

A new species of *Ripipteryx* from Belize with a key to the species of the Scrofulosa Group (Orthoptera, Ripipterygidae)

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Abstract

A new species of the genus *Ripipteryx* (Orthoptera: Tridactyloidea: Ripipterygidae) from the Toledo District of southern Belize is described and illustrated. *Ripipteryx mopana* **sp. n.** is placed in the Scrofulosa Group based on its elaborately ornamented frons and is readily distinguished from its congeners by the fusion of the superior and inferior frontal folds to form a nasiform median process, the epiproct with both anterior and posterior margins emarginate, the subgenital plate with distinct lateroapical depressions either side of the median line, the basal plate of the phallus strongly bilobed apically, and the development of well-demarcated denticular lobes in the dorsal endophallic valves. A preliminary key to the species of the Scrofulosa Group is provided.

Keywords

Orthoptera, Caelifera, Tridactyloidea, Ripipterygidae, *Ripipteryx*, new species, Mesoamerica

Introduction

Neotropical tridactyloids are both diminutive and cryptic, and being collected only rarely, are also underrepresented in collections. The tridactyloid fauna of Central

America in particular is extremely diverse and yet simultaneously poorly documented. Indeed, only 19 tridactyloid species are recorded from Mesoamerica compared to over 100 known from South America (Otte 1997; Günther 1980; Eades et al. 2011). Work on Mesoamerican tridactyloids began with Saussure's (1859) description of *Ripipteryx mexicana* from Oaxaca, Mexico and continued with his contribution to *Biologia Centrali-Americana* (Saussure 1896) in which he described 17 additional species. These taxa were subsequently revised by Günther (1969, 1975–1977, 1989) who added several species to the fauna and synonymized others. Despite Günther's work however, chronic under-sampling in the region means that very little is known about tridactyloid diversity in Mesoamerica and even less about their biology.

The genus *Ripipteryx* Newman, 1834 is exclusively Neotropical, with some 44 species distributed throughout South and Central America (Günther 1969, 1980; Heads 2010). The majority of *Ripipteryx* species known from Mesoamerica belong to the Scrofulosa Group, a presumably monophyletic group comprised of small, variegated species characterized by their peculiar and elaborately ornamented frons and tuberculate or denticulate dorsal endophallic valvulae (Heads 2010). Here, we provide for the first time, a key to the Scrofulosa Group and describe a distinctive new species as the first record of the family Ripipterygidae from Belize.

Material and methods

The holotype is deposited in the Entomology Collection of the Illinois Natural History Survey (INHS), Prairie Research Institute, University of Illinois, and was studied using an Olympus SZX12 zoom stereomicroscope with 1× and 2× objectives. Drawings were produced with the aid of a *camera lucida*. Photomicrographs were made using a digital SLR camera and 65 mm macro lens. To examine the terminalia and phallic complex, the abdomen was removed using Vannas' scissors and cleared in warm 10% KOH. The phallus was then dissected and subsequently stored together with the terminalia under glycerin in a glass microvial pinned beneath the specimen. Terminology generally follows that of Heads (2010) with modifications concerning structures associated with the highly modified male paraproct. In most tridactyloids, the paraproct bears two distinctive processes: [1] a well-sclerotized proximal hook-like structure, herein termed the *uncus* ("Hakensklerit" of Günther 1969); and [2] an elongate, cercus-like structure, herein termed the *brachium* ("Paraproctfortsatz" of Günther 1969).

Systematics

Genus *Ripipteryx* Newman, 1834

Scrofulosa Group *sensu* Heads, 2010

Ripipteryx mopana Heads & Taylor, sp. n.

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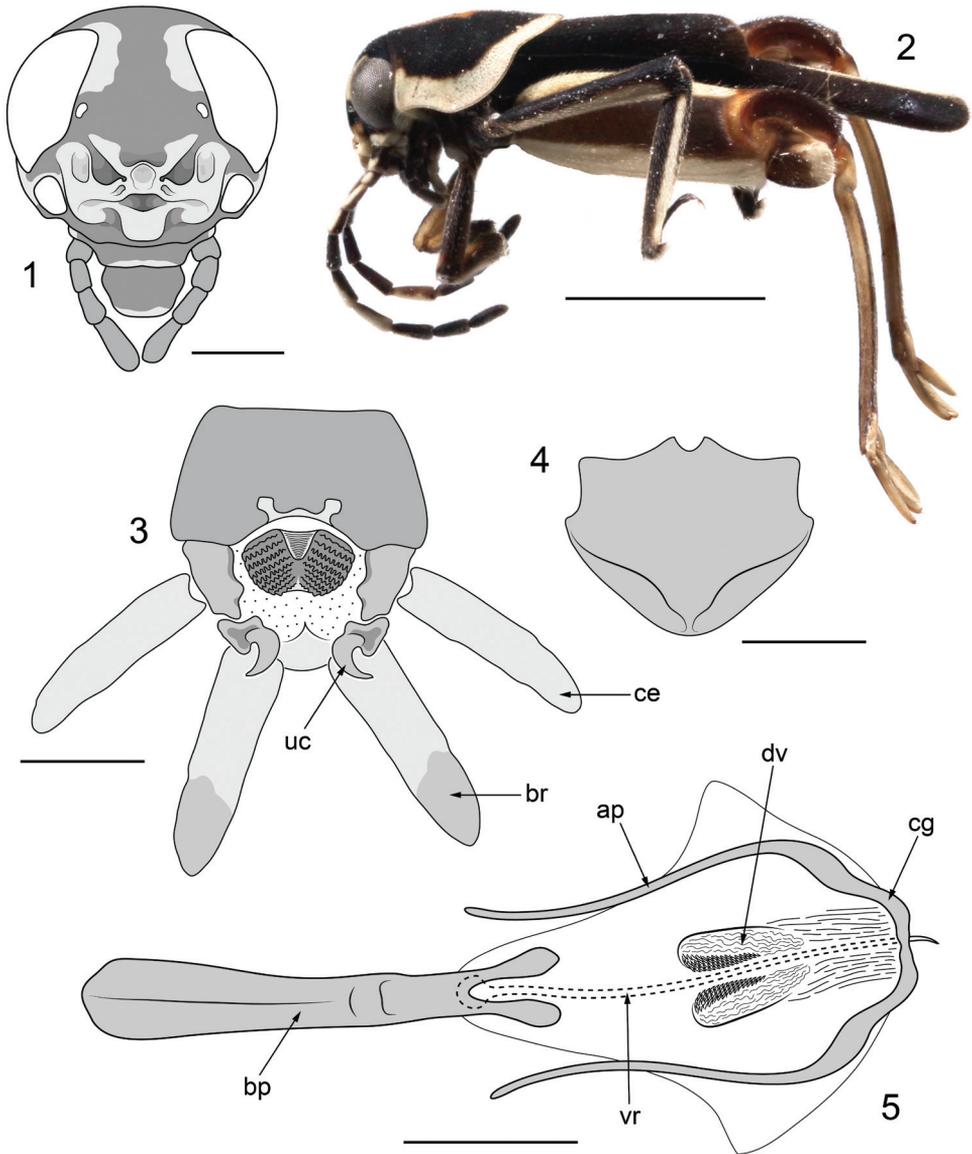
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http://species-id.net/wiki/Ripipteryx_mopana

Figs 1–5

Diagnosis. The new species is readily separated from other small, variegated *Ripipteryx* by the elaborately ornamented frons characteristic of *Scrofulosa* Group species. From other members of the *Scrofulosa* Group the new species is distinguished by [1] fusion of the superior and inferior frontal folds forming a nasiform median process; [2] the emarginated anterior and posterior margins of the epiproct; [3] the subgenital plate with distinct lateroapical depressions either side of the median line; [4] the strongly bilobed apex of the basal plate of phallus; and [5] the presence of well-demarcated denticular lobes in the dorsal endophallic valves.

Description. *Male:* Body form small (length 4.54 mm from frons to apex of subgenital plate) and compact with coloration highly variegated (Figs 1–2). Vertex largely black, with crescent-shaped pale cream patches circumscribing the anterodorsal margins of the compound eyes. Interocular distance 0.73 mm. Compound eyes broadly subovoid, 0.86 mm high. Lateral ocelli very small, situated very close to the medial margin of the compound eyes. Median ocellus absent. Frons largely pale cream fringed with reddish brown and bearing numerous elaborate folds and lobes; comprising a central nasiform process formed through fusion of the superior and inferior folds, flanked by deep, sinuous furrows themselves bordered by broad ridges and lobes; frontoclypeal lobe present (Fig. 1). Antennae ten segmented, moniliform, inserted directly beneath the compound eyes. Scape twice as long as pedicel; flagellomeres densely pubescent and wider apically than at their base. Scape, pedicel and flagellomeres 1 and 2 pale cream dorsally and black ventrally; flagellomere 3 almost entirely black; flagellomere 4 with triangular-shaped pale cream patch dorsally and black ventrally; flagellomere 5 almost entirely pale cream; remaining flagellomeres entirely black. Pronotum somewhat tectate anteriorly (Fig. 2), 1.77 mm long, broadly rounded posteriorly; black with broad, pale cream lateral and posterior margins and a prominent orange-brown median patch dorsally that is obovate anteriorly and rhombiform posteriorly. Tegmen entirely black, 2.38 mm long. Hind wing remigium entirely black; posterior fan cream. Profemora 1.18 mm long, black to dark brown dorsally and pale brown to cream ventrally. Protibiae claviform and largely black with a pale cream longitudinal stripe. Mesofemora 1.91 mm long, subquadrate in section, black dorsally and pale cream ventrally. Mesotibiae black with a prominent pale cream longitudinal stripe along the dorsolateral margin. Metafemora large and robust, 3.28 mm long, reddish brown medially with broad pale



Figures 1–5. Holotype ♂ of *Ripipteryx mopana* Heads & Taylor, sp. n. **1** frontal view of head capsule with antennae omitted (scale bar 0.5 mm) **2** lateral habitus (scale bar 2.0 mm) **3** dorsal view of terminalia with setae omitted for clarity (scale bar 0.25 mm) **4** ventral view of subgenital plate with setae omitted for clarity (scale bar 0.25 mm) **5** dorsal view of phallic complex (scale bar 0.25 mm). Abbreviations: **ap** apodemes of cingulum; **bp** basal plate; **br** brachium; **ce** cercus; **cg** cingulum; **dv** dorsal valve; **uc** uncus; **vr** virga.

cream bands dorsally and ventrally; geniculae well-developed, dark reddish brown with pale cream apices. Metatibiae 3.14 mm long, pale yellowish brown with prominent darker dorsal carinae; apical metatibial spurs blade-like with prominent apical hooks, more than twice as long as subapical spurs. Metatarsus sublanceolate, 0.66 mm long,

marginally shorter than the apical metatibial spurs. Posterior margin of abdominal tergite 10 broadly emarginate with prominently bilobed membranous median region (Fig. 3). Epiproct with large, densely reticulate lateral lobes and emarginate anterior and posterior margins. Cerci fusiform, bearing numerous long and evenly spaced setae. Paraprocts with large, well-sclerotized and strongly hooked uncuses and robust, apically thickened brachia bearing numerous strong ventroapical setae; brachia only marginally longer than cerci (Fig. 3). Subgenital plate broadly rounded with prominent lateroapical depressions either side of the median line; densely pubescent apically (Fig. 4). Phallus with basal plate strongly bilobed apically; cingulum broad and furcate, thickened laterally and bearing elongate, gently curved apodemes; dorsal valves of the endophallus forming flexible lobes armed with numerous denticles; virga filiform with an uncinat basal articulating process (Fig. 5).

Female: Unknown.

Holotype. ♂: Belize, Toledo District, hand collected on shore of Rio Grande at night, approx. 2 hrs after sunset, 28.1 km NNW of Punta Gorda, 16.31739°N, 88.93442°W, 15 April 2011, sjt11-016, coll. S. J. Taylor, sample # 231, specimen # 0338 (INHS).

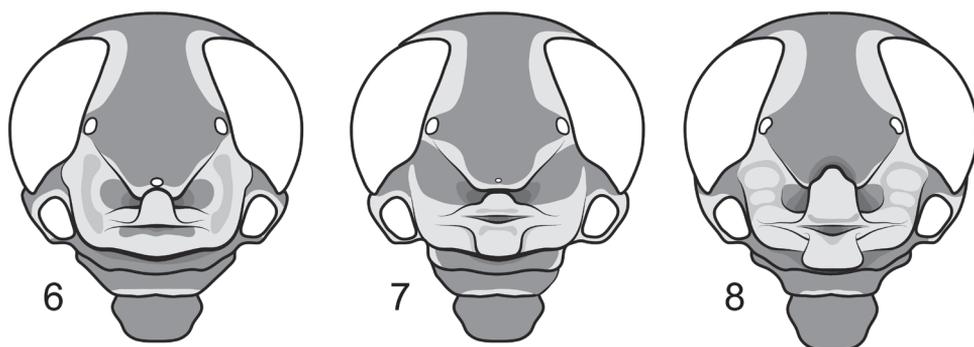
Etymology. The specific epithet honors the Mopan, a Mayan people that live primarily in the southern part of Belize where the new species was collected. There is considerable ethno-historic and toponymic evidence to suggest that the Mopan have lived in this region since before the Spanish conquest (Jones 1998; Wainwright 2009). The Mopan people are recognized by their eponymous language (a form of Yucatec Mayan), spoken by 11,800 people in Belize and Guatemala (Lewis 2009). The gender of the epithet is feminine.

Remarks. Ordinarily, we would hesitate to describe a new species based on a single specimen. However, given the number of robust morphological apomorphies there can be no doubt that *R. mopana* is a distinct species. Within the Scrofulosa Group, *R. mopana* is most similar to *R. biolleyi* Saussure, 1896 sharing with this species the loss of the median ocellus and the distinctive nasiform frontal process. The nasiform process in *R. biolleyi* is formed by the upturned apex of the inferior fold strongly overlapping that of the superior fold. *Ripteryx mopana* differs in that the apex of the inferior fold is completely fused to the underlying superior fold (Fig. 1). The frontal ornament of *R. mopana* further differs from that of *R. biolleyi* in the presence of carinated pits on the lateral lobes of the inferior fold and deep, sinuous furrows (rather than ovoid cavities as in *R. biolleyi*) flanking the nasiform process. Both species possess a furcate cingulum with long, slender apodemes, though the apex of the basal plate is strongly bifurcated in *R. mopana* and undivided in *R. biolleyi*. Together, *R. biolleyi* and *R. mopana* appear to be most closely related to *R. saltator* Saussure, 1896 and *R. saussurei* Günther, 1969 sharing with these species a deep invagination of the inferior fold above the frontoclypeal lobe and the development of well-sclerotized denticles in the dorsal valves of the endophallus. These denticles are directed posteriorly and arranged in rows along valvular axial lobes, which are particularly well developed in *R. mopana* (Fig. 5). Denticular lobes are not present in *R. mediolineata* Saussure, 1896, *R. mexicana* Saussure, 1859,

R. scrofulosa Günther, 1969 and *R. tricolor* Saussure, 1896 all of which instead possess rows of weakly sclerotized, tubercle-like rugosities (Günther 1969). Of these species, *R. mediolineata* and *R. scrofulosa* are apparently the most primitive of the group having the frontal folds poorly developed and lacking a frontoclypeal lobe.

Preliminary key to species of the Scrofulosa Group

- 1 Frontal folds poorly-developed; frontoclypeal lobe absent; uncus reduced with retrograde apex; brachium long, about twice the length of the cercus..... **2**
- Frontal folds well-developed; frontoclypeal lobe present; uncus large with either retrograde or dorsolaterally directed apex; brachium almost equal in length to slightly longer than cercus..... **3**
- 2 Inferior frontal fold pale cream or white with two small black spots; pronotum black with broad yellowish white margins; brachium strongly claviform ***R. scrofulosa* Günther**
- Inferior frontal fold entirely pale cream or white, lacking black spots; pronotum black with broad yellowish white margins and a distinctive median yellow stripe with black spots in anterior half; brachium fusiform..... ***R. mediolineata* Günther**
- 3 Inferior frontal fold with shallow depression above the frontoclypeal lobe; dorsal valves of endophallus with weakly sclerotized tubercle-like rugosities..... **4**
- Inferior frontal fold with deep invagination above the frontoclypeal lobe; dorsal valves of endophallus with more or less developed lobes bearing well-sclerotized rows of posteriorly directed denticles **5**
- 4 Frontal depression lenticular and flanked by two small black spots; posterior margin of abdominal tergum 10 with median membranous region unilobate ***R. tricolor* Saussure**
- Frontal depression ovoid and lacking black spots; posterior margin of abdominal tergum 10 with median membranous region bilobed..... ***R. mexicana* Saussure**
- 5 Median ocellus nascent or entirely lost; lateral lobes of inferior frontal fold with prominent rounded callosities or pits; frontoclypeal lobe well-developed **6**
- Median ocellus present; lateral lobes of inferior frontal fold with a shallow longitudinal sulcus; frontoclypeal lobe weakly developed (Fig. 6)..... ***R. saussurei* Günther**
- 6 Median ocellus entirely lost; apices of superior and inferior folds strongly overlapped or fused forming a nasiform process; subgenital plate broadly rounded..... **7**
- Median ocellus nascent; apices of superior and inferior folds closely approximated but not overlapping (Fig. 7); subgenital plate paraboliform ***R. saltator* Saussure**



Figures 6–8. Head capsules of representative Scrofulosa Group species. **6** *Ripteryx saussurei* Günther (Mexico); **7** *Ripteryx saltator* Saussure (Costa Rica) **8** *Ripteryx biolleyi* Saussure (Costa Rica).

- 7 Nasiform process formed from strongly overlapping apex of inferior frontal fold and flanked by deep, ovoid cavities; lateral lobes of inferior frontal fold with two swollen callosities, the dorsalmost at least twice as large as the ventral (Fig. 8); apex of basal plate undivided; dorsal valves of endophallus with poorly-developed denticular lobes.....*R. biolleyi* Saussure
- Nasiform process formed from fused apices of the superior and inferior frontal folds and flanked by deep sinuous furrows; lateral lobes of inferior frontal folds with large outer and smaller inner pits each bordered by very weak carinae; apex of basal plate strongly bifurcate; dorsal valves of endophallus with well-developed denticular lobes.....*R. mopana* Heads & Taylor, sp. n.

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A new species of *Orobdella* (Hirudinida, Arhynchobdellida, Gastrostomobdellidae) and redescription of *O. kawakatsuorum* from Hokkaido, Japan with the phylogenetic position of the new species

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Abstract

A new quadrannulate *Orobdella* Oka, 1895 species, *Orobdella koikei* **sp. n.**, is described on the basis of six specimens collected from Hokkaido, Japan. In addition, an emended description of quadrannulate *Orobdella kawakatsuorum* Richardson, 1975 is also provided. *Orobdella koikei* differs from other quadrannulate species of *Orobdella* in possessing the following combination of characters: color dorsally brown, IV uniannulate, male gonopore at XI b6, gastropore and female gonopore at XIII a1, 1/2 + 4 + 1/2 between gonopores, XXV triannulate, tubular but bulbous at junctions with gastropore and crop gastroporal duct, epididymides in XVII to XIX, and atrial cornua ovate. The phylogenetic position of the newly described species is estimated using mitochondrial COI, tRNA^{Cys}, tRNA^{Met}, 12S rDNA, tRNA^{Val} and 16S rDNA markers. *Orobdella koikei* is a sister taxon of *O. kawakatsuorum* according to the molecular phylogenetic analyses.

Keywords

Hirudinida, Hirudinea, Gastrostomobdellidae, *Orobdella kawakatsuorum*, new species, molecular phylogeny, Japan

Introduction

The genus *Orobdella* Oka, 1895 consists of terrestrial gastroporous leeches in East Asia (Sawyer 1986). The species diversity of *Orobdella* has been revised recently, and now this genus includes eight species (Nakano 2010, 2011a, b). Among these species, only one quadrannulate species, *Orobdella kawakatsuorum* Richardson, 1975, has been known from Hokkaido, Japan (Richardson 1975). This species was described based on the two specimens collected from Sapporo, and its holotype has been deposited at the National Museum of Nature and Science, Tokyo (NSMT). *Orobdella kawakatsuorum* is characterized especially by its possession of six annuli between gonopores and a simple tubular gastroporal duct.

Quadrannulate *Orobdella* specimens were recently obtained from various places in Hokkaido. Most of these specimens were identified as *O. kawakatsuorum*. However, several specimens differ from not only *O. kawakatsuorum*, but also the other quadrannulate species, *O. esulcata* Nakano, 2010, *O. tsushimensis* Nakano, 2011, and *O. whitmani* Oka, 1895, in several characteristics. Therefore, they are described as a new species herein. In addition, an emended description of *Orobdella kawakatsuorum* is presented on the basis of its holotype and newly collected materials. The phylogenetic position of the new species is also estimated using mitochondrial COI, tRNA^{Cys}, tRNA^{Met}, 12S rDNA, tRNA^{Val} and 16S rDNA sequence data.

Materials and methods

For the taxonomic study, leeches were collected from Hokkaido, Japan (Fig. 1), under rocks along mountain or forest trails. Altitude and coordinates for localities were obtained using a Garmin eTrex GPS unit.

The preparation of the collected materials for the morphological and molecular analyses follows Nakano (2011b). Two measurements were taken: body length (BL) from the anterior margin of the oral sucker to the posterior margin of the caudal sucker, and maximum body width (BW). Examination, dissection, and drawing of the specimens were accomplished under stereoscopic microscopes with drawing tubes (Leica S6E, M125 and WILD HEERBRUGG TYP 308700).

The numbering convention is based on Moore (1927): body somites are denoted by Roman numerals and annuli in each somite are given alphanumeric designations.

For the molecular phylogenetic analyses, the sequence data of nine *Orobdella* species were newly obtained (Table 1). As outgroup, three Erpobdelliformes leeches, *Gastrostomobdella monticola* Moore, 1929 (Gastrostomobdellidae), *Erpobdella japonica* Pawłowski, 1962 (Erpobdellidae), and *Mimobdella japonica* Blanchard, 1897 (Salifidae), were included.

Voucher specimens used in this study have been deposited in the National Museum of Nature and Science, Tokyo (NSMT), the Universiti Malaysia Sarawak (UNIMAS), and the Zoological Collection of Kyoto University (KUZ).

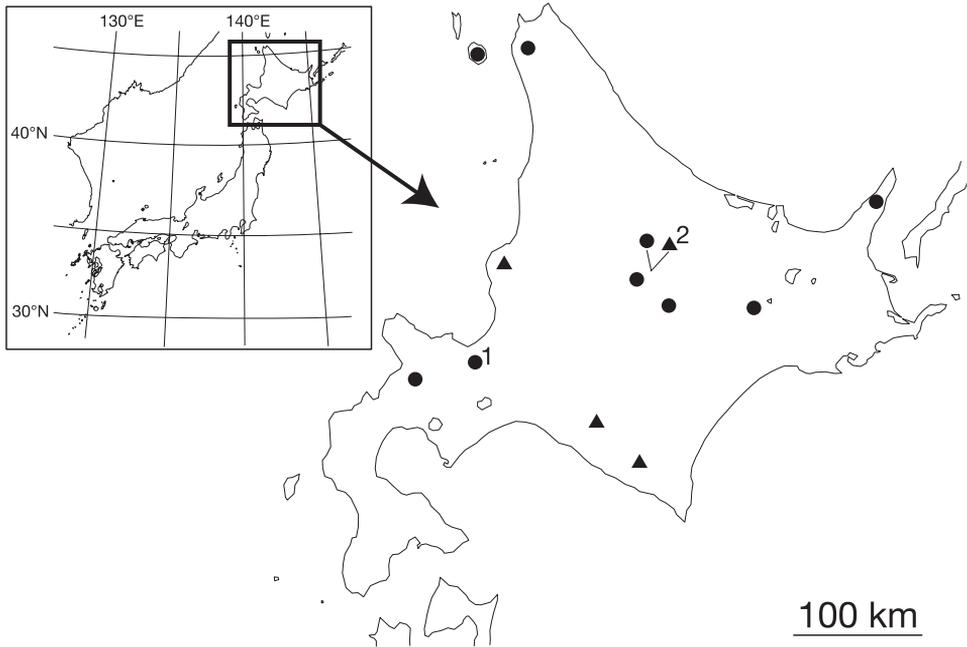


Figure 1. Map showing the collection localities of *Orobdella koikei* sp. n. and *Orobdella kawakatsuorum* Richardson, 1975. Black triangles indicate the localities of *O. koikei*; black circles indicate those of *O. kawakatsuorum* **1** type locality of *O. kawakatsuorum*; and **2** type locality of *O. koikei*.

Table 1. Samples used for the phylogenetic analyses. The information on voucher, collection locality, and GenBank accession numbers are indicated.

Species	Voucher	Locality	COI	12S
<i>Orobdella esulcata</i>	KUZ Z29 Holotype	Kumamoto, Japan (32°48.60'N, 130°38.48'E)	AB679664	AB679665
<i>Orobdella esulcata</i>	KUZ Z170	Ikinoshima Isl., Japan (33°44.47'N, 129°42.25'E)	AB679666	AB679667
<i>Orobdella dolichopharynx</i>	KUZ Z120 Holotype	Amamioshima Isl., Japan (28°17.18'N, 129°18.93'E)	AB679680	AB679681
<i>Orobdella dolichopharynx</i>	KUZ Z122	Kinsakubaru, Amamioshima Isl., Japan	AB679682	AB679683
<i>Orobdella ijimai</i>	KUZ Z110 Topotype	Tochigi, Japan (36°46.98'N, 139°34.93'E)	AB679672	AB679673
<i>Orobdella ijimai</i>	KUZ Z188	Nagano, Japan (36°12.44'N, 138°37.74'E)	AB679674	AB679675
<i>Orobdella kawakatsuorum</i>	KUZ Z148	Toyotomi, Hokkaido, Japan (45°13.22'N, 141°41.07'E)	AB679692	AB679693
<i>Orobdella kawakatsuorum</i>	KUZ Z150	Richirito Isl., Hokkaido, Japan (45°11.99'N, 141°14.26'E)	AB679694	AB679695
<i>Orobdella kawakatsuorum</i>	KUZ Z152	Shari, Hokkaido, Japan (44°06.09'N, 145°06.09'E)	AB679696	AB679697

Species	Voucher	Locality	COI	12S
<i>Orobdella kawakatsuorum</i>	KUZ Z153	Ashoro, Hokkaido, Japan (43°23.70'N, 143°59.23'E)	AB679698	AB679699
<i>Orobdella kawakatsuorum</i>	KUZ Z154	Kamikawa, Hokkaido, Japan (43°43.55'N, 142°57.53'E)	AB679700	AB679701
<i>Orobdella kawakatsuorum</i>	KUZ Z159	Kyowa, Hokkaido, Japan (42°56.17'N, 140°35.57'E)	AB679702	AB679703
<i>Orobdella kawakatsuorum</i>	KUZ Z167	Sapporo, Hokkaido, Japan (43°03.15'N, 141°18.71'E)	AB679704	AB679705
<i>Orobdella koikei</i>	KUZ Z145	Hiratori, Hokkaido, Japan (42°40.82'N, 142°25.44'E)	AB679684	AB679685
<i>Orobdella koikei</i>	KUZ Z146	Shinhidaka, Hokkaido, Japan (42°42.86'N, 142°38.30'E)	AB679686	AB679687
<i>Orobdella koikei</i>	KUZ Z156 Holotype	Kamikawa, Hokkaido, Japan (43°43.36'N, 142°56.85'E)	AB679688	AB679689
<i>Orobdella koikei</i>	KUZ Z158	Mashike, Hokkaido, Japan (43°46.23'N, 141°30.63'E)	AB679690	AB679691
<i>Orobdella octonaria</i>	KUZ Z177	Tokyo, Japan (35°42.94'N, 139°12.20'E)	AB679706	AB679707
<i>Orobdella octonaria</i>	KUZ Z181 Topotype	Kanagawa, Japan (35°14.06'N, 139°04.21'E)	AB679708	AB679709
<i>Orobdella shimadae</i>	KUZ Z128 Holotype	Okinawajima Isl., Japan (26°49.08'N, 128°16.90'E)	AB679676	AB679677
<i>Orobdella shimadae</i>	KUZ Z138	Okinawajima Isl., Japan (26°40.20'N, 128°11.20'E)	AB679678	AB679679
<i>Orobdella tsushimensis</i>	KUZ Z133	Tsushimajima Isl., Japan (34°34.66'N, 129°22.49'E)	AB679660	AB679661
<i>Orobdella tsushimensis</i>	KUZ Z134 Holotype	Tsushimajima Isl., Japan (34°15.29'N, 129°17.28'E)	AB679662	AB679663
<i>Orobdella whitmani</i>	KUZ Z45 Topotype	Gifu, Japan (35°25.65'N, 136°46.91'E)	AB679668	AB679669
<i>Orobdella whitmani</i>	KUZ Z191	Shiga, Japan (35°39.63'N, 136°11.30'E)	AB679670	AB679671
<i>Erpobdella japonica</i>	KUZ Z178	Nagano, Japan (36°12.43'N, 138°36.93'E)	AB679654	AB679655
<i>Gastrostomobdella monticola</i>	UNIMAS/ A03/ BH01/10	Kuching, Malaysia	AB679656	AB679657
<i>Mimobdella japonica</i>	KUZ Z179	Amamioshima Isl., Japan (28°26.53'N, 129°33.60'E)	AB679658	AB679659

PCR and DNA sequencing

Genomic DNA was extracted from botryoidal tissues preserved in 99% ethanol using a modification of the method in Okamoto et al. (2006). After digestion of botryoidal tissues with proteinase K (100 µg/ml) at 37°C for eight–ten hours, DNA was extracted two times with phenol and one time with 25:24:1 phenol/chloroform/isoamyl-alcohol, and precipitated in two volumes of 99% ethanol with one-tenth volume of 3.0 M

sodium acetate (pH 5.2). Precipitated samples were dried and stored in TE buffer (10 mM Tris-HCl and 1 mM EDTA [pH 8.0]). Primer sets used in this study are listed in Table 2: for COI, LCO1490 and HCO2198 (Folmer et al. 1994), and LCO-in and HCO-out; for tRNA^{Cys}, tRNA^{Met}, 12S, tRNA^{Val} and 16S (abbreviated 12S), 12SA-out and 12SB-in, and 12SA-in and 12SB-out. All amplification reactions were performed in a GeneAmp PCR System 2700 (Applied Biosystems) or a MyCycler (Bi-Rad Laboratories) using an Ex *Taq* Polymerase Kit (Takara Bio Inc.). Reaction mixtures were heated to 94°C for 5 min, followed by 35 cycles of 94°C (10 s), 42.5°C (20 s), and 72°C (1 min 13 s for COI, and 1 min for 12S) and a final extension at 72°C for 6 min. The amplified DNA fragments were purified using polyethylene glycol (20% PEG 6000) precipitation.

Table 2. PCR and cycle sequencing (CS) primers used in this study.

Gene	Primer name	Reaction	Primer sequence (5'→ 3')	Source
COI				
1	LCO1490	PRC & CS	GGTCAACAAATCATAAAGATATTGG	Folmer et al. (1994)
	HCO2198	CS	TAAACTTCAGGGTGACCAAAAAATCA	Folmer et al. (1994)
2	LCO-in	CS	TCCAGAACGTATTCCATTATTTG	This study
	HCO-out	PCR & CS	TCTGGGTAGTCAGAATATCG	This study
tRNA ^{Cys} , tRNA ^{Met} , 12S rDNA, tRNA ^{Val} and 16S rDNA				
1	12SA-out	PCR & CS	TTGATGAACAACATTAAATTGC	This study
	12SB-in	CS	TAAGCTGCACTTTGACCTGA	This study
2	12SA-in	CS	AATTAACAAGGATTAGATACCC	This study
	12SB-out	PCR & CS	AACCCATAATGCAAAGGTAC	This study

All samples were sequenced in both directions. Sequencing reactions were performed using a BigDye Terminator v3.1 Cycle Sequencing Kit (Applied Biosystems). Each sequencing reaction mixture was incubated at 96°C for 2 min, followed by 40 cycles of 96°C (10 s), 50°C (5 s), and 60°C (45 s for COI, and 40 s for 12S). The products were collected by ethanol precipitation and sequenced on an ABI 3130xl Genetic Analyzer (Applied Biosystems). Obtained sequences were edited using DNA BASER (Heracle Biosoft S.R.L.). These sequence data were deposited in GenBank.

Phylogenetic analyses

COI sequences were aligned by eye since there were no indels. Mitochondrial 12S sequences were aligned using MAFFT X-INS-i (Hofacker et al. 2002, Katoh and Toh 2008, McCaskill 1990, Tabai et al. 2008) taking into account RNA secondary structure information, and then refined with GBLOCKS (Castresana 2000). The length of aligned sequences of COI was 1266 bp, and that of 12S was 718 bp. Prior to phylogenetic analyses, transition/transversion (ti/tv) rate ratios for each gene sequence was calculated using MEGA5 (Tamura et al. 2011) to test for saturation in base substitu-

tions. It was confirmed that COI and 12S did not show any signs of saturation (ti/tv rate ratio of COI was 1.02, and that of 12S was 1.07). Therefore, the concatenated sequences yielded a total of 1984 bp positions.

Phylogenetic trees were constructed using maximum likelihood (ML) and Bayesian inference (BI). Pairwise comparisons of Kimura-2 parameter (K2p) distance (Kimura 1980) were also calculated using MEGA5. ML phylogenies were calculated using TREEFINDER v October 2008 (Jobb et al. 2004) with the tool package PHYLOGEARS v 2.0 (Tanabe 2008), and then non-parametric bootstrapping (Felsenstein 1985) was conducted with 500 replicates. The best-fit models for each partition were selected using the Akaike Information Criterion (Akaike 1974) by using KAKUSAN4 (Tanabe 2011). For the 1st position of COI, the Tamura-Nei model (TN93) with gamma distribution (+G) and proportion of invariant sites (+I) was selected. The transversion model (TVM)+I was selected for the 2nd position, the transition model (TIM)+G for the 3rd position of COI, and the general time reversal model (GTR)+G for 12S. BI and Bayesian posterior probabilities (BPPs) were estimated using the MPI version of MRBAYES v 3.1.2 (Altekar et al. 2004, Huelsenbeck et al. 2001, Ronquist and Huelsenbeck 2003). The best-fit models for each partition were identified using the Bayesian Information Criterion (Schwarz 1978) also by using KAKUSAN4: for COI 1st position, GTR+G+I; the Felsenstein 1981 model (F81)+I for COI 2nd position; the Hasegawa-Kishino-Yano model (HKY85)+G for COI 3rd position; and GTR+G for 12S. Two independent runs for four Markov chains were conducted for 1.5 million generations and the tree was sampled every 100 generations. Based on checking the parameter estimates and convergence using TRACER v 1.5 (Rambaut and Drummond 2009), the first 5,001 trees were discarded.

The nodes with bootstrap value (BS) higher than 70% were regarded as sufficiently resolved (Hillis and Bull 1993). Nodes with BPP higher than 95% were considered statistically significant (Leaché and Reeder 2002).

Results

Taxonomy

Genus *Orobdella* Oka, 1895

Orobdella koikei sp. n.

urn:lsid:zoobank.org:act:7DBE6F21-E4C3-4CBF-9469-2B13121F56D4

http://species-id.net/wiki/Orobdella_koikei

Figs 2–5

Diagnosis. In life, dorsal surface brown. Somites III and IV uniannulate, somites VIII–XXIV quadrannulate, somites XXV and XXVI triannulate. Pharynx reaching to XIV. Gastropore conspicuous at XIII a1 (slightly posterior to middle of annulus). Gas-

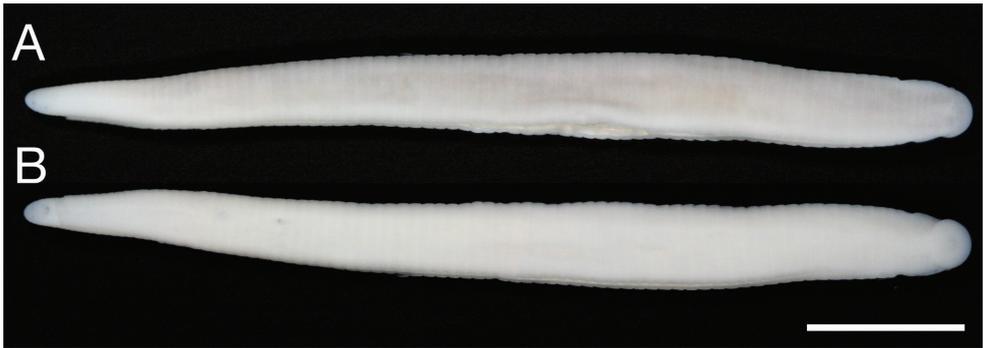


Figure 2. *Orobdella koikei* sp. n., holotype, KUZ Z156 **A** Dorsal and **B** ventral views. Scale bar, 5 mm.

troporal duct, tubular, but bulbous at junction with gastropore and at junction with crop. Male gonopore at XI b6, female gonopore at XIII a1 (slightly posterior to middle of annulus), gonopores separated by $1/2 + 4 + 1/2$. Paired epididymides in XVI/XVII–XVII a2 to XIX a2/b5. Atrial cornua ovate.

Type materials. KUZ Z156, **holotype**, dissected, collected from under a rock along a mountain trail at Sounkyo, Kamikawa, Hokkaido, Japan ($43^{\circ}43.36'N$, $142^{\circ}56.85'E$; Alt. 712 m), by Naoki Koike on 17 August, 2010.

Five **paratypes** collected from Hokkaido, Japan. Two specimens from the type locality ($43^{\circ}43.36'N$, $142^{\circ}56.85'E$; Alt. 712 m): KUZ Z157, dissected, by Naoki Koike on 17 August, 2010, and KUZ Z186, by TN on 19 September, 2011. KUZ Z145, dissected, from Hiratori ($42^{\circ}40.82'N$, $142^{\circ}25.44'E$; Alt. 220 m), by Naoki Koike on 2 August, 2010. KUZ Z146, dissected, from Mt. Pisenaiyama, Shinhidaka ($42^{\circ}42.86'N$, $142^{\circ}38.30'E$; Alt. 981 m), by Naoki Koike on 3 August, 2010. KUZ Z158, dissected, from Mt. Shokanbetsudake, Mashike ($43^{\circ}46.23'N$, $141^{\circ}30.63'E$; Alt. 288 m), by Naoki Koike on 18 August, 2010.

Etymology. The specific name is a noun in the genitive case formed directly from the name of Mr Naoki Koike, who collected many valuable specimens of *Orobdella* leeches from Hokkaido.

Description of holotype. Body firm, muscular, elongated, gaining regularly in width in caudal direction, dorso-ventral depressed, sides nearly parallel from mid length to point just anterior to caudal sucker, BL 30.5 mm, BW 2.5 mm (Fig. 2). Caudal sucker ventral, oval, its diameter smaller than BW (Figs 2B, 3D). In life, dorsal surface brown, ventral surface grayish white. Color faded in preservative, without any dark lines (Fig. 2)

Somite I completely merged with prostomium (Fig. 3A). Somites II–IV unianulate (Fig. 3A). Somite V biannulate, $(a1+a2) = a3$ (Fig. 3A), V a3 forming posterior margin of oral sucker (Fig. 3B). Somites VI and VII triannulate (Fig. 3A–B). Somites VIII–XXIV quadrannulate, $a1 = a2 = b5 = b6$ (Fig. 3A–B, E). Somites XXV and XXVI triannulate (Fig. 3C–D), XXVI a3 being last complete annulus on venter (Fig. 3D). Somite XXVII unianulate with one slight furrow on dorsal; anus behind it with no post-anal annulus (Fig. 3C).

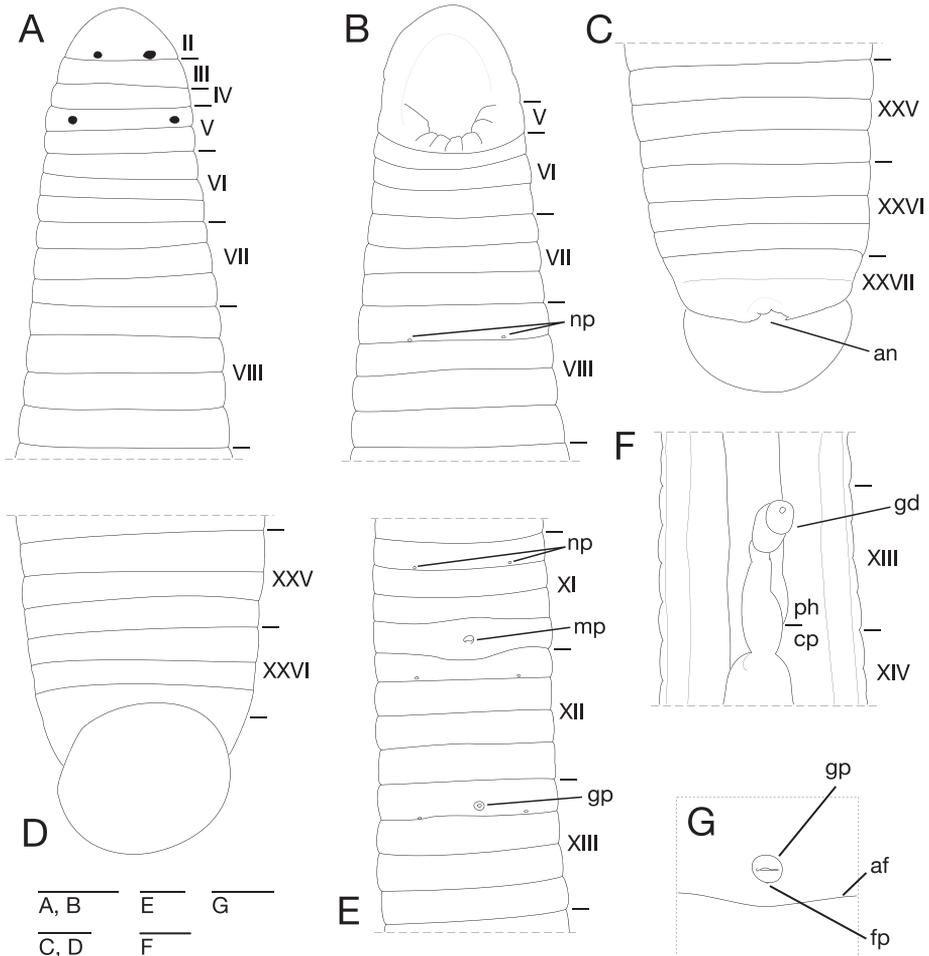


Figure 3. *Orobdella koikei* sp. n., holotype, KUZ Z156 **A** Dorsal view of somites I–VIII **B** ventral view of somites I–VIII **C** dorsal view of somites XXV–XXVII and caudal sucker **D** ventral view of somites XXV–XXVII and caudal sucker **E** ventral view of somites XI–XIII **F** ventral view of gastroporal duct; and **G** ventral view of gastropore and female gonopore. Scale bars, 0.5 mm (A–F) and 0.25 mm (G). Abbreviations: af, annular furrow; an, anus; cp, crop; fp, female gonopore; gd, gastroporal duct; gp, gastropore; mp, male gonopore; np, nephridiopore; and ph, pharynx.

Anterior ganglionic mass in VI a2 and a3. Ganglion VII in a2. Ganglion VIII in a2 and b5. Ganglion IX in a2. Ganglia X–XII in a2 and b5 of each somite (Fig. 4A). Ganglion XIII in b5 (Fig. 4A). Ganglia XIV and XV in a2 and b5 of each somite (Fig. 4A). Ganglia XVI–XXI in a2 of each somite (Fig. 4A). Ganglia XXII–XXIV in a1 and a2 of each somite. Ganglia XXV and XXVI in a1 of each somite. Posterior ganglionic mass in XXVII a2 and a3.

Eyes two pairs, first pair dorsally on posterior margin of II, second pair dorso-laterally on middle of V (a1 + a2) (Fig. 3A). Nephridiopores in 17 pairs, ventrally at

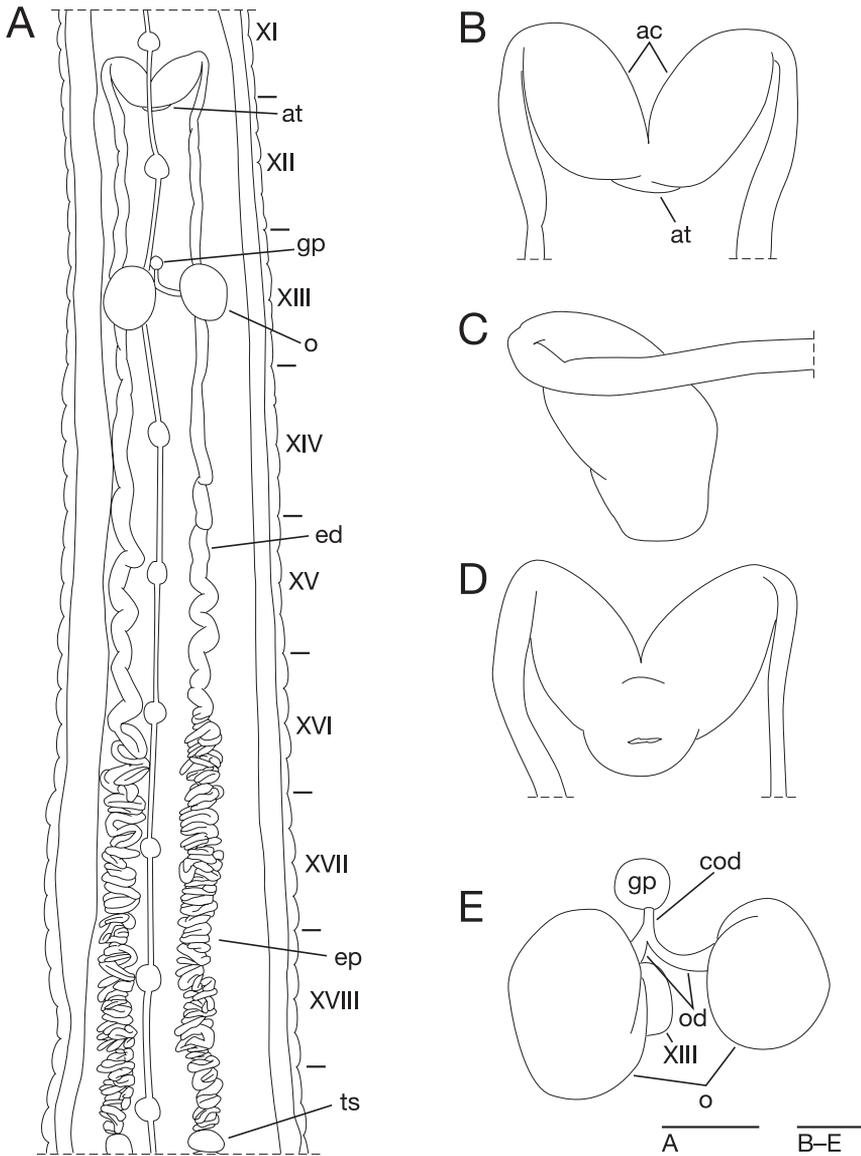


Figure 4. *Orobdella koikei* sp. n., holotype, KUZ Z156 **A** Dorsal view of reproductive system including ventral nervous system **B** dorsal view of male atrium **C** lateral view of male atrium **D** ventral view of male atrium; and **E** dorsal view of female reproductive system including position of ganglion XIII. Scale bars, 1mm (**A**) and 0.25 mm (**B–E**). Abbreviations: ac, atrial cornu; at, atrium; cod, common oviduct; ed, ejaculatory duct; ep, epididymis; gp, gastropore; o, ovisac; od, oviduct; and ts, testisac.

posterior margin of a1 of each somite of VIII–XXIV (Fig. 3A, E). Papillae numerous, minute, hardly visible, one row on every annulus.

Pharynx agnathous, euthylaematous, reaching to XIII/XIV (Fig. 3F). Crop tubular, acaecate, in XIII/XIV to XIX b5/b6. Gastropore conspicuous, ventral, located



Figure 5. *Orobdella koikei* sp. n., paratype, KUZ Z186, taken of live animal, dorsal view.

slightly posterior to middle of XIII a2 (Fig. 3E, G). Gastroporal duct, winding and bulbous at junction with gastropore, tubular but bulbous at junction with crop, joining with crop in XIV a1 (Fig. 3F). Intestine tubular, acaecate, in XIX b5/b6 to XXIII a2. Rectum, tubular, thin-walled.

Male gonopore at middle of XI b6 (Fig. 3E). Female gonopore located slightly posterior to middle of XIII a2, inconspicuous, located behind gastropore (Fig. 3G). Gonopores separated by $1/2 + 4 + 1/2$ annuli (Fig. 3E). Testisacs multiple, one or two testisacs on each side in each annulus, in XIX a2/b5 to XXIV a1 (Fig. 4A). Paired epididymides in XVI a2/b5 to XIX a2/b5 (Fig. 4A). Ejaculatory bulbs absent. Ejaculatory ducts in XI a2/b5 to XVI a2/b5, loosely coiled, each winding from each junction with epididymis, narrowing at junction with atrial cornu, then turning sharply inward toward atrial cornu without pre-atrial loop (Fig. 4A–D). Pair of atrial cornua in XI b5 and b6, muscular, ovate (Fig. 4B). Atrium short, muscular, globular in XI b6 (Fig. 4B–D). Penis sheath and penis absent. Ovisacs one pair, thin-walled, globular, in XIII a2 and b5 (Fig. 4A, E). Oviducts thin-walled, left oviduct crossing ventrally beneath nerve cord, both oviducts converging into common oviduct in XIII a2 (Fig. 4A, E). Common oviduct thin-walled, short, directly ascending to female gonopore (Fig. 4E).

Variation. In life, color generally same as holotype (Fig. 5). Somite III with slight furrow on dorsal (KUZ Z146). Somite IV with slight furrow on dorsal (KUZ Z158), or biannulate (KUZ Z146). Somite XXVI incomplete triannulate. Pharynx reaching to XIII b5/b6–XIV a1. Crop reaching to XIX b5–XX a1. Gastropore at middle of XIII. Gastroporal duct simple tubular (KUZ Z145 and Z146). Intestine reaching to XXIII a1–XXIV a2. Female gonopore at middle of XIII. Testisacs in XVIII a1–XIX a2/b5 to XXIII a2/b5. Epididymides in XVI/XVII–XVII a2 to XIX a2/b5. Right or left oviduct crossing ventrally beneath nerve cord.

Distribution. Known in mountainous regions of the central part of Hokkaido, Japan (Fig. 1).

Remarks. The specimens examined in this study consist of small individuals. However, testisacs and ovisacs of the holotype, of which BL is 30.5 mm, are developed. In immature *Orobdella* specimens, testisacs are usually undeveloped, and hardly detected (Nakano pers. obs.). Therefore, there is a possibility that the holotype of this species is a mature leech.

Orobdella koikei is syntopic with *O. kawakatsuorum* at Sounkyo (Locality No. 2 in Fig. 1). Specimens of *O. koikei* collected from Sounkyo were clearly distinguished from those of *O. kawakatsuorum* in Sounkyo by the number of annuli between the

gonopores, annulation of XXV, morphology of the gastroporal duct and male atrium, and the length of epididymides. Therefore, *Orobdella koikei* can be treated as a distinct new species from Hokkaido.

***Orobdella kawakatsuorum* Richardson, 1975**

http://species-id.net/wiki/Orobdella_kawakatsuorum

Figs 6–11

Orobdella kawakatsuorum Richardson, 1975: 42–51, figs 1, 2; Sawyer 1986: 680, 747.

Diagnosis. In life, dorsal surface grayish blue. Somites III and IV biannulate, somites VIII–XXV quadrannulate, somite XXVI triannulate, clitellum from X b5 to XIII a2. Pharynx reaching to XIV. Gastropore conspicuous in furrow of XIII a1/a2. Gastroporal duct, simple tubular. Male gonopore in furrow of XI b5/b6, female gonopore in furrow of XIII a1/a2, gonopores separated by 6 annuli. Paired epididymides in XVI a2/b5–XVII b5 to XVI b5–XVII b6. Atrial cornua, coniform, undeveloped.

Material examined. NSMT-An 53, **holotype**, dissected by Richardson, LR, collected from a home garden of Professor Masaharu Kawakatsu, Sapporo, Hokkaido, Japan, by Tetsuya Kawakatsu and Miyuki Kawakatsu on 1 June, 1974.

Additional materials. 22 specimens collected from Hokkaido, Japan. Six specimens collected from Maruyama–koen Park, Chuo–ku, Sapporo: KUZ Z24, dissected, and Z140 (43°03.12'N, 141°18.53'E; Alt. 50 m) by Naoyuki Nakahama on 14 June, 2009; KUZ Z166, Z167, dissected (43°03.15'N, 141°18.71'E; Alt. 34 m), Z168 and Z169, dissected (43°03.15'N, 141°18.61'E; Alt. 29m), by TN on 5 October, 2010. Six specimens from Sounkyo, Kamikawa: KUZ Z154, dissected, and Z155 (43°43.55'N, 142°57.53'E; Alt. 705 m), by Naoki Koike on 16 August, 2010; KUZ Z183 (43°43.45'N, 142°56.86'E; Alt. 674 m), Z184 and Z185 (43°43.39'N, 142°56.88'E; Alt. 678 m), and Z187 (43°43.29'N, 142°56.87'E; Alt. 758 m), by TN on 19 September, 2011. Two specimens from Mt. Asahidake, Higashikawa by Naoyuki Nakahama: KUZ Z141, dissected (43°38.82'N, 142°47.73'E; Alt. 1090 m) on 16 June, 2009, and KUZ Z142 (43°39.12'N, 142°48.10'E; Alt. 1120 m) on 17 June, 2009. Two specimens from near the Kabutonuma Pond, Toyotomi (45°13.22'N, 141°41.07'E; Alt. 16 m), by Naoki Koike on 6 August, 2010: KUZ Z147 and Z148, dissected. Two specimens from Mt. Rishirizan, Rishirifuji (Rishirito Island) (45°11.99'N, 141°14.26'E; Alt. 914 m), by Naoki Koike on 8 August, 2010: KUZ Z149 and Z150, dissected. KUZ Z143, dissected, from Nukabira, Kamishihoro (43°22.05'N, 143°11.62E; Alt. 490 m), by Naoyuki Nakahama on 18 June, 2009. KUZ Z152, dissected, from Mt. Rausudake, Shari (44°06.09'N, 145°06.09'E; Alt. 630 m), by Naoki Koike on 13 August, 2010. KUZ Z153, dissected, from Mt. Meakandake, Ashoro (43°23.70'N, 143°59.23'E; Alt. 755 m), by Naoki Koike on 15 August, 2010. KUZ Z159, dissected, from near the Shinsennuma Pond, Kyowa (42°56.17'N, 140°35.57'E; Alt. 781 m), by Naoki Koike on 19 August, 2010.

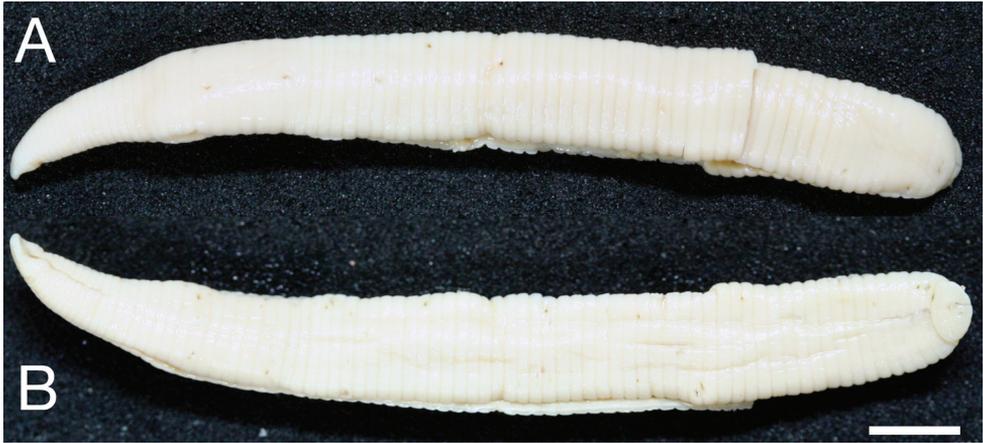


Figure 6. *Orobdella kawakatsuorum* Richardson, 1975, holotype, NSMT-An 53 **A** Dorsal and **B** ventral views. Scale bar, 5 mm.



Figure 7. *Orobdella kawakatsuorum* Richardson, 1975, collected from near the type locality, KUZ Z167 **A** Dorsal and **B** ventral views. Scale bar, 5 mm

Emended description. Body firm, muscular, elongated, gaining regularly in width in caudal direction, dorso-ventral depressed, sides nearly parallel from mid length to point just anterior of caudal sucker (Figs 6, 7), maximum BL 111.64 (KUZ Z142), maximum BW 8.19 (KUZ Z154). Caudal sucker ventral, ova, its diameter smaller than BW (Figs 6, 7, 9D, 10D). In life, dorsal surface grayish blue, ventral surface bluish white (Fig. 8). Color faded in preservative, without any dark lines (Figs 6, 7).

Somite I completely merged with prostomium (Fig. 10A). Somite II uniannulate (Figs 9A, 10A). Somite III uniannulate in small specimens, biannulate in large specimens (Figs 9A, 10A). Somite IV generally biannulate (Figs 9A, 10A), but uniannulate in a few small specimens. Somite V biannulate, $(a1 + a2) = a3$, V $a3$ forming posterior margin of oral sucker (Figs 9A–B, 10A–B). Somites VI and VII triannulate, $a1 = a2 = a3$ (Figs 9A–B, 10A–B). Somites VIII–XXV quadrannulate, $a1 = a2 = b5 = b6$ (Figs 9A–E, 10A–E); X $b5$ being first annulus of clitellum, XIII $a2$ being last annulus of clitellum. Somite XXVI triannulate, $a1 = a2 = a3$, $a3$ being last complete annulus on venter (Figs 9C–D, 10C–D); $a3$ with furrow on dorsal in large specimens (Fig. 10C).



Figure 8. *Orobdella kawakatsuorum* Richardson, 1975, collected from near the type locality, KUZ Z167, taken of live animal, dorsal view.

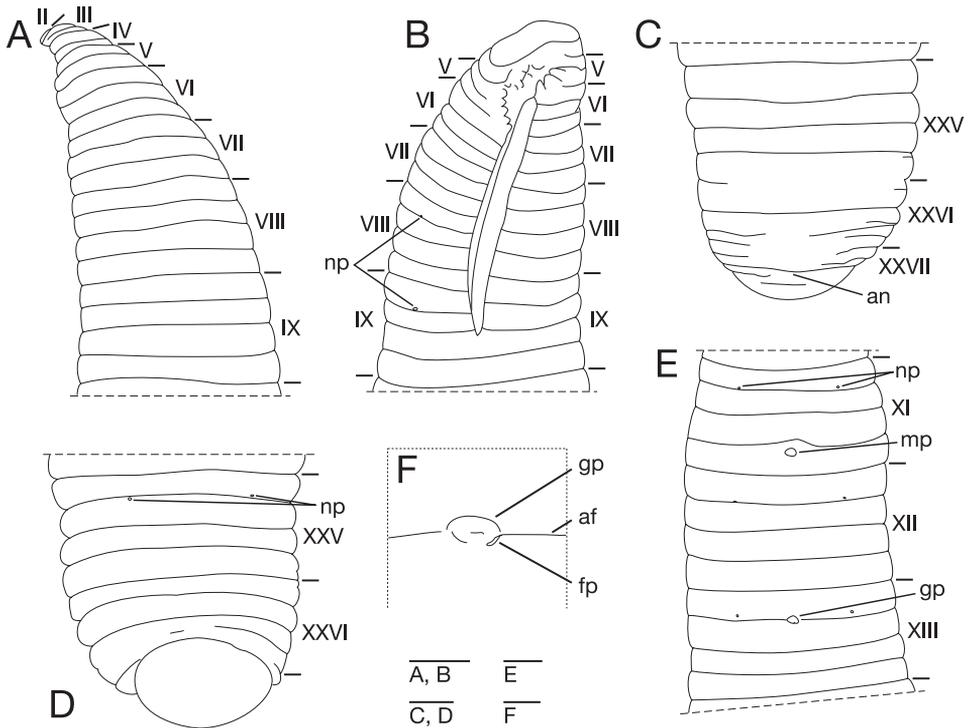


Figure 9. *Orobdella kawakatsuorum* Richardson, 1975, holotype, NSMT-An 53 **A** Dorsal view of somites I–IX **B** ventral view of somites I–IX **C** dorsal view of somites XXV–XXVII and caudal sucker **D** ventral view of somites XXV–XXVII and caudal sucker **E** ventral view of somites XI–XIII; and **F** ventral view of gastropore and female gonopore. Scale bars, 1 mm (A–E) and 0.25 mm (F). Abbreviations, see Fig. 3.

Somite XXVII uniannulate, or biannulate; anus behind it with no post-anal annulus (Fig. 9C, 10C).

Anterior ganglionic mass in VI a2– VII a1. Ganglion VII in a2, a2 and a3, or a3. Ganglia VIII–XV mainly in a2 of each somite, but also a2 and b5, or b5 in several specimens (Fig. 11A). Ganglion XVI in a2 (Fig. 11A). Ganglia XVII–XXIV generally in a2 of each somite (Fig. 11A), but rarely in a1 and a2, or a2 and b5. Ganglion XXV generally in a1, but also a1 and a2, or a2 in several specimens. Ganglion XXVI

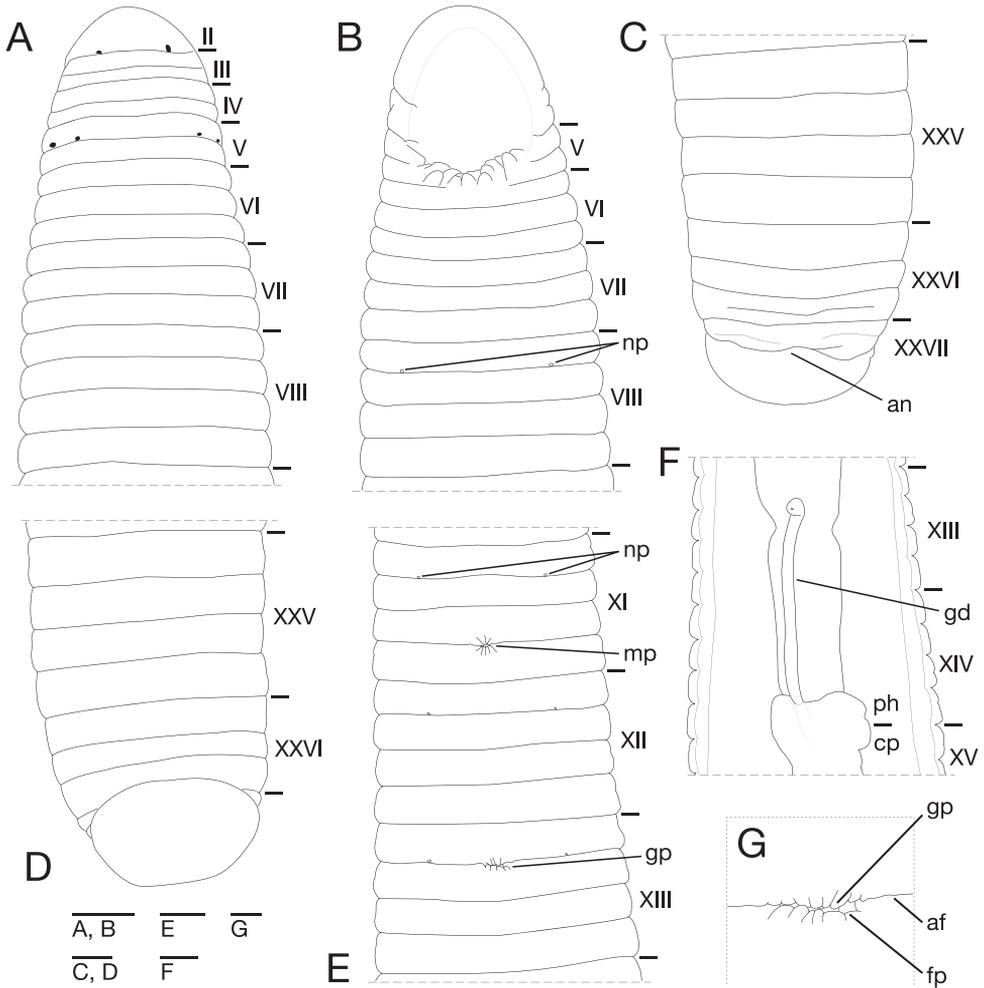


Figure 10. *Orobodella kawakatsuorum* Richardson, 1975, collected from near the type locality, KUZ Z167 **A** Dorsal view of somites I–VIII **B** ventral view of somites I–VIII **C** dorsal view of somites XXV–XXVII and caudal sucker **D** ventral view of somites XXV–XXVII and caudal sucker **E** ventral view of somites XI–XIII **F** ventral view of gastroporal duct; and **G** ventral view of gastropore and female gonopore. Scale bars, 1 mm (**A–F**) and 0.25 mm (**G**). Abbreviations, see Fig. 3.

in a1, XXV b6, XXV b6 and XXVI a1, or XXVI a2. Posterior ganglionic mass in XXVI a1–a3.

Eyes three pairs, first pair dorsally on posterior margin of II, second and third pairs dorsolaterally on posterior margin of V (a1 + a2) (Fig. 10A); eyes one pair in several large specimens, dorsally on posterior margin of II. Nephridiopores in 17 pairs, ventrally at posterior margin of a1 of each somite of VIII–XXIV (Fig. 10B, E); rarely in 18 pairs at a1 of each somite of VIII–XXV (NSMT-An 53, KUZ Z24, Z143, and Z155) (Fig. 9B, D–E). Papillae numerous, minute, hardly visible, one row on every annulus.

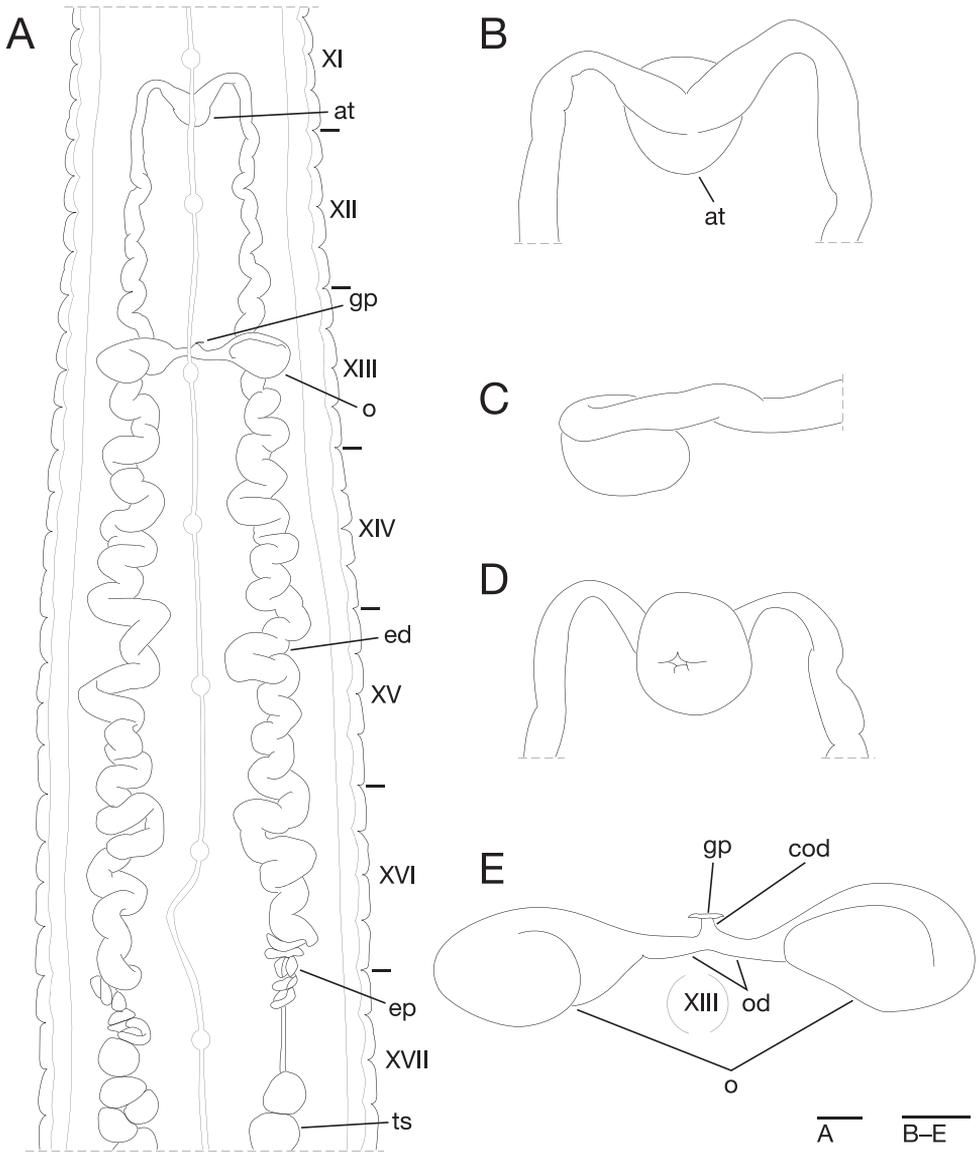


Figure 11. *Orobodella kawakatsuorum* Richardson, 1975, collected from near the type locality, KUZ Z167 **A** Dorsal view of reproductive system including ventral nervous system **B** dorsal view of male atrium **C** lateral view of male atrium **D** ventral view of male atrium; and **E** dorsal view of female reproductive system including position of ganglion XIII. Scale bars, 1mm (**A**) and 0.5 mm (**B–E**). Abbreviations, see Fig. 4.

Pharynx agnathous, euthylaematous, reaching to XIV a2–XIV/XV (Fig. 10F). Crop tubular, acaecate, in XIVa2–XIV/XV to XX b5/b6–XXI a1/a2. Gastropore conspicuous, ventral, generally in furrow of XIII a1/a2 (Figs 9E–F, 10E, G). Gastroporal duct, simple tubular, thin-walled, joining with crop in XIV a2–XIV/XV (Fig. 10F).

Intestine tubular, acaecate, in XIV a2–XIV/XV to XXIII b5–XIV b5/b6. Rectum, tubular, thin-walled.

Male gonopore generally in furrow of XI b5/6, or at anterior part of XI b6 (Figs 9E, 10E). Female gonopore in furrow of XIII a1/a2, located behind gastropore (Figs 9F, 10G). Gonopores separated by six annuli (Figs 9E, 10E). Testisacs multiple, two or three testisacs on each side in each annulus, in XVI b5–XVII b6 to XXIII a1–XXV b6 (Fig. 11A). Paired epididymides in XVI a2/b5–XVII b5 to XVI b5–XVII b6 (Fig. 11A). Ejaculatory bulbs absent. Ejaculatory ducts in XI b5 to XVI a2/b5–XVII b5, loosely coiled, each winding from each junction with epididymis, narrowing at junction with atrial cornu, then turning inward toward atrial cornu without pre-atrial loop (Fig. 11A–D). Pair of atrial cornua in XI b5 and b6, undeveloped, coniform (Fig. 11B). Atrium short, muscular, globular in XI b5 and b6 (Fig. 11B–D). Ovisacs one pair, thin-walled, globular, in XIII a2 and b5 (Fig. 11A, E). Oviducts thin-walled, right or left oviduct crossing ventrally beneath nerve cord, both oviducts converging into common oviduct in XIII a2 (Fig. 11A, E). Common oviduct thin-walled, short, directly ascending to female gonopore (Fig. 11E).

Distribution. Known in mountainous regions of Hokkaido, Japan (Fig. 1).

Remarks. Richardson (1975) described that a gastropore of the holotype opened at the middle of XIII a1, and the female gonopore in the furrow of XIII a1/a2. However, both the gastropore and the female gonopore of *O. kawakatsuorum* are in the furrow of XIII a1/a2 on the basis of examination of the holotype and newly collected specimens. A gastropore of this species is coincident with a female gonopore. Richardson also noted that a pair of nephridiopores opened in XXV (XXIV in his paper). But it is rare for *O. kawakatsuorum* to possess 18 pairs of nephridiopores.

Phylogenetic relationships

The ML tree with $\ln L = -12757.40$ (Fig. 12) was nearly identical to the obtained BI tree (not shown). Monophyly of the genus *Orobdella* was well supported (BS = 99%, BPP = 100%). Two *Orobdella* species from Hokkaido, *Orobdella koikei* and *Orobdella kawakatsuorum*, formed a monophyletic group (BS = 100%, BPP = 100%). This clade was a sister taxon of the other *Orobdella* species. Monophyly of *O. koikei* and *O. kawakatsuorum* was well supported (*O. koikei*: BS = 94%, BPP = 100%; *O. kawakatsuorum*: BS = 97%, BPP = 100%).

The COI sequence divergence between *O. koikei* and *O. kawakatsuorum* was between 8.1–9.9% (mean = 9.0%). Intraspecific variation of COI sequences ranged between 4.8–8.1% (mean = 7.1%) in *O. koikei*, and 0.30–4.9% (mean = 3.7%) in *O. kawakatsuorum*. Sequence divergence of 12S between these two species was between 3.3–5.5% (mean = 4.3%). It was between 2.8–4.8% (mean = 3.9%) within *O. koikei*, and 0–1.1% (mean = 0.71%) within *O. kawakatsuorum*. Interspecific genetic distance of COI between *O. koikei* and *O. kawakatsuorum* had a significantly higher mean divergence as compared to the intraspecific variation of *O. koikei* (*t*-test with unequal

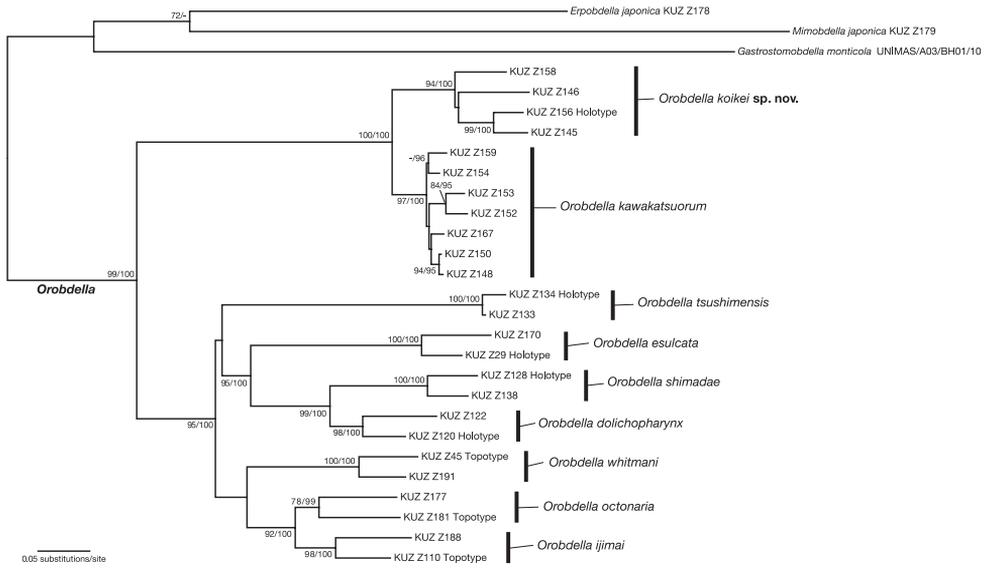


Figure 12. The ML tree of 1984 bp of mitochondrial COI, tRNA^{Cys}, tRNA^{Met}, 12S rDNA, tRNA^{Val} and 16S rDNA. The numbers associated with the nodes represent the bootstrap values for ML (BS)/ and Bayesian posterior probabilities (BPPs). BS higher than 70% and/or BPP higher than 95% are indicated.

variance, $p = 0.0096$), but that of 12S did not have a significantly higher mean divergence (t -test with unequal variance, $p = 0.22$).

Monophyly of seven *Orobdella* species distributed in areas south of Hokkaido was recovered (BS = 95%, BPP = 100%). Monophyly of *O. esulcata* + *O. shimadae* + *O. dolichopharynx* received strong support (BS = 95%, BPP = 100%), and that of *O. jimai* + *O. octonaria* was also recovered (BS = 92%, BPP = 100%).

Discussion

Orobdella koikei differs from the four other quadrannulate species of the genus, *O. esulcata*, *O. kawakatsuorum*, *O. tsushimensis*, and *O. whitmani*, in the following combination of characteristics (Table 3): 1) dorsal surface brown ; 2) IV uniannulate; 3) male gonopore at XI b6; 4) gastropore nad female gonopore at XIII a1; 5) gonopores separated by 1/2 + 4 + 1/2 annuli; 6) XXV triannulate; 7) gastroporal duct, tubular, but bulbous at junctions with gastropore and crop; 8) epididymides in XVII to XIX; and 9) atrial cornua ovate. *Orobdella koikei* is easily distinguished from *O. dolichopharynx* Nakano, 2011, *O. ijimai* Oka, 1895, *O. shimadae* Nakano, 2011, and *O. octonaria* Oka, 1895, in having mid-body somites that are quadrannulate; they are sexannulate in *O. dolichopharynx*, *O. ijimai*, and *O. shimadae*, and octannulate in *O. octonaria*.

The phylogenetic tree showed that the clade, which includes *Orobdella* species in Hokkaido, was a sister taxon of the other *Orobdella* species. This result is also recovered by the other phylogenetic analyses based on nucleic 18S and 28S sequences

Table 3. Comparisons of morphological characters between *Orobdella koikei* sp. n. and four quadrannulate congeneric species.

Character	<i>O. koikei</i> sp. n.	<i>O. esulcata</i>	<i>O. kawakatsuorum</i>	<i>O. tsushimensis</i>	<i>O. whitmani</i>
Color	brownish	bluish	bluish	yellowish	yellowish
Annulation of IV	uniannulate	uniannulate	biannulate	unianulate	uni- or biannulate
Number of annuli between gonopores	1/2 + 4 + 1/2	2/3 + 4 + 1/3	6	1/2 + 5	1/2 + 4 + 1/2
Annulation of XXV	triannulate	quadrannulate	quadrannulate	quadrannulate	quadrannulate
Gastroporal duct	tubular, but bulbous at junctions with gastropore and crop	tubular, but bulbous at junction with gastropore	simple tubular	bottle-shaped	bulbiform
Epididymides	XVII to XIX	XVI to XX	XVI to XVII	XVI to XIX	XVI to XVIII
Atrial cornua	ovate	ovate	undeveloped	coniform	ovate

(Nakano et al. in press). According to the phylogenetic analyses, several characteristics are considered to have evolved in parallel. Each of *O. kawakatsuorum* and *O. esulcata* possess a tubular gastroporal duct (Nakano 2010). However, these two species are phylogenetically distant. The mid-body somite annulation of *Orobdella* leeches does not indicate phylogenetic relationships either. In the genus *Orobdella*, it is clear that the quadrannulate mid-body somite is a plesiomorphic character. Sexannulate mid-body somite, which *O. dolichopharynx*, *O. ijimai*, and *O. shimadae* possess, evolved in parallel. *Orobdella kawakatsuorum*, and two species from Ryukyu Archipelago, Japan, *O. dolichopharynx* and *O. shimadae*, possess rudimentary male atrial cornua (Nakano 2011b). However, undeveloped male atrial cornua do not indicate any phylogenetic relationships between *O. kawakatsuorum* and Ryukyu *Orobdella* species. These characters are not useful for estimating phylogenetic relationships in the genus *Orobdella*, although they are suitable for the species level classification.

Species delimitation in leeches based on genetic analyses, especially using COI DNA-barcode locus, has been discussed in many papers (see DeSalle et al. 2005 for review). The average sequence divergence of COI between *O. koikei* and *O. kawakatsuorum* was 9.0%, and that of 12S was 4.3%. Interspecific genetic divergence of COI between these two species showed a significantly higher value than that of the intraspecific variation, although the intraspecific genetic divergence of 12S sequences in *O. koikei* (2.8–4.8%) was overlapped to a large extent with the interspecific divergence of 12S (3.3–5.5%). Thus, only the genetic distance of COI (mean = 9.0%) can be used as an indicator for deciding whether leeches are distinct species or not in the genus *Orobdella*, since *O. koikei* and *O. kawakatsuorum* are distributed syntopically at Sounkyo (Fig.1).

Gilyarov et al. (1969) reported quadrannulate *Orobdella* species from Primorsky Krai, Russia, as *O. whitmani*. Although they did not describe the detailed internal

anatomy of the specimen, the photograph of the ventral surface of their specimen (fig. 1 in their paper) clearly shows that the male gonopore opened in the furrow of XI/XII and the female gonopore was at XIII a1. Thus, the number of annuli between the gonopores was $4 + 1/2$. This characteristic is not identical to those of the other known quadrannulate *Orobdella* species. There is a strong possibility that the quadrannulate *Orobdella* species distributed in Primorsky Krai is an undescribed species. Primorsky Krai is located at the same latitude as Hokkaido, Japan. Clarifying the taxonomic status and phylogenetic position of *Orobdella* in Primorsky Krai will help to reveal the species diversity and the evolutionary history of the genus *Orobdella*.

Key to the known species of the genus *Orobdella*

- 1 Mid-body somites more than quadrannulate 2
- Mid-body somites quadrannulate 5
- 2 Mid-body somites sexannulate 3
- Mid-body somites octannulate..... *Orobdella octonaria* Oka, 1895
- 3 Pharynx reaching to XVI 4
- Pharynx reaching to XIV, gonopores separated by $1/2 + 7 + 1/2$ annuli
..... *Orobdella ijimai* Oka, 1895
- 4 Gonopores separated by 8 annuli... *Orobdella dolichopharynx* Nakano, 2011
- Gonopores separated by 9 annuli..... *Orobdella shimadae* Nakano, 2011
- 5 Color yellowish..... 6
- Color grayish blue or brown 7
- 6 Gonopores separated by $1/2 + 5$ annuli, gastroporal duct bottle-shaped.....
..... *Orobdella tsushimensis* Nakano, 2011
- Gonopores separated by $1/2 + 4 + 1/2$ annuli, gastroporal duct bulbiform....
..... *Orobdella whimtani* Oka, 1895
- 7 Color grayish blue..... 8
- Color brown, gonopores separated by $1/2 + 4 + 1/2$ annuli.....
..... *Orobdella koikei* sp. n.
- 8 Gonopores separated by $2/3 + 4 + 1/3$ annuli, gastroporal duct tubular, but
bulbous at junction with gastropore..... *Orobdella esulcata* Nakano, 2010
- Gonopores separated by 6 annuli, gastroporal duct simple tubular.....
..... *Orobdella kawakatsuorum* Richardson, 1975

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First record of the genus *Phradis* Förster (Hymenoptera, Ichneumonidae, Tersilochinae) from the Neotropical Region

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Abstract

One new species of the genus *Phradis*, *P. peruvianus* sp. n., from the mountainous part of Peruvian Amazonia, is described and illustrated. This is the first record of the genus from South America and the Neotropical region.

Keywords

Peru, Western Amazonia, *Phradis*, new species, taxonomy

Introduction

Phradis Förster, 1869 is one of the most species rich genera of Tersilochinae with almost world wide distribution (not recorded from the Neotropical and Oriental regions and absent in New Zealand). The genus is best represented in the Holarctic region and comprises 38 species in the Palaearctic region (Khalaim 2007b, Khalaim et al. 2009), and one described (Khalaim 2002) and 17 undescribed species in the Nearctic region (Horstmann in press.); all these species are restricted either by Palaearctic or

Nearctic region. Very few taxa are known beyond the Holarctic region; two species were described from South Africa (Khalaim 2007a), and five undescribed species were mentioned from Australia by Gauld (1984).

The genus belongs to the “*Phradis*” group of genera as well as the genera *Allophrys* Förster and *Heterocola* Förster (Horstmann 1981). Genera of this group can easily be distinguished by the combination of first metasomal segment without glymmae, propodeum with basal area or rarely with basal groove, without basal keel, and also by fore wing usually with second recurrent vein interstitial or antefurcal, mesopleuron usually without or with weak and short foveate groove and propodeal spiracle separated from pleural carina by 3–5 diameters of spiracle (this distance is much shorter in most other tersilochines). Within this group of genera, the genus *Phradis* differs from *Heterocola* by short maxillary and labial palpi (extremely long in *Heterocola*), interstitial (rarely antefurcal or slightly postfurcal) second recurrent vein (always strongly antefurcal in *Heterocola*), usually longer basal area of propodeum, and larger distance between propodeal spiracle and pleural carina. It also differs from *Allophrys* by nervellus less reclivous, eyes of both sexes not enlarged, with inner margins more or less parallel, being conspicuously enlarged and strongly convergent dorsad in males of *Allophrys* (females of *Allophrys* possess not enlarged eyes similar to that in *Phradis*, thus sometimes females of these two genera are hardly distinguishable), and usually lacking hypostomal carina (well developed in *Allophrys*).

Some species of *Phradis* are common parasitoids of sap beetle larvae (Coleoptera: Nitidulidae: *Meligethes* spp.) on rape in Europe (Horstmann 1971, 1981, Nilsson 1985, Nilsson and Andreasson 1987, Osborne 1960, etc).

Studying large quantities of material of Tersilochinae from Western Amazonia, a new species of the genus has been found from the mountainous Peruvian Amazonia.

Material and methods

About 530 specimens of Tersilochinae from the ichneumonid collections of the Zoological Museum of University of Turku, Finland, the Entomological Museum Klaus Raven Büller of Universidad Nacional Agraria la Molina, Lima, Peru, and the Entomological Collection of the University of Alicante, Spain, collected in Western Amazonia (Ecuador and Peru) in 1994–2010, have been studied. Material of *Phradis* was collected in Poromate basin (Quillabamba, La Convención Prov., Cusco Dept., Peru), a premontane area at 1,600 m a.s.l., mostly covered with a closed to open broadleaved evergreen or semi-deciduous subtropical dry forest. The climate is classified as dry sub-humid (dry winter, warm summer). The soil in the area is high in leptosols with a weakly developed shallow soil.

Morphological terminology predominantly follows Townes (1969) with changes according to Khalaim (2011).

The type material of the new species described in the present paper is deposited in the Museo de Entomología Klaus Raven Büller (MEKRB), in the Entomological Col-

lection of University of Alicante (CEUA), and in the Zoological Institute of Russian Academy of Sciences, St. Petersburg, Russia (ZISP).

Layer photos were taken in the Zoological Museum of University of Turku, Finland, using an Olympus SZX16 stereomicroscope attached to an Olympus E520 digital camera. Digital photos were combined by using the software Deep Focus 3.1. Scanning electron microscope images were taken in the University of Alicante using a Hitachi S-3000N in low vacuum mode. All images were assembled and edited with Adobe Photoshop CS2 software.

Results

Phradis peruvianus Khalaim & Bordera, sp. n.

urn:lsid:zoobank.org:act:98014132-8082-4A52-ADFF-E44B5B1EEDB6

http://species-id.net/wiki/Phradis_peruvianus

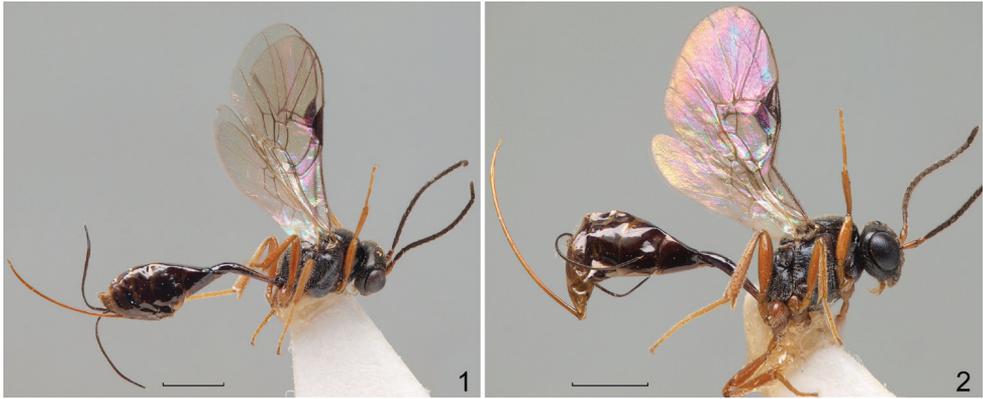
Figs 1–10

Diagnosis. Differs from other species of the genus by the extremely deep and broad foveate groove of mesopleuron extending from anterior margin of mesopleuron to base of mid coxa (Fig. 9). It is also characterized by the slender, black, 17-segmented flagellum (Fig. 6), propodeum with broad, impressed, longitudinally wrinkled basal area (basal longitudinal carinae indistinct), and fore wing with interstitial or slightly antefurcal second recurrent vein.

Description. Female. Body length 4.6 mm. Fore wing length 3.8 mm.

Head. Roundly narrowed behind eyes in dorsal view; temple 0.42–0.48 times as long as eye width (Fig. 4). Distance between lateral ocellus and eye 2.2 times the maximum diameter of ocellus. Upper tooth of mandible much longer and broader than lower tooth. Clypeus lenticular, mostly smooth, finely punctate near its upper margin, with few larger punctures in its upper half and apical margin with a row of long setae (Fig. 3). Malar space 0.6 times as long as basal width of mandible. Flagellum of antenna with 17 flagellomeres (Fig. 6); second flagellomere almost twice as long as broad, subapical flagellomere about 1.6 times as long as broad; flagellomeres 4–6 bearing finger-shaped structures near apex on outer surface (Figs 7, 8). Inner eye orbits slightly convergent ventrally. Face and frons densely punctate on a granulate background. Vertex matt, finely punctate-granulate. Temple finely punctate, more or less smooth between punctures. Occipital carina complete.

Mesosoma. Notaulus short, rather deep, with strong wrinkle (Fig. 4). Mesoscutum densely punctate on a granulate background. Scutellum with lateral longitudinal carinae reaching from its base to about posterior 0.5. Foveate groove of mesopleuron extending from anterior margin of mesopleuron to base of mid coxa, deep, anteriorly very broad and with strong transverse wrinkles, posteriorly narrow and crenulate (Fig. 9). Mesopleuron predominantly smooth, with fine, moderately dense punctures. Propodeum granulate, dull, dorsolateral area very finely punctate, apical area with



Figures 1–2. *Phradis peruvianus* sp. n. **1** holotype **2** paratype.

more or less distinct fine transverse wrinkles. Basal part of propodeum short, 0.25–0.27 times as long as apical area. Basal longitudinal carinae indistinct, propodeum dorsally with broad impressed area with few longitudinal wrinkles. Propodeal spiracle very small, round; distance between spiracle and pleural carina equal to about 3.0 diameters of spiracle. Apical area flat, anteriorly broadly rounded, sometimes slightly truncated.

Wings. Fore wing with second recurrent vein interstitial or slightly antefurcal, unpigmented in its anterior about 0.4. Intercubitus rather long. First abscissa of radius straight, distinctly longer than width of pterostigma. Metacarpus almost reaching apex of fore wing. Hind wing with nervellus slightly inclivous.

Legs. Hind femur 4.6 times as long as broad, and 0.82–0.84 times as long as tibia. Hind spurs almost straight, slightly curved at apex. Tarsal claws not pectinate.

Metasoma. First tergite slender, 4.7 times as long as posteriorly broad, smooth and shiny; down-curved from level of spiracle to the end of postpetiole, with some striae laterally, round in transverse cross-section (Fig. 10). Glymma absent. Second tergite 1.9–2.0 times as long as anteriorly broad. Thyridial depression about twice as long as broad. Ovipositor upcurved, thin, with shallow, dorsal, subapical depression; sheath about 1.8 times as long as first tergite and 1.85–1.92 times as long as hind tibia.

Coloration. Head, mesosoma (including tegula) and flagellum of antenna black; clypeus slightly brownish in its lower part; palpi, mandible (teeth blackish), scape and pedicel of antenna and legs reddish brown. Pterostigma and metasoma dark brown to brownish black.

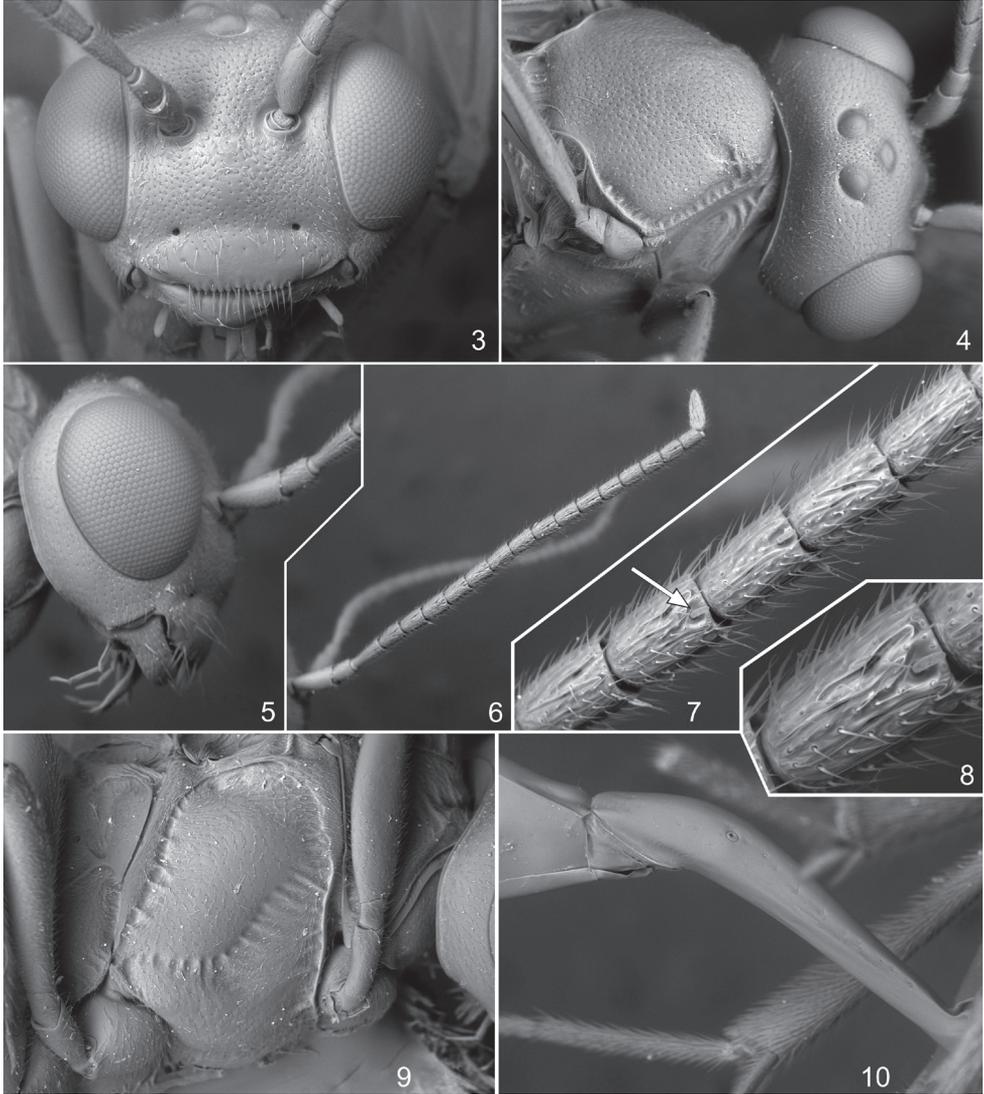
Male unknown.

Variation. All specimens are very similar in structure and colour, without obvious variation.

Material examined. Holotype female, Peru, Cuzco Prov., La Convención, Quillabamba, Poromate, 1600 m, 12.XII.2007, leg. A. Rodríguez (MEKRB). Paratypes: one female with same data as holotype (CEUA), one female with same data except 11.XI.2007 (ZISP).

Distribution. Peru (Cuzco).

Etymology. The species name means “from Peru”.



Figures 3–10. *Phradis peruvianus* sp. n. **3** head, frontal view **4** head and mesoscutum, dorsal view **5** head, lateral view **6** antenna, lateral view **7** flagellomeres 3–7 of antenna, lateral view **8** flagellomere 4 of antenna, lateral view **9** mesopleuron, lateral view **10** base of metasoma, lateral view.

Discussion

Very little is known about Tersilochinae of the Neotropical Region. Only eight species of *Stethantyx* Townes (Blanchard 1945, Graf 1980), two species of *Allophrys* Förster (Horstmann 2010) and one species of *Meggoleus* Townes (Townes 1971) were described from this region. *Stethantyx* is a dominant tersilochine genus in the Neotropical region with at least 20 undescribed species in Costa Rica and 14 in Western Amazonia (Khalaim pers. obs.), in

addition to eight previously described species which occur in south-eastern and southern Brazil, Argentina and Uruguay. *Meggoleus spirator* Townes is widely distributed through the Neotropical region, extending from Guatemala to Southern Brazil (Khalaim and Broad in press). Among two described species of *Allophrys*, *A. oculata* (Ashmead) is known only from Grenada in West Indies, and another one, the recently described *A. divaricata* Horstmann, is widely distributed from south-eastern U.S.A. to Argentina (Horstmann 2010). Over ten undescribed species of *Allophrys* also occur in Costa Rica (Khalaim and Broad in press) and about six species are recognized in Western Amazonian material (Khalaim pers. obs.).

The genus *Phradis* has almost a world wide distribution but is not recorded from the Neotropical and Oriental regions and is also absent in New Zealand (Khalaim pers. obs.), although it is quite possible that representatives of this genus may be found in the Oriental region, as some other large Palaearctic tersilochine genera (*Barycnemis* Förster, *Probles* Förster and *Tersilochus* Holmgren) are represented by one or few species in this region (Khalaim 2011).

In North America only the species *Phradis kasparyani* Khalaim was described from California, U.S.A. (Khalaim 2002), but neither this nor other species of *Phradis* were recorded from Mexico, where over 100 specimens of Tersilochinae from Tamaulipas and some other Mexican provinces were studied by the first author. A large number of tersilochines was also collected during many years in various terrestrial biotopes of Costa Rica (Gauld 1991 and further publications), but no species of *Phradis* was registered from this country (Khalaim pers. obs.). This can suggest that this genus does not occur in Costa Rica, and probably nowhere in Central America. But a single species of *Phradis* has been found in Western Amazonian material, where only three specimens were collected in a mountainous area of Peruvian Amazonia. This is the first and unexpected finding of *Phradis* in tropical America.

Regarding the morphology of the new species we can highlight the possession, near the apex of the outer surface of flagellomeres 4–6, of finger-shaped structures. Such structures also were recently described in two European species of *Phradis* (Khalaim et al. 2009) and later in many Costa Rican species of other tersilochines (in all species of *Allophrys*, in one undescribed species of *Barycnemis* and in *Meggoleus spirator*; Khalaim and Broad in press). We have seen this also in one species of *Barycnemis* in Europe (Bordera pers. obs.), and in one undescribed species of *Stethantyx* from Argentina (Khalaim pers. obs.). These structures are very small and hardly visible in light microscope, but very distinct in SEM photos (Figs 7, 8). These observations may suggest that these structures may occur in many tersilochine genera, but they have not been registered before because of their small size. The structures have been observed both in males and females and their function could be sensitive sensilla but further studies should demonstrate their real function.

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New species of *Plectrocnemia* and *Nyctiophylax* (Trichoptera, Polycentropodidae) from China

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Abstract

Four new species of genus *Plectrocnemia* and 4 new species of genus *Nyctiophylax* are described, namely: *Plectrocnemia verticalis* **sp. n.**; *Plectrocnemia acuminata* **sp. n.**; *Plectrocnemia cryptoparamere* **sp. n.**; *Plectrocnemia qianshanensis* **sp. n.**; *Nyctiophylax* (*Nyctiophylax*) *senticosus* **sp. n.**; *Nyctiophylax* (*Paranyctiophylax*) *gracilis* **sp. n.**; *Nyctiophylax* (*Paranyctiophylax*) *pungens* **sp. n.**; and *Nyctiophylax* (*Paranyctiophylax*) *auriculatus* **sp. n.**

Keywords

Insecta, male genitalia, Oriental Biogeographic Region, East Palearctic Biogeographic Region, stream

Introduction

Dr Youwen Li included 4 new species of *Plectrocnemia* and 4 new species of *Nyctiophylax* in his doctoral dissertation (Li 1998) based on specimens collected by him, authors John C. Morse and Yang Lian-fang, and other colleagues during an expedition into southeastern and southcentral People's Republic of China (PRC) in 1990. Although most of these species have been found many times in other Chinese localities since then,

corroborating their standing as distinct species, their names have been unavailable until now. In addition to validating Li's species, we provide here more detailed illustrations, descriptions, and distributions.

Since its original description, *Plectrocnemia* Stephens, 1836 (type species: *Plectrocnemia senex* Stephens, 1836 nec Pictet, 1834, monotypic, = *Plectrocnemia geniculata*, McLachlan 1871, according to Fischer 1962), has been reviewed by McLachlan (1878, for Europe), Ulmer (1907, for the world), Martynov (1934, for the former U.S.S.R.), Mosely (1939, for the United Kingdom), Tsuda (1942, for Japan), Mosely and Kimmins (1953, for Australia and New Zealand), and Ohkawa and Ito (2007, for Japan). The genus includes 97 extant species and 24 fossil species worldwide, with extant species occurring in the Oriental (48 spp.), West Palearctic (22 spp.), East Palearctic (19 spp.), and Australasian (8 spp.) Biogeographic Regions. The Chinese fauna presently includes 17 extant species. Four species described herein bring the total to 21 Chinese species of *Plectrocnemia*.

The genus *Nyctiophylax* Brauer, 1865 (type species: *Nyctiophylax sinensis* Brauer, monotypic) has been reviewed by Ulmer (1907, for the world), Morse (1972, for North America), and Neboiss (1993, for the world). *Paranyctiophylax* Tsuda, 1942 (type species: *Paranyctiophylax kisoensis* Tsuda, 1942, original designation) was redefined by Neboiss (1993) to include most of the species previously included in *Nyctiophylax*, but Malicky (1994), Li (1998), and Olah and Johanson (2010a, b) treated *Paranyctiophylax* as a subgenus of *Nyctiophylax*. The genus *Nyctiophylax* includes 107 extant species and 23 fossil species worldwide, with extant species occurring in the Oriental (58 spp.), Australasian (14 spp.), Afrotropical (12 spp.), Nearctic (10 spp.), East Palearctic (8 spp.), and Neotropical (5 spp.) Biogeographic Regions. The Chinese fauna presently includes 2 species. Four species described herein bring the total to 6 Chinese species of *Nyctiophylax*.

The monophyly of each of these genera and the relationships of the genera of Polycentropodidae were recently explored according to morphological characters by Chamorro and Holzenthal (2011).

Methods

Adults were collected with ultraviolet lights unless otherwise indicated. The abdomens of males were cleared with a heated KOH solution to reveal internal and other hidden structures. Each dissected abdomen is preserved with the remainder of its specimen in 80% ethyl alcohol.

Pencil drawings were prepared through use of an ocular grid in a Wild® M5 dissecting microscope, then these pencil templates were inked with various sizes of Rapidograph® pens. In the descriptions, colors are those observed for the specimens in alcohol. The morphological terms for male genitalia and wing venation follow Arefina et al. (2003), Ohkawa and Ito (2007), and Hamilton and Holzenthal (2011). All specimens,

except as noted, have been deposited in the Nanjing Agricultural University Insect Collection (NAU) and the Clemson University Arthropod Collection (CUAC).

Species descriptions

Plectrocnemia verticalis Morse, Zhong & Yang, sp. n.

urn:lsid:zoobank.org:act:606DA6D6-74FA-4282-92F1-692E79B9139B

http://species-id.net/wiki/Plectrocnemia_verticalis

Fig. 1

Plectrocnemia verticalis Li 1998: 51–52, figs 3.7–3.9, *nomen nudum*.

Type material. Holotype male, PRC, Yun-nan Province, Ji-ping County, Kun-he Village, 10 km N of A-de-bo Township, 22.80°N, 103.30°E, 1350 m elevation, 19-vii-1990, collected by Li You-wen, Ke Xin; deposited in NAU.

Diagnosis. The male genitalia of the species are somewhat similar to those of *Plectrocnemia banksi* Fischer, 1962, in that each preanal appendage has a dorsal process and the inferior appendages are concave on their subapicomesal margins. However, the preanal appendages are somewhat crescentic in lateral view and the apex of the lower arm of each preanal appendage is acute with a hairy wart on the ventral margin near the middle in the new species, characters which are unique in the genus.

Description of adult male: Color of unique (holotype) specimen in alcohol generally yellowish brown. Length of body with folded wings: 7.0 mm.

Male genitalia: Tergum IX semi-membranous, with pair of setose patches posteriorly; sternum IX with anteromesal margin convex and posteromesal margin deeply excised except for small, median, triangular protrusion (Fig. 1B), posterolateral margins each with triangular incision at 1/3rd distance from dorsal margin (Fig. 1A). Tergum X semi-sclerotized, broadly trapezoidal, and with base covered by tergum IX in dorsal view (Fig. 1C). Intermediate appendages, set basolaterally from X, each slender, curved posterodorsad, forked in distal half, with longer ventral branch bearing long, apical seta (Figs 1A, 1C, 1D). Preanal appendages somewhat crescentic in lateral view (Fig. 1A); each with slender, setose dorsal process directed posterad and shorter than tergum X; lower branch longer than tergum X and shorter than inferior appendages, with hairy wart on ventral margin near middle and with apex acute; ventrobasal branch of each preanal appendage vertical, thick, and thumb-like. Subphallic sclerite absent. Inferior appendages sclerotized, each compressed, broadly foliaceous, tapering from middle to apex in lateral view (Fig. 1A); in ventral view (Fig. 1B) densely covered with short, stout setae and concave mesally on distal 1/3rd, each with small mound basomesally. Phallus (Fig. 1E) tube-like, with pair of lanciform projections arising subapicoventrally and exceeding apex of phallic tube, each with row of ventral hairs; without paramere spines or internal phallic sclerites..

Female and immature stages. Unknown.

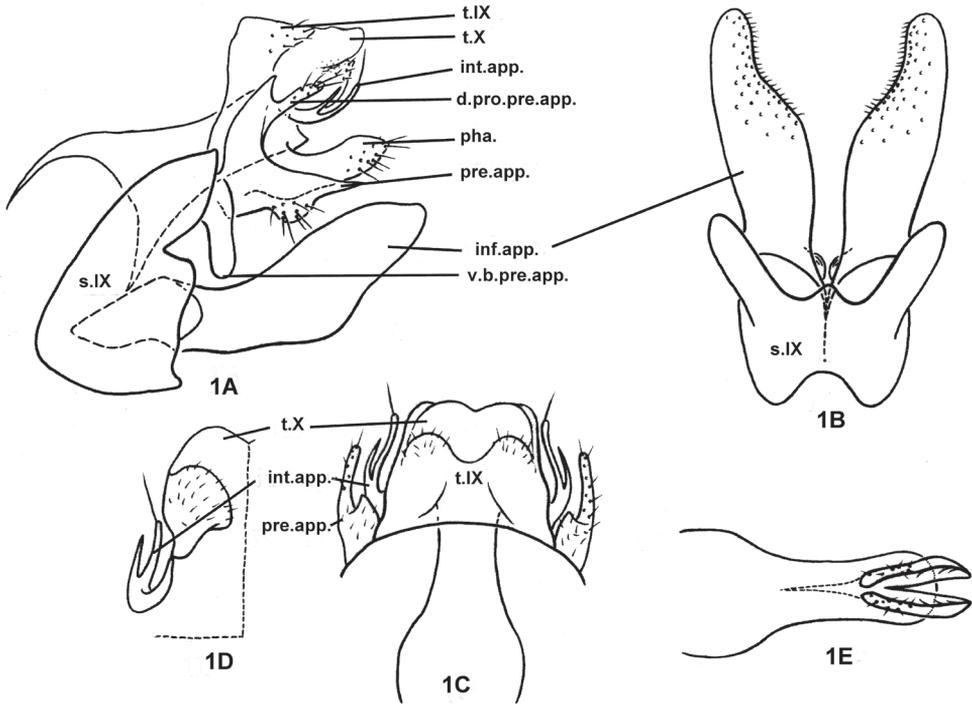


Figure 1. *Plectrocnemia verticalis* Morse, Zhong & Yang, sp. n., male genitalia. **1A** left lateral view **1B** ventral view **1C** dorsal view **1D** tergum X, ventral view **1E** phallus, ventral view. d.pro.pre.app. = dorsal process of a preanal appendage; inf.app. = inferior appendage; int.app. = intermediate appendage; pha. = phallus; pre.app. = preanal appendage; s.IX = sternum IX; t.IX = tergum IX; t.X = tergum X; v.b.pre.app. = ventrobasal branch of preanal appendage.

Etymology: *Verticalis*, Latin adjective, “vertical,” referring to the vertical ventrobasal branch of each preanal appendage.

Distribution. Oriental Biogeographic Region, China (Yun-nan). The species, known only from the holotype, has been found only at the type location in southern Yun-nan Province.

***Plectrocnemia acuminata* Morse, Zhong & Yang, sp. n.**

urn:lsid:zoobank.org:act:35C1A91C-B319-4B05-AAF6-7D12FA4C245C

http://species-id.net/wiki/Plectrocnemia_acuminata

Fig. 2

Plectrocnemia acuminata Li 1998: 54–55, figs 3.13–3.15, *nomen nudum*.

Type specimens. Holotype male, PRC, Si-chuan Province, Mt. Qing-cheng, Wei-jiang River, 32 km SW of Guan County (now, Du-jiang-yan City), 31.00°N, 103.60°E,

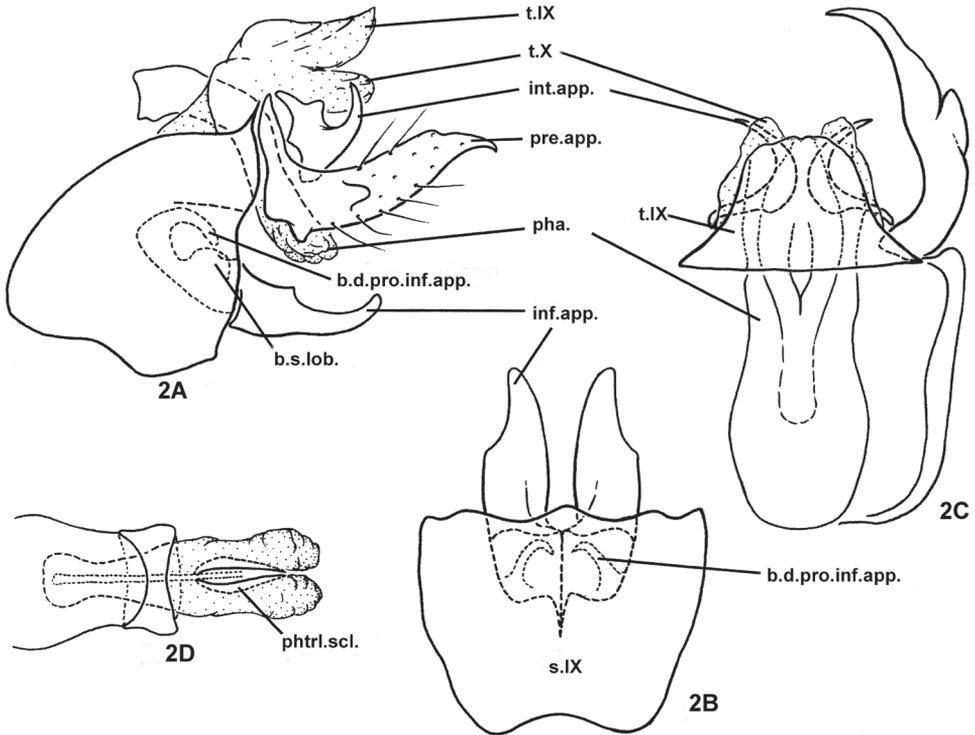


Figure 2. *Plectrocnemia acuminata* Morse, Zhong & Yang, sp. n., male genitalia. **2A** left lateral view **2B** ventral view **2C** dorsal view **2D** phallus, dorsal view. b.d.pro.inf.app. = basodorsal process of an inferior appendage; b.s.lob. = basomesal setose lobe of an inferior appendage; inf.app. = inferior appendage; int.app. = intermediate appendage; pha. = phallus; phtrl. scl. = phallotremal sclerite; pre.app. = preanal appendage; s.IX = sternum IX; t.IX = tergum IX; t.X = tergum X.

930 m elevation, 20-vi-1990, collected by JC Morse, Yang Lian-fang, Li You-wen; deposited in NAU.

Paratypes: PRC, Si-chuan Province: same data as holotype, 3 males (CUAC); Ya-an, Zhou-gong Stream branches, alt. 600–800 m elevation, 08-vi-1996, coll. Wang Bei-xin, 9 males (NAU); Mei-gu County, Mei-gu Da-feng-ding National Nature Preserve, Shu-wo-xiang village, Cha-cha-ku Stream, 8.3 km E of Long-wo, 28.7603°N, 103.2471°E, 1671 m elevation, 06-vii-2005, Coll. Sun Chang-hai, 1 male (NAU).

PRC, An-hui Province: Yang-jia-tan, Feng-yuan-shui Stream, Xi-xian County, 29.90°N, 118.45°E, 215 m elevation, 24-v-1992, collected by JC Morse, Sun Chang-hai, 4 males (NAU).

Diagnosis. The male genitalia of this species are very similar to those of *Plectrocnemia munitalis* Mey, 1996 in the apically acute preanal appendages and in the presence of a hooked basodorsal process on each inferior appendage. However, the intermediate appendages of segment X are slender, longer than the inferior appendages in *P. munitalis*, but much shorter, and forming irregular, broad plates each with an acute posterior projection directed dorsolaterad in the new species.

Description of adult male: Head and thorax dark brown with antennae and warts yellowish brown, forewings light brown. Length of body with folded wings: 7.0 – 9.0 mm. (n = 10).

Male genitalia. Highly sclerotized. Tergum IX fused basally with broader tergum X, with posterior margin narrower than anterior margin in dorsal view (Fig. 2C); sternum IX with anteromesal margin concave (Fig. 2B), anterolateral margins broadly protruding cephalad at middle, posterolateral margins sinuate (Fig. 2A). Intermediate appendages each short, irregularly broad plate beneath and beside tergum X, with acute posterior projection directed dorsolaterad (Figs 2A, 2C). Preanal appendages nearly twice as long as tergum X and inferior appendages, each cylindrical, with distal portion narrowing more or less evenly to acute apex, evenly curved mesad, with small conical ventrobasal projection and with short lobe projecting posterolaterad from its lateral surface near middle; ventral subphallic sclerite absent (Figs 2A, 2C). Inferior appendages depressed (flattened dorsoventrally), each evenly broad at basal half with lateral margin of distal half shallowly excised (Fig. 2B); basodorsal process of each inferior appendage slender, hooked dorsomesad (Figs 2B, 2A); basal setose lobe on dorsal base of each inferior appendage rounded (Fig. 2A), both basodorsal process and basal setose lobe hidden within segment IX. Phallus with long and broad phallobase somewhat constricted subapically; sclerotized ring near middle of phallus about 1/4th as long as phallobase; phallicata constricted subbasally, membranous apically, with pair of thin, short phallostremal sclerites visible from dorsal view (Fig. 2D).

Female and immature stages. Unknown.

Etymology. *Acuminata*, Latin adjective, “narrowed,” referring to the distal portion of each preanal appendage gradually narrowing to an acute apex.

Distribution. Oriental Biogeographic Region, China (Si-chuan, An-hui).

***Plectrocnemia cryptoparamere* Morse, Zhong, & Yang, sp. n.**

urn:lsid:zoobank.org:act:83B082DB-74DA-4405-9F3D-2D24238037AA

http://species-id.net/wiki/Plectrocnemia_cryptoparamere

Fig. 3

Plectrocnemia cryptoparamere Li 1998: 67–68, figs 3.52–3.55, *nomen nudum*.

Type material. Holotype male, PRC, Hu-bei Province, Ma-cheng County, Tong-jian-chong River, 27 km N. of Ma-cheng, 31.10°N, 115.01°E, 12-vii-1990, 150 m elevation, collected by JC Morse & Yang Lian-fang; deposited in NAU.

Paratypes. PRC, Hu-bei Province: same data as holotype, 10 males, deposited in NAU (6 males) and CUAC (4 males).

PRC, Jiang-xi Province: Mt. Wu-yi National Nature Preserve, Unnamed tributary of Tong-Mu River, 18 km upstream of Mt. Wu-Yi Station, 27.8275°N, 117.74356°E, 1450 m elevation, 02-vi-2005, Coll. Sun Chang-hai, 1 male (NAU).

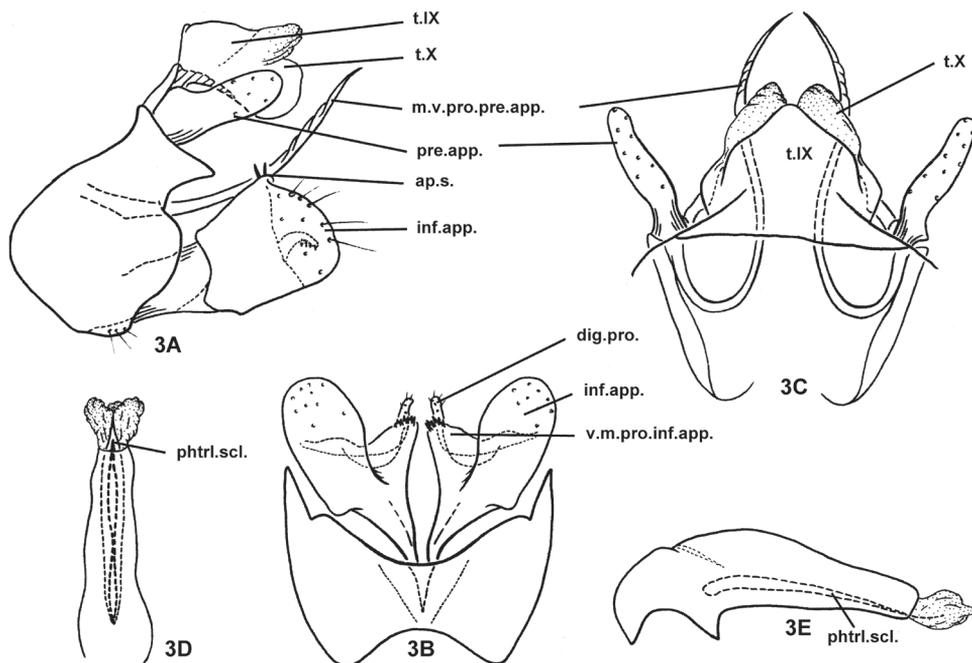


Figure 3. *Plectrocnemia cryptoparamere* Morse, Zhong & Yang, sp. n., male genitalia. **3A** left lateral view **3B** ventral view **3C** dorsal view **3D** phallus, ventral view **3E** phallus, left lateral view. ap.s. = apical setae of mesal plate of an inferior appendage; dig.pro. = digitate process of a mesal plate of an inferior appendage; inf.app. = inferior appendage; m.v.pro.pre.app. = mesoventral process of a preanal appendage; phtrl.scl. = phallotremal sclerite; pre.app. = preanal appendage; s.IX = sternum IX; t.IX = tergum IX; t.X = tergum X; v.m.pro.inf.app. = ventromesal process of an inferior appendage.

PRC, Guang-dong Province: Zhao-qing City, Ding-hu District, Mt. Ding-hu Forest Ecosystem Research Station, Academia Sinica, Dong Gou at Shui-lian-dong-tian waterfall, 23.1604°N, 112.5250°E, 170 m elevation, 24-v-2004, Coll. CJ Geraci, JC Morse, Sun Chang-hai, 3 males (NAU).

Diagnosis. The male genitalia of this species are similar to those of *Plectrocnemia plicata* Schmid, 1959 and *P. wui* (Ulmer, 1932) in the shape of the posterolateral margins of sternum IX with a conspicuous division at its middle on each side in lateral view, inferior appendages broad and truncate in lateral view, and preanal appendages each with a long, needle-like mesoventral process. However, the new species has acute posterior dorsolateral margins on sternum IX (these margins are blunt and rectilinear in the other 2 species), narrow and parallel-sided preanal appendages in lateral view (oval in the other 2 species), the ventromesal process of each inferior appendage is triangular in ventral view and broadly connected basally with the body of the appendage (digitate and deeply separated from the body of the appendage in the other 2 species), and it lacks parameres on the phallus (parameres are present in the other 2 species).

Description of adult male. Head brown with antennae and palpi pale yellow, pronotum light brown, meso- and metanota brown with yellowish warts, forewings light brown. Length of body with folded wings: 6.8 – 7.2 mm. (n = 5).

Male genitalia. Tergum IX fused with tergum X; upper lobes of tergum X semi-membranous, lower lobes of tergum X sclerotized, both upper and lower lobes divided apicomesally, each lobe with rounded apex (Figs 3A, 3C). In lateral view (Fig. 3A), sternum IX narrowed subdorsally, its anterior margins broadly protruding cephalad at middle, posterior margins sinuate, with posterior dorsolateral corners produced in acute, triangular process on each side; anteromesal and posteromesal margins concave, lower posterolateral margins broadly convex (Fig. 3B). Intermediate appendages not well developed, represented only as thickened lateral margins of tergum X, slightly broader at base, narrowing to acute apex. Preanal appendages slightly shorter than tergum X, each broader at base, narrower and straight from basal 1/3rd to rounded apex (Figs 3A, 3C); mesoventral process of each preanal appendage recurved anterad then posterad, needle-like, wrinkled distally, guided by semi-membranous string across genitalia chamber between bases of inferior appendages, this string represented in other species by sclerotized subphallic sclerite. Inferior appendages compressed (flattened from side to side), subquadrate, about as long as tall, with distal margin broad and truncate in lateral view (Fig. 3A), distinctive mesal plate forming short vertical ridge with 2–3 short apicodorsal setae in lateral view (3A); in ventral view (Fig. 3B) ventromesal processes of inferior appendages each triangular with blunt apex covered with tiny teeth; basal digitate process of each inferior appendage mesal plate slender and simple, conspicuously extending beyond mesal plate. Phallus broad at base, more slender and tapered distally, without parameres, with pair of slender phallic sclerites (possibly elongated phallotremal sclerite) visible in ventral and lateral views (Figs 3D, 3E).

Female and immature stages. Unknown.

Etymology. *Crypt*, Greek adjective, “hidden,” referring to the absence of phallic parameres.

Distribution. Oriental Biogeographic Region, China (Hu-bei, Jiang-xi, Guangdong).

***Plectrocnemia qianshanensis* Morse, Zhong & Yang, sp. n.**

urn:lsid:zoobank.org:act:BFF78E8A-CBF8-4513-8846-5A63FCC47BB8

http://species-id.net/wiki/Plectrocnemia_qianshanensis

Fig. 4

Plectrocnemia qianshanensis Li 1998: 68–69, figs 3.56–3.59, *nomen nudum*.

Type material. Holotype male, PRC, Jiang-xi Province, Qian-shan County, Shi-long, 27.20°N, 114.08°E, 24-vii-1993, collected by Lu Liang; deposited in NAU.

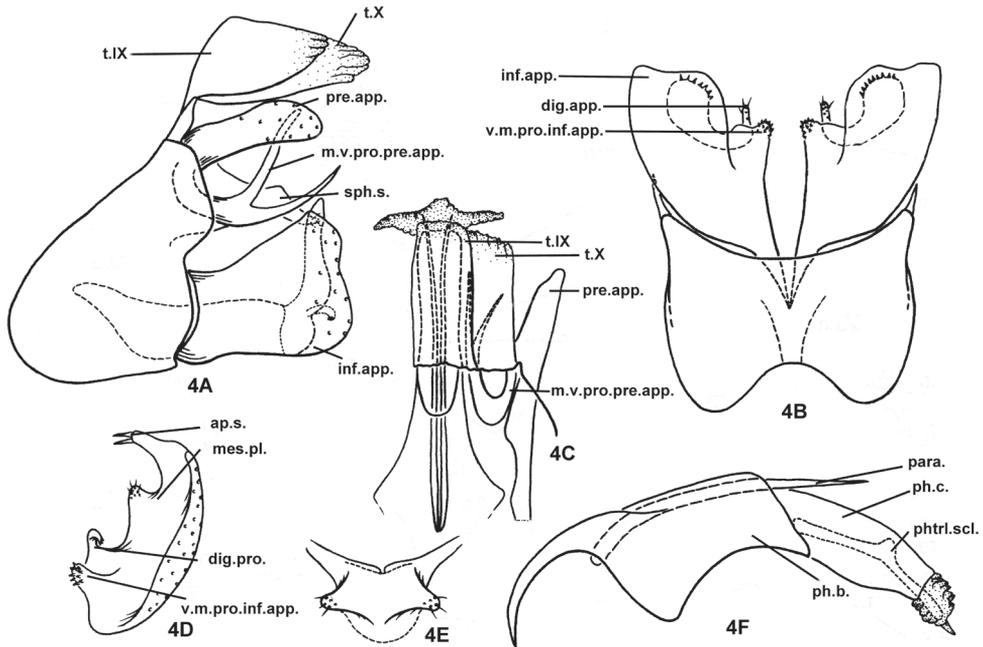


Figure 4. *Plectrocnemia qianshanensis* Morse, Zhong & Yang, sp. n., male genitalia. **4A** left lateral view **4B** ventral view **4C** dorsal view **4D** right inferior appendage, caudal view **4E** subphallic sclerite, caudal view **4F** phallus, left lateral view. ap.s. = apical setae of mesal plate of an inferior appendage; dig.pro. = digitate process of a mesal plate of an inferior appendage; inf.app. = inferior appendage; mes.pl. = mesal plate of an inferior appendage; m.v.pro.pre.app. = mesoventral process of a preanal appendage; para. = paramere; ph.b. = phallobase; ph.c. = phallicata; phtrl. scl. = phallotremal sclerite; pre.app. = preanal appendage; s.IX = sternum IX; sph.s. = subphallic sclerite; t.IX = tergum IX; t.X = tergum X; v.m.pro.inf.app. = ventromesal process of an inferior appendage.

Paratypes. PRC, Jiang-xi Province: Mt. Jiu-lian National Nature Preserve, confluence of Huang-niu-shi & Da-shui-keng Streams, 1.2 km SE of Dun-tou Village, 24.5256°N, 114.4225°E, 546 m elevation, 09-vi-2005, Coll. Sun Chang-hai, 2 males (NAU).

PRC, An-hui Province: Qi-men County, 29.8°N, 117.7°E, Peng-long Township, Yang Village, 122 km on Provincial Road, 25-viii-2002, Coll. Hu Ben-jin, Lu Shuang, 1 male (NAU).

PRC, Shaan-xi Province: Fu-ping County, Long-cao-ping Village, 1100 m elevation, 03-vi-1998, coll. Sun Chang-hai, 1 male (NAU).

Diagnosis. The male genitalia of this species are similar to those of *Plectrocnemia plicata* and *P. wui* in the shape of the posterolateral margins of sternum IX, with a conspicuous division at the middle, in the inferior appendages being broad and truncate in lateral view. However, in this new species, although the preanal appendages are narrow and parallel-sided as in *P. cryptoparamere*, these appendages are distinctly shorter than tergum X (subequal in the other 3 species). The posterior dorsolateral

corners of sternum IX are rounded on each side in this species (blunt and rectilinear in *P. plicata* and *P. wui*, acute in *P. cryptoparamere*). A subphallic sclerite is present in this new species (absent in the other 3 species). Like *P. cryptoparamere*, the ventromesal process of each inferior appendage is triangular in ventral view and broadly connected basally with the body of the appendage (digitate and deeply separated from the body of the appendage in *P. plicata* and *P. wui*), but the main body of each inferior appendage is apically truncate in ventral view in this species (rounded in the other 3 species). As in *P. plicata* and *P. wui*, the phallus of this species bears paramere spines (parameres are lacking in *P. cryptoparamere*). The new species has the mesoventral process of each preanal appendage forked (unforked in the other 3 species).

Description of adult male. Head brown with antennae and palpi pale yellow, pronotum light brown, meso- and metanota brown with yellowish warts, forewings greyish brown. Length of body with folded wings: 6.0–6.5 mm. (n=4).

Male genitalia. Tergum IX semimembranous apically, fused with semimembranous tergum X (t.X), these fused terga as long as inferior appendages (Figs 4A, 4C). In ventral view (Fig. 4B) anteromesal margin of sternum IX narrowly excised, posteromesal margin broadly excised; in lateral view (Fig. 4A) sternum IX subtriangular, anterior margin broadly rounded and projecting anterad; posterior margin sinuate, with upper half protruding posterad beyond lower half. Intermediate appendages absent. Preanal appendages slightly shorter than fused terga IX and X, about 4 times as long as wide in lateral view (Fig. 4A), each parallel-sided, with rounded apex; mesoventral process of each preanal appendage heavily sclerotized, divided into upper and lower branches at middle and both curved dorsad, with upper branch nearly vertical and apically blunt in lateral view, lower branch slightly more slender and acute, and exceeding slightly beyond apex of preanal appendages; subphallic sclerite long, its paired apices almost reaching tips of inferior appendages in lateral view, in caudal view (Fig. 4E) united basomesally with each other, each with setose, thumb-like apex directed caudolaterad. Inferior appendages each about 1.5 times as long as its mid width, narrowed at base and with distal margin broad and sinuously truncate in lateral view (Fig. 4A); in ventral view (Fig. 4B) ventromesal process of each inferior appendage quadrate, with mesal end covered with tiny teeth (Figs 4B, 4D); vertical mesal plate with basal digitate process (dig.pro.) conspicuous, slender, simple, hooked laterad; in caudal view (Fig. 4D) mesal plate well developed with 2 stout apicodorsal setae on elongate process, and additionally with 1 short, blunt, setose lobe between elongate process and basal digitate process. Phallus with broad phallobase, more-slender and parallel-sided phallicata, pair of long, paramere spines (para.); pair of phallotremal sclerites (or phallic sclerites) slender, about as long as phallicata (Fig. 4F).

Female and immature stages. Unknown.

Etymology. The species is named after the holotype locality.

Distribution. East Palearctic and Oriental Biogeographic Regions, China (Jiang-xi, An-hui, Shaan-xi).

***Nyctiophylax (Nyctiophylax) senticosus* Morse, Zhong & Yang, sp. n.**

urn:lsid:zoobank.org:act:5840A196-3704-443F-BC23-8228D4140E25

http://species-id.net/wiki/Nyctiophylax_senticosus

Fig. 5

Nyctiophylax (Nyctiophylax) senticosus Li 1998: 89–90, figs 4.1–4.3, 4.9–4.12, *nomen nudum*.

Type materials. Holotype male, PRC, An-hui Province, Jin County, Song Village, Ding-xi Stream, 33 km E. of Jin County, 30.70°N, 118.35°E, 08-vi-1990, 120 m elevation, collected by JC Morse, Sun Chang-hai, Yang Lian-fang; deposited in NAU.

Paratypes. PRC, An-hui Province: same data as holotype, 4 males (NAU).

PRC, Guang-xi Province: Shang-si County, Na-lin Stream, tributary of Ming-jiang River, 2.0 km NW of main entrance to Mt. Shi-wan-da National Forest Park, 21.9070°N, 107.8966°E, 281 m elevation, 05-vi-2004, Coll. JC Morse, Sun Chang-hai, 3 males (NAU); Shang-si County, Na-lin Stream, tributary of Ming-jiang River, 2.2 km NW of main entrance to Mt. Shi-wan-da National Forest Park, 21.9062° N, 107.8962° E, 284 m elevation, 05-vi-2004, Coll. Zhou Xin, Karl M Kjer, 2 males (NAU); Shang-si County, Mt. Shi-wan-da National Forest Park, Shi-tou Stream, tributary of Ming-jiang River, 1.35 km SW of main entrance to Park, 21.9022° N, 107.9046° E, 300 m elevation, 05-vi-2004, Coll. Yang Lian-fang, CJ Geraci, 4 males (NAU); Xing-an County, Liu-dong Stream and Hua-jiang Stream confluence, ~1 km S of Hua-jiang town, 25.7657° N, 110.4820° E, 262 m elevation, 16-vi-2004, Coll. Yang Lian-fang, JC Morse, Sun Chang-hai, CJ Geraci, 4 males (NAU).

Diagnosis. The male genitalia of *Nyctiophylax (N.) senticosus* are somewhat similar to those of *N. (N.) sinensis* Brauer, 1865 in the deeply inserted dorsal processes of the preanal appendages set under tergum VIII, but differ from those of *N. (N.) sinensis* by the inferior appendages with their acute apices strongly curved dorsad in the new species; they are almost straight in lateral view with the apices rounded in *N. sinensis*.

The male genitalia of *N. (N.) senticosus* are also very similar to those of *N. (N.) maath* (Malicky & Chantaramongkol, 1993) in the following characters: 1) The preanal appendages have a ventral lobe; 2) the preanal appendages have their dorsal processes inserted under tergum VIII; and 3) the inferior appendages have basomesal processes. However, the differences between the 2 species are obvious. The apex of each inferior appendage of *N. maath* is straight, like that of *N. sinensis*, while it is up-curved in the new species. The basomesal processes of the inferior appendages in *N. maath* are hook-like, mostly exposed in ventral view, but in the new species club-like, densely covered with tiny teeth apically, and with only the apices exposed.

Description of adult male. Head grayish brown with yellowish antennae, pronotum light brown, meso- and metanota brown, with thoracic legs yellowish, forewings light brown. Length of body with folded forewings: 4.5–4.8 mm (n=10).

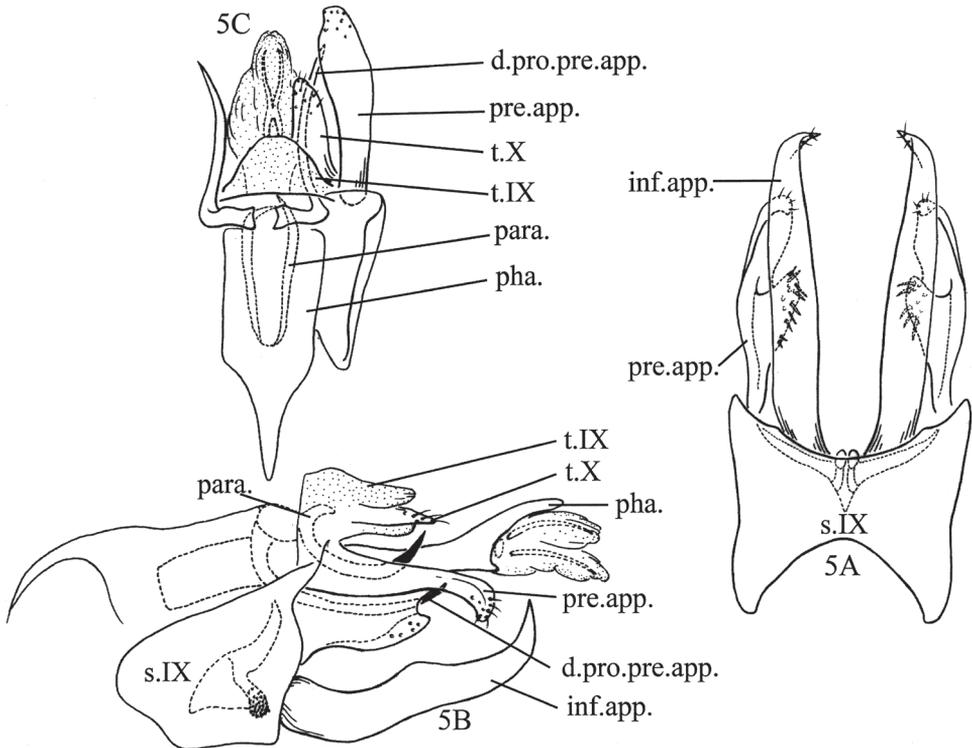


Figure 5. *Nyctiophylax (Nyctiophylax) senticosus* Morse, Zhong & Yang, sp. n., male genitalia. **5A** left lateral view **5B** ventral view **5C** dorsal view. d.pro.pre.app. = dorsal process of a preanal appendage; inf.app. = inferior appendage; para. = paramere; pha. = phallus; pre.app. = preanal appendage; s.IX = sternum IX; t.IX = tergum IX; t.X = tergum X.

Male genitalia. Tergum IX parabolic in dorsal view (Fig. 5C), membranous, almost transparent. In lateral view (Fig. 5A), sternum IX obliquely protruded anterad subventrally, posterolateral margins vertical and sinuous, ventral surface horizontal and as long as anteroventral margins; in ventral view (Fig. 5B), posterior and anterior margins each with wide, shallow excision. Tergum X semi-sclerotized, setose, deeply divided apicomeresally (Figs 5A, 5C). Preanal appendages slightly longer than tergum X, each with broad lobe along basal 2/3rds of ventral edge (Fig. 5A), this lobe with setose basoventral apex directed ventromesad in ventral view (Fig. 5B); dorsal processes of preanal appendages inserted deeply under tergum VIII, each consisting of broad basal plate with long, slender process coiled laterad, ventrad, and then caudad to acute, out-turned apex. Inferior appendages depressed (flattened dorsoventrally), about 1.5 times as long as sternum IX, each with acute apex curved dorsad; with short, club-like, basomesal projection hidden inside sternum IX, its apex densely covered with tiny teeth. Phallus with thick phallobase half as long as entire phallus; pair of parameres curved dorsad; phallicata membranous, enlarged to apex, with 2 spines among retracted membranes.

Female and immature stages. Unknown.

Distribution. Oriental Biogeographic Region, China (An-hui, Guang-xi).

Etymology. *Senticosus*, Latin, „of many spines,“ referring to the spines of the phallus.

***Nyctiophylax (Paranyctiophylax) gracilis* Morse, Zhong & Yang, sp. n.**

urn:lsid:zoobank.org:act:AD32B3CC-FE44-41F4-8DD5-4AB7D3B06785

http://species-id.net/wiki/Nyctiophylax_gracilis

Fig. 6

Nyctiophylax (Paranyctiophylax) gracilis Li 1998: 92–93, figs 4.13–4.18, *nomen nudum*.

Type material. Holotype male, PRC, Jiang-xi Province, 38 km. from Cong-an City and 2 km from Jiang-xi Provincial border at 80-km marker, 27.78°N, 118.03°E, 550 m elevation, 26-v-1990, collected by Sun Chang-hai; deposited in NAU.

Paratypes. PRC, Jiang-xi Province: same data as holotype, 11 males (NAU); Mt. Jiu-lian National Nature Preserve, unnamed tributary 0.5 km from Xia-Gong-Tang Stream, 24.5347°N, 114.4689°E, 630 m elevation, 07-vi-2005, Coll. Zhou Xin, Sun Chang-hai, 5 males (NAU).

PRC, Zhe-jiang Province: Mt. Tian-mu, 30.4°N, 119.5°E, San-mu-ping, 780 m elevation, 26–29-vii-1998, black light, coll. Wu Hong, 8 males (NAU); San-mu-ping, 780 m elevation, 23-vi-1998, black light, coll. Zhao Ming-shui, 4 males (NAU); Kai-shan-lao-dian, 1090 m elevation, 14vii-1999, light, coll. Zhao Ming-shui, 2 males (NAU); San-mu-ping, 780 m elevation, 15-ix-1998, coll. Zhao Ming-shui, 1 male (NAU); San-mu-ping, 780 m elevation, 01-vii-1998, coll. Wu Hong, 1 male (NAU); An-ji County, 30.6345°N, 119.676°E, Mt. Long-wang, 400 m elevation, 03-vi-1999, Coll. Du Yu-zhou, 2 males (NAU).

PRC, An-hui Province: Qi-men County, 50 m upstream of Shu-ang-he-kou, Tang-yun-li tributary, 29.8°N, 117.7°E, 530 m elevation, 30-v-2002, coll. Shan Lin-na, Hu Ben-jin, 2 males (NAU); Shu-ang-he-kou, Tao-yuan-li tributary, 29-ix-2003; coll. Shan Lin-na, Sun Chang-hai, 2 males (NAU); Shu-ang-he-kou, Tao-yuan-li tributary, 26-viii-2003, coll. Sun Chang-hai, Shan Lin-na, 17 males (NAU).

PRC, Guang-xi Province: Shang-si County, Mt. Shi-wan-da National Forest Park, 1st tributary of Shi-tou Stream, Zhu-jiang-yuan Waterfall, ~4 km SW of main entrance to Park, 485 m elevation, 06-vi-2004, Coll. Zhou Xin, Karl M Kjer, 1 male (NAU).

PRC, Si-chuan Province: Mei-gu County, Mei-gu Da-feng-ding National Nature Preserve, Shu-wo Village, Cha-cha-kou Stream, 9.0 km E of Long-wo, 28.7608°N, 103.2535°E, 1650 m elevation, 06-vii-2005, Coll. CJ Geraci, JC Morse, 4 males (NAU); Mei-gu County, Mei-gu Da-feng-ding National Nature Preserve, Shu-wo Village, Gong-fan-yi Stream, 9.5 km E of Long-wo, 28.7605°N, 103.2581°E, 1653 m elevation, 06-vii-2005, Coll. Zhou Xin, 3 males (NAU); Du-jiang-yuan County,

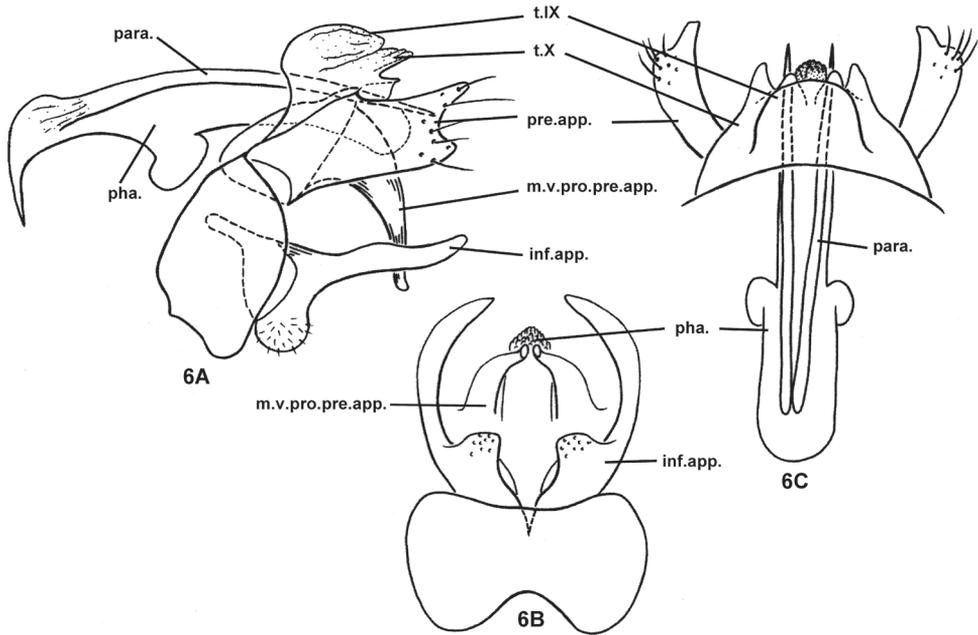


Figure 6. *Nyctiophylax (Paranyctiophylax) gracilis* Morse, Zhong & Yang, sp. n., male genitalia. **6A** left lateral view **6B** ventral view **6C** dorsal view. inf.app. = inferior appendage; m.v.pro.pre.app. = mesoventral process of a preanal appendage; para. = paramere; pha. = phallus; pre.app. = preanal appendage; s.IX = sternum IX; t.IX = tergum IX; t.X = tergum X.

Qing-cheng Hou-shan Scenic Area, Tong-ling-gou Stream, 600 m upstream of Qing-quan-yuan Hotel, 8.7 km S main gate, 30.9301°N, 103.4957°E, 985 m elevation, 10-vii-2005, Coll. Sun Chang-hai, 1 male (NAU).

Diagnosis. The male of this species is similar to that of *N. (P.) sagax* Mey, 1995 in the thick base and slender finger-shaped distal part of each inferior appendage and in the shape of the preanal appendages. However, the 2 species differ in that the mesoventral process of each preanal appendage is evenly curved caudoventrad and blunt apically, and there is no internal spine at the apex of the phallus in the new species. In contrast, in *N. sagax*, the mesoventral process of each preanal appendage is curved ventrad at a right angle in the middle and acute apically, and there is a longitudinal row of internal spines at the apex of the phallus.

Description of adult male. Head light brown with yellowish antennae, pronotum yellowish, meso- and metanota brown, with warts and thoracic legs yellowish, forewings light brown. Length of body with folded forewings: 5.5–7.0 mm. (n=10).

Male genitalia. Tergum IX ovate in lateral view (Fig. 6A) and subquadrate in dorsal view (Fig. 6C), completely membranous. In lateral view (Fig. 6A), sternum IX (s.IX) quadrate, in ventral view (Fig. 6B), posteromesal margin slightly concave, anteromesal margin with shallow, “V-shaped” excision Tergum X broad, widely divided apically, each process with small lobe apicoventrally, acute in lateral view and

blunt in dorsal view. Preanal appendages rectangular in lateral view (Fig. 6A), about 2 times as long as wide, each with broad incision apically; mesoventral processes evenly curved caudoventrad, broad at bases, each gradually reduced to a narrow, blunt apex; in ventral view (Fig. 6B) apices extended mesad beneath phallus. Inferior appendages each with basoventral part much thicker than slender, digitate, incurved distal part; in ventral view (Fig. 6B) basoventral parts each produced in subquadrate lobe with truncate apex. Phallus with phallobase broad and depressed, pair of slender parameres slightly longer than phallicata; phallicata slender, round at apex (Figs 6B, 6A, 6C).

Female and immature stages. Unknown.

Distribution. Oriental Biogeographic Region, China (Jiang-xi, Zhe-jiang, An-hui, Si-chuan).

Etymology. *Gracilis*, Greek adjective, „slender,“ referring to the slender distal part of each inferior appendage.

***Nyctiophylax (Paranyctiophylax) pungens* Morse, Zhong & Yang, sp. n.**

urn:lsid:zoobank.org:act:D6571186-7FBE-420E-BB82-FA638FD302D1

http://species-id.net/wiki/Nyctiophylax_pungens

Fig. 7

Nyctiophylax (Paranyctiophylax) pungens Li 1998: 93–94, figs 4.19–4.21, *nomen nudum*.

Type material. Holotype male, PRC, An-hui Province, Jin County, Song Village, Ding-xi Stream, 33 km E of Jin County, 08-vi-1990, 120 m elevation, coll. JC Morse, Sun Chang-hai, and Yang Lian-fang, deposited in NAU.

Paratypes. PRC, An-hui Province, 3 males, same data as holotype (NAU); 20 males, Qi-men County, 29.8°N, 117.7°E, Peng-long Township, Yang Village, provincial highway at 122 km marker, 249 m elevation, 04-vi-2003, Shan Lin-na, Lu Shuang (NAU); 5 males, Peng-long Township, Yang Village, provincial highway at 122 km marker, 29-v-2002, coll. Shan Lin-na, Hu Ben-jin (NAU); 1 male, Peng-long Township, Yang Village provincial highway at 122 km marker, 25-viii-2002, coll. Hu Ben-jin and Lu Shuang (NAU).

PRC, Jiang-xi Province: 1 male, Mt. Wu-yi National Nature Preserve, Li-tou-jian Stream, 100 m upstream of protected area marker, 27.9862°N, 117.8561°E, 342 m elevation, 05-vi-2005, Coll. Yang Lian-fang, CJ Geraci (NAU); 1 male, Mt. Wu-yi National Nature Preserve, Li-tou-jian Stream, 500–900 m upstream of protected area marker, 27.9803°N, 117.8619°E, 375–404 m elevation, 05-vi-2005, Coll. Sun Chang-hai, Zhou Chang-fa, Zhou Xin (NAU); 1 male, Mt. Wu-yi National Nature Preserve, Lei-gu-ling Stream, 27.9914° N, 117.8911° E, 424 m elevation, 04-vi-2005, Coll. Yang Lian-fang, CJ Geraci (NAU); 12 males, Mt. Wu-yi National Nature Preserve, Lei-gu-ling Stream, 28.0045° N, 117.8814° E, 344 m elevation, 04-vi-2005, Coll.

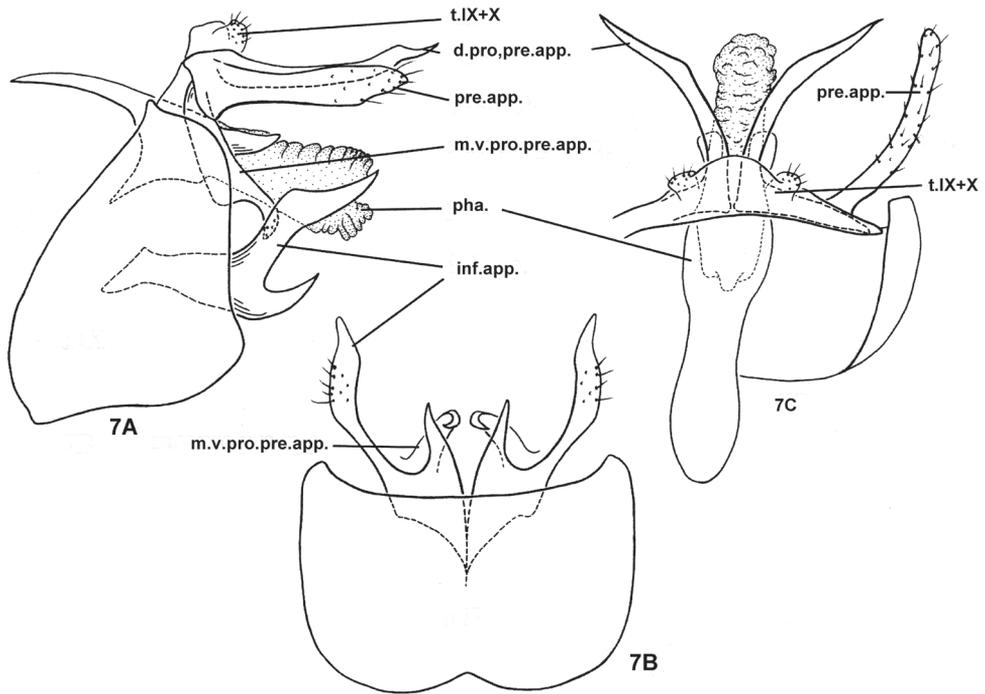


Figure 7. *Nyctiophylax (Paranyctiophylax) pungens* Morse, Zhong & Yang, sp. n., male genitalia. **7A** left lateral view **7B** ventral view **7C** dorsal view. d.pro.pre.app. = dorsal process of a preanal appendage; inf.app. = inferior appendage; m.v.pro.pre.app. = mesoventral process of a preanal appendage; pha. = phallus; pre.app. = preanal appendage; s.IX = sternum IX; t.IX = tergum IX; t.X = tergum X.

Zhou Xin, Zhou Chang-fa (NAU); 3 males, Mt. Wu-yi National Nature Preserve, Lei-gu-ling Stream, 04-vi-2005, Coll. Sun Chang-hai (NAU).

Diagnosis. The genitalia of this species are very similar to those of *N. (P.) nabum* (Malicky & Chantaramongkol, 1993) in the long basoventral process of each inferior appendage and in the long slender dorsal process of each preanal appendage. However, in the new species the dorsal process of each preanal appendage is long and stout, curved caudolaterad in dorsal view, but straight and much more slender in *N. nabum*; and the basoventral process of each inferior appendage forms a 45-degree angle with the main body of the appendage in lateral view in the new species, but an angle of about 90 degrees in *N. nabum*. The shape of the mesoventral process of each preanal appendage is somewhat similar to that of *N. (P.) devanampriya* (Schmid, 1958), but in that species the basoventral process of each inferior appendage is much shorter than that of the new species, which is about 1/3rd as long as the main body of the appendage.

Description of adult male. Head grayish brown with yellowish antennae, pronotum light gray, meso- and metanota brown dorsally, yellowish lateroventrally with concolorous thoracic legs, forewings light brown. Length of body with folded forewings: 4.3–5.5 mm (n=15).

Male genitalia. Tergum IX short, membranous, broadly rounded apically in dorsal view (Fig. 7C). Sternum IX relatively large, in lateral view (Fig. 7A) subtriangular, with short posterodorsal margins 1/3rd as long as ventral surface, anterolateral margins oblique and convex, especially subventrally, posterolateral margins nearly straight, vertical; in ventral view (Fig. 7B), posteromesal margin broadly and shallowly excised, anteromesal margin with short V-shaped excision. Tergum X fused laterally to tergum IX, represented as 2 small setose lateral lobes. Without obvious intermediate appendages. Preanal appendages slender, straight in lateral view (Fig. 7A), curved slightly caudad in dorsal view (Fig. 7C); each with long dorsal process curved caudolaterad, acute apically; its mesoventral process broad at basal 2/3rds, with acute apex hooked slightly ventrad and mesad beneath phallus. Inferior appendages each with acute posterior basoventral process half as long as main body of appendage; main body of appendage slender, setose, and acute apically. Phallus with phallobase sclerotized, broader apically, with pair of short sclerites dorsally, phallicata membranous, without internal spines.

Female and immature stages. Unknown.

Distribution. Oriental Biogeographic Region, China (An-hui, Jiang-xi).

Etymology. *Pungens*, Latin adjective, „acute,“ referring to the acute, posterior basoventral process of each inferior appendage.

***Nyctiophylax (Paranyctiophylax) auriculatus* Morse, Zhong & Yang, sp. n.**

urn:lsid:zoobank.org:act:5B0B4469-C51F-46C3-B286-7AE27A5244E9

http://species-id.net/wiki/Nyctiophylax_auriculatus

Fig. 8

Nyctiophylax (Paranyctiophylax) auriculatus Li 1998: 94–96, figs 4.22–4.24, *nomen nudum*.

Type material. Holotype male, PRC, Jiang-xi Province, Wu-yuan County, Qin-hua River, 57 km N of Wu-yuan, 29.15°N, 117.53°E, 25-v-1990, 250 m elevation, collected by JC Morse, Yang Lian-fang, and Sun Chang-fai, deposited in NAU.

Paratype. PRC, Guang-dong Province: Bo-luo County, Mt. Luo-fu, unnamed stream, 400 m on trail to Shan-bei-shui, trailhead 3.2 km W of ridge of Mt. Cha, 23.3190°N, 114.0115°E, 290 m elevation, 01-vi-2004, Coll. JC Morse, Zhou Xin, CJ Geraci, 1 male (NAU).

Diagnosis. The genitalia of the new species are similar to those of *Nyctiophylax (Paranyctiophylax) hjiangsanchnus* (Botosaneanu, 1970) and *N. (P.) cascadenis* (Malicky, 1995) in the short and broad preanal appendages and in the pair of long and slender phallic parameres. However, in lateral view, where the preanal appendages are semicircular in *N. hjiangsuchonus* and triangular in *N. cascadenis*, they are somewhat quadrate in the new species. Also, the inferior appendages each have a mesal process in *N. hjiangsuchonus*, a ventral process in *N. cascadenis*, and no conspicuous process in the new species.

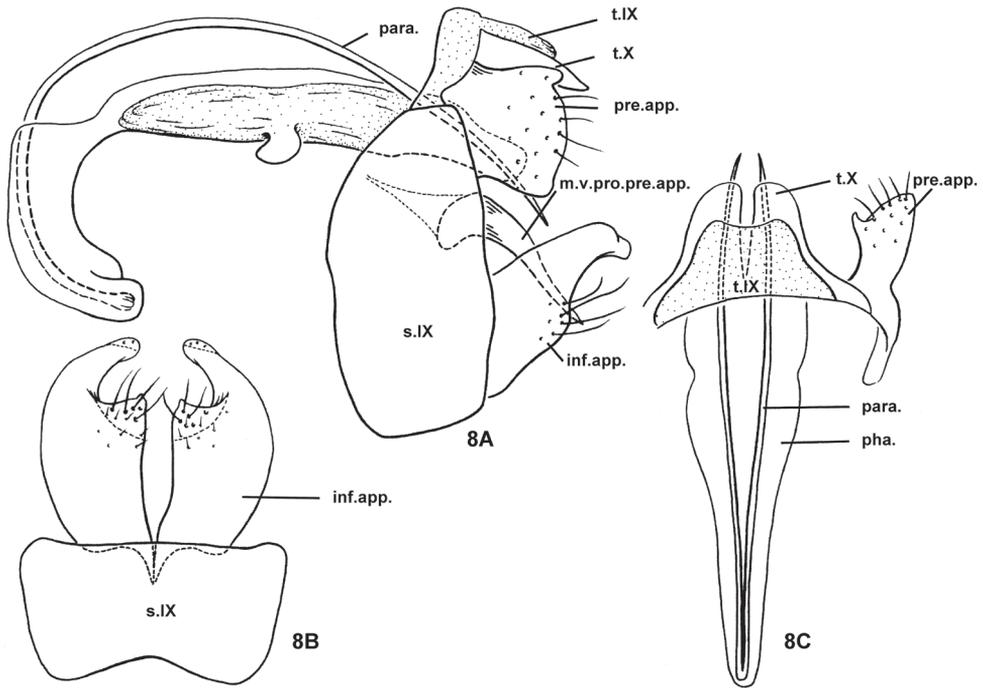


Figure 8. *Nyctiophylax* (*Paranyctiophylax*) *auriculatus* Li & Yang, sp. n., male genitalia. **8A** left lateral view **8B** ventral view **8C** dorsal view. inf.app. = inferior appendage; m.v.pro.pre.app. = mesoventral process of a preanal appendage; para. = paramere; pha. = phallus; pre.app. = preanal appendage; s.IX = sternum IX; t.IX = tergum IX; t.X = tergum X.

Description of adult male. Head and thorax light yellowish brown with yellowish antennae, pronotum light brown, meso- and metanota yellowish-brown dorsally, pale yellowish lateroventrally with concolorous thoracic legs, forewings light brown. Length of body with folded forewings: 5.6–5.8 mm (n=2).

Male genitalia. Tergum IX membranous, short, trapezoid in dorsal view (Fig. 8C), with shallow incision on posterior margin. In lateral view (Fig. 8A), sternum IX tall, subquadrangular, with anterolateral margins convex, dorsal margins short and round, posterolateral margins almost straight and vertical, ventral surface about twice as long as dorsal margin; in ventral view (Fig. 8B), posterior margin nearly straight, anteromesal margin with broad and shallow excision. Tergum X lightly sclerotized, deeply divided apicomically into 2 broad lobes in dorsal view (Fig. 8C). Without obvious intermediate appendages. Preanal appendages shorter than tergum X, almost square in lateral view (Fig. 8A), obliquely truncate; with long, stout mesoventral process (m.v.pro.pre.app.) tapering gradually to acute apex directed caudoventrad. Inferior appendages each with basal 2/3rds much broader than apical 1/3rd; basoventral process not visible in lateral view; distal 1/3rd narrower and curved mesad with obtuse apex in ventral and lateral views (Figs 8B, 8A). Phallus with sclerotized phallobase twice as long as phallicata, curved ventrad and tapering anteriorly and with pair of short blunt lobes

posteroventrally; parameres (para.) longer than phallus, arising at ventral, anterior end of phallobase; phallicata membranous dorsally, without internal spines.

Female and immature stages. Unknown.

Distribution. Oriental Biogeographic Region, China (Jiang-xi, Guang-dong).

Etymology. *Auriculatus*, Latin adjective, “ear-like,” referring to the shape of the preanal appendages in lateral view.

Acknowledgements

The dissertation research of Dr Li You-wen formed the template and inspiration for this publication. We were unable to communicate with Dr Li to assure his agreement to publish the work, necessitating our publishing it without his explicit authorship. Even so, we are very thankful for his significant scientific contributions to it. We are grateful also for assistance by colleagues Dr Du Yu-zhou, Dr Zhou Chang-fa, Dr Christy Jo Geraci, Dr Karl M Kjer, Dr Zhou Xin, Dr Shan Lin-na, Dr Sun Chang-hai, Dr Wang Bei-xin, Dr Wu Hong, Mr Hu Ben-jin, Dr Ke Xin, Dr Lu Liang, Mr Lu Shuang and Mr Zhao Ming-shui for assistance in the collection of specimens reported here. The research was supported by United States National Science Foundation Grant DEB-9318074. We are grateful to Drs Peter H Adler, Francis Reay-Jones, Juang-Hong Chong, 2 anonymous reviewers, and ZooKeys Associate Editor Ralph W Holzenthal for helpful reviews of the manuscript. This is Technical Contribution No. 5967 of the Clemson University Experiment Station.

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Notes on the *Stenus cirrus* group, with description of two new species from China (Coleoptera, Staphylinidae)

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Abstract

Two new species, *S. zhangdinghengi* sp. n., *S. maoershanus* sp. n., of the *Stenus cirrus* group are described from South China, Guangxi Province. The male of *S. fellowesi* Puthz, 2003 and the female of *S. huanghaoi* Tang & Li, 2008 were discovered for the first time. Their diagnostic characters are illustrated and a key to the Chinese species of the *Stenus cirrus* group is provided.

Keywords

Coleoptera, Staphylinidae, *Stenus*, *cirrus* group, identification key, new species, China

Introduction

The *Stenus cirrus* group is a large group of the genus with 57 species worldwide and 24 species in China. The members of the group are characterized by the presence of long and erect setae on the abdomen. A detailed group definition was given by Puthz (2009).

Among the specimens we collected from China recently, the male of *S. fellowesi* Puthz, 2003, described from Hainan Province, and the female of *S. huanghaoi* Tang &

Li, 2008, described from Guangdong Province, were discovered for the first time. Two species of the *Stenus cirrus* group collected from Guangxi Province are recognized as new and described for the first time.

Material and methods

The specimens examined in this paper were collected by sifting leaf litter in forests. For an examination of the male genitalia, the last three abdominal segments were detached from the body after softening in hot water. The aedeagi, together with other dissected parts, were mounted in Euparal (Chroma Gesellschaft Schmidt, Koengen, Germany) on plastic slides. Photos of sexual characters were taken with a Canon G9 camera attached to an Olympus SZX 16 stereoscope; habitus photos were taken with a Canon macro photo lens MP-E 65 mm attached to a Canon EOS40D camera.

The type specimens treated in this study are deposited in the following public and private collections:

- SHNU** Department of Biology, Shanghai Normal University, P. R. China
cPut private collection V. Puthz, Schlitz, Germany
cRou private collection G. de Rougemont, London, England

The measurements of proportions are abbreviated as follows:

- BL** body length, measured from the anterior margin of the clypeus to the posterior margin of abdominal tergite X
FL forebody length, measured from the anterior margin of the clypeus to the apicolateral angle of elytra
HW width of head including eyes
PW width of pronotum
EW width of elytra
PL length of pronotum
EL length of elytra, measured from humeral angle
SL length of elytral suture

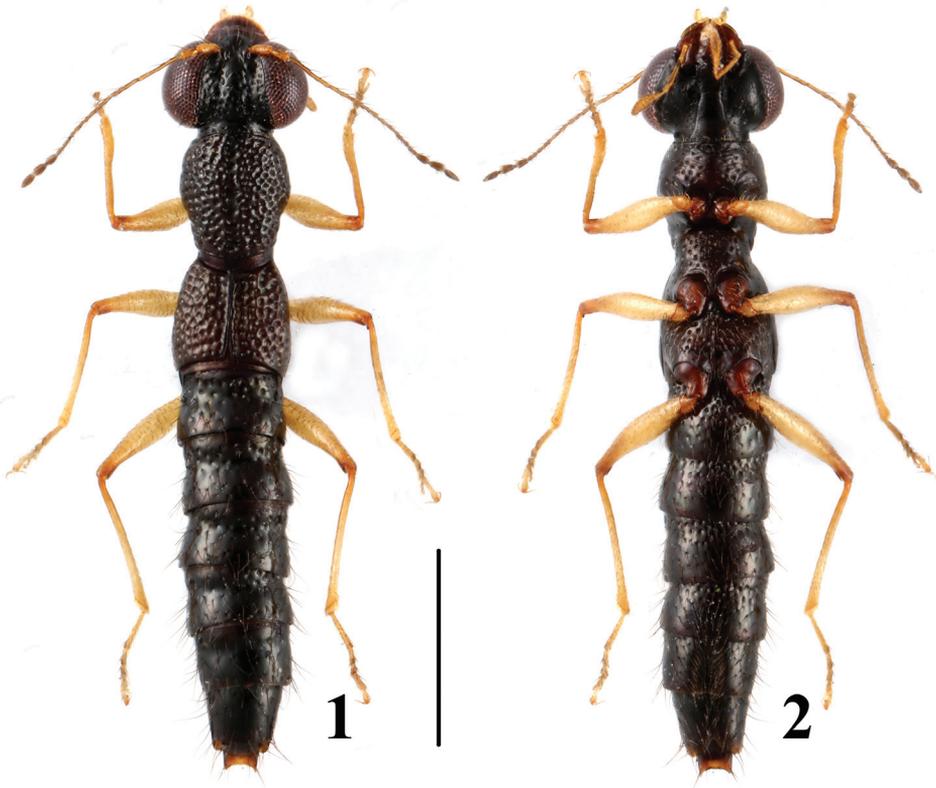
Taxonomy

Stenus fellowesi Puthz, 2003

http://species-id.net/wiki/Stenus_fellowesi

Figs 1–2, 9–21

Material examined. CHINA: Hainan Prov.: Holotype: ♀, Mt. Diaoluoshan, alt. 1040 m, 24.V.1999, J. R. Fellowes leg. (cRou). **Other material:** 42♂♂, 30♀♀, Mt.



Figures 1–2. Habitus of *Stenus fellowesi* in dorsal and ventral view. Scale = 1 mm.

Diaoluoshan, Diaoluozhandao, alt. 930–1000 m, 20–23.IV.2010, YIN Zi-Wei, FENG Ting & YUAN Xiao-Zhuan leg. (1♂, 1♀ in cPut, remainder in SHNU).

Male. Sternite VII (Fig. 9) impressed in posteromedian portion with emargination along posterior margin of impression, impression densely setose; sternite VIII (Fig. 10) with a triangular emargination at middle of posterior margin, length of the emargination about 1/5 of total length along the midline; sternite IX (Fig. 11) with long and slightly acute apicolateral projections, posterior margin nearly straight; tergite X (Fig. 12) with posterior margin truncate. Median lobe of aedeagus (Fig. 13) broad near base and tapering apicad, apex of median lobe (Fig. 14) forming an acute projection with two pairs of short setae; parameres (Fig. 14) slightly longer than median lobe, swollen at apex, each with about 14 to 15 setae on apico-internal margins.

Variation. The duct of the spermatheca may be folded to different degrees (Figs 18–21).

Distribution. China (Hainan Province: Diaoluoshan).

***Stenus huanghaoi* Tang & Li, 2008**

http://species-id.net/wiki/Stenus_huanghaoi

Figs 3–4, 22–30

Material examined. CHINA: Guangdong Prov.: Holotype: ♂, Ruyuan County, Nanling Nature Reserve, alt. 1019 m, 18.VI.2007, HUANG Hao & XU Wang leg. (SHNU). **Other material:** 1♂, Ruyuan County, Nanling Nature Reserve, alt. 1500–1800 m, 17.VIII.2008, QI Nan & YIN Zi-Wei leg. (SHNU); 2♀♀, Ruyuan County, Nanling Nature Reserve, alt. 1100 m, 14.VIII.2008, QI Nan & YIN Zi-Wei leg. (SHNU); 1♂, Shaoguan City, Nanling Nature Reserve, alt. 700 m, 18.VIII.2010, TANG Liang leg. (SHNU).

Female. Sternite VIII (Fig. 27) with posterior margin indistinctly prominent in the middle; tergite X (Fig. 28) with posterior margin broadly rounded and slightly emarginated at apex; valvifers (Fig. 29) each with big tooth at apex, posterior margin serrate; strongly sclerotized spermatheca very simple (Fig. 30).

Notes. In the original description, the elytral mark of the species was described as obsolete. In fact, there is an indistinct elongate orange mark in the lateral portion of each elytron (Fig. 3).

Distribution. China (Guangdong Province: Nanling).

***Stenus zhangdinghengi* Pan, Tang & Li, sp. n.**

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http://species-id.net/wiki/Stenus_zhangdinghengi

Figs 5–6, 31–40

Type material. Holotype: CHINA: Guangxi Prov.: ♂, Lingui County, Huaping Nature Reserve, Anjiangping, alt. 1400–1700 m, 14.VII.2011, PENG Zhong leg. (SHNU). **Paratypes: CHINA: Guangxi Prov.:** 4♂♂, 7♀♀, Lingui County, Huaping Nature Reserve, Anjiangping, alt. 1300–1700 m, 14–18.VII.2011, TANG Liang, HE Wen-Jia & PENG Zhong leg. (1♂, 1♀ in cPut, remainder in SHNU).

Description. BL: 3.5–3.9 mm; FL: 1.6–1.8 mm.

HW: 0.72–0.79 mm, PW: 0.53–0.55 mm, PL: 0.55–0.60 mm, EW: 0.60–0.68 mm, EL: 0.59–0.66 mm, SL: 0.44–0.49 mm.

Brachypterous; body brownish except for the blackish head, anterior margin of labrum, antennae, maxillary palpi and legs yellowish brown, each elytron with an elongate ill-defined orange mark near lateral side, this mark 1/3 to 1/2 as long and about 1/3 to 2/5 as broad as the respective elytron.

Head 1.16–1.21 times as wide as elytra; interocular area with two broad longitudinal furrows, median portion convex dorsally, not reaching level of inner eye margins; punctation round and slightly confluent, uniform except for several large punctures at posterior part of median portion; diameter of large punctures about as wide as antennal segment II in cross-section, interstices between punc-



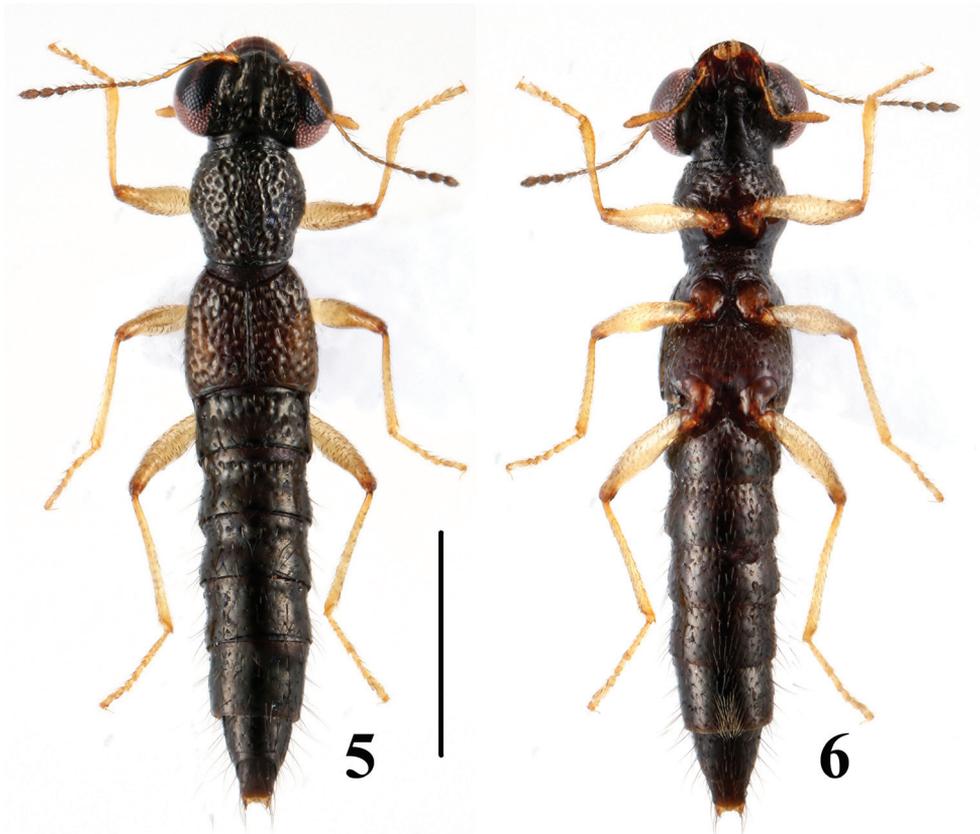
Figures 3–4. Habitus of *Stenus huanghaoui* in dorsal and ventral view. Scale = 1 mm.

tures smooth, mostly narrower than half the diameter of punctures, those along midline much wider, forming a broad impunctate line. Relative length of antennal segments from base to apex 12: 9: 20: 11: 10.5: 10.5: 9: 6.5: 7: 8: 10.5. Paraglossae oval.

Pronotum 1.05–1.09 times as long as wide, 0.81–0.88 times as wide as elytra; disk with shallow median longitudinal furrow about 1/2 the length of pronotum; punctures round and moderately confluent, smaller in size than largest punctures on head, interstices smooth, narrower than half the diameter of punctures.

Elytra 0.96–0.98 times as long as wide, distinctly constricted at base, lateral margins gently divergent posteriad; disk almost even; punctures round to elliptic, uniform, slightly coarser than those of pronotum, interstices smooth, narrower than half the diameter of punctures.

Legs with hind tarsi 0.72–0.78 times as long as hind tibiae, tarsomere IV strongly bilobed.



Figures 5–6. Habitus of *Stenus zhangdinghengi* in dorsal and ventral view. Scale = 1 mm.

Abdomen cylindrical; paratergites very narrow and smooth, present only at abdominal segment III, tergite VII with indistinct palisade fringe; punctuation of tergite III–VIII sparse and shallow, gradually becoming finer posteriad, interstices smooth, varying from narrower to much wider than diameter of punctures.

Male. Sternite VII with shallow emargination at middle of posterior margin and a depression before it; sternite VIII (Fig. 31) with semi-circular emargination at middle of posterior margin; sternite IX (Fig. 32) with long apicolateral projections, posterior margin serrate; tergite X (Fig. 33) with posterior margin convex. Aedeagus (Fig. 34) with apical sclerotized portion of median lobe pointed at apex; expulsion hooks (Fig. 36) very large; parameres longer than median lobe, slightly swollen at apex, each with about 14 short setae at apico-internal margins.

Female. Sternite VIII (Fig. 37) with posterior margin entire; tergite X (Fig. 38) with posterior margin convex. Valvifers (Fig. 39) each with large apicolateral tooth; sclerotized spermatheca as in Fig. 40.

Distribution. China (Guangxi Province: Huaping).

Diagnosis. The new species resembles *S. huanghaoi* Tang & Li, 2008, with which it shares the faint elytral marks, but it may be distinguished by the heterogeneous

punctuation of the frons (in *S. huanghanoi* always similar in size), the shallower pronotal punctuation (especially in the median furrow) and smaller body size (in *S. huanghanoi* BL: 3.9–4.5 mm).

Etymology. This species is named in honor of Mr. Zhang Ding-Heng, administrator of the Huaping Nature Reserve, who provided help in various ways during our field work.

Biological notes. All the specimens were collected by sifting the leaves of bamboo and broad-leaved shrubs in a thick forest (Fig. 50).

***Stenus maoershanus* Pan, Tang & Li, sp. n.**

urn:lsid:zoobank.org:act:7B0F14EB-F7AA-4B85-A751-B2E3A15EEC87

http://species-id.net/wiki/Stenus_maoershanus

Figs 7–8, 41–49

Type material. Holotype: CHINA: Guangxi Prov.: ♂, Xing'an County, Mt. Mao'ershan, alt. 2100 m, 10.VII.2011, TANG Liang & HE Wen-Jia leg. (SHNU).

Paratype: CHINA: Guangxi Prov.: 1 ♀, same data as holotype. (SHNU).

Description. BL: 4.3 mm; FL: 2.0 mm.

HW: 0.81–0.82 mm, PW: 0.60–0.61 mm, PL: 0.63–0.64 mm, EW: 0.76 mm, EL: 0.71–0.72 mm, SL: 0.54–0.55 mm.

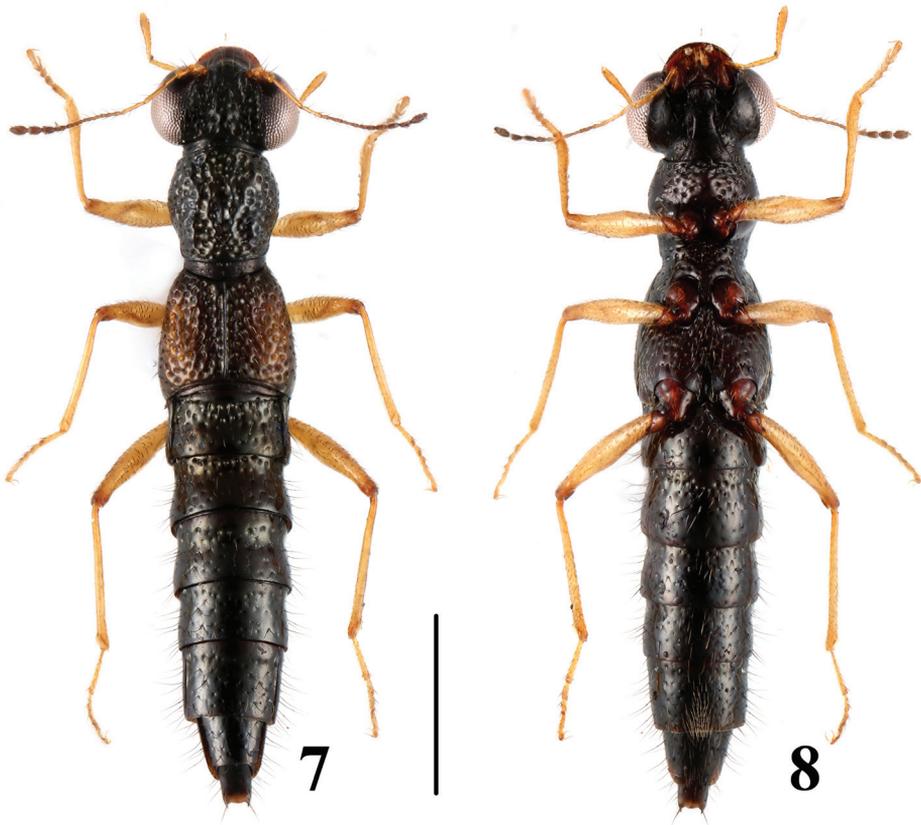
Brachypterous; body brownish black, head darker, anterior margin of labrum, antennae, maxillary palpi and legs yellowish brown, each elytron with a large elongate orange mark near lateral margin, this mark $\frac{4}{5}$ as long as and about $\frac{3}{5}$ as broad as the respective elytron.

Head 1.07–1.08 times as wide as elytra; interocular area with two broad longitudinal furrows, median portion convex, almost reaching the level of inner eye margins; punctures round, slightly larger and sparser in median area than those near inner margins of eyes, diameter of large punctures as wide as apical cross section of antennal segment II, interstices between punctures smooth, mostly narrower than half the diameter of punctures, those along midline a little wider. Relative length of antennal segments from base to apex 15: 9: 24: 14: 12: 9.5: 9.5: 6.5: 7: 8: 10. Paraglossae oval.

Pronotum 1.04–1.05 times as long as wide, 0.80–0.81 times as wide as elytra; disk with distinct median longitudinal furrow, this furrow about half the length of pronotum; punctuation round and confluent, similar to that of head, interstices smooth, much narrower than half the diameter of punctures except for those in median furrow, which may be wider.

Elytra 0.94–0.95 times as long as wide, distinctly constricted at base, lateral margins gently divergent posteriad; punctuation similar to that of pronotum, but slightly coarser, interstices similar to those of pronotum.

Legs with hind tarsi 0.74–0.75 times as long as hind tibiae, tarsomere IV strongly bilobed.



Figures 7–8. Habitus of *Stenus maoershanus* in dorsal and ventral view. Scale = 1 mm.

Abdomen cylindrical; paratergites very narrow and smooth, present only in abdominal segment III, posterior margin of tergite VII with indistinct palisade fringe; punctuation of tergite III–VIII sparse and shallow, gradually becoming finer posteriorly, interstices smooth, varying from narrower to much wider than diameter of punctures.

Male. Sternite VII with inconspicuous emargination at middle of posterior margin, anterior to this emargination flattened; sternite VIII (Fig. 41) with semi-circular emargination at middle of posterior margin; sternite IX (Fig. 42) with long apicolateral projections, posterior margin serrate; tergite X (Fig. 43) with posterior margin truncate and slightly emarginated at middle. Aedeagus (Fig. 44) with apical sclerotized portion of median lobe triangular; expulsion hooks absent (probably lost in this specimen); parameres longer than median lobe, each with 8–9 setae on apico-internal margins.

Female. Sternite VIII (Fig. 46) inconspicuously prominent at middle of posterior margin; tergite X (Fig. 47) with posterior margin truncate and slightly emarginated at middle. Valvifers (Fig. 48) each with big apicolateral tooth; spermatheca strongly sclerotized (Fig. 49).

Distribution. China (Guangxi Province: Mao'ershan).

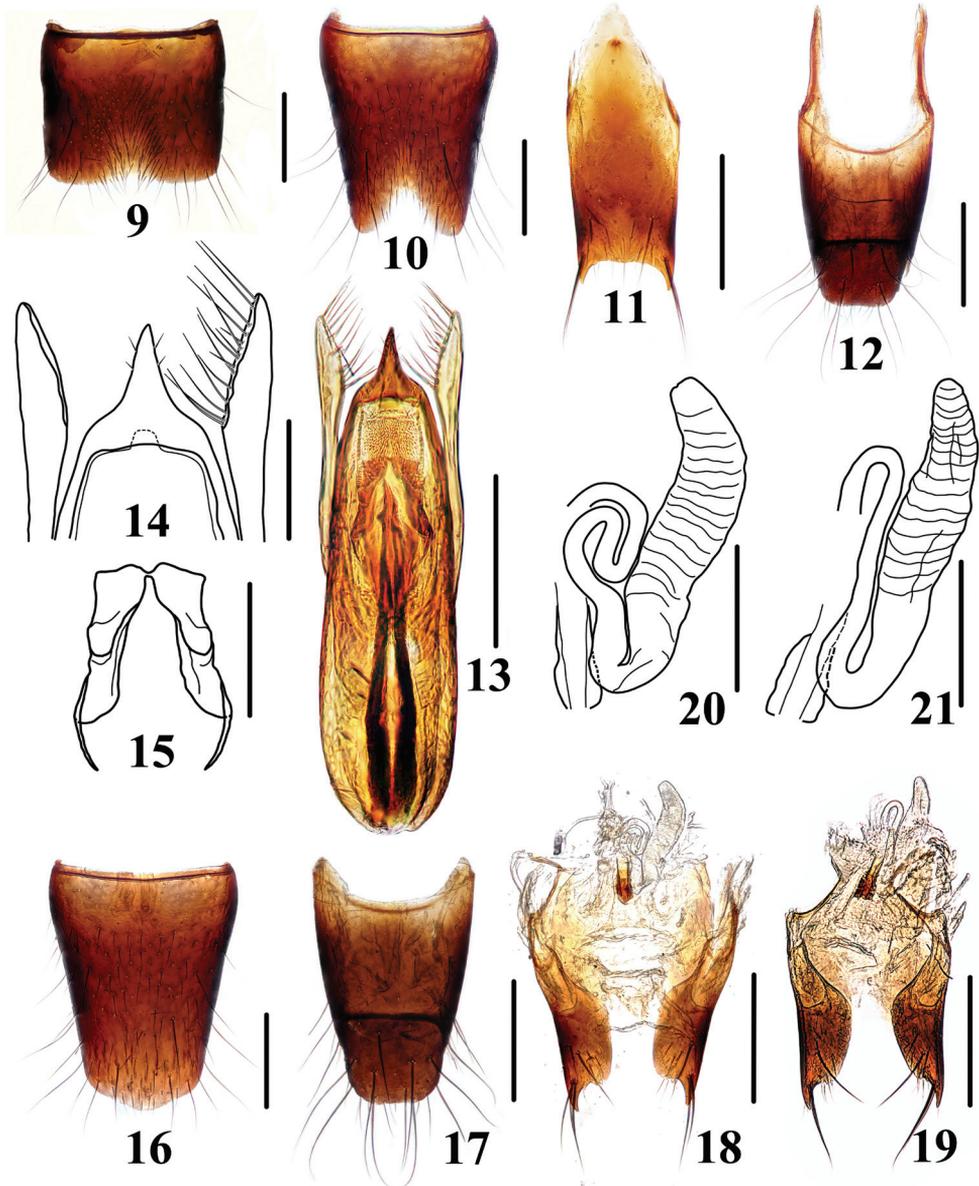
Diagnosis. The new species resembles *S. nanlingmotis* Tang & Li, 2008 from Guangdong, but may be distinguished by the broader and deeper pronotal furrow with wider interstices, which may be as wide as diameter of punctures (in *S. nanlingmotis* smaller than half the diameter of punctures); the elytral marks are broader, about 3/5 as broad as the respective elytron (in *S. nanlingmotis* about 2/5 as broad as the respective elytron).

Etymology. The specific name is derived from "Mao'ershan", the type locality of this species.

Biological notes. The female specimen was collected by sifting the leaves of bamboo and broad-leaved shrubs near the mountain summit, the male specimen was collected by beating grass along a drain exposed in sunshine.

Key to the Chinese species of the *Stenus cirrus* group

- | | | |
|---|--|--|
| 1 | Paraglossae coniform (<i>flammeus</i> -complex)..... | 2 |
| – | Paraglossae oval (<i>cirrus</i> -complex)..... | 3 |
| 2 | Body on average broader and larger; punctuation of abdominal tergites VI and VII denser, interstices at most as wide as punctures. Habitus: Fig. 5 in Tang et al. 2008; sexual characters: Figs 25–29 in Tang et al. 2008. BL: 3.7–5.7 mm | <i>S. flammeus</i> Tang & Puthz, 2008
China (Sichuan : Erlangshan) |
| – | Body on average narrower and slightly smaller; punctuation of abdominal tergites VI and VII less dense, interstices up to twice as wide as punctures. Habitus: Fig. 6 in Tang et al. 2008; sexual characters: Figs 30–34 in Tang et al. 2008. BL: 4.0–4.5 mm | <i>S. bostrychus</i> Tang & Puthz, 2008
China (Sichuan: Hailuogou) |
| 3 | Abdominal tergite III without paratergites | 4 |
| – | Abdominal tergite III with paratergites | 5 |
| 4 | Elytra unicolored; pronotum and elytra with smooth interstices. Habitus: Figs 1, 2; sexual characters: Figs 9–19. BL: 3.6–4.9 mm | <i>S. fellowesi</i> Puthz, 2003
China (Hainan: Diaoluoshan) |
| – | Elytra bicolored; pronotum and elytra with more strongly sculptured interstices. Spermatheca: Fig. 14 in Puthz, 2003; male unknown. BL: 3.0–4.2 mm..... | <i>S. hainanensis</i> Puthz, 2003
China (Hainan: Jianfengling) |
| 5 | Tergites and sternites of abdominal segments IV–VI separated by sutures... | 6 |
| – | Tergites and sternites of abdominal segments IV–VI fused without sutures.... | 7 |
| 6 | Elytra strongly glossy with irregular and slightly confluent punctuation, interstices smooth. Sexual characters: Figs 15, 16 in Puthz, 2003. BL: 2.6–3.4 mm..... | <i>S. huangganmontium</i> Puthz, 2003
China (Jiangxi: Huanggangshan) |

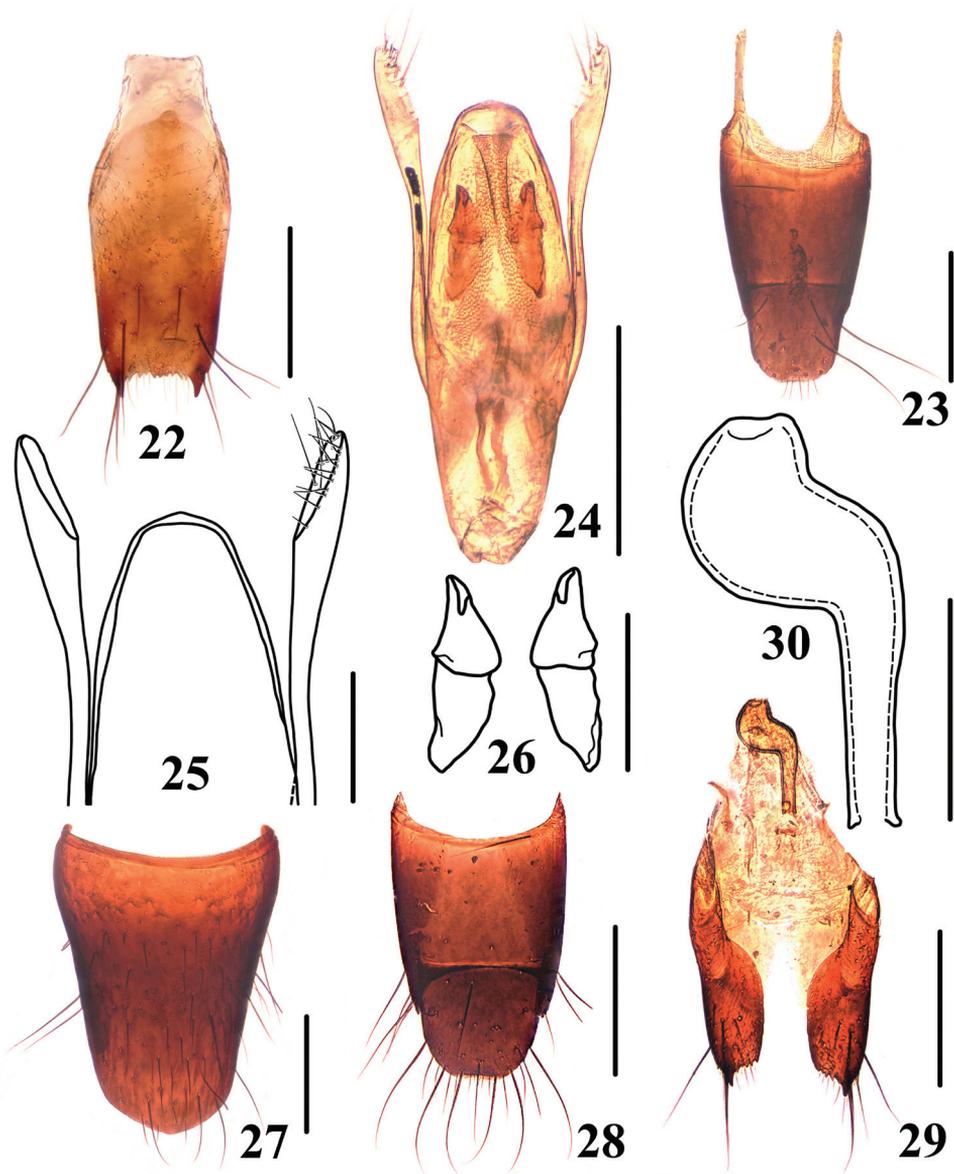


Figures 9–21. *Stenus fellowesi* **9** male sternite VII **10** male sternite VIII **11** male sternite IX **12** male tergite IX, X **13** aedeagus in ventral view **14** apex of aedeagus **15** expulsion hooks **16** female sternite VIII **17** female tergite IX, X **18–19** valvifers and spermatheca **20–21** spermatheca. Scales = 0.1 mm (14–15, 20–21), scales = 0.25 mm (9–13, 16–19).

- Elytra slightly glossy with regular and deep, less distinctly confluent punctation. Sexual characters: Figs 35–39 in Tang et al. 2008. BL: 2.6–3.6 mm ..*S. cirrus* L. Benick, 1940

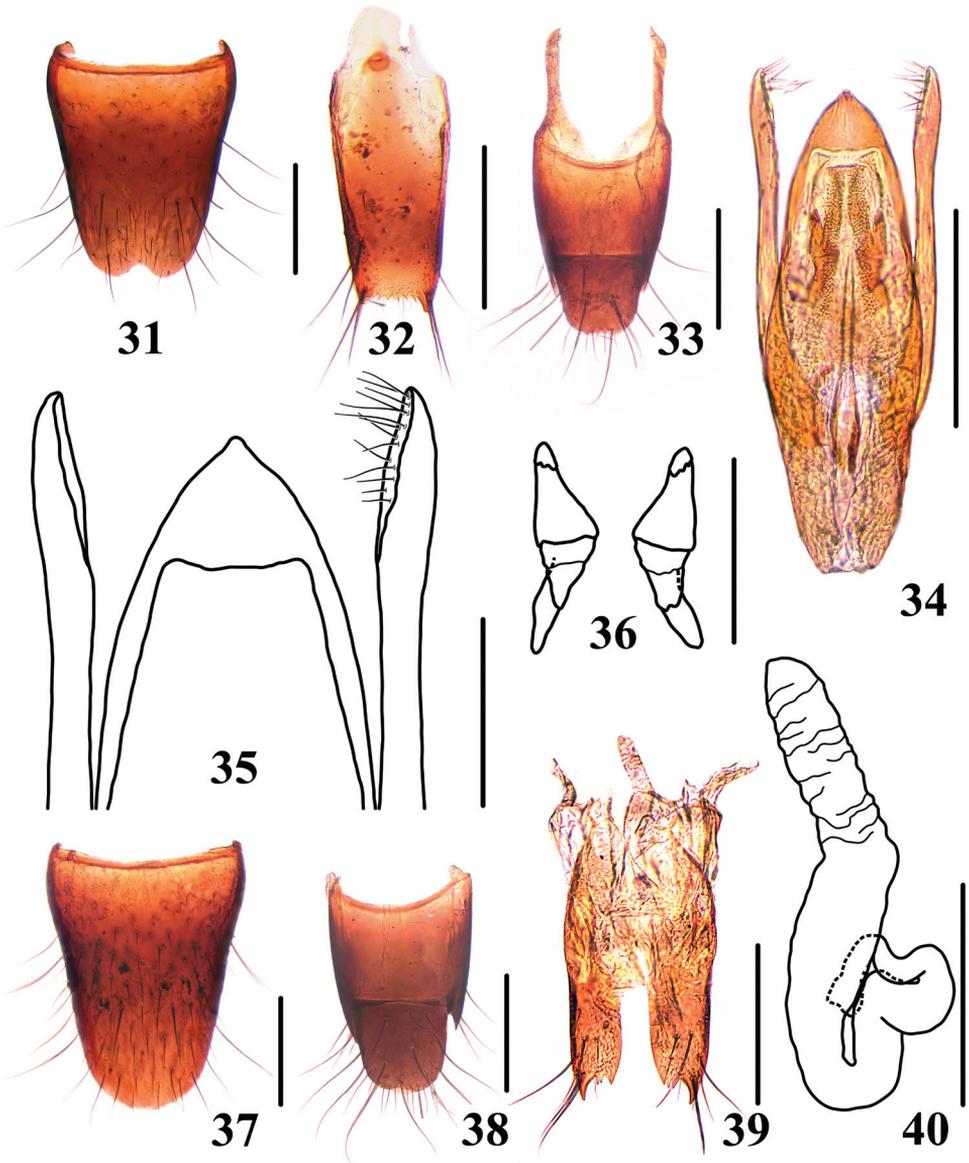
China (Zhejiang: Tianmushan)

- 7 Smaller species, BL \geq 3.5 mm; elytra unicolored **8**
- Larger species, BL \leq 3.0 mm; elytra bicolored, with elytral marks or with lateral elytral portion lighter..... **10**
- 8 Punctuation of forebody moderately dense, interstices strongly glossy, punctures defined. Aedeagus: Fig. 26 in Puthz, 2003. BL: 2.5–3.5 mm.....
..... ***S. falsus* L. Benick, 1940**
China (Jiangsu: Chinkiang)
- Punctuation of forebody very dense, interstices weakly glossy at most, punctures less defined **9**
- 9 Interstices of pronotal punctuation distinctly reticulate. Habitus: Fig. 4 in Tang et al. 2008; sexual characters: Figs 20–24 in Tang et al. 2008. BL: 2.3–2.8 mm..... ***S. shenshanjiai* Tang & Puthz, 2008**
China (Zhejiang: Niutoushan)
- Interstices of pronotal punctuation indistinctly reticulate. Habitus: Fig. 2 in Tang, Li and Zhao 2005; sexual characters: Figs 8–11 in Tang, Li and Zhao 2005. BL: 2.3–3.2 mm ***S. nigritus* Tang, Li & Zhao, 2005**
China (Shaanxi: Qinling)
- 10 Head narrower than or slightly wider than elytra **11**
- Head distinctly wider than elytra **13**
- 11 Head slightly wider than elytra; elytra wider than long. Aedeagus: Fig. 1 in Puthz, 1983; female unknown. BL: 3.0–3.5 mm
..... ***S. splendidulus* Puthz, 1983**
China (Guangxi: S. Guilin)
- Head distinctly narrower than elytra; elytra longer than wide. Two very similar species with fully developed wings **12**
- 12 Aedeagus with narrow apical sclerotized portion, pointed at apex: Fig. 3 in Puthz, 1998. BL: 3.5–4.7 mm ***S. guangxiensis* Rougemont, 1984**
China (Guangxi, Zhejiang)
- Aedeagus with broad apical sclerotized portion, rounded at apex: Fig. 4 in Puthz, 1998. BL: 3.3–4.7 mm ***S. aeneonitens* Puthz, 1998**
China (Sichuan: Qingchengshan)
- 13 Punctuation of frons sparse and heterogeneous **14**
- Punctuation of frons dense and almost uniform..... **15**
- 14 Elytral marks very distinct; punctuation of elytra very dense, interstices of basal half of elytra narrow, forming sharp rugae. Male characters: Figs 11, 12 in Puthz, 2003; female unknown. BL: 3.0–4.0 mm..... ***S. cactiventris* Puthz, 2003**
China (Guangdong: Dawuling)
- Elytral marks faint; punctuation of elytra less dense, interstices of basal half of elytra relatively broad, not forming sharp rugae. Habitus: Figs 5, 6; sexual characters: Figs 31–40. BL: 3.5–3.9 mm..... ***S. zhangdinghengi* sp. n.**
China (Guangxi: Huaping)
- 15 Punctuation of pronotum and elytra dense, but not confluent **16**



Figures 22–30. *Stenus huanghanoi* **22** male sternite IX **23** male tergite IX, X **24** aedeagus in ventral view **25** apex of aedeagus **26** expulsion hooks **27** female sternite VIII **28** female tergite IX, X **29** valvifers and spermatheca **30** spermatheca. Scales = 0.1 mm (25–26, 30), scales = 0.25 mm (22–24, 27–29).

- Punctuation of pronotum and elytra very dense and confluent, that of the pronotum irregular. Species reliably identified only by their sexual characters....**19**
- 16** Elytral marks very indistinct; punctuation of pronotum homogeneous and mostly well defined. Habitus: Fig. 2 in Tang, Zhao and Li 2008; sexual char-

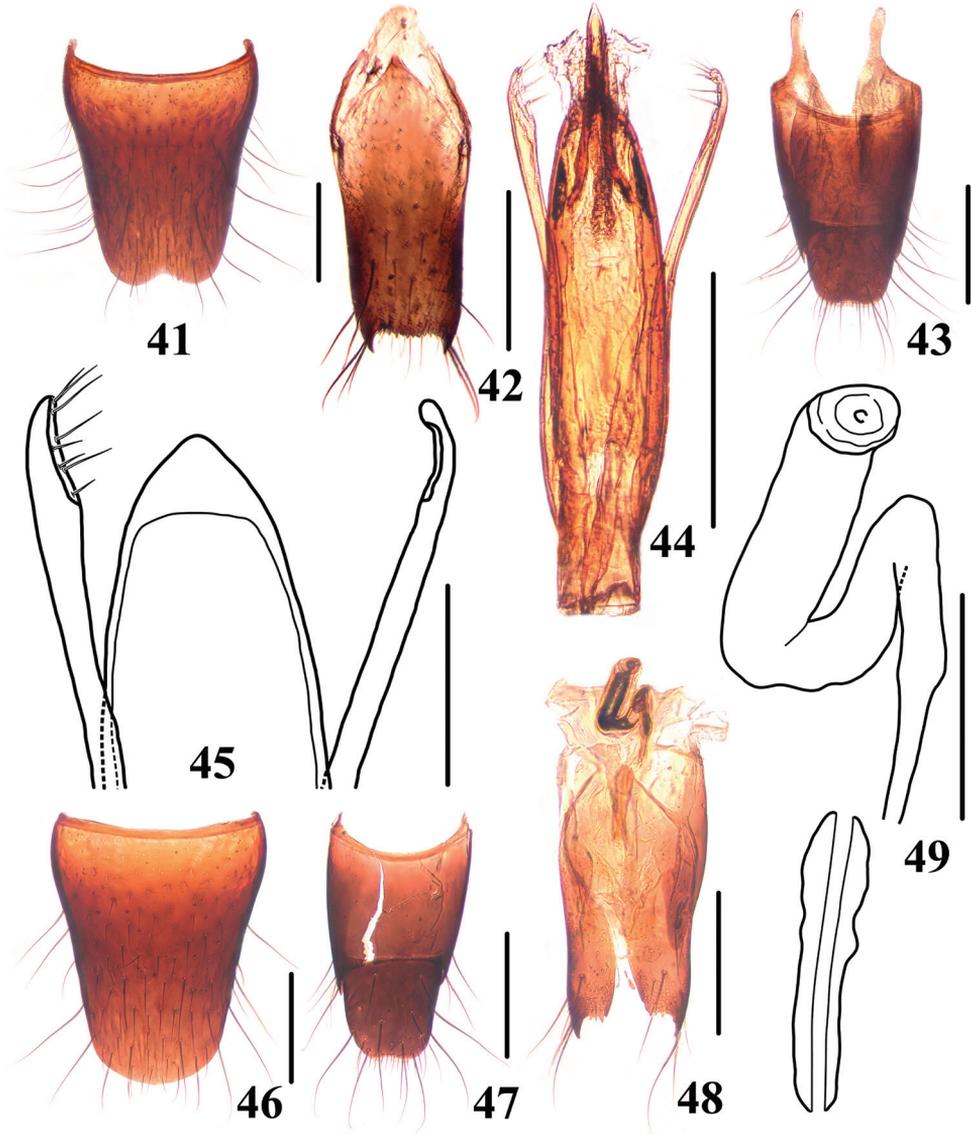


Figures 31–40. *Stenus zhangdinghengi* **31** male sternite VIII **32** male sternite IX **33** male tergite IX, X **34** aedeagus in ventral view **35** apex of aedeagus **36** expulsion hooks **37** female sternite VIII **38** female tergite IX, X **39** valvifers and spermatheca **40** spermatheca. Scales = 0.1 mm (35–36, 40), scales = 0.25 mm (31–34, 37–39).

acters: Figs 8–12 in Tang, Zhao and Li 2008. BL: 3.4–4.0 mm

..... ***S. xuwangi* Tang & Li, 2008**
 China (Guangdong: Nanling)

– Elytral marks distinct; punctuation of pronotum heterogeneous and/or moderately confluent **17**



Figures 41–49. *Stenus maoershanus* **41** male sternite VIII **42** male sternite IX **43** male tergite IX, X **44** aedeagus in ventral view **45** apex of aedeagus **46** female sternite VIII **47** female tergite IX, X **48** valvifers and spermatheca **49** spermatheca. Scales = 0.1 mm (45, 49), scales = 0.25 mm (41–44, 46–48).

- 17 Punctuation on elytral marks very sparse, interstices partly wider than diameter of punctures. Male characters: Figs 9, 10 in Puthz, 2003; female unknown. BL: 3.2–4.2 mm ***S. cooterianus* Puthz, 2003**
China (Fujian: Wuyishan)
- Punctuation on elytral marks dense, interstices slightly wider than half the diameter of punctures **18**

- 18 Body larger, BL 3.8–4.5 mm, FL 1.9–2.1 mm; elytral marks longer than half the elytra, extending towards humeral angles. Habitus: Fig. 3 in Tang, Li and Zhao 2005; sexual characters: Figs 12–15 in Tang, Li and Zhao 2005
 ***S. ovalis* Tang, Li & Zhao, 2005**
 China (Zhejiang: Wuyanling)
- Body smaller, BL 3.2–4.1 mm, FL 1.6–1.7 mm; elytral marks shorter than half of elytral length, not extending towards humeral angles. Habitus: Fig. 1 in Tang, Li and Zhao 2005; sexual characters: Figs 4–7 in Tang, Li and Zhao 2005
 ***S. andoi* Tang, Li & Zhao, 2005**
 China (Hubei: Houhe)
- 19 Punctuation of elytra very dense and confluent; male apical emargination of abdominal sternite VIII broad and shallow: Fig. 7 in Tang et al. 2008 **20**
- Punctuation of elytra less dense, and less confluent; male apical emargination of abdominal sternite VIII narrower, rounded: Fig. 12 in Tang et al. 2008 **21**
- 20 Elytral marks shorter, not extending towards humeral angles. Habitus: Fig. 1 in Tang et al. 2008; sexual characters: Figs 7–11 in Tang et al. 2008. BL: 3.7–5.0 mm
 ***S. zhulilongi* Tang & Puthz, 2008**
 China (Zhejiang: Gutianshan)
- Elytral marks longer, extending towards humeral angles. Sexual characters: Figs 19, 20 in Puthz, 2003. BL: 3.5–4.7 mm
 ***S. lacrimulus* L. Benick, 1942**
 China (Fujian: Wuyishan)
- 21 Elytral marks distinct, less than half the length of elytra; punctuation of pronotum less confluent. Habitus: Fig. 3 in Tang et al. 2008; sexual characters: Figs 16–19 in Tang et al. 2008. BL: 3.7–5.0 mm
 ***S. jiulongshanus* Tang & Puthz, 2008**
 China (Zhejiang: Jiulongshan)
- Elytral marks more than half the length of elytra (elytral marks of *S. huang-haoi* may be ill-defined); punctuation of pronotum more confluent **22**
- 22 Median longitudinal pronotal furrow deep, with interstices as wide as diameter of punctures. Habitus: Figs 7, 8; sexual characters: Figs 41–49. BL: 4.3 mm
 ***S. maoershanus* sp. n.**
 China (Guangxi: Mao'ershan)
- Median longitudinal pronotal furrow shallow or indistinct, with interstices narrower than half the diameter of punctures **23**
- 23 Body larger, FL 2.0–2.2 mm **24**
- Body smaller, FL 1.8–1.9 mm **25**
- 24 Head relatively wide, HW 0.87–0.96 mm, HW/EW 1.12–1.17. Habitus: Fig. 3 in Tang, Zhao and Li 2008; sexual characters: Figs 13–16 in Tang, Zhao and Li 2008. BL: 4.2–4.9 mm
 ***S. nanlingmontis* Tang & Li, 2008**
 China (Guangdong: Nanling)
- Head relatively narrow, HW 0.79–0.91 mm, HW/EW 1.06–1.12. Habitus: Fig. 2 in Tang et al. 2008; sexual characters: Figs 12–15 in Tang et al. 2008. BL: 3.8–5.0 mm
 ***S. lijinweni* Tang & Puthz, 2008**



Figure 50. Habitat of *Stenus zhangdinghengi* in Huaping Nature Reserve.

- China (Jiangxi: Sanqingshan; Zhejiang: Gutianshan)
- 25 Punctuation of pronotum heterogeneous, with moderately coarse to very coarse punctures; elytral marks distinct. Male characters: Figs 17, 18 in Puthz, 2003; female unknown. BL: 3.6–4.3 mm *S. wuyiensis* Puthz, 2003
China (Fujian: Wuyishan)
- Punctuation of pronotum uniform, very coarse; elytral marks indistinct. Habitus: Fig. 1 in Tang, Zhao and Li 2008; sexual characters: Figs 4–7 in Tang, Zhao and Li 2008. BL: 3.9–4.5 mm *S. huangbaoi* Tang & Li, 2008
China (Guangdong: Nanling)

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