

# Stoneflies of the genus *Neoperla* (Plecoptera, Perlidae) from Wuyi Mountain National Nature Reserve, Fujian of China

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## Abstract

The species of the genus *Neoperla* are reviewed from Wuyi Mountain National Nature Reserve located in the Fujian Province of southeastern China, including the description of a new species, *Neoperla brevistyla* sp. n. The new species is compared to similar taxa. The first records of five *Neoperla* species, *N. henana* Li, Wu & Zhang, 2011, *N. similiserecta* Wang & Li, 2012, *N. qingyuanensis* Yang & Yang, 1995, *N. xuan-songae* Li & Li, 2013 and *N. tuberculata* Wu, 1938 are given for the Wuyi Mountain. A provisional key is provided for facilitating the identification of these species.

## Keywords

Plecoptera, Perlidae, *Neoperla*, new species, China

## Introduction

The stonefly genus *Neoperla* is the most species-rich genus within the subfamily Perlinae (Sivec et al. 1988, DeWalt et al. 2013). There are over 70 known species in China described by Chu (1929), Du (1999, 2000a, 2000b), Du and Sivec (2004, 2005), Du and Wang (2005, 2007), Du et al. (1999, 2001), Sivec and Zwick (1987), Wu (1935, 1938, 1948, 1962, 1973), Wu and Claassen (1934), Yang and Yang (1990, 1991), Yang and Yang (1992, 1993, 1995a, 1995b, 1996, 1998), Li et al. (2011), Li et al. (2011), Li and Wang (2011), Li et al. (2012), Li et al. (2012), Li and Li (2013), Li et al. (2013a) and Li et al. (2013b).

In the present paper, the species of the genus *Neoperla* are reviewed from Wuyi Mountain National Nature Reserve, Fujian Province of China based on the fresh material collected in recent years. With a total area of ca. 565 km<sup>2</sup>, the Reserve possesses a typical subtropical forest ecological system and is the largest area for biodiversity conservation in Fujian Province, south-east China (<http://www.wbr.cn/>).

## Material and methods

Types and other examined material are deposited in the Insect Collection of Henan Institute of Science and Technology (HIST), Xinxiang, and the Entomological Museum of China Agricultural University (CAU), Beijing. They were examined with the aid of a Motic SMZ 168 microscope and the color illustrations were captured using digitalized software Motic Images Advanced 3.2. All specimens were kept in 75% ethanol. Aedeagi were everted using the cold maceration technique of Zwick (1983). Terminology follows that of Sivec et al. (1988).

## Taxonomy

### *Neoperla breviscrotata* Du, 1999

[http://species-id.net/wiki/Neoperla\\_breviscrotata](http://species-id.net/wiki/Neoperla_breviscrotata)

*Neoperla breviscrotata* Du, 1999: 312. Type locality: Guizhou Province, Sandou, Chengguan.

**Distribution.** China (Guizhou, Anhui, Shandong, Fujian, Shaanxi).

**Remarks.** This species was recently described by Du (1999) from the localities listed above including the Wuyi Mountain, but no new material was available to the present study.



***Neoperla brevistyla* Li & Murányi, sp. n.**

<http://zoobank.org/6FB22544-4438-4E18-8E5C-4F68C9BB1498>

[http://species-id.net/wiki/Neoperla\\_brevistyla](http://species-id.net/wiki/Neoperla_brevistyla)

Figs 1–2

**Type material.** 1 male (CAU), China: Fujian Province, Mt. Wuyishan, Sangang, 735 m, 27°74.78'N, 117°68.31'E, light trap, 12 Jul. 2009, Li Shi and Xiaoyan Liu. Paratypes: 2 males, the same data as holotype, (CAU); 6 males, the same locality, 16 Aug. 2006, Hui Dong, (HIST).

**Male.** Forewing length 15.6–16.0 mm. Distance between ocelli about as wide as diameter of the ocellus. Head slightly wider than pronotum, with an obscure quadrate dark stigma on frons and a brown area covering ocelli (Fig. 1a); compound eyes black and antennae dark; maxillary palpi brown. Pronotum with obscure rugosities and dark brown anterior and lateral margins, thorax mostly brown (Fig. 1a); wing membrane subhyaline, veins brown; legs brown but distal half of femora and basal one fourth and distal one sixth of tibia dark brown, tarsi dark brown (Fig. 2d).

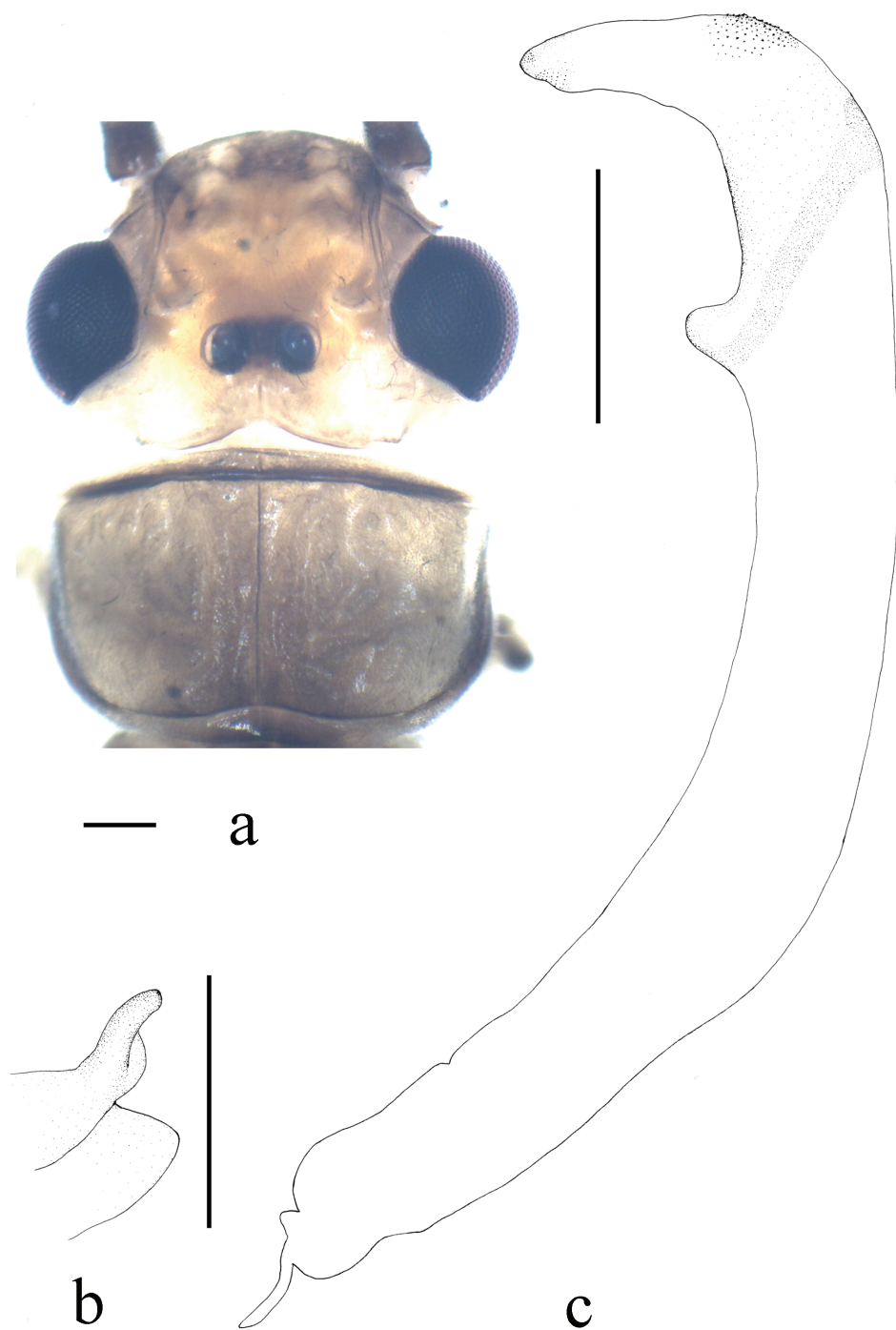
**Terminalia.** The posterior margin of tergum 7 with quadrate, rounded and elevated process covered with dense sensilla basiconica (Fig. 2a). Tergum 8 with recurved tongue-like process (Figs 2a). Tergum 9 without sensilla basiconica. Hemitergal processes of tergum 10 with enlarged base and beak-like apex (Figs 1b and 2b). Aedeagal tube strongly sclerotized, with a pair of separate ventroapical lobes, in lateral view nipple like and triangular in shape (Figs 1c and 2c). Aedeagal sac short and gradually tapering to apex, forming nearly a right angle with tube; basal part unarmed and plump, median part with a patch of small spines and apex bearing fine spinules (Figs 1c and 2c).

**Female.** Unknown.

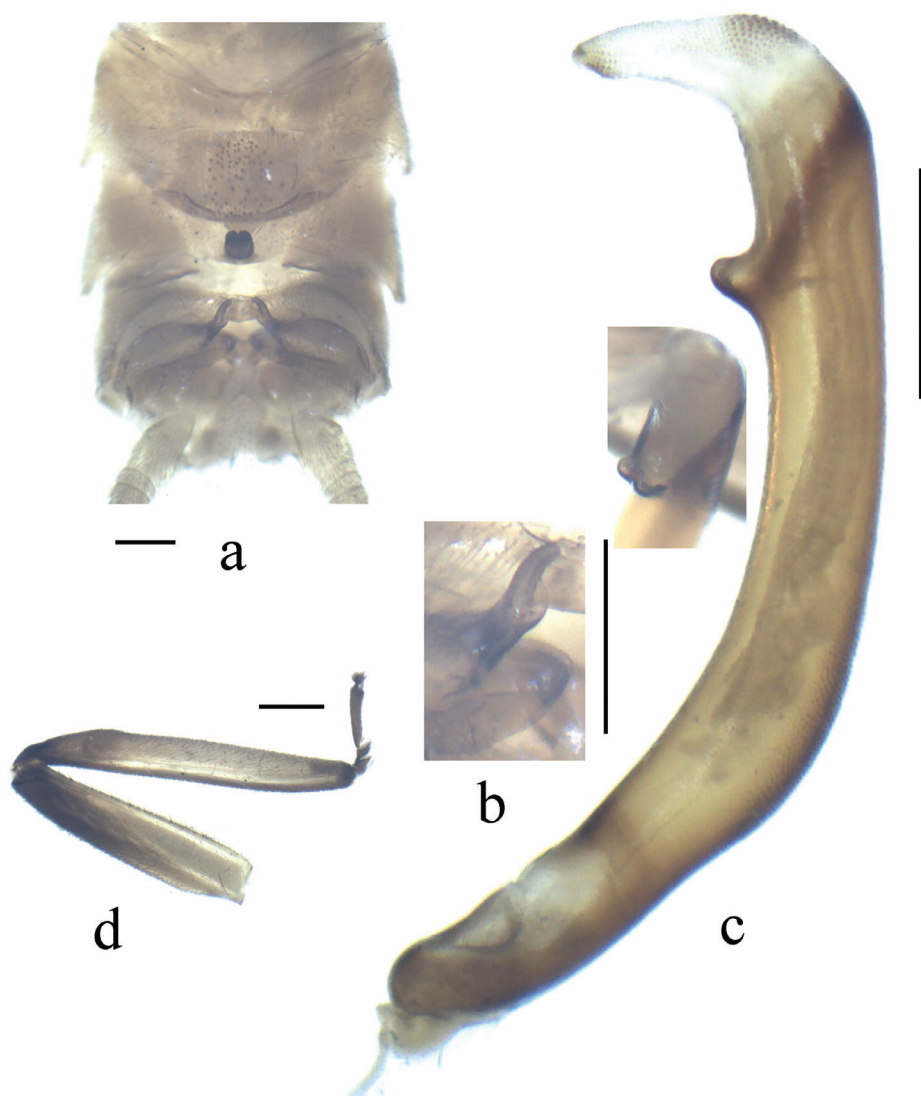
**Etymology.** The specific epithet refers to the short ventral lobe of aedeagal tube.

**Distribution.** China (Fujian).

**Diagnosis and remarks.** *N. brevistyla* belongs to an informal group of species including *N. biprojecta* Du, 2001, *N. duratubulata* Du, 1999, *N. qingyuanensis* Yang & Yang, 1995, *N. yentu* Cao & Bae, 2007 that bear similar terminalia, sclerotized aedeagal tube and short sac, and a pair of separate ventral lobes of aedeagal tube (for comparison, see figs 3–4, 7 in Li et al. 2013, figs 25–13 in Du 1999, figs 75–77 in Stark and Sivec 2008, and Fig. 6). This species shares a pair of short ventral aedeagal lobes with *N. biprojecta* Du, 2001 (fig. 4 in Li et al. 2013), but the lobes of *N. brevistyla* are triangular and stouter, a patch of dorsal armatures occurs at midlength of the sac (Fig. 1c) which is absent in *N. biprojecta*.



**Figure 1.** *Neoperla brevistyla* Li & Murányi, sp. n. Male **a** Head and pronotum, dorsal view **b** Hemitergal process, dorsal view **c** Aedeagus, lateral view. Scale bars: 0.5 mm.



**Figure 2.** *Neoperla brevistyla* Li & Murányi, sp. n. Male **a** Terminalia, dorsal view **b** Hemitergal process, dorsal view **c** Aedeagus, lateral view **d** Foreleg, lateral view. Scale bars: 0.5 mm.

***Neoperla duratubulata* Du, 1999**

[http://species-id.net/wiki/Neoperla\\_duratubulata](http://species-id.net/wiki/Neoperla_duratubulata)

*Neoperla duratubulata* Du, 1999: 313. Type locality: Fujian Province, Mt. Wuyishan, Sangang.

**Remarks.** No new material was available for examination. It was stated to be similar to *N. flavescens* Chu, 1929 but bearing paired ventral aedeagal lobes (Du 1999). *N.*

*duratubulata* may be assigned to the above mentioned subgroup and seems similar to *N. qingyuanensis*. The aedeagal sac of *N. duratubulata* is a very short conical structure with several rows of subapical fine spinules and the head lacks distinct color pattern (modified from the original descriptions of Du 1999).

***Neoperla henana* Li, Wu & Zhang, 2011**

[http://species-id.net/wiki/Neoperla\\_henana](http://species-id.net/wiki/Neoperla_henana)

Fig. 3

*Neoperla henana* Li, Wu & Zhang, 2011: 33. Type locality: Henan Province, Nanyang, Laojieling.

**Material examined.** 2 males, (CAU), China: Fujian Province, Mt. Wuyishan, Sangang, 27°74.78'N, 117°68.31'E, light trap, 6 Aug. 2006, Hui Dong.

**Distribution.** China (Fujian and Henan provinces).

**Remarks.** This species was recently described by Li et al. (2011). The color pattern and terminalia among the types and present material show no variations. The type material (figs 1–3 in Li et al. 2011) seems two teneral specimens where the fine spinules of aedeagal sac are not as well developed as of the present ones (Fig. 3).

***Neoperla lii* Du, 1999**

[http://species-id.net/wiki/Neoperla\\_lii](http://species-id.net/wiki/Neoperla_lii)

Figs 4–5

*Neoperla lii* Du, 1999: 315. Type locality: Fujian Province, Mt. Wuyishan, Sangang.

**Material examined.** 1 male, (CAU), China: Fujian Province, Mt. Wuyishan, Sangang, 27°74.78'N, 117°68.31'E, light trap, 19 Aug. 2006, Xian Zhou; 4 males, same locality, 25 Sep. 2009, Tingting Zhang, (HIST).

**Distribution.** China (Fujian).

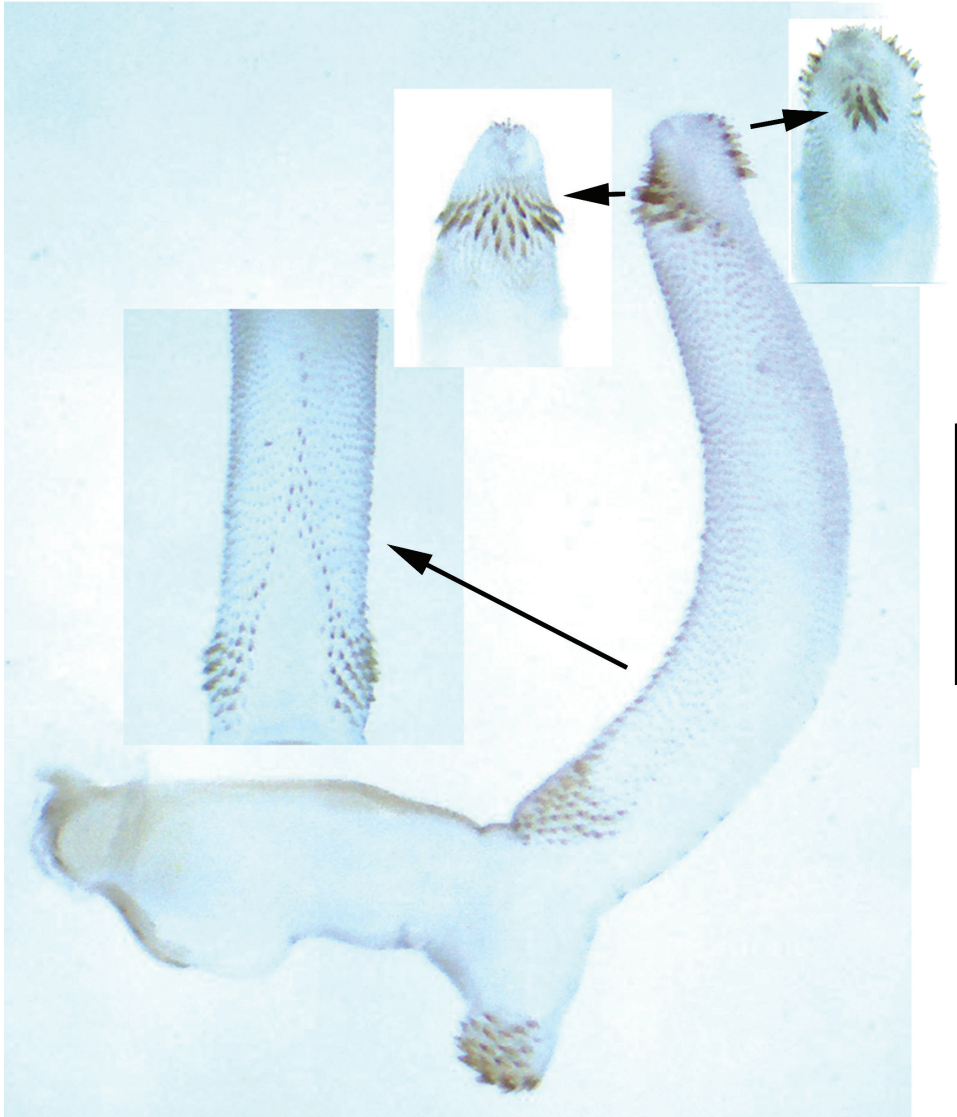
**Remarks.** This species was recently described by Du (1999). The original illustrations are rather small in print and show no details on the fine armatures of the sac but the detailed descriptions agree well with the fresh material. We present herein the detailed illustrations of the aedeagal sac for a better diagnosis of *N. lii*.

***Neoperla qingyuanensis* Yang & Yang, 1995**

[http://species-id.net/wiki/Neoperla\\_qingyuanensis](http://species-id.net/wiki/Neoperla_qingyuanensis)

Fig. 6

*Neoperla qingyuanensis* Yang & Yang, 1995b: 59; Li et al. 2013: 361. Type locality: Zhejiang Province, Qingyuan County, Mt. Baishanzu, Chameiyu.



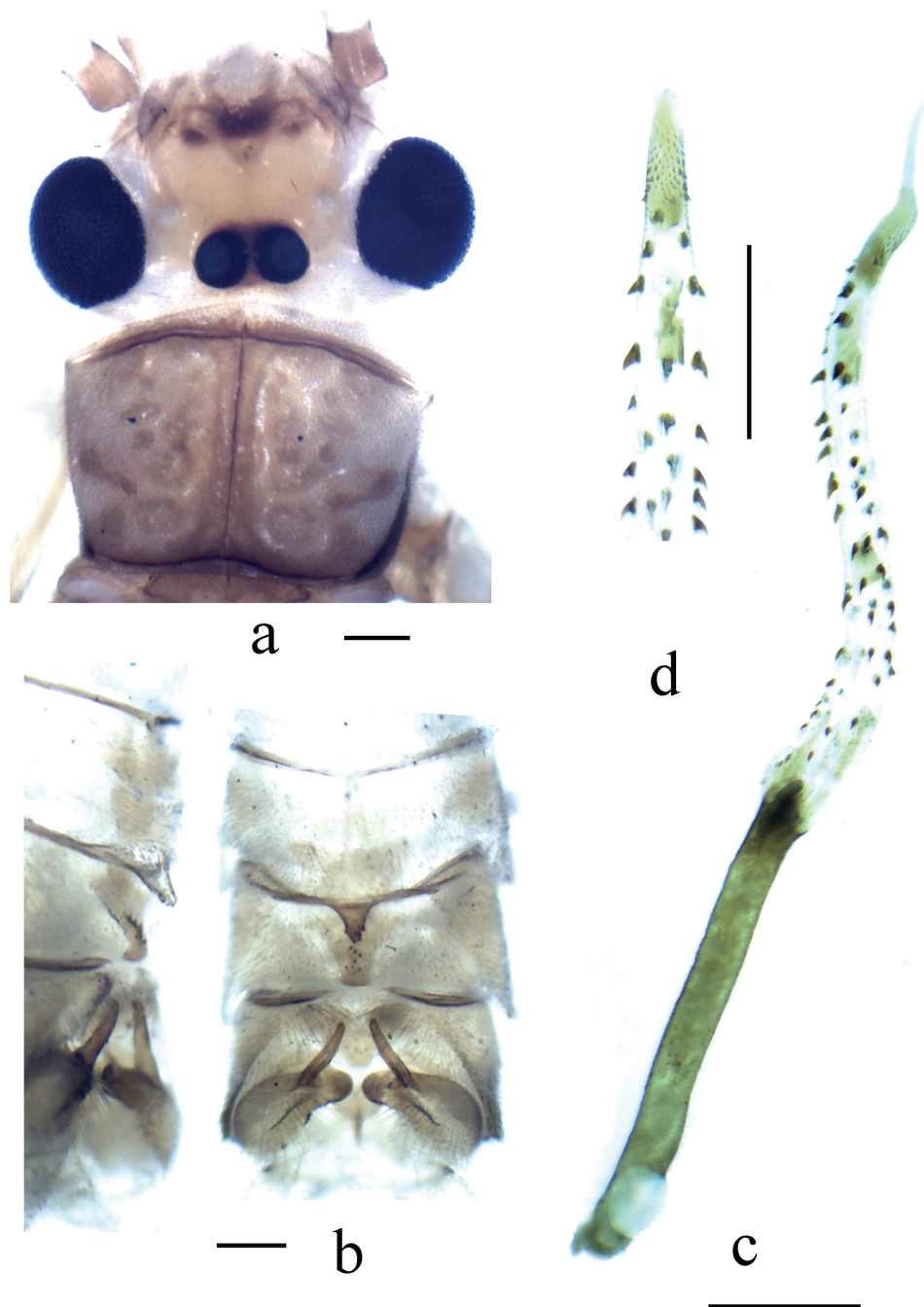
**Figure 3.** *Neoperla henana*. Male aedeagus, lateral view. Scale bar: 0.5 mm.

**Material examined.** 2 males, (CAU), China: Fujian Province, Mt. Wuyishan, Sangang, 27°74.78'N, 117°68.31'E, light trap, 6 Aug. 2006, Hui Dong; 1 male, same locality, 19 Aug. 2006. Xian Zhou.

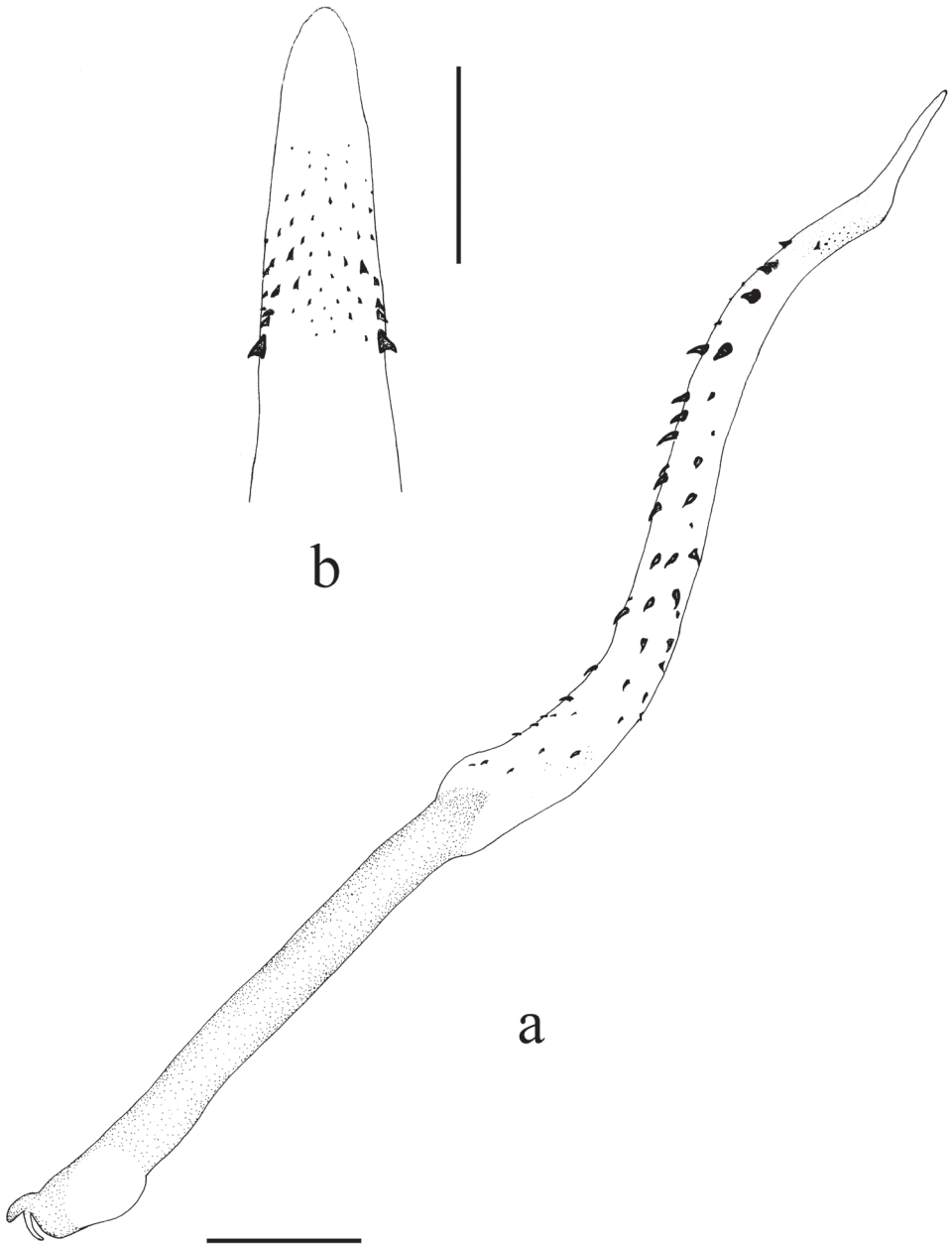
**Distribution.** China (Zhejiang, Fujian).

**Remarks.** This species was recently redescribed by Li et al. (2013). The head patterns of the examined types were faded. The illustrations of head pattern and fully extruded aedeagus are provided here on the fresh material to facilitate the identifying of *N. qinyuanensis*.

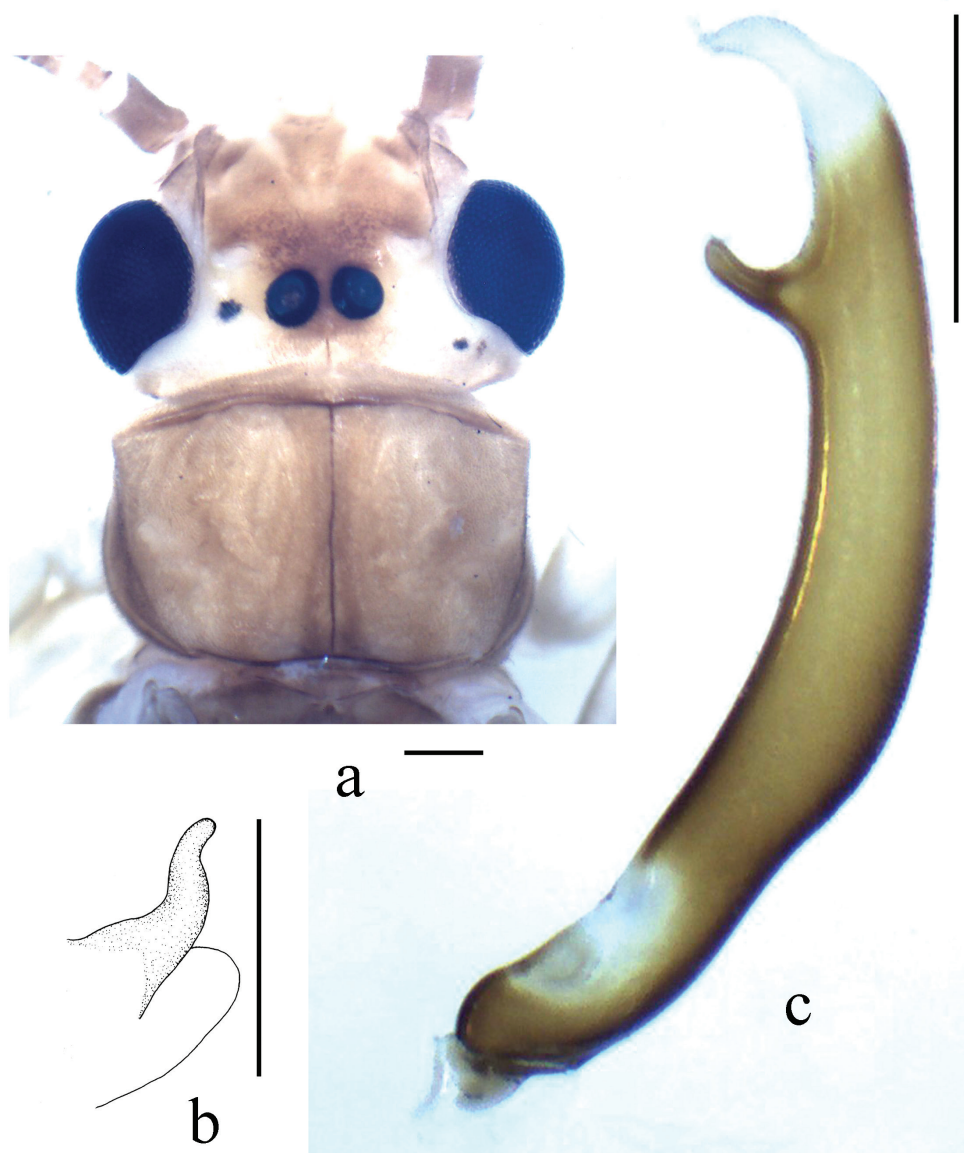




**Figure 4.** *Neoperla lii*. Male **a** Head and pronotum, dorsal view **b** Terminalia, dorsal view **c** Aedeagus, lateral view **d** Distal half of aedeagal sac, ventral view. Scale bars: 0.5 mm.



**Figure 5.** *Neoperla lii*. Male **a** Aedeagus, lateral view **b** Apex of aedeagal sac, ventral view. Scale bars: 0.5 mm.



**Figure 6.** *Neoperla qingyuanensis*. Male **a** Head and pronotum, dorsal view **b** Hemitergal process, dorsal view **c** Aedeagus, lateral view. Scale bars: 0.5 mm.

***Neoperla tuberculata* Wu, 1938**

[http://species-id.net/wiki/Neoperla\\_tuberculata](http://species-id.net/wiki/Neoperla_tuberculata)

Fig. 7

*Neoperla tuberculata* Wu, 1938: 122; Du et al. 2001: 77. Type locality: Zhejiang Province, Mt. Tianmushan.



**Material examined.** 4 males, (CAU), China: Fujian Province, Mt. Wuyishan, Sangang, 27°74.78'N, 117°68.31'E, 9 May 2004, Xingyue Liu.

**Remarks.** Our specimens bear slight variation in the aedeagal sac armatures (Fig. 7): the subapical cluster of larger spines in Zhejiang specimens are not prominent in these ones; but they agree well with the Zhejiang one in terminalia features, the head and leg patterns.

***Neoperla similidella* Li & Wang, 2013**

[http://species-id.net/wiki/Neoperla\\_similidella](http://species-id.net/wiki/Neoperla_similidella) according to Qin et al 2013

*Neoperla similidella* Li & Wang, 2013: 25. Type locality: China: Fujian Province, Mt. Wuyishan, Kekao Station.

**Additional material examined.** 3 males, (CAU), China: Fujian Province, Mt. Wuyishan, Sangang, 27°74.78'N, 117°68.31'E, light trap, 27 Jun. 2009, Li Shi and Xiaoyan Liu.

**Distribution.** China (Fujian Province).

**Remarks.** This species was recently recognized by Li et al. (2013) from Wuyi Mountain.

***Neoperla similiserecta* Wang & Li, 2012**

[http://species-id.net/wiki/Neoperla\\_similiserecta](http://species-id.net/wiki/Neoperla_similiserecta)

*Neoperla similiserecta* Wang & Li, 2012: 18. Type locality: China: Guangdong Province, Xinfeng County, Mt. Yunjishan.

**Material examined.** 2 males, (CAU), China: Fujian Province, Mt. Wuyishan, Sangang, 27°74.78'N, 117°68.31'E, light trap, 12 Jul. 2009, Shi Li and Liu Xiao-Yan.

**Distribution.** China (Fujian and Guangdong provinces).

**Remarks.** This species was recently described from Guangdong by Li et al. (2012). The present specimens agree well with the type material.

***Neoperla xuansongae* Li & Li, 2013**

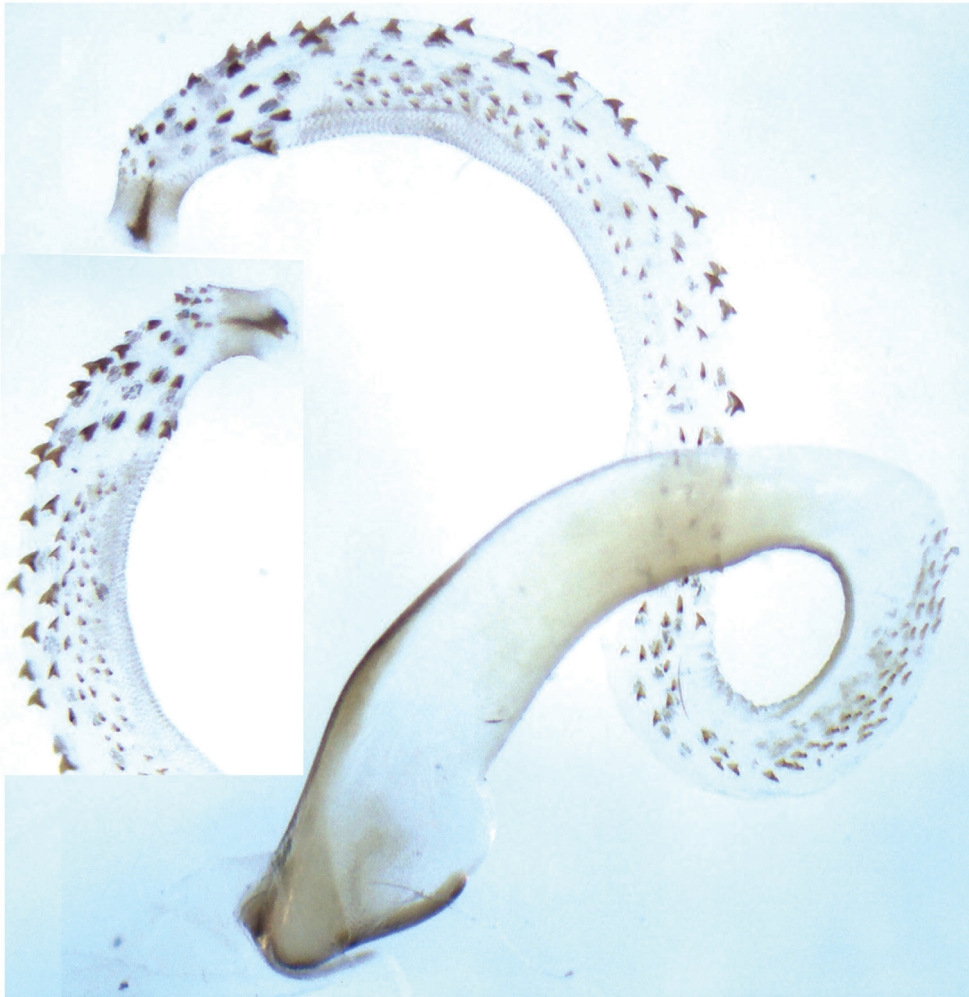
[http://species-id.net/wiki/Neoperla\\_xuansongae](http://species-id.net/wiki/Neoperla_xuansongae)

Fig. 8

*Neoperla xuansongae* Li & Li, 2013: 362. Type locality: Zhejiang Province, Li'an County, Mt. Tianmushan, Sanmuping.

**Material examined.** 4 males, (CAU), China: Fujian Province, Mt. Wuyishan, Sangang, 27.7478'N, 117.6831'E, 16 Aug. 2006, Hui Dong.

**Distribution.** China (Fujian and Zhejiang provinces).

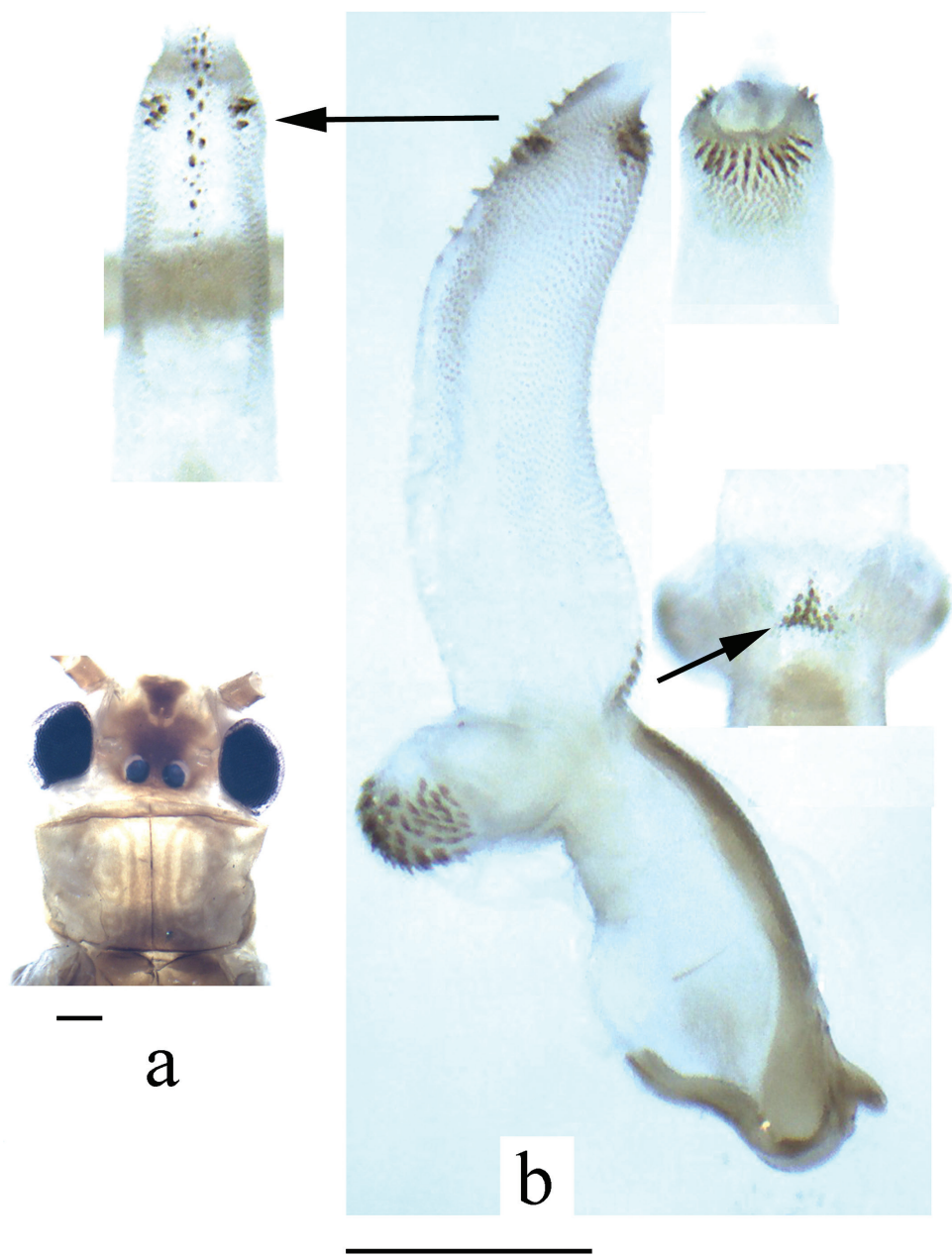


**Figure 7.** *Neoperla tuberculata*. Male aedeagus, lateral view. Scale bars: 0.5 mm.

**Remarks.** One of the present fresh specimens of *N. xuansongae* shows a heavier head pattern than types (Fig. 8a), and a small mesodorsal patch of spines at base of the aedeagal sac is also present in types but was overlooked in the original descriptions (Fig. 8c).

**Provisional key to *Neoperla* species (males) from Wuyi Moutain, Fujian Province, China**

- 1        Aedeagal tube completely sclerotized (Figs 2c, 4c & 6c ).....2
- Aedeagal tube incompletely sclerotized (Figs 3, 7 & 8) .....7
- 2        Aedeagal tube with ventral lobes (Figs 1 & 6c) .....3



**Figure 8.** *Neoperla xuansongae*. Male **a** Head and pronotum, dorsal view **b** Aedeagus, lateral view with details in dorsal and ventral views. Scale bars: 0.5 mm.

- Aedeagal tube without ventral lobes (Fig. 4c).....5
- 3 Aedeagal tube with slender and finger like ventral lobes.....4
- Aedeagal tube with nipple like and stout lobes (Fig. 1) .... *N. brevistyla* sp. n.

- 4 Aedeagal sac a short cone with blunt tip, head without distinct pattern (figs 25–13 in Du 1999) ..... *N. duratubulata*
- Aedeagal sac with a median constrict and tapering apex, head with distinct median dark brown pattern (Fig. 6)..... *N. qingyuanensis*
- 5 Posterior process of tergum 7 triangular..... **6**
- Posterior process of tergum 7 quadrate ..... *N. similidella*
- 6 Aedeagal sac shorter than tube, covered with spinules (figs 25–12 in Du 1999)..... *N. breviscrotata*
- Aedeagal sac longer than tube, covered with many large spines (Figs 4–5, figs 25–16 in Du 1999) ..... *N. lii*
- 7 Aedeagal tube with lobes..... **8**
- Aedeagal tube without lobes (Fig. 7) ..... *N. tuberculata*
- 8 Aedeagal tube with an apical lobe (fig. 14 in Li et al. 2012) ..... *N. similiserecta*
- Aedeagal tube without an apical lobe ..... **9**
- 9 Aedeagal sac with three apical patches of ventral spines (figs 8–9 in Li et al. 2013; Fig. 8)..... *N. xuansongae*
- Aedeagal sac with only one apical patches of ventral spines (Fig. 3).... *N. henana*

## Concluding remarks

This study was at the scale of the Wuyi Mountain Nature Reserve. Du (1999) summarized the stonefly fauna in Fujian Province and described three new *Neoperla* from the Reserve: *N. breviscrotata*, *N. duratubulata* and *N. lii*. In the present study, an additional new species is described and added to stonefly fauna of this area: *Neoperla brevistyla* sp. n. The first records of *Neoperla henana* Li, Wu & Zhang, 2011, *Neoperla similiserecta* Wang & Li, 2012, *Neoperla qingyuanensis* Yang & Yang, 1995, *Neoperla xuansongae* Li & Li, 2013 and *Neoperla tuberculata* Wu, 1938 are given for the Reserve. The present study showed that *Neoperla* is the most species rich genus with 10 species currently known from the reserve, 6 species added after the work of Du (1999).

## Acknowledgments

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# ***Pengzhongiella daicongchaoi* gen. et sp. n., a remarkable myrmecophile (Staphylinidae, Pselaphinae, Batrisitae) from the Gaoligong Mountains**

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**Citation:** Yin Z-W, Li L-Z (2013) *Pengzhongiella daicongchaoi* gen. et sp. n., a remarkable myrmecophile (Staphylinidae, Pselaphinae, Batrisitae) from the Gaoligong Mountains. ZooKeys 326: 17–26. doi: 10.3897/zookeys.326.5933

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## **Abstract**

A new genus and species, *Pengzhongiella daicongchaoi*, of the subtribe Batrisina (Batrisitae: Batrisini) is described from the Gaoligong Mountains, Yunnan, Southwest China. Adults were collected in a colony of *Odontomachus monticola*, and presented reduction of certain external characters and elongate appendages relating to myrmecophily. Description and illustrations of the habitus and major diagnostic features of the new taxon are provided; a brief discussion of its taxonomic placement is included. The new species also represents the first record of a Pselaphinae in association with an *Odontomachus* ant.

## **Keywords**

Coleoptera, Batrisini, taxonomy, new genus, new species, myrmecophily, *Pengzhongiella daicongchaoi*, *Odontomachus monticola*, Yunnan, China

## **Introduction**

Currently in China, eleven genera of the subtribe Batrisina (Batrisitae: Batrisini) were reported to contain myrmecophilous species. These species were found inhabiting colonies of the ant genera *Lasius* Fabricius (*Batrisus* Aubé, *Dendrolasiophilus* Nomura, *Sinotrisus* Yin

& Li, *Songius* Yin & Li, *Tangius* Yin & Li [uncertain record]), *Formica* Linnaeus (*Batrisodes* Reitter, *Sinotrisus*), *Myrmica* Latreille (*Hingtoniella* Jeannel, *Myrmicophila* Yin & Li), *Vol-lenhovia* Mayr (*Cerochusa* Yin & Nomura), and *Pachycondyla* Smith (*Tribasodes* Jeannel, *Tribasodites* Jeannel) (Besuchet 1979; Löbl and Besuchet 2004; Yin et al. 2010, 2011a, 2011b, 2012a, 2012b, 2012c; Yin and Li 2013a, 2013b; Zhao et al. 2010a, 2010b).

The general appearance of some Chinese myrmecophilous batrisines (e.g. *Batrisus*, *Dendrolasiophilous*, *Songius*, *Tangius*) tends to be more stout, with the antennae often compressed, smooth body surface, and reduction/loss of foveae, sulci, and carinae. While some species may not show particular morphological adaptations to myrmecophily (e.g. *Batrisodes*, *Sinotrisus*).

During a recent (April 2013) expedition made to the south Gaoligong Mountains in Yunnan, South China, an unusual batrisine was collected from a nest of *Odontomachus monticola* Emery, and presented remarkably elongate appendages and reduced foveae on the head, pronotum, and elytra. Despite the inadequate knowledge of the Asian Batrisitae, this species is readily recognized as new, though it cannot be placed in any described genus. We here establish a new genus, *Pengzhongiella* gen. n., for this unusual beetle, and provide a formal description. So far, no pselaphine has been recorded to live with *Odontomachus* ants.

## Material and methods

The type series is housed in the Insect Collection of Shanghai Normal University, Shanghai, China (SNUC).

The collection data of the referred material are quoted verbatim. A slash (/) is used to separate different labels.

The terminology follows Chandler (2001), except for using ‘ventrite’ instead of ‘sternite’ when describing meso- and metathoracic structures.

Measurements are in millimeters. The following abbreviations are applied: **AL**—length of the abdomen along the midline; **AW**—maximum width of the abdomen; **EL**—length of the elytra along the sutural line; **EW**—maximum width of the elytra; **HL**—length of the head from the anterior clypeal margin to the occipital constriction; **HW**—width of the head across eyes; **PL**—length of the pronotum along the midline; **PW**—maximum width of the pronotum. Length of the body equals HL + PL + EL + AL.

## Taxonomy

### *Pengzhongiella* Yin & Li, gen. n.

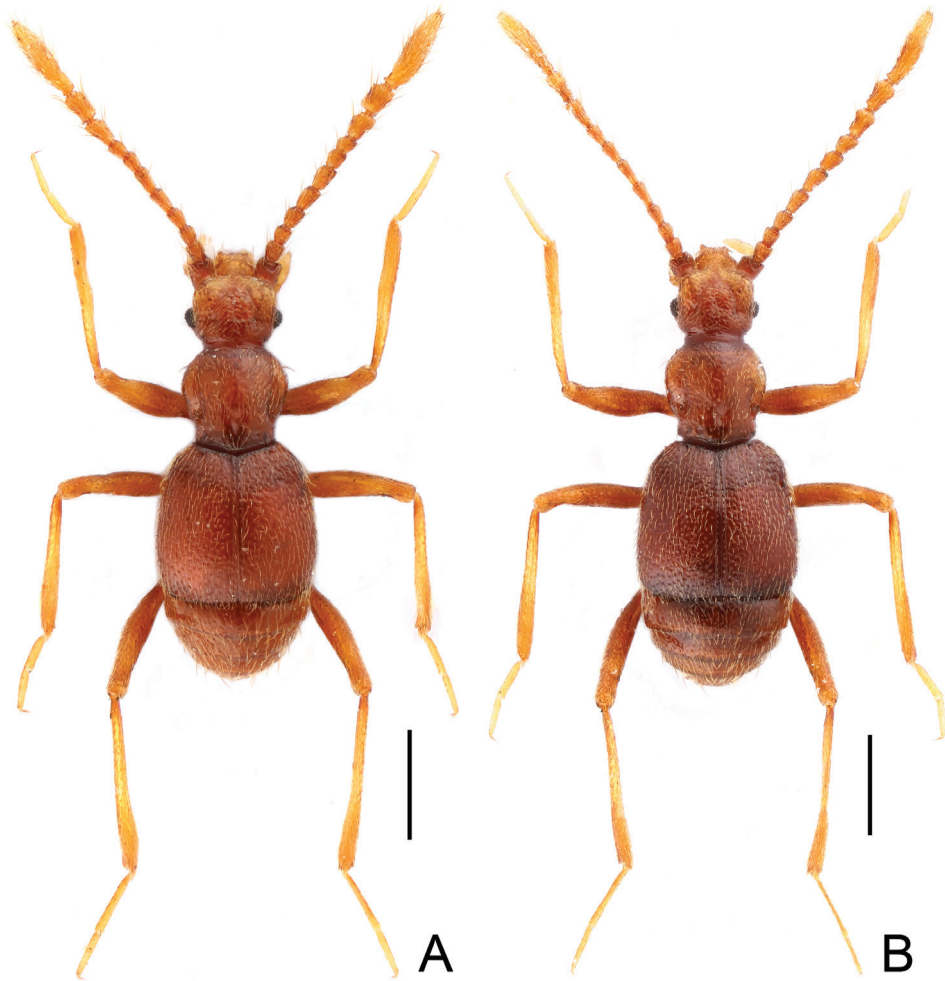
<http://zoobank.org/8F5265D2-9927-421F-ABEC-B246C3BD22F7>

<http://species-id.net/wiki/Pengzhongiella>

Figs 1–3

**Type species.** *Pengzhongiella daicongchaoi* sp. n. (here designated).





**Figure 1.** Habitus of *Pengzhongiella daicongchaoi*. **A** male **B** female. Scales: 0.5 mm

**Diagnosis.** Head rectangular; lacking frontal rostrum. Pronotum with distinct lateral longitudinal sulci, disc barely convex; lateral antebasal foveae present; lacking median antebasal fovea, antebasal sulcus, antebasal tubercles, and basolateral foveae. Each elytron with three reduced basal foveae, lacking discal stria. Abdomen with basolateral foveae on tergites IV–VII; tergite IV the longest.

**Description.** Length 2.02–2.18 mm. Head (Fig. 2A) rectangular; lacking frontal rostrum and frontal fovea, antennal tubercles indistinct; punctiform vertexal foveae nude, shallow U-shaped impression connecting foveae; with 11 antennomeres, clubs formed by apical three antennomeres (Figs 3A, B); lacking ocular-mandibular carinae; eyes rounded, with posteroventral margins shallowly emarginate; maxillary palpi with palpomeres II basally pedunculate, III nearly triangular, IV fusiform; gular foveae (Fig. 2B) in shared opening, linear gular carina slightly indicated.



**Figure 2.** Diagnostic features of *Pengzhongella daicongchaoi*. **A** head, in dorsal view **B** same, in ventral view **C** pronotum **D** prosternite. Scales: 0.1 mm.

Pronotum (Fig. 2C) with distinct lateral longitudinal sulci, lacking median longitudinal and antebasal sulci; small lateral antebasal foveae nude, lacking median antebasal fovea and antebasal spines; basolateral foveae absent, replaced by shallow impressions; lateral margins lacking spines. Prothorax (Fig. 2D) lacking paranotal sulci; with lateral procoxal foveae.

Each elytron with three punctiform basal foveae (Figs 3C, D), lacking discal stria; lacking subbasal foveae; sutural stria complete; subhumeral fovea present, with complete marginal stria (Fig. 3E); apicolateral margins broadly emarginate.

Mesoventrite (Fig. 3F) with lateral foveae forked for short distance, anterior fork as wide as median fork, median fovea widely separated, opening into shared transverse cavity; lateral mesocoxal foveae small; small lateral metaventral foveae close; metacoxae moderately separated; metaventrite with median sulcus extending to near apex, apex with narrow slit.

Tergite IV (first visible tergite) longest (Fig. 3I), deeply impressed across base, basolateral foveae in lateral endings of sulcus; lacking marginal carinae; V–VII subequal in length, lacking mediobasal sulcus, with basolateral foveae. Sternite IV (second visible sternite) longest (Fig. 3J), with mediobasal foveae at inner margins of shallow basolateral sulci, two pairs of small basolateral foveae present; sternite IV about twice length of V at midline, V–VII successively shorter, with pair of basolateral foveae.

First two pairs of tarsi with second and third tarsomeres subequal in length, metatarsi with second tarsomeres longer than third ones.

Males with antennae, mesotibiae, and metatrochanters modified. Aedeagus with dorsal lobe largely fused to median lobe, paramere connected with median lobe by membrane.

**Comparative notes.** At this time *Pengzhongiella* cannot be placed near any genus, and seems to form an isolated group within Batrisina. The long appendages are rarely observed in Asian myrmecophilous batrisines. Coupled with the foveal pattern of the head, pronotum, and elytra, and other external characters, *Pengzhongiella* can be quickly separated from all known genera, especially the myrmecophilous members of the Asian Batrisitae. The exceptionally elongate antennae and legs are shared with the Sumatran *Akarbatrus* Löbl and the Australian *Mossman* Chandler. Both *Akarbatrus* and *Mossman* lack elytral basal foveae and the basal impression of the tergite IV. The former has a sexually modified pronotum in the male, while *Mossman* has the pronotum lacking lateral longitudinal sulci, with two antebasal tubercles, and an outer pair of basolateral foveae (Chandler 2001, Löbl 2009). *Pengzhongiella* has three punctiform foveae at the base of each elytron, the pronotum has a pair of lateral sulci and small antebasal foveae, while other sulci and foveae are completely reduced probably due to the myrmecophily, and tergite IV has a thin, deep basal sulcus.

**Etymology.** The new genus and species is named in honor of Zhong Peng and Cong-Chao Dai, respectively, for their collection of the type series. Gender of the generic name is feminine.

***Pengzhongiella daicongchaoi* Yin & Li, sp. n.**

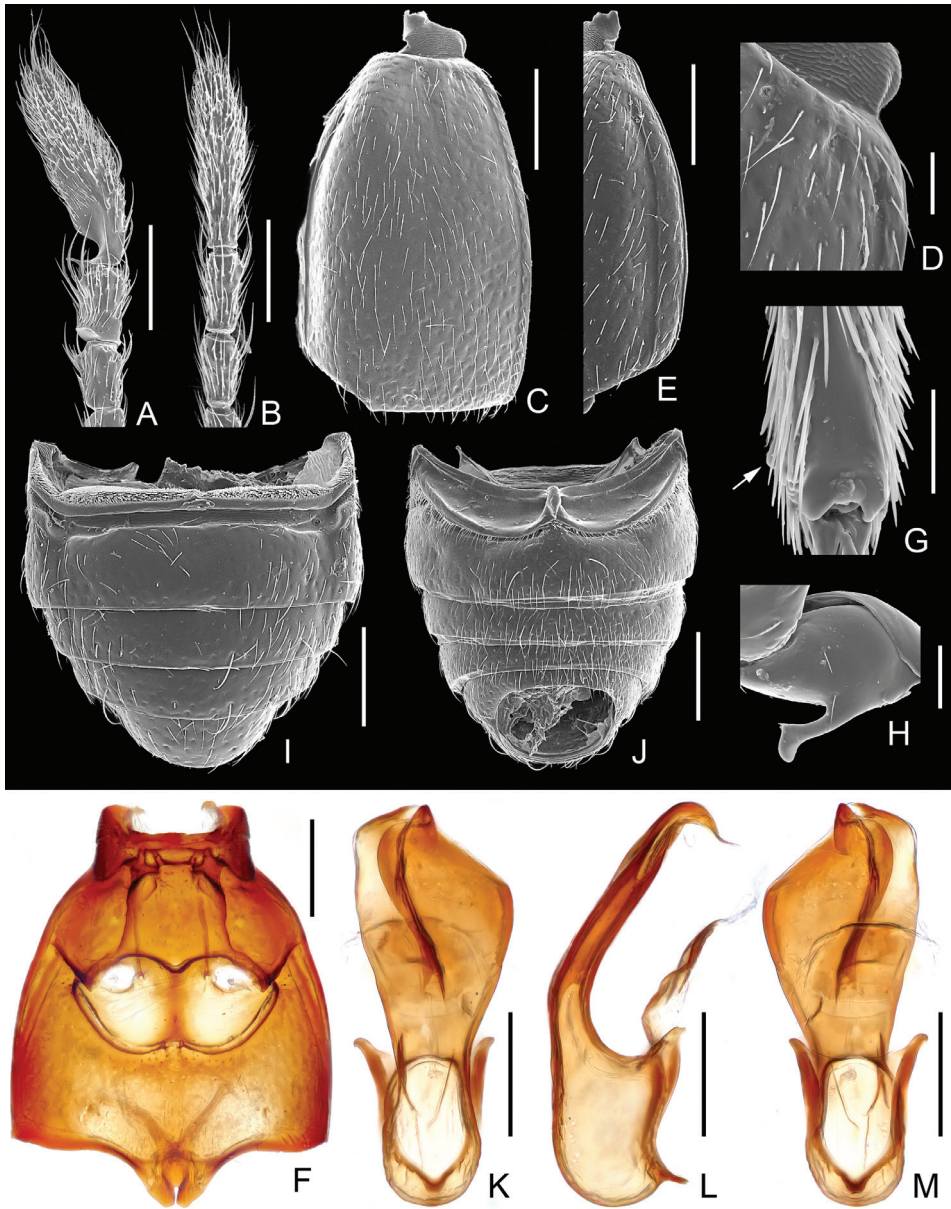
<http://zoobank.org/C1D36E04-F0AC-4C06-98EC-900B35348211>

[http://species-id.net/wiki/Pengzhongiella\\_daicongchaoi](http://species-id.net/wiki/Pengzhongiella_daicongchaoi)

Figs 1–3

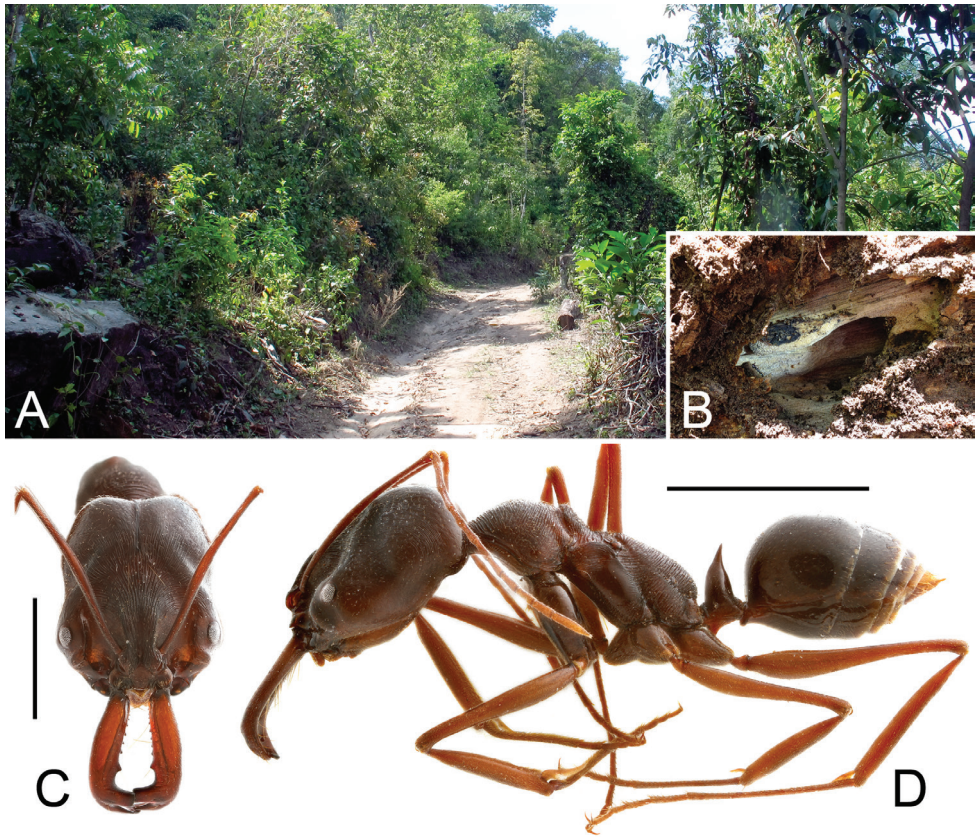
**Type material** (6 ♂♂, 35 ♀♀). **Holotype:** CHINA: ♂, labeled ‘China: W. Yunnan, Baoshan, S. Gaoligong Mt., Baihualing, ca. 42 km NE Tengchong, 25°11'36"N, 98°47'51"E, broad-leaved forest, nest of *Odontomachus monticola*, 1550–1600 m, 20.iv.2013, Peng & Dai leg. / Holotype [red], *Pengzhongiella daicongchaoi* sp. n., det.





**Figure 3.** Diagnostic features of *Pengzhongiella daicongchaoi*. **A** male antennal club **B** female antennal club **C** left elytron **D** elytral base, enlarged **E** elytral lateral margin **F** Meso- and metaventrite **G** apical portion of mesotibia **H** metatrochanter **I** abdomen, in dorsal view **J** same, in ventral view **K** aedeagus, in dorsal view **L** same, in lateral view **M** same, in ventral. Scales (mm): **A, B, C, E, F, I, J** = 0.2; **K, L, M** = 0.1; **D, H, G** = 0.05

Yin & Li, 2013, SNUC'. **Paratypes: CHINA:** 5 ♂♂, 35 ♀♀, same label data as holotype, and all bear a paratype label as 'Paratype [yellow], *Pengzhongiella daicongchaoi* sp. n., det. Yin & Li, 2013, SNUC'.



**Figure 4.** Habitat and ant host of *Pengzhongiella daicongchaoi*. **A** general habitat **B** nest of the host ant in a rotten tree **C** head of *Odontomachus monticola*, in frontal view **D** lateral habitus of *O. monticola*. Scales (mm): **C** = 3 mm; **D** = 5 mm.

**Description.** Male (Fig. 1A). BL 2.02–2.07 mm. Body reddish brown, maxillary palpi, tibiae, and tarsi lighter in color. Head, pronotum and elytra covered with fine setae. Head (Fig. 2A) as long as wide, HL 0.40–0.42 mm, HW 0.42–0.44 mm; vertex flat, vertexal foveae at level of posterior margins of eyes, connected by weakly indicated U-shaped impression; eyes moderately developed, each composed of about 40 facets; antennae greatly elongate, antennomeres X–XI (Fig. 3A) modified, XI longest, markedly concave basally. Pronotum (Fig. 2C) as long as wide, PL 0.46–0.47 mm, PW 0.47–0.48 mm; shallowly punctate; with rounded lateral margins; narrowed at base. Elytra (Fig. 3C) slightly wider than long, EL 0.66–0.67 mm, EW 0.71–0.72 mm; with rounded lateral margins. Metathoracic wings fully developed. Protibiae thickened (Fig. 1A); mesotibiae (Fig. 3G) bear tiny preapical tubercle; metatrochanters (Fig. 3H) greatly projecting at ventral margins. Abdomen wider than long, AL 0.50–0.51 mm, AW 0.64–0.65 mm, rounded at posterior margin. Aedeagus (Figs 3K–M) asymmetric, length 0.32 mm; basal bulb with large foramen; median lobe flattened dorso-ventrally; paramere weakly sclerotized.

Female (Fig. 1B). Similar to male in general. Measurements: BL 2.13–2.18 mm, HL 0.43–0.44 mm, PL 0.50–0.51 mm, PW 0.50–0.51 mm, EL 0.69–0.71 mm, EW 0.76–0.79 mm, AL 0.51–0.52 mm, AW 0.69–0.74 mm. Each eye composed of about 32 facets. Antennae simple. Metathoracic wings fully developed. Legs with protibiae narrower than those in male; mesotibiae lacking tubercle; metatrochanters simple. Width of genital complex 0.22 mm, slightly sclerotized, transverse.

**Comparative notes.** The characteristic antennae and aedeagus, combined with the generic characters (see ‘Comparative notes’ of the genus), provide a quick separation of the new species from all other members of the Batrisini.

**Distribution.** Southwest China: Yunnan.

**Host ant and biology.** All individuals of *P. daicongchaoi* were collected from a colony of *Odontomachus monticola* nested inside a rotten fallen tree, at the side of a road in an evergreen broad-leaved forest (Fig. 4A–D). It’s worthy of a note that a highly specialized species (lacking vertexal and pronotal median antebasal foveae) of *Batraxis* Reitter (22 ex.), one species of *Batrisoschema* Reitter (18 ex.), and one species of *Harmophorus* Motschulsky (5 ex.) were found in the same nest. Previously, no pselaphine has ever been reported living with members of the ant genus *Odontomachus*.

## Acknowledgements

We thank Zhong Peng and Cong-Chao Dai (Shanghai) for the collection of the type series. Ivan Löbl (Geneva), Shûhei Nomura (Tokyo) and Donald S. Chandler (Durham) provided feedbacks or discussion on the systematics and biology of the new taxon. Donald S. Chandler also corrected the English and provided comments on the manuscript. The present study is supported by the National Science Foundation of China (No. 31172134), and Shanghai Normal University (Sk201242, DZL125).

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# On *Levymanus*, a remarkable new spider genus from Israel, with notes on the Chediminae (Araneae, Palpimanidae)

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## Abstract

*Levymanus gershomi* **gen. n.** et **sp. n.**, is described from southern Israel. The eye arrangement and structure of the male palp indicate that this genus belongs to Chediminae Simon, 1893. *Levymanus* **gen. n.** differs from other chedimine genera by its unusually long and slender legs, an elongate body, a unique shape of the bipartite thoracic fovea, reduced leg scopulae, smaller spinnerets, and other characters, which are presumably apomorphic. We propose two taxonomic changes: 1) based on widely spaced lateral eyes the Western African genus *Badia* Roewer, 1961 is transferred from Chediminae to Palpimaninae, and 2) *Fernandezina gyirongensis* Hu & Li, 1987 from China, based on palpal morphology, is transferred to the Asian genus *Steriphopus* Simon, 1887 for a new combination *Steriphopus gyirongensis* (Hu & Li, 1987) **comb. n.**

## Keywords

Spiders, new taxa, taxonomy, Palearctic, South-Western Asia, Near East

## Introduction

The Palpimanidae is a relatively small family of araneophagous spiders consisting of 131 species in 15 genera (Platnick 2013), distributed in tropical and sub-tropical zones worldwide and absent only in the Nearctic and Australia. The family was divided by Platnick (1975) into three subfamilies: Palpimaninae Thorell, 1870 (Africa and Eurasia), Otiiohopinae Platnick, 1975 (almost entirely Neotropical), and Chediminae Simon, 1893 (mainly Palearctic). The Chediminae includes taxa with closely spaced or touching lateral eyes (Palpimaninae have widely spaced lateral eyes) and with regular sclerites (lacking in Otiiohopinae). Currently, the Chediminae includes 30 species in 9 genera, three of which are monotypic (Platnick 2013). While studying spiders in Israel we found one species that seems to belong to Chediminae, but which had a peculiar carapace shape (especially the fovea) and strongly reduced scopulae. In order to allocate this taxon, the senior author examined representatives of all available genera referred to Chediminae – *Boagrius* Simon, 1893, *Chedima* Simon, 1873, *Diaphorocellus* Simon, 1893, *Hybosida* Simon, 1898, *Sarascelis* Simon, 1887, *Scelidocteus* Simon, 1907, *Scelidomachus* Pocock, 1899 and *Steriphopus* Simon, 1893 (including the holotypes), as well as some specimens belonging to *Colopaea* Simon, 1893 (Stenochilidae). As a result we concluded that the specimens from southern Israel belonged to a new genus and species. The main goals of this paper are: 1) to diagnose and describe the new genus and species; 2) to discuss the relationships of the new genus; 3) to discuss the questionable position of some taxa within the subfamily Chediminae.

## Material and methods

Specimens of the following spider taxa were studied.

*Boagrius* sp. aff. *incisus* Tullgren, 1910 (Zambia), NMHL.

*Diaphorocellus* sp. (two species from South Africa), MNHN, NHML.

*Chedima purpurae* Simon, 1873 (Morocco), MNHN.

*Colopaea* sp. (Vietnam), MNHN.

*Hybosida lesserti* Berland, 1920, MNHN.

*Sarascelis* (six species, including types: *S. chaperi* Simon, 1887, *S. junquai* Jézéquel, 1964, *S. lamtoensis* Jézéquel, 1964, *S. luteipes* Simon, 1887 and *S. rebiereae* Jézéquel, 1964, and an undescribed species from Nigeria), MNHN, NHML.

*Scelidocteus* (five species, including types: *S. baccatus* Simon, 1907, *S. lamottei* Jézéquel, 1964, *S. pachypus* Simon, 1907, *S. ochreateus* Simon, 1907, *S. vuattouxi* Jézéquel, 1964), *Steriphopus lacertosus* Simon, 1898), MNHN, and two undescribed species from Cameroon, NHML.

*Scelidomachus socotranus* Pocock, 1899, NHML.

*Steriphopus crassipalpis* Thorell, 1895 and *S. macleayi* (O. Pickard-Cambridge, 1873), NHML.

The holotype and paratypes of the new taxon described here, including SEM mounts and dissected specimens were deposited in the spider collection of Tel-Aviv University, Israel (**TAU**) and in the Zoological Museum of the Moscow State University (**ZMMU**).

Photographs were taken using a Zeiss Discovery V20 stereomicroscope with a Canon PowerShot G9 camera, and an Olympus SZX16 stereomicroscope with an Olympus E-520 camera, and prepared using the CombineZP software. Scanning electron micrographs were made using the SEM JEOL JSM-5200 scanning microscope at the Zoological Museum, University of Turku, Finland. Photographs of landscapes showing the surroundings of the type locality were taken by Vasilii Kravchenko. Background maps were obtained from the public internet source <http://www.maps-for-free.com>. Measurements were made to an accuracy of 0.01 mm. Lengths of leg and palp segments were measured on the dorsal side, from the midpoint of the anterior margin to the midpoint of the posterior margin. All measurements are given in millimetres.

Abbreviations used are as follows. *Eyes*: **ALE** – anterior lateral, **AME** – anterior median, **PLE** – posterior lateral, **PME** – posterior median; *Spinnerets*: **ALS** – anterior lateral, **PLS** – posterior lateral, **PMS** – posterior median; *Is* – inframamillar scutum; *Bulb details*: **Co** – conical outgrowth; **Em** – embolus; **Eo** – opening of embolus; **Ed** – embolic division; **La** – lamella; **Tf** – tegular fovea, **Tp** – tegular process; *Palp and leg structures*: **Cs** – cymbial scopula, **Mc** – metatarsal comb, **On** – onychium, **Sh** – spatulate hairs, **Ts** – tarsal scopula. Arrows indicate the elevated posterior rim of the carapace, separate small scuta of the abdomen and claw teeth.

Other used institutional acronyms are: **MNHN** – Muséum national d'Histoire naturelle, Paris, France; **NHML** – The Natural History Museum, London, UK; **SMF** – Senckenberg-Museum (Senckenberg Forschungsinstitut und Naturmuseum), Frankfurt am Main, Germany.

## Taxonomy

### *Levymanus* gen. n.

<http://zoobank.org/BFC42358-F98D-4B14-AE8B-72173B265D9A>

<http://species-id.net/wiki/Levymanus>

**Type species.** *Levymanus gershomi* sp. n., by monotypy.

**Etymology.** Both the generic name and the specific epithet are given in honour and memory of Gershon Levy (1937–2009), the prominent Israeli arachnologist, for his immense contribution to Israeli and Near East arachnological research. The gender is masculine.

**Diagnosis.** In general appearance, especially by the elongate body and the extended dorsal abdominal scutum, *Levymanus* gen. n. resembles the otiothopine genus *Fernandezina* Birabén, 1951 (cf. Platnick 1975, fig. 80; Grismado 2002, fig. 1;

Grismado and Ramírez 2008, fig. 4; Piacentini et al. 2013, fig. 5a–f), but can be easily distinguished from it by the presence of the accessory structures in the male palp, accompanying the embolus (Figs 38–48), characteristic for the Chediminae, but absent in the Otiothopinae. Both males and females belonging to the new genus are easily distinguishable from other palpimanids due to the characteristic bipartite thoracic fovea (Figs 10, 12).

**Description.** Small bicolored chedimine palpimanids with body length 2.0–2.5 in males and 2.5–3.0 in females; legs and abdomen without pattern. Carapace with corrugated cuticle, diamond-oval in dorsal view, narrowed anteriorly and posteriorly. Cephalic part somewhat raised behind eye area – slightly in males, and more noticeably in females. Thoracic fovea short and bipartite, with two separate sulci located side by side; posterior edge of carapace slightly raised (Figs 14–15). Eight eyes. ALE largest, about four to five times larger than other eyes, which are subaequal in size. ALE and PLE almost touching each other. PME widely spaced from each other, as well as from AMEs and from PLEs. Clypeus about two times higher than AME diameter. Chilum inconspicuous. Chelicerae small, equal in length with clypeus; stridulatory ridges absent; cheliceral furrow without true or peg teeth. Sternum shield-like with fine reticulation; labium about as broad at base as it is long. Prosoma posteriorly with short paired triangular extensions and narrow tubular structure (Figs 11, 13) entering pedicel tube of abdomen (= scutopetiole apparatus *sensu* Saaristo and Marusik (2008)). Palps relatively short; legs I–IV long and slender. Leg formula: 1=4,2,3. Femora with well-developed scale-like microsculpture on the cuticle; scales weakly developed on patella and other segments. Femur I rather long and moderately swollen; patella very long (longer than tibia). Tibia and metatarsus I with weakly developed prolateral scopula. Leg tarsi slightly curved and ascopulate. Claw tufts weakly developed. Leg tarsi with two narrow and dentate claws. Abdominal scuta conforming a rather long and corrugated pedicel tube; dorsal portion of scutum with irregular posterior margin. Scutum in male larger than in female, its dorsal part longer than the ventral in the male (Fig. 15) and ventral and dorsal parts subequal in the female (Fig. 14). Although the dorsal and ventral parts of the scutum are fused, the seams are clearly visible in females (Fig. 12) and the dorsal part is rather narrow. Spinneret group very small (Fig. 34). Sclerotised ring encircling spinnerets present but weakly raised. AMS tiny and domed (Fig. 32); PMS and PLS reduced to a few sessile spigots in females, absent in males. Male palp: patella very small without dorsal process; tibia enlarged (swollen); both articles sub-globular. Cymbium moderately long lacking processes and with clusters of setae: a bunch of setae near prolateral base (Figs 43, 48), and larger setae on retrolateral side (Figs 44, 48). Tegulum with relatively short embolic division (Figs 41–46). Female genitalia with large spermathecae and with short and distal seminal ducts (Figs 49, 50).

**Species included.** *L. gershomi* sp. n.

**Distribution.** The genus is currently known only from the Arava Valley, Israel.

***Levymanus gershomi* sp. n.**

<http://zoobank.org/BBABE77C-15AE-494D-8A61-6309D6541855>

[http://species-id.net/wiki/Levymanus\\_gershomi](http://species-id.net/wiki/Levymanus_gershomi)

Figs 1–2, 10–50

**Types.** Male holotype, 3 ♂ and 2 ♀ paratypes from the vicinity of Qetura (Ktura), Arava Valley, Israel (29°58'N, 35°03'E), 8 May 2003, coll. E. Topel, deposited in TAU (holotype and most paratypes) and ZMMU (few paratypes).

**Diagnosis.** As for the genus.

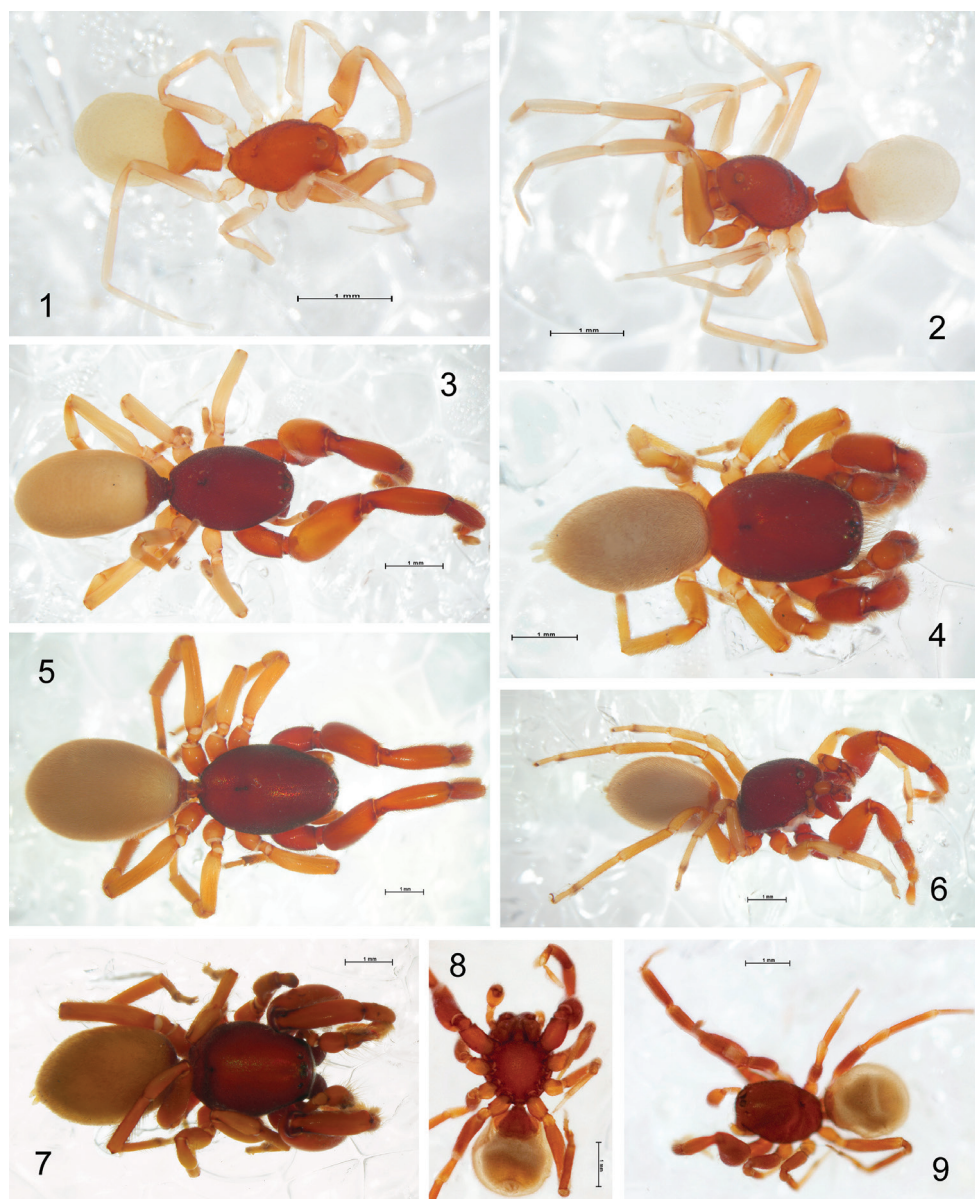
**Description.** Male (holotype): Total length 2.55; carapace, sternum and labium intensive carmine-red; chelicerae, palps (entirely), coxa and femur I light reddish orange, other segments of leg I and entire legs II–IV pale yellowish red; abdomen milk-white with intensive reddish orange dorsal scutum. Carapace (Fig. 10): 1.10 long, 0.76 wide. Diameters of AME, ALE, PLE, PME: 0.10, 0.02, 0.02, 0.02. Interdistances: AME–AME 0.08, ALE–AME 0.05, ALE–PLE <0.01, PLE–PME 0.11, PME–PME 0.14. Chelicerae as shown in Figs 17–18. Sternum (Fig. 11) 0.85 long, 0.65 wide; labium 0.21 long, 0.18 wide at base. Measurements of palp and leg segments as shown in Table 1. Scopulae and tarsal claws as shown in Figs 23, 26–31 and 22, 24, 25, 36, 37 respectively. Scarcely distributed scopular hairs approximately as long as metatarsus and tarsus width (Figs 26–31) At least metatarsus III with comb of setae (Fig. 35). Tarsi I–IV with claw tufts, better developed on tarsi I–II (Figs 22, 24). Tarsal claws I–II with few teeth (Figs 22, 25), III–IV with more and longer teeth (Figs 36, 37). Spinnerets, pedicel tube, and ventral parts of abdominal scutum as shown in Figs 32–34.

Palp (Figs 38–48): femur short and swollen, 2 times longer than wide, subequal in length to tibia and slightly shorter than cymbium. Patella globular. Tibia without apophyses, strongly swollen, 1.5 times longer than wide, 1.3 times wider than femur. Cymbium narrow, shorter than bulb, without outgrowths, with two clusters of hairs on prolateral side (Figs 39, 46). Bulb as wide (in widest part) as long (not counting embolic division and tegular process), tegulum with strong and long retrolateral tegular process (*Tp*); base of process with conical outgrowth (*Co*) and deep furrow (*Tf*); embolus fused with other sclerites of the embolic division (*Ed*). Embolic division, at-

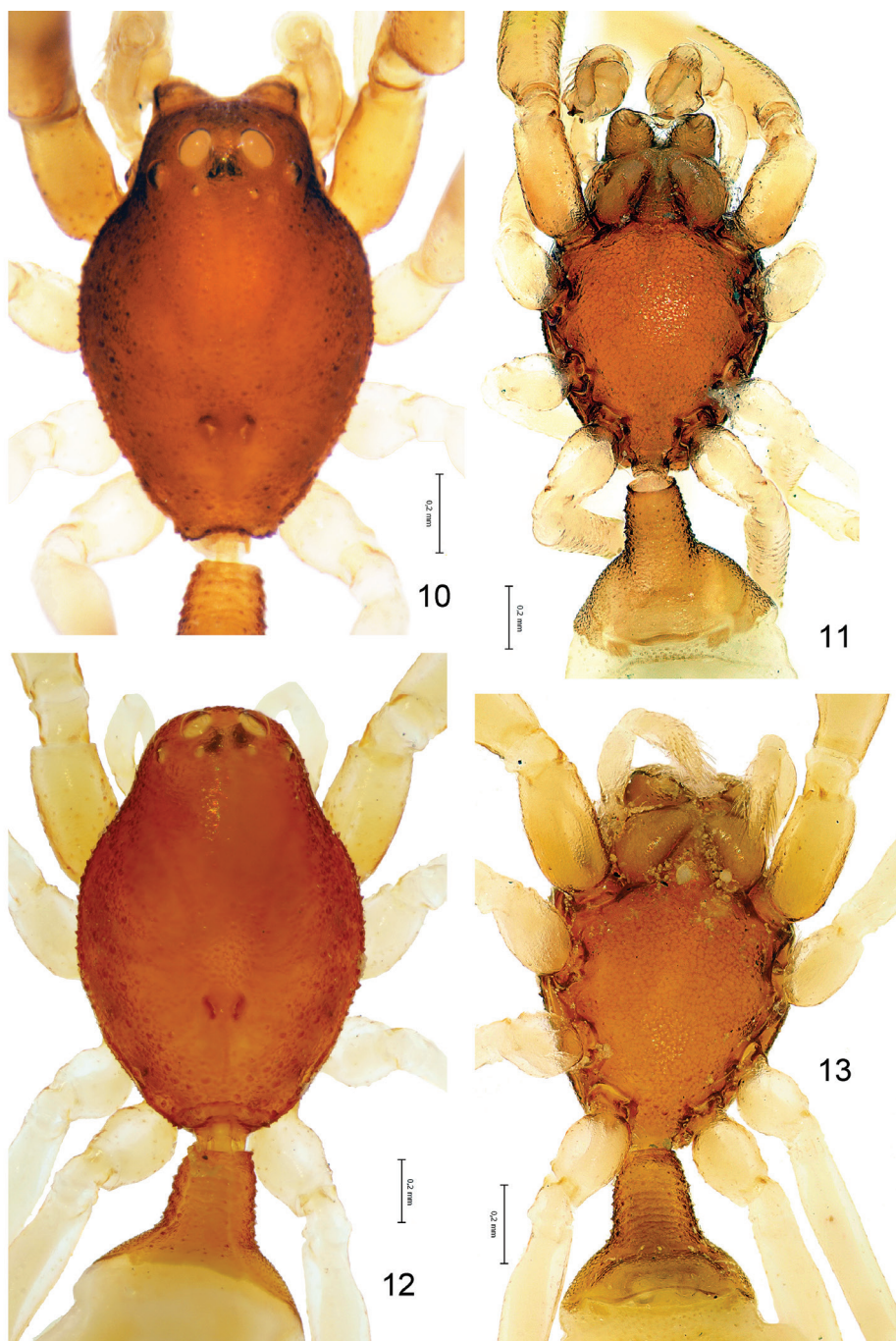
**Table 1.** *Levymanus gershomi*, gen. et sp. n., palp and leg measurements (in mm). Male holotype and female paratype (in parentheses).

	Palp	Leg I	Leg II	Leg III	Leg IV
Femur	0.19 (0.29)	1.10 (1.36)	0.78 (0.97)	0.78 (0.82)	1.08 (1.19)
Patella	0.11 (0.12)	0.88 (1.09)	0.53 (0.69)	0.36 (0.49)	0.47 (0.65)
Tibia	0.18 (0.20)	0.71 (0.84)	0.53 (0.73)	0.51 (0.68)	0.69 (0.96)
Metatarsus		0.42 (0.53)	0.47 (0.70)	0.60 (0.64)	0.85 (1.11)
Tarsus	0.27 (0.25)	0.43 (0.55)	0.36 (0.49)	0.32 (0.39)	0.39 (0.46)
Total	0.75 (0.86)	3.54 (4.37)	2.67 (3.58)	2.57 (3.02)	3.48 (4.37)



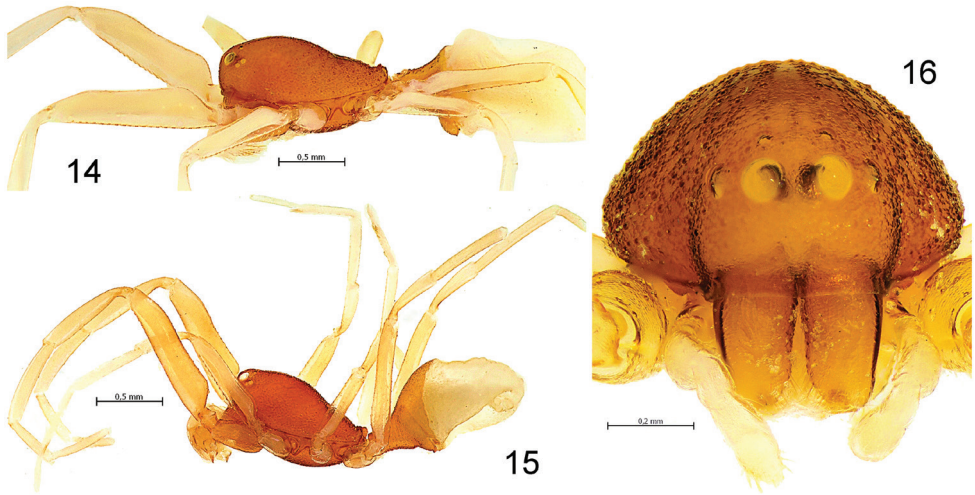


**Figures 1–9.** Spiders belonging to the subfamily Chediminae; habitus in lateral (1, 2, 6), dorsal (3–5, 7, 9) and ventral (8) view. 1, 2 *Levymanus gershomi* sp. n., holotype male and paratype female, respectively 3 *Boagrius* sp. aff. *incisus*, female 4 *Scelidocteus* sp. aff. *vuattouxi*, male 5, 6 *Sarascelis chaperi*, female and male, respectively 7 *Scelidomachus socotranus*, conspecific male 8, 9 *Steriphopus macleayi*, holotype male (scale bar = 1 mm).

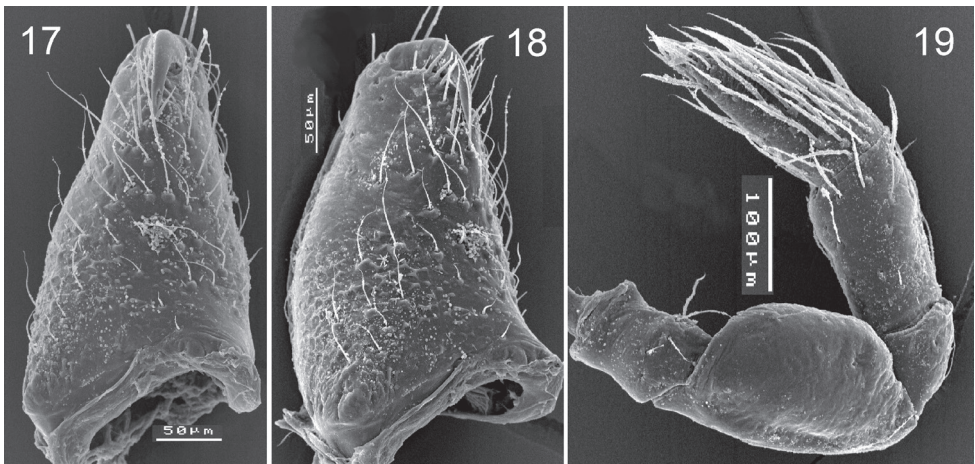


**Figures 10–13.** *Levymanus gershomi* sp. n., male (10, 11) and female paratypes (12, 13). 10, 12 Carapace, dorsal view 11, 13 Sternum, labium, maxillae and chelicerae; ventral view (scale bar = 0.2 mm).





**Figures 14–16.** *Levymanus gershomi* sp. n., male (14) and female paratype (15, 16). 14, 15 Habitus, lateral view 16 Carapace and chelicerae, frontal view (scale bar = 0.5 mm for 14, 15; 0.2 mm for 16).

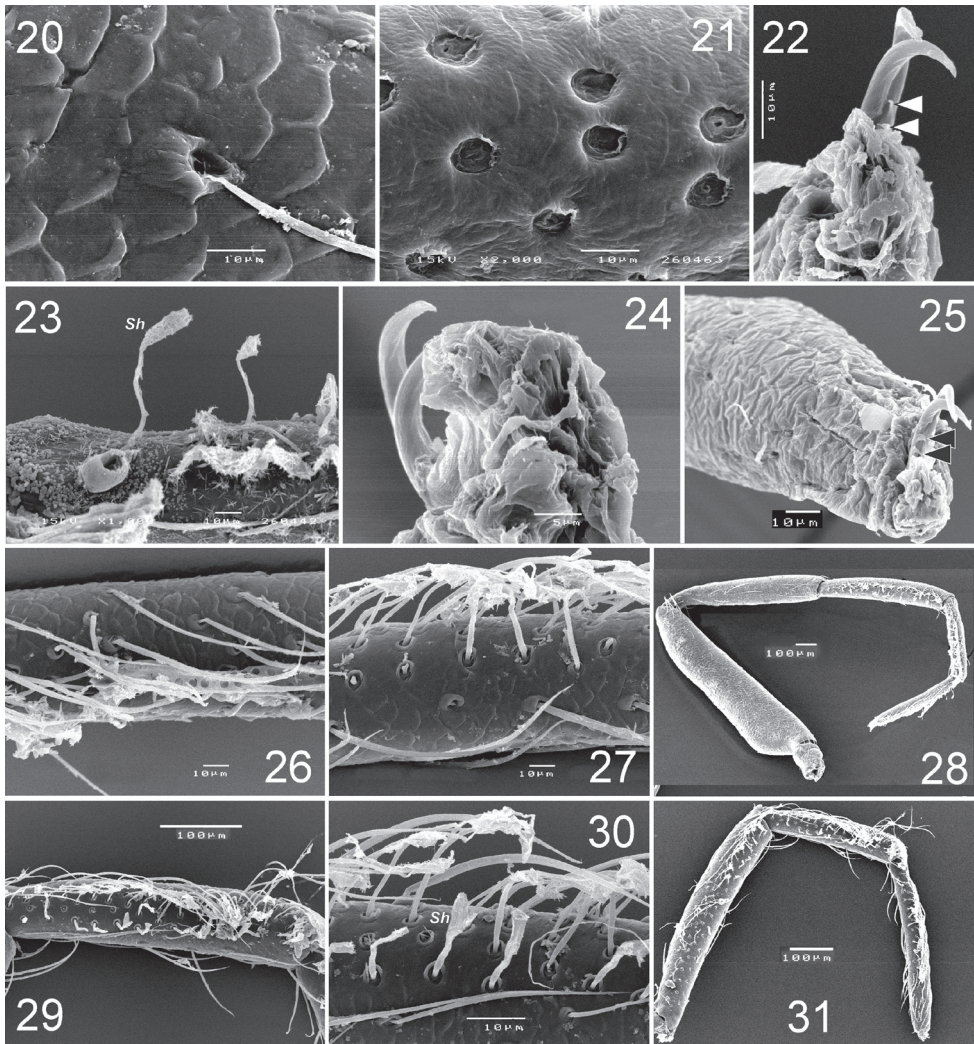


**Figures 17–19.** *Levymanus gershomi* sp. n., male (17, 18) and female paratype (18). 17, 18 right chelicera, frontal (17) and prolateral (18) view 19 right palp, femur to tarsus, retrolateral view. (scale bar = 0.05 mm for 17, 18; 0.1 mm for 19).

tached to tegulum by a flexible membrane, and bears embolus (*Em*) with retrolateral outgrowth (*Eo*), and lamella (*La*) located between embolus and cymbium.

Female (paratype): coloration as in male. Total length 2.93. Carapace (Fig. 12): 1.34 long, 0.92 wide. Diameters of AME, ALE, PLE, PME: 0.10, 0.03, 0.02, 0.02. Interdistances: AME–AME 0.08, ALE–AME 0.05, ALE–PLE <0.01, PLE–PME 0.10, PME–PME 0.12. Sternum (Fig. 13) 0.94 long, 0.80 wide; labium 0.22 long, 0.24

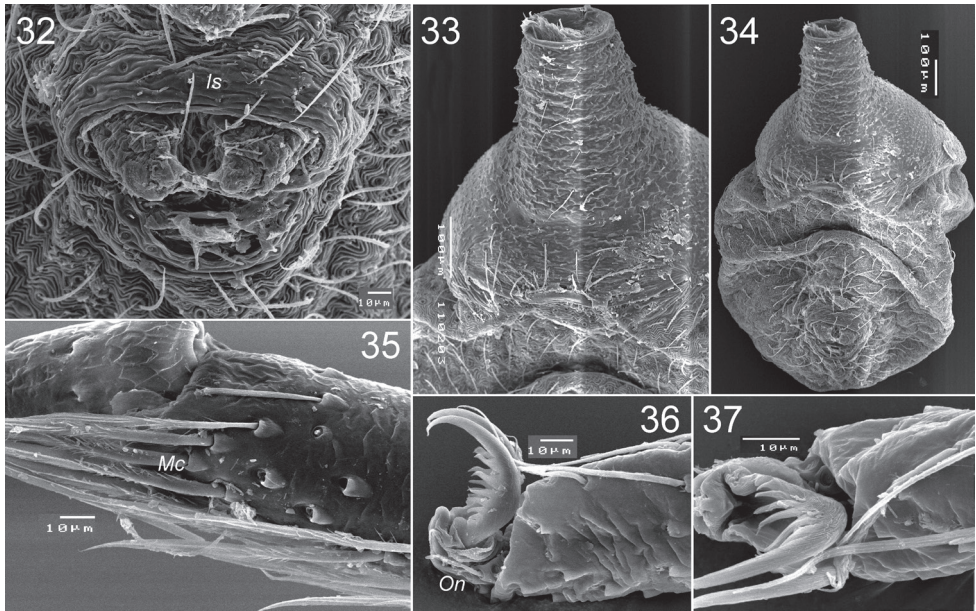




**Figures 20–31.** *Levymanus gershomi* sp. n., paratype male, leg I, prolateral view. **20** femur **21** patella **22** tarsus, showing claws with teeth **23** tibia, showing spatulate hair **24** tarsus, showing claws and claw 'pillow' **25** tarsus, showing claws and 'pillow' **26** tarsus, showing scopula **27** tibia, showing scopula **28** whole leg, showing scopula and enlarged patella **29**, **30** metatarsus I, showing scopula **31** tibia to tarsus, showing scopula (scale bar = 0.1 mm for **20–23**, **25–27**, **30**; 0.05 mm for **24**; 0.2 mm for **29**, **31**).

wide at base. Measurements of palp and leg segments as shown in Table 1. Spermathecae weakly sclerotised, round, touching each other, each spermatheca with a pair of accessory glands (Figs 49, 50). Due to the weak sclerotisation the outline of the spermathecae and their ducts are not very clear.

**Variability.** Carapace length in males 1.01–1.12, in females 1.22–1.34. Coloration varies very slightly, recently moulted specimens are lighter.



**Figures 32–37.** *Levymanus gershomi* sp. n., paratype male. **32** spinnerets, ventral view **33** epigastral scutum, ventral view **34** abdomen, ventral view **35** distal part of metatarsus III, showing metatarsal comb, ventral view **36** distal part of tarsus III, showing onichum and claws, ventral view **37** same, prolateral view (scale bar = 0.01 mm for **32, 35–37**; 0.1 mm for **33, 34**).

**Distribution and habitat.** The species is known only from the type locality (Qetura) represented by an extra-arid stony desert at 200–500 m above sea level. All specimens were collected with pitfall traps.

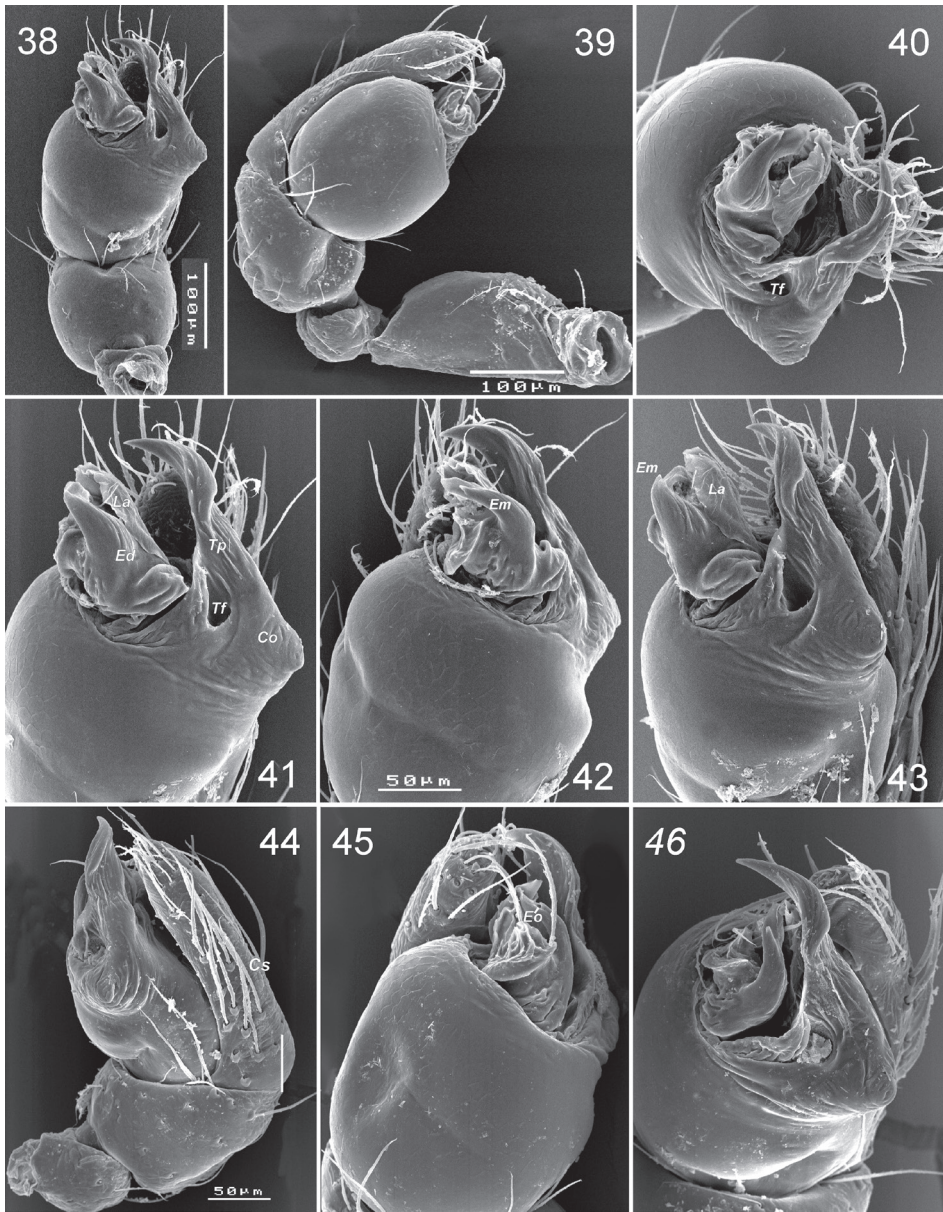
## Discussion

### The composition and distribution of the Chediminae

Of the three recognized palpimanid subfamilies, the Palpimaninae was reviewed by Platnick (1981) and the Otiiothopinae was revised by Platnick (1975) and Platnick et al. (1999). On the contrary, the Chediminae was briefly surveyed only once, by Simon (1893).

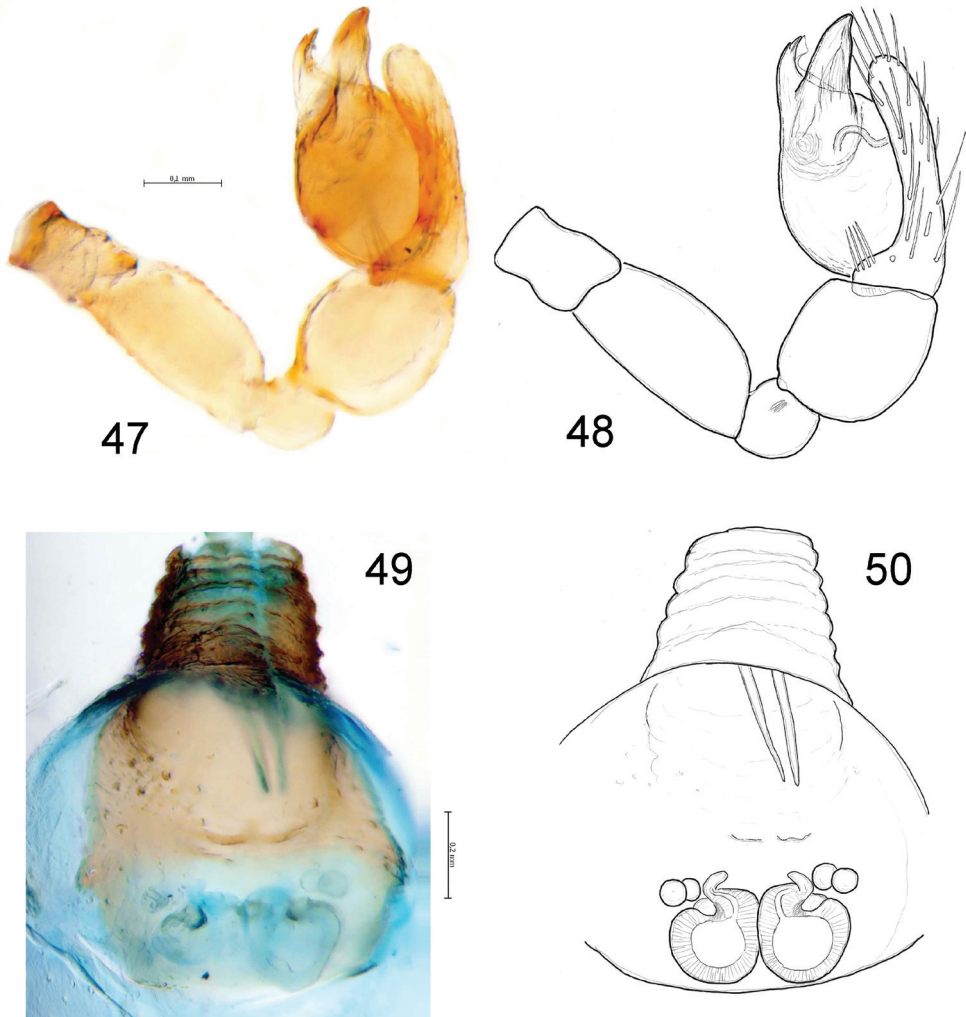
The currently known Chediminae are distributed mainly within the Paleotropical area (Fig. 51). This subfamily includes nine genera: *Badia* Roewer, 1961 (West Africa), *Boagrius* Simon, 1893 (East Africa and South-East Asia), *Chedima* Simon, 1873 (Morocco), *Diaphorocellus* Simon, 1893 (South and South-East Africa), *Hybosida* Simon, 1898 (East Africa, Seychelles), *Sarascelis* Simon, 1887 (tropical parts of Africa and Asia), *Scelidocteus* Simon, 1907 (West Africa), *Scelidomachus* Pocock, 1899 (Socotra) and *Steriphopus* Simon, 1893 (Seychelles and South Asia). Almost all of them are undoubtedly correctly placed in this subfamily, apart from *Badia* Roewer.





**Figures 38–46.** *Levymanus gershomi* sp. n., palp of paratype male **38** palp, ventral view **39** whole palp, prolateral view **40** same, apical view **41** terminal part of bulb, ventral view **42, 43** same, prolateral-ventral view **44** same, ventral-retrolateral view **45** palp, retrolateral view **46** same, apical-retrolateral view. **39, 44–46** palp with embolic division sunken into tegulum (scale bar = 0.1 mm for **38, 39**; 0.05 mm for **40–46**).

Roewer (1961) considered *Badia* as a close relative of *Hermipella* Lessert, 1936 and therefore the former genus was placed in the palpimanid subfamily Hermipellinae Roewer, 1942. Platnick (1989) transferred *Hermipella* to Zodariidae, and later this genus was syn-



**Figures 47–50.** *Levymanus gershomi* sp. n., male (47, 48) and female paratypes (49, 50). 47, 48 palp, ventral view 49, 50 epigyne; ventral view (scale bar = 0.2 mm).

onymized with the zodariine genus *Palfuria* Simon, 1910 (Jocqué 1991). Thus, the current placement of *Badia* within Chediminae (Dippenaar-Schoeman & Jocqué 1997) seems to represent a default taxonomic position since it was not included in either Otiiothopinae (Platnick 1975; Platnick, Grismado & Ramírez 1999), or in Palpimaninae (Platnick 1981).

The holotype of *B. rugosa* was not found. Only a single microslide containing a separate leg of this specimen is deposited in SMF (Julia Altmann, personal communication). We thus consider the holotype of *B. rugosa* to be lost as is the case in several other types from the same study (see Sierwald 1997, Lotz 2007).

According to the original description, *Badia* possesses lateral eyes, ALE and PLE, widely spaced from each other (cf. Roewer 1961, fig. 3a), like in the members of the





**Figure 51.** Distribution of genera of the Chediminae: 1 *Boagrius* 2 *Chedima* 3 *Diaphorocellus* 4 *Hybosida* 5 *Levymanus* gen. n. 6 *Sarascelis* 7 *Scelidocteus* 8 *Scelidomachus* 9 *Steriphopus*.



**Figure 52.** *Levymanus gershomi* sp. n., distribution.

Palpimaninae. Meanwhile, all chedimine genera recognised by Simon (1893, 1898, 1907) have these eyes (near) contiguous. This feature is considered as one of the key characters of the group and a reliable criterion to distinguish representatives of both



**Figures 53–56.** Surroundings of Qetura (Ktura), the type locality of *Levymanus gershomi* sp. n.

subfamilies (see Forster and Platnick 1984, p. 76, fig. 282; Dippenaar-Schoeman and Jocqué 1997, pp. 239, 240, figs 100a, b, d–f). Hence, we conclude that *Badia* should be excluded from the Chediminae and transferred to the Palpimaninae.

The taxonomic position of *Fernandezina gyirongensis* Hu & Li, 1987 from Xizang (Tibet) also appears doubtful. *Fernandezina* Birabén, 1951, the genus to which this species was originally referred is known exclusively from the Neotropical Region, from Guyana to Northern Argentina (Platnick 1975; Platnick et al. 1999). Platnick (1989, 2013) considered this Chinese taxon as certainly misplaced.

The structure of the male bulb in this species, bearing a tegular process (see also Hu 2001, fig. 8–15, 3, 4), does not actually resemble the palps of any *Fernandezina* species (cf. Platnick 1975, figs 86, 87, 90–93; Ramírez and Grismado 1996, figs 1, 2; Platnick et al. 1999, figs 19–24, 29–33; Grismado 2002, figs 2–4; Piacentini et al. 2013, fig. 6c–e). On the contrary, this structure does not differ significantly from that observed in the chedimine genera (cf. Jézéquel 1964, figs 2a, 2b, 4a, 4b, 7a, 7b, 9a, 9b, 11a, 11b).

Within three Oriental genera of the Chediminae, *Boagrius*, *Sarascelis* and *Steriphopus*, the two former genera possess much larger anterior median eyes (see Hu 2001, figs 8–15, 1; Jézéquel 1964, figs 5a–c; Deeleman-Reinold 2001, fig. 76); additionally, in males belonging to these two genera the additional palpal structures are either consid-



erably longer (*Boagrius*) or look more massive (*Sarascelis*) than in *Fernandezina gyirongensis*. Furthermore, the palpal patella in males of *Sarascelis* is more or less hooked and the cymbium is either asymmetrical or with a well-developed lateral process. All these characters are absent in *F. gyirongensis*.

The third genus, *Steriphopus* (described originally under *Pachypus* Pickard-Cambridge, 1873 *nom. praeocc.*), possesses smaller AMEs (like in *F. gyirongensis*). Strictly speaking, at the first view other characters noted and figured by Pickard-Cambridge (1873) make *Steriphopus* dissimilar not only to *F. gyirongensis*, but also to any other palpimanids. According to the original description, the holotype male of *S. macleayi* (Pickard-Cambridge, 1873), the generotype, has a developed ventral scutum that extends almost to the spinnerets (Pickard-Cambridge 1873, pl. 16, figs 2b, 2c) and an unusually long cymbium which is figured as a structure about three times longer than the palpal tibia (Pickard-Cambridge 1873, pl. 16, fig. 2m). But it should be noted that these described features and the corresponding figures do not reflect the actual characters of the holotype we examined. Contrary to the description, the holotype possesses a moderately sclerotised abdomen and a large sub-globular palpal tibia that appears to be even slightly longer than the cymbium (Figs 8, 9). Other characters of the holotype, including the broad-oval shape of the carapace and configuration of the bulb bear a certain resemblance to *F. gyirongensis*.

Therefore, the given species is provisionally placed in *Steriphopus* and the new combination is proposed: *Steriphopus gyirongensis* (Hu & Li, 1987), comb. n., with reservation and assumption, that this species may represent a separate chedimine genus, as yet undescribed (since we could not study the holotype, which is lost – Shuqiang Li personal communication).

### Characters and relationships of *Levymanus gershomi* sp. n.

The distinctive characters of the new taxon are listed and discussed below. It should be noted that within the Chediminae some characters, such as the structure of the spermathecae and fine structure of the male palp are known only for a few species described or surveyed after the 1960s (Jézéquel 1964; Platnick 1979; Forster and Platnick 1984). Since we have to exclude these parameters from the comparison, our conclusions are thus preliminary (the putative apomorphies of the new taxon are marked A1–A7).

First and foremost, *Levymanus gershomi* sp. n. differs from all other chedimine palpimanids by having long slender legs (A1) and an elongate body (A2) – as shown in Figs 1–2. All examined members of Chediminae may be referred to the “standard” palpimanid type with a more or less compact or robust body and considerably shorter and thicker legs, as in Figs 3–9. Among other palpimanids, some species of *Fernandezina* (Otiiothopinae) also have somewhat longer and thinner legs and a more elongate body (Platnick 1975, figs 80, 85; Grismado 2002, fig. 1). However, the modifications are considerably less strong than in *L. gershomi* sp. n. In addition, species of *Fernandezina* possess a much shorter pedicel tube (cf. Platnick 1975, fig. 88).

As has already been noted, *L. gershomi* sp. n. possesses a thoracic fovea divided into two parts (A3); all other palpimanids have an entire, short fovea that may be longitudinal, transverse, pit-like, or anchor-shaped (Platnick 1975, figs 10, 80; Forster and Platnick 1984, figs 269, 282; Dippenaar-Schoeman and Jocqué 1997, figs 100a, 100b; Platnick et al. 1999, figs 25, 63, 67; Buckup and Ott 2004, figs 1, 2). A bipartite thoracic fovea is characteristic for members of the Stenochilidae, the sister group of palpimanids, but stenochilids possess foveal sulci located longitudinally (cf. Platnick and Shadab 1974, figs 1, 16, 24, 25; Forster and Platnick 1984, figs 308, 310), whereas in *Levymanus gershomi* sp. n. they are located transversely (Figs 10, 12). Hence, in view of this state in the latter species, one of the diagnostic characters of the Palpimanidae given by Forster and Platnick (1984), “the fovea is usually distinct but in contrast to the stenochilids is always single” (op. cit., p. 76), should be reconsidered.

Other characteristic features of the new taxon are edentate chelicerae, lacking the stridulatory ridges (A4), and the considerably reduced scopula (A5) and spinnerets (A6). The presence of stridulatory organs in palpimanids is not well documented. Platnick et al. (1999) showed that most the Otiiothopinae genera possess stridulatory files on the chelicerae (op. cit., figs 7, 8, 41, 54–56). Within the Chediminae we have observed similar structures at least in *Boagrius*, *Sarascelis* and *Scelidoucteus* (Zonstein and Marusik in prep.) – i.e., in all available genera represented by large-sized species.

A dense prolateral brush of scopular hairs on the tibia, metatarsus and tarsus of leg I is very characteristic for the whole family Palpimanidae (Forster and Platnick 1984; Jocqué and Dippenaar-Schoeman 2006), though we found that in *Steriphopus macleayi* it seems to be less developed than in other examined palpimanids (cf. Figs 3–9). However, in *L. gershomi* sp. n. the scopula is even weaker and represented only by sparsely distributed spatulate hairs (Figs 26–31).

Although all palpimanids possess strongly reduced spinnerets (Forster and Platnick 1984; Jocqué and Dippenaar-Schoeman 2006), in *L. gershomi* sp. n. this reduction is extreme, and only tiny mound-shaped ALS are visible both in male and female (as in Figs 32, 34). In all other members of Chediminae the ALS are conical to cylindrical and well-discernible (Figs 4, 6–8; Platnick 1979, figs 1, 3, 4; Hu 2001, fig. 2).

The structure of the palp in the new taxon does not differ strongly from that in other members of the subfamily. The most significant distinction is the presence of a regular furrow (A7) (Figs 38, 40, 41, 43), a detail that has not been found in any other examined genera of the chedimine palpimanids.

We thus conclude that *Levymanus* gen. n. is distinct from all other genera within the subfamily. Moreover, the above-noted characters contrast with all other genera of Chediminae taken as a whole. Currently it is not certain whether this new taxon represents a separate subfamily or whether it should be considered only as a specialized chedimine palpimanid. This question might be answered in the course of a taxonomic revision and phylogenetic study of the Chediminae.

## Acknowledgements

Jan Beccaloni (NHML), Christine Rollard and Elise-Ann LeGuin (MNHN) kindly helped us to examine the specimens used in this study. Ning Sun (Capital Normal University, Beijing, China) generously translated a description of *Fernandezina gyirongensis* from Chinese to English. Peter Jäger and Julia Altman (SMF) helped us with information concerning *Badia rugosa*. Shuqiang Li (Institute of Zoology, Chinese Academy of Sciences, Beijing, China) helpfully confirmed that the holotype of *F. gyirongensis* is lost. Vasilii Kravchenko (TAU) provided us with his landscape photographs of the surroundings of Qetura. We thank David Penney (Manchester University) for his linguistic help. We are also thankful to Christian Grismado and an anonymous reviewer for their helpful comments. This study received financial support from the Ministry of Absorption, Israel and from the Russian Foundation for Fundamental Research (grants # 11-04-01716 and 12-04-01548).

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# A new species and additional records of *Lobrathium* Mulsant & Rey (Coleoptera, Staphylinidae, Paederinae) from China

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## Abstract

*Lobrathium fuscoguttatum* **sp. n.** (type locality: Guangxi) is described and illustrated. The latest key to the *Lobrathium* species of mainland China is modified to include the new species. Additional data are provided for six previously described species.

## Keywords

Coleoptera, Staphylinidae, Paederinae, *Lobrathium*, China, taxonomy, new species

## Introduction

According to a recent checklist provided by Assing (2012), 43 species of the genus *Lobrathium* Mulsant & Rey, 1878 were reported from China. Later, 13 additional species were described from mainland China (Assing 2013; Li et al. 2013; Li et al.

2013), thus raising the total number of species known from China to 56. In this paper we report a new species of *Lobrathium* (Guangxi), and additional locality data for six previously described species. Illustrations of the previously described species listed below are provided by Assing (2012), Li et al. (2013) and Li et al. (2013).

## Material and methods

The material treated in this study is deposited in the Insect Collection of Shanghai Normal University, Shanghai, China (SNUC).

Type labels are cited in their original spelling. A slash (/) is used to separate different labels. Type material bears the following type label: 'HOLOTYPE [red] or PARATYPE [yellow], [genus name, species name], sp. n., [authors of the species], det. 2013.

The specimens were killed with ethyl acetate and then dried. Materials were stored in 75% ethanol; genitalia and small parts were embedded in Euparal on plastic slides that were attached to the same pin with the specimens.

Morphological studies were carried out using an Olympus SZX 16 stereoscope. A digital camera Canon EOS 7D with MP-E 65 mm Macro Photo Lens was used for the habitus photos. An Olympus CX31 microscope and a Canon G9 digital camera were used for the photos of small structures.

The measurements of various body parts are abbreviated as follows: **BL** – length of the body from the labral anterior margin to the anal end; **HL** – length of the head from the anterior margin of the frons to the posterior margin of the head; **HW** – maximum width of the head; **PL** – length of the pronotum along the midline; **PW** – maximum width of the pronotum; **EL** – length of the elytra from the anterior margin to the elytral posterior margin along the suture; **EW** – maximum width of the elytra; **AL** – length of the aedeagus from the apex of the ventral process to the base of the aedeagal capsule.

## Taxonomy

### Modified couplets of the key (Li et al. 2013) to the *Lobrathium* species of mainland China

- |    |   |   |
|----|---|---|
| 5a | ♂: aedeagus 1.70–1.72 mm long, ventral process apically not bifid. Guangxi... | <b>5b</b>                                   |
| –  | ♂: aedeagus 1.35 mm long, ventral process apically bifid.....                 | <b>6</b>                                    |
| 5b | ♂: ventral process of the aedeagus broader.....                               | <b><i>L. anatinum</i> Li &amp; Li, 2013</b> |
| –  | ♂: ventral process of the aedeagus slender.....                               | <b><i>L. fuscoguttatum</i> sp. n.</b>       |

***Lobrathium configans* Assing, 2012**

[http://species-id.net/wiki/Lobrathium\\_configans](http://species-id.net/wiki/Lobrathium_configans) according to Li et al 2013

**Material examined** (5 ♂♂, 11 ♀♀). **China, Sichuan:** 4 ♂♂, 11 ♀♀, Erlang Shan, 1310 m, 01–VII–2009, Li leg. **Hubei:** 1 ♂, Muyu, Shennongjia, 05–VIII–2002, Li & Tang leg.

**Comment.** Some specimens from Erlang Shan, Sichuan, have indistinct or very small reddish elytra spots.

***Lobrathium demptum* Assing, 2012**

[http://species-id.net/wiki/Lobrathium\\_demptum](http://species-id.net/wiki/Lobrathium_demptum) according to Li et al 2013

**Material examined** (1 ♂, 4 ♀♀). **China, Zhejiang:** 1 ♂, 2 ♀♀, Anji County, Longwang Shan, 30°26'N, 119°26'E, 1050–1200 m, 13–V–2013, Chen et al. leg.; 2 ♀♀, Tianmu Shan, Gaoling, 800 m, 26–IV–2008, He & Tang leg.

**Comment.** *Lobrathium demptum* had previously been recorded from Longwang Shan and Tianmu Shan, Zhejiang (Li et al. 2013).

***Lobrathium fuscoguttatum* sp. n.**

<http://zoobank.org/31EB556C-EF29-4E37-8066-710DEC726CB3>

[http://species-id.net/wiki/Lobrathium\\_fuscoguttatum](http://species-id.net/wiki/Lobrathium_fuscoguttatum)

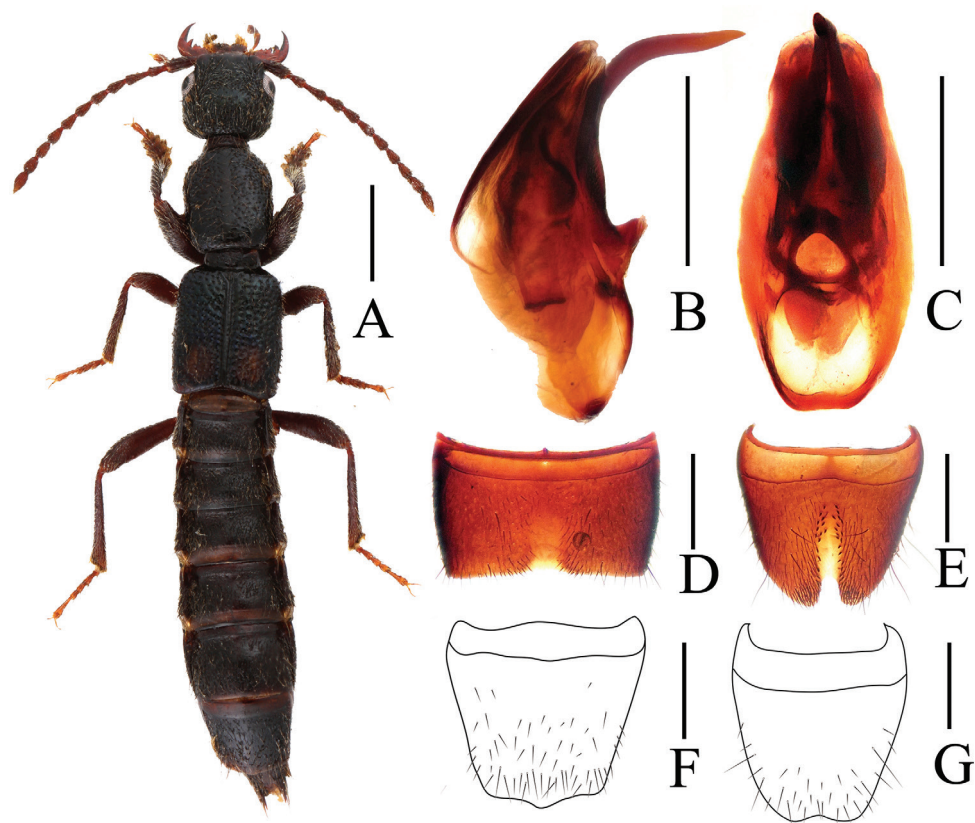
Figure 1

**Type material** (8 ♂♂, 1 ♀). **Holotype**, ♂: “China, Guangxi, Lingui County, Anjiangping, 1700 m, 25°33'N, 109°55'E, 17–VII–2011, Peng Zhong leg. / Holotype ♂, *Lobrathium fuscoguttatum*, sp. n. Li et al., det. 2013”. **Paratypes**, 1 ♂: “China, Guangxi, Lingui County, Anjiangping, 1700 m, 25°33'N, 109°55'E, 17–VII–2011, Peng Zhong leg.”; 3 ♂♂: “China: Guangxi, Lingui County, Anjiangping, 1400–1700 m, 25°33'N, 109°56'E, 14–VII–2011, Peng Zhong leg.”; 3 ♂♂, 1 ♀: “China: Guangxi, Jinxiu County, Yinshan Station, 1200 m, 24°10'N, 110°13'E, 23–VII–2011, Peng Zhong leg.”

**Description.** Body length 6.75–7.51 mm, length of fore body 3.45–3.89 mm. Habitus as in Fig. 1A. Coloration: body black with bluish hue, middle of elytra with yellowish spot not reaching lateral and posterior margins; legs blackish with paler tarsi, antennae dark brownish to blackish.

Head weakly transverse (HW/HL = 1.06–1.18), widest across eyes; posterior angles broadly rounded; punctation dense and moderately coarse, sparser in median dorsal portion; interstices without microsculpture. Eyes large, more than half as long as distance from posterior margin of eye to neck in dorsal view. Antenna 2.0–2.17 mm long.

Pronotum 1.19–1.27 times as long as broad, nearly as wide as head (PW/HW = 0.91–1.0), lateral margins convex in dorsal view, punctation similar to that of head, but with impunctate midline, interstices glossy.



**Figure 1.** *Lobrathium fuscoguttatum*. **A** habitus **B** aedeagus in lateral view **C** aedeagus in ventral view **D** male sternite VII **E** male sternite VIII **F** female tergite VIII **G** female sternite VIII. Scales: **A** 1mm, **B–G** 0.5mm.

Elytra wider, and nearly as long as pronotum ( $EL/EW = 0.91–1.04$ ,  $EW/PW = 1.13–1.27$ ,  $EL/PL = 0.92–1.01$ ); punctation coarse and dense, arranged in series; interstices without microsculpture.

Abdomen broader than elytra; punctation fine and dense; posterior margin of tergite VII with palisade fringe.

**Male.** Sternite VII (Fig. 1D) strongly transverse and with distinct median impression, this impression without pubescence, posterior margin with distinct median concavity; sternite VIII (Fig. 1E) weakly transverse, with long and pronounced postero-median impression, this impression with a few modified, stout and short black setae (10–20 on either side of middle), posterior excision rather narrow and moderately deep, on either side of this excision with a cluster of long dark setae; aedeagus (Figs 1B, C) 0.82–0.87 mm long, ventral process long, curved, and apically acute in lateral view.

**Female.** Sternite VIII (Fig. 1G) weakly transverse, posteriorly convex; tergite VIII (Fig. F) posteriorly convex in middle.



**Etymology.** The specific epithet (Latin, adjective) refers to the dark elytral spots.

**Comparative notes.** This species is similar to *L. tortuosum* Li et al. (2013) in the shape and chaetotaxy of the sternites VII-VIII and the morphology of the aedeagus (the sternite VII of *L. tortuosum* see Li et al., 2013). The new species differs from *L. tortuosum* by the shape of the ventral process of the aedeagus in lateral view.

**Habitat and distribution.** The specimens were sifted from wet moss near a cold stream in the Anjiangping National Reserve, Guangxi, in July (see fig. 20A in Li et al. 2013).

### ***Lobrathium hebeatum* Zheng, 1988**

[http://species-id.net/wiki/Lobrathium\\_hebeatum](http://species-id.net/wiki/Lobrathium_hebeatum) according to Li et al 2013

**Material examined** (2 ♂♂, 1 ♀). **China, Henan:** 1 ♂, 1 ♀, Luoyang City, Baiyun Shan, 18–VII–2008, Li leg. **Ningxia:** 1 ♂, Jingyuan County, Erlonghe Forestry, Xiaonanchuan, Liangdianxia, 2000 m, 09–VII–2008, Yin leg.

**Comment:** *Lobrathium hebeatum* was previously known only from Sichuan, Yunnan, Shaanxi and Gansu (Assing 2012; Assing 2013; Li et al. 2013). The above specimens represent the first records from Henan and Ningxia.

### ***Lobrathium hongkongense* (Bernhauer, 1931)**

[http://species-id.net/wiki/Lobrathium\\_hongkongense](http://species-id.net/wiki/Lobrathium_hongkongense) according to Li et al 2013

**Material examined** (11 ♂♂, 1 ♀). **China, Fujian:** 1 ♂, Longyan City, Guihe Village, 1200 m, 25–V–2007, Huang & Xu leg. **Yunnan:** 1 ♂, 1 ♀, Nabanhe N. R., Chuguohe, Bengganhani, 1750 m, 28–IV–2009, Hu & Yin leg. **Zhejiang:** 2 ♂♂, Zhuji City, Dongbai Shan, 300 m, 29°28'N 120°26'E, 04–X–2012, Zhao leg.; 1 ♂, Jingning County, Baiyunlin Village, 27°43'N 119°39'E, 1100–1270 m, 07–V–2012, Zhu leg. **Hubei:** 6 ♂♂, Wufeng County, Houhe N. R., 1100 m, 30°04'N, 110°37'E, 27–IV–2004, Li leg.

**Comment.** *Lobrathium hongkongense* is the most widespread species in China, and distributed also in southern Japan (Assing 2012; Assing 2013; Li et al. 2013).

### ***Lobrathium quadrum* Li et al., 2013**

[http://species-id.net/wiki/Lobrathium\\_quadrum](http://species-id.net/wiki/Lobrathium_quadrum)

**Material examined** (1 ♂, 10 ♀♀). **China, Sichuan:** 1 ♂, 10 ♀♀, Dujiangyan City, Qingcheng Shan, 20–VII–2003, Li leg.

**Comment.** The above specimens were collected from the type locality (Qingcheng Shan, Sichuan).

***Lobrathium spathulatum* Assing, 2012**

[http://species-id.net/wiki/Lobrathium\\_spathulatum](http://species-id.net/wiki/Lobrathium_spathulatum) according to Li et al 2013

**Material examined** (2 ♂♂, 1 ♀). **China, Shaanxi:** 1 ♂, 1 ♀, Hanzhong City, Liping N. R., 1400–1600 m, 32°50'N. 106°36'E, 15–VII–2012, Chen et al. leg. **Jiangxi:** 1 ♂, Jinggangshan City, Ciping Town, 850 m, 26°29'N, 114°05'E, 18–X–2010, Peng et al. leg.

**Comment.** This species has been recorded from Hubei, Shanxi, Zhejiang, Sichuan, Yunnan and Shaanxi (Assing 2012; Li et al. 2013). The above male from Jiangxi represents a new province record.

***Lobrathium tortile* Zheng, 1988**

[http://species-id.net/wiki/Lobrathium\\_tortile](http://species-id.net/wiki/Lobrathium_tortile) according to Li et al 2013

**Material examined** (11 ♂♂, 5 ♀♀). **China, Shaanxi:** 8 ♂♂, 2 ♀♀, Hanzhong City, Liping N. R., 32°50'N 106°36'E, 1400–1600 m, 15–VII–2012, Chen et al. leg.; 2 ♂♂, 1 ♀, Zhouzhi County, Houzhenzi, Qinling Shan, West Sangongli Valley, 33°50'N, 107°48'E, 18–V–2008, Xu leg.; 1 ♂, 2 ♀♀, Ankang City, Ningshaan County, Huoditang, 1500–1700 m, 12–VII–2012, Chen et al. leg.

**Comment.** The specimens from Liping N. R., Hanzhong City, Shaanxi, were sifted from leaf litter near a stream after rain.

**Acknowledgements**

We thank Volker Assing (Hannover, Germany) for reviewing this manuscript. The research was supported by the National Natural Science Foundation of China (No. 31101659) and Shanghai Normal University (DZL125).

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# Revision of the genera *Hovadelium* Ardoïn and *Mimolaena* Ardoïn (Coleoptera, Tenebrionidae, Laenini) from Madagascar, with remarks on tribal assignment<sup>1</sup>

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## Abstract

The genera *Hovadelium* Ardoïn, 1961 and *Mimolaena* Ardoïn, 1961, endemic in Madagascar, are revised and assigned to the tribe Laenini Seidlitz, 1896 (subfamily Lagriinae Latreille, 1825). New species: *Hovadelium ardoïni* sp. n., *Hovadelium bremeri* sp. n. and *Mimolaena janaki* sp. n. An identification key is compiled for all taxa. Distribution of *Hovadelium* (5 species) and *Mimolaena* (3 species) is mapped. The congeners might be indicator species for the highly endangered mature forests in Madagascar.

## Keywords

Coleoptera, Tenebrionidae, Lagriinae, Laenini, *Hovadelium*, *Mimolaena*, taxonomy, new species, Madagascar

## Introduction

Ardoïn (1961) described the genera *Hovadelium* Ardoïn, 1961 (type species *H. discoïdale* Ardoïn, 1961) and *Mimolaena* Ardoïn, 1961 (type species *M. pauliani* Ardoïn, 1961), endemic to Madagascar, and placed them into the tenebrionid tribe Adeliini. Subsequently, additional species were described by Ardoïn (1976) and Ferrer (1998).

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<sup>1</sup> Contributions to Tenebrionidae no. 113. For no. 112 see: Annales Zoologici 63, 2013.



In the revision of the tribe Adeliini, Matthews (1998) mentioned, that the tribal assignment of the Malagasy genera *Hovadelium* and *Mimolaena* either to Adeliini or to Laenini remains doubtful. Both genera are placed now herein finally into Laenini because of the lack of defensive glands. Different genera of this tribe are also known from South Africa (Endrödy-Younga and Schawaller 2002, Ferrer 2005).

So far, all descriptions were based only on single specimens. Recently, a huge number of newly collected specimens, mainly of *Hovadelium*, were handed over to the author for examination by Prof. Dr. H. J. Bremer (Osnabrück, Germany). This material, including three so far undescribed species, is represented herein, together with reexamination of the previously described taxa.

As other members of Laenini, all species are wingless and have restricted distributional patterns (Map see Fig. 1). So far, all records originate from the southeastern part of the island, additional taxa might be present in the northeastern part. Living in litter of the broadleaved evergreen forests, the congeners can be considered as indicator species for these mature and highly endangered forests in Madagascar.

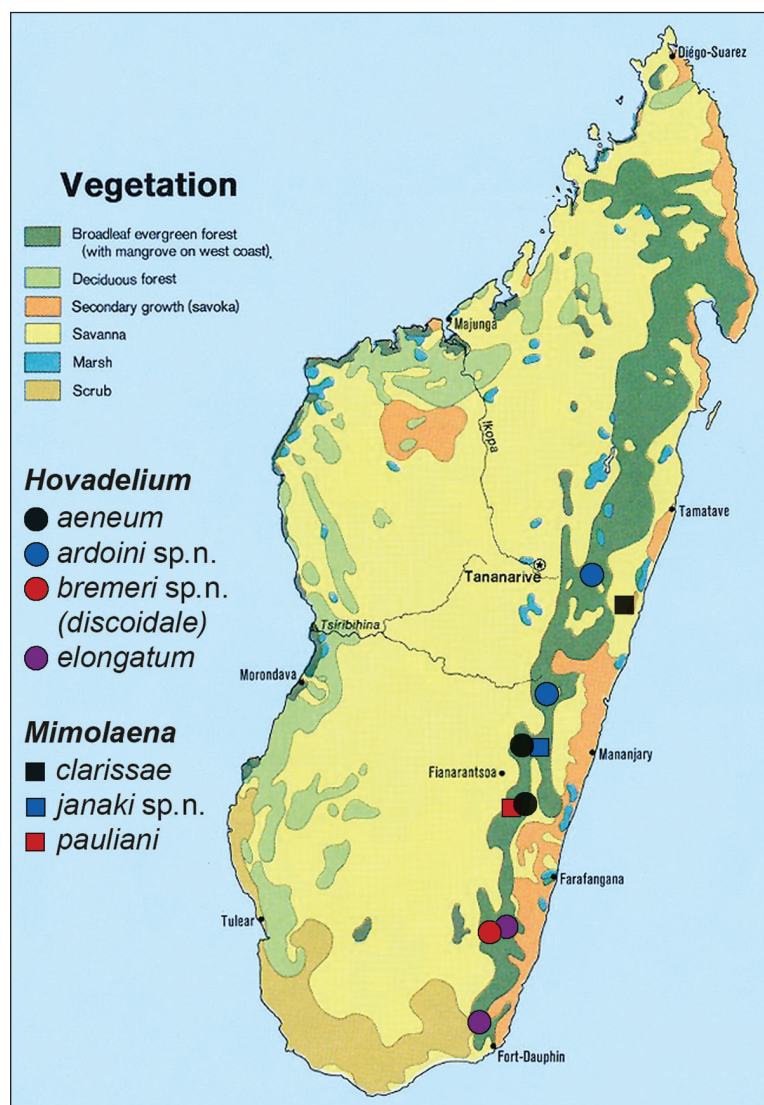
## Depositories

<b>CRFL</b>	Collection René Fouquè, Liberec, Czech Republic
<b>HNHM</b>	Hungarian Natural History Museum, Budapest, Hungary
<b>MNHN</b>	Muséum national d'Histoire naturelle, Paris, France
<b>MZUF</b>	Museo Zoologico de "La Specola", Firenze, Italy
<b>NMPC</b>	National Museum, Prague, Czech Republic
<b>SMNS</b>	Staatliches Museum für Naturkunde, Stuttgart, Germany
<b>TMSA</b>	Ditsong National Museum of Natural History, Pretoria, South Africa
<b>ZSM</b>	Zoologische Staatssammlung, München, Germany

## Tribal assignment

Some specimens of *Hovadelium ardoini* sp. n. were sent to E. Matthews (Adelaide) for a personal dissection of the female genital tract. The examination showed, that defensive glands are completely absent in all the dissected specimens, which is characteristic for Laenini and the only difference to Adeliini.

Matthews (in litteris): "I have dissected the females and can't see any trace of defensive glands, certainly not the long ones between segments 8 and 9 which are found in all Adeliini. There are no 7/8 glands either, although finding those in Laenini would not be surprising since they are characteristic of many Lagriinae. Stridulatory files (plectron) are absent. There are also no vaginal sclerites, such as the ones I found in one *Laena* (and most Adeliini). The spermatheca consists of three short wide tubules on the side of the vagina, similar to those of a species of *Laena* (Matthews 1998: fig. 57) which however has two long narrow tubules. Too few Laenini have been dissected for us to know the



**Figure 1.** Records of Laenini in Madagascar, vegetation map (modified from NationMaster.com). *Hovadelium discoide* could not be mapped (known only from “Madagascar” without detailed locality).

significance of these details, but the general configuration of the female system is typical of Laenini/Adeliini. The aedeagus of the male is of the usual simple type.”

Ovipositor and female genital tract (Fig. 15): Paraproct and coxite subequal in length, coxite lobes 3 and 4 fused, digitiform, gonostyles terminal in position, coxite baculi transverse, paraproct baculi longitudinal, spiculum gastrale a slender rod without terminal fork. No bursa copulatrix, three short and wide spermathecal tubules attached to side of vagina, vaginal sclerites absent, long slender spermathecal accessory gland attached to anterior end of vagina.

## The genus *Hovadelium*

### *Hovadelium aeneum* Ardoïn, 1961

[http://species-id.net/wiki/Hovadelium\\_aeneum](http://species-id.net/wiki/Hovadelium_aeneum)

Figs 2, 10

**Reexamined type-material.** C Madagascar, Plateau Soaindrana, Andringitra-Ambalavao, 2090 m, 16.I.1958, leg. R. Paulian, ♀ holotype MNHN.

**New material.** C Madagascar, Andringitra, Andohariana, 2000–2100 m, mission C.N.R.S., 1 ex. MNHN (det. Ardoïn). – E Madagascar, Massiv Ambondrombe, Iko-ka, 1300–1400 m, 12.–13.III.1996, leg. J. Janák & P. Moravec, 11 ex. SMNS, 5 ex. ZSM. – E Madagascar, Massiv Ambondrombe, 1300–1400 m, 14.III.1996, leg. J. Janák & P. Moravec, 11 ex. SMNS, 5 ex. TMSA, 5 ex. ZSM. – E Madagascar, Massiv Ambondrombe, cote 1579, 1500–1600 m, 15.–18.III.1996, leg. J. Janák & P. Moravec, 11 ex. SMNS, 5 ex. HNHM, 5 ex. NMPC, 5 ex. ZSM. – E Madagascar, Massiv Ambondrombe, 1700 m, 17.III.1996, leg. J. Janák & P. Moravec, 1 ex. SMNS.

**Diagnostic characters.** Body length 2.7–4.0 mm (the holotype has a length of 4.0 mm and not of 5.0 mm as given by Ardoïn 1961). Pronotum subquadrate, widest before the middle, with rounded anterior and posterior angles, surface slightly convex, with fine and sparse punctation, between punctation slightly shagreened. Elytra with punctural rows in striae, intervals convex, slightly shagreened and with an irregular row of tubercles, interval 7 at base near shoulders with a longer seta. Aedeagus see Fig. 10.

### *Hovadelium ardoïni* sp. n.

<http://zoobank.org/9E7A178D-AC88-4A2A-A947-5A05D8931C50>

[http://species-id.net/wiki/Hovadelium\\_ardoïni](http://species-id.net/wiki/Hovadelium_ardoïni)

Figs 3, 11

**Type specimens.** Holotype male: E Madagascar, Fianaratsua Prov., Ambohimahamasoa, 1300–1400 m, 21.–23.III.1996, leg. J. Janák & P. Moravec, SMNS. – Paratypes: Same data as holotype, 20 ex. SMNS, 5 ex. HNHM, 5 ex. TMSA, 5 ex. ZSM. – E Madagascar, Ranomafana NP, Sahavondrona, 1150–1250 m, 3.–4.II.1995, leg. J. Janák, 13 ex. SMNS, 5 ex. NMPC, 5 ex. ZSM. – E Madagascar, Ranomafana NP, Vohiparara, 1100–1200 m, 21.–24.I.1993, leg. J. Janák, 2 ex. SMNS. – E Madagascar, Fianaratsua Prov., Ranomafana, 29.XI.–2.XII.1995, leg. I. Jeniš, 1 ex. SMNS. – E Madagascar, Maromiza, Andasibe (Périnet), 1000–1200 m, 9.II.1993, leg. J. Janák, 1 ex. SMNS. – E Madagascar, Maromiza, Andasibe (Périnet), 930–1000 m, 7.–10.I.1995, leg. J. Janák, 5 ex. SMNS. – E Madagascar, Maromiza, Andasibe (Périnet), 7.XI.1998, leg. R. Müller, 1 ex. TMSA.

**Diagnosis.** *H. ardoïni* sp. n. is similar to *H. discoidale* Ardoïn, 1961, but lacks the striking deep groove ventral of the eyes. Both can be separated also by the shape of the pronotum widest behind the middle in *H. discoidale* (Fig. 5), but widest in the middle in *H. ardoïni* sp. n. (Fig. 3), and by the anterior angles of the pronotum, which are



**Figures 2–5.** Dorsal view of *Hovadelium* species. **2** *H. aeneum*, holotype MNHM **3** *H. ardoini* sp. n., paratype SMNS **4** *H. bremeri* sp. n., holotype SMNS **5** *H. discoidale*, holotype MNHN. – Scale line 2 mm.



distinctly marked in *H. discoidale*, and completely rounded in *H. ardoini* sp. n. The elytral punctural rows are identical in both species, but the disc of the elytra is flattened in *H. discoidale*, whereas in *H. ardoini* sp. n. the elytra are more convex. See also under *Hovadelium bremeri* sp. n. and key below.

**Description.** Body length 3.3–4.7 mm, unicoloured dark brown. Eyes flat, not prominent; without a deep groove ventral of the eyes. Head with deep clypeal suture and two pairs of long setae as characteristic for the genus; frons shining and without punctures. Shape of the antennomeres see Fig. 3. Pronotum subquadrate, widest in the middle, anterior and posterior angles completely rounded, anterior and posterior margin finely bordered, lateral margins with broader border, anterior margin not excavated; surface slightly convex, with fine and sparse punctation, punctures only weakly impressed, surface between punctation shining and only slightly shagreened; propleura shining, without punctation. Elytra with nine punctural rows in distinct striae, these punctures small and elongate, only slightly broader than striae, without setae; intervals convex, shining and without punctures nor tubercles, interval 7 at base near shoulders with a longer seta. Ventriles shining, ventrites 1–4 in the middle with a pair of longer setae, last ventrite in both sexes unbordered. Femora and tibiae in both sexes without teeth or other modifications. In males protarsi only slightly dilatated, without other external differences. Aedeagus see Fig. 11.

**Etymology.** Named in honour of Jean Paul Ardoin (1918–1978), former pharmacist in Arcachon (France), author of the Malagasy genera of Laenini and specialist of other tenebrionids from Africa and Madagascar.

***Hovadelium bremeri* sp. n.**

<http://zoobank.org/1F59CF9F-4AF5-4510-9915-F1BB12C6CFAA>

[http://species-id.net/wiki/Hovadelium\\_bremeri](http://species-id.net/wiki/Hovadelium_bremeri)

Figs 4, 12

**Type specimens.** Holotype male: E Madagascar, 30 km ESE Betroka, Vohitrosa Forest, 1400–1500 m, 17.–18.XII.1998, leg. J. Janák, SMNS. – Paratypes: Same data as holotype, 7 ex. SMNS, 2 ex. ZSM.

**Diagnosis.** *Hovadelium bremeri* sp. n. and *Hovadelium ardoini* sp. n. are similar, both share the general body shape, the lacking of a groove ventral of the eyes, the shining surface of pronotum and elytra, the elytral interval 7 at base near shoulders with a longer seta, and the lacking tubercles on the elytral intervals. In *H. bremeri* sp. n., the body length is somewhat shorter in the average, the pronotum is narrower towards base, the pronotal punctation is larger and denser, the anterior pronotal margin is unbordered in the middle, the punctures of the elytral rows are larger, and the apicale of the aedeagus is shorter. See also under *Hovadelium ardoini* sp. n. and key below.

**Description.** Body length 2.8–3.5 mm, unicoloured dark brown. Eyes flat, not prominent; without a deep groove ventral of the eyes. Head with deep clypeal suture and two pairs of long setae as characteristic for the genus; frons shining and without punctures. Shape of the antennomeres see Fig. 4. Pronotum subquadrate, widest in the



middle, anterior and posterior angles completely rounded, anterior margin unborded in the middle, posterior margin finely bordered, lateral margins with broader border, anterior margin not excavated; surface slightly convex, with irregular larger, but not confluent punctation, punctures only weakly impressed, surface between punctation shining; propleura shining, without punctation. Elytra with nine punctural rows in weak striae, these punctures large and broader than striae, without setae; intervals convex, shining and without punctures nor tubercles, interval 7 at base near shoulders with a longer seta. Ventrites shining, ventrites 1–4 in the middle with a pair of longer setae, last ventrite in both sexes unborded. Femora and tibiae in both sexes without teeth or other modifications. In males protarsi only slightly dilatated, without other external differences. Aedeagus see Fig. 12.

**Etymology.** Named in honour of Prof. Dr. H. J. Bremer (Osnabrück, Germany), who provided me with most of the newly collected specimens, and allowed to keep the larger part in SMNS.

***Hovadelium discoidale* Ardoïn, 1961**

[http://species-id.net/wiki/Hovadelium\\_discoidale](http://species-id.net/wiki/Hovadelium_discoidale)

Fig. 5

**Reexamined type-material.** “Madagascar” (without detailed data), collection Oberthuer, male holotype MNHN.

**Remarks.** The type specimen has a quite unique character, namely the head with a deep groove ventral of the eyes (Fig. 5). Ardoïn (1961) assumed that this might be a sexualdimorph character of males within the genus. However, in all the plenty herein presented males and females of other species of *Hovadelium*, such a groove is not present. Thus, this structure (of unknown biological function) is considered as not generic but just as specific for *H. discoidale*. Unfortunately, an exact type locality is unknown.

**Diagnostic characters.** Body length 4.2 mm (not 5.0 mm as given by Ardoïn 1961). Head with a deep groove ventral of the eyes (Fig. 5). Pronotum subquadrate, widest somewhat behind the middle, with marked anterior and rounded posterior angles, surface slightly convex, with fine and sparse punctation, between punctation slightly shagreened. Elytra with punctural rows in striae, intervals convex, shining and without tubercles, interval 7 at base near shoulders with a longer seta. Aedeagus not examined herein (because of the fragility of the type).

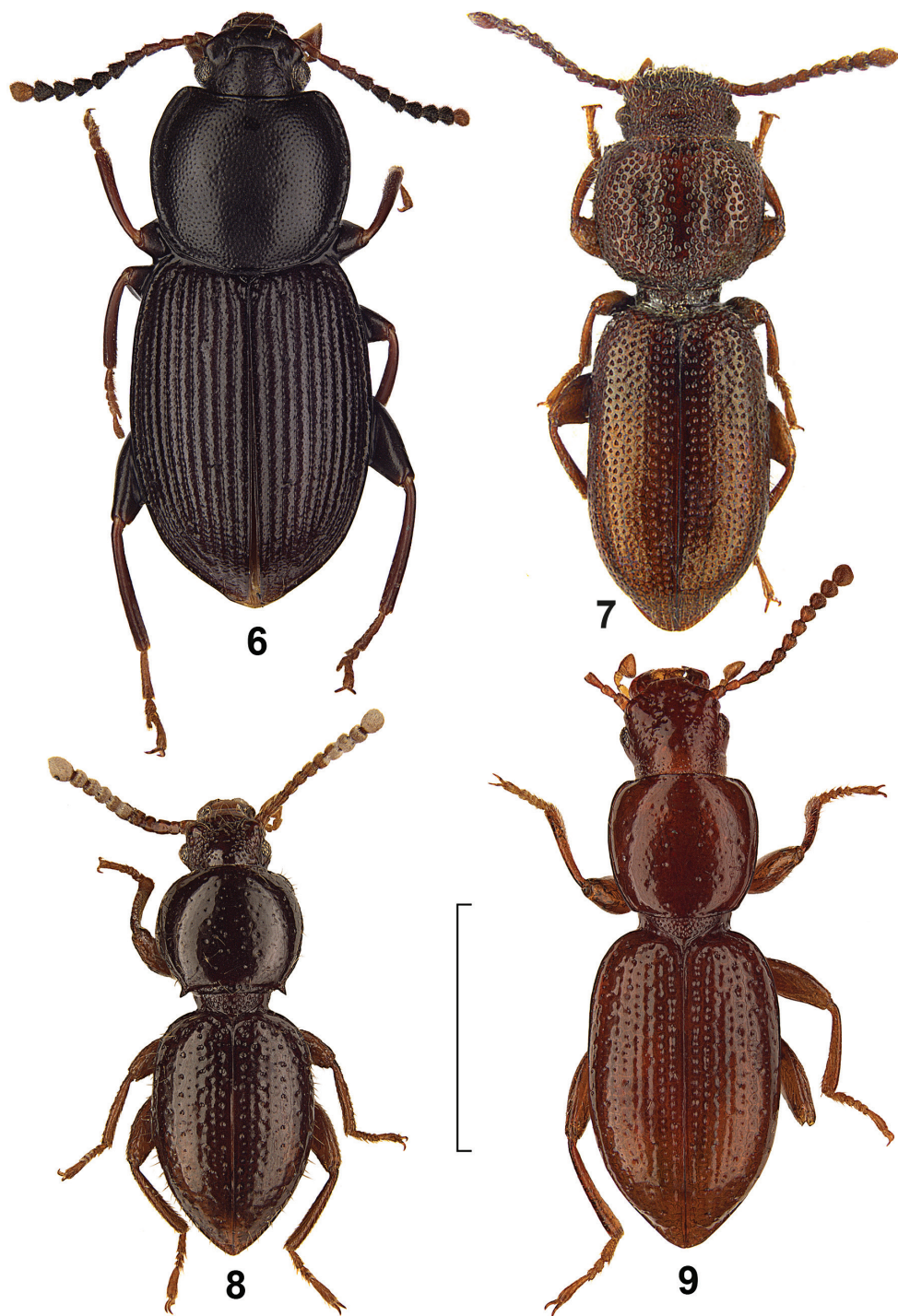
***Hovadelium elongatum* Ardoïn, 1976**

[http://species-id.net/wiki/Hovadelium\\_elongatum](http://species-id.net/wiki/Hovadelium_elongatum)

Figs 6, 13

**Reexamined type-material.** None, not found in MNHN.

**Type locality.** SE Madagascar, Plateau Andohahelo, SE Trafonaomby, 1770–1950 m.



**Figures 6–9.** Dorsal view of *Hovadelium* and *Mimolaena* species. **6** *H. elongatum*, non-type SMNS **7** *M. clarissae*, holotype MZUF **8** *M. janaki* sp. n., holotype SMNS. **9** *M. pauliani*, holotype MNHN. — Scale line 2 mm.

**New material.** SE Madagascar, 3 km NW Fort Dauphin, Pic St. Louis, 150–250 m, 19.II.2004, leg. P. Bulirsch, 6 ex. CRFL, 2 ex. SMNS. – E Madagascar, 38 km ESE Betroka, Kalambatritra Forest, 3 km SSE Ambaro, 1400 m, 29.XII.1998, leg. J. Janák, 2 ex. SMNS.

**Remarks.** I hope not to fail in assigning the newly collected specimens to this species, described upon a single female. Distinct differences between the description and the new specimens do not exist, and the larger part of the new material originates from the surroundings of the type locality nearby Fort Dauphin.

**Diagnostic characters.** Body length 4.0–6.0 mm (holotype 5.0 mm). Pronotum cordiform, anterior margin regularly excavated, widest before the middle, with rounded anterior and posterior angles, surface slightly convex, with fine and sparse punctation, between punctation distinctly shagreened. Elytra with punctural rows in striae, intervals convex, slightly shagreened and somewhat uneven (“petit granules peu saillants” in description), interval 7 at base near shoulders with a longer seta. Aedeagus see Fig. 13.

### The genus *Mimolaena*

#### *Mimolaena clarissae* Ferrer, 1998

[http://species-id.net/wiki/Mimolaena\\_clarissae](http://species-id.net/wiki/Mimolaena_clarissae)

Fig. 7

**Reexamined type-material.** E Madagascar, Ambila Lemaitso (labelled as Ambila La Maintso), V.1990, leg. C. Raharimina, female holotype MZUF.

**Diagnostic characters.** Body length 4.4 mm. Pronotum subquadrate, with slightly prominent anterior and with rounded posterior angles, surface slightly convex and with rough and partly confluent punctures. Elytra with rough irregular punctation without any separation in rows and intervals. Aedeagus unknown, only ♀ holotype known.

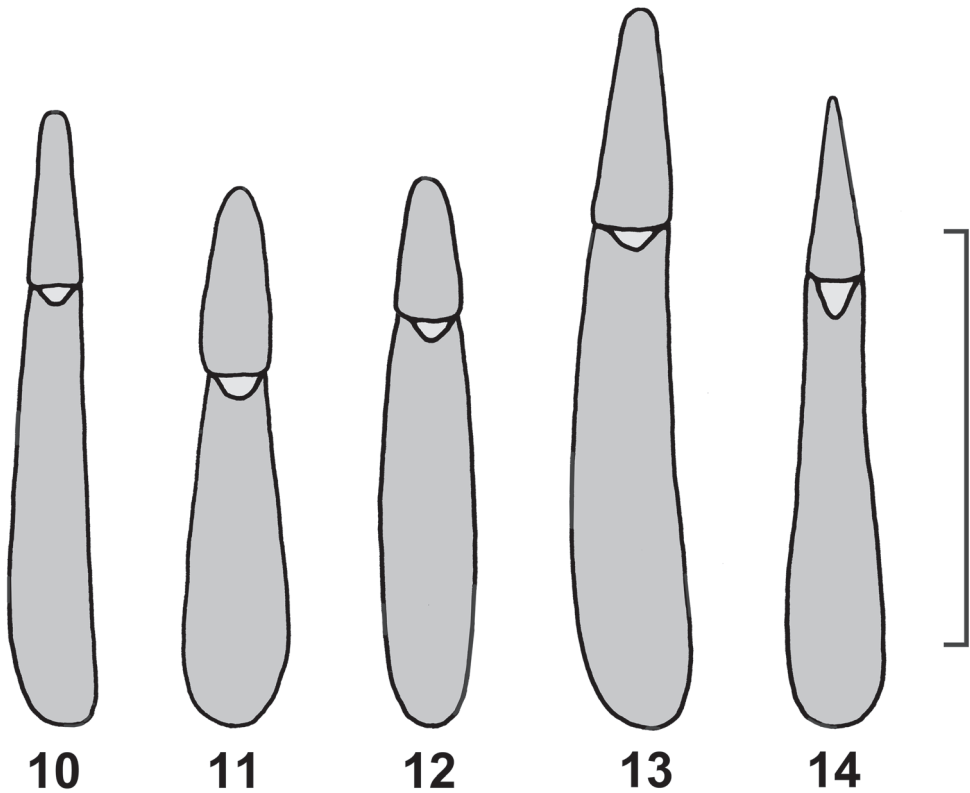
#### *Mimolaena janaki* sp. n.

<http://zoobank.org/CB2004A1-7F5A-423C-99C7-AF4BAC9E1EE3>

[http://species-id.net/wiki/Mimolaena\\_janaki](http://species-id.net/wiki/Mimolaena_janaki)

Figs 8, 14

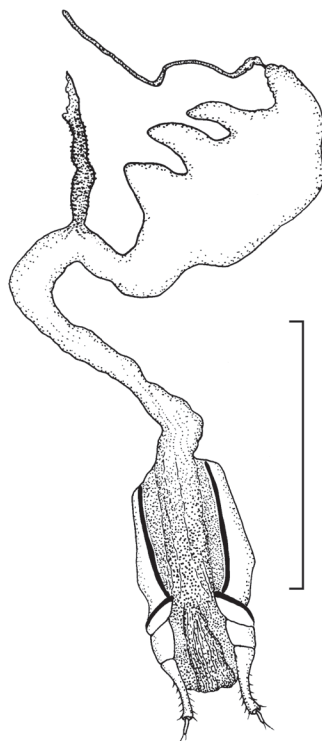
**Type specimens.** Holotype male: E Madagascar, Ranomafana NP, Vohiparara, 1100–1200 m, 21.–24.I.1993, leg. J. Janák, SMNS. – Paratypes: Same data as holotype, 3 ex. SMNS, 2 ex. ZSM. – E Madagascar, Massiv Ambondrombe, 1600–1700 m, 17.III.1996, leg. J. Janák & P. Moravec, 1 ♀ SMNS. – E Madagascar, Massiv Ambondrombe, 1500–1600 m, 15.–18.III.1996, leg. J. Janák & P. Moravec, 1 ♀ ZSM. – E Madagascar, Massiv Ambondrombe, 1300–1400 m, 14.III.1996, leg. J. Janák & P. Moravec, 1 ♀ SMNS.



**Figures 10–14.** Aedeagus of *Hovadelium* and *Mimolaena* species. **10** *H. aeneum*, non-type SMNS **11** *H. ardoini* sp. n., holotype SMNS **12** *H. bremeri* sp. n., holotype SMNS **13** *H. elongatum*, non-type SMNS **14** *M. janaki* sp. n., holotype SMNS. – Scale line 0.5 mm.

**Diagnosis.** To be recognized by the shape of the pronotum with spine-like posterior angles, by scattered and fine punctation of the pronotum, by only six elytral rows of punctures extinguished in the posterior and external part of elytra, and by the shape of the aedeagus. The two other known species of *Mimolaena* possess nearly rounded posterior angles of the pronotum, and the punctation on the pronotum is either fine and the elytra bear punctural rows (*M. pauliani* Ardoïn, 1961), or the punctation on the pronotum is rough and dense and the elytra bear an dense irregular punctation not separated in rows and intervals (*M. clarissae* Ferrer, 1998). See also key below.

**Description.** Body length 3.5–4.7 mm, unicoloured dark brown. Eyes (Fig. 8) not reduced, slightly prominent. Shape of the antennomeres see Fig. 8. Shape of pronotum see Fig. 8, disc with a few scattered punctures, most punctures bearing a longer erect seta; surface without any impressions, surface shining, lateral margins bordered, basal margin bordered and not bent downwards, posterior angles prominent spine-like, propleura unpunctured. Elytra (Fig. 8) with only six punctural rows without striae, these rows extinguishing in posterior and external part of elytra, punctures of rows of similar size as pronotal punctures, punctures of the elytral rows without setae,



**Figure 15.** Ovipositor and female genital tract of *Hovadelium ardoïni* sp. n. (drawing by Eric Matthews).  
– Scale line 1 mm.

a few additional punctures apart from the rows laterally and distally on the elytra bear a longer erect seta, intervals shining without any punctures and setation, intervals flat. Ventrites shining, in males with fine punctation and short setation, in females nearly unpunctured and without setation, last ventrite in both sexes unbordered. Femora and tibiae in both sexes without teeth or other modifications. Aedeagus see Fig. 14.

**Etymology.** Named in honor of J. Janák, one of the collectors of the type series and of other Malagasy Laenini.

***Mimolaena pauliani* Ardoïn, 1961**

[http://species-id.net/wiki/Mimolaena\\_pauliani](http://species-id.net/wiki/Mimolaena_pauliani)

Fig. 9

**Reexamined type-material.** C Madagascar, Plateau Soaindrana, Andringitra-Ambalavao, 2090 m, 16.I.1958, leg. R. Paulian, male holotype and 1 male paratype MNHN.

**Diagnostic characters.** Body length 4.4–4.8 mm. Pronotum subquadrate, with rounded anterior and posterior angles, surface flat and with sparse and fine punctation. Elytra with distinct punctural rows without striae, size of the punctures diminishing

laterally and apically. Aedeagus not examined herein (because of the fragility of the type). It is said (but not figured) in the description, that the apicale is short and acute at the tip, and the basale is long and bent.

### Identification key of Laenini from Madagascar

- 1 Base of elytra excavated for pronotum, humeral angle protruding; head between eyes and clypeus each with a pair of long tactile setae; elytral interval 7 at base near shoulders with a long tactile seta (genus *Hovadelium*) ..... **2**
- Base of elytra not excavated, humeral angle rounded; head with irregular short setation, without pairs of long setae; elytral interval 7 at base near shoulders without a long tactile seta (genus *Mimolaena*) ..... **6**
- 2 Head with a deep groove ventral of the eyes – Fig. 5 ..... ***H. discoidale***
- Head “normal”, without groove ..... **3**
- 3 Pronotum cordiform, surface of head and pronotum distinctly mat and shagreened – Fig. 6 ..... ***H. elongatum***
- Pronotum subquadrate, surface of head and pronotum shining or at most weakly shagreened ..... **4**
- 4 Pronotum widest before the middle, elytral intervals with an irregular row of tubercles – Fig. 2 ..... ***H. aeneum***
- Pronotum widest in the middle, elytral intervals without tubercles ..... **5**
- 5 Lateral margin of pronotum regularly rounded towards anterior and posterior angles, anterior margin of pronotum completely bordered, pronotal punctation fine, punctures of elytral rows small, elongate and not distinctly broader than distinct striae – Fig. 3 ..... ***H. ardoini* sp. n.**
- Lateral margin of pronotum narrower towards base, anterior margin of pronotum unbordered in the middle, pronotal punctation larger and denser, punctures of elytral intervals larger and broader than weak striae – Fig. 4 ..... ***H. bremeri* sp. n.**
- 6 Posterior angles of pronotum prominent spine-like – Fig. 8 ..... ***M. janaki* sp. n.**
- Posterior angles of pronotum rounded ..... **7**
- 7 Pronotum with fine and separate punctation, elytra with punctural rows – Fig. 9 ..... ***M. pauliani***
- Pronotum with rough and partly confluent punctation, elytra with rough irregular punctation without any separation in rows and intervals – Fig. 7 ..... ***M. clarissae***

### Acknowledgements

I cordially thank Prof. Dr. Hans J. Bremer (Osnabrück), who provided me with most of the newly collected specimens already many years ago, and allowed to keep the lar-



ger part in SMNS. Dr. Luboš Purchart (Brno) kindly searched in Paris in the course of his visit successfully for most of the types of Ardoïn. For the loan of material from the collections under their care I thank Dr. Luca Bartolozzi (Firenze), René Fouqu  (Liberec), Antoine Mantilleri (Paris) and Ruth M ller (Pretoria). Dr. Eric Matthews (Adelaide) dissected some female genitalia, provided a figure, recognised the assignment to the tribe Laenini and generously allowed me to publish the results herein. The photographs were taken by Johannes Reibnitz (Stuttgart) with a Leica DFC320 digital camera on a Leica MZ16 APO microscope and subsequently processed by him with Auto-Montage (Syncroscopy) software. Two referees, unknown to me, improved the manuscript by their comments and corrections.

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# New lucinid bivalves from shallow and deeper water of the Indian and West Pacific Oceans (Mollusca, Bivalvia, Lucinidae)

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## Abstract

Four new species and a new genus of lucinid bivalves are described from shallow and deeper waters in the Indian and West Pacific Oceans. The new genus *Scabrilucina* (subfamily Lucininae) includes the little-known *S. victorialis* (Melvill, 1899) from the Arabian Sea and *S. vitrea* (Deshayes, 1844) from the Andaman Sea as well as a new species *S. melvilli* from the Torres Strait off northeastern Australia. *Ferrocina brunei* new species (Lucininae) was recovered from 60 m near oil drilling activities off Borneo; its anatomy confirmed the presence of symbiotic bacteria. Two unusual deeper water species of Leucosphaerinae are described, both species included in on-going molecular analyses; *Gonimyrtea ferruginea* from 400–650 m in the southwest Pacific and *Myrtina reflexa* from 200–825 m off Zanzibar and Madagascar.

## Keywords

Bivalvia, Lucinidae, chemosymbiosis, taxonomy, new species, deep water, Indo-West Pacific

## Introduction

Over the last 20 years there has been much taxonomic interest in the chemosymbiotic bivalve family Lucinidae with many new genera and species described from shallow to bathyal depths of the tropical Indo-West Pacific (Taylor and Glover 1997, 2002, 2005; Glover and Taylor 2001, 2007, 2008; Glover et al. 2008; Oliver and Holmes 2006; Bouchet and Cosel 2004, Cosel and Bouchet 2008, Okutani 2011, Glover and Taylor in press). Despite this activity there remain many undescribed or unregarded species whose systematic position is obscure.

In this paper a new genus is introduced to accommodate *Lucina victorialis* (Melvill, 1899) previously known from just a few valves collected in the Arabian Sea in the late 1800s but classified initially as *Cryptodon* (i.e. Thyasiridae) because of the deep sulcus and trigonal shape. Discovery in the Museum of Comparative Zoology, Harvard University of a large sample collected in the Arabian Sea as part of the 1963 International Indian Ocean Expedition has allowed re-description and assessment of the unusual features of this species. We also include within this genus the neglected species *Lucina vitrea* Deshayes, 1844, with new records from Southeast Asia, and another species with similar characters is newly described from the Torres Strait off northeastern Australia.

Benthic sampling at about 60 m depth off Brunei in north Borneo recovered from near oil drilling activities an unusual, small, mottled red-brown lucinid that on shell characters can be classified as a new species of *Ferrocina* a genus previously known from the rare type species *F. multiradiata* Glover & Taylor, 2007 from off Fiji and New Caledonia and another species from the Philippines (Glover and Taylor in press). Formalin preserved animals were available and we include some anatomical information.

In a molecular analysis of Lucinidae we included an individual of an undescribed genus and species dredged from over 600 m on the Chesterfield Bank west of New Caledonia (UGS-3 in Taylor et al. 2011, fig. 7J). This taxon grouped with a cluster of other genera in the subfamily Leucosphaerinae and we now classify and describe it as a new species of *Gonimyrtea* Marwick, 1929. Also in the Leucosphaerinae we describe a new species of *Myrtina* Glover & Taylor, 2007 from off Zanzibar and Madagascar between 200–800m and for which molecular data is available.

## Institutional abbreviations

AM	Australian Museum, Sydney
MCZ	Museum of Comparative Zoology, Harvard University
NHMUK	The Natural History Museum, London
MNHN	Muséum national d'Histoire Naturelle, Paris
UMC	Zoological Museum, University of Copenhagen
USNM	United States National Museum of Natural History

## Other abbreviations

<b>H</b>	shell height
<b>IWP</b>	Indo-West Pacific
<b>L</b>	shell length
<b>LV</b>	left valve
<b>PI</b>	protoconch I length
<b>PII</b>	protoconch II length
<b>pv</b>	paired valves
<b>RV</b>	right valve
<b>T</b>	tumidity of single valve
<b>v</b>	valve (s)

## Systematics

### Family Lucinidae Fleming, 1828

### Subfamily Lucininae Fleming, 1828

#### *Scabrilucina* gen. n.

<http://zoobank.org/78644155-2436-4683-8C37-DB6E3A00A0AC>

<http://species-id.net/wiki/Scabrilucina>

**Type species.** *Cryptodon victorialis* Melvill, 1899. Here designated. Northern Indian Ocean.

**Diagnosis.** Small to medium size, L to 40 mm, thin, semi-translucent, usually slightly higher than long, ovoid to subtrigonal, strong posterior sulcus with broad sinus at posterior margin. Sculpture of sharp, fine, commarginal lamellae. Ligament short, set in shallow resilifer. Hinge with small to vestigial cardinal teeth in both valves, lateral teeth usually absent but small anterior lateral tooth may be present in juvenile shells. Anterior adductor muscle scar long, thin, ventrally detached from pallial line for  $\frac{1}{2}$ – $\frac{3}{4}$  of length, dorsal part runs on to hinge. Interior shell with translucent spots.

**Etymology.** Derived from Latin *scaber* rough and *Lucina*, reference to the rough surface formed by closely spaced, sharp, commarginal lamellae. Feminine.

**Comparison with other genera.** *Scabrilucina* can be readily distinguished from other lucinids by the subtrigonal outline with a prominent posterior sulcus, the fine, regular, sharp-edged, commarginal lamellae and the absence of radial sculpture. No preserved samples of *Scabrilucina* were available for molecular analysis but a small lucinid from the Philippines with some similar characters was included in a prior analysis (Taylor et al. 2011) as '*Lucina*' *desiderata* Smith, 1885. We now consider this a new species in a separate genus (Glover and Taylor in press) and related to *Scabrilucina*. Evidence from 18 S and 28 S rRNA genes places '*L.*' *desiderata* in the subfamily Lucininae that by inference also includes *Scabrilucina*.

The little known genus *Semelilucina* Cosel & Bouchet, 2008, type species *S. semeliformis* from offshore muddy habitats in Tanimbar, SE Indonesia, may be related to *Scabrilucina*. The two genera differ in shell shape but have similar sculpture of fine, regularly spaced, sharp commarginal lamellae. Cosel and Bouchet 2008 considered *Semelilucina* closely related to *Dulcina* (Leucosphaerinae) and we followed this in our classification (Taylor et al. 2011). However, shell morphology suggests that *Semelilucina* is better placed in the Lucininae.

***Scabrilucina victorialis* (Melvill, 1899)**

[http://species-id.net/wiki/Scabrilucina\\_victorialis](http://species-id.net/wiki/Scabrilucina_victorialis)

Figs 1–2, 3A

*Cryptodon victorialis* Melvill, 1899: 98–9, pl. 2, figs 9, 9a.

*Loripes victorialis* – Smith 1906: 256.

*Loripes victorialis* – Melvill and Standen 1907: 815.

*‘Lucina’ victorialis* – Oliver 1995: 235, fig. 1024.

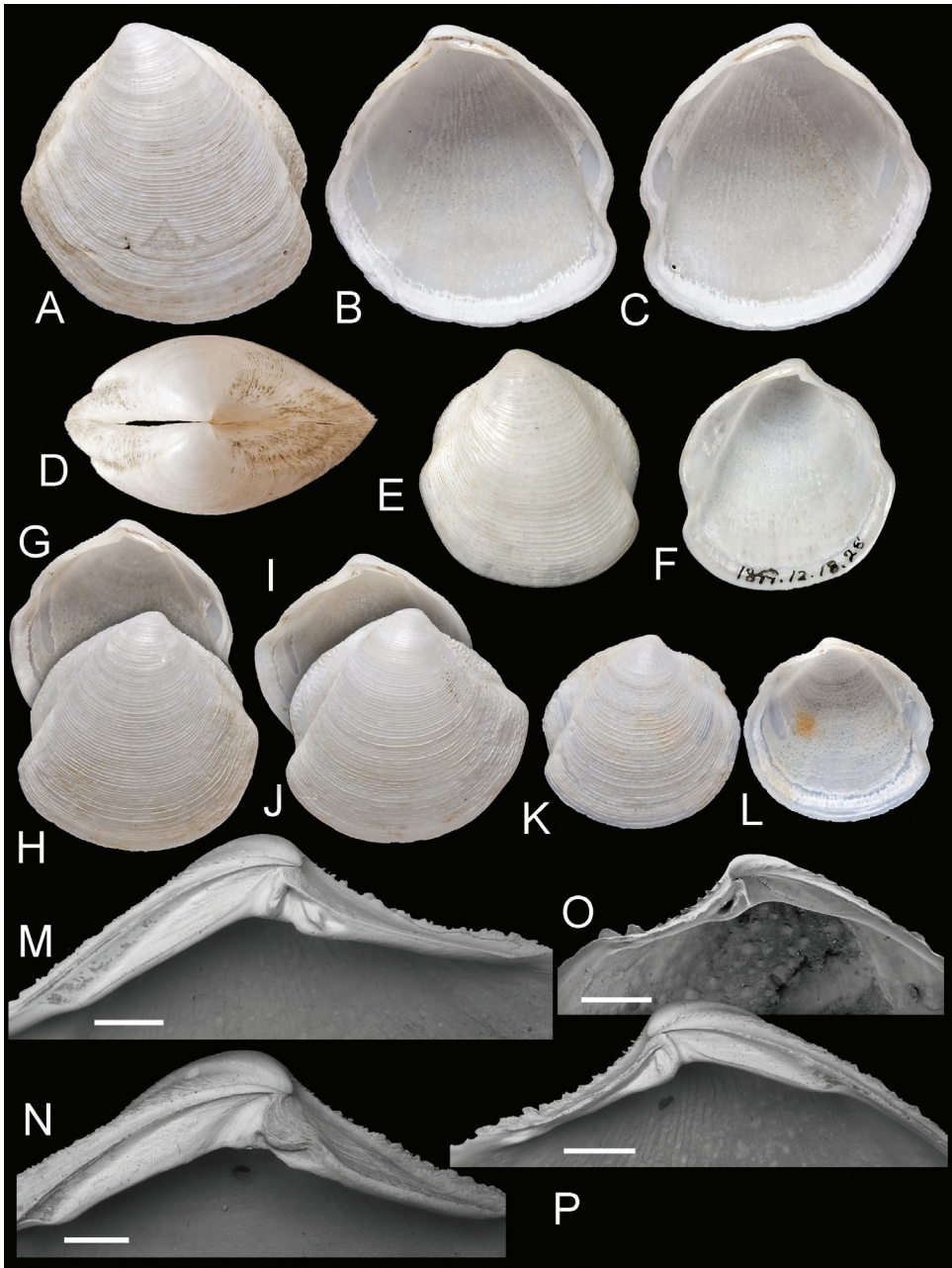
**Type material.** Holotype, left valve (NHMUK 1899.12.18.28), H 25.3 mm, L 23.5 mm.

**Type locality.** Melvill (1899) p. 99 states ‘near Karachi, and also Malcolm Inlet nr Muscat, Oman 24 fathoms’ (44 m) (Malcolm Inlet is Ghubbat al Ghazira).

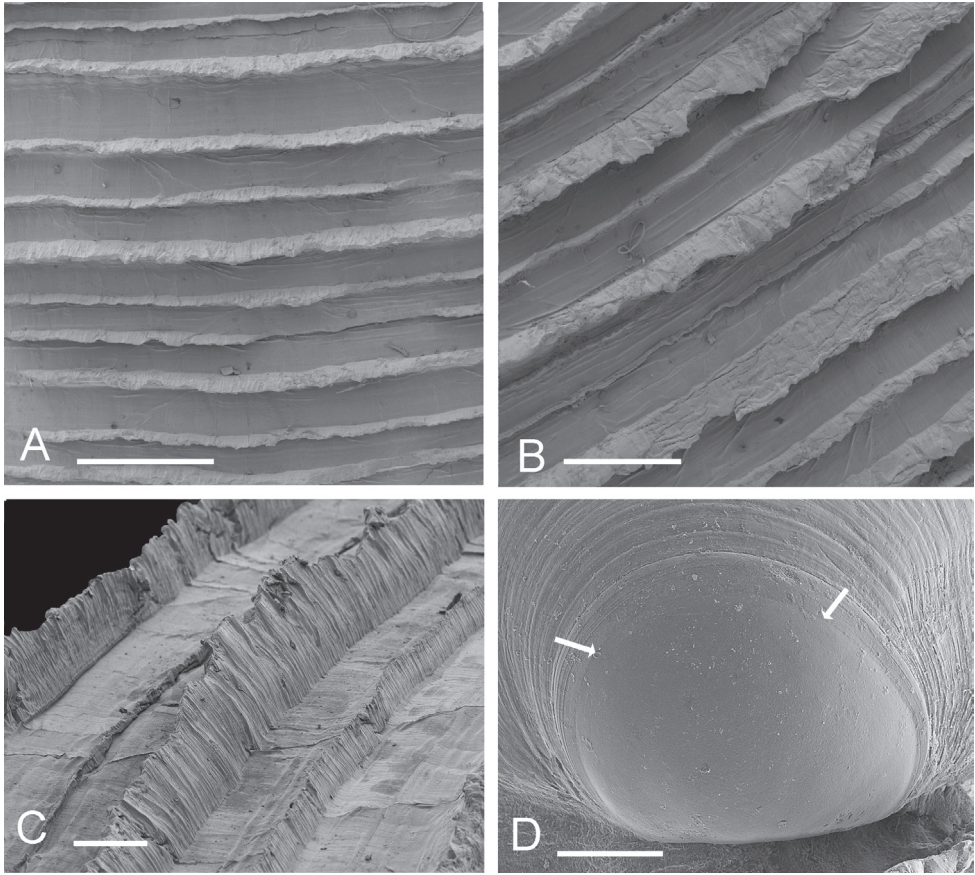
**Other material examined. Northern Arabian Sea:** 141 valves (MCZ 362493), 47 miles E of Duhat Sharjah, Oman, Arabian Sea, 50.5–52 fthms (92–95 m), Anton Brunn Cruise, 4b stn 255A (25°50'N, 57°07'E, 30 November 1963). 2 valves (USNM 716871), locality as above, Anton Brunn station 255A. 1 valve (NHMUK 99.2.18.10) 25 fthms (45.7 m), 26°23'N, 54°53'E, Melvill collection. 1 valve (NHMUK) off Gwadhur (Gwadar), Pakistan, 70 fthms (128 m), Townsend collection. 4 valves, NHMUK, Gulf of Oman, Townsend collection. 1 valve (NHMUK 1906.10.12.90) Arabian Gulf, 47 fthms, Investigator station 346, (Smith 1906).

**Description.** Shell white, thin, often semi-translucent, H to 43 mm, L to 39 mm, higher than long, H/L =  $1.03 \pm \text{SD } 0.03$  (n=17), moderately inflated T/L  $0.27 \pm \text{SD } 0.014$  (n=17), outline subtrigonal in larger shells, juvenile shells subcircular. Posterior sulcus, prominent, deeply incised, with marginal sinus; anterior sulcus narrow and shallow. Sculpture of fine, closely spaced (200–500  $\mu\text{m}$  apart), thin, sharp-edged, striated, commarginal lamellae (Figs 2 A–C) that narrow to around 30  $\mu\text{m}$  at the distal edges and are slightly elevated along the posterior and anterior dorsal margins. Fine sediment is frequently trapped between lamellae. Protoconch (Fig. 2D): PI 150  $\mu\text{m}$ , PI + PII 165  $\mu\text{m}$ , PII with 2–3 growth increments. Lunule long, lanceolate and asymmetric, slightly larger in left valve. Ligament short, set in narrow groove. Hinge plate narrow, LV with 2 cardinal teeth, the anteriormost reduced and often obscured by ventral extension of lunule (Fig. 1M–P), lateral teeth absent; RV with 1–2 small cardinal teeth, sometimes obscure, small anterior lateral tooth sometimes visible in younger shells (Fig. 1P). Anterior adductor muscle scar long, thin, tapering at ventral tip, detached for  $\frac{1}{2}$ – $\frac{2}{3}$





**Figure 1.** *Scabrilucina victorialis* (Melvill, 1899) except where otherwise stated all specimens MCZ 362493. **A–C** exterior of left valve and interiors of right and left valves, L = 40.4 mm **D** Dorsal view of **A–C** **E–F** Holotype *Cryptodon victorialis* Melvill, 1899, NHMUK 1899.12.18.28 exterior and interior of left valve, L = 23.5 mm **G–H** Interior and exterior of right valve L = 32.1 mm **I–J** Interior and exterior of right valve, L = 36.2 mm **K–L** Exterior and interior of juvenile right valve, L = 22.9 mm **M** Detail of hinge teeth of left valve. Scale bar = 1 mm **N** Hinge of left valve Scale bar = 1 mm. **O** Hinge of right valve juvenile shell, NHMUK Scale bar 1 mm **P** Hinge of right valve. Scale bar = 1 mm.

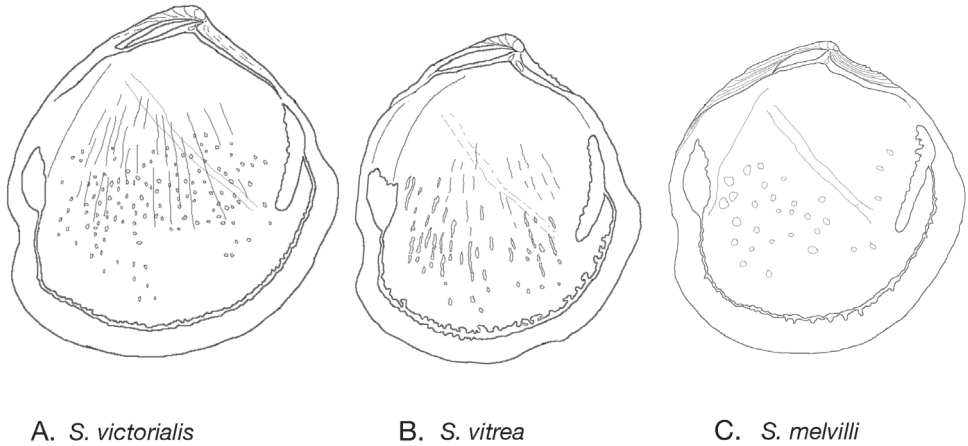


**Figure 2.** *Scabrilucina victorialis* shell features. **A–C** MCZ 362493 **A** Commarginal lamellae. Scale bar = 1 mm. **B** Detail of commarginal lamellae. Scale bar = 500 µm. **C** Detail of commarginal lamellae. Scale bar = 200 µm. **D** Protoconch NHMUK. Arrows mark boundary between PI and PII. Scale bar = 50 µm.

length and diverging ventrally at angle of 25–30° from pallial line, posterior adductor scar ovate. Pallial line broad, continuous, inner shell surface rough with many small translucent circular spots representing mantle attachment points and prominent radial grooves. Track of pallial blood vessel visible. Inner shell margin smooth.

**Distribution.** 50 – ca 150 m in offshore muds, northern Arabian Sea, Gulf of Oman, northeastern Arabian Gulf (Fig. 4). Smith (1906) records *victorialis* from the Arabian Gulf, 47 fthms, Investigator station 346, 26°37'30"N, 53°03'30"E.

**Remarks.** This species is known only from shells. *Scabrilucina victorialis* is characterised by the deep cleft of the posterior sulcus and the fine, sharp, commarginal lamellae. *Scabrilucina vitrea* (see below) from off Sumatra and Gulf of Thailand is smaller, taller, and thinner shelled. The shell shape and the deep posterior sulcus superficially resemble some Thyasiridae such as *Conchocele* and this influenced Melvill's initial placement in *Cryptodon*. *Scabrilucina victorialis* is also similar to *S. melvilli* (new



**Figure 3.** Internal drawings *Scabrilucina* species. **A** *S. victorialis* **B** *S. vitrea* **C** *S. melvilli*.

species below) from Australia that is distinguished by its smaller size, less deeply incised posterior sulcus and more widely spaced commarginal lamellae. Many of the shells of *S. victorialis* from off Oman (MCZ 362493) and *S. vitrea* from Thailand are penetrated by narrow, straight-sided holes ca 450  $\mu\text{m}$  diameter (Figs 1A, C, 5E) comparable with those resulting from octopus predation (Cortez et al. 1998, Todd and Harper 2010).

***Scabrilucina vitrea* (Deshayes, 1844)**

[http://species-id.net/wiki/Scabrilucina\\_vitrea](http://species-id.net/wiki/Scabrilucina_vitrea)

Figs 3B, 5

*Lucina vitrea* Deshayes 1844: pl. 106.

**Type material.** Not located. Original description L 22 mm, H 20 mm.

**Type locality.** ‘les mers de Sumatra’

**Material examined. Thailand:** 2 paired valves and 5 valves (ZMC), Andaman Sea, 27–35 m, 7°00'15"N, 99°21'42"E, 5<sup>th</sup> Thai Danish Expedition stn 1052 & 1054, sandy mud with dead shells, 10 February 1966. 1 valve (ZMC) Gulf of Thailand, 30 fthms (54 m) 10°04.10'N, 100°10.1E, Naga Expedition 1960, stn 60–853. **Malaysia:** 1 valve (NHMUK 163529), Malacca, Cuming Collection.

**Description.** Shell white, L to 22.0 mm, H to 25.1 mm, slightly higher than long, H/L 1.08  $\pm$  SD 0.05 (n=5), very thin shelled, translucent, prominent posterior and anterior sulcus, umbones prominent. Sculpture of fine, thin commarginal lamellae, lamellae slightly irregular and elevated at posterior and anterior dorsal area, radial sculpture absent. Lunule broad, lanceolate, slightly impressed. Hinge extremely narrow, right valve with single cardinal tooth, lateral teeth absent, left valve with 2 small cardinal teeth, lateral teeth absent. Anterior adductor scar long, narrow, pointed, detached



**Figure 4.** Distribution map - *Scabrilucina victorialis*, solid triangles; *Scabrilucina vitrea*, open triangles; *Scabrilucina melvilli*, solid squares; *Gonimyrtea ferruginea*, solid stars; *Myrtina reflexa*, solid circles, *Ferrocina brunei* open star.

for 2/3rds of length, posterior scar ovoid, pallial line entire with dorsal elevations, close to shell margin, inner shell surface with many fine points of mantle attachment, shell surface glossy outside the pallial line.

**Distribution.** Andaman Sea, Straits of Malacca and Gulf of Thailand (Fig. 4).

**Remarks.** Similar to *S. victorialis* but smaller and less trigonal in outline of the adult shell, with finer commarginal sculpture and thinner shell.

The type material of *S. vitrea* has not been located but the original figures of Deshayes are clear (Figs 5 A, B). The type locality of Sumatra is close to that of the other samples mentioned here. As far as we are aware, except for a listing in Tryon (1872), this species name has not been mentioned since the original description in 1844.

***Scabrilucina melvilli* sp. n.**

<http://zoobank.org/EC1E8F2B-0F9E-4DE1-8DE7-4C26695A61FB>

[http://species-id.net/wiki/Scabrilucina\\_melvilli](http://species-id.net/wiki/Scabrilucina_melvilli)

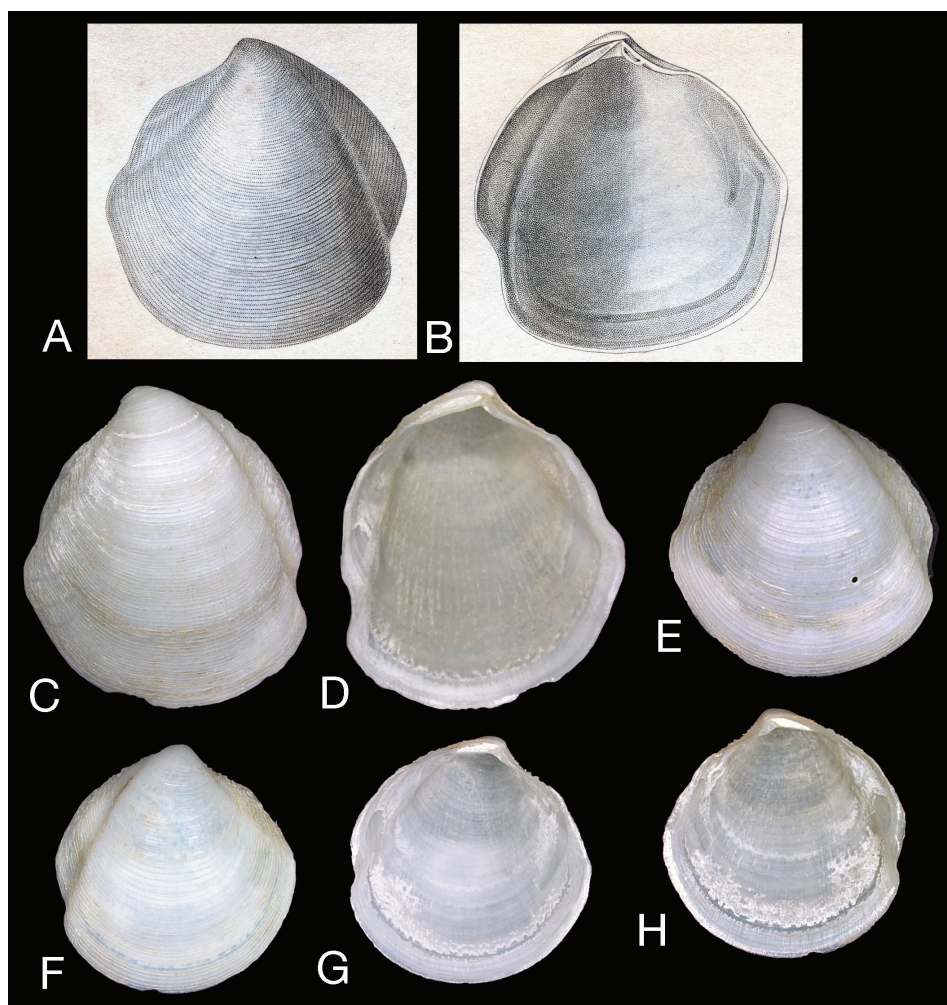
Figs 3C, 6

**Type material.** *Holotype*: 1 whole shell (AM C. 360708), H 21.2 mm, L 21.0, T (single valve) 5.2 mm. *Paratypes*: single left valve, H 20.5mm, L 18.3 mm, juvenile shells 4 LV and 4 RV, locality as holotype (AM C. 479181).

**Type locality.** Northeastern Australia, Queensland, E of Bowen 19°45.7'S, 148°19'E, 46 m, thin, grey mud, coll. PH Colman & F Rowe.

**Other material examined.** Australia, Queensland: 6 valves (AM C. 036166), Albany Passage, Cape York Peninsula, 10°45'S, 142°37'E, 4–14 fthms (7–26 m), mud &



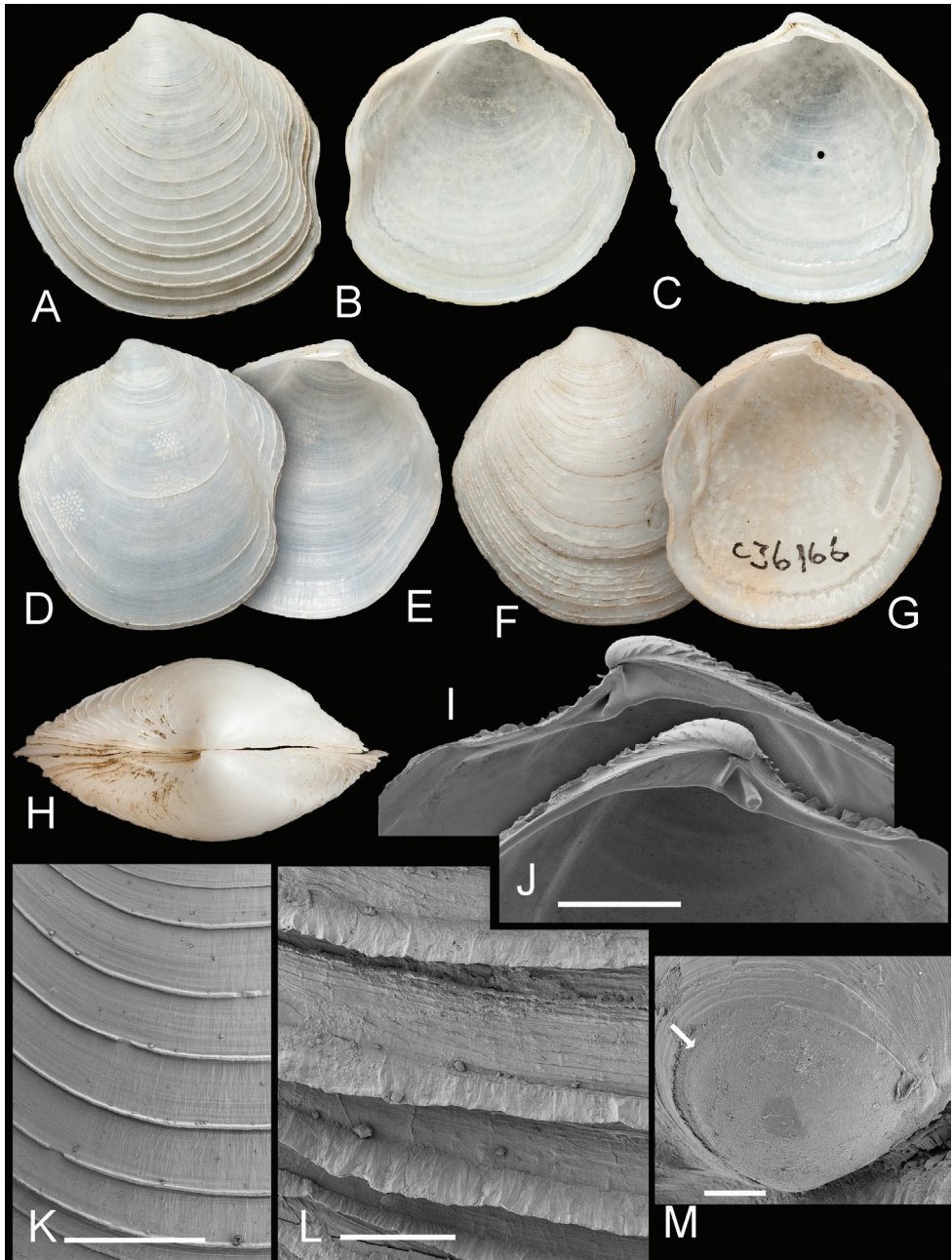


**Figure 5.** *Scabrilucina vitrea* (Deshayes, 1844) **A–B** Scanned images of the original illustrations of *Lucina vitrea* from Deshayes, 1844 pl. 106, length 22 mm **C–H** specimens from Andaman Sea, Thailand (ZMC) **C–D** Exterior and interior left valve L = 21.9 mm **E** Exterior of left valve, L = 16.8 mm **F–H** Exterior of RV, interiors of left and right valves, L = 16.8 mm.

sand, coll. C. Hedley & A. McCulloch. (3 LV, 3 RV+ juveniles. Left valves – H 26.3 mm, L 24.3 mm; H 24.3 mm, L 23.2 mm; H 23.3 mm, L 20.9 mm; right valves - 19.0 mm L 18.6 mm; H 18.7 mm, L 17.2 mm). 1 valve (AM C. 360707), Horn Island, Torres Strait, 10°35.6S, 142°14.6'E, mangroves and sand flats, near jetty, coll. W.F. Ponder & I. Loch. (1 LV H 18.6 mm, L 17.3 mm).

**Description.** Shell fragile, thin, white, semi-translucent, subtrigonal, L to 26.3 mm, H to 26.3 mm, higher than long  $H/L = 1.05 \pm SD 0.04$  ( $n = 9$ ), moderately inflated  $T/L = 0.27 \pm 0.02$  ( $n = 9$ ). Posterior sulcus broad, shallow with marginal sinus. Anterior dorsal area weakly defined. Sculpture (Fig. 6K,L) of regularly spaced, low, thin, sharp, commarginal lamellae with faint radial folds in interspaces. Commarginals more closely





**Figure 6.** *Scabrilucina melvilli* sp. n. **A–C** Holotype AMS C. 360708 exterior of left valve and interior of left and right valves, L = 21 mm **D–E** paratype AMS C. 360708 exterior and interior of left valve, L= 18.3 mm **F–G** paratype AMS 036166 exterior and interior of left valve, L= 23.1 mm **H** Dorsal view of holotype **I–J** Detail of hinge teeth of right and left valves of juvenile shells. Scale bar = 1 mm **K** External sculpture. Scale bar = 1 mm **L** Detail of commarginal lamellae. Scale bar = 200 µm **M** Protoconch. Arrow marks boundary between PI and PII. Scale bar = 50 µm.

spaced in larger specimens. Commarginal lamellae elevated to scales along dorsal margin. Protoconch (Fig. 6M): 150  $\mu$ m, PII a narrow rim. Lunule short, lanceolate, with more prominent growth increments in LV. Ligament short, set in groove. Hinge plate narrow (Fig. 6I, J), LV with two small cardinal teeth, anterior tooth larger, RV with single cardinal tooth, in larger specimens teeth sometimes obscure. Small anterior lateral present in RV of juveniles. Anterior adductor scar long, thin, detached ventrally from pallial line for  $\frac{3}{4}$  of length at angle of 25°. Posterior adductor scar ovoid. Pallial line narrow, entire. Shell inside pallial line with small round points of mantle attachment, radial grooves, track of pallial blood vessel visible as shallow groove. Shell margin smooth.

**Distribution.** Torres Strait, northeastern Australia (Fig. 4) shallow water mud to 50 m.

**Remarks.** See above for comparison with *S. victoralis*.

**Etymology.** Named for James Cosmo Melvill (1845–1929), British malacologist who described many IWP species. Noun in genitive case.

### ***Ferrocina* Glover & Taylor, 2007**

<http://species-id.net/wiki/Ferrocina>

**Type species.** *Ferrocina multiradiata* Glover & Taylor, 2007 by original designation.

**Diagnosis.** Shell to 20 mm, thin, subovate, posteriorly truncate, sculpture of numerous fine, often indistinct radial ribs crossed by fine commarginal threads. Hinge plate thin, small single cardinal tooth in RV, two cardinals in LV, lateral teeth very small or obsolete. Anterior adductor scar short, detached for 1/3 of length. Interior shell margin finely to coarsely dentate. Colour pale orange to rusty red-brown, sometimes blotchy.

**Remarks.** The unusual and rare genus *Ferrocina* was first recognised from Vanuatu, Fiji and New Caledonia at depths from 80–400 m (Glover and Taylor 2007) and is known from a few shells of the type species. A second species has been identified from the Philippines (Glover and Taylor in press) also from a few shells. From shell features including the dentition and presence of a pallial blood vessel scar we classify this genus in the Lucininae. Additionally the ramshorn shaped visceral extension is also seen in the lucinine *Bathyaustriella* (Glover et al. 2004).

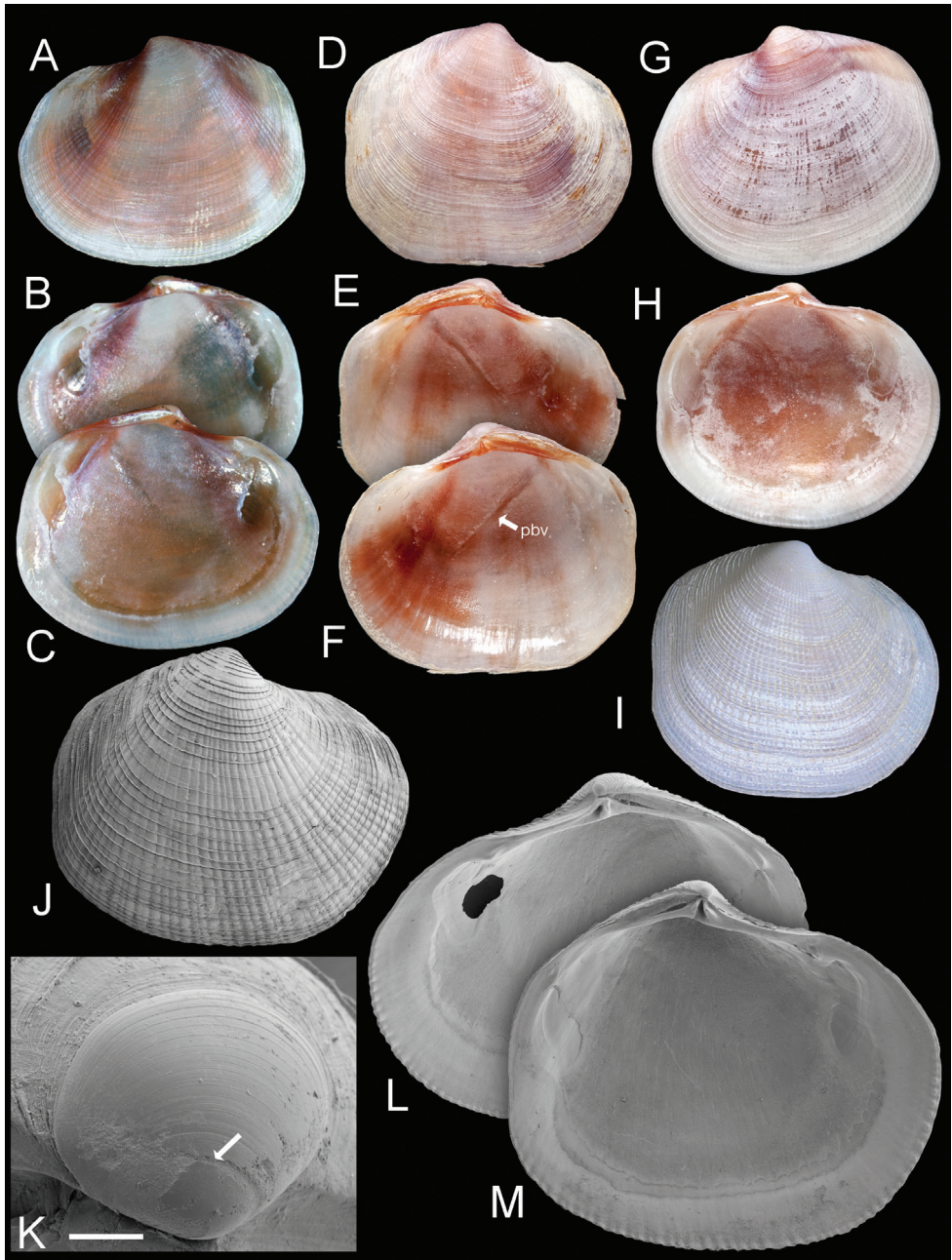
### ***Ferrocina brunei* sp. n.**

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[http://species-id.net/wiki/Ferrocina\\_brunei](http://species-id.net/wiki/Ferrocina_brunei)

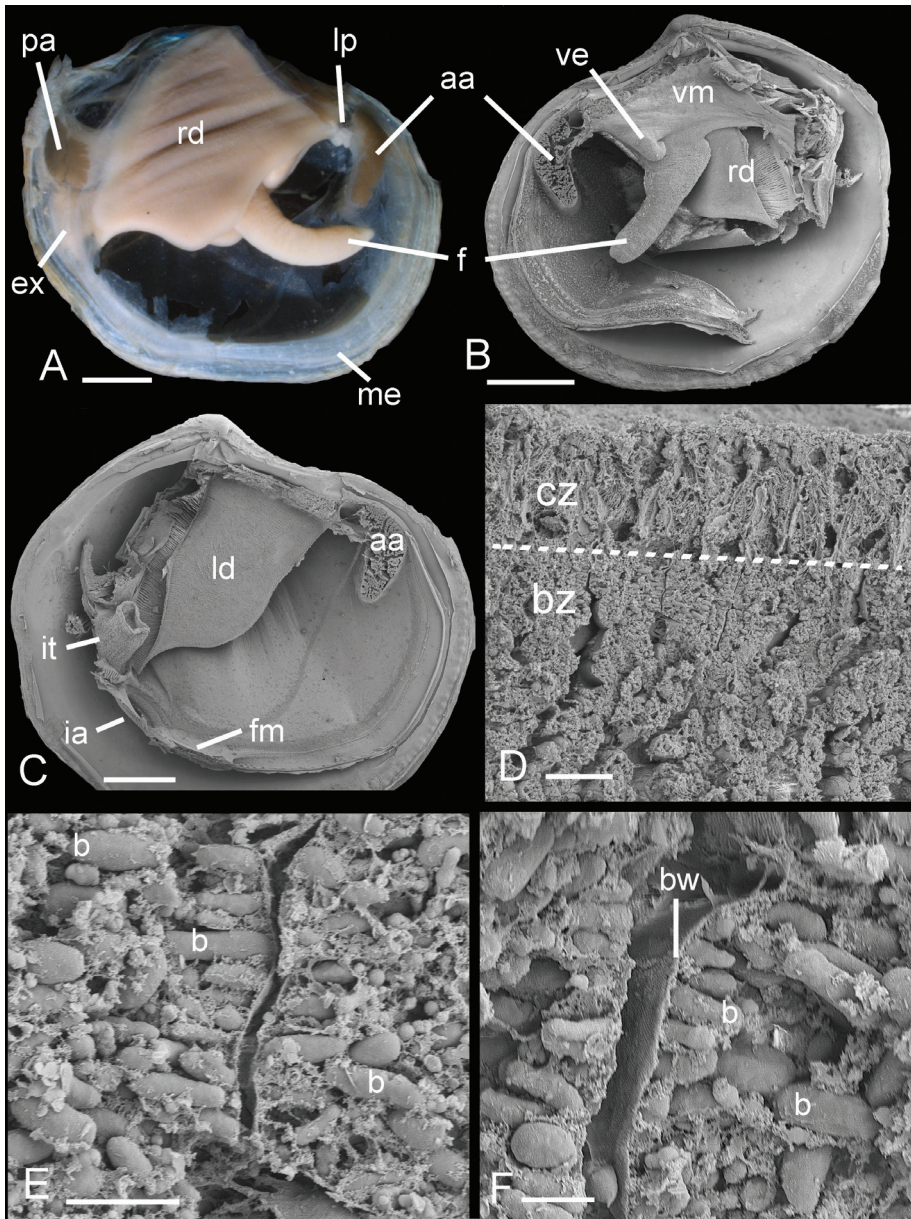
Figs 7, 8, 9C

**Type material.** *Holotype*: whole shell NHMUK 20130122 L 8.2 mm, H 6.7 mm, T 1.6 mm; *Paratypes*: NHMUK 20130123, figured L 8.4 mm, H. 7.3 mm, T 2.1 mm; L 8.9 mm, H 7.8 mm, T 2.1 mm, non figured 19 v.

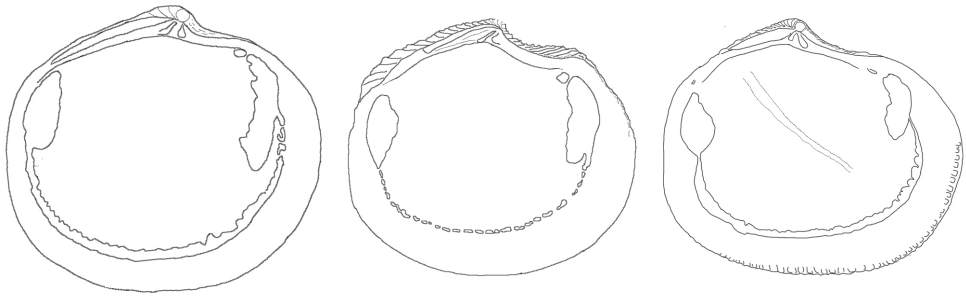


**Figure 7.** *Ferrocina brunei* sp. n. **A–C** Holotype NHMUK 20130122 Exterior of left valve and interior of right and left valves, L = 8.2 mm **D–F** Paratype NHMUK 20130123 exterior of right valve and interior of left and right valves, L = 8.4 mm. pbv trace of pallial blood vessel **G–H** Paratype NHMUK 20130123 exterior and interior of left valve, L = 8.9 mm **I** Exterior of right valve of white form NHMUK 20130123, L = 7.9 mm **J** SEM of right valve L = 6.0 mm **K** Protoconch, arrow at PI /PII junction. Scale bar = 50  $\mu$ m **L–M** Interior of right and left valves L = 5.2 mm.





**Figure 8.** *Ferrocina brunei* sp. n. **A** Body from right side. Scale bar =1 mm **B** Body from left side, mantle and left demibranch removed showing foot and visceral extension. Scale bar =1 mm **C** Body from right side with visceral mass, right demibranch and mantle removed. Scale bar =1 mm **D** Section through part of demibranch showing ciliated and bacteriocyte zones. Scale bar = 20  $\mu$ m **E** Part of ctenidial filament in bacteriocyte zone showing bacteria. Scale bar = 5  $\mu$ m **F** Detail of bacteriocytes and bacteria aligned normal to the apical cell wall. Scale bar = 2  $\mu$ m. aa, anterior adductor muscle. b, bacteria. bw, bacteriocyte apical wall. bz, bacteriocyte zone. cz, ciliated zone. ex, exhalant aperture. f, foot. fm, fused mantle. ia, inhalant aperture. it, inverted tube of posterior exhalant aperture. ld, left demibranch. lp, labial palps. me, mantle edge. pa, posterior adductor muscle. rd, right demibranch. ve, visceral extension. vm, visceral mass.

A. *Gonimyrtea ferruginea*B. *Myrtina reflexa*C. *Ferrocina brunei*

**Figure 9.** Internal outline drawings of **A** *Gonimyrtea ferruginea* **B** *Myrtina reflexa* **C** *Ferrocina brunei*. Not to scale.

**Type locality.** Brunei, 05°21'12"N, 111°26'21"E, 63 m, muddy sand near oil drilling rig.

**Description.** Shell small, H to 7.8 mm, L to 8.9 mm, T to 2.1 mm, longer than high  $H/L = 0.89 \pm 0.034$  ( $n=13$ ). Colour grey-white with patches, streaks or stripes of rusty red, more pronounced dorsally, including lunule, occasionally whole shell red-brown; internally red brown particularly at anterior. Sculpture of numerous (ca 40) low, radial ribs that divide and intercalate, crossed by very fine, widely spaced commarginal lamellae. Shallow posterior sulcus and posterior dorsal area with slightly elevated commarginal lamellae, radial ribs absent. Anterior dorsal area also without ribs. Protoconch (Fig. 7K) PI = 82  $\mu$ m, PI+ PII = 159  $\mu$ m, PII with many growth increments. Lunule short lanceolate, slightly impressed, asymmetrical, greater part in right valve, brown coloured. Ligament set in shallow groove. Hinge plate thin (Figs 7 L,M), RV with single cardinal tooth and small anterior and posterior lateral teeth; LV with two cardinal teeth, anteriormost is larger and faint sockets for anterior and posterior lateral teeth. Anterior adductor muscle scar broad, short, detached for  $\frac{1}{2}$  of length at an angle of 25°. Pallial blood vessel trace prominent, terminates ventral to anterior adductor scar. Pallial line entire. Inner shell margin denticulate.

**Anatomy.** Ctenidia comprising inner demibranchs (Fig. 8A), pink, thick, occupying about  $\frac{1}{2}$  of mantle cavity. Foot cylindrical with small heel. Labial palps small ridges. Visceral mass anterior to foot laterally extended into pair of ramshorn-like coiled structures (Fig. 8B). Posterior exhalant aperture with inverted tube (Fig. 8C), inhalant aperture with small papillae, short section of fused mantle ventral to aperture. Ctenidial filaments with thick bacteriocyte zone with bacteriocytes packed with short rod-shaped bacteria 2–5  $\mu$ m long and 1–2  $\mu$ m wide (Figs 8D–F). Bacteria aligned with long axes normal to apical surfaces of bacteriocytes.

**Distribution.** Known only from type locality (Fig. 4).

**Etymology.** Named for Sultanate of Brunei. Noun in apposition.

**Remarks.** *Ferrocina brunei* is similar to the type species *F. mutiradiata* from Fiji but has much less prominent radial ribs, a less strongly denticulate shell margin and is smaller (shell length to 9 mm compared to 18 mm).



The anatomy is similar to most Lucinidae and bacterial symbiosis is confirmed by the presence of abundant bacteria in the ctenidial filaments. A distinctive feature of the anatomy is the bilateral ramshorn-like extension of the visceral mass anterior to the foot. We have observed similar structures only in *Bathyaustriella thionipta* Glover, Taylor & Rowden, 2004 from a hydrothermal vent on the Kermadec Ridge and in a *Ferrocina* species recently discovered off the southern USA in the Western Atlantic (unpublished observations). The function of this structure is unknown but thin sections of the structure in *B. thionipta* showed that it consisted of diverticula of the digestive gland.

### **Subfamily Leucosphaerinae Taylor et al., 2011**

#### **Genus *Gonimyrtea* Marwick, 1929**

<http://species-id.net/wiki/Gonimyrtea>

**Type species.** *Loripes concinna* Hutton, 1885. Original designation.

**Definition.** Shells small, subcircular to ovate, higher than long, inflated. Sculpture of closely spaced thin, low commarginal lamellae. Right valve with single cardinal tooth and small anterior and posterior laterals sometime present; left valve with two cardinal teeth and small anterior and posterior laterals sometimes present. Lunule narrow lanceolate. Ligament short, curved. Anterior adductor scar detached for about 1/5–1/2 of length.

**Remarks.** There has been much confusion concerning the concept of this genus following from Chavan's (1969) illustration of an Eocene species with little resemblance to the type and also his assignment of *Alucinoma* as a synonym (see Glover and Taylor 2007). We originally placed this genus (based on shell morphology) in the Myrteinae (Taylor et al. 2011) but continuing molecular analysis (species described below as UGS-3 in Taylor et al. 2011 and unpublished data) suggests that it should be classified in the sub-family Leucosphaerinae, although the type species has not yet been investigated. As well as the genotype *G. concinna* from New Zealand we include *G. avia* and *G. fidelis* from around New Caledonia (Glover and Taylor 2007) and two new species from the Philippines (Glover and Taylor in press).

#### ***Gonimyrtea ferruginea* sp. n.**

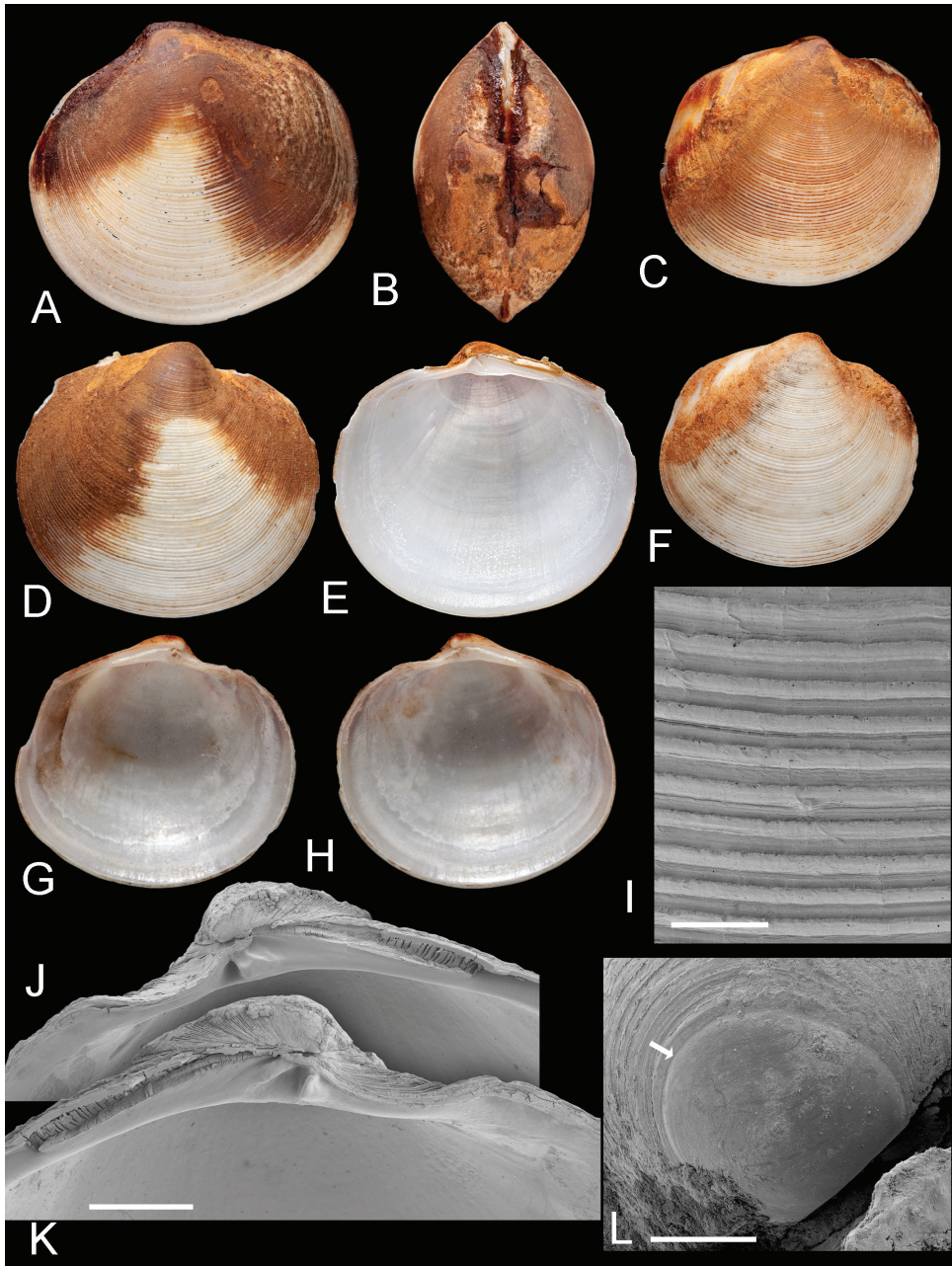
<http://zoobank.org/4BD0BF6A-71CE-47B0-8C70-5D0D2D148BFB>

[http://species-id.net/wiki/Gonimyrtea\\_ferruginea](http://species-id.net/wiki/Gonimyrtea_ferruginea)

Figs 9A, 10

UGS-3, unidentified genus & species - Taylor et al. 2011, fig. 7J.

**Type material.** *Holotype*: paired valves, live collected (MNHN IM-2009-10376) L 24.5 mm H 23.2 mm T whole shell 15.0 mm. *Paratypes*: 1 paired valve (MNHN



**Figure 10.** *Gonimyrtea ferruginea* new species. **A** Holotype, MNHN IM-2009-10376 exterior of left valve. L = 24.5 mm **B** Holotype, dorsal view **C** Paratype MNHN IM-2009-10376 exterior right valve L = 15.9 mm **D–E** Paratype MNHN IM-2009-10376 exterior and interior of right valve, sequenced specimen L = 24.0 mm **F–H** Paratype MNHN XXXXXXXX exterior of right valve and interior of left and right valves. New Caledonia MUSORSTOM 4 stn CP236, 495–550 m, L = 12.5 mm **I–L** from BATHUS 2: stn DW740, 22°36'S, 166°27'E, 570–605 m **I** Detail of sculpture, scale bar = 500 µm **J, K** Details of hinge teeth right and left valves. Scale bar = 1 mm. **L** Protoconch. Arrow marks boundary between PI and PII. Scale bar = 100 µm.

IM-2009-10376) L 24.0 mm H 22.0 mm T 6.5 mm (single valve); 1 pv (MNHN IM-2009-10376) L 15.9 mm H 14.2 mm T 7.7 mm.

**Type locality.** New Caledonia, Chesterfield Bank, 19°35'S, 158°48'E, 680–722 m. N/O Alis campagne EBISCO 2005 stn CP2614.

**Material examined.** All MNHN material from several deep water cruises in South west Pacific (for details see - [www.mnhn.fr/musorstom/](http://www.mnhn.fr/musorstom/)). **New Caledonia**, MUSORSTOM 4: 1 valve, stn CP158, 18°49'S, 163°15'E, 625 m. 2 valves, stn CP179 18°57'S 163°14'E, 475 m. 1 paired valve, stn CP 236, 22°11'S, 167°15'E, 495–550 m. **BATHUS** 2: 1 paired valve, stn DW740, 22°36'S, 166°27'E, 570–605 m. **BATHUS** 4: 1 valve, stn CP 900, 20°17'S, 163°50'E, 580 m. 2 valves, stn DW 908, 18°58'S, 163°11'E, 502–527 m. 1 valve, stn CP905, 19°02'S, 163°16'E, 294–296 m. 1 valve, stn CP954, 21°44'S, 166°36'E 250–255 m. **BIOCAL**: 1 valve, stn DW40, 22°55'S, 167°24'E, 650 m. **Chesterfield Bank**, MUSORSTOM 5: 5 valves, stn 380, 19°38'S, 158°44'E, 555–570 m. 24 valves, stn 381, 19°38'S, 158°47'E, 620 m. **Coral Sea, Kelso Bank**, MUSORSTOM 5: 2 valves, stn 284, 24°10'S, 159°33'E, 225–230 m. **Vanuatu**, MUSORSTOM 8: 1 valve, stn DW1072, 15°40'S, 167°20'E, 622–625 m. **SW Pacific, Wallis Island**, MUSORSTOM 7: 3 valves, stn DW526, 13°13'S, 176°15'E, 355–360 m. 5 valves, stn DW527, 13°24'S, 176°15'W 540–560 m. 10 valves, stn DW 528, 13°24'S, 176°13'W, 435–515 m. 8 valves, stn DW601, 13°19'S, 176°17'W, 350 m. **Bank Bayonnaise**, MUSORSTOM 7: 1 valve, stn DW626, 11°54'S, 179°32'W 597–600 m. 2 valves, stn CP629, 11°54'S, 179°32'W, 400–420 m. **Tuscarora Bank**, MUSORSTOM 7: 35 valves, stn DW556, 11°49'S, 178°18'W, 440 m.

**Description.** Shell white, L to 25 mm H to 23.5 mm; subcircular, H/L  $0.91 \pm 0.017$  (n=10), inflated T/L  $0.28 \pm 0.02$  (n=10), sculpture of fine, low, rounded, regular, closely spaced, commarginal lamellae, radial sculpture absent, dorsal areas characteristically with ferruginous encrustations. Lunule short, lanceolate, symmetric. Protoconch (Fig. 10L): PI+PII 275  $\mu$ m, PII, a narrow, 19  $\mu$ m rim with fine increments. Ligament inset in narrow groove. Hinge (Figs 10J, K) LV with 2 cardinal teeth the posterior larger, can be obscure, lateral teeth not visible, RV with 2 cardinals, very small anterior lateral tooth, posterior lateral absent. Anterior adductor muscle scar long detached for  $\frac{1}{2}$  length, at an angle of 10–15°. Posterior adductor scar ovoid. Pallial line continuous, shell margin smooth.

**Distribution.** New Caledonia, Vanuatu, and banks and islands in SW Pacific, in deeper water between 350 and 650 m (Fig. 4).

**Remarks.** Compared to the genotype, *G. concinna* from New Zealand, at depths to 200 m, *G. ferruginea* occurs in much deeper water, is larger, the lateral teeth are less distinct, and commarginal lamellae are more closely spaced. Another deeper water species of *Gonimyrtea* is known from the Philippines (Glover and Taylor in press) occurs at depths of 500–1000 m but is smaller than *G. ferruginea*, more elongate, lamellae are narrower, the interspaces wider, and the lunule deeper and longer.

Both *G. ferruginea* and the new species from the Philippines typically have dense iron-rich encrustations on the dorsal areas of the shell (Fig. 10A–D). This also occurs in *Dulcina guidoi* from central Philippines at similar depths (Cosel and Bouchet 2008)

but is an unusual feature of lucinids that otherwise often exhibit some brown staining around the anterior inhalant area and posterior apertures.

Molecular analyses show that *G. ferruginea* (as UGS-3 in Taylor et al. 2011) aligns in the subfamily Leucosphaerinae close to species of *Dulcina*. GenBank numbers FR 686701, FR 686779, FR 686606

**Etymology.** Derived from Latin *ferrugineus* meaning rust-coloured. Adjective in nominative singular.

### Genus *Myrtina* Glover & Taylor, 2007

<http://species-id.net/wiki/Myrtina>

**Type species.** *Myrtina porcata* Glover & Taylor, 2007 original designation.

**Diagnosis.** Shell small, L to 16 mm, subcircular, posterior margin quadrate, sculpture of commarginal lamellae, elevated commarginal lamellae on dorsal margin, radial sculpture absent, lunule often strongly asymmetric, hinge with cardinal teeth in both valves, lateral teeth strong to obscure with RV anterior lateral tooth generally larger, anterior adductor muscle scar short, detached for about 1/5 length, pallial line either entire or in close, small blocks.

**Remarks.** Eight species of *Myrtina* are known from the central IWP from shallow offshore to deeper water (Glover and Taylor 2007, in press; Fengshan 2011), including the Japanese species formerly known as *Lucinoma adamsiana* Habe, 1958.

### *Myrtina reflexa* sp. n.

<http://zoobank.org/C5254102-0F66-41A0-9A3E-8DB483BB7D44>

[http://species-id.net/wiki/Myrtina\\_reflexa](http://species-id.net/wiki/Myrtina_reflexa)

Figs 9B, 11

*Lucina inanis* (Prashad, 1932) - Knudsen 1967: 286, pl. 2 figs 9,11. (non Prashad 1932). 'Lucina inanis Prashad' - Cosel and Bouchet 2008: 188, figs 55 A–F.

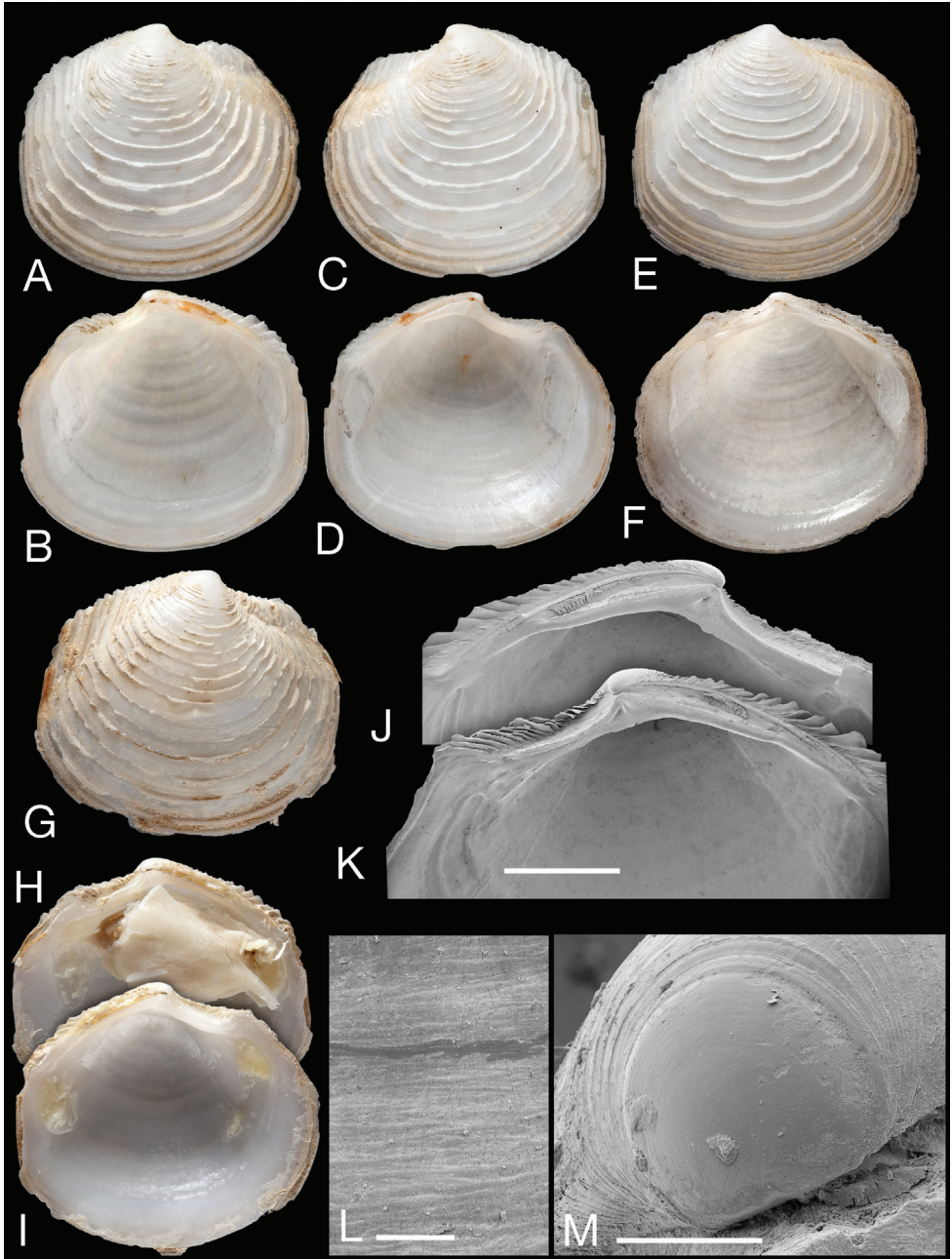
**Type material.** *Holotype*: 1 whole shell, L 10.5 mm, H 9.4 mm, T 2.5 mm, NHMUK 1968738, John Murray Expedition stn 125, 825m, 5°36'12"S, 39°28'24"E off Zanzibar.

*Paratypes*: 2 RV, L 10.7 mm H 9.5 mm T 2.5 mm, L 11.8 mm H 10.7 mm T 2.8 mm, NHMUK 1968738 locality as holotype; 17 valves (13 RV, 4 LV), figured paratype (Fig. 11E–F) RV, L 15 mm, H 13.3 mm, NHMUK 20130121, John Murray Expedition stn 106, 183–194 m, 5°38'54"S, 39°18'42"E, off Zanzibar.

**Other material.** 1 whole shell (live collected) L 14.2 mm, H 12.7 mm, T 3.3 mm, MNHN IM 2009-8733, MIRIKY stn DW3239 14°30'S, 47°26'E, 230–288 m, off NW Madagascar.

**Description.** Shells greyish white, H to 13.5 mm, L to 15.2 mm, T 3.8 mm, longer than high H/L =  $0.91 \pm 0.038$  (n=8), T/L =  $0.24 \pm 0.018$  (n=8), subovate,





**Figure 11.** *Myrtina reflexa* new species. **A–D** Holotype, NHMUK 196838 exterior and interior of right (**A–B**) and left valves (**C–D**), L = 10.5 mm **E–F** Paratype NHMUK 20130121 John Murray Expedition stn 106, exterior and interior of right valve. L = 15 mm **G–I** Exterior of right valve and interior of right and left valves, MNHN IM 2009-8733, MIRIKY stn DW3239, 14°30'S, 47°26'E, 230–288 m, off NW Madagascar, L = 14.2 mm **J–K** Details of hinge of holotype left and right valves. Scale bar = 2.0 mm **L** Detail of microsculpture, holotype. Scale bar = 50  $\mu$ m **M** Protoconch of holotype. Scale bar = 100  $\mu$ m.



posterior truncate, anterior dorsal area marked by shallow double sulcus, anterior dorsal margin with elevated lamellae, umbones low, sculpture of widely spaced commarginal lamellae that are reflected ventrally, no radial sculpture. Microsculpture of fine growth increments (Fig. 11L). Lunule lanceolate, strongly asymmetric with larger part in LV. Protoconch (Fig. 11M): PI+ PII 183  $\mu\text{m}$ , PII a narrow rim. Hinge (Figs 11J, K): LV with 1 thin cardinal tooth, laterals absent, RV with small, single, cardinal tooth, small anterior lateral tooth, posterior lateral teeth absent. Anterior adductor scar short, detached from pallial line for  $\frac{1}{4}$  of length, posterior scar ovoid. Pallial line discontinuous in short narrow blocks. Shell interior glossy, shell margin smooth.

**Distribution.** Western Indian Ocean, off Zanzibar and Madagascar from 200–825 m (Fig. 4).

**Etymology.** Latin *reflexa* means bent or turned back, a reference to the form of the commarginal lamellae. Adjective nominative singular

**Remarks.** This species was referred to *Lucina inanis* (Prashad) by Knudsen (1967) and the same specimens were figured and briefly discussed by Bouchet and Cosel (2008) who thought they more closely resembled species of *Alucinoma*. The type and other material of *L. inanis* from Indonesia and Philippines differ in shape and lack the regular, reflexed commarginal lamellae (Glover and Taylor in press). Characters of the new species suggest a placement in *Myrtina* and this position is corroborated by molecular evidence that places *Myrtina reflexa* in the subfamily Leucosphaerinae close to species UGS -1 (now recognised as a new *Myrtina* species) from the Philippines (Taylor et al. 2011). *Myrtina* occur in offshore habitats from 30–1200 m from the Philippines and New Caledonia and are likely present in organically enriched sediments throughout the tropical Indo-West Pacific.

*Myrtina reflexa* differs from the genotype, *M. porcata*, by the more widely spaced and reflexed commarginal lamellae. It is most similar to a new *Myrtina* species (Glover and Taylor in press) from 200–1200 m around the Philippines but is larger and has more prominent and reflexed commarginal lamellae.

## Acknowledgements

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# A new genus and species of Tullbergiidae (Collembola) from the Pacific Mexican coast

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## Abstract

The new genus *Mexicaphorura*, and its type species *M. guerrensis* **sp. n.** are described from marine littoral sand. The new genus is similar to *Sensilatullbergia* Thibaud & Ndiaye, 2006 in having very big sensilla on sensorial organ of antennal segment III, but of different shape, the kind of postantennal organ, with simple vesicles in *Mexicaphorura* versus composed vesicles in *Sensilatullbergia* and formulae of the pseudocelli.

## Keywords

Tullbergiidae, Taxonomy, Mexico

## Introduction

The family Tullbergiidae has 32 genera and 212 species in the world (Bellinger et al. 2013), but from Mexico only 23 species in 6 genera are known (Palacios-Vargas 1997; Thibaud and Palacios-Vargas 2000). It is an euedaphic group of Collembola, which members usually are very small (500–600 µm) without pigmentation, eyes

and furcula. The body chaetotaxy of the taxa are very similar, and the main differences among the genera are the sense organ structure of antennal organ III, and the chaetotaxy of the antennal segment IV. The type and number of the pseudocelli and the shape and number of vesicles of postantennal organ have importance at specific and generic level.

Tullbergiidae are much more diverse and abundant in the Southern Hemisphere, where it seems to have its center of dispersion and diversification (Dunger and Schlitt (2011) it has eight endemic genera in this region and only three cosmopolitan genera: *Fissuraphorura*, *Mesaphorura* and *Tullbergia*. While the members of the related family Onychiuridae are widely and often only distributed in the Northern Hemisphere (except for the cosmopolitan genera *Protaphorura*, *Thalassaphorura*, *Agraphorura*, *Deuteraphorura* and *Orthonychiurus*).

Most remarkable contributions on this family from Mexico are those of Bonet (1946) and Palacios-Vargas and Díaz 1995a; 1995b). *Mesaphorura matilei* Thibaud & Palacios-Vargas was described from marine littoral sand (Thibaud and Palacios-Vargas 2000). In this paper we describe one new Tullbergiidae also from marine littoral sand but this is the most extraordinary species found in Mexico because of its morphology.

## Materials and methods

Specimens of the new taxa were obtained by washing sand in sea water and the floating specimens were preserved in alcohol 75%. In the laboratory they were sorted and mounted on Hoyer's solution for their taxonomic study.

Abbreviations used in this paper are: Ant. = antennal segment; Abd. = abdominal segment; PAO = postantennal organ; Th. = thoracic tergite.

## Taxonomy

### *Mexicaphorura* gen. n.

<http://zoobank.org/5194EC74-6F45-4D90-8F3F-797267412A3D>

<http://species-id.net/wiki/Mexicaphorura>

**Diagnosis.** Habitus of *Mesaphorura*. Small size, about 0.6 mm. Color white. Tegumentary grain fine and uniform. Ant. III with 2 big and modified dorsal sensilla of different shape and one big ventral sensillum cup-like shaped. Formulae of the pseudocelli in the type species 11/122/22221. Pseudocelli of Abd. V guarded by the sensory setae similar to normal setae. Abd. IV tergite without posterior surrounding semicircular narrow ridge. One pair of small and simple anal spines.

**Type species.** *Mexicaphorura guerrensis* sp. n.



***Mexicaphorura guerrerensis* sp. n.**

<http://zoobank.org/5BD1D88F-3D9E-477F-8162-1BA4F99A6F13>

[http://species-id.net/wiki/Mexicaphorura\\_guerrerensis](http://species-id.net/wiki/Mexicaphorura_guerrerensis)

Figs 1–7

**Material examined.** Type-locality: Mexico: Guerrero State: Marquelia. La Bocana beach. 16°34'60"N; 98°49'0"W; ex littoral marine sand. February and April of 2013, José G. Palacios-Vargas, Jaramar Villareal, Fernando Villagomez collectors. Specimens come from the Pacific Mexican coast, this place is known because the presence of turtle camps for protection of the turtles which come to lay their eggs.

Holotype. Male mounted on slide. Original label: 12/02/2012, ex littoral marine sand from a nest of turtle, J. G. Palacios-Vargas col. Paratypes. 4 females, 2 males, 2 juveniles. Original labels. 14/04/2012, ex littoral marine sand, J. Villarreal and F. Villagomez col. All the material is deposited at Facultad de Ciencias, UNAM.

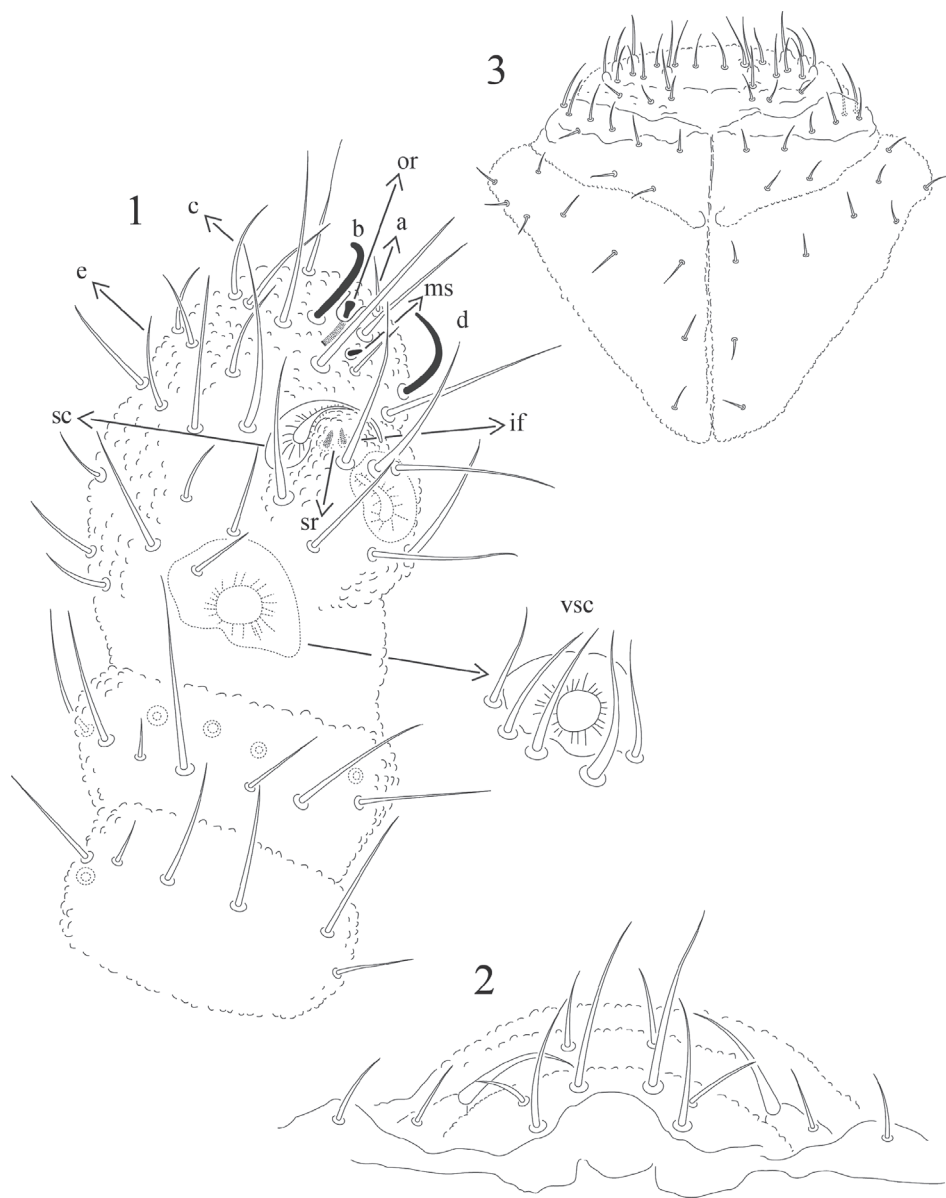
**Diagnosis.** Ant. III with 2 big and modified dorsal sensilla of different shape and one big ventral sensillum cup-like shaped. Postantennal organ with 31–43 simple vesicles in four irregular rows. Pseudocelli are star shaped (type 1 of Dunger and Schlitt 2011), formula 11/122/22221. Sensory setae on Abd. V similar to normal setae. Abd. IV without semicircular narrow ridge. One pair of very small and simple anal spines.

**Description.** Body length (n=9) 600 µm (range 410–720), body with moderately long macrosetae (33 µm), and short microsetae (7 µm), all smooth and thin. Tegumentary granules fine, equally distributed on head and thoracic and abdominal tergites, with relatively uniformly distributed fine intersegmentary granules, interspersed with somewhat coarser granules on Abd. VI. Antennal bases well delimited.

Ratio head: antenna = 1: 0.7. Lengths ratios of Ant. segments I: II; III; IV as 1:0.8; 0.8; 1.3. Sense organ of Ant. III with two small sensory rods concealed behind one big integumentary fold; two thick cup-shaped sensory clubs present, which are rounded at the tip, strongly bend each other and not completely concealed by papillae. Three thick and long guard setae inserted at base of papillae. One big cup-like ventral sensillum protected by five setae (Fig. 1). Ant. IV with 2 thick distinct sensilla, 3 thin sensilla difficult to distinguish except for their size shorter than ordinary setae. There is also one distinct subapical pit with the “organite”, one microsensillum and probably one apical bulb very difficult to distinguish (Fig. 1).

Labrum formula, 2/4/2, as illustrated in Fig. 2. Mandible only with one big apical tooth and basal molar surface. Maxilla with six fringed lamellae. Labium with 3 similar pairs of postlabial setae (Fig. 3), and labial palp with one apical thick setae and one thin and short lateral setae (Fig. 2). PAO ovoid, about half as long and the width of the Ant. I, with about 37 (31–43) simple vesicles lying in four irregular rows (Fig. 4).

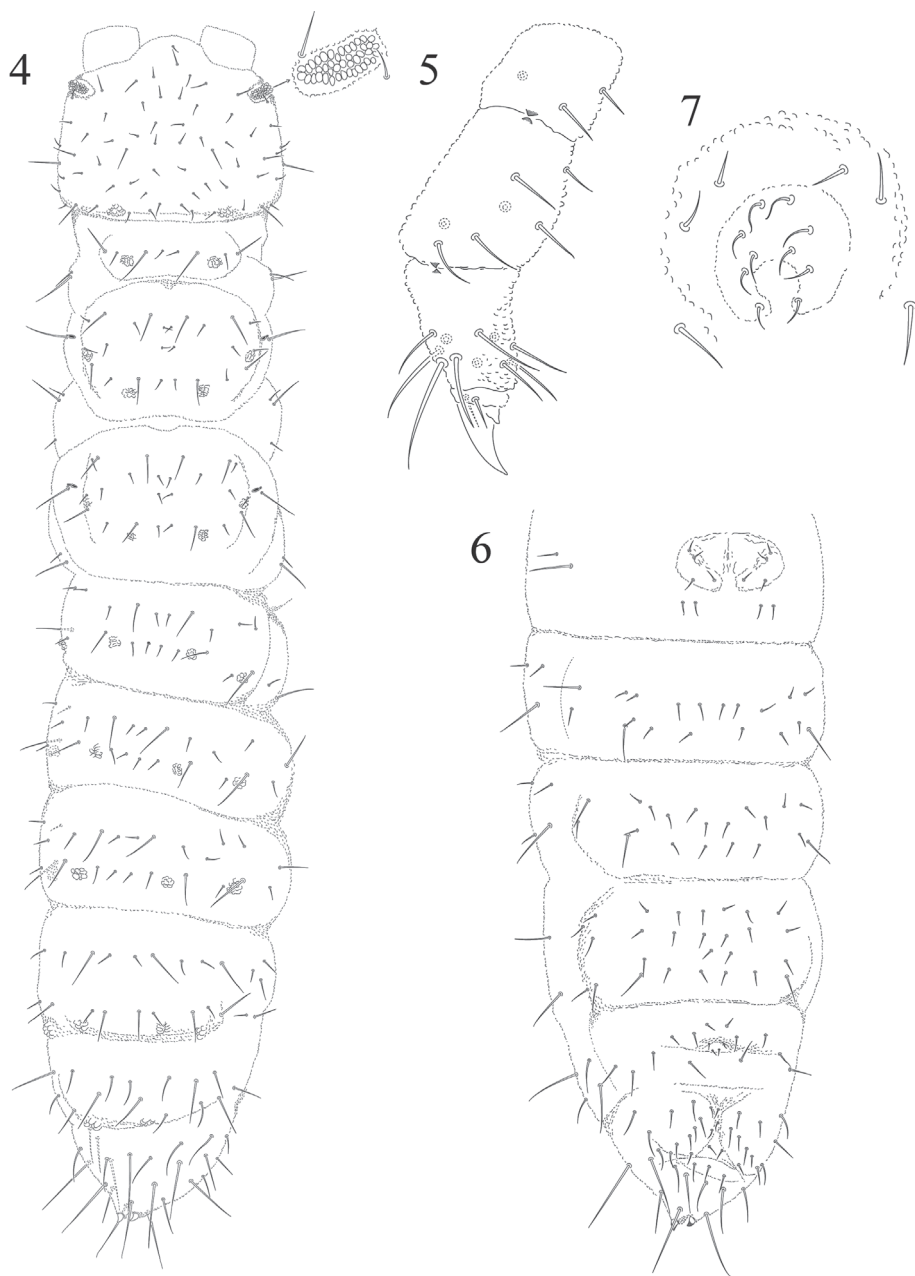
Leg chaetotaxy from I to III, coxae 3,5,5; trochanters 5,5,5; femora 8,8,8; tibiotarsi 12,12, 11. Claw untoothed. Empodial appendage rudimentary, in shape of a minute claw-like process. Clavate tibiotarsal setae absent (Fig. 5), three dorso-distal



**Figures 1–3.** *Mexicaphorura guerrensis* sp. n. **1** dorsal antennal segments I to IV, with detail of the ventral sensillum of Ant. III **2** chaetotaxy of labrum **3** chaetotaxy of labium. a,b,d,e = sensilla on Ant. IV, so = subapical organite, ms = microsensillum, sc = thick sensory clubs on Ant. III, sr = sensory rods, if = integumentary fold, vsc = ventral sensory club on Ant. III.

setae thicker and longer than the others. Dorsal pseudocelli are irregular in shape and arranged as follows: 11/122/22221 (Fig. 4).

Body chaetotaxy in figure 4 and Table 1. Th. I with one row of 5 + 5 setae, first and third very small, second and fourth long; two lateral setae on each side. Th. II



**Figures 4–7.** *Mexicaphorura guerrensis* sp. n. **4** dorsal chaetotaxy of body **5** tibiotarsus III **6** ventral abdominal chaetotaxy **7** male genital plate.

and III with lateral microsensillum, both with 3 rows of setae, m2 absent. Abd. I to Abd. V with 2 rows of setae, Abd. V lacking a2. Pseudocelli are star shaped. Ventral tube with 6 + 6 setae. (Fig. 6). Pseudocelli of Abd. V guarded by sensory setae similar

**Table 1.** Dorsal chaetotaxy of *Mexicaphorura guerrerensis* sp. n.

row	Thorax			Abdomen				
	I	II	III	I	II	III	IV	V
a	-	10	10	10	10	10	10	8
m	-	8*	8*	2**	2**	2**		8
p	8	10	10	10	10	10	10	8
pl	2	3	2	2	2	3	4	2

\* Missing m2, \*\* m4 present

to normal setae. Abd. IV tergite without a surrounding semicircular narrow ridge (Fig. 4).

Female genital plate similar to lips, furnished on upper lip with three pairs of pre-genital setae, two circumgenital setae and one pair of eugenital setae (Fig. 6). Male genital plate with two pairs of pregenital setae, two pairs of circumgenital and three pairs of eugenital setae. Anal spines very short and weak, but usually slightly curved and placed on small papillae which touch at their bases (Fig. 4). Ratio anal spine: unguis: 1: 1.9.

**Etymology.** The species is named after the State of Guerrero, where it was found.

**Distribution.** Known only from the type locality, at Guerrero State, México.

**Ecology.** This species lives in marine littoral sand. The first specimen was obtained in the floating foam of samples of sand taken from a nest of the Golf turtle *Lepidochelys olivacea* (Cheloniidae). Other specimens were obtained from 12 different places where 4 samples of sand were taken at each and washed. It seems to be very rare species as only 9 specimens were obtained from a total of 48 samples of sand. The new species have fringed maxillae as most of marine littoral Collembola.

**Discussion.** The new genus is similar *Sensilatullbergia* Thibaud & Ndiaye, 2006 from Senegal because the presence of three big sensilla on Ant. III, two dorsal and one ventral. Because of the number of sensilla on the sensorial organ of Ant. III, this genus belongs to the Tullberginae. Although both genera share the presence of big sensilla on Ant. III, they completely differ in their shape. Other important differences are, vesicles of the postantennal organ in *Mexicaphorura* gen. n. are simple while in *Sensilatullbergia* they are composed of several vesicles each; the number of sensilla on Ant. IV (5 versus 6), apical bulb of antennal segment (indistinguishable versus present), and the sensillum of Abd. V (seta-like versus sensilliform).

*Mexicaphorura guerrerensis* sp. n. is completely different from any Mexican Tullbergiidae known from Mexico. It only can be compared with *Sensilatullbergia senegalensis* Thibaud & Ndiaye, 2006 from littoral marine sand of Senegal because the presence of three big sensilla on Ant. III. Any way they have many differences as the kind of vesicle of the postantennal organ, the number of sensilla on Ant. IV, apical bulb of antennal segment and the sensillum of Abd. V. The chaetotaxy also differs, because the Th. II and III of *M. guerrerensis* sp. n. lacks the seta m2; Abd. V has only two rows of setae while *S. senegalensis* has 3 rows of setae and the presence of a2.

**Variation.** The number of vesicles of postantennal organ varies from 31 to 41. The length of PAO varies from 8 to 15 µm. The total body goes from 411 to 670 µm.

## Acknowledgements

The type locality was visited thanks to the invitation of Mr. José A. Palacios Pineda. One field trip to obtain more specimens was done by Biols. Jaramar Villarreal and Fernando Villagomez, the first one made the revision of the samples, sorting of the specimens and prepared the slides in Hoyer's solution. María de Jesús Martínez prepared the final plates of the new taxa.

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