

# Three new species of *Potamothrix* (Oligochaeta, Naididae, Tubificinae) from Fuxian Lake, the deepest lake of Yunnan Province, Southwest China

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## Abstract

Three new species of *Potamothrix* Vejvodský & Mrázek, 1902 (Oligochaeta: Tubificinae), *P. praeprostatus* sp. n., *P. paramoldaviensis* sp. n. and *P. parabedoti* sp. n., are reported from Fuxian Lake of Yunnan Province, Southwest China. *P. praeprostatus* differs from its allies by its prostate glands joining atria in its proximal to middle portion, and spermathecal chaetae. *P. paramoldaviensis* is distinguishable from its allies by having penial chaeta but no penes, and differs from *P. moldaviensis* by its homogenous atrium. *P. parabedoti* is distinctive in the position of its reproductive organs, and differs from *P. bedoti* by its homogenous atrium. Hitherto, 34 freshwater oligochaete species have been recorded in Yunnan Province, including nine endemic species from the plateau lakes.

## Keywords

*Potamothrix*, Naididae, Tubificinae, taxonomy, new species, Yunnan Province, China

## Introduction

The existence of unique faunae in ancient lakes of Yunnan Province, Southwest China has been recognized in several studies (Yang and Chen 1995; Sket 2000). However, our knowledge of freshwater oligochaetes in these lakes is poor; only an aberrant bran-

chiobdellidan species was reported from Erhai Lake (Liang 1963). During a limnological investigation of lakes in this province in 2002–2003, a number of oligochaete samples were collected. In five previous accounts (Cui and Wang 2005, 2008, 2009, 2012; Cui et al. 2008), 31 species representing 14 genera were reported on the basis of the collected material. As a serial study, this paper gives the description of three new species of *Potamothrix* Vejdovský & Mrázek, 1902 (Oligochaeta: Naididae, Tubificinae) from Fuxian Lake, *P. praeprostatum* sp. n., *P. paramoldaviensis* sp. n. and *P. parabedoti* sp. n.

## Material and methods

Being the deepest lake on the Yunnan-Guizhou Plateau, the Fuxian Lake (24°17'–37'N, 102°49'–57'E) is located in the eastern part of Yunnan Province, and it discharges into the upper reaches of Nanpanjiang River. The lake covers an area of 211 km<sup>2</sup> at its surface water-level of 1721 m ASL, attaining a maximum depth of 155 m and a shoreline development ( $D_L$ ) of 1.72. For other characteristics of the lake, the reader may refer to our three previous accounts (Cui et al. 2008; Cui and Wang 2008, 2009).

Lake sediment samples were collected with a weighted Petersen grab (1/16 m<sup>2</sup>) and cleaned with a 250 µm sieve. Large worms were manually sorted in a white porcelain dish and small ones were sorted under a dissecting microscope. Specimens were all preserved in 10% formalin.

Preserved specimens were examined first in temporary glycerine mounts, then stained with borax carmine, dehydrated in an alcohol series, cleared in xylene and mounted in Canada balsam. Measurements of body and chaeta were made from the glycerine mounts. Other observations were made on the permanent mounts. Drawings were made using a camera lucida. Types and other specimens were deposited in Institute of Hydrobiology (IHB), Chinese Academy of Sciences (CAS), Wuhan, China.

## Abbreviation used in the figures

Roman numerals = segment number; at = atrium; mu = muscle; pc = penial chaeta; pe = penis; pr = prostate gland; ps = penial sac; sa = spermathecal ampulla; sc = spermathecal chaeta; scs = spermathecal chaeta sac; sd = spermathecal duct; sf = sperm funnel; sz = spermatozeugmata; vd = vas deferens.

## Taxonomy

### *Potamothrix* Vejdovský & Mrázek, 1902

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

**Type species.** *Potamothrix moldaviensis* Vejdovský and Mrázek, 1902

**Emended diagnosis.** Hair chaetae present or absent, dorsal chaetae bifid and always pectinated, or only bifids. Ventral chaetae bifids. No coelomocytes. Vas deferens very short, entering atrium apically; atrium tubular, long. Prostate gland small, attached to proximal part of atrium by a short stalk, or no prostate gland. No ejaculatory duct. Penis with or without cuticular sheath. Spermatzozeugmata present. Modified spermathecal chaetae present or absent.

**Remarks.** The genus *Potamothrix*, established by Vejvodský and Mrázek (1902) for *P. moldaviensis* Vejvodský & Mrázek, 1902, was revised by Holmquist (1985) and Finogenova and Poddubnaja (1990). Altogether, 20 species were previously known and mainly distributed in the Holarctic region (Table 1) (Brinkhurst and Jamieson 1971; Hrabě 1981; Brinkhurst and Wetzel 1984; Finogenova and Poddubnaja 1990; Šporka 1994; Milbrink 1999; Milbrink and Timm 2001). Through recent investigation of the plateau lakes, three species of *Potamothrix* (Oligochaeta: Tubificinae), *P. rhytipeniatus* Cui & Wang, 2012, *P. aductus* Cui & Wang, 2012 and *P. scleropenis*, have been found in the Fuxian Lake and Xingyun Lake of Yunnan Province, Southwest China (Cui and Wang 2005). They are the lowest-latitude members of the genus hitherto known. Moreover, studies show that *Potamothrix* is unexpectedly species-rich in plateau lakes of Yunnan Province, especially in Fuxian Lake where five species were recorded (Cui 2008; Cui and Wang 2005; Cui et al. 2008). In this paper, we will give the description of three new species, *P. praeprostatatus* sp. n., *P. paramoldaviensis* sp. n. and *P. parabedoti* sp. n., from Fuxian Lake.

***Potamothrix praeprostatatus* sp. n.**

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[http://species-id.net/wiki/Potamothrix\\_praeprostatatus](http://species-id.net/wiki/Potamothrix_praeprostatatus)

**Holotype.** IHB YAN 20021205b, mature specimen mounted in Canada balsam, and stained with borax carmine.

**Type locality.** East of Lichang (24°32'04"N, 102°51'43"E) in Fuxian Lake, eastern Yunnan, China; depth 113 m, bottom temperature 13.5°C, dissolved oxygen at bottom 5.2 mg/L, total nitrogen in water 0.164 mg/L, total phosphorus in water 0.037 mg/L, fine clay; Dec 11, 2002, coll. Y. Cui and X. Liu.

**Etymology.** “*prae*” and “*prostatatus*” are Latin for “proximal” and “prostate”, respectively. The specific name refers to the prostate glands proximally attached to atria.

**Description.** One complete specimen 7.6 mm long, diameter at XI about 0.8 mm, 27 segments. Prostomium conical. Clitellum inconspicuous.

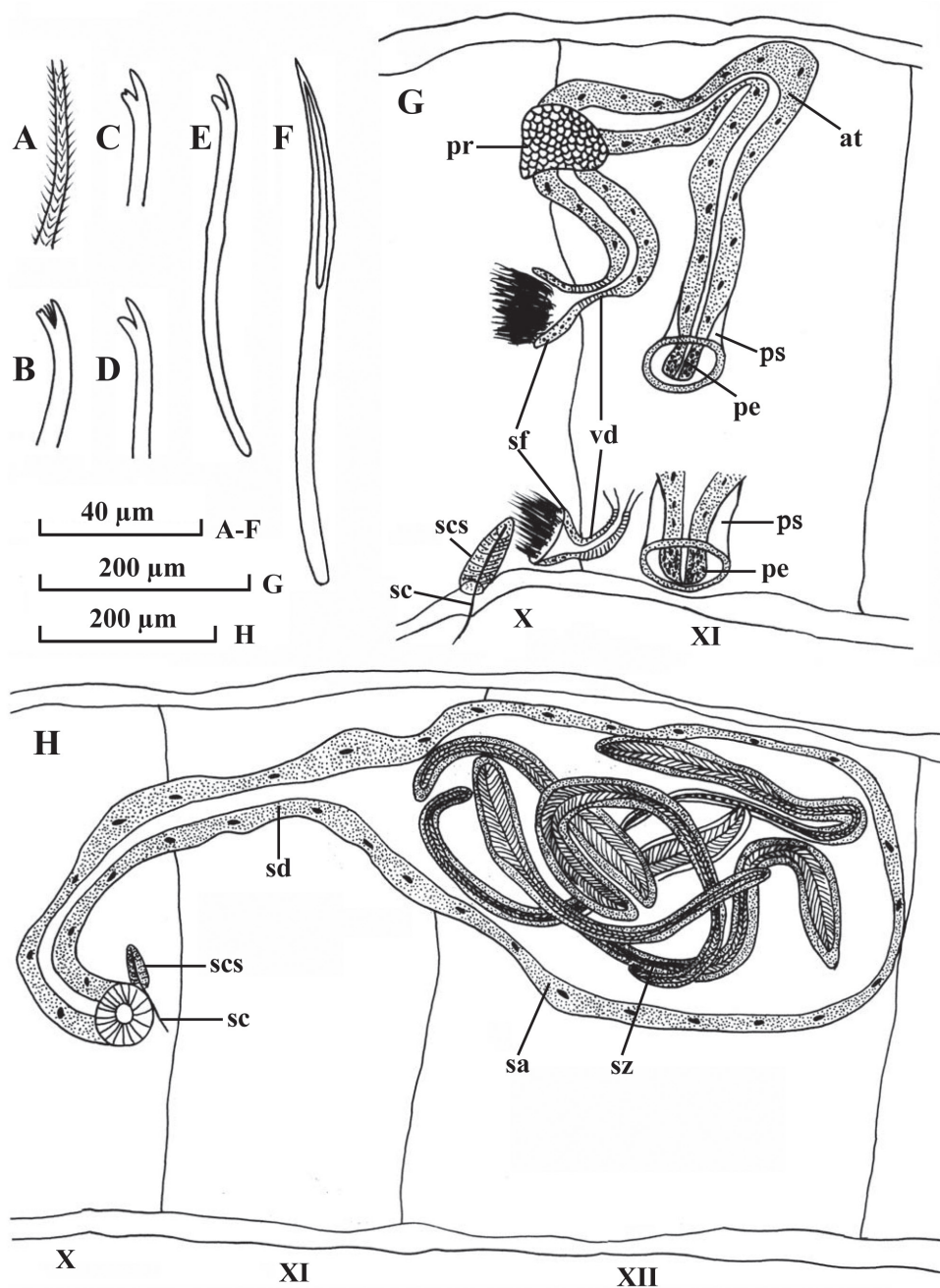
Dorsal chaetae (Fig. 1C–D) of II–IV bifid only, 7–10 per bundle, 135–148 µm long, 3.0–3.5 µm thick, upper tooth longer and thinner than lower, lower tooth occasionally bifurcated. Dorsal bundles of V–X with 5–8 hair chaetae and 5–7 bifid chaetae; plumose hair chaetae (Fig. 1A), 240–420 µm long, 2.6–3.2 µm thick basally; pectinate bifid chaetae (Fig. 1B), 120–140 µm long, 2.8–3.2 µm thick, with 1–2 intermediate teeth, upper tooth slightly longer and thinner than lower tooth (usually bifurcated), or equally long. Dorsal bundles in posterior segments with 1–4 hair chae-

**Table 1.** Principal distinguishing characteristics of the species of *Potamothrix*

| No | Species                                         | Chaetae |              |                       | Length ratio of vd/at | Prostate gland | Atrium     | Penis   | Distribution                      | References                                                                           |
|----|-------------------------------------------------|---------|--------------|-----------------------|-----------------------|----------------|------------|---------|-----------------------------------|--------------------------------------------------------------------------------------|
|    |                                                 | Hair    | Dorsal bifid | Spermathecal          | Penial                |                |            |         |                                   |                                                                                      |
| 1  | <i>P. alatus</i> (Finogenova, 1972)             | present | pectinated   | present               | absent or unmodified  | present        | tripartite | present | Russia                            | Finogenova and Poddubnaja 1990                                                       |
| 2  | <i>P. bavariensis</i> (Oschmann, 1913)          | present | pectinated   | present               | unmodified            | absent         | tripartite | present | Holarctic, Australia, New Zealand | Timm 1970; Brinkhurst and Jamieson 1971; Finogenova and Poddubnaja 1990              |
| 3  | <i>P. bedoti</i> (Piguet, 1931)                 | present | pectinated   | present               | unmodified            | absent         | tripartite | present | Europe, North America, China      | Timm 1970; Timm 1999; Wang and Liang 2001                                            |
| 4  | <i>P. caspicus</i> (Lastockin, 1937)            | absent  | bifid        | absent, or 2–3 bifids | absent or unmodified  | present        | bipartite  | present | Russia                            | Finogenova and Poddubnaja 1990                                                       |
| 5  | <i>P. cekanovskajae</i> (Finogenova, 1972)      | absent  | bifid        | absent, or 4–5 bifids | unmodified            | absent         | bipartite  | present | Caspian Sea                       | Finogenova and Poddubnaja 1990                                                       |
| 6  | <i>P. danubialis</i> (Hrabě, 1941)              | absent  | bifid        | present               | absent or unmodified  | present        | bipartite  | present | Russia                            | Finogenova and Poddubnaja 1990                                                       |
| 7  | <i>P. hammoniensis</i> (Michaelsen, 1901)       | present | pectinated   | present               | absent or unmodified  | present        | bipartite  | present | Holarctic                         | Finogenova and Poddubnaja 1990                                                       |
| 8  | <i>P. heuscheri</i> (Bretscher, 1900)           | present | pectinated   | present               | unmodified            | absent         | tripartite | present | Europe, Israel                    | Brinkhurst and Jamieson 1971; Finogenova and Poddubnaja 1990; Milbrink 1999          |
| 9  | <i>P. isochaetus</i> (Hrabě, 1931)              | absent  | bifid        | present               | -                     | present        | -          | present | Europe                            | Brinkhurst and Jamieson 1971                                                         |
| 10 | <i>P. manus</i> (Finogenova, 1972)              | absent  | bifid        | present               | unmodified            | absent         | bipartite  | present | Caspian Sea                       | Finogenova and Poddubnaja 1990                                                       |
| 11 | <i>P. marsekei</i> (Hrabě, 1941)                | absent  | bifid        | absent, or 1–2 bifids | absent or unmodified  | present        | bipartite  | present | Russia, Czech                     | Hrabě 1981; Finogenova and Poddubnaja 1990                                           |
| 12 | <i>P. moldaviensis</i> Vejdovsky & Mrazek, 1902 | absent  | bifid        | present               | unmodified            | absent         | tripartite | present | Holarctic                         | Brinkhurst and Jamieson 1971; Finogenova and Poddubnaja 1990; Milbrink and Timm 2001 |
| 13 | <i>P. ochridanus</i> (Hrabě, 1931)              | present | bifid        | absent                | unmodified            | present        | -          | present | North America, Serbia             | Brinkhurst and Jamieson 1971                                                         |

|    |                                             |         |            |         |                         |         |         |                  |         |                          |                                |
|----|---------------------------------------------|---------|------------|---------|-------------------------|---------|---------|------------------|---------|--------------------------|--------------------------------|
| 14 | <i>P. orientalis</i><br>(Černosvitov, 1938) | present | bifid      | present | -                       | -       | absent  | -                | -       | North America            | Brinkhurst and Jamieson 1971   |
| 15 | <i>P. postojnae</i><br>Karaman, 1974        | present | pectinated | absent  | -                       | -       | present | homo-<br>geneous | -       | Slovenia                 | Brinkhurst and Wetzel 1984     |
| 16 | <i>P. prespatensis</i><br>(Hrabě, 1931)     | present | bifid      | present | -                       | -       | absent  | -                | present | Serbia                   | Brinkhurst and Jamieson 1971   |
| 17 | <i>P. svirenkoi</i><br>Lastočkin, 1937      | present | bifid      | present | -                       | -       | present | -                | -       | Europe, Russia           | Brinkhurst and Jamieson 1971   |
| 18 | <i>P. thermalis</i><br>(Pop, 1968)          | present | pectinated | present | unmodified              | 1:20    | present | tripartite       | present | Romania                  | Pop 1976                       |
| 19 | <i>P. tudomanceai</i><br>Šporka, 1994       | present | pectinated | present | -                       | 1:34    | absent  | homo-<br>geneous | present | Africa                   | Šporka 1994                    |
| 20 | <i>P. vejdoskyi</i><br>(Hrabě, 1941)        | present | bifid      | present | absent or<br>unmodified | 1:30–33 | present | bipartite        | present | Europe, North<br>America | Finogenova and Poddubnája 1990 |

“ - ” Unmentioned in the original descriptions



**Figure 1.** *Potamothrix praeprostata* sp. n., **A** hair **B** distal end of dorsal bifid from V **C** distal end of dorsal bifid from III **D** distal end of ventral chaeta from V **E** ventral chaeta from III **F** spermathecal chaeta **G** lateral view of male ducts in segments X–XI **H** lateral view of spermatheca in segments X–XII. Scale bars: A–F 40 μm; G–H 200 μm.

tae and 2–6 bifid chaetae, shorter and thinner than those of anterior segments, hair chaetae 280–320  $\mu\text{m}$  long, bifid chaetae 90–110  $\mu\text{m}$  long, 2.6–2.8  $\mu\text{m}$  thick. Ventral chaetae (Fig. 1D–E) bifid, 6–8 per bundle anteriorly, 140–150  $\mu\text{m}$  long, 3.0–3.5  $\mu\text{m}$  thick; 2–4 (5) per bundle in postclitellar segments, 80–110  $\mu\text{m}$  long, 2.4–3.2  $\mu\text{m}$  thick, all with teeth similar to the ones in dorsal chaetae in II–IV. Spermathecal chaetae (Fig. 1F, H, sc) one per bundle in middle to posterior of X, entally embedded in glandular sacs, about 145–160  $\mu\text{m}$  long, 4.0  $\mu\text{m}$  thick, with ectal part grooved. Penial chaetae absent. Male pores paired in line with ventral chaetae, anterior to middle of XI. Spermathecal pores paired in line with ventral chaetae, posterior to middle of X, immediately anterior to spermathecal chaetae.

Pharyngeal glands in II–III. Chloragogen cells from VI onwards. No coelomocytes. Male genitalia (Fig. 1G) paired. Vasa deferentia (Fig. 1G, vd) 38–65  $\mu\text{m}$  long, 16–22  $\mu\text{m}$  wide, entering atria apically. Atria (Fig. 1G, at) 690  $\mu\text{m}$  long, 28–80  $\mu\text{m}$  wide, tubular and rather homogenous throughout, with thin outer muscular layer and thick inner epithelium. Prostate glands (Fig. 1G, pr) small, proximally attached to atria, and far from vasa deferentia. Soft part of penis (Fig. 1G, pe) small, 38–54  $\mu\text{m}$  long, 22–44  $\mu\text{m}$  wide, cylindrical, enclosed in penial sacs. Penial sacs (Fig. 1G, ps) 65–80  $\mu\text{m}$  long, 54–80  $\mu\text{m}$  wide, with muscular layer 3–4  $\mu\text{m}$  thick.

Spermathecae (Fig. 1H) in X–XII, ducts (Fig. 1H, sd) 470–490  $\mu\text{m}$  long, 38–65  $\mu\text{m}$  wide, ampullae (Fig. 1H, sa) elongated, 520–540  $\mu\text{m}$  long, maximally 300–315  $\mu\text{m}$  wide. Spermatzeugmata (Fig. 1H, sz) 5–8 in each ampulla, about 300–460  $\mu\text{m}$  long.

**Distribution and habitat.** Known only from its type locality, Yunnan Province, China; freshwater lake, 113 m depth, water temperature less than 14 °C, fine clay.

**Remarks.** According to short vasa deferentia, long tubular atria, each with a small prostate gland, and lack of ejaculatory ducts, the new species fits more closely the definition of *Potamothrix* Vejdovský & Mrázek, 1902 than that of any other described tubificine genus (Brinkhurst and Jamieson 1971; Finogenova and Poddubnaja 1990).

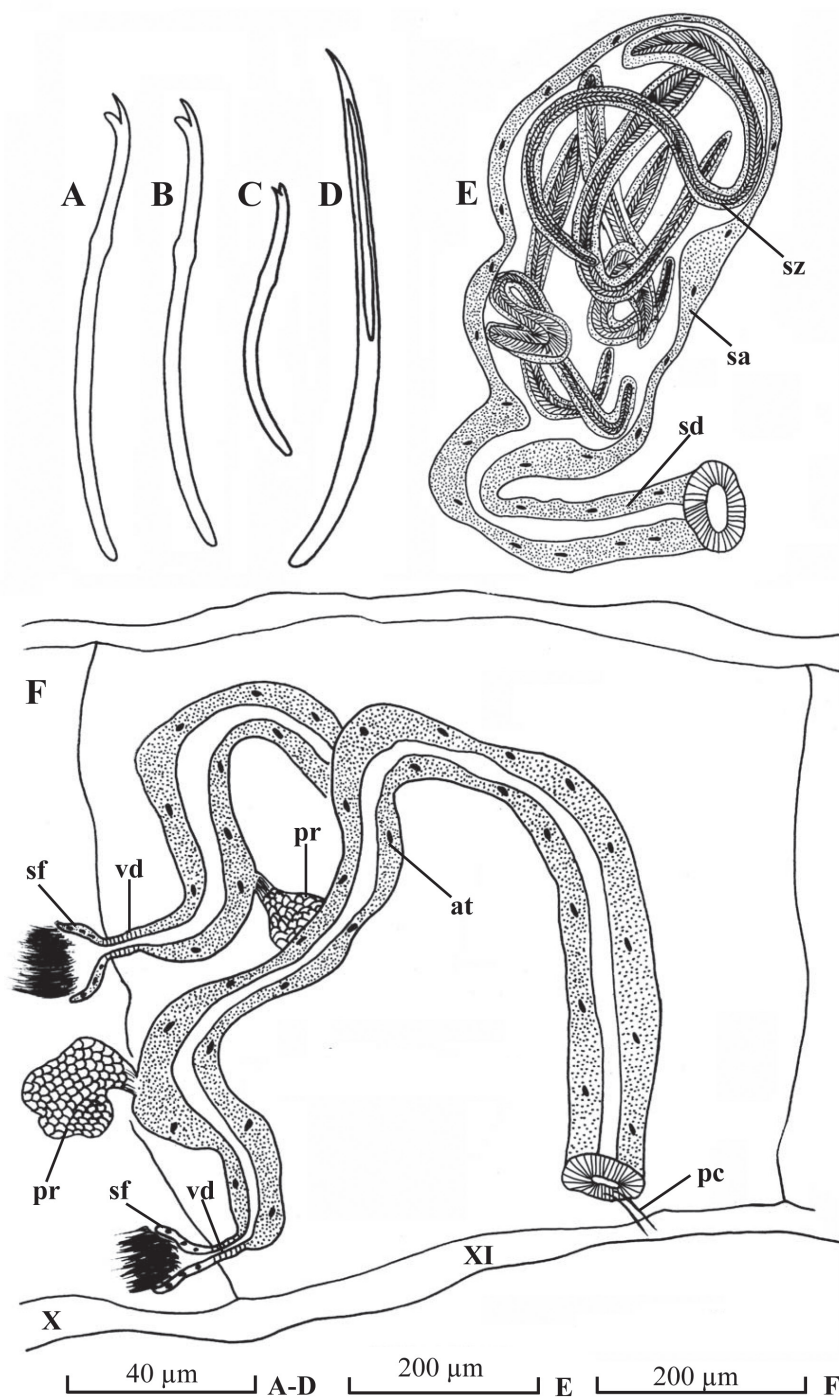
*P. praeprostatus* sp. n. differs from its allies by its prostate glands joining atria in their proximal to middle portion. With regard homogenous atria with prostate glands, the new species is similar to *P. postojnae* Karaman, 1974, *P. scleropenis* Cui & Wang, 2005, *P. aductus* Cui & Wang, 2012, and *P. paramoldaviensis* sp. n. However, these species differ from *P. praeprostatus* sp. n. in that *P. postojnae* has no spermathecal chaeta (Brinkhurst and Wetzel 1984); *P. scleropenis* has penial sheath (Cui and Wang 2005); *P. paramoldaviensis* sp. n. has no hairs and no penis (Fig. 2); *P. aductus* Cui & Wang, 2012 has no spermathecal duct and its spermathecal chaeta has contorted ectal part.

***Potamothrix paramoldaviensis* sp. n.**

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[http://species-id.net/wiki/Potamothrix\\_paramoldaviensis](http://species-id.net/wiki/Potamothrix_paramoldaviensis)

**Holotype.** IHB YAN 20020812i, mature specimen mounted in Canada balsam, and stained with borax carmine.



**Figure 2.** *Potamothrix paramoldaviensis* sp. n., **A** dorsal chaeta from III **B** ventral chaeta from VII **C** penial chaeta **D** spermathecal chaeta **E** spermatheca **F** lateral view of male ducts in segments X–XI. Scale bars: A–D 40 μm; E–F 200 μm

**Type locality.** East of Gushan Island (24°24'05"N, 102°52'45"E) in Fuxian Lake, eastern Yunnan, China; depth 78 m, bottom temperature 15.9 °C, dissolved oxygen at bottom 9.6 mg/L, total nitrogen in water 0.155 mg/L, total phosphorus in water 0.0234 mg/L, fine clay; Aug 8, 2002, coll. Y. Cui and X. Liu.

**Etymology.** Named "*paramoldaviensis*" for its resemblance with *Potamothrix moldaviensis* Vejvodský & Mrázek, 1902 in terms of its male genitalia.

**Description.** Specimen incomplete, length > 4.4 mm, diameter at XI about 0.7 mm, segments > 13. Clitellum inconspicuous.

Chaetae (Fig. 2A–B) all bifid, 4–6 per bundle dorsally, 3–6 per bundle ventrally, 80–120 µm long, 2.0–2.6 µm thick, upper tooth longer and thinner than lower. Spermathecal chaetae (Fig. 2D) one per bundle in posterior to middle of X, entally embedded in glandular sacs, 145–160 µm long, 4.0–4.5 µm thick, with curved ental part, and grooved ectal part. Penial chaetae (Fig. 2C, F, pc) slightly different to other ventral chaetae, 1–2 per bundle in postero-XI, 70–74 µm long, 2.0–2.4 µm thick, upper tooth as long as, but thicker than lower tooth. Male pores paired in line with ventral chaetae in postero-XI, immediately anterior to penial chaetae. Spermathecal pores paired in line with ventral chaetae in posterior to middle of X, immediately anterior to spermathecal chaetae.

Pharyngeal glands in II–III. Chloragogen cells from VI onwards. No coelomocytes. Male genitalia (Fig. 2F) paired. Vasa deferentia (Fig. 2F, vd) very short, 27–38 µm long, 16–20 µm wide, entering atria apically. Atria (Fig. 2F, at) 1050–1130 µm long, 38–90 µm wide, tubular and rather homogenous throughout, with thin outer muscular layer and thick inner epithelium. Prostate gland small, attached proximally to atrium. Penis absent.

Spermathecae ducts (Fig. 2E, sd) 345–360 µm long, 38–70 µm wide, ampullae (Fig. 2H, sa) pear-shaped, 420–430 µm long, maximally 230–250 µm wide. Spermatzeugmata (Fig. 2H, sz) 6–9 in each ampulla, about 300–640 µm long.

**Distribution and habitat.** Known only from its type locality, Yunnan Province, China; freshwater lake, 78 m depth, water temperature less than 16 °C, fine clay.

**Remarks.** According to very short vasa deferentia, long tubular atria each with a small prostate gland, and lack of ejaculatory ducts, the new species fits more closely the definition of *Potamothrix* Vejvodský & Mrázek, 1902 than that of any other described tubificine genus (Brinkhurst and Jamieson 1971; Finogenova and Poddubnaja 1990).

This new species resembles *P. moldaviensis* in some aspects of the male organs (Vejvodský and Mrázek 1902), e.g. the very short vasa deferentia, tubular atria, and the length ration of the vasa deferentia to the atria, and their differences are obvious. *P. paramoldaviensis* sp. n. has homogenous atria with prostate glands and no penes, while *P. moldaviensis* has tripartite atria without prostate glands, with short penes.

The new species is distinguishable from other species from the Yunnan lakes in the characteristics of some somatic chaetae. For instance, hair chaetae and pectinate bifid chaetae are present in *P. scleropenis* Cui & Wang, 2005, *P. rhytipeniatus* Cui & Wang, 2012, *P. aductus* Cui & Wang, 2012, *P. praeprostatatus* sp. n. and *P. parabedoti* sp. n.,

but hair chaetae are absent in *P. paramoldaviensis*; the spermathecal chaetae of these six species are dissimilar; slightly modified penial chaetae are present in *P. scleropenis* and *P. paramoldaviensis*, but are absent in the other three species (Table 2).

**Table 2.** Comparison of six species of *Potamothrix* from Yunnan Lakes.

| Species                 | <i>P. aductus</i><br>Cui & Wang, 2012                                             | <i>P. parabedoti</i><br>sp. n.                                                    | <i>P. paramoldaviensis</i><br>sp. n.                                              | <i>P. praeprorstatus</i><br>sp. n.                                                | <i>P. rhytipeniatus</i><br>Cui & Wang, 2012                                       | <i>P. scleropenis</i><br>Cui & Wang, 2005                                           |
|-------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Hair chaetae            | forward VII, plumose                                                              | forward III or V, plumose                                                         | absent                                                                            | forward V, plumose                                                                | forward II, smooth                                                                | forward VI, plumose                                                                 |
| Pectinate bifid chaetae | associated with hairs                                                             | associated with hairs                                                             | absent                                                                            | associated with hairs                                                             | present                                                                           | associated with hairs                                                               |
| Ventral chaetae         | bifid                                                                             | bifid                                                                             | bifid                                                                             | bifid, lower prong usually secondarily branched                                   | bifid                                                                             | bifid, lower prong usually secondarily branched                                     |
| Spermathecal chaetae    |  |  |  |  |  |  |
| Penial chaetae          | absent                                                                            | absent                                                                            | present                                                                           | absent                                                                            | absent                                                                            | present                                                                             |
| Length ration of vd/at  | 1:12-16                                                                           | 1:11-20                                                                           | 1:30-42                                                                           | 1:10-18                                                                           | 1:14-30                                                                           | 1:3                                                                                 |
| Prostate glands         | present                                                                           | absent                                                                            | present                                                                           | present                                                                           | absent                                                                            | absent                                                                              |
| Male ducts              | homogenous                                                                        | homogenous                                                                        | homogenous                                                                        | homogenous                                                                        | bipartite                                                                         | homogenous                                                                          |
| Penial sheath           | absent                                                                            | absent                                                                            | absent                                                                            | absent                                                                            | absent                                                                            | present                                                                             |
| Habitats                | Freshwater lake, 70-110 m depth, <15°C, fine clay                                 | Freshwater lake, 70-120 m depth, <15°C, fine clay.                                | Freshwater lake, 78 m depth, <16°C, fine clay                                     | Freshwater lake, 113 m depth, <14°C, fine clay                                    | Freshwater lake, 5 m depth, 18°C, mud                                             | Freshwater lake, 74 m depth, <15°C, fine clay                                       |

***Potamothrix parabedoti* sp. n.**

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[http://species-id.net/wiki/Potamothrix\\_parabedoti](http://species-id.net/wiki/Potamothrix_parabedoti)

**Holotype.** IHB YAN 20021205c, mature specimen mounted in Canada balsam, and stained with borax carmine.

**Type locality:** IHB YAN20021205c, East of Lichang (24°32'04"N, 102°51'43"E) in Fuxian Lake, eastern Yunnan, China; depth 113 m, bottom temperature 13.5 °C, dissolved oxygen at bottom 5.2 mg/L, total nitrogen in water 0.164 mg/L, total phosphorus in water 0.037 mg/L, fine clay; Dec 11, 2002, coll. Y. Cui and X. Liu.

**Paratypes:** IHB YAN20021012b, East of Gushan Island (24°24'05"N, 102°52'45"E) in Fuxian Lake, eastern Yunnan, China; depth 76 m, bottom tempera-

ture 14.8 °C, dissolved oxygen at bottom 8.7 mg/L, total nitrogen in water 0.163 mg/L, total phosphorus in water 0.0203 mg/L, fine clay; Oct 8, 2002, coll. Y. Cui and X. Liu. IHB YAN20021009c, North of Dasazui (24°22'58"N, 102°49'49"E) in Fuxian lake, eastern Yunnan, China; depth 87 m, bottom temperature 14.7 °C, dissolved oxygen at bottom 8.7 mg/L, total nitrogen in water 0.165 mg/L, total phosphorus in water 0.022 mg/L, fine clay; Oct 8, 2002, coll. Y. Cui and X. Liu.

**Etymology:** Named "*parabedoti*" for its resemblance with *Potamothrix bedoti* (Piguet, 1913) in terms of male genitalia.

**Description:** Two complete specimen 8.9–19.8 mm long (Holotype: 8.9 mm), with 36–131 segments (Holotype: 36), diameter at XI about 0.8 mm. Prostomium conical. Clitellum inconspicuous.

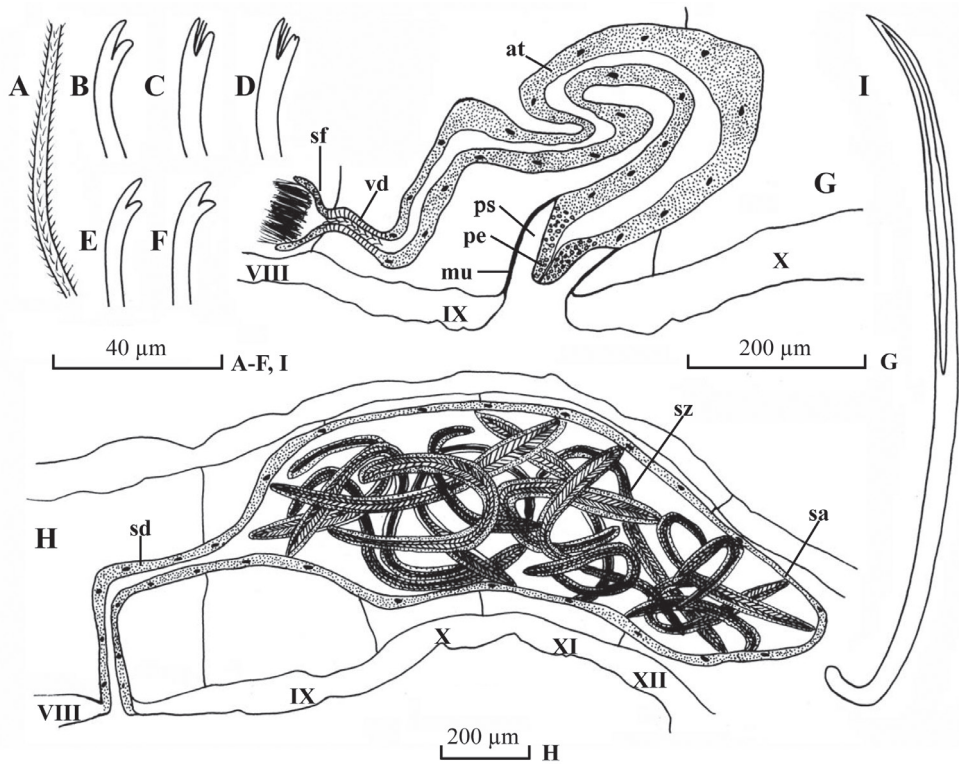
Dorsal chaetae (Fig. 3B) of II (II–IV) bifid only, 7–8 per bundle, 100–145 µm long, 2.8–3.0 µm thick, upper tooth longer and thicker than lower. Dorsal bundle of III (V)–IX 4–8 hair chaetae and 5–8 bifid chaetae per bundle; plumose hair chaetae (Fig. 3A), 250–300 µm long, 2.8–3.2 µm thick basally; pectinate bifid chaetae (Fig. 3C–D), 140–150 µm long, 2.8–3.2 µm thick, with 1–3 intermediate teeth, upper tooth slightly longer and thinner than lower (usually bifurcated), or equally long. Dorsal bundles of posterior segments 2–4 hair chaetae and 3–4 bifid chaetae per bundle, shorter and thinner than those of anterior segments, hair chaetae 200–240 µm long, bifid chaetae 100–120 µm long, 2.6–2.8 µm thick. Ventral chaetae (Fig. 3E–F) bifid, 6–10 per bundle anteriorly, 100–150 µm long, 2.8–3.0 µm thick; 3–5 per bundle in postclitellar segments, 100–125 µm long, 2.4–2.6 µm thick, all with tooth similar to dorsal chaetae in II–IV. Spermathecal chaetae (Fig. 3I) one per bundle in middle to posterior of VIII or IX, entally embedded in glandular sacs, about 125–140 µm long, 4.0 µm thick, ental end strongly curved, with ectal part grooved. Penial chaetae absent. Male pores paired in line with ventral chaetae, middle to posterior of IX or X. Spermathecal pores paired in line with ventral chaetae, middle of X, immediately anterior to spermathecal chaetae.

Pharyngeal glands in II. Chloragogen cells from IV or V onwards. No coelomocytes. Male genitalia (Fig. 3G) paired. Vasa deferentia (Fig. 3G, vd) 45–70 µm long, 18–24 µm wide, entering atria apically. Atria (Fig. 3G, at) 880 µm long, 44–80 µm wide, tubular and rather homogenous throughout, with thin outer muscular layer and thick inner epithelium. Prostate gland absent. Soft part of penis (Fig. 3G, pe) cylindrical and tapering ectally, 80–100 µm long, basally 45–60 wide, ectally 25–36 wide, enclosed in penial sacs. Penial sac (Fig. 3G, ps) 80–130 µm long, 72–92 µm wide, with muscular layer 2–4 µm thick.

Spermathecae (Fig. 3H) in VIII–XIII or VIII, ducts (Fig. 3H, sd) 500–568 µm long, 74–95 µm wide, ampullae (Fig. 3H, sa) elongated, 470–1280 µm long, maximally 320–442 µm wide. Spermatozeugmata (Fig. 3H, sz) 10–25 in each ampulla, about 400–860 µm long.

**Distribution and habitat:** Known only from its type locality, Yunnan Province, China; freshwater lake, 70–110 m depth, water temperature less than 15 °C, fine clay.

**Remarks:** According to short vasa deferentia, long tubular atria and lack of ejaculatory ducts, the new species fits more closely the definition of *Potamothrix* Vejvodský



**Figure 3.** *Potamothenrix parbedoti* sp. n., **A** hair **B-D** distal end of dorsal bifids (VI, VII, XX, respectively) **E-F** distal end of ventral chaetae (II, XV, respectively) **G** lateral view of male duct in segments VIII–X **H** lateral view of spermatheca in segments VIII–XII **I** spermathecal chaeta. Scale bars: **A–F, I** 40 µm; **G–H** 200 µm.

and Mrázek, 1902 than that of any other described tubificine genus (Brinkhurst and Jamieson 1971; Finogenova and Poddubnaja 1990).

The new species resembles *P. bedoti* (Piguet, 1913) in some aspects of reproductive organ (Vejdovský and Mrázek 1902), e.g. has a very short vasa deferentia, tubular atria without prostate gland, the length ration of vasa deferentia to atria, and the reproductive organs move to VIII–X. However, their differences are obvious. *P. parbedoti* sp. n., has homogenous atria with prostate glands, while *P. bedoti* has tripartite atria without prostate glands. In additional, the shapes of spermathecal chaetae are dissimilar in two of the species, the form is scalpel-like, and the ental part straight in *P. bedoti* (Timm 1970, 1999), but the ental end part is strongly curved in *P. parbedoti* sp. n (Fig. 3I).

The new species are distinguishable from other species from Yunnan Lakes in that of the position of their reproductive organs and the characteristic of some somatic chaetae. For instance, the reproductive organs are move to VIII–X in *P. parbedoti* sp. n. but that were in X–XIII in other species; the hair and pectinate bifids are absent in *P. rhytipeniatus* Cui & Wang, 2012 and *P. paramoldaviensis* sp. n., but present in other four species.

## Discussion

The principal distinguishable characteristics of the species of *Potamothrix* are given in Table 1 and Table 2. Nineteen previous species (Table 1) were divided into two groups, considered as subgenera, by lacking or possessing the prostate gland, respectively: *Potamothrix Potamothrix* Vejdovský & Mrázek, 1902 (type species: *P. moldaviensis* Vejdovský & Mrázek, 1902) and *Potamothrix Euilyodrilus* Brinkhurst, 1963 (type species: *P. hammoniensis* (Michaelson, 1901) (Finogenova and Poddubnaja 1990)). Hence, six species of Yunnan lakes (Table 2), *P. scleropenis* Cui & Wang, 2005, *P. rhytipeniatus* Cui & Wang, 2012, and *P. parabedoti* sp. n., which lack prostate gland, belonged to the subgenus *Potamothrix*, and *P. aductus* Cui & Wang, 2012, *P. peniibristlatus* and *P. paramoldaviensis* sp. n., which possess prostate glands, belonged to the subgenus *Eui-lyodrilus*.

In the genus of *Potamothrix*, the histological structure of the epithelium of the atrium is taxonomically useful (Holmquist 1985; Finogenova and Poddubnaja 1990). According to histologically structure of the atrium, twenty previous species (Table 1) were divided into three types: (1) the 'tripartite type', which includes all the species with tripartite atrium, the short proximal part with densely granular inner epithelium layer, the long middle part with light granular inner epithelium, and the short distal part with homogenous inner layer (*P. alatus*, *P. bavaricus*, *P. bedoti*, *P. heuscheri*, *P. moldaviensis*, *P. thermalis*) (Brinkhurst and Jamieson 1971; Finogenova and Poddubnaja 1990; Milbrink and Timm 2001; Milbrink 1999; Timm 1970, 1999); (2) the 'bipartite type', comprising of the members with bipartite atrium, the short proximal part with densely granular inner epithelium layer and the long distal part with light granular inner epithelium (*P. caspicus*, *P. cekanovskajae*, *P. danubiali*, *P. hammonien- sis*, *P. manus*, *P. marzeki*, *P. vej dovskyi*) (Finogenova and Poddubnaja 1990; Hrabě 1981); and (3) the 'homogenous type', which consists of the taxa with homogenous atrium (*P. tudoranceai*, *P. postojnae*) (Šporka 1994; Brinkhurst and Wetzel 1984). Except the above mentioned 15 species, the histological of atrium of *P. prespaensis*, *P. isochaetus*, *P. orientalis*, and *P. ochridanus* was unmentioned in the original description (Brinkhurst and Jamieson 1971; Pop 1976), so that will need to be re-examined in the future. The species from Yunnan lakes except *P. rhytipeniatus* are part of the 'homogenous type' (Table 2).

In addition, the presence of pectinate bifid chaetae accompanied with hair chaetae in the Yunnan lake species could be a special feature, but their position is variable. For instance, the hairs and pectinate bifids begin from segments V, VI, VII, III or V, respectively in *P. praeproratus* sp. n., *P. scleropenis* Cui & Wang, 2005, *P. aductus* Cui & Wang, 2012, and *P. parabedoti* sp. n. The position of spermathecal pores of *Pota- mothrix* always lies in lateral line; however, in species from the Yunnan lakes, they were ventral instead of lateral.

As for habitat and distribution, the five species of *Potamothrix* from Fuxian Lake are well adapted to low dissolved oxygen concentrations, only found in the profundal region, to water depths lower than 70 m, water temperatures less than 16 °C, and they

are found in sediments always clayey and sandy. Another species, *P. rhytipeniatus* Cui & Wang, 2012 was found in Xingyun Lake, in water depth of about 5 m, water temperature around 18 °C, and muddy sediments.

Lastly, according to some specific features, such as hair and pectinate bifid chaetae, spermathecal pore position, atrium histological structure, and their habitat, the species from Yunnan lakes maybe one new taxonomical group, the systematic placement of which needs further confirmation from more work.

### Key to the genus of *Potamothenrix* Vejdovský and Mrázek, 1902

- 1 Prostate glands present.....2
- Prostate glands absent .....15
- 2 Hair chaetae present .....3
- Hair chaetae absent.....11
- 3 With plumose hair chaetae.....4
- Without plumose hair chaetae .....5
- 4 Prostate glands small, proximally attached to atria .....  
.....*P. aductus* Cui & Wang, 2012
- Prostate glands small, proximally attached to atria and far from vasa deferentia ..... *P. praeprostatus* sp. n.
- 5 Dorsal bifid chaetae pectinated .....6
- Dorsal chaetae bifid .....9
- 6 Spermathecal chaetae present.....7
- Spermathecal chaetae absent .....*P. postojnae* Karaman, 1974
- 7 Histological atria tripartite.....8
- Histological atria bipartite .....*P. hammoniensis* (Michaelsen, 1901)
- 8 Length ratio of vasa deferentia to atria about 1:33–35 .....  
.....*P. alatus* Finogenova, 1972
- Length ratio of vasa deferentia to atria about 1:20 ....*P. thermalis* (Pop, 1968)
- 9 Spermathecal chaetae present and modified .....10
- Spermathecal chaetae absent or 1–2 bifid chaetae .....  
.....*P. ochridanus* (Hrabě, 1931)
- 10 Upper tooth of ventral chaetae just shorter or equal the lower .....  
.....*P. vejdoskyi* (Hrabě, 1941)
- Upper tooth of ventral chaetae reduced ..... *P. svirenkoi* Lastočkin, 1937
- 11 Spermathecal chaetae present and modified .....12
- Spermathecal chaetae absent or 1–3 bifid chaetae .....14
- 12 Penes present .....13
- Penes absent ..... *P. paramoldaviensis* sp. n.
- 13 Ventral chaetae 5–6 per bundle .....*P. danubialis* (Hrabě, 1941)
- Ventral chaetae 8–10 per bundle .....*P. isochaetus* (Hrabě, 1931)

|    |                                                                                |                                                   |
|----|--------------------------------------------------------------------------------|---------------------------------------------------|
| 14 | Upper tooth of bifid chaetae longer and thinner than the lower .....           | <i>P. caspicus</i> (Lastoĉkin, 1937)              |
| –  | Upper tooth of bifid chaetae equal the lower .....                             | <i>P. marzeki</i> (Hrabě, 1941)                   |
| 15 | Hair chaetae present .....                                                     | 16                                                |
| –  | Hair chaetae absent .....                                                      | 23                                                |
| 16 | With plumose hair chaetae .....                                                | 17                                                |
| –  | Without plumose hair chaetae .....                                             | 18                                                |
| 17 | Male genitalia in X–XI, with penial sheath .....                               | <i>P. scleropenis</i> Cui & Wang, 2005            |
| –  | Male genitalia in VIII–IX, without penial sheath .....                         | <i>P. parabedoti</i> sp. n.                       |
| 18 | Dorsal bifid chaetae pectinated .....                                          | 20                                                |
| –  | Dorsal chaetae bifid .....                                                     | 9                                                 |
| 19 | Upper tooth of ventral chaetae slightly longer and thinner than the lower .... | <i>P. orientalis</i> (Černosvitov, 1938)          |
| –  | Tooth of ventral chaetae equal in length .....                                 | <i>P. prespaensis</i> (Hrabě, 1931)               |
| 20 | Histological atria homogeneous .....                                           | <i>P. tudoranceai</i> Šporka, 1994                |
| –  | Histological atria bipartite .....                                             | <i>P. rhytipeniatus</i> Cui & Wang, 2012          |
| –  | Histological atria tripartite .....                                            | 21                                                |
| 21 | Male genitalia in X–XI .....                                                   | 22                                                |
| –  | Male genitalia in VIII–IX .....                                                | <i>P. bedoti</i> (Piguet, 1931)                   |
| 22 | Length ratio of vasa deferentia to atria about 1:20 .....                      | <i>P. heuscheri</i> (Bretscher, 1900)             |
| –  | Length ratio of vasa deferentia to atria about 1:8–9 .....                     | <i>P. bavaricus</i> (Oschmann, 1913)              |
| 23 | Spermathecal chaetae present and modified .....                                | 24                                                |
| –  | Spermathecal chaetae absent or 4–5 bifid chaetae .....                         | <i>P. cekanovskajae</i> Finogenova, 1972          |
| 24 | Histological atria bipartite .....                                             | <i>P. manus</i> Finogenova, 1972                  |
| –  | Histological atria tripartite .....                                            | <i>P. moldaviensis</i> Vejvodský and Mrázek, 1902 |

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# ***Darwininitium* – a new fully pseudosigmurethrous orthurethran genus from Nepal (Gastropoda, Pulmonata, Cerastidae)**

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§ [urn:lsid:zoobank.org:author:866F2AA2-24A7-48A9-B638-1445AB9C696F](https://doi.org/urn:lsid:zoobank.org:author:866F2AA2-24A7-48A9-B638-1445AB9C696F)

| [urn:lsid:zoobank.org:author:E6F42575-36AE-4AD7-98C6-D083EF052568](https://doi.org/urn:lsid:zoobank.org:author:E6F42575-36AE-4AD7-98C6-D083EF052568)

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## **Abstract**

A new genus and species of pseudosigmurethrous orthurethran pulmonate of the family Cerastidae, *Darwininitium shiwalikianum* **gen. n.** and **sp. n.** is described from the Lesser Himalaya of Nepal. It represents the first record of an orthurethran with a fully developed pseudosigmurethrous pallial system, having a completely closed secondary ureteric system. Biogeographically this new taxon provides a significant range extension for the family north of the previously known distribution range.

## **Keywords**

Pseudosigmurethrous, Orthurethran, Pulmonata, *Darwininitium*, Nepal

## Introduction

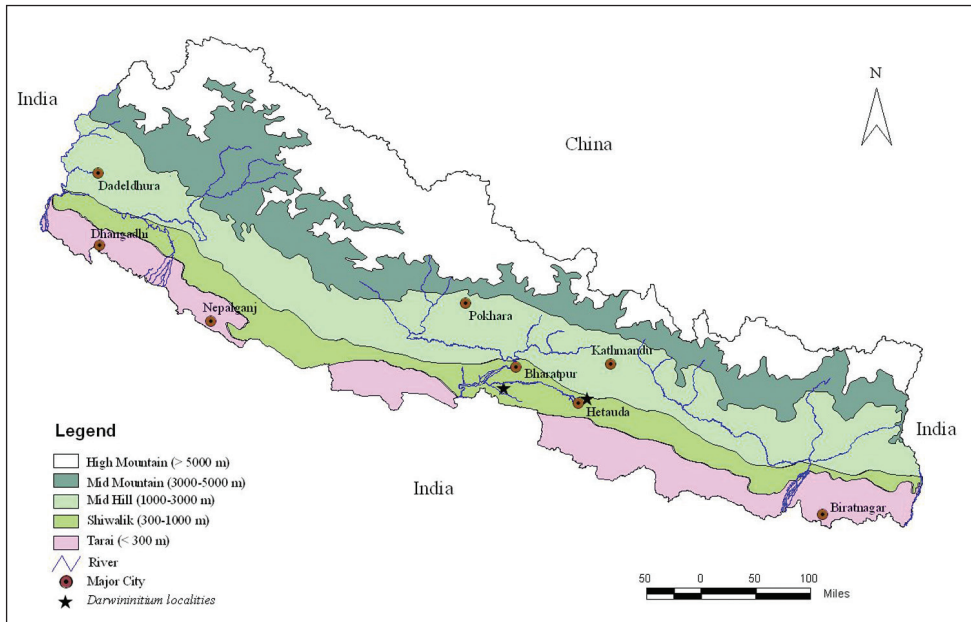
There are currently some 14 genera recognised in the orthurethran land snail family Cerastidae. Their greatest diversity is found in the Afro-tropical zone, but the family extends eastwards into the Indian subcontinent and beyond, and one genus, *Amimopina*, occurs in Australia and New Guinea (Solem 1964), Thailand (Sutcharit et al. 2010), and probably also Cambodia (Mordan 1992). A few species have become widely dispersed in many of the islands of the Indo-Pacific by human agency.

The family Cerastidae Wenz, 1923 was previously included in the Enidae sensu lato (Enoidea sensu Bouchet and Rocroi 2005), and first recognised as a distinct group of orthurethran land snails by Watson (1920: 22), who stated that there can be little doubt that *Pachnodus* and its allies should be placed in a separate subfamily from the Palearctic forms, or perhaps even in a distinct family. The phylogenetic relationship of several cerastid genera was subjected to a morphology-based cladistic analysis by Mordan (1992), and the monophyletic nature of the family has recently been supported by molecular evidence (Wade et al. 2006).

The principal distinguishing anatomical feature of cerastids is the excretory system which, whilst generally being of the normal orthurethran form comprising an elongate kidney with a straight primary ureter running directly towards the pneumostome, has developed what Solem (1964: 115) has termed a ‘pseudo-sigmurethrous’ secondary ureter. This takes the form of a fold or tube running from the renal orifice back along the kidney to the top of the lung, and usually a partial or complete fold running back along the rectum, towards the pneumostome, the whole ureteric anatomy mirroring that of true sigmurethrous Stylommatophora. Partial or complete closure of the renal fold to form a tube is known in *Edouardia*, *Amimopina*, *Rachistia* and *Limicena* (Solem 1964, Mordan 1992, 1998), but none of these has a partly, let alone completely closed rectal fold. Presumably these anatomical structures have the effect of directing the excretory products of the kidney along a pathway in which there can be some water resorption, and are consistent with the group being broadly xerophilic in its habits.

Here we present an account of a new genus and species of cerastid from the Lesser Himalaya of Central Nepal. Along its E-W axis, Nepal is divided into five east-west parallel physiographic elevational regions i.e. from south (lower) to north (higher): 1) Tarai (southern flat belt from 67 m – 300 m), 2) Shiwalik (from 300 m – 1000 m), 3) Mid Hill (1000 m – 3000 m), 4) Mid Mountain (3000 m – 5000 m) and 5) High Himalaya (> 5000 m). Our surveys were conducted in these five zones in Central Nepal but the new genus was reported only from the Shiwalik range (Figure 1). The type material has been deposited at the museum of the Central Department of Zoology, Tribhuvan University (CDZTU), Kathmandu, Nepal.

Shell measurements are expressed in mm as follows: shell height × max. shell width × min. shell width. Abbreviation for internal parts used are; AG- albumen gland, ATR- atrium, AU- auricle, E- epiphallus, EC- epiphallar caecum, GS- gametolytic sac, HD- hermaphrodite duct, KI- kidney, P- penis, PI- pilaster, PNE- pnerumostome, PR- penis retrac-



**Figure 1.** Map of Nepal showing the collection localities of *Darwininitium shiwalikianum* sp. n.

tor, REU- renal branch of secondary ureter, RT- rectum, RTU- rectal branch of secondary ureter, SO- spermoviduct, UO- ureteric orifice, VD- vas deferens and VE- ventricle.

## Taxonomic treatment

### *Darwininitium* Budha & Mordan, 2012, gen. n.

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**Type species.** *Darwininitium shiwalikianum* Budha & Mordan, 2012, sp. n.

### *Darwininitium shiwalikianum* Budha & Mordan, 2012, sp. n.

urn:lsid:zoobank.org:act:4C8FA14B-A9CA-49D6-A91A-B532B2EDBAEE  
[http://species-id.net/wiki/Darwininitium\\_shiwalikianum](http://species-id.net/wiki/Darwininitium_shiwalikianum)

**Material.** Holotype CDZTU0114: Kasara near Tamor Lake, Chitwan National Park, Central Nepal, ca 210 m. 27°61'10"N, 85°20'05"E, sal (*Shorea robusta*) forest, leg P.B. Budha 5 May 2008. Paratype from the type locality, CDZTU0114a/1 shell. Other paratypes CDZTU0115/2: Taubas along the road side of Tribhuvan Highway, Bhainse, left bank of Rapti river, Makwanpur [=district], Central Nepal, ca 520 m. 27°30'13"N, 85°02'59"E, 2 live. Mixed riverine forest, leg P.B. Budha 7 May 2008.

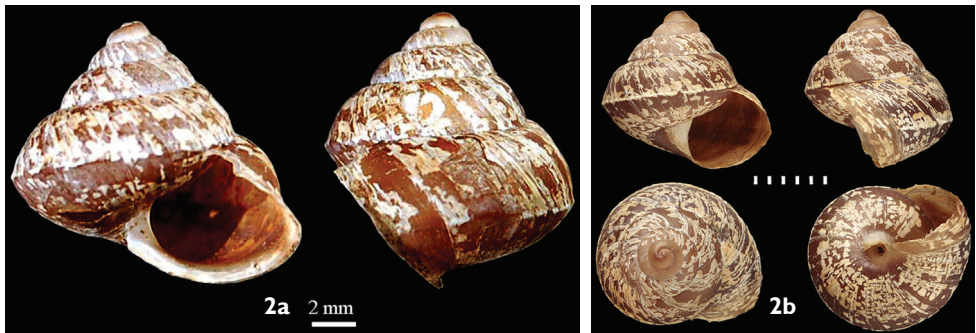
**Diagnosis.** Cerastidae with a fully pseudosigmorethrous pallial system including fully enclosed renal and rectal branches of ureter; penial appendix lacking, which is present in all known cerastid genera. Shell carinated, white flecks on a dark-brown background.

**Description:** Shell (Figure 2a, 2b): Dextral, globosely turbinate, weakly carinated, rimately perforate, whorls 5, apex blunt, suture shallow, chestnut with wide and irregular shaped radial white patches both in upper- and under- surface, first two whorls smooth but under magnification (60×) shallow dotted wrinkles visible, later whorls with weak radial striae, aperture ovate, peristome thin and reflected slightly descended toward the aperture, columellar margin reflected covering nearly half the umbilicus.

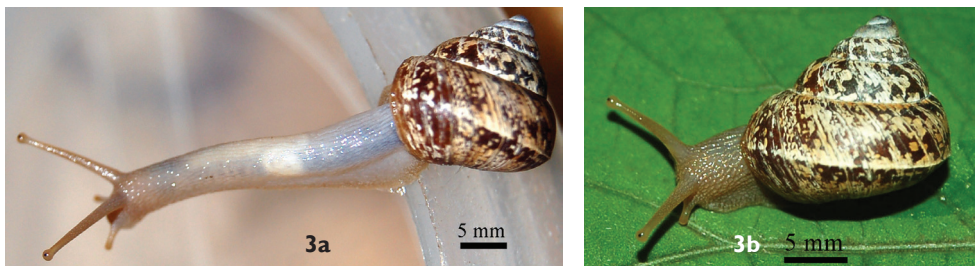
**Shell dimensions** (mm). Holotype:  $13.6 \times 15.2 \times 12.6$ , aperture  $7.9 \times 8.0$ , whorls 5, paratype from the type locality  $14.1 \times 13.8 \times 12.5$ , whorls 5, aperture  $7.8 \times 7.9$ , paratypes from Taubas  $11.7 \times 12.5 \times 10.6$ , aperture  $6.9 \times 7.5$ , whorls 4.5,  $12.3 \times 15.7 \times 12.9$ , aperture  $8.1 \times 10.5$ , wh. 4.5.

**Etymology.** The genus is named as a tribute to the Darwin Initiative for having supported land snail projects and in particular for supporting the senior authors' participation in the project Developing land snail expertise in South and Southeast Asia from 2006-2011. The species name derives from the Lesser Himalaya Shiwalik range, from where it was reported.

**Animal** (Figures 3a, 3b). The anterior of the uniformly pale cream body can extend significantly more than 2× of the shell length.



**Figure 2.** Shell of *D. shiwalikianum* sp. n. **2a** holotype CDZTU0114 **2b** paratype CDZTU0115

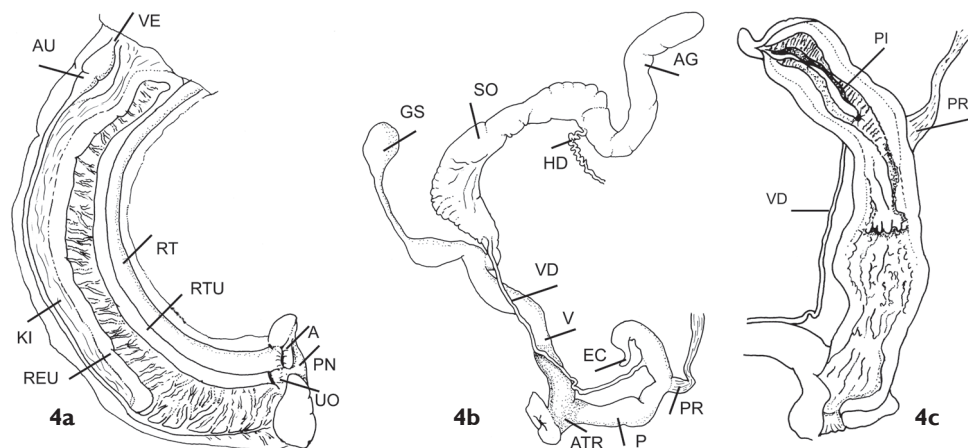


**Figure 3.** Live animal of *D. shiwalikianum*, paratype CDZTU0115 **3a** anterior portion extended **3b** animal *in situ*.

**Pallial cavity** (Figure 4a). Kidney of the typical orthurethran type, running approximately four-fifths the length of the pulmonary cavity; a thin-walled, completely closed tube runs from the renal pore along the full length of the inner margin of the kidney, folding at the top to run a short distance towards the rectum, and then down along the inner margin of the rectum, again as a fully closed tube, almost as far as the anus and close to the pneumostome, where it opens with a slight flare. Pallial venation is prominent and a mantle gland is lacking.

**Reproductive system** (Figures 4b, 4c). The female system has a well-developed gametolytic sac with a long peduncle with an expanded basal portion, and darkly pigmented spongy tissue in the atrium and at the base of the free-oviduct. The penis lacks an appendix, but has a prominent epiphallar caecum. The penial retractor inserts well below and opposite the point of insertion of the vas deferens. Internally the penis is separable into two regions, the lower having numerous longitudinal pilasters with a knobbly appearance. Above there is a slight constriction of the lumen by an undulating ring pilaster with a smooth, forked pilaster above, running downwards from the level of the opening of the vas deferens. The epiphallus has a thick pad of transverse, weakly ridged tissue running down its length more-or-less opposite the pore of the vas deferens, as well as a smooth longitudinal fold which runs down from within the caecum as far as the top of the vas deferens opening. There is no obvious penial sheath. The hermaphrodite duct lacks the clump of diverticulae characteristic of the Enidae sensu stricto.

**Distribution.** The genus *Darwininitium* was collected in the Dun valley of the Lesser Himalaya in the Rapti river basin from an elevation of ca 210 m in Chitwan National Park and extending northward to Taubas, Bhainse Makwanpur, Central Nepal at an elevation of ca 520 m above sea level. The area has a humid, sub-tropical climate and comprises sandstones, siltstones and mudstones. The forest is dominated by tropical sal (*Shorea robusta*) mixed with *Terminalia* sp. in the national park, and mixed riverine forest with major tree species of *Acacia catechu*, *Dalbergia sissoo*, *Bombax ceiba* along the river belt at Bhainse (Figure 5).



**Figure 4.** Genitalia in *D. shiwalikianum* sp. n. paratype CDZTU0115 **4a** Pallial cavity **4b** General view of genitalia **4c** Interior of the penis



**Figure 5.** Habitat of *D. shiwalikianum* sp. n.

## Discussion

*Darwininitium* is of particular interest on two counts: firstly its distribution represents a considerable extension of the known range of the Cerastidae, and secondly it exhibits the most advanced development of the pseudosigmurethrous condition yet found in the family, or indeed in any orthurethran species.

A very short partial renal fold is found in some genera in a few families of Orthurethra, for example *Acanthinula* (family Acanthinulidae), but a secondary ureteric structure is by far the most clearly and widely developed in the Cerastidae. Pseudosigmurethry was first described in the Australian cerastid *Amimopina macleayi* (Brazier) by Solem (1964). This monotypic genus has a fully closed renal tube running along the side of the kidney, from the renal pore to almost the top of the lung. It terminates as a short, so-called ‘renal ridge’. There is a short open gap across the top of the lung cavity before a rectal fold, open along its entire length, runs almost the full length of the rectum as far as the pneumostomal complex. In *Darwininitium* the rectal fold is fused to the rectum along its entire length, meaning that there is a continuous tube running from the tip of the kidney to its opening adjacent to the anus and pneumostome, mirroring more closely than previously known the situation in the true Sigmurethra.

The position of *Darwininitium* within the Cerastidae is confirmed by the well-developed pseudosigmurethry, as well as by the highly characteristic darkly pigmented spongy tissue lining the atrium, not known in any other orthurethran family, and the prominent

pallial venation (Mordan 1992). It differs from the Enidae, in which the family was earlier included, in lacking hermaphrodite duct diverticulae and a mantle gland.

In addition to its unique pallial anatomy, *Darwininitium* is immediately separable from other cerastid genera for which there is anatomical information, by the absence of a penial appendix: an elongate, tubular structure, highly differentiated into several distinct regions along its length, inserting well below the point of insertion of the vas deferens, and with its own retractor muscle system. The appendix is found in all other cerastid genera, and occurs commonly throughout the Orthurethra. Indeed, it is difficult to associate *Darwininitium* phylogenetically with any of the existing cerastid genera. Mordan (1992, 1998) has analysed the anatomy of the reproductive, alimentary and pallial systems of 11 genera of cerastid and produced a morphological phylogeny based largely on these characters. One clade, which includes *Rhachistia*, *Edouardia*, *Amimopina* and *Limicena*, has a renal fold which is either partly or wholly fused along its length to form a tube, and therefore most closely approaches the condition found in *Darwininitium*, but none of these shows any fusion of the rectal fold, let alone complete fusion in the form of a tube along its entire length. However, this clade is further characterised by an extremely short gametolytic duct, and a relatively long and very narrow flagellum which inserts on the caecum at the head of the penis, level with or above the point of insertion of the vas deferens, characters not found in *Darwininitium* which has a rather long gametolytic duct and no flagellum. The shell of *Darwininitium* is closest in shape to certain carinated species of *Edouardia*, but the pigmentation of white flecks on a dark-brown background is unlike any other cerastid.

Biogeographically this new record provides a significant range extension to the family Cerastidae, Nepal lying significantly further north of the previous known distribution. Mordan (1992; Fig. 1) summarised the distribution of the Cerastidae, which is centred on the Afro-tropical region with by far the greatest diversity being found in southern Africa and Arabia. There are outliers in the Indian subcontinent, Cambodia, Thailand, Australia, South-Eastern New Guinea, and now Nepal. Additionally a few species such as *Rhachistia histrio* (Pfeiffer) have spread into many other islands of the Indo-Pacific, and were considered by Solem (1959) at least in some cases to have been dispersed by human agency. In the Indian subcontinent cerastids are restricted to a band running down the west coast and including Sri Lanka, and an area around the Ganges delta.

The detailed anatomy of the Australian species, *Amimopina macleayi*, was described by Solem (1964). Mordan (1992) postulated that *Bulimus subangulatus* Pfeiffer from the Lao Mountains, Cambodia, was a species of *Amimopina*, based on the two shells in the syntype series in the Natural History Museum, London. Since then, Sutcharit et al. (2010) have recorded *subangulatus* from Thailand, along with two species of *Rhachistia*, and have shown *subangulatus* to be an *Amimopina* on the basis of dissection. We are thus gaining ever more detailed information on the continental distribution of the Cerastidae in the Australasian region, and this is turning out to be far less disjunct than previously thought.

## Acknowledgements

Prem Budha is extremely grateful to the Darwin Initiative Programme “Developing land snail expertise in South and Southeast Asia” run by the Natural History Museum London, for financial support and arranging museum visits to study reference collections. Prem Budha would also like to acknowledge the Malacological Society of London and University Grants Commission, Nepal for a research grant and the Department of National Parks and Wildlife Conservation, Kathmandu and its Chief warden Mr. Megh Bahadur Pandey for providing permission to collect snail specimens from the park. Thierry Backeljau was supported by BELSPO project MO/36/017. Shell images of paratype were produced by Harold Taylor, Natural History Museum, London.

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# *Loxosceles niedeguidonae* (Araneae, Sicariidae) a new species of brown spider from Brazilian semi-arid region

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## Abstract

A new species of recluse spider, *Loxosceles niedeguidonae* **sp. n.**, is described from the Parque Nacional Serra da Capivara, State of Piauí, Brazil. This is the first endemic species described from Brazilian semi-arid environment. The species is included in *gaucho* group of Gertsch (1967) due to its spermathecal shape and is considered close to *L. chapadensis* Bertani, Fukushima & Nagahama, 2010 by the unusual long male palpal tibia, a character not common for species of this group. An updated key for *Loxosceles* species of *gaucho* group is presented.

## Keywords

Brown spider, Semi-arid region, Piauí, Taxonomy, Araneae, Sicariidae, *Loxosceles*, *Loxosceles niedeguidonae*

## Introduction

The *Loxosceles* Heineken & Lowe, 1832 species, brown recluse spiders, are spread throughout the world. Currently, there are 102 species described for the whole Neotropical region, Europe, Asia and Africa, eleven of them present and/or endemic to Brazil (Gertsch 1967; Gertsch and Ennik 1983; Bertani et al. 2010; Platnick 2011).

In general, for the classified species of this genus the authors have adopted the species groups proposed by Gertsch (1967), based mainly on characteristics of the female genitalia and the male copulatory organ. This author proposed four species groups for South America: *amazonica* group – with a single species, *L. amazonica* Gertsch, 1967 (Brazil) – characterized by males having a palpal tarsus considerably shorter than the tibia, and the females having spermathecae with a group of small, globular lobes at the apex; *gaucho* group – with five species, *L. adelaida* Gertsch, 1967 (Brazil), *L. gaucho* Gertsch, 1967 (Brazil, Tunisia), *L. similis* Moenkhaus, 1898 (Brazil), *L. variegata* Simon, 1897 (Paraguay) and recently described Brazilian species *L. chapadensis* Bertani, Fukushima & Nagahama, 2010 – the tibia and palpal tarsus of males is equivalent in length (except *L. chapadensis*) and females have a crosswise sclerotized plate connected to the spermathecae; *laeta* group – with 24 species – American widespread species *L. laeta* (Nicolet, 1849) (New World, introduced in Finland and Australia); fourteen Peruvian species *L. accepta* Gertsch, 1967, *L. alicia* Gertsch, 1967, *L. bettyae* Gertsch, 1967, *L. blancasi* Gertsch, 1967, *L. conococha* Gertsch, 1967, *L. frizzelli* Gertsch, 1967, *L. harrietae* Gertsch, 1967, *L. herreri* Gertsch, 1967, *L. inca* Gertsch, 1967, *L. julia* Gertsch, 1967, *L. olmea* Gertsch, 1967, *L. piura* Gertsch, 1967, *L. pucara* Gertsch, 1967, *L. surca* Gertsch, 1967; *L. gloria* Gertsch, 1967 (Peru e Ecuador), *L. taeniopalpis* Simon, 1907 (Ecuador), *L. lutea* Keyserling, 1877 (Colombia, Ecuador), *L. rufipes* (Lucas, 1834) (Guatemala, Panama, Colombia), *L. lawrencei* Caporiacco, 1955 (Venezuela, Trinidad, Curaçao), *L. panama* Gertsch, 1958 (Panama), *L. coquimbo* Gertsch, 1967 (Chile) and Brazilian species *L. puortoi* Martins, Knysak & Bertani, 2002 – male palpal tibia at least two times longer than tarsus, whereas in females the spermathecae vary, but in general they are long with receptacles nearby and free; *spadicea* group – *L. hirsuta* Mello-Leitão, 1931 (Brazil, Paraguay, Argentina), *L. intermedia* Mello-Leitão, 1934 (Brazil, Argentina) and *L. spadicea* Simon, 1907 (Peru, Bolivia, Argentina) – males have a spherical palpal bulb and a thin embolus with a carina at its base and females have well-separated spermathecae with small epigynum ducts.

After Gertsch (1967), and despite the medical importance of the genus, little more has been added to the taxonomy of the South-American *Loxosceles*. Brignoli (1978) transferred *Calheirosa anomala* Mello-Leitão, 1917 and *Calheirosa immodesta* Mello-Leitão, 1917 to the genus *Loxosceles*. Álvares et al. (2004) redescribed *L. anomala* (Mello-Leitão, 1917) and considered this species to belong to the *spadicea* group. Other authors have expanded the knowledge about the geographic distribution of some species (Gonçalves-de-Andrade et al. 2001, 2007; Gonçalves-de-Andrade and Tambourgi 2003; Silveira 2009). In the last decade two new species were described: *L. puortoi* considered to belong to *laeta* group, the first species of this group endemic to Brazil and, more recently (2010), *L. chapadensis*, which was included in the *gaucho* group.

The Parque Nacional Serra da Capivara is a federal protected area in Southeastern State of Piauí, Brazil. The 129,953 ha cover areas in the municipalities of São Raimundo Nonato, Coronel José Dias, João Costa and Brejo do Piauí (08°26', 08°54'S and 42°19', 42°45'W). Together with Parque Nacional Serra das Confusões it is one of the largest protected areas in the world with “Caatinga” vegetation formation, situated between the “Médio São Francisco” depression (Precambrian) and the Piauí–Maranhão sedimentary basin (Silurian-Devonian), the two largest geological formations in Brazilian Northeastern. Rainfall period is from November to March, with a yearly median precipitation of 689 mm. The annual median temperature is 28°C. General landscape of Parque Nacional da Serra da Capivara consists of uplands, plateaus, hills, mountain chains and plains. This distinct relief is a result of transformations occurring during millions of years in the sedimentary basin of Piauí–Maranhão and in the central São Francisco Depression composed of different types of minerals and rocks.

In this work we describe a new species of *Loxosceles* endemic to the Brazilian semi-arid environment, from Parque Nacional Serra da Capivara, the second species of the *gaucho* group described for Northeastern Brazil and present an updated key for *Loxosceles* species of *gaucho* group.

## Material and methods

Spiders were collected (the permissions for collect - number 11971-2 - and for work in Parque Nacional Serra da Capivara – number 18413-1 - was conceded to Rute Maria Gonçalves-de-Andrade by ICMBio a instance of the Brazilian Ministry of the Environment) in two localities: Toca do Buraco da Pedra Furada and Boqueirão do Gato. The specimens examined are deposited in Museu Nacional, Rio de Janeiro, RJ, Brazil (Dr. Adriano B. Kury). The copulatory organs of females were dissected and cleared with clove oil. A LEICA® MZ7.5 Stereomicroscope with 10x eyepiece was used for illustrations (with a camera lucida attachment) and measurements (using an ocular micrometer). Measurements are in millimeters. Abbreviations: ALE = anterior lateral eye, PLE = posterior lateral eye and PME = posterior median eye.

## Taxonomy

### *Loxosceles* Heineken & Lowe, 1832

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

**Identification key for species of *Loxosceles* of *gaucho* group** [Modified from Gertsch (1967)]

|   |              |   |
|---|--------------|---|
| 1 | Males.....   | 2 |
| – | Females..... | 7 |

- 2 Palpal tibia more than 2 times longer than palpal tarsus.....3
- Palpal tibia at most 1.5 times longer than palpal tarsus .....4
- 3 Palpal tarsus almost 2 times longer than wide (Figs 2–4); lateral dentate dark bands on the dorsal side of the carapace faded (Fig. 9)...***L. niedeguidonae* sp. n.**
- Palpal tarsus less than 1.5 times longer than wide; lateral dentate dark bands on dorsal side of the carapace conspicuous (Fig. 10) ..... ***L. chapadensis***
- 4 First femur 2.1 times, first leg more than seven times longer than carapace.... 5
- First femur at most 1.7 times, first leg at most seven times longer than carapace .....6
- 5 Embolus straight in ventral view (Brignoli 1972 fig. 1) ..... ***L. adelaida***
- Embolus strongly curved in ventral view (Gertsch 1967 pl. 4, fig. 4) ..... ***L. similis***
- 6 Femur of palpus 3 times longer than wide (Gertsch 1967 pl. 4, fig. 1) ..... ***L. gaucho***
- Femur of palpus 5 times longer than wide (Gertsch 1967 pl. 4, fig. 6) ..... ***L. variegata***
- 7 Palpal tarsus incrassated and broader than palpal tibia (Fig. 6) .....8
- Tarsus evenly tapered .....9
- 8 Seminal receptacles inconspicuous ..... ***L. adelaida***
- Seminal receptacles conspicuous (Figs 7–8)..... ***L. niedeguidonae* sp. n.**
- 9 Seminal receptacles small, oval pouches (Gertsch 1967 pl.3, fig. 9) ..... ***L. variegata***
- Seminal receptacles much larger..... 10
- 10 Seminal receptacles curved (Gertsch 1967 pl.3, fig. 5); first femur 1.3 times longer than carapace ..... ***L. gaucho***
- Seminal receptacle straight or almost so; first femur 1.8 times longer than carapace .....11
- 11 Dorsal part of the bursa copulatrix weakly sclerotized (Gertsch 1967 pl. 3, fig. 6) ..... ***L. similis***
- Dorsal part of the bursa copulatrix strongly sclerotized (Bertani et al. 2010 figs 6–7)..... ***L. chapadensis***

***Loxosceles niedeguidonae* sp. n.**

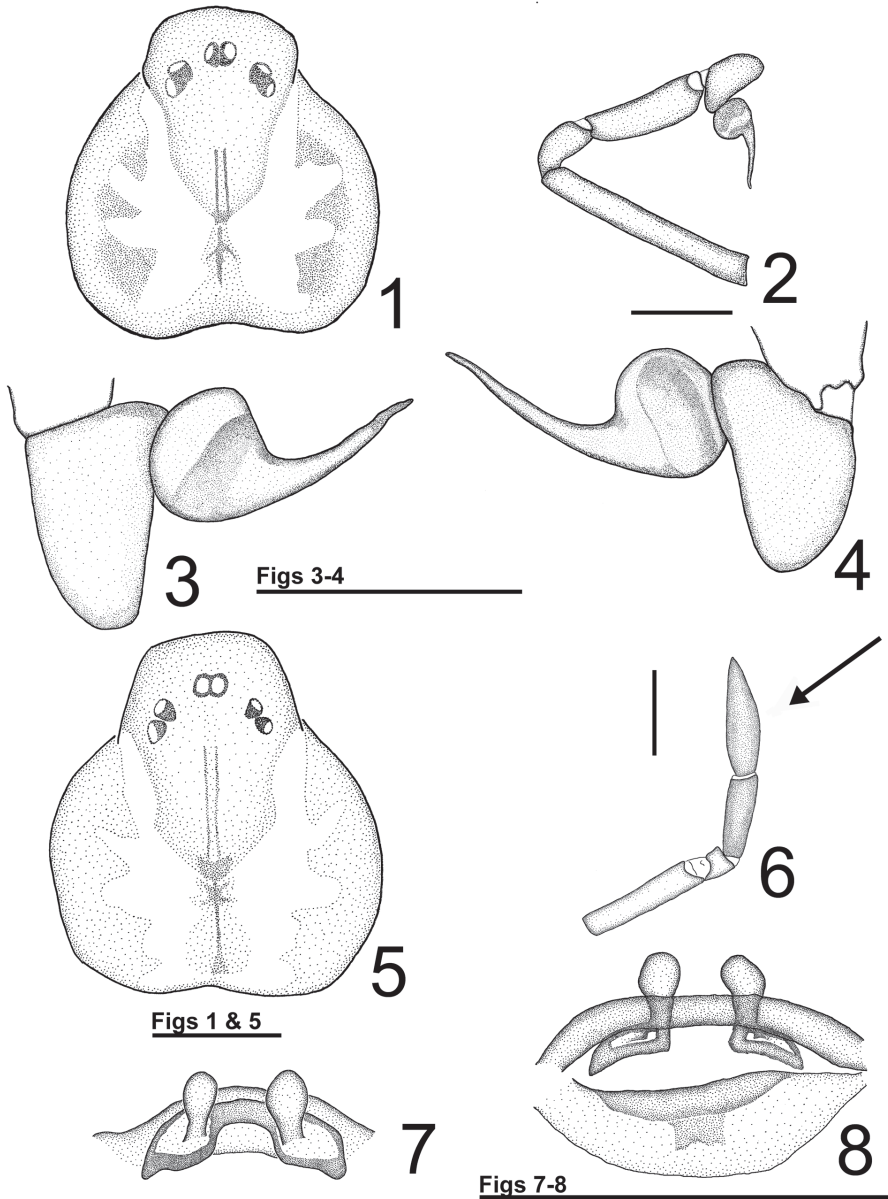
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[http://species-id.net/wiki/Loxosceles\\_niedeguidonae](http://species-id.net/wiki/Loxosceles_niedeguidonae)

Figures 1–13

**Type material.** Holotype: male: Brazil, Piauí, Coronel José Dias, Boqueirão do Sítio da Pedra Furada – Toca, 8°51'S 42°33'W, 16 March 2009, R. M. Gonçalves-de-Andrade & Maria Fátima Ribeiro Barbosa (MNRJ 04359).

Paratype female (MNRJ 04360) with same data as for holotype.



**Figures 1–8.** *Loxosceles niedeguidonae* sp. n. **1–4** holotype male **1** carapace **2** left palp **3** bulb, prolateral view **4** bulb, retrolateral view **5–8** paratype female **5** carapace **6** right palp - incassate tarsus (arrow) **7** spermathecae, dorsal view **8** spermathecae, ventral view. Scale bar: 1 mm.

**Other material examined.** *Loxosceles chapadensis*. Holotype: Male: Brazil, Bahia, Palmeiras, Chapada Diamantina National Park (12°28'S, 41°25'W), 15 February 2008, R. Bertani, C. S. Fukushima & R. H. Nagahama, (MNRJ 6047); Paratypes:

Brazil, Bahia: 1 female, with same data as for holotype (MNRJ 6048); 3 females and 1 male, Lençóis, Chapada Diamantina National Park (12°33'S, 41°23'W), 19 February 2008, same collectors as for holotype, (MNRJ 6049); 1 female, Iraquara, Fazenda Pratinha (12°21'S, 41°32'W), 16.II.2008, same collectors as for holotype, (MNRJ 6050).

**Diagnosis.** Males can be readily distinguished from other species, except *L. chapadensis* by the following characters in combination: Palpal tibia more than 1.5 times longer than tarsus, embolus 1.5–1.8 times longer than diameter of tegulum, arising at distal half of tegulum, distally thin but not filiform and hardly curved, particularly not in distal direction (Fig. 2). Males differ from *L. chapadensis* by palpal tarsus almost two times longer than wide (Figs 2–4), embolus less curved (Fig. 4) and faded lateral dentate dark bands on the dorsal side of the carapace (Fig. 9). Females can be recognized by the following characters in combination: A narrow transversal plate in the spermathecae, straight, apically enlarged seminal receptacles and incrassate palpal tarsus, which is broader than palpal tibia (Figs 6–8).

**Etymology.** The specific name is a patronym in honor of Dr Niéde Guidon, one of the most important Brazilian archeologists, internationally acknowledged for her archeological work and her battle for the preservation of archeological sites in Brazil and the conservation of remnant patches of Caatinga vegetation, as well as important social work, especially in the Parque Nacional da Serra da Capivara.

**Description.** Male (holotype). Total length (without chelicerae) 6.01. Carapace 3.29 long, 3.1 wide. Eye size: ALE: 0.2, PME: 0.22, PLE: 0.18. Clypeus: 0.32. Interocular distance - PME and PLE: 0.04, PME and ALE: 0.2. Leg formula: II, IV, I, III. Legs and palp length and width in Table 1. Labium 0.75 long, 0.42 wide. Sternum 1.59 long, 1.48 wide. Femur I 2.58 times longer than the carapace. Palpal femur 7.13 times longer than wide, tibia 2.81 times longer than wide (Fig. 2), tarsus almost two times longer than wide (Figs 3–4). Bulb suboval, slightly shorter than tarsus length. Embolus almost straight, approximately two times longer than bulb width, without carina (Fig. 4). Cephalic region of carapace covered by many long setae. Carapace with pars cephalic and chelicerae light brown (Fig. 1). Pars thoracica pale yellow, carapace border mottled, light brown (Figs 1, 9). Legs and palps pale yellow, covered by short grayish setae. Coxae and sternum pale yellow, labium and endites brown. Abdomen covered with grayish setae.

Female (paratype MNRJ 04360) Total length (without chelicerae) 7.35. Carapace 3.79 long, 3.71 wide. Eye sizes: ALE: 0.22, PME: 0.16, PLE: 0.18. Clypeus: 0.32. Interocular distances - PME and PLE: 0.05, PME and ALE: 0.24. Leg formula: II, I, VI, III. Legs and palp length and width in Table 2. Labium 0.7 long, 0.54 wide.

**Table 1.** *Loxosceles niedeguidonae* sp. n. Male holotype. Length/width of right legs and palpal segments.

|              | Palp      | I        | II         | III       | IV         |
|--------------|-----------|----------|------------|-----------|------------|
| Tarsi        | 0.75/0.46 | 1.9/0.1  | 1.75/0.12  | 1.37/0.12 | 1.75/0.12  |
| Metatarsi    | ---       | 11.4/0.2 | 13.87/0.12 | 2.05/0.25 | 12.12/0.25 |
| Tibiae       | 1.55/0.55 | 10.1/0.3 | 12.12/0.37 | 7.62/0.25 | 9.37/0.37  |
| Patellae     | 0.7/0.45  | 1.3/0.4  | 1.25/0.5   | 1.25/0.5  | 1.25/0.5   |
| Femora       | 2.64/0.37 | 8.5/0.6  | 10.25/0.62 | 8.0/0.62  | 9.12/0.62  |
| Total length | 5.64      | 33.2     | 39.24      | 20.29     | 33.61      |

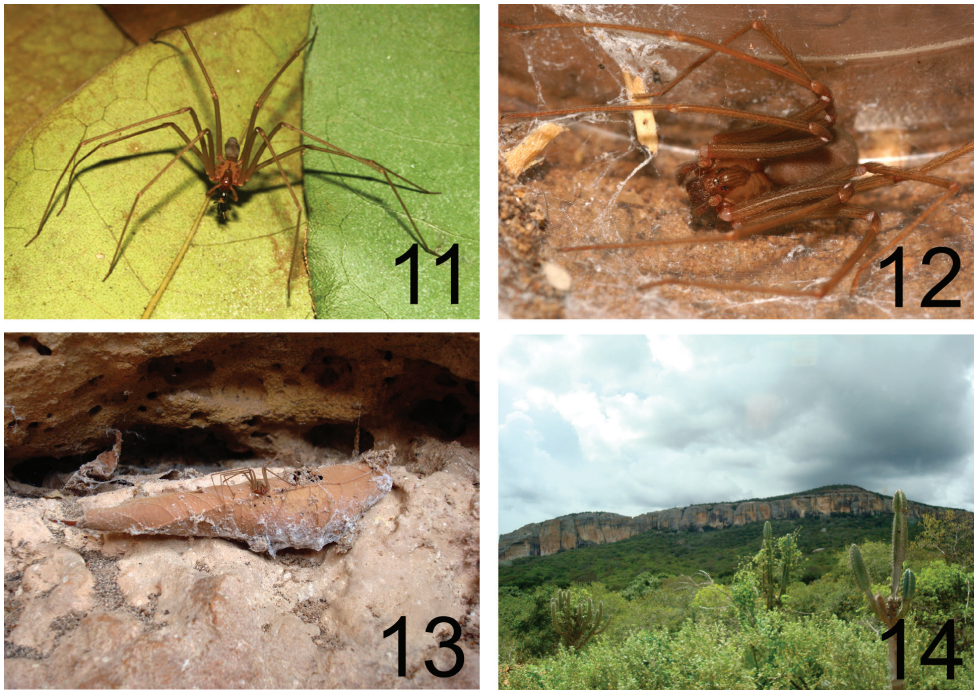
**Table 2.** *Loxosceles niedeguidonae* sp. n. Female paratype (MNRJ 04360). Length/width of right legs and palpal segments.

|              | Palp      | I         | II        | III       | IV        |
|--------------|-----------|-----------|-----------|-----------|-----------|
| Tarsi        | 1.42/0.39 | 1.58/0.08 | 1.58/0.16 | 1.18/0.16 | 1.26/0.16 |
| Metatarsi    | ---       | 6.24/0.16 | 7.19/0.16 | 5.85/0.16 | 6.95/0.16 |
| Tibiae       | 1.11/0.32 | 6.32/0.32 | 6.79/0.32 | 4.42/0.32 | 5.45/0.32 |
| Patellae     | 0.47/0.32 | 1.11/0.47 | 1.03/0.32 | 1.03/0.39 | 1.11/0.47 |
| Femora       | 1.58/0.32 | 6.0/0.63  | 6.4/0.63  | 5.45/0.47 | 5.85/0.63 |
| Total length | 4.58      | 21.25     | 22.99     | 17.93     | 20.62     |

**Figures 9–10.** Carapaces, males. **9** *Loxosceles niedeguidonae* sp. n., holotype **10** *Loxosceles chapadensis*, holotype.

Sternum 1.85 long, 1.78 wide. Femur I 1.58 times longer than carapace. Palpal femur 5.0 times longer than wide, tibia 3.5 longer than wide, tarsus incrassate (Fig. 6). Spermathecae with long, straight, apically enlarged seminal receptacles; transversal plate narrow, weakly sclerotized; atriobursal orifices well visible, ovals, positioned on the internal edge of the central windows; dorsal part of bursa copulatrix weakly sclerotized (Figs 7–8). Coloration as in male, but darker (Fig. 12). Tarsi and tibiae of palps reddish-brown.

**Discussion.** The female *Loxosceles niedeguidonae* sp. n. can undoubtedly be included in the *gaucho* group of Gertsch (1967) due to spermathecae bearing a transverse plate (Figs 7–8), which is characteristic of the group. However, the male resembles species of the *laeta* group due to its long palpal tibia (Fig. 2). These characteristics are also found in the recently described species *Loxosceles chapadensis* with which *Loxosceles niedeguidonae* sp. n. seems to be closely related. As already discussed by Bertani et al. 2010, the long palpal tibia of males of *L. chapadensis* (and



**Figures 11–14.** *Loxosceles niedeguidonae* sp. n. **11** male **12** female **13** male in type locality – Toca do Buraco da Pedra Furada, Parque Nacional Serra da Capivara, Piauí, Brazil **14** General view of Parque Nacional Serra da Capivara, Piauí, Brazil. Photos **11–12** R. Bertani; **13–14** R. M. Gonçalves-de-Andrade.

now, *L. niedeguidonae* sp. n.) could be an homoplasy with species of the *laeta* and *spadicea* groups or a plesiomorphy, indicating a more basal position of the species in the *gaucho* group relative to these other species (Bertani et al. 2010). Despite these shared characteristics they can be separated by genitalic and somatic characteristics. The male has a straighter embolus (Figs 3–4), palpal tarsus almost two times longer than wide and color pattern are not very similar to the typical *gaucho* pattern, i. e. lateral dentate dark bands on the dorsal side of carapace. The male resembles an individual of the *laeta* group due to its light-brown coloration and faded dentate dark bands on the carapace (Figs 1–9, 11). The female can be easily separated by the narrow transversal plate in spermathecae (Figs 7–8) and incrassate palpal tarsus (Fig. 6), which is like the female *Loxosceles adelaida*, *gaucho* group (Gertsch, 1967), but more dilated than the latter.

The distinct, but close geographical distribution of *L. chapadensis* and *L. niedeguidonae* sp. n. in Northeastern Brazil provides an additional indication that these two species are closely related.

**Natural History.** Specimens of *Loxosceles niedeguidonae* sp. n. were found in the locality of “Buraco da Pedra Furada”. The male was collected over the ground and the female in a rock crevice close to a cave mouth. The arenitic walls in the Parque Nacional Serra da Capivara have innumerable crevices that make typical retreats for brown

recluse spiders (Figs 13–14). However, despite the presence of so many crevices, a low population density was found in the analyzed ecotope.

**Distribution.** Known only from Parque Nacional Serra da Capivara, Piauí State, Brazil.

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# *Katatopygia* gen. n., a monophyletic branch segregated from *Boletina* (Diptera, Mycetophilidae)

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## Abstract

The genus *Katatopygia* **gen. n.** is proposed for the *Boletina erythropygala/punctus*-group that was first introduced by Garrett (1924, 1925) and currently comprises eight described species. Molecular studies have strongly indicated that this group forms a monophyletic sister-group to a clade consisting of all other *Boletina*, *Coelosia* and *Gnoriste*, and its monophyly is supported by morphological data as well. The new genus includes the following species: *Katatopygia antoma* (Garrett, 1924), **comb. n.**, *Katatopygia antica* (Garrett, 1924), **comb. n.**, *Katatopygia erythropygala* (Holmgren, 1883), **comb. n.**, *Katatopygia hissarica* (Zaitzev & Polevoi, 2002), **comb. n.**, *Katatopygia magna* (Garrett, 1925), **comb. n.**, *Katatopygia laticauda* (Saigusa, 1968), **comb. n.**, *Katatopygia neoerythropygala* (Zaitzev & Polevoi, 2002), **comb. n.** and *Katatopygia sahlbergi* (Lundström, 1906), **comb. n.**, all transferred from *Boletina*. *K. sahlbergi* is found to be a senior synonym of *Boletina punctus* Garrett, 1925, **syn. n.** A phylogeny based on morphological data and using parsimony analysis yielded four most parsimonious trees where the new genus is retrieved as monophyletic with high support. *Katatopygia neoerythropygala* is found to be the sister-taxon to all other species that form two clades, one with *K. sahlbergi*-like species and one with *K. erythropygala*-like species. A key to males of *Katatopygia* is provided.

## Keywords

New genus, taxonomy, Gnoristinae, new synonymy, revision, identification key, phylogeny

Introduction

In two papers Garrett (1924, 1925) described four closely allied species of *Boletina* Staeger from North America that he in the latter paper named the *punctus*-group and provided a sketchy plate with all four species’ male gonostyles aligned. Zaitzev and Polevoi (2002) revised the same group under the name *erythropyg*a-group, but were apparently not aware of and failed to include Garrett’s species although their revision was intended to be Holarctic. Although traditionally placed in *Boletina*, species of this group are morphologically quite distinct in several aspects and well separated from other *Boletina* as well as from *Saigusaia* Vockeroth and *Aglaomyia* Vockeroth, both of which Vockeroth (1980) distinguished from *Boletina* based on morphological characters. The segregation of *Saigusaia* has later been supported by phylogenetic studies, both morphological (Søli 1997) and molecular (Martinsson et al. 2011), whereas *Aglaomyia* may be nested within *Boletina* (Martinsson et al. 2011). Molecular studies have strongly suggested that *Boletina* as currently delimited is paraphyletic (Baxter 1999; Martinsson et al. 2011) and given support for the *B. erythropyg*a/*punctus*-group being the sister-group to a clade consisting of all other *Boletina*, *Aglaomyia*, *Coelosia* Winnertz and *Gnoriste* Meigen (Martinsson et al. 2011).

Accordingly, a new genus *Katatopygia* gen. n. is here proposed and described for the *B. erythropyg*a/*punctus*-group. Holmgren (1883) described the first species as *Boletina erythropyg*a Holmgren, 1883, based on material from Novaya Zemlya in northern Russia. Lundström (1906) added *Boletina sahlbergi* Lundström, 1906 from Finnish Lapland, while Johannsen (1911) added *Boletina longicornis* Johannsen, 1911 from Idaho in USA. Garrett (1924, 1925) described four additional species based on material from British Columbia in Canada, of which *Boletina punctus* syn. n. is considered here a junior synonym of *Boletina sahlbergi*. Saigusa (1968) added *Boletina laticauda* Saigusa, 1968 from Taiwan. Laštovka and Matile (1988) erroneously synonymized *Boletina sahlbergi* with *Boletina erythropyg*a, leading Zaitzev (1994) to

**Table 1.** List of World species of the genus *Katatopygia* gen. n. All species are being transferred from *Boletina* Staeger. Their known distribution in faunal regions and subregions is given to the right. Abbreviations: **ORI** – Oriental Region **EN** – Eastern Nearctic subregion **WN** – Western Nearctic subregion **WP** – Western Palaearctic subregion **EP** – Eastern Palaearctic subregion.

| Species                                                                | Region<br># species | ORI<br>1 | EN<br>1 | WN<br>4 | EP<br>4 | WP<br>2 |
|------------------------------------------------------------------------|---------------------|----------|---------|---------|---------|---------|
| <i>Katatopygia antica</i> (Garrett, 1924), comb. n.                    |                     | –        | –       | •       | –       | –       |
| <i>Katatopygia antoma</i> (Garrett, 1924), comb. n.                    |                     | –        | –       | •       | –       | –       |
| <i>Katatopygia erythropyg</i> a (Holmgren, 1883), comb. n.             |                     | –        | •       | –       | •       | •       |
| <i>Katatopygia hissarica</i> (Zaitzev & Polevoi, 2002), comb. n.       |                     | –        | –       | –       | •       | –       |
| <i>Katatopygia laticauda</i> (Saigusa, 1968), comb. n.                 |                     | •        | –       | –       | –       | –       |
| <i>Katatopygia magna</i> (Garrett, 1925), comb. n.                     |                     | –        | –       | •       | –       | –       |
| <i>Katatopygia neoerythropyg</i> a (Zaitzev & Polevoi, 2002), comb. n. |                     | –        | –       | –       | •       | –       |
| <i>Katatopygia sahlbergi</i> (Lundström, 1906), comb. n.               |                     | –        | –       | •       | •       | •       |

describe a new species representing the former. Zaitzev and Polevoi (2002) resolved these confusing species interpretations by reinstating *Boletina sahlbergi* and suggesting two new synonyms, and finally added two more species. With these changes a group that currently includes eight species can be assigned to *Katatopygia* gen. n. (Table 1), all being transferred from *Boletina* s.l.

## Material and methods

The examined material was gathered from museum collections and surveys, and mainly consists of the type series of the species described by CBD Garrett (Fig. 1) from Canada, some material from Alaska (USA) and European material from the Nordic region. The following collection acronyms for depositories are used in the text:

- AMNH** American Museum of Natural History, New York, USA
- CNC** Canadian National Museum, Ottawa, Canada
- CUIC** Cornell University, Ithaca, New York, USA
- KMNH** Kyushu University Museum, Fukuoka, Japan
- MZLU** Museum of Zoology, Lund University, Lund, Sweden
- NHRS** Swedish Museum of Natural History, Stockholm, Sweden
- ZMUN** Zoological Museum, University of Oslo, Oslo, Norway

All specimens examined were recorded with unique identification codes prefixed by “JKJ–SPM–” in a BIOTA 2.04 database (Colwell 2007), and the lists of material examined were extracted from this database. For each species and country the localities are sorted hierarchically within provinces, districts, localities and sites, respectively.

Morphological terminology mainly follows Söli (1997), the term “retinacula” is here used for any assemblage of strong, short and blunt macrosetae. The term “apical processus” is adopted from Zaitzev & Polevoi (2002) and is used for a small appendage that articulates to an unsclerotized area apically on the gonostylus. Terminology of sensillae follows Seifert (1975).

Terminalia were macerated in heated KOH (90°C) and transferred to acetic acid for neutralisation, then to alcohol and finally to glycerine. Most terminalia are preserved in glycerine in micro-vials together with the rest of the specimen, while some specimens are permanently mounted in Canada balsam on slides as outlined by Kjærandsen (2006). In order to produce plates the terminalia were either photographed in glycerine with a Nikon Digital Sight DS-M5 microscope camera mounted on a Nikon SMZ1500 stereomicroscope, or placed in alcohol gel under a coverslip and photographed through a Nikon Eclipse 50i compound microscope. Series of z-stack photos were taken and combined for extended focus using HELICON FOCUS. The images were digitally edited in ADOBE PHOTOSHOP and GIMP. Scanned sketches, drawn using a drawing tube attached to a Nikon Eclipse 50i compound microscope, were used as templates to produce digital illustration with GIMP.

## Phylogenetic analysis

A data matrix (Table 2) for phylogenetic reconstruction was constructed using WIN-CLADA v1.00.08 (Nixon 2002). Characters dealing with structures of the thoracic sclerites, wings, abdominal sclerites and male terminalia were used, with a focus on characters of the terminalia. The characters were either coded as binary (15) or multi-state (8). Missing data was coded as “?”. All species of *Katatopygia* were included as the ingroup. Character states for *K. laticauda*, *K. neoerythropya* (Zaitzev & Polevoi, 2002) and *K. hissarica* (Zaitzev & Polevoi, 2002) were derived from the original descriptions (Saigusa 1968; Zaitzev and Polevoi 2002). As outgroups we used *Coelosia gracilis* Johannsen, *Gnoriste longirostris* Siebke, an undescribed species of *Docosia* cf. *gilvipes* (Kjærandsen & Hedmark in prep.) and four species of *Boletina*, viz. *Boletina trivittata* (Meigen), *Boletina gripha* Dziedzicki, *Boletina hedstroemi* Polevoi & Hedmark and *Boletina sciarina* Staeger. The trees were rooted with the *Docosia* species. The following 23 characters were used in the analysis; observed character states are given in Table 2.

1. Thorax with: dorsocentrals present = 0; dorsocentrals absent = 1; dispersed setae = 2.
2. Mesonotal stripes: indistinct or absent = 0; distinct = 1.
3. Costa: ending at  $R_5$  termination = 0; produced beyond  $R_5$  = 1.
4. Sc: non setose = 0; with a few apical setae = 1; mostly setose = 2.
5. CuA-stem: without setae = 0; with setae = 1.
6. Pale abdominal markings: absent = 0; present = 1.
7. Medial fold line of abdominal sternites: absent = 0; present = 1.
8. Tergite VIII: not bearing setae = 0; bearing setae = 1.
9. Male terminalia: not dorsoventrally flattened = 0; dorsoventrally flattened = 1
10. Tergite IX: small, not covering most of gonocoxites and gonostylus = 0; large, covering most of gonocoxites and gonostylus = 1.
11. Gonocoxites: separated = 0; ventrally connected, but not fused = 1; ventrally fused = 2.
12. Gonocoxites: not projected mesocaudally = 0; moderately projected mesocaudally = 1; strongly projected mesocaudally = 2.
13. Hypandrial lobe: vestigial or absent = 0; weakly sclerotized = 1; heavily sclerotized = 2.
14. Gonostylus: without apical process = 0; with apical process = 1.
15. Gonostylus: without strong setae on interior surface = 0; with one strong seta on interior surface = 1; with two or more strong setae on interior surface = 2.
16. Apex of gonostylus: without retinacula = 0; with retinacula = 1.
17. Parameres: without microtrichia = 0; with microtrichia = 1.
18. Parameres: paired dorsally = 0; fused into one rod dorsally = 1.
19. Sperm sac: weakly developed or hyaline = 0; well developed and sclerotized = 1.
20. Gonocoxal apodeme: vestigial or absent = 0; weakly sclerotized = 1; heavily sclerotized = 2.

- 21. Cerci: not bearing retinacula = 0; with retinacula evenly distributed = 1; retinacula arranged in lines = 2.
- 22. Tergite IX: without mesial suture = 0; with mesial suture = 1.
- 23. Gonostylus: simple = 0; branched = 1.

**Table 2.** Observed states of morphological characters used in the phylogenetic studies of *Katatopygia* gen. n., *K. hissarica*, *K. laticauda* and *K. neoerythropya* are coded based on original descriptions.

| Taxon                            | Characters |     |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|----------------------------------|------------|-----|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
|                                  | 1          | 2   | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
| <i>Docosia</i> sp. A             | 2          | 0   | 1 | 2 | 1 | 0 | 0 | 1 | 0 | 0  | 2  | 0  | 0  | 0  | 2  | 0  | 0  | 0  | 0  | 0  | 2  | 0  | 1  |
| <i>Coelosia</i> gracilis         | 0          | 0   | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 2  | 0  | 0  | 1  |
| <i>Gnoriste</i> longirostris     | 1          | 1   | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0  | 2  | 0  | 2  | 0  | 0  | 0  | 0  | 1  | ?  | ?  | 0  | 0  | 1  |
| <i>Boletina</i> gripha           | 0          | 0   | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 2  | 0  | 1  |
| <i>Boletina</i> hedstroemi       | 0          | 1   | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1  | 0  | 0  | 0  | 0  | 2  | 0  | 0  | 0  | ?  | ?  | 2  | 0  | 0  |
| <i>Boletina</i> sciarina         | 0          | 0   | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1  | 0  | 0  | 0  | 0  | 2  | 0  | 0  | 0  | ?  | ?  | 2  | 0  | 0  |
| <i>Boletina</i> trivittata       | 1          | 1   | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1  | 2  | 0  | 0  | 0  | 2  | 0  | 0  | 0  | 0  | 2  | 1  | 0  | 0  |
| <i>Katatopygia</i> antica        | 0          | 1   | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0  | 1  | 2  | 1  | 1  | 0  | 1  | 1  | 1  | 1  | 1  | 0  | 1  | 0  |
| <i>Katatopygia</i> erythropya    | 0          | 1   | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0  | 1  | 0  | 1  | 1  | 1  | 1  | 0  | 1  | 1  | 1  | 0  | 0  | 0  |
| <i>Katatopygia</i> antoma        | 0          | 1   | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0  | 1  | 2  | 1  | 1  | 0  | 1  | 1  | 0  | 1  | 1  | 0  | 1  | 0  |
| <i>Katatopygia</i> sahlbergi     | 0          | 0,1 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0  | 1  | 1  | 1  | 1  | 0  | 1  | 1  | 1  | 1  | 1  | 0  | 1  | 0  |
| <i>Katatopygia</i> laticauda     | ?          | 0   | 0 | 0 | 0 | 1 | ? | ? | 1 | 0  | 1  | 1  | 1  | 1  | 0  | 1  | 1  | 1  | ?  | ?  | 0  | 0  | 0  |
| <i>Katatopygia</i> hissarica     | ?          | 1   | 1 | 1 | ? | 1 | ? | ? | 1 | 0  | ?  | 0  | 1  | 1  | 1  | 1  | ?  | 1  | ?  | ?  | 0  | 0  | 0  |
| <i>Katatopygia</i> neoerythropya | ?          | 1   | 1 | 0 | ? | 0 | ? | ? | 1 | 0  | 1  | 2  | 1  | 0  | 1  | 1  | ?  | ?  | ?  | ?  | 0  | ?  | 0  |
| <i>Katatopygia</i> magna         | 0          | 0   | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0  | 1  | 0  | 1  | 1  | 1  | 1  | 0  | 1  | 1  | 1  | 0  | 0  | 0  |

The data matrix was analysed using parsimony in NONA v2.0 (Goloboff 1999) used together with WINCLADA. The analysis was carried out with a heuristic search with 10 000 replicates (mult\*10 000) and 10 starting trees per replicate (hold/10), holding 1000 trees in memory (hold 1000), using the multiple TBR + TBR search strategy (mult\*max\*) and random starting seed (rs 0). Characters were treated as unordered and with equal weights. Jackknifing (Farris et al. 1996) were preformed in NONA v2.0 (Goloboff 1999) used together with WINCLADA in order to explore support for nodes. The analysis was carried out with 1000 jackknife replicates and 100 heuristic searches in each replicate, saving one tree per replicate.

The heuristic search produced four most parsimonious trees (L 49; CI 63; RI 79). A strict consensus tree was calculated and is shown in Fig. 2 with all unambiguous character changes and unsupported nodes collapsed. The new genus *Katatopygia* forms a monophyletic group that is statistically supported (92%) by Jackknifing. This is in accordance with previous molecular studies (Martinsson et al. 2011) although we here end up with a different arrangement among outgroup genera and clades that gain little or no statistical support by the Jackknife analysis.

The monophyly of *Katatopygia* is supported by two unique and one non-unique synapomorphies (character and states given in parenthesis), viz.: 1) Male terminalia dorsoventrally flattened (#9:1), 2) gonostylus with apex covered with retinacula (#16:1), and 3) gonostylus simple (#23:0).

The genus *Katatopygia* has the parameres fused into one dorsal rod (#18:1) in all species except *K. antoma* where paired parameres are retained. This is interpreted as a secondary reversal and this character is here a synapomorphy shared with *Gnoriste*.

Among the *Katatopygia* species *K. neoerythropya* is found as the sister-group to the other species. This clade is supported by two synapomorphies viz.: 1) pale abdominal markings present (#6:1) and 2) gonostylus with an apical process (#14:1). This clade is further subdivided into two distinct clades. One includes the ‘*erythropya*-like’ species (*K. erythropya*, *K. hissarica* and *K. magna*) that is moderately (58 %) supported by Jackknifing and has one synapomorphy; Sc with a few apical setae (#4:1). The other clade includes the ‘*sahlbergi*-like’ species (*K. sahlbergi*, *K. antica*, *K. antoma*, and *K. laticauda*) that is moderately (65%) supported by Jackknifing and has three synapomorphies, viz.: 1) costa ending at  $R_5$  termination (#3:0, a character state also found in *Boletina trivittata*), 2) gonocoxites moderately projected mesocaudally (#12:1), and 3) parameres covered with microtrichia (#17:1).

The *erythropya*-clade is unresolved, whereas the *sahlbergi*-clade is fully resolved with *K. laticauda* being the sister-group to the remaining species that are united by having tergite IX with a mesal suture (#22:1). *K. antica* and *K. antoma* share one synapomorphy; gonocoxites strongly projected mesocaudally (#12:2, this state is also found in *K. neoerythropya*).

The data matrix and trees are deposited in the Dryad Data Repository at doi: 10.5061/dryad.682t7442

## Systematics

### Genus *Katatopygia* gen. n.

urn:lsid:zoobank.org:act:1A68AEFE-FE7E-4D92-BC9B-430B52D6979A

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

<http://sciaroidea.info/taxonomy/41708>

**Type species.** *Boletina sahlbergi* Lundström, 1906: 14 (type deposited in MZHF)

**Diagnosis.** The genus consists of medium sized slender Gnoristinae with long abdomen where the males have a very characteristically flattened and dilated terminalia (eg. Fig. 3E). They can be recognized on a combination of the following characters: mouthparts not prolonged; scutum with setae arranged in acrostichals, dorsocentrals and laterals; laterotergite bare; wing with Sc ending in C; M-petiole as long as or longer than ta; CuA-furcation before level of M-fork, approximately level with base of  $R_s$ ; abdominal sternites with median fold-line absent; male terminalia broad and dorsoventrally flattened, often rotated about 180°; gonostylus large and simple, bear-

ing an apical processus (except in *K. neoerythropya*); parameres fused dorsally into one caudally directed rod (with one exception, *K. antoma*, that has paired parameres); cerci large and without retinacula, covered with long trichia; hypoproct well developed; female terminalia with unsegmented cerci. The best characters to separate between *Katatopygia* and *Boletina* s.s. are further listed in Table 3.

**Description.** Adults: Medium sized, slender with long abdomen, body length 4.5–6.5 mm (Fig. 3).

**Head** (Fig. 4A). Vertex with scattered setae. Ocelli three, almost in line, the median slightly smaller than laterals, lateral ocelli separated from eye by approximately 1.5 times its diameter; below the ocelli, protuberances present and well sclerotized. Eyes with shallow emargination above antennal base. Frons without setae but with small microtrichia and on lateral parts some stronger microtrichia; frontal furrow well developed and reaching apex of frontal tubercle. Antenna with 14 flagellomers; scape and pedicel with a few scattered setae and short microtrichia (Fig. 4E); flagellomeres long rectangular, densely covered with medium sized setae; apical flagellomere with a somewhat stronger terminal seta (Fig. 4D). Face with scattered setae. Mouthparts not prolonged; clypeus oval to subtriangular and well separated from face, sclerotized and bearing setae; palps with five palpomeres, the first being reduced and easily overlooked, third palpomere with sensillae on inner surface.

**Thorax** (Fig. 4B). Anteprenotum fused with proepisternum, bearing some setae, the suture between the sclerites weak. Scutum with setae arranged in acrostichals, dorsocentrals and laterals, otherwise bare. Scutellum with one pair of bristles and scattered setae. Anepisternum, anepimeron latero- and mediotergite all bare.

**Wings** (Fig. 5A–B). Wing membrane unspotted, yellow tinged with dense, irregular arranged microtrichia and no macrotrichia. Crossvein h bare; costa,  $R_1$ , and  $R_5$  with both dorsal and ventral setae;  $M_1$ ,  $M_2$ ,  $CuA_1$  and  $CuA_2$  with dorsal setae; subcosta bare or with a few setae on distal part;  $ta$ ,  $tb$ , M-petiole, CuA-petiole,  $A_1$  and  $A_2$  without setae; C ending in, or slightly produced beyond apex of  $R_5$ ; Sc ending in C before or in level with base of  $R_5$ ;  $Sc_2$  present, but may be reduced;  $R_4$  absent; M-petiole between 1

**Table 3.** Comparison of *Katatopygia* gen. n. and *Boletina* Staeger s. str.

| Character                               | <i>Katatopygia</i>                                             | <i>Boletina</i> s. str.                                            |
|-----------------------------------------|----------------------------------------------------------------|--------------------------------------------------------------------|
| Laterotergite                           | bare                                                           | bare or setose                                                     |
| Median fold line on abdominal sternites | absent                                                         | present or absent                                                  |
| Male terminalia                         | broad and dorsoventrally flattened                             | shaped differently                                                 |
| Male parameres                          | fused (one exception <i>K. antoma</i> )                        | paired                                                             |
| Male cercus                             | large, not bearing retinacula                                  | smaller, bearing retinacula                                        |
| Male tergite IX                         | small                                                          | large                                                              |
| Male gonostylus                         | with apical processus (one exception <i>K. neoerythropya</i> ) | without apical processus                                           |
| Apex of male gonostylus                 | bearing retinacula                                             | not bearing retinacula                                             |
| Female cercus                           | one segmented                                                  | two segmented (except in <i>B. abdita</i> and <i>B. oviducta</i> ) |

and 2 times as long as ta; CuA-fork starts proximally of M-fork, approximately at the level of base of Rs; A<sub>1</sub> ending at or slightly before CuA-fork; A<sub>2</sub> indistinct and short.

**Legs** (Fig. 4C). Legs often pale with dark setation; fore and mid coxae with some setae on apical part; trochanter dark; bearing sensillae and a few small setae; femur with numerous setae and no bristles; tibia covered with irregularly arranged setae and with bristles mainly confined to ventral surface; fore tibia with anteroapical depressed area semicircular and densely covered with long microtrichia; apical tibial spur serrated and covered with microtrichia, no apical comb present; tarsus covered with macrotrichia and some stronger setae; claws with a small ventral lobe; empodium pulvilliform.

**Abdomen.** Pale abdominal markings, when present, situated towards the apices of the tergites. Sternite 1 with a few weak setae apically, all other segments haired; sternites with sublateral fold-lines, median fold-line absent; segment 7 and 8 reduced and retracted into segment 6.

**Male terminalia** (Fig. 6A–B). Broad and dorsoventrally flattened; often rotated about 180°. Tergite IX rather small and subrectangular, in some species with a mesial sclerotized suture, scattered with setae. Cerci large, rounded to oval, without retinacula, densely covered with long microtrichia. Gonocoxites large, moderately incised ventrally with a hypandrial lobe situated in this incision; hypandrial lobe well developed and more or less branched; gonocoxite bearing scattered macro- and microtrichia, long microtrichia densely covering apical margin. Tergite X present as a weakly sclerotized, short and broad plate situated ventrally, near apex of tergite IX. Hypoproct well developed, situated ventrally to cerci and fused with tergite X, setose and resembling a second segment of cercus. Gonostylus large, unbranched except possessing a tiny apical processus which articulates to a small unsclerotized area and bears 1–2 strong setae, in some species this processus is minute or absent; apex of gonostylus covered with dense retinacula; ventrobasally surface of gonostylus with patch of placoid sensillae; inner surface of gonostylus usually fringed with small dentations. Accessory copulatory appendages joined to gonocoxite through a weakly sclerotized gonocoxal apodeme attached near apex of aedeagus. Aedeagus apically connected with parameres; in most species the parameres are fused dorsally into one caudally directed rod; aedeagus with well developed sperm sacs, to which vas deferens is attached.

**Female terminalia** (Fig. 7A–F). Tergite VIII well developed, subrectangular. Sternite VIII well developed, entirely fused with gonocoxite VIII that is tapered and bearing several strong setae at apical margin. Tergite IX well developed, shorter than Tergite VIII. Gonapophysis VIII hyaline, indistinct. Gonapophysis IX ventrally divided and retracted into segment VIII, in some species projected into a pointed apex, while in other short and blunt. Tergite X very short, laterally fused with sternite X that is completely divided ventrally and projected caudally. Cerci one-segmented, ovate.

**Larvae** unknown.

**Notes on biology.** The Nordic species are most abundant in boreal Taiga and subarctic environments, and are possibly strictly boreal-montane. The adults, at least of *K. sahlbergi*, seem to be attracted by light, which could suggest nocturnal activity. Larval habitats are unknown for all species in the genus.

**Distribution.** A mainly Holarctic genus with the exception of *Katatopygia laticauda* (Saigusa, 1968), comb. n. described from Taiwan in the Oriental Region (Saigusa 1968). The greatest diversity is found in Western North America and in the Eastern Palaearctic with four species in each of the regions (Table 1).

**Etymology.** *Katatopygia* is derived from the Greek words *katatonis*, meaning “broader than high”, *pygo-*, meaning “rump” or “buttock” and the suffix *-ia* denoting pertaining to. The name refers to the characteristic broad and dorsoventrally flattened terminalia shared by all males in the genus. The name is a noun and is feminine.

### The species of *Katatopygia*

***Katatopygia antica* (Garrett, 1924), comb. n.**

<http://sciaroidea.info/taxonomy/41721>

Fig. 1A, 8A–C

*Boletina anticus* Garrett, 1924:165

**Diagnostic characters.** Most similar to *K. antoma*, with which it shares the projected dorsomesal corners of the male gonocoxites. Distinguished from *K. antoma* by having parameres fused, a small median tooth on hypandrial lobe and brown tip of halter.

**Re-description.** Male. **Wing length** 5.0–5.5 mm.

**Head** brown; palps and mouthparts pale. Antenna with scape brown, pedicel and basal part of first flagellomere pale, rest of flagellum brown.

**Thorax** brown with distinct, dark brown mesonotal stripes, humeral area yellow. Anteprepronotum brown; anepisternum brown; preepisternum brown; laterotergite brown; mediotergite brown. Halter pale with apical part of knob brown.

**Wings** weakly brownish tinged; veins yellowish brown; stem of M approximately 1.7 times the length of  $ta$ ;  $Sc_2$  present;  $Sc$  bare and ending in C at or slightly before base of  $R_s$ ; C ending at apex of  $R_5$ .

**Legs** pale with joints darker.

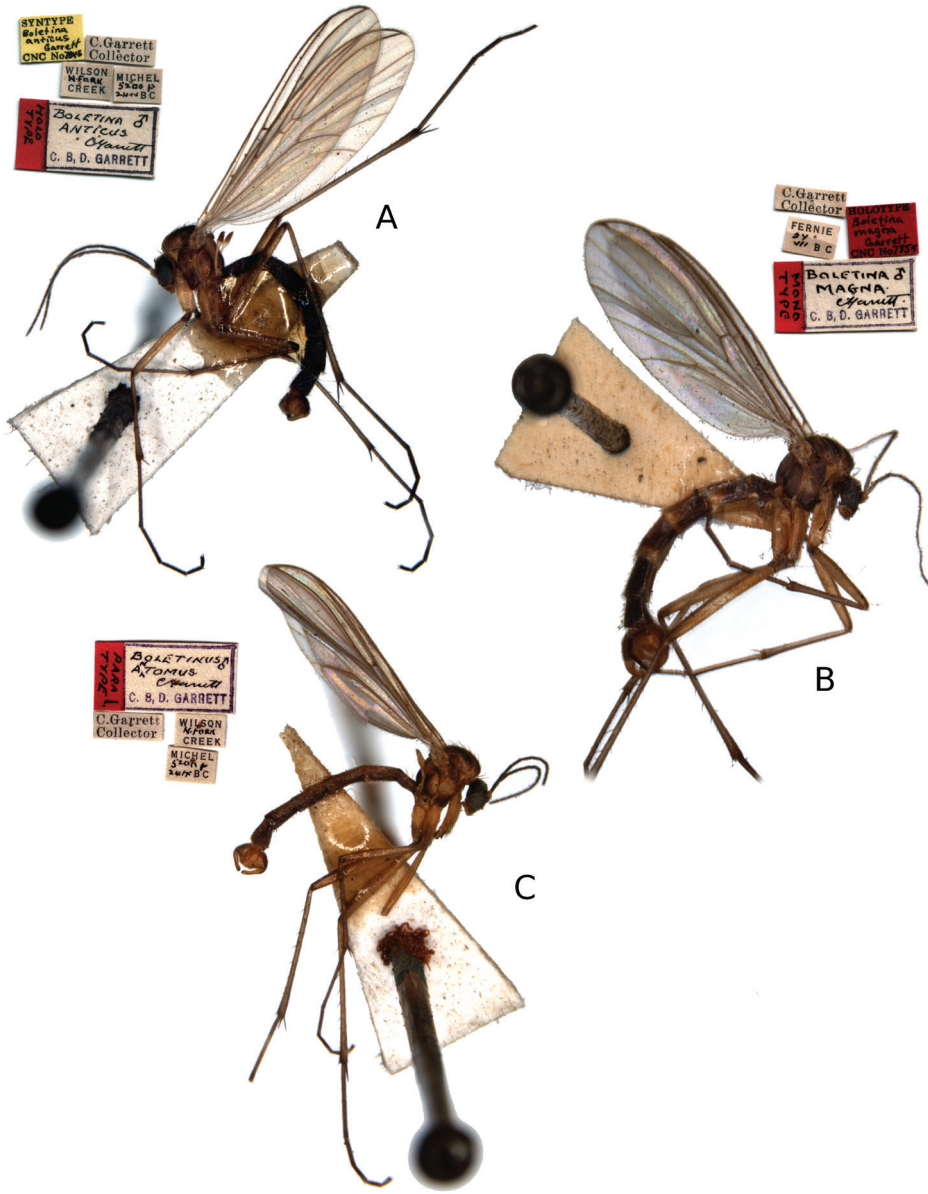
**Abdomen** dark brown often with narrow pale apical bands on tergites II–IV.

**Terminalia** brown. Gonocoxite with dorsomesal corner forming a mesocaudally directed horn-like processus, distinctly more projected than the ventromesal corner. Hypandrial lobe well developed and only shallowly emarginated medially with a small sharp medial tooth. One slender paramer, bearing microtrichia. Tergite IX subrectangular, with a sclerotized mesal suture. The apical processus on gonostylus approximately half as long as the diameter of gonostylus and slightly branched with two strong setae. Interior surface of gonostylus without strong setae.

Female. **Coloration** as in male, with brown tip of halter. **Terminalia** not studied.

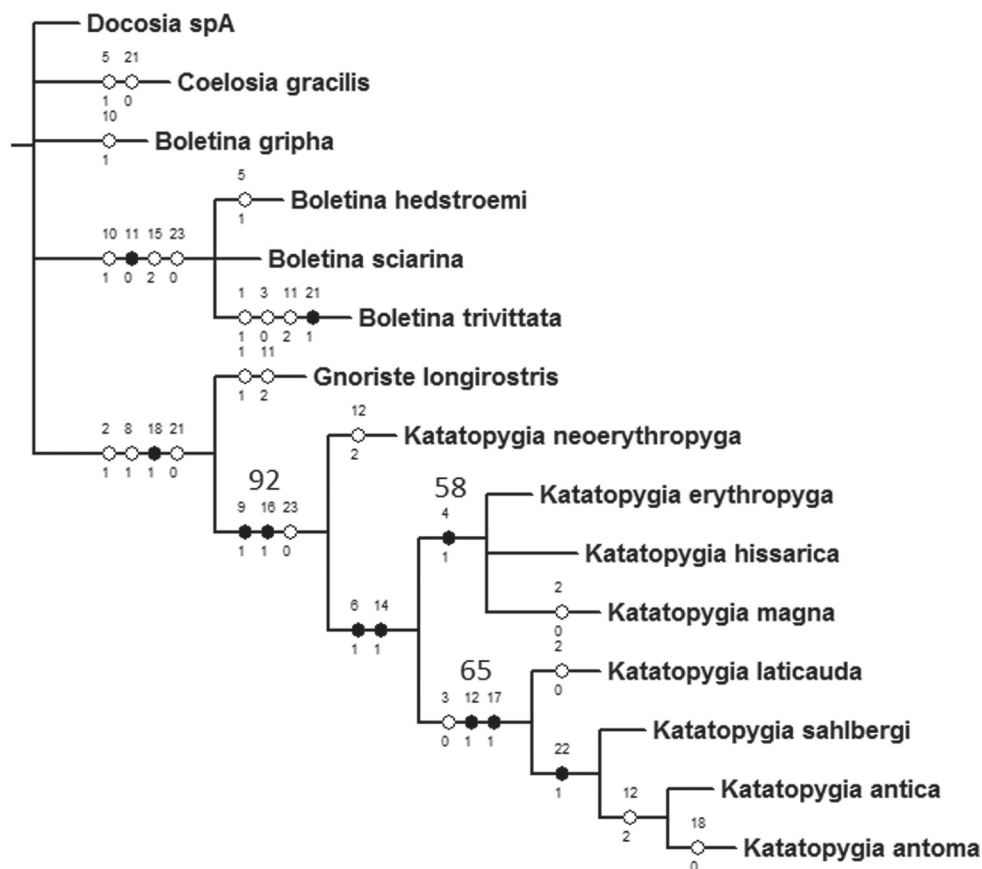
**Distribution.** Nearctic: Canada, British Columbia.

**Remarks.** Only known with the type material.



**Figure 1.** Type material with original labels of species of *Katatopygia* gen. n. described by Garrett (1924, 1925). **A** *Katatopygia antica* (Garrett, 1924) male syntype **B** *Katatopygia magna* (Garrett, 1925) male holotype. **C** *Katatopygia antoma* (Garrett, 1924) male syntype.

**Type material studied. Syntype series. Canada:** **B. C. Michel**, Wilson Creek. 21 Sep (year unknown pre 1925), leg. C. Garrett – 2 males (CNC, 1 pinned, JKJ-SPM-057739, and 1 pinned with abdomen mounted on separate slide, JKJ-SPM-057740); 24 Sep (year unknown pre 1925), leg. C. Garrett – 3 females (CNC, pinned, JKJ-SPM-057743-45).



**Figure 2.** Phylogeny of *Katatopygia* gen. n. Strict consensus tree (L 53; CI 58; RI 74) calculated from the four most parsimonious trees (L 49; CI 63; RI 79) obtained with the program NONA, with all unambiguous character changes shown and unsupported nodes collapsed. Numbers above branches indicate Jackknife support above 50%. Numbers above hatch marks (black = unique, open = homoplasious) refer to characters, numbers under hatch marks refer to a state changes to the state indicated.

***Katatopygia antoma* (Garrett, 1924), comb. n.**

<http://sciaroidea.info/taxonomy/41722>

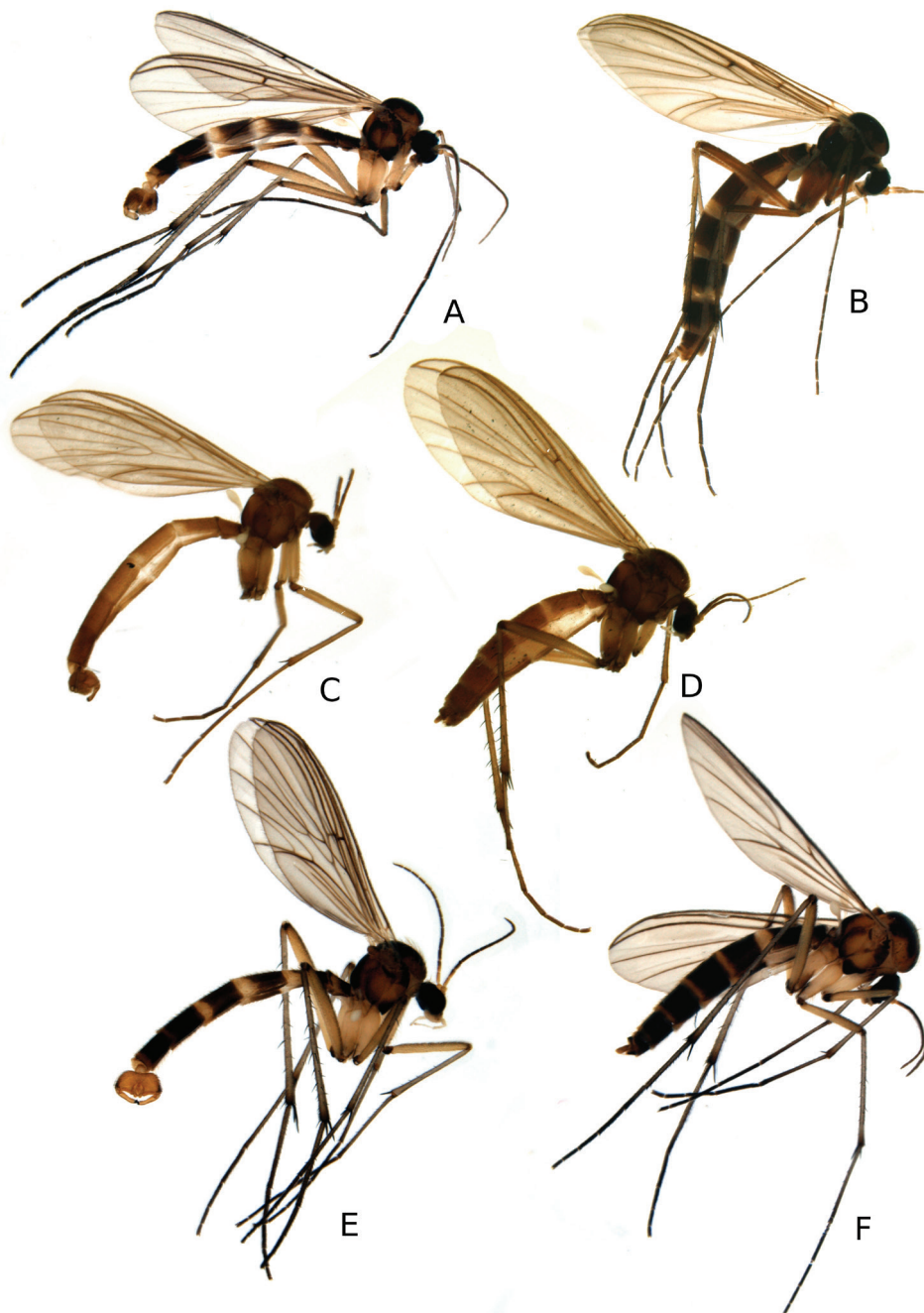
Figs 1C, 3C–D, 5B, 7C–D, 9A–G

*Boletina antomus* Garrett, 1924:166

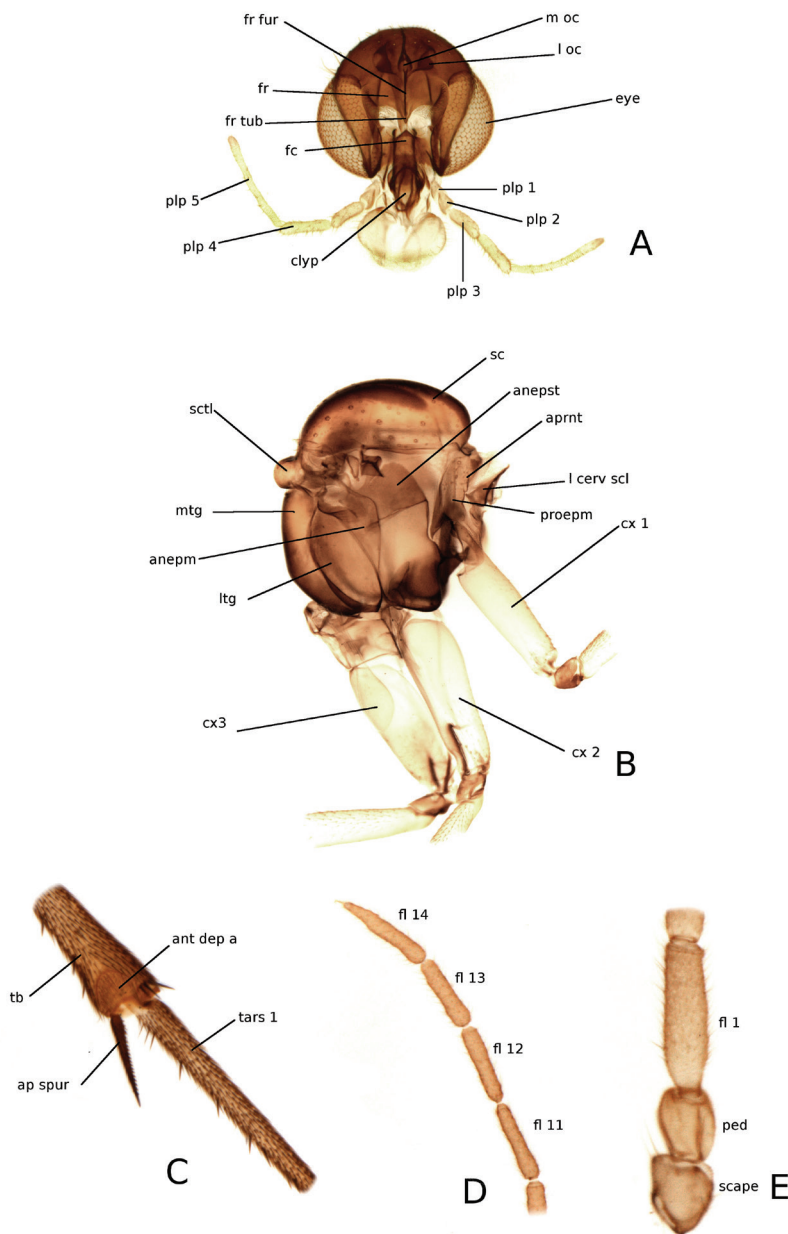
**Diagnostic characters.** Most similar to *K. antica*, with which it shares the projected dorsomesal corners of the male gonocoxites. Distinguished from *K. antica* by having two parameres, hypandrial lobe without median tooth and pale halter.

**Re-description.** Male. Wing length 4.5 mm.

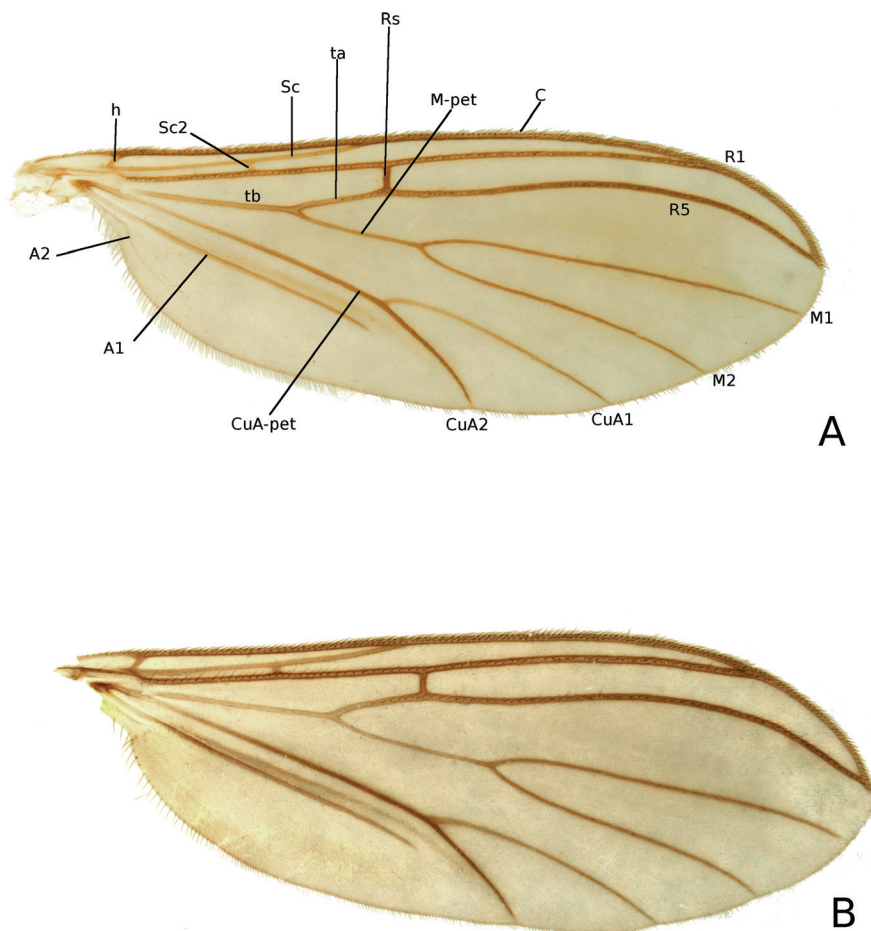
**Head** brown; palps and mouthparts pale. Antenna with scape, pedicel and basal part of first flagellomere pale, rest of flagellum brown.



**Figure 3.** Habitus photos of species of *Katatopygia* gen. n. Lateral view **A** *K. erythropygia* (Holmgren, 1883), male **B** *K. erythropygia* (Holmgren, 1883), female. **C** *K. antoma* (Garrett, 1924), male **D** *K. antoma* (Garrett, 1924), female **E** *K. sahlbergi* (Lundström, 1906), male **F** *K. sahlbergi* (Lundström, 1906), female



**Figure 4.** Morphology of *Katatopygia* gen. n. [*K. sahlbergi* (Lundström, 1906)] **A** Head, frontal view. **B** Thorax, lateral view **C** Front leg **D** Apex of antenna **E** Base of antenna. Abbreviations: anepist = anepisternum; anepm = anepimeron; aprnt = anteprononun; ap spur = apical spur; clyp = clypeus; cx 1 = forecoxa; cx 2 = midcoxa; cx 3 = hindcoxa; eye = compound eye; fc = face; fl = flagellar segment; fr fur = frontal furrow; fr tub = frontal tubercle; l oc = lateral oculus; l cerv scl = lateral cervical sclerite; ltg = laterotergite; m oc = medial ocellus; mtg = mediotergite; ped = pedicel; proepm = proepimeron; sc = scutum; sctl = scutellum; tars 1 = tarsomere one; tb = tibia.



**Figure 5.** Wing photos of *Katatopygia* gen. n. **A** *K. sahlbergi* (Lundström, 1906) **B** *K. antoma* (Garrett, 1924) [Abbreviations: A1 = anterior anal vein; A2 = posterior anal vein; C = Costal vein; CuA1 and CuA 2 = anterior branch of cubitus; CuA–pet = petiole of CuA; h = humeral; M–pet = petiole of media; M1 and M2 = branches of media; R1 = anterior branch of radius; R5 = posterior branch of radius; sc = subcosta; ta = anterior transversal (= crossvein rm); tb = basal transversal.

**Thorax** pale with 3 distinct, dark brown mesonotal stripes on yellow ground, humeral area pale. Mediotergite with a darker central stripe; preepisternum darker ventrally. Halter whitish.

**Wings** weakly brownish tinged; stem of M approximately 1.9 times the length of ta; Sc<sub>2</sub> present; Sc bare and ending in C slightly before base of Rs. C ending in apex of R<sub>5</sub>.

**Legs** pale brown.

**Abdomen** brown often with narrow pale bands on tergites II–III.

**Terminalia** brown. Gonocoxite with dorsomesal corner forming a mesocaudally directed horn-like processus, distinctly more projected than the ventromesal corner.

Hypandrial lobe well developed and only shallowly emarginated medially, without medial tooth. Two slender parameres, bearing microtrichia. Tergite IX subrectangular, with a sclerotized mesal suture. The apical processus on gonostylus approximately half as long as the diameter of gonostylus and slightly branched with two strong setae. Interior surface of gonostylus without strong setae.

Female. **Coloration** as in male except pale apical bands on tergite II-V.

**Terminalia.** Tergite VIII broad with rounded apicolaterally margin; sternite VIII and gonocoxite VIII short and broad with about 6 strong apical setae; gonapophysis IX long and projected into a pointed apex.

**Distribution.** Nearctic, known from Canada, British Columbia and USA, Alaska.

**Type material studied. Syntype series.** **Canada:** BC, Cranbrook, 24 Sep 1922, leg. C. Garrett – 1 female (CNC, pinned, JKJ-SPM-057751); Michel, Wilson Creek, 1 Sep (year unknown pre 1925), leg. C. Garrett – 1 female (CNC, pinned, JKJ-SPM-057753); 24 Sep (year unknown pre 1925), leg. C. Garrett – 3 males (CNC, 1 pinned with cleared terminalia in glycerine, JKJ-SPM-057747, 2 pinned, JKJ-SPM-057748-49), 4 females (CNC, pinned, JKJ-SPM-057755&59-61); 27 Sep (year unknown pre 1925), leg. C. Garrett – 1 female (CNC, pinned, JKJ-SPM-057756); 28 Sep (year unknown pre 1925), leg. C. Garrett – 1 female (CNC, pinned, JKJ-SPM-057757); 2 Oct (year unknown pre 1925), leg. C. Garrett (CNC, pinned, JKJ-SPM-057750); locality and date unknown, marked T.112 – 1 female (CNC, pinned, JKJ-SPM-057752); locality and date unknown, labelled 1815 – 1 female (CNC, pinned, JKJ-SPM-057758).

**Other material studied.** **USA:** Alaska, Palmer, 13 Jul 1964 (Leg. K. M. Sommerman) – 2 males, 1 female (MZLU, in alcohol, JKJ-SPM-034388-89).

***Katatopygia erythropyga* (Holmgren, 1883), comb. n.**

<http://sciaroidea.info/taxonomy/41709>

Figs 3A–B, 6A–B, 7A–B, 10A–G

*Boletina erythropyga* Holmgren, 1883:189

=*Boletina longicornis* Johannsen, 1911:272

*Boletina notescens* Johannsen, misident. in Zaitzev 1994:223 fig. 74:2

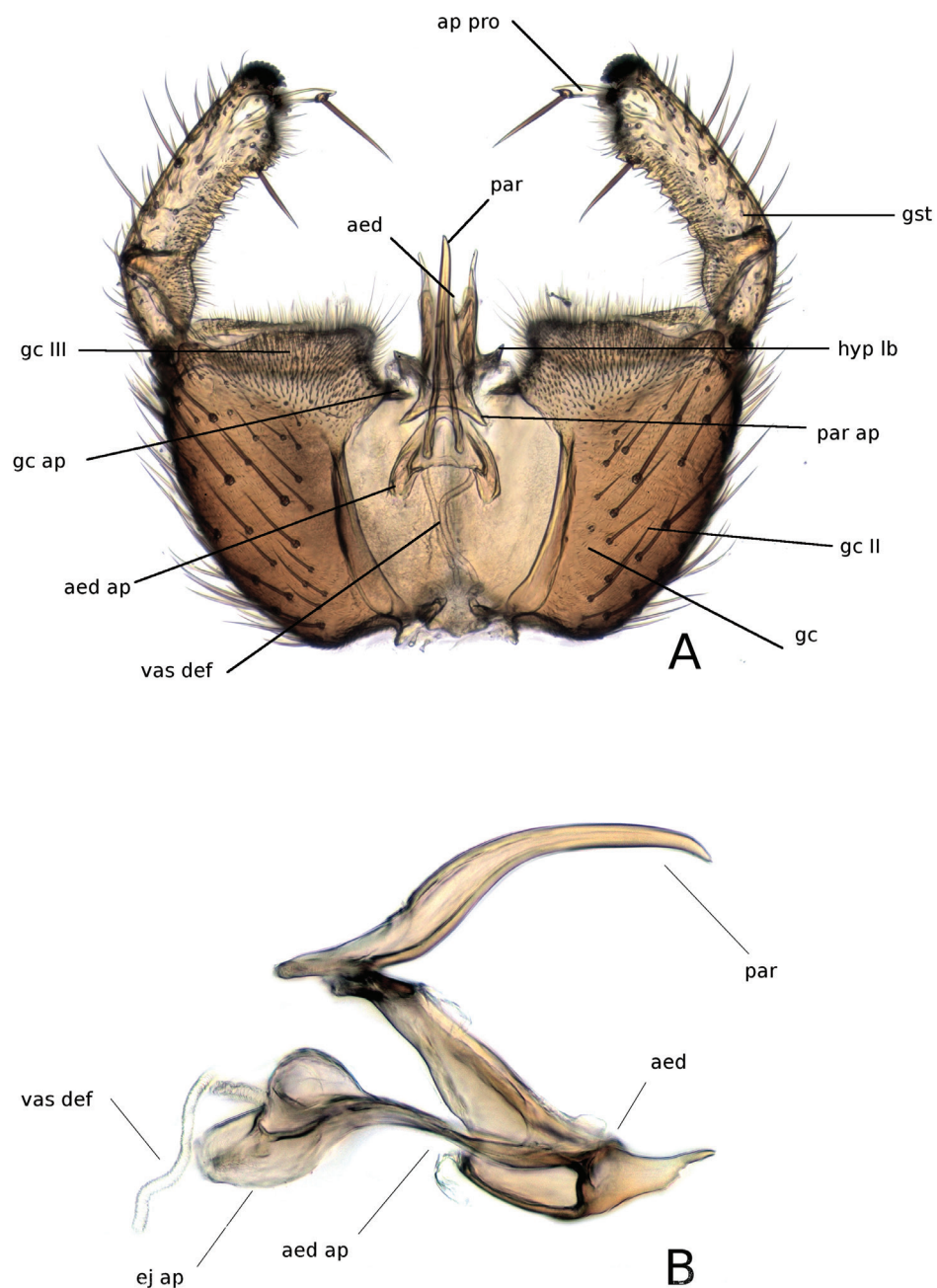
*Boletina erythropyga* Zaitzev & Polevoi 2002:640 figs 2, 4–6, 10

**Diagnostic characters.** Most similar to *K. magna* and *K. hissarica*, but can be distinguished by having distinct and separated mesonotal stripes and on the evenly broad male gonostylus on which the inner dentations are reaching the basal curve.

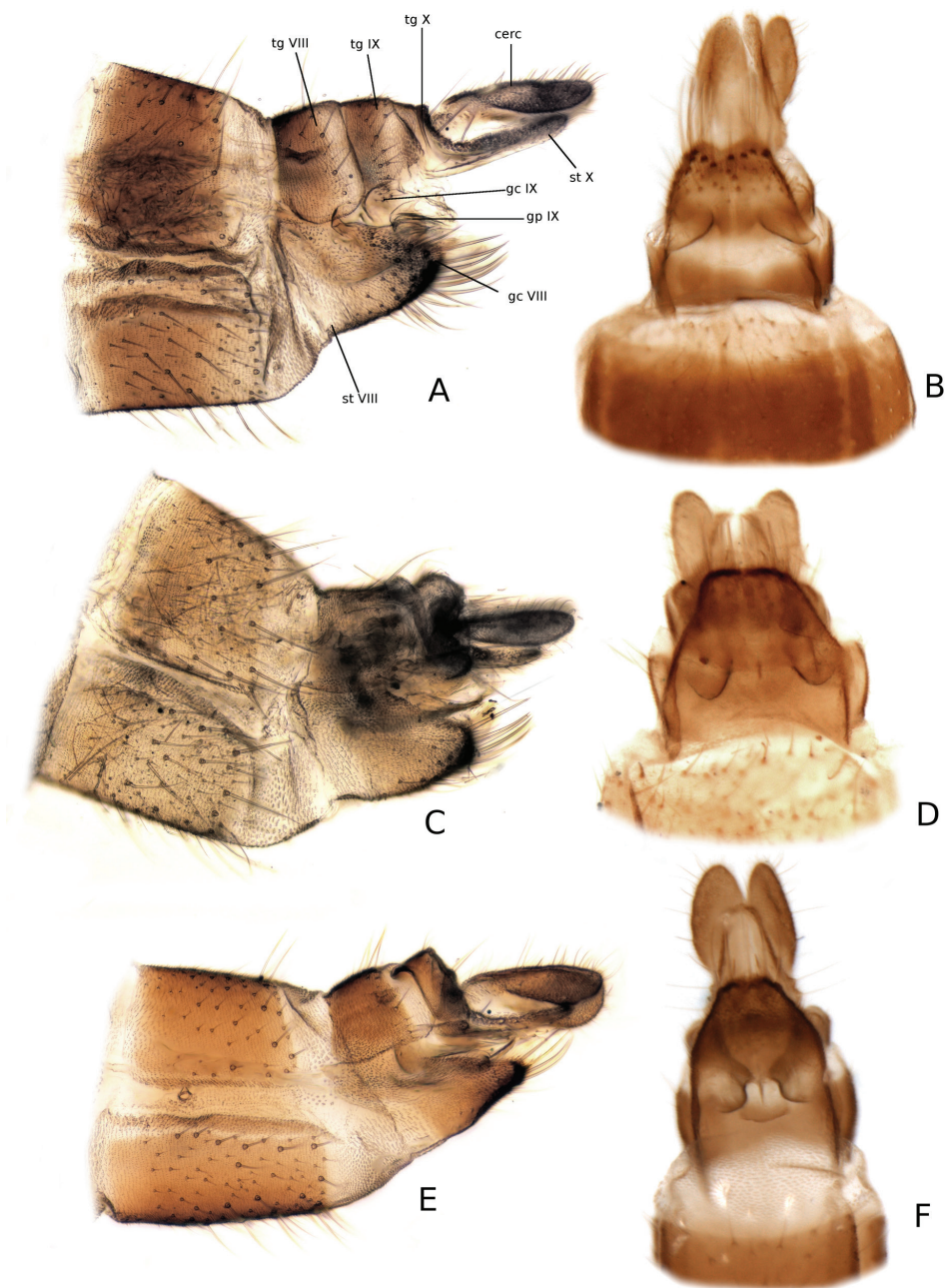
**Re-description.** Male. Wing length 5.5 mm.

**Head** blackish brown; mouthparts and palps yellow. Antenna with scape, pedicel and basal part of first flagellomere pale yellow, rest of flagellum brown.

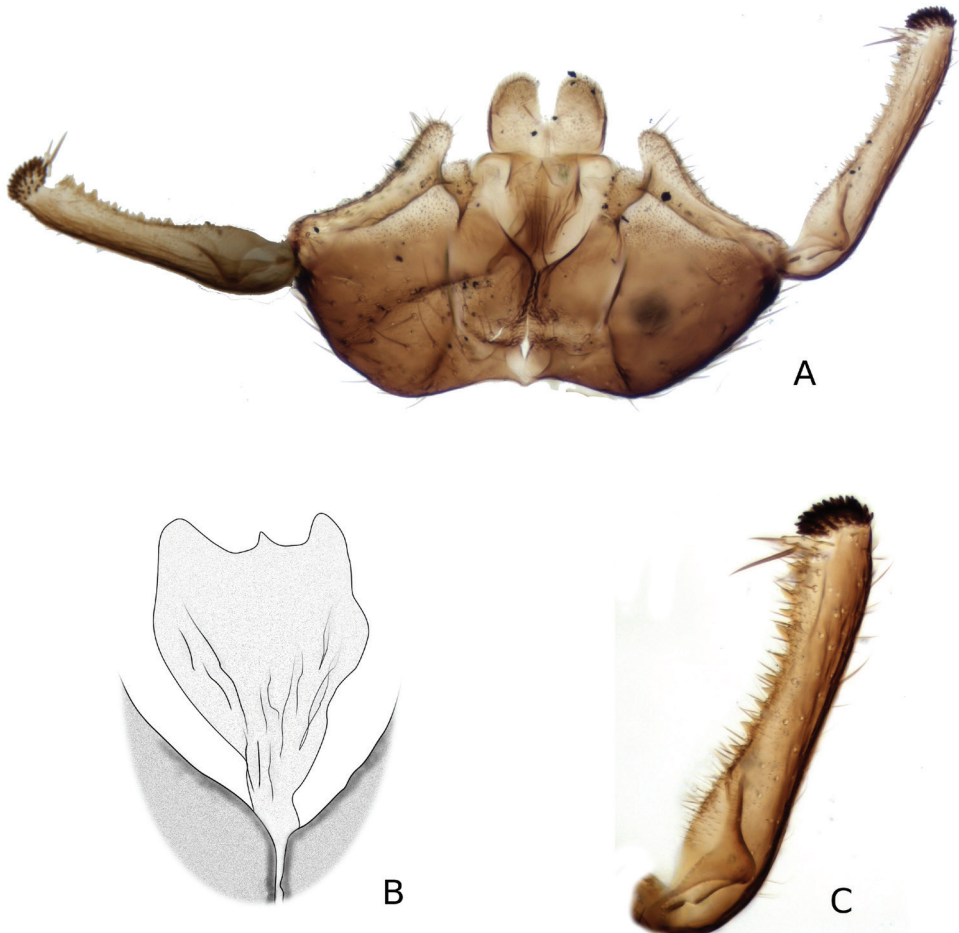
**Thorax** with three distinct, black mesonotal stripes on yellow ground, humeral area yellow; anteprepectum pale; anepisternum brown; preepisternum pale with ventral



**Figure 6.** Morphology of male terminalia of *Katatopygia* gen. n. **A** Male terminalia of *K. erythropyga* (Holmgren, 1883), dorsal view, T9 removed **B** Aedeagus and parameres of *K. erythropyga* (Holmgren, 1883), lateral view. Abbreviations: **aed** = aedeagus; **aed ap** = aedeagal apodeme; **ap pro** = apical process of gonostylus; **ej ap** = ejaculatory apodeme; **gc II** = section II of gonocoxite; **gc III** = section III of gonocoxite; **gc ap** = gonocoxal apodeme; **gst** = gonostylus; **hyp lb** = hypandrial lobe; **par** = paramere; **par ap** = parameral apodeme; **vas def** = vas deferens.



**Figure 7.** Female terminalia of *Katatopygia* gen. n. **A, B** *K. erythropoga* (Holmgren, 1883) **C, D** *K. antoma* (Garrett, 1924) **E, F** *K. sahlbergi* (Lundström, 1906) [A, C and E in lateral view, B, D and F in ventral view]. Abbreviations: cerc = cercus; gc = gonocoxite; gp = gonapophysis; st = sternite; tg = tergite.



**Figure 8.** *Katatopygia antica* (Garrett, 1924) **A** Male terminalia, ventral view **B** Hypandrial lobe **C** Gonostylus, dorsal view.

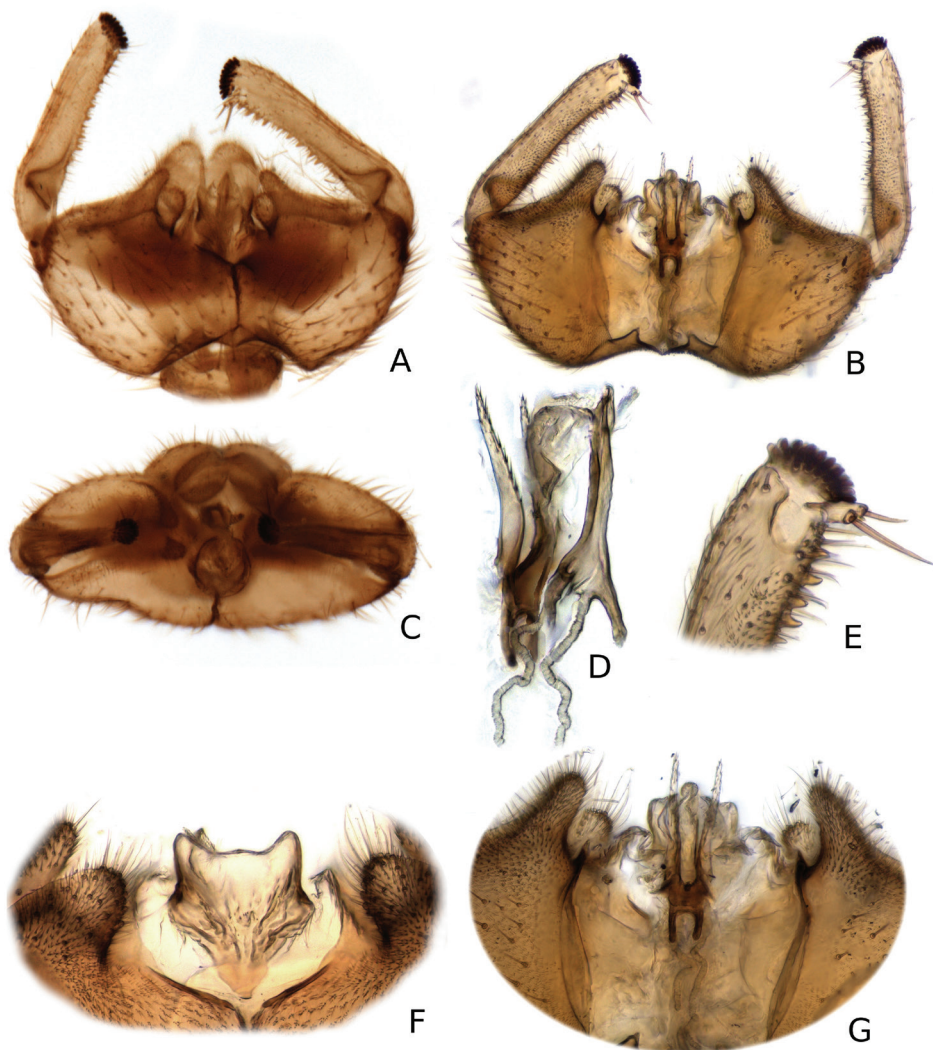
half darker, brown; laterotergite brown with anterior part paler; mediotergite pale with a broad dark central stripe. Halter pale.

**Wing** pale with veins yellowish brown; M-petiole approximately 1.5 times the length of ta;  $Sc_2$  present; Sc ending in C slightly before  $R_s$ ; Sc bearing a few setae on apical portion; C ending beyond apex of  $R_s$ .

**Legs** pale yellow with joints darker.

**Abdomen** dark brown with yellow apical bands on tergites II–VI.

**Terminalia** brownish. Gonocoxite with mesal corners not projected; gonostylus evenly broad, angled inwards about  $40^\circ$  and bearing one strong seta on interior surface, dentations on interior surface reaching curve. Apical process approximately as long as the diameter of gonostylus, bearing one apical seta. Hypandrial lobe deeply forked with four lobes. Dorsal fused paramere rod long, slender and without microtrichia.



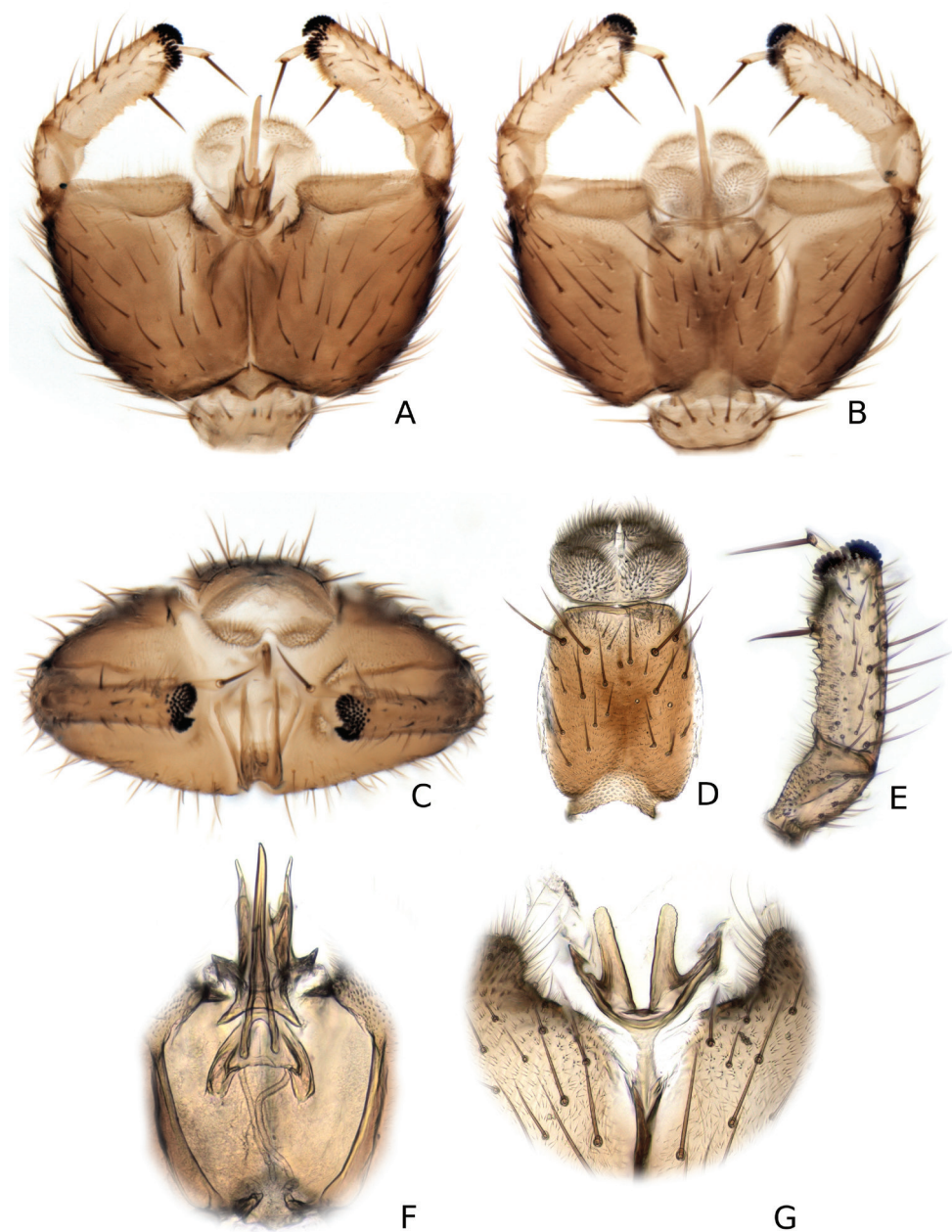
**Figure 9.** *Katatopygia antoma* (Garrett, 1924). **A** Male terminalia, ventral view **B** Male terminalia, dorsal view with tergite 9 removed **C** Male terminalia, caudal view **D** Aedeagus and parameres, lateral view **E** Apex of gonostylus, dorsal view **F**. Hypandrial lobe **G** Aedeagus and parameres dorsal view.

Tergite IX subrectangular, with 4 stronger setae on apical part and without a sclerotized mesial suture.

Female. Body length 6.0 mm; wing length 5.5 mm. **Coloration** as male.

**Terminalia.** Tergite IX broad with sharp apicolateral corner; gonocoxite VIII slightly incised ventrally bearing many strong apical setae; gonapophysis IX short and blunt.

**Distribution.** Holarctic, with records from north-western USA (Idaho) (Johannsen 1911), northern Europe (Scandinavia and northern parts of European Russia) (Zaitzev and Polevoi 2001) and Novaya Zemlya (Holmgren 1883).



**Figure 10.** *Katatopygia erythropgya* (Holmgren, 1883) **A** Male terminalia, ventral view **B** Male terminalia, dorsal view **C** Male terminalia, caudal view **D** Tergite 9 and cerci, dorsal view **E** Gonostylus, dorsal view **F** Aedagus and paramere, dorsal view **G** Hypandral lobe.

**Remarks.** The species has been confused with *K. sahlbergi* and there are some records e.g. from the Alps and Siberia that at least partly refer to the latter species (Zaitzev and Polevoi 2001).

**Type material.** We were not able to locate the holotype of *B. longicornis* in the Johannsen collection at Cornell University (CUIC), nor can it be found in American Museum of Natural History (AMNH) (V. Blagoderov pers. com.) and should probably be regarded as lost.

**Material examined.** **NORWAY:** FV, Alta, Elby, Valsetmoen, sandy slope, 10 Jun-6 Jul 1995 (ZMUN, leg. L.O. Hansen & H. Rinden) – 1 male. **SWEDEN:** LU, Jokkmokk, Messaure, 2 Sep-4 Oct 1971 (MZLU, leg. K. Möller) – 3 males; Luot-täive NR, 28 km S Jokkmokk, 14 Jul-18 Aug 2004 (MZLU, leg. K. Hedmark & J. Kjærandsen) – 1 male; Gällivare, Haapavaara/Annavaara, 8 km WNW Vettasjärvi, 1 Jun-26 Jul 1994 (MZLU, leg. R. Rova) – 1 female, 3 male; **SÖ**, Haninge, Tyresta National Park, 19 Jun-28 Jul 2000 (NHRS, leg. B. Viklund) – 1 male; **TO**, Kiruna, Abisko, 150–500 m W Naturv. stn., 18–25 Aug 1975 (MZLU, leg. K. Möller) – 1 male; LF-05, 150–500 m W Naturv. stn., 28 Jun-5 Jul 1976 (MZLU, leg. K. Möller) – 2 males; above tree limit 26 Jun-15 Jul 2006 (NHRS, Leg. Swedish Malaise Trap Project) – 1 female, 10 males; **VB**, Skellefteå, Stenträsk, Björnhultet Domänreservat, 17 May-17 Oct 1997 (NHRS, leg. B. Viklund) – 4 males.

***Katatopygia hissarica* (Zaitzev & Polevoi, 2002), comb. n.**

<http://sciaroidea.info/taxonomy/41710>

*Boletina hissarica* Zaitzev & Polevoi, 2002: 640 (figs 1, 3 & 9)

**Diagnostic characters.** Very similar to *K. erythropyga*, from which it can be separated only on details of the male terminalia. Zaitzev & Polevoi (2002) used four key characters to distinguish them: 1) Apical process of the gonostylus slightly bolder and with more developed unsclerotized area around base of this process; 2) Dentations on the inner surface of gonostylus being restricted to distal part, not reaching the curve basally; 3) Apical part of tergite IX less sclerotized; 4) Details of aedeagus as figured by them.

**Distribution.** The species is known only from the holotype from Tadjikistan.

**Remarks.** The species limit between *K. erythropyga* and *K. hissarica* seems vague, and it is possibly that *K. hissarica* will fall inside the variation of *K. erythropyga* when a wider range of material is studied.

**Type material.** The holotype is deposited in the Zoological Institute in St. Petersburg, Russia – not studied.

***Katatopygia laticauda* (Saigusa, 1968), comb. n.**

<http://sciaroidea.info/taxonomy/41790>

*Boletina laticauda* Saigusa, 1968: 4 (figs 1–4)

**Diagnostic characters.** Very similar to *K. sahlbergi* from which it can be separated by the following characters (from Saigusa 1968, table 2): 1) wing vein  $Sc_2$  absent; 2) wing veins M-pet and ta of approximately the same length; 3) scutum with black mesonotal stripes fused; 4) thoracic pleura entirely black; 5) middle and hind coxae black.

**Distribution.** Taiwan, only known with the holotype.

**Type material.** The holotype is deposited in the Kyushu University Museum, Japan – not studied.

***Katatopygia magna* (Garrett, 1925), comb. n.**

<http://sciaroidea.info/taxonomy/41796>

Figs 1B, 11A–D

*Boletina magna* Garrett, 1925: 5

**Diagnostic characters.** *K. magna* is most similar to *K. erythropyga* and *K. hissarica*, but can be distinguished by having fused mesonotal stripes and on the apically broadened gonostylus on which the inner dentations are reaching the basal curve.

**Re-description.** Male. Wing length 6.0 mm.

**Head** blackish brown; palps yellow. Antenna with scape brown, pedicel and flagellum yellow.

**Thorax** with black mesonotal stripes fused on yellow ground, humeral area yellow; antepronotum brown; anepisternum brown; preepisternum dark with a diffuse pale spot; laterotergite brown; mediotergite dark. Halter pale.

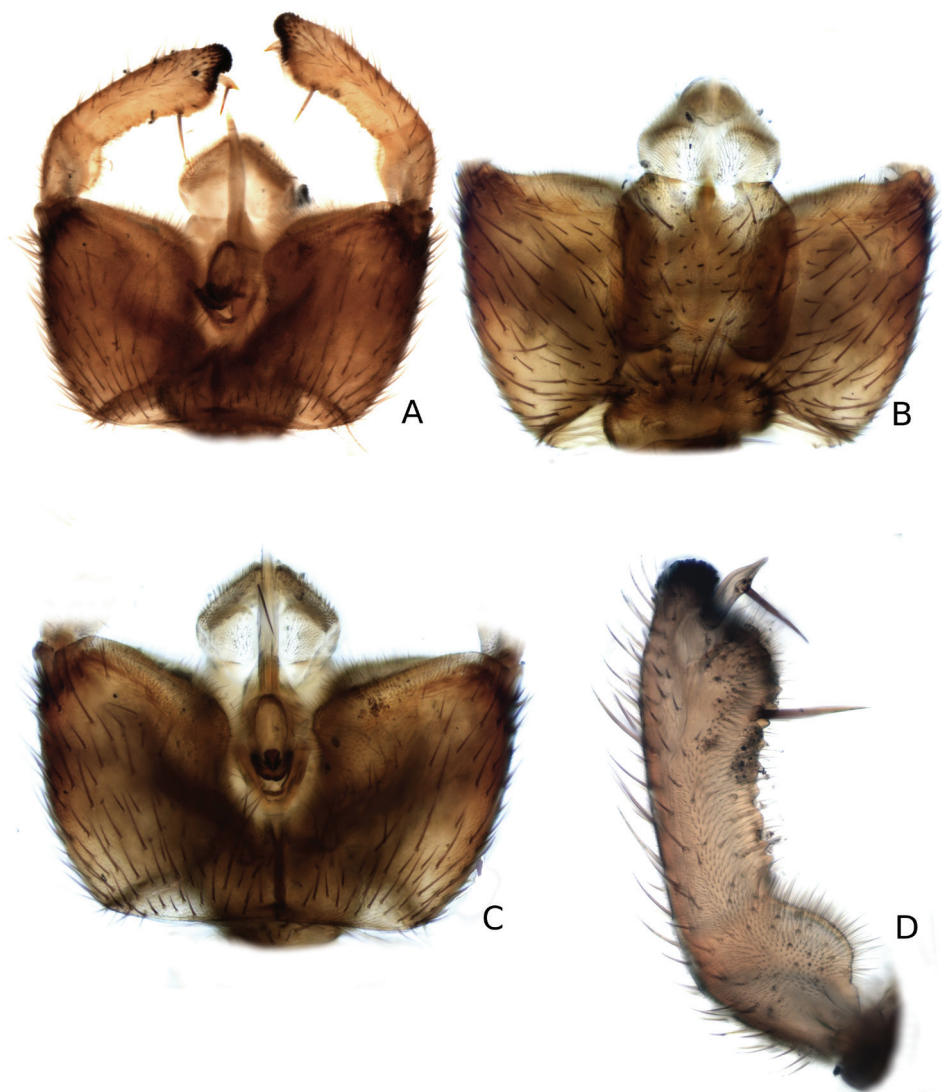
**Wing** pale with veins yellowish brown; M-petiole approximately 1.8 times the length of ta;  $Sc_2$  present; Sc ending in C clearly before Rs; Sc bearing a few setae on apical portion; C ending beyond apex of  $R_5$ .

**Legs** pale yellow with joints darker.

**Abdomen** dark brown with yellow apical bands on tergite II–IV.

**Terminalia** yellowish. Gonocoxite with mesal corners not projected; gonostylus with broadened apex; gonostylus angled inwards about  $65^\circ$  and bearing one strong seta on interior surface, dentations on interior surface reaching curve. Apical process approximately as long as the diameter of gonostylus and bearing one subapical seta. Hypandrial lobe deeply forked with four lobes. Dorsal fused paramere rod long and straight, without microtrichia. Tergite IX subrectangular, without sclerotized mesial suture.

Female unknown.



**Figure 11.** *Katatopygia magna* (Garrett, 1925) **A** Male terminalia, ventral view **B** Male terminalia, dorsal view, gonostylus omitted **C** Male terminalia, caudal view, gonostylus omitted **D** Gonostylus, dorsal view.

**Distribution.** Nearctic: Canada, British Columbia.

**Remarks.** Known only from the holotype.

**Type material studied. Holotype male. Canada: BC, Fernie, 24 Jul (year unknown pre 1925), leg. C. Garrett (CNC, pinned with cleared terminalia in glycerine in microtube on same pin, JKJ-SPM-057738).**

***Katatopygia neoerythropyga* (Zaitzev & Polevoi, 2002), comb. n.**

<http://sciaroidea.info/taxonomy/41711>

*Boletina neoerythropyga* Zaitzev & Polevoi, 2002: 641 (figs 7–8)

**Diagnostic characters.** Most similar to *K. antica* and *K. antoma* from which it can be separated on coloration and details of the male terminalia. Zaitzev & Polevoi (2002) used four key characters to distinguish it from *K. erythropyga*: 1) absence of the apical process of the male gonostylus; 2) longer stem of M-fork; 3) scape of antenna brown; 4) abdomen uniformly brown.

**Distribution.** The species is known only from the Yamal peninsula north in West Siberia.

**Remarks.** The absence of the apical process of the male gonostylus is unique among the known species of *Katatopygia* and may be regarded as a secondary reduction (see discussion of phylogeny).

**Type material.** The holotype is deposited in the A.N. Severtzov Institute of Ecology and Evolution in Moscow, Russia – not studied.

***Katatopygia sahlbergi* (Lundström, 1906), comb. n.**

<http://sciaroidea.info/taxonomy/41712>

Figs 3E–F, 4A–E, 5A, 7E–F, 12A–F

*Boletina sahlbergi* Lundström, 1906:14, fig 8

=*Boletina punctus* Garrett, 1925:5 syn. n.

=*Boletina altaica* Zaitzev, 1994:203

*Boletina sahlbergi* Lundström 1912:20, figs 22–24

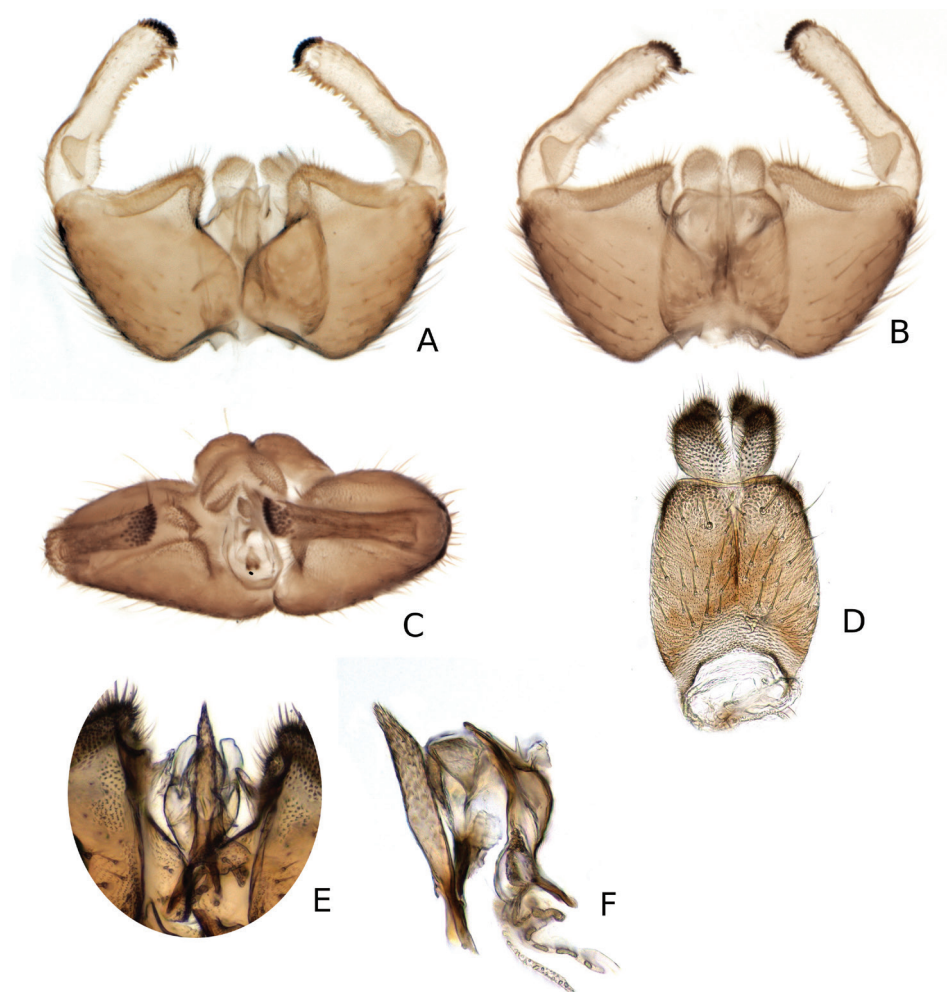
*Boletina sahlbergi* Zaitzev & Polevoi 2002:642, fig. 11

**Diagnostic characters.** Most similar to *K. laticauda* from which it can be distinguished by having wing vein  $Sc_2$  present and M-pet longer than  $ta$ , and in coloration with distinct and separated mesonotal stripes and paler coxae where at most hind coxa are darkened.

**Re-description.** Male. Body length 4.5–6.5 mm; wing length 4.5–6.0 mm.

**Head** blackish brown; mouthparts and palps yellow. Antenna with scape, pedicel, and basal part of first, in some specimens the whole first and basal part of second, flagellomere pale yellow, rest of flagellum brown.

**Thorax** in most specimens with 3 distinct, black mesonotal stripes on yellow ground, humeral area yellow, a few specimens with mesonotal stripes indistinct and humeral area brownish; anteprepectum pale; anepisternum brown; preepisternum pale with ventral half darker, brown; laterotergite brown with anterior part paler; mediotergite pale with a broad dark central stripe. Halter pale.



**Figure 12.** *Katatopygia sahlbergi* (Lundström, 1906) **A** Male terminalia, ventral view **B** Male terminalia, dorsal view, tergite 9 removed **C** Male terminalia, caudal view **D** Tergite 9 and cerci, dorsal view **E** Aedeagus and parameres dorsal view **F** Aedeagus and parameres, lateral view.

**Wing** pale with veins yellowish brown; stem of M approximately 1.5 times the length of ta;  $Sc_2$  present; Sc ending in C slightly before  $R_s$ ; C ending at apex of  $R_5$ .

**Legs** pale yellow with joints darker.

**Abdomen** dark brown, usually with yellow apical bands on tergite I–IV.

**Terminalia** often yellow with dark lateral markings, in some specimens brownish and not distinctly paler than rest of abdomen. Gonocoxite with mesal corners slightly projected. Tergite IX subrectangular, with a sclerotized mesal suture. Paramere simple, strong, blunt and covered with microtrichia. Gonostylus straight with apical processus approximately half as long as the diameter of gonostylus.

Female. Body length 6.0–6.5 mm; wing length 6.0–6.5 mm.

**Coloration** as male.

**Terminalia.** Tergite IX short with rounded apicolateral corner; sternite VIII and gonocoxite VIII long and narrow, bearing about 6 strong apical setae; gonapophysis IX long and projected into a pointed apex.

**Distribution.** Holarctic. Possibly boreal-alpine with records from Scandinavia, northern parts of European Russia, The Alps, West Siberia (Zaitzev & Polevoi 2002), Japan (Saigusa 1968) and Canada (Garrett 1925).

**Remarks.** The proposed synonymy of *K. sahlbergi* and *B. punctus* is based on the study of type material of *B. punctus* and Nordic material of *K. sahlbergi*. *K. sahlbergi* has been confused with *K. erythropyga* and there are some records of the latter species that at least partly refer to *K. sahlbergi* (Zaitzev & Polevoi 2002).

**Material examined.** **NORWAY:** **FV**, Alta, Detsika, Buolamalia, 6 Aug-25 Sep 1996 (ZMUN, leg. L. O. Hansen & H. Rinden) – 2 males; **STI**, Oppdal, Kongsvoll, 19-26 Jul 1995 (MZLU, leg. J. Skartveit) – 1 male; Kongsvoll, Sprænbekken, 16 Aug-19 Sep 1994 (MZLU, leg. J. Skartveit) – 1 male; **SWEDEN:** **LU**, Jokkmokk, Kaltisbäcken 1 km NNE Messaure, 21 Jun-12 Jul 2004 (MZLU, leg. J. Kjærandsen & K. Hedmark) – 1 female, 10 males; 12 Jul-17 Aug 2004 (MZLU, leg. J. Kjærandsen & K. Hedmark) – 3 males; above parking lot, 12 Oct 1997 (MZLU, leg. S. Lundberg) – 1 male; Messaure, 2 Sep-4 Oct 1971 (MZLU, leg. K. Möller) – 14 males; Porsitjärn/Porsi VVO, 1.5 km SE Vuollerim, 6 May-13 Aug 2004 (MZLU, leg. M. Karström) – 2 females, 2 males; 15 Jun-1 Jul 2005 (MZLU, leg. K. Hedmark & M. Karström) – 2 males; 1-16 Jul 2005 (MZLU, leg. K. Hedmark & M. Karström) – 1 male; Tapmokbäckravinen, 12 km SSE Vuollerim, 16 Jun 2004 (MZLU, leg. J. Kjærandsen) – 1 male; Bombmurkleskogen VVO, 4 km SSE Messaure, 17 Jun 2004 (MZLU, leg. J. Kjærandsen) – 1 male; 21 Jun 2004 (MZLU, leg. J. Kjærandsen) – 1 male; 7-19 Jul 2005 (NHRS, leg. Swedish Malaise Trap Project) – 2 males; Luottäive NR, 28 km S Jokkmokk, 14 Jul-18 Aug 2004 (MZLU, leg. K. Hedmark & J. Kjærandsen) – 2 males; 18 Aug-20 Sep 2004 (MZLU, leg. K. Hedmark & J. Kjærandsen) – 4 females, 2 males; Gällivare, Haapaavaara/Annavaara, 8 km WNW Vettasjärvi, 1 Jun-26 Jul 1994 (NHRS, leg. R. Rova) – 1 male; Jokkmokk, Bombmurkleskogen VVO, 9-25 Sep 2005 (NHRS, leg. Swedish Malaise Trap Project) – 1 male; 25 Sep-13 Oct 2005 (NHRS, leg. Swedish Malaise Trap Project) – 1 female, 3 males; **TO**, Kiruna, Abisko, 14-20 Jul 1975 (MZLU, leg. K. Möller) – 4 males; GF-02, 150-500 m W Naturv. stn., 10-25 Jul 1975 (MZLU, leg. K. Möller) – 1 male; LF-01, 150-500 m W Naturv. stn., 6-20 Jun 1975 (MZLU, leg. K. Möller) – 2 males; 22-29 Sep 1975 (MZLU, leg. K. Möller) – 1 male; 29 Sep-6 Oct 1975 (MZLU, leg. K. Möller) – 1 male; LF-02, 150-500 m W Naturv. stn., 21-28 Jul 1975 (MZLU, leg. K. Möller) – 1 male; 28 Jul-4 Aug 1975 (MZLU, leg. K. Möller) – 2 males; 29 Sep-6 Oct 1975 (MZLU, leg. K. Möller) – 1 male; LF-03, 150-500 m W Naturv. stn., 25 Sep-6 Oct 1975 (MZLU, leg. K. Möller) – 13 males; 6-20 Oct 1975 (MZLU, leg. K. Möller) – 2 males; 20-27 Oct 1975 (MZLU, leg. K. Möller) – 1 male; LF-04, 150-500 m W Naturv. stn., 22-29 Sep 1975 (MZLU, leg. K. Möller) – 1 female, 2 males; LF-05, 150-500 m W Naturv. stn., 6-20 Oct 1975 (MZLU, leg. K. Möller) – 1

female, 11 males; 20-27 Oct 1975 (MZLU, leg. K. Möller) – 1 male; LF-06, 150-500 m W Naturv. stn., 4-11 Aug 1975 (MZLU, leg. K. Möller) – 1 male; 1-8 Sep 1975 (MZLU, leg. K. Möller) – 1 male; 15-22 Sep 1975 (MZLU, leg. K. Möller) – 3 males; 22-29 Sep 1975 (MZLU, leg. K. Möller) – 2 females, 11 males; 29 Sep-6 Oct 1975 (MZLU, leg. K. Möller) – 24 males; LF-07, 150-500 m W Naturv. stn., 8-15 Sep 1975 (MZLU, leg. K. Möller) – 1 male; 29 Sep-6 Oct 1975 (MZLU, leg. K. Möller) – 14 males; 6-20 Oct 1975 (MZLU, leg. K. Möller) – 2 males; LF-08, 150-500 m W Naturv. stn., 1-8 Sep 1975 (MZLU, leg. K. Möller) – 1 male; LF-09, 150-500 m W Naturv. stn., 21-28 Jul 1975 (MZLU, leg. K. Möller) – 1 male; 8-15 Sep 1975 (MZLU, leg. K. Möller) – 1 male; 22-29 Sep 1975 (MZLU, leg. K. Möller) – 4 males; 29 Sep-6 Oct 1975 (MZLU, leg. K. Möller) – 14 males; 6-20 Oct 1975 (MZLU, leg. K. Möller) – 1 female, 10 males; LF-10, 150-500 m W Naturv. stn., 22-29 Sep 1975 (MZLU, leg. K. Möller) – 2 males; LSF, 15 Aug-1 Sep 1975 (MZLU, leg. K. Möller) – 1 male; 1-15 Sep 1975 (MZLU, leg. K. Möller) – 2 males; Abisko, Stordalen NR, 9-24 Jul 1975 (MZLU, leg. K. Möller) – 5 males; 7-14 Aug 1975 (MZLU, leg. K. Möller) – 3 males; 4-11 Sep 1975 (MZLU, leg. K. Möller) – 2 males; above tree limit 26 Jun.-15 Jul. 2006 (NHRS, leg. Swedish Malaise Trap Project) – 4 males.

**Type material of *Boletina punctus* examined.** **Holotype** male. **Canada:** BC, Creston 4 Jul (year unknown pre 1926), leg B. C. D. Garrett (CNC, pinned with terminalia mounted on separate slide, JKJ-SPM-057764). **Paratypes.** Same data as holotype, marked as **allotype** – 1 female (CNC, pinned, JKJ- SPM-057778), same data as holotype – 3 females (CNC, pinned, 1 with abdomen in glycerine in micro-tube on same pin, JKJ- SPM-057779-81), 13 males (CNC, pinned, 2 with terminalia mounted on separate slide, JKJ-SPM-057765-77).

### Key to the males of *Katatopygia*

The key is partly based on the key from Zaitzev and Polevoi (2002).

- 1 Gonostylus with distinct apical processus (cf. Fig. 6A). Abdominal tergites often with pale apical bands.....**2**
- Gonostylus without distinct apical processus (Zaitzev and Polevoi 2002: fig. 7). Abdomen uniformly brown..... ***K. neoerythropya***
- 2 Costa extending clearly beyond  $R_5$ -termination. Gonostylus curved inwards, with strong seta on interior surface (cf. Fig. 10E). Sc with a few setae on apical portion. Parameres fused and bare (Fig. 6B) .....**3**
- Costa ending at or slightly beyond  $R_5$ -termination (Fig. 5A–B). Gonostylus straighter, without strong seta on interior surface (cf. Fig. 8C). Sc bare. Parameres forked or fused, covered with microtrichia (cf. Figs 9G, 12F) .....**5**
- 3 Dentations on the inner surface of gonostylus reaching the curve. Apical part of tergite IX well sclerotized.....**4**

- Dentations on the inner surface of gonostylus restricted to distal part, not reaching the curve (Zaitzev and Polevoi 2002: fig. 1). Apical part of tergite IX weakly sclerotized (Zaitzev and Polevoi 2002: fig. 9).....***K. hissarica***
- 4 Gonostylus broadened apically (Fig. 11D). Scutum with dark mesonotal stripes fused ..... ***K. magna***
- Gonostylus evenly broad (Fig. 10E). Scutum with dark mesonotal stripes distinct and separated ..... ***K. erythropyga***
- 5 Mesodorsal corners of gonocoxite distinctly projected caudally (cf. Fig. 9A). Hypandrial lobe only shallowly emarginated (Figs 8B, 9F). Parameres forked or fused..... **6**
- Mesodorsal corners of gonocoxite not projected (Fig. 12B). Hypandrial lobe deeply divided mesially. Parameres fused into single rod..... **7**
- 6 Dorsal part of parameres split into two processes caudally (Figs 9D, G). Hypandrial lobe without a small sharp medial tooth (Fig. 9F). Halter pale (Figs 1C, 3B).....***K. antoma***
- Dorsal part of parameres fused into one rod caudally. Hypandrial lobe with a small sharp medial tooth (Fig. 8B). Tip of halter brown (Fig. 1A)....***K. antica***
- 7 M-pet and ta of approximately the same length. Sc<sub>2</sub> absent (Saigusa 1968: plate 1:1). Scutum with black mesonotal stripes fused. Middle and hind coxae black.....***K. laticauda***
- M-pet longer than ta. Sc<sub>2</sub> usually present (Fig. 5A). Scutum pale with dark mesonotal stripes distinct and separated, scutum rarely more uniformly brown. At most hind coxa darkened .....***K. sahlbergi***

## Discussion

Resolving phylogeny of the extended Gnoristinae clade is way beyond the scope of this study and the quantitative phylogenies that have been presented so far (e.g. Söli 1997; Baxter 1999; Rindal et al. 2009; Martinsson et al. 2011) are partly conflicting and not very convincing when it comes to stable intergeneric relationships. With some 160 species placed in the rather heterogeneous genus *Boletina* we still think that it will benefit from being split into subsets of putatively natural entities, and that these taxa will shed new light on the phylogeny of the entire group. The process was initiated by Martinsson et al. (2011) who estimated the first molecular phylogenies focused on *Boletina* and related genera. The decision to erect the new genus *Katatopygia* rest largely on the supportive results from Martinsson et al. (2011) where the two European species consistently and with support across different genes were found as the basal sister-group to all the other species of *Boletina*, *Coelosia* and *Gnoriste* included in the analysis. The unequivocal basal position makes it rather unlikely that our splitting will render *Boletina* s.s. paraphyletic with respect to *Katatopygia*. The idea to segregate species of the *B. erythropyga/punctus*-group from *Boletina* s.l. is, however, not new and grew out

of a long-funded distinct impression that these species form a morphological uniform group with highly specialized male terminalia that don't naturally fit together with the remaining *Boletina* s.s.

The additional morphological analysis presented here was designed to test the monophyly of the extended group of eight *Katatopygia* species and resolve their interrelationships. The characters included in the analysis were thus chosen mainly for resolving relationships among *Katatopygia* species, not to resolve relationships among Gnoristinae genera. A few outgroup taxa were, based on the available phylogenies (Søli 1997; Rindal et al 2009; Martinsson et al 2011), selected among genera available to us that have been indicated to be closely related to *Boletina* s.l. (including *Katatopygia*). Given the rather limited selection of informative characters found and the few outgroup taxa included the present analysis cannot be given the same credit to support the segregation of *Katatopygia* as did the molecular study (Martinsson et al. 2011). Focused mainly on terminalia morphology the analysis mainly summarizes those characters we found to be diagnostic for the new genus and gives a first clue to inter-relationships among its species. Accordingly the morphological analysis retrieved a monophyletic *Katatopygia* with high support whereas relationships among the outgroup taxa are not supported and somewhat contrasting those found by Martinsson et al. (2011).

The segregation of *Katatopygia* rise new questions related to the increasing number of *Boletina* "look-alike" genera. Are they forming a monophyletic clade together with *Boletina* s.s. or rather constitute an assemblage of less related plesiomorphous genera? Another recently described genus, *Heamesphaerenotus* Saigusa from China (Saigusa 2007), show some affinities with *Katatopygia* in general appearance and they have some possibly apomorphic characters in common (retinacula on male gonostylus and one-segmented female cercus). But like for *Katatopygia*, *Heamesphaerenotus* also show a number of unique apomorphies, notably the expanded eave-like mesonotum (Saigusa 2007) not seen in *Katatopygia*. Unlike species of *Boletina* s.s. species of *Aglaomiya*, *Heamesphaerenotus*, *Katatopygia* and *Saigusaia* all have some form of retinacula on the apical part of the gonostylus, and this can also be found among species of *Synapha*. The females of *Saigusaia* and *Synapha* have two-segmented cerci (e.g. Saigusa 1968) whereas all known females of *Katatopygia* and *Heamesphaerenotus* have one-segmented cerci. In fact, *Saigusaia* seems to be much closer *Synapha* than to *Boletina* (Søli 1997; Martinsson et al. 2011) and the general outline of the male terminalia among species of *Saigusaia* (see e.g. Niu et al. 2008) very much resembles that of some *Synapha* (see e.g. Kallweit and Martens 1995).

Even after the segregation of *Katatopygia*, *Boletina* s.s. remain as a large and somewhat heterogeneous genus. It is noteworthy that the type-species of the genus, *B. trivittata*, may also form a separate clade (Martinsson et al. 2011) including some 10 morphological similar species. Some aberrant species currently included in *Boletina*, e.g. *B. abdita* Plassmann, *B. anderschi* (Stannius) and *B. ovata* (Garrett), needs further studies to see if they fit within a restricted definition of the genus.

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# A new species of *Hedgpethia* (Arthropoda, Pycnogonida, Colossendeidae) from southwestern Japan

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§ [urn:lsid:zoobank.org:author:323734E7-A545-4533-AE47-70C2672FD85D](https://zoobank.org/urn:lsid:zoobank.org:author:323734E7-A545-4533-AE47-70C2672FD85D)

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[urn:lsid:zoobank.org:pub:CD0AD49A-7024-49EE-8D5D-4B667635ECB2](https://zoobank.org/pub:CD0AD49A-7024-49EE-8D5D-4B667635ECB2)

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## Abstract

We describe *Hedgpethia spinosa* **sp. n.** based on a single male specimen obtained from 197–207 m depth, south of Yaku Island, Kagoshima Prefecture, Japan. Among 15 previously known congeners, the new species resembles *H. bicornis* (Losina-Losinsky & Turpaeva, 1958), *H. chitinosa* (Hilton, 1943), and probably *H. brevitarsis* (Losina-Losinsky & Turpaeva, 1958), in having a mid-dorsal tubercle on the posterior rim on each trunk segment. The new species, however, is distinguishable from those by a pair of horns on the anterior margin of the cephalic segment, spines on the first coxae, and denticulate spines on the strigilis. The new species represents the fifth member of the genus so far known from Japanese waters, in addition to *H. brevitarsis* (Losina-Losinsky & Turpaeva, 1958), *H. chitinosa* (Hilton, 1943), *H. dofleini* (Loman, 1911), and *H. elongata* Takahashi, Dick & Mawatari, 2007.

## Keywords

Pantopoda, Nansei Islands, TRV *Toyoshio-maru*, new species, taxonomy

## Introduction

Pycnogonids have been taxonomically relatively well studied in Japan, beginning with Böhm's (1879) report of two new species from Enoshima, Sagami Bay; about 160 species have now been recorded from Japanese waters (Miyazaki and Stock 1995, Na-

kamura 1995, Child 1996, Nakamura et al. 1996, Takahashi et al. 2007). While most studies have focused on the Pacific coast of central Japan, there have been fewer reports of pycnogonids from waters adjacent to the Nansei Islands, from where 23 species in 17 genera belonging to nine families have so far been recorded (Ohshima 1935, Nakamura and Child 1988, Child 1996, Takahashi et al. 2007).

The colossendeid genus *Hedgpethia* Turpaeva, 1973 contains 15 species (Arango 2009, Bamber 2010). All of these are fairly small in body size compared to most species of *Colossendeis*, the type genus of Colossendeidae. Species of *Hedgpethia* have been collected from a wide range of depths, from 20 m [*H. chitinos* (Hilton, 1943) (Utinomi 1971: 338)] to 4294 m [*H. articulata* (Loman, 1908) (Turpaeva 1994: 135)]; most species have been collected infrequently, at only a few sites. From Japanese waters, four species of *Hedgpethia* have been reported so far, viz. *H. brevitarsis* (Losina-Losinsky & Turpaeva, 1958) (Nakamura and Child 1983, 1991), *H. chitinos* (Hilton, 1943) (Hedgpeth 1949, Utinomi 1955, 1962, 1971, Nakamura and Child 1983, 1991, Nakamura 1987), *H. dofleini* (Loman, 1911) (Loman 1911, Hedgpeth 1949, Utinomi 1951, 1955, 1971, Nakamura and Child 1991), and *H. elongata* Takahashi, Dick and Mawatari, 2007 (Takahashi et al. 2007).

During a research cruise of the Training and Research Vessel *Toyoshio-maru*, Hiroshima University, in May 2005, a specimen of *Hedgpethia* was procured. We describe it as a new species in this paper.

## Material and methods

Collection, preparation, and measurements of the specimens primarily follow the methods of Takahashi et al. (2007). The voucher specimen has been deposited in the Hokkaido University Museum, Sapporo, Japan (ZIHU).

## Results

### *Hedgpethia spinosa* sp. n.

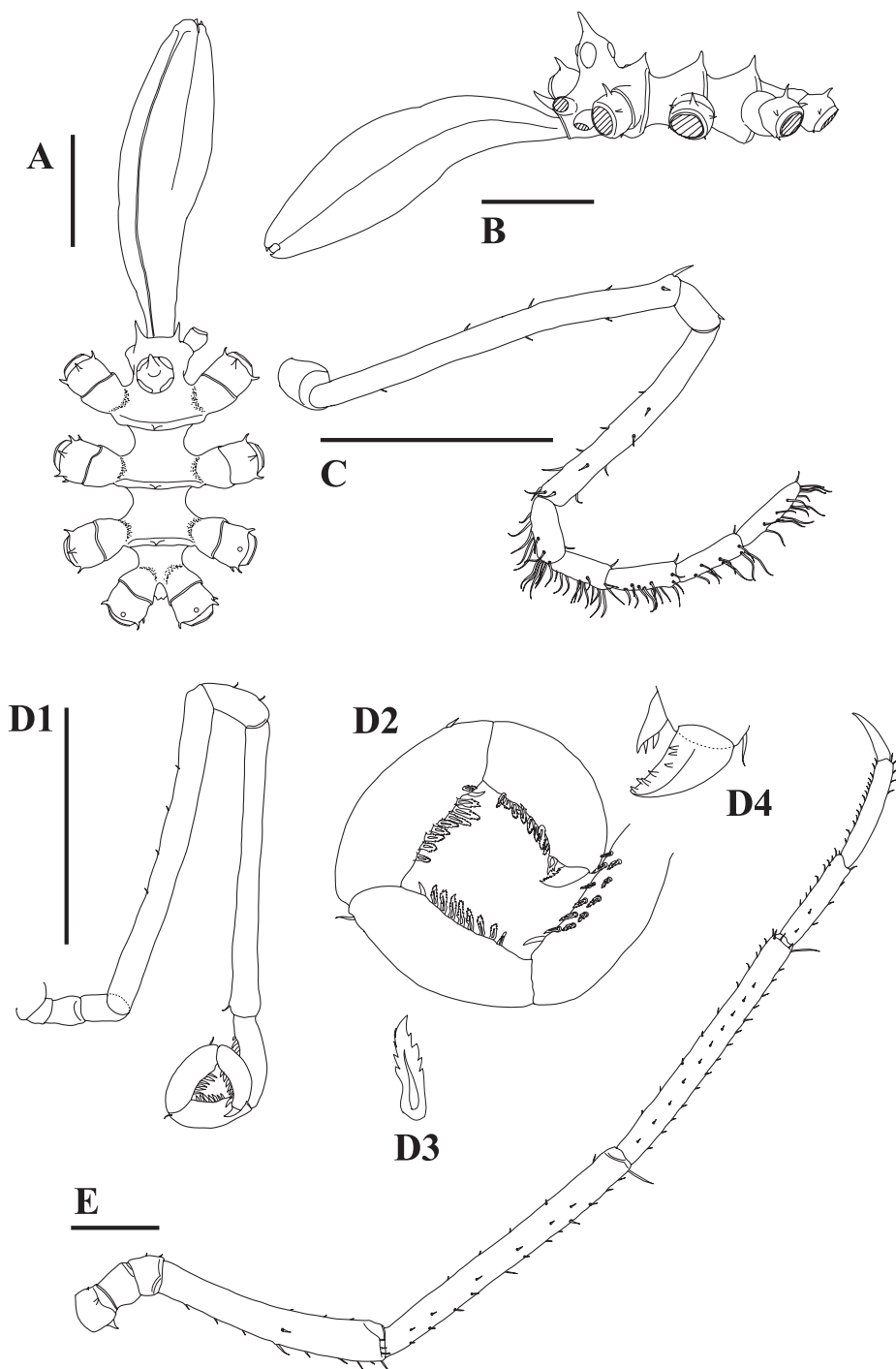
urn:lsid:zoobank.org:act:C228D530-5701-46F7-894F-EC12941C99C7

[http://species-id.net/wiki/Hedgpethia\\_spinosa](http://species-id.net/wiki/Hedgpethia_spinosa)

Fig. 1

**Material examined.** Holotype: male, ZIHU 3335, 30°08.90'N, 130°38.04'E, south of Yaku Island, Kagoshima, 26 May 2005, 197–207 m depth, collected by plankton net in a beam trawl [inner net *sensu* Akiyama et al. (2008)], S. Ohtsuka leg.

**Measurements of holotype (millimeters).** Trunk length, 1.28; body width, 0.62; length of proboscis, 1.43; length of abdomen, 0.08; length of palp, 2.26; first article of palp (P1), 0.06; P2, 0.03; P3, 0.83; P4, 0.10; P5, 0.50; P6, 0.14; P7, 0.12; P8, 0.15; P9, 0.16; P10, 0.17; third leg, coxa 1, 0.21; coxa 2, 0.18; coxa 3, 0.16; femur, 1.33;



**Figure 1.** *Hedgpethia spinosa* sp. n. Holotype, male (ZIHU 3335). **A** trunk, dorsal view **B** trunk, lateral view **C** palp **D1** oviger **D2** enlargement of distal segments of oviger **D3** enlargement of denticulate spine constituting strigilis **D4** enlargement of terminal claw of oviger **E** left third leg. Scale bars: 0.5 mm.

tibia 1, 1.73; tibia 2, 1.52; tarsus, 0.56; propodus, 0.65; claw, 0.33; oviger, first article (O1), 0.04; O2, 0.11; O3, 0.11; O4, 1.20; O5, 0.21; O6, 1.18; O7, 0.21; O8, 0.19; O9, 0.19; O10, 0.14.

**Description.** Size small for genus, leg span only 6.5 mm. Trunk (Fig. 1A, 1B) moderately short for genus, completely segmented, posterior rims of segments 1–3 inflated, each with pointed dorsal median tubercle. Lateral processes almost as long as their basal width, separated from one another by slightly more than their basal width, glabrous. Cephalic segment with pair of horn-like spines at anterior margin. Ocular tubercle dome shaped, 1.5 times as high as its basal width, with pointed apex projecting slightly forward. Eyes slightly pigmented, anterior pair larger than posterior pair. Proboscis (Fig. 1A, 1B) 1.2 times as long as trunk, swollen, spindle shaped, constricted at middle of total length, slightly curved downward, tapering distally; lips rounded, each with short ciliary sheet. Abdomen very small, located on ventral side.

Palps (Fig. 1C) longer than proboscis, slender; 10-segmented, with two short basal segments; first segment about twice as wide as other segments; second segment shortest; third segment longest, straight, with sparse, short setae, and with a few longer setae dorsodistally; fourth segment same length as sixth; fifth segment 0.6 times as long as third, with sparse setae over entire surface of distal half; seventh, eighth, and ninth segments subequal to sixth segment in length and slightly shorter than terminal segment; distal five segments fairly setose ventrally, setae as long as segment width, each segment with single short dorsodistal seta.

Oviger (Fig. 1D1) slender, long, 10-segmented; fourth and sixth segments longest, with very tiny setae ectally; fifth segment almost as long as second and third combined; strigilis (Fig. 1D2) armed with single short seta ectodistally, with rows of slender endal spines having denticles (Fig. 1D3); seventh segment equal to fifth in length; terminal segment less than two-thirds length and width of seventh segment; terminal claw short, about one-fifth as long as terminal segment, having small spines endally (Fig. 1D4).

Legs (Fig. 1E) slender, with many tiny setae over entire surface; first coxa with one small spine dorsally, one or two spines anteriorly and posteriorly, respectively; first and third coxae subequal and shorter than second coxa; femur almost equal to second tibia in length, curved ventrally, thickened in distal half, with several longer setae on distal end; tibia straight, with single long seta on distal end; first tibia 1.3 times as long as femur; tarsus slightly longer than propodus, both segments with dense, short setae ventrally and sparse, short setae dorsally; main claw about two-thirds as long as propodus.

**Etymology.** The specific name, a Latin adjective, refers to the spines on first coxae, anterior trunk margin, and terminal claw of oviger.

**Remarks.** Three species of *Hedgpethia* have pointed dorsomedian tubercles: *H. bicornis* (Losina-Losinsky & Turpaeva, 1958), *H. chitinsa* (Hilton, 1943), and probably *H. brevitarsis* (Losina-Losinsky & Turpaeva, 1958), the tubercles of which are slightly rounded. However, none of these has a pair of horns on the anterior margin of the cephalic segment, spines on the first coxae, or denticulate spines on the strigilis. The anterior spines of the cephalic segment have the appearance of vestiges of chelifores. This is one of the smallest species in the genus.

## Acknowledgements

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# Two new species of *Pselaphodes* Westwood and new record of *Taiwanophodes minor* Hlaváč from South China (Coleoptera, Staphylinidae, Pselaphinae)

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<sup>‡</sup> [urn:lsid:zoobank.org:author:BBACC7AE-9B70-4536-ABBE-54183D2ABD45](https://zoobank.org/BBACC7AE-9B70-4536-ABBE-54183D2ABD45)

<sup>§</sup> [urn:lsid:zoobank.org:author:FBE4FA1F-5BCF-405E-98C1-4F86894643EA](https://zoobank.org/FBE4FA1F-5BCF-405E-98C1-4F86894643EA)

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[urn:lsid:zoobank.org:pub:3CC23029-FEA1-489B-8D14-6D895FF8900B](https://zoobank.org/pub/3CC23029-FEA1-489B-8D14-6D895FF8900B)

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## Abstract

Two new species, *Pselaphodes liniae* Yin & Li, **sp. n.** (Hainan, Fujian) and *P. shii* Yin & Li, **sp. n.** (Hainan) are described from South China. *Taiwanophodes minor* Hlaváč is reported from outside Taiwan for the first time. Illustrations of major diagnostic features are provided for all treated taxa. The latest key to Chinese *Pselaphodes* is modified to include the new species.

## Keywords

Staphylinidae, Pselaphinae, *Pselaphodes*, *Taiwanophodes*, taxonomy, new species, new record, South China

## Introduction

A number of tyrine specimens have been submitted for determination since the publication of our previous papers of the genus *Pselaphodes* Westwood (Yin et al. 2010, 2011, 2012). Among this material were two new *Pselaphodes* species, and two males and three females of *Taiwanophodes minor* Hlaváč, a species previously known only from Taiwan. This information is reported herein.

## Methods

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

A slash (/) is used to separate lines on the same label, and a double slash (//) is used to separate different labels on the same pin.

Measurements are in millimeter, the following acronyms are used in the text: **AL**—length of the abdomen along the midline; **AW**—maximum width of the abdomen; **BL**—length of the body (= HL + PL + EL + AL); **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.

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

## Taxonomy

### *Pselaphodes liniae* Yin & Li, sp. n.

urn:lsid:zoobank.org:act:7C845FB3-6BEA-4CEC-91CC-75805DF662BE

[http://species-id.net/wiki/Pselaphodes\\_liniae](http://species-id.net/wiki/Pselaphodes_liniae)

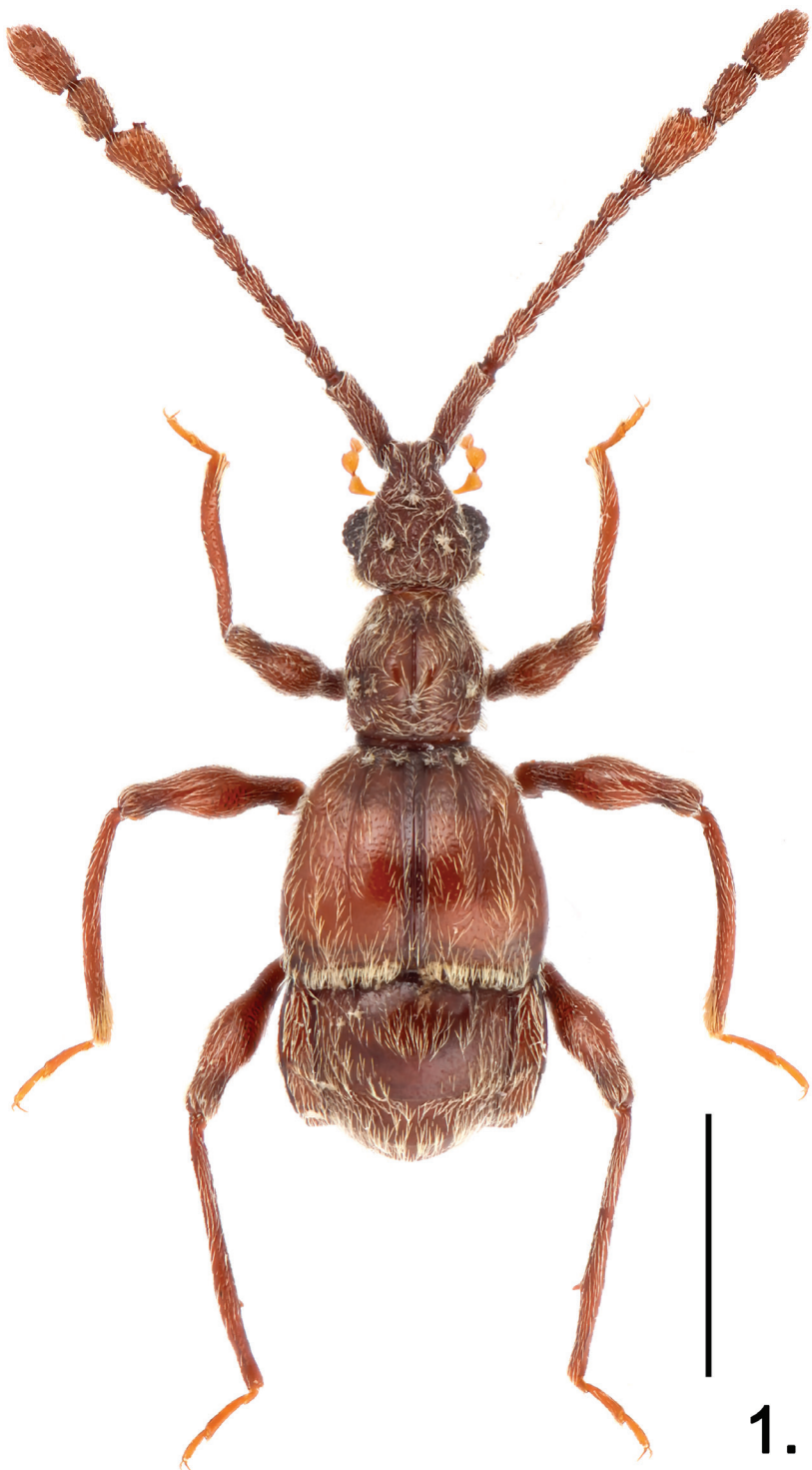
Figs 1, 2

**Type locality.** China, Hainan Province, Wuzhishan Mountain.

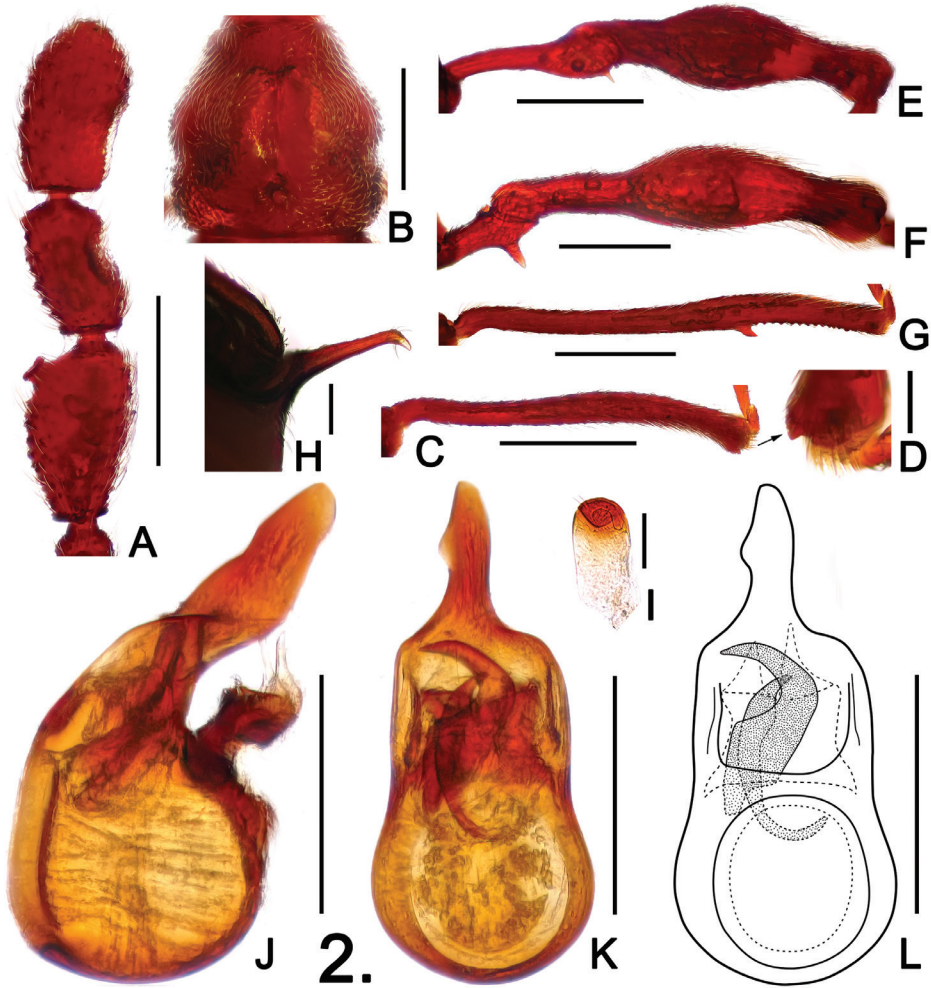
**Type material** (11 ♂♂, 5 ♀♀). HOLOTYPE: ♂, labeled ‘**CHINA:** Hainan Prov. / Wuzhishan Mt. / Guzhandao / ca. 640 m, 30.xi.2009 / 18.86657°N, 109.68285°E / Mei-Ying Lin leg. // [red] HOLOTYPE / *Pselaphodes liniae* Yin & Li / det. 2012, SNUC’. PARATYPES (all bear the following label: ‘[yellow] PARATYPE / *Pselaphodes liniae* Yin & Li / det. 2012, SNUC’): 2 ♂♂, 3 ♀♀, same label data as holotype; 2 ♂♂, 1 ♀, labeled ‘**CHINA:** Hainan Prov. / Yinggeling N. R. / Daoyin–Shenfu / ca. 425 m, 22.xi.2009 / Mei-Ying Lin leg.’; 1 ♀, same label data, except ‘14.IV.2010 / 18.98399°N, 109.33585°E’; 5 ♂♂, labeled ‘**CHINA:** Hainan Prov. / Baisha, Yuanmen / Yinggeling N. R. / Yinggezui / 660 m, 26.iv.2011 / Wen-Xuan Bi leg.’; 1 ♂, labeled ‘**CHINA:** Fujian Prov. / Nanjing County / Huboliao / ca. 200 m, 22.xi.2008 / Gan-Yan Yang leg. (beating)’.

**Diagnosis.** Reddish brown; medium-sized; genae rounded; antennomeres IX–XI strongly modified; pronotum with rounded lateral margins; with thin and long metaventral processes (in lateral view); pro- and metatibiae sinuate; aedeagus with asymmetric median lobe and small parameres.

**Description.** Male (Fig. 1). Length 2.65–2.87. Head as long as wide, HL 0.56–0.58, HW 0.56–0.58; eyes large, each composed of about 40 facets. Antennal clubs as in Fig. 2A. Pronotum (Fig. 2B) slightly longer than wide, PL 0.55–0.56, PW 0.50–0.52, with round lateral margins. Elytra wider than long, EL 0.80–0.81, EW



**Figure 1.** Habitus of *Pselaphodes lineae*. Scale: 1.0 mm.



**Figure 2.** Details of male *Pselaphodes lineae*. **A** right antennal club **B** pronotum **C** protibia **D** apex of protibia, enlarged **E** mesotrochanter and mesofemur **F** metatrochanter and metafemur **G** metatibia **H** metaventral process, in lateral view **I** sternite IX **J** aedeagus, in lateral view **K–L** same, in dorsal view. Scales: A, B, C, E, F, G = 0.3 mm, H, I = 0.1 mm, D = 0.05 mm, J, K, L = 0.2 mm.

0.99–1.04. Metaventral horn-like processes long (Fig. 2H). Legs having protibiae with blunt and slightly serrate apical projection (Figs 2C, D); mesotrochanters with minute ventral spine (Fig. 2E); metatrochanters with large robust spine (Fig. 2F). Abdomen large, AL 0.74–0.92, AW 1.00–1.02. Sternite IX as in Fig. 2I. Aedeagus length 0.39; with long asymmetric median lobe; apical half of parameres membranous (Figs 2J–L).

Female. Similar to male in general; BL 2.60–2.75, HL 0.56–0.58, HW 0.53–0.57, PL 0.56–0.58, PW 0.50–0.52, EL 0.67–0.70, EW 0.98–1.04, AL 0.81–0.89, AW 1.05–1.09. Eyes each composed of about 30 facets. Antennae simple; protibiae not spinose; metaventral horn-like processes absent.

**Distribution.** South China: Hainan, Fujian.

**Comparative notes.** Very distinctive species, easily separable from all other *Pselaphodes* species by the sinuate pro- and metatibiae, the metatibiae with a blade-shaped ventral tooth near apical 1/3, and the serrate ventral margin for the distance posterior to the tooth. The new species shares with *P. bomiensis* Yin et al., 2011 and *P. condylus* Yin et al., 2011 a similar placement of the antennal modification, but can be readily separated from both by the pronotal lateral margins being rounded. On the contrary the lateral margins of the pronotum are more or less angularly expanded laterally in *P. bomiensis* and *P. condylus*.

**Etymology.** The species name is dedicated to Mei-Ying Lin for the collection of part of the type series.

***Pselaphodes shii* Yin & Li, sp. n.**

urn:lsid:zoobank.org:act:CE8869A2-3929-4D1B-9D4D-89407D7D026B

[http://species-id.net/wiki/Pselaphodes\\_shii](http://species-id.net/wiki/Pselaphodes_shii)

Figs 3, 4

**Type locality.** China, Hainan Province, Jianfengling Natural Reserve

**Type material** (2 ♂♂). HOLOTYPE: ♂, labeled 'CHINA: Hainan Prov. / Ledong County / Jianfengling N. R. / Yulingu, river bank / 18.74686°N, 108.92988°E / ca. 635, 20.iii.2007 / H.L. Shi, F. Yuan leg. // [red] HOLOTYPE / *Pselaphodes shii* Yin & Li / det. 2012, SNUC'. PARATYPE: 1 ♂, labeled 'CHINA: Hainan Prov / Yinggeling, Nankai / Daoyin–Mohao / ca. 335 m, 15.iv.2010 / 19.01021°N, 109.36910°E / Mei-Ying Lin leg. // [yellow] PARATYPE / *Pselaphodes shii* Yin & Li / det. 2012, SNUC'.

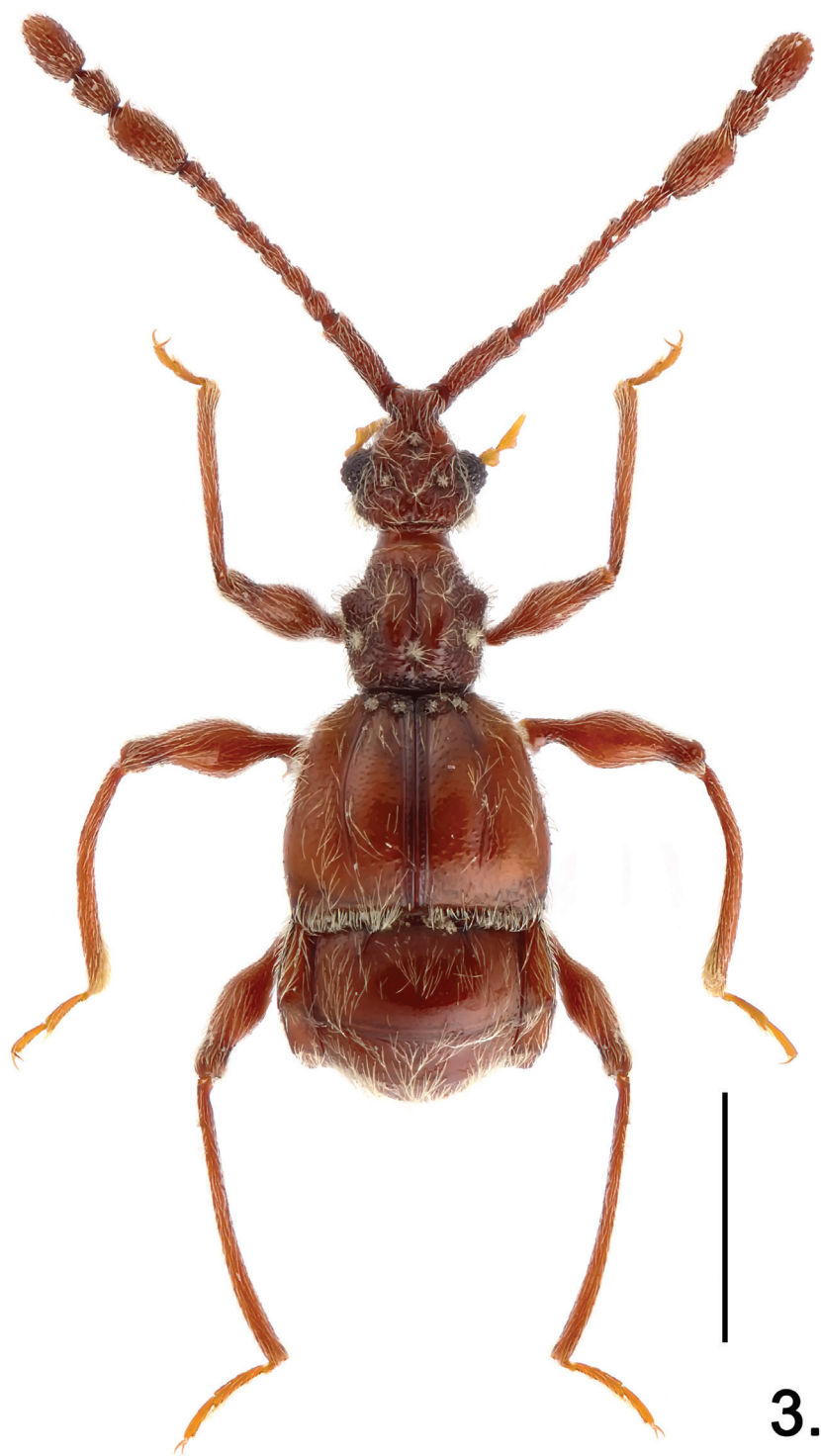
**Diagnosis.** Reddish brown; medium-sized; postocular margins rounded; antennomeres IX strongly modified; pronotum angularly expanded laterally; with robust and long metaventral processes (in lateral view); aedeagus with asymmetric median lobe and long parameres.

**Description.** Male (Fig. 3). Length 2.85–2.95. Head as long as wide, HL 0.56–0.60, HW 0.58–0.59; genae rounded; eyes large, each composed of about 40 facets. Antennal clubs as in Fig. 4A. Pronotum (Fig. 4B) almost as long as wide, PL 0.55–0.56, PW 0.57–0.58, with angulate anterolateral margins. Elytra wider than long, EL 0.81–0.84, EW 1.07–1.10. Metaventral horn-like processes long (Fig. 2G). Legs having protibiae with blunt and slightly serrate apical projection (Figs 2C, D); mesotrochanters with distinct ventral spine (Fig. 2E); metatrochanters with long, apically blunt spine (Fig. 2F). Abdomen large, AL 0.93–0.95, AW 1.08–1.12. Sternite IX as in Fig. 2H. Aedeagus length 0.59; with broad asymmetric median lobe and elongate parameres (Figs 4I–K).

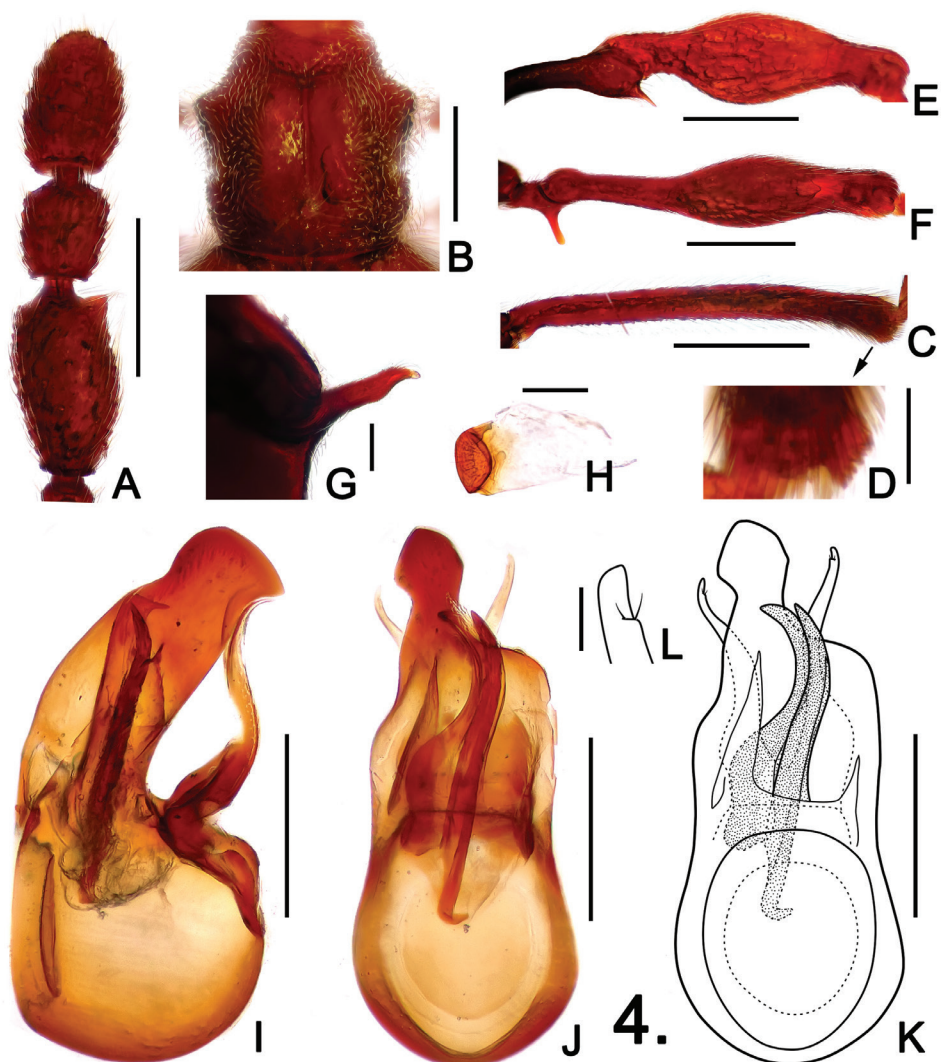
Female. Unknown.

**Distribution.** South China: Hainan.

**Comparative notes.** This species is placed close to *P. bomiensis*, *P. condylus* and *P. jizushanus* Yin et al., 2011 by sharing a similar placement of the antennal modification and projected anterolateral margins of the pronotum. It can be readily separated from



**Figure 3.** Habitus of *Pselaphodes shii*. Scale: 1.0 mm.



**Figure 4.** Details of male *Pselaphodes shii*. **A** left antennal club **B** pronotum **C** protibia **D** apex of protibia, enlarged **E** mesotrochanter and mesofemur **F** metatrochanter and metafemur **G** metaventral process, in lateral view **H** sternite IX **I** aedeagus, in lateral view **J–K** same, in dorsal view **L** right paramere, enlarged. Scales: A, B, C, E, F = 0.3 mm, D = 0.05 mm, G, H = 0.1 mm, L = 0.025 mm, I, J, K = 0.2 mm.

*P. bomiensis* and *P. condylus* by the much smaller size and different form of the antennomeres IX, from *P. jizushanus* by the metaventral processes being slightly curved posteriorly, the metatrochanters being protuberant ventrally and the metatibiae being simple. *Pselaphodes jizushanus* has the metaventral processes being curved anteriorly, the metatrochanters are simple, and the metatibiae are bluntly projected at apical 1/5.

**Etymology.** The species is named after Hong-Liang Shi for the collection of the holotype.

## Identification key

The latest key to the Chinese *Pselaphodes* (Yin et al. 2012: 36) is modified as the following to include the two new species described in the present paper.

- 11 Metatibiae modified in apical half (Fig. 2G; Yin et al. 2010: 11, Fig. 59; 12, Fig. 70; Yin et al. 2011: 467, Fig. 8) ..... **12**
- Metatibiae simple ..... **14**
- 12 Protibiae with median or apical projection..... **13a**
- Protibiae lacking projection. (Yunnan) .... ***P. jizushanus* Yin, Li & Zhao, 2011**
- 13a Protibiae with projection near middle (Yin et al. 2010: 6, Fig. 11). (Anhui, Yunnan, Hainan)..... ***P. aculeus* Yin, Li & Zhao, 2010**
- Protibiae with projection at apex ..... **13**
- 13 Body black (Yin et al. 2010: 4, Fig. 3); antennomeres X slightly transverse (Yin et al. 2010: 13, Fig. 93). (Qinghai)..... ***P. torus* Yin, Li & Zhao, 2010**
- Body reddish brown (Fig. 1); antennomeres X much longer than wide (Fig. 2-A). (Hainan)..... ***P. liniae* Yin & Li, sp. n.**
- 14 Metacoxae protuberant ..... **15**
- Metacoxae simple..... **16**
- 15 Elytra with two pairs of discal humps (Yin et al. 2011: 466, Fig. 6). (Yunnan) ..... ***P. gongshanensis* Yin, Li & Zhao, 2011**
- Elytra lacking discal humps (Yin et al. 2012: 32, Fig. 2). (Guangxi) ..... ***P. hui* Yin & Li, 2012**
- 16 Mesofemora simple (Yin et al. 2011: 472, Fig. 68; Yin et al. 2010: 12, Fig. 76)..... **17**
- Mesofemora with tiny admesal spine (Yin et al. 2010: 11, Fig. 61). (Henan) ..... ***P. cornutus* Yin, Li & Zhao, 2010**
- 17 Protrochanters simple (Yin et al. 2010: 12, Fig. 70)..... **17a**
- Protrochanters with distinct ventral spine (Yin et al. 2011: 471, Fig. 51). (Guizhou, Guangxi)..... ***P. condylus* Yin, Li & Zhao, 2010**
- 17a Large-sized (3.4 mm); antennae and legs conspicuously elongate (Yin et al. 2010: 6, Fig. 12); meso- and metatrochanters simple (Yin et al. 2010: 12, Fig. 76–77). (Yunnan) ..... ***P. subtilissimus* Yin, Li & Zhao, 2010**
- Medium-sized (less than 3 mm); antennae and legs normally elongate (Fig. 3); meso- and metatrochanters spinose (Figs 4E, F). (Hainan) ..... ***P. shii* Yin & Li, sp. n.**

***Taiwanophodes minor* Hlaváč, 2002**

[http://species-id.net/wiki/Taiwanophodes\\_minor](http://species-id.net/wiki/Taiwanophodes_minor)

Figs 5, 6

**Type locality.** China, Taiwan, Nantou.

**Material examined** (2 ♂♂, 3 ♀♀). 2 ♂♂, labeled ‘**CHINA:** Hainan Prov. / Yinggeling, Nankai / Daoyin–Mohao / ca. 335 m, 15.iv.2010 / Mei-Ying Lin leg.’; 3 ♀♀, labeled ‘**CHINA:** Hainan Prov. / Wuzhishan Mt. / Guzhandao / ca. 640 m, 30.xi.2009 / 18.86657°N, 109.68285°E / Mei-Ying Lin leg.’.

**Measurements.** Male (female): BL 2.78–2.87 (2.68–2.74), HL 0.56–0.57 (0.57–0.58), HW 0.53–0.54 (0.52–0.54), PL 0.57–0.58 (0.58–0.60), PW 0.55–0.57 (0.53–0.58), EL 0.82–0.84 (0.67–0.69), EW 1.11–1.15 (1.06–0.10), AL 0.83–0.88 (0.86–0.87), AW 1.13–1.16 (1.16–1.22), length of aedeagus 0.50.

**Diagnosis.** Male. Reddish brown; medium-sized (Fig. 5); postocular margins rounded; each eye composed of about 40 facets; antennomeres X modified, ventrally concave at apical half (Fig. 6A); pronotum with angulate anterolateral margins; robust and short metaventral processes with hook-like apices (in lateral view) (Fig. 6B); pro-trochanters spinose ventrally; protibiae with small apical spur (Fig. 6D); tarsomeres II extending to mid-length of tarsomeres III (Figs 6D–F); aedeagus asymmetric, median lobe elongate, parameres largely reduced (Figs 6G–I).

Female. Similar to male in general; each eye composed of about 30 facets; lacking antennal modification; lacking metaventral process; apices of protibiae simple.

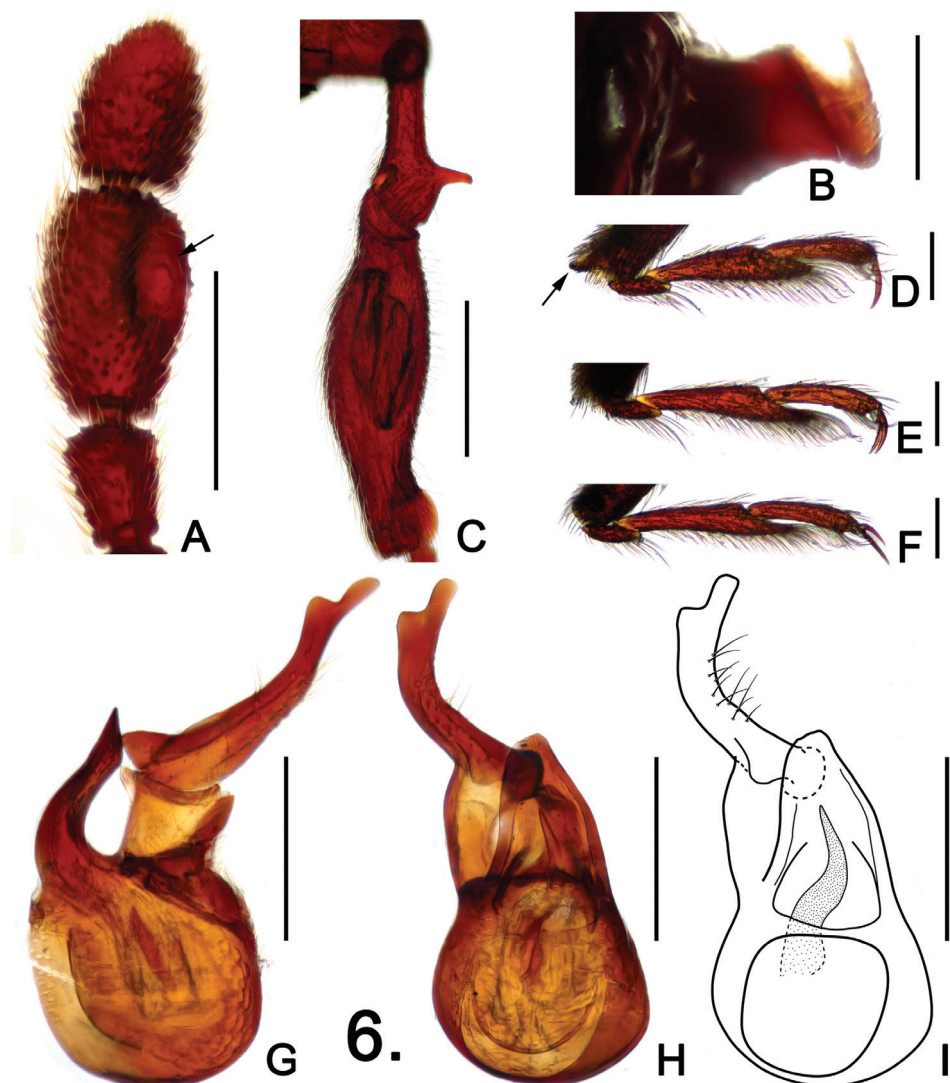
**Distribution.** South China: Taiwan, Hainan (**New Province Record**).

**Comparative notes.** Readily distinguished from the only other congener *T. magnus* Bekchiev, 2010 by the smaller size, antennomeres X being less modified, pronotum being angularly expanded anterolaterally, profemora and protibiae being simple, different conformation of the metaventral processes, and aedeagus with more elongate median lobe and reduced parameres.

**Comments.** *Taiwanophodes minor* was originally described from central Taiwan (Hlaváč, 2002). It is somewhat surprising that this species also occurs in the Hainan Island, suggesting geographic affinities between the two islands.



**Figure 5.** Habitus of *Taiwanophodes minor*. Scale: 1.0 mm.



**Figure 6.** Details of *Taiwanophodes minor*. **A** right antennal club **B** metaventral process, in lateral view **C** protrochanter and profemur **D** protasus **E** mesotarsus **F** metatarsus **G** aedeagus, in lateral view **H-I** aedeagus, in dorsal view. Scales: A, C, G, H, I = 0.3 mm, B, D, E, F = 0.1 mm.

## Acknowledgments

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