

# Revision of the southeast Asian soldier-fly genus *Parastratiosphecomyia* Brunetti, 1923 (Diptera, Stratiomyidae, Pachygastrinae)

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## Abstract

The genus *Parastratiosphecomyia* Brunetti is revised with the description of two new species: *P. freidbergi* **sp. n.** from India and *P. rozkosnyi* **sp. n.** from Laos and Thailand. All four species in the genus are illustrated and a key to species is provided. Type localities of previously described taxa are briefly discussed.

## Keywords

Oriental Region, Pachygastrinae, taxonomy, new species, wasp mimicry

## Introduction

The subfamily Pachygastrinae is a somewhat heterogeneous group that is defined by having lost vein  $M_3$ , a loss that has occurred numerous times independently in the Stratiomyidae (Woodley 2001). The Oriental genera *Parastratiosphecomyia* and the similar appearing *Stratiosphecomyia* Brunetti were placed by James (1952) in the tribe Meristomeringini, along with some African genera. Woodley (2010) expressed doubts as to whether or not the two Oriental genera were related to the Afrotropical ones.

Only a comprehensive phylogenetic study of the Pachygastrinae will elucidate the relationships within the subfamily and determine if the subfamily is monophyletic.

Brunetti (1923) described the genus *Parastratiosphecomyia* based on a single new species, *P. stratiosphecomyioides* Brunetti from Thailand. Subsequently, Lindner (1954) described a second species, *P. szechuanensis*, from China. Other than these original descriptions, the genus has remained unstudied and few additional specimens have been found in museums. New specimens have come to hand from fairly recent collecting in which two undescribed species have been discovered. It is the purpose of this paper to summarize knowledge of this genus and describe the new species.

As can be surmised by the generic and specific names, species of *Parastratiosphecomyia* are excellent mimics of aculeate wasps, possibly sphecids, but putative models have never been recorded. In *Parastratiosphecomyia* the elongate antennae, darkened wings, and strongly clavate abdomen contribute to its resemblance to wasps. Mimicry of wasps and bees has arisen numerous times in the Stratiomyidae with mimics known from at least six subfamilies. At least some of these mimics also have behavior that contributes to the overall effect, such as fast flight, how they hold their wings at rest, and how they sit on perches when not flying (Woodley, pers. obs.).

## Methods

Specimens have been borrowed from several institutions for which acronyms are given that are used in the specimen data citations:

- MMB** Department of Entomology, Moravian Museum, Brno, Czech Republic
- FSMU** Faculty of Science, Masaryk University, Brno, Czech Republic
- ZIB** Institute of Zoology, Slovak Academy of Sciences, Bratislava, Slovakia
- MHPC** Martin Hauser Personal Collection, Sacramento, California, USA
- MNHN** Muséum national d'Histoire naturelle, Paris, France
- USNM** National Museum of Natural History, Smithsonian Institution, Washington, DC, USA
- NBC** Naturalis Biodiversity Center, Leiden, Netherlands
- SMF** Senckenberg Forschungsinstitut und Naturmuseum, Frankfurt-am-Main, Germany
- BMNH** The Natural History Museum, London, England
- ZFMK** Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn, Germany

Specimens were examined with a Zeiss Stemi SV 11 stereomicroscope. Male terminalia were dissected from specimens relaxed in a humidity chamber for about 24 hours, cleared in hot KOH, neutralized with weak acetic acid, and rinsed with water. The terminalia are preserved in a microvial on the specimen pin.

*Parastratiosphecomyia stratiosphecomyioides* Brunetti, 1923, the type species, is re-described first in detail. Species that follow are described based on how they differ from *P. stratiosphecomyioides*. This methodology is chosen because the known species are very similar in coloration and morphology and full descriptions of each species would be largely repetitious. Morphological terminology follows that of McAlpine (1981) as modified by Cumming and Wood (2009). Body lengths are given exclusive of antennae.

### ***Parastratiosphecomyia* Brunetti, 1923**

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

Figs 1–30

*Parastratiosphecomyia* Brunetti 1923: 67. Type species, *Parastratiosphecomyia stratiosphecomyioides* Brunetti, by original designation.

**Diagnosis.** This genus can be separated from all other genera of Stratiomyidae by its long antennae that have the bases widely separated, the sockets being closer to the eye margin than their diameter (Figs 1–5). This is certainly an apomorphic character state. The pair of bluntly conical processes on the lower face is also an apomorphic feature of this genus (Figs 9, 10).

Slender, elongate, wasp-mimicking flies generally about 10–12 mm in length (Fig. 1). *Head:* Eyes bare, strongly holoptic in males with upper ommatidia enlarged, females with eyes smaller, dichoptic with uniform ommatidia; lower margin of face with a pair of bluntly conical tubercles, each near the intersection of the face with the gena; antenna about three to four times length of head, cylindrical, scape about three times as long as pedicel, flagellum with eight flagellomeres, first six subequal in length, seventh and eighth slightly more elongate; palpus small, two-segmented, nearly cylindrical, second segment two to three times as long as first.

*Thorax:* Scutum convex; scutellum moderately convex, rounded, without spines; post-tegula with some short hairs; legs unmodified, hind femur very slightly clavate, tibiae without spurs; wing infuscated subapically in all known species; mostly set with microtrichia, with noticeable bare areas in cells c, br, bm, and cup and at base of wing; costal vein extending just beyond apex of  $R_3$ , ending before wing apex;  $R_{2+3}$  originating beyond r-m by about or slightly more than length of r-m, ending in costa;  $R_4$  present; discal cell angular, about twice longer than wide;  $M_3$  absent; crossvein dm-cu absent; alula ovoid, posterior margin rounded, gradually widening distally.

*Abdomen:* Longer than thorax, very strongly clavate, second segment very narrow, almost cylindrical, dorsum of segments 3–5 nearly flat.

**Remarks.** The four species treated in this revision are very similar in coloration and in morphological details. However, the male terminalia are strikingly different between the species. The terminalia are large and protrude from the end of the abdomen, so some details, particularly the structure of the gonostyli, can be viewed without dissection.



**Figure 1.** Dorsal habitus illustration of *Parastratiosphecomyia freidbergi* Woodley. Illustration by Taina Litwak.

### Key to the species of *Parastratiosphecomyia*

- 1 Antennal scape strongly produced ventrally (Fig. 9); scutellum with apical half or more yellow; Malaysia, Thailand..... *P. stratiosphecomyioides*
- Antennal scape weakly or not modified, not strongly produced ventrally (Fig. 10); scutellum with only margin yellow, the coloration at most one-third of scutellar length..... 2
- 2(1) Hind coxa uniformly pale yellow; tarsi unicolorous, the apical tarsomeres not darker than basal ones; India..... *P. freidbergi* sp. n.

- Hind coxa infuscated on external lateral surface with brownish to blackish coloration; tarsi with apical one or two tarsomeres darkened, brownish to blackish, especially on front and hind legs.....**3**
- 3(2) Male with epandrium evenly arcuate in lateral view; gonostylus apically divided into two processes (Fig. 22); female tergite 8 with juncture of posterior and lateral margins evenly curved; Laos, Thailand..... *P. rozkosnyi* sp. n.
- Male with epandrium bent ventrally in lateral view; gonostylus not strongly divided, with a large, sickle-shaped apical lobe (Fig. 27); female tergite 8 with juncture of posterior and lateral margins angulate, produced dorsally with a sharply rounded apex; China, Laos, Vietnam..... *P. szechuanensis*

***Parastratiosphecomyia stratiosphecomyioides* Brunetti, 1923**

[http://species-id.net/wiki/Parastratiosphecomyia\\_stratiosphecomyioides](http://species-id.net/wiki/Parastratiosphecomyia_stratiosphecomyioides)

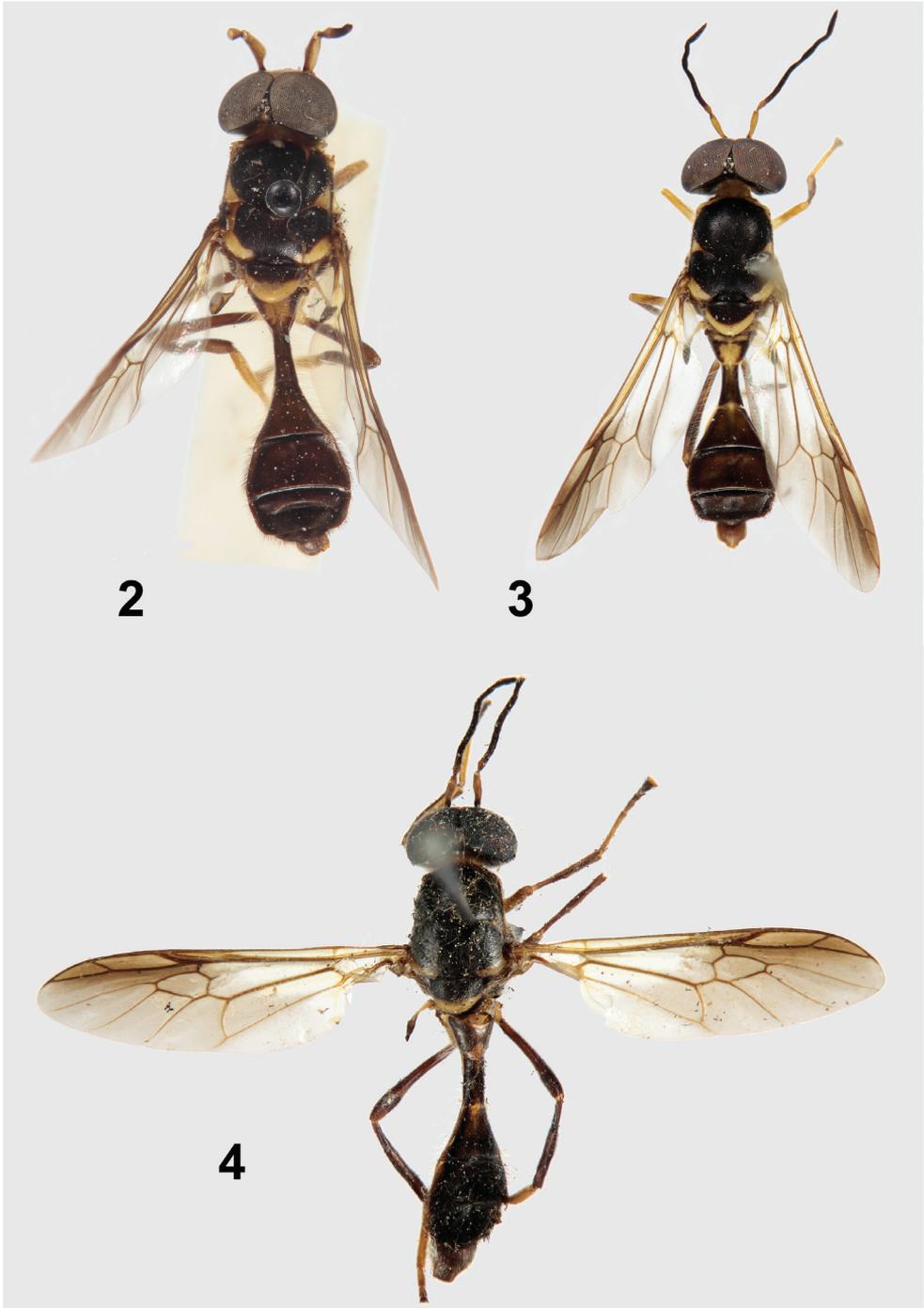
Figs 2, 6, 9, 11–15

*Parastratiosphecomyia stratiosphecomyioides* Brunetti, 1923: 67.

**Diagnosis.** *Parastratiosphecomyia stratiosphecomyioides* is easily distinguished from the other three known species in the genus by its remarkably produced ventral side of the antennal scape (Fig. 9).

**Redescription. Male.** *Head:* Brownish black, but lower frons and most of face pale yellow, lower frons with small diffuse brownish spots adjacent to inner margins of antennal sockets, face dark near oral margin, including conical processes; face slightly convex but depressed medially on lower part, not concave on lowest part between conical processes, with upper medial portion moderately striate, and with a tiny conical process at lower, outer margin of each antennal socket; lower frons with very narrow band of pale tomentum at eye margins, similar tomentum along eye margin at gena and postgena; face, gena, and ocellar tubercle with short to moderate length silvery white hair-like setae, longest on genal area; antenna with scape and pedicel dark yellow, scape slightly darker dorsally, both with short, dark, semi-appressed hair-like setae, densest dorsally; scape with ventral surface markedly produced, inner region near base with rounded excavation; flagellum blackish with dense pilosity (most of flagellum missing in males examined, presumably as in female described below); palpus with first segment pale yellow, second dark brownish; proboscis dark yellowish.

*Thorax:* Prothorax yellow but proepisternum is brownish black; scutum black with a pair of triangle-shaped lateral spots that are mostly on the presutural part, and area around postalar callus similarly yellow; scutellum black with apical half or more yellow; pleura yellow but ventral part of anepisternum, most of katepisternum, ventral part of meron, laterotergite and mediotergite brownish black; scutum with short, semi-appressed pilosity consisting of dark hair-like setae on dark cuticular areas, and pale hair-like setae on yellow areas, except laterally slightly longer hair-like setae present



**Figures 2–4.** Primary types of *Parastratiosphecomyia* species. **2** *Parastratiosphecomyia sphecomyioides* Brunetti (lectotype) **3** *Parastratiosphecomyia freidbergi* Woodley (holotype) **4** *Parastratiosphecomyia szechuanensis* (holotype) Lindner.

that are mostly pale; pilosity of pleura pale, slightly longer than on dorsal part of thorax and more erect, dorsal part of anepisternum bare; legs with coxae and trochanters pale yellow; front femur dark brown at base, gradually becoming dark yellow in basal third, middle and hind femora similar but the basal brown region more extensive, becoming yellow in apical half; front tibia mostly dark yellowish, narrowly dark dorsally; middle and hind tibiae brownish, more yellowish on ventral parts; tarsi yellowish, middle tarsus paler than others; halter with stem yellowish white, knob dark brown; wing (Fig. 6) with subapical cloud of infuscation starting at the proximal edge of discal cell, darkest and most evident in basal two-thirds of cell  $r_5$ .

*Abdomen:* Blackish brown, first tergite with irregular yellowish medial spot, tergites 3-5 with narrow lateral margins vaguely paler; first tergite with moderately long, pale hair-like setae, tergites 2-5 densely set with short, dark hair-like setae on most of dorsal surface, tergites 2-3 with longer pale hair-like setae laterally (similar to those on first segment) and tergites 4-5 with longer dark hairs along lateral and posterolateral margins; sternites 1-3 yellowish, 4-5 brownish, with short, pale hair-like setae basally which become dark from apical half of sternite 3 posteriorly.

*Terminalia:* Gonocoxites (Fig. 11) with lateral margins nearly straight, diverging posteriorly, with a pair of rounded processes posterior to gonocoxal apodemes; gonocoxal apodemes extending anteriorly to about anterior margin of genital capsule; synsternite of genital capsule with posterior process that is slightly bilobed; gonostyli arcuate, without processes (Figs 11, 12); phallic complex (Figs 13, 14) small, trilobed, the medial lobe shorter than lateral lobes; epandrium (Fig. 15) large, evenly convex, slightly indented posterolaterally, posterior margin truncate; hypoproct sclerotized, but not expanded dorsolaterally.

*Length:* 10.8 mm.

**Female.** Differs from male as follows: *Head:* Frons 0.27–0.28 head width, upper and lower frons gradually widening ventrally, upper frons with slight medial depression in front of anterior ocellus, junction of upper and lower frons with indistinct elevation on each side of median line; upper frons with pale, appressed hair-like setae except on ocellar tubercle and in medial depression; antenna 3.6 times length of head; first five flagellomeres of antennal flagellum with dense, black velvety vestiture, with scattered fine, erect hair-like setae especially posteriorly, flagellomeres 6–8 with more erect, longer pilosity that is gradually longer toward apex, last flagellomere tapered apically; palpus with second segment more robust than in male.

*Thorax:* Scutum with hair-like setae mostly appressed, golden yellow; front femur sometimes more extensively dark on basal two-thirds; front tibia more extensively brownish black on dorsal part.

*Abdomen:* Tergite 2 and basal part of tergite 3 suffused with yellowish color medially; tergites 4–5 with shorter golden yellow hairs laterally and posterolaterally; sternite 8 with lateral margins evenly rounded, evenly continuous with posterior margin, produced dorsally along sides of terminalia; cercus yellowish brown, with first segment cylindrical, about three times as long as short, ovoid second segment.

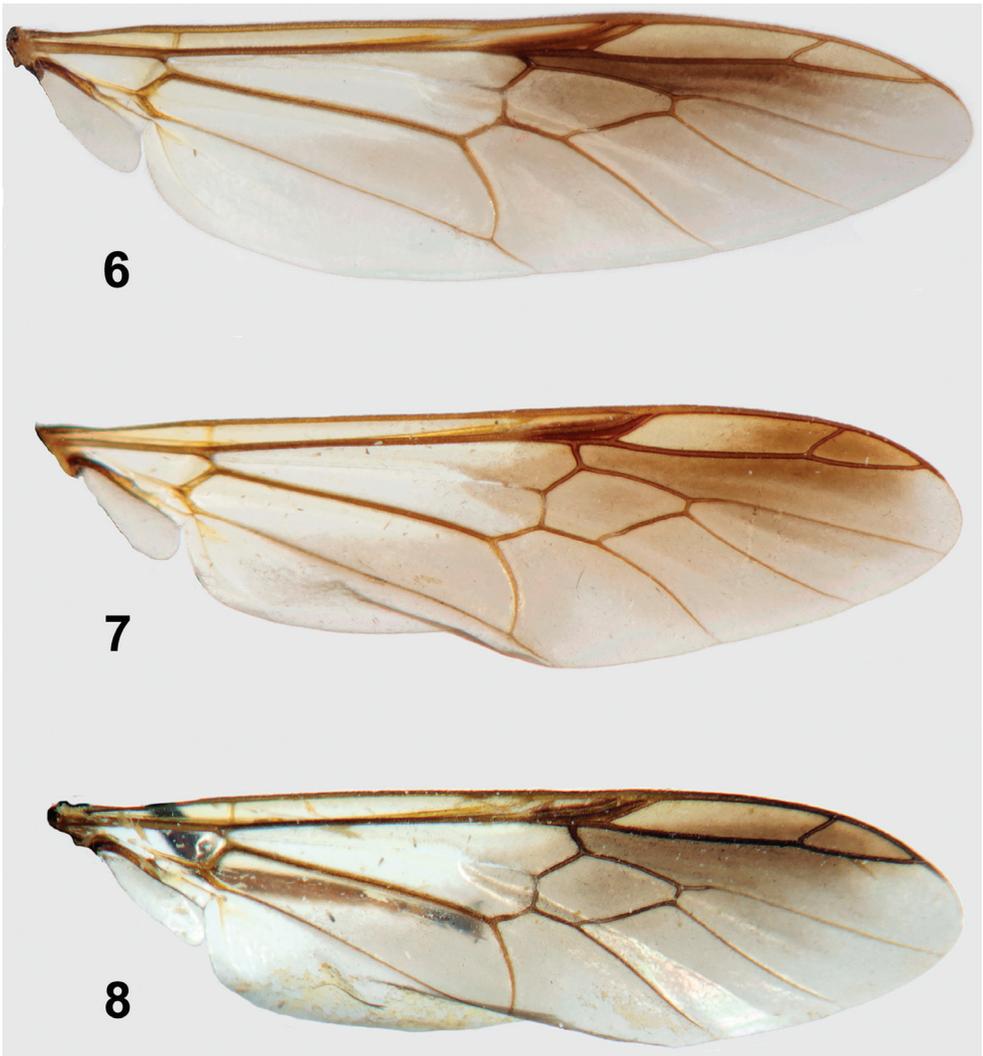


**Figure 5.** Holotype of *Parastratiosphecomyia rozkosnyi* Woodley.

*Length:* 10.3–10.4 mm.

**Distribution.** Known from peninsular Malaysia and adjacent Thailand.

**Type material examined.** The four syntypes noted in Brunetti (1923) are present in BMNH, three of which were subsequently labeled as syntypes. I am hereby designating the male specimen in the most complete condition as lectotype to stabilize the taxonomic concept of this species and its name. The specimen is labeled: “Siam: Bultit Besar. H.C.Robinson & N.Annandale. 1916–21./LECTOTYPE ♂ *Parastratiosphecomyia stratisphecomyioides* Brunetti, 1923 des. N. E. Woodley 2012”. As can be seen from the label data, this specimen had not previously been labeled as a syntype, but it clearly is one. There is no date on the data label. The specimen (Fig. 2) is in moderately good condition, but is missing the left antennal flagellum, the apical seven flagellomeres of the right antenna, and the right middle leg beyond the trochanter.



**Figures 6–8.** Wings of *Parastratiosphecomyia* species. **6** *Parastratiosphecomyia sphaemyioides* Brunetti **7** *Parastratiosphecomyia freidbergi* Woodley **8** *Parastratiosphecomyia rozkosnyi* Woodley.

Lectotype male (BMNH), **THAILAND:** Pattani Province, Bukit Besar, H.C. Robinson and N. Annandale; paralectotype male (BMNH), same data but 2500 feet, 1.ix.1901; paralectotype male (BMNH), same data but 2500 feet, 30.viii.1901; paralectotype female (BMNH), same data but 2500 feet, 4.ix.1901.

**Additional material examined. MALAYSIA:** 1 female (FSMU), Perak, Cameron Highlands, environs of Batu Village, 4°22'N, 101°20'E, 590 meters, v.2009, Pacholátko leg.

**Remarks.** Brunetti (1923) cited the type locality for *P. stratiosphecomyioides* as “Bukit Besar, Patani, Peninsular Siam”. However, the labels on all four of the origi-

nal syntypes read “Bulsit Besar” rather than “Bukit”. Using internet searches I found nothing about a possible locality for Bulsit Besar, but there are several localities called Bukit Besar in peninsular Malaysia (it apparently means “Big Hill” in Malay). Although “Patani” is not part of the actual specimen labels, it seems that by some means Brunetti was aware that the type locality was in Patani. According to *Webster’s Geographical Dictionary* (Bethel 1967: 860) Patani was “formerly, a Malay state in the Malay Penin. under Siamese protection, included among the Malay States; now Patani prov. in Thailand.” Still a province in southeastern Thailand, Pattani has some mountainous areas, so a locality of 2500 feet, as noted on data labels of some of the syntype specimens, is possible. Therefore, I think it is highly likely that the type locality is in Pattani province.

***Parastratiosphecomyia freidbergi* Woodley, sp. n.**

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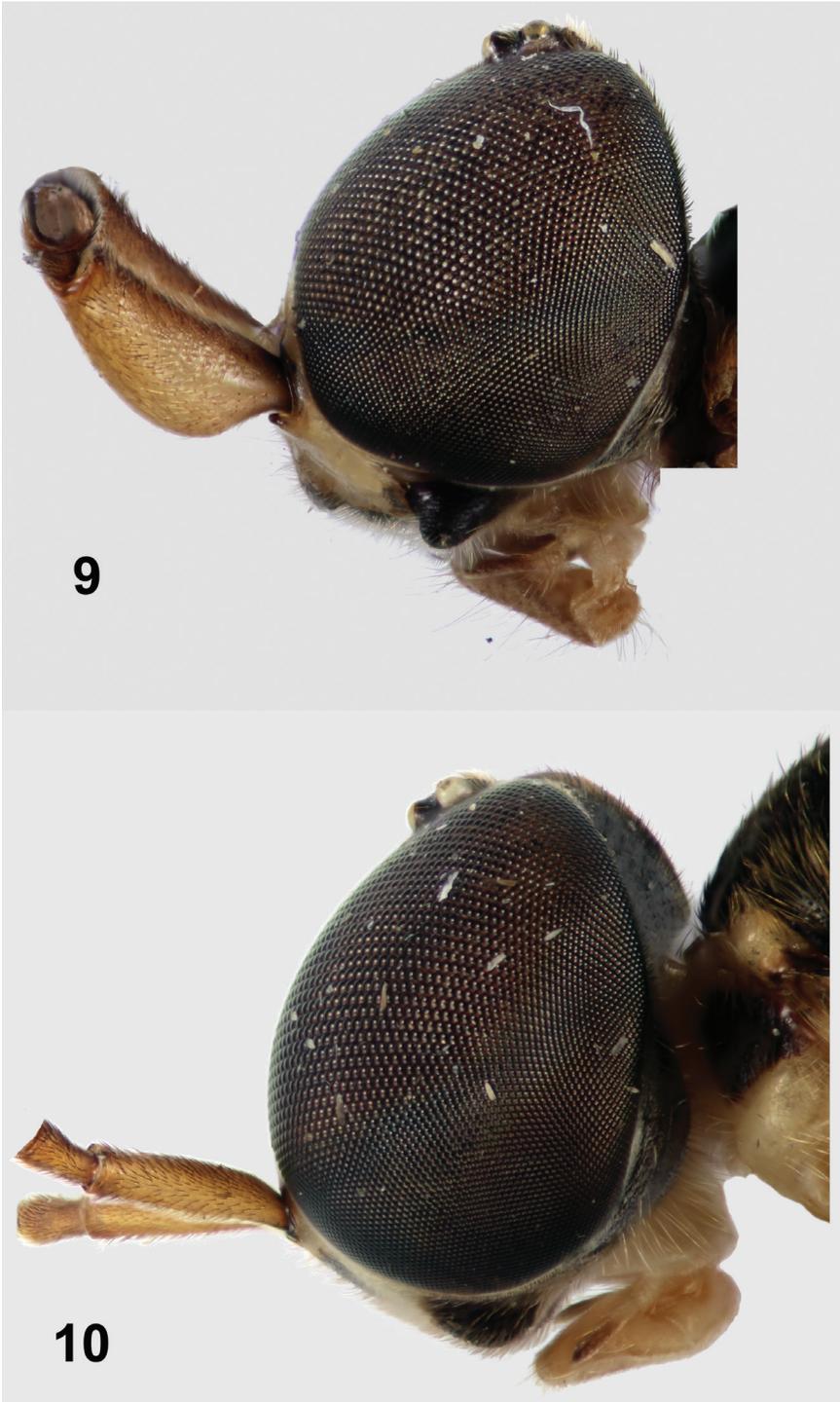
Figs 1, 3, 7, 10, 16–20

**Diagnosis.** *Parastratiosphecomyia freidbergi* can easily be distinguished from *P. stratiosphecomyioides* because its antennal scape is not produced ventrally (Fig. 10) and its scutellum (Figs 1, 3) is more extensively black. It differs from *P. rozkosnyi* and *P. szechuanensis* by having the hind coxa uniformly pale, without any darkened areas, and by the structure of the male terminalia.

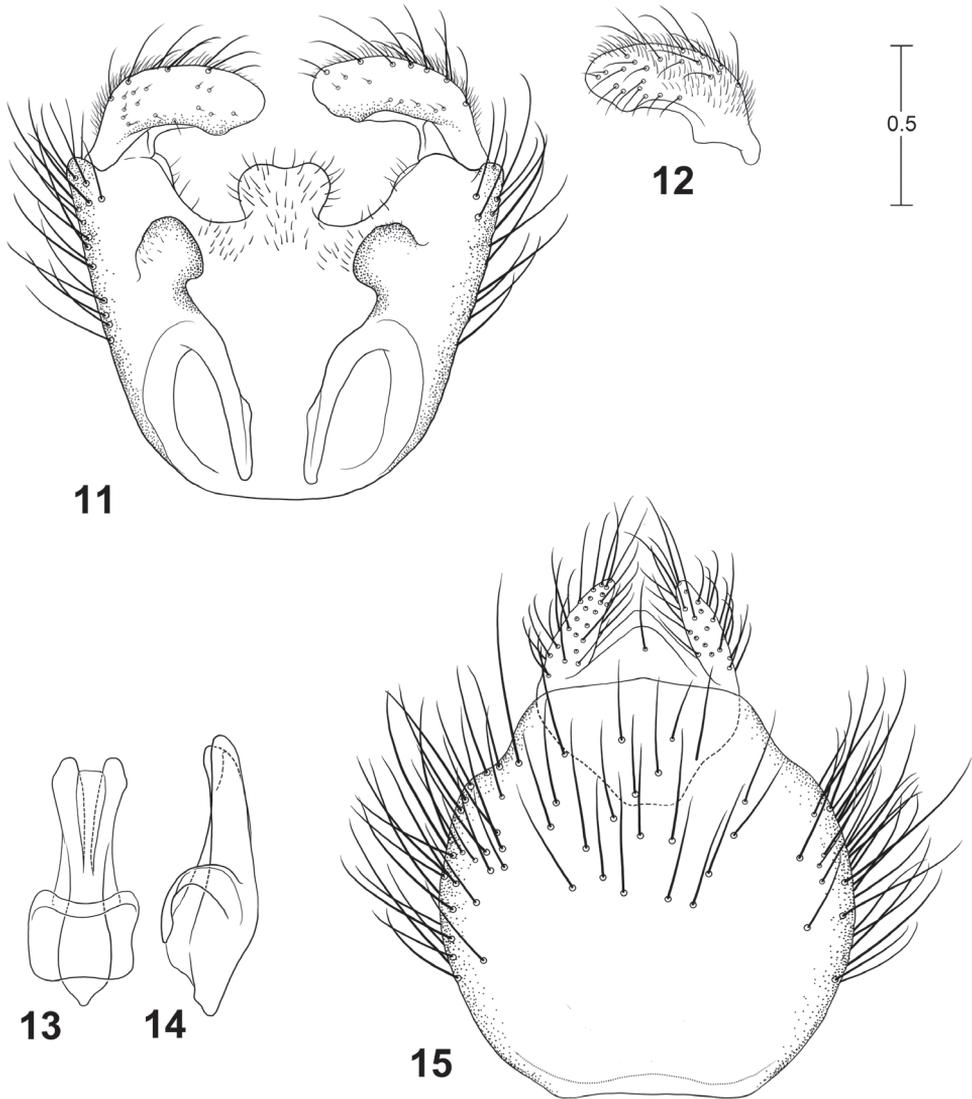
**Description.** Differs from *P. stratiosphecomyioides* as follows: **Male.** *Head:* Lower frons with dark spots larger and more distinct; face with a pair of nearly quadrate blackish spots below antennal bases, medial part not convex and only vaguely impressed medially, concave on lowest part between conical processes, medial portion shiny and only vaguely striate, conical process on lower, outer margin of antennal socket minute; pilosity on dark portion of lower face dark; antennal scape more evenly pilose, cylindrical, not produced ventrally, and with less evident concave area at inner base; second segment of palpus with basal half to entirely pale yellow.

*Thorax:* Scutum with pale spots at transverse suture more ovoid; scutellum with basal two-thirds to three-fourths blackish, with broad yellow margin; ventral part of katepisternum with mostly dark hair-like setae on dark cuticular region; front femur pale yellow at base, becoming brownish yellow on slightly less than apical half; middle femur pale yellow with distinct dark brown coloration on slightly less than apical half that is sharply delimited; hind femur entirely dark brown with extreme apex becoming yellowish; hind tibia almost completely dark brown, apicoventral third vaguely paler; wing with apical infuscation somewhat darker, the infuscation extending nearly to the wing apex, darkest area includes apical half of cell  $r_{2+3}$  and all of  $r_4$ .

*Abdomen:* Medial portion of tergite 2 and basal portion of tergite 3 yellowish but the cuticular coloration largely obscured by dark pilosity; narrow lateral margins of tergites 2–5 distinctly yellow.



**Figures 9–10.** Left lateral views of heads of *Parastratiosphecomyia* species. **9** *Parastratiosphecomyia sphecomyioides* Brunetti **10** *Parastratiosphecomyia freidbergi* Woodley (antennal flagellae removed digitally).



**Figures 11–15.** Male terminalia of *Parastratiophecomyia sphecomyioides* Brunetti. **11** Genital capsule, dorsal view **12** Gonostylus, anterolateral view **13** Phallic complex, dorsal view **14** Phallic complex, left lateral view **15** Epandrium and postgenital segments.

*Terminalia:* Gonocoxites (Fig. 16) with lateral margins nearly parallel, with a pair of ovoid dorsal processes that project posteriorly just anterior to gonocoxal apodemes and that have weakly serrate medial margins; posterior margin of synsternite with a pair of sharp, conical processes just ventral to gonostyli and a narrowly rounded medial process; gonocoxal apodemes just reaching anterior margin of genital capsule; gonostylus (Figs 16, 17) arcuate, with a large, subapical dorsal tooth and a small, narrowly rounded process just posterior to tooth; phallic complex (Figs 18, 19) larger than in

*P. stratiosphecomyioides*, more elongate, with medial lobe slightly longer than lateral lobes; epandrium (Fig. 20) large, evenly convex, posterior margin with rounded medial projection; epiproct and hypoproct deflexed ventrally.

*Length*: 11.3–12.0 mm.

**Female.** Unknown.

**Distribution.** Known only from Meghalaya state in northeastern India.

**Type material.** Holotype male (Fig. 3; USNM), **INDIA**: Meghalaya, Nongph [= Nongpoh] Forest, 25–28.iv.1980, Amnon Freidberg. The holotype is in excellent condition. Paratype: 1 male (USNM), same data as holotype.

**Etymology.** The species epithet, *freidbergi*, is a patronym in honor of Amnon Freidberg of Tel Aviv, Israel, whose excellent collecting over many years has produced numerous interesting Stratiomyidae.

**Remarks.** This is the only species of *Parastratiosphecomyia* known from India and this represents the western-most record of the genus.

***Parastratiosphecomyia rozkosnyi* Woodley, sp. n.**

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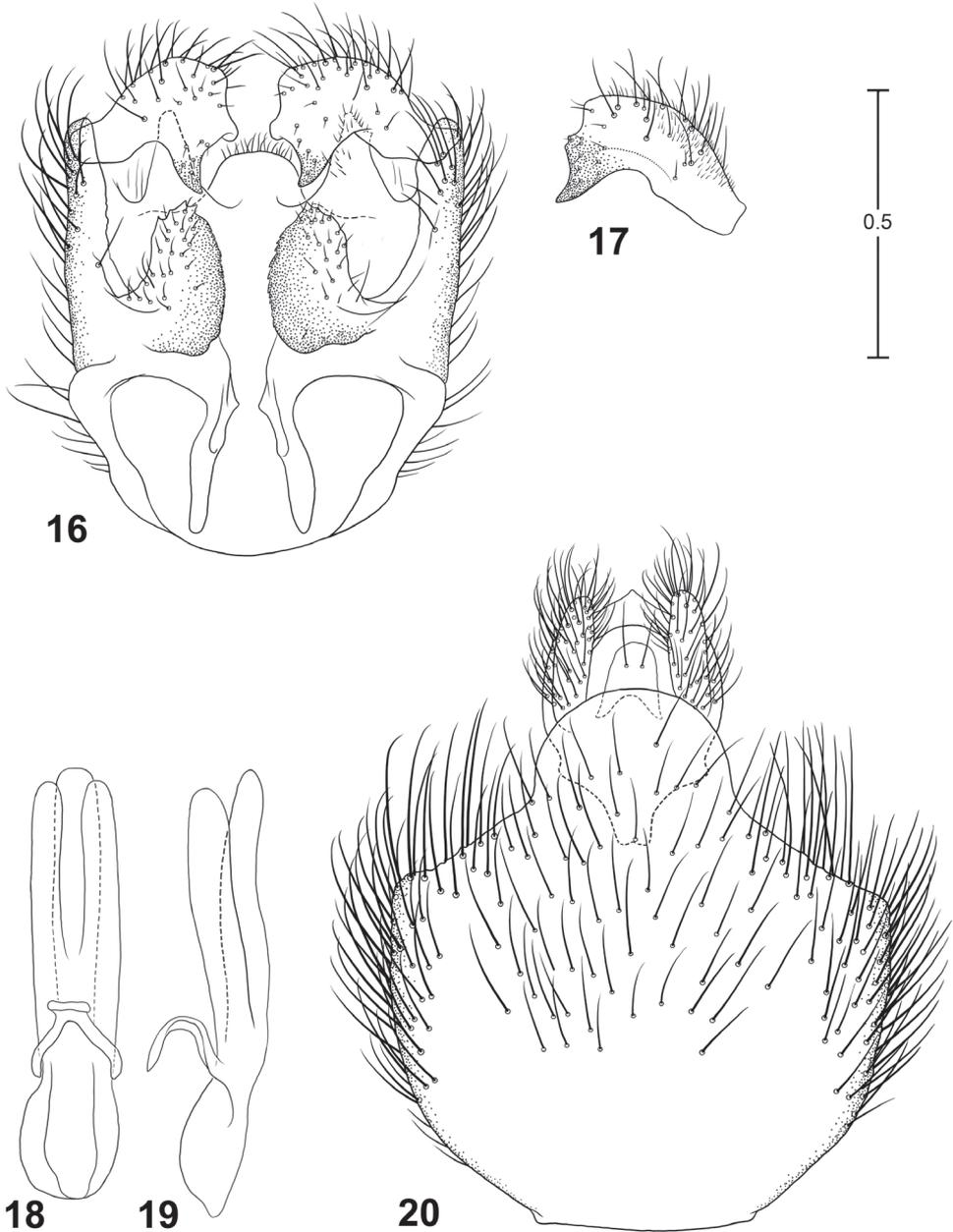
[http://species-id.net/wiki/Parastratiosphecomyia\\_rozkosnyi](http://species-id.net/wiki/Parastratiosphecomyia_rozkosnyi)

Figs 5, 8, 21–25

**Diagnosis.** *Parastratiosphecomyia rozkosnyi* can be distinguished from *P. stratiosphecomyioides* and *P. freidbergi* by having the lateral surface of the hind coxa with some dark coloration. This can be small in extent but is always visible. It differs from *P. szechuanensis* (as well as the other species) by its distinctive male genitalia in which the gonostylus possesses two subequal tooth-like processes (Fig. 22). Females are very similar to those of *P. szechuanensis* but differ by having the juncture of the posterior and lateral margins of tergite 8 evenly rounded.

**Description.** Differs from *P. stratiosphecomyioides* as follows: **Male.** *Head*: Lower frons with dark spots larger and more distinct; face with a pair of irregularly ovoid blackish spots below antennal bases, medial part not convex and only vaguely impressed medially, concave on lowest part between conical processes, medial portion shiny and weakly to indistinctly striate, process on lower, outer margin of antennal socket minute, sometimes not developed; pilosity on dark portion of lower face dark; antennal scape more evenly pilose, sometimes darkened narrowly at base, slightly swollen, not produced ventrally, and concave area at inner base distinct but smaller.

*Thorax*: Scutum with lateral yellowish spots near transverse suture much smaller, not easily seen with naked eye, narrow ovoid; scutellum black with broad yellow posterior margin, the yellow coloration about one-fourth to one-third length of scutellum; scutum with hair-like setae entirely pale, golden yellow, with much of scutum also with scattered, more erect pale hair-like setae in addition to semi-appressed pilosity; hind coxa with some lateral darkened areas, sometimes extensive, the coloration somewhat diffuse rather than forming distinct markings; front femur brownish black on



**Figures 16–20.** Male terminalia of *Parastratiosphecomyia freidbergi* Woodley. **16** Genital capsule, dorsal view **17** Gonostylus, lateral view **18** Phallic complex, dorsal view **19** Phallic complex, left lateral view **20** Epandrium and postgenital segments.

about basal one-third, this area sometimes yellowish dorsally, also a moderately well-defined brownish area ventrally near apex; middle femur coloration similar to front femur except that dark coloration at base occupies about half of the femur; hind fe-

mur brownish black becoming narrowly yellowish at apex; hind tibia brownish black, vaguely yellowish at extreme apex; tarsi with fifth tarsomeres brownish dorsally; wing with apical infuscation somewhat darker, the infuscation extending nearly to the wing apex, darkest area includes part of cell  $r_{2+3}$ , all of  $r_4$ , and basal three-fourths of  $r_5$ .

*Abdomen:* Tergite 1 brownish black with broad pale yellow margins both anteriorly and posteriorly, yellowish medially except for narrow band near base; tergite 2 yellowish medially, this coloration extending indistinctly on basal part of tergite 3.

*Terminalia:* Gonocoxites (Fig. 21) with lateral margins rounded, with a pair of posterodorsal processes that are rounded posteriorly, concave laterally; gonocoxal apodemes very small, ending far posterior of anterior margin of genital capsule; posterior margin of syssternite with narrow medial process that is rounded posteriorly; gonostylus (Figs 21, 22) arcuate, divided into a pair of sharp, subequal teeth; phallic complex (Figs 23, 24) small, narrow, trilobed, medial lobe subequal to lateral lobes in length; epandrium (Fig. 25) large, evenly convex, posterior margin with rounded medial projection; epiproct and hypoproct deflexed ventrally, hypoproct strongly sclerotized, not expanded dorso-laterally, with narrow anteromedial process that is slightly bent ventrally.

*Length:* 12.0–13.2 mm.

**Female.** Differs from male as follows: *Head:* Frons 0.25–0.27 head width, upper frons with slightly raised medial strip that is about one-fourth of head width and widens slightly toward antennae; dark spots above antennae small, sometimes indistinct; junction of upper and lower frons flat, face slightly concave medially; upper frons with pale, appressed hair-like setae.

*Thorax:* Scutum with erect hair-like setae slightly shorter than in male; hind tibia mostly brownish in specimens examined.

*Abdomen:* Sternite 8 with lateral margins extending dorsally toward posterior end, forming evenly rounded angle with posterior margin that does not overlap sides of terminalia.

*Length:* 10.3–10.4 mm.

**Distribution.** Known from Laos and northern Thailand.

**Type material.** Holotype male (Fig. 5; MMB), **LAOS:** Louang Namtha Province, Namtha to Muang Sing, 21°09'N, 101°19'E, 900–1200 m, 5–31.v.1997, Vít Kubán. Paratypes: 2 males, 1 female, same data as holotype; 1 male (MMB), **LAOS:** Oudomaxi Province, 17 km NEE of Oudom Xai, 20°45'N, 102°09'E, ca. 1100 m, 1–9.v.2002, Vít Kubán; 1 male (ZIB), **LAOS:** (central), environs of Ban Phabat, 70 km NE of Vientiane, 18°16.1'N, 103°10.9'E, 150 m, 27.iv–1.v.1997, E. Jendek, O. Sauša; 1 male, 1 female (SMF), **THAILAND:** (north), Mae Hong Son Province, Phangmapha, near Ban Nam Rin, 11.v.2011, D. Kovac, sweeping along small stream.

**Etymology.** The species epithet, *rozkosnyi*, is a patronym in honor of Rudolf Rozkošný of Brno, Czech Republic, who has produced many excellent contributions to the knowledge of Stratiomyidae over a distinguished and continuing career.

**Remarks.** *Parastratiosphecomyia rozkosnyi* is very similar to *P. szechuanensis* in coloration and general structure. The main distinguishing features are the very different male terminalia and slightly different sternite 8 in the female.

***Parastratiosphecomyia szechuanensis* Lindner, 1954**

[http://species-id.net/wiki/Parastratiosphecomyia\\_szechuanensis](http://species-id.net/wiki/Parastratiosphecomyia_szechuanensis)

Figs 4, 26–30

*Parastratiosphecomyia szechuanensis* Lindner, 1954: 208.

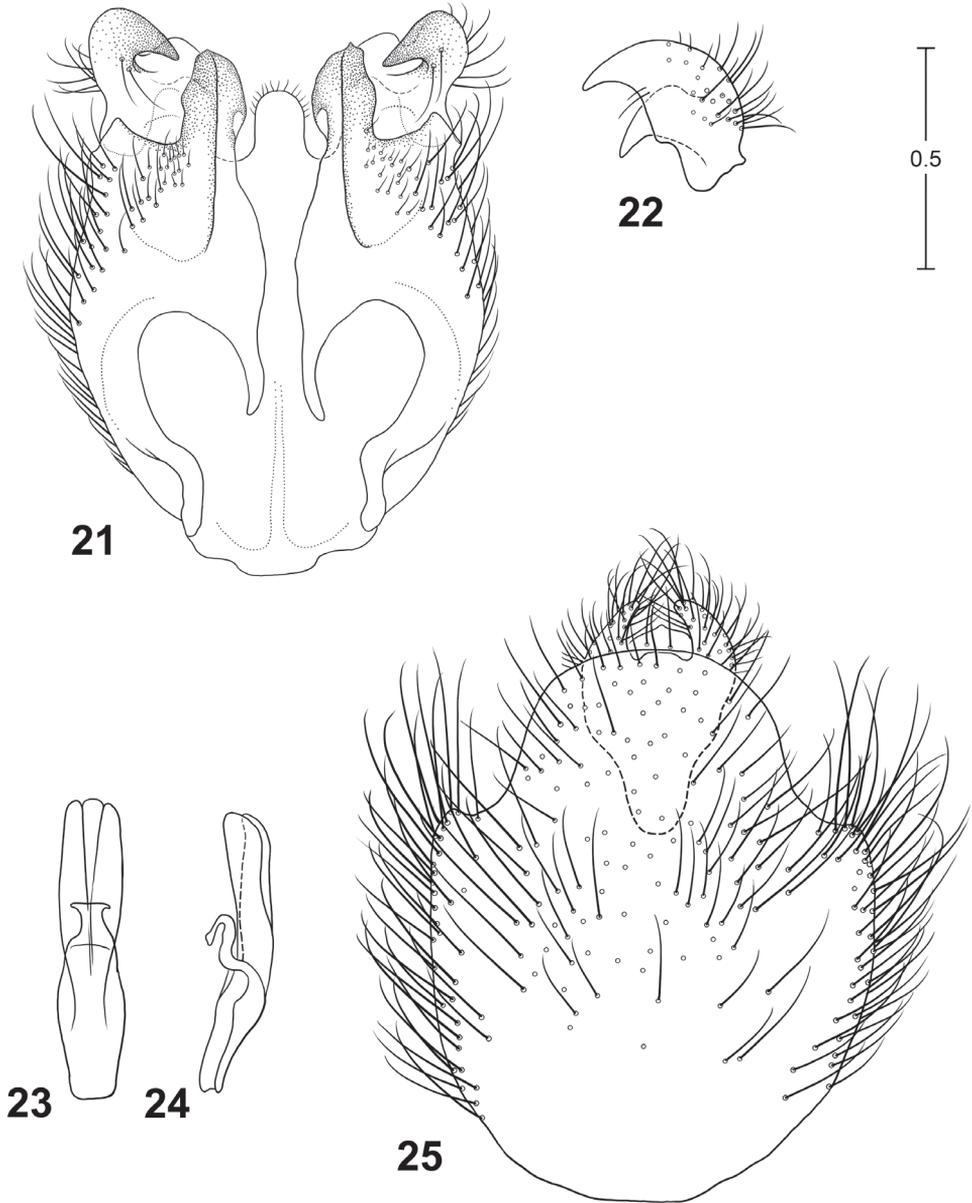
**Diagnosis.** *Parastratiosphecomyia szechuanensis* can be distinguished from *P. stratiophemyioides* and *P. freidbergi* by having the lateral surface of the hind coxa with some dark coloration. This can be small in extent but is always visible. It differs from *P. rozkosnyi* (as well as the other species) by its very distinctive male genitalia in which the gonostylus is elongate and sickle-shaped apically (Fig. 27). Females are very similar to those of *P. rozkosnyi* but differ by having the juncture of the posterior and lateral margins of tergite 8 produced into a sharply rounded angle.

**Redescription.** Differs from *P. stratiophemyioides* as follows: **Male.** *Head:* Lower frons with dark spots larger and more distinct, sometimes taking up much of lower frontal surface; face with a pair of irregularly ovoid blackish spots below antennal bases, medial part not convex and only vaguely impressed medially, concave on lowest part between conical processes, medial portion shiny and only vaguely striate, conical process on lower, outer margin of antennal socket minute; pilosity on dark portion of lower face dark; antennal scape more evenly pilose, sometimes darkened narrowly at base, slightly swollen, not produced ventrally, and concave area at inner base distinct but smaller.

*Thorax:* Scutum with lateral yellowish spots near transverse suture much smaller, not easily seen with naked eye, narrow ovoid; scutellum black with broad yellow posterior margin, the yellow coloration about one-fourth to one-third length of scutellum; pleura with ventral part of meron sometimes only vaguely brownish; scutum with some dark hair-like setae on medial area, but much of scutum also with scattered, more erect pale hair-like setae in addition to semi-appressed pilosity; hind coxa with some lateral darkened areas, at least along posterolateral margin, the coloration somewhat diffuse rather than forming distinct markings; front femur with brownish coloration on basal one-half or less on ventral side but ranging to completely yellow, also a moderately well-defined brownish area ventrally near apex; middle femur coloration similar to front femur; hind femur ranging from basal three-fourths yellowish with apical one-fourth brownish black becoming slightly paler at apex, to having brownish coloration on basal part as well, but apical darkened area is always visible and darker than ground color; hind tibia usually almost entirely dark brown, but can be yellowish on up to apical three-fourths; tarsi with fifth tarsomeres brownish dorsally; wing with apical infuscation somewhat darker, the infuscation extending nearly to the wing apex, darkest area includes part of cell  $r_{2+3}$ , all of  $r_4$ , and basal three-fourths of  $r_5$ .

*Abdomen:* Tergite 1 brownish black with broad pale yellow margins both anteriorly and posteriorly, narrow medial region only vaguely or not yellowish; tergite 2 occasionally with indistinct yellowish coloration medially.

*Terminalia:* Gonocoxites (Fig. 26) with lateral margins rounded, with a pair of posterodorsal processes that are narrowly truncate posteriorly; gonocoxal apodemes



**Figures 21–25.** Male terminalia of *Parastratiosphecomya rozkosnyi* Woodley. **21** Genital capsule, dorsal view **22** Gonostylus, anterolateral view **23** Phallic complex, dorsal view **24** Phallic complex, left lateral view **25** Epandrium and postgenital segments.

very small, ending far posterior of anterior margin of genital capsule; posterior margin of synsternite rounded but mostly membranous, narrowly sclerotized medially which appears like a narrow process; gonostylus (Figs 26, 27) elongate, bent dorsally in medial region, appearing sickle-like in lateral view, with short, narrow basal tooth; phallic

complex (Figs 28, 29) small, narrow, trilobed, medial lobe subequal to lateral lobes in length; epandrium (Fig. 30) large, evenly convex, posterior margin with rounded medial projection that is curved posteroventrally; epiproct and hypoproct deflexed ventrally, hypoproct strongly sclerotized, somewhat expanded dorsolaterally, with narrow anteromedial process that is bent ventrally.

*Length:* 12.0–13.2 mm.

**Female.** Differs from male as follows: *Head:* Frons 0.25–0.28 head width, upper frons with slightly raised medial strip that is about one-fourth of head width and widens slightly toward antennae; junction of upper and lower frons flat; upper frons with pale, appressed hair-like setae that are often sparse or nearly absent on medial elevation.

*Thorax:* Scutum with pilosity entirely pale, silvery to slightly golden, with scattered slightly longer, erect hair-like setae; hind tibia mostly brownish in specimens examined.

*Abdomen:* Tergite 2 with medial strip of yellowish coloration more distinct than in male, and basal part of tergite 3 suffused with yellowish color medially; sternite 8 with lateral margins extending dorsally toward posterior end, forming sharply rounded angle with posterior margin that is produced dorsally along sides of terminalia and slightly overlaps them.

*Length:* 11.3–13.6 mm.

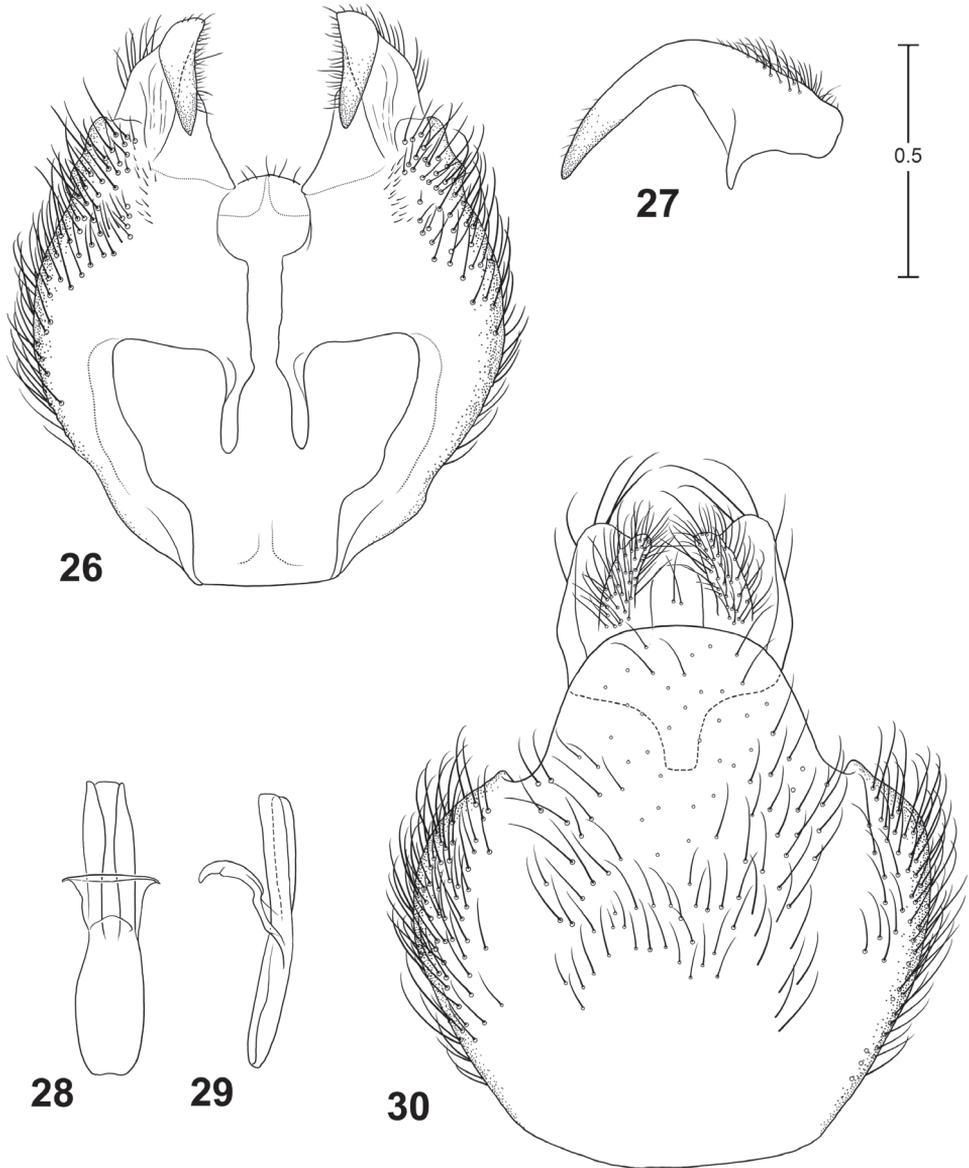
**Distribution.** Known from China (Fujian, Guizhou), Laos, and Vietnam.

**Type material examined.** The holotype male (Fig. 4; ZFMK) is labeled: “Kuantun(2300 m) 27,40n. Br. 117,40ö. L. J. Klapperich 5.6.1938(Fukien)/Parastratio-spheco-myia szechua-nensis Lind. Lindner det./Holotypus Lindner 1954/Holotypus”. The specimen is in fair condition, missing the apical flagellomere of the right antenna, the left middle leg beyond trochanter, right middle tarsus, and the last tarsomere of the left hind leg, and the right halter. The abdomen has at sometime in the past been glued to the specimen and is slightly crooked. The specimen has a small amount of mold on it.

In ZFMK there are an additional 14 males and 4 females from the same locality that have later paratype labels not provided by Lindner. Of these, 4 males and all 4 females bear Lindner determination labels in his handwriting. Within this subset, 1 male and 2 females have paratype labels handwritten by Lindner, and 1 female is labeled as allotype in Lindner’s handwriting. Lindner (1954: 208) mentioned “eine größere Serie in beiden Geschlechtern” but no numbers, so it is not possible to determine if Lindner actually examined all of these specimens. He also mentioned that there were paratypes in the museum in Stuttgart, which I have not examined.

Specimens labeled as paratypes, all in ZFMK: 3 males, **CHINA:** Fujian Province, Guadun, 27°40’N, 117°40’E, “2300 m”, 5.v.1938, Klapperich; 1 male, same data but 13.v.1938; 1 male, same data but 4.vi.1938; 2 males, same data but 5.vi.1938; 3 males, same data but 8.vi.1938; 1 male, same data but 10.vi.1938; 1 female, same data but 12.vi.1938; 1 male, 1 female, same data but 17.vi.1938; 1 males, 2 females (1 labeled as allotype), same data but 26.vi.1938; 1 male, same data but 28.vi.1938.

**Additional material examined.** **CHINA:** 1 male (MHPC), Guizhou Province, Xingyi, 800 m, 17.vii.2005, Yang Zaihua; 1 female (MHPC), Guizhou Province, Chishui, 315 m, 28.v.2006, Yang Zaihua. **LAOS:** 1 male (FSMU) Bolikhamsai Prov-



**Figures 26–30.** Male terminalia of *Parastratiosphecomyia freidbergi* Woodley. **26** Genital capsule, dorsal view **27** Gonostylus, anterolateral view **28** Phallic complex, dorsal view **29** Phallic complex, left lateral view **30** Epandrium and postgenital segments.

ince, Ban Nape–Kaew Nua Pass, 18°22.3'N, 105°09.1'E (GPS), 600 ±100 m, 18.iv.–1.v.1998, E. Jendek, O. Sauša. **VIETNAM:** 1 female (NBC), Ninh Binh Province, Cuc Phuong National Park, near centre, ca. 225 m, 29.vi–18.vii.2000, Mai Phu Quy; 1 male, 2 females (USNM), [Ha Tay Province], Mount Ba Vi, 900–1000 m, viii.1940, P.A. de Cooman; 1 male (USNM), same data but 800–1000 m, vii.1941; 1 female

(USNM), Cao Bang Province, Phja-Den environs, 22°32.433'N, 105°52.012'E, 948 m, 1–6.vi.2011, Steven W. Lingafelter, daytime collecting; 1 female (USNM), Cao Bang Province, Phja-Den environs, 22°34.026'N, 105°52.246'E, 987 m, 25.v.–5.vi.2011, Steven W. Lingafelter, at lights.

**Remarks.** The type locality, as stated on the locality label, is “Kuatun, Fukien” which in modern lexicon is Guadun, Fujian Province, in China. This settlement is located in the Wuyi Mountains, west of Wuyishan city. The 2300 m elevation given on the data labels is inaccurate, as the highest point in the Wuyi Mountains is a peak that is about 2150 m, and it is likely that the specimens were collected at a lower elevation than this. The type locality is nearly 1000 km from Sichuan Province in China, so it is a mystery as to why Lindner named this species *P. szechuanensis*.

Leg coloration in this species is somewhat variable, but this may be in part due to preservation and the age of the specimens when captured.

## Acknowledgments

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# Water mites of the genus *Lebertia* Neuman, 1880 (Acari, Hydrachnidia, Lebertiidae) from Turkey, with the description of one new species

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## Abstract

A list of species of the water mite genus *Lebertia* Neuman, 1880 known from Turkey is provided, based on bibliographical data and results from recent field work, mainly in the Southwestern part of the country. We describe one new species, *Lebertia martini* sp. n. and report new 28 locality records from 6 provinces for the three previously known species.

## Keywords

Acari, water mites, new species, *Lebertia*, Turkey

## Introduction

Water mites of the family Lebertiidae reach their maximum diversity in the Holarctic region, but isolated species have been recorded in several parts of South Asia, Africa and South America (Gerecke 2009). The genus *Lebertia* is the most species-rich member of the family. *Lebertia* species are found most frequently, and with the highest diversity, in springs and streams of temperate or boreal regions (Gerecke 2009).

Compared with intrageneric variation in other water mite genera, most *Lebertia* species are highly uniform in the shape of coxae, legs and mouth parts. Characters useful for discrimination of species and subgenera are mainly integument structures, as well as details in setation and shape of legs and palps (Di Sabatino et al. 2010).

The genus *Lebertia* is divided into 5 subgenera: *Eolebertia*, *Mixolebertia*, *Pilolebertia*, *Brentalebertia* and *Lebertia* s. str. (Gerecke 2009). So far, representatives of all subgenera except for *Brentalebertia* and *Eolebertia* have been found in Turkey. The water mite fauna of Turkey includes 240 species in 55 genera and 23 families, with 7 species of *Lebertia* known up to now (Erman et al. 2010, Bursalı et al. 2011). Here we report results of further field work, mostly done in SW Turkey, resulting in the detection of one new species (described below) and new locality records of three *Lebertia* species previously known from other parts of the country.

## Methods

Water mites were collected by hand netting and sorted on the spot from the living material, preserved in Koenike's fluid (50% glycerin, 20% acetic acid, 30% aqua dest.) and dissected for slide mounting in Hoyer's fluid. The composition of the material is given as males/females. All measurements are given in  $\mu\text{m}$ . The following abbreviations are used: Cx-I = first coxae, Cx-I mL = first coxae medial length, Dc-1-4 = dorsocentralia 1-4, H = height, L = length, n = number of specimens examined, P-1 = palp segment 1, W = width, IV-L-5 = fourth leg, fifth segment.

## Results

### Family Lebertiidae Thor, 1900

### Genus *Lebertia* Neuman, 1880

### Subgenus *Lebertia* Neuman, 1880

### *Lebertia (Lebertia) castalia* Viets, 1925

[http://species-id.net/wiki/Lebertia\\_castalia](http://species-id.net/wiki/Lebertia_castalia)

**New records. Antalya Province:** 21.07.2009, 37°03.03'N, 31°36.09'E, 4/4, 665m a.s.l., spring with *Fontinalis* mosses and water cress, İbradı; 09.04.2010, 36°54.84'N, 31°09.82'E, 0/2, 110m a.s.l., dense filamentous green algae, Aksu stream, Serik, collected by P. Gülle.

**Former records from Turkey.** Muş Province (Özkan 1982); Afyon Province (Aşçı et al. 2006–2007); Erzurum Province (Boyacı and Özkan 2007).

**Distribution.** Central, eastern and northern Europe (Gerecke 2009).

***Lebertia (Lebertia) glabra* Thor, 1897**[http://species-id.net/wiki/Lebertia\\_glabra](http://species-id.net/wiki/Lebertia_glabra)

**New records. Burdur Province:** 24.05.2008, 37°24.43'N, 29°48.72'E, 4/5, 1050m a.s.l., small stream feeding pond, İncekiniş, Karamanlı; 18.06.2008, 37°44.48'N, 30°31.16'E, 4/3, 980m a.s.l., stream with sandy bottom, Andık stream; 18.05.2008, 37°35.34'N, 29°54.64'E, 4/3, 1100m a.s.l., spring under agricultural and anthropogenic effect, Güneykent, Uluharman; 23.06.2008, 37°39.00'N, 30°28.48'E, 2/1, 1060m a.s.l., Aksu Spring; 17.7.2008, 37°03.47'N, 29°40.98'E, 7/2, 1180m a.s.l., Kocayayla, Kozağaç; 04.08.2008, 37°45.44'N, 29°59.66'E, 2/6, 1330m a.s.l., small stream with organic pollution (small amount of farm animal feces discharge was observed), Ulupınar; 10.07.2008, 36°59.12'N, 29°29.08'E, 9/3, 1185m a.s.l., small slow flowing stream, Ballık Maşat, Altınyayla; 14.5.2008, 36°57.02'N, 29°23.01'E, 8/2, 1250m a.s.l., Elmaliyurt stream; 09.06.2008, 37°24.04'N, 30°25.05'E, 12/8, 1215m a.s.l., small spring with sandy and gravel bottom, Hasanpaşa, Tefenni; 03.06.2008, 36°59.09'N, 29°23.90'E, 5/8, 1080m a.s.l., small spring, İbecik, Altınyayla, collected by Y. Ö. Boyacı. **Isparta Province:** 16.06.2008, 37°42.56'N, 31°20.16'E, 12/20, 1290m a.s.l., small spring with gravel bottom, Pınargözü, Yenişarbademli; 13.9.2008, 38°19.15'N, 31°12.32'E, 5/8, 1060m a.s.l., spring with gravel bottom with sparse algae and aquatic plants, near trout farm, Yalvaç; 19.08.2008, 37°34.00'N, 30°52.63'E, 6/8, 945m a.s.l., fast flowing stream with clear water, Eğirdir; 22.08.2008, 37°33.23'N, 31°18.80'E, 3/6, 1300m a.s.l., spring, Yaylabeli village, Sütçüler; 21.08.2008, 37°34.00'N, 30°52.63'E, 7/14, 455m a.s.l., fast flowing stream with gravel bottom, Çandır, Sütçüler; 18.07.2008, 17.08.2008, 37°45.82'N, 31°02.00'E, 8/8, 6/8, 1190m a.s.l., fast flowing stream with gravel and sandy bottom, Köprüçay river, Pazarköy, collected by Y. Ö. Boyacı. **Antalya Province:** 18.10.2009, 36°30.52'N, 32°18.16'E, 5/3, 265m a.s.l., helocrene spring, Alanya; 23.07.2009, 36°43.40'N, 32°12.43'E, 4/2, 560m a.s.l., rheocrene spring with stony bottom, Alara River, Gündoğmuş, collected by P. Güllü. **Afyonkarahisar Province:** 24.05.2008, 37°51.81'N, 30°02.34'E, 9/6, 890m a.s.l., small stream with muddy bottom, Başmakçı; 18.06.2008, 38°00.14'N, 30°08.09'E, 1/3, 1125m a.s.l., Pınarlı stream, collected by Y. Ö. Boyacı. **Denizli Province:** 23.08.2008, 36°59.44'N, 29°33.62'E, 8/12, 1205m a.s.l., Gürsu stream, Çameli, collected by Y. Ö. Boyacı. **Konya Province:** 05.07.2009, 37°51.74'N, 31°38.38'E, 11/5, 965m a.s.l., stream with muddy bottom covered by algae, Üstünler, Beşehir, Konya, collected by Y. Ö. Boyacı.

**Former records from Turkey.** Niğde Province (as *L. lineata*, Smit 1995).

**Distribution.** West Palaearctic (Gerecke 2009).

***Lebertia (Lebertia) maculosa* Koenike, 1902**[http://species-id.net/wiki/Lebertia\\_maculosa](http://species-id.net/wiki/Lebertia_maculosa)

**Former records from Turkey.** Rize Province (Pešić et al. 2007).

**Distribution.** Central, western and southeastern Europe (Gerecke 2009).

***Lebertia (Lebertia) schechteli* Thor, 1913**

[http://species-id.net/wiki/Lebertia\\_schechteli](http://species-id.net/wiki/Lebertia_schechteli)

**Former records from Turkey.** Erzurum and Van provinces (as *L. tuberosa*, Özkan 1982); Karaman province (Boyacı 1995); Kayseri province (as *L. tuberosa*, Özkan et al. 1996); Elazığ province (as *L. tuberosa*, Erman and Özkan 2000; as *L. tuberosa*, Erman et al. 2006); Erzurum province (as *L. tuberosa*, Boyacı and Özkan 2007).

**Distribution.** Restricted to higher mountain ranges in western, central and south-eastern Europe (Gerecke 2009). In Turkey, it is found in moderate to high altitudes.

***Lebertia (Lebertia) martini* sp. n.**

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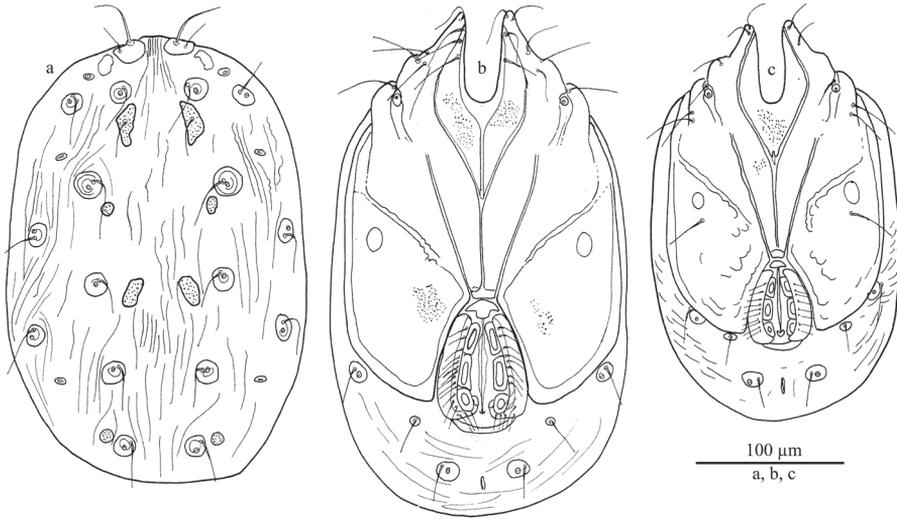
[http://species-id.net/wiki/Lebertia\\_martini](http://species-id.net/wiki/Lebertia_martini)

**Type series.** Holotype male, Darıbükü spring, Sütçüler, Isparta, 17.08.2008, 37°33.66'N, 31°11.84'E, 870m a.s.l., leg. Y. Ö. Boyacı. Paratypes: 4 females, same data as holotype. Paratypes: 2 female, seepage spring feeding the Köprüçay river, Pazarköy, Isparta, 22.06.2008, 37°45.82'N, 31°2.00'E, 1190m a.s.l., leg. Y. Ö. Boyacı; Paratypes: 2 female and 3 male, Gürsu spring, Çameli, Denizli, 23.08.2008, 36°59.44'N, 29°33.62'E, 1500m a.s.l., leg. Y. Ö. Boyacı. Type material dissected and slide mounted in Hoyer's fluid, deposited at the Faculty of Fisheries, Süleyman Demirel University, Isparta, Turkey.

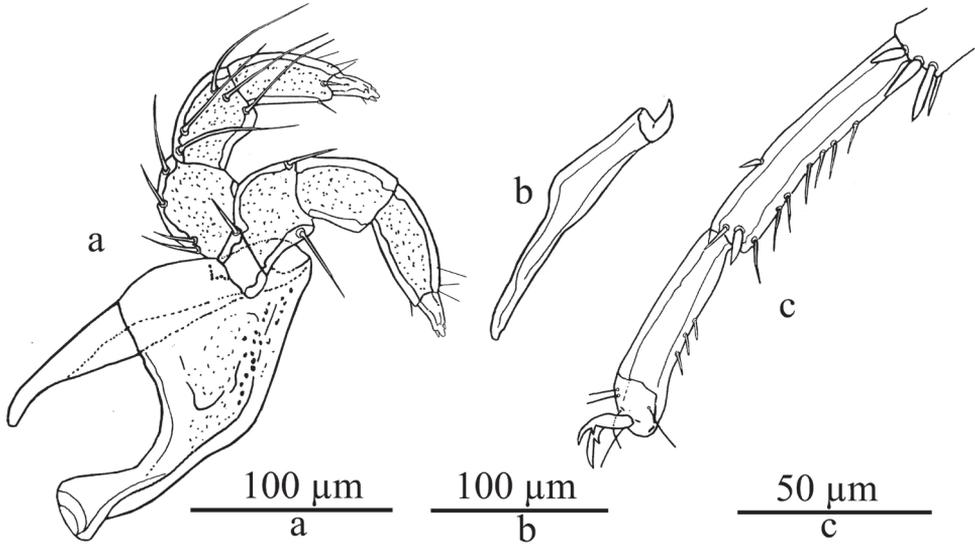
**Diagnosis.** Integument lined. Dorsum with four paired median plates Dc-1-4 (Fig. 1a). Legs without swimming setae. Palp relatively small and stout; P-3 with paired dorsal setae located far proximally, tips of distomedial setae not extending beyond the tip of P-5, dorsodistal seta distanced from distal segment edge (Fig. 2a).

**Description. Both sexes.** Integument dorsally and ventrally lined. Dorsum with four paired median plates (equal in size in the both sexes) Dc-1-4, Dc-1 largest, triangular in shape and bearing the postocular setae, Dc-3 oval, Dc-2 and -4 much smaller and circular (Fig. 1a). Dorsoglandularia relatively large. Leg setation inconspicuous, no swimming setae present; number of ventral setae on IV-L-5-6: 7 and 3 respectively. Excretory pore unsclerotized. Palp relatively small and very stout; P-3 with tips of distal setae not extending beyond tip of P-5, dorsal mediodistal seta distanced from segment edge, paired dorsal setae located close together far proximally near segment base.

Male. (holotype, in parentheses variability of the paratypes given as mean, n = 3): Idiosoma L/W 275 (285)/165 (166) (Fig. 1c), integument dorsally and ventrally lined. Capitular bay 30 (33), Cx-I mL 38 (38), capitulum 165 (171), chelicera 160 (162) (Fig. 2b), claw 14 (17) (Fig. 2c). Palp: total L 195, L/H: P-1, 17/23 (18/23); P-2, 50/47 (49/46); P-3, 53/40 (50/40); P-4, 56/25 (55/25); P-5, 19/8 (19/8). Coxae covering most of the ventral surface; posterior margin of Cx-IV smooth, not including posterior glandularia. Genital flap L 56 (58), distance between genital flap



**Figure 1.** *Lebertia (Lebertia) martini* sp. n., Female: **a** idiosoma, dorsal view **b** idiosoma, ventral view, Male: **c** idiosoma, ventral view.



**Figure 2.** *Lebertia (Lebertia) martini* sp. n., Male: **a** gnathosoma **b** chelicera **c** IV-L-5-6.

and posterior tip of the idiosoma 57 (59) (Fig. 1c). Leg segments L and total L: I-L: 22,27,23,31,39,46 = 188; II-L: 27,33,29,37,46,56 = 228; III-L: 31,37,33,44,57,55 = 257; IV-L: 40,37,45,52,68,56 = 298.

Female. (allotype, in parentheses variability of the paratypes given as mean, n = 8): Idiosoma L/W 340 (344)/200 (203). Capitular bay 33 (34), Cx-I mL 60 (61), capitulum 168 (170), chelicerae 158 (161), claw 17 (17). Palp: total L 197, L/H: P-1, 20 (21)/20 (20); P-2, 55 (55)/53 (53); P-3, 48 (48)/37 (37); P-4, 53 (54)/30 (30); P-5, 21 (22)/9 (9), distance between anterior edge of Cx-I and posterior mar-

gin of Cx-IV 307 (309). Genital flap, L 73 (74), distance between genital flap and posterior tip of the idiosoma 58 (58) (Fig. 1b). Leg segments L and total L: I-L: 23,29,25,35,42,50=204; II-L: 28,35,31,38,49,58=239; III-L: 31,37,35,49,58,57=267; IV-L: 40,38,48,55,70,71=322.

**Discussion.** *Lebertia martini* sp. n. is the first *Lebertia* species having dorsal plates to be recorded from the Palaearctic. Presence of these plates, combined with the very stout palps will allow an easy distinction from all other *Lebertia* species in the region (Gerecke 2009). *Lebertia ventriscutata* Cook, 1974, the only further known species of the genus bearing dorsal plates was described from a spring habitat in North America (Michigan - Cook 1974), is obviously not related to *L. martini*. Among others, it differs strongly in the shape of the palp and the extreme extension of the male coxal field which forms a shield completely surrounding the genital field (Cook 1974).

**Etymology.** The species name is given in honour of the water mite specialist Dr Peter Martin (Kiel).

**Habitat.** Crenobiontic species.

### Subgenus *Pilolebertia* Thor, 1900

#### *Lebertia (Pilolebertia) porosa* Thor, 1900

[http://species-id.net/wiki/Lebertia\\_porosa](http://species-id.net/wiki/Lebertia_porosa)

**New records. Burdur Province:** 20.05.2008, 37°13.17'N, 29°41.86'E, 7/10, 995m a.s.l., small stream with sandy bottom, Beyköy, Gölhisar; 20.09.2009, 37°02.16'N, 29°48.73'E, 8/13, 1400 m a.s.l., small spring with sandy bottom, Güllük, Söğüt, collected by Y. Ö. Boyacı. **Antalya Province:** 01.08.2008, 37°04.72'N, 30°34.77'E, 3/6, 305m a.s.l., reeds and reservoir channel with dense growth of submerged plants (*Ceratophyllum*), Yağca village, Kırkgöz; 29.07.2009, 37°07.37'N, 31°13.05'E, 0/2, 165m a.s.l., main stream bed, Köprüçay Beşkonak village, Manavgat, collected by P. Gülle.

**Former records from Turkey.** Konya Province (Smit 1995); Afyon Province (Aşçı et al. 2006–2007); Erzurum Province (as *L. leioderma*, Özkan 1982; as *L. leioderma*, Boyacı and Özkan 2007); Elazığ Province (as *L. leioderma*, Erman and Özkan 2000; as *L. leioderma*, Erman et al. 2006).

**Distribution.** Holarctic (Gerecke 2009).

#### *Lebertia (Pilolebertia) insignis* Neumann 1880

[http://species-id.net/wiki/Lebertia\\_insignis](http://species-id.net/wiki/Lebertia_insignis)

**Former records from Turkey.** Tokat Province (Bursalı et al. 2011).

**Distribution.** Central-northern Europe (Gerecke 2009).

## Subgenus *Mixolebertia* Thor, 1906

### *Lebertia (Mixolebertia) turcica* Bursalı & Özkan, 2004

[http://species-id.net/wiki/Lebertia\\_turcica](http://species-id.net/wiki/Lebertia_turcica)

**Former records from Turkey.** Tokat Province (Bursalı and Özkan 2004).

**Distribution.** Turkey (Bursalı et al. 2011).

## Conclusion

Examination of *Lebertia* material collected mainly from southwestern Turkey revealed the presence of a very distinct new species, as well as the new provincial records (28 locality from 6 province) for the three previously recorded species: *Lebertia (Lebertia) castalia* Viets, 1925 from Antalya Province; *Lebertia (Pilolebertia) porosa* Thor, 1900 from Antalya, Burdur and Konya provinces; *Lebertia (Lebertia) glabra* Thor, 1897 from Afyonkarahisar, Antalya, Burdur, Denizli, Isparta and Konya provinces. The faunistic investigation of the genus *Lebertia* in Turkey is still restricted to limited geographical regions, leaving big gaps in our knowledge of diversity of this genus in the regions of Marmara, Trakya, Eastern and Western Black Sea coast. Our results suggest that in the course of further investigations extended to cover all regions many more species will be founds.

## Acknowledgements

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# Description and phylogeny of *Namalycastis jaya* sp. n. (Polychaeta, Nereididae, Namanereidinae) from the southwest coast of India

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## Abstract

*Namalycastis jaya* sp. n. (Polychaeta: Nereididae: Namanereidinae) is described from the southern coast of Kerala in southwest India. One important characteristic feature of the species is the lack of notochaetae in all parapodia, a characteristic that it shares with at least two other species, *Namalycastis elobeyensis* Glasby, 1999 and *Namalycastis hawaiiensis* Johnson, 1903. It differs from *N. elobeyensis* by virtue of its smaller antennae, unequal eye size, bilobed acicular neuropodial ligule and multi-incised pygidium rim. Moreover, it differs from *N. hawaiiensis* by having fewer teeth on the serrated blades of the sub-neuroacicular falciger in chaetiger 10, and by possessing finely serrated falcigers in posterior segments. Beyond morphological analyses, molecular phylogenetics was used for the first time for *Namalycastis* to support population monophyly and recognition of the new species. The analysis, using both mitochondrial and nuclear data, corroborated the morphological analysis in suggesting that our specimens represent an as yet undescribed species, *Namalycastis jaya* sp. n., which forms a monophyletic group among the sampled nereidid taxa. Finally, a taxonomic key for *Namalycastis* species recorded from the Indian region is provided.

**Keywords**

Annelida, Polychaeta, Nereididae, *Namalycastis*, 16s rRNA, 18s rRNA, COI, phylogeny, systematics, new species, India

**Introduction**

Namanereidinae (Polychaeta: Nereididae) represents one of the most successful groups of colonizers of brackish waters (Wesenberg Lund 1958). The subfamily is currently recognized to consist of three genera: *Namalycastis* Hartman, 1959, *Namanereis* Chamberlin, 1919, and *Lycastoides* Johnson, 1903. *Namalycastis* is currently the most species-rich genus within Namanereidinae and it is also one of the most successful polychaetes in polluted coastal areas (Glasby 1999). The species are commonly found in littoral or supralittoral areas in association with decaying vegetation and other organic-rich areas on or close to the shore. The genus presents several adaptations to this low-salinity or semi-terrestrial habitat, including modifications to the eye, integument and epidermis (Sadasivan Tampi 1949, Storch and Welsch 1972), modification to the nephridia (Krishnan 1952, Florence Mary 1966), the production of large yolky eggs and an apparent tendency towards hermaphroditism or parthenogenesis (Glasby et al. 1990). Although taxonomic records of *Namalycastis* species from off the coast of the Indian subcontinent are not infrequent (Sinha and Das 1998, Glasby et al. 2003), the boundaries of the geographic distribution of the genus are poorly known. *Namalycastis indica* (Southern, 1921) represents both the easternmost (Chilika Lake, an inlet of the Bay of Bengal) and westernmost (Mumbai, Arabian Sea) records of the genus (Southern 1921, Mandal and Harkantra 2012). In addition, *Namalycastis abiuma* Müller in Grube, 1871 has been recorded as far south in India as the Kayankulam estuaries (Glasby 1999). As no obvious biogeographical barrier exists throughout the coastline of either the Arabian Sea or the Bay of Bengal, it is likely that the genus is more widespread in this area than indicated in the current record (see Glasby 1999).

Morphological variation between species of *Namalycastis* is often minute, presenting a possible problem for taxonomists. This is in part due to their simplified body form – lack of a notopodium and few types of chaetae – compared to other Nereididae. For example, *N. abiuma* was long considered a single, widespread species with a high level of intraspecific morphological variation, attributed to the differences in habitat choice. However, close investigations of the details of the serrations on the falciger blades of the species group revealed that American populations could be divided into at least two separate species, *N. abiuma sensu* Müller in Grube, 1871 and *Namalycastis borealis* Glasby, 1999. Nevertheless, Indo-Pacific populations of *N. abiuma* are still indistinguishable from their American counterparts. Because of the aforementioned, the inclusion of molecular data in association with phylogenetic analyses represents the

first step in the molecular characterization of members of the genus and may assist with understanding the taxonomic boundaries within *Namalycastis*.

Here, we describe a new species of *Namalycastis* from the southwest coast of India on the basis of morphological investigations and corroborate the novelty of the species by phylogenetic analysis using both mitochondrial and nuclear loci. In addition, a morphological key to the different *Namalycastis* species recorded from India is provided.

## Material and methods

In March of 2009 and January of 2010, several polychaete samples were collected from the retting zone (upper intertidal zone characterized by accumulation of rotting coconut husks) of the Kadinamkulam estuary, near Thiruvananthapuram off the southwest coast of India. Specimens were sizeable enough to be collected by eye from rotting organic matter mixed with muddy sediments at the shoreline. The polychaetes associated with retting coconut husk were collected by breaking the coconut husk with hammer and chisel. Identifications were facilitated by previous contributions and morphological keys (e.g., Glasby 1999). Approximately 20–40 segments of the posterior portion (without pygidium) were used for DNA extraction. Samples used for DNA work were fixed in 95% ethanol, whereas those for morphological investigation were relaxed in isotonic  $MgCl_2$ , rapidly submerged in 95% ethanol (for proboscis everting), fixed in 10% formalin and later transferred to 70% ethanol. The fixed specimens then were dissected and mounted in polyvinyl lactophenol on microscope slides for permanent preservation. Dissections were carried out using an Olympus SZ61 stereomicroscope and the drawings were made with the help of an Olympus BX41 camera lucida. Images were captured using an AX10STAR Plus camera.

Total genomic DNA was extracted from the tissue samples following the extraction procedure of Miller et al. (1988) with minor modifications. Partial sequences of 16S ribosomal mtDNA, cytochrome *c* oxidase subunit I (COI) mtDNA and nuclear 18S rDNA were PCR-amplified using the following primers: 16SAR-L (5'-CGC-CTGTTTATCAAAAACAT-3') and 16SBRH (5'-CCGGTCTGAACTCAGAT-CACGT-3') for 16S (Palumbi 1996); FR1d (5' TTCTCCACCAACCACAARGAYATYGG -3') and FR1d\_t1 (5'-CACCTCAGGGTGTCCGAARAAYCARAA-3') for COI (Ivanova et al. 2007); and 18SA (5'-AACCTGGTTGATCCTGC-CAGT -3') and 18SB (5'-TGATCCTTCCGCAGGTTACCT -3') for 18S (Medlin et al. 1988). The PCR used the following protocol: an initial 5 minute denaturation step at 94°C for all samples, followed by 30 seconds denaturation at 94°C (1 minute for 16S and 18S), 30 seconds annealing at 55°C (1 minute at 58°C for 16S and 18S), 2 minutes extension at 72°C (1 minute for 16S and 18S) and a final 5 minute extension step at 72°C for all samples; the program was run

for 30 cycles (COI) or 35 cycles (16S and 18S). All PCR products were checked by gel electrophoresis on a 2% agarose gel and successful amplifications were purified using a PureFast® Genomic DNA purification kit (Helini Biomolecules, Chennai, India) following the instructions given by the manufacturer. Thereafter, cycle sequencing (using the same primers as mentioned above) and ethanol precipitation was carried out, and nucleotide sequencing was performed on an ABI 3500 XL Genetic Analyzer (Applied Biosystems, Foster City, CA).

Nucleotide sequences were deposited at NCBI (accession numbers HQ456363 and JN790065–67 for COI, HM138706 and JX483868–70 for 16S, and HQ157238 and JX483865–67 for 18S) and type specimens were deposited in the collections of the WGRC- ZSI.

### DNA analyses

Sequence reconciliation of forward and reverse sequences was carried out using BioEdit ver. 7.0.5.2 (Hall 1999). The sequences then were aligned using MAFFT (Kato et al. 2002) on the European Bioinformatics Institute website (<http://www.ebi.ac.uk/Tools/msa/mafft/>) applying default settings. A phylogenetic analysis was performed under the criterion of maximum parsimony in TNT (Goloboff et al. 2008). A heuristic search was performed using the New Technology search parameters, employing sectorial searching, with the tree fusing and ratcheting algorithms turned on. Trees were retrieved by a driven search using 100 initial addition sequences and requiring that the minimum length tree be found at least 5 times. All characters were equally weighted and non-additive, and gaps were treated as missing data. The results of the New Technology searches were subsequently resubmitted to TNT for TBR branch swapping. Support values for nodes also were estimated in TNT through standard bootstrap resampling, using 1000 iterations, each subjected to five iterations of ratcheting and three rounds of tree fusing after an initial five rounds of Wagner tree building. The trees were rooted at *Pectinaria koreni* (Malmgren, 1866) following Rousset et al. (2007).

### The following abbreviations are used in the text:

PSU	Practical Salinity Unit
NCBI	National Center for Biotechnology Information
WGRC, ZSI	Western Ghats Regional Centre, Zoological Survey of India.
ICZN	International Code of Zoological Nomenclature

## Systematics

Order Phyllodocida Dales, 1962

Family Nereididae Blainville, 1818

Subfamily Namanereidinae Hartman, 1959

Genus *Namalycastis* Hartman, 1959

*Namalycastis jaya* Magesh, Kvist & Glasby, 2012, sp. n.

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[http://species-id.net/wiki/Namalycastis\\_jaya](http://species-id.net/wiki/Namalycastis_jaya)

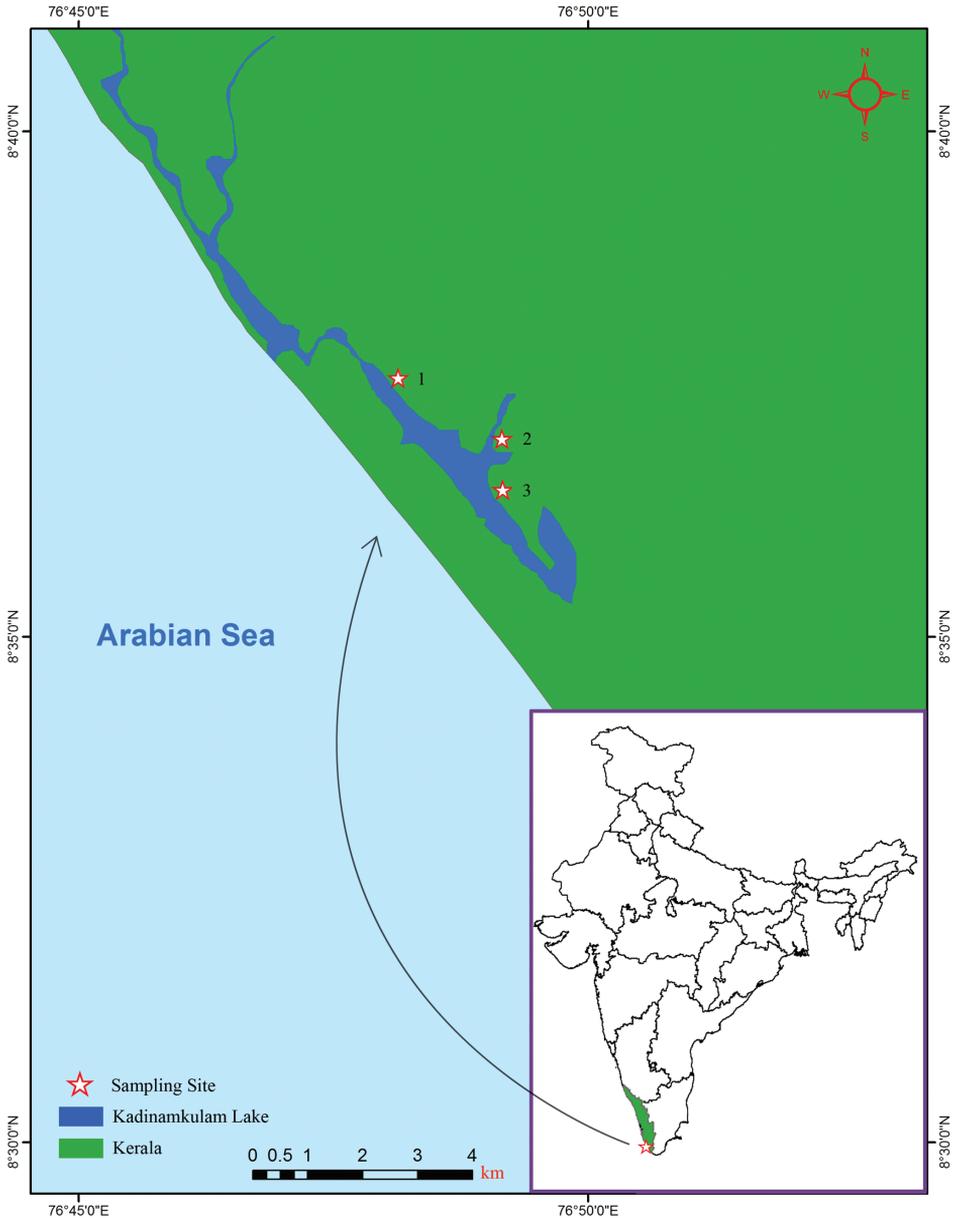
Figures 2a–k, 3a–l

**Type locality.** Murukkumpuzha retting zone, Thiruvananthapuram coast, Kerala, India, 8°36'57.47"N, 76°49'8.914"E (Fig. 1; site 2).

**Type material.** Holotype AQJ1 (ZSI/WGRC/IR/IV 2330), adult specimen collected from muddy sediment in Murukkumpuzha retting zone, 8°36'57.47"N, 76°49'8.914"E (Fig. 1; site 2) by M. Magesh on 31 March, 2009. Paratypes, four specimens: AQJ2–4 (ZSI/WGRC/IR/IV 2331, 2332 and 2337) collected in Kadinamkulam estuary, Thiruvananthapuram coast, Kerala, India, 8°37'33.34"N, 76°48'7.827"E (Fig. 1; Site 1); and AQPE1 (ZSI/WGRC/IR/IV 2191), collected in muddy sediment from Kadinamkulam estuary, Thiruvananthapuram coast, Kerala, India, 8°36'27.21"N, 76°49'9.474"E (Fig. 1; site 3). All paratypes collected by M. Magesh on 21 January, 2010.

**Description.** Holotype with body widest mid-anteriorly, tapering gradually anteriorly and posteriorly. Antennae small, distally subacute, aligned over mid-palps. Brown epidermal pigmentation present anterodorsally and posterodorsally. Prostomium triangular, deeply cleaved anteriorly. Longitudinal groove extending from tip to posterior part of prostomium, slightly indented laterally. Eyes 2 pairs, black, arranged obliquely, posterior pair considerably smaller. Posterodorsal tentacular cirri extending posteriorly to chaetiger 2. Jaws with 8 teeth, 4 subterminal and 4 ensheathed proximally. Acicular neuropodial ligule bilobed, superior lobe larger than inferior lobe. Dorsal cirri increasing in length posteriorly. Typically less than 4 sesquigomph spinigers in neuropodial supra-acicular fascicle in midbody. Notochaetae absent in all parapodia. Heterogomph chaetae with boss not lengthened. Supra-neuroacicular falcigers in chaetiger 10 with finely serrated blades, 9–12 teeth, approximately uniform in length. Sub-neuroacicular falcigers in chaetiger 10 with roughly serrated blades, about 20 teeth. Sub-neuroacicular spinigers in anterior region (up to segment 50) with blades finely serrated. Sub-neuroacicular spinigers in mid and posterior region (from about segment 70) with blades coarsely serrated proximally. Supra-neuroacicular spinigers in mid and posterior region with blades finely serrated. Pygidium with multi-incised rim, black with two lateral anal cirri.

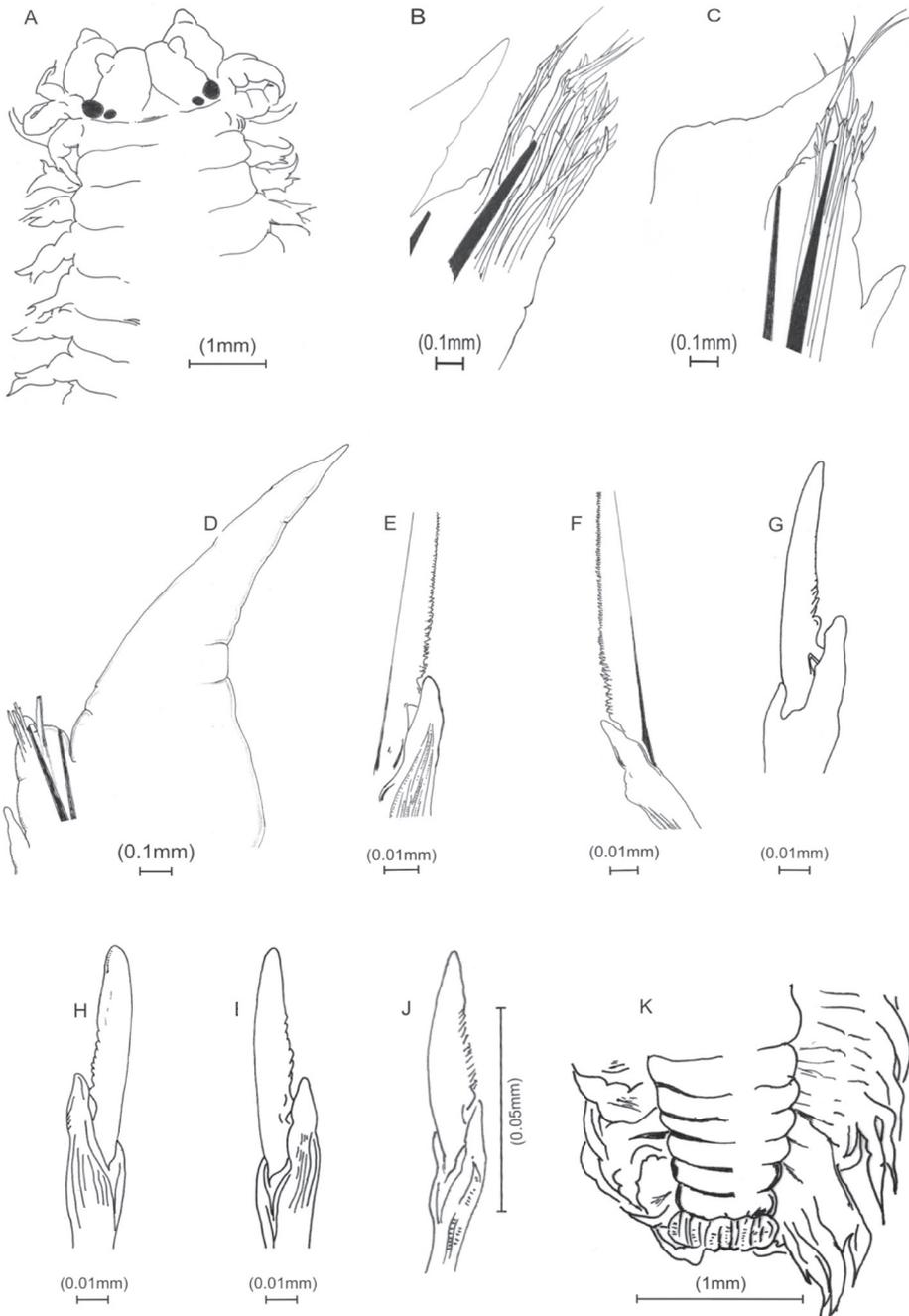
**Etymology.** Named in honour of Dr. Jayalalithaa Jayaram (born 1948), the current Chief Minister of Tamil Nadu State of India, in recognition of her contributions to the field of education (especially for impoverished people) and scientific research. The specific epithet is considered to be a noun in apposition.



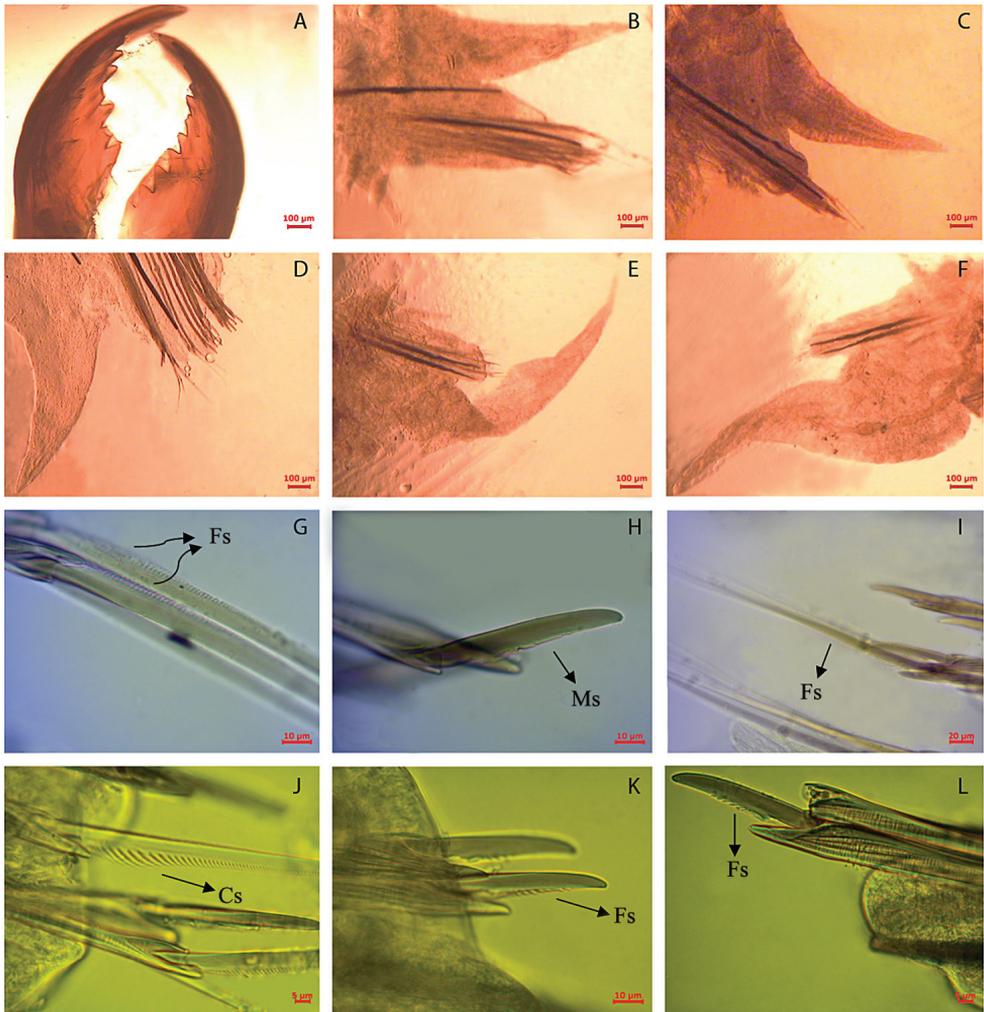
**Figure 1.** Map showing the positions of the collection localities of *Namalycastis jaya* sp. n. in Kerala, India. Site 1, Kadinamkulam estuary (8°37'33.34"N, 76°48'7.827"E); Site 2, Murukkumpuzha retting zone (8°36'57.473"N, 76°49'8.914"E); and Site 3, Kadinamkulam estuary (8°36'27.21"N, 76°49'9.474"E).

**Distribution.** Known only from the Thiruvananthapuram coast of southwest India (but see note below).

**Taxonomic remarks.** *Namalycastis jaya* sp. n. resembles *Namalycastis elobeyensis* Glasby, 1999 and *N. hawaiiensis* Johnson, 1903 by virtue of lacking notochaetae.



**Figure 2.** *Namalycastis jaya* sp. n. Holotype: **a** anterior end, dorsal view **b** anterior parapodium from chaetiger 8 **c** mid-body parapodium from chaetiger 80 **d** posterior parapodium from chaetiger 230 **e** sub-neuroacicular spiniger, chaetiger 10 **f** sub-neuroacicular spiniger, chaetiger 30 **g** sub-neuroacicular falciger, chaetiger 10 **h** sub-neuroacicular falciger, chaetiger 80 **i** supra-neuroacicular falciger, chaetiger 80 **j** supra-neuroacicular falciger, chaetiger 120 **k** pygidium, dorsal view.



**Figure 3.** *Namalycastis jaya* sp. n. Holotype: **a** jaw pieces, ventromedial view **b** anterior parapodium from chaetiger 10 **c** parapodium from chaetiger 50 **d** parapodium from chaetiger 100 **e** posterior parapodium from chaetiger 210 **f** posterior parapodium from chaetiger 230 **g** sub-neuroacicular spiniger, chaetiger 10 **h** sub-neuroacicular falciger, chaetiger 109 **i** supra-neuroacicular spiniger, chaetiger 80 **j** sub-neuroacicular spiniger, chaetiger 210 **k** sub-neuroacicular falciger, chaetiger 210 **l** supra-neuroacicular falciger, chaetiger 20. **Fs** Finely serrated; **Cs** Coarsely serrated; **Ms** Medium serrated.

However, our new species differs from *N. elobeyensis* as the latter has long antenna, equal size eyes, comparatively longer posterodorsal tentacular cirri, subconical acicular neuropodial ligule, tripartite pygidium and no epidermal pigmentation. *Namalycastis jaya* sp. n. also differs from *N. hawaiiensis*, by the latter possessing 35 to 70 teeth on the blades of the sub-neuroacicular falcigers in parapodia of chaetiger 10, mid-posterior falcigers with proximally coarsely serrated blades from chaetiger 120 (chaetiger 30 in smaller specimens) and by the absence of epidermal pigmentation. The lack of no-

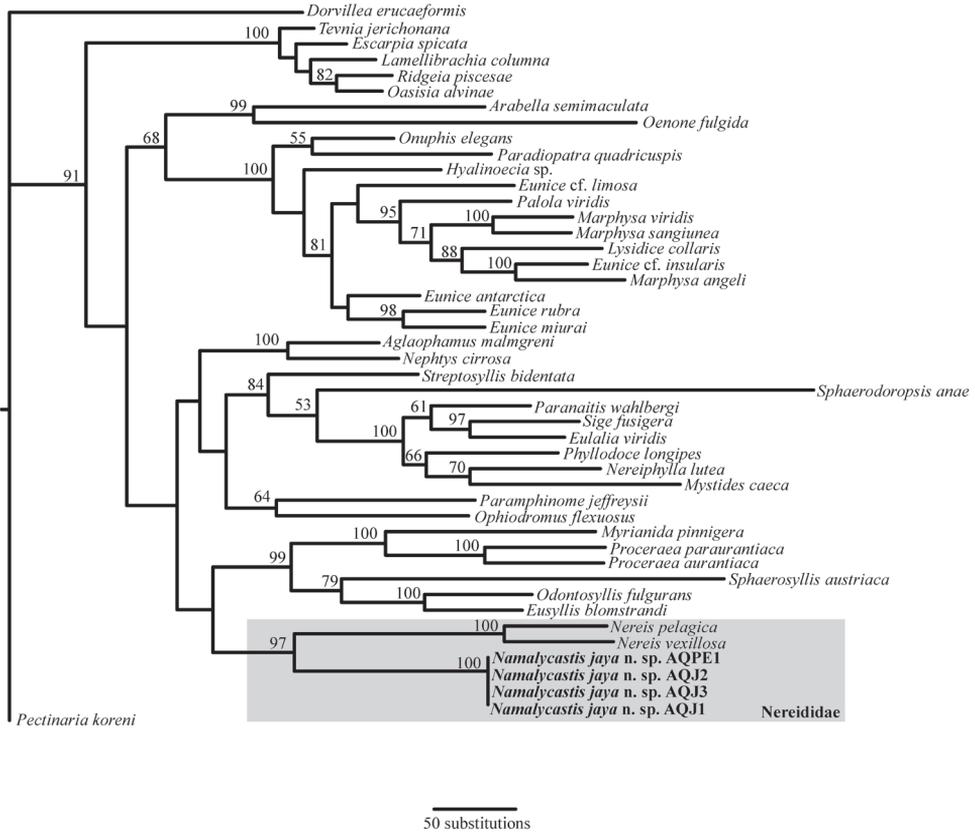
tochaetae sets *Namalycastis jaya* sp. n. apart from other Indian species, including *N. indica* Southern, 1921, the *N. abiuma* species group, *Namalycastis fauveli* Nageswara Rao, 1981 and the recently described species *Namalycastis glasbyi* Fernando and Rajasekaran, 2007. These other species typically have 1–3 notochaetae in at least some parapodia, except those in the anterior-most and posterior-most body. *Namalycastis jaya* sp. n. most closely resembles *N. abiuma*, but differs from the holotype of that species in having very short tentacular cirri (posterodorsal one only extending to chaetiger 2 as compared to chaetiger 5 in *N. abiuma*), in the very short, distally sub-acute antennae (antennae pointed and extending to end of palps in *N. abiuma*) and in lacking notochaetae (present from chaetiger 12 in *N. abiuma*). A key for taxonomic differentiation between species recorded from the Indian region is provided below.

Based on the above comparative account of the features used for identifying the species of the family Nereididae, the present species can be distinguished as a new species by the following combination of characters: (1) smooth and small antennae, (2) absence of notochaetae in all chaetigerous segments, (3) sub and supra-neuroacicular falcigers of parapodia 10 with finely serrated blades, (4) coarsely serrated teeth in sub-neuroacicular spinigers in mid-posterior region, (5) brown pygidium with multi incised rim and two lateral anal cirri, (6) jaws with 8 teeth, and (7) eye capsule protruded above the dorsal alignment of the head. In all of these features, the new species resembles *Namalycastis meraukensis* (var. *zeylanica*), described from Dondra, southern Sri Lanka by de Silva (1961). This taxon was considered to be a junior synonym of the *Namalycastis abiuma* species group by Glasby (1999). However, de Silva's (1961) variety name is not an available name under the ICZN (1999; Article 15.2), and so the name *zeylanica* cannot technically be considered a synonym or elevated to a species to represent the present specimens. The name *Namalycastis jaya* sp. n. is therefore likely attributable to the Dondra population and the species more widely distributed throughout southern India and Sri Lanka. Interestingly, the Dondra specimens also live in the retting zone (C. Glasby, pers. obs. 1987).

**Ecological note.** This species is able to sustain in polluted (sulphide rich and odorous) sediments and is especially associated with decaying materials such as bark and retting coir; the salinity at the collection localities ranged from 5–22 psu.

## Phylogeny

In order to rigorously test the familial placement of our species, the phylogenetic analysis used numerous specimens from various polychaete families as well as the only two members of Nereididae for which data were available for all of COI, 16S and 18S (*Nereis pelagica* Linnaeus, 1758 and *Nereis vexillosa* Grube, 1849). The final molecular matrix contained 3789 aligned sites. The TNT analysis recovered 5 equally parsimonious trees, 8426 steps long and the strict consensus of these (Fig. 4) corroborates the morphological analysis in confirming the novelty of the species. The specimens of *Namalycastis jaya* sp. n. form a monophyletic group among the sampled



**Figure 4.** Strict consensus of five equally parsimonious trees from the TNT analysis (Length: 8426; CI: 0.357; RI: 0.543). Bootstrap support values are shown above the nodes and representatives of the new species are shown in bold font. See text for further discussion.

nereidid taxa. This position is supported by a bootstrap value of 97% and the monophyly of the specimens received maximum support. The details of the remainder of the tree are presented in Fig. 4.

**Discussion**

The monophyletic status of the mostly tropical or subtropical subfamily Namanereidinae has been confirmed by phylogenetic analyses (Fitzhugh 1987, Glasby 1991, 1999), yet the status of the genera within the subfamily have been debated. Hartman (1959) recognized three genera (*Namalycastis*, *Namanereis* and *Lycastoides*) as well as a monotypic fourth group of questionable generic status represented by *Lycastis geayi* Gravier, 1901. The doubt shed on the generic status of this group stems from uncertainty in the number of peristomial tentacles (Hartman 1959)

and Glasby (1999) transferred *L. geayi* to *Namalycastis*, which enjoyed seniority over *Lycastis*. In addition, two monotypic genera within the subfamily, *Cryptonereis* Gibbs, 1971 and *Lycastilla* Solis-Weiss and Luis Espinasa, 1991, have since been synonymized by Glasby (1999). The three current genera in the subfamily share distinct synapomorphic features, including a combination of either reduced notopodia or the absence of dorsal cirrophores, as well as spherical palpostyles and an indistinct separation between neuropodia and notopodia (Glasby 1999). Much like *Namanereis* species, our new species lacks notochaetae in all parapodia but, like other species of *Namalycastis*, it does possess very short, conical antennae and posterior leaf-like dorsal cirri; features that define the genus.

*Namalycastis jaya* sp. n. represents the fifth species of *Namalycastis* recorded from India, the remaining species being the *N. abiuma* species group, *N. indica*, *N. fauveli* and *N. glasbyi*. We note that *N. glasbyi*, which is known only from the type locality, Mumbai, bears a close resemblance to *N. indica* (see Fernando and Rajasekaran 2007) for which verified records are known from the east coast of India, Sri Lanka and Bangladesh (Glasby 1999). Both species share the distinctive elongated dorsal cirri of posterior chaetigers, but completely lack associated molecular data. Together, these five species show a wide distribution across India and, at least the Indian members of the genus, seem to have a particular talent for inhabiting odd, inhospitable and vastly different surroundings. Species of the genus have been recorded from waters ranging dramatically in salinity, from drinkable freshwater to full salinity waters, freshwater container habitats such as plant-leaf axils (Glasby et al. 2003) and in severely contaminated waters such as those subjected to industrial pollution. This tolerance for varying environments may also indicate that the abundance of the genus is richer and its distribution wider than currently recognized.

### Key to the Indian species of genus *Namalycastis* Hartman, 1959

- 1        Articulation of heterogomph chaetae with boss extraordinarily expanded; antennae minute.....*N. fauveli*
- Articulation of heterogomph chaetae with boss not extraordinarily expanded (equal or little longer); antennae extending beyond tip of prostomium ..... 2
- 2        Notochaetae present in all or several parapodia; antennae distally pointed ... 3
- Notochaetae absent in all parapodia; antennae distally sub-acute .....  
.....*Namalycastis jaya* sp. n.
- 3        Anterior and posterior eyes more or less same size ..... 4
- Anterior eyes substantially smaller than posterior ones .....*N. glasbyi*
- 4        Lengthy posterodorsal tentacular cirri reaching back to chaetiger 5–6 and tripartite pygidium.....*N. indica*
- Postero-dorsal tentacular cirri only reaching back to chaetiger 2–5; multi-incised pygidium .....*N. abiuma* species group

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# First record in the Tropical Eastern Pacific of the exotic species *Ficopomatus uschakovi* (Polychaeta, Serpulidae)

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## Abstract

The exotic Indo-West-Pacific species, *Ficopomatus uschakovi* (Polychaeta, Serpulidae) is recorded for the first time in the Tropical Eastern Pacific from two sites in La Encrucijada Biosphere Reserve, Chiapas, a coastal lagoon in the Pacific south of Mexico. The means of dispersal of this serpulid species still remains unclear, as the nearest port (Puerto Chiapas) is 70 km to the south, and there are no port installations or shrimp cultures in the lagoon. The record of this serpulid species, apparently widely distributed in this coastal lagoon, has implications regarding possible effects on the brackish-water ecosystem, since the invasion event very well may have occurred several years ago. It is recommended that an exhaustive study be carried out in the coastal lagoons of Chiapas to evaluate the real distribution and the effects of this invasive species on the ecosystem. A complete description, including photographs and drawings, is provided.

## Resumen

Se registra por primera vez la especie exótica del Indo-Pacífico occidental, *Ficopomatus uschakovi* (Polychaeta, Serpulidae), en el Pacífico oriental tropical, en dos sitios de la reserva de la biosfera La Encrucijada, Chiapas, una laguna costera en el Pacífico sur de México. El medio de dispersión de este serpúlido no es claro, debido a que el puerto más cercano (Puerto Chiapas) está 70 km al sur de la laguna, tampoco hay instalaciones portuarias ni estanques de cultivo de camarón. El registro de esta especie de serpúlido, aparentemente bien distribuida en esta laguna costera, tiene implicaciones con respecto a posibles efectos sobre el ecosistema salobre, sobretodo considerando que el evento de invasión pudo suceder hace ya varios años. Se recomienda realizar un estudio exhaustivo en las lagunas costeras de Chiapas para evaluar la distribución real y los efectos de esta especie invasora en el ecosistema. Se incluye una descripción completa, con fotografías e ilustraciones de la especie.

## Keywords

Annelida, brackish-water, Chiapas, fouling, ecologic impacts, La Encrucijada, México, polychaete taxonomy, systematics

## Introduction

The genus *Ficopomatus* Southern, 1921 includes five species of brackish-water serpulids (ten Hove and Kupriyanova 2009): *Ficopomatus macrodon* Southern, 1921, from India and Sri Lanka (ten Hove and Weerdenburg 1978); *F. enigmaticus* (Fauvel, 1923), recorded from subtropical-temperate waters worldwide (Fauvel 1923, ten Hove and Weerdenburg 1978); *F. miamiensis* (Treadwell, 1934), widely distributed in the Gulf of Mexico and Caribbean (Rioja 1945, ten Hove and Weerdenburg 1978, Bastida-Zavala and Salazar-Vallejo 2000, and see below); *F. uschakovi* (Pillai, 1960), from Indo-Pacific and West Africa (ten Hove and Weerdenburg 1978); and *F. talchapsensis* Pillai, 2008, known only from Taléh Sap, Gulf of Thailand (Pillai 2008). It should be noted that we do not follow Pillai (2008), who reinstated the genus *Neopomatus* for the species *uschakovi* on the single autapomorphy of left and right thoracic membranes joined over the thorax.

On the Pacific Coast of America, no indigenous species of *Ficopomatus* has been described (Bastida-Zavala 2008). However, *F. enigmaticus*, was recorded as an exotic species from San Francisco Bay, California (ten Hove and Weerdenburg 1978, Bastida-Zavala 2008), and, recently, *F. miamiensis* was recorded from Urías lagoon, near Mazatlán, southeast of the Gulf of California, as an exotic species related to shrimp-ponds; however, the introduction could have taken place 20 years ago, when shrimp larvae were imported from Florida (Salgado-Barragán et al. 2004, Tovar-Hernández et al. 2009).

The case of *F. enigmaticus*, a serpulid widely dispersed around the world and with a long historical record of invasions, is a well-known example, because it can have dramatic impacts in invaded habitats building large, reef-like colonies in some coastal lagoons that cause major changes in benthic communities, especially in the Lake of Tunis (ten Hove and van den Hurk 1993) and the Mar Chiquita Lagoon, Argentina (Schwindt et al. 2001, Luppi and Bas 2002, Bazterrica et al. 2012). Rioja (1943) recorded, for the first time, *F. enigmaticus* from Puerto Quequén, south of Mar del Plata, and now the species is widely distributed in the Mar Chiquita Lagoon, forming annular reefs and having several effects on the ecosystem and navigation of fishing boats in this lagoon-system (Schwindt et al. 2001, Luppi and Bas 2002, Schwindt et al. 2004a, b). Borthagaray et al. (2006) analysed the potential impacts of this invasive species in other lagoons of La Plata River, especially of the Uruguay coast.

The effects of *F. miamiensis* in Urías lagoon were considered to be positive in the shrimp-ponds because the population of these serpulids (densities higher than 230,000

ind/m<sup>2</sup>) helps to clean the water and control the suspended particulates. However, the impact of the colonies attached to the mangrove roots is negative, because the serpulid competes with other fouling and filter-feeding invertebrates such as native barnacles, mussels and oysters (Tovar-Hernández et al. 2009).

*Ficopomatus uschakovi* has been recorded from the Gulf of Guinea, West Africa since the 1950's (Hartmann-Schröder 1971). Recently, this species was recorded in north-eastern Brazil (de Assis et al. 2008) and Venezuela (Liñero-Arana and Díaz-Díaz 2012).

## Materials and methods

From 19–24 September, 2011, we visited several sites to collect marine invertebrates in Chiapas, including Puerto Chiapas (or Puerto Madero, as its old name), La Encrucijada Biosphere Reserve, Chocohuital, Boca del Cielo Lagoon, Paredón (Mar Muerto Lagoon) and ending in Oaxaca, in San Dionisio del Mar (Superior Lagoon). Serpulid samples were taken from hard substrates such as rocks, mangrove roots and artificial structures (e.g. piers, submerged buildings, etc.). The preliminary examination of the specimens included only the samples from La Encrucijada Biosphere Reserve because *Ficopomatus* tubes were immediately identified in the field. In the other sites in Chiapas and Oaxaca the typical tubes of *Ficopomatus* were not found. Most specimen lots were deposited in the Colección de Invertebrados Marinos, Universidad del Mar, Puerto Ángel, Oaxaca (UMAR-Poly), other samples were deposited in the collections of El Colegio de la Frontera Sur, Chetumal, Quintana Roo (ECOSUR), and in the Universidad Autónoma de Nuevo León, Monterrey, México (UANL). Topotypical specimens examined came from the Los Angeles County Museum of Natural History, Allan Hancock Foundation, Los Angeles, California, USA (LACM-AHF).

The specimens were fixed with 10% formalin and preserved in 70% alcohol. The line drawings were made using camera lucida, the photographs were taken with a digital camera (Nikon Coolpix). Opercula were generally found to be covered in silt and algae, and were, therefore, cleaned with a fine brush.

Standard measurements and counts were total length, measured from the most distal part of the operculum to the pygidium; thoracic length, from the apron to the base of the collar; thoracic width, measured across the collar region; the number of thoracic chaetigers, the number of radioles in each lobe of the branchial crown; opercular length, from the base of peduncle to the end plate; and opercular diameter, measured across the dorso-ventral axis of the end plate.

The abbreviations used in the text were as follows: OL (opercular length), OD (opercular diameter), THL (thoracic length), THW (thoracic width), TL (total length of the body), n (sample size), r (range of data),  $\mu$  (mean), and  $\pm$  (standard deviation).

## Systematics

**Class Polychaeta Grube, 1850**

**Family Serpulidae Rafinesque, 1815**

**Genus *Ficopomatus* Southern, 1921**

**Type species.** *Ficopomatus macrodon* Southern, 1921 by monotypy.

***Ficopomatus uschakovi* Pillai, 1960**

[http://species-id.net/wiki/Ficopomatus\\_uschakovi](http://species-id.net/wiki/Ficopomatus_uschakovi)

Figs 1A–E, 2A–I

*Neopomatus uschakovi* Pillai, 1960: 28–32, text-figs 10H, 11A–H, 12A–H, plate I, figs 1–2; Pillai 2008: 43–49, Fig 5–6, reinstated the genus *Neopomatus*.

*Neopomatus uschakovi* var. *lingayanensis* Pillai, 1965: 170–172, Fig. 23A–I. Type locality: Lingayan Gulf, Luzon Island, Philippines.

*Neopomatus similis* Pillai, 1960: 32–33, text-figs 12I–M, plate II, fig. 1. Type locality: Negombo Lagoon, Sri Lanka.

*Neopomatus similis* var. *rugosus* Pillai, 1960: 33–35, plate II, fig. 2. Type locality: Negombo Lagoon, Sri Lanka.

*Mercierella enigmatica* (not Fauvel, 1923): Several examples of incorrect use of this name have been studied by ten Hove and Weerdenburg 1978: 109–110.

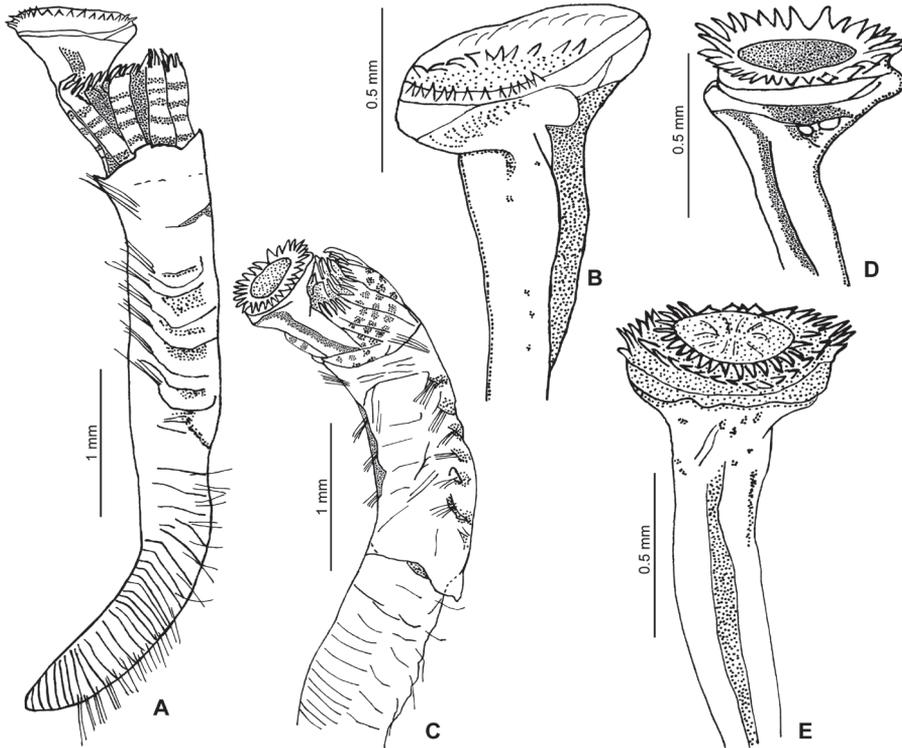
*Ficopomatus uschakovi*: ten Hove and Weerdenburg 1978: 109–112, figs 2a–d, 3a, f–k, 4j–n, r, x–z, jj–mm, yy, 5d, revision; de Assis et al. 2008: 51–58, Fig. 2A–G, Brazil; Liñero-Arana and Díaz-Díaz 2012: 234–237, fig. 1a–j, Venezuela.

**Type locality.** Panadura River estuary, Madu Ganga estuary at Balapitiya and Ratgama Lake at Dodanduwa, Sri Lanka.

**Material examined.** **Chiapas, South Pacific of Mexico.** Five specimens (ECOSUR), three specimens (UANL), more than 100 specimens (UMAR-Poly 112), La Encrucijada Biosphere Reserve, Barra San Juan, 15°09'58"N, 92°51'12"W, 0.5–1 m, submerged mangrove root (*Rhizophora mangle*), September 21, 2011, Rolando Bastida-Zavala et al. leg. Five specimens (ECOSUR), 20 specimens (UMAR-Poly 113), La Encrucijada Biosphere Reserve, Zacapulco, 15°11'37"N, 92°53'22"W, on rotting mangrove root and gastropod shell, 0–0.5 m, September 21, 2011, Rolando Bastida-Zavala et al. leg.

**Topotypical material.** Two specimens (LACM-AHF N10947), Panadura River estuary, Sri Lanka, brackish water (donated by T.G. Pillai), October 9, 1961.

**Description.** Mass occurrence is present (Fig. 2A, D); however, some specimens were solitary (Fig. 2E). The tube colour varies from pink to red in live material, changing to white, brown or orange in preserved material (Fig. 2D–E). They possess several prominent to shallow peristomes (Fig. 2D) or only low growth rings (annulations, Fig. 2E), but lack longitudinal ridges and alveoli.

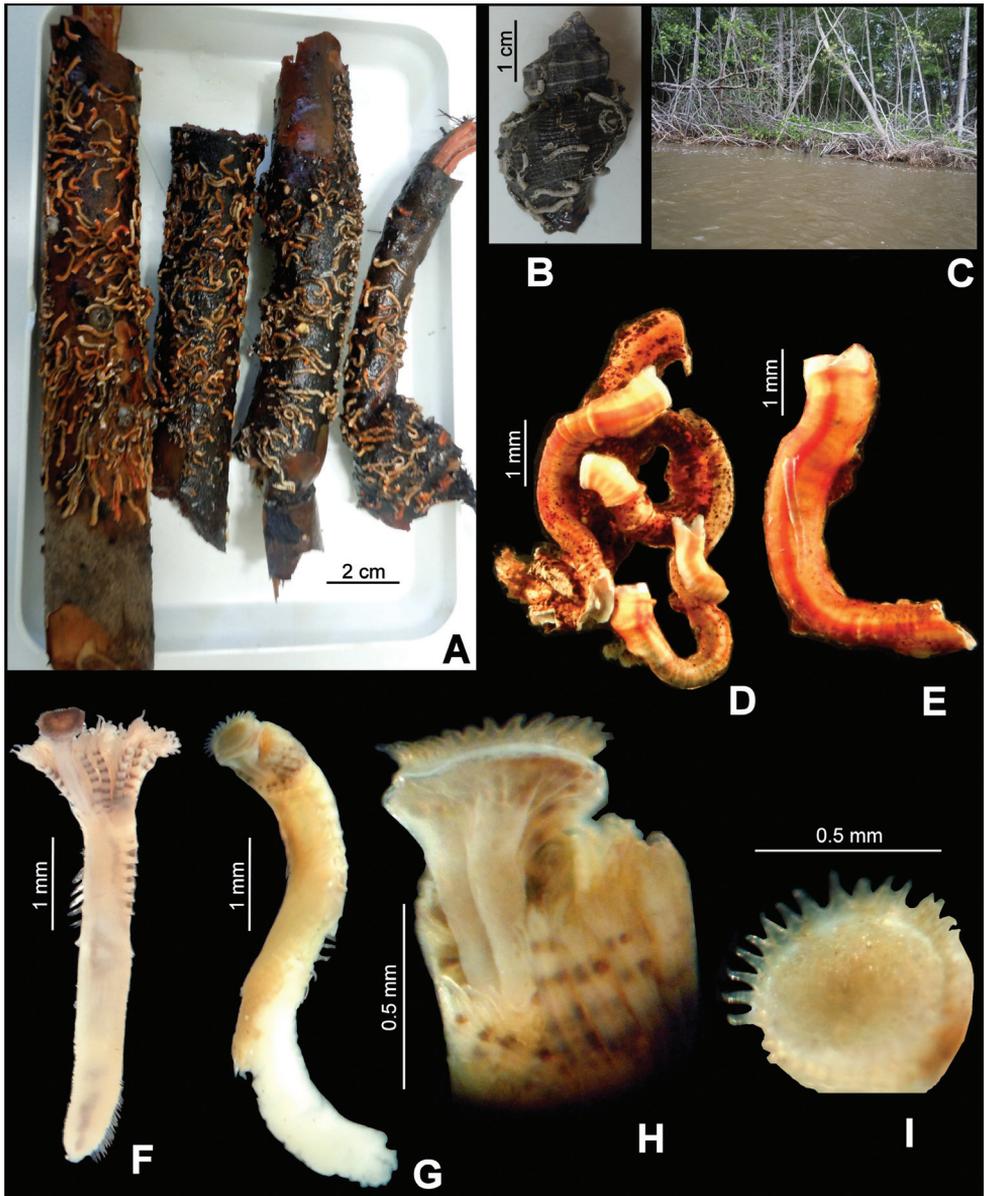


**Figure 1. A–E** *Ficopomatus uschakovi*, from La Encrucijada Biosphere Reserve, UMAR-Poly 112–113. **A, C** complete body in lateral and dorsal views; **B, D–E** opercula, lateral views.

The body is yellow; with 6–7 dark bands on the radioles (preserved material, Figs 1A, 2F). The thorax has five dark bands on the lateral side, between the notopodial bundles, although sometimes these bands are blurred. TL=6.7 mm (n=10, r:4–6.7,  $\mu=5.2 \pm 1$ ); THL=2 mm (n=10, r:1.4–2,  $\mu=1.7 \pm 0.2$ ); THW=0.7 mm (n=10, r:0.5–0.7,  $\mu=0.6 \pm 0.1$ ). The branchial crown has nine radioles (n=10, r:6–9,  $\mu=7.4 \pm 0.8$ ) on the left, and eight on the right (n=10, r:7–9,  $\mu=8 \pm 0.7$ ). Interradiolar membrane absent.

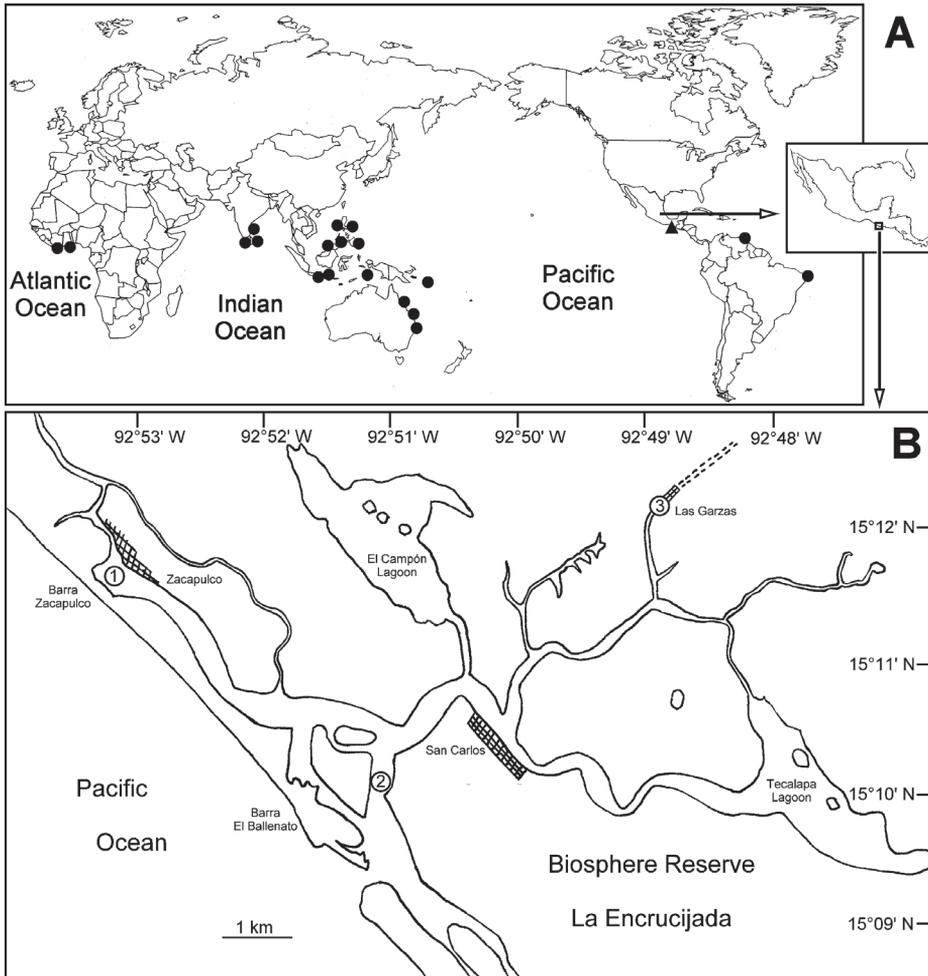
The peduncle is smooth, inserted in the left branchial lobe; lacks a constriction (Fig. 1D–E); OL=1.8 mm (n=9, r:1–1.9,  $\mu=1.6 \pm 0.4$ ). The operculum is spherical to oval in shape, with a slightly convex, flat or slightly concave horny plate (Fig. 1B–E). OD=0.6 mm (n=9, r:0.5–0.8,  $\mu=0.6 \pm 0.1$ ). The end plate bears 1–5 concentric rows of spines (Fig. 2H); the rows are sometimes incomplete or converge with the other rows. The spines are transparent (Fig. 2I).

The collar is entire, with well-developed lobes. The collar chaetae include coarsely serrated chaetae and hooded (capillary) chaetae. The thoracic membranes are fused dorsally, ventrally forming a small apron. The thorax has six chaetigers with hooded (limbate) chaetae, and saw-shaped uncini. A short achaetous region is present between the thorax and abdomen. Most of the abdominal segments possess geniculate chaetae and rasp-shaped uncini.



**Figure 2.** A–I *Ficopomatus uschakovi*, from La Encrucijada Biosphere Reserve, UMAR-Poly 112–113. **A** tubes on mangrove roots **B** tubes on the shell of the gastropod *Thaisella kiosquiformis* **C** mangroves in the collecting site **D** tubes forming small aggregations **E** large, single tube **F** complete specimen in dorsal view **G** complete specimen with mass of sperm attached to the abdomen **H** operculum in dorsal view **I** operculum in aboral view.

**Distribution.** Originally limited to Indo-West Pacific and Gulf of Guinea (ten Hove and Weerdenburg 1978), the species was also recorded in some isolated areas of the tropical and subtropical Western Atlantic: Sossego Creek, Brazil (de Assis et al. 2008), Morocoto Creek, Venezuela (Liñero-Arana and Díaz-Díaz 2012) (Fig. 3A) and



**Figure 3.** **A** World-wide distribution of *Ficopomatus uschakovi*. Triangles denote examined material, circles literature records (data from ten Hove and Weerdenburg 1978) **B** Study area and the localities where specimens of *Ficopomatus uschakovi* were recollected. 1: Zacapulco; 2: Barra San Juan; 3: Las Garzas boat pier (observed by S.I. Salazar-Vallejo et al., pers. comm.).

several sites in the Northern Gulf of Mexico (Bastida-Zavala et al. in prep.). There have been new records in Chiapas coast, Southern Pacific of Mexico (Fig. 3B).

**Ecology.** Depth: Intertidal to 1 m. On mangrove roots (Fig. 2A, C) and on the shell of the gastropod *Thaisella kiosquiformis* (Duclos, 1832) (Fig. 2B); coastal lagoon with salinity ranges approximately 20–35 o/oo. On shells, stones and petiole bases of coconut leaves in the topotypical area (Pillai 1960); on submerged piece of bamboo, with salinity ranges approximately 4–11 o/oo in Brazil records (de Assis et al. 2008).

**Reproductive characters.** Two specimens (TL=4 mm and 4.2 mm) have masses of sperm glued to the abdomen (Fig. 2G); however, eggs have not been found in the specimens studied in detail (n=10).

**Remarks.** The specimens of *F. uschakovi* from Chiapas are slightly bigger than the topotypical specimens (TL=4–4.2 mm, THL=1.1–1.4 mm, THW=0.7–0.8 mm, OL=1.1–1.2, OD=0.3–0.5 mm); however, the rest of the morphological characteristics are very similar.

Apart from the spines of the operculum, the main character that separates *Ficopomatus uschakovi* from *F. enigmaticus* and *F. miamiensis* is the dorsally fused thoracic membranes. This autapomorphy of *F. uschakovi* is regarded to be of generic level by Pillai (2008), but is not followed by us.

In the local community the serpulid tubes on the mangroves are called ‘broca’ (more or less ‘drill’), just like all other sessile invertebrates with calcareous covers, such as barnacles and oysters.

## Discussion

The presence of a species, resembling *F. uschakovi*, from La Encrucijada Biosphere Reserve was initially brought to the attention of the authors two years ago (S.I. Salazar-Vallejo et al. pers. comm. 2009). Previously, no other record of the species existed throughout the Tropical Eastern Pacific. However, the observations in the field show that *F. uschakovi* is widely distributed in La Encrucijada, suggesting that the invasion event of this species may have occurred several years ago.

Although ballast water, sediment transport and fouling are the main means of dispersal of aquatic exotic species (Carlton and Geller 1993, Ruiz et al. 2000, Okolodkov et al. 2007), the means of dispersal of *F. uschakovi* in La Encrucijada Biosphere Reserve still remains unclear, as the nearest port (Puerto Chiapas) is 70 km to the south, and there are no port installations or any shrimp cultures in the lagoon. The local people mentioned that these serpulids had gone unnoticed until now and apparently negative effects to the ecosystem have not been detected, except the fouling of the fishing boats, which require frequent cleaning.

Mass occurrence of *F. uschakovi* was observed (Fig. 2A), however, not to the extent of the reef-like structures, formed by *F. enigmaticus* in Argentina (Schwindt et al. 2004a, b) and by *F. miamiensis* in Mazatlán (Tovar-Hernández et al. 2009). However, similar impacts as caused by the latter species may be expected for *F. uschakovi*. Therefore, it is necessary to conduct detailed monitoring of *F. uschakovi* in the sites that have been invaded. It is also recommend that an exhaustive study in the coastal lagoons of Chiapas be conducted to evaluate the real distribution and the impact generated by *F. uschakovi*.

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# Orientisargidae fam. n., a new Jurassic family of Archisargoidea (Diptera, Brachycera), with review of Archisargidae from China

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## Abstract

A pair of fly impressions is described as a new species of a new genus, *Orientisargus illecebrosus* **gen. et sp. n.**, referred to a new family Orientisargidae **fam. n.** within Archisargoidea of Brachycera, Diptera. The systematic position of Orientisargidae is discussed. *Daohugosargus* **gen. n.** is proposed for *Sharasargus eximius* KY Zhang et al., 2008. Uranorhagionidae is a junior synonym for Archisargidae. Meanwhile, Mostovskisarginae is a junior synonym for Uranorhagionidae. *Mostovskisargus* JF Zhang, 2010 and *Strenorhagio* KY Zhang et al., 2010 are synonymized with *Uranorhagio* KY Zhang et al., 2010. *Uranorhagio* includes three species: *Uranorhagio asymmetricus* (KY Zhang et al., 2010), **comb. n.**, *U. daohugouensis* KY Zhang et al., 2010 and *U. deviatius* (KY Zhang et al., 2010), **comb. n.** *Strenorhagio grimaldi* KY Zhang et al., 2010 is synonymous with *U. deviatius*. *Mostovskisargus portentosus* JF Zhang, 2010, *M. signatus* JF Zhang, 2010 and *Strenorhagio conjugovenius* KY Zhang et al., 2010 are synonymous with *U. asymmetricus*. *Brevisolva* KY Zhang et al., 2010 is a junior synonym for *Mesosolva* Hong, 1983. A new specific name, *Mesosolva zhangae* **nom. n.**, is proposed for *Brevisolva daohugouensis* KY Zhang et al., 2010. *Mesosolva jurassica* KY Zhang et al., 2010 should be synonymized under *M. sinensis* KY Zhang et al., 2010. *Sinallomyia* **nom. n.** is proposed for *Allomyia* Ren, 1998. The systematic positions for *Helempis eucalla* Ren, 1998, *H. yixianensis* Ren, 1998, *Pauromyia oresbia* Ren, 1998 and *Sinallomyia ruderalis* (Ren, 1998) are reassessed. These taxa belong to Archisargidae rather than to Tabanidae, Rhagionidae and Protempididae, respectively.

## Keywords

Diptera, Orientisargidae fam. n., *Orientisargus illecebrosus* gen. et sp. n., Archisargidae, *Daohugosargus* gen. n., Uranorhagionidae, Jurassic and Early Cretaceous, China

## Introduction

The superfamily Archisargoidea comprises three families: Archisargidae, Kovalevisargidae and Eremochaetidae. The Archocyrtidae is probably the fourth family of archisargoids (Mostovski 1997). It is interesting that Archisargidae and Kovalevisargidae constitute one sister group; whereas Eremochaetidae and Archocyrtidae probably form another sister group. All these families synchronously appeared in the Callovian–Oxfordian from the Karabastau Formation at the Karatau-Mikhailovka locality in the Karatau Mountain Ridge, Chimkent Region, South Kazakhstan Province, Kazakhstan. To date, however, only the representatives of archisargids and eremochaetids are known to extend into the Early Cretaceous.

Lately, thousands of brachycerans have been discovered from the “Daohugou Formation” in the vicinity of Daohugou, Ningcheng, Chifeng, Inner Mongolia (JF Zhang and HC Zhang 2003; JF Zhang 2010a, 2010b, 2010c, 2011a, 2011b, 2012a, 2012b, in press; JF Zhang and Li 2012; KY Zhang et al. 2006, 2007a, 2007b, 2008a, 2008b, 2008c, 2008d, 2009, 2010a, 2010b) and the Yixian Formation in the vicinity of Huangbanjigou, Shangyuan, Beipiao, Liaoning, China (Ren et al. 1995; Ren 1998; Huang and Lin 2006). It is interesting that the members of almost all the archisargid and kovalevisargid genera recorded from the Karabastau Formation were also recovered from the “Daohugou Formation”. Meanwhile, on the basis of review of brachycerans from the Yixian Formation, it is clear that some relics of archisargid genera and species did also occur in the Early Cretaceous (see Discussion below).

A new family, Orientisargidae fam. n., composed of a new genus and species, *Orientisargus illecebrosus* gen et sp. n., is described here. Another new genus, *Daohugosargus* gen. n., is proposed for the known species *Sharasargus eximius* KY Zhang et al., 2008. *Daohugosargus eximius* (KY Zhang et al., 2008), comb. n. has a characteristic wing venation, which differs sharply from all the known representatives of archisargids, and may be temporarily assigned to the subfamily Uranorhagioninae (stat. n.) within Archisargidae. The systematic position for Uranorhagionidae is reassessed. It is a junior synonym for Archisargidae, and may be degraded as a subfamily within Archisargidae. Mostovskisarginae is a junior synonym for Uranorhagionidae. Meanwhile, *Mostovskisargus* JF Zhang, 2010 and *Strenorhagio* KY Zhang et al., 2010 can be synonymized with *Uranorhagio* KY Zhang et al., 2010. Two species, *Strenorhagio deviatus* KY Zhang et al., 2010 and *S. grimaldi* KY Zhang et al., 2010, can be united into one species: *Uranorhagio deviatus* (KY Zhang et al., 2010), comb. n. *Mostovskisargus portentosus* JF Zhang, 2010, *M. signatus* JF Zhang, 2010 and *Strenorhagio conjugovenius* KY Zhang et al., 2010 are synonyms for *U. asymmetricus* (KY Zhang et al. 2010), comb. n. The species of *Mesosolva* and related taxa recently described from the “Daohugou Formation” are reassessed: *Brevisolva* KY

Zhang et al., 2010 is a junior synonym for *Mesosolva* Hong, 1983. A new specific name, *Mesosolva zhangae* nom. n., is proposed for the *Brevisolva daohugouensis* KY Zhang et al., 2010. *Mesosolva jurassica* KY Zhang et al., 2010 should be synonymized under *M. sinensis* KY Zhang et al., 2010. A new generic name, *Sinallomyia* nom. n., is proposed instead of *Allomyia* Ren, 1998 which is a junior homonym for *Allomyia* Banks, 1916 (a genus of Trichoptera). The Early Cretaceous *Helempis eucalla* Ren, 1998, *H. yixianensis* Ren, 1998, *Pauromyia oresbia* Ren, 1998 and *Sinallomyia ruderalis* (Ren, 1998) from the Yixian Formation previously placed, respectively, in the Tabanidae, Rhagionidae and Protempididae should be transferred to the Archisarginae of Archisargidae.

## Material and methods

Specimen descriptions, photographs, and drawings were obtained without the application of glycerol to the surface of the specimens. The specimens collected by the author in field were examined under a stereomicroscope (Wild Heerbrugg) and illustrated with the aid of a drawing tube attached to it, re-adjusted using image-editing software (Adobe Photoshop CS). The digital photographs were taken using stereomicroscope (AXioCamHR3).

Wing venation terminology here follows Wootton and Ennos (1989), and Shcherbakov et al. (1995). The cell traditionally named the anal cell is, in fact, considered to be the cubital cell herein. The specimens are deposited in the Nanjing Institute of Geology and Palaeontology (NIGP), Chinese Academy of Sciences.

## Systematics

### Superfamily Archisargoidea Rohdendorf, 1962

#### Family Orientisargidae fam. n.

urn:lsid:zoobank.org:act:6E5DC307-FFD3-48A6-895E-12047C8A9001

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

**Type genus.** *Orientisargus* gen. n.

**Included genus.** The type genus only.

**Diagnosis.** Large sized (more than 12 mm) flies. Legs and abdomen slender, strongly pubescent but devoid of bristles; antennal pedicel longest, first flagellomere neither segmented nor arista or style on its tip; wing narrow and long, subpetiolate, alula absent; venation not costalized; R pectinate; C running around entire wing margin although thinned beyond wing tip; C, Sc, R and CuA strong; Sc, R1 and R2+3 long; R4+5 simple (not bifurcated); origin of Rs proximal, nearly at level of M fork; discoidal cell slightly shifted distally; crossvein m-cu absent; M3+4 stem strongly flexed, and touching CuA; cell m3 closed; hind legs stout and long, tibial spurs well developed, empodium wanting; female cerci foliaceous.

**Remarks.** This new family demonstrates similar body structures and wing venation to the family Archisargidae Rohdendorf, 1962 based on the following characters: large sized flies with hind legs and abdomen stout and long, body strongly pubescent but devoid of bristles; wing narrow and long, subpetiolate, alula absent; venation: C running around wing margin although thinned beyond wing tip; long and strong Sc and R1 (R1 more than four-fifths of wing length, and clearly stouter than M); and the position of r-m, which meets R4+5 and fore margin of d, respectively; as well as the position of discoidal cell, which is more or less shifted distally. However, from all known representatives of Archisargidae it differs by the simple R4+5, which is not bifurcated, the origin of Rs which is clearly proximal, the strongly flexed M3+4 stem, of which bM3+4 section becomes short, crossvein-like, and touches CuA instead of m-cu; Furthermore, considering the characteristic features that R4+5 is simple, R furcated pectinately and the origin of Rs is proximal, *Orientisargidae* fam. n. is similar to the family *Kovalevisargidae* Mostovski, 1997, the sister group of Archisargidae within Archisargoidea. It is distinct from all the kovalevisargids in having longer Sc, R1 and R2+3, the closed cell m3, and the absence of m-cu. It is interesting that the long pedicel, the absence of arista or style on the tip of antenna, the absence of empodium may be the unique features of *Orientisargidae* and are found neither in Archisargidae nor in *Kovalevisargidae*. It is also interesting that the new family has a pair of foliaceous cerci on the female terminalia, which is only present in *Uranorhagioninae* (=Mostovskisarginae) within Archisargidae (JF Zhang, 2010a).

As for m-cu is concerned, an alternative explanation is possible that a very short, but thick, rudimentary m-cu connecting CuA and flex point of M3+4 is present (see Figure 1F, G). In such case, however, it becomes too short to measure.

### **Genus *Orientisargus* gen. n.**

urn:lsid:zoobank.org:act:670D9E14-08A2-4352-9297-28137CE511F7

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

**Type species.** *Orientisargus illecebrosus* sp. n.

**Included species.** The type species only.

**Derivation of name.** Latin, *orient-*, oriental, alluding to the origin of the fossils, and *sargus*, a common ending in archisargid genera (the masculine gender).

**Diagnosis.** First antennal flagellomere conical. R2+3 arched medially, ending in C before wing tip, and far from R1 end. R4+5 ending beyond wing tip. Rs stem and bR4+5 short. Origin of Rs nearly at level of d base. Rs fork shifted distally of M fork. Crossvein r-m meeting R4+5 and M1+2, near to d base. Four medial veins present. Cells d and m3 narrow and long, the latter cell with long petiole. Section bM3+4 shorter than r-m. CuA and CuP subparallel, and cu cell (traditionally anal cell) wide open.

**Remarks.** Usually, the generic diagnosis is covered by the familial diagnosis when the family comprises only one genus. Nevertheless, the familial diagnosis can be well defined based on the characteristics of its sister groups Archisargidae and *Kovalevisar-*

gidae. In such case, a generic diagnosis is temporarily proposed but need to be revised when another new genus (or genera) within the new family has (have) been discovered.

***Orientisargus illecebrosus* sp. n.**

urn:lsid:zoobank.org:act:08E30A96-3B6C-4705-B7BC-26CBF0A791A8

[http://species-id.net/wiki/Orientisargus\\_illecebrosus](http://species-id.net/wiki/Orientisargus_illecebrosus)

Figures 1–3

**Derivation of name.** Latin, *illecebrosus*, enchanting, alluding to the special wing venation.

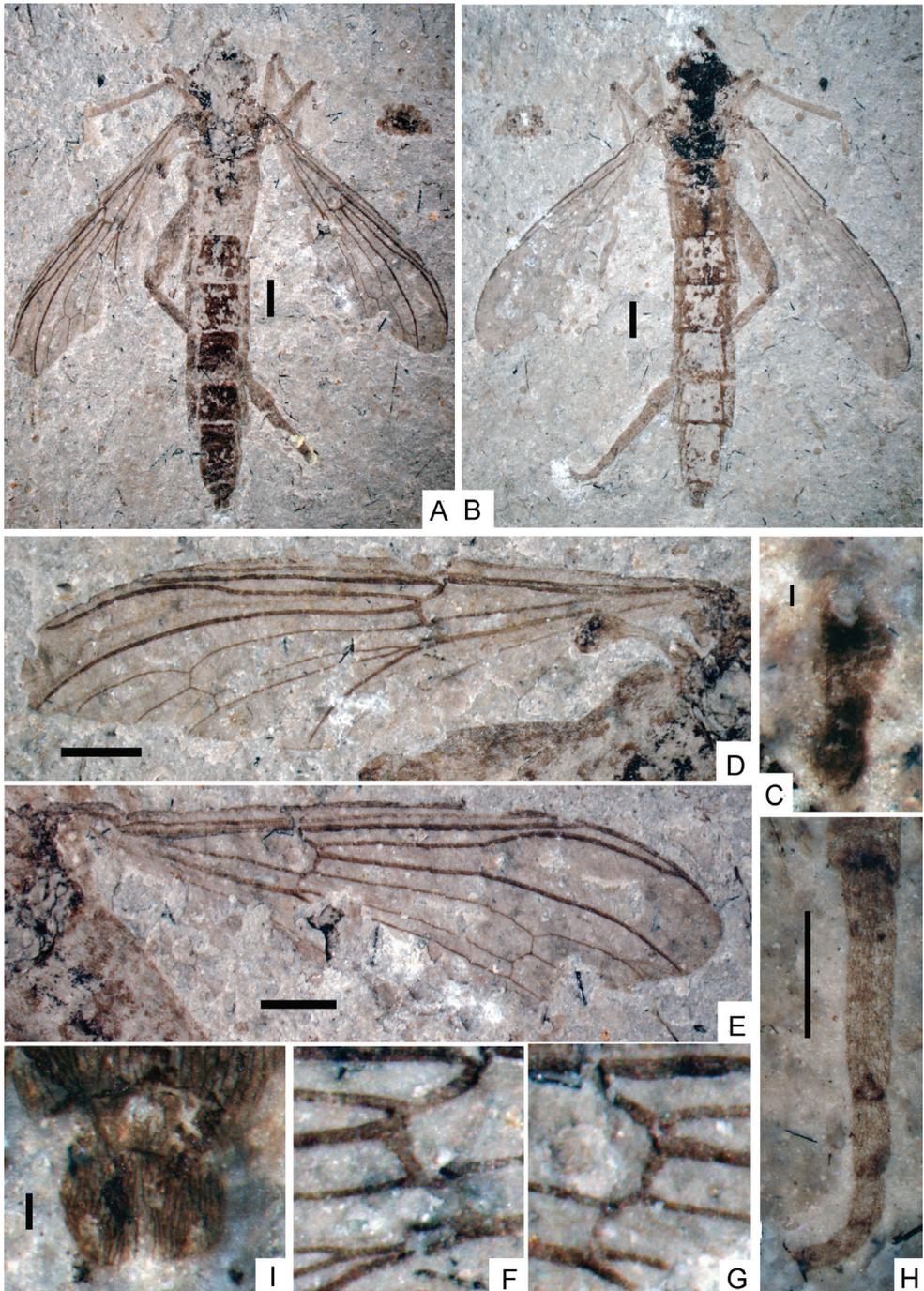
**Holotype:** NIGP DHG901a, NIGP DHG901b, part and counterpart, a pair of nearly complete female archisargoid flies, is held in the Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences.

**Type area and horizon.** “Daohugou Formation”, in the vicinity of Daohugou, Ningcheng, Inner Mongolia, China (uppermost Middle Jurassic – lowermost Upper Jurassic).

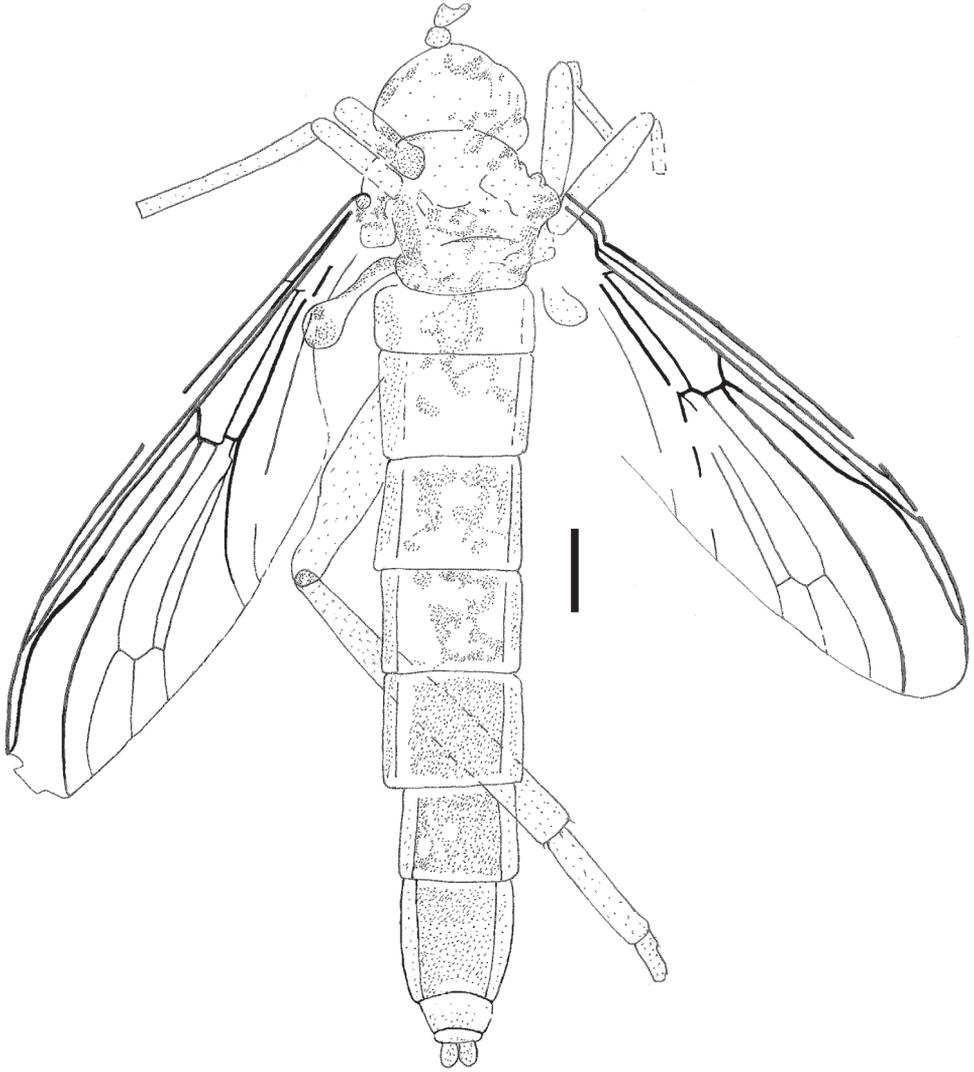
**Repository.** The Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences.

**Description.** Female insect relatively slender and long. Head and thorax dark brown, otherwise yellowish brown. Head large, semiglobose. Antenna stout, scape ovate, pedicel trapeziform, apically wider than basally, flagellomere short and stout with rounded tip, slightly wider than long. Thorax subovate, clearly longer and wider than head. Wing 3.8 times longer than wide, all veins are markedly thickened except M and CuP, which become moderately thin. Sc nearly four-fifths wing length. R1 straight, more than four-fifths wing length. Origin of Rs slightly basal to midpoint of wing or M fork. Rs stem slightly longer than r-m, and less than one-tenth R2+3 length. Basal section of R2+3 straight, distal section clearly arched forward, ending near to wing tip. Rs fork a little distad to M fork. Section bR4+5 very short, dR4+5 arched, and nearly as long as R2+3. Crossvein r-m dividing anterior margin of discoidal cell as 1:21. Discoidal cell about one-third wing length, and 11 times longer than wide. M1 slightly arched forward, and more than one half diacoidal cell length. M2 straight. Section bM2 some as long as m-m. Section bM3+4 as long as bM1+2, and about one half dM3+4 length. Cell m3 rather narrow and long, some 10 times longer than wide. Section dM3 short, about one half m-m length, and nearly perpendicular to M4. Petiole of cell m3 straight, some one-third cell m3 length. Halter relatively short and stout, club subovate, some one-third halter length. Abdomen cylindrical, more than three times longer than head and thorax combined. Hind leg stout and long. Femur clavate, a little shorter, but stouter, than tibia. Tibial spurs slender and long, nearly one-third basitarsus length. Ratio of tarsomeres 1:0.43:0.28:0.11:0.17, basitarsus nearly as long as remainder tarsomeres combined. Claws small, slender. Female cerci small, longer than ninth tergite.

**Dimensions.** Length of body 12.2 mm; head, 1.0 mm; thorax, 2.0 mm; abdomen, 9.2 mm. Length of wing, 8.4 mm; width of wing, 2.2 mm. Length of femur of hind leg, c. 4.0 mm; tibia, 4.4 mm; tarsus, 3.2 mm.



**Figure 1.** *Orientisargus illecebrosus* gen et sp. n., NIGP DHG901a, NIGP DHG901b, part and counterpart, holotype, photographs, female, dorsal view. **A B** body **C** antenna **D** left wing **E** right wing **F** part enlarged of left wing **G** part enlarged of right wing **H** tarsus of hind leg **I** abdominal apex of female. Scale bars represent 1 mm except for C and I for which scale bars represent 0.1 mm.



**Figure 2.** *Orientisargus illecebrosus* gen et sp. n., body, line drawing of holotype NIGP DHG901a. Scale bars represent 1 mm.

**Family Archisargidae Rohdendorf, 1962**

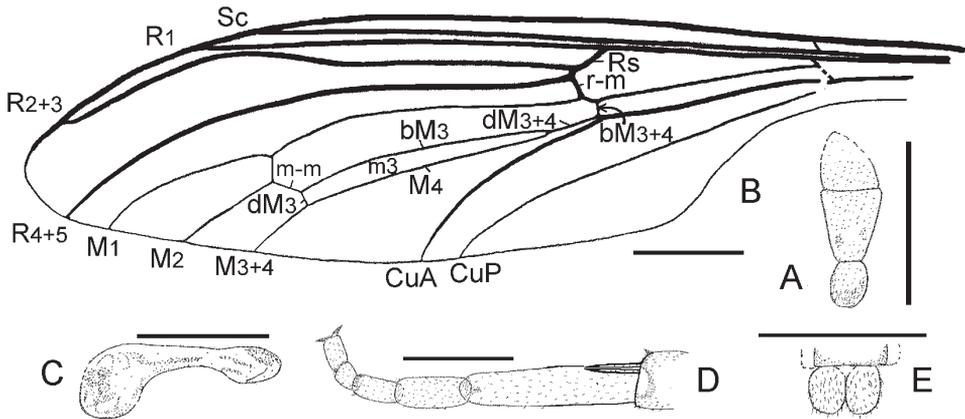
<http://species-id.net/wiki/Archisargidae>

Uranorhagionidae KY Zhang, Yang et Ren, 2010, p. 564, syn. n.

Origoasilidae KY Zhang, Yang et Ren, 2011, p. 995, syn. n.

**Type genus.** *Archisargus* Rohdendorf, 1938

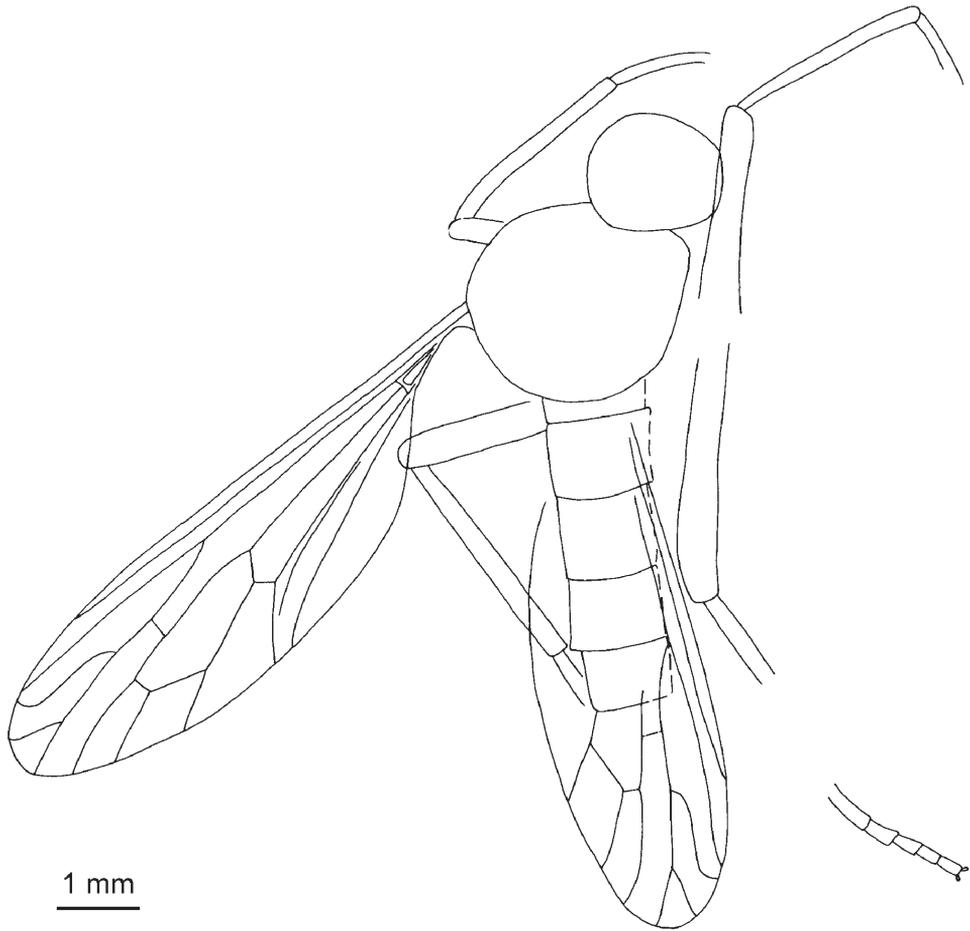
**Included subfamilies.** Archisarginae Rohdendorf, 1962 and Uranorhagioninae KY Zhang, Yang et Ren, 2010, stat. n. (=Mostovskisarginae JF Zhang, 2010, syn. n.).



**Figure 3.** *Orientisargus illecebrosus* gen et sp. n., line drawings, **A** antenna of holotype NIGP DHG901b **B** left wing of holotype NIGP DHG901a (vein sections bM1+2, bM3+4 and dM3+4 reconverted based on right wing) **C** halter of holotype of NIGP DHG901a **D** tarsus of hind leg of holotype NIGP DHG901b **E** female cerci of holotype NIGP DHG901a. Scale bars represent 1 mm.

**Redefinition.** Moderate- to large-sized flies. Body robust but usually narrow and long, strongly pubescent but devoid of bristles; first flagellomere of antenna unsegmented, arista well developed at tip of first flagellomere; hind legs stout and long, femora clavate; tibial spurs and pulvilliform empodium well developed; wing narrow and long, subpetiolate, alula absent; all longitudinal veins well developed, ending at wing margin; C running around entire wing margin although thinned near to, or beyond, wing tip, C and R strong, Sc and R1 long, R4+5 bifurcated, R2+3 usually straight and long but in some specific members R2+3 short and significantly curved [see Figure 4, *Daohugosargus eximius* (KY Zhang et al., 2008) comb. n., originally *Sharasargus eximius* KY Zhang et al., 2008], in most representatives crossvein r-m meeting R4+5 distad to Rs fork but in some specific members far basad to Rs fork (see Figure 4, *Daohugosargus eximius*), origin of Rs usually basad to, but in some specific members distad to, d base (see Figure 4, *Daohugosargus eximius*), discoidal cell shifted distally of wing midpoint.

**Remarks.** Rohdendorf (1962) defined the family Archisargidae based on a single poorly preserved wing from the Callovian–Oxfordian Karabastau Formation. Kovalev (1981) argued that this family was described from very poor material and thus nothing definite can be said about its systematic position. However, the type genus *Archisargus* Rohdendorf, 1938, the only representative of the Archisargidae, clearly has little in common with the Jurassic Rhagionidae: it is a large fly with a long (16 mm) narrow wing. Mostovski (1996a, 1996b) described many new species referred, respectively, to some new genera or the known genera and assigned these to Archisargidae. Immediately after these, he re-described the type species of type genus based on the holotype; and a redefinition of the Archisargidae was proposed: wing venation not, or slightly, costalized; C running around entire wing margin although thinned beyond wing tip or R4 end; R1 long; R4+5 bifurcated; crossvein r-m meeting R4+5 distad to Rs fork; base of discoidal cell distad to origin of Rs from R; M4, if present, connecting with discoidal cell (Mostovski 1997).



**Figure 4.** *Daobugosargus eximius* (KY Zhang, Yang et Ren, 2008) comb. n. (originally *Sharasargus eximius* KY Zhang, Yang et Ren, 2008; after KY Zhang et al. 2008).

Recently, numerous well preserved archisargid flies have been recovered from the Daohugou biota, China (JF Zhang and HC Zhang 2003; JF Zhang 2010a, 2012b; KY Zhang et al., 2007a, 2007b, 2008a, 2009, 2010a, 2010b). The familial diagnosis may be further supplemented based on information derived from these new results.

### **Subfamily Archisarginae Rohdendorf, 1962**

**Type genus:** *Archisargus* Rohdendorf, 1938

**Included genera.** *Archirhagio* Rohdendorf, 1938, *Archisargus* Rohdendorf, 1938, *Calosargus* Mostovski, 1997, *Flagellisargus* JF Zhang, 2012, *Mesosolva* Hong, 1983 (= *Prosolva* Hong, 1983; *Brevisolva* KY Zhang et al., 2010, syn. n.), *Origoasilus* KY Zhang et al., 2011, *Ovisargus* Mostovski, 1996 (= *Helempis* Ren, 1998, syn. n.),

*Parvisargus* Mostovski, 1996, *Sharasargus* Mostovski, 1996 (= *Pauromyia* Ren, 1998, syn. n.), *Sinallomyia* nom. n. (pro n *Allomyia* Ren, 1998).

**Diagnosis.** R1 rather long (four-fifths or more of wing length). R2+3 relatively straight. Crossvein r-m meeting R4+5 distad to Rs fork. Female cerci segmented, not foliaceous.

### **Subfamily Uranorhagioninae KY Zhang, Yang & Ren, 2010, stat. n.**

Uranorhagionidae KY Zhang, Yang et Ren, 2010, p. 564

Mostovskisarginae JF Zhang, 2010, p. 310, syn. n.

**Type genus.** *Uranorhagio* KY Zhang, Yang et Ren, 2010

**Included genera.** *Daohugosargus* gen. n. and *Uranorhagio* KY Zhang, Yang et Ren, 2010 (= *Mostovskisargus* JF Zhang, 2010; *Strenorhagio* KY Zhang, Yang et Ren, 2010).

**Diagnosis.** R2+3 significantly bent. Position of r-m inconstant, distad to, just at, or basad to, Rs fork. Female cerci foliaceous, unsegmented.

### **Genus *Uranorhagio* KY Zhang, Yang & Ren, 2010**

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

*Uranorhagio* KY Zhang, Yang et Ren, 2010, pp. 564, 565

*Strenorhagio* KY Zhang, Yang et Ren, 2010, p. 566, syn. n.

*Mostovskisargus* JF Zhang, 2010, p. 310, syn. n.

**Type species.** *Uranorhagio daohugouensis* KY Zhang, Yang et Ren, 2010

**Included species.** *Uranorhagio asymmetricus* (KY Zhang, Yang et Ren, 2010) comb. n. (= *Strenorhagio conjugovenius* KY Zhang, Yang et Ren, 2010, syn. n.; *Mostovskisargus portentosus* JF Zhang, 2010, syn. n.; *M. signatus* JF Zhang, 2010, syn. n.), *U. deviatu*s (KY Zhang, Yang et Ren, 2010) comb. n. (= *Strenorhagio grimaldi* KY Zhang, Yang et Ren, 2010, syn. n.), besides the type species.

**Redefinition.** R1 relatively short (some four-fifths of wing length). R2+3 strongly arched basally. Origin of Rs basad to d base. Rs fork basad to midlength of d. Crossvein r-m inconstant: slightly distad to, or just at, or somewhat basad to, Rs fork. M with four terminal branches. M1+2 furcated distad to d end.

### **Genus *Daohugosargus* gen. n.**

urn:lsid:zoobank.org:act:2A134429-08CE-4D3F-8CBA-7ACD933A8620

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

**Type species.** *Sharasargus eximius* KY Zhang, Yang & Ren, 2008

**Included species.** The type species only.

**Derivation of name.** Chinese, *Daohugou*, alluding to the fossil locality, and *sargus*, a common ending in archisargid genera (the masculine gender).

**Diagnosis.** R1 long (more than four-fifths of wing length). R2+3 short, significantly S-shaped. Origin of Rs distad to d base. Rs fork nearly at level of d end. Crossvein r-m far basad to Rs fork, and meeting anterior margin of d distad to its midlength. M with three terminal branches. M1+2 bifurcated basad to d end. Cell cu open.

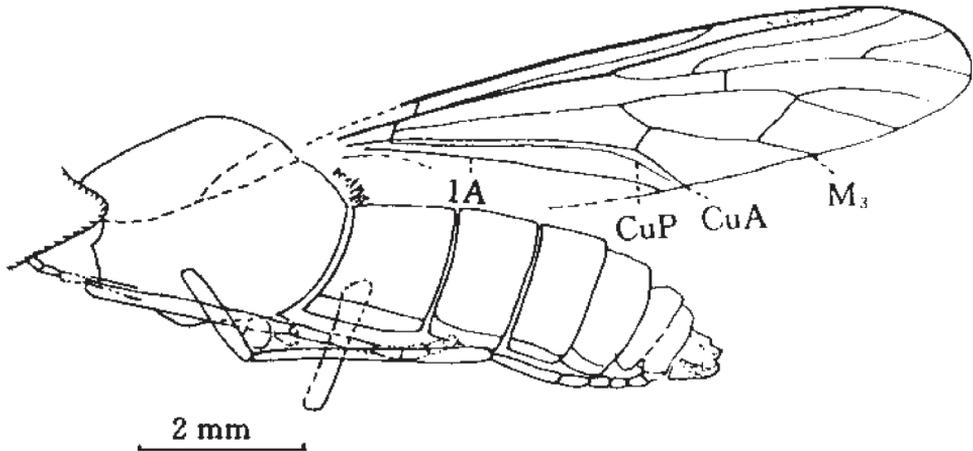
**Remarks.** The present new genus differs from *Uranorhagio* by the short, S-shaped R2+3; the origin of Rs, which is distally of d base, the position of r-m, which is far basad to Rs fork, and meeting anterior margin of d distad to its midlength; and by the M with three terminal branches, on which M1+2 fork basad to d end.

On the other hand, *Daohugosargus* gen. n. is distinct from *Sharasargus* Mostovski, 1996 in that: origin of Rs distad to d base; very short, S-shaped R2+3; first fork of Rs nearly at level of d end; and r-m meeting Rs stem far basad to Rs fork.

## Discussion

KY Zhang et al. (2010a) erected a new family, Uranorhagionidae KY Zhang, Yang et Ren, 2010 including five new species referred to two new genera based on several specimens from the “Daohugou Formation” in the vicinity of Daohugou, Inner Mongolia of China (not the true Jiulongshan Formation). They assigned Uranorhagionidae to the superfamily Tabanoidea, and considered Uranorhagionidae exhibiting a mixture of distinct characteristics of two families, the Rhagionemestriidae (Nemestrinoidea) and the Rhagionidae (Tabanoidea), but failed to discuss the relationship of Uranorhagionidae and Archisargidae (Archisargoidea).

Comparing Uranorhagionidae with the Archisargidae, however, almost all the characteristics derived from body structures and wing venation in the former family are very closely similar to the latter family. The major difference of significantly bent R2+3 also demonstrates close resemblance to that of *Daohugosargus eximius*, an undoubted representative of archisargids although its systematic position at generic level is debatable (see Figure 4). It should be noted that the position of r-m in Uranorhagionidae is unstable: in some species slightly distad to, or just at, in other species slightly basad to, Rs fork. Nevertheless, this character also exists in Archisargidae (most representatives versus *Daohugosargus eximius*). As far as the petiolate M1+2 behind d end is concerned, there are some members of archisargids with M1+2 fork just at d end [see Figure 5, *Sharasargus oresbius* (Ren, 1998), comb. n., originally *Pauromyia oresbia* Ren, 1998], which does belong rather to Archisargidae than to Rhagionidae (detailed discussion, see below); and is more or less similar to that of uranorhagionids. The distal position of the M1+2 fork with respect to the d cell distal end may be a unique feature of uranorhagionids, which has the taxonomic significance only at generic, at most subfamilial, rank. Thus, Uranorhagionidae is a junior synonym for Archisargidae, and could be degraded as a subfamily referred to Archisargidae.



**Figure 5.** *Sharasargus oresbius* (Ren, 1998) comb. n. (originally *Pauromyia oresbia* Ren, 1998; after Ren 1998).

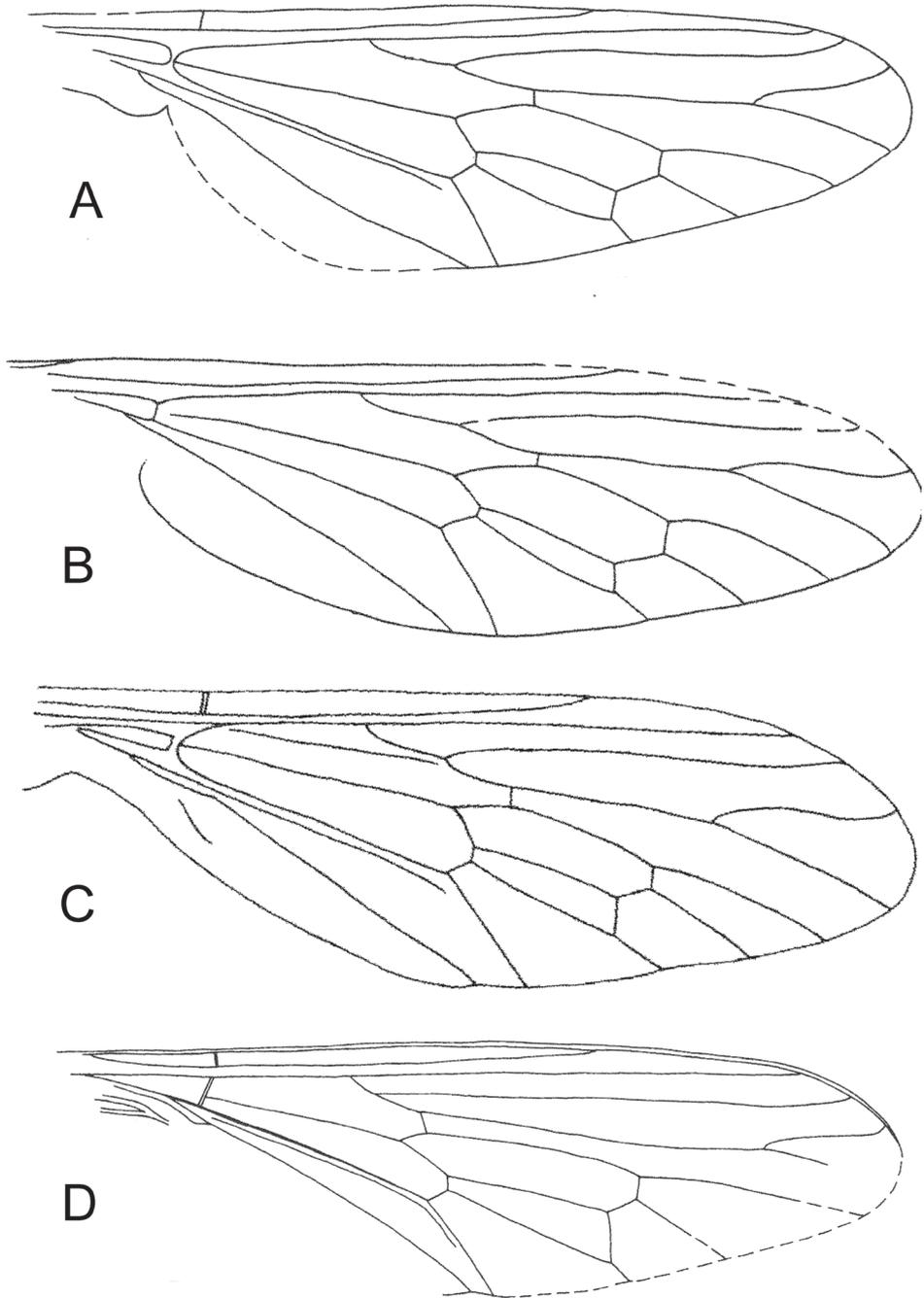
KY Zhang et al. (2010a) described five new species respectively assigned to two new genera: *Uranorhagio daohugouensis*, *Strenorhagio deviatius*, *S. grimaldi*, *S. asymmetricus* and *S. conjugovenius*. However, these impressions demonstrate close similarities in body structures and wing venation each other, and then could be united into three species referred to a single genus: *Uranorhagio daohugouensis*, *U. deviatius* (KY Zhang et al., 2010) and *U. asymmetricus* (KY Zhang et al., 2010). The genus *Strenorhagio* KY Zhang et al., 2010 could be synonymized with *Uranorhagio* KY Zhang et al., 2010. The *S. grimaldi* and *S. conjugovenius* are synonyms for *U. deviatius* and *U. asymmetricus*, respectively. It should be noted that minor differences in the wing venation should be attributed to individual variation, which can be quite substantial in the extinct archisargids. For example, the holotype of *U. asymmetricus* (CNU-DIB-NN2007020) (KY Zhang et al. 2010, p. 569, fig. 10) shows the r-m clearly basad to Rs fork in its left wing, but just at Rs fork in its right wing. That is to say the position of r-m being inconstant not only in different individuals but even in a single specimen.

The author (JF Zhang, 2010a) described two new species referred to a new genus within a new subfamily based on two specimens from the “Daohugou Formation” in the vicinity of Daohugou, Inner Mongolia of China, and assigned them to Archisaragidae — Mostovskisarginae: *Mostovskisargus*: *Mostovskisargus portentosus* and *M. signatus*. However, these taxa were published somewhat later (publication date: 16 March, 2010) than those described by KY Zhang et al. (26 February, 2010). Thus, Mostovskisarginae, *Mostovskisargus*, *Mostovskisargus portentosus* and *M. signatus* are junior synonyms of Uranorhagioninae, *Uranorhagio* and *Uranorhagio asymmetricus*, respectively.

KY Zhang et al. (2010b) described a new species referred a new genus *Brevisolva daohugouensis* and two additional *Mesosolva* species: *Mesosolva jurassica* and *M. sinensis*. Judging from the original descriptions, drawings and photographs (KY Zhang et al., 2010b, pp.76–79, figs 1–8), *M. jurassica* demonstrates very close resemblance in body structures and wing venation to *M. sinensis*, and then, both species should be united

into a single one (see Figure 6A–C herein). It should be repeatedly emphasized: due to individual variation and/or sexual dimorphism, some minor differences in the wing venation usually occur within an archisargid species. Such differences may exist even between the left and right wings of a single specimen. It is evident that *M. sinensis* is closely similar in body structure and wing venation to *M. daohugouensis* JF Zhang et HC Zhang, 2003. Both species are from the same fossil site. It might be debatable whether the two species could also be united into one species. On account of the characteristic wing venation of *Brevisolva daohugouensis* (see Figure 6D) showing close similarities to *M. sinensis* it is difficult to see how the genus *Brevisolva* could be separated. The genus *Brevisolva* as defined by its authors (KY Zhang et al, 2010b) does not have diagnostic features that separate it from *Mesosolva*. As for the short Rs stem, short R5, the position of r-m which is close to d base, these characteristics in wing venation of *Brevisolva* could be treated as the difference between species, and are also similar respectively to some known species of *Mesosolva*, for example, in *M. longivena* Mostovski, 1996 and *M. balyshevae* Mostovski, 1996. Additionally, the short petiole of cell m3 is not the particular feature of *Brevisolva*. There is an undescribed impression of *Mesosolva* showing its petiole clearly shorter than the section dM3 (see Figure 7). *Brevisolva daohugouensis* could be regarded as a species of *Mesosolva*. A new specific name, *Mesosolva zhangae* (KY Zhang et al., 2010), nom. n., is proposed because the *M. daohugouensis* has already been occupied (JF Zhang and HC Zhang 2003).

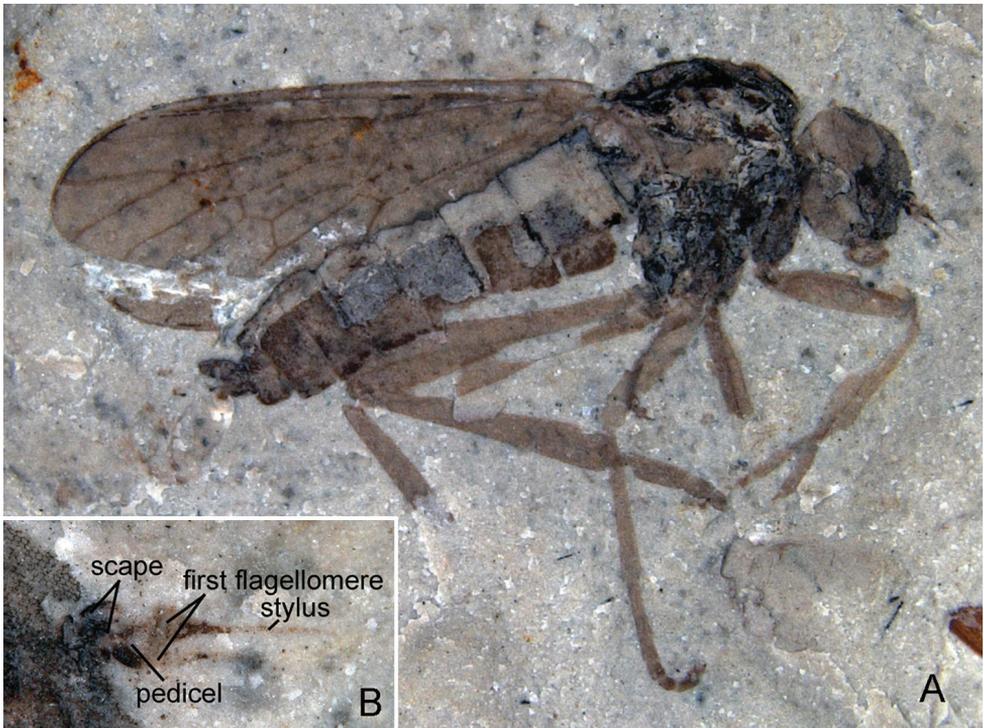
Hong (1983) described two monobasic genera, *Mesosolva* and *Prosolva* from the Callovian–Oxfordian Haifanggou Formation in Beipiao, Liaoning, China. He assigned these to the family Xylomyiidae (originally Solvidae). JF Zhang et al. (1993) discussed the systematic position of *Mesosolva parva* Hong, 1983 and *Prosolva huabeiensis* Hong, 1983, pointed out that these probably belong in an unnamed group at familial level, which is probably related to the family Rhagionidae based on the characteristics of antenna; but the structures of antenna were mistakenly described: the so-called second segment (i.e. pedicel) is, in fact, the third segment (i.e. first flagellomere) (JF Zhang et al., 1993, p. 667). In the author's collection of brachycerous flies from Daohugou biota, there is another nearly complete impression of male *Mesosolva* with antennae visible, which consist of the scape, pedicel, first flagellomere, and stylus (Figure 8). It is evident that the so-called pedicel described by Hong (1983) is the first flagellomere, in size and shape very closely resembling that of the present undescribed specimen (see Figure 8), although they are from different individuals at different fossil localities. Mostovski (1996a, 1996b) redefined Archisargidae and *Mesosolva*. Meanwhile, he transferred *Mesosolva* into Archisargidae, and described seven new *Mesosolva* species. He thought that *Mesosolva parva* and *Prosolva huabeiensis* probably belong to the same genus (Mostovski 1996b). JF Zhang and HC Zhang (2003) described the first record of *Mesosolva* from the Daohugou biota, and agreed with Mostovski's (1996b) conclusion mentioned above. Recently, KY Zhang et al. (2010b) revised the diagnosis of *Mesosolva* proposed by Mostovski (1996b). Unfortunately, the redefinition is unsatisfactory. What is striking is the additional characteristic: CuA1 arising from cell bm, mouth of cell sc wide open, much wider than that of cells r1 and r2+3.



**Figure 6.** Similarity between four set of wings **A** *Mesosolva sinensis* KY Zhang et al., 2010 (after KY Zhang et al., 2010) **B** *Mesosolva sinensis* KY Zhang et al., 2010 (originally *Mesosolva jurassica* KY Zhang et al., 2010; after KY Zhang et al., 2010) **C** *Mesosolva sinensis* KY Zhang et al., 2010 (originally *Mesosolva jurassica* KY Zhang et al., 2010; after KY Zhang et al., 2010) **D** *Mesosolva zhangae* (KY Zhang et al., 2010) nom. n. (originally *Brevisolva daohugouensis* KY Zhang et al., 2010; after KY Zhang et al., 2010).

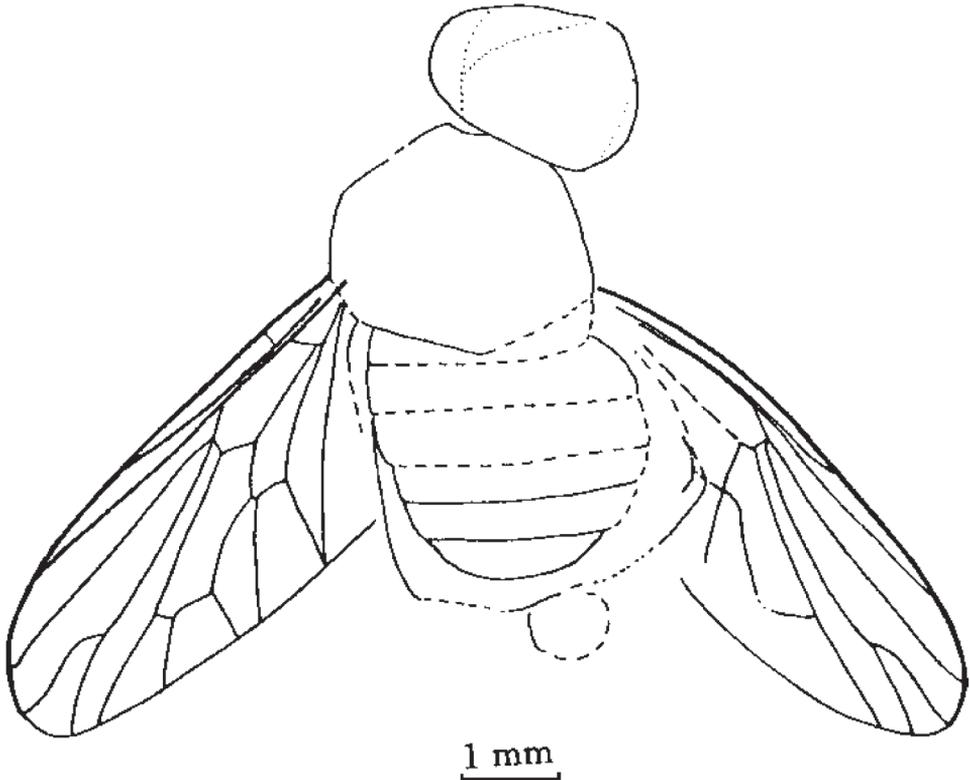


**Figure 7.** An undescribed wing of *Mesosolva* NIGP DHG902.



**Figure 8.** An undescribed male impression of *Mesosolva* NIGP DHG903, **A** habitus (lateral view) **B** antennae.

They failed to explain how these features could be defined as the *Mesosolva* diagnosis. Actually, these that they added are common characteristics of archisargid genera, and occur in almost all representatives referred to various genera in the two subfamilies (Archisarginae and Uranorhagioninae) of Archisargidae. The author argues that these delineations proposed by KY Zhang et al. (2010) do not conform to the diagnoses of all the archisargid genera.

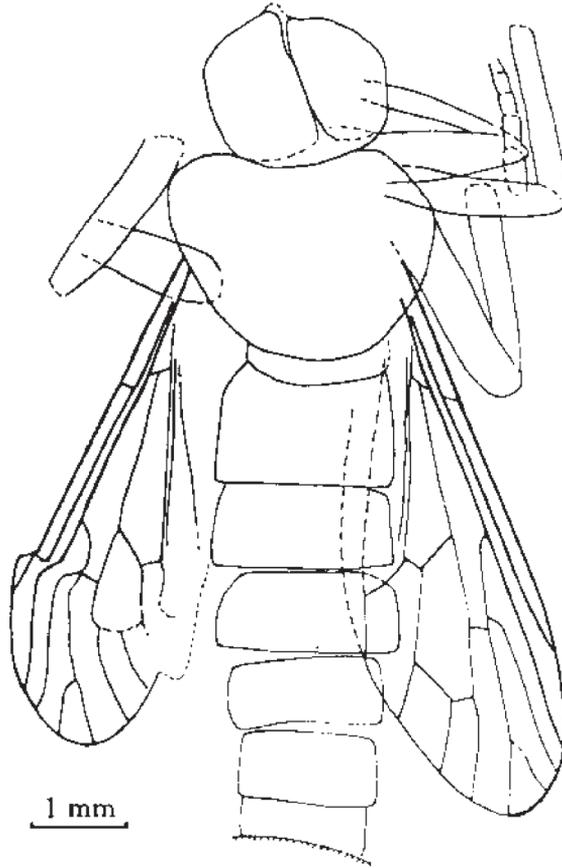


**Figure 9.** *Sinallomyia ruderalis* (Ren, 1998) (originally *Allomyia ruderalis* Ren, 1998; after Ren 1998).

*Sinallomyia ruderalis* from the Lower Cretaceous Yixian Formation was originally regarded as a new genus and species of the subfamily Tabaninae within Tabanidae. Judging from the original illustration (Ren 1998, p. 69, fig. 6; Figure 9 herein) the R1 is some four-fifths of wing length; and the venation and body structure demonstrate, more or less, resemblance to *Mesosolva zhangae* (KY Zhang et al., 2010), nom. n.; hence, this genus and species can be transferred to the Archisarginae of Archisargidae (JF Zhang, 2012a).

*Pauromyia oresbia* from the same locality and horizon was previously assigned to the Rhagionidae (Ren 1998, p. 72, fig. 11; Figure 5 herein). This species can be moved into *Sharasargus* within Archisarginae, Archisargidae because its venation shares close similarity to *S. spiniger* Mostovski, 1996 referred to Archisarginae, Archisargidae (JF Zhang, in press).

Ren (1998) described two new species of a new genus: *Helempis yixianensis* and *H. eucalla* from the same locality and horizon. He considered these taxa having typical wing venation of Protempididae. On the basis of original drawings (Ren 1998, pp. 80, 81, figs 22, 23; Figures 10, 11 herein), the two species which might be probably united into one species have very long R1, which is some four-fifths (or more) of wing length, relatively narrow and long wings, unsegmented arista, and the characteristic discoidal

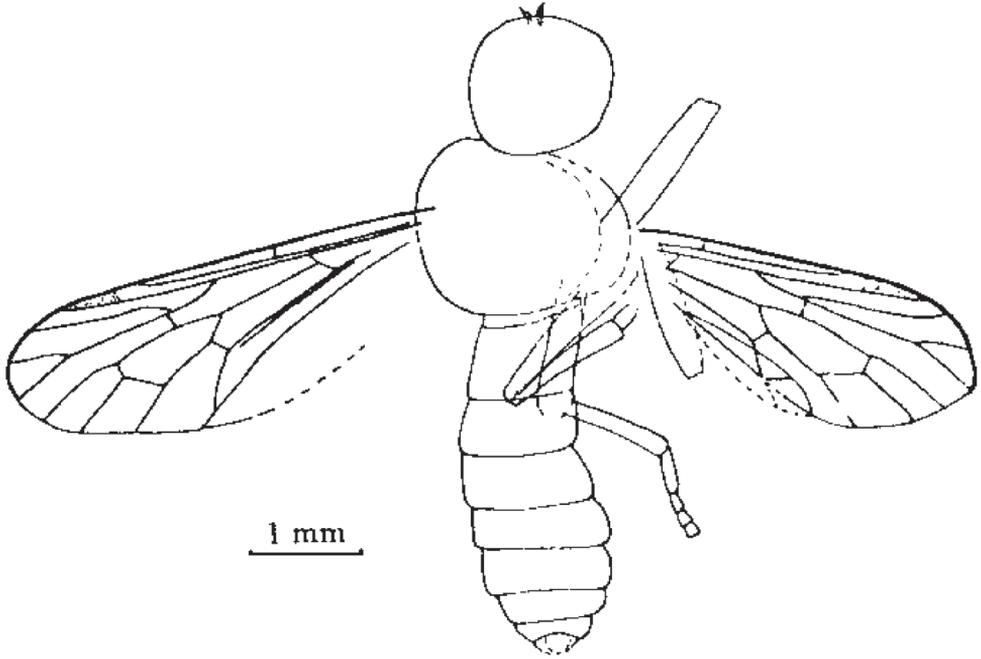


**Figure 10.** *Ovisargus (Helempis) yixianensis* (Ren, 1998) comb. n. (originally *Helempis yixianensis* Ren, 1998; after Ren 1998).

cell, which is distinctly shifted distally. All the characters contradict to including these species in the Protempididae. On the contrary, *Helempis yixianensis* and *H. eucalla* demonstrate close resemblance in wing venation to *Ovisargus gracilis* Mostovski, 1996, and then could be transferred to *Ovisargus* Mostovski, 1996 (Archisarginae, Archisargidae). A detailed discussion will be made in a separate paper.

The *Origoasilus* KY Zhang et al., 2011 previously erected as a new genus and assigned to a new family Origoasilidae KY Zhang et al., 2011 has been transferred to Archisarginae of Archisargidae. The Origoasilidae is a junior synonym for Archisargidae (JF Zhang, 2012b).

Ideally, these previously described species from the upmost Middle–lowest Upper Jurassic “Daohugou Formation” and the Lower Cretaceous Yixian Formation should be revised properly through re-examination of the type material, since the original drawings may contain details resulted from misinterpretation of insufficiently preserved structures. For this reason, until such time as reinvestigation of these specimens is possible, their taxonomic positions could be temporarily assigned to Archisarginae,



**Figure 11.** *Ovisargus (Helempis) yixianensis* (Ren, 1998) comb. n. (originally *Helempis eucalla* Ren, 1998; after Ren 1998).

Archisargidae based on original descriptions and drawings because the Mesozoic archisargid flies have characteristic wing venation (see revised diagnosis of Archisargidae mentioned above) which is easily separated from other extinct and extant families within the lower Orthorrhapha, Brachycera.

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# Two new species of Tornidae (Caenogastropoda, Risssooidea) from Espírito Santo, Brazil

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## Abstract

Two new species of shallow water Tornidae are found in Espírito Santo state, Brazil, formally described herein. They belong to a complex group of tiny gastropods, in such the taxonomy is very confused. *Cyclostremiscus mohicanus* **sp. n.** is characterized by three well-developed spiral, equidistant carinas, working as base of three series of tall, aligned periostracal rods. *Episcinia itanhuna* **sp. n.** has as single sculpture a series of pustules in periphery, but the periostracum bears three series of peripheral fringes with irregular rods. The new species are compared with the allies, showing a close relation with Caribbean fauna, but possessing worthy differences. These similarities have raised misidentifications.

## Keywords

Tornidae, Caenogastropoda, biodiversity, coastal waters, Espírito Santo, Brazil

## Introduction

The Tornidae Sacco, 1896 has also been called Vitrinellidae Bush, 1897. They normally are tiny (~2 mm), discoid gastropods living in coastal shallow waters, usually associated with other organisms, such as algae, worm galleries, etc.

Possibly because of the minute size, the tornids are normally absent in faunal inventories. In collections, the few samples are normally poorly identified, and the draft identification, at least in Brazilian samples, is normally south expansions of North Atlantic or Caribbean species, resulting exceedingly wide distributed species. The

same has reflected in the pertinent literature. This wide distribution contrasts with the minute size and the paucispiral protoconch, both normally indicating short or no planktonic phase, and low dispersion. On the other hand, this supposedly wide distribution does not resist to a close look, in such interesting and important differences appear confronting distant collected samples. This paper is just another example. It deals with two species so far identified as species described from Florida and North Carolina, which has been extended to Caribbean. However, some significant details have demonstrated that the Brazilian samples actually belong to different, undescribed species.

The western Atlantic tornid fauna had an important improvement with a recent revision (Rubio et al. 2011), allowing a better analysis of samples. The genus *Cyclostremiscus* Pilsbry & Olsson, 1945 (type species, OD, *Vitrinella panamensis* C.B. Adams, 1852, from Caribbean) has a worldwide, tropical distribution. It is mainly characterized by usually carina-bearing shell, normally with secondary sculpture in intervals of carinas, and a wide, opened umbilicus (Pilsbry and Olsson 1945: 266; Rubio et al. 2011: 83). The genus *Episcynia* Mörch, 1875 (type species, M, *Solarium inornatum* d'Orbigny, 1842, from Caribbean), is restricted to Pacific and Atlantic coasts of Americas. It is mainly characterized by serrate peripheral keel, deep umbilicus, and spiral fringes with periostracal filaments (Rubio et al. 2011: 125). This paper deals with the formal descriptions of two species belonging to these genera, recently collected in sediment sorting by local researchers, as well as confrontation with type specimens.

## Material and methods

The studied samples are only empty shells in all kinds of preservation levels, since specimens with periostracum to eroded shells. They are photographed in multi-focus dissecting microscope and in SEM (Laboratório de Microscopia Eletrônica do Museu de Zoologia da USP).

Abbreviations of institutions are: MNRJ: Museu Nacional da Universidade Federal do Rio de Janeiro; MZSP, Museu de Zoologia da Universidade de São Paulo; USNM, National Museum of Natural History, Smithsonian Institution.

## Systematics

### Genus *Cyclostremiscus* Pilsbry & Olsson, 1945

#### *Cyclostremiscus mohicanus* sp. n.

urn:lsid:zoobank.org:act:FF9F3D9C-8BF9-4CAB-A236-8C143BA62A6F

[http://species-id.net/wiki/Cyclostremiscus\\_mohicanus](http://species-id.net/wiki/Cyclostremiscus_mohicanus)

Figs 1–15

**Types.** Holotype MZSP 106551 (Figs 1–5). Paratypes: 106552, 16 shells from type locality.

**Type locality.** BRAZIL. **Espírito Santo;** São Mateus, Guriri, 18°47'S, 32°39'W, 3 m depth.

**Diagnosis.** Shell of about 2.5 mm; almost planispiral. Three carina-like spiral threads somewhat equidistant; superior surface smooth or with scanty spiral cords. Periphery smooth except threads. Peri-umbilical area with string spiral cords. Periostracum with aligned series of tall rods on spiral threads.

**Description. Shell.** Up to ~2.5 mm, discoid; height ~52% of maximum width (Figs 3, 10, 12). Color pure white, weakly translucent (Figs 1, 2, 5, 6). Protoconch of 2 whorls, weakly-turbiform (Figs 4, 10, 11, 15); whorls of rounded profile, suture shallow; surface glossy, smooth; occupying ~10% of shell size; located almost central, weakly dislocated towards right. Transition protoconch-teleoconch unclear (Fig. 15). Spire weakly elevated, with ~45% of shell width; ~15% of shell height. Teleoconch up to 2.5 whorls, uniformly growing weakly planispiral, bearing three somewhat equidistant carinas (Figs 9, 10, 11, 12); peripheral carina as tallest, profile blunt, ~100°, located in middle level of last whorl, inflating ~15% shell width; inferior carina similar to peripheral carina, located midway between this and peri-umbilical slope (Figs 10, 12, 13); superior carina with ~half size as peripheral carina, located midway between this and adjacent suture (Figs 6, 8, 9, 11); between carinas somewhat planar surface, being weakly elevated in carina's base. Sculpture superior to peripheral carina absent (Figs 11, 14) to series of narrow, low, obsolete spiral cords (Figs 6, 8), varying from zero (surface smooth, Fig. 14) to ~10 (Fig. 8); interspaces between spiral cords ~1/4 their width; sculpture inferior to peripheral carina absent (smooth). Umbilicum widely opened; maximum diameter ~30% shell width; flanking by strong, somewhat planar slope; sculptured from 1 to 5 spiral cords, with interspaces ~3 times their width (Figs 5, 7, 12, 13). Aperture weakly prosocline (Figs 4, 9, 11, 13); rounded, weakly pentangular, i.e., bearing somewhat equidistant blunt angles produced by three carinas and umbilical slope (Figs 10, 12); with ~35% shell width, ~70% of shell height. Callus practically absent, weakly covering adjacent whorl in apertural implantation.

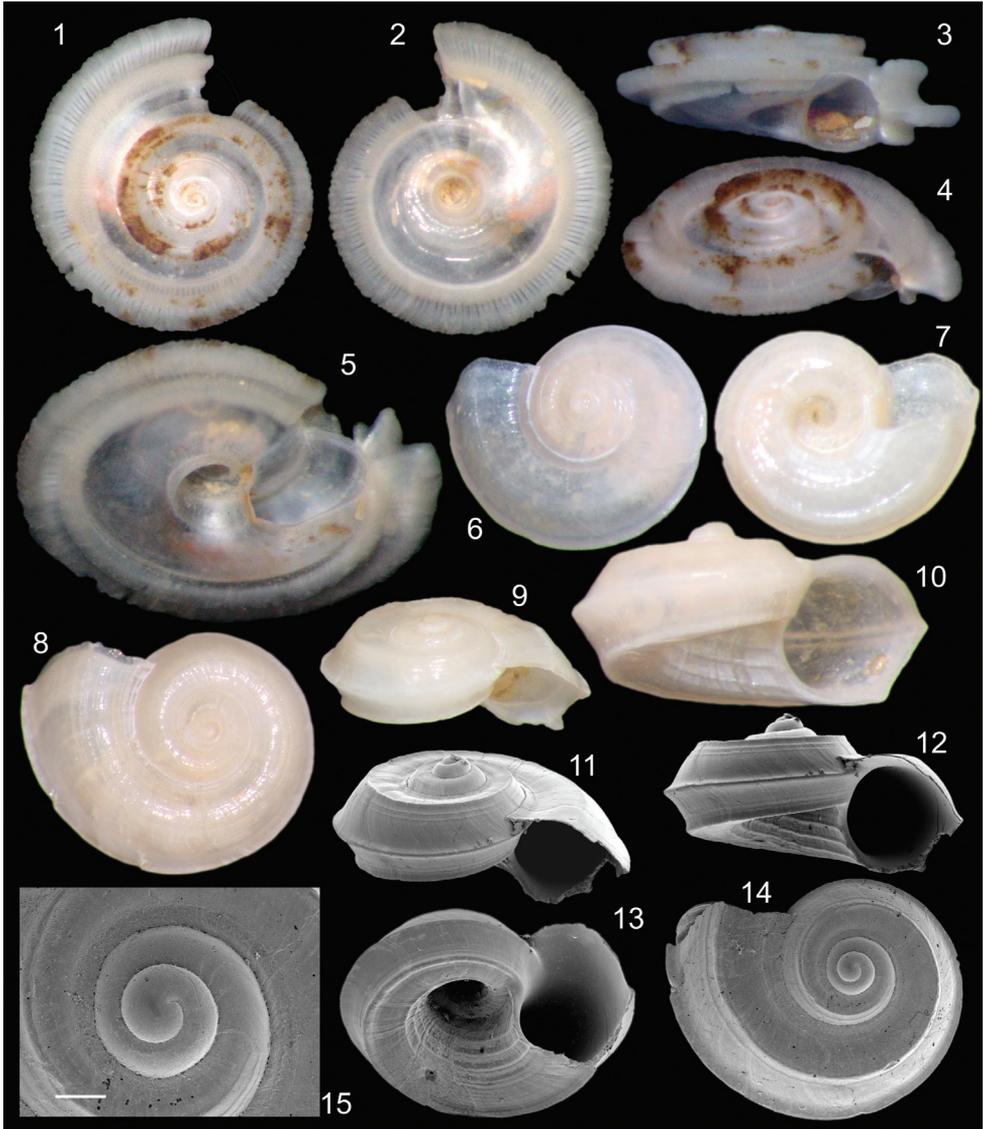
Periostracum (Figs 1–5). Opaque, transparent, color pale beige. Series of tall rods aligned on three carinas; rods of peripheral carina augmenting ~10% shell width (Figs 1, 2), about twice taller than wide, tip rounded, slightly broader than base; rods of superior carina similar to those of peripheral carina, with ~80% of their size (Figs 3, 4); rods of inferior carina also similar to those of peripheral carina, with ~30% their height and ~60% their width (Figs 3, 5). Each rod blade-like, flexible, located close to each other from same carina, forming tall flexible ridge on each carina. Periostracum ridge on three carinas suddenly finishing at apertural level. On aperture, region between ridge of superior carina and insertion of outer lip in adjacent preceding whorl a small region with ridge of peripheral ridge reabsorbed, forming anal notch with ~1/5 of aperture size (Figs 1, 2, 5).

**Measurements** (in mm). Holotype: 2.8 by 0.9; paratype 106552 (Fig.10): 1.7 by 0.8.

**Distribution.** Only known from type locality.

**Habitat.** Sandy bottoms, 3 m depth (no living specimens).

**Material examined.** Types.



**Figures 1–15.** *Cyclostremiscus mohicanus* sp. n. types **1** holotype MZSP 106551 (W 2.8 mm), apical view **2** same, umbilical view **3** same, apertural view **4** same, apertural-slightly apical view **5**, same, apertural-slightly umbilical view **6** paratype MZSP 106552 #1, apical view (W 1.8 mm) **7** same, umbilical view **8** #2, apical view (W 1.7 mm) **9** #1, apertural-slightly apical view **10** same, apertural view **11** #3, SEM, apertural-slightly apical view (W 1.7 mm) **12** same, apertural view **13** same, apertural-slightly umbilical view **14** #4, SEM, apical view (W 1.5 mm) **15** same, detail of apical region, scale 0.1 mm.

**Discussion.** *Cyclostremiscus mohicanus* is similar to *C. beauii* (Fischer, 1857) (Rosenberg et al. 2009; Rubio et al. 2011) from Florida and Caribbean. It differs by the smoother superior surface, lacking so developed spiral cords, the contrary happens in the umbilicum, in such that of *C. mohicanus* has a series of spiral cords, while *C.*

*beauui* has only growth lines; the size is also different, as *C. mohicanus* has about 3 mm, while *C. beauui* reaches 9–10 mm. *C. mohicanus* also resembles *C. pentagonus* (Gabb, 1873), also from Caribbean, it differs by the more developed spiral sculpture in the superior shell surface, by the peri-umbilical spiral sculpture, in being slightly taller (height/width tax= ~52% against ~48% of *C. pentagonus*), and in having the peripheral carina slightly more elevated. *Cyclostremiscus pentagonus* has been referred as occurring in south Brazil (Rios 2009: 59, in Porto Belo, Santa Catarina; Rubio et al. 2011: 91); as that material was not found, this record is here considered doubtful, but possibly they are of *C. mohicanus*. Another important difference between *C. mohicanus* and *C. pentagonus* is the protoconch, it has ~2 whorls (Fig. 15), while that of *C. pentagonus* is ~0.5 whorl longer (Rubio et al. 2011, fig. 46F). *Cyclostremiscus mohicanus* is also somewhat similar to *C. trilix* (Bursh, 1885), sharing the size and the carinas shape; however, it differs from that species in lacking the microtubercles on the protoconch, in having spiral sculpture in surface between suture and superior carina, and in being taller (height/width tax= ~52% against ~42% of *C. trilix*).

The periostracum bearing expansions are relatively common in living and fresh-died specimens of tornids. However, a periostracum with the *Cyclostremiscus mohicanus* arrangement appears to be novelty. Nothing like that has been found in other congeneric species. *C. mohicanus* clearly belongs to the “group 1” as defined by Rubio et al. (2011: 84), which encompasses carinate species of the genus, with 2 or 3 peripheral carinas. Possibly all carinas of those species are base of periostracal expansions like those of *C. mohicanus*.

## Genus *Episcynia* Mörch, 1875

### *Episcynia itanhura* sp. n.

urn:lsid:zoobank.org:act:154F48BF-4FB0-44B1-B83A-62C1650CB74E

[http://species-id.net/wiki/Episcynia\\_itanhura](http://species-id.net/wiki/Episcynia_itanhura)

Figs 16–27

*Episcynia inornata*: Rios 1994: 59 (fig. 221), 2009: 101 (fig. 245) (non d’Orbigny 1842).

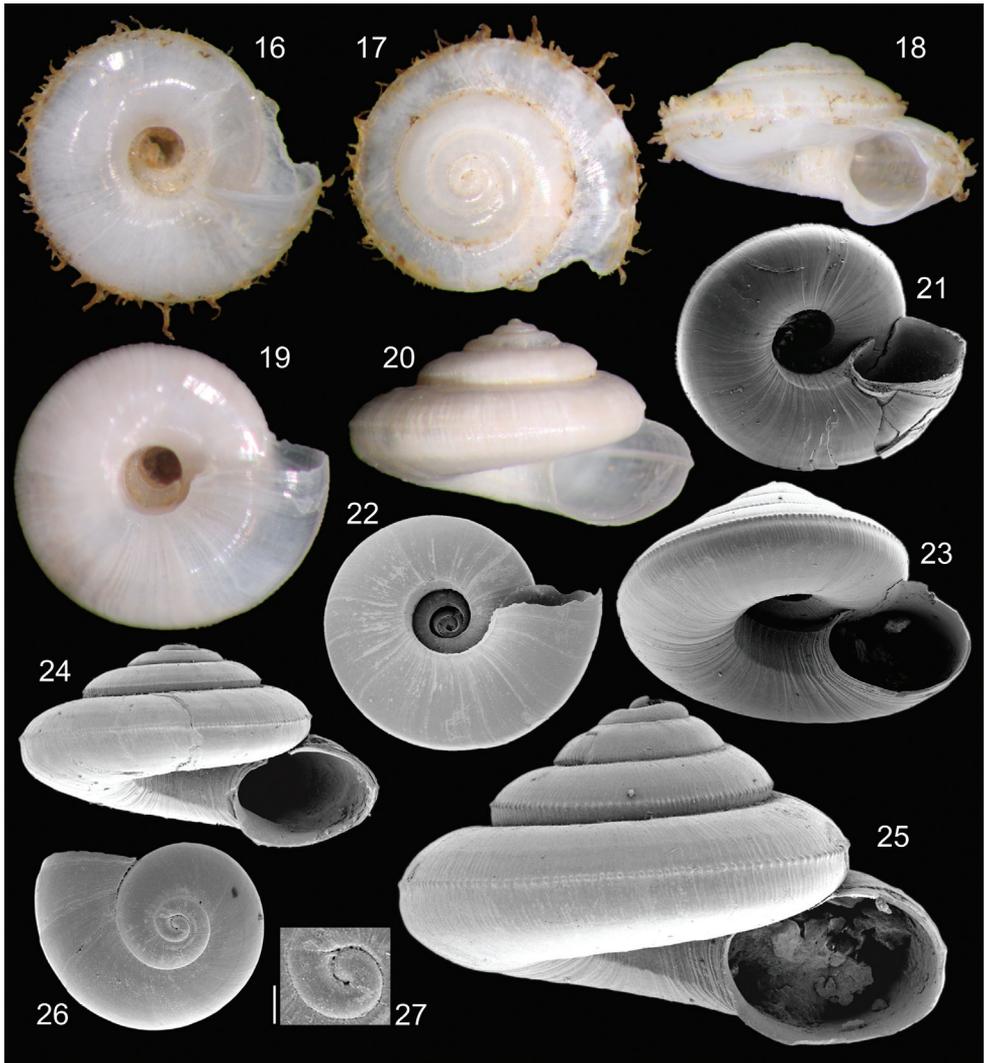
*Episcynia inornata* form “*multicarinata*”: Rubio et al. 2011: 126 (fig. 68D) (non Dall 1889).

**Types.** Holotype MZSP 106553 (Figs 16–18). Paratypes: 106556, 18 shells, MNRJ, 3 shells, USNM, 3 shells, all from type locality.

**Type locality.** BRAZIL. **Espírito Santo**; São Mateus, Guriri, 18°47'S, 32°39'W, 3 m depth.

**Diagnosis.** Shell relatively trochoid. Periostracum with 3 series of peripheral fringes constituted of irregular rods. Surface smooth except for peripheral line of pustules. Peripheral carina wanting (profile rounded).

**Description. Shell.** Up to ~2.5 mm, discoid (Figs 18, 24) to trochiform (Figs 20, 25); height ~57–68% of maximum width (Figs 18, 20, 24, 25). Color white,



**Figures 16–27.** *Episcynia itanhura* sp. n. types **16** holotype MZSP 106553, umbilical view (W 2.0 mm) **17** same, apical view **18** same, apertural view **19** paratype MZSP 106556#1, umbilical view (W 2.2 mm) **20** same, apertural view **21** #2, SEM, umbilical-slightly apertural view (W 2.5 mm) **22** #3, SEM, umbilical view (W 2.1 mm) **23** #4, SEM, apertural-slightly umbilical view (W 2.5 mm) **24** #5, SEM, apertural view (W 2.6 mm) **25** #4, SEM, apertural view **26** #6, SEM, apical view (W 1.0 mm) **27** #6, detail of protoconch (scale 50 $\mu$ m).

weakly translucent (Figs 16–20). Protoconch of 1 whorl,  $\sim$ 90  $\mu$ m, weakly-turbiform (Figs 26, 27); whorl of rounded profile, suture shallow; surface glossy, smooth; occupying  $\sim$ 7% of shell size; located almost central, weakly dislocated towards right (Fig. 17). Transition protoconch-teleoconch clear, orthocone (Figs 26, 27). Spire dome-shaped to elevated, with  $\sim$ 66% of shell width;  $\sim$ 60–64% of shell height. Tel-

eoconch up to 4 whorls, uniformly growing inferiorly; last whorl with rounded profile, lacking peripheral carina. Sculpture practically absent, except for growth lines looking undulations and aligned set of small pustules located just superiorly to suture and in middle level of past whorl periphery; each pustule rounded, separated from neighboring pustules by space equivalent to half its width; 2 to 4 equidistant, very weak spiral cords present in ~50% of specimens located in superior region of each whorl (Figs 20, 25); inferior region of body whorl only with growth lines (Figs 19, 22). Umbilicum widely opened; maximum diameter ~30% shell width; flanking by strong, somewhat planar slope, bearing only growth lines; weak angulation marking periphery of umbilicum (Figs 19, 23, 24, 25). Aperture slightly prosocline (Figs 21, 22, 23); elliptical (longer axis vertical) (Figs 24, 25); with ~36% shell width, ~40–43% of shell height. Callus practically absent, weakly covering adjacent whorl in apertural implantation (Figs 21, 23).

Periostracum (Figs 16–18). Opaque, transparent, color yellowish beige (Figs 16–18). Three series of rods running on periphery (Fig. 18); central fringe running on pustule lines; other 2 fringes running above and below central fringe, distance between fringes equivalent to ~1/3 of whorl height; periostracum rods located on fringes not uniformly distributed and sized; longer rods extending ~10% shell width, weakly coiled, distantly separated from neighbor rods.

**Measurements** (in mm). Holotype (Fig. 18): 2.0 by 1.1; paratypes MZSP 106556 (Fig. 20)#1: 2.2 by 1.3; (Fig. 24)#5: 2.6 by 1.5; (Fig. 25)#4: 2.5 by 1.6.

**Distribution.** Brazil, from Bahia to São Paulo.

**Habitat.** Sandy bottoms, ~3 m depth (no living specimens collected).

**Material examined.** Types. Additional material: MZSP 106571, 90 shells from type locality. BRAZIL. **Bahia;** Salvador, Itapoã beach, MZSP 53439, 1 shell (C.M. Cunha col.). **Rio de Janeiro;** Cabo Frio, MZSP 57159, 2 shells (17/ii/1970). **São Paulo;** off Ubatuba, MZSP 88431, 1 shell (Veliger II, sta. PI-15; 21/i/1986); 23°33'978"S, 45°09'821"W, 12.3 m depth, MZSP 42087, 1 shell (Biota sta. 145i; 16/iv/2002). N.B. These samples are not part of the type material because of low quality of the shell preservation.

**Etymology.** The specific epithet is derived from the Paritintin word Itanhura'mbi – chain used as necklace (Betts 1981), an allusion to the peripheral ornamentation of the shell.

**Discussion.** *Episcynia itanhura* is similar to *E. inornata* (d'Orbigny 1842), from Florida and Caribbean, differing in lacking so developed peripheral carina, the profile of each whorl is rounded while that of *E. inornata* is bluntly pointed (Rubio et al. 2011, Figs 68B, 69); *E. itanhura* has a more developed axial undulation, almost sculpture (e.g., Figs 20, 25), this is rare in *E. inornata*, in such the surface is smoother and glossy. The size of the protoconch of *E. inornata* has been referred as 190 µm (Rubio et al. 2011), while that of *E. itanhura* is about half that size (~90 µm, Figs 26, 27). The periostracum rods are organized in 3 fringes in *E. itanhura* (Fig. 18), while a single pair is found in *E. inornata* (Andrews 1971: 68; Abbott 1974: 86). The 3 fringes are also found in *E. multicarinata* (Dall 1889), from North Carolina

to north Caribbean, *E. itanhura* differs in having periostracum rods more sparsely and less uniformly developed, by the deeper suture, and by the straighter profile of spire. The differences between Caribbean and Brazilian specimens have been pointed in literature (Rubio et al. 2011, fig. 68D), however, the differences obviously did not influenced the specific separation. Nevertheless, some doubt still remains in relation to the specimen figures in that paper (Rubio et al. 2011), because that illustrated specimen has whorls with almost squared profile, possibly it belong to another undescribed specimen. No specimen with such features has been examined herein. Additionally, there is some uncertainties respect to the possible synonymy between *E. inornata* and *E. multicarinata* (Dall 1889), described from North Carolina. Dall (1889: 392-393) clearly stated a specimen with four to five carinas per whorl. This feature is not found in *E. inornata* or allied species; this can demonstrate a valid entity. Moreover, Dall still described a more richness of sculpture, a lack of periostracal fringe in peripheral carina, and color yellow, whose can be extra indicative of specific differentiation. Despite further studies are necessary to clarify the question, *E. itanhura* cannot be confused with *E. multicarinata*.

## Acknowledgments

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# ***Psechrus kunmingensis*: description of male and supplementary description of female, with discussion on intraspecific variation (Araneae, Psechridae, *Psechrus*)**

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## **Abstract**

*Psechrus kunmingensis* Yin, Wang & Zhang, 1985 was first described from the female only. The first illustration of the male appeared without any text description and lacked other critical information. For this study, we collected fresh specimens of this species from diverse localities around Yunnan Province, China. Here, the male is described in detail for the first time and a supplementary description of the female is given. Based on the largest collection of *P. kunmingensis* specimens ever assembled, we found a remarkably high level of morphological variation in this species.

## **Keywords**

Araneae, taxonomy, intraspecific variation, morphology

## **Introduction**

Psechridae Simon, 1890 is a small spider family with 2 genera, 46 species (Bayer 2012). Among them, 14 species belonging to both genera are reported from China (Li and Wang 2012). The distribution of psechrids runs from southern China and South East Asia to Queensland, Australia (Platnick 2012). Up to now, there were

three revisions on this family: Levi (1982) made a revision of all psechrids known at that time, Wang and Yin (2001) focused on psechrids in China, and recently Bayer (2011, 2012) respectively revised all species of *Fecenia* and *Psechrus*. In the genus *Psechrus*, several species are known from only one sex. *Psechrus borneo* Levi, 1982, *P. kunmingensis* Yin, Wang & Zhang, 1985, *P. jinggangensis* Wang & Yin, 2001, and *P. kenting* Yoshida, 2009, for example, are known only from females. Many species of *Psechrus* vary a lot and it is very important to differentiate intraspecific variation from characters of different species. Levi (1982) illustrated variation of several species, but Bayer (2012) pointed out that Levi considered clearly differing structures of copulatory organs as intraspecific variation.

*Psechrus kunmingensis* was described and illustrated for the first time by Yin et al. (1985) based on 4 female specimens collected from Kunming, Yunnan Province, China. Later, Song et al. (1999) illustrated both the male and the female, but provided neither descriptions nor exact specimen collection locality or place of deposition. They gave no justification for their conclusion that the male they illustrated was conspecific with *P. kunmingensis*. Wang and Yin (2001) redescribed and illustrated the female.

We examined specimens collected from the type locality of *P. kunmingensis* (Kunming, Yunnan Province, China) at the same time of year (April to July) and many specimens from places around Kunming. Based on examination of these specimens, we concluded that the male illustrated by Song et al. (1999) is indeed conspecific with the *P. kunmingensis* female. In the present paper, the male of *P. kunmingensis* is described in detail. Additionally, a supplementary description of females is provided. We illustrate and describe a high level of morphological intraspecific variation for the first time, which will be important for further research and proper identification of this species. Some photographs generated in the course of this study were shared with Steffen Bayer and appeared with our permission in the recent taxonomic revision of *Psechrus* (Bayer 2012). Based on this, Bayer was able to include a brief description of the male palp of *P. kunmingensis* in his monograph. In this paper, we are able to provide a more complete description of the male anatomy and coloration, measurement data, and a survey of intraspecific variation.

## Methods

Specimens were preserved in 75% ethanol. Female copulatory organs were dissected and cleared in 90% lactic acid for a few minutes. Photographs were taken with Nikon digital Sight DS-Fi1 mounted on Nikon SMZ1000 Stereoscopic Zoom Microscope. Copulatory organs were illustrated using Adobe Illustrator CS5, with a Wacom Bamboo CTL-660 pen and tablet device. Illustrations were rendered in Adobe Photoshop CS5 Extended.

All measurements are in millimeters (mm), and taken with Nikon NIS-Elements Imaging Software Br (version 2.34). All scale bars are 0.5mm length. We measured two male specimens and 5 female specimens to obtain size range data. Specimens were

selected to cover the widest possible size range. The “prosoma length” or “opisthosoma length” respectively refers to length of the main part of prosoma or opisthosoma, without spinnerets and petiolus. The whole “body length” is regarded as length from clypeus to the posterior tip of opisthosoma. Every individual was given a code, consisting of abbreviation of the locality and a sequence number. For instance, “KM18” represents a specific specimen collected from Kunming. Non-quantitative descriptions of somatic morphology are based on KM37 (female) and KM38 (male). Palpal and leg spination pattern is given as: prolateral, dorsal, retrolateral, ventral (the latter digit may be omitted in the case of the absence of ventral spines) (Jäger and Kunz 2010). The term “subadult” female refers to specimens that possess only pre-epigynes (Bayer 2011). All material is deposited at College of Agronomy and Bioscience, Dali University, Yunnan, China, except the following specimens, which are deposited at Sencenber Museum, Frankfurt am Main, Germany (SMF): 1 male (KM04), one female (KM07) and one subadult female (KM25).

## Abbreviations

ALE—anterior lateral eyes, AME—anterior median eyes, PLE—posterior lateral eyes, PME—posterior median eyes; C—conductor, CB—cymbium, E—embolus, EA—embolic apophysis; CD—copulatory duct, CO—copulatory opening, FD—fertilisation duct, LL—lateral lobe, MS—median septum, SB—spermathecal base, SG—muscle sigilla, SH—spermathecal head, SO—slit sense organ; I, II, III, IV—legs I to IV.

## Taxonomy

### *Psechrus kunmingensis* Yin, Wang & Zhang, 1985

[http://species-id.net/wiki/Psechrus\\_kunmingensis](http://species-id.net/wiki/Psechrus_kunmingensis)

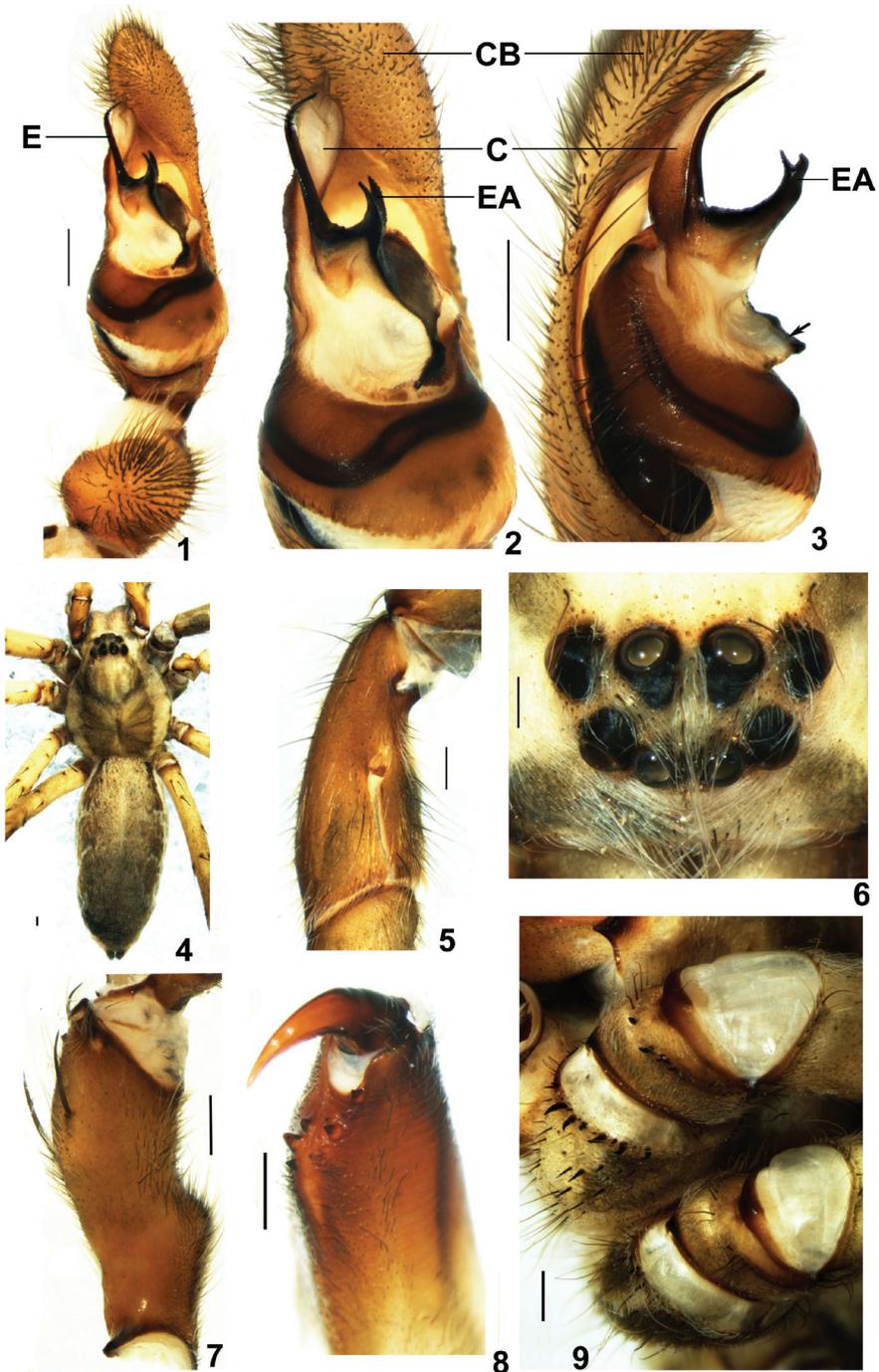
Figs 1–24

*P. kunmingensis* Yin, Wang & Zhang 1985: 25, Fig. 5A–D (Description and illustration of female).

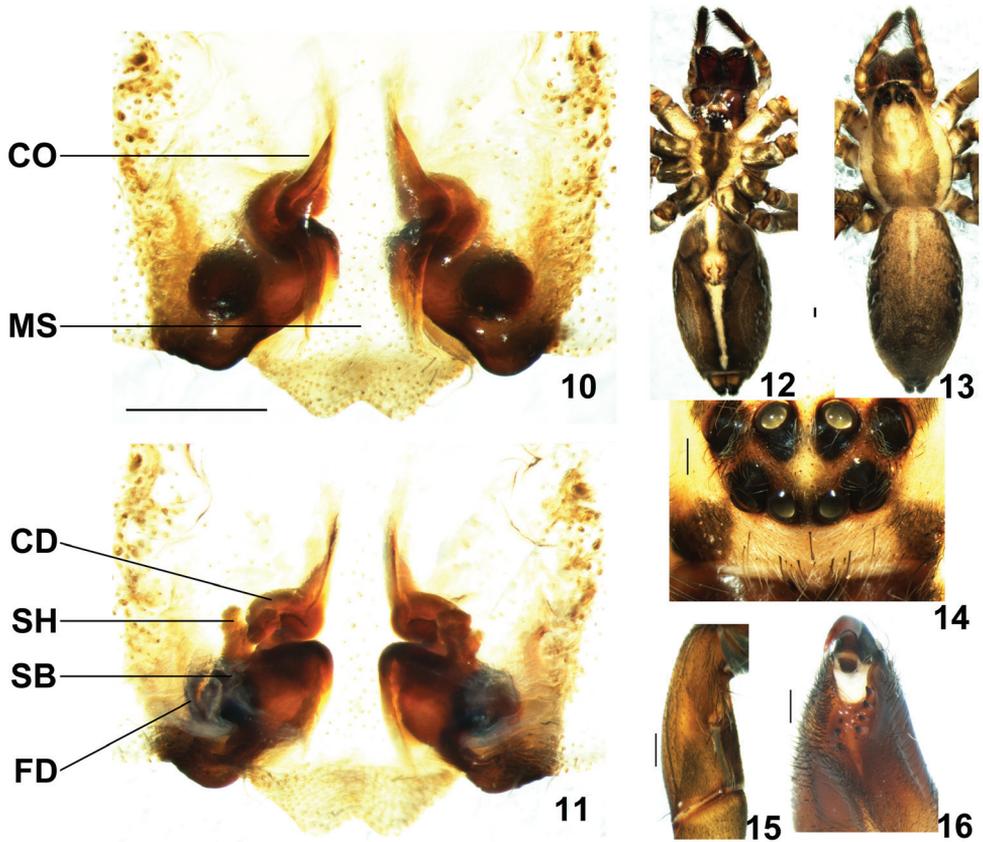
*P. kunmingensis* Song, Zhu & Chen 1999: 397, Fig. 232C–D, O–P (Illustration of male and female).

*P. kunmingensis* Wang & Yin 2001: 334, Figs 9–10 (Description and illustration of female).

**Material examined.** China, Yunnan Province: Xi Shan, Kunming, 2260m, 24°57'24.3"N, 102°37'43.7"E: 4 ♂ (KM01-04), 6 ♀ (KM05-10), 27-IV-2004, Zi Zhong Yang leg.; 5 ♀ (KM11-15), 27-IV-2004, Zhi Sheng Zhang leg.; 1 ♂ (KM18), 5 ♀ (KM16-17, KM19-21), 2 subadults (KM22, KM25), 12 juveniles (KM23-24, KM26-35), 20-IV-2011, Ping Feng and Yan Yan Ma leg.; 1 ♀ (KM36), 07-IX-2011, Zi Zhong Yang leg.; 1 ♂ (KM38),

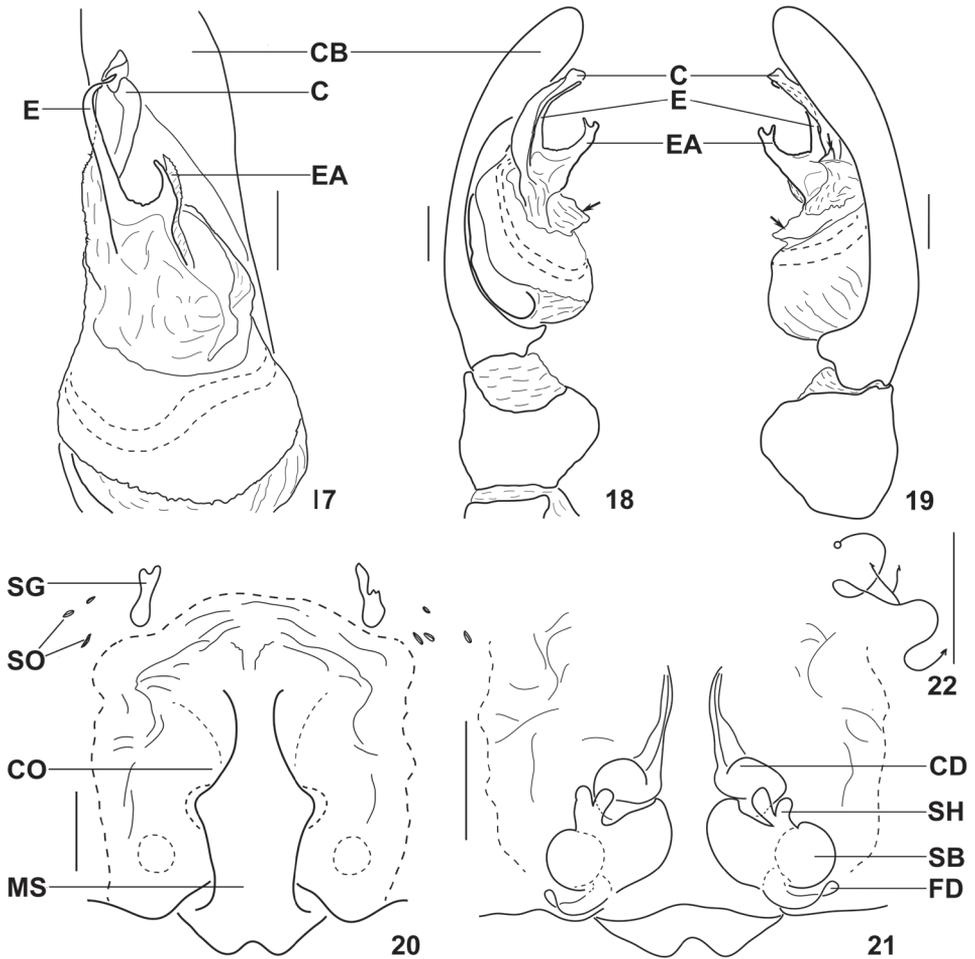


**Figures 1–9.** *Psecbrus kunmingensis* Yin, Wang & Zhang, 1985. Male (KM18). 1–3 left palp (1, 2 ventral 3 prolateral) 4 habitus, dorsal 5 left patella, retrolateral 6 eyes arrangement, dorsal 7 left femur , prolateral 8 left chelicera, retrolateral 9 left coxa I ventral. Arrow indicates a broad apophysis at embolic base. C conductor CB cymbium E embolus EA embolic apophysis (Scale bar 0.5mm).



**Figures 10–16.** *Psechrus kunmingensis* Yin, Wang & Zhang, 1985. Female (KM37). **10** epigyne, ventral **11** vulva, dorsal **12–13** habitus (**12** ventral **13** dorsal,) **14** eyes arrangement, dorsal **15** left patella, retrolateral **16** left chelicera, ventral. **CD** copulatory duct **CO** copulatory opening **FD** fertilisation duct **MS** median septum **SB** spermathecal base **SH** spermathecal head (Scale bar 0.5mm).

1 ♀ (KM37), 04-V-2011, Zong Xu Li leg.. Maguohe township (by the 101 provincial road), Malong county, Qujing, 1880m, 25°27'50.7"N, 103°22'42.8"E, 3 ♀ (ML01-03), 18-VII-2012, Ping Feng and Ting Bang Yang leg.. Dong Shan, Xuanwei, Qujing, ca 2150m, 26°12'42.0"N, 104°08'15.6"E, 10 ♀ (XW01-10), 7 juveniles (XW11-17), 17-VII-2012, Ping Feng, Yan Yan Ma and Ting Bang Yang leg.. Yongfeng town, Zhaotong, ca 1930m, 27°14'55.6"N, 103°40'10.6"E, 1 ♀ (ZT01), 23-VII-2004, Zi Zhong Yang leg.. Fenghuang Shan, Zhaotong, 1970m, 27°18'30.0"N, 103°42'16.7"E, 4 ♀ (ZT02-05), 14-VII-2012, Ping Feng and Yan Yan Ma leg.. Huaning county, Yuxi, ca 1660m, 24°10'59.3"N, 102°56'45.2"E, 1 ♀ (HN01), 09-VIII-2002, Jin Yin Lu leg.. Mopan Shan, Xinping county, Yuxi, ca 1630m, 24°01'21.3"N, 101°58'15.7"E, 2 ♀ (XP01-02), 05-V-2012, Zi Zhong Yang leg.. Lukou village (by the 204 provincial road), Luxi county, Honghe Autonomous Prefecture, 1600m, 24°28'30.2"N, 103°32'35.7"E, 3 ♀ (LX01-03), 1 juvenile (LX04), 27-VII-2012, Ping Feng and Ting Bang Yang leg.. Kaiyuan (by the 323 national road), Honghe Autonomous Prefecture, 1980m, 23°43'27.7"N,



**Figures 17–22.** *Psechrus kunmingensis* Yin, Wang & Zhang, 1985. Copulatory organs. **17–19** male palp (**17** ventral **18** prolateral **19** retrolateral) **20–22** female copulatory organ (**20** epigyne, ventral **21** vulva, dorsal **22** Schematic course of internal duct system). Arrow in Fig. 18 and the lower one in Fig. 19 indicate the broad apophysis at embolic base; the upper arrow in Fig. 19 indicate the triangular apophysis besides embolus. C conductor CB cymbium E embolus EA embolic apophysis CD copulatory duct CO copulatory opening FD fertilisation duct MS median septum SB spermathecal base SG muscle sigilla SH spermathecal head SO slit sense organ (Scale bar 0.5mm).

103°23'05.9"E, 5 ♀ (KY01-05), 1 juvenile (KY06), 26-VII-2012, Ping Feng and Yan Yan Ma leg.. Baila Shan, Luoping county, Qujing, 1710m, 24°52'20.1"N, 104°15'37.2"E, 1 ♀ (LP01), 19-VII-2012, Ping Feng and Yan Yan Ma leg.. Guizhou Province: Weining county (by the 326 national road), Bijie, 2330m, 26°51'44.0"N, 104°18'15.2"E, 1 ♀ (WN01), 15-VII-2012, Ping Feng, Yan Yan Ma and Ting Bang Yang leg.

**Type records.** Kunming, Yunnan Province, China, 1 ♀ holotype, 5-IV-1979, Jia Fu Wang leg.; 3 ♀ paratypes, VII-1983, Ming Yao Liu leg.; 4 ♀, 21-VII-1981, Jia Fu Wang leg.

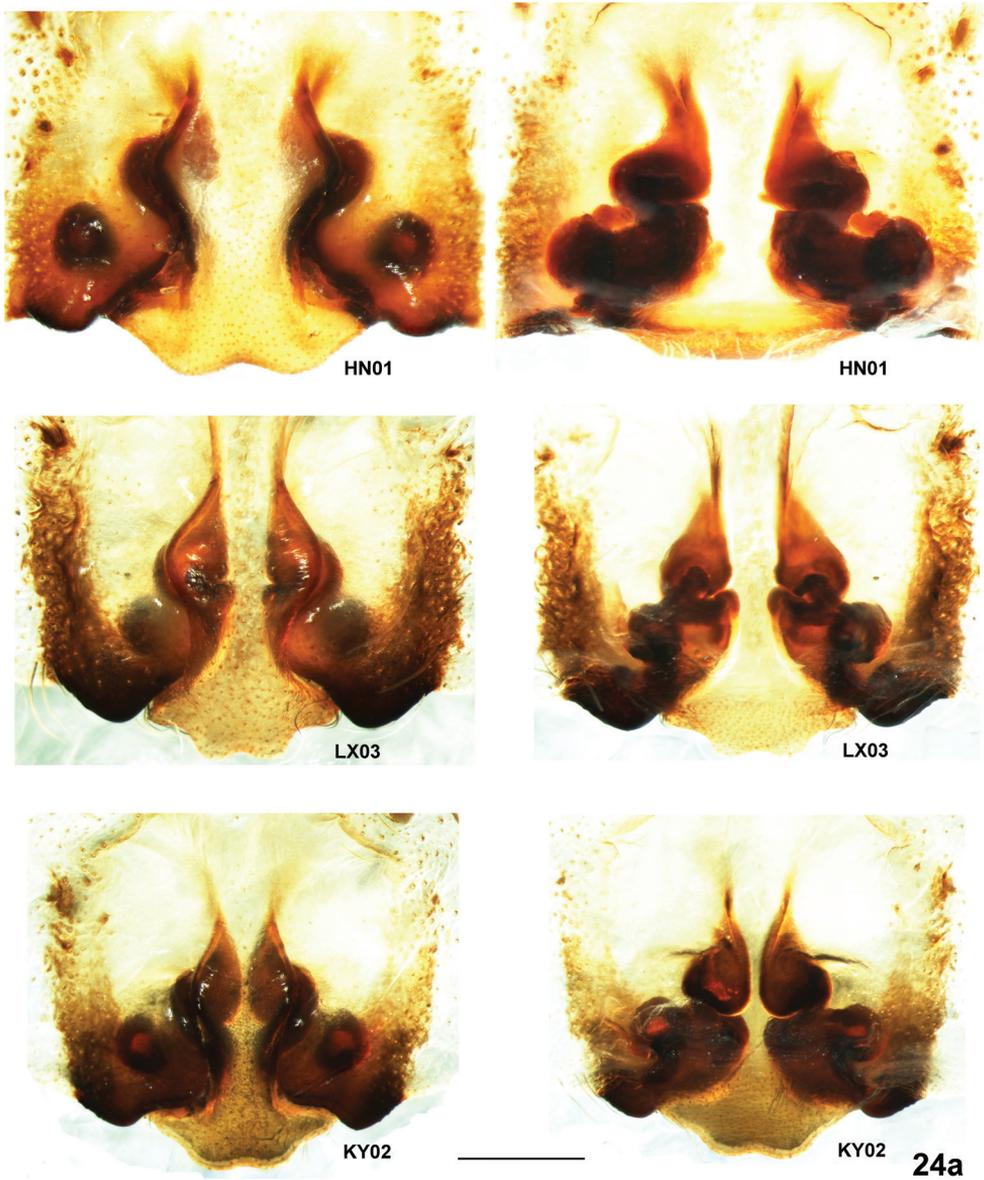


**Figure 23.** *Psechrus kunmingensis* Yin, Wang & Zhang, 1985. Intraspecific variation of male palp, retro-lateral. Arrows indicate the triangular apophysis besides embolus (Scale bar 0.5mm).

**Diagnosis.** Male resembles *P. sinensis* Berland & Berland, 1914 (Wang & Yin 2001: 338, Figs 25–26), *P. tingpingensis* Yin, Wang & Zhang, 1985 (Wang & Yin 2001: 340, Figs 31–33) and *P. triangulus* Yang et al., 2003 (Yang et al. 2003: 45, Figs D-F) by having an embolic basal apophysis (Figs 1–3) and a rounded bulge with dense patch of hairs on the ventral palpal femur (Fig. 7); distinguished from these species by: 1) embolic basal apophysis long and distally bifurcated (Figs 1–3, 17–19); 2) much longer embolus (almost as long as the width of the tegulum) (Figs 2, 17); 3) distal section of embolus directed retrolaterally. Female copulatory organs similar to *P. sinensis* (Wang & Yin 2001: 338, Fig. 28) and *P. jinggangensis* Wang & Yin, 2001 (Wang & Yin 2001: 335, Fig. 12) by having coiled copulatory ducts; distinguished from these species by the posteriorly and laterally lobed epigynal median septum, which interlocks with lateral lobe, and folds inward; the spermathecal heads arise anteriorly at spermathecae (Figs 11, 24a, 24b).

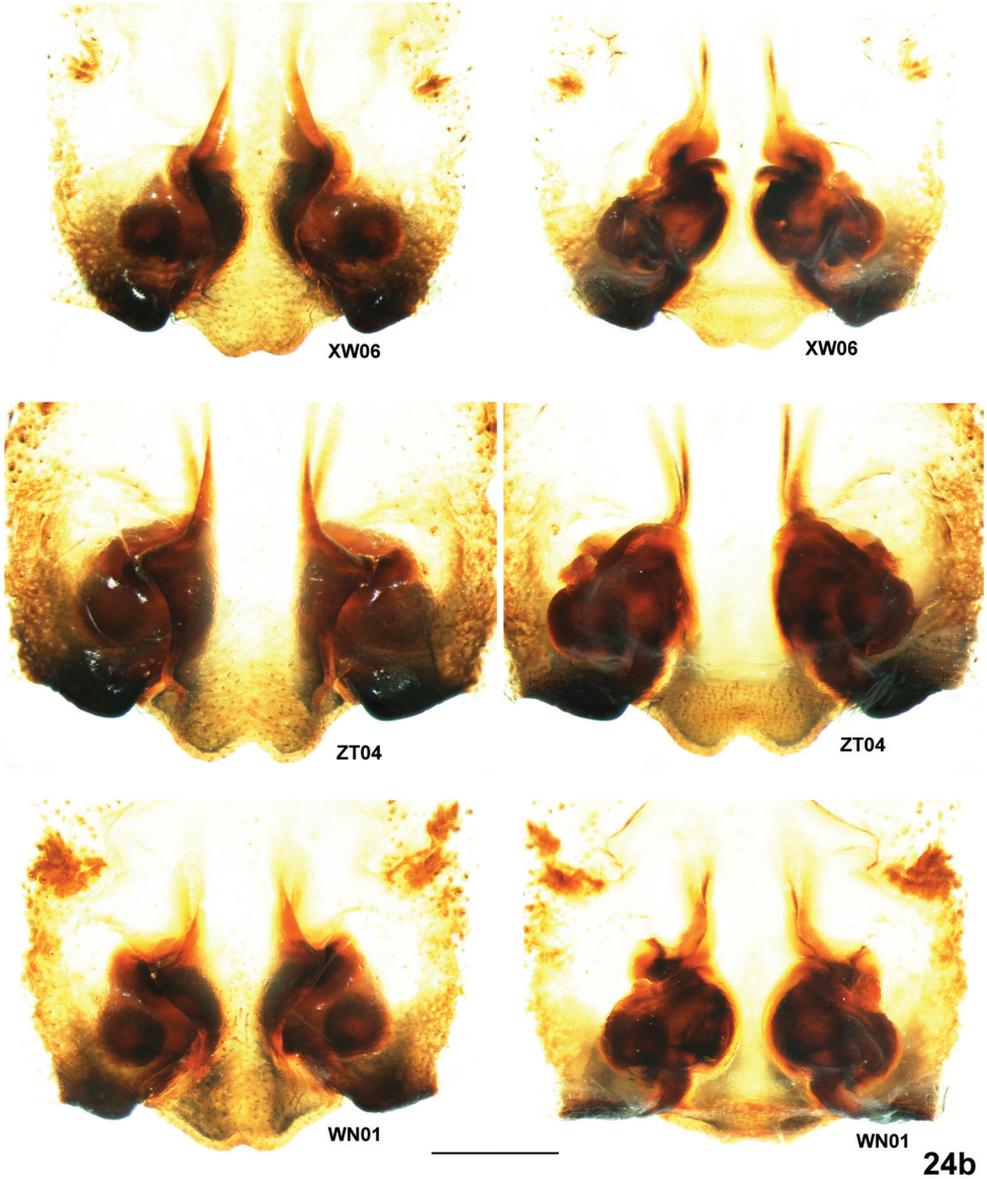
**Description.** Males (KM38 first, KM03 in parentheses): Body length 18.21 (15.05). Prosoma length 7.53 (6.46), prosoma width 5.89 (4.56), opisthosoma length 11.18 (7.37), opisthosoma width 5.08 (2.93). Eyes diameter: AME 0.32 (0.34), ALE 0.39 (0.37), PME 0.35 (0.37), PLE 0.43 (0.42). Distance between eyes: AME-AME 0.23 (0.18), AME-ALE 0.14 (0.08), ALE-PLE 0.53 (0.44), PME-PME 0.23 (0.25), PME-PLE 0.38 (0.33), AME-PME 0.57 (0.56). Clypeus height at AME 0.85 (0.76), clypeus height at ALE 0.80 (0.69).

Carapace brown, with a gray band at central part and white hair along the margin (Fig. 4). Cervical groove and fovea with dark stripe (Fig. 4). Eight eyes arranged in two recurved rows, eye region with long white hairs (Fig. 6). Sternum light brown, with an inverted triangle dark mark and long hairs. Labium deep reddish brown; gnathocoxae brown. Chelicerae yellow at basal part, and reddish brown at terminal



**Figure 24a.** *Psechrus kunmingensis* Yin, Wang & Zhang, 1985. Intraspecific variation of female copulatory organ (left row, epigyne, ventral; right row, vulva, dorsal). (Scale bar, 0.5mm).

part, with 3 promarginal, 5 retromarginal teeth, and 3 denticles (Fig. 8). Legs yellow to reddish brown; Coxae and trochanteri of the first walking legs with short macrosetae in a distal row each (Fig. 9). Patellae of legs with a slit at retrolateral side (Fig. 5). Dorsal opisthosoma dark gray, with a pair of longitudinal black patches at lateral side, and pairs of white radiative patches. Ventral opisthosoma with a white band, from pedicel to cribellum.



**Figure 24b.** *Psechrus kunmingensis* Yin, Wang & Zhang, 1985. Intraspecific variation of female copulatory organ (left row, epigyne, ventral; right row, vulva, dorsal). (Scale bar, 0.5mm).

Male palp: distal 1/3 part of dorsal palpal CB with dense scopula. Embolic base with a long and distally bifurcated apophysis (Figs 1–3, 17–19); conductor close to embolus, almost joined together along their entire lengths. In retrolateral view, there is a small triangular apophysis (as indicated by arrows) beside the embolus (Figs 19, 23); Tegulum with a broad apophysis (as indicated by arrows) under embolic base (Figs 3, 18–19). Sperm duct visible through tegulum, follows slightly meandering path ven-

trally (Figs 1, 2, 17). Palpal tibia very short, with dense patch of hairs at retrolateral side (Fig. 1); palpal femur with a rounded bulge and dense patch of hairs (Fig. 7).

Spinination of palp and legs as shown in Table 1; Measurements of the palp and legs as shown in Table 2. KM38 first, KM03 in parentheses. Leg formula: 1423.

Females (KM37 first, together with those of others [KM05, KM06, KY02 and ZT04] given as ranges in parentheses): Body length 16.75 (14.17–20.30). Prosoma length 7.09 (5.15–7.50), prosoma width 5.07 (4.26–4.83), opisthosoma length 9.90 (8.52–13.46), opisthosoma width 5.08 (4.19–7.75). Eyes diameter: AME 0.33 (0.30–0.33), ALE 0.36 (0.44–0.47), PME 0.39 (0.38–0.44), PLE 0.43 (0.41–0.47). Distance between eyes: AME–AME 0.20 (0.18–0.16), AME–ALE 0.11 (0.07–0.13), ALE–PLE 0.59 (0.42–0.55), PME–PME 0.29 (0.24–0.27), PME–PLE 0.34 (0.35–0.37), AME–PME 0.64 (0.55–0.53). Clypeus height at AME 0.75 (0.72–0.83), clypeus height at ALE 0.72 (0.71–0.81).

Coloration (Figs 12–13) as in male only generally darker; other characters as in male except as noted. Chelicerae with 3 promarginal, 5 retromarginal teeth, and 4 denticles (Fig. 16). Patellae of legs with a slit at retrolateral side (Fig. 15).

Female copulatory organ: the SO and SG are outside the epigynal field (the SO are anterior and lateral to the epigyne, while the SG are right anterior to the epigyne); the MS lobed at the posterior and lateral edges; there are many wrinkles at the epigyne, especially at the anterior part (Fig. 20); the shadow of the round spermathecae is evidently visible through the ventral view of epigyne (Fig. 10). Copulatory ducts coiled; the spermathecae is mostly covered by folds of LL and MS; the spermathecal heads arise anteriorly at spermathecae (Figs 11, 21). The incision at posterior margin of MS, shape of lobes of MS, the length of CD and shape of SH vary a lot (Fig. 24); schematic course of internal duct system shown in Fig. 22.

Note. Illustrations given in previous publications about *P. kunmingensis* were wrong with the arising position of the spermathecal heads or the position of the spermathecae. Yin et al. (1985, 25, Fig. 5A–D) and Song and Chen (1999, 397 Fig. 232 C–D) were almost the same. They mis-illustrated the spermathecal heads arise posteriorly. The spermathecae are at lateral vulva not medial vulva as shown by Wang and Yin (2001, 334, Figs 9–10).

Spinination of palp and legs as shown in Table 1; Measurements of the palp and legs as shown in Table 2. KM37 first, those of others given as ranges in parentheses. Leg formula: 1423.

**Intraspecific variation.** All 6 examined males were collected from the type locality. The distal fork of EA is relatively variable (Fig. 23): one male (KM18) with 2 short and tiny apophysis, some with relatively strong and blunt forks (KM01, KM04 and KM38), while others exhibit slender and sharp forks with the ventral one curved distally (KM02 and KM03).

All examined adult females vary in many aspects (Figs 10–11, 24a, 24b): 1) the number of SO varies from five (KM05, ZT01, HN01 and WN01) to seven (KM37 and KM36); 2) incision at posterior margin of MS is less distinct in some individuals (XW06, WN01, LX03 and KY02), but others are evident and symmetrical (KM37,

**Table 1.** Spination of palp and legs of *Psechrus kunmingensis* Yin, Wang & Zhang, 1985

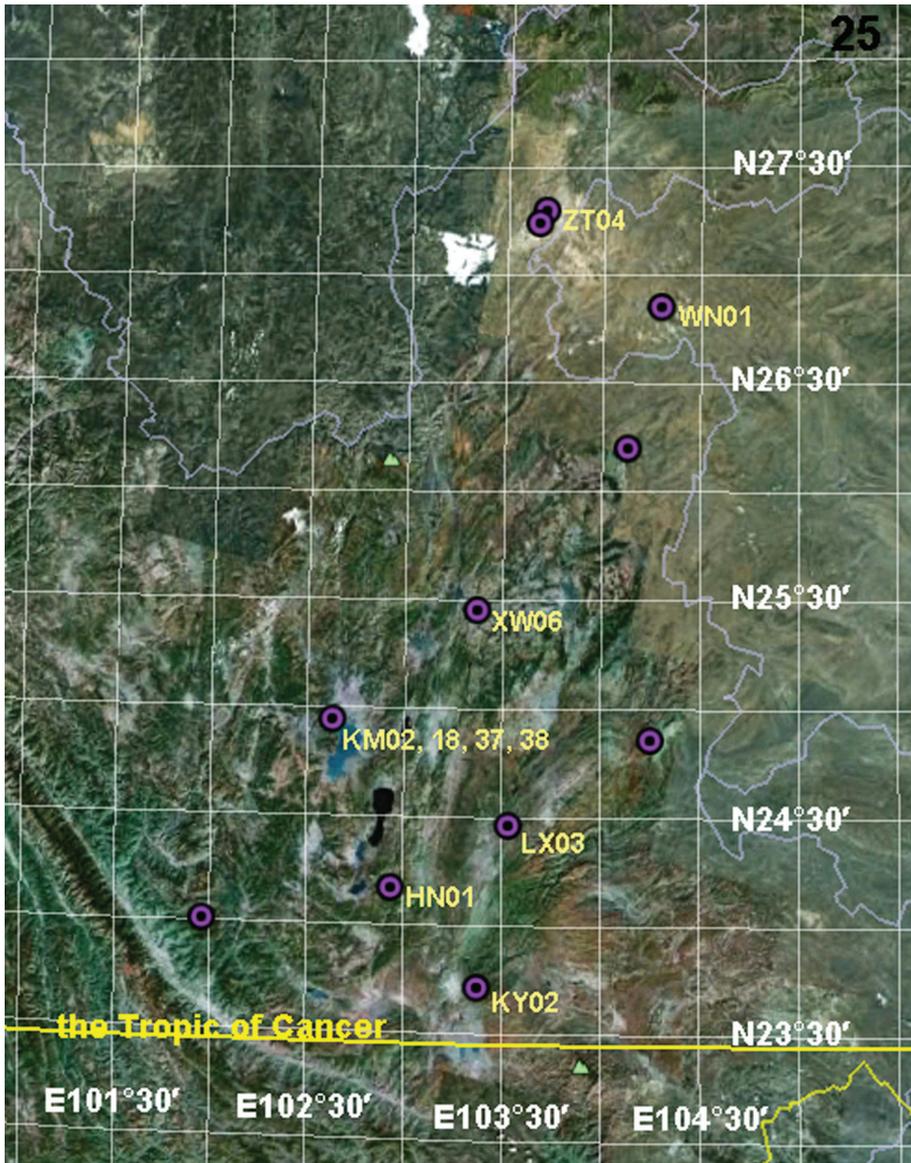
Male	Femur	Patella	Tibia	Metatarsus
Palp	131	000	000	–
I	625	000	3038	4041
II	526	000	3036	3035
III	536	000	2033	3035
IV	435	000	3024	3035
Female	Femur	Patella	Tibia	Metatarsus
Palp	131	020(010 right)	012	2031
I	525	000	3037	2025
II	525	000	3036	2025
III	425	000	2034	3035
IV	543	000	2034	3045

**Table 2.** Measurements of palp and legs of *Psechrus kunmingensis* Yin, Wang & Zhang, 19850

Male	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
Palp	2.94(2.81)	1.24(1.06)	1.08(0.96)	–	3.55(3.00)	8.81(7.83)
I	14.04(11.99)	3.70(3.00)	17.36(14.12)	16.18(13.07)	6.83(5.83)	58.11(48.01)
II	12.50(10.42)	3.21(2.76)	12.97(10.71)	12.58(10.33)	5.09(4.69)	46.35(38.91)
III	9.13(7.69)	2.72(2.25)	7.89(6.55)	8.55(7.13)	3.75(3.43)	32.04(27.05)
IV	12.80(10.27)	3.10(2.33)	12.98(10.30)	13.14(10.95)	5.60(5.30)	47.62(39.15)
Female	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
Palp	2.74 (2.74–3.38)	1.18 (1.05–1.61)	1.32 (1.45–1.61)	–	2.29 (2.29–3.30)	7.53 (7.53–9.90)
I	10.11 (9.98–10.17)	3.27 (2.85–3.27)	11.52 (10.24–11.52)	9.41 (8.84–9.41)	5.11 (4.26–5.11)	39.42 (37.96–36.45)
II	8.31 (8.31–11.93)	2.78 (2.43–3.40)	9.06 (8.40–13.27)	7.61 (7.28–11.09)	4.23 (3.89–5.82)	31.99 (30.79–45.51)
III	6.94 (6.66–7.55)	2.28 (2.05–2.42)	5.93 (5.34–6.36)	5.33 (5.04–6.16)	3.33 (2.90–3.47)	23.81 (21.99–25.96)
IV	9.36 (8.91–10.57)	2.53 (2.08–2.90)	8.95 (8.28–9.50)	8.02 (7.84–8.81)	4.38 (4.15–4.38)	33.24 (31.26–36.07)

HN01 and ZT04); The epigyne of female specimens collected from Zhaotong (the northernmost locality) to Kaiyuan (the southernmost localiy) show disciplinary changes: the lateral bulges of MS range from very sharp (ZT04) to really broadly rounded (KY02); the CD vary from broad and distinctly visible (KM37, HN01, LX03 and KY02 ) to almost invisible (WN01 and ZT04); almost the whole spermathecae are covered (KM37, XW06, ZT04) to more than half part spermathecae are exposed (HN01, LX03 and KY02); 6) spermathecal heads show huge variation in shape and length, and among the dissected vulvae, no two are exactly the same, even opposing sides of the same individual.

**Distribution.** CHINA: Yunnan Province (Kunming, Qujing, Zhaotong, Yuxi, Honghe), Guizhou Province (Bijie), see Fig. 25.



**Figure 25.** Known collecting localities of *Psechrus kunmingensis* Yin, Wang & Zhang, 1985. The labels near the dots indicate the specimens those shown in the above figure plates.

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