allied with any superfamily of the Cucujiformia including the remaining Cucujoidea. For these families, Robertson et al. (2015) established a new superfamily Coccinelloidea.

Most of the standard classifications of Coccinellidae (Sasaji1968, 1971, Gordon 1985, Kovář 1996, Vandenberg 2002) recognized six or seven subfamilies (Coccinellinae, Coccidulinae, Scymninae, Chilocorinae, Epilachninae, Sticholotidinae and, sometimes, Ortaliinae) with numerous tribes within each subfamily. Ślipiński (2007) found these classifications as phylogenetically unacceptable and argued the basal split of Coccinellidae into two subfamilies Microweiseinae and Coccinellinae comprising all the remaining coccinellid groups.

This split of the family was confirmed by subsequent molecular and combined molecular and morphological research (Robertson et al. 2008; Giorgi et al. 2009, Seago et al. 2011, Robertson et al. 2015). But Nedvěd and Kovář (2012) incorporated some results of recently published molecular and morphological research, and proposed nine subfamilies and 42 tribes.

Small and the least apparent members of Coccinellidae were historically placed in the subfamily Sticholotidinae described by Weise (1901) and redefined by Sasaji (1968, 1971). Sticholotidinae (*sensu* Sasaji 1968) contained four tribes: Sticholotidini Weise, Shirozuellini Sasaji, Serangiini Blackwelder and Sukunahikonini Kamiya (Vandenberg and Perez–Gelabert 2007) and was defined primarily by the presence of a narrow and apically pointed terminal maxillary palpomere and a narrow junction between mentum and submentum. However, subsequently included tribes Limnichopharini Miyatake, Argentipilosini Gordon and Almeida, Plotinini Miyatake, Cephaloscymnini Miyatake and Carinodulini Gordon, Pakaluk and Ślipiński, with the terminal maxillary palpomere paralel sided, distally expanded or even securiform, made this group taxonomically heterogenous.

Kovář (1996) in a comprehensive classification of Coccinellidae divided Sticholotidinae into ten tribes without providing any basis for the monophyly of this subfamily. It was later recognized as polyphyletic group (Duverger 2003, Ślipiński and Tomaszewska 2005, Vandenberg and Perez-Gelabert 2007). Ślipiński (2007) proposed the formal classification of Coccinellidae with Microweiseinae containing Sukunahikonini, Microweiseini, Serangiini and Carinodulini, while placed remaining tribes of the former Sticholotidinae (Shirozuellini, Limnichopharini, Argentipilosini, Cephaloscymnini, Plotinini, Sticholotidini) in a redefined subfamily Coccinellinae. Nedvěd and Kovář (2012) in their classification placed these tribes in the narrowly defined subfamily Sticholotidinae.

After the split of former Sticholotidinae, research conducted so far revealed well defined Microweiseinae. This subfamily contains now three tribes (Microweiseini in-

cluding Sukunahikonini, Serangiini and Carinodulini) and is well defined by a set of morphological characters: antenna inserted in front of eyes, often separated from eyes anteriorly, antennal insertions exposed and close together, clypeus well developed and emarginate around antennal insertions, subgena with glandular openings, mandible simplified with single apical tooth and no mola; ventral mouthparts retracted causing unusual projection of genae into a frame enclosing strongly elongate maxillae and labium; male genitalia with asymmetrical tegmen (Escalona and Ślipiński 2012). The remaining tribes of former Sticholotidinae either together or most tribes separately do not form clearly defined taxonomic entities and need more study. The geniculate maxillary palps with terminal maxillary palpomere pointed, bearing long oblique sensory area and compact antenna with spindle-shaped club bearing group of short sensory setae on the terminal antennomere were listed as characters for subfamily Sticholotidinae by Nedvěd and Kovář (2012). To date, these tribes are treated as a widely conceived tribe Sticholotidini in the widely conceived subfamily Coccinellinae (Ślipiński 2007).

The recent checklist of Coccinellidae of Iran provided by Moddarres-Awal (2012) included 125 species of which only seven species belong to the subfamily Sticholotidinae *sensu* Sasaji (1968) and Kovář (1996): *Diloponis fuerschi* Yazdani & Ahmadi, 1992, *Pharoscymnus arabicus* Fürsch, 1979, *Pharoscymnus flexibilis* (Mulsant, 1853), *Pharoscymnus ovoideus* Sicard, 1929, *Pharoscymnus pharoides* Marseul, 1868, *Pharoscymnus setulosus* (Chevrolat, 1861), *Serangium montazerii* Fürsch, 1995.

The current study was inspired by a collection of the new material of species belonging to the former Sticholotidinae and was aimed to update the information on the current classification, occurrence, host plants and the prey of species of this group in Iran. Similar studies on other, more speciose, tribes of the family will follow.

Material and methods

The study area in Iran is located in southwest of Asia in the Middle East region. More than half of the country's land is arid or semi-arid; almost one third of the country is mountainous and a small part contains fertile plains. In winter, the temperature difference between the coldest and warmest place may exceed 50 °C. Precipitation in Iran is highly variable, from more than 2000 mm of rain a year in north to less than 15 mm in desert areas.

The arrangements of tribes, genera and species are listed alphabetically for convenience, according to classification of Seago et al. (2011). The geographical distribution, host plants and prey species are given for all the species based on literature and labels of the museum specimens examined by the first author and on personal observations of authors. The geographical distribution therein also is arranged according to the year of record publication and in alphabetical order.

Identification of *Pharoscymnus pharoides* (Marseul, 1868) was based on the original description of Smirnoff (1956a). Specific terminology used in morphology of Coccinellidae follows Ślipiński (2007) and Ślipiński and Tomaszewska (2010).

New specimens examined were collected in 2013 and 2014 in different parts of Iran, and are deposited in Plant Protection Department, Lorestan University, Agricultural faculty, Khorramabad, Iran and Gorgan University of Agricultural Sciences and Natural Resources, Iran.

Results

This checklist includes eleven species of the Sticholotidinae *sensu lato*. According to the current classification of Coccinellidae, two species belong to the subfamily Microweiseinae (to the tribes Microweiseini and Serangiini) and nine species to the tribe Sticholotidini of the subfamily Coccinellinae. *Pharoscymnus smirnovi* Dobzhansky, 1927, which was first recorded by Zare Khormizi (2014) from Iran, was removed from the list of Iranian coccinellids after re-examination of the specimens, as they appeared to be misidentified. For *Pharoscymnus pharoides* (Marseul, 1868) new locality in Iran (Lorestan province) and new host plants (pine, walnut and hawthorn trees) are recorded.

The updated list of the species is as follows:

Subfamilly Microweiseinae Leng, 1920
Tribe Microweiseini Leng, 1920
***Paracoelopterus* Normand, 1936**

***Paracoelopterus berytensis* (Weise, 1884)**

(= *Diloponis fuerschi* Yazdani & Ahmadi, 1992)

General distribution. Greece, Israel, Iran, Lebanon, Morocco, Tunisia (Kovář 2007).

Distribution in Iran. Fars, Sistan and Baluchestan (Ahmadi and Yazdani 1993; Moddarres-Awal 2012).

Host plants and prey species in Iran. This species has been collected from almond, ash, date palm, willow and wild pistachio as the predator of Hemiptera, Diaspididae: *Chionaspis salicis* (Linnaeus), *Lepidosaphes malicola* Borchsenius, *Melanaspis inopinata* (Leonardi), *Parlatoria blanchardi* Targioni Tozzetti, *Pistaciaspis pistaciae* Borchsenius, *P. pistacicola* Borchsenius, *Tecaspis asiatica* Bazarov (Moddarres-Awal 2012).

Tribe Serangiini Blackwelder, 1945
***Serangium* Blackburn, 1889**

***Serangium montazerii* Fürsch, 1995**

General distribution. France, Georgia, Israel, India, Iran, Pakistan, Syria (Kovář 2007).

Distribution in Iran. Gilan, Golestan, Mazandaran, Zanjan (Fürsch 1995; Hajizadeh et al. 2003; Moddarres-Awal 2012).

Host plants and prey species in Iran. This species has been collected from citrus, olive, pomegranate and *Salvia* as the predator of *Euphyllura olivina* (Costa) (Hemiptera, Psyllidae) (Hajizadeh et al. 2003; Moddarres-Awal 2012).

Subfamilly Coccinellinae Latreille, 1807
Tribe Sticholotidini Weise, 1901
***Coelopterus* Mulsant & Rey, 1852**

***Coelopterus salinus* Mulsantand Rey, 1852**

General distribution. Somalia, Syria (Plaza 1986), Algeria, France, Italy (Sardinia), Iran, Morocco, Portugal, Spain, Tunisia (Kovář 2007), The United Arab Emirates (Raimundo et al. 2008).

Distribution in Iran. Iran (Kovář 2007) – no specific distribution known.

Remarks. This species is known to be present in *Salicornia* habitats periodically inundated by sea water (Canepari 2010).

***Pharoscymnus* Bedel, 1906**

***Pharoscymnus angohranensis* Duverger, 1983**

General distribution. Iran (Kovář 2007).

Distribution in Iran. Hormozgan (Duverger 1983).

***Pharoscymnus arabicus* Fürsch, 1979**

General distribution. Iran, Saudi Arabia, The United Arab Emirates (Kovář 2007).

Distribution in Iran. Fars, Gilan (Moddarres-Awal 2012).

Host plants and prey species in Iran. This species has been collected from date palm as the predator of *Parlatoria blanchardi* (Hemiptera: Diaspididiae; Yazdani 1990; Moddarres-Awal 2012).

***Pharoscymnus brunneosignatus* Mader, 1949**
Figure 1

Material examined. Iran, North Khorasan Prov., Baba Aman (37°29'34"N 57°26'19"E), Tamarisk, iv.2013, lgt. et coll. Hamidi, det. Nedvěd and Canepari.

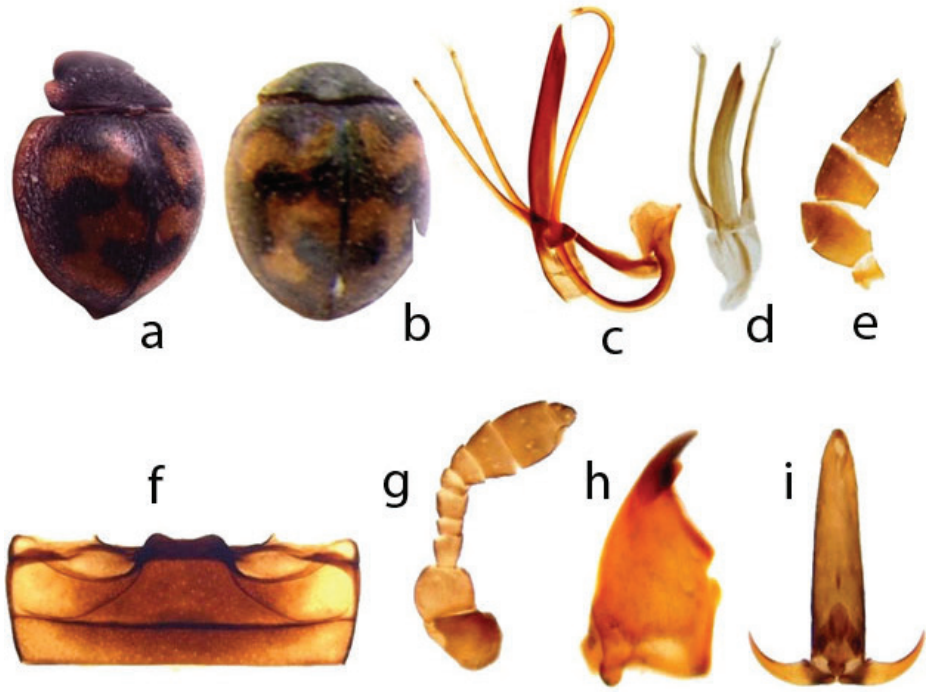

Figure 1. *Pharoscymnus brunneosignatus*. **a, b** dorsal view at various angles **c** aedeagus **d** tegmen **e** maxillary palp **f** abdominal ventrites 1–2 **g** antenna **h** mandible, **i** terminal tarsomere and claws.

Diagnosis. Body length 2.1 mm. Dorsal surface black and setose with orange, transverse bands of irregular shape on elytra (Fig. 1 a, b); head, antennae and mouthparts dark brown (Fig. 1a, e, g, h). Male genitalia with penis strongly curved near base and before apex – in form of question mark (Fig. 1 c); tegminal strut about as long as basal piece, parameres slender, nearly as long as penis guide (Fig. 1c, d).

General distribution. China, Mongolia (Kovář 2007), Iran (Ebrahimi et al. 2014).

Distribution in Iran. North Khorasan, Khorasan Razavi (Ebrahimi et al. 2014; Nedvěd et al. unpublished).

Pharoscymnus fleischeri (Weise, 1883)

General distribution. Greece, Iran, Turkey (Kovář 2007).

Distribution in Iran. Iran (Kovář 2007) – no specific distribution known.

Pharoscymnus flexibilis (Mulsant, 1853)

General distribution. Afghanistan, India, Iran, Pakistan (Kovář 2007), Oman, Yemen, The United Arab Emirates (Raimundo et al. 2008).

Distribution in Iran. Fars (Moddarres-Awal 2012).

***Pharoscymnus ovoideus* Sicard, 1929**

General distribution. Israel (Halperin et al. 1995), Iran, Jordan, Syria (Kovář 2007), Algeria, Morocco, Tunisia, The United Arab Emirates (Raimundo et al. 2008).

Distribution in Iran. Fars, Gilan, Kerman, Lorestan, Tehran (Hajizadeh et al. 2003; Jafari and Kamali 2007; Abdi et al. 2012; Moddarres-Awal 2012).

Host plants and prey species in Iran. This species has been collected from almond, apple, ash, citrus, conifer trees, oleander, olive, date palm, pomegranate, sloe and willow as the predator of Hemiptera, Diaspididae: *Aonidiella orientalis* (Newstead) and *Parlatoria blanchardi* (Hajizadeh et al. 2003, Jafari and Kamali 2007; Abdi et al. 2012; Moddarres-Awal 2012).

Remarks. This ladybird is one of the most important predators of scale insects, including *Parlatoria blanchardi*, on palm trees (Smirnoff 1956b). This species was imported from Iran to France; after rearing, it was used against *P. blanchardi* in mixed fruit groves of Moritani in 1967 (Iperti 1970).

***Pharoscymnus pharoides* (Marseul, 1868)**
Figure 2 a–h

Material examined. 3 females, 4 males, Iran, Lorestan Prov., Azna Mmyl (33°23'00"N 48°36'05"E), on hawthorn, pine, walnut, iii.2013, lgt. et coll. Biranvand, det. Canepari.

Diagnosis. Body length 1.9 mm. Dorsal surface black and setose with three pairs of orange spots on elytra; head, antennae and mouthparts dark brown; eyes completely visible from dorsal view; coxa, trochanter and basal part of femur black, distal part of femur, tibia and tarsus dark brown (Fig. 2 a–c). Male genitalia with penis weakly curved near base (Fig. 2 d, h); tegminal strut about as long as basal piece, parameres slender and distinctly longer than penis guide (Fig. 2 e–g).

General distribution. Egypt, Iran, Israel, Libya, Syria, Saudi Arabia, Turkey (Kovář 2007).

Distribution in Iran. Chaharmahal and Bakhtiari, Fars (Bagheri and Mosadegh 1997, Moddarres-Awal 2012), Lorestan (current study).

Host plants and prey species in Iran. This species has been collected from almond and oak (Bagheri and Mosadegh 1997), and recently from hawthorn, pine, and walnut (current study).

Remarks. This species was reported by Erler and Tunc (2001) on *Olea europaea* as a predator of *Lineaspis riccae* (Targioni Tozzetti).

***Pharoscymnus setulosus* (Chevrolat, 1861)**

General distribution. Algeria, Egypt, Iran, Israel, Jordan, Libya, Morocco, Saudi Arabia, Spain, Tunisia, The United Arab Emirates (Kovář 2007).

Distribution in Iran. Fars (Moddarres-Awal 2012).

Figure 2. *Pharoscymnus pharoides*. **a, b** dorsal view at various angles **c** ventral view **d** penis **e–g** tegmen at various angles **h** tip of penis.

Host plants and prey species in Iran. This species has been collected from date palm as the predator of *Parlatoria blanchardi* (Hemiptera, Diaspididae; Yazdani 1990; Moddarres-Awal 2012).

Conclusion

Species of Microweiseinae and Sticholotidini from Iran belong to four genera. Eight of a total of eleven species belong to the Sticholotidini genus *Pharoscymnus*. For two species, no details are known about their distribution in Iran. Fars is the best investigated province of Iran with six known species belonging to the investigated groups of ladybirds; Gilan and Lorestan have three and two known species respectively, and the other provinces have only a single species each. Most of these species have western Palaearctic or Mediterranean distribution in general, but a few species extend to India or China.

Host plants in Iran were recorded for six species. Three species were found on both almond and date palm, two species on ash, citrus, olive and pomegranate. Prey species, always scale insects, were recorded for five of the eleven listed ladybird species. For four species, *Parlatoria blanchardi* was the single prey or one of the prey species.

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Review of *Dolichostyrax* Aurivillius (Cerambycidae, Lamiinae) in Borneo, with descriptions of three new genera and the first case of (ovo)viviparity in the long-horned beetles

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Abstract

We reviewed the species of genus *Dolichostyrax* Aurivillius (Cerambycidae: Morimopsini) from Borneo, which included the redescriptions of two species – *D. moultoni* Aurivillius, 1911 and *D. longipes* Aurivillius, 1913, with the first female description for the latter. After the examination of the additional material previously identified as *Dolichostyrax*, we described three new genera – *Borneostyrax* **gen. n.**, *Microdolichostyrax* **gen. n.**, and *Eurystyrax* **gen. n.** *Borneostyrax cristatus* **sp. n.** was described based on the male and female specimens, whilst *Microdolichostyrax hefferni* **sp. n.**, *M. minutus* **sp. n.** and *Eurystyrax nemethi* **sp. n.** are known only from females. All studied species are distributed in the mountain regions of Sabah, with the exception of *D. moultoni* from Sarawak. An identification key to the genera of Bornean Morimopsini and species of *Dolichostyrax*, *Borneostyrax* **gen. n.**, *Microdolichostyrax* **gen. n.** and *Eurystyrax* **gen. n.** is provided and their distributions and intraspecific morphological variability are discussed. The short and wide ovipositor, loss of spermatheca, and presence of large larvae without apparent eggbursters inside the female abdomens indicate the presence of (ovo)viviparity in *Borneostyrax* **gen. n.** This is the first case of this rare phenomenon within Cerambycidae.

Keywords

Coleoptera, diversity, endemism, hot-spots, Malaysia, Morimopsini

Introduction

Long-horned beetles (Cerambycidae) with about 35,000 described species are the fifth largest beetle family in the world (Švácha and Lawrence 2014). Although they are widespread, well-known, easily recognized and intensively collected by both amateurs and professional entomologists, their classification is still not well understood. For example, Lamiinae forms by far the most species-rich cerambycid subfamily, however, almost nothing is known about their interrelationships. Many supraspecific taxa are only vaguely defined, and a complete revision of the tribal classification is deeply warranted (Ślipiński and Escalona 2013). Morimopsini is most probably a polyphyletic lineage currently containing about 200 species classified in 50 genera distributed mainly in the tropical areas of Africa and Asia (e.g., Breuning 1950, Sudre and Teocchi 2002, Vitali and Menufandu 2010, Nearns et al. 2015, Tavakilian and Chevillotte 2015, Weigel 2015). Three small genera are reported from Borneo: endemic *Anexodus* Pascoe (two species) and *Pantilema* Aurivillius (monotypic), and *Dolichostyrax* Aurivillius (two species; with remaining congeners known also from Java and Sumatra) (Breuning 1950). Members of these genera are flightless and inhabit the leaf litter in rain forests. They are only rarely collected and there is absolutely no information on their morphological inter- and intraspecific variability, immature stages, distribution, relationships, biology, and ecology. Breuning (1950) made a generic and species identification key and since then, no attention was paid to the Bornean Morimopsini except for an isolated description of a new *Anexodus* by Sudre (1997).

Herein, we review the *Dolichostyrax* species in Borneo, which includes the redescriptions of *D. moultoni* Aurivillius, 1911 and *D. longipes* Aurivillius, 1913 and the descriptions of three new genera closely related to *Dolichostyrax*. For the first time, male and female genitalia are investigated and the identification key is provided for the Bornean Morimopsini.

Material and methods

The study is based on adult semaphoronts of both sexes. Before the investigation of the external morphological characters, specimens were cleaned from a crust of dirt in a sonicator, following the method of Harrison (2012). The genitalia of both sexes were briefly kept in hot 10% KOH, dissected, transferred to glycerol and subsequently photographed using a Zeiss Discovery.V12 with ZEN software. The line illustrations were derived from the photographs. All dissected parts were mounted on the separate cardboards using the DMHF (Dimethyl Hydantoin Formaldehyde) resin and pinned with specimens. The measurements of taxonomically relevant morphological structures were taken with a measuring tool in ZEN software. The following abbreviations were used: BL – body length, measured from the fore margin of head to the apex of elytra; BW – maximal body width. Data from the locality labels are cited verbatim. A slash (/) is used to separate lines on the same label and a double slash (//) is used to separate different labels on the pin. The morphological terminology follows those of Ślipiński and Escalona (2013) and Švácha and Lawrence (2014).

Depositories

HNHM	Hungarian Natural History Museum, Budapest, Hungary (O. Merkl, T. Németh)
NHRS	Swedish Museum of Natural History, Stockholm, Sweden (J. Bergsten)
PCDH	personal collection of Daniel J. Heffern, Houston, TX, USA
PCJC	personal collection of Jim Cope, San Jose, CA, USA
PCLB	personal collection of Larry G. Bezark, Sacramento, CA, USA

Taxonomy

Genus *Dolichostyrax* Aurivillius, 1911

Dolichostyrax Aurivillius, 1911: 194.
Dolychostyrax Breuning, 1950: 162 (incorrect subsequent spelling).

Type species. *Dolichostyrax moultoni* Aurivillius, 1911.

Diagnosis. *Dolichostyrax* differs from *Microdolichostyrax* gen. n. and *Eurystyrax* gen. n. by longer antennae (0.9–1.3 times as long as BL vs. 0.6–0.7, respectively), antennomere XI shorter than III (Figs 5, 16, 24, 31, 37, 44), relatively thinner antennomeres (antennomere III length/width ratio = 3.2–4.1 vs. 1.7–2.4, respectively), and metatarsomere III longer than metatarsomere I. *Borneostyrax* gen. n. differs from *Dolichostyrax* by bidentate mandibular apex (vs. unidentate; Figs 6, 52), elytra with tubercles forming distinct ridges (vs. rows of individual tubercles; Figs 2, 48, 60), distinct protrusions on apices of protibiae and mesotibiae along with tibial spurs 0-0-2 in males (vs. no protrusions and tibial spurs 2-2-2; Figs 8, 54), and terminal maxillary and labial palpomeres widened, flattened and truncate in males (vs. fusiform; Figs 7, 53).

Redescription. Body elongate to broadly oval, 9.4–11.8 mm long and 3.5–4.3 mm wide in males, and 11.1–12.5 mm long and 4.3–4.9 mm wide in females. Body coloration brown to black; antennae, palpi and legs (or only appendage joints) lighter (Figs 1–2, 13–14, 21–22). Body densely clothed with very short yellowish to light brown pubescence, incorporating fine detritus particles.

Prothorax sub-cylindrical, 0.9–1.1 times as long as wide, widest slightly before middle, then gradually narrowed towards posterior margin, laterally with one small more or less distinct tubercle; pronotal disc weakly convex, sparsely covered with deep punctuation, with more or less distinct, smooth or punctured tubercles (Figs 1, 13, 21), anterior and posterior angles obtuse. Prosternum in front of coxae 0.6–0.7 times shorter than diameter of coxal cavity, procoxal cavities circular, with lateral extension, narrowly separated. Scutellum transverse, widely rounded apically, about 3–4 times as wide as long. Elytra elongate, 1.4–1.6 times as long as wide at widest part, 1.6–1.9 times as long as pronotum in males and 1.8–2.3 times in females, basally slightly wider than posterior pronotal margin, widest near middle, from middle gradually tapered

towards apex, fused along the elytral suture; each elytron with three rows of tubercles irregular in shape and size (Figs 1, 13, 21), sparsely covered by large deep punctures arranged irregularly in rows; outer elytral margin curved at lateral view (Figs 2, 14, 22). Mesoventrite with anterior edge on different plane than metaventrite; mesocoxal cavities circular, separated slightly wider than in procoxal cavities. Metaventrite transverse, more than two times as wide as long, posterior margin emarginated, with short narrow median groove. Metacoxal cavities separated as widely as mesocoxal ones, extending laterally to meet elytra. Hind wings absent. Legs long, slender; femora weakly swollen distally, tibial spurs 2-2-2, protibiae with pubescent groove (antennal cleaner) on inner face, mesotibiae with pubescent groove on outer face, metatibiae without groove; tarsal formula 4-4-4, relative lengths of metatarsomeres 1.0 : 0.7–1.0 : 1.2–1.5 : 1.8–2.4; last tarsomere with four long erected setae at ventral face, claws simple, empodium absent.

Abdomen with five ventrites (Fig. 3), first ventrite (excluding intercoxal process) almost two times longer than second; intercoxal process short, broadly rounded. Fifth ventrite with apex truncate, margin with sparse semi-erect pubescence. Male genitalia with tegmen elongate, widest before middle, basally with or without strut; parameres elongate, less than half of phallobase length, setose apically (Figs 11–12, 19–20). Penis weakly curved at lateral view, apically truncate; dorsal struts diverged from about 1/2 of penis length. Internal sac long, with paired small medial sclerites and distinct flagellar sclerites (Figs 9–10, 17–18). Female genitalia with ovipositor elongate, narrow, apically with short styli (Fig. 25). Vagina narrow, with pair of vaginal plates. Bursa copulatrix small. Spermatheca present, well-sclerotized, simple, slender, elongate, curved; sclerotized part of spermathecal duct simply coiled, distinctly shorter than spermatheca itself (Fig. 26).

Distribution. Malaysia: Borneo (Sarawak: *D. moultoni* Aurivillius, 1911; Sabah: *D. longipes* Aurivillius, 1913), Indonesia (Sumatra: *D. basispinosus* Breuning & de Jong, 1941; Java: *D. tuberculatus* Fisher, 1936; *D. cylindricus* Breuning, 1939).

Dolichostyrax moultoni Aurivillius, 1911

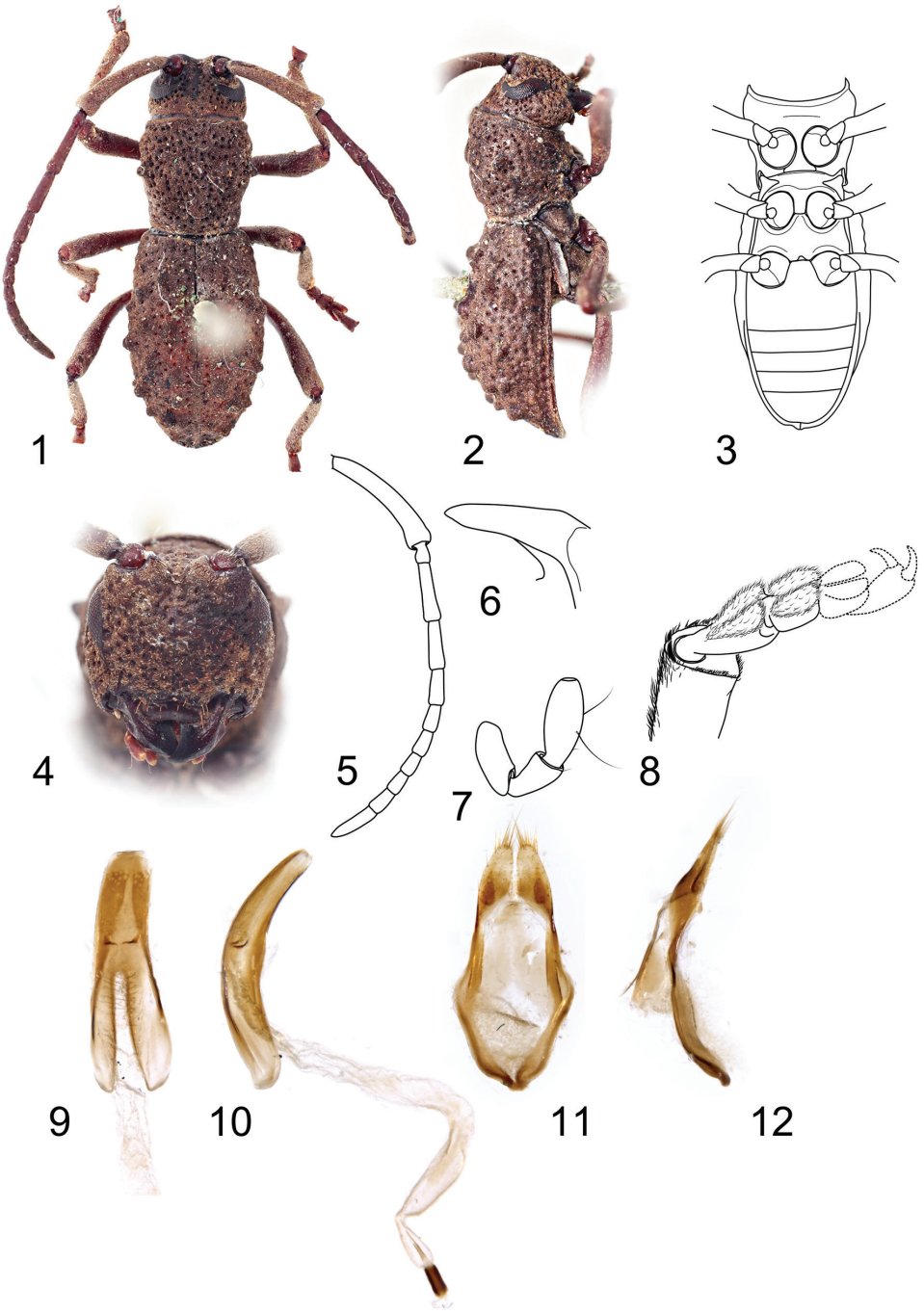
Figs 1–12

Dolichostyrax moultoni Aurivillius, 1911: 195.

Type material. Holotype, male, "Klinkang / 1-01 // Type // NHRS-JLKB / 000022860 // 5185 / E94 + // HOLOTYPE / *Dolichostyrax* / *moultoni* Aurivillius, 1911 / Labelled by Gabriš, 2016" (NHRS).

Diagnosis. This species differs from *Dolichostyrax longipes* by apex of scape without a distinct bulge (Figs 5, 16, 24), tegmen basally without distinct strut (vs. short strut in *D. longipes*; Figs 11, 19), and parameres with sparse long setae at apex only (vs. parameres with dense long setae at whole apical half; Figs 11, 19).

Redescription of holotype (male). Body length 11.2 mm, body width 3.9 mm. Body brown; appendage joints and palpi lighter. Body densely clothed with very short



Figures 1–12. *Dolichostyrax moultoni* Aurivillius, holotype male: **1** Dorsal habitus **2** Lateral habitus **3** Ventral habitus **4** Head, frontal view **5** Antenna **6** Mandible apex **7** Apical maxillary palpomeres **8** Apex of protibia with protarsus **9** Penis, ventral view **10** Penis, lateral view **11** Tegmen, ventral view **12** Tegmen, lateral view. Not to scale.

golden brown pubescence, incorporating fine detritus particles. Head slightly narrower than anterior margin of pronotum. Antennae as long as body; scape gradually widened towards apex, thickest at apical part, covered with very short dense light brown pubescence; the relative ratio of antennomere lengths 2.0 : 0.2 : 1.0 : 0.8 : 0.6 : 0.4 : 0.4 : 0.4 : 0.4 : 0.5 : 0.8.

Prothorax 1.1 times as long as wide, laterally with one small obtuse tubercle; pronotal disc with a pair of distinct tubercles near middle and one median at second half; pronotal tubercles not punctured. Prosternum in front of coxae 0.7 times shorter than diameter of coxal cavity. Scutellum transverse, about four times as wide as long. Elytra elongate, 1.6 times as long as wide at widest part, 1.9 times as long as pronotum, widest before middle; each elytron with three rows of tubercles irregular in shape and size (Figs 1, 2), sparsely covered with large deep punctures arranged irregularly in rows, more distinct near elytral suture. Legs long, slender; tibial spurs with mesotibial ones inconspicuous; protarsi and left mesotarsus preserved with tarsomeres I–II only, metatarsus with tarsomere I only; relative lengths of metatarsomeres 1.0 : 1.0 : 1:3 : 2.1.

Male genitalia with tegmen elongate, widest before middle, basally without distinct strut; parameres elongate, less than half of phallobase length, apically with sparse long setae (Figs 11, 12). Penis weakly curved at lateral view, apically truncate; dorsal struts diverged from 1/2 of penis length. Internal sac long, with paired small medial and distinct flagellar sclerites (Fig. 9–10).

Female unknown.

Distribution. Malaysia: Borneo (Sarawak: "Klinkang"). There is "Klinkang" written on the original label, but "Kuching" in the original description (Aurivillius 1911).

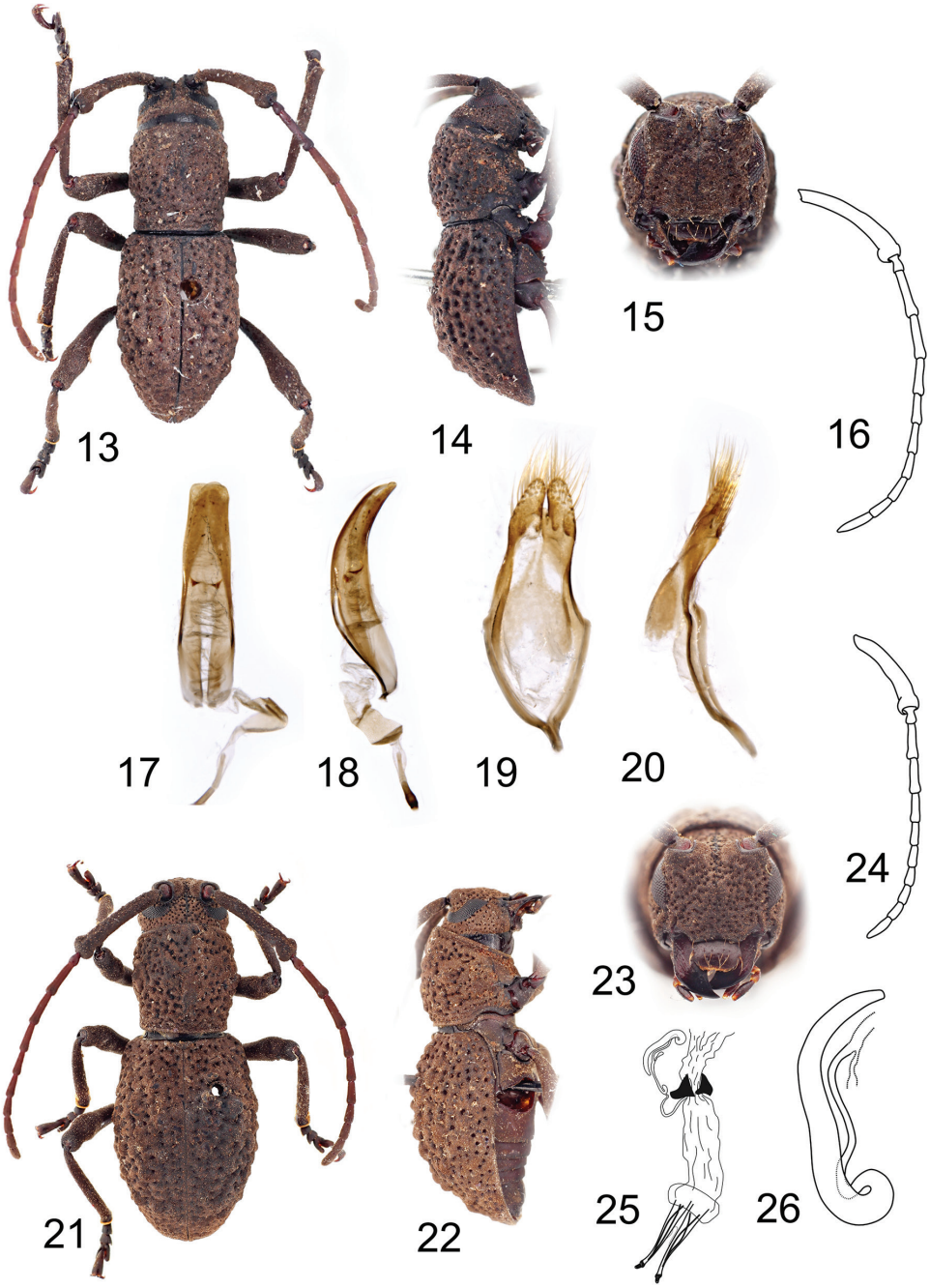
Dolichostyrax longipes Aurivillius, 1913

Figs 13–26

Dolichostyrax longipes Aurivillius, 1913: 239.

Type material. Holotype, male, "Batu Lawi / Expedition / Between ulu / Madihil and Lim- / bang, 5-1911 / Gazette Aug. / 1911 // NHRS-JLKB // 000022861 // 5816 / E94 + // HOLOTYPE / *Dolichostyrax* / *longipes* Aurivillius, 1913 / Labelled by Gabriš, 2016" (NHRS).

Other material examined. Male, "Malaysia, Sabah / Crocker Range / I-12-2004 / Jackson coll // *Dolichostyrax* / n. sp. 1 / det. J. Sudre 06 // *Dolichostyrax* / *longipes* Aurivillius, 1913 / Gabriš det., 2016" (PCDH); male, "BORNEO, Sabah, Malaysia / Kinabalu Park, HQ / 31.1.–2.2.2000, 1500 m / lgt. Jan Cempírek // *Dolichostyrax* / *longipes* Aurivillius, 1913 / Gabriš det., 2016" (PCJC); female, "Malaysia, Sabah / Sipitang vic / II-26-2005 / local coll // *Dolichostyrax* / *longipes* Aurivillius, 1913 / Gabriš det., 2016" (PCDH); female, "Malaysia, Sabah / Ranau / II-12-2004 / Lubin coll // *Dolichostyrax* / n. sp. 1 / det. J. Sudre 06 // *Dolichostyrax* / *longipes* Aurivillius, 1913 / Gabriš det., 2016" (PCDH); female, "Malaysia, Sabah / Tenom / IV-1-2004 / local



Figures 13–26. 13–20 *Dolichostyrax longipes* Aurivillius, holotype male: **13** Dorsal habitus **14** Lateral habitus **15** Head, frontal view **16** Antenna **17** Penis, ventral view **18** Penis, lateral view **19** Tegmen, ventral view **20** Tegmen, lateral view **21–26** *Dolichostyrax longipes* Aurivillius, female: **21** Dorsal habitus **22** Lateral habitus **23** Head, frontal view **24** Antenna **25** Reproductive system **26** Spermatheca. Not to scale.

coll // *Dolichostyrax* / n. sp. / det. J. Sudre // *Dolichostyrax* / *longipes* Aurivillius, 1913 / Gabriš det., 2016" (PCDH).

Diagnosis. *Dolichostyrax longipes* differs by *D. moultoni* by presence of a distinct bulge at apex of scape (Figs 16, 24), tegmen basally with short strut (missing in *D. moultoni*; Fig. 19), and parameres with with dense long setae at whole apical half (vs. setae distributed sparsely at apex of paramere only; Figs 19–20).

Redescription of holotype (male). BL 9.4 mm, BW 3.5 mm. Body black, antennae and legs slightly lighter. Body densely clothed with very short golden brown pubescence, incorporating fine detritus particles. Head about as wide as anterior margin of pronotum. Antennae 1.3 times longer than body length; scape gradually only slightly widened towards apex, apical part distinctly thicker than the rest of scape, forming a distinct bulge (Fig. 16), densely covered with very short light brown pubescence; the relative ratio of antennomere lengths 2.5 : 0.3 : 1.0 : 1.0 : 0.8 : 0.7 : 0.6 : 0.6 : 0.6 : 0.6 : 0.8.

Prothorax as long as wide, laterally with one indistinct tubercle; pronotal disc with a pair of indistinct tubercles near middle and one median at second half; pronotal tubercles punctured. Prosternum in front of coxae 0.6 times shorter than diameter of coxal cavity. Scutellum transverse, more than three times as wide as long. Elytra elongate, 1.4 times as long as wide at widest part, 1.6 times as long as pronotum, widest at middle; each elytron with three rows of tubercles irregular in shape and size (Figs 13, 14), tubercles only slightly elevated from deeply wrinkled elytral surface; sparsely covered with large deep punctures arranged in rows, visible mainly from the lateral view. Legs long, slender; with all tibial spurs distinct; right protarsus and metatarsus with only tarsomere I preserved, right mesotarsus missing; relative lengths of metatarsomeres 1.0 : 0.8 : 1.2 : 1.8.

Male genitalia with tegmen elongate, widest before middle, basally with short strut; parameres elongate, less than half of phallobase length, with dense long setae at apical half (Fig. 19). Penis weakly curved at lateral view, apically truncate; dorsal struts diverged from about 1/2 of penis length. Internal sac long, with paired small medial and distinct flagellar sclerites (Figs 17–18).

Variability in males. BL 9.4–11.8 mm, BW 3.5–4.3 mm. Antennae 1.0–1.3 times longer than body length. Prothorax laterally with one more or less distinct obtuse tooth; pronotal disc slightly to deeply wrinkled; pronotal and elytral tubercles more distinct in other males than holotype. Male from Kinabalu Park (PCJC) large, with pubescence very dense, yellowish brown, and with slightly narrower tegmen.

Description of female. Most characters same as for males. BL 11.7–12.5 mm, BW 4.3–4.9 mm. Antennae 0.9–1.0 times longer than body length. Pronotal and elytral tubercles more or less distinct; tubercles smooth or with individual punctures. Elytra elongate, 1.4–1.6 times as long as wide at widest part, 1.8–2.3 times as long as pronotum. Female genitalia with elongate ovipositor (Fig. 25). Bursa copulatrix small. Spermatheca slender, elongate, curved; sclerotized part of spermathecal duct simply coiled, distinctly shorter than spermatheca itself (Fig. 26).

Distribution. Malaysia: Borneo (Sabah).

Genus *Microdolichostyrax* gen. n.
http://zoobank.org/0F156593-8C03-452B-8F91-C4EDC18FD6DC

Type species. *Microdolichostyrax hefferni* sp. n.

Diagnosis. The genus *Microdolichostyrax* can be easily recognized by the following combination of characters: generally smaller habitus (BL 9.0–10.5), antennae 0.7 times as long as body, surface of scape slightly distorted (unique in Bornean Morimopsini), antennomere II 0.5–0.8 times as long as antennomere III, antennomere IV longer than antennomere III, antennomere XI longer than antennomere III, antennomeres relatively short (e.g. antennomere III length/width ratio = 1.7–1.8), mandibular apex unidentate, elytra with rows of individual tubercles, and tibial spurs 2-2-2 (Figs 27–28, 34–35).

Etymology. The name *Microdolichostyrax* gen. n. refers to the smaller size of the specimens belonging to the genus, and to its similarity to *Dolichostyrax* Aurivillius. Gender: masculine.

Description. Female. Body elongate, BL 9.0–10.5 mm, BW 2.9–3.7 mm. Body brown; antennae, legs and palpi lighter (Figs 27, 34). Body densely clothed with very short yellowish or chestnut brown pubescence, incorporating fine detritus particles.

Head slightly wider than anterior pronotal margin; genae convex at frontal view; frontoclypeus with midline running from interantennal groove to labrum, sparsely punctured; antennal tubercles prominent with deep depression in between; anterior margin of anteclypeus shallowly emarginate, with sparse long yellowish semi-erected setae. Labrum free, transverse, glabrous, with sparse long semi-erect setae (Figs 30, 36). Eyes rather small, reniform, vertically elongate, slightly emarginate at antennal articulations, lower lobes narrower than genae. Antennae 11-segmented, 0.7 times as long as body; scape enlarged, slightly curved, longest, reaching about half of pronotum, gradually widened towards apex, thickest at apical part, surface slightly distorted, not smooth, covered with very short dense pubescence; the rest of antennomeres with sparser pubescence, pedicel very small, shortest, the relative ratio of antennomere lengths: I–IV 3.2–3.9 : 0.5–0.8 : 1.0 : 1.1–1.3; antennomere III relatively wide (length/width ratio = 1.7–1.8), antennomere V slightly shorter than IV, antennomeres VI–X subequal in length, apical antennomere simple, 1.4–1.5 times as long as antennomere III (Figs 31, 37). Mandibles short and broad; apex unidentate (Fig. 6). Maxillary palpi 4-segmented, apical palpomere fusiform (Fig. 7). Labial palpi 3-segmented, apical palopmere fusiform.

Prothorax sub-cylindrical, 0.9–1.0 times as long as wide, widest at middle, gradually narrowed towards posterior margin, laterally with one small obtuse tubercle; pronotal disc weakly convex, sparsely covered with deep puncturation, with a pair of tubercles near middle and one median at second half; anterior and posterior angles obtuse; pronotal tubercles punctured (Figs 27, 34). Prosternum in front of coxae 0.8–0.9 times shorter than diameter of coxal cavity, procoxal cavities circular, narrowly separated (Fig. 29). Scutellum transverse, more than three times as wide as long. Elytra elongate, 1.6–1.8 times as long as wide at widest part, 2.1–2.3 times as long as

pronotum, basally slightly wider than posterior pronotal margin, widest near middle, from middle gradually tapered towards apex; each elytron with three rows of irregular, slightly elevated tubercles (Figs 27, 34), sparsely covered by large deep punctures irregularly in rows, surface not wrinkled; outer elytral margin curved at lateral view (Figs 28, 35). Mesoventrite with anterior edge on different plane than metaventrite. Mesocoxal cavities circular, separated slightly wider than in procoxal cavities. Metaventrite transverse, more than two times wide as long, posterior margin emarginated, with wide, moderately deep median emargination. Metacoxal cavities separated as widely as mesocoxal ones, extending laterally to meet elytra (Fig. 29). Hind wing absent. Legs long, slender; femora weakly swollen distally, tibial spurs 2-2-2, protibiae with pubescent groove (antennal cleaner) on inner face, mesotibiae with pubescent groove on outer face, metatibiae without groove; tarsal formula 4-4-4; relative lengths of metatarsomeres 1.0 : 0.6 : 1:0 : 1.6–1.7; last tarsomere with four long erected setae at ventral face, claws simple, empodium absent.

Abdomen with five ventrites (Fig. 29), first ventrite (excluding intercoxal process) almost two times longer than second; intercoxal process short, broadly rounded. Fifth ventrite with apex truncate, margin with sparse semi-erect pubescence. Female genitalia with ovipositor elongate, narrow, apically with short styli (Figs 32, 38). Vagina narrow, with pair of vaginal plates. Bursa copulatrix small. Spermatheca present, well-sclerotized, elongate, more or less curved, apex rounded or tapered; sclerotized part of spermathecal duct short or very long, strongly coiled (Figs 33, 39).

Male unknown.

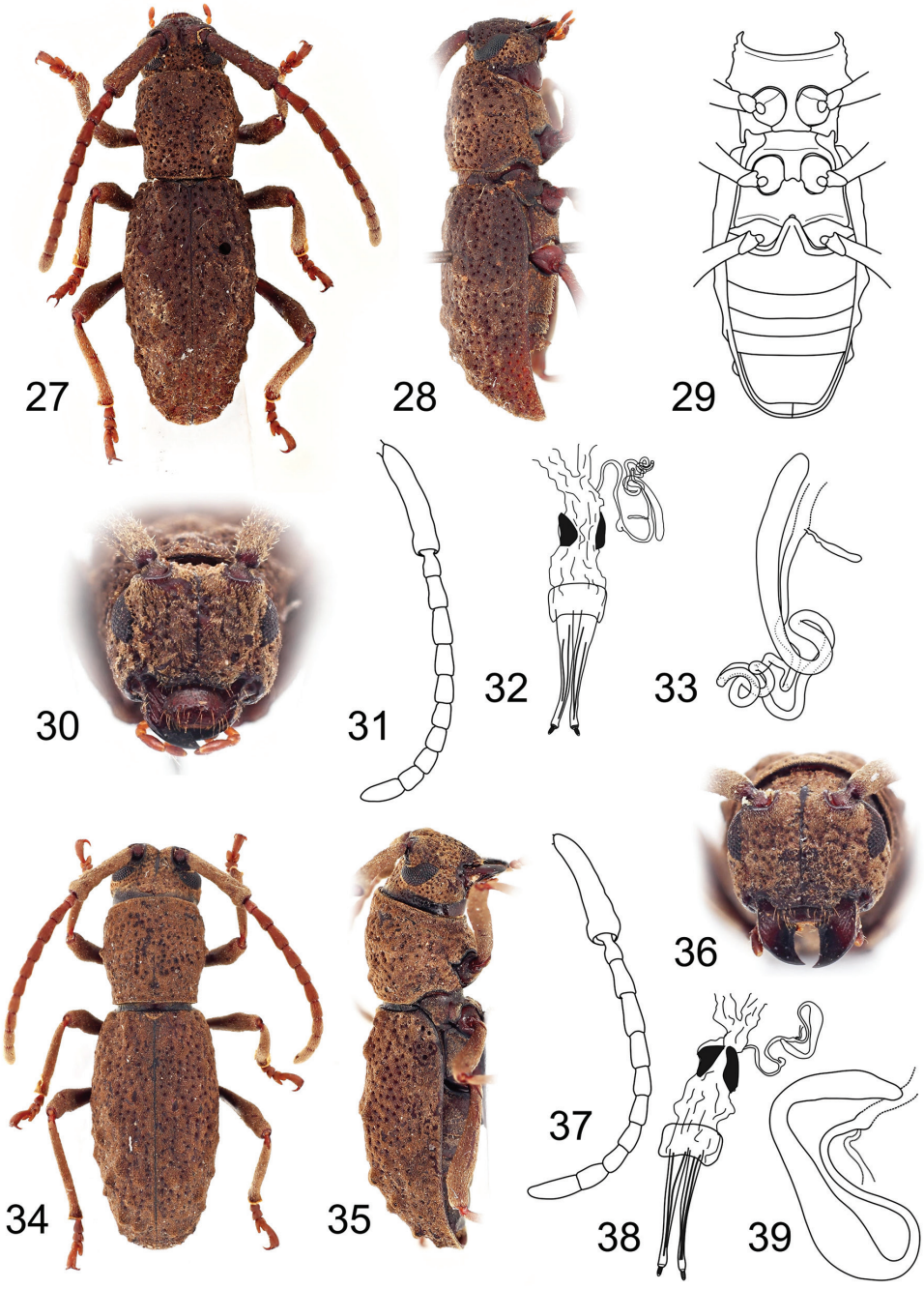
Distribution. Malaysia: Borneo (Sabah).

Microdolichostyrax hefferni sp. n.

http://zoobank.org/FFFF7E31-3701-455A-B3F5-394D76983B7F
Figs 27–33

Type material. Holotype, female, "Malaysia, Sabah / Sipitang area / II-1-2003 / local coll // *Dolichostyrax* / *longipes* / Aurivillius / det J. Sudre 06 // HOLOTYPE / *Microdolichostyrax* / *hefferni* Gabriš, Kundrata / & Trnka, 2016 / gen. et sp. n." (HNHM, ex PCDH). Three paratypes. Female, "Malaysia, Sabah / Sipitang area / II-1-2003 / local coll // *Dolichostyrax* / *longipes* / Aurivillius / det. J. Sudre 06 // PARATYPE / *Microdolichostyrax* / *hefferni* Gabriš, Kundrata / & Trnka, 2016 / gen. et sp. n." (PCDH); female, "Malaysia, Sabah / Mt. Trus-Madi / III-17-2003/ local coll 'Addle' // *Dolichostyrax* / *longipes* / Aurivillius / det J. Sudre // PARATYPE / *Microdolichostyrax* / *hefferni* Gabriš, Kundrata / & Trnka, 2016 / gen. et sp. n." (PCDH); female, "Malaysia, Sabah / Sipitang area / III-3-2003 / local coll 'Unil' // *Dolichostyrax* / *longipes* / Aurivillius / det J. Sudre 06 // PARATYPE / *Microdolichostyrax* / *hefferni* Gabriš, Kundrata / & Trnka, 2016 / gen. et sp. n." (PCDH).

Diagnosis. This species is very similar to *Microdolichostyrax minutus* sp. n., but differs by slightly larger body (BL 9.8–10.5 mm vs. 9.0, respectively); body pubescence darker, chestnut brown (vs. yellowish brown; Figs 27, 34), antennomere II relatively



Figures 27–39. 27–33 *Microdolichostyrax hefferni* sp. n., holotype female: **27** Dorsal habitus **28** Lateral habitus **29** Ventral habitus **30** Head,frontal view **31** Antenna **32** Reproductive system **33** Spermatheca **34–39** *Microdolichostyrax minutus* sp. n., holotype female: **34** Dorsal habitus **35** Lateral habitus **36** Head, frontal view **37** Antenna **38** Reproductive system **39** Spermatheca. Not to scale.

longer, 0.7 times as long as antennomere III (vs. 0.5 times), spermatheca with apex rounded (vs. tapered), and the sclerotized part of spermathecal duct very long, strongly coiled (vs. short; Figs 33, 39).

Description of holotype (female). BL 9.8 mm, BW 3.3 mm. Body brown; antennae, legs and palpi lighter. Body densely clothed with very short chestnut brown pubescence, incorporating fine detritus particles (Fig. 27).

Head slightly wider than anterior pronotal margin. Antennae 0.7 times as long as body; scape enlarged, reaching about half of pronotum, gradually widened towards apex, thickest at apical part, surface slightly distorted, not smooth, covered with very short dense pubescence; the relative ratio of antennomere lengths: 3.4 : 0.7 : 1.0 : 1.2 : 1.1 : 0.9 : 0.8 : 0.8 : 0.8 : 0.8 : 1.4 (Fig. 31).

Prothorax as long as wide, laterally with one small obtuse tubercle; pronotal disc with pair of tubercles near middle and one median at second half; pronotal tubercles punctured. Prosternum in front of coxae 0.8 times shorter than diameter of coxal cavity. Scutellum transverse, about 3.5 times as wide as long. Elytra elongate, 1.8 times as long as wide at widest part, 2.3 times as long as pronotum, widest near middle; each elytron with three rows of irregular, slightly elevated tubercles (Figs 27–28), sparsely covered by large deep punctures irregularly in rows, surface not wrinkled. Legs long, slender; relative lengths of metatarsomeres 1.0 : 0.6 : 1:0 : 1.6.

Female genitalia with ovipositor elongate, narrow, apically with short styli (Fig. 32). Vagina narrow, with pair of vaginal plates. Bursa copulatrix small. Spermatheca well-sclerotized, simple, slender, elongate, slightly curved, apex rounded; sclerotized part of spermathecal duct very long, strongly coiled (Fig. 33).

Variability. BL 9.8–10.5 mm, BW 3.3–3.7 mm. Paratypes are slightly larger and more oval than holotype.

Distribution. Malaysia: Borneo (Sabah: Sipitang, Trus Madi).

Etymology. The specific name is a patronym in honor of Mr. Daniel J. Heffern (Houston, USA), who kindly provided us with the type material.

***Microdolichostyrax minutus* sp. n.**
http://zoobank.org/F634EFA8-6969-43B0-A553-29BC2DB7F5C1
Figs 34–39

Type material. Holotype, female, "Malaysia, Sabah / Kuamut / III-13-2014 / local coll // HOLOTYPE / *Microdolichostyrax* / *minutus* Gabriš, Kundrata / & Trnka, 2016 / sp. n. " (HNHM, ex PCDH).

Diagnosis. *Microdolichostyrax minutus* sp. n.can be recognized by the smaller body (BL 9.0 mm), body pubescence paler, yellowish brown (vs. chestnut brown in *M. hefferni* sp. n.; Figs 27, 34), antennomere II 0.5 times as long as antennomere III, spermatheca with apical part tapered (vs. rounded), and the sclerotized part of spermathecal duct short, curved (vs. very long; Figs 33, 39).

Description of holotype (female). BL 9.0 mm, BW 2.9 mm. Body brown; antennae, legs and palpi lighter. Body densely clothed with very short yellowish brown pubescence, incorporating fine detritus particles (Fig. 34).

Head slightly wider than anterior pronotal margin. Antennae 0.7 times as long as body; scape enlarged, reaching about half of pronotum, gradually widened towards apex, thickest at apical part, surface slightly distorted, not smooth, covered with very short dense pubescence; relative ratio of antennomere lengths: 3.2 : 0.5 : 1.0 : 1.1 : 1.0 : 0.7 : 0.8 : 0.7 : 0.7 : 0.7 : 1.5 (Fig. 37).

Prothorax 0.9 times as long as wide, widest at middle, laterally with one small obtuse tubercle; pronotal disc with pair of tubercles near middle and one median at second half; pronotal tubercles punctured. Prosternum in front of coxae 0.9 times shorter than diameter of coxal cavity. Scutellum transverse, about three times as wide as long. Elytra elongate, 1.8 times as long as wide at widest part, 2.3 times as long as pronotum, widest near middle; each elytron with three rows of irregular, slightly elevated tubercles (Figs 34–35), sparsely covered by large deep punctures irregularly in rows; surface not wrinkled. Legs long, slender; relative lengths of metatarsomeres 1.0 : 0.6 : 1:0 : 1.7.

Female genitalia with ovipositor elongate, narrow, apically with short styli (Fig. 38). Vagina narrow, with pair of vaginal plates. Bursa copulatrix small. Spermatheca present, well-sclerotized, elongate, curved, basally wider, constricted at apical 1/3, apex tapered; sclerotized part of spermathecal duct short, curved (Fig. 39).

Distribution. Malaysia: Borneo (Sabah: Kuamut).

Etymology. The name "*minutus*" refers to the smaller size of the species.

Genus *Eurystyrax* gen. n.
http://zoobank.org/1559EF45-63F6-4331-9931-6508C8C5A5A8

Type species. *Eurystyrax nemethi* sp. n.

Diagnosis. The *Eurystyrax nemethi* gen. et sp. n. can be easily recognized by its robust body (BL 14.3 mm), genae parallel-sided at frontal view (Fig. 43), elytra with distinct ridges without individual tubercles (Fig. 40), and outer elytral margin straight at lateral view (Fig. 41).

Description. Female. Body robust, elongate, BL 14.3 mm, BW 5.1 mm. Body black, densely clothed with very short greyish pubescence, incorporating fine detritus particles.

Head about as wide as anterior pronotal margin, subquadrate at frontal view (genae parallel-sided); frontoclypeus with midline running from interantennal groove to labrum, sparsely punctured; antennal tubercles prominent with deep depression in between; anterior margin of anteclypeus shallowly emarginate, with sparse long yellowish semi-erected setae (Fig. 43). Labrum free, transverse, glabrous, with sparse long erected setae at apical half; frontal margin with very short dense golden pubescence. Eyes rather small, reniform, vertically elongate, slightly emarginate at antennal

articulations, lower lobes distinctly narrower than genae. Antennae 11-segmented, 0.6 times as long as body; scape enlarged, slightly curved, longest, reaching about half of pronotum, gradually widened towards apex, thickest at apical part, surface smooth, covered with very short dense pale pubescence; the rest of antennomeres with sparser pubescence, pedicel very small, shortest, the relative ratio of antennomere lengths: 3.4 : 0.4 : 1.0 : 1.1 : 0.8 : 0.8 : 0.7 : 0.6 : 0.6 : 0.7 : 1.4 (Fig. 44), antennomere III 2.4 times as long as wide. Mandibles short and broad, apex unidentate (Fig. 6). Maxillary palpi 4-segmented, apical palpomere fusiform. Labial palpi 3-segmented, apical palpomere of same shape as maxillary one.

Prothorax sub-cylindrical, as long as wide, widest at middle, gradually slightly narrowed towards posterior margin, laterally without tubercles; pronotal disc subparallel sided, weakly convex, surface coarsely wrinkled, without distinct tubercles, sparsely covered with deep puncturation, anterior and posterior angles obtuse (Fig. 40). Prosternum in front of coxae 0.8 times shorter than diameter of coxal cavity, procoxal cavities circular, narrowly separated (Fig. 42). Scutellum transverse, about four times as wide as long. Elytra elongate, sub-parallel, 1.7 times as long as wide at widest part, 2.2 times as long as pronotum, basally slightly wider than posterior pronotal margin, widest near middle, from middle gradually slightly tapered towards apex; each elytron with three elevated ridges, without individual tubercles, sparsely covered with deep punctures arranged in rows; outer elytral margin straight at lateral view (Fig. 41). Mesoventrite with anterior edge on different plane than metaventrite. Mesocoxal cavities circular, separated slightly wider than in procoxal cavities. Metaventrite transverse, more than 2.5 times wide as long, posterior margin emarginated, with wide moderately deep median emargination. Metacoxal cavities separated slightly wider than mesocoxal ones, extending laterally to meet elytra (Fig. 42). Hind wing absent. Legs long, slender; femora weakly swollen distally, not reaching elytral apex; tibial spurs 2-2-2, protibiae with pubescent groove (antennal cleaner) on inner face, mesotibiae with pubescent groove on outer face, metatibiae without groove; tarsal formula 4-4-4; relative lengths of metatarsomeres 1.0 : 0.7 : 1:0 : 1.5; last tarsomere with four long erected setae at ventral face, claws simple, empodium absent.

Abdomen with five ventrites; first ventrite (excluding intercoxal process) more than 1.5 times longer than second; intercoxal process short, broadly rounded (Fig. 42). Fifth ventrite with apex truncate, margin with sparse semi-erect pubescence. Female genitalia with ovipositor elongate, narrow, apically with short styli (Fig. 45). Vagina narrow, with pair of vaginal plates. Bursa copulatrix small. Spermatheca present, well-sclerotized, simple, elongate, slightly curved, widened basally; sclerotized part of spermathecal duct simple, short (Fig. 46).

Male unknown.

Etymology. The name *Eurystyrax* is a combination of words "eury" (referring to the wide habitus of the holotype) and "styrax" (part of the generic name *Dolichostyrax*). Gender: masculine.

***Eurystyrax nemethi* sp. n.**
http://zoobank.org/87E1ED94-FFD2-47CE-AFB6-DA44C96B0BE4
Figs 40–46

Type material. Holotype, female, "Nord-Borneo / Kinabalu, West- / hang, ca 2800 m // 4.III.1969 / Dr. H. Löffler leg. // *Dolichostyrax* / *longipes* Aur. / det. Breuning 72. // HOLOTYPE / *Eurystyrax* / *nemethi* Gabriš, Kundrata / & Trnka, 2016 / gen. et sp. n. " (HNHM).

Description of holotype (female). BL 14.3 mm, BW 5.1 mm. Body black, densely clothed with very short greyish pubescence, incorporating fine detritus particles.

Head about as wide as anterior pronotal margin, subquadrate at frontal view (genae parallel-sided); frontoclypeus sparsely punctured; anterior margin of anteclypeus shallowly emarginate, with sparse long yellowish semi-erected setae (Fig. 43). Labrum transverse, glabrous, with sparse long erected setae at apical half; frontal margin with very short dense golden pubescence. Eyes rather small, reniform, slightly emarginate at antennal articulations, lower lobes distinctly narrower than genae. Antennae 0.6 times as long as body; scape enlarged, slightly curved, longest, reaching about half of pronotum, gradually widened towards apex, surface smooth, covered with very short dense pale pubescence; the rest of antennomeres with sparser pubescence, pedicel very small, shortest, the relative ratio of antennomere lengths: 3.4 : 0.4 : 1.0 : 1.1 : 0.8 : 0.8 : 0.7 : 0.6 : 0.6 : 0.7 : 1.4 (Fig. 44), antennomere III 2.4 times as long as wide. Mandibles short and broad, apex unidentate (Fig. 6). Maxillary and labial palpi with apical palpomere fusiform.

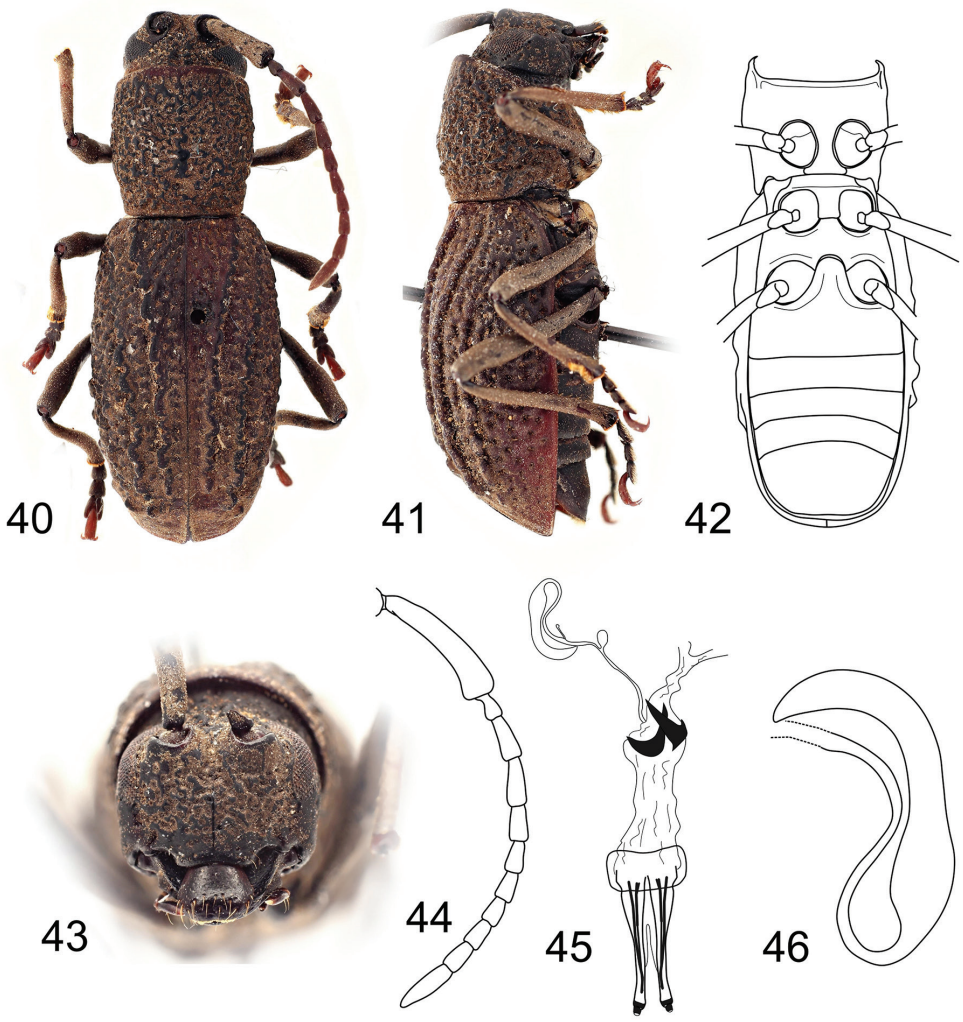
Prothorax as long as wide, widest at middle, laterally without tubercles; pronotal disc sub-parallel sided, weakly convex, surface coarsely wrinkled, without distinct tubercles, sparsely covered with deep puncturation, anterior and posterior angles obtuse (Fig. 40). Scutellum about four times as wide as long. Elytra elongate, sub-parallel, widest near middle, from middle gradually slightly tapered towards apex; each elytron with three elevated ridges, without individual tubercles, sparsely covered with deep punctures arranged in rows; outer elytral margin straight at lateral view (Fig. 41). Legs long, slender; tibial spurs 2-2-2, tarsal formula 4-4-4; relative lengths of metatarsomeres 1.0 : 0.7 : 1:0 : 1.5.

Abdomen with fifth ventrite truncate apically, margin with sparse semi-erect pubescence. Female genitalia with ovipositor elongate, narrow, apically with short styli (Fig. 45). Vagina narrow, with pair of vaginal plates. Bursa copulatrix small. Spermatheca present, well-sclerotized, simple, elongate, slightly curved, widened basally; sclerotized part of spermathecal duct simple, short (Fig. 46).

Male unknown.

Distribution. Malaysia: Borneo (Sabah: Kinabalu).

Etymology. This species is named after Mr. Tamás Németh (HNHM, Budapest, Hungary).



Figures 40–46. *Eurystyrax nemethi* sp. n., holotype female: **40** Dorsal habitus **41** Lateral habitus **42** Ventral habitus **43** Head, frontal view **44** Antenna **45** Reproductive system **46** Spermatheca. Not to scale.

Genus *Borneostyrax* gen. n.
http://zoobank.org/0D57C7D9-A3A5-4435-ACF5-9908E0DD10F7

Type species. *Borneostyrax cristatus* sp. n.

Diagnosis. This genus is unique within Bornean Morimopsini by having bidentate mandibular apex (Fig. 52) and elytra with tubercles forming distinct ridges (Figs 48, 60) in both sexes; tibial spurs 0-0-2, distinct protrusions on apices of protibiae and mesotibiae (Fig. 54), and terminal maxillary and labial palpomeres widened, flattened and truncate in males (Fig. 53), and short, wide ovipositor, large sac-like vagina and missing spermatheca in females (Fig. 63).

Description. Body robust, elongate, 10.8 mm long and 3.9 mm wide in male, and 12.6–14.6 mm long and 4.9–5.5 mm wide in females. Body reddish brown to dark brown; appendage joints lighter, palpi brown to black. Body very densely clothed with very short golden brown pubescence; scape, legs, scutellum, apex of elytra and abdominal ventrites covered with longer sparse semi-erected yellow setae (Fig. 47).

Head about as wide as anterior margin of pronotum; genae convex at frontal view; frontoclypeus with distinct midline running from interantennal groove to labrum, sparsely punctured, punctures deep with setae inside; antennal tubercles prominent with moderately deep depression in between; antennal cavities opened dorsally; anterior margin of anteclypeus shallowly emarginate, with sparse long yellowish semi-erected setae. Labrum free, transverse, glabrous, covered with long, sparse semi-erect setae, apical margin with short dense pubescence (Fig. 50). Eyes moderately-sized, vertically elongate, emarginate at antennal articulations, lower lobes slightly narrower than genae. Antennae 11-segmented, about as long as body in male and 0.8–0.9 times in females; scape enlarged, slightly curved, longest, reaching the second half of pronotum, gradually widened towards apex, thickest at apical part, with sparse yellow semi-erect setae, the rest of antennomeres with much sparser and thinner setae, pedicel very small, shortest, the relative length ratio of antennomeres I–IV 2.4–2.9 : 0.2–0.3 : 1.0 : 0.9–1.0; antennomere III relatively narrow (length/width ratio = 3.4–3.6; Fig. 51); antennomere V slightly shorter than antennomere IV, antennomeres VI–X subequal in length, antennomere XI shorter than antennomere III. Mandibles short and broad; apex bidentate (Fig. 52). Maxillary palpi 4-segmented, ultimate palpomere with apical half widened, flattened, apex truncate in males; ultimate palpomere fusiform in females (Fig. 53). Labial palpi 3-segmented, ultimate palpomere with apical half widened, flattened, apex truncate in males; ultimate palpomere fusiform in females.

Prothorax sub-cylindrical, as long as wide, widest at middle, laterally with one small obtuse tubercle; pronotal disc weakly convex, sparsely covered with deep punctuation, with pair of more or less distinct tubercles near middle and two median at first and second half, respectively; pronotal tubercles smooth or sparsely punctured; anterior and posterior angles obtuse. Prosternum in front of coxae 0.7 times shorter than diameter of coxal cavity, sparsely punctured; procoxal cavities circular, narrowly separated (Fig. 49). Scutellum transverse, about three times as wide as long. Elytra elongate, 1.6–1.7 times as long as wide at widest part, 2.1–2.5 times as long as pronotum, basally wider than posterior pronotal margin, widest slightly after middle, then gradually tapered towards apex, fused along the elytral suture; each elytron with three rows of prominent irregular tubercles forming distinct ridges (Figs 47–48), sparsely covered with large deep punctures located irregularly in rows; elytra covered with very dense short pubsecence, apically with sparse long erected yellowish brown setae; outer elytral margin curved at lateral view (Fig. 48). Mesoventrite with anterior edge on different plane than metaventrite. Both mesoventrite and metaventrite without punctuation. Mesocoxal cavities circular, separated wider than in procoxal cavities. Metaventrite transverse, more than two times wider than long, posterior margin emarginated, with short narrow median emargination. Metacoxal cavities separated slightly wider

than in mesocoxal ones, extending laterally to meet elytra (Fig. 49). Hind wing absent. Legs long, slender; femora weakly swollen distally, tibial spurs 0-0-2 in male, 2-2-2 in females, protibiae with pubescent groove (antennal cleaner) on inner face, inner face apically prolonged forming distinct, wide, gradually tapered protrusion in male (Fig. 54), simple in females; mesotibiae with pubescent groove on outer face, inner face with distinct protrusion as in protibiae but shorter in male, simple in female; metatibiae without groove, without protrusion; tarsal formula 4-4-4, relative lengths of metatarsomeres 1.0 : 0.5–0.6 : 0.8–0.9 : 1.2–1.7; last tarsomere with four long erected setae at ventral face, claws simple, empodium absent.

Abdomen with five ventrites; first ventrite (excluding intercoxal process) about or slightly more than 1.5 times longer than second; intercoxal process short, broadly rounded. Fifth ventrite with apex broadly rounded in male, truncate in females, margin with very sparse semi-erect pubescence. Male genitalia with tegmen elongate, widest at posterior 1/3, basally with long strut; parameres short, distinctly shorter than phallobase, apically with short fine setae (Figs 57–58). Penis weakly curved at lateral view, apically acuminate; dorsal struts diverged before 1/2 of penis length. Internal sac moderately long, with paired short medial and distinct flagellar sclerites (Figs 55–56). Female genitalia with ovipositor short, wide, apically with short styli (Fig. 63). Vagina sac-like, large, with pair of vaginal plates. Spermatheca absent.

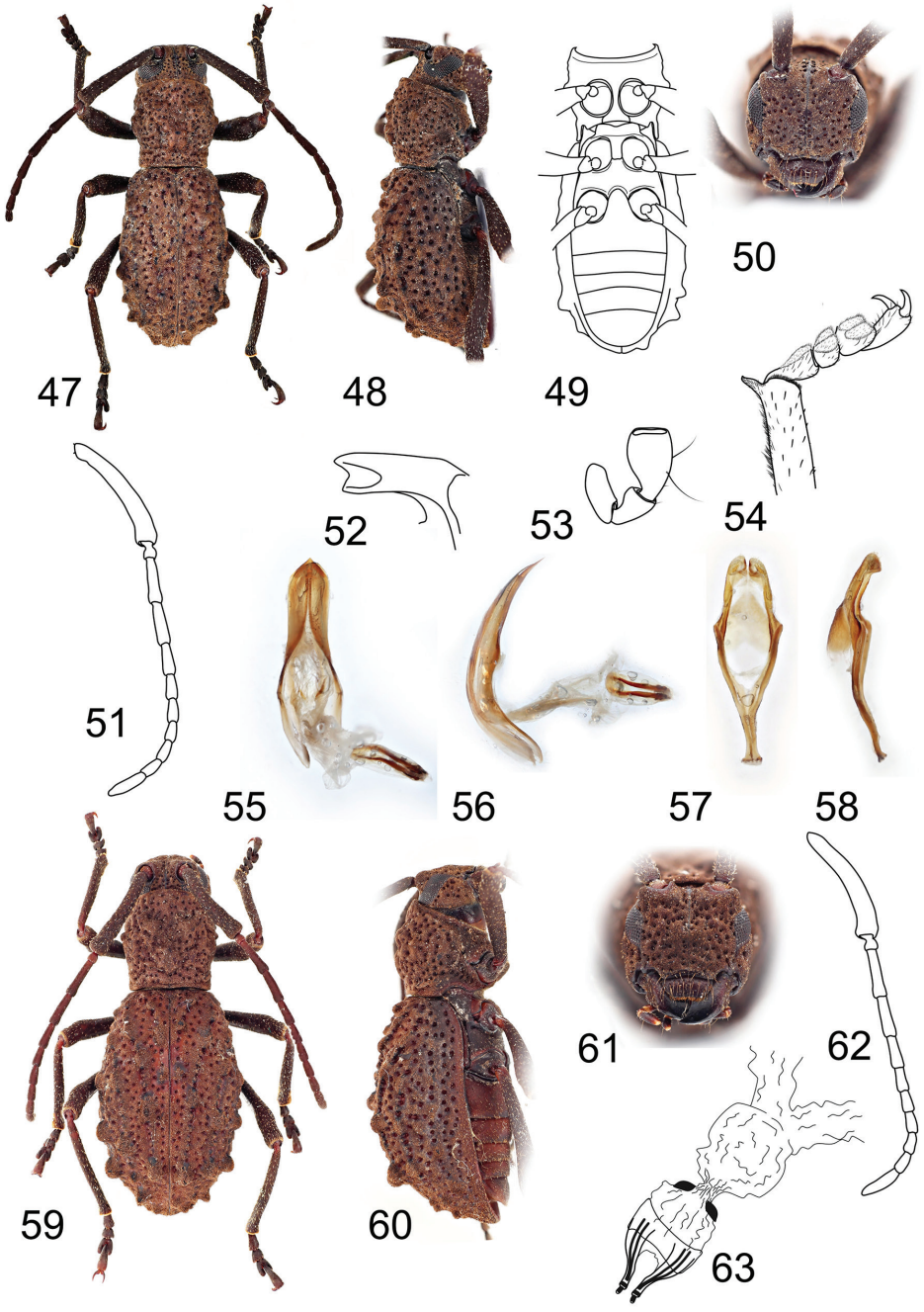
Etymology. The name *Borneostyrax* is a combination of words "Borneo" (geographical origin of the genus) and "styrax" (part of the generic name *Dolichostyrax*). Gender: masculine.

***Borneostyrax cristatus* sp. n.**
http://zoobank.org/18C7327E-8B12-4073-AFEC-A109D89E4665
Figs 47–67

Type material. Holotype, male, "Malaysia, Sabah / Tenom / III-12-2008 / local coll // *Dolichostyrax* / *moultoni* / Aurivillius / det J. Sudre 06 // HOLOTYPE / *Borneostyrax* / *cristatus* Gabriš, Kundrata / & Trnka, 2016 / gen. et sp. n. " (HNHM, ex PCDH). Three paratypes. Female, "Malaysia, Sabah / Crocker Range, vic. / Trus Madi, III-26- / 2000 local coll. // PARATYPE / *Borneostyrax* / *cristatus* Gabriš, Kundrata / & Trnka, 2016 / gen. et sp. n. " (PCDH); female, "Malaysia, Sabah / Tongod 500m / III-18-2014 / local coll // PARATYPE / *Borneostyrax* / *cristatus* Gabriš, Kundrata / & Trnka, 2016 / gen. et sp. n. " (PCDH); female, "Malaysia: Sabah / Crocker Range / 10 February 2003 / LG Bezark, collection // PARATYPE / *Borneostyrax* / *cristatus* Gabriš, Kundrata / & Trnka, 2016 / gen. et sp. n. " (PCLB).

Other material examined. Female, "Malaysia, Sabah / Sipitang area / IV-11-2002 / local coll 'Unil' // *Dolichostyrax* / *moultoni* / Aurivillius / det J. Sudre // *Borneostyrax* / *cristatus* Gabriš, Kundrata / & Trnka, 2016 / Gabriš det., 2016" (PCDH).

Description of holotype (male). BL 10.8 mm, BW 3.9 mm. Body dark brown; appendage joints lighter, palpi black. Body very densely clothed with very short golden



Figures 47–63. 47–58 *Borneostyrax cristatus* sp. n., holotype male: **47** Dorsal habitus **48** Lateral habitus **49** Ventral habitus **50** Head, frontal view **51** Antenna **52** Mandible apex **53** Apical maxillary palpomeres **54** Apex of protibia with protarsus **55** Penis, ventral view **56** Penis, lateral view **57** Tegmen, ventral view **58** Tegmen, lateral view **59–63** *Borneostyrax cristatus* sp. n., paratype female: **59** Dorsal habitus **60** Lateral habitus **61** Head, frontal view **62** Antenna **63** Reproductive system. Not to scale.

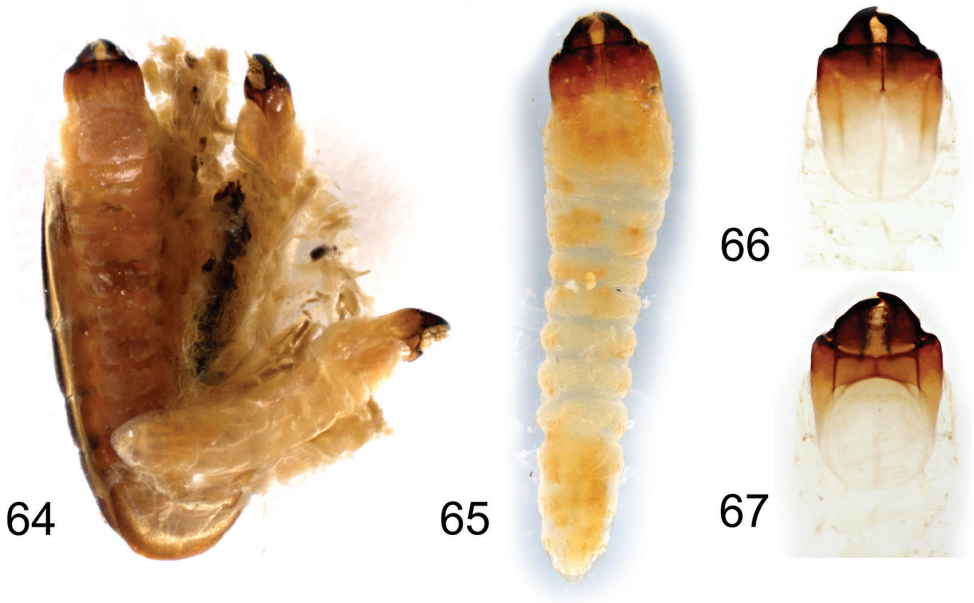
brown pubescence; scape, legs, scutellum, apex of elytra and abdominal ventrites covered with longer sparse semi-erected yellow setae (Fig. 47).

Head about as wide as anterior margin of pronotum; genae convex at frontal view; frontoclypeus with distinct midline running from interantennal groove to labrum, sparsely punctured; anterior margin of anteclypeus shallowly emarginate, with sparse long yellowish semi-erected setae. Labrum transverse, glabrous, covered with long, sparse semi-erect setae, apical margin with short dense pubescence (Fig. 50). Eyes moderately-sized, vertically elongate, emarginate at antennal articulations, lower lobes slightly narrower than genae. Antennae about as long as body; scape enlarged, slightly curved, longest, reaching the second half of pronotum, gradually widened towards apex, with sparse yellow semi-erect setae, the rest of antennomeres with much sparser and thinner setae, pedicel very small, shortest, the relative ratio of antennomere lengths 2.9 : 0.3 : 1.0 : 1.0 : 0.8 : 0.6 : 0.6 : 0.5 : 0.5 : 0.6 : 0.8, antennomere III relatively narrow (length/width ratio = 3.4–3.6; Fig. 51). Mandibles short and broad; apex bidentate (Fig. 52). Maxillary palpi and labial palpi with ultimate palpomere widened apically, flattened, apex truncate (Fig. 53).

Prothorax sub-cylindrical, as long as wide, widest at middle, laterally with one small obtuse tubercle; pronotal disc weakly convex, sparsely covered with deep punctuation, with pair of distinct tubercles near middle and two median at first and second half, respectively; pronotal tubercles sparsely punctured; anterior and posterior angles obtuse. Scutellum transverse, about three times as wide as long. Elytra elongate, 1.7 times as long as wide at widest part, 2.1 times as long as pronotum; each elytron with three rows of prominent irregular tubercles forming distinct ridges (Figs 47–48), sparsely covered with large deep punctures located irregularly in rows; elytra covered with very dense short pubsecence, apically with sparse long erected yellowish brown setae; outer elytral margin curved at lateral view (Fig. 48). Legs long, slender; femora weakly swollen distally, tibial spurs 0-0-2, tarsal formula 4-4-4, relative lengths of metatarsomeres 1.0 : 0.5 : 0.8 : 1.4.

Abdomen with five ventrites; first ventrite (excluding intercoxal process) about 1.5 times longer than second; intercoxal process short, broadly rounded. Fifth ventrite with apex broadly rounded, margin with very sparse semi-erect pubescence. Male genitalia with tegmen elongate, widest at posterior 1/3, basally with long strut; parameres short, distinctly shorter than phallobase, apically with short fine setae (Figs 57–58). Penis weakly curved at lateral view, apically acuminate; dorsal struts diverged before 1/2 of penis length. Internal sac moderately long, with paired short medial and distinct flagellar sclerites (Figs 55–56).

Description of female. Most characters same as for males. BL 12.6–14.6 mm, BW 4.9–5.5 mm. Body reddish brown to brown; appendage joints lighter, palpi brown. Antennae 0.8–0.9 times as long as body length. Maxillary and labial palpi with ultimate palpomeres fusiform (Fig. 7). Pronotal tubercles less distinct; tubercles smooth or with individual punctures. Elytra elongate, 1.6–1.7 times as long as wide at widest part, 2.1–2.5 times as long as pronotum. Legs long, slender; tibial spurs 2-2-2; protibiae and mesotibiae without wide apical protrusions on inner faces, relative lengths of



Figures 64–67. *Borneostyrax cristatus* sp. n., larvae from one of the paratype females: **64** Separated and partially opened female abdomen with three larvae, dorsal view **65** Larva, dorsal habitus **66** Larval head capsule, dorsal view **67** Larval head capsule, ventral view. Not to scale.

metatarsomeres 1.0 : 0.5–0.6 : 0.8–0.9 : 1.2–1.7. Abdomen with first ventrite (excluding intercoxal process) more than 1.5 times longer than second; fifth ventrite with apex truncate. Female genitalia with ovipositor short, wide, apically with short styli (Fig. 63). Vagina sac-like, large, with pair of vaginal plates. Spermatheca absent.

Remark. Two females contained large larvae (two and three, respectively) inside their abdomens. The larvae filled most of the females' abdomens and were located with their heads oriented towards the abdominal base (Fig. 64). Apparently, there were thin egg shells at least partly covering the larvae, but unfortunately, we were not able to specify where exactly in internal genitalia were larvae localized due to the partly damaged thin membranous structures inside the female internal reproductive organs. This damage was caused by the dissection because of two factors - first, the presence of larvae in the female abdomen was an unexpected finding as (ovo)viviparity has not been reported for any long-horned beetle to date, and second, it was studied in dry material, re-moistened only before the dissection.

Description of larva. Body up to 7.0 mm long and 1.6 mm wide, elongate, subcylindrical, creamy white, heavily sclerotized head capsule and mandibles darker (Fig. 65). Head capsule (Figs 66–67) 1.7 mm long and 1.3 mm wide, prognathous; anterior margin of cranium with long erect setae; medial endocarina extending to clypeus. Clypeus membranous, broad, trapezoidal. Labrum free, broadly rounded apically, sparsely setose. Antennae very small, terminal antennomere reduced, narrow. Mandibles broad, slightly curved, basally with long sparse setae. Maxillary palpi 3-segmented, api-

cal palpomere elongate, narrow, longer than palpomere II. Labial palpi 2-segmented. Legs absent. Thoracic and abdominal segments not sclerotized, laterally sparsely setose; last two segments bearing also long erect setae dorsally.

Distribution. Malaysia: Borneo (Sabah).

Etymology. The specific name refers to the distinct ridges of tubercles on elytra (Fig. 48).

Identification key to the genera of Bornean Morimopsini and species of *Dolichostyrax* Aurivillius, *Borneostyrax* gen. n., *Microdolichostyrax* gen. n. and *Eurystyrax* gen. n.

1 Antennomere II distinctly longer than antennomere III..... ..... ***Anexodus*** **Pascoe, 1886**

– Antennomere II shorter than antennomere III..... **2**

2 Body slender, narrow, parallel-sided; BL/BW = 3.5; tibial spurs 1-1-2; elytral apex truncate; elytral tubercles only at apical half (females unknown)..... ..... ***Pantilema*** **Aurivillius**

– Body more robust, mostly broadly oval; BL/BW = 2.4–3.1; tibial spurs 0-0-2 or 2-2-2; elytral apex rounded; elytral tubercles distributed along whole elytral length and/or forming distinct ridges..... **3**

3 Antennomere III shorter than antennomere XI; antennomere II 0.4–0.7 times as long as antennomere III; antennomere III 1.7–2.4 times longer than wide..... **4**

– Antennomere III longer than antennomere XI; antennomere II 0.2–0.3 times as long as antennomere III; antennomere III 3.2–4.1 times longer than wide **6**

4 Body larger (BL 14.3 mm); genae parallel-sided at frontal view (Fig. 43); surface of scape smooth; elytra with distinct ridges without individual tubercles (Fig. 40); outer margin straight at lateral view (Fig. 41)..... ..... **(*Eurystyrax* gen. n.) *E. nemethi* sp. n.**

– Body smaller (BL 9.0–10.5 mm); genae convex at frontal view (Figs 30, 36); surface of scape slightly distorted; elytra with rows of individual tubercles (Figs 27, 34); outer margin curved at lateral view (Figs 28, 35)..... ..... **(*Microdolichostyrax* gen. n.) 5**

5 Body pubescence darker, chestnut brown; antennomere II 0.7 times as long as antennomere III; spermatheca with apex rounded; sclerotized part of spermathecal duct very long, strongly coiled (Fig. 33)..... ***M. hefferni*** **sp. n.**

– Body pubescence paler, yellowish brown; antennomere II 0.5 times as long as antennomere III; spermatheca with apex tapered; sclerotized part of spermathecal duct short, curved (Fig. 39)..... ***M. minutus*** **sp. n.**

6 Mandibular apex bidentate (Fig. 52); elytra with tubercles forming distinct ridges (Figs 48, 60); tibial spurs 0-0-2 in male; protibiae and mesotibiae apically with distinct protrusions in male (Fig. 54); terminal maxillary and labial

palpomeres widened, flattened and truncate in male (Fig. 53); metatarsomere III 0.8–1.0 times as long as metatarsomere I .... **(*Borneostyrax* gen. n.) *B. cristatus* sp. n.**

– Mandibular apex unidentate (Fig. 6); elytra with rows of individual tubercles (Figs 1, 13); tibial spurs 2-2-2 in male; protibiae and mesotibiae apically without distinct protrusions in male; terminal maxillary and labial palpomeres fusiform in male (Fig. 7); metatarsomere III 1.2–1.5 times as long as metatarsomere I..... **(*Dolichostyrax* Aurivillius) 7**

7 Apex of scape thickened moderately (Fig. 5); tegmen basally without distinct strut; parameres with sparse long setae at apex only (Fig. 11) .... ***D. moultoni* Aurivillius**

– Apex of scape thickened substantially, forming distinct bulge (Figs 16, 24); tegmen basally with short strut; parameres with dense long setae at apical half (Fig. 19)..... ***D. longipes* Aurivillius**

Discussion

Diversity of *Morimopsini* in Borneo

Borneo is one of the major biodiversity hotspots in the world (de Bruyn et al. 2014) and especially mountain ranges of north-eastern Borneo, which is the presumed Pleistocene rainforest refugium, host numbers of endemic organisms (e.g. Gathorne-Hardy et al. 2002, Merckx et al. 2015). This is also the case for the flightless Bornean longhorned beetle genera classified in Morimopsini (Breuning 1950), which are distributed almost exclusively in the mountain regions of Sabah, where the endemism appears to be highest (Gathorne-Hardy et al. 2002). This is, however, challenged by some recent studies, which pointed out that the northern parts of the island are just incomparably better sampled than the interior Borneo (see Beck and Rüdlinger 2014 for a review). Therefore, it is not clear whether the current northern distribution of Morimopsini in Borneo is caused by an influence of the Pleistocene refugial history or fact, that no material is known from the Indonesian part of the island which is hardly accessible to scientific exploration.

The cerambycid tribe Morimopsini contains many morphologically distinct lineages, and its limits and classification are in deep need of revision (Breuning 1950, Sudre 1997). Because the higher lamiine classification is beyond the scope of this paper, we retain using the Breuning's (1950) concept of the tribe with the inclusion of the Bornean genera *Dolichostyrax*, *Anexodus*, and *Pantilema*. The specimens of Morimopsini are rarely collected, probably due to their cryptic life in the tropical forest litter and highly restricted vagility caused by the absence of wings. Therefore, we had only a limited number of specimens available for our study, but in spite of it, our study revealed that this group is much more speciose than previously believed. We found surprisingly high morphological diversity in the Bornean Morimopsini, which resulted

in the descriptions of three new genera with four new species. Given their limited distributional ranges in stable long-term habitats of humid mountain forests together with the high speciation rates known for the flightless lineages (Ikeda et al. 2012, Vogler and Timmermans 2012), the high diversity found in the studied genera is not such surprising. Considering the rarity of Morimopsini specimens in the collections, their life-history and hitherto unexplored areas in Borneo, we can expect many more species will be discovered in that island in the near future.

First case of (ovo)viviparity in Cerambycidae

The vast majority of insects are oviparous, i.e. their females lay eggs and embryogenesis occurs after oviposition. Ovoviviparous species retain their eggs in the genital tracts until the larvae are ready to hatch. There are no special nutritional adaptations developed in egg or female's body; embryo uses only nutritional reserves from the egg cytoplasm. On the other hand, in truly viviparous species the embryo receives nourishment also (or only) from the parent. The ovoviviparity is sometimes considered as a transitional stage between oviparity and viviparity, but also very often treated as a special case of viviparity (Hagan 1951, Iwan 2000, Gullan and Cranston 2014). The (ovo)viviparous reproduction is a relatively rare phenomenon in insects and occurs in some Ephemeroptera, Dermaptera, Blattodea, Plecoptera, Psocodea, Thysanoptera, Homoptera, Neuroptera, Coleoptera, Strepsiptera, Hymenoptera, Diptera, Trichoptera and Lepidoptera (e.g. Hagan 1951, Michaelis 1984, Meier et al. 1999, Iwan 2000, Heppner 2009, Kočárek 2009). However, the reproductive strategies of many insect lineages remain unknown, and the viviparity might be in fact much more common.

Within Coleoptera, viviparity (in all cases as ovoviviparity) has been reported only for the several phylogenetically unrelated families – adephagan Carabidae (Liebherr and Kavanaugh 1985) and polyphagan Staphylinidae (Aleocharinae; Schiødte 1853), Chrysomelidae (Chrysomelinae: Chrysomelini; Perroud 1855, Bontems 1984), Micromalthidae (Barber 1913), and Tenebrionidae (Tenebrioninae: Pedinini and Ulomini; Tschinkel 1978, Iwan 2000, Dutrillaux et al. 2010). Here we add also Cerambycidae to the list of beetle families for which some (ovo)viviparous species are known. In Chrysomelidae, which are phylogenetically related to Cerambycidae (see e.g. McKenna et al. 2015), ovoviviparous females are characterized by the loss of spermatheca and the first instar larvae by the loss of eggbursters (Reid 2014). Another morphological feature associated with ovoviviparity is shortened ovipositor, which is more adapted to laying large eggs or to larviposition (Meier et al. 1999, Iwan 2000). Indeed, the females of *Borneostyrax* gen. n. have genitalia with short, wide ovipositor and without spermatheca (Fig. 63). In two females out of four, we found relatively large larvae (two and three, respectively) without any visible eggbursters (Fig. 65). These morphological features, which are present exclusively in this genus, clearly indicate the presence of (ovo)viviparity in *Borneostyrax* gen. n. This phenomenon is commonly associated with parthenogenesis in Chrysomelidae; however, we have a male associated with females in

Borneostyrax gen. n. and absolutely no information on the life-history for this lineage. Further detailed study of more material is needed for the better understanding of the reproductive strategy in this genus.

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RESEARCH ARTICLE

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A revision of the Chinese Aulacidae (Hymenoptera, Evanioidea)

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Abstract

The Chinese Aulacidae are revised, keyed and illustrated for the first time. In total twenty-five species are recorded from China, included within two genera *Aulacus* Jurine, 1807 and *Pristaulacus* Kieffer, 1900, with five and twenty species respectively. Among the treated species, six are newly described for science: *Aulacus magnus* **sp. n.**, *Pristaulacus calidus* **sp. n.**, *P. centralis* **sp. n.**, *P. fopingi* **sp. n.**, *P. obscurus* **sp. n.**, and *P. pseudoiosephi* **sp. n.** Three species are newly recorded from China: *P. excisus* Turner, 1922, *P. iosephi* Turrisi & Madl, 2013, and *P. rufobalteatus* Cameron, 1907.

Keywords

Aulacidae, *Aulacus*, China, keys, new species, *Pristaulacus*, revision, taxonomy

Introduction

Aulacidae (Evanioidea) are a small cosmopolitan family, with two extant genera, containing 247 recognized species: *Aulacus* Jurine, 1807, with 77 species, and *Pristaulacus* Kieffer, 1900, with 170 species (Smith 2001, 2005a, 2005b, 2008; Jennings and Austin 2006; Turrisi et al. 2009; Smith and Carvalho 2010; Turrisi and Konishi 2011; Turrisi and Watanabe 2011; Turrisi 2013a, 2014; Turrisi and Madl 2013; Watanabe et al. 2013; Sundu-

Table 1. List of the Chinese species of Aulacidae before this study, with distribution in China.

Species	Chinese distribution
Aulacus flavigenis Alekseev, 1986	Heilongjiang
Aulacus schoenitzeri Turrisi, 2005	Shaanxi
Aulacus sinensis He & Chen, 2007	Zhejiang
Aulacus striatus Jurine, 1807	Inner Mongolia
Pristaulacus albitarsatus Sun & Sheng, 2007	Henan
Pristaulacus asiaticus Turrisi & Smith, 2011	Hubei
Pristaulacus comptipennis Enderlein, 1912	Taiwan, Hongkong
Pristaulacus intermedius Uchida, 1932	Shaanxi
Pristaulacus karinulus Smith, 2001	Henan, Jiangsu, Taiwan
Pristaulacus longicornis Kieffer, 1911	China (unknown whether Palaearctic or Oriental)
Pristaulacus memnonius Sun & Sheng, 2007	Henan
Pristaulacus nobilei Turrisi & Smith, 2011	Jiangsu, Guangdong, Hongkong, Macao
Pristaulacus pieli Kieffer, 1924	Jiangxi
Pristaulacus porcatus Sun & Sheng, 2007	Henan
Pristaulacus rufipes Enderlein, 1912	Taiwan
Pristaulacus zhejiangensis He & Ma, 2002	Zhejiang

kov and Lelej 2015). Both genera occur in all zoogeographic regions, except Antarctica, although *Aulacus* is not known from the Afrotropics (Kieffer 1912; Hedicke 1939; Smith 2001; Turrisi 2004; Turrisi 2006; Turrisi et al. 2009). Most species of this family occur in tropical and subtropical regions (Smith 2001; Jennings et al. 2004a, 2004b, 2004c; Turrisi et al. 2009). Aulacids are endoparasitoids of wood-boring larvae of Xiphydriidae (Hymenoptera), Buprestidae and Cerambycidae (Coleoptera) (Barriga 1990; Gauld and Hanson 1995; Smith 2001; Jennings and Austin 2004; Jennings et al. 2004a).

China is located between two zoogeographical regions, Palaearctic and Oriental, and thus includes mixed faunistic characters of both regions. However, Chinese Aulacidae are currently very poorly known (Turrisi 2007) and there have been no comprehensive revisionary attempts, although a few scattered taxonomic papers have been published since the World Aulacidae catalogue by Smith (2001) (He et al. 2002; He 2004; Turrisi 2005, 2007; Sun and Sheng 2007a, 2007b; Turrisi and Smith 2011; Sundukov and Lelej 2015). To date, only sixteen species are recorded from China, four *Aulacus* and twelve *Pristaulacus* (Table 1). This number is believed to be an underestimate, suggesting the need for extensive investigation and more research for a better knowledge of the Chinese Aulacidae (Turrisi 2007).

The extensive search for aulacid-specimens in several museums of China as well as relevant material from European museums resulted in the discovery of a total of 25 species, 6 of which are newly described, one *Aulacus* and five *Pristaulacus*. The present paper is the first attempt to revise the Chinese Aulacidae as a framework for further possible contributions.

Material and methods

Descriptions of the species have been made under either an Olympus SZ61 or SZ40 stereomicroscope, with lighting achieved through a 40W LED lamp or a 27W fluorescent lamp. Photographic images were produced by a digital microscope (VHX-2000c, KEYENCE, Osaka, Japan), and plates were finished with ACDSee 10.0 and Photoshop CS 8.0.1, mostly to adjust the size and background.

Morphological nomenclature follows Crosskey (1951), Huber and Sharkey (1993), and Gauld and Bolton (1996). Terminology for surface sculpture follows Harris (1979). For the number of tooth-like processes on inner margin of pretarsal claw, apex is not included since it represents the tip of the claw (Turrisi 2007).

In text, the following abbreviations are used for some morphological structures: **A** = antennomere; **OOL** = distance between outer margin of posterior ocellus and eye; **POL** = distance between inner margins of posterior ocelli; **T** = Tergite; **S** = Sternite.

Type material and other specimens have been examined from the following institutions:

BMNH The Natural History Museum, London, UK (Ms. Suzanne Ryder).
BPBM Bernice P. Bishop Museum, Honolulu (Hawaii), U.S.A. (Dr. Francis G. Howarth).
CAS California Academy of Sciences, San Francisco, California, U.S.A. (Dr. Wojciech J. Pulawski).
HNHM Hungarian Natural History Museum, Budapest, Hungary (Dr. Csosz Sandor).
IZCAS Institute of Zoology, Chinese Academy of Sciences, Beijing, China (Dr. Jun Chen, Mr. Jian Yao, Mrs. Hong Liu).
LACM Los Angeles County Museum of Natural History, Los Angeles, California, U.S.A. (through courtesy of Dr. David R. Smith).
OLML Oberosterreichisches Landesmuseum, Linz, Austria (Dr. Fritz Gusenleitner).
NHRS Swedish Museum of Natural History, Department of Entomology, Stockholm, Sweden (Dr. Hege Vårdal).
SCAU Hymenopteran Collection, South China Agricultural University, Guangzhou, China (Dr. Zai-fu Xu).
SDEI Deutsches Entomologisches Institut, Müncheberg, Germany (Prof. Joachim Oehlke, Dr. Andreas Taeger).
SEMC Shanghai Entomological Museum, Shanghai, China (Dr. Hai-sheng Ying).
SFPS General Station of Forest Pest Management, State Forestry Administration, Shenyang, China (Prof. Mao-Ling Sheng).
TCUC Turrisi G.F. Collection, University of Catania, Catania, Italy.
USNM National Museum of Natural History, Smithsonian Institution, Washington, DC, USA (Dr. David R. Smith).
ZJU Department of Plant Protection, Zhejiang University, Hangzhou, China (Prof. Jun-hua He & Prof. Xue-xin Chen).
ZMHB Museum für Naturkunde der Humboldt-Universität, Berlin, Germany (Dr. Frank Koch).

Systematics

Key to Chinese genera of Aulacidae

1 Occipital carina absent (Fig. 5); forewing with cross-vein 2r-m, with 2-rs+m long (as in Fig. 8), almost as long as 1sr+m; hind coxa of female without groove or notch on inner lateral surface (Fig. 9); pretarsal claw not pectinate, without tooth-like processes along inner margin (Fig. 11) .... ***Aulacus*** **Jurine**

– Occipital carina present (Figs 16, 17, 27, 28, 39, 40, 49, 60, 71, 79, 80, 92, 103, 104, 114, 115); forewing without cross-vein 2r-m, with 2-rs+m relatively short (as in Figs 95, 107, 118) or extremely short (as in Figs 20, 31, 43, 74, 83); hind coxa of female with groove or notch on inner lateral surface (Figs 32, 44, 96, 108); pretarsal claw pectinate with two to six distinct tooth-like processes along inner margin (Figs 22, 37, 54, 64, 68, 85, 97, 101, 120)..... ..... ***Pristaulacus*** **Kieffer**

Genus *Aulacus* Jurine, 1807

Aulacus Jurine, 1807: 89. Type species: *Aulacus striatus* Jurine, by monotypy.
Aulacus Jurine: Blanchard 1840: 300; Bradley 1908: 120; Kieffer 1912: 344; Hedicke 1939: 4; Konishi 1990: 641; Alekseev 1995: 39; Smith 2001: 277; Turrisi et al. 2009.

Remarks. The genus *Aulacus* has been demonstrated to be paraphyletic (Turrisi et al. 2009), and to date lacks a comprehensive revision of the taxa included to ascertain phylogenetic relationships.

Key to Chinese species of *Aulacus*

1 Metasoma entirely black **2**

– Metasoma at least with 2nd and 3rd tergites brown or reddish-brown **3**

2 Antenna black (Fig. 2); forewing with large dark brown spot under stigma and at apex (Fig. 8) ..... ***A. magnus*** **sp. n.**

– Antenna extensively reddish-orange, with A1–A4 and A11–A14 dark orange; forewing without dark brown spots..... ***A. schoenitzeri*** **Turrisi**

3 Head mainly black with malar area and gena brown ..... ***A. striatus*** **Jurine**

– Head mainly reddish-brown, with upper part of frons and median part of vertex black..... **4**

4 Fore coxa brown; lower part of frons with sparse punctures, upper part with oblique transverse carinulae ..... ***A. flavigenis*** **Alekseev**

– Fore coxa black; lower part of frons transverse-carinate, upper part punctate.... ..... ***A. sinensis*** **He & Chen**

***Aulacus flavigenis* Alekseev, 1986**
Fig. 122

Aulacus flavigenis Alekseev, 1986: 17.
Aulacus salicius Sun & Sheng, 2007b: 122. Synonymized by Sundukov and Lelej (2015).
Aulacus salicius Sun & Sheng: Turrisi et al. 2009: 56; Smith and Tripotin 2011: 520.

Material examined. No available material from China for this study. Examined material: 1 ♀ from South Korea (Tripotin P., gift to Turrisi G.F.).

Diagnosis. Head mainly reddish-brown, with upper part of frons and median part of vertex black; fore coxa brown; metasoma black with most of first tergite (except base) and second tergite reddish-brown; lower part of frons with sparse and indistinct punctures, upper part with distinct oblique transverse carinulae; ovipositor about 0.8 × forewing length.

Distribution. China (Heilongjiang); Russia (Primorski Krai and Skotovo) (Alekseev 1986; Sundukov and Lelej 2015); South Korea (Gangwon-do) (Smith and Tripotin 2011).

Biology. Collected in June (Sun and Sheng 2007b). Host: *Xiphydria palaeanarctica* Semenov-Tian-Shanskij (Hymenoptera, Xiphydriidae) (Smith and Tripotin 2011), *Xiphydria popovi* Semenov-Tian-Shanskij & Gussakovskij (Sun and Sheng 2007b). Additional data on biology are provided by Smith and Tripotin (2011).

Remarks. Redescription is provided by Sundukov and Lelej (2015).

***Aulacus magnus* sp. n.**
http://zoobank.org/3EB00C7D-A9F2-4DB8-A543-95AD3AAB4479
Figs 1–12, 122

Material examined. Holotype, ♀ (IZCAS), CHINA: Hainan, Mt. Jianfengling, 670 m, 6.V.1964, IOZ(E)1903950.

Etymology. From the Latin adjective "*magnus*", meaning "large", a noun in apposition.

Diagnosis. Antenna entirely black; forewing with large dark brown spots under stigma and at apex; head largely smooth with sparse and fine punctures; lateroventral margin of pronotum without teeth; scutellum mostly rugose with nearly smooth area posteriorly; pretarsal claw with one basal large tooth-like process; ovipositor 0.9 × forewing length.

Description. Holotype. *Female*. Body length 16.2 mm; forewing length 14.0 mm.

Colour. Black except: apical half of mandible reddish-brown; forewing hyaline, with large dark brown spot under stigma and large dark brown spot at apex; hind wing hyaline.

Head. From above, 1.2 × wider than long, shiny; lower interocular distance 1.5 × eye height; malar space 0.3 × eye height; occipital margin straight; temple, from above, rounded, slightly longer than eye length; occipital carina 0.1 × diameter of an ocellus; POL:OOL=0.8; head largely smooth with sparse and fine punctures (distance between punctures 1.0–4.0 × diameter of a puncture); A3 5.0 × longer than wide; A4

Figure 1. *Aulacus magnus* sp. n., holotype, female, habitus, lateral. Scale bar: 1 mm.

6.0 × longer than wide, and 1.4 × longer than A3; A5 5.5 × longer than wide, and 1.3 × longer than A3.

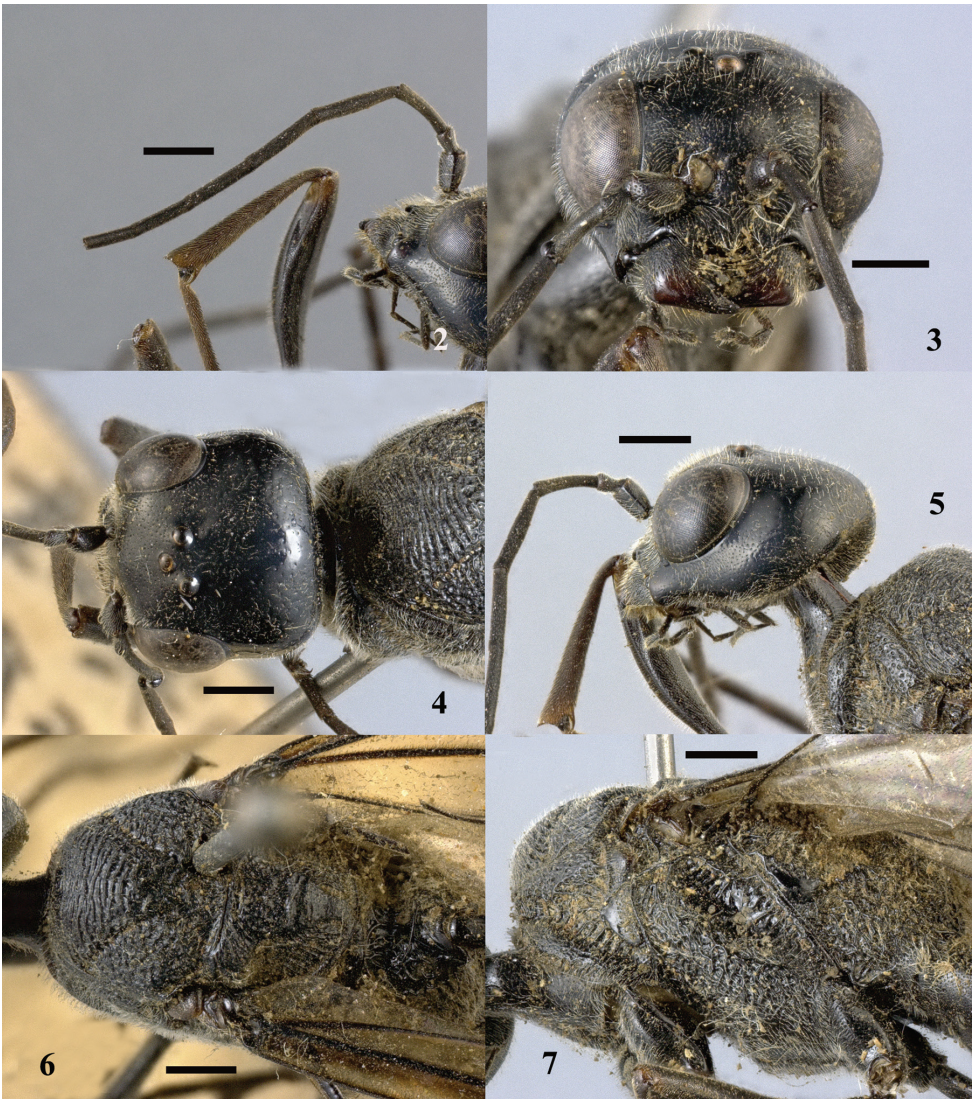
Mesosoma. Pronotum largely rugose, coarsely areolate-rugose in middle, with lateroventral margin regularly rounded and without teeth; propleuron shiny and largely smooth with sparse and fine punctures; mesoscutum transverse-carinate anteriorly, areolate-rugose posterior to notaulus, prescutum not emarginate medially; notaulus shallow and narrow; scutellum mostly rugose with nearly smooth area posteriorly; axilla oblique-rugulose; metanotum irregularly rugose; propodeum coarsely areolate-rugose; mesopleuron and metapleuron coarsely areolate-rugose; forewing with vein 2-rs+m long: cells SM2 and D1 distantly separated; hind wing veins faint to absent; hind coxa with dorsal surface transverse-carinate basally, densely and finely punctate apically, and ventral surface rugulose-punctate to punctate, punctures coarse and dense; hind basitarsus 12.0 × longer than wide, 1.2 × longer than tarsomeres 2–5; pretarsal claw with one large basal tooth-like process.

Metasoma. Pyriform (lateral view), compressed laterally; petiole elongate, 7.0 × longer than wide; segments 1 and 2 polished and shiny; following segments with fine and dense punctures; ovipositor 0.9 × forewing length.

Male. Unknown.

Distribution. China (Hainan).

Biology. Collected in May. Host not known.

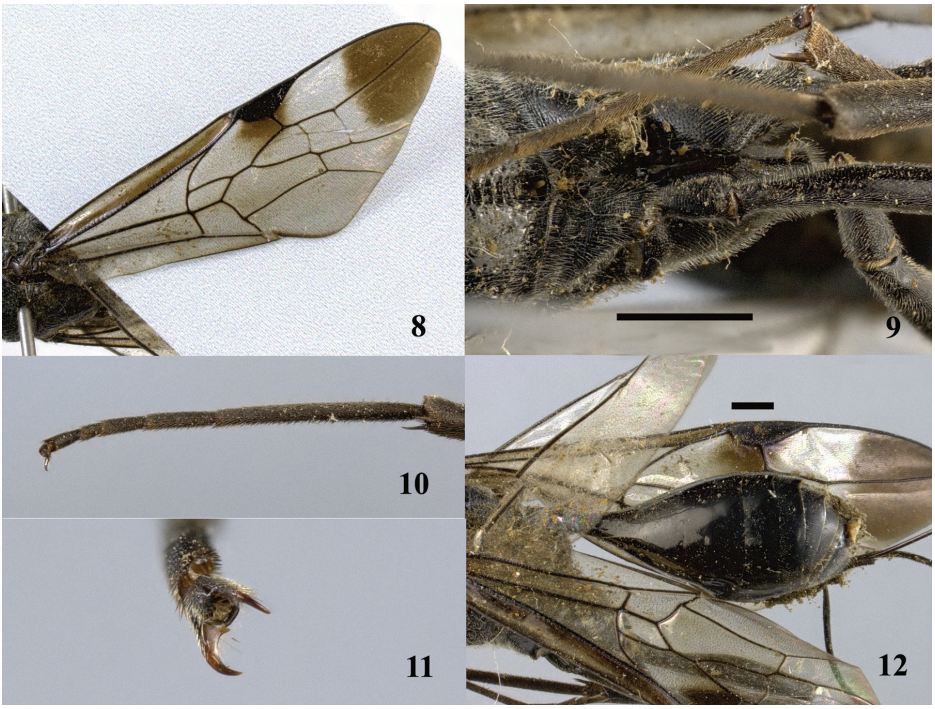


Figures 2–7. *Aulacus magnus* sp. n., holotype, female. **2** Antenna **3** head anterior **4** head dorsal **5** head lateral **6** mesosoma dorsal **7** mesosoma lateral. Scale bar: 1 mm.

***Aulacus schoenitzeri* Turrisi, 2005**
Fig. 122

Aulacus schoenitzeri Turrisi, 2005: 798.
Aulacus schoenitzeri Turrisi: Turrisi et al. 2009: 56.

Material examined. Holotype, ♀ (OLML), CHINA: Shaanxi, Qinling, Xunyangba, 23.V–13.VI.1998, I. H. Marshal leg/*Aulacus schoenitzeri* Turrisi sp. n.



Figures 8–12. *Aulacus magnus* sp. n., holotype, female. **8** Forewing **9** hind coxae **10** hind tarsus **11** pretarsal claws **12** metasoma dorso-lateral. Scale bar: 1 mm.

Diagnosis. Antenna extensively reddish-orange with A1–A4 and A11–A14 darker; legs blackish, except tibiae and tarsi reddish-orange; metasoma entirely black; vertex dull, strongly striolate-punctate; ovipositor 0.9 × forewing length.

Distribution. China (Shaanxi).

Biology. Collected in May or June. Host not known.

Aulacus sinensis He & Chen, 2007

Fig. 122

Aulacus erythrogaster He & Chen, 2002: 149 (preoccupied by *Aulacus erythrogaster* Kieffer, 1904).

Aulacus sinensis He & Chen, 2007: 66 (replacement name for *Aulacus erythrogaster* He & Chen, 2002).

Aulacus sinensis He & Chen: Turrisi et al. 2009: 56; Turrisi 2013a: 332.

Material examined. Holotype, ♀ (ZJU), CHINA: Zhejiang, Mt. Tianmu, 2–4. VI.1990, Xin-geng Wang, No. 903191/*Aulacus erythrogaster* He & Chen sp. n., 2002/ *Aulacus sinensis* He & Chen, nom. n., 2007.

Diagnosis. Head mainly reddish brown, upper portion of frons and median portion of vertex black; fore and middle femora black, apically yellow, hind tibia yellow at basal 0.14, the rest blackish brown; frons punctate on upper half, transverse-striate on lower half; apical half of hind coxa with a longitudinal groove along inner side.

Distribution. China (Zhejiang).

Biology. Collected in June. Host not known.

Aulacus striatus Jurine, 1807

Fig. 122

Aulacus striatus Jurine, 1807: 89–90.

Aulacus striatus Jurine: Sun and Sheng 2007b: 124; Turrisi et al. 2009: 56; Broad and Livermore 2014: 2.

Material examined. No available material from China for this study.

Diagnosis. Antenna entirely blackish-brown; femora, tibiae and tarsi extensively reddish-orange; metasoma extensively reddish-orange; vertex shining, irregularly, coarsely and deeply punctured, sometimes with very fine carinulae; propodeum weakly declivous; ovipositor 0.7–0.8 × forewing length.

Distribution. China (Inner Mongolia) (Sun and Sheng 2007b); Europe (Smith 2001; Broad and Livermore 2014).

Biology. Collected in August (Sun and Sheng 2007b). Host not known.

Remarks. The diagnosis is based on European specimens. Unfortunately, we were unable to examine Sun & Sheng's specimens. Therefore, the status of this species in China is unclear to us.

Genus *Pristaulacus* Kieffer, 1900

Pristaulacus Kieffer, 1900: 813. Type species: *Pristaulacus chlapowskii* Kieffer, designated by Kieffer, 1903: 455.

Pristaulacus Kieffer: Kieffer 1903: 455; 1910: 350; 1911: 215; 1912: 376; Bradley 1908: 212; Hedicke 1939: 4; Koslov 1988: 243; Konishi 1990: 641; Alekseev 1995: 39; Smith 2001: 277; Turrisi 2006: 28; Turrisi 2007: 28; Turrisi et al. 2009: 53; Watanabe et al. 2013: 188.

Key to Chinese species of *Pristaulacus*

1 Hind margin of head straight or weakly concave, without medial groove (Figs 59, 72, 91, 114); occipital carina not interrupted (Figs 59, 72, 91, 114).....**2**

– Hind margin of head more or less grooved medially (Figs 16, 27, 39, 48, 79, 103); occipital carina interrupted (Figs 16, 27, 39, 48, 79, 103).....**12**

2 Lateroventral margin of pronotum without tooth-like process ..... ***P. pieli* Kieffer**

– Lateroventral margin of pronotum at least with one tooth-like process (Figs 19, 30, 42, 51, 62, 73, 82, 94, 104, 117) **3**

3 Hind basitarsus 1.9 × longer than tarsomeres 2–5 ..... ***P. rufipes* Enderlein**

– Hind basitarsus at most 1.3 × longer than tarsomeres 2–5 ..... **4**

4 Occipital carina wide, 0.5 × diameter of ocellus, lamelliform, brownish **5**

– Occipital carina at most 0.2 × diameter of ocellus, pad-shaped, blackish **7**

5 Large sized species (body length, excluding ovipositor about 15.0 mm); basal antennomeres very elongate (A3 8.3 × longer than wide, A4 14.0 × longer than wide) ..... ***P. longicornis* Kieffer**

- Medium sized species (body length, excluding ovipositor about 10.0-11.0 mm); basal antennomeres elongate (A3 5.0–6.0 × longer than wide, A4 10.0 × longer than wide) (Fig. 67) **6**

6 Metasoma entirely blackish, at most slightly lightened basally (Fig. 75) ..... ***P. intermedius* Uchida**

– Metasoma extensively reddish orange ..... ***P. karinulus* Smith**

7 Hind coxa entirely smooth, polished ..... ***P. memnonius* Sun & Sheng**

– Hind coxa transverse-carinate or rugose **8**

8 Hind coxa rugose ..... ***P. zhejiangensis* He & Ma**

– Hind coxa transverse-carinate **9**

9 Forewing with vein 2-rs+m short, cells SM2 and D1 continuous ..... ***P. albitarsatus* Sun & Sheng**

– Forewing with vein 2-rs+m long, cells SM2 and D1 distinctly separated (Figs 95, 118) **10**

10 Metasoma entirely black (Fig. 98); hind tarsus black (Fig. 88) ..... ***P. obscurus* sp. n.**

– Metasoma at least with first tergite brown (Figs 65, 121); hind tarsus yellowish-brown (Figs 56, 111) **11**

11 Frons with yellow areas around antennae (Fig. 58); propleuron largely finely rugose with small smooth area posterodorsally (Fig. 60) ..... ***P. fopingi* sp. n.**

– Frons entirely black (Fig. 113); propleuron densely punctate ventrally, finely rugose with small smooth area dorsally (Fig. 115) ... ***P. rufobalteatus* Cameron**

12 Pronotum, in lateral view, with two projecting tooth-like processes, one anteroventral, the other ventral; pretarsal claw with six tooth-like processes **13**

– Pronotum with one anteroventrally projecting tooth-like process; pretarsal claw with four or five tooth-like processes **16**

13 Occipital groove pronounced, as deep or deeper than wide ..... ***P. asiaticus* Turrisi & Smith**

– Occipital groove shallow, less deep than wide (Fig. 103) **14**

14 Ovipositor 1.4 × forewing length ..... ***P. nobilei* Turrisi & Smith**

– Ovipositor 0.8–0.9 × forewing length **15**

15 Forewing with vein 2-rs+m short, cells SM2 and D1 slightly separated; propleuron dull, finely rugose with small smooth area dorsally..... ..... ***P. iosephi* Turrisi & Madl**

– Forewing with vein 2-rs+m long, cells SM2 and D1 distantly separated (Fig. 107); propleuron shiny, largely smooth with sparse fine punctures (Fig. 104)..... ***P. pseudoiosephi* sp. n.**

16 Occipital carina not interrupted along occipital medial groove (Fig. 49); occipital medial groove V-shaped, its depth very shallow (Fig. 49) .... ***P. excisus* Turner**

– Occipital carina interrupted along occipital medial groove; occipital medial groove abruptly shaped, from narrow to wide and deep (Figs 27, 39) **17**

17 Forewing with wide and irregular brown spots on basal part, below stigma and on apex ..... ***P. comptipennis* Enderlein**

– Forewing with only one brown spot below stigma **18**

18 Mesoscutum mostly areolate-rugose..... ***P. porcatus* Sun & Sheng**

– Mesoscutum mostly transverse-carinate (Figs 18, 29) **19**

19 Setae on body golden brown (Fig. 24); punctures on frons deep and dense, distance between punctures 0.5–1.0 × diameter of a puncture (Fig. 26)..... ..... ***P. centralis* sp. n.**

– Setae on body white (Fig. 13); punctures on frons deep and scattered, distance between punctures 2.0–3.0 × diameter of a puncture (Fig. 15) .... ***P. calidus* sp. n.**

***Pristaulacus albitarsatus* Sun & Sheng, 2007**

Fig. 122

Pristaulacus albitarsatus Sun & Sheng, 2007a: 216.
Pristaulacus albitarsatus Sun & Sheng: Turrisi et al. 2009: 56.

Material examined. No available material for this study.

Diagnosis. Metasoma more or less extensively reddish; hind tarsus withish-yellow; hind margin of head straight or weakly concave, without medial groove; occipital carina at most 0.2 × diameter of ocellus, pad-shaped, blackish; lateroventral margin of pronotum at least with one tooth-like process; forewing with vein 2-rs+m short, cells SM2 and D1 continuous; hind coxa transverse-carinate; hind basitarsus at most 1.3 × longer than tarsomeres 2–5 (Sun and Sheng 2007a).

Distribution. China (Henan) (Sun and Sheng 2007a).

Biology. Collected in May. Host not known (Sun and Sheng 2007a).

Remarks. Unfortunately, we were unable to examine Sun & Sheng's specimens. The diagnosis is based on the original description of Sun and Sheng (2007a).

***Pristaulacus asiaticus* Turrisi & Smith, 2011**
Fig. 122

Pristaulacus asiaticus Turrisi & Smith, 2011: 10.

Material examined. Holotype, ♂ (CAS), CHINA: W. Hupeh Prov., Lichuan District, Hsiao-Ho/10 August 1948, Gressit & Djou, Calif. Acad. Sciences/*Pristaulacus asiaticus* Turrisi & Smith sp. n.

Diagnosis. Antenna with A1 dark reddish-brown on ventral surface; forewing infuscate, strongly infuscate on basal third and largely below stigma; hind margin of head grooved medially, occipital groove pronounced, as deep or deeper than wide; pronotum, in lateral view, with two projecting tooth-like processes, one anteroventral, the other ventral; pretarsal claw with six tooth-like processes; forewing with vein 2-rs+m long, cells SM2 and D1 distantly separated.

Distribution. China (Hubei) (Turrisi and Smith 2011).

Biology. Collected in August. Host not known (Turrisi and Smith 2011).

***Pristaulacus calidus* sp. n.**
http://zoobank.org/A4F26A90-5202-4075-B32F-9508528E8565
Figs 13–23, 122

Material examined. Holotype, ♂ (IZCAS), CHINA: Yunnan, Cheli, 560 m, 26.IV.1957, Da-hua Liu, IOZ(E) 1903971.

Etymology. From the Latin adjective "*calidus*", meaning "hot", a noun in apposition.

Diagnosis. Antenna black with scape yellowish-orange; metasoma black with posterior margin of first tergite brown; forewing hyaline with a small dark brown spot under stigma; occipital margin concave, with a wide and deep medial groove; pronotum with one anteroventrally projecting tooth-like process; pretarsal claw with five tooth-like processes; forewing with vein 2-rs+m short, cells SM2 and D1 slightly separated.

Description. Holotype. *Male*. Body length 12.1 mm; forewing length 7.1 mm.

Colour. Antenna black with scape yellowish-orange; head black with clypeus dark brown; mesosoma black; metasoma black with posterior margin of first tergite brown; mandible brown with teeth darker; palpi black; fore leg, tibia and tarsus of mind leg and tarsus of hind leg yellowish-brown, remainder of legs dark brown to black; forewing hyaline with a small dark brown spot under stigma; hind wing hyaline.

Head. From above, 1.2 × wider than long, shiny; lower interocular distance 1.4 × eye height; malar space 0.4 × eye height; occipital margin concave, with a wide and deep medial groove; temple, from above, rounded, distinctly longer than eye length; occipital carina 0.5 × diameter of an ocellus; POL:OOL=0.9; lower frons and clypeus densely and finely punctate, remainder of head largely smooth with sparse and fine

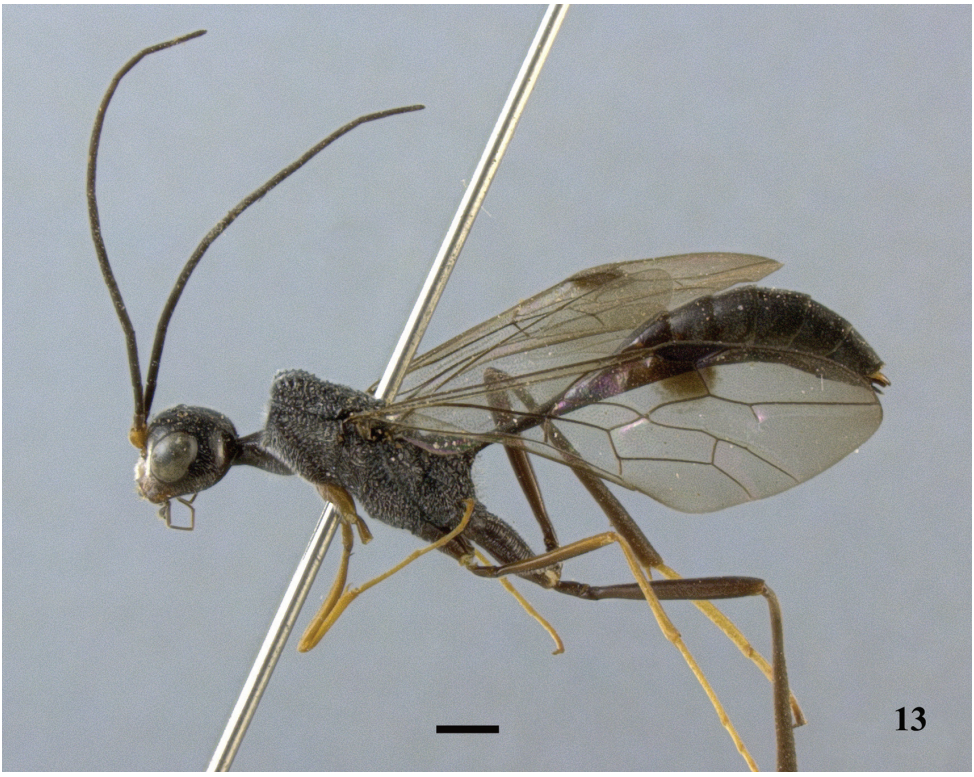


Figure 13. *Pristaulacus calidus* sp. n., holotype, male, habitus, lateral. Scale bar: 1 mm.

punctures; A3 3.5 × longer than wide; A4 5.8 × longer than wide, and 2.0 × longer than A3; A5 5.6 × longer than wide, and 1.9 × longer than A3.

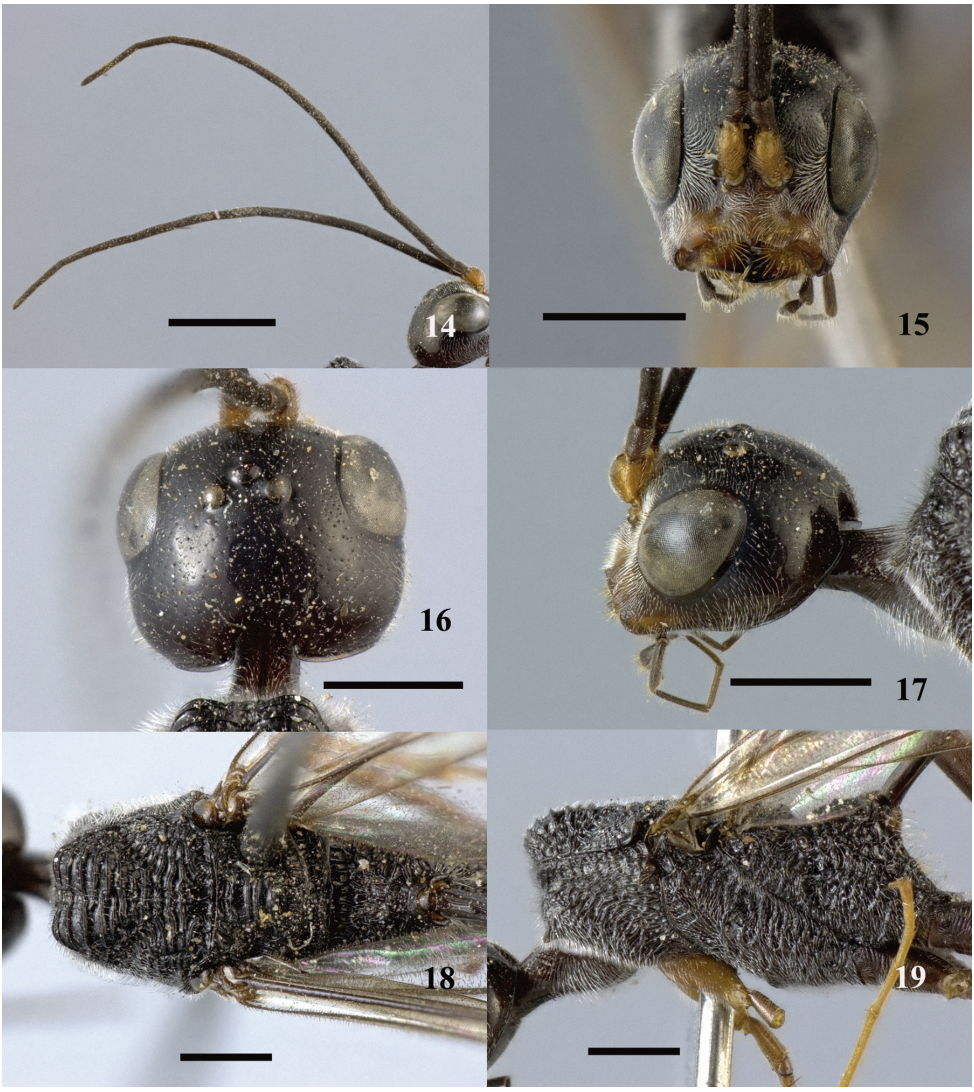
Mesosoma. Pronotum coarsely areolate-rugose, with one anterior short tooth-like process on lateroventral margin; propleuron shiny and smooth ventrally, finely rugose on dorsal surface; mesoscutum mostly transverse-carinate, coarsely areolate-rugose along transscutal fissure and on sides, anterior part slightly emarginate medially, rounded laterally; notauli deep and wide; scutellum transverse-carinate in middle, coarsely areolate-rugose on anterior and posterior margin; axillae, metanotum, propodeum, mesopleuron and metapleuron coarsely areolate-rugose; forewing with vein 2-rs+m short, cells SM2 and D1 slightly separated; hind wing veins faint to absent; hind coxa transverse-carinate; hind basitarsus 10.0 × longer than wide, and 1.3 × of tarsomeres 2–5; pretarsal claw with five tooth-like processes.

Metasoma. Smooth, shining, with fine white pubescence on segment 2 to apex; petiole elongate, 5.7 × longer than wide.

Female. Unknown.

Distribution. China (Yunnan).

Biology. Collected in April. Host not known.

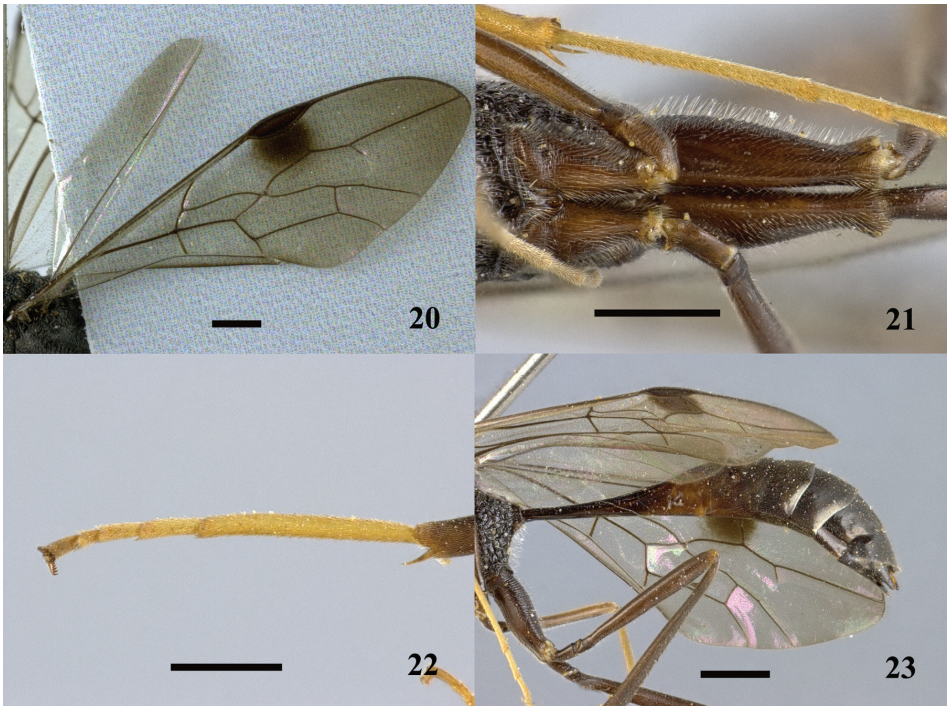


Figures 14–19. *Pristaulacus calidus* sp. n., holotype, male. **14** Antennae **15** head anterior **16** head dorsal **17** head lateral **18** mesosoma dorsal **19** mesosoma lateral. Scale bar: 1 mm.

***Pristaulacus centralis* sp. n.**
http://zoobank.org/0B488BA3-8A8A-4C82-AF41-7F07BB80C214
Figs 24–34, 122

Material examined. Holotype, ♀ (IZCAS), CHINA: Hubei, Zigui, Mt. Jiulingtou, 250 m, 27.VII.1993, Xiao-lin Chen, IOZ(E) 1903961.

Etymology. From the Latin adjective "*centralis*", meaning "placed in the middle", a noun in apposition.



Figures 20–23. *Pristaulacus calidus* sp. n., holotype, male. **20** Forewing **21** hind coxae **22** hind tarsus **23** metasoma lateral. Scale bar: 1 mm.

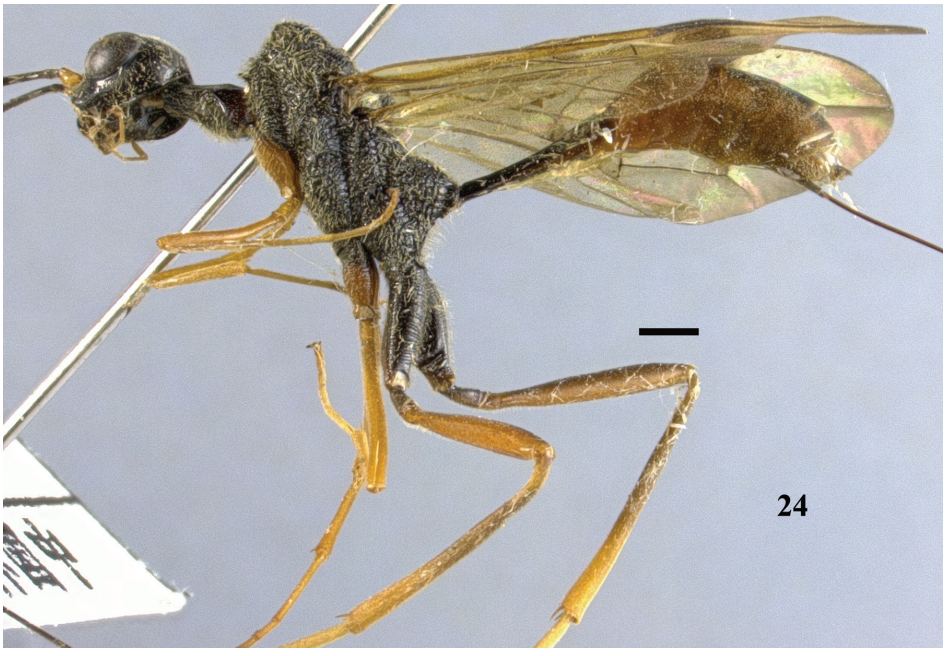
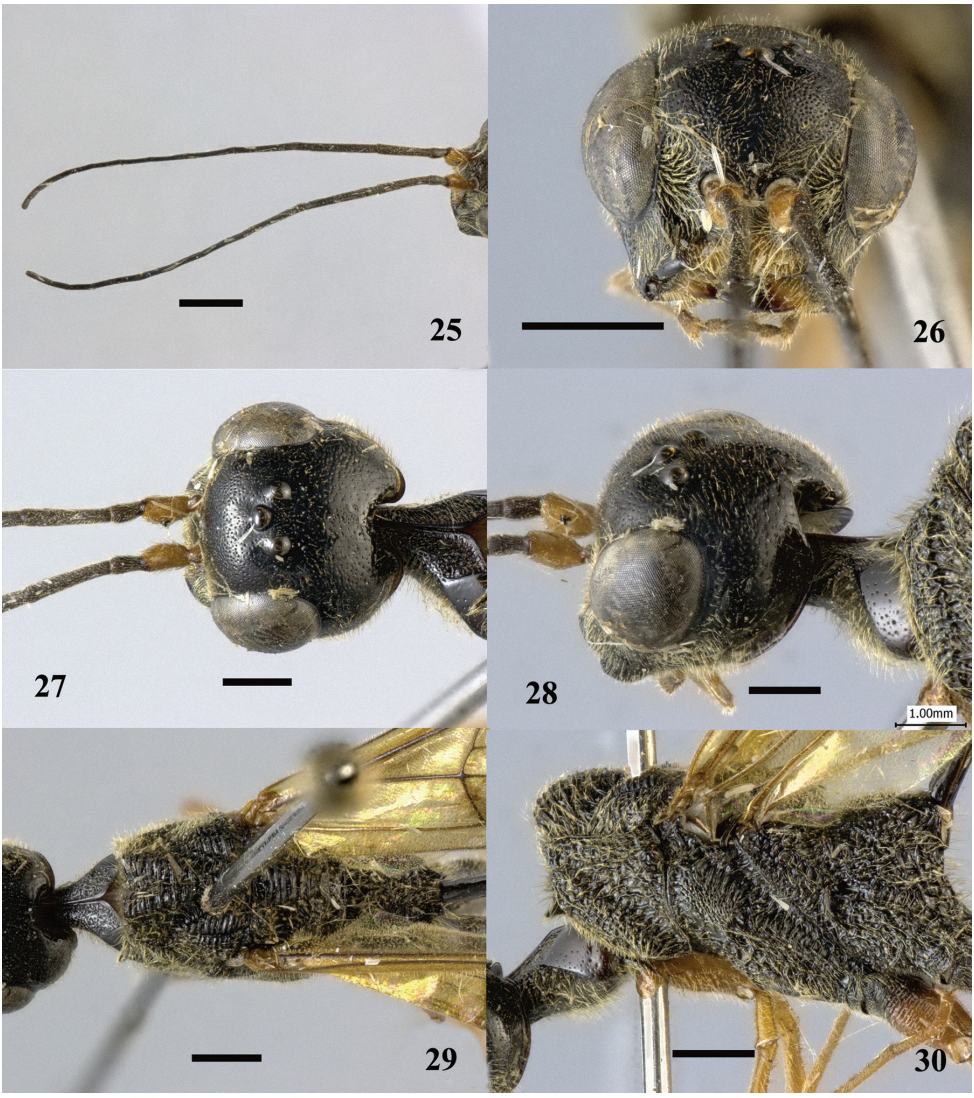


Figure 24. *Pristaulacus centralis* sp. n., holotype, female, habitus, lateral. Scale bar: 1 mm.

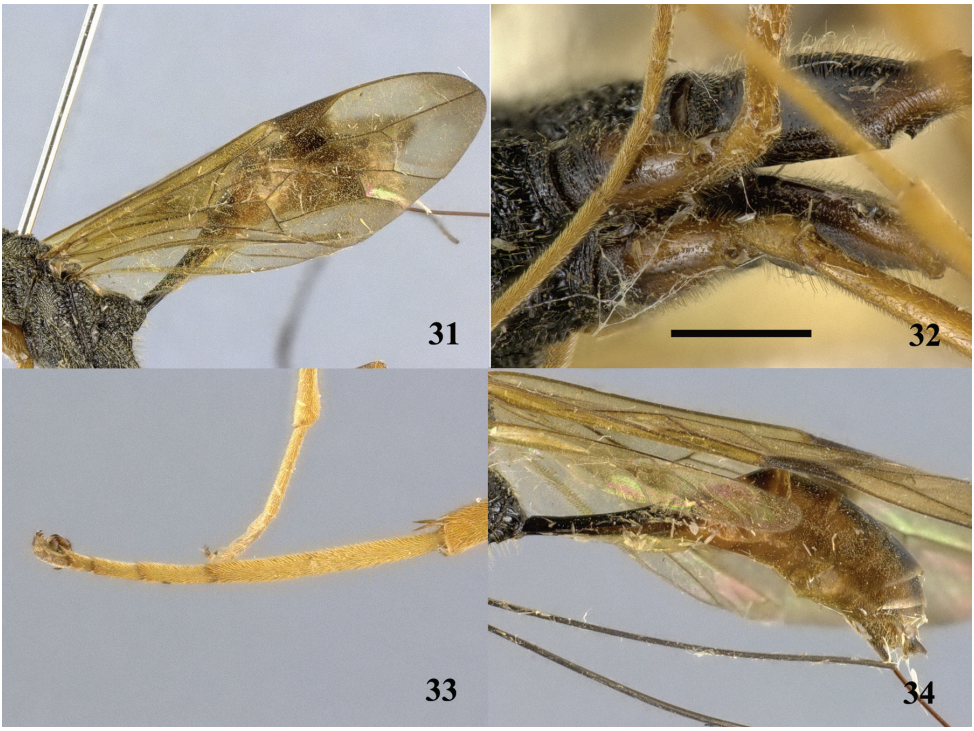


Figures 25–30. *Pristaulacus centralis* sp. n., holotype, female. **25** Antennae **26** head anterior **27** head dorsal **28** head lateral **29** mesosoma dorsal **30** mesosoma lateral. Scale bar: 1 mm.

Diagnosis. Forewing with only one brown spot below stigma; metasoma mostly yellowish-brown with first tergite largely black; occipital margin concave, with a strongly wide and deep medial groove; pronotum with one anteroventrally projecting tooth-like process; mesoscutum mostly transverse-carinate; pretarsal claw with four tooth-like processes; ovipositor 1.6 × forewing length.

Description. Holotype. *Female*. Body length 14.2 mm; forewing length 9.4 mm.

Colour. Antenna black with scape yellowish-orange; head black with clypeus orange; mesosoma black; metasoma mostly yellowish-brown with first tergite largely



Figures 31–34. *Pristaulacus centralis* sp. n., holotype, female. **31** Forewing **32** hind coxae **33** hind tarsus **34** metasoma lateral. Scale bar: 1 mm.

black; mandible orange with teeth dark brown; palpi dark brown; hind coxa black, remainder of legs yellowish-orange with tarsi paler; ovipositor sheath black; forewing infuscate, with dark brown spot under stigma; hind wing hyaline.

Head. From above, 1.3 × wider than long, shiny; lower interocular distance 1.4 × eye height; malar space 0.4 × eye height; occipital margin concave, with a strongly wide and deep medial groove; temple, from above, rounded, slightly shorter than eye length; occipital carina 0.8 × diameter of an ocellus; POL:OOL=1.1; frons, clypeus and marlar space densely and finely punctate; vertex and temple largely smooth with sparse and fine punctures; A3 6.5 × longer than wide; A4 8.7 × longer than wide, and 1.3 × longer than A3; A5 9.6 × longer than wide, and 1.1 × longer than A3.

Mesosoma. Pronotum coarsely areolate-rugose, with one anterior short tooth-like process on lateroventral margin; propleuron dull, largely finely rugose or punctate with small smooth area posterodorsally; mesoscutum mostly transverse-carinate, coarsely rugose on sides, anterior part slightly emarginate medially, rounded laterally; notauli deep and wide; scutellum transverse-carinate in middle, coarsely rugose on posterior margin; axillae, metanotum and propodeum coarsely areolate-rugose; mesopleuron mostly coarsely areolate-rugose with small rugose area anteriodorsally; metapleuron coarsely areolate-rugose; forewing with vein 2-rs+m short, cells SM2 and D1 slightly

separated; hind wing with veins somewhat distinct, cells Cu and R1+Rs contiguous; hind coxa transverse-carinate; hind basitarsus 9.5 × longer than wide, and 1.2 × of tarsomeres 2–5; pretarsal claw with four tooth-like processes.

Metasoma. Smooth, shining, with fine white pubescence on segment 3 to apex; petiole elongate, slender, 4.5 × longer than wide; ovipositor 1.6 × forewing length.

Male. Unknown.

Distribution. China (Hubei).

Biology. Collected in July. Host not known.

Pristaulacus comptipennis Enderlein, 1912

Figs 35–44, 122

Pristaulacus comptipennis Enderlein, 1912: 265.

Pristaulacus comptipennis Enderlein: Enderlein 1913: 319, 326; Hedicke 1939: 7; Konishi 1990: 652; 1991: 564; Smith 2001: 282; Turrisi 2007: 28; Turrisi et al. 2009: 56; Turrisi and Smith 2011: 14.

Material examined. Lectotype, ♀ (SDEI), TAIWAN: Hoozan, Formosa, II.10, H. Sauter/*Pristaulacus comptipennis* Enderl., ♀, Type, Dr. Enderlein det. 1912/Syntypus/ Eberswalde coll. DEI/Lectotypus ♀, *Pristaulacus comptipennis* Enderlein, 1912, des. T. Megjaszai 1999/*Pristaulacus comptipennis* Enderlein, 1912, ♀, Lectotypus G.F. Turrisi

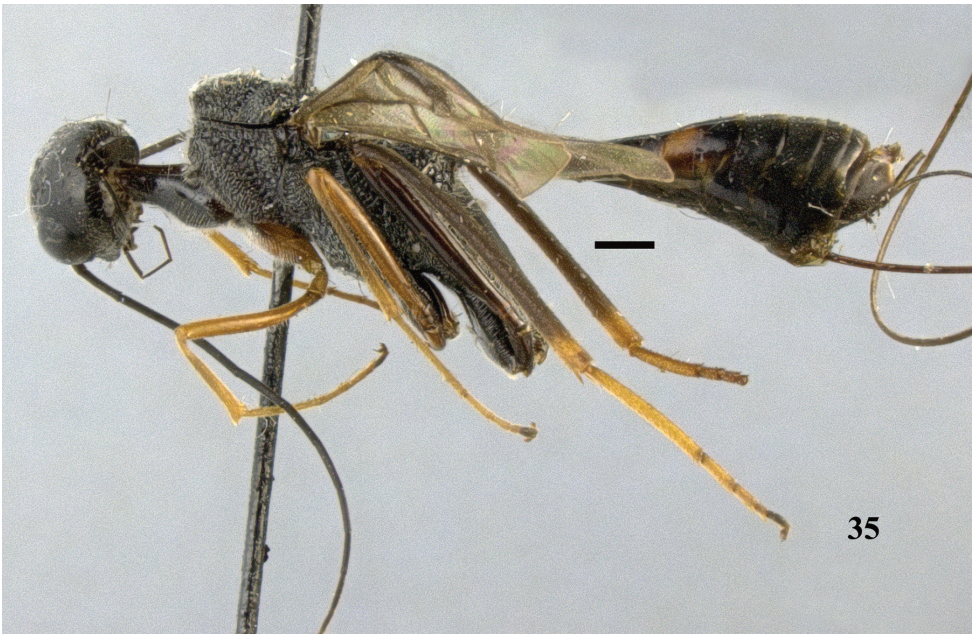
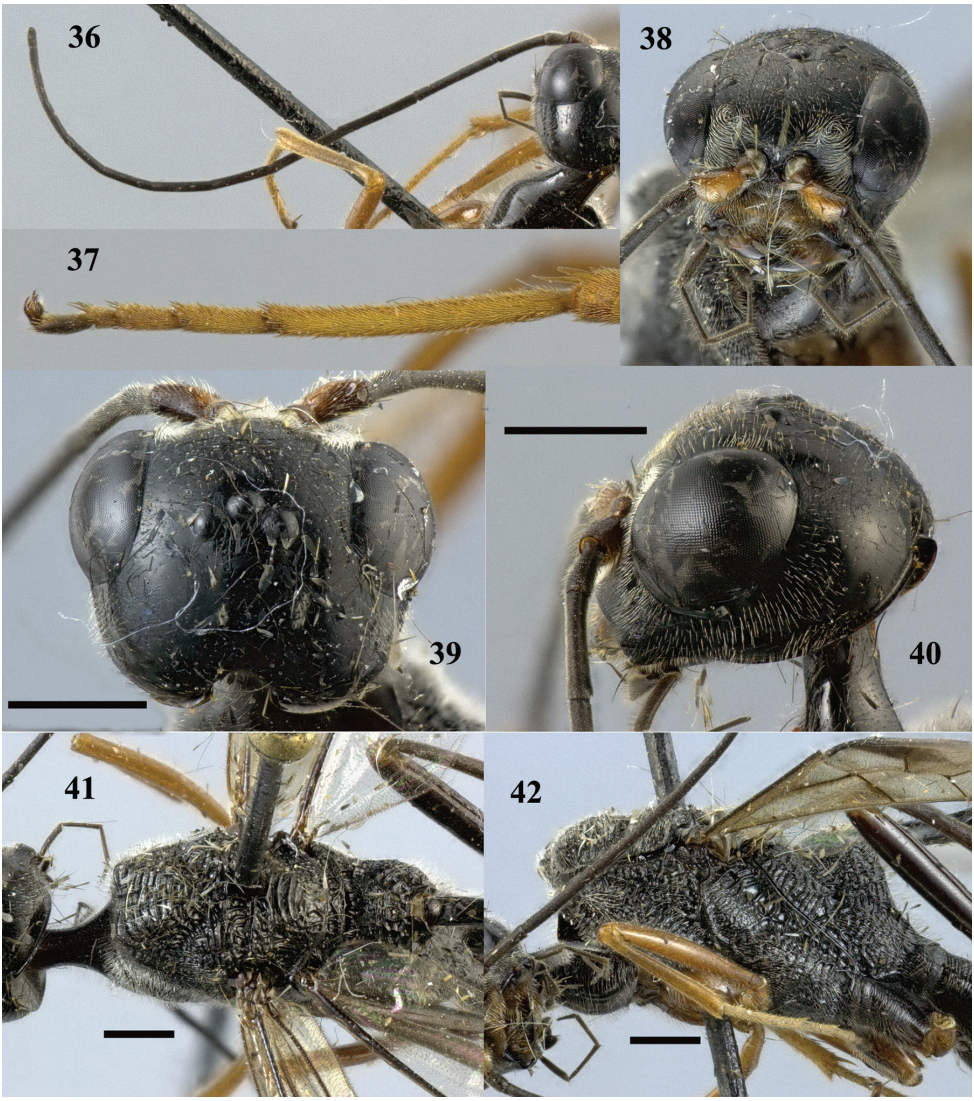
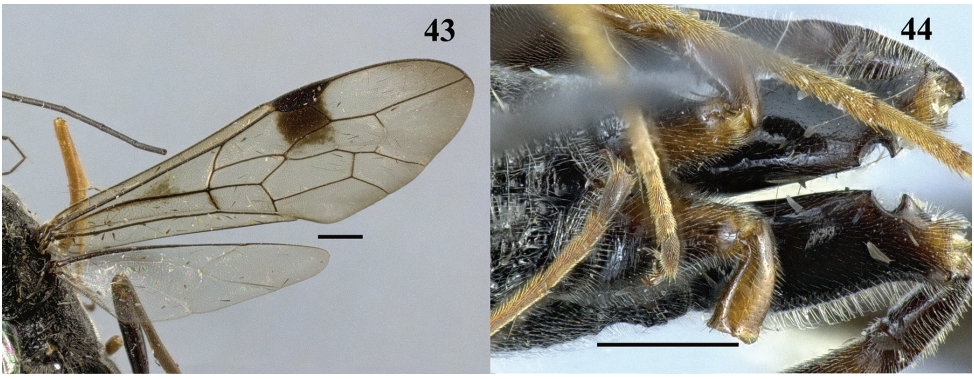


Figure 35. *Pristaulacus comptipennis* Enderlein, 1912, female, habitus, lateral. Scale bar: 1 mm.



Figures 36–42. *Pristaulacus comptipennis* Enderlein, 1912, female. **36** Antenna **37** hind tarsus **38** head anterior **39** head dorsal **40** head lateral **41** mesosoma dorsal **42** mesosoma lateral. Scale bar: 1 mm.

des. 2006. Paralectotypes: 2 ♀♀ (SDEI), Hoozan, Formosa, V.10, H. Sauter/*Pristaulacus comptipennis* Enderl., ♀, Type, Dr. Enderlein det. 1912/Syntypus/Eberswalde coll. DEI/ Paralectotypus ♀, *Pristaulacus comptipennis* Enderlein, 1912, des. T. Megjaszai 1999/ *Pristaulacus comptipennis* Enderlein, 1912, ♀, Paralectotypus G.F. Turrisi des. 2006. Additional material: 1 ♀ (SDEI), Taiwan, Hoozan, V.1910, H. Sauter; 2 ♀♀ (SDEI), Taiwan, Anping, 22.VII.1911, H. Sauter; 1 ♀ (SDEI), Taiwan, Kankau (Koshun), V.1912, H. Sauter; 2 ♀♀ (SDEI, USNM), Taiwan, Kosempo, H. Sauter; 1 ♀ (SDEI),



Figures 43–44. *Pristaulacus comptipennis* Enderlein, 1912, female. **43** Forewing and hind wing **44** hind coxae. Scale bar: 1 mm.

Taiwan, Kosempo, 1911, H. Sauter; 2 ♂♂ (SDEI, USNM), Taiwan, Kosempo, 1912, H. Sauter; 7 ♂♂ (SDEI), Taiwan, Kosempo, V.1912, H. Sauter; 2 ♀♀, 2 ♂♂ (SDEI), Taiwan, Tainan, 22.VII.1911, H. Sauter; 2 ♀♀ (SDEI), Taiwan, Taihorin, V.1910, H. Sauter; 1 ♀ (ZMHB), Taiwan, Hoozan, IX.1910, Sauter (ZMHB); 2 ♀♀ (ZMHB), Taiwan, Taihorish, VI.1910, H. Sauter S-G.; 1 ♀, 1 ♂ (ZMHB), Taiwan, IX.1910; 1 ♂ (ZMHB), Taiwan, X.1910; 1 ♀ (HNHM), Taiwan, Taihorinsho, IX.1909, Sauter; 3 ♀♀ (HNHM), Taiwan, Kosempo, IX.1909, Sauter; 1 ♀ (LACM), Taiwan, Puli Village, Nam-tou, Hsien, 15-30.XII.1963, coll. K.H. Chen. 1 ♀ (NHRS) Taiwan, Hoozan, 7.IX.1910, H. Sauter leg. (labelled as "Cotypus"); 1 ♂ (USNM), Taiwan, Keelung, 1910, Victor Kühne leg. CHINA: 1 ♀ (IZCAS), Hainan, Mt. Jianfengling, 2.VI.1982, Pei-zheng Chen, IOZ(E) 1903947; 1 ♀ (SCAU), Hunan, Yongzhou, 27.VI.1981, Tong Xin-wang; 1 ♀ (USNM), Hong Kong, Pak Sha O, 22.25N, 114.19E, 3.VI.2005, Ch. Bartelemy leg.; 1 ♀ (TCUC), Hong Kong, Tai Po Kau Forest, 50Q KK 094 813, 370 m, 21.VI.2006, Ch. Barthélémy leg.

Diagnosis. Antenna black with scape brown; forewing with wide and irregular brown spots on basal part, below stigma and on apex; metasoma black with second tergite brown anteriorly; occipital margin concave, with a wide and deep medial groove; pronotum with one anteroventrally projecting tooth-like process; ovipositor 1.2 × forewing length.

Distribution. China (Taiwan, Hunan, Hongkong, Hainan); Korea; Japan; Laos (Turrisi and Smith 2011; Choi et al. 2013).

Remarks. Redescriptions and data on intraspecific variation are provided by Konishi (1990, 1991) and Turrisi (2007). Additional notes on identification and distribution are provided by Turrisi and Smith (2011).

Biology. Collected in May–July, September, October, and December. Host: *Ceresium elongatum* Matsushita, 1933 (Coleoptera, Cerambycidae) (Konishi 1991) and *Olenecamptus bilobus nipponensis* Dillon & Dillon (Coleoptera, Cerambycidae) (Turrisi and Smith 2011).

***Pristaulacus excisus* Turner, 1922**
Figs 45–55, 122

Pristaulacus excisus Turner 1922: 271.
Pristaulacus excisus Turner: Hedicke 1939: 7; Smith 2001: 283; Turrisi et al. 2009: 57; Turrisi and Smith 2011: 25.

Material examined. Holotype, ♀ (BMNH) examined (see Turrisi and Smith 2011). Additional material: 1 ♂ (IZCAS), CHINA: Guangxi, Ningming, 102 m, 17.V.1984, Gui-biao Luo, IOZ(E) 1903963; 1 ♂ (IZCAS), Guangxi, Chongming, 110 m, 20.V.1984, Jin-yi Huang, IOZ(E) 1903964.

Diagnosis. Metasoma black with transverse patch near posterior margin of first tergite and anterior margin of second tergite yellowish-brown; forewing infuscate, with anterior third darker and dark brown spot under stigma; occipital margin concave, V-shaped, its depth very shallow; pronotum with one anteroventrally projecting tooth-like process; pretarsal claw with four tooth-like processes.

Distribution. China (Guangxi); Vietnam (Turrisi and Smith 2011).

Biology. Collected in May and August (Turrisi and Smith 2011). Host not known.

Remarks. Redescription is provided by Turrisi (2007). This is the first description of the male and the first record of this species from China.

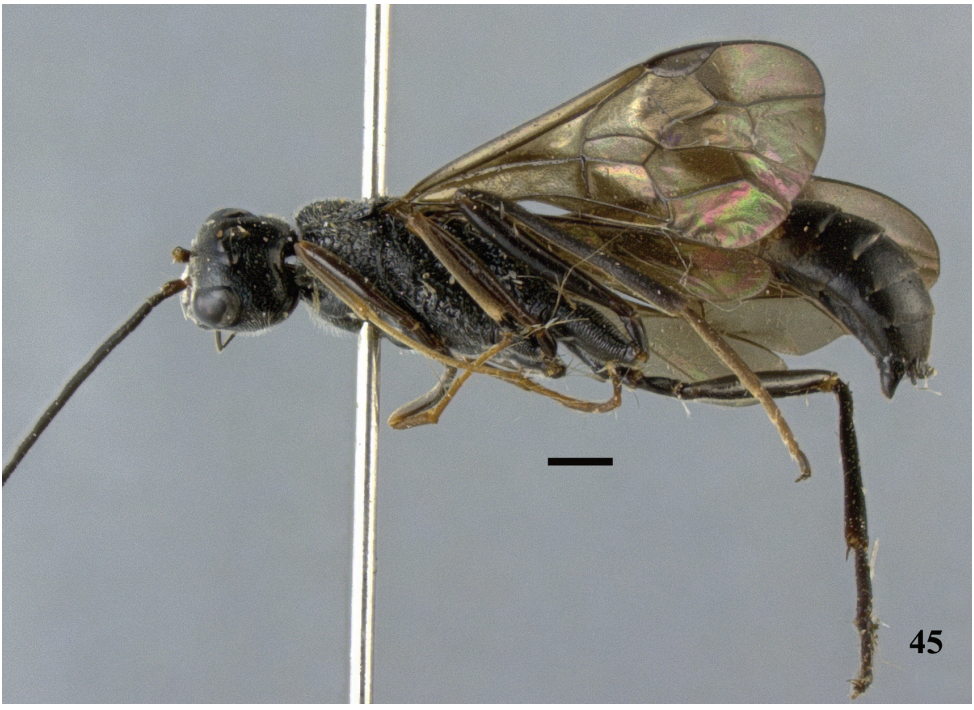
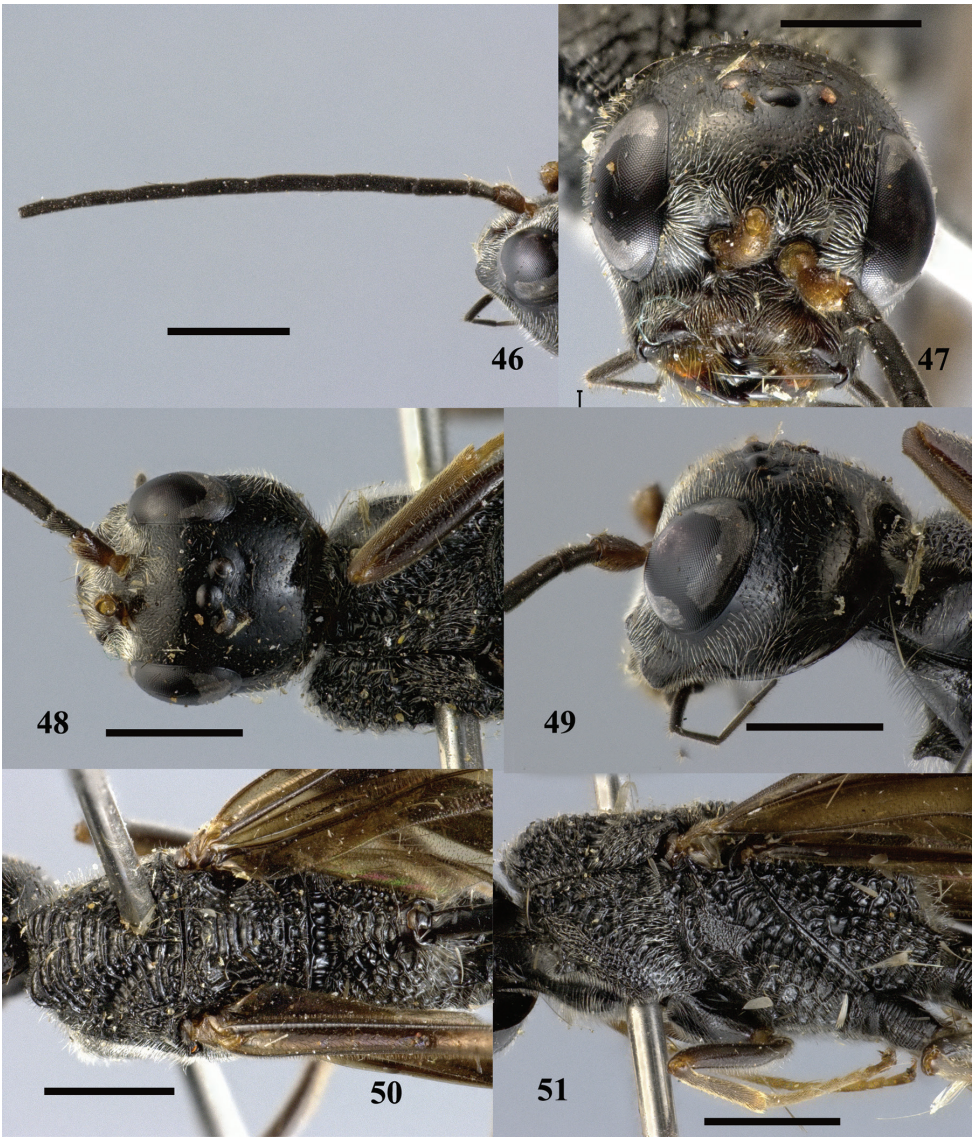


Figure 45. *Pristaulacus excisus* Turner, 1922, male, habitus, lateral. Scale bar: 1 mm.

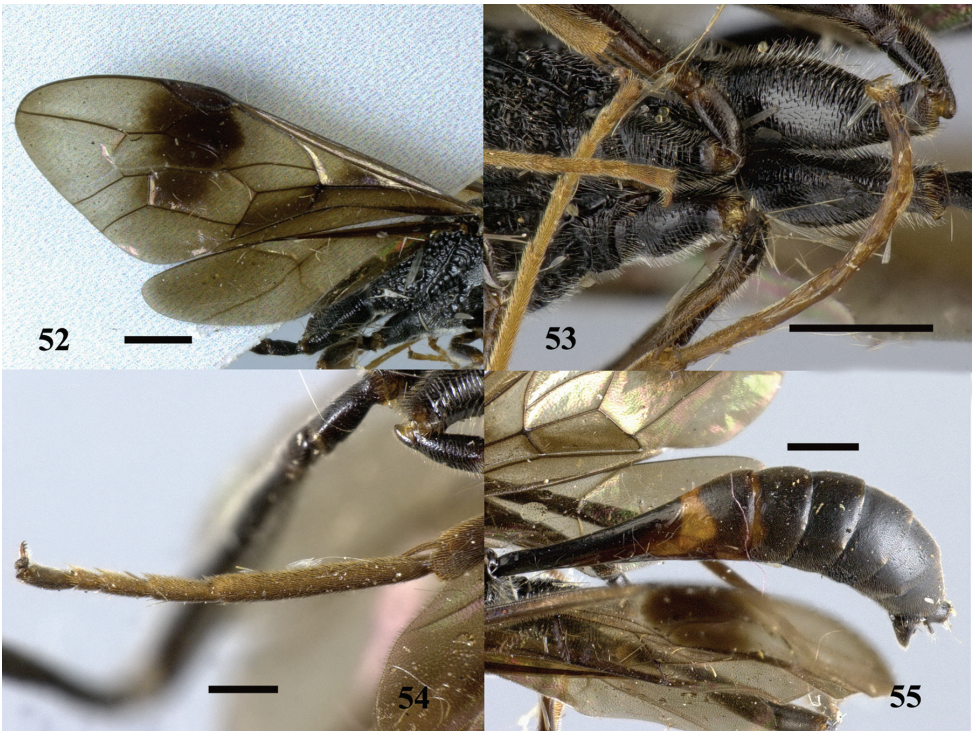


Figures 46–51. *Pristaulacus excisus* Turner, 1922, male. **46** Antenna **47** head anterior **48** head dorsal **49** head lateral **50** mesosoma dorsal **51** mesosoma lateral. Scale bar: 1 mm.

***Pristaulacus fopingi* sp. n.**
http://zoobank.org/68C2B82D-9CEB-48BD-9097-DEF7A9CE4E2A
Figs 56–65, 122

Material examined. Holotype, ♂ (IZCAS), CHINA: Shaanxi, Foping, 900 m, 27.VI.1999, Jian Hu, IOZ(E) 1903962.

Etymology. Named after the type locality.



Figures 52–55. *Pristaulacus excisus* Turner, 1922, male. **52** Forewing and hind wing **53** hind coxae **54** hind tarsus **55** metasoma lateral. Scale bar: 1 mm.

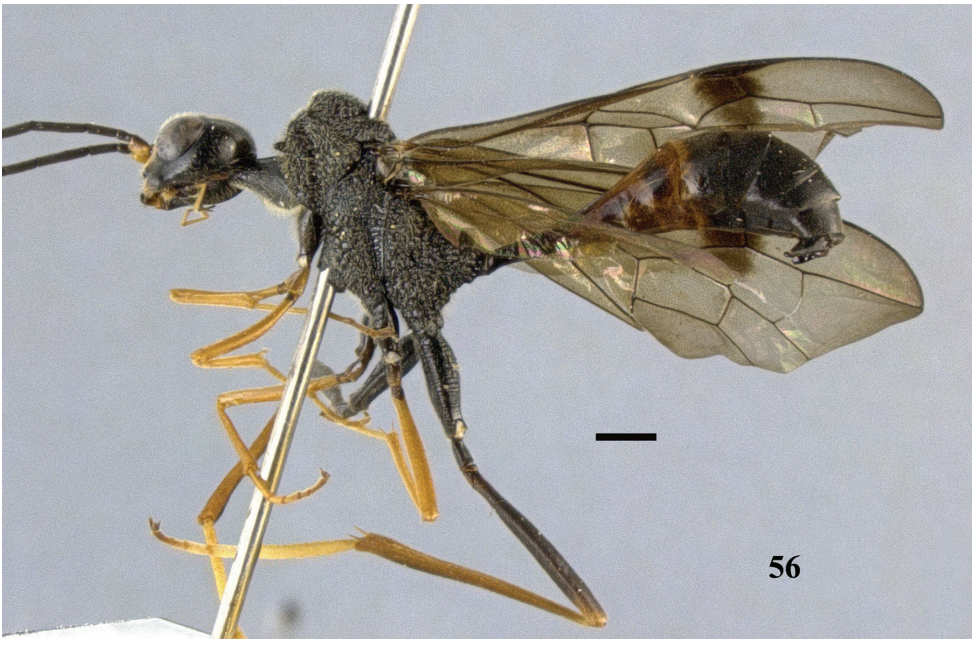
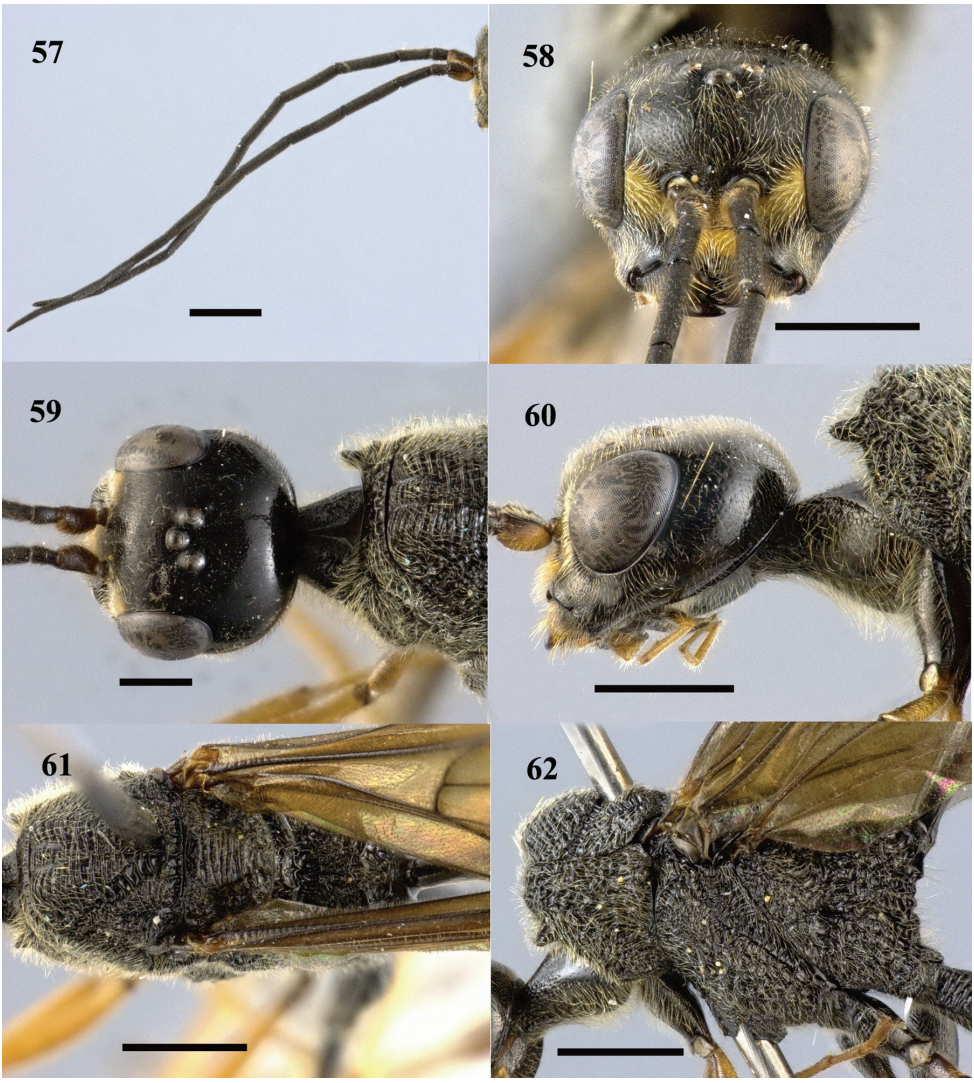


Figure 56. *Pristaulacus fopingi* sp. n., holotype, male, habitus, lateral. Scale bar: 1 mm.

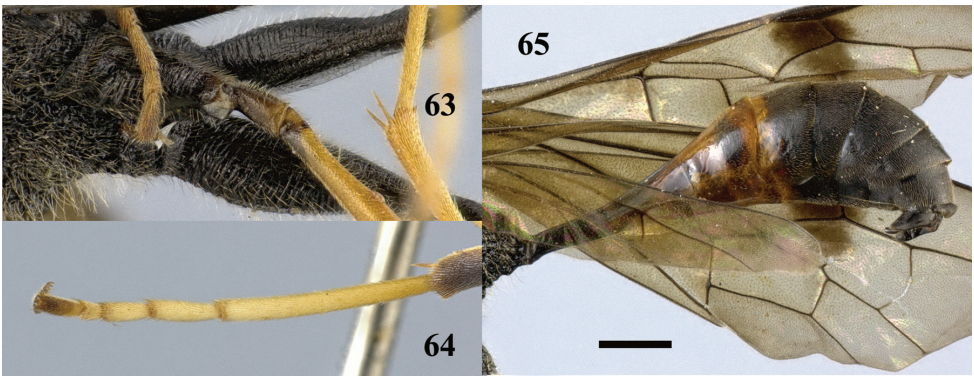


Figures 57–62. *Pristaulacus fopingi* sp. n., holotype, male. **57** Antennae **58** head anterior **59** head dorsal **60** head lateral **61** mesosoma dorsal **62** mesosoma lateral. Scale bar: 1 mm.

Diagnosis. Frons with yellow areas around antennae; hind margin of head straight, without medial groove; lateroventral margin of pronotum with one tooth-like process; propleuron largely finely rugose with small smooth area posterodorsally; forewing with vein 2-rs+m long, cells SM2 and D1 distantly separated; hind coxa transverse-carinate.

Description. Holotype. *Male*. Body length 12.3 mm; forewing length 8.8 mm.

Colour. Antenna black with scape brown; head black with clypeus and lower frons under antennal sockets yellow; mesosoma black; metasoma black with first tergite and



Figures 63–65. *Pristaulacus fopingi* sp. n., holotype, male. **63** Hind coxae **64** hind tarsus **65** metasoma lateral. Scale bar: 1 mm.

anterior margin of second tergite brown; mandible dark brown; palpi yellowish-brown; coxae and hind femura black, remainder of legs yellowish-orange with tarsi paler; forewing slightly infuscate, with dark brown spot under stigma; hind wing hyaline.

Head. From above, 1.2 × wider than long, shiny; lower interocular distance 1.5 × eye height; malar space 0.3 × eye height; occipital margin straight; temple, from above, rounded, slightly shorter than eye length; occipital carina 0.1 × diameter of an ocellus; POL:OOL=0.8; frons above antennal sockets and marlar space densely and finely punctate, remainder of head largely smooth with sparse and fine punctures; A3 3.0 × longer than wide; A4 5.0 × longer than wide, and 1.6 × longer than A3; A5 5.4 × longer than wide, and 1.7 × longer than A3.

Mesosoma. Pronotum coarsely areolate-rugose, with one anterior short tooth-like process on each lateroventral margin; propleuron dull, largely finely rugose with small smooth area posterodorsally; mesoscutum transverse-carinate anteriorly, coarsely areolate-rugose posterior to notauli, anterior part emarginate medially, rounded laterally; notauli deep and wide posteriorly, becoming narrower anteriorly; scutellum transverse-carinate in middle, coarsely rugose on posterior margin; axillae, metanotum and propodeum coarsely areolate-rugose; mesopleuron mostly coarsely areolate-rugose with small rugose area anteriodorsally; metapleuron coarsely areolate-rugose; forewing with vein 2-rs+m long, cells SM2 and D1 distantly separated; hind wing with veins distinct, cells Cu and R1+Rs contiguous; hind coxa transverse-carinate; hind basitarsus 9.6 × longer than wide, and 1.2 × of tarsomeres 2–5; pretarsal claw with four tooth-like processes.

Metasoma. Smooth, shining, with fine white pubescence on segment 3 to apex; petiole elongate, slender, 3.5 × longer than wide.

Female. Unknown.

Distribution. China (Shaanxi).

Biology. Collected in June. Host not known.

***Pristaulacus intermedius* Uchida, 1932**
Figs 66–75, 122

Pristaulacus intermedius Uchida, 1932: 190.
Pristaulacus intermedius Uchida: Hedicke 1939: 11; Smith 2001: 288; Turrisi 2007: 48; Lee and Turrisi 2008: 115; Turrisi et al. 2009: 57; Smith and Tripotin 2011: 523.

Material examined. CHINA: 1 ♀ (IZCAS), Jilin, Jiaogou, 21.VII.1985, IOZ(E) 1903967; 1 ♀ (IZCAS), Jilin, Mangjiang, 26.VII.1955, Zhi-yin Li, IOZ(E) 1903965; 1 ♀ (IZCAS); Yunnan, Menghai, 17.IV.1982, Chun-mei Huang, IOZ(E) 1903966; 1 ♀ (OLML), Shaanxi province, Mounts Qinling, Xunyangba (6 km E), 1000–1300 m, 23.V–13.VI.1998, I.H. Marshal leg.

Diagnosis. Forewing slightly infuscate, with large dark brown spot under stigma; metasoma entirely blackish, at most slightly lightened basally; basal antennomeres

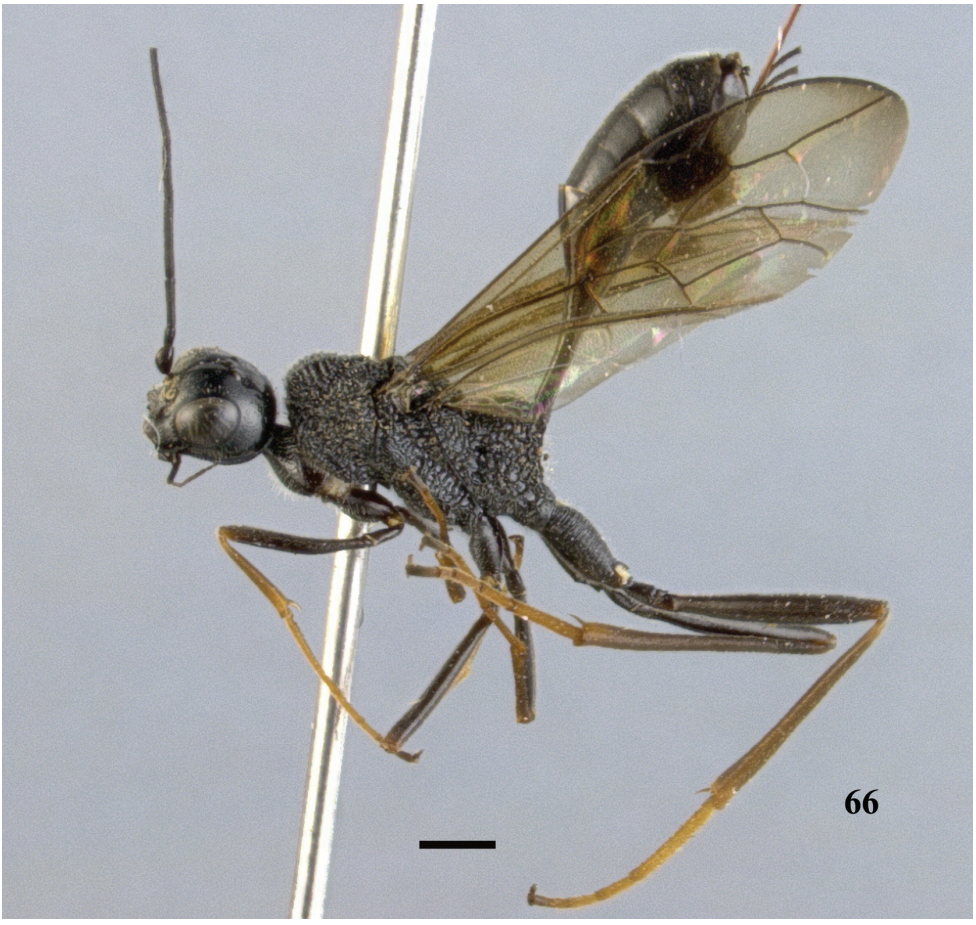
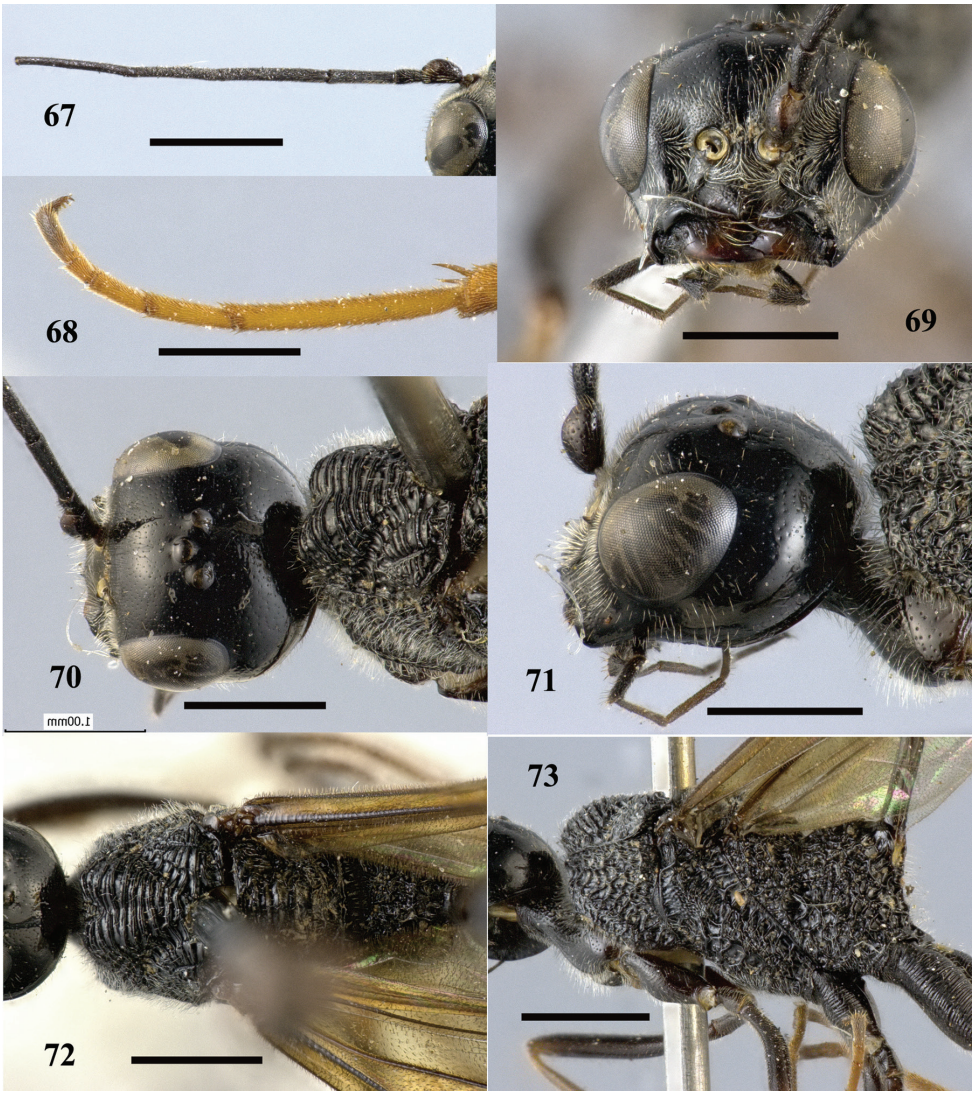


Figure 66. *Pristaulacus intermedius* Uchida, 1932, female, habitus, lateral. Scale bar: 1 mm.



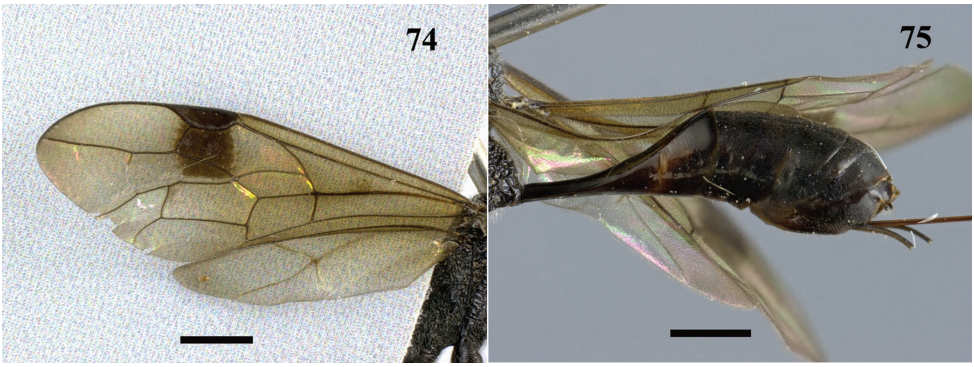
Figures 67–73. *Pristaulacus intermedius* Uchida, 1932, female. **67** Antenna **68** hind tarsus **69** head anterior **70** head dorsal **71** head lateral **72** mesosoma dorsal **73** mesosoma lateral. Scale bar: 1 mm.

elongate (A3 5.0–6.0 × longer than wide, A4 10.0 × longer than wide); occipital margin straight, wide, 0.5 × diameter of ocellus, lamelliform, brownish; lateroventral margin of pronotum without process; ovipositor 1.3 × forewing length.

Distribution. China (Liaoning, Jilin, Shaanxi, Yunnan); Japan; South Korea (Lee and Turrisi 2008; Smith and Tripotin 2011).

Biology. Collected from April to August. Host: *Chlorophorus japonicus* (Chevrolat, 1863) (Coleoptera, Cerambycidae) (Uchida 1932).

Remarks. This is the first record of this species from the Oriental Region.



Figures 74–75. *Pristaulacus intermedius* Uchida, 1932, female. **74** Forewing and hind wing **75** metasoma lateral. Scale bar: 1 mm.

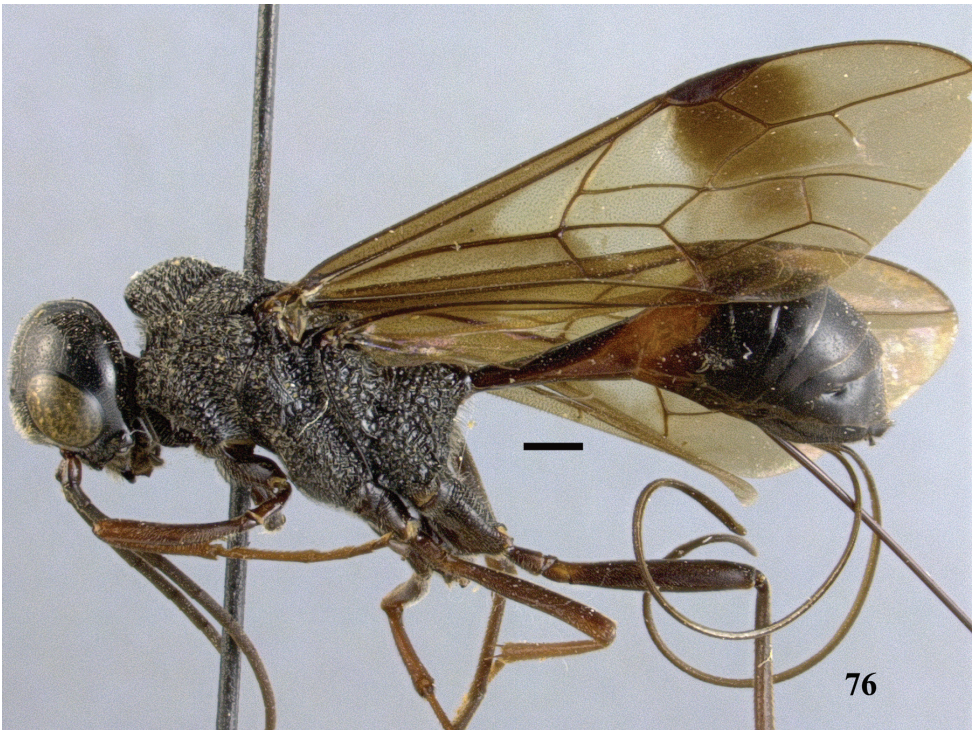


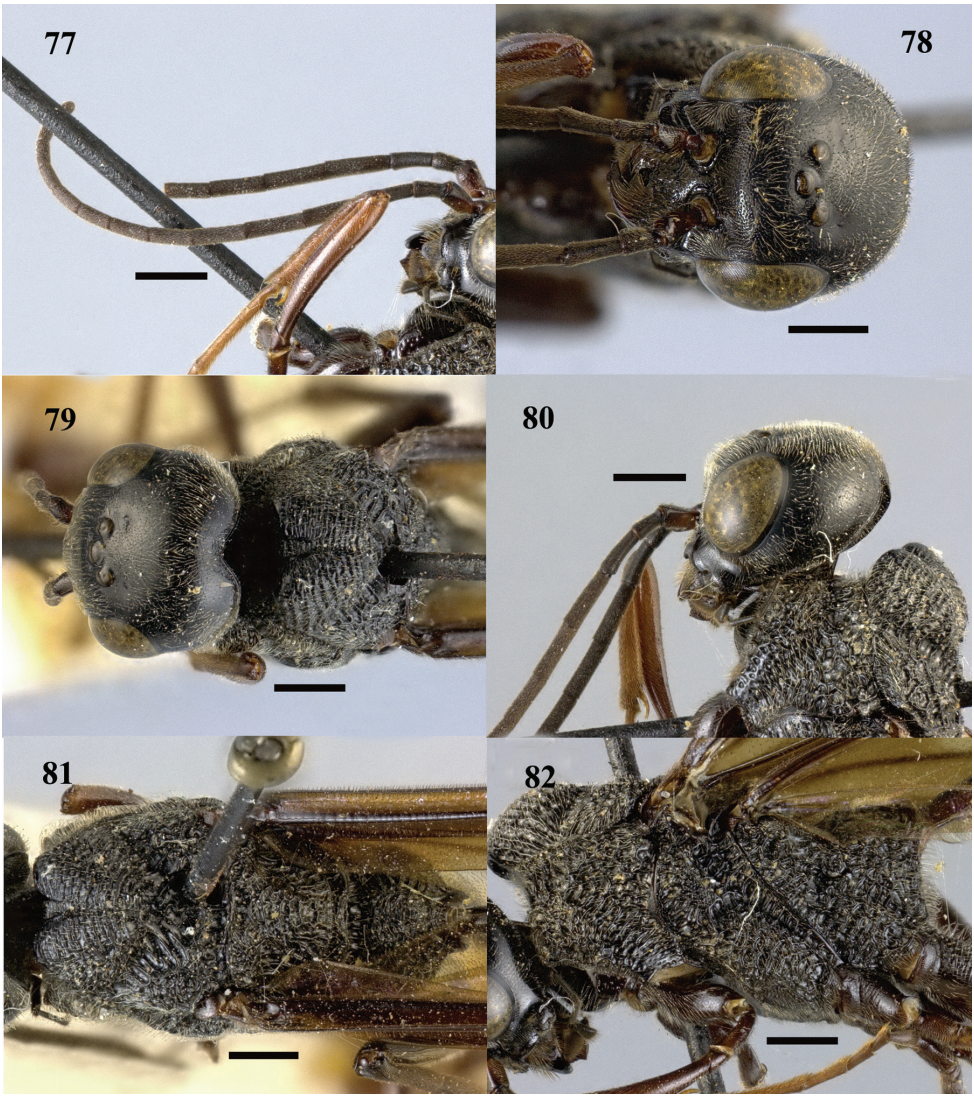
Figure 76. *Pristaulacus iosephi* Turrisi & Madl, 2013, female, habitus, lateral. Scale bar: 1 mm.

Pristaulacus iosephi Turrisi & Madl, 2013

Figs 76–87, 122

Pristaulacus iosephi Turrisi & Madl, 2013: 239.

Material examined. Holotype, ♀ (BPBM), THAILAND: NW. Chiangmai: Fang, 500 m. IV–12–19–'58/T.C. Maa Collector, No. 388/*Pristaulacus iosephi* Turrisi and



Figures 77–82. *Pristaulacus iosephi* Turrisi & Madl, 2013, female. **77** Antennae **78** head anterior **79** head dorsal **80** head lateral **81** mesosoma dorsal **82** mesosoma lateral. Scale bar: 1 mm.

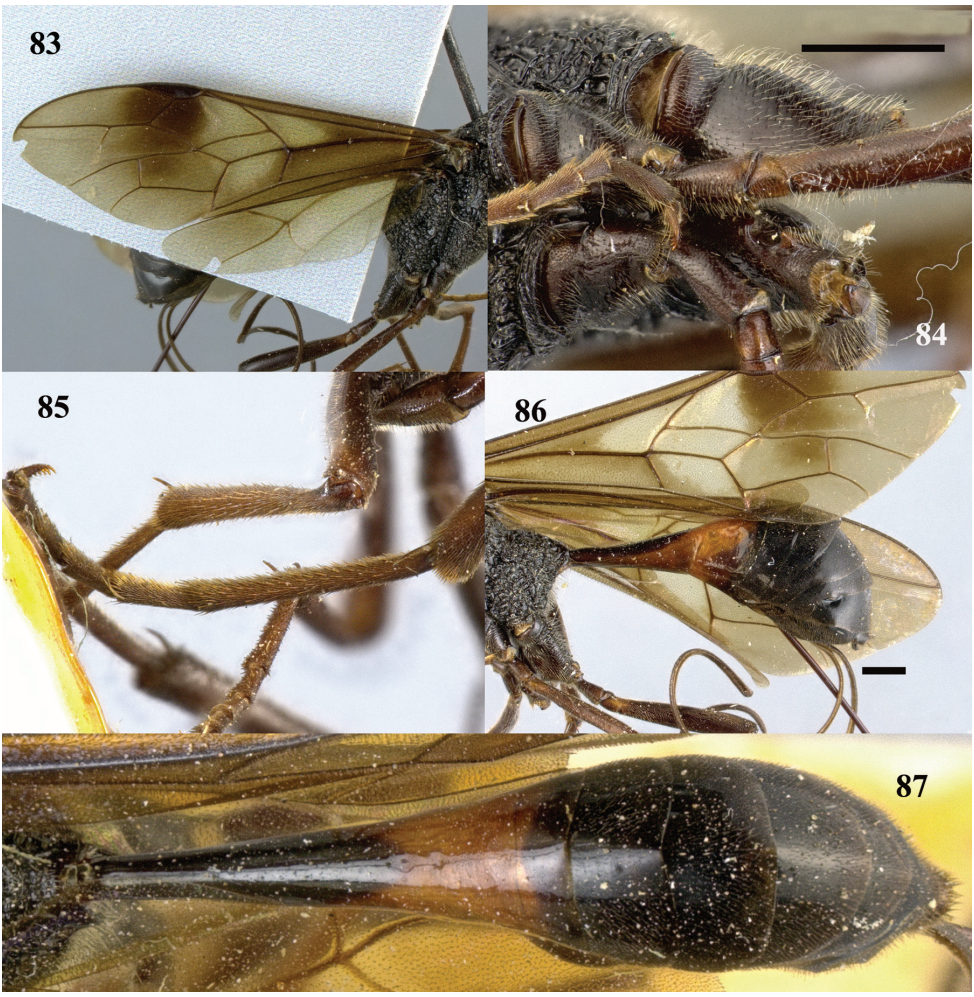
Madl sp. n. ♀ 2010 Holotypus. Additional material: CHINA: 1 ♀ (IZCAS), Yunnan, Baoshan, 1700 m, 18.V.1955, Крыжановский О. Л., IOZ(E) 1903954.

Diagnosis. Metasoma black with posterior half of first tergite brown; forewing infuscate, with anterior third darker and large dark brown spot under stigma; lateral margin of pronotum with two well-developed tooth-like processes; pretarsal claw with six tooth-like processes; ovipositor 0.8 × forewing length.

Distribution. China (Yunnan); Thailand (Turrisi and Madl 2013).

Biology. Collected in April and May. Host not known.

Remarks. This species is newly recorded from China.



Figures 83–87. *Pristaulacus iosephi* Turrisi & Madl, 2013, female. **83** Forewing and hind wing **84** hind coxae **85** hind tarsus **86** metasoma lateral **87** metasoma dorsal. Scale bar: 1 mm.

Pristaulacus karinulus Smith, 2001

Fig. 122

Pristaulacus kiefferi Enderlein, 1912: 266 (preoccupied by Bradley 1908).
Pristaulacus karinulus Smith, 2001: 288 (replacement name for *Pristaulacus kiefferi* Enderlein, 1912).
Pristaulacus karinulus Smith: Sun and Sheng 2007a: 219; Turrisi et al. 2009: 57.

Material examined. CHINA: 1 ♀, Taiwan (Hoozan), labelled as syntypus of *Pristaulacus kiefferi* (SDEI).

Diagnosis. Metasoma extensively reddish orange; basal antennomeres elongate (A3 5.0–6.0 × longer than wide, A4 10.0 × longer than wide); occipital carina straight, wide, 0.5 × diameter of ocellus, lamelliform, brownish.

Distribution. China (Henan, Jiangsu, Taiwan) (Sun and Sheng 2007a); India (Smith 2001).

Biology. Collected from May to July. Host not known.

Remarks. Sun and Sheng (2007a) recorded this species from Henan and Jiansu. However, we were unable to examine Sun & Sheng's specimens.

Pristaulacus longicornis Kieffer, 1911

Pristaulacus longicornis Kieffer, 1911: 230.
Pristaulacus longicornis Kieffer: Kieffer 1912: 386; Hedicke 1939: 12; Smith 2001: 289; Turrisi 2007: 54; Turrisi et al. 2009: 57.

Material examined. Holotype, ♀, CHINA: "B.M. Type Hym. 3.a.99/*Pristaulacus longicornis* Kieff./F. Sm. Coll. 79.22/ determined by Dr. Kieffer" (BMNH).

Diagnosis. Mandible extensively dark red, with base and apex blackish; forewing slightly infuscate at apex, with a small irregular and narrow brown substigmal spot and a small irregular brown spot on middle part of B; metasoma reddish-brown, with T1 and T2 extensively reddish-orange and petiole blackish; occipital carina wide, lamelliform, 0.5 × diameter of an ocellus; A3 8.3 × longer than wide; A4 14.0 × longer than wide, and 1.7 × longer than A3; pronotum with a weak anterior tooth-like process on lateroventral margin; hind basitarsus 14.0 × longer than wide, and slightly longer than tarsomeres 2–5; pretarsal claw with four tooth-like processes; metasoma with petiole elongate and slender, 2.0 × longer than wide.

Distribution. China (unknown whether Palaearctic or Oriental) (Turrisi 2007; Turrisi et al. 2009).

Biology. Unknown.

Remarks. Redescription is provided by Turrisi (2007).

Pristaulacus memnonius Sun & Sheng, 2007

Fig. 122

Pristaulacus memnonius Sun & Sheng, 2007a: 217.
Pristaulacus memnonius Sun & Sheng: Turrisi et al. 2009: 57.

Material examined. Paratype: 1 ♀ (SFPS), CHINA: Lingshan, Henan, 1999.5.24, M.-L. Sheng//400–500 m, 1999.5.24/*Pristaulacus memnonius* Sun & Sheng.

Diagnosis. Hind margin of head straight; occipital carina about 0.2 × diameter of ocellus, pad-shaped, blackish; lateroventral margin of pronotum with one tooth-like process; hind coxa entirely smooth, polished.

Distribution. China (Henan) (Sun and Sheng 2007a).

Biology. Collected in May (Sun and Sheng 2007a). Host not known.

Pristaulacus nobilei Turrisi & Smith, 2011

Fig. 122

Pristaulacus nobilei Turrisi & Smith, 2011: 41.

Material examined. Holotype, ♀ (ZMHB), CHINA: Canton (China), Westfluss, Ting-Wu-San, Mell S.G./Zool. Mus. Berlin/[unreadable handwritten label]/*Pristaulacus nobilei* Turrisi & Smith sp. n., ♀, 2009, Holotypus. Paratypes: 1 ♀ (USNM), F, China, NGistGee, coll./*Pristaulacus nobilei* Turrisi & Smith sp. n., ♀, 2009, Paratypus; 3 ♀♀ (BMNH), China Macao/*Pristaulacus nobilei* Turrisi & Smith sp. n., ♀, 2009, Paratypus; 1 ♀ (USNM), Tai-o Lantau Isl, Hong Kong, VI.12.1978/RD Montgomery colr/Davis/USNM 2046975/*Pristaulacus nobilei* Turrisi & Smith sp. n., ♀, 2009, Paratypus.

Diagnosis. Metasoma with second tergite extensively dark reddish; occipital margin weakly grooved medially; lateroventral margin of pronotum with two well-developed tooth-like processes; pretarsal claw with six tooth-like processes; ovipositor 1.4 × forewing length.

Distribution. China (Jiangsu, Guangdong, Hongkong, Macao) (Turrisi and Smith 2011).

Biology. Collected in June. Host not known (Turrisi and Smith 2011).

Pristaulacus obscurus sp. n.

http://zoobank.org/65606CFD-531D-4BD4-9AED-FB05CC4976C5

Figs 88–98, 122

Material examined. Holotype, ♀ (IZCAS), CHINA: Yunnan, Nanhua County, 2400 m, 24.VI.1980, Pei-zhi Yang, IOZ(E) 1903948. Paratype, 1 ♀ (IZCAS), CHINA: Yunnan, Jingdong, Waidaba, 1250 m, 26.V.1956, Xing-chi Yang, IOZ(E) 1903949.

Etymology. From the Latin adjective "*obscurus*", meaning "dark, black", a noun in apposition.

Diagnosis. Body and legs entirely black; forewing hyaline, with dark brown spot under stigma; occipital margin straight; lateroventral margin of pronotum with one tooth-like processes; forewing with vein 2-rs+m long, cells SM2 and D1 distantly separated; ovipositor 0.8 × forewing length.

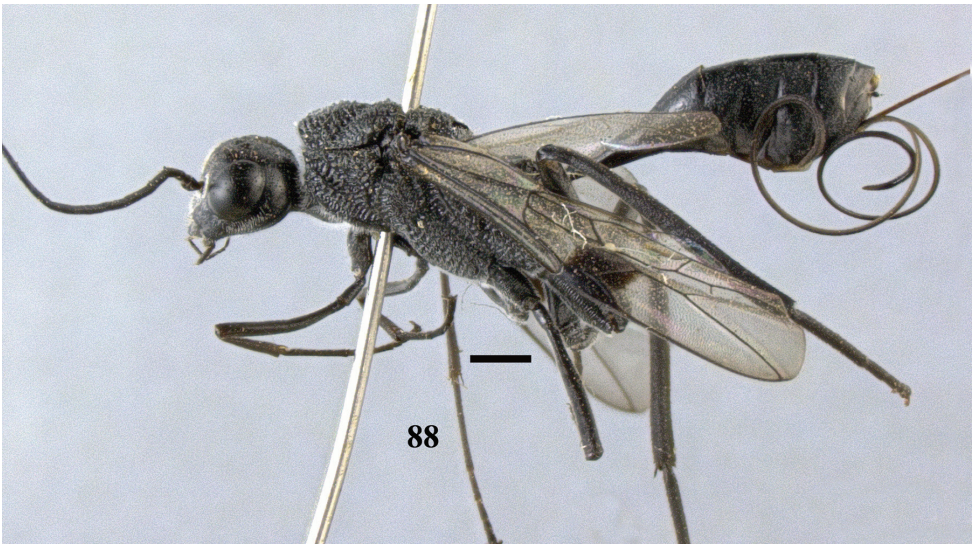


Figure 88. *Pristaulacus obscurus* sp. n., holotype, female, habitus, lateral. Scale bar: 1 mm.

Description. Holotype. *Female*. Body length 12.0 mm; forewing length 9.4 mm.

Colour. Black except: forewing hyaline, with dark brown spot under stigma; hind wing hyaline.

Head. From above, 1.3 × wider than long, shiny; lower interocular distance 1.7 × eye height; malar space 0.3 × eye height; occipital margin straight; temple, from above, rounded, distinctly shorter than eye length; occipital carina 0.1 × diameter of an ocellus; POL:OOL=1.0; head largely smooth except frons above and lateral antenna densely and finely punctate; A3 3.7 × longer than wide; A4 6.0 × longer than wide, and 1.6 × longer than A3; A5 6.3 × longer than wide, and 1.8 × longer than A3.

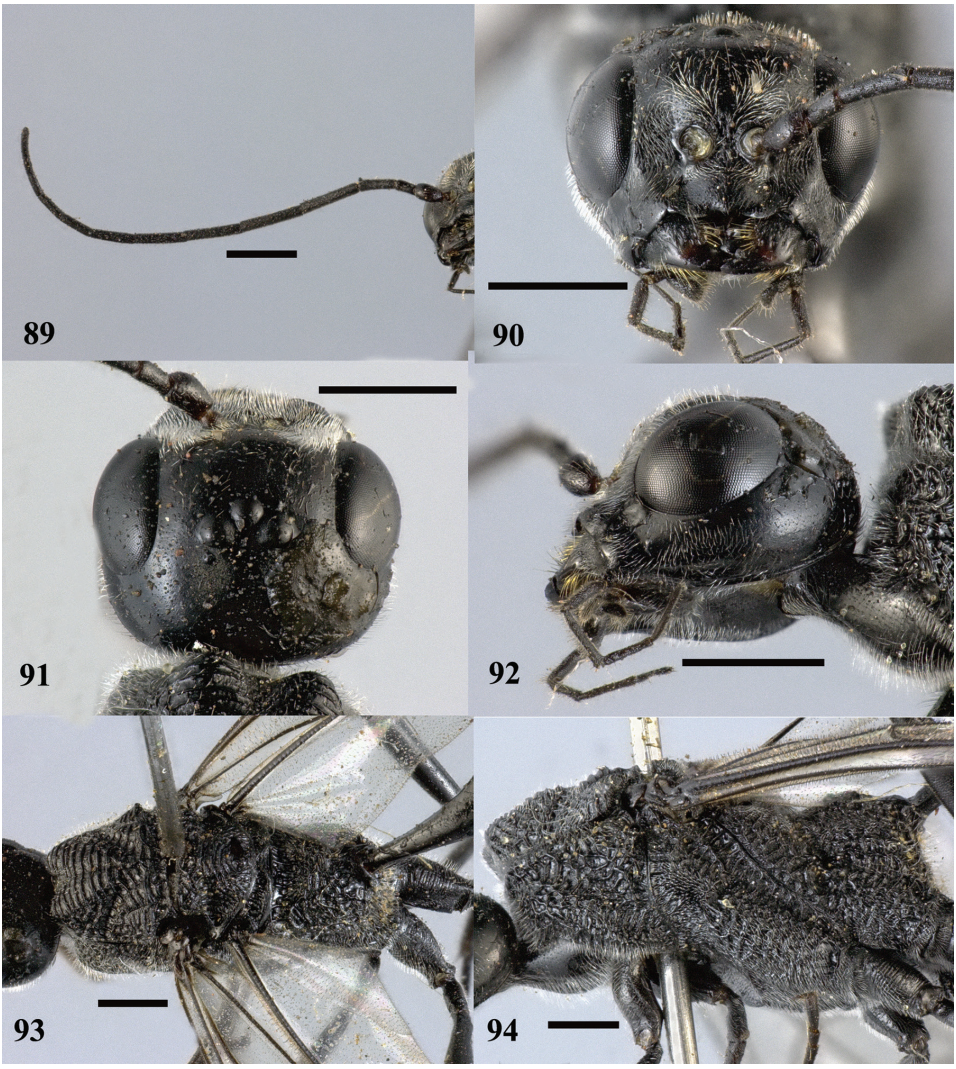
Mesosoma. Pronotum coarsely areolate-rugose, with one anterior short tooth-like process on lateroventral margin; propleuron smooth and shiny; mesoscutum transverse-carinate anteriorly, irregularly rugose posterior to notauli, anterior part strongly emarginate medially, slightly pointed laterally; notauli deep and wide; scutellum transverse-carinate medially, areolate-rugose laterally; axillae areolate-rugose; metanotum, propodeum, mesopleuron and metapleuron coarsely areolate-rugose; forewing with vein 2-rs+m long, cells SM2 and D1 distantly separated; hind wing veins faint to absent; hind coxa transverse-carinate; hind basitarsus 8.5 × longer than wide, and 1.2 × of tarsomeres 2–5; pretarsal claw with four tooth-like processes.

Metasoma. Smooth, shining, with fine white pubescence on segment 3 to apex; petiole elongate, 3.8 × longer than wide; ovipositor 0.8 × forewing length.

Male. Unknown.

Distribution. China (Yunnan).

Biology. Collected in May and June. Host not known.



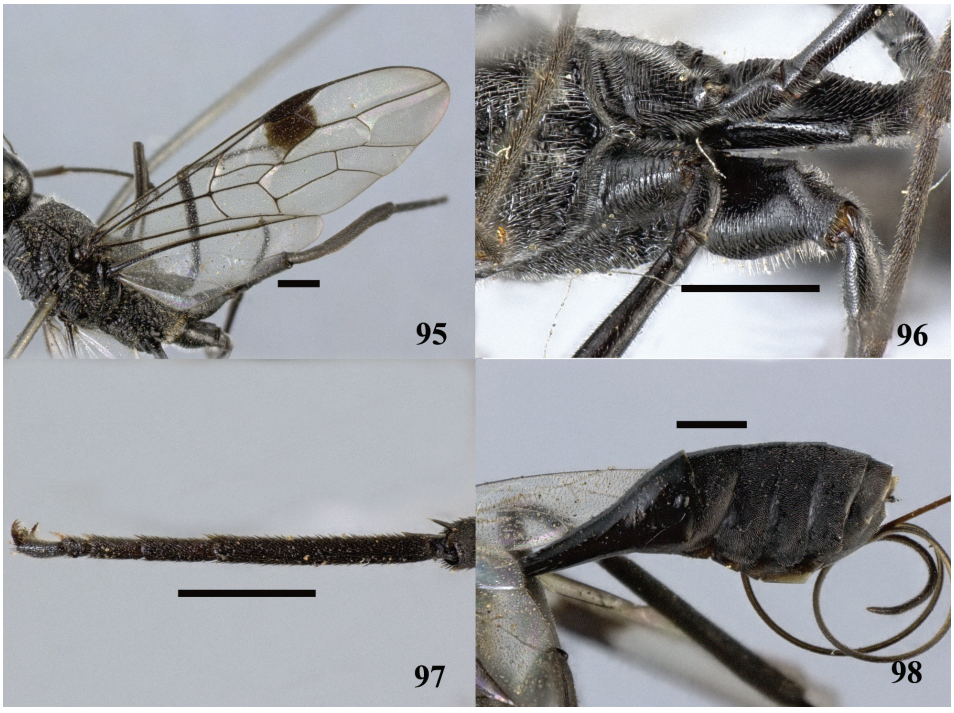
Figures 89–94. *Pristaulacus obscurus* sp. n., holotype, female. **89** Antenna **90** head anterior **91** head dorsal **92** head lateral **93** mesosoma dorsal **94** mesosoma lateral. Scale bar: 1 mm.

Pristaulacus pieli Kieffer, 1924

Fig. 122

Pristaulacus pieli Kieffer, 1924: 79.
Pristaulacus pieli Kieffer: Hedicke 1939: 14; Wu 1941: 90; Smith 2001: 294; Turrisi et al. 2009: 58.

Material examined. The type material is not known (Smith 2001), and no additional specimen is currently known.



Figures 95–98. *Pristaulacus obscurus* sp. n., holotype, female. **95** Forewing **96** hind coxae **97** hind tarsus **98** metasoma lateral. Scale bar: 1 mm.

Diagnosis. Hind margin of head straight, without medial groove; lateroventral margin of pronotum without tooth-like process (Kieffer 1924).

Distribution. China (Jiangsu).

Biology. The holotype was collected in July. Host not known.

Pristaulacus porcatus Sun & Sheng, 2007

Fig. 122

Pristaulacus porcatus Sun & Sheng, 2007a: 217.
Pristaulacus porcatus Sun & Sheng: Turrisi et al. 2009: 58; Turrisi and Smith 2011: 43.

Material examined. Paratype, 1 ♀ (SFPS), CHINA: Henan, Lingshan, 400–500 m, 24.V.1999, M. L. Sheng/*Pristaulacus porcatus* Sun & Sheng, sp. n.

Diagnosis. Antenna with A1 light orange and A2 dark reddish; metasoma with side of first tergite, most of second tergite and side of third tergite irregulary orange; occipital margin concave, with a wide and deep medial groove; pronotum with one anteroventrally projecting tooth-like process; pretarsal claw with four tooth-like processes; ovipositor 1.2 × forewing length.

Distribution. China (Henan) (Sun and Sheng 2007a).
Biology. Collected in May (Sun and Sheng 2007a). Host not known.
Remarks. Redescription is provided by Turrisi and Smith (2011).

***Pristaulacus pseudoiosephi* sp. n.**
http://zoobank.org/B66E7537-6642-4B01-9DE2-7315591CDC6F
Figs 99–110, 122

Material examined. Holotype, ♀ (IZCAS), CHINA: Guangxi, Longteng, Mt. Tianping, 740 m, 18.VI.1962, Shu-yong Wang, IOZ(E) 1903953. Paratypes: 1 ♀ (IZCAS), CHINA: Yunnan, Jinping, Mengla, 420 m, 21.IV.1956, Ke-ren Huang et al., IOZ(E) 1903951; 1 ♀ (IZCAS), Yunnan, Jinping, Mengla, 400 m, 24.IV.1956, Ke-ren Huang et al., IOZ(E) 1903952.

Etymology. The name refers to the similar appearance to *P. iosephi*.

Diagnosis. Body black; forewing infuscate, with large dark brown spot under stigma; occipital margin concave, with a wide and deep medial groove; pronotum with two anteroventrally projecting tooth-like process; pretarsal claw with six tooth-like processes; ovipositor 0.9 × forewing length.

Description. Holotype. *Female*. Body length 16.6 mm; forewing length 11.3 mm.

Colour. Black except: scape of antenna, palpi and tarsi dark brown; forewing infuscate, with large dark brown spot under stigma; basal 2/3 of hind wing hyaline, apical 1/3 infuscate.

Head. From above, 1.2 × wider than long, shiny; lower interocular distance 1.3 × eye height; malar space 0.2 × eye height; occipital margin concave, with a wide and deep medial groove; temple, from above, rounded, distinctly longer than eye length; occipital carina 0.3 × diameter of an ocellus; POL:OOL=1.1; frons and clypeus densely and finely punctate; vertex and temple largely smooth with sparse and fine punctures;

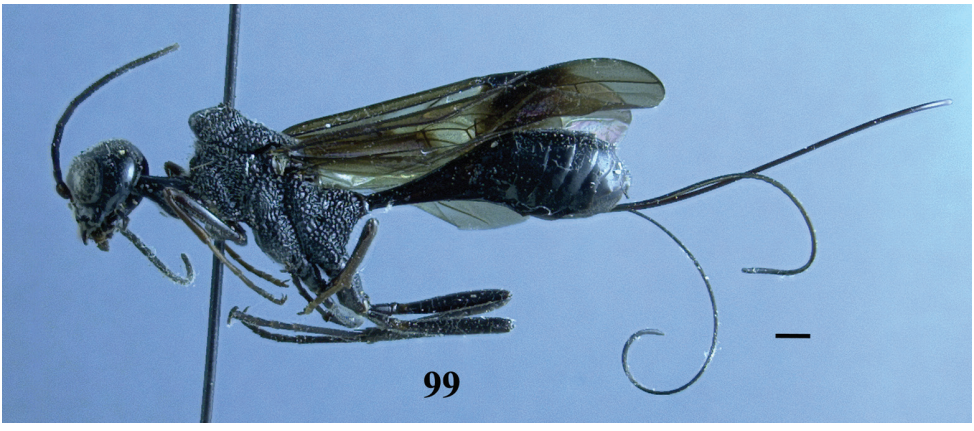
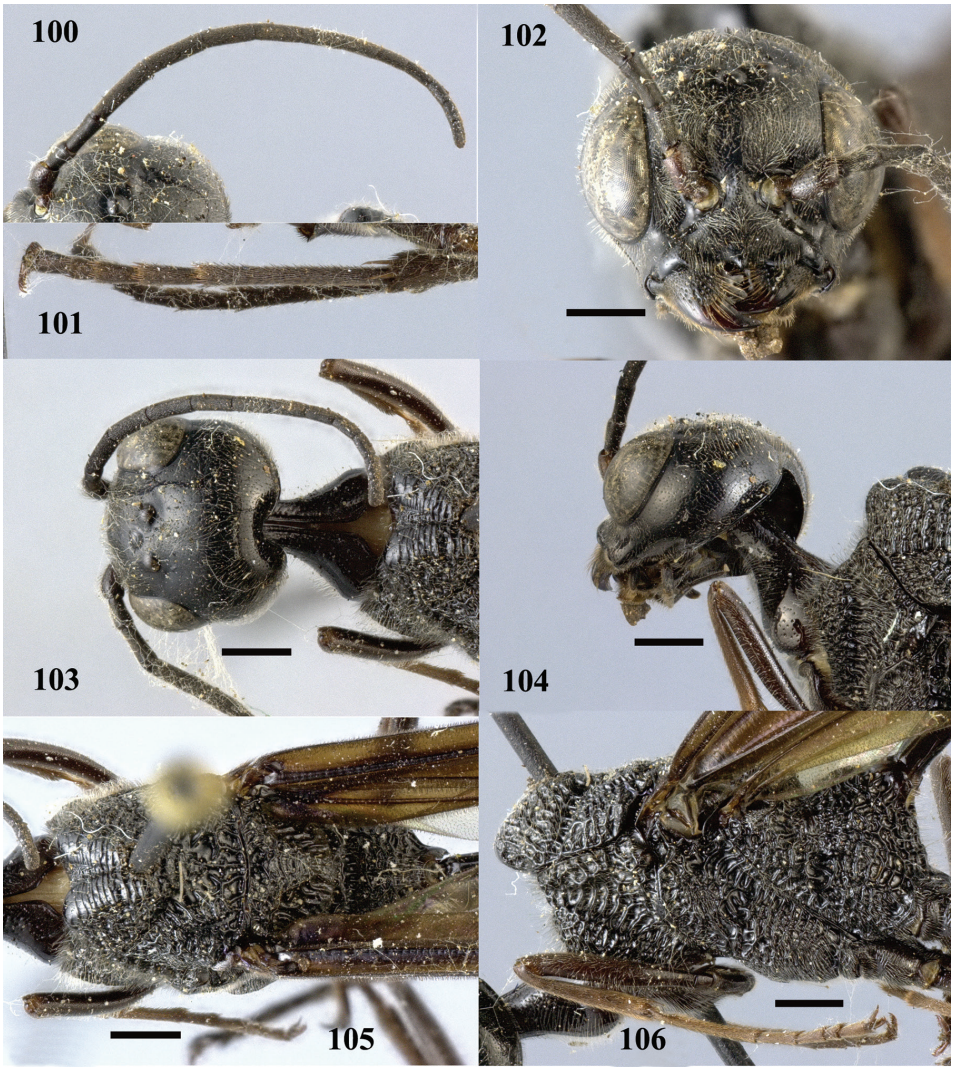


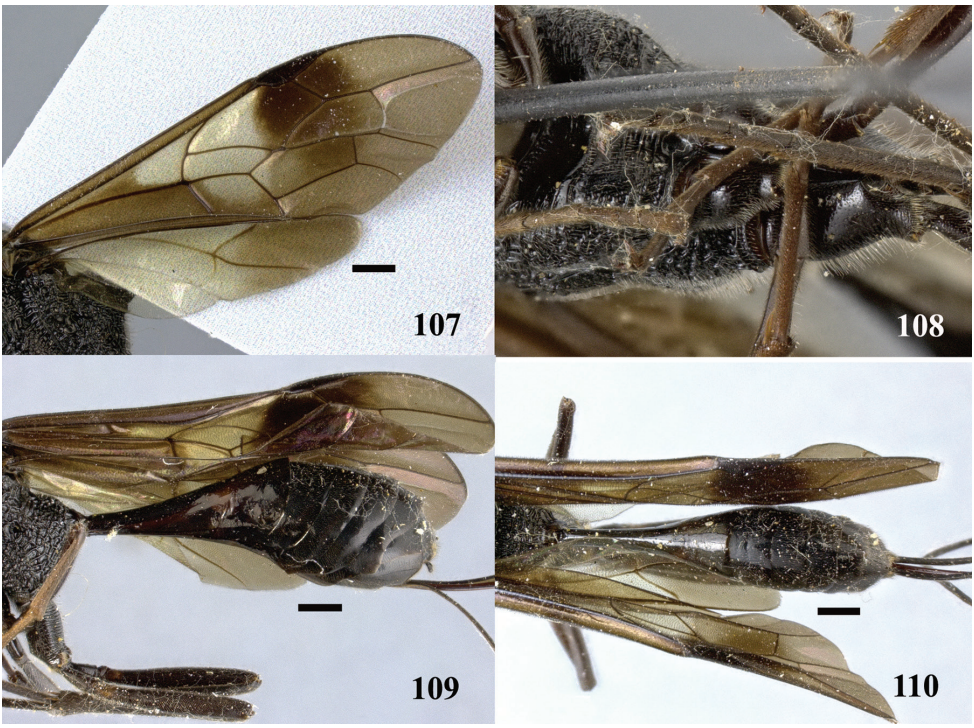
Figure 99. *Pristaulacus pseudoiosephi* sp. n., paratype, female, habitus, lateral. Scale bar: 1 mm.



Figures 100–106. *Pristaulacus pseudoiosephi* sp. n., paratype, female. **100** Antenna **101** hind tarsi **102** head anterior **103** head dorsal **104** head lateral **105** mesosoma dorsal **106** mesosoma lateral. Scale bar: 1 mm.

A3 2.4 × longer than wide; A4 3.7 × longer than wide, and 1.8 × longer than A3; A5 3.2 × longer than wide, and 1.5 × longer than A3.

Mesosoma. Pronotum coarsely areolate-rugose, with two well-developed anterior and posterior tooth-like processes on lateroventral margin; propleuron largely smooth with sparse fine punctures, shiny; mesoscutum transverse-carinate anteromedially, remainder of mesocutum coarsely areolate-rugose, anterior part strongly emarginate medially, rounded laterally; notauli deep but narrow; scutellum, axillae, metanotum, propodeum, mesopleuron and metapleuron coarsely areolate-rugose; forewing with vein 2-rs+m long,



Figures 107–110. *Pristaulacus pseudoiosephi* sp. n., paratype, female. **107** Forewing and hind wing **108** hind coxae **109** metasoma lateral **110** metasoma dorsal. Scale bar: 1 mm.

cells SM2 and D1 distantly separated; hind wing with veins somewhat distinct, cells Cu and R1+Rs contiguous; hind coxa transverse-carinate; hind basitarsus 11.3 × longer than wide, and 1.1 × of tarsomeres 2–5; pretarsal claw with six tooth-like processes.

Metasoma. Smooth, shining, with fine white pubescence on segment 3 to apex; petiole elongate, 3.3 × longer than wide; ovipositor 0.9 × forewing length.

Male. Unknown.

Distribution. China (Guangxi, Yunnan).

Biology. Collected in April and June. Host not known.

Pristaulacus rufipes Enderlein, 1912

Fig. 122

Pristaulacus rufipes Enderlein, 1912: 266.
Pristaulacus rufipes Enderlein: Hedicke 1939: 15; Smith 2001: 295; Turrisi et al. 2009: 58.

Material examined. Holotypus, ♀ (SDEI), CHINA: Formosa, Hoozan, Sauter H./ *Pristaulacus rufipes* Enderlein sp. n. Other material: 1 ♂ (TCUC), Taiwan, Gaofong Ln., about 1400 m, Ren-ai T. Nantou, 7–9.V.2009, Takakuwa M. leg.

Diagnosis. Antenna reddish-orange with A1 lighter; legs light reddish-orange, except coxae and hind trochanters darker; metasoma largely black, except S1, most part of T2 and apex of following tergites dark reddish; occipital margin straight; pronotum with one anteroventrally projecting tooth-like process; pretarsal claw with four tooth-like processes; ovipositor 1.8 × forewing length.

Redescription. Holotype. *Female*. Body length 14.8 mm; forewing length 11.9 mm.

Colour. Blackish-brown except: clypeus extensively dark brown; mandible extensively reddish-orange, with apex blackish; maxillo-labial complex brownish to dark brownish; antenna reddish-orange with A1 lighter; legs light red orange, except coxae and hind trochanter darker; wings hyaline, forewing with a wide brown spot below stigma (two third as wide as stigma width) not extending beyond cells SM-1 and R; metasoma largely black, except S1, most part of T2 and apex of following tergites dark reddish; valvula 3 of ovipositor dark brown to blackish-brown. Setae: whitish to goldish.

Head. From above, 1.4 × wider than long, shiny; occipital margin straight; temple, from above, weakly developed, weakly convex; occipital carina about 0.2 × diameter of an ocellus; POL:OOL= 1.2; vertex and temple with fine, and scattered to dense punctures (distance between punctures 3.0–1.5 × diameter of a puncture); frons with coarse, and scattered to dense punctures (distance between punctures 3.0–1.0 × diameter of a puncture); clypeus with coarse, and dense punctures; malar area with coarse, and dense punctures; occipital area with fine, and dense punctures (distance between punctures about 1.5 × diameter of an ocellus).

Mesosoma. Coarsely sculptured; pronotum areolate punctate, except lower third, coarsely punctate to areolate rugulose, with one weakly developed anterior tooth on each lateroventral margin; propleuron polished and shiny, coarsely, deeply, and densely punctate-rugulose on dorsal surface, with coarse, deep, and scattered to dense punctures on ventral surface (distance between punctures 1.0–2.0 × diameter of a puncture); prescutum sub-triangular, very wide, not concave, transverse-carinulate-punctate to transverse-carinate; mesoscutum transverse-carinate, with anterior part slightly emarginate in middle, rounded (lateral view); notauli deep and narrow; scutellum transverse-carinate; mesopleuron areolate-rugose (upper part) to rugulose-punctate-carinulate (lower part), except a wide part of subalar area, punctate-rugulose; metanotum mostly smooth, with a few confused carinulae; propodeum areolate-rugose, except anterior margin longitudinally carinate; ventral parts of mesosoma rugose to punctate; forewing with vein 2-rs+m short, cells SM2 and D1 continuous; fore coxa polished with coarse, deep, and dense punctures; mid coxa rugulose-punctate; hind coxa with very coarse, deep, and dense punctures on most of dorsal surface (with a few transverse weakly defined carinae in middle), mostly polished (rugose on sides) and punctate on ventral surface (punctures coarse, deep, and dense, distances between punctures 0.5–1.0 × diameter of a puncture); hind basitarsus 13.4 × longer than wide and 1.9 × longer than tarsomeres 2–5; pretarsal claw with four tooth-like processes.

Metasoma. Pyriform (lateral view), compressed laterally; petiole elongate, slender, 4.4 × as long as wide; segments 1 and 2 polished and shiny; following segments with fine and dense punctures; ovipositor 1.8 × forewing length.

Male. Similar to the female, but metasoma darker.
Distribution. China (Taiwan).
Biology. Unknown.

Pristaulacus rufobalteatus Cameron, 1907

Figs 111–121, 122

Pristaulacus rufobalteatus Cameron, 1907: 222.
Pristaulacus rufobalteatus Cameron: Smith 2001: 297; Turrisi et al. 2009: 58.

Material examined. 1 ♀ (IZCAS), CHINA: Yunnan, Jingdong, 1200 m, 6.III.1957, IOZ(E) 1903968; 1 ♀ (IZCAS), Yunnan, Lushui, 1900 m, 8.VI.1981, Su-bo Liao, IOZ(E) 1903969; 1 ♀ (IZCAS), CHINA: Gansu, Kang County, Qinghe Forestry Station, 2250 m, 8.VII.1999, Hong-jian Wang, IOZ(E) 1903970.

Diagnosis. Metasoma black with first tergite largely brown; fore hyaline with dark brown spot under stigma; occipital margin straight; occipital carina 0.1 × diameter of an ocellus; pronotum with one anteroventrally projecting tooth-like process; pretarsal claw with four tooth-like processes; ovipositor 0.9 × forewing length**.**

Redescription. *Female*. Body length 8.7 mm; forewing length 6.8 mm.

Colour. Antenna black with scape yellowish-orange; head black with clypeus dark brown; mesosoma black; first tergite largely brown, and remainder of tergites black; mandible brown with teeth darker; palpi brown; coxae black, femur and tibia dark brown, remainder of legs yellowish-orange with tarsi paler; ovipositor brown; fore hyaline with dark brown spot under stigma; hind wing hyaline.

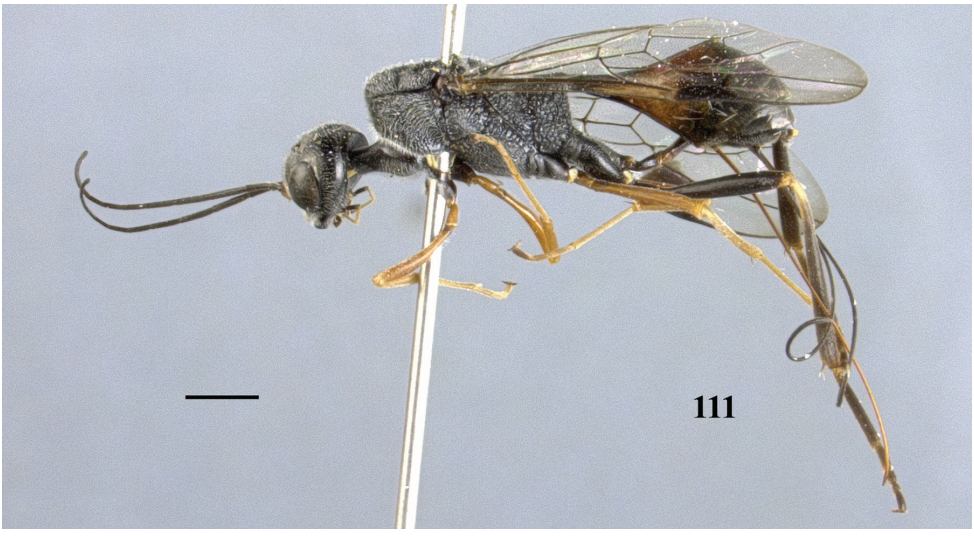
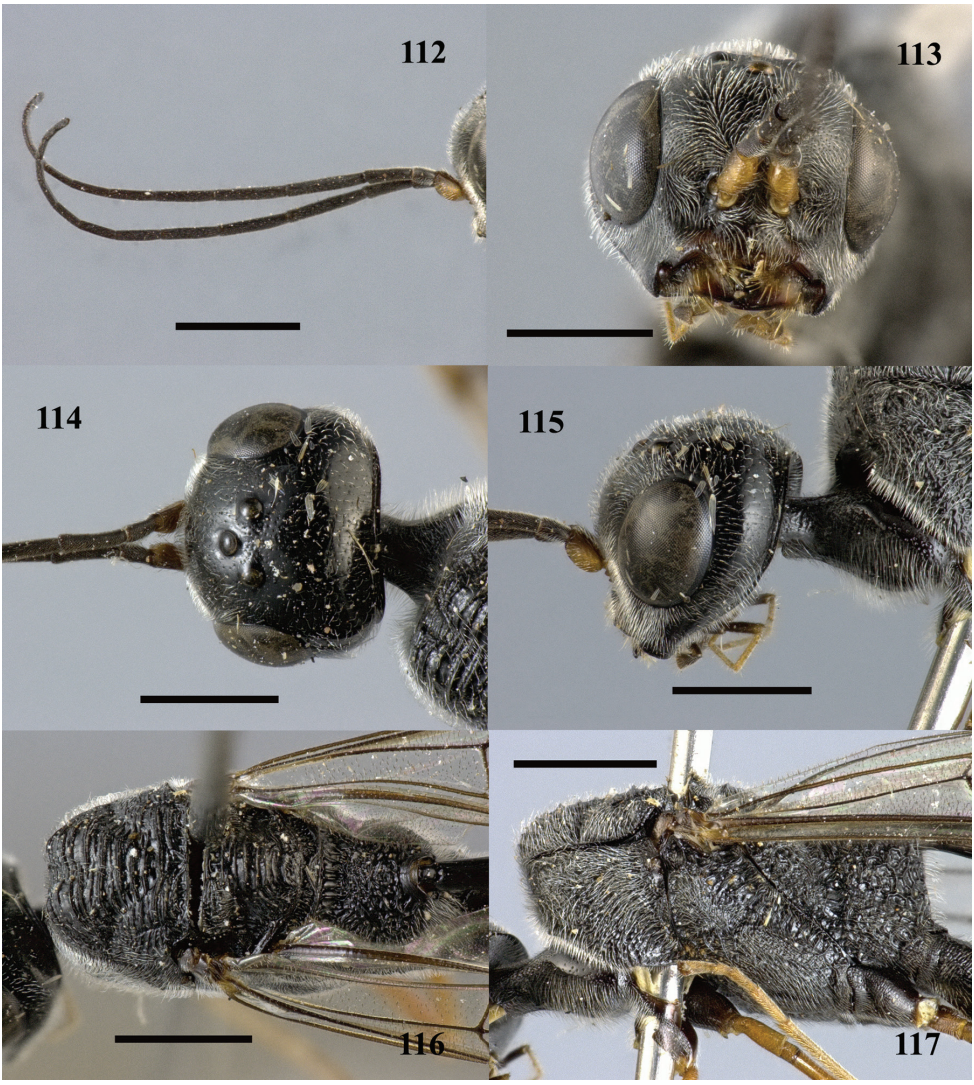


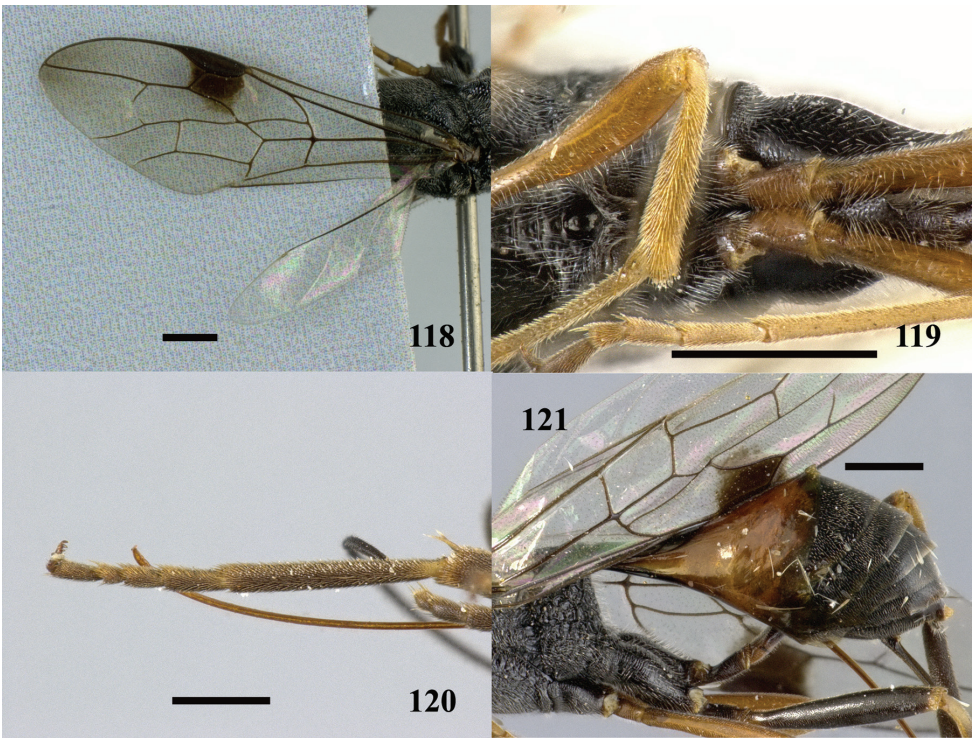
Figure 111. *Pristaulacus rufobalteatus* Cameron, 1907, female, habitus, lateral. Scale bar: 1 mm.



Figures 112–117. *Pristaulacus rufobalteatus* Cameron, 1907, female. **112** Antennae **113** head anterior **114** head dorsal **115** head lateral **116** mesosoma dorsal **117** mesosoma lateral. Scale bar: 1 mm.

Head. From above, 1.4 × wider than long, shiny; lower interocular distance 1.5 × eye height; malar space 0.3 × eye height; occipital margin straight; temple, from above, rounded, slightly shorter than eye length; occipital carina 0.1 × diameter of an ocellus; POL:OOL=1.3; lower frons and clypeus densely and finely punctate, remainder of head largely smooth with sparse and fine punctures; A3 3.7 × longer than wide; A4 6.6 × longer than wide, and 1.7 × longer than A3; A5 6.2 × longer than wide, and 1.5 × longer than A3.

Mesosoma. Pronotum coarsely rugose, with one anterior small process on lateroventral margin; propleuron dull, densely punctate ventrally, finely rugose with



Figures 118–121. *Pristaulacus rufobalteatus* Cameron, 1907, female. **118** Forewing and hind wing **119** hind coxae **120** hind tarsus **121** metasoma lateral. Scale bar: 1 mm.

small smooth area dorsally; mesoscutum mostly transverse-carinate, coarsely rugose on sides, anterior part slightly emarginate medially, rounded laterally; notauli deep and wide; scutellum transverse-carinate in middle, coarsely rugose on anterior and posterior margin; axillae coarsely areolate-rugose; metanotum coarsely rugose; propodeum largely coarsely areolate-rugose, coarsely rugose in middle; mesopleuron coarsely areolate-rugose posteriodorsally, remainder rugose; metapleuron coarsely areolate-rugose; forewing with vein 2-rs+m long, cells SM2 and D1 distantly separated; hind wing veins faint to absent; hind coxa transverse-carinate; hind basitarsus 8.5 × longer than wide, and 1.3 × of tarsomeres 2–5; pretarsal claw with four tooth-like processes.

Metasoma. Smooth, shining, with fine white pubescence on segment 2 to apex; petiole elongate, 2.4 × longer than wide; ovipositor 0.9 × forewing length.

Male. Unknown.

Distribution. China (Gansu, Yunnan); India (Cameron, 1907).

Biology. Collected in March, June and July. Host not known.

Remarks. This is a newly recorded species for China.

Figure 122. Distribution map of the species of Chinese Aulacidae (*Pristaulacus longicornis* Kieffer, 1911 is not included). **1** *Aulacus flavigenis* Alekseev, 1986 **2** *Aulacus magnus* sp. n. **3** *Aulacus schoenitzeri* Turrisi, 2005 **4** *Aulacus sinensis* He & Chen, 2007. **5** *Aulacus striatus* Jurine, 1807. **6** *Pristaulacus albitarsatus* Sun & Sheng, 2007 **7** *Pristaulacus asiaticus* Turrisi & Smith, 2011 **8** *Pristaulacus calidus* sp. n. **9** *Pristaulacus centralis* sp. n. **10** *Pristaulacus comptipennis* Enderlein, 1912. **11** *Pristaulacus excisus* Turner, 1922 **12** *Pristaulacus fopingi* sp. n. **13** *Pristaulacus intermedius* Uchida, 1932 **14** *Pristaulacus iosephi* Turrisi & Madl, 2013 **15** *Pristaulacus karinulus* Smith, 2001 **16** *Pristaulacus memnonius* Sun & Sheng, 2007 **17** *Pristaulacus nobilei* Turrisi & Smith, 2011 **18** *Pristaulacus obscurus* sp. n. **19** *Pristaulacus pieli* Kieffer, 1924 **20** *Pristaulacus porcatus* Sun & Sheng, 2007 **21** *Pristaulacus pseudoiosephi* sp. n. **22** *Pristaulacus rufipes* Enderlein, 1912 **23** *Pristaulacus rufobalteatus* Cameron, 1907 **24** *Pristaulacus zhejiangensis* He & Ma, 2002. Note: The South China Sea islands are not shown on this map.

Pristaulacus zhejiangensis He & Ma, 2002

Fig. 122

Pristaulacus zhejiangensis He & Ma, 2002: 150.
Pristaulacus zhejiangensis He & Ma: Turrisi et al. 2009: 59.

Material examined. Holotype, ♀ (ZJU), CHINA: Zhejiang, Mt. Fengyang, 16.VIII.1982, De-ming Yu, No. 826802/*Pristaulacus zhejiangensis* He & Ma, sp. n. Paratypes: 1 ♀ (ZJU), Zhejiang, Mt. Fengyang, 19.IV.1984, li-rong Shen, No. 843798/*Pristaulacus zhejiangensis* He & Ma, sp. n. Additional material: 1 ♀ (SEMC),

CHINA: Fujian, Yong'an, Xiyang, 27.IV.1960, Geng-tao Jin, 34008303; 1 ♀ (SCAU), CHINA: Hunan, 1981, Tong Xin-wang.

Diagnosis. Metasoma black with posterior margin of first tergite dark brown; tibiae and tarsi yellowish-brown with tarsi paler, remainder of legs dark brown to black; forewing infuscate, with large dark brown spot under stigma; occipital margin straight; occipital carina 0.1 × diameter of an ocellus; pronotum with one anteroventrally projecting tooth-like process; pretarsal claw with four tooth-like processes; ovipositor 0.9 × forewing length.

Redescription. *Female*. Body length 10.1 mm; forewing length 7.2 mm.

Colour. Black except: scape of antenna dark brown; mandible yellowish-brown with teeth darker; posterior margin of first tergite dark brown; tibiae and tarsi yellowish-brown with tarsi paler, remainder of legs dark brown to black; forewing infuscate, with large dark brown spot under stigma; hind wing infuscate.

Head. From above, 1.4 × wider than long, shiny; lower interocular distance 1.5 × eye height; malar space 0.3 × eye height; occipital margin straight; temple, from above, rounded, slightly longer than eye length; occipital carina 0.1 × diameter of an ocellus; POL:OOL=1.1; malar area densely and finely punctate, remainder of head largely smooth with sparse and fine punctures; A3 3.4 × longer than wide; A4 5.8 × longer than wide, and 1.8 × longer than A3; A5 5.3 × longer than wide, and 1.6 × longer than A3.

Mesosoma. Pronotum coarsely areolate-rugose, with one anterior short tooth-like process on lateroventral margin; propleuron dull, mostly finely rugose, posteroventral corner smooth with sparse fine punctures; mesoscutum transverse-carinate anteriorly, irregularly rugose posterior to notauli, anterior part slightly emarginate medially, rounded laterally; notauli deep and wide; scutellum transverse-carinate in middle, irregularly rugose on anterior and posterior margin; axillae, metanotum and propodeum coarsely areolate-rugose; mesopleuron mostly coarsely areolate-rugose with small rugose area anteriodorsally; metapleuron coarsely areolate-rugose; forewing with vein 2-rs+m short, cells SM2 and D1 slightly separated; hind wing with veins somewhat distinct, cells Cu and R1+Rs contiguous; hind coxa rugose; hind basitarsus 11.4 × longer than wide, and 1.1 × of tarsomeres 2–5; pretarsal claw with four tooth-like processes.

Metasoma. Smooth, shining, with fine white pubescence on segment 2 to apex; petiole elongate, slender, 2.9 × longer than wide; ovipositor 0.9 × forewing length.

Male. Unknown.

Distribution. China (Zhejiang, Fujian, Hunan).

Biology. Collected in April and August. Host not known.

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Braconinae parasitoids (Hymenoptera, Braconidae) emerged from larvae of *Lobesia botrana* (Denis & Schiffermüller) (Lepidoptera, Tortricidae) feeding on *Daphne gnidium* L.

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Abstract

Bracon admotus Papp, 2000, and three species of the genus *Habrobracon* Ashmead, 1895, *H. concolorans* (Marshall, 1900), *H. hebetor* (Say, 1836) and *H. pillerianae* Fischer, 1980, were obtained from the larvae of *Lobesia botrana* (Denis & Schiffermüller, 1775) (Lepidoptera, Tortricidae) feeding on *Daphne gnidium* Linnaeus, 1753 (Thymelaeaceae) in the natural reserve of Migliarino-San Rossore-Massaciuccoli (Pisa-Central Italy). *Bracon admotus*, *Habrobracon concolorans* and *H. pillerianae* were found for the first time to be associated with *L. botrana*, while *H. hebetor* was reared for the first time from the larvae of *Cryptoblabes gnidiella* (Millière, 1867) (Lepidoptera, Pyralidae, Phycitinae) that was found on the same host plant. *Bracon admotus* and *H. pillerianae* are new to the fauna of Italy and Western Europe. A key is proposed for the determination of *Habrobracon* species reared from *L. botrana* and related Palaearctic species of this genus. *Habrobracon lineatellae* Fisher, 1968 is considered as a valid species.

Keywords

European grapevine moth, idiobiont ectoparasitoids, Italy, natural environment, spurge flax, Thymelaeaceae, Tuscany

Introduction

With about 2,500 species from almost two hundred genera, Braconinae is one of the largest subfamilies within the family Braconidae (Shaw and Huddleston 1991, Quicke 2015). This parasitoid group has a worldwide distribution with the largest number of taxa found in the Old World tropics (Quicke 2015). Most Braconinae species are idiobiont ectoparasitoids that develop on concealed or semi-concealed hosts mainly represented by late larval instars of numerous Coleoptera and Lepidoptera taxa, and more rarely by sawflies (Hymenoptera, Symphyta) and flies (Diptera), predominantly gall midges (Cecydomyiidae) and fruit flies (Tephritidae). Females of Braconinae are synovigenic, practicing additional host feeding and laying large eggs. The larvae develop as gregarious or solitary parasitoids (Shaw and Huddleston 1991, Quicke 2015). Their host range includes many species with a large variety of habits, but all the victims show a certain degree of concealment in the tissues of annual and biennial plants, including galls, rolled leaves, inflorescences, seeds, stems and, more rarely, leaf mines or hard wood tissues (Quicke 2015). Several species of Braconinae attack pests of an economic interest, such as stored products and field crops pests (Quicke 2015).

Among Braconinae, *Bracon* Fabricius, 1804 is a cosmopolitan and very common genus composed of the largest number of species. European fauna includes about 200 species of *Bracon* living on larvae of Lepidoptera, Coleoptera and Diptera (van Achterberg 2013). This genus is considered as a para- or also a polyphyletic group, predominantly of small and middle-sized species (Quicke 2015) spread over several subgenera. *Habrobracon* Ashmead, 1895 was once considered to be a distinct genus (Quicke 2015, Papp 2008, Yu et al. 2012) or one of the *Bracon* subgenera (Shenefelt 1978, Tobias 1986, Belokobylskij et al. 2012, Broad et al. 2012, Ameri et al. 2013, 2015, Zargar et al. 2015) or sometimes is considered as a synonym (Marsh 1979, van Achterberg 2013).

In agreement with the latest opinions of Papp (2008) and Quicke (1987, 2015) recorded in the World Catalogue by Yu et al. (2012), we consider *Habrobracon* as a separate genus in spite of the intermediate position of *Bracon variegator* Spinola and various Nearctic species between the two genera together with the lack of diagnostic characters at the generic level.

Habrobracon is a worldwide group of small to very small wasps (Quicke 1987). Twenty-one *Habrobracon* species have been recorded in the Western Palaearctic (Papp 2008), some of which have a host range of more than 50 host-species with a high ecological flexibility (Tobias 1986, Yu et al. 2012, Beyarslan et al. 2014). *Bracon admotus* Papp, 2000 was originally included in the *B. obscurator* species-group within the subgenus *Glabrobracon* Fahringer, 1927.

This paper presents the results of a study carried out in the natural reserve of Migliarino-San Rossore-Massaciuccoli in the province of Pisa (Tuscany, Italy). All over this area there is a large population of spurge flax, *Daphne gnidium* Linnaeus, 1753, a small shrub of the family Thymelaeaceae, whose sprouts, flowers and infructescences host a large community of moth larvae, most of which are represented by *Lobesia botrana* (Denis & Schiffermüller, 1775) (Lepidoptera: Tortricidae). This species which was recently de-

fined as European grapevine moth (EGVM) is a major pest of grapes in the Mediterranean basin and had recently been found in the Americas (Ioriatti et al. 2011, 2012).

Predators and parasitoids associated with this moth have been studied in various European countries, and more than a hundred works have been published on the subject. To date there is still an incomplete list of the natural enemies of *L. botrana*, and information about these enemies is contained in some works published in the twentieth century, when the moth caused the first extensive damage to European vineyards (Marchal 1912, Voukassovitch 1924, Leonardi 1925, Boselli 1928, Stellwaag 1928, Thompson 1946, Coscollà 1997, Hoffmann and Michl 2003, Villemant et al. 2011).

In Italy, about thirty studies have been published reporting on 89 species of parasitoids living on *L. botrana* (Del Guercio 1899, Catoni 1914, Silvestri 1912, Nuzzaci and Triggiani 1982, Delrio et al. 1987, Luciano et al. 1988, Pinna et al. 1989, Lozzia and Rigamonti 1991, Roat and Forti 1994, Marchesini and Dalla Montà 1994, Colombera et al. 2001, Bagnoli and Lucchi 2006, Lucchi and Santini 2011).

One of the problems with identifying the parasitoid complex of a pest is that the much of the data regards pests in agroecosystems, which usually simply represent pests outside of their natural environment. This is also valid for the European grapevine moth. The hundred or so published papers on its parasitoids only concern the dynamics in the vineyard. There are only three exceptions, all by Italian authors (Nuzzaci and Triggiani 1982, Luciano et al. 1988, Lucchi and Santini 2011) who have tried to highlight the population dynamics of the moth and its parasitoids on *D. gnidium*, which is its typical spontaneous host plant in wild habitats.

This paper reports on a study carried out in 2014 and 2015. It provides new information on one species of *Bracon* and three species of *Habrobracon* obtained from the larvae of *L. botrana* living on *D. gnidium* in a natural reserve in Tuscany (Italy). The massive presence of this important pest in a wild area offers a very interesting environmental context where to perform observations on the relationships among this phytophagous and its parasitoids complex in comparison with the cultivated field.

Methods

The environmental context

Weekly surveys were carried out in 2014 and 2015 in the natural reserve of Migliarino-San Rossore-Massaciuccoli, which covers around 23,000 hectares in the provinces of Pisa and Lucca (Tuscany, Italy) (http://www.parcosanrossore.org/). The landscape has a variety of environments, such as sandy shores and dunes stretching for about 23 km along the coast, wetlands with marshes, rivers, lakes, ponds, and forests. The Tyrrhenian Sea delimits the western border, the Lake of Massaciuccoli, the northern border, and the river Arno, the southern border. To the east, the landscape changes gradually from wild to rural areas. The distance from the east border to the west coast varies ranging from 6 to 10 kilometers.

In the back dunes and the thermophile Mediterranean wood, dominated by pine tree and holm oak, *Daphne gnidium* L. (Malvales, Thymelaeaceae) shrubs are widespread,

covering the spaces where the sun can easily penetrate and the soil is mostly sandy. From March to October, sprouts, flowers and infructescences, depending on the period, host a wide and diverse community of Lepidoptera, mainly represented by *Lobesia botrana*.

Sampling methodology

An experimental area was selected, delimited by the following four geographical points 43.733642 N, 10.277524 E; 43.712864 N, 10.279648 E; 43.732913 N, 10.292371 E; 43.720101 N, 10.293094 E (DDM) and characterized by various habitats (Fig. 1). We subdivided this area in a hypothetical grid of 3 × 3 rectangles, each one being 500m x 300m, thus the sampling was replicated in each habitat typology three times (Fig. 2). In each of the nine rectangular sites, transects of 200 meters in length were organized along where *D. gnidium* sprout sampling was carried out. On a weekly basis in each transect 20 infested sprouts were sampled from ten plants (two per plant) (Fig. 3A). In 2014, sampling was begun on May 22 and concluded on October 23. In 2015, surveys started on May 14 and finished on October 23. On the same or the following day of the sample collection, the sprouts were analyzed under a stereomicroscope to isolate the preimaginal stages of the moths. Then each individual specimen was stored inside a glass vial, recording its precise developmental stage. Until the moth or the parasitoids emerged, samples were stored in boxes and maintained in an unheated room with an open window, to maintain as similar environmental conditions as possible to those of the sampling sites (Fig. 3B).

Among the huge number of parasitoid species that emerged during the rearing period, we focused on a small group of individuals belonging to the genera *Bracon* and *Habrobracon*, examining their role in the observed context, and their geographical distribution. The species mentioned in this work were identified by K. Samartsev. The specimens are now stored both at the Laboratory of Insect Taxonomy of the Zoological Institute of the Russian Academy of Sciences (St Petersburg, Russia) and at the Department of Agriculture, Food and Environment of Pisa University (Italy). For a description of the morphological features of the species, we referred to Quicke (2015). The following abbreviations are used in the paper:

POL postocellar line;
OOL ocular-ocellar line;
Od maximum diameter of lateral ocellus.

Wing venation nomenclature follows van Achterberg (1993). Those terms that follow Tobias's nomenclature (1986) are:

1-R1 metacarp;
2-SR first radiomedial vein;
2-SR+M second medial abscissa;
3-SR second radial abscissa;

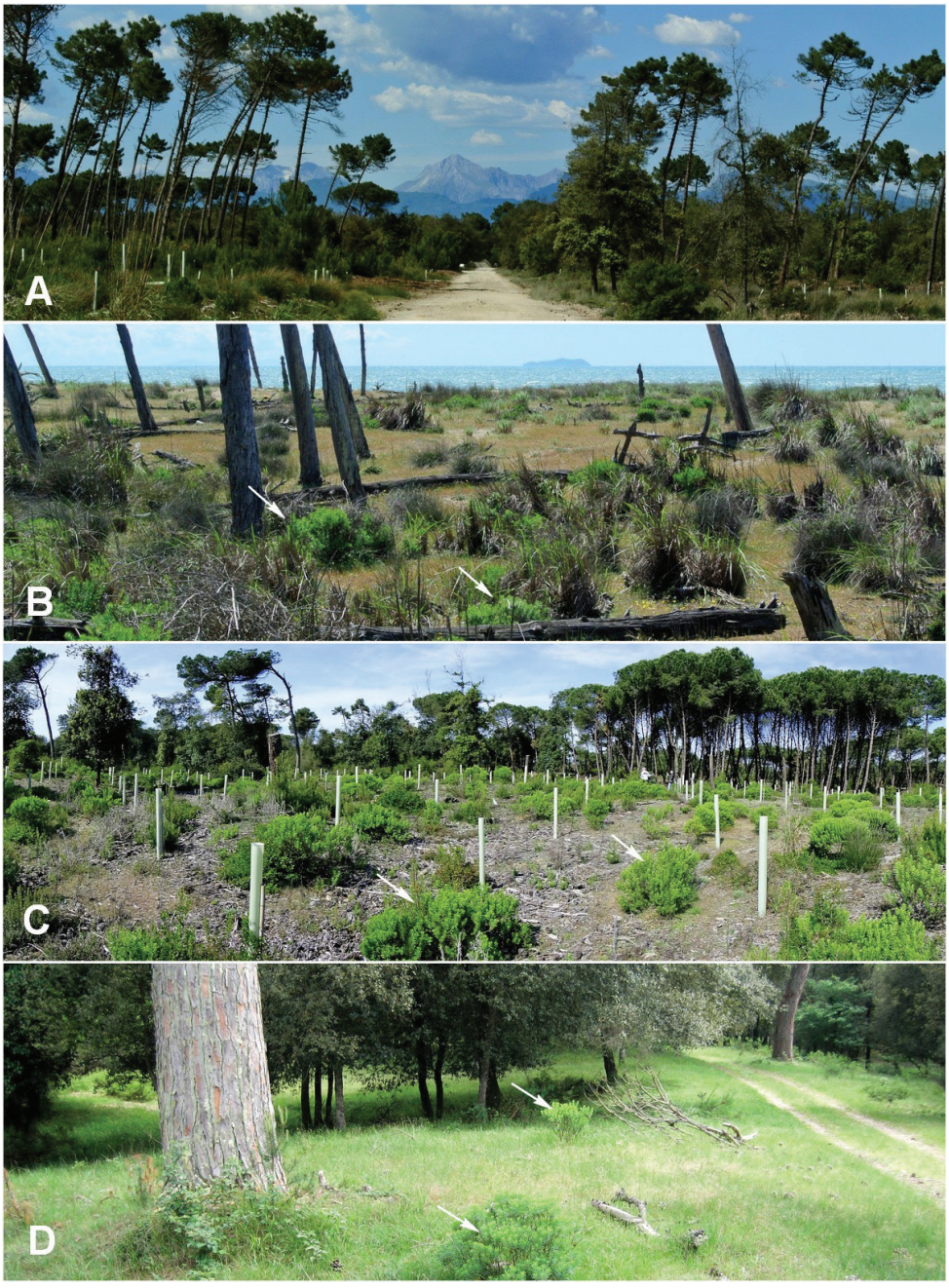

Figure 1. Natural Reserve of San Rossore (Pisa): different habitats of the experimental area. **A** Landscape **B** Fore dune close to sandy shores **C** vegetation of established dunes **D** Wooded area with holm oak. White arrows indicate plants of *Dapne gnidium*.

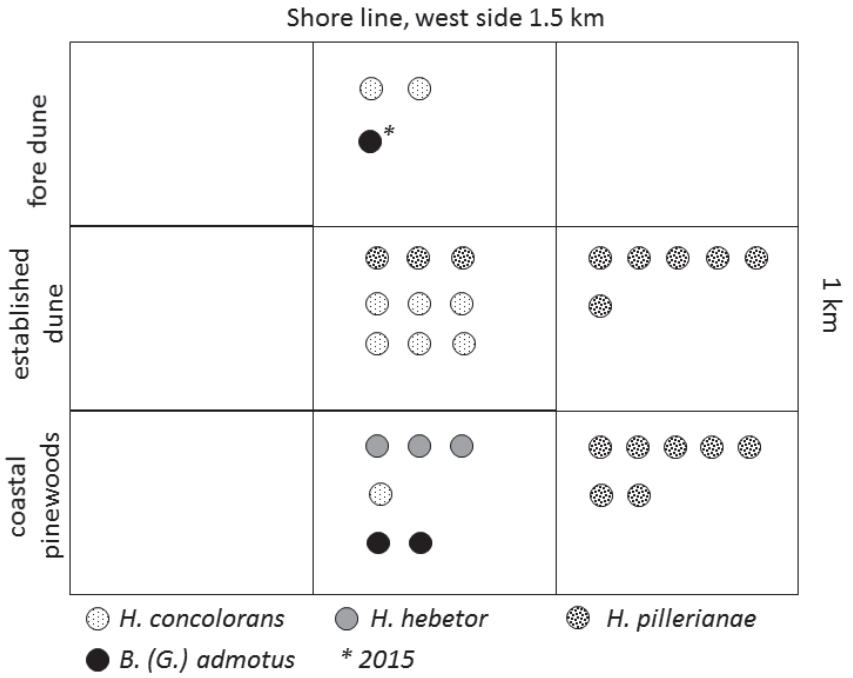

Figure 2. Sampling grid, with distribution of specimens collected.

Figure 3. Sprouts of *D. gnidium* infested by moth larvae. **A** Field situation **B** Nests stored in vials until emergence of the moth or the parasitoid.

m-cu	recurrent vein;
r	first radial abscissa;
SR1	third radial abscissa;
marginal cell	radial cell.

Results

In 2014 and 2015 approximately 4,200 infested sprouts of *D. gnidium* were examined, obtaining 1,254 larvae of *L. botrana* in 2014, and 942 in 2015. In 2014 30 specimens of two genera were obtained, *Bracon* spp. and *Habrobracon* spp., emerging from the larvae of *L. botrana* and *Cryptoblabes gnidiella* (Millière, 1867) (Lepidoptera: Pyralidae), one of the other moths found on *D. gnidium*, while in 2015 we obtained only one specimen of *Bracon*.

These specimens represent approximately 11% of the parasitoid complex emerging from all samples in 2014, the majority of which were Ichneumonidae. They were mainly represented by the species *Campoplex capitator* Aubert, 1960, occurring across all sites and which contributed for more than 58% of the total number of parasitoids found in 2014 (Table 1) and more than 73% in 2015. In 2014 we obtained 2 males of *Bracon admotus* Papp, 7 females and 2 males of *Habrobracon concolorans* (Marshall, 1900), 3 females of *H. hebetor* (Say, 1836), 9 females and 7 males of *H. pillerianae* Fischer, 1980. Each species of *Habrobracon* was distributed at most over three of the nine collecting sites, the two specimens of *B. admotus* were collected only in one site (Fig. 2). In 2015 we obtained one male of *B. admotus*.

Bracon (*Glabrobracon*) *admotus* Papp, 2000

Bracon admotus Papp, 2000: 237; Yu et al. 2012.

Material examined. 2 males, October 14, 2014; 1 male, October 1, 2015.

This is the first record for Italy and Western Europe and *L. botrana* represents a new host for this parasitoid. The most important characters for distinguishing of *B. admotus* from the similar species of *B. variator* and *B. obscurator* species groups are: longitudinal diameter of eye 3.3–3.4 times (about 4.4 times in males) longer than malar space (front view); hypoclypeal depression 1.5–1.6 times (1.6–1.7 times in male) as wide as distance from depression to eye; mesosoma short, about 1.4 times (about 1.5 times in males)

Table 1. List of the main parasitoids emerged from the *Daphne gnidium* sprouts (2014).

Campoplex capitator Auber, 1960 (Ichneumonidae)	Other Ichneumonidae	Bracon spp. Habrobracon spp. (Braconinae)	Other Braconidae (Cheloninae and Rogadinae)	Chalcidoidea	Diptera Tachinidae
126	35	30	9	13	7

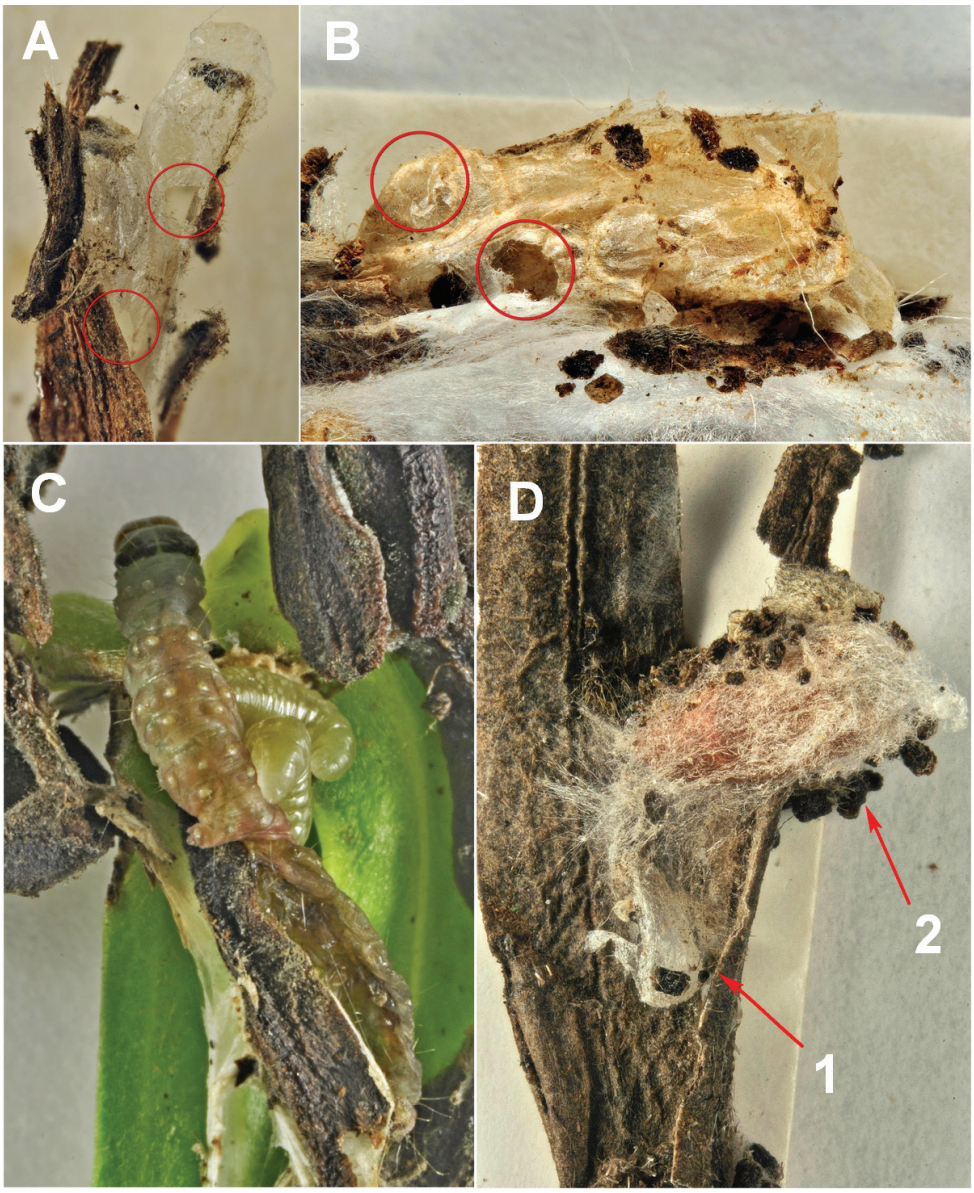

Figure 4. *Habrobracon* preimaginal stages on the hosts *L. botrana* (**A, B, C**) and *C. gnidiella* (**D**). **A** *H. pillerianae* cocoons, the circles surround the exit holes **B** *H. concolorans* cocoons **C** *H. pillerianae* larvae feeding on mature larvae of *L. botrana* **D** *H. hebetor* (1) and *C. gnidiella* (2) cocoons.

longer than maximum height; face and frons evenly granulate; vein r issued clearly before middle of pterostigma; first metasomal tergite (if measured from basomedian tubercle) 1.1–1.3 times as long medially as its apical width; furrow of first tergite and suture between second and third tergites crenulate; metasoma usually completely smooth.

Figure 5 reports various morphological details of the species.

***Habrobracon concolorans* (Marshall, 1900)**

Bracon concolor Thomson, 1892: 1807; Yu et al. 2012.
Bracon concolorans Marshall, 1900: 345 (new name for *Bracon concolor* Thomson, 1892 nec *Bracon concolor* Walker, 1871); Yu et al. 2012.
Habrobracon nigricans Szépligeti, 1901: 181; Yu et al. 2012.
Habrobracon mongolicus Telenga, 1936: 130, 342; Yu et al. 2012.

Material examined. 1 female, May 29, 2014; 4 females from the same host larva, July 4, 2014; 2 males from the same host larva, July 23, 2014; 2 females, October 2, 2014.

Habrobracon concolorans is a Trans-Eurasian species (Samartsev and Belokobylskij 2013), widely distributed in the Palaearctic region and has been recorded in the following countries (Yu et al. 2012): Europe: Ireland, United Kingdom, Sweden, Denmark, France, Spain, Italy, including Sicily (Zappala et al. 2012b), Lithuania, Russia (Kaliningrad and Astrakhan provinces), Poland, Czech Republic, Slovakia, Hungary, Romania, Moldova, Bulgaria, Croatia, Greece; Middle East: Turkey, Cyprus, Jordan (Al-Jboory et al. 2012; Zappalà et al. 2013), Iran; Caucasus: Russia (Ciscaucasia: Krasnodar Territory), Georgia, Armenia, Azerbaijan; Central Asia: Kazakhstan, Turkmenistan (Papp 2008), Kyrgyzstan, Mongolia (Papp 2009); Russian Far East: Sakhalin, Khabarovsk Territory, Primorskiy Territory; China: Shanxi, Ningxia, Fujian; Africa: Egypt (Zappalà et al. 2013), Tunisia (Papp 2014), Sudan (Ghoneim 2014, Mahmoud 2013).

The collecting period of the *L. botrana* larvae hosting *H. concolorans* ranged from May 29 to October 2. *L. botrana* is considered a new host for *H. concolorans*. Also on *L. botrana*, *H. concolorans* develops as ectoparasitoids of mature larvae showing both solitary and gregarious habit, with up to four individuals feeding on the same host larva (Fig. 4B). Figure 6 reports the morphological details of the species.

***Habrobracon hebetor* (Say, 1836)**

Bracon hebetor Say, 1836: 252; Yu et al. 2012.
Bracon brevicornis Wesmael, 1838: 23; Yu et al. 2012.
Bracon juglandis Ashmead, 1889: 621; Yu et al. 2012.
Other less valuable synonyms are listed in Yu et al. 2012.

Material examined. 1 female from larva of *C. gnidiella*, May 29, 2014; 2 females from larvae of *L. botrana*, June 6, 2014.

We found two specimens on mature larvae of *L. botrana*, but we also obtained one specimen by *C. gnidiella* (Fig. 4D), thus confirming its suitability in many environmental situations, where it can occupy a large variety of ecological niches.

Figure 7 shows various morphological details of this species.

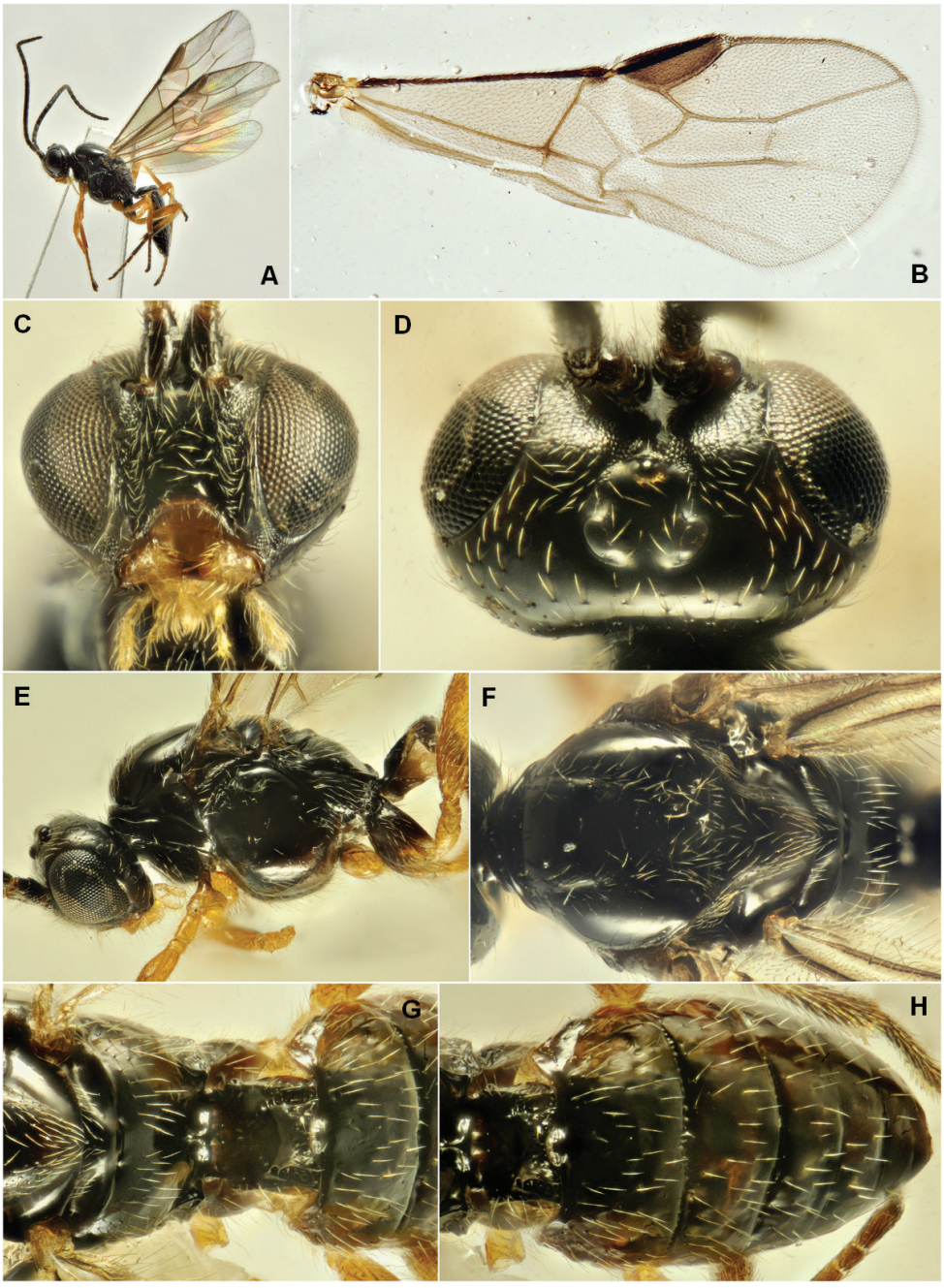

Figure 5. *B.* (*G.*) *admotus* Papp 2000, male. **A** Body, lateral view **B** Fore wing **C** Head, front view **D** Head, dorsal view **E** Head and mesosoma, lateral view **F** Mesosoma, dorsal view **G** Metanotum, propodeum and basal segments of metasoma, dorsal view **H** Metasoma, dorsal view.

Figure 6. *H. concolorans* (Marshall, 1900), female. **A** Body, dorsal view **B** Wings **C** Head and mesonotum, dorsal view **D** Head, sub-lateral view **E** Head, front view **F** Propodeum and metasoma, dorsal view **G** Metasoma, dorsal view.

Habrobracon pillerianae Fischer, 1980

Habrobracon pillerianae Fischer, 1980: 150; Yu et al. 2012.

Material examined. 5 females and 2 males, June 27, 2014 (3 females and 1 female + 2 males from the same host larva); 2 females and 1 male (1 male and 1 female reared from the same host larva) July 23, 2014; 1 female, 4 males, July 31, 2014; 1 female September 10, 2014.

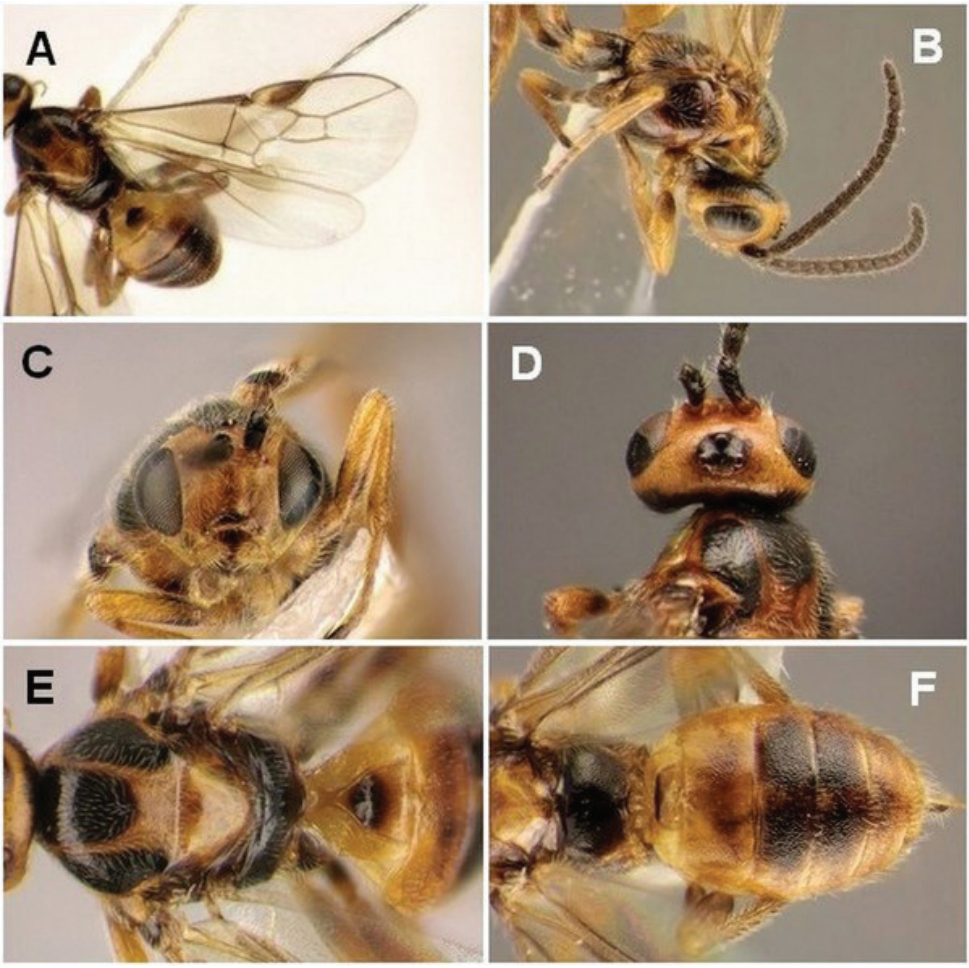

Figure 7. *H. hebetor* Say, 1936, female, **A** Wings **B** Head and mesosoma, lateral view **C** Head, front view **D** Head, dorsal view **E** Mesosoma, dorsal view **F** Metasoma, dorsal view.

Six specimens of this species were described by Fischer (1980) which were reared from larvae of *Sparganothis pilleriana* (Denis & Schiffermüller, 1775) (Lepidoptera Tortricidae) in Ankara Province, Central Anatolia, Turkey (Fischer 1980). To date, this is the only paper reporting original information on this species (Yu et al. 2012). We obtained this species in our rearing programme from June 27 to September 10, 2014. The dates of the emergence of the specimens well fitted with those reported by Fisher, who described *H. pillerianae* from specimens collected on July 20, 1976. Also in this species the larvae developed both solitary and gregariously, with up to three individuals feeding on the same host larva (Fig. 4A, C). This is the first report of this species for Italy and Europe as well as the first association with *L. botrana*. Figure 8 shows various morphological features of this species.

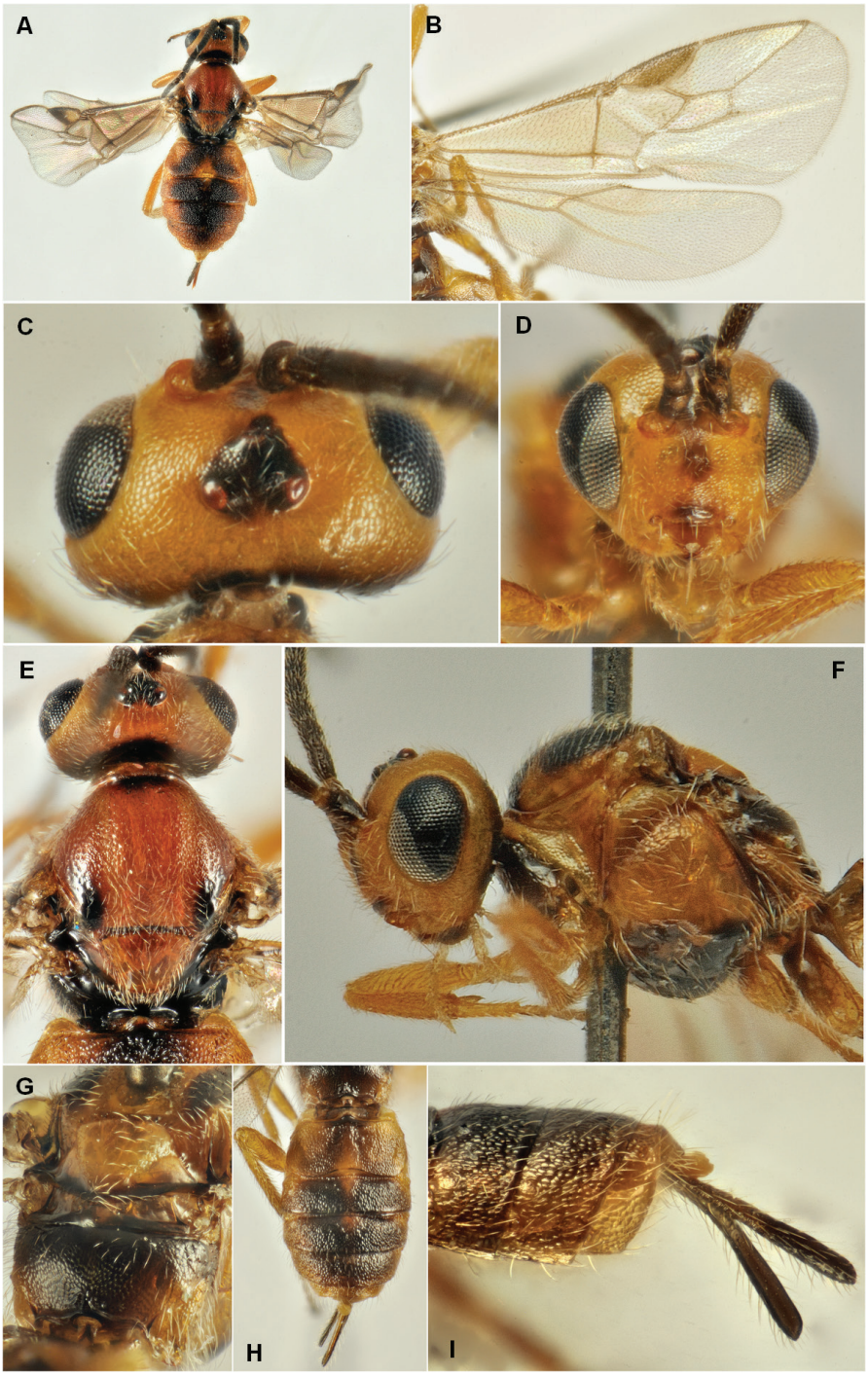

Figure 8. *H. pillerianae* Fischer, 1980, female. **A** Body, dorsal view, **B** Wings **C** Head, dorsal view **D** Head, front view **E** Mesosoma, dorsal view **F** Head and mesosoma, lateral view **G** Metanotum and propodeum, subdorsal view **H** Metasoma, dorsal view **I** Apex of metasoma, lateral view.

Key to the *Habrobracon* species reared from *Lobesia botrana* on *Daphne gnidium* with respect to related species recorded in the Western Palaearctic

Using the most complete key for the Palaearctic species (Tobias 1986), the specimens of *H. pillerianae* are to be identified as *H. telengai* or *H. viktorovi*, the difference between *H. concolorans* and related species is also not very clear. Therefore, it seems appropriate to indicate the position of the three identified species in the whole genus by providing the following key. Suggested key does not aim to help to identify the *Habrobracon* species groups not related with *H. concolorans*, *H. hebetor* and *H. pillerianae*. Such unrelated species are distinguished in the key couplets 1 and 5. In some couplets, additional information helping the species identification is listed after a dash (–). Measures adopted for the head in the key are shown in Figure 9A. Wing veins are measured excluding their junctions (Fig. 9B). The most important synonyms are given in parentheses.

1 Middle lobe of mesoscutum glabrous (as in Fig. 5F). Vein 3-SR 1.1–1.3 times longer than vein 2-SR..... ..... ***H. variegator* (Spinola, 1808) species group** (sensu Tobias)

– Middle lobe of mesoscutum (often evenly) setose (Figs 6C, 7E, 8E). Vein 3-SR not longer than vein 2-SR (except *H. lineatellae*; Figs 6B, 7A, 9B) 2

2 Mesoscutum (except middle lobe posteriorly and notauli lines) and most of mesopleuron completely smooth. Vein 2-SR+M 0.5–0.7 times as long as vein 2-SR, 1.1–1.4 times as long as vein m-cu (Fig. 7A; if rarely 0.8–0.9 times then vein 1-R1 not longer than pterostigma). - Metanotum smooth (Fig. 7F). Metasomal tergites with weak sculpture, shiny (Fig. 7F). First metasomal tergite with smooth furrow (Fig. 7E) **3**

– Mesoscutum and mesopleuron distinctly granulose or shagreened (Fig. 6C), if sometimes with smoothed areas (Fig. 8E, 8F) then vein 2-SR+M 0.3–0.5

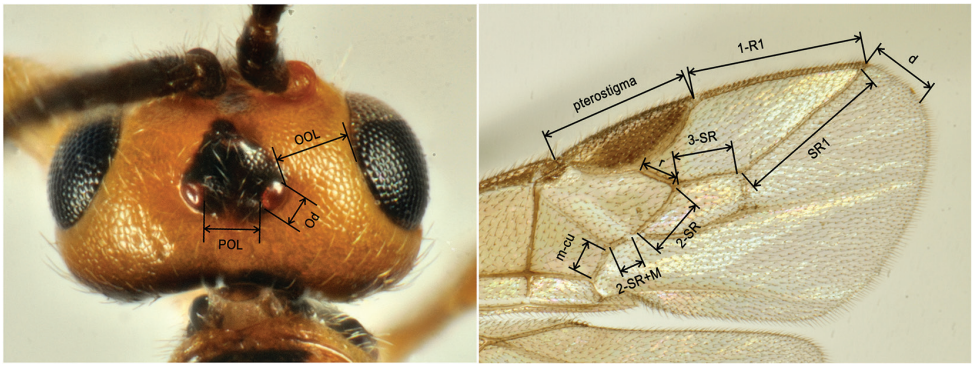

Figure 9. Measures adopted in the key for head. **A** (Od = Ocellar diameter, OOL = Ocular - Ocellar Line, POL = Post-Ocellar Line) and distal part of fore wing **B** (d = distance from apex of marginal cell to apex of wing).

times as long as vein 2-SR and 0.4–0.8 times as long as vein m-cu (Fig. 8B) and first metasomal tergite usually with crenulate furrow.....**4**

3 Antennae not thickened; first flagellar segment 1.8–2.0 times longer than its apical width, middle flagellar segments 1.6–1.7 times longer than wide. Vein 1-R1 0.85–1.00 times as long as pterostigma, 1.1–1.3 times longer than distance from apex of marginal cell to apex of wing. Face width 1.8–1.9 times its height with clypeus. Hypoclypeal depression 1.4–1.5 times wider than shortest distance from depression to eye. Transverse diameter of eye (dorsal view) 2.3–2.6 times longer than temple. Fore wing almost hyaline. 2.0–2.6 mm..... ***H. breviradiatus*** **Tobias, 1957**

– Antennae thickened; first flagellar segment 1.5–1.8 times longer than its apical width, middle flagellar segments 1.3–1.4 times longer than wide (Fig. 7B). Vein 1-R1 1.3–1.5 times longer than pterostigma, 3.5–5.0 times longer than distance from apex of marginal cell to apex of wing. Face width 1.4–1.6 times its height with clypeus. Hypoclypeal depression 1.1–1.2 times wider than distance from depression to eye. Transverse diameter of eye (dorsal view) 1.5–1.6 times longer than temple. Fore wing faintly darkened in basal half and under pterostigma. 2.0–3.5 mm..... ***H. hebetor*** **(Say, 1836)**

4 Mesosoma usually black, evenly granulose (except ventral side of mesopleuron; Figs 6A, 6C, 6D). Vein 2-SR+M 0.5–0.9 times as long as vein 2-SR, 0.8–1.3 times as long as vein m-cu (Fig. 6B). - Transverse pronotal sulcus deep and often crenulate (Fig. 6D). Lateral area of metanotum usually sculptured. Antero-lateral areas on third metasomal tergite not separated by grooves.....**5**

– Mesosoma reddish-yellow or black, with wide reddish pattern and smoothed areas on mesoscutum, pronotum and lateral side of mesopleuron (Fig. 8E, 8F). Vein 2-SR+M 0.25–0.50 times as long as vein 2-SR, 0.4–0.8 times as long as vein m-cu (Fig. 8B, 9B) **8**

5 Vein 1-R1 0.8–1.1 times as long as pterostigma complex of species [*H. didemie* (Beyarslan, 2002), *H. excisus* Tobias, 1957, *H. kopetdagi* Tobias, 1957, *H. marshakovi* (Tobias, 2000), *H. nigerrimus* Fischer, 1968, *H. ponticus* (Tobias, 1986), *H. radialis* Telenga, 1936]

– Vein 1-R1 1.3–1.5 times longer than pterostigma (Fig. 6B) **6**

6 Vein 3-SR 0.75–0.95 times as long as vein r (Fig. 6B). OOL 3.0–4.0 times Od; POL 2.3–3.0 times Od (Fig. 6C). Face width 1.7–1.8 times its height with clypeus (Fig. 6E). - Hypoclypeal depression 1.2–1.6 times wider than shortest distance from depression to eye. Middle lobe of mesoscutum without longitudinal stripes of smoothed sculpture (Fig. 6C). Fore wing almost hyaline. Vein 1-R1 2.0–2.5 times longer than distance from apex of marginal cell to apex of wing (Fig. 6B). 2.0–3.2 mm.....***H. concolorans*** **(Marshall, 1900)**

– Vein 3-SR 1.4–1.7 times longer than vein r. OOL 2.2–2.8 times Od; POL 1.3–1.9 times Od. Face width 1.4–1.6 times its height with clypeus.....**7**

7 Second tergite basally 1.4–1.6 times wider than its median length, coarsely rugose on sides of median convex area. Fore wing almost hyaline. Vein 1-R1

1.8–2.1 times longer than distance from apex of marginal cell to apex of wing. Hypoclypeal depression 1.2–1.3 times wider than minimum distance from depression to eye. Middle lobe of mesoscutum sometimes only with two longitudinal stripes of smoothed sculpture. 2.3–3.2 mm .... ***H. crassicornis*** **(Thomson, 1892)** (*H. flavosignatus* Tobias, 1957)

– Second tergite basally 1.7–2.0 times wider than its median length, evenly striate-rugose medially and without median convex area. Fore wing faintly darkened in basal half. Vein 1-R1 3.0–4.5 times longer than distance from apex of marginal cell to apex of wing. Hypoclypeal depression 0.9–1.0 times as wide as shortest distance from depression to eye. Middle lobe of mesoscutum with two smooth longitudinal stripes. 2.5–3.0 mm .... ***H. stabilis*** **(Wesmael, 1838)**

8 Vein 3-SR 1.2–1.3 times longer than vein 2-SR. Vein 1-R1 1.4–1.5 times longer than pterostigma, 5.0–6.0 times longer than distance from apex of marginal cell to apex of wing. Fore wing distinctly darkened in apical half. - Second metasomal tergite coarsely rugose on sides of short, almost smooth and convex median area. Middle lobe of mesoscutum with two smooth longitudinal stripes, but sometimes completely smooth. Median area of first metasomal tergite with roughly crenulate margins. Sculpture of mesosoma and metasoma often smoothed. 2.5–3.0 mm..... ..... ***H. lineatellae*** **Fischer, 1968, stat. resurr.**

– Vein 3-SR 0.6–1.0 times as long as vein 2-SR (Fig. 8B). Vein 1-R1 1.00–1.35 times as long as pterostigma, 1.7–5.5 times longer than distance from apex of marginal cell to apex of wing. Fore wing hyaline in apical half.....**9**

9 Vein 1-R1 1.0–1.2 times as long as pterostigma, 1.7–2.2 times longer than distance from apex of marginal cell to apex of wing. Vein SR1 4.0–4.5 times longer than vein 3-SR. Fore wing almost hyaline. – First flagellar segment 2.1–2.3 times longer than its apical width; middle and penultimate flagellar segments 1.7–1.9 times longer than wide.....**10**

– Vein 1-R1 1.25–1.35 times longer than pterostigma, 2.5–5.5 times longer than distance from apex of marginal cell to apex of wing. Vein SR1 2.4–3.8 times longer than vein 3-SR. Fore wing faintly darkened at least under pterostigma (Figs 8B, 9B). – Side of metanotum smooth (Fig. 8G). Middle lobe of mesoscutum with two smoothed longitudinal stripes (sometimes hardly visible Fig. 8E).....**11**

10 Antennae 23–25-segmented. Vein 3-SR 1.75–1.85 times longer than vein r. Transverse diameter of eye (dorsal view) 1.9–2.2 times longer than temple. Lateral areas of metanotum rugose to areolate with granulation. Propodeum with median keel and rugosity on wide area. OOL 1.4–2.0 times POL; POL 0.9–1.5 times Od. 2.8–3.6 mm ..... ***H. nygmiae*** **Telenga, 1936**

– Antennae 17–19-segmented. Vein 3-SR 1.0–1.4 times as long as vein r. Transverse diameter of eye (dorsal view) 2.6–3.1 times longer than temple. Lateral areas of metanotum faintly granulose to smooth. Propodeum evenly

granulose, without median keel. OOL 1.1–1.2 times POL; POL 1.6–2.0 times Od. 2.0–2.6 mm ..... ***H. telengai*** **Mulyarskaya, 1955**

11 In female, POL 1.2–1.6 times Od, OOL 1.5–1.7 times POL (male unknown). Metasomal sculpture finer and shiny (same in large specimens; as in Fig. 7F). Lateral and median areas of first tergite almost with same type of sculpture, with carinate furrow (i.e. with carinae going beyond furrow). - In small specimens (body length 1.5–2.0 mm), all tergites weakly sculptured, shagreened; - first tergite with smooth furrow. 1.5–2.7 mm ..... ***H. viktorovi*** **Tobias, 1961**

– In female, POL 1.7–2.2 times Od, OOL 1.2–1.4 times POL (Fig. 8C; in male, 1.3–1.4 and 1.05–1.10 times, respectively). Metasomal sculpture coarser, matt (Fig. 8H, I). Lateral areas of first tergite coarser sculptured in comparison with median area, with areolate furrow (*i.e.* with carinae not going beyond furrow). - In small specimens (body length 2.1–2.2 mm), metasomal sculpture shiny but distinctly visible; - first tergite with smooth furrow. 2.1–2.7 mm..... ***H. pillerianae*** **Fischer, 1980**

Discussion and conclusions

Our data provide new information about host association and distribution of *Bracon* and *Habrobracon* species. In the literature, there are few reports of *Habrobracon* or *Bracon* species living on *L. botrana* (Table 2). *Habrobracon gelechiae* (Ashmead, 1889), a well-known parasitoid of the potato tuber moth, *Phthorimaea operculella* (Zeller, 1873) (Lepidoptera, Gelechiidae), was introduced into France to control this harmful insect, and has been experimentally reared from larvae of *L. botrana* (Trouvelot 1924). In the vineyards of Sardinia, Delrio et al. (1987) obtained an unidentified *Habrobracon* from the larvae of EGVM, while from the same host in northwest Iran, along with *H. hebetor*, an unidentified *Bracon* was also obtained (Akbarzadeh Shoukat 2012). As it is well known (Tobias 1961, Shaw and Huddleston 1991, Quicke 2015), *Bracon* and *Habrobracon* are all generalist idiobiont, solitary or gregarious ectoparasitoids, predominantly of Lepidoptera and Coleoptera mature larvae. The data we obtained on *B. admotus*, *H. concolorans, H. hebetor* and *H. pillerianae* consistently matched with the existing knowledge of these genera.

B. admotus was described by J. Papp (2000) by examining 14 specimens (13 females and 1 male) from Hungary and Bulgaria. Ten females were obtained by Papp himself, from the larvae of *Bycticus betulae* (Linnaeus, 1758) (Coleoptera: Attelabidae), which fed on rolled leaves of *Populus tremula* L. Beyarslan and Erdoğan (2012) recorded the species in Turkey.

H. concolorans was re-described by J. Papp in 2008; however, it is still reported as *Bracon* (*Habrobracon*) *nigricans* (Szépligeti) in recent papers (Wang et al. 2012, Zappalà et al. 2012a, b, 2013, Biondi et al. 2013a, b, Beyarslan et al. 2014, Gabarra et al. 2014,). *H. concolorans* was considered as a synonym of *Bracon stabilis* Wesmael by Belokobylskij et al. (2003) following the World Catalogues by Shenefelt and van

Table 2. List of records of *Habrobracon* and *Bracon* spp. on *Lobesia botrana* arranged in chronological order.

Names as used in scientific publication	Valid names	Geographic area	Authors
Habrobracon sp.	*Habrobracon* sp.	Sardinia	Delrio et al. 1987
Habrobracon spp.	*Habrobracon* sp.	South Italy	Moleas 1979, 1995; Coscollà 1997
Habrobracon johannseni Viereck, 1912	*Habrobracon gelechiae* (Ashmead, 1889)	France, experimentally reared from *L. botrana* larvae	Trouvelot 1924
Microbracon gelechiae Ashmead	*Habrobracon gelechiae* (Ashmead)	France	Trouvelot 1924; Thompson 1946; Coscollà 1997
Habrobracon gelechiae (Ashmead)	*Habrobracon gelechiae* (Ashmead)	France	Coscollà 1997; Hoffman and Michl 2003
Bracon sp.	*Bracon* sp.	Northwest Iran	Akbarzadeh-Shoukat 2012
Habrobracon sp.	*Habrobracon* sp.	Northwest Iran	Lotfalizadeh et al. 2012

Achterberg (1978), and is still considered as such by Beyarslan et al. (2014). This species is a generalist ectoparasitoid of various Lepidopteran families and one coleopteran species of the family Anobiidae. Table 3 reports an updated and revised list of its host species. Biondi et al. (2013b) studied the biology and the developmental strategies of this species on the highly invasive South American tomato leafminer, *Tuta absoluta* (Meyrick) (Lepidoptera Gelechiidae), on tomato in Italy.

Habrobracon hebetor has been re-described many times and has a large number of synonyms because of the wide distribution, the broad host range and morphological variability. Regarding its generic attribution, in addition to *Bracon* and *Habrobracon*, it was also once assigned to *Microbracon* Ashmead, 1890 (synonym of *Bracon*). Although they were synonymised for the first time more than 50 years ago (Lal 1942, Puttarudriah and Channa Basavanna 1956, cited through Yu et al. 2012, Tobias 1959), *H. hebetor* was later separated from *H. brevicornis* (Wesmael, 1838) on the basis of various morphological characteristics: the number of antennal segments and the length of the antenna, the length of the vein 3-SR of the fore wing in relation to that of the vein r (van Achterberg and Polaszek 1996). Today *H. brevicornis* is not considered to be valid, given the large variability of the species, and in more recent works, it is reported as a junior synonym of *H. hebetor* (Papp 2008, Yu et al. 2012). The names *Habrobracon brevicornis* and *Microbracon brevicornis* were also used in the case of *L. botrana* (Table 4), but should be replaced by the name *H. hebetor*, which is a well-known species: Yu et al. (2012) list 631 papers on it in their database. The host range is also very large. Yu et al. (2012) list 130 species, of which the vast majority are Lepidoptera, but there are also two Coleoptera and one Hymenoptera, Cynipidae. The behavior of *H. hebetor* is well known and, like the other species of the same genus, it acts as a gregarious larval ectoparasitoid. *H. hebetor* has been the object of great interest regarding its mass rearing and is used as a biocontrol agent against many pests (Ghimire and Phillips 2014).

Table 3. List of the hosts of *Habrobracon concolorans* (Marshall).

Taxa	Main references
LEPIDOPTERA	
GELECHIIDAE	
Pexicopia malvella (Hübner, 1805)	Tobias 1971 1986; Tobias and Belokobilskij 2000; Belokobylskij et al. 2012; Yu et al. 2012
Phthorimaea operculella (Zeller, 1873)	Ortu and Floris 1989
Tuta absoluta (Meyrick, 1917)	Zappalà et al. 2013; Ghoneim 2014
NOCTUIDAE	
Heliothis maritima Graslin, 1855	Tobias and Belokobilskij 2000; Belokobilskij et al. 2012
NYMPHALIDAE	
Vanessa cardui (Linnaeus, 1758)	Tobias and Belokobilskij 2000; Belokobilskij et al. 2012
PYRALIDAE	
Assara terebrella (Zincken, 1818) (=*Ephestia terebrellum* Zincken nec Zeller)	Györfi 1956; Yu et al. 2012
Etiella zinckenella (Treitschke, 1832)	Tobias 1971, 1986; Tobias and Belokobilskij 2000; Belokobylskij et al. 2012; Yu et al. 2012
Loxostege sticticalis (Linnaeus, 1761)	Tobias 1971, 1986; Tobias and Belokobilskij 2000; Belokobylskij et al. 2012; Yu et al. 2012
TORTRICIDAE	
Cnephasia sedana (Constant, 1884)	Tobias 1971, 1986; Tobias and Belokobilskij 2000; Belokobylskij et al. 2012; Yu et al. 2012
Cydia cosmophorana (Treitschke, 1835)	Györfi 1956
Cydia strobilella (Linnaeus, 1758)	Györfi 1956; Yu et al. 2012
Lobesia botrana (Denis et Schiffermüller, 1775)	new host for *H. concolorans*
COLEOPTERA	
ANOBIIDAE	
Ernobius nigrinus (Sturm, 1837)	Györfi 1956; Yu et al. 2012

Table 4. List of records of *H. hebetor* on *L. botrana* arranged in chronological order.

Names as used in scientific publication	Geographic area	Authors
Habrobracon sp.	South Italy	Silvestri 1912; Boselli 1928; Stellwaag 1928
Habrobracon brevicornis (Wesmael)	Italy	Silvestri 1912; Goidanich 1934
Microbracon brevicornis (Wesmael)	Italy	Silvestri 1912; Thompson 1946; Coscollà 1997
Habrobracon hebetor (Wesmael)	South Italy	Moleas 1979
Bracon sp. [*Habrobracon* sp.]	Italy	Stellwaag 1928; Hoffman and Michl 2003
Habrobracon hebetor (Say)	Greece, laboratory test	Milonas 2005
Habrobracon hebetor (Say)	Northwest Iran	Akbarzadeh Shoukat et al. 2008; Akbarzadeh Shoukat 2012; Lotfalizadeh et al. 2012

All these collected Braconinae represent only a minor component of the parasitoid complex we found, mainly represented by the larval endophagous koinobiont *Campoplex capitator* (Hymenoptera: Ichneumonidae). They showed a reduced prevalence,

occurring only in three sites out of the nine sampled, while *C. capitator* was found everywhere. These are the typical features of rare taxa, that can play a crucial role in the case of a local and temporal extinction of the main parasitoids (Jain et al. 2014). It is known that generalist parasitoids can play a key role in many insect communities, since they can more easily switch between different species, exerting an influence on the abundance, coexistence and the community structure of many host populations (Jones et al. 2015). In terms of their strong phenotypic plasticity, they are a very important resource as pest-control agents. Their "switching" behavioral skills (Murdoch 1969) make them very suitable to performing rapid changes in the host range, depending on the relative abundance of hosts, or the establishment of a new host in the community. This is a very important behavioural trait under the current climate-change scenario, where increasingly more frequently and intensively, exotic pest introductions occur, often breaking the ecological balance (Stireman et al. 2005, Tylianakis et al. 2008). It is not by chance that two of the first autochthone parasitoids, switched on the introduced exotic pest *Tuta absoluta* (Meyrick) in Europe, are represented by *H. hebetor* and *H. concolorans* (Al-Jboory et al. 2012, Doğanlar and Yiğit 2011, Ferracini et al. 2012, Zappalà et al. 2013).

Our findings of three *Habrobracon* and one *Bracon* species living on *L. botrana* larvae in the natural reserve of Migliarino-San Rossore-Massaciuccoli provide important evidence that this wild area could be of great advantage to the surrounding territories. The Tuscan rural landscape is covered in vineyards, where *L. botrana* is the key pest. The vineyard agroecosystem is well integrated with the surrounding areas, rich in natural habitats, and hosts a very diverse braconid fauna (Loni et al. 2012, Belokobylskij et al. 2013, Loni and Lucchi 2014). Indeed, the presence of a natural wild reserve, near to rural and anthropic areas, can play a crucial role as a biodiversity reservoir from which beneficials can spill over and colonize or recolonize perturbed areas.

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RESEARCH ARTICLE

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Two new species of the genus *Panorpa* Linnaeus (Mecoptera, Panorpidae) from Yunnan, China

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Abstract

Two new scorpionfly species, *Panorpa reflexa* **sp. n.** and *Panorpa parallela* **sp. n.**, are described and illustrated from Yunnan Province, China. *Panorpa reflexa* can be readily differentiated from its congeners by the 3-shaped parameres in male genitalia. *Panorpa parallela* is unique for its parallel parameres in male genitalia. The number of *Panorpa* species is raised to four in Yunnan Province, and to 113 throughout China.

Keywords

Biodiversity, Hengduan Mountains, Mount Daxueshan, scorpionfly, taxonomy

Introduction

Panorpidae are the largest family in Mecoptera, and currently consist of approximately 400 species in six genera worldwide (Hu et al. 2015). Panorpids are commonly called scorpionflies, because the genitalia of their males are globular and recurved over the back, resembling the tail of a scorpion (Byers and Thornhill 1983; Bicha et al. 2015). Scorpionflies mostly live in humid, high-elevated and vegetation-rich habitats (Byers

and Thornhill 1983; Byers 2002a). Males of many scorpionflies offer nuptial gifts to the female during courtship and copulation, and use the clamp-like notal organ on the third tergum to seize the anterior edge of the wings of the female (Zhong and Hua 2013a). These insects are frequently considered to represent ideal models for the study of mating systems and behavior in insects (Ma and Hua 2011a; Zhong et al. 2015a). However, the males of *Furcatopanorpa longihypovalva* (Hua & Cai, 2009) lack a notal organ, and assume an unusual O-shaped position during copulation (Zhong et al. 2015b).

Panorpa Linnaeus, 1758 is the most speciose genus in Panorpidae, consisting of approximately 252 species worldwide and 111 species in China to date (Esben-Petersen 1921; Carpenter 1945; Byers 1970; 2002b; Chou et al. 1981; Fu and Hua 2009; Zhang and Hua 2012; Zhong and Hua 2013b). *Panorpa* differs from *Neopanorpa* Weele, 1909 and *Leptopanorpa* MacLachlan, 1875 by the vein 1A ending at or beyond the level of the origin of Rs, in addition to genital features (Cheng 1957). Based on morphological and molecular data (Misof et al. 2000; Ma et al. 2011, 2012; Hu et al. 2015), the genus *Panorpa* has been confirmed to be a paraphyletic group. Recently, three genera have been established from *Panorpa* Linnaeus: *Sinopanorpa* Cai & Hua in Cai et al. 2008 (3 spp.), *Furcatopanorpa* Ma & Hua, 2011 (1 sp.) and *Dicerapanorpa* Zhong & Hua, 2013 (8 spp.).

Yunnan is a province in southwestern China and well-known for its richness in biodiversity (Yang et al. 2004). Historically, five species of *Panorpa* were recorded from Yunnan. Recently, *Panorpa kimminsi* Carpenter, 1948, *Panorpa triclada* Qian & Zhou, 2001, and *Panorpa tjederi* Carpenter, 1938 were transferred to *Dicerapanorpa* Zhong & Hua, 2013. Consequently, only two species, *Panorpa issikiana* Byers, 1970 and *Panorpa kunmingensis* Fu & Hua, 2009, remain in the genus *Panorpa* from Yunnan. In our recent survey in the Mount Daxueshan, the southernmost prolongation of the Hengduan Mountains, numerous scorpionfly specimens were collected and determined to belong to two undescribed species of *Panorpa* Linnaeus, raising the number of *Panorpa* species to four in Yunnan Province, and to 113 throughout China.

Material and methods

Specimens examined in this study were captured with collecting nets and temporarily preserved in 75% ethanol. After observation and initial measurements, some type materials were pinned as permanent preservation and deposited in the Entomological Museum, Northwest A&F University, China **(NWAU)**.

Measurements of the right wings of 20 males and 20 females of the two new species were made with a vernier calliper, calculated with Microsoft Excel 2010 and are presented as mean ± SD (standard deviation). Some genitalia were macerated in 10% NaOH solution for 3 minutes and then rinsed with tap water. Photographs were taken with a Nikon D7000 digital camera, and further treated with Adobe Photoshop CS4. Dissections and observations were made under a Nikon SMZ 1500 microscope. The abdominal segments are described as abbreviates, e.g., A1 is the first segment.

Description

***Panorpa reflexa* sp. n.**
http://zoobank.org/3264DA6D-00F6-4302-9AE0-302C058641B1
Figs 1–3, 4A

Type material. Holotype: CHINA: Yunnan Province: ♂, Mt. Daxueshan [大雪山] (24°11.27'N, 99°37.35'E), 2000 m, Yongde County [永德县], 21 Aug. 2015, leg. Ji-Shen Wang. **Paratypes.** 31♂♂48♀♀, same data as the holotype, 21–23 Aug. 2015.

Diagnosis. The new species can be recognized by the following features: 1) dorsum of body with one broad pale longitudinal stripe mesally; 2) head yellowish brown with the ocellar triangle and the postvertex black; 3) wings hyaline with a greatly reduced pterostigmal band; 4) hypandrium greatly shortened, with hypovalves only reaching the basal third of the gonocoxites; and 5) parameres 3-shaped.

Description of male. *Head*. Head mostly yellow. A black pattern on postvertex, transverse, shallowly notched on anterior margin, and laterally adjacent to compound eyes; another black pattern around ocellar triangle, almost pentagonal, with its anterior margin extending to the upper border of the light yellow antennal sockets. Antennal scape brown, pedicel dark brown, flagellum black with 38–42 segments. Rostrum unevenly yellowish brown with genae pale. Maxillary and labial palps yellowish with distal segments darkening toward the apex (Fig. 1C).

Thorax. Pronotum brown, with 6–10 stout setae along its anterior margin. Meso- and metanotum brown with a broad pale longitudinal stripe and a narrow brown mesal line (Fig. 1D). Pleura pale yellow. Legs light brown with coxae pale yellow and distal tarsomeres brown.

Wings. Forewing length 10.40 ± 0.37 mm, width 2.40 ± 0.17 mm. Pterostigma light brown with dense microtrichia. Wing membrane hyaline, devoid of markings except the greatly reduced brown pterostigmal band, which forms an irregular spot at vein R_1 and extending to vein M_1 as a series of discontinuous spots. Vein 1A ending at the hind margin beyond the level of the origin of Rs. Hindwing length 9.47 ± 0.36 mm, width 2.28 ± 0.11 mm, similar to forewings, but with the pterostigmal band more degenerated (Fig. 1A).

Abdomen. Terga I–V brown, with a pale longitudinal mesal stripe connected with the thoracic stripe anteriorly and narrowing posteriorly. Notal organ on the posterior margin of tergum III slightly developed and covering the acute dorsal process of tergum IV (Fig. 1D). Sterna I–V light brown, pleura pale. A6 blackish brown with distal third yellowing gradually, cylindrical, without anal horns. A7 and A8 yellowish orange, with faint brown textures laterally; A7 nearly cylindrical, A8 slightly constricted basally and beveled apically (Fig. 1E).

Male genitalia. Genital bulb yellowish orange, oval, slightly flat in lateral view (Fig. 2). Epandrium (tergum IX) extending beyond the apex of gonocoxite, slightly constricted midway, distal half tapering toward the apex, with a deep U-shaped terminal emargination and forming two parallel digital processes (Fig. 2C). Cerci clavate. Hyp-

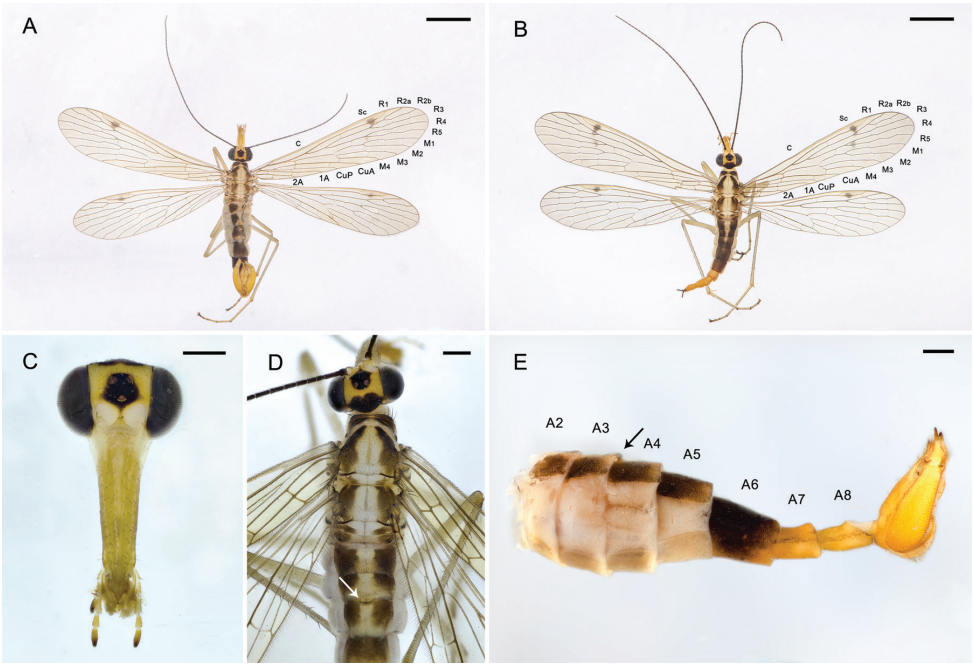

Figure 1. Adults of *Panorpa reflexa* sp. n. **A** Habitus of male, dorsal view **B** habitus of female, dorsal view **C** head of male with antennae removed, frontal view **D** dorsum of male **E** abdomen of male, lateral view. Arrows show the notal organ on tergum III. Scale bars: 2.5 mm (**A, B**); 0.5 mm (**C**–**E**).

andrium (sternum IX) greatly shortened, extending only to the basal third of gonocoxites, hypovalves bearing long bristles along inner margins (Fig. 2A). Gonostylus shorter than half the length of gonocoxite, outer margin slightly concaved, inner margin with a blunt median tooth and a curved subbasal process (Fig. 2G). Parameres 3-shaped; both arms nearly half the length of aedeagus, with acute tips, and bearing numerous microtrichia along inner margins; anterior arms stretched under hypovalves. (Fig. 2A, B). Ventral valves of aedeagus thick, slightly sclerotized with apexes rounded, bearing numerous soft setae; dorsal valves strongly sclerotized, with many marginal spines and prominent, flattened apexes, exceeding to the base of gonostylus; the joint edge of dorsal and ventral valves rolled ventrad, with three acute teeth ventrally, and one long spine dorsolaterally (Fig. 2D–F).

Description of female. Similar to males in general appearance. The ocellar pattern more rounded than that of males; wings with pterostigmal band more developed (Fig. 1B). Forewing length 11.10 ± 0.35 mm, width 2.48 ± 0.13 mm; hindwing length 10.17 ± 0.27 mm, width 2.31 ± 0.11 mm, similar to forewings.

Female genitalia. A9 nearly twice the length of A8. Subgenital plate accompanied with two lateral plates, which slightly beyond half the length of the main part; main part with basal half trapezoid, distal half vase-shaped and bearing long thick setae marginally (Fig. 3A, B). Genital plate small, shorter than half of subgenital plate; axis

Figure 2. Male genitalia of *Panorpa reflexa* sp. n. **A**–**C** Genital bulb in ventral, lateral, and dorsal views **D–F** aedeagal complex in ventral, lateral, and dorsal views, arrows pointing to the teeth along the joint edges of dorsal and ventral aedeagal valves **G** gonostylus, dorsal view. **ae** aedeagus; **ce** cercus; **dv** dorsal valve; **ep** epandrium; **gcx** gonocoxite; **gs** gonostylus; **hv** hypovalve; **mt** median tooth; **pm** paramere; **sbp** subbasal process; **stp** stalk of paramere; **vv** ventral valve. Scale bars: 0.2 mm.

short, entirely concealed in the main plate, posterior apex acute; anterior arms shorter than main plate, curved entad; posterior arms longer than main plate, straight, narrowed toward the apex, slightly convergent (Fig. 3C).

Etymology. The specific epithet is derived from the Latin *reflex-* (turned back, reflected), referring to the anterior arms of the paramere in male genitalia being reflected, and not directed caudad as usual.

Distribution. China (Yunnan Province).

Comparisons. *Panorpa reflexa* sp. n. is similar to *P. decolorata* Chou & Wang, 1981 from Shaanxi Province, *P. filina* Chou & Wang, 1987 from Hunan Province, *P. waongkehzengi* Navás, 1935 from Jiangxi Province, China in abdominal morphology, but differs from the latter three species by the males of *P. reflexa* with the paramere

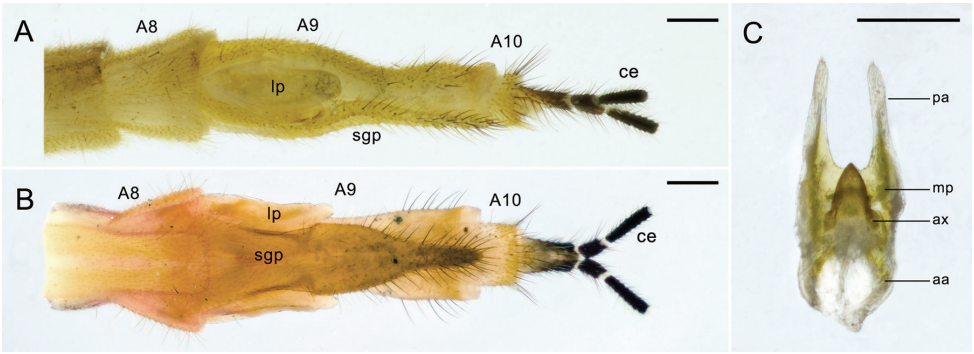

Figure 3. Female terminalia of *Panorpa reflexa* sp. n. **A** and **B** Terminalia in lateral and ventral views **C** genital plate, ventral view. **aa** anterior arm; **ax** axis; **ce** cercus; **lp** lateral plate; **mp** main plate; **pa** posterior arm; **sgp** subgenital plate. Scale bars: 0.2 mm.

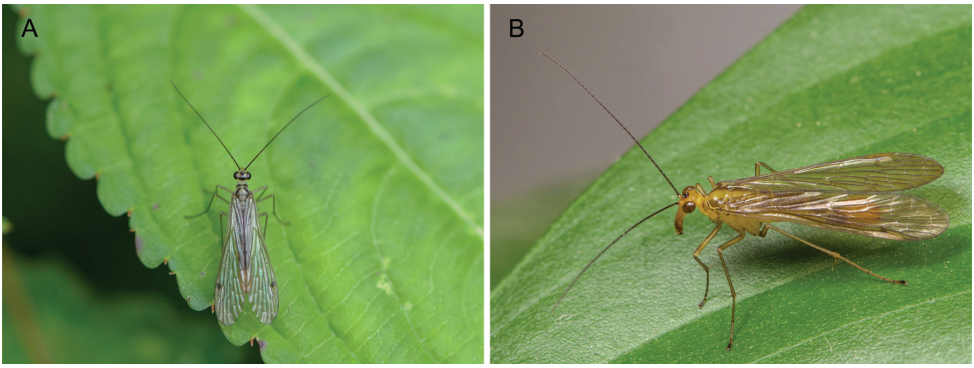

Figure 4. Male adults in the field. **A** *Panorpa reflexa* sp. n. **B** *Panorpa parallela* sp. n.

3-shaped and its anterior arm directed cephalad (cf. parameres are directed caudad, whether branched or not).

Panorpa reflexa resembles *P. guttata* Navás, 1908 from Sichuan Province, China in the greatly reduced pterostigmal band in wings, but can be easily distinguished from the latter by the black ocellar triangle and postvertex (cf. vertex is uniformly colored).

Panorpa parallela sp. n.

http://zoobank.org/243661E8-7438-4B26-B3C6-5D904B7CDBCD
Figs 4B, 5–7

Type material. Holotype: CHINA: Yunnan Province: ♂, Mt. Daxueshan [大雪山] (24°11.27'N, 99°37.35'E), 2000 m, Yongde County [永德县], 21 Aug. 2015, leg. Ji-Shen Wang. **Paratypes.** 22♂♂32♀♀, same data as the holotype, 21–23 Aug. 2015.

Diagnosis. This new species resembles *P. reflexa* sp. n. in appearance, but can be readily differentiated from the latter by the following characters: 1) head yellowish

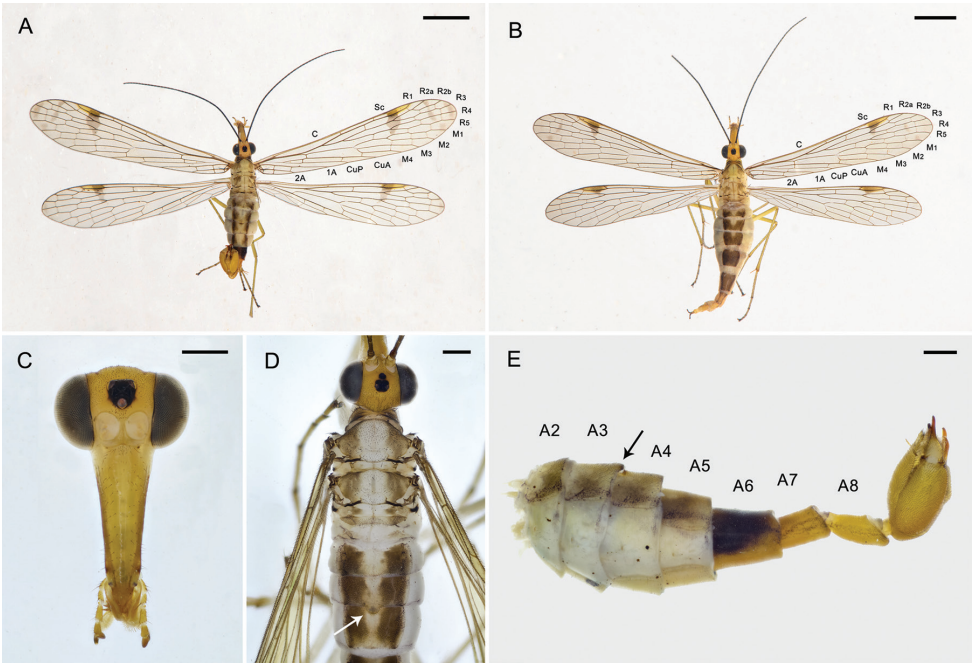

Figure 5. Adults of *Panorpa parallela* sp. n. **A** Habitus of male, dorsal view **B** habitus of female, dorsal view; **C** head of male with antennae removed, frontal view; **D** dorsum of male; **E** abdomen of male, lateral view. Arrows show the notal organ on tergum III. Scale bars: (**A, B**): 2.5 mm; (**C–E**): 0.5 mm.

brown, with ocellar triangle black (cf. head yellow with two black patterns, one on dorsum and the other one around ocellar triangle); 2) forewing with a faint apical band (cf. apical band absent); 3) hypandrium with elongated basal stalk (cf. basal stalk extremely shortened); 4) parameres in male genitalia simple and protruding caudad, almost parallel (cf. 3-shaped).

Description of male. *Head*. Head muddy yellow with ocellar triangle black. Antennal socket light yellow, scape yellowish brown, pedicel dark brown, flagellum black and with 39–42 segments. Rostrum unevenly muddy yellow with genae pale, subgenae brown. Maxillary and labial palps yellowish brown with distal segments darkening toward the apex (Fig. 5C).

Thorax. Pronotum brown, bearing 4–6 stout setae along its anterior margin. Meso- and metanotum light brown with a broad yellowish longitudinal stripe and a faint brown mesal line (Fig. 5D). Pleura pale brown. Legs yellow, with distal tarsi deep brown.

Wings. Forewing length 10.81 ± 0.51 mm, width 2.37 ± 0.10 mm, membrane hyaline, pterostigma reddish brown with dense microtrichia. Pterostigmal band brown, reduced to an irregular spot with acute hind apex, extending to vein R_{2+3}, even to M_1 in some individuals. Apical band faint, degenerated as two irregular stripes, very faint in a few individuals. Vein 1A ending almost at the level of the origin of Rs. Hindwing length 9.98 ± 0.40 mm, width 2.19 ± 0.08 mm, similar to forewings but pterostigmal band and apical band more degenerated (Fig. 5A).

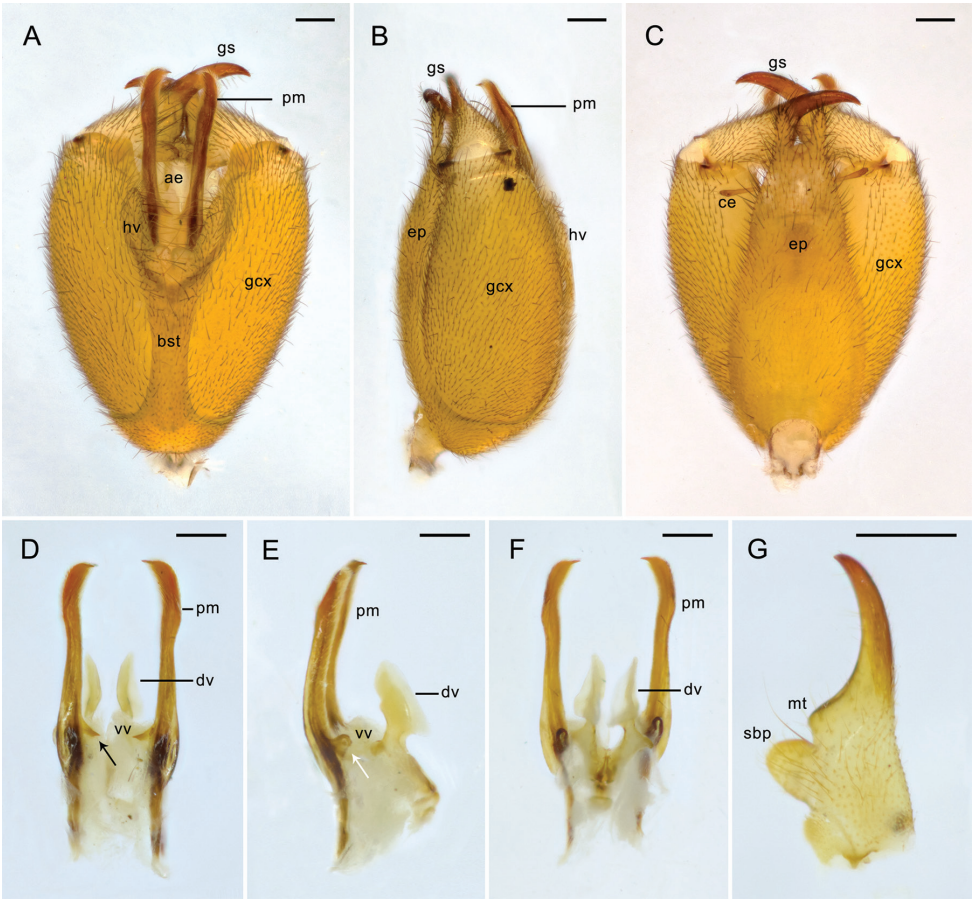

Figure 6. Male genitalia of *Panorpa parallela* sp. n. **A–C** Genital bulb in ventral, lateral, and dorsal views **D–F** aedeagal complex in ventral, lateral, and dorsal views, black and white arrows show the inner teeth and dorsal process of paramere, respectively **G** gonostylus, ventral view. **ae** aedeagus; **bst** basal stalk of hypandrium; **ce** cercus; **dv** dorsal valve; **ep** epandrium; **gcx** gonocoxite; **gs** gonostylus; **hv** hypovalve; **mt** median tooth; **pm**, paramere; **sbp** subbasal process; **vv** ventral valve. Scale bars: 0.2 mm.

Abdomen. Terga I–V sordidly brown, with a yellowish longitudinal mesal stripe, which is weakened and forms several continuous or discontinuous triangular spots at each tergum; pleura pale, sterna light brown. Notal organ on the posterior margin of tergum III slightly developed, covering the acute dorsal process of tergum IV (Fig. 5D). A6 dark brown dorsally and yellowish ventrally, without anal horns. A7 and A8 yellowish orange, with some faint brown textures along lateral surfaces; A7 cylindrical, A8 constricted basally and beveled apically (Fig. 5E).

Male genitalia. Genital bulb yellowish orange, oval (Fig. 6A–C). Epandrium (tergum IX) extending beyond the apex of gonocoxite, broad basally and tapering toward the apex, with a deep U-shaped terminal emargination (Fig. 6C). Cerci brown. Hypandrium (sternum IX) Y-shaped, with a narrow elongated basal stalk and splitting into

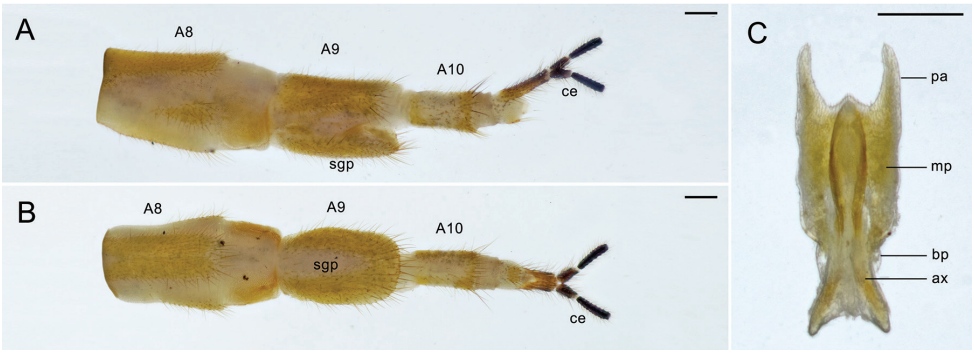

Figure 7. Female terminalia of *Panorpa parallela* sp. n. **A, B** Terminalia in lateral and ventral views; **C** genital plate, ventral view. **ax** axis; **bp** basal plate; **ce** cercus; **mp** main plate; **pa** posterior arm; **sgp** subgenital plate. Scale bars: 0.2 mm.

Figure 8. Habitat of the type locality.

paired hypovalves distally, extending to four-fifths of gonocoxite (Fig. 6A). Posteroventral margin of gonocoxite with a flat triangular process. Gonostylus slightly concaved along outer margin, inner margin with a blunt median tooth and an oval subbasal process, a long bristle rising between them (Fig. 6G). Parameres reddish brown, stick-like, extending far beyond the median tooth of gonostylus, approximately parallel, apexes acute and curved convergently, distal third with numerous microtrichia; inner margin with a pointed tooth subbasally, dorsal margin with a flat process next to the subbasal tooth (Fig. 6D–F). Ventral valves of aedeagus poorly developed, membra-

nous; dorsal valves sclerotized, separated, with thin neck-like stalks, distal parts swollen and flatiron-shaped (Fig. 6D–F), extending nearly to the base of gonostylus.

Description of female. Similar to males in coloration and patterns (Fig. 5B). Forewing length 11.72 ± 0.41 mm, width 2.58 ± 0.15 mm; hindwing length 10.76 ± 0.52 mm, width 2.33 ± 0.15 mm, similar to forewings.

Female genitalia. A9 slightly shorter than A8. Subgenital plate long elliptic (Fig. 7A, B). Genital plate with main plate oblong and intensely constricted at base, posterior margin with a triangular mesal prominence; basal plate slightly wider than axis but narrower than main plate; axis elongated beyond the main plate, anterior third divergent widely, posterior third long elliptic with an acute apex; posterior arms almost half the length as main plate, broad basally and narrowed toward the apex, almost parallel (Fig. 7C).

Etymology. The specific epithet is derived from the Latin *parallel-* (parallel), referring to the parallel parameres in male genitalia.

Distribution. China (Yunnan Province).

Comparisons. *Panorpa parallela* sp. n. is similar to *P. rufostigma* Westwood, 1842 from Europe in the reddish pterostigma, but can be recognized by its greatly reduced wing markings (cf. wing markings well-developed).

Panorpa parallela resembles *P. chengi* Chou, 1981 from Shaanxi Province, China in body coloration, especially the pale-brown thoracic terga, but can be differentiated from the latter by the reddish pterostigma and the wing pattern (cf. pterostigma indistinct, wings devoid of markings).

The two new species, *P. reflexa* and *P. parallela*, resemble each other in general appearance at first glance. In living animals, the wings are held in close contact along the mid-line over the abdomen, and in the same plane at repose (Fig. 4). This condition is different for most species of *Panorpa*, the wings of which are mostly divergent and kept in a V-shape over the abdomen at repose.

Habitat. In the type locality, Mount Daxueshan, these two species share the same habitat among several mountain valleys with streams around an elevation of 2000 m. Suitable microhabitats lie mostly in a slope surrounded by evergreen broad-leaved forests and with dense herbaceous groundcover (Fig. 8). In the daytime of August, these valleys are mostly overspread with mist, receiving little direct sunlight, and the temperature ranges approximately from 16 to 22 °C.

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