ZooKeys 198: 1–23 (2012)
doi: 10.3897/zookeys.198.3030
www.zookeys.org

RESEARCH ARTICLE

A peer-reviewed open-access journal
ZooKeys
Launched to accelerate biodiversity research

Serpula and *Spiraserpula* (Polychaeta, Serpulidae) from the Tropical Western Atlantic and Gulf of Guinea

Rolando Bastida-Zavala[1,†]

1 *Laboratorio de Sistemática de Invertebrados Marinos (LABSIM), Universidad del Mar, campus Puerto Ángel, Ciudad Universitaria, Apdo. Postal 47, Puerto Ángel, Oaxaca, 70902, México*

† *urn:lsid:zoobank.org:author:1512199F-C9A2-41FC-B474-786F512D38B7*

Corresponding author: *Rolando Bastida-Zavala* (rolando@angel.umar.mx)

Academic editor: *Chris Glasby* | Received 29 February 2012 | Accepted 15 May 2012 | Published 30 May 2012

urn:lsid:zoobank.org:pub:E560B1E4-2C12-45A9-B026-EE942C6EC240

Citation: Bastida-Zavala R (2012) *Serpula* and *Spiraserpula* (Polychaeta, Serpulidae) from the Tropical Western Atlantic and Gulf of Guinea. ZooKeys 198: 1–23. doi: 10.3897/zookeys.198.3030

Abstract

Six species of *Serpula* and *Spiraserpula* were identified, mainly, from the material of the expeditions of the Rosenstiel School of Marine and Atmospheric Science, University of Miami, including two new species of *Serpula*. *Serpula madrigalae* **sp. n.** from the Turks and Caicos has a tube with five longitudinal ridges, four rows of alveoli and a medium-sized shallow symmetrical opercular funnel with 17 radii, and an inner surface with opercular tubercles. *Serpula vossae* **sp. n.** from the Western Caribbean and Bahamas has a tube with 6–8 longitudinal ridges, and a large, deep symmetrical opercular funnel, with 21–33 radii, and a smooth inner surface. *Serpula* cf. *vermicularis*, recorded from the Gulf of Guinea (tropical eastern Atlantic), is distinguished from the nominal species in possessing fewer opercular radii (33–39) and the lack of a proximal rasp in the bayonet chaetae; tubes are missing. The distribution range is extended for the three known *Spiraserpula* species found in the collections, *S. caribensis*, *S. karpatensis* and *S. ypsilon*.

Resumen

Seis especies de *Serpula* y *Spiraserpula* fueron identificadas, principalmente del material de las expediciones de la Rosenstiel School of Marine and Atmospheric Science, University of Miami, incluyendo dos nuevas especies de *Serpula*. *Serpula madrigalae* **sp. n.** es descrita de las Turks y Caicos, se caracteriza por tener un tubo con cinco costillas longitudinales, con cuatro hileras de alvéolos y un embudo simétrico, mediano y somero, con 17 radios, y la superficie opercular interna con tubérculos. *Serpula*

vossae **sp. n.** es descrita del Caribe occidental y Bahamas; su tubo tiene 6–8 costillas longitudinales, un embudo opercular simétrico, largo y profundo, con 21–33 radios, y la superficie opercular interna lisa. *Serpula* cf. *vermicularis* es registrada del golfo de Guinea (Atlántico oriental tropical); se distingue de la especie nominal por tener menos radios operculares (33–39) y le falta la denticulación fina proximal en las setas bayoneta, los tubos se perdieron. Para las tres especies de *Spiraserpula* halladas, *S. caribensis*, *S. karpatensis* y *S. ypsilon*, se amplió el ámbito de distribución.

Keywords
Annelida, Bahamas, Caribbean, new records, new species, taxonomy, Turks and Caicos

Introduction

Serpula Linnaeus, 1758 the type genus of the polychaete family Serpulidae Rafinesque, 1815, has 31 species (ten Hove and Kupriyanova 2009, Pillai 2009). Six species have been described in the Eastern Atlantic and Mediterranean, including the type species, *S. vermicularis* Linnaeus, 1767, *S. concharum* Langerhans, 1880, *S. lobiancoi* Rioja, 1917, *S. planorbis* Southward, 1963, *S. israelitica* Amoureux, 1976 and *S. cavernicola* Fassari & Mòllica, 1991. However, there are taxonomic problems in some species because they were poorly described and/or recorded from widely separated localities. For example, *S. vermicularis* has been recorded from several tropical, subtropical, temperate and cold water localities of the world (Kupriyanova 1999). There is a consensus now that *S. vermicularis*, previously considered to be a cosmopolitan species, is ill-defined and its distribution is possibly restricted to temperate and cold waters of the North Atlantic Ocean and Mediterranean (ten Hove and Jansen-Jacobs 1984, Imajima and ten Hove 1984, Kupriyanova and Jirkov 1997, Kupriyanova 1999, ten Hove and Kupriyanova 2009).

In the Western Atlantic, the genus *Serpula* is very poorly known, as only two species have been recorded: *S. vermicularis granulosa* by Day (1973) from Beaufort, North Carolina, and *Serpula* sp. A by ten Hove and Wolf (1984) from the northeastern Gulf of Mexico. Another taxon, *S. sombreriana* McIntosh, 1885, from Sombrero and St. Thomas Islands, lacks an operculum and was therefore transferred to *Hyalopomatus* (Ben-Eliahu and Fiege 1996).

The current state of our knowledge on *Serpula* species, compared to that of almost 100 species of *Hydroides* (ten Hove and Kupriyanova 2009, Pillai 2009), is probably explained by the fact that most tropical *Serpula* species are sublittoral and many extend their distribution into deeper waters. In cold and temperate waters, *Serpula* species can be present in shallow waters, attain larger sizes (Kupriyanova 1999), and form large aggregations, even reefs (Ramos and San Martin 1999).

Spiraserpula Regenhardt, 1961 was established initially for fossil serpulids. Pillai and ten Hove (1994) revised the Recent species belonging to the genus. They described 16 species out of 19 currently included in the genus, and eight of them were from the Caribbean. The main distinguishing feature of this genus is their complex internal tube

structures (ITS), described by Pillai and ten Hove (1994). Unfortunately, the species remain mostly unknown to non-specialists, mainly because they are tiny, most are sublittoral, and often overlooked or confused with other taxa.

This work is part of a larger study examining subtidal and deep sea serpulids from the Grand Caribbean region and from the Gulf of Guinea, tropical eastern Atlantic.

Materials and methods

Between 1963 and 1975, the Rosenstiel School of Marine and Atmospheric Science (RSMAS) conducted the University of Miami Deep Sea Expeditions aboard of R/V Gerda, John Elliot Pillsbury, James M. Gillis and Columbus Iselin, and sampled more than 3,350 stations from the Gulf of Panama, throughout the Caribbean to the Gulf of Guinea, the Straits of Florida, the Bahamas, the area northward to the Bermudas and the deep basins and the deep waters, from the intertidal to 8,650 m in the Puerto Rico Trench (Voss et al. 1977, Bastida-Zavala et al. 2001). The revision of the serpulid material from these expeditions resulted in finding of 11 *Serpula* and 10 *Spiraserpula* specimens from the western Caribbean, Bahamas, Turks and Caicos, Los Roques Islands, Trinidad and Tobago, and in the Gulf of Guinea.

Additionally, two specimens of *Serpula* (recorded by Bastida-Zavala and Salazar-Vallejo 2000) and 14 specimens of *Spiraserpula* of the collections of El Colegio de la Frontera Sur and the Instituto de Oceanología of Cuba were available for study. Type specimens were deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C. Other specimens were deposited in the collections of the respective lending institutions.

The specimens of *Serpula* and *Spiraserpula* were fixed with 10% formalin and preserved with 70% alcohol. They were studied in a standardized way (ten Hove and Jansen-Jacobs 1984, Bastida-Zavala and ten Hove 2002). Line drawings were made using a camera lucida, and the photographs were taken with a digital camera Canon G11 fitted to a microscope adapter.

The main standard measurements and observations on *Serpula* were: total length (measured from most distal part of the operculum to the pygidium), thoracic width (measured from the collar region level), number of thoracic chaetigers, number of radioles in each lobe of the branchial crown, number of longitudinal ridges on the tube (not counting basal ridges attached to the substratum), presence or absence of peristomes, transverse ridges or alveoli on the tube, opercular length (measured from the base of funnel, or constriction, if present, to the tips of the radii), opercular diameter (measured across the distal part of the funnel), number of funnel radii, number of teeth on bayonet chaetae and the presence or absence of a proximal rasp in these chaetae. An exploratory analysis of the number of opercular radii and body length ratio of the *Serpula* species is included. Scales of figures and photographs are in millimeters.

The following abbreviations are used in the text:

Collections

ECOSUR Colección de Referencia. El Colegio de la Frontera Sur, Chetumal, Quintana Roo, México.
UMML Marine Invertebrate Museum, Rosenstiel School of Marine and Atmospheric Science, University of Miami, Miami, Florida, USA.
UMAR Colección de Invertebrados Marinos, Universidad del Mar, Puerto Ángel, Oaxaca, México.
USNM National Museum of Natural History, Washington D.C., USA.

Characters

OL Opercular length
OD Opercular diameter
THW Thoracic width
TL Total length of the body

Statistical terms

n sample size
r: range of data
μ mean
± standard deviation

Systematics

Class Polychaeta Grube, 1850
Family Serpulidae Rafinesque, 1815

Genus *Serpula* Linnaeus, 1758

Type species. *Serpula vermicularis* Linnaeus, 1767 by subsequent designation (Heppell 1963) under the plenary powers of the International Commission on Zoological Nomenclature (Evans and China 1966).

***Serpula madrigalae* sp. n.**
urn:lsid:zoobank.org:act:1EACCEA3-111D-4F4A-AF5B-CD03E15FBF6C
http://species-id.net/wiki/Serpula_madrigalae
Figs 1A–D, 2A–G, 5, 6

Type locality. Turks and Caicos. East of Caicos Island.

Type material. Turks and Caicos. Holotype (USNM 1157006), RV Pillsbury, cruise 7106, sta. 1423, 21°41'N, 71°23'W, 10-feet otter trawl, 18 m, July 19, 1971 (ex UMML 22.1054).

Description. Tube color greenish yellow (Fig. 2A–B); with five longitudinal ridges, lateral-most ridges larger than middle ones (Figs 1C–D, 2A–B); lacking transverse ridges and peristomes; with four rows of alveoli, more evident between dorsal-most longitudinal ridges (Figs 1C, 2A–B).

Body yellowish-brown, branchial crown and operculum yellow pale (preserved material only, Fig. 2C). TL= 20 mm; THW= 1.6 mm. Branchial crown with 18 radioles in each lobe; lacking branchial membrane.

Peduncle smooth, with well-defined constriction (Fig. 2D); inserted in left lobe. Club-shaped pseudoperculum present.

Operculum with moderately long, shallow, symmetrical funnel; lacking bulbous basal part (Figs 1A, 2D–E). OL= 2.3 mm, OD= 1.4 mm. Interradial grooves 1/3 of funnel length (Figs 1A, 2E). Funnel has 17 radii with rounded tips. Opercular inner surface with irregular tubercles (Figs 1B, 2D).

Collar thick, with short ventral and dorsal lobes. Thorax consists of seven chaetigers. Collar chaetal fascicles symmetrical with regard to size and composition, unlike in some specimens of *S. vossae* sp. n. Bayonet chaetae with two blunt-elongate teeth, distal blade smooth, lacking proximal rasp (Figs 2F); hooded (capillary) chaetae present (Fig. 2G).

Thoracic membranes well developed, narrowing toward to last thoracic chaetigers, fused ventrally, forming a short apron. Remaining six thoracic chaetigers with hooded (limbate) chaetae of two sizes; saw-shaped uncini.

Anterior part of abdomen lacking distinct achaetous region. Anterior and middle abdominal chaetigers with flat-trumpet chaetae. Posterior chaetigers with 'capillary' chaetae. Anterior and posterior uncini saw-shaped.

Etymology. Named after my wife, Dr Socorro García-Madrigal, a specialist on crustaceans, who gave me the necessary encouragement and time to undertake this research.

Distribution. Only recorded from the vicinity of Caicos Island, Turks and Caicos Islands (Fig. 6).

Ecology. Sublittoral, 18 m. In the same sample there were other serpulids: *Pomatostegus stellatus*, *Pseudovermilia multispinosa*, *Spirobranchus giganteus*, and *Vermiliopsis annulituba*.

Remarks. *Serpula madrigalae* sp. n. resembles other *Serpula* species with symmetrical, moderately long and shallow funnels, such as *S. cavernicola*, *S. granulosa* Marenzeller, 1884, *S. israelitica* Amoureux, 1976, *S. jukesii* Baird, 1865, *S. narconensis* Baird, 1865, *S. oshimae* Imajima & ten Hove, 1984, *S. tetratropia* Imajima & ten Hove,

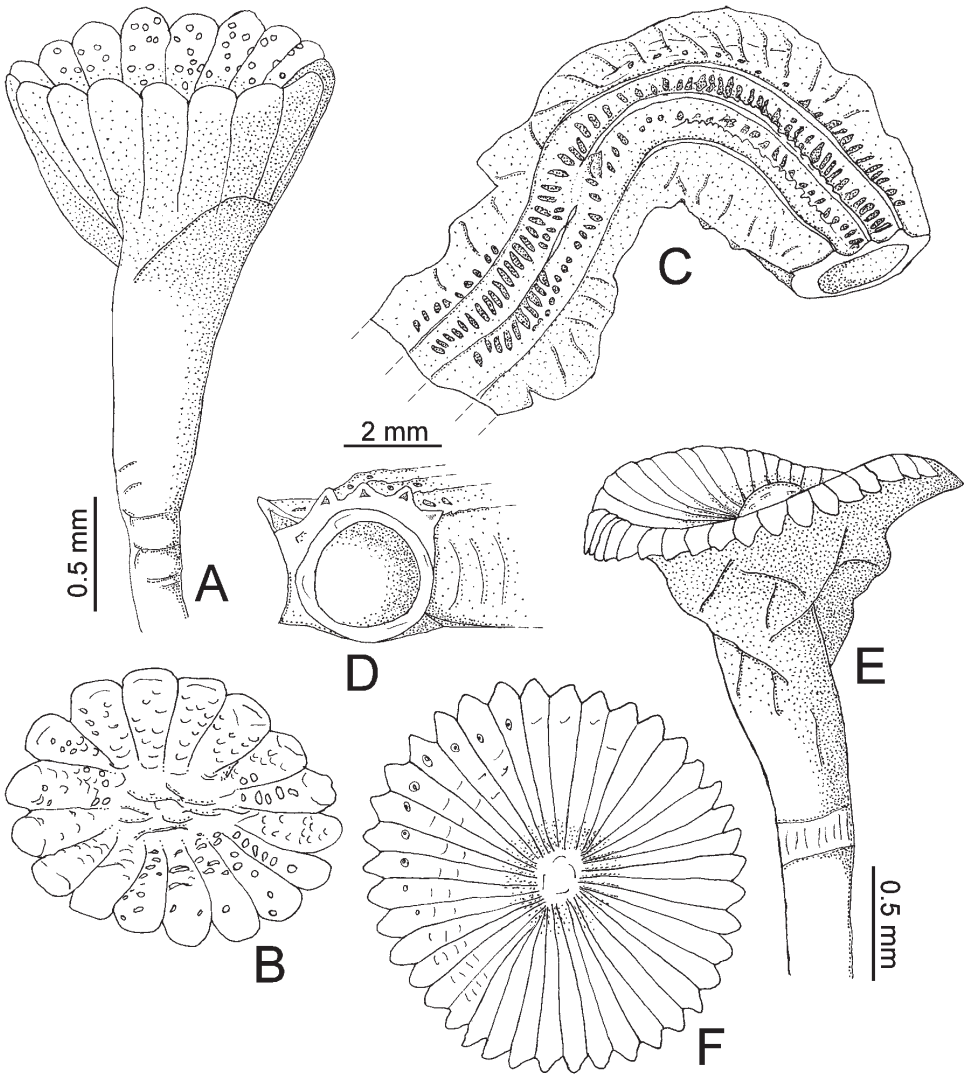


Figure 1. A–D *Serpula madrigalae* sp. n., from Turks and Caicos Islands, USNM 1157006, holotype **A–B** operculum in lateral and aboral views **C–D** tube in dorsal and frontal views **E–F** *Serpula* cf. *vermicularis*, from Nigeria, UMML 22.545 **E–F** operculum in lateral and aboral views.

1984, *S. vermicularis* Linnaeus, 1767, and *S. zelandica* Baird, 1865. However, *S. madrigalae* sp. n. differs from all other *Serpula* species with regard to its characteristic tube which has five longitudinal ridges and four rows of alveoli (Figs 1C–D, 2A–B).

Serpula madrigalae sp. n. resembles *S. vermicularis granulosa*, in having tubercles on the internal surface of the operculum; however, the diagnosis of the latter species

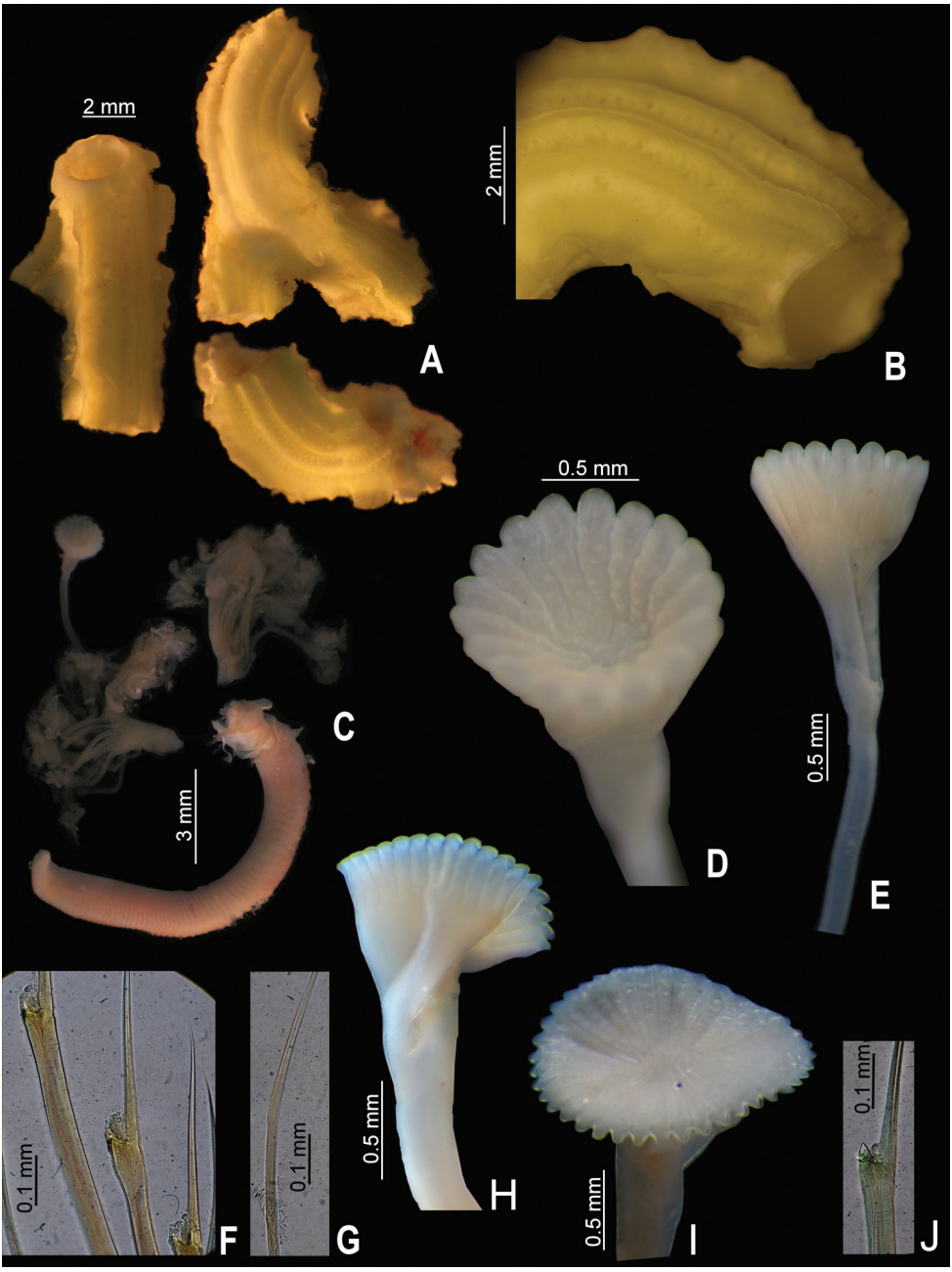


Figure 2. A–G *Serpula madrigalae* sp. n., from Turks and Caicos, USNM 1157006, holotype **A–B** tube and detail **C** entire body **D–E** operculum, in aboral and lateral views **F** bayonet chaetae **G** hooded (capillary) chaetae **H–J** *Serpula* cf. *vermicularis*, from Nigeria, UMML 22.545 **H–I** two distinct opercula in lateral and aboral views **J** bayonet chaetae.

was brief (Day 1973). At least *S. madrigalae* sp. n. differs by the tube with five longitudinal ridges and four rows of alveoli (Figs 1C–D, 2A–B), while *S. vermicularis granulosa* is "faintly ridged" (Day 1973:131); also, Day (1973) mentioned more opercular radii (20–40) than present in *Serpula madrigalae* sp. n. (17, Figs 1B, 5).

Serpula madrigalae sp. n. also resembles *Serpula* sp. A, from the northeastern part of the Gulf of Mexico, with regard to the shape of the operculum, the number of radii and the depths from which they were collected. However, they differ with regards to other features: *S. madrigalae* sp. n. has irregular tubercles on the internal surface of the operculum (Figs 1B, 2D) and lacks a proximal rasp in the bayonet chaetae (Fig. 2F), while *Serpula* sp. A lacks tubercles (ten Hove and Wolf 1984, Fig. 55–8a) and has bayonet chaetae with a proximal rasp. Additionally, ten Hove and Wolf (1984) mentioned that all the specimens lacked their tubes. Hence is not possible to assign the specimens recorded as *Serpula* sp. A. to *S. madrigalae* sp. n.

***Serpula vossae* sp. n.**
urn:lsid:zoobank.org:act:3165E4EF-A4B8-47B2-B500-D5C8C1557646
http://species-id.net/wiki/Serpula_vossae
Figs 3A–D, 4A–J, 5, 6

Serpula sp. Bastida-Zavala and Salazar-Vallejo, 2000:852–854, fig. 4B–K.

Type locality. Honduras. Southwest of Honduras.

Type material. Holotype (USNM 1157004), RV Pillsbury, cruise 6802, sta. 629, 15°58'N, 86°09'W, 40 m, March 21, 1968 (ex UMML 22.611); paratype (USNM 1157005), RV Pillsbury, cruise 6802, sta. 628, Honduras, East of Cayos Cochinos, 15°57'N, 86°15'W, 47 m, March 21, 1968 (ex UMML 22.610).

Additional material. Guatemala. One complete specimen (UMML 22.1053) RV Pillsbury, cruise 6802, sta. 613, West of Punta Cortes, 15°58'N, 88°20'W, 10-feet otter trawl, 39 m, March 19, 1968. **México.** One complete specimen (ECOSUR s.n.) RV Edwin Link sta. 2792, 13 km from East of Isla Mujeres, Quintana Roo, 21°14'N, 86°36'W, 130 m, August 28, 1990, E. Escobar and L. Soto leg. **Cuba.** One complete specimen (Instituto de Oceanología de Cuba) Cayo Diego Pérez, Golfo de Batabanó, 15 m, July 20, 1988, D. Ibarzábal leg. **Bahamas.** Two complete specimens (UMML 22.435) RV Gerda, cruise 6433, sta. 391, North of Bahamas, 27°20'N, 79°11'W, screen dredge, 68 m, September 19, 1964.

Description. Tube color brownish, or light brown to white; with 6–8 longitudinal ridges, all similar in size; some tubes with shallow transverse ridges, forming a rugged surface, other tubes lacking transverse ridges; most tubes lacking peristomes, two have only one peristome with appearance of a groove with shallow growth lines. Tubes lacking alveoli (Fig. 4A, C–D).

Body pale yellow (preserved material only, Fig. 4B). TL= 38.5 mm (n=7, r:20–45.5, μ=36.6 ±10.3); THW= 2 mm (n=7, r:1.5–3.4, μ=2.3 ±0.6). Branchial crown

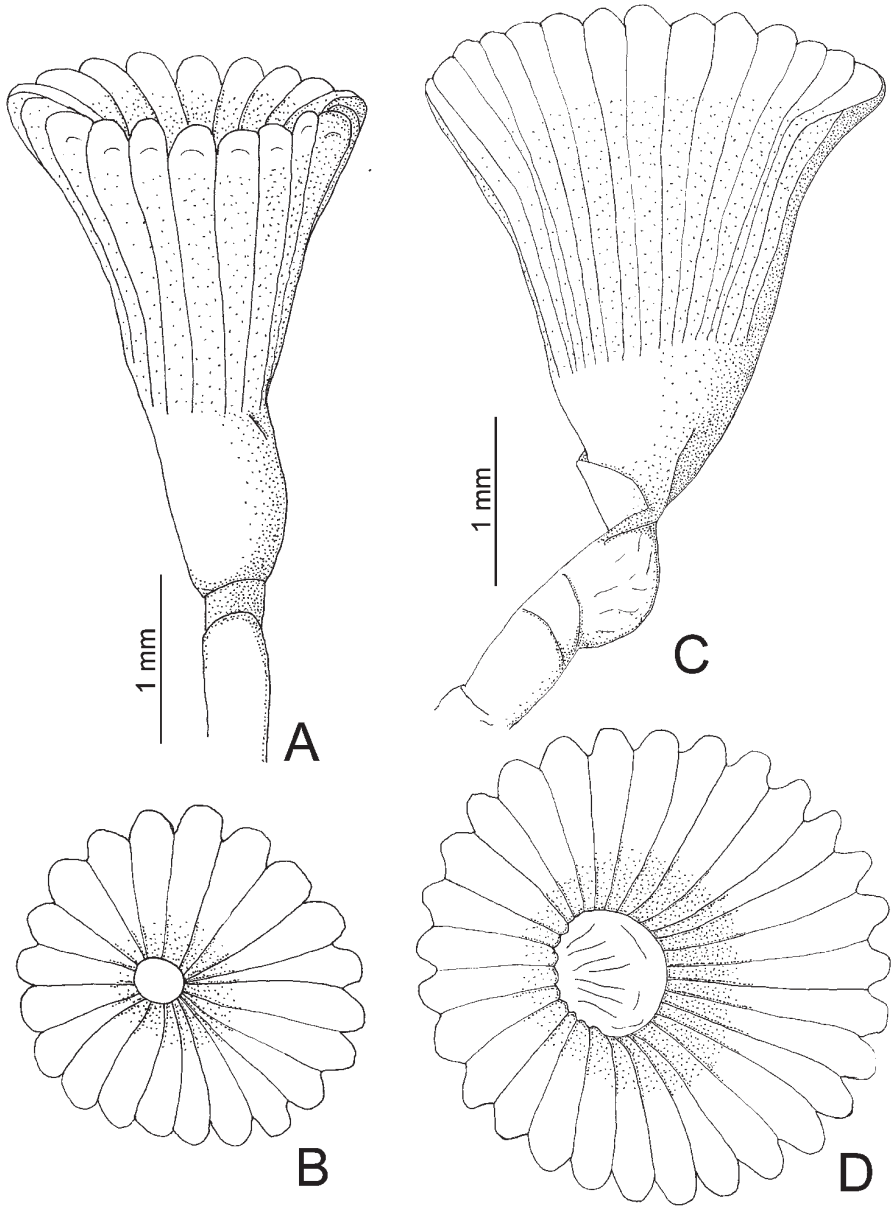


Figure 3. A–D *Serpula vossae* sp. n., from Honduras, USNM 1157004, holotype **A–B** operculum in lateral and aboral views; from Bahamas, UMML 22.435 **C–D** operculum in lateral and aboral views.

with 29 radioles (n=7, r:19–37, μ=30.9 ±6.4) left, and 29 right (n=7, r:12–35, μ=30.9 ±8.8); lacking branchial membrane (Fig. 4E).

Peduncle smooth with insertion on left (n=2) or right (n=5); with shallow (n= 4) to well-defined constriction (n= 3) (Figs 3A, C, 4H–J). Pseudoperculum club-shaped, present in all specimens.

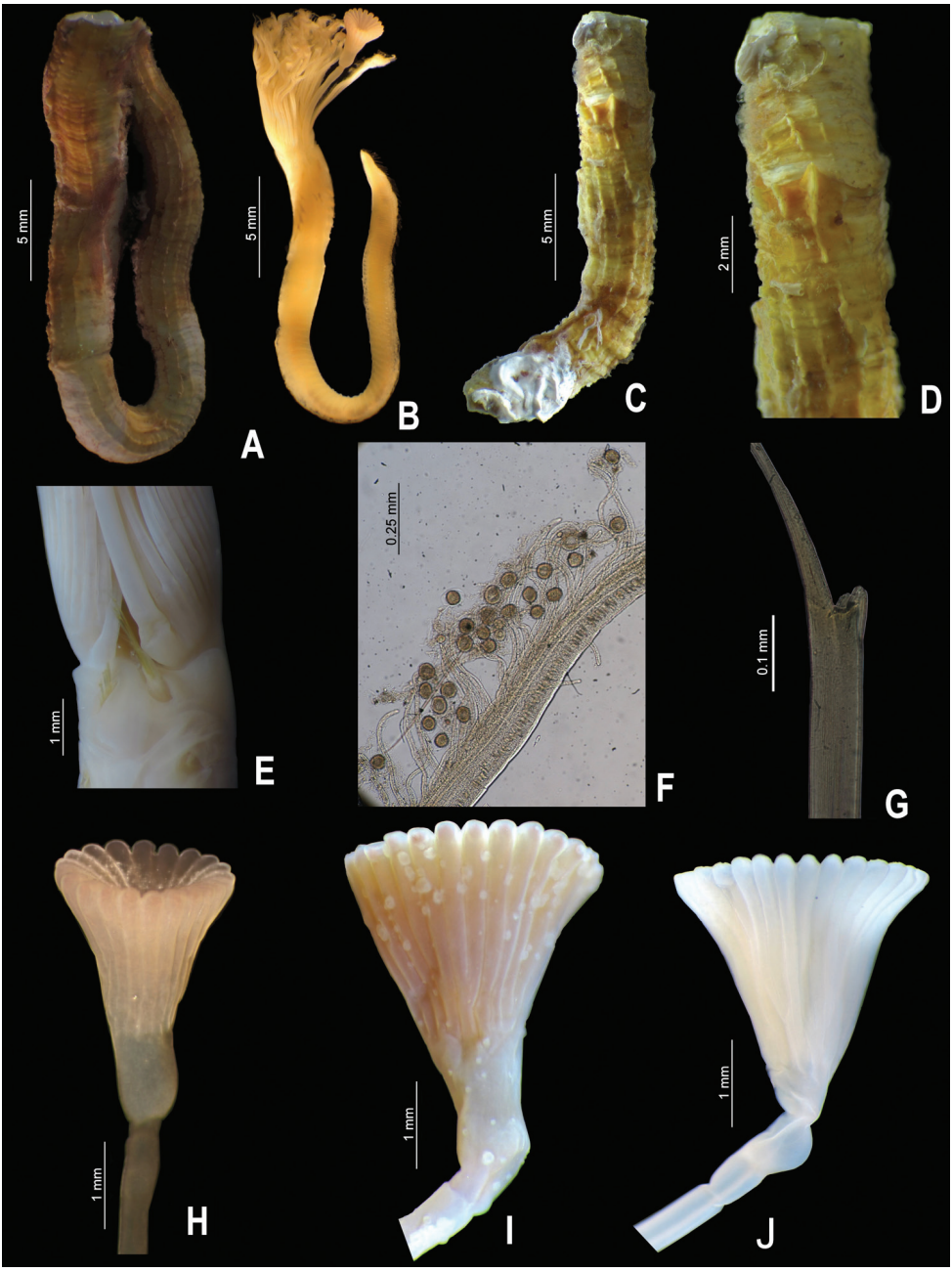


Figure 4. A–J *Serpula vossae* sp. n., from Honduras, USNM 1157004, holotype **A** tube **B** entire body; from Guatemala, UMML 22.1053 **C–D** tube and detail of peristome; from Bahamas, UMML 22.435 **E** collar region; from Cuba, IO **F** radiole with eggs; from Honduras, USNM 1157004, holotype **G** bayonet chaetae **H** operculum; from Guatemala, UMML 22.1053 **I** operculum; from Bahamas, UMML 22.435 **J** operculum.

Operculum with long, deep symmetrical funnel; with a slightly bulbous basal part above constriction (Figs 3A, C, 4H–J). OL= 3.2 mm (n=7, r:2–4.5, μ=3.3 ±0.8), OD= 2 mm (n=7, r:1.4–2.8, μ=2.3 ±0.5). Interradial grooves 2/3 of funnel length. Funnel with 21 radii (n=7, r:21–33, μ=27.4 ±3.7) with rounded tips (Figs 3A, C, 4H–J). Opercular inner surface lacking tubercles (Fig. 3A–D).

Collar thick, with short ventral and dorsal lobes. Thorax consists of seven chaetigers. Collar fascicles in three specimens asymmetrical with regard to sizes and number of chaetae; right fascicle with larger and more chaetae than left fascicle (Fig. 4E). Bayonet chaetae with two blunt-elongate teeth, distal blade smooth, lacking proximal rasp (Fig. 4G); hooded (capillary) chaetae present.

Thoracic membranes well developed, narrowing toward last thoracic chaetigers, fused ventrally, forming a short apron. Remaining six thoracic chaetigers with hooded (limbate) chaetae of two sizes; saw-shaped uncini.

Anterior part of abdomen lacks a distinct achaetous region. Anterior and middle abdominal chaetigers with flat-trumpet chaetae. Posterior chaetigers with 'capillary' chaetae. Anterior and posterior uncini saw-shaped.

Variation. Operculum of holotype (USNM 1157004) has roseate radial tips (Fig. 4H); the rest of specimens are yellow to white (Fig. 4I–J). Operculum and radioles of specimen from Guatemala (UMML 22.1053) have hard particles adhered, possibly salt concretions (Fig. 4I); operculum more rigid compared with the other specimens.

Etymology. Named after Professor Nancy Voss, a distinguished cephalopod specialist and Director of the Marine Invertebrate Museum, who generously loaned the serpulid samples from the oceanographic expeditions of the University of Miami.

Distribution. Tropical Caribbean. Bahamas, Cuba, Mexican Caribbean, Guatemala and Honduran Caribbean (Fig. 6).

Ecology. Sublittoral, 15 to 130 m. On rocky and sandy bottoms, and associated with siliceous sponges and several syllid polychaetes specimens. In the same samples, there were other serpulids: *Hyalopomatus* sp., *Hydroides parvus*, *Pomatostegus stellatus*, *Pseudovermilia fuscostriata*, *P. occidentalis*, *Spiraserpula ypsilon*, and a vermetid shell.

Reproductive characters. The specimen from Cayo Diego Pérez, Cuba, has eggs adhering to the pinnules of the radioles. The eggs, circular to slightly oval, are 55–68 μm (Fig. 4F).

Remarks. *Serpula vossae* sp. n. resembles other *Serpula* species with long and deep symmetrical funnels, as in *S. columbiana* Johnson, 1901, *S. concharum* Langerhans, 1880, *S. longituba* Imajima, 1979, *S. sinica* Wu & Chen, 1979, *S. uschakovi* Kupriyanova, 1999, *S. vittata* Augener, 1914, and *S. watsoni* Willey, 1905. However, *S. vossae* sp. n. differs in having an operculum with a smooth inner surface, while *S. watsoni* has tubercles (Pillai 2009); *S. vossae* sp. n. has fewer opercular radii (21–33, Figs 4B–D, 5) than *S. columbiana* (55–160) or *S. uschakovi* (62–136) (Kupriyanova 1999); *S. vossae* sp. n. has 6–8 longitudinal ridges in the tube (Fig. 4A, C–D), while *S. columbiana*, *S. longituba* and *S. uschakovi* lack longitudinal ridges

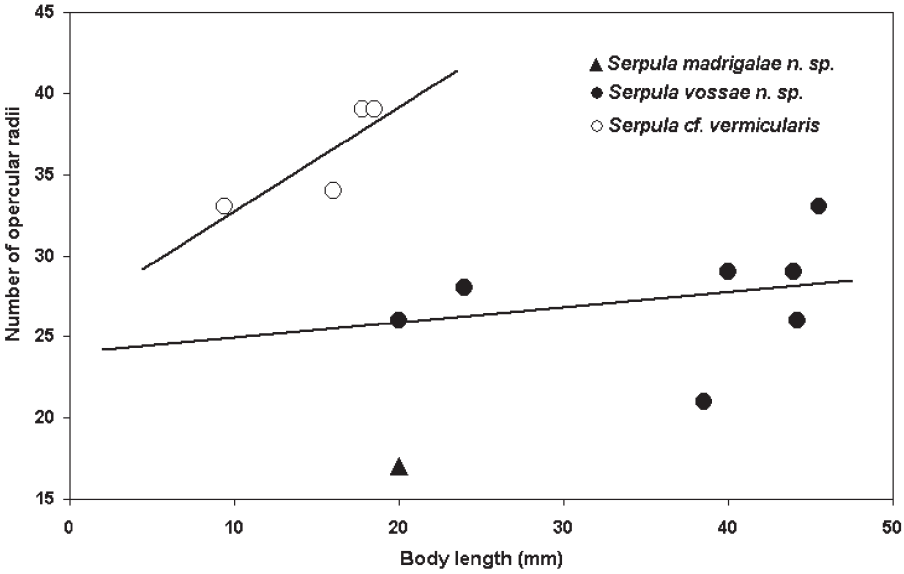


Figure 5. Exploratory analysis of the number of opercular radii and body length ratio: *Serpula madrigalae* sp. n. (n= 1, only for reference), *S. vossae* sp. n. (n= 7), and *S.* cf. *vermicularis* (n= 4).

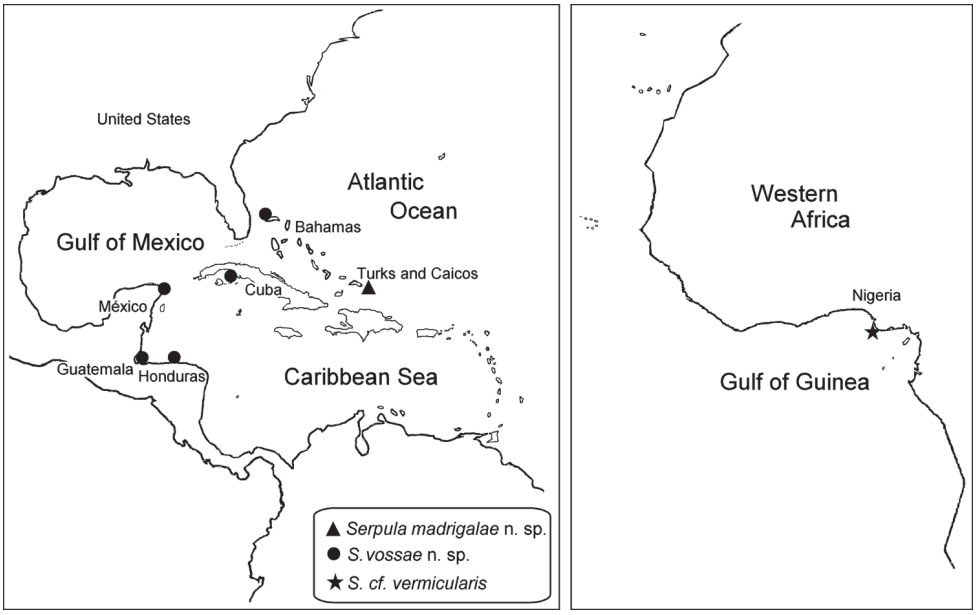


Figure 6. Distribution of *Serpula madrigalae* sp. n., *Serpula vossae* sp. n., and *Serpula* cf. *vermicularis*.

(Imajima 1979, Kupriyanova 1999), whereas *S. concharum*, *S. vittata*, and *S. watsoni* have five or less (Rioja 1931, Imajima 1977, 1982); *S. vossae* sp. n. has more radioles per branchial lobe (19–37) than *S. concharum* (6–15), *S. longituba* (9–10),

S. sinica (13), while *S. uschakovi* has even more (43–61) than *S. vossae* sp. n. *Serpula vossae* sp. n. has collar chaetae with two teeth (Fig. 4G), while *S. longituba* lacks bayonet chaetae (Imajima 1979), *S. sinica* has bayonet chaetae lacking basal teeth (Wu et al. 1979), and *S. vittata* and *S. watsoni* have 10 and five basal teeth in the bayonet chaetae, respectively (Imajima 1977, 1982). These characters and others have been compared in Table 1.

Regarding the *Serpula* species recorded in the Western Atlantic, *S. vossae* sp. n. differs from *S. vermicularis granulosa* Day, 1973, from Beaufort, North Carolina, because the former has a longer, deeper operculum, and lacks tubercles on the internal funnel surface (Figs 3A–D, 4H–J); while *S. vossae* sp. n. differs from *Serpula* sp. A (ten Hove and Wolf 1984) and *S. madrigalae* sp. n. because the former has a longer and deeper operculum, with more opercular radii (21–33) than the latter (*Serpula* sp. A has 18 radii, *S. madrigalae* sp. n. has 17).

Serpula vossae sp. n. differs from *S.* cf. *vermicularis*, recorded here from Nigeria, in the same characters mentioned for *S. vermicularis granulosa*, and, additionally in having fewer opercular radii in relation to the body length than the latter (Fig. 5).

Serpula cf. *vermicularis*

Figs 1E–F, 2H–J, 5, 6

Material examined. Nigeria. Five specimens (UMML 22.545), RV Pillsbury, sta. 248, Southeast of Lagos, 4°05'N, 5°40'E, 10-foot try-net, 33 m, May 13, 1965.

Description. Tubes missing. Body light brown (preserved material only). TL= 18.5 mm (n=4, r:9.4–18.5, μ=36.6 ±10.3); THW= 1.7 mm (n=5, r:1.2–1.7, μ=1.6 ±0.2). Thoracic membranes and opercular peduncles of all the specimens damaged. Branchial crown with 27 radioles (n=4, r:19–27, μ=23.8 ±3.4) left, and 25 right (n=4, r:17–25, μ=22.5 ±3.7); lacking inter-radiolar membrane.

Peduncle smooth, with insertion on left (n=2) or right (n=2); lacking constriction between it and operculum, its position represented only by a slight change in color (Figs 1E, 2I). Club-shaped pseudoperculum present in all specimens.

Operculum with short, shallow symmetrical funnel; lacking bulbous basal part (Figs 1E, 2I). OL= 2 mm (n=4, r:1.3–2.1, μ=1.9 ±0.4), OD= 1.8 mm (n=4, r:1.1–1.8, μ=1.6 ±0.3). Interradial grooves 1/4 of funnel length (Fig. 2H). Funnel with up to 39 radii (n=4, r:33–39, μ=36.3 ±3.2) with blunt tips (Fig. 1E–F). Opercular inner surface lacking tubercles (Figs 1E–F, 2I).

Collar thick, with ventral and dorsal lobes short. Thorax consists of seven chaetigers. Collar chaetal fascicles symmetrical with regard to size and composition unlike in *S. vossae* sp. n. Bayonet chaetae with two blunt-elongate teeth, distal blade smooth, lacking proximal rasp (Fig. 2J); hooded (capillary) chaetae present.

Thoracic membranes apparently well developed (membranes damaged), narrowing toward posterior thorax, fused ventrally, forming a short apron. Remaining six thoracic chaetigers with hooded (limbate) chaetae of two sizes; saw-shaped uncini.

Table 1. Comparison between *S. vossae* sp. n. and other similar species (AD) = according to published illustrations.

Species:	***S. columbiana***	***S. concharum***	***aS. longitub***	***S. sinica***	***S. uschakovi***	***S. vittata***	***S. watsoni***	***S. vossae***
Localities	Puget Sound	Atlantic of Spain and Mediterranean	Kushimoto Harbour, South Japan	South China Sea	Sea of Japan	Micronesia, Melanesia, West Australia	Sri Lanka, Japan, Micronesia, Melanesia, South China Sea, Australia	West Caribbean and Bahamas
References	Kupriyanova 1999, Bastida-Zavala 2008	Rioja 1931, Zibrowius 1968, Bianchi 1981	Imajima 1979 (as *Semiserpula*)	Wu et al. 1979	Kupriyanova 1999	Augener 1914, Imajima 1982, Imajima and ten Hove 1984, 1986	Willey 1905, Imajima 1977, 1982, Imajima and ten Hove 1984, 1986, Pillai 2009	This work
Depth (m)	15–60	0–500	30–40	202–219	15	7–11	shallow	15–130
Tube color	white	white	white	violet-red	white	brownish	white	white to brownish
Longitudinal ridges	absent	3–5, smooth	absent	?	?	5	5	6–8
Transverse ridges	present	absent (AD)	absent	?	?	present	?	present
Peristomes	absent	absent (AD)	absent	?	absent	absent	absent	absent to one
Alveoli	absent	absent (AD)	absent	?	?	absent	absent	absent
TL (mm)	56	(13–25) 15–20	29	17	120	31	24	20–45.5
TW (mm)	6	(1–1.5)	0.8	?	11	1.5	1.8	1.5–3.4
Opercular radii	55–160	15–25	32	32	62–136	18–23	25–55	21–33
Opercular tubercles on inner surface	present	?	absent (AD)	?	present	absent	present	absent
Constriction	well defined	well defined	well defined	well defined (AD)	absent	well defined	well defined	well defined

Species:	***S. columbiana***	***S. concharum***	***aS. longitub***	***S. sinica***	***S. uschakovi***	***S. vittata***	***S. watsoni***	***S. vossae***
Sides of thoracic membrane	not fused	apron	apron	?	short apron	not fused	apron	short apron
Number of radioles per branchial lobe	10–35	6–15	9–10	13	43–61	16–30	22–30	12–37
Teeth of bayonet chaetae	2	2–4	not applicable	0	2	10	5	2
Proximal rasp of bayonet chaetae	absent	?	not applicable	present	absent	present	absent	absent

Abdomen with anterior achaetous region. Anterior and middle abdominal chaetigers with flat-trumpet chaetae. Posterior chaetigers with 'capillary' chaetae. Anterior and posterior uncini saw-shaped.

Variation. Two specimens with a hyaline circle in radii tip (Fig. 1F). One specimen with few inconspicuous tubercles in interior funnel surface.

Distribution. Nigeria, Gulf of Guinea (Fig. 6).

Ecology. Sublittoral, 33 m.

Remarks. *Serpula* cf. *vermicularis* resembles the nominal species; unfortunately, the tubes of all the specimens are missing. There are some differences with the nominal species, particularly with regard to the number of radii: *Serpula* cf. *vermicularis* has 33–39 opercular radii (Fig. 1F, 2I, 5), while Zibrowius (1968) recorded specimens from Marseille with more than 40 opercular radii, and Kupriyanova and Jirkov (1997) recorded specimens from Norway and Iceland with a mean of 50.8 opercular radii; and the proximal rasp of the bayonet chaetae: *Serpula* cf. *vermicularis* lacks a proximal rasp (Fig. 2J), while Rioja (1931) and Kupriyanova (1999, Table 1) mentioned that their specimens have a proximal rasp.

Zibrowius (1973) recorded several specimens as *S. vermicularis*, from Western Africa (from Angola to Morocco); unfortunately the description was too brief and did not included figures; however, Zibrowius (1973) mentioned that the specimens that he reviewed showed considerable variation.

Genus *Spiraserpula* Regenhardt, 1961

Type species. ***Spiraserpula spiraserpula*** **Regenhardt, 1961** (fossil), by original designation.

Spiraserpula caribensis Pillai & ten Hove, 1994

http://species-id.net/wiki/Spiraserpula_caribensis
Figs 7A–D, 8

Spiraserpula caribensis Pillai & ten Hove 1994:68–76, Figs 3L, 14A–M, 15A–Y, 16A–K, Pls. 4E–F, 5A–E.

Type locality. Awa Blancu, Curaçao.

Material examined. Panama Caribbean. One specimen (ECOSUR P0615) Colon, Club Náutico, fouling prospection, June 3, 2002, S.I. Salazar-Vallejo leg. **Mexican Caribbean.** Nine specimens (ECOSUR P0614, P0616), two specimens (UMML 22.1061), two specimens (UMAR-Poly 110), Playa Azul, Cozumel, coral rock, 10 m, March 25, 2001, leg. H.A. ten Hove.

Description. Some specimens forming tube aggregations; others were found isolated. Tubes sinuous or spiraled (Fig. 7A), with two internal ridges: mid-dorsal one

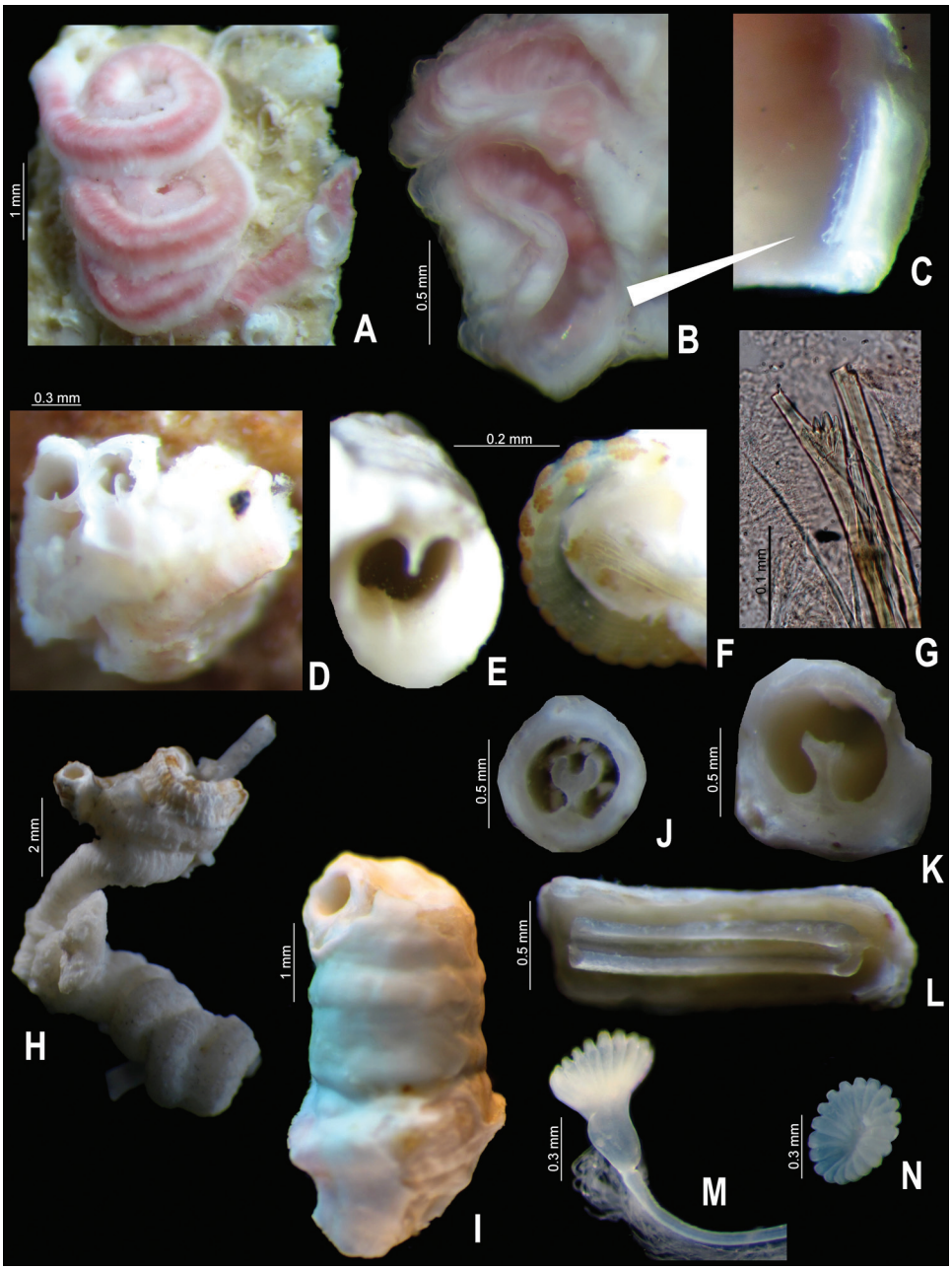


Figure 7. A-D: *Spiraserpula caribensis*, from Cozumel, UMAR-Poly 110 **A** complete tube **B–C** internal surface of the tube and detail of ventral internal ridge **D** other specimen with lateral internal ridges **E–F** *S. karpatensis*, from Los Roques Islands, UMML 22.1055 **E** detail of the mouth tube **F** abdomen with gametes **G–L** *S. ypsilon*, from Trinidad and Tobago, UMML 22.1059 **G** collar chaetae; from Bahamas, UMML 22.1056 **H** tube attached to *Pseudovermilia fuscostriata*; from Trinidad and Tobago, UMML 22.1059 **I** tube; from Honduras, UMML 22.1057 **J–K** tube in cross section **L** tube in longitudinal section **M–N** *Spiraserpula* sp., from Los Roques Islands, UMML 22.1060 **M–N** operculum, lateral and aboral views.

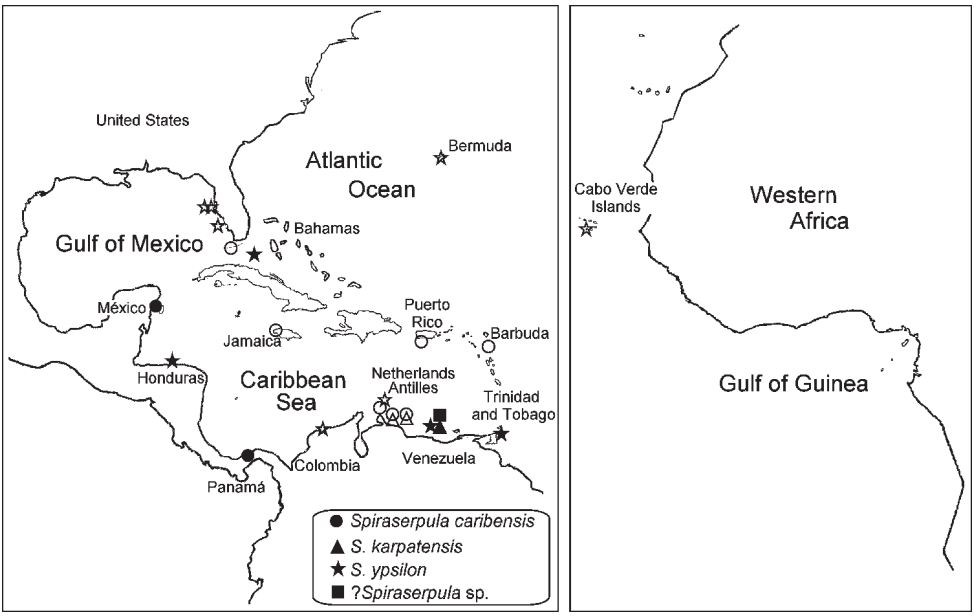


Figure 8. Distribution of *Spiraserpula caribensis*, *S. karpatensis*, *S. ypsilon* and ?*Spiraserpula* sp. Closed symbols denote examined material, open symbols literature records.

smooth, mid-ventral one serrated (Fig. 7B–C), occasionally with two internal lateral ridges (Fig. 7D). Some tubes externally pinkish, others with two dorsal pink bands (Fig. 7A–B). Body brown to dark brown (preserved material only). The worms are damaged. Branchial crowns lost. Thorax with eight chaetigers, including collar fascicles. Abdomen damaged.

Distribution. Caribbean, Florida and Pacific of Panama.

Ecology. Intertidal to sublittoral, 10 m. On coral debris. Pillai and ten Hove (1994) recorded the species from 0–18 m deep.

Remarks. *Spiraserpula caribensis* is easily distinguishable from the other Caribbean species by their pink tubes (Fig. 7A).

Spiraserpula karpatensis Pillai & ten Hove, 1994

http://species-id.net/wiki/Spiraserpula_karpatensis
Figs 7E–F, 8

Spiraserpula karpatensis Pillai & ten Hove 1994:64–65, Figs 3N, 11A–K.

Type locality. Karpata, Bonaire.

Material examined. Venezuela. One incomplete specimen and one empty tube (UMML 22.1055), RV Pillsbury, cruise 6806, sta. 745, North of Los Roques Islands, 11°58'N, 66°50'W, 10-feet otter trawl, 65 m, July 24, 1968.

Description. Empty tube larger (Fig. 7E) than occupied one attached to empty tubes of *S. ypsilon*. Tubes sinuous or spiraled, with two internal ridges: mid-dorsal one smooth, mid-ventral one serrated (Fig. 7E). Both tubes white, internal and externally (Fig. 7E). The branchial crown and thorax of incomplete specimen is missing. Abdomen partially transparent, with double packets of gametes in each segment (Fig. 7F).

Distribution. Eastern Caribbean. Bonaire, Curaçao and Los Roques Islands.

Ecology. Sublittoral, 65 m. On coral debris. Pillai and ten Hove (1994) recorded the species from depths of 10–30 m. The sample also contained two *Spiraserpula* species: *S. ypsilon* and *Spiraserpula* sp., a chaetopterid tube, a lumbrinerid and several empty tubes of serpulids resembling *Protula* and *Vermiliopsis*.

Remarks. *Spiraserpula karpatensis* resembles *S. caribensis* with regard to the dorsal and ventral ridges (Fig. 7C, E); however, *S. karpatensis* does not possess pinkish tubes unlike *S. caribensis*.

***Spiraserpula ypsilon* Pillai & ten Hove, 1994**
http://species-id.net/wiki/Spiraserpula_ypsilon
Figs 7G–L, 8

Spiraserpula ypsilon Pillai & ten Hove 1994:56–60, Figs 6A–K, 7A–T, 34G, Pl. 1B.

Type locality. Brava, Cape Verde Islands.

Material examined. Bahamas. Two empty tubes (UMML 22.1056), RV Gerda, cruise 6804, sta. 983, North of Elbow Cay, Bahamas, 24°05'N, 80°20'W, triangle dredge, 216 m, March 5, 1968). **Honduras.** One specimen (UMML 22.1057), RV Pillsbury, cruise 6802, sta. 629, Southwest of Honduras Cape, 15°58'N, 86°09'W, 41-feet otter trawl, 40 m, March 21, 1968. **Venezuela.** Two empty tubes (UMML 22.1058), RV Pillsbury, cruise 6806, sta. 745, North of Los Roques Islands, 11°58'N, 66°50'W, 10-feet otter trawl, 65 m, July 24, 1968. **Trinidad and Tobago.** One specimen (UMML 22.1059), one specimen (UMAR-Poly 111), RV Pillsbury, cruise 6907, sta. 840, East of Trinidad Island, 10°40'N, 60°37'W, 10-feet otter trawl, 33 m, sponges, July 1, 1969.

Description. One specimen (UMML 22.1058) attached to tube of *S. karpatensis* and another (UMML 22.1056) attached to *Pseudovermilia fuscostriata* tube (Fig. 7H). Tubes sinuous or strongly spiraled (Fig. 7H); in another the tube forms a very tight cylindrical spiral (Fig. 7I). Tubes with two internal longitudinal ridges: mid-dorsal one serrated, mid-ventral one Y-shaped (Fig. 7J–L); sometimes, along length of tube, Y-shaped ridge changes to smooth ridge. Tubes white (Fig. 7H–I). Body pale to dark brown (preserved material only). Worms damaged. Branchial crown with 5–6 radioles by branchial lobe. Collar damaged, lobes could not be observed. Bayonet chaetae with 3–4 blunt teeth (Fig. 7G); hooded (capillary) chaetae present. Thorax with seven chaetigers, including collar chaetae. Abdomen damaged.

Distribution. Caribbean, Florida and Pacific of Panama.

Ecology. Sublittoral, 33–216 m. On coral debris. Pillai and ten Hove (1994) recorded the species from 0.5 to 200 m. In the same samples studied there were other serpulids: *Spiraserpula karpatensis*, *Spiraserpula* sp., *Hydroides gairacensis*, *Hydroides* sp. 1, *Pomatostegus stellatus*, *Protula* sp., *Pseudovermilia fuscostriata*, *P. occidentalis*, *Salmacina huxleyi*, *S. vossae* sp. n., *Vermiliopsis annulata*, a chaetopterid tube, and other polychaetes: a lumbrinerid, several syllids, sipunculids and a vermetid shell.

Remarks. *Spiraserpula ypsilon* is very similar to *S. paraypsilon* Pillai & ten Hove, 1994, described from the Netherlands Antilles, mainly with regard to the internal ridges of the tube. However, some differences separate both species, mainly the absence of lateral tubercles in the thoracic uncini in *S. ypsilon***,** characteristic of *S. paraypsilon*; additionally, *S. ypsilon* has fewer radioles (6–7) than *S. paraypsilon* (11).

?Spiraserpula sp.

Figs 7M–N, 8

Material examined. Venezuela. One specimen (UMML 22.1060), RV Pillsbury, cruise 6806, sta. 745, North of Los Roques Islands, 11°58'N, 66°50'W, 10-feet otter trawl, 65 m, July 24, 1968.

Description. Tube attached to a chaetopterid tube, is white and lacks any internal ridges characteristic of *Spiraserpula*. External surface with granular appearance, internally smooth. Body white, fragmented and damaged but complete. Branchial crown with nine radioles per lobe; lacking inter-radiolar membrane.

Peduncle smooth, inserted in right lobe, with well-defined constriction between it and operculum (Figs 7M). Pseudoperculum club-shaped. Operculum is zygomorphic; with a conspicuous bulbous basal part above constriction (Fig. 7M). Interradial grooves 1/3 of funnel length; 19 radii with rounded tips (Fig. 7N); inner surface smooth (Fig. 7N).

Collar damaged, lobes could not be observed. Bayonet chaetae with 2–3 sharp-elongate teeth; hooded (capillary) chaetae present. Thorax with eight chaetigers, including collar chaetae. Abdomen damaged, with approximately 61 segments, a distinct achaetous region absent between the thorax and abdomen.

Distribution. Only recorded from Los Roques Islands, Venezuela.

Ecology. Sublittoral, 65 m. The same sample contained other serpulids: *Spiraserpula karpatensis*, *S. ypsilon*, several empty tubes of serpulids resembling *Protula* and *Vermiliopsis*, a chaetopterid tube, and a lumbrinerid.

Remarks. Most of the tube belonging to this specimen is missing and the remaining fragments lacked the internal ridges characteristic of *Spiraserpula*. The operculum of this *Spiraserpula* sp. resembles that of *S. karpatensis*, *S. plaiae* Pillai & ten Hove, 1994 and *S. sumbensis* Pillai & ten Hove, 1994; the former two are from Caribbean and the latter is from Indonesia. Due to the loss of the rest of the tube the present specimen cannot be assigned to species. It may be a juvenile stage of another genus, such as *Crucigera* or *Serpula*.

Discussion

Despite having reviewed 158 lots of serpulids from the same number of stations collected during past deep sea expeditions, specimens of *Serpula* were found only at six stations (3.8%), which combined with the fact that there were only two previous records of *Serpula* (Day 1973, ten Hove and Wolf 1984) from the U.S. Atlantic, indicates that the genus is very rare in the Western Atlantic.

However, the original descriptions of the species mentioned in the remarks, indicate that many are incomplete, unclear or contradictory with respect to the figures provided. Descriptions need to be standardized and include as many characters as possible, as argued extensively by ten Hove and Jansen-Jacobs (1984), Kupriyanova (1999), and ten Hove and Kupriyanova (2009).

As regards *Spiraserpula*, another little-known serpulid genus in the Caribbean closely similar to *Serpula*, complete descriptions of species were made in an important and recent revision of the genus, including most species from the Caribbean (Pillai and ten Hove 1994). Unfortunately, due to the characteristics of the internal tube structures and small size of the specimens, their manipulation and study of *Spiraserpula* is more difficult as compared to other serpulids.

Acknowledgements

The serpulid collections of the oceanographic expeditions of the Rosenstiel School of Marine and Atmospheric Science, University of Miami were made available by Nancy Voss (UMML-RSMAS, Miami) and the specimen from Cuba was loaned by Diana Ibarzábal (IO-Cuba). Generous accommodation and laboratory space were made available by Sergio Salazar-Vallejo and Emilia González (ECOSUR, Chetumal) besides their time, to study these interesting serpulids. Harry ten Hove (NCB Naturalis, Leiden) and Luis Carrera-Parra (ECOSUR, Chetumal) provided some critically important papers. Nancy Voss and Sergio Salazar-Vallejo made corrections and comments to an earlier draft. Two anonymous referees and Chris Glasby (as editor) made careful corrections and comments to the latest version. This work was partially supported by the project PROMEP/103–5/09/1353.

References

Augener H (1914) Polychaeta. II. Sedentaria. Michaelsen, W. & Hartmeyer, R. Die fauna Südwest-Australiens, 5(1): 1–170.

Bastida-Zavala JR (2008) Serpulids (Annelida: Polychaeta) from the Eastern Pacific, including a brief mention of Hawaiian serpulids. Zootaxa 1722: 1–61. http://www.mapress.com/zootaxa/2008/f/z01722p061f.pdf

Bastida-Zavala JR, ten Hove HA (2002) Revision of *Hydroides* Gunnerus, 1768 (Polychaeta: Serpulidae) from the Western Atlantic Region. Beaufortia 52: 103–178.

Bastida-Zavala JR, Salazar-Vallejo SI (2000) Serpúlidos (Polychaeta: Serpulidae) del Caribe noroccidental: *Hydroides* y *Serpula*. Revista de Biología Tropical 48(4): 841–858. http://www.scielo.sa.cr/scielo.php?pid=S0034-77442000000400009&script=sci_arttext&tlng=e

Bastida-Zavala JR, Carrera-Parra LF, Delgado-Blas VH, Londoño-Mesa MH, Salazar-Silva P, Salazar-Vallejo SI (2001) Polychaetes (Polychaeta) from the Gulf of Guinea, the Grand Caribbean Sea, and the Gulf of Panama deposited in the Museum of Marine Invertebrates, University of Miami. Final Report, ECOSUR, México, 60 pp. http://w2.ecosur-qroo.mx/Bentos/wbentos/Documentos/polychaetes-Miami.doc

Ben-Eliahu MN, Fiege D (1996) Serpulid tube-worms (Annelida: Polychaeta) of the Central and Eastern Mediterranean with particular attention to the Levant Basin. Senckenbergiana Maritima 28(1–3): 1–51. doi: 10.1007/BF03042821

Bianchi CN (1981) Policheti Serpuloidei. Guideper il riconoscimento delle specie animali delle acque lagunari e costiere italiane, AQ/1/96, Consiglio Nazionale delle Ricerche, Genova 5: 1–187.

Day JH (1973) New Polychaeta from Beaufort with a key to all species recorded from North Carolina. NOAA Technical Report, Seattle, 140 pp.

Evans GO, China WE (1966) *Serpula* Linnaeus, 1758 (Annelida, Polychaeta): designation of a type-species under the plenary powers. Bulletin of Zoological Nomenclature 23(1): 29–30.

Heppell D (1963) *Serpula* Linnaeus, 1758 (Annelida, Polychaeta): proposed designation of a type-species under the plenary powers and relevant proposals. Z.N.(S.) 1606. Bulletin of Zoological Nomenclature 20(6): 443–446.

Hove HA ten, Jansen-Jacobs MJ (1984) A revision of the genus *Crucigera* (Polychaeta; Serpulidae); a proposed methodical approach of serpulids, with special reference to variation in *Serpula* and *Hydroides*. In: Hutchings PA (Ed.) Proceedings of the First International Polychaete Conference, The Linnean Society of New South Wales, Sydney, 143–180.

Hove HA ten, Kupriyanova EK (2009) Taxonomy of Serpulidae (Annelida, Polychaeta): The state of affairs. Zootaxa 2036: 1–126. doi: 10.3853/j.0067-1975.61.2009.1489

Hove HA ten, Wolf PS (1984) Family Serpulidae Johnston, 1865. In: Uebelacker JM, Johnson PG (Eds), Taxonomic guide to the polychaetes of the northern Gulf of Mexico, Barry A. Vittor, Mobile, Vol 7, 55.1–55.34

Imajima M (1977) Serpulidae (Annelida, Polychaeta) collected around Chichi-jima (Ogasawara Islands). Memories of the National Science Museum, Tokyo 10: 89–111.

Imajima M (1979) Serpulidae (Annelida, Polychaeta) collected around Cape Shionomisaki, Kii Peninsula. Memories of the National Science Museum, Tokyo 12: 159–183.

Imajima M (1982) Serpulinae (Polychaetous Annelids) from the Palau and Yap Islands, Micronesia. Proceedings of the Japanese Society Systematic Zoology 23: 37–55.

Imajima M, ten Hove HA (1984) Serpulinae (Annelida, Polychaeta) from the Truk Islands, Ponape and Majuro Atoll, with some other new Indo-Pacific records. Proceedings of the Japanese Society Systematic Zoology 27: 35–66.

Imajima M, ten Hove HA (1986) Serpulinae (Annelida, Polychaeta) from Nauru, the Gilbert Islands (Kiribati) and the Solomon Islands. Proceedings of the Japanese Society Systematic Zoology 32: 1–16.

Kupriyanova EK (1999) The taxonomic status of *Serpula* cf. *columbiana* Johnson, 1901 from the American and Asian coasts of the North Pacific Ocean (Polychaeta: Serpulidae). Ophelia 50(1): 21–34. doi: 10.1080/00785326.1999.10409386

Kupriyanova EK, Jirkov IA (1997) Serpulidae (Annelida, Polychaeta) of the Arctic Ocean. Sarsia 82: 203–236.

Pillai TG (2009) Description of new serpulid polychaetes from the Kimberleys of Australia and discussion of Australian and Indo-West Pacific species of *Spirobranchus* and superficially similar taxa. Records of the Australian Museum 61(2): 93–199. doi: 10.3853/j.0067-1975.61.2009.1489

Pillai TG, ten Hove HA (1994) On recent species of *Spiraserpula* Regenhardt, 1961, a serpulid polychaete genus hitherto known only from Cretaceous and Tertiary fossils. Bulletin of the Natural History Museum, London, Zoology Series 60(1): 39–104.

Ramos A, San Martín G (1999) On the finding of a mass occurrence of *Serpula narconensis* Baird, 1885 (Polychaeta, Serpulidae) in South Georgia (Antarctica). Polar Biology 22: 379–383. doi: 10.1007/s003000050432

Rioja E (1931) Estudio de los poliquetos de la Península Ibérica. Memorias de la Academia de Ciencias Exactas y Físicas., Naturales, Madrid, 2: 1–471.

Voss GL, Robins CR, Staiger JC (1977) Study of the macro-fauna of the Tropical Western Atlantic. In: FAO Symposium of the Program of the Maritime Research of the Caribbean and Adjacent Regions, Caracas, FAO, Rome, 483–503.

Willey A (1905) Report on the Polychaeta collected by Professor Herdman, at Ceylon, in 1902. In Herdman, W.A. Report to the government of Ceylon on the pearl oyster fisheries of the Gulf of Manaar. London, Royal Society, 4, Supplement Report 30: 243–324.

Wu BL, Sun R, Chen M (1979) Two new species of the Polychaeta from the South China Sea. Oceanic Selections 2(2): 89–94.

Zibrowius H (1968) Étude morphologique, systematique et écologique, des Serpulidae (Annelida Polychaeta) de la région de Marseille. Recueil des travaux de la Station Marine d'Endoume, Bulletin 43(59): 81–253.

Zibrowius H (1973) Serpulidae (Annelida Polychaeta) des côtes Ouest de l'Afrique et des archipels voisins. Annales Musee Royal de l'Afrique Centrale, Belgique, series 8, Sciences Zoologiques (208): 1–93.

ZooKeys 198: 25–68 (2012)
doi: 10.3897/zookeys.198.2337
www.zookeys.org

RESEARCH ARTICLE

A peer-reviewed open-access journal
ZooKeys
Launched to accelerate biodiversity research

New systematic assignments in Gonyleptoidea (Arachnida, Opiliones, Laniatores)

Ricardo Pinto-da-Rocha[1], Alípio Rezende Benedetti[1], Eduardo Gomes de Vasconcelos[2], Marcos Ryotaro Hara[3]

1 *Departamento de Zoologia, Instituto de Biociências, Universidade de São Paulo, Caixa Postal 11461, São Paulo, SP, Brazil, 05422-970* **2** *Núcleo de Estudos da Biodiversidade da Amazônia Matogrossense, Instituto de Ciências Naturais, Humanas e Sociais, Universidade Federal de Mato Grosso, Av. Alexandre Ferronato, 1200, 78557-267 Sinop, MT, Brazil* **3** *Escola de Artes, Ciências e Humanidades, Universidade de São Paulo, Av. Arlindo Bettio no 1000, Ermelino Matarazzo, São Paulo, SP, Brazil , 03828-000*

Corresponding author: *Ricardo Pinto-da-Rocha* (ricrocha@usp.br)

Academic editor: *Yuri Marusik* | Received 9 November 2011 | Accepted 2 May 2012 | Published 30 May 2012

Citation: Pinto-da-Rocha R, Benedetti AR, Vasconcelos EG, Hara MR (2012) New systematic assignments in Gonyleptoidea (Arachnida, Opiliones, Laniatores). ZooKeys 198: 25–68. doi: 10.3897/zookeys.198.2337

Abstract

As part of an ongoing revision of the family Gonyleptidae, we have identified many species that are synonyms of previously described species or misplaced in this family. This article summarizes these findings, adding previously unavailable information or correcting imprecise observations to justify the presented taxonomic changes.

The following new familial or subfamilial assignments are proposed: *Nemastygnus* Roewer, 1929 and *Taulisa* Roewer, 1956 are transferred to Agoristenidae, Agoristeninae; *Napostygnus* Roewer, 1929 to Cranaidae; *Ceropachylinus peruvianus* Roewer, 1956 and *Pirunipygus* Roewer, 1936 are transferred to Gonyleptidae, Ampycinae; *Gyndesops* Roewer, 1943, *Haversia* Roewer, 1913 and *Oxapampeus* Roewer, 1963 are transferred to Gonyleptidae, Pachylinae.

The following generic synonymies are proposed for the family Gonyleptidae: *Acanthogonyleptes* Mello-Leitão, 1922 = *Centroleptes* Roewer, 1943; *Acrographinotus* Roewer, 1929 = *Unduavius* Roewer, 1929; *Gonyleptes* Kirby, 1819 = *Collonychium* Bertkau, 1880; *Mischonyx* Bertkau, 1880 = *Eugonyleptes* Roewer, 1913 and *Gonazula* Roewer, 1930; *Parampheres* Roewer, 1913 = *Metapachyloides* Roewer, 1917; *Pseudopucrolia* Roewer, 1912 = *Meteusarcus* Roewer, 1913; *Haversia* Roewer, 1913 = *Hoggellula* Roewer, 1930.

The following specific synonymies are proposed for the family Gonyleptidae: *Acanthogonyleptes singularis* (Mello-Leitão, 1935) = *Centroleptes flavus* Roewer, 1943, **syn. n.**; *Geraeocormobius sylvarum* Holmberg, 1887 = *Discocyrtus serrifemur* Roewer, 1943, **syn. n.**; *Gonyleptellus bimaculatus* (Sørensen, 1884) = *Gonyleptes cancellatus* Roewer, 1917, **syn. n.**; *Gonyleptes atrus* Mello-Leitão, 1923 = *Wey-*

hia brieni Giltay, 1928, **syn. n.**; *Gonyleptes fragilis* Mello-Leitão, 1923 = *Gonyleptes banana* Kury, 2003, **syn. n.**; *Gonyleptes horridus* Kirby, 1819 = *Collonychium bicuspidatum* Bertkau, 1880, **syn. n.**, *Gonyleptes borgmeyeri* Mello-Leitão, 1932, **syn. n.**, *Gonyleptes curvicornis* Mello-Leitão, 1932, **syn. n.**, *Metagonyleptes hamatus* Roewer, 1913, **syn. n.** and *Paragonyleptes simoni* Roewer, 1930, **syn. n.**; *Gonyleptes pustulatus* Sørensen, 1884 = *Gonyleptes guttatus* Roewer, 1917, **syn. n.**; *Haversia defensa* (Butler, 1876) = *Sadocus vallentini* Hogg, 1913, **syn. n.**; *Liogonyleptoides minensis* (Piza, 1946) = *Currala bahiensis* Soares, 1972, **syn. n.**; *Megapachylus grandis* Roewer, 1913 = *Metapachyloides almeidai* Soares & Soares, 1946, **syn. n.**; *Mischonyx cuspidatus* (Roewer, 1913) = *Gonazula gibbosa* Roewer, 1930 **syn. n.**; *Mischonyx scaber* (Kirby, 1819) = *Xundarava holacantha* Mello-Leitão, 1927, **syn. n.**; *Parampheres tibialis* Roewer, 1917 = *Metapachyloides rugosus* Roewer, 1917, **syn. n.**; *Parapachyloides uncinatus* (Sørensen, 1879) = *Goyazella armata* Mello-Leitão, 1931, **syn. n.**; *Pseudopucrolia mutica* (Perty, 1833) = *Meteusarcus armatus* Roewer, 1913, **syn. n.**

The following new combinations are proposed: *Acrographinotus ornatus* (Roewer, 1929), **comb. n.** (ex *Unduavius*); *Gonyleptellus bimaculatus* (Sørensen, 1884), **comb. n.** (ex *Gonyleptes*); *Gonyleptes perlatus* (Mello-Leitão, 1935), **comb. n.** (ex *Moojenia*); *Mischonyx scaber* (Kirby, 1819), **comb. n.** (ex *Gonyleptes*); and *Neopachyloides peruvianus* (Roewer, 1956), **comb. n.** (ex *Ceropachylus*).

The following species of Gonyleptidae, Gonyleptinae are revalidated: *Gonyleptes atrus* Mello-Leitão, 1923 and *Gonyleptes curvicornis* (Roewer, 1913).

Keywords
Agoristenidae, Cranaidae, Gonyleptidae, Neotropics, taxonomy

Introduction

Opiliones is currently divided into four monophyletic suborders (Gonzalo and Kury 2007), of which Laniatores, with 29 families and 4040 described species (Kury 2011), is the most diverse. Indeed, it is the main component of tropical opilionid faunas. Recently the Neotropical harvestmen (mainly Gonyleptidae and Cranaidae) have been the subject of many revisions (e.g., DaSilva and Pinto-da-Rocha 2010; Bragagnolo and Pinto-da-Rocha 2009; Yamaguti and Pinto-da-Rocha 2009; Pinto-da-Rocha and Villarreal-Manzanilla 2009; Orrico and Kury 2009), and their subfamilial relationships have gradually been made clear (for instance, compare the above mentioned articles with Kury 1994a). These efforts aim to reverse the twentieth-century classification system in harvestmen systematics known as the "Roewerian system," which was based on few characteristics and emphasized morphological differences. In addition, species sampling was poor, and intraspecific variation was overlooked. Thus many monotypic and/or artificial groups were created in this period, especially for Neotropical harvestmen. In order to resolve the taxonomically confusing Laniatores, modern studies are based on the examination of the type material as well as other material deposited in museum collections to determine the species identity. This part is especially important because the former classification system did not take intraspecific variations into account. Another important step is to gather overlooked information, such as those from male genitalia, which have shown to be

quite reliable as indicative of monophyletic groups (e.g., Pinto-da-Rocha and Hara 2009; Kury and Pinto-da-Rocha 2007a).

From recent phylogenetic studies on the Gonyleptidae subfamilies Gonyleptinae, Pachylinae, and Metasarcinae, as well as visits to such European museums as the Senckenberg Museum (Frankfurt), Muséum National d'Histoire Naturelle (Paris), and Zoologisches Institut and Zoologisches Museum (Hamburg), we were able to precisely identify many gonyleptids, resulting in the detection of numerous synonymies and the misplacement of several species relative to modern family and subfamily concepts. Thus, we decided to publish these systematic findings in this format instead of many revisions of the respective families/subfamilies, which would take several years to finish. The aim of this article is to propose nomenclatural changes in an attempt to resolve the taxonomic nightmare in Neotropical harvestmen systematics.

Material and methods

The following abbreviations were adopted (curators in parentheses) to refer to the depositories:

NHM The Natural History Museum [formerly British Museum], London, England (Janet Beccaloni).
HEMS Hélia Eller Monteiro Soares private collection, now included in MNRJ.
IBSP Instituto Butantan, São Paulo, São Paulo, Brazil (Darci M. Barros Battesti).
ISNB Institut Royal des Sciences Naturelles de Belgique, Brussels, Belgium (Léon Baert).
MNRJ Museu Nacional do Rio de Janeiro, Rio de Janeiro, Rio de Janeiro, Brazil (Adriano Brilhante Kury).
MZLQ Museu de Zoologia Luiz de Queiroz, now housed in IBSP.
MZSP Museu de Zoologia da Universidade de São Paulo, São Paulo, São Paulo, Brazil (Ricardo Pinto-da-Rocha).
NHMW Naturhistorisches Museum, Vienna, Austria (Jürgen Gruber).
SMF Naturmuseum Senckenberg, Frankfurt am Main, Germany (Peter Jäger).
ZMB Institut für Systematische Zoologie, Museum für Naturkunde der Humboldt-Universität zu Berlin, Germany (Jason Dunlop).
ZMH Zoologisches Museum Hamburg, Germany (Hieronymus Dastich).
ZMUC Zoologisk Museum, Universität København, Zoological Museum, University of Copenhagen, Denmark (Nikolaj Scharff).

We did not exhaustively cite literature in synonymic listings (for this purpose see Kury 2003), but we updated it when necessary. We also placed information regarding the type material altogether. The list of material examined is only cited if

more than one vial other than the type material was examined. Pictures of specimens were taken using a Canon EOS digital camera and edited using Adobe Photoshop and Corel PhotoPaint computer software. The illustrations of the external morphology were made under LEICA MZAPO stereomicroscope using camera lucida. Male genitalia were prepared according to Pinto-da-Rocha (1997) for illustrations as well as SEM (Scanning Electronic Microscope) pictures. In the redescriptions, nomenclature of structures and relative positions follow Acosta et al. (2007b), with some modifications to best fit the taxa. Prolateral and retrolateral setae formulae of pedipalpal tibia and tarsi follow Pinto-da-Rocha (1997). The prosomal part of dorsal scutum and the scutal area V are here called the "carapace" and "posterior margin of dorsal scutum", respectively. Measurements of the body parts (except for genitalia) are in millimeters.

Taxonomy

Agoristenidae Šilhavý, 1973
Leiosteninae Šilhavý, 1973

***Nemastygnus* Roewer, 1929, new family assignment**
http://species-id.net/wiki/Nemastygnus

Nemastygnus Roewer, 1929: 277; Kury 2003: 145; (type species: *Nemastygnus ovalis* Roewer, 1929, by monotypy).

Diagnosis. *Nemastygnus* was transferred from Cranaidae to Gonyleptidae, Metasarcinae by Kury (2003). It is closely related to *Avima* Roewer, 1949, based on dorsal scutum shape (rectangular) and scutal area III (unarmed). It is impossible to distinguish both genera mainly because *Avima,* the largest genus of Leiosteninae with 33 species, is a heterogeneous genus based on penial characters. The type-species of *Avima*, *A. leucobunus* Roewer, 1949, is known only from the original description (and only external morphology). However, we will not propose synonymy in this paper because *Nemastygnus* is older and 33 new combinations should be proposed. A review of *Avima* plus *Nemastygnus* species is needed.

Description. Ocularium unarmed, saddle-shaped. Areas and posterior margin of dorsal scutum and free tergites unarmed (Fig. 1A). Scutal area I undivided. Lateral margin of dorsal scutum coriaceus. Chelicera dimorphic. Pedipalp with slender articles; femur without dorsoapical spine, with row of three ventral large setae and two ventroapical large setae; patella with prolateral large setae; tibia–tarsus with ectal-mesal large setae. Leg I filiform, three-segmented. Penis: basal setae of truncus and basal setae of ventral plate very long and bifid; stylus with a large, longitudinal keel.

***Nemastygnus ovalis* Roewer, 1929**
http://species-id.net/wiki/Nemastygnus_ovalis
Fig. 1

Nemastygnus ovalis Roewer, 1929: 277, fig. 44 (♂); Kury 2003: 145; (male holotype, Colombia, Cundinamarca, Bogotá, SMF RI 1005/4, examined).

Description. Penis (Fig. 1 B–C; holotype): truncus with three pairs of bifid setae (basal, subdistal lateral and distal ventral). Ventral plate with rounded lobe on corners, two dorso-basal pairs of small single branched setae, a ventral distal pair of small single branched setae and a ventral median bifid setae. Glans dorsally projected, slender, with a small ventral crest and a long dorsal crest. Stylus smooth.

Taxonomical note. *Nemastygnus* was originally placed in Gonyleptidae, Prostygninae. Kury (1994b) transferred Prostygninae to Cranaidae. Later, in his catalogue, Kury (2003) transferred *Nemastygnus* to Gonyleptidae, Metasarcinae without examining the type material. We herein propose the transfer of *Nemastygnus* to Agoristenidae Leiosteninae, based on characteristics of body and male genitalia, viz., filiform leg I, saddle-shaped ocularium, pedipalpus with well developed setae in ventral row of femur (basalmost longest, size including socket about length of pedipalpal femur) and prolateral/retrolateral of tibia and tarsus, penis with typical ventral plate and bifid setae (Kury 1993; Pinto-da-Rocha 1996; Kury 1997; Pinto-da-Rocha and Hara 2009).

***Taulisa* Roewer, 1956, new family assignment**
http://species-id.net/wiki/Taulisa

Taulisa Roewer, 1956: 433; Kury 2003: 145; (type species: *Taulisa koepckei* Roewer, 1956, by original designation).

Diagnosis. *Taulisa* (Fig. 2) differs from the other 10 genera of Leiosteninae by the following combination of characters: ocularium unarmed, saddle-shaped; areas of dorsal scutum with two large tubercles each, posterior margin of dorsal scutum and free tergites, each one with a central large tubercle; area I undivided; lateral margin of dorsal scutum coriaceus; pedipalp with slender articles, its femur with dorsoapical spine, with row of four ventral large setae; pedipalpal patella with prolateral large setae; pedipalpal tibia–tarsus with ectal-mesal large setae; leg I filiform, three-segmented. Male unknown.

Taxonomical note. *Taulisa* was originally placed in Phalangodidae, Tricommatinae. Kury (1992a) elevated Tricommatinae to family level. In 2003, Kury transferred *Taulisa* from Tricommatinae to Gonyleptidae, Metasarcinae without further remarks. We propose to transfer *Taulisa* to Agoristenidae, Leiosteninae based on characteristics of the body, viz., filiform leg I, saddle-shaped ocularium, pedipalpus with well developed and long setae in ventral row of femur and on prolateral/retrolateral of tibiae/tarsi (Kury 1993; Pinto-da-Rocha 1996; Kury 1997; Pinto-da-Rocha and Hara 2009).

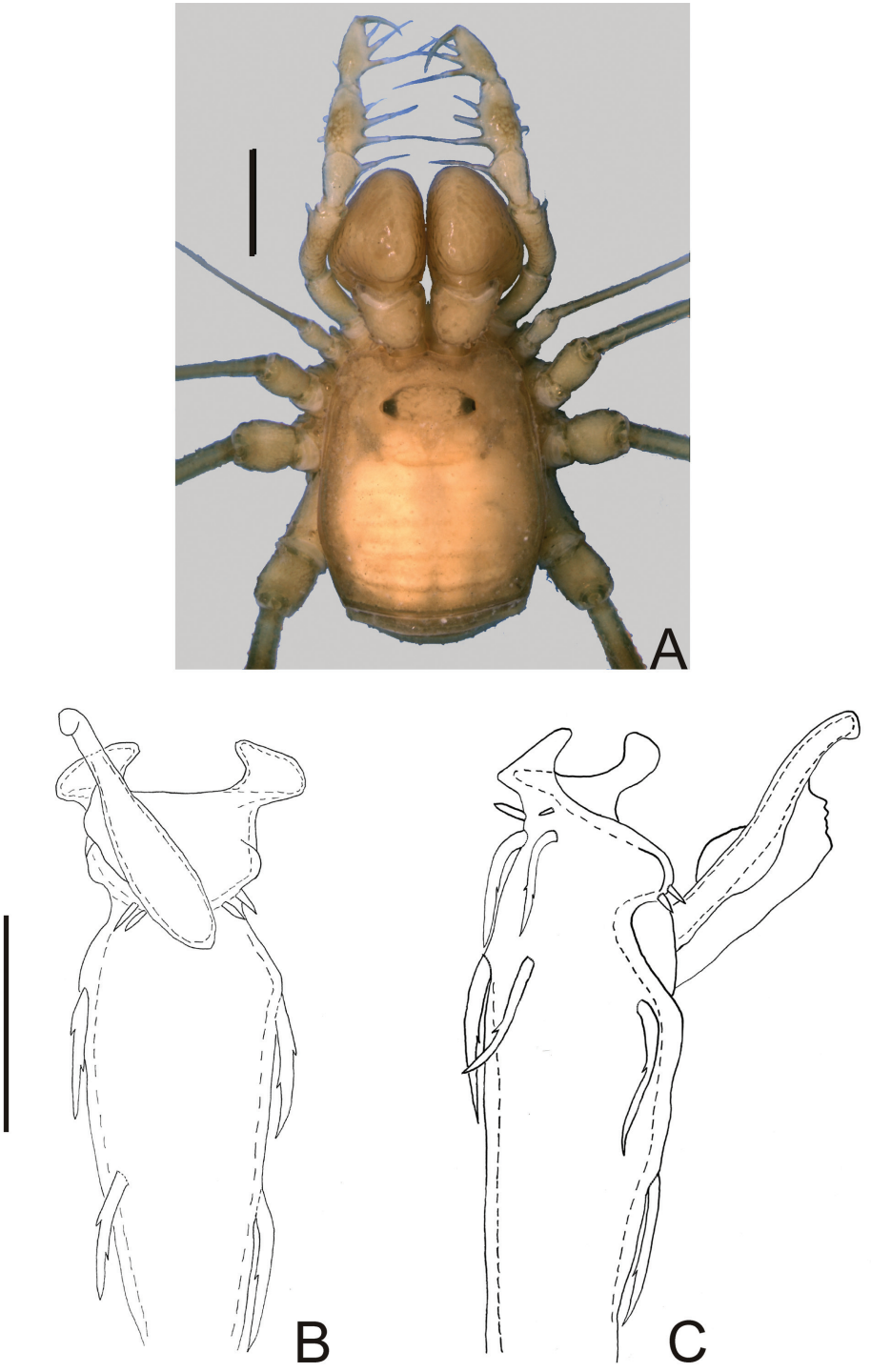


Figure 1. *Nemastygnus ovalis* Roewer. Male (holotype): **A** habitus, dorsal view. Distal part of penis **B** in dorsal view **C** ditto, left lateral view. **B, C** at same scale. Sale bars: **A** = 1 mm; **B** = 0.1 mm.

Information regarding male genitalia was unavailable, since this species is only known from the female holotype.

Composition. Monotypic.

***Taulisa koepckei* Roewer, 1956**
http://species-id.net/wiki/Taulisa_koepckei
Fig. 2

Taulisa koepckei Roewer, 1956: 433, fig. 3–4 (♀); Kury 2003: 145; (female holotype, Peru, Lambayeque, Hacienda Taulis, 6°50'S, 79°10' W, 1700 m, SMF 9697, examined).

Diagnosis. As for genus.

Cranaidae Roewer, 1913

***Napostygnus* Roewer, 1929, new family assignment**
http://species-id.net/wiki/Napostygnus

Napostygnus Roewer, 1929: 274, 275; Kury 2003: 145; (type species: *Napostygnus bispinosus* Roewer, 1929, by monotypy).

Diagnosis. *Napostygnus* was originally placed in Gonyleptidae, Prostygninae and transferred to the Gonyleptidae, Metasarcinae by Kury (2003). It differs from the other 75 genera of Cranaidae by the following combination of characters: ocularium, scutal areas I–IV, posterior margin of dorsal scutum and free tergite I unarmed; free tergites II–III with one spine; posterior margin of dorsal scutum concave; legs thin and unarmed; penis with ventral plate wider at the middle, three pairs of distal setae, two pairs of basal setae, glans with dorsal process, stylus with apex enlarged.

Composition. Monotypic.

***Napostygnus bispinosus* Roewer, 1929**
http://species-id.net/wiki/Napostygnus_bispinosus
Fig. 3

Napostygnus bispinosus Roewer, 1929: 275, fig. 42 (♀); Kury 2003: 145; (female holotype, Ecuador, Napo, Valley of Rio Napo, SMF RI 1004/3, examined).

Material examined. ECUADOR. Napo: Valley of Rio Napo, 1 female holotype (SMF RI 1004/3); Cantón Quijos, Parroquira Cozanga, Yanayacu Research Station (0°35'S, 78°57'W, 2128 m), 1 ♂ & 2 ♀ (MZSP 36132); ditto, 1 ♀ (IBSP 10550).

Figure 2. *Taulisa koepckei* Roewer. Female (holotype): Habitus, dorsal view. Scale bar: 1 mm.

Description. *Male* (MZSP 36132). Dorsum (Fig. 3A). Measurements: dorsal scutum length 4.1; dorsal scutum maximum width 3.5; carapace length 2.1; carapace maximum width 2.9; femur IV length 11.2. Body outline nearly subrectangular. Anterior margin of dorsal scutum with a median frontal hump small-granulate. Ocularium near middle of carapace, saddle shaped, with small granules near the eyes, unarmed. Carapace higher than the rest of dorsal scutum, with 4 tubercles behind ocularium. Scutal areas I–III with 2 small median tubercles on each area; IV with 4 tubercles. Lateral margin of dorsal scutum with a low density of small granules. Posterior margin of dorsal scutum and free tergite I with a row of small granules, unarmed. Free tergites II–III each with a median spine, small granulate.

Chelicera: segment I unarmed. Segment II swollen, finger II with 3 teeth, III with 4 teeth.

Pedipalpus: trochanter with 2 ventral tubercles, femur and patella smooth. Tibial setation: retrolateral iiIii; prolateral iiiIiii. Tarsal setation: retrolateral IiIi; prolateral IiiiIi.

Legs: legs I–IV unarmed and without granules, except for trochanters, which are small granulate. Basitarsus I slightly inflated. Tarsal process present. Tarsal segmentation: 6(3); 16(3); 6; 7.

Penis (Fig. 3B–C): ventral plate with almost straight distal margin, thick median lobe and folded ventrally to the distal setae, 3 pairs of distal setae and 2 pairs of basal setae. Glans with thumb-like dorsal process. Stylus with dorsal apical projection and ventral apical small trichomes.

Coloration (in ethanol) (Fig. 3A): body background yellow with brown spots mainly on carapace, scutal areas, lateral and posterior margins of dorsal scutum and free tergites. Mesotergum with one longitudinal yellow stripe surrounded by blackish pigment at grooves I–V. Pedipalpus and chelicera yellowish brown with a brown reticulate pattern. Legs yellowish brown.

Taxonomical note. *Napostygnus* was originally placed in Gonyleptidae, Prostygninae. Kury (1994b) transferred Prostygninae to Cranaidae and later transferred *Napostygnus* to Gonyleptidae, Metasarcinae (Kury 2003). We herein propose the removal of *Napostygnus* from Metasarcinae based on male genitalia, which does not present the diagnostic character for the subfamily (Kury and Maury 1998; Kury and Pinto-da-Rocha 2007b), viz., a pair of spiny laterobasal sacs on the ventral plate. Another remarkable difference from Metasarcinae is the unarmed ventral pedipalpus femur. The combination of characteristics of penis and body morphology does not allow placing *N. bispinosus* in any other family of Laniatores which bear tarsal process on legs III–IV. The slightly swollen male basitarsus I is not equal to those of Manaosbiidae, and furthermore the genitalia is distinct, since it possesses a dorsal process. The ocularium resembles those of Gonyleptidae, Bourguyiinae, but the penis is not similar, because there is only a dorsal process and no ventral process. The aspect of the penis resembles those of Cranaidae (presence of dorsal process, ventral plate and setae shape) and therefore, we propose its transfer to this family. It is noteworthy to mention that the morphology of the body of *N. bispinosus* is somewhat distinct from the typical Cranaidae. We will not assign it to any subfamily, following the opinion of Orrico and Kury (2009) on the meaninglessness of current subfamily classifications in Cranaidae.

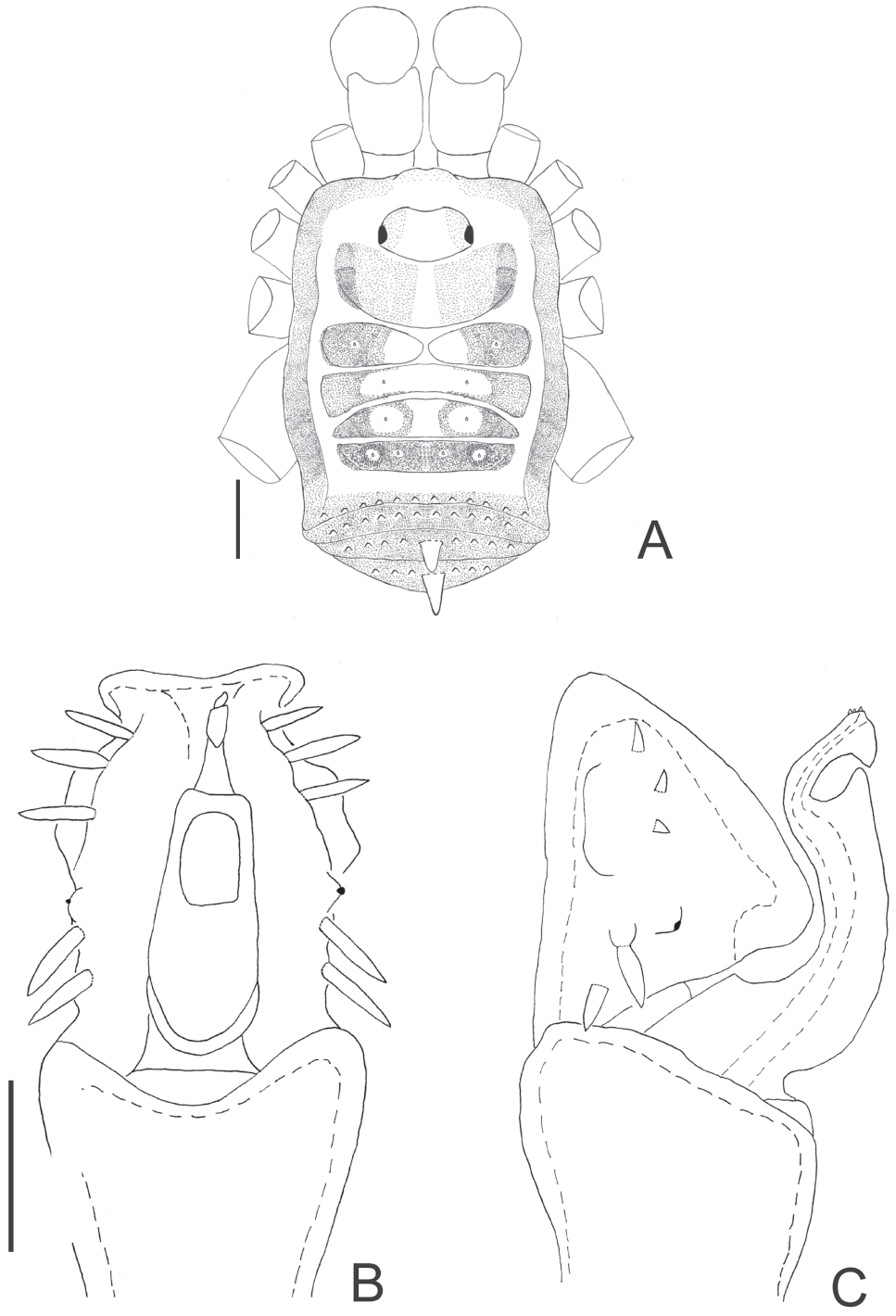


Figure 3. *Napostygnus bispinosus* Roewer. Male (MZSP 36132): **A** habitus, dorsal view. Distal part of penis **B** in dorsal view **C** ditto, left lateral view. **B, C** at same scale. Scale bar **A** = 1 mm. Scale bar **B** = 0.1 mm.

Gonyleptidae Sundevall, 1833
Ampycinae Kury, 2003

***Neopachyloides peruvianus* (Roewer, 1956), new comb., new subfamily assignment**
http://species-id.net/wiki/Neopachyloides_peruvianus
Fig. 4

Ceropachylinus peruvianus Roewer, 1956: 440, fig. 19 (♂); Kury 2003: 158; (male holotype, Peru, near San Luis de Shuaro, 700–750 m, Koepcke leg, 17.III.1955, SMF 9791/1, examined).

Diagnosis. *Neopachyloides* was a hitherto monotypic genus that resembles Ampycinae genera with a paired armature on ocularium and free tergite III with a median, long spiniform apophysis as in *Ampycella* Roewer, 1929, *Ampycus* Simon, 1879, *Hutamaia* Soares & Soares, 1977 and *Sibollus* Roewer, 1929. *Neopachyloides* can be distinguished from these genera by the following combination of characteristics: scutal area III with a paramedian pair of enlarged, pointed tubercles, scutal area IV undivided and free tergite II unarmed. *Neopachyloides peruvianus* can be distinguished from *N. spinipes* Roewer, 1913 by the dorsal scutum covered by granules and scutal areas I–II unarmed (Fig. 4A).

Description. Penis (Fig. 4B–C; holotype): ventral plate with sub hexagonal shape, deep cleft on distal margin, 4 pairs of distal setae (distalmost curved and basalmost small), 3 pairs of basal setae straight. Glans very long (⅔ of ventral plate length), stylus smooth and curved dorsally, without dorsal and ventral processes.

Taxonomical note. The assignment of *N. peruvianus* to *Neopachyloides* is based on overall similarity and should be considered tentative. *Neopachyloides peruvianus* is the only Ampycinae which presents just one scutal area armed with a paramedian enlarged pair of tubercles (most genera present 3 scutal areas armed with a paramedian pair of enlarged tubercles, as *Ampycus*, *Hexabunus* and *Pirunipygus* or all of them unarmed). We preferred to place *N. peruvianus* under *Neopachyloides* instead of proposing a new genus because monophyly of Ampycinae genera (most of them monotypic) are doubtful. See taxonomical note of *Pirunipygus paradoxus* for the reasons of the new placement of *N. peruvianus*.

***Pirunipygus* Roewer, 1936, new subfamily assignment**
http://species-id.net/wiki/Pirunipygus

Pirunipygus Roewer, 1936: 341; Kury 2003: 187; (type species: *Pirunipygus paradoxus* Roewer, 1936, by monotypy).

Diagnosis. *Pirunipygus* is a monotypic genus and resembles Ampycinae genera with a paramedian pair of enlarged tubercles on scutal areas I–II as *Ampycus* Simon, 1879, *Hexabunus* Roewer, 1913, *Neopachyloides* Roewer, 1913 and *Parahernandria* Good-

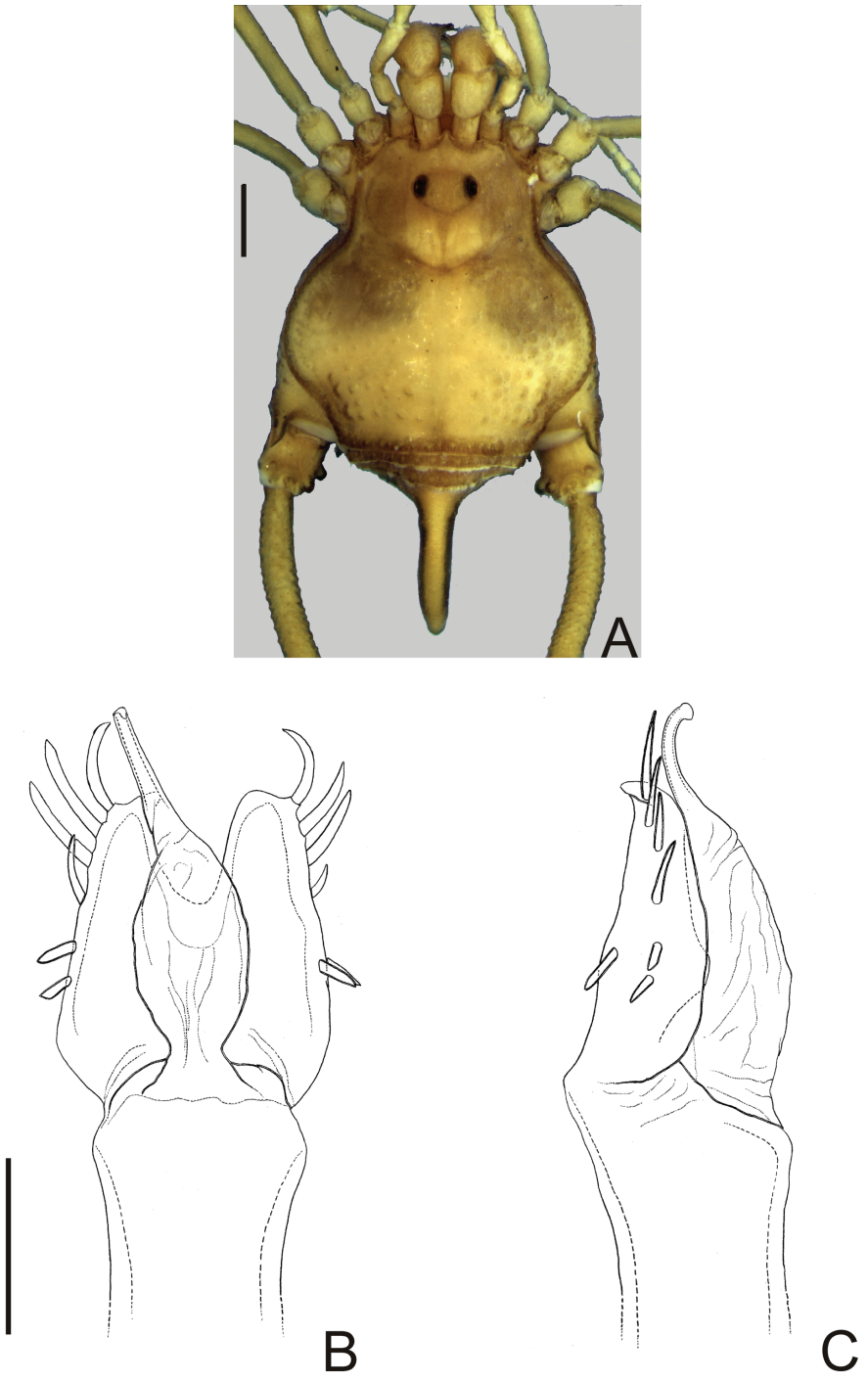


Figure 4. *Neopachyloides peruvianus* (Roewer) **comb. n.** Male (holotype): **A** habitus, dorsal view. Distal part of penis (holotype) **B** in dorsal view **C** ditto, left lateral view. **B, C** at same scale. Scale bars: **A** = 1 mm; **B** = 0.1 mm.

night & Goodnight, 1947. *Pirunipygus paradoxus* can be distinguished from these genera by the following combination of characters: ocularium with a median spiniform apophysis (Fig. 5A); dorsal scutum with secondary tubercles (sensu Maury 1992); scutal area III with a paramedian pair of spiniform apophyses; free tergite II with a median spiniform apophysis; free tergite III with three spiniform apophyses, the middle one largest and bifid.

Composition. Monotypic.

***Pirunipygus paradoxus* Roewer, 1936**
http://species-id.net/wiki/Pirunipygus_paradoxus
Fig. 5

Pirunipygus paradoxus Roewer, 1936: 341, fig. 4 (♂); Kury 2003: 106; (male holotype, Peru, Junin, Tarma, SMF 6180/85, examined).

Description. Penis (Fig. 5B–C; holotype): ventral plate sub hexagonal, deep U-cleft on distal margin, 3–4 distal pairs of setae (2–3 distalmost curved), 2 pairs of dorsal median setae of moderate size, 2 pairs of ventral median small setae. Stylus wide on basal ¾, apex twisted, with a patch of ventral subapical trichomes and some scattered apically. Glans without dorsal and ventral processes.

Taxonomical note. Both *Neopachyloides peruvianus* and *P. paradoxus* were formerly placed in Gonyleptidae, Pachylinae. These two species show the following diagnostic characteristics of Ampycinae (Kury 2003), viz., body coloration black, integument with huge rounded tubercles, stout apophysis on free tergite III, ventral plate of penis with deep U-shape cleft on distal margin, absence of dorsal and ventral processes of glans.

Gonyleptinae Sundevall, 1833

***Acanthogonyleptes* Mello-Leitão, 1922**
http://species-id.net/wiki/Acanthogonyleptes

Acanthogonyleptes Mello-Leitão, 1922: 336; Kury 2003:137; DaSilva and Pinto-da-Rocha 2010: 626; (type species: *Acanthogonyleptes pulcher* Mello-Leitão, 1922, by original designation).

Centroleptes Roewer, 1943: 45; Kury 2003: 122; (type species: *Centroleptes flavus* Roewer, 1943, by monotypy). **Syn. n.**

Diagnosis. As in Kury (2003: 137).

Taxonomical note. The monotypic genus *Centroleptes* is a subjective synonym of *Acanthogonyleptes*, since the type examined material of *C. flavus* and *A. singularis* are identical and synonymized here.

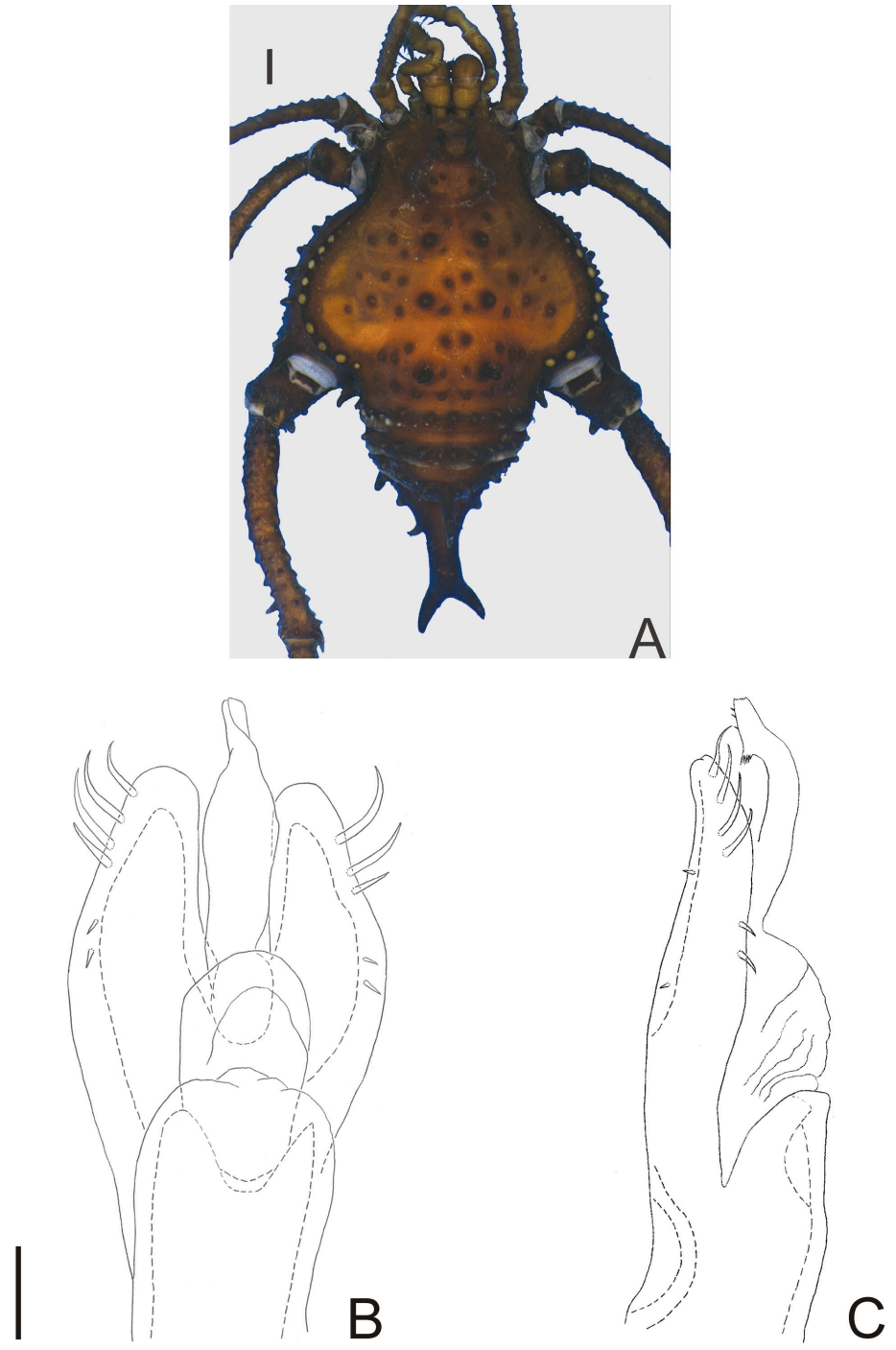


Figure 5. *Pirunipygus paradoxus* Roewer. Male (holotype): **A** habitus, dorsal view. Distal part of penis (holotype) **B** in dorsal view; **C** ditto, left lateral view. **B, C** at same scale. Scale bar: **A** = 1 mm. Scale bar: **B** = 0.1 mm.

Composition. *Acanthogonyleptes alticola* (Mello-Leitão, 1922); *A. editus* (Roewer, 1943); *A. fallax* (Mello-Leitão, 1932); *A. fulvigranulatus* (Mello-Leitão, 1922); *A. marmoratus* (Mello-Leitão, 1940); *A. pictus* (Piza, 1942); *A. singularis* (Mello-Leitão, 1935); *A. soaresi* (Mello-Leitão, 1944); *A. variolosus* (Mello-Leitão, 1940).

***Acanthogonyleptes singularis* (Mello-Leitão, 1935)**
http://species-id.net/wiki/Acanthogonyleptes_singularis

Adelphobunus singularis Mello-Leitão, 1935: 392, fig. 19 (♂); Kury 2003: 137; (male holotype; Brazil, São Paulo, Ribeirão Pires, IBSP 17, examined).
Sphaerobunus singularis: Kury 2003: 139.
Acanthogonyleptes singularis: DaSilva and Pinto-da-Rocha 2010: 626.
Bocaina marmorata Piza, 1943: 46, fig. 5 (♂); Kury 2003: 139; (male holotype, Brazil, São Paulo, Serra da Bocaina, Fazenda Águas de Santa Rosa, MZSP 810, examined). Synonymy established by Soares and Soares (1987).
Centroleptes flavus Roewer, 1943: 45, fig. 50 (♀); Kury 2003: 122; (female holotype, Brazil, Santa Catarina, Seara, Nova Teutonia, SMF 6430/63, examined). **Syn. n.**

Material examined. BRAZIL. São Paulo: São José do Barreiro (Serra da Bocaina, Fazendas Águas de Santa Rosa), female holotype of *Bocaina marmorata* Piza (MZSP 810); Ribeirão Pires, male holotype of *Adelphobunus singularis* Mello-Leitão (IBSP 17); São José do Barreiro, 1 ♂ (HEMS 761); Santo André, 1 ♂ & 1 ♀ (MZSP 21257). Santa Catarina: Seara (Nova Teutônia), ♀ holotype of *Centroleptes flavus* Roewer (SMF 6430/63).

Diagnosis. *Acanthogonyleptes singularis* and *A. variolosus* can be distinguished from the remaining species of the genus by the presence of a median single elevation on scutal area III. Males of *A. singularis* can be distinguished from those of *A. variolosus* by the presence of a robust curved retrolateral apophysis on trochanter IV.

Taxonomical note. The genus *Acanthogonyleptes* is a morphologically homogeneous group, probably representing a monophyletic group (see *Sphaerobunus* in Kury 2003). *Acanthogonyleptes singularis* and *C. flavus* bear a median single elevation on scutal area III. In addition, the morphology of female leg IV of both *A. singularis* and *C. flavus* are identical. The geographical records of *A. singularis* include localities in the Brazilian states of São Paulo and Rio de Janeiro. The only known specimen identified as *C. flavus* is the holotype, supposedly collected in Seara (Nova Teutônia), and therefore the locality cited by Roewer (1943) is considered wrong.

***Geraeocormobius sylvarum* Holmberg, 1887**
http://species-id.net/wiki/Geraeocormobius_sylvarum

Geraecormobius sylvarum Holmberg, 1887: 211, fig. unnumbered (♂); Kury 2003: 125; (1 male & 1 female syntypes, Argentina, Misiones, Santa Ana, near river Piraí Mirín, type depository unknown).

Discocyrtus serrifemur Roewer, 1943: 21, fig. 10 (♂); (1 male & 8 female syntypes, Brazil, Santa Catarina, Nova Teutônia, SMF 6193/104, examined). **Syn. n.**
Geraeocormobius sylvarum Acosta et al. 2007a: 303, figs 1–3 (map, ♂♀).

Other material examined. Brazil. Paraná: Cachoeirinha, 2 ♂ & 5 ♀ (MNRJ 26912); Paranavaí, 6 ♂ & 7 ♀ (MNRJ 4732).

Taxonomical note. Roewer (1943) placed *D. serrifemur* in the Pachylinae based on the observation of pigmentation on posterior part of dorsal scutum, which he assumed erroneously to be the scutal area IV. Both sexes of type series of *D. serrifemur* are identical to *G. sylvarum*. In general, females of Gonyleptinae do not show conspicuous diagnostic characters, which are mainly seen in male tegumentary ornamentation. Both male and female specimens of *G. sylvarum* preserved in 70% alcohol present a general black coloration with olive or yellowish lateral marks on the dorsal scutum, with white pedipalps. *Geraeocormobius sylvarum* could be confused with *G. rohri* (Mello-Leitão) and *G. salebrosus* (Roewer) because of its relatively larger body size, presence of large rounded tubercles on the scutal area III, general black coloration and geographical occurrence. However, *G. sylvarum* can be distinguished from them by the white pedipalps.

***Gonyleptellus bimaculatus* (Sørensen, 1884), comb. n.**
http://species-id.net/wiki/Gonyleptellus_bimaculatus

Gonyleptes bimaculatus Sørensen, 1884: 605; (female holotype, Brazil, ZMUC, examined from digital photos).
Paragonyleptes bimaculatus: Roewer 1913: 243.
Gonyleptes cancellatus Roewer, 1917: 127, fig. 26 (♂); (male holotype, Brazil, São Paulo, Santos, SMF 1320, examined). **Syn. n.**
Gonyleptellus cancellatus: Kury 2003: 126.
"Paragonyleptes" bimaculatus: Kury 2003: 121.

Material examined. BRAZIL. Locality not specified further, female holotype of *Gonyleptes bimaculatus*, examined by digital photos (ZMUC). São Paulo: Santos, ♂ holotype of *Gonyleptes cancellatus* (SMF 1320); Bananal (Estação Ecológica do Bananal), A. Monteiro leg., IV.2004, 10 ♂ & 10 ♀ (MZSP 27804). Rio de Janeiro: Itatiaia (Parque Nacional do Itatiaia), Equipe Biota leg., 8–15.VI.2001, 3 ♂ & 1 ♀ (MZSP 21746); Terezópolis (Parque Nacional da Serra dos Órgãos, sede), R. Pinto-da-Rocha, S. Outeda-Jorge, C. Mattoni leg., 10.II.2007, 3 ♂ & 5 ♀ (MZSP 28223); Nova Friburgo (Mury, Debossan, 950 m), R.S. Bérnils & P. Labiak leg., 29.VII.1996, 6 ♂ & 3 ♀ (MZSP 15120).

Taxonomical note. Sørensen (1884) described *Gonyleptes bimaculatus* from Brazil without any illustration. Roewer (1913) transferred it to *Paragonyleptes* Roewer,

1913. Kury (2003) synonymized the type species (*Gonyleptes bicuspidatus* Koch, 1839) of *Paragonyleptes* with *Collonychium bicuspidatum* Bertkau, 1880 and considered some species allocated in *Paragonyleptes* as Gonyleptinae *incertae sedis*, such as *G. bimaculatus*. The examination of *G. bimaculatus* from detailed photos of the holotype, which is reasonably well preserved, allowed us to recognize it as *Gonyleptellus cancellatus*, a well-known species from the Brazilian states of Rio de Janeiro and São Paulo (Serra da Bocaina mountain range). Therefore, *G. cancellatus* is a junior synonym of *G. bimaculatus*. The other species of *Gonyleptellus* is *G. bufoninus* (Mello-Leitão, 1949), known only by its original description, which lacks illustration and its type depository is unknown (Kury 2003).

***Gonyleptes* Kirby, 1819**
http://species-id.net/wiki/Gonyleptes

Gonyleptes Kirby, 1819: 450; Kury 2003: 126; (type species: *Gonyleptes horridus* Kirby, 1819, by subsequent designation, Roewer 1913).
Collonychium Bertkau, 1880: 108; Kury 2003: 122; (type species: *Collonychium bicuspidatum* Bertkau, 1880, by monotypy). **Syn. n.**

Diagnosis. *Gonyleptes* is a genus composed of generally large species (dorsal scutum length longer than 8 mm), which males present femur IV with conspicuous armature and scutal areas I–III convex in lateral view. The penis presents ventral plate very convex and apex of ventral process serrate and semicircular. See taxonomical note below.

Taxonomical note. *Gonyleptes* possesses 23 species and its habitus resembles other genera placed in Gonyleptinae. As Kury (2003) already suggested, the generic boundaries are not so clear cut. *Collonychium* is an objective synonym of *Gonyleptes* since both type species are synonymous. It can be only distinguished from related taxa, such as *Geraeocormobius* Holmberg, 1887, by a combination of unsatisfactory Roewerian characteristics. The composition of the genus below includes the changes proposed in this article.

Composition. *Gonyleptes acanthopus* (Quoy & Gaimard, 1824); *G. armatus* Perty, 1833; *G. atrus* Mello-Leitão, 1923, **revalidated**; *G. barbiellinii* Mello-Leitão, 1932; *G. calcaripes* (Roewer, 1917); *G. curticornis* (Mello-Leitão, 1940); *G. curvicornis* (Roewer, 1932), **revalidated**, **comb**. **n**.; *G. fragilis* Mello-Leitão, 1923; *G. gertschi* Soares & Soares, 1948; *G. gonyleptoides* (Soares & Soares, 1945); *G. granulatus* (Piza, 1940); *G. horridus* Kirby, 1819; *G. parcigranulatus* Soares & Soares, 1949; *G. pectinatus* Koch, 1845; *G. pectinipes* Roewer, 1917; *G. perlatus* (Mello-Leitão, 1935), **comb**. **n**.; *G. pseudogranulatus* Soares & Soares, 1946; *G. pseudoguttatus* Giltay, 1928; *G. pustulatus* Sørensen, 1884; *G. recentissimus* Mello-Leitão, 1932; *G. saprophilus* Mello-Leitão, 1922; *G. vatius* Bertkau, 1880; *G. viridisagittatus* Soares & Soares, 1945.

***Gonyleptes horridus* Kirby, 1819**
http://species-id.net/wiki/Gonyleptes_horridus
Figs 6A–D; 7

Gonyleptes horridus Kirby, 1819: 452, pl. 22, fig. 16 (♂); Kury 2003: 128; (male holotype, Brazil, NHM 1863.41, examined from detailed photos).
Gonyleptes bicuspidatus Koch, 1839: 13; (2 females syntypes, Brazil, NHMW, not examined; 2 males & 2 females syntypes, Brazil, ZMB 905, not examined). **Syn. n.**
Collonychium bicuspidatum Bertkau, 1880: 108, pl. 2, fig. 39 (♀); (female nymph holotype, Brazil, Rio de Janeiro, Rio de Janeiro [Copacabana], ISNB, not examined). **Syn. n.**
Metagonyleptes hamatus Roewer, 1913: 213, fig. 89 (♂); (male holotype, Brazil, São Paulo, SMF 891, examined). **Syn. n.**
Paragonyleptes simoni Roewer, 1930: 379, fig. 12 (♂); (male holotype, Brazil, Santa Catarina, Serra Azul, SMF RII 1333, examined). **Syn. n.**
Gonyleptes borgmeyeri Mello-Leitão,1932: 305, fig. 167 (♂); (male holotype, MNRJ, lost, Brazil, Rio de Janeiro, Petrópolis). **Syn. n.**
Gonyleptes curvicornis Mello-Leitão, 1932: 305, fig. 166 (♂); (male holotype, MNRJ, lost, Brazil, Rio de Janeiro, Itatiaia). **Syn. n.**
Gonyleptes melloleitaoi Kury & Alonso-Zarazaga, 2011: 54 (replacement name for *Gonyleptes curvicornis* Mello-Leitão, secondary homonym of *Weyhia curvicornis* Roewer).

Material examined. BRAZIL. Locality not specified further, male holotype of *G. horridus*, examined by digital photos (NHM 1863.41). São Paulo: São Paulo, male holotype of *M. hamatus* (SMF 891). Rio de Janeiro: Rio de Janeiro (Gávea), 1 male (MZSP 1370). Santa Catarina: (Serra Azul), male holotype of *P. simoni* (SMF RII 1333).

Diagnosis. *Gonyleptes horridus* can be recognized by: the relatively larger size; anterior border of carapace smooth (without tubercles or spines in the corners); frontal hump on anterior border of carapace and ocularium with white small tubercles; prolateral apical apophysis of coxa IV long, with abrupt curvature backwards. *Gonyleptes horridus*, *G. perlatus* and *G. pustulatus* can be distinguished from all other species of *Gonyleptes* by the robust and bifid (two distal tips) retrolateral apical apophysis of coxa IV. Females of *G. horridus* and *G. perlatus* present dimorphic sulfur yellow spines on the free tergites, not present in females of *G. pustulatus*. *Gonyleptes horridus* can be distinguished from *G. perlatus* by the armature pattern of femur IV of the males (see note on *G. perlatus* below). *Gonyleptes horridus* has relatively smaller tubercles on posterior part of the lateral margins of abdominal scutum than in *G. perlatus*.

Description. Dorsal scutum length 7–9 mm. Anterior margin of carapace without tubercles or spines. Median frontal hump on anterior margin of carapace and ocularium with a pair of tubercles on each one (Fig. 6A). Four scutal grooves delimiting three scutal areas. Scutal areas I, II with low white tubercles in the median region; III with high paramedian tubercles. Lateral margin of dorsal scutum with flattened white

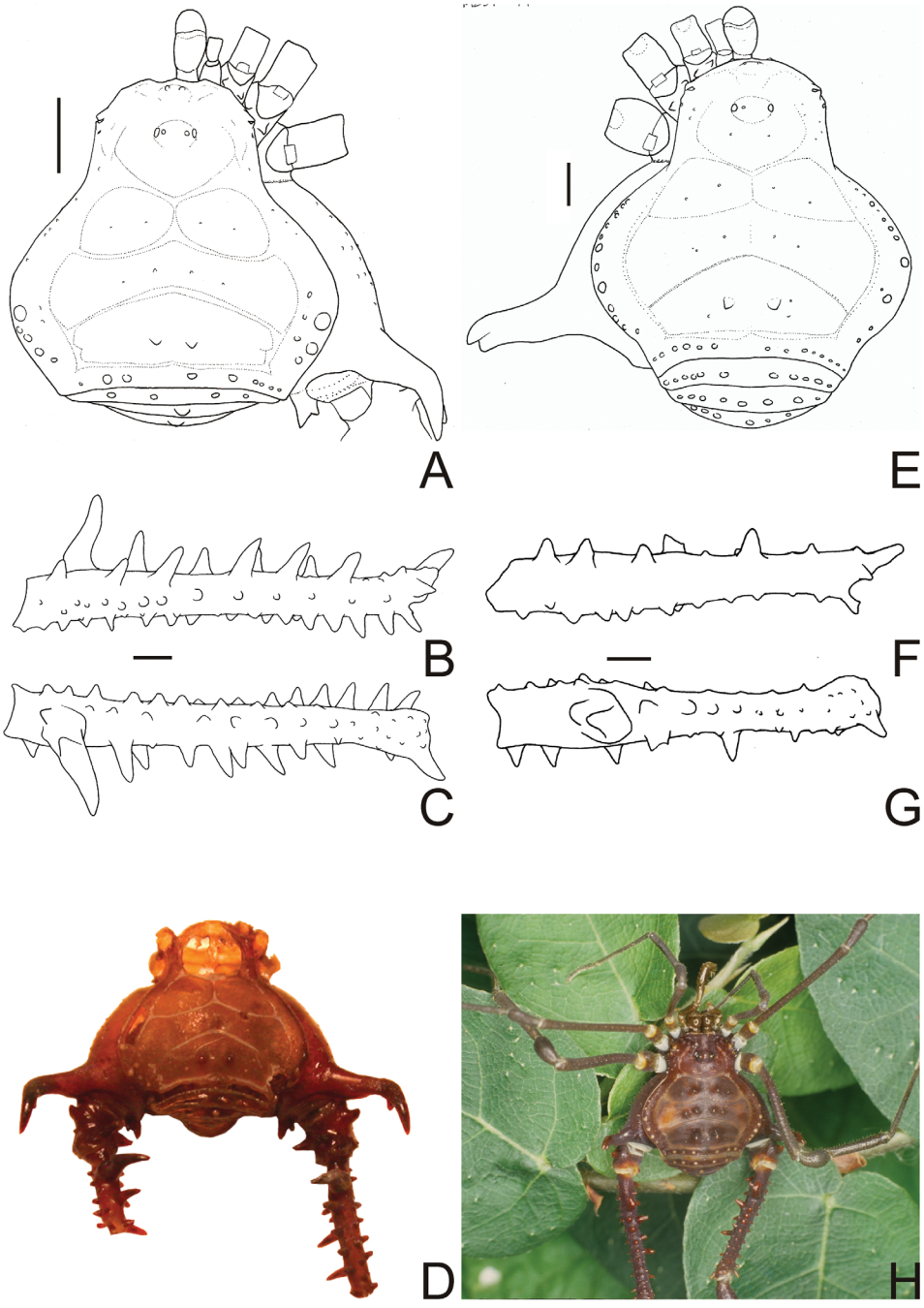


Figure 6. *Gonyleptes* spp. male dorsal habitus and femora IV: **A–D** *Gonyleptes horridus* Kirby (HEMS 103): **A** habitus, dorsal view **B** right femur IV ventral view **C** ditto, dorsal view **D** picture of the holotype (NHM 1863.41). **E–H** *Gonyleptes curvicornis* (Roewer) (MZSP 0871): **E** habitus, dorsal view **F** right femur IV ventral view **G** ditto, dorsal view **H** picture of a live specimen. **B, C** at same scale. **F, G** at same scale. Scale bars: 1 mm.

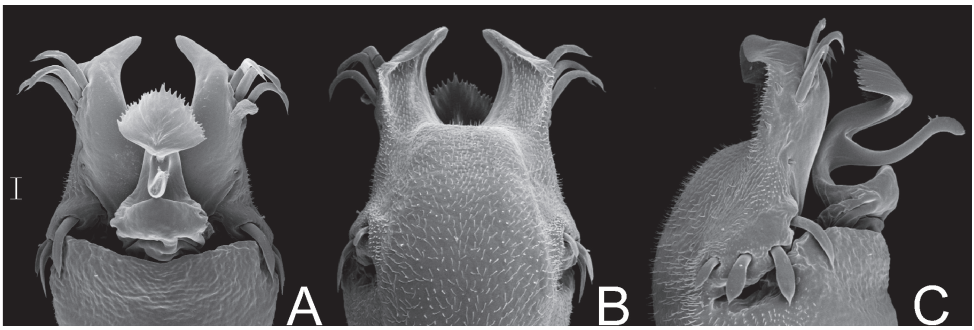


Figure 7. *Gonyleptes horridus* Kirby. Distal part of penis (MZSP 15496) **A** dorsal view **B** ditto, ventral view **C** ditto, left lateral view. Scale bar: 0.02 mm.

tubercles. Pedipalps approximately same length as dorsal scutum. Prolateral apophyses of coxa IV elongated, strongly curved backwards, dorsal branch longest. Retrolateral apophysis of coxa IV bifid. Femur IV straight, with dorsobasal apophyses and longitudinal rows of spines (Fig. 6B–C). Penis with typical Gonyleptinae-like pattern (Kury 1992b). Tarsal segmentation: 6(3); 10–12(3); 7–8; 8–9. Females with dimorphic cones (one yellowish huge median spine) on free tergites II and III. General coloration brown with white tubercles (Fig. 6D). Penis (Fig. 7A–C; MZSP 15496): ventral plate with a deep U-cleft on anterior margin (its distal tips convergent), 3 distal, 1 median and 4 basal pairs of setae, ventrally with a subdistal and a median pair of setae. Stylus sigmoid, with ventral subapical trichomes. Ventral process robust, apex as a flabellum with several small projections on distal margin.

Taxonomical note. All synonyms given in Kury (2003) for *Gonyleptes horridus* refer, in fact, to *G. curvicornis* (Roewer, 1913). The type material of *Gonyleptes curvicornis* Mello-Leitão, 1932 was lost, but the original descriptions and illustrations are sufficient to propose the present synonymy. The types of *Metagonyleptes hamatus* Roewer and *Paragonyleptes simoni* Roewer are identical to that of *G. horridus* Kirby. The record of *G. horridus* in Santa Catarina (type locality of *P. simoni)* is dubious. The synonymy of *G. bicuspidatus* with *G. horridus* is here proposed based on the reasoning of Kury (2003), who considered this nominal species as synonym of *C. bicuspidatum*. In turn, *Collonychium bicuspidatum* is clearly a synonym of *G. horridus*.

***Gonyleptes curvicornis* (Roewer, 1913), revalidated, comb. n.**
http://species-id.net/wiki/Gonyleptes_curvicornis
Figs 6E–H; 8

Weyhia curvicornis Roewer, 1913: 193, fig. 80 (♂); Kury 2003: 128; (holotype male, Brazil, São Paulo, SMF 979, examined).
Gonyleptes lacrimosus Mello-Leitão, 1932: 294, fig. 148 (♂); (male holotype, Brazil, Rio de Janeiro (Floresta da Tijuca), MNRJ 11789, not examined).

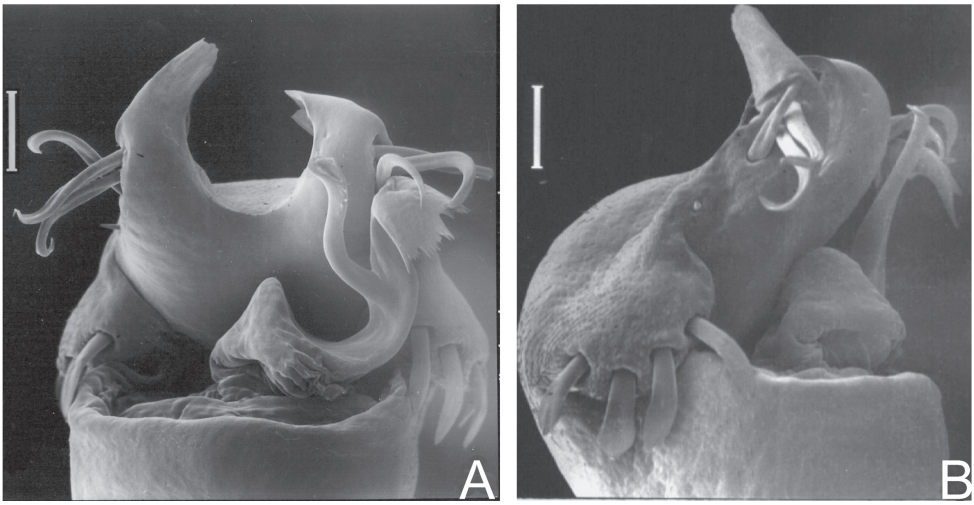


Figure 8. *Gonyleptes curvicornis* (Roewer). Distal part of penis (MZSP 1117) **A** dorsal view **B** ditto, left lateral view. Scale bars: 0.05 mm.

Mendesius albipunctatus Roewer, 1943: 41, pl. 5, fig. 45 (♀); (female holotype, Brazil, Mendes, SMF 5389/47).

Material examined. BRAZIL. São Paulo: Locality not specified further, male holotype (SMF 979); São Paulo (Chácara Dr. J. L. Lane), male (MZSP 0871). Rio de Janeiro: Rio de Janeiro (Grajaú), 1 male (MZSP 1117).

Diagnosis. *Gonyleptes curvicornis* resembles *G. horridus* (see diagnosis above) but can be distinguished by the relatively shorter prolateral apical apophysis of coxa IV, lacking the abrupt backwards curvature (Fig. 6E). The retrolateral apical apophysis of coxa IV is reduced and not bifid as in *G. horridus*. The male femur IV has a different pattern of armature (Fig. 6F–G) compared to *G. horridus*. Carapace with a pair of tubercles on the posterior area (posterior to ocularium). Females of *G. curvicornis* do not present dimorphic sulfur yellow spines on the free tergites.

Description. Penis (Fig. 8A–B; MZSP 1117): ventral plate sub hexagonal, with a deep U-cleft on distal margin (its distal tips convergent), 3 distal, 1 median, 4 basal pairs of setae (distal ones curved, median ones shortest). Stylus sigmoid, with ventral subapical trichomes. Ventral process robust, apex flabelliform with several projections of varying sizes on distal margin.

Taxonomical note. Roewer's (1913; 1923) redescriptions of *Gonyleptes horridus* and *W. curvicornis* are the same. Following *G. horridus sensu* Roewer, Soares and Soares (1988) considered *W. curvicornis* as its junior synonym. However, as seen above, such redescription of *G. horridus* was mistaken and, therefore, *W. curvicornis* can no longer be considered as a junior synonym. *Weyhia* was synonymized with *Geraeocormobius* by Soares and Soares (1949). The Gonyleptinae genera definition is still unsatisfactory, but the placement of *W. curvicornis* in *Gonyleptes* is more reasonable than its placement in

Geraeocormobius, due to morphological similarities shared with *G. horridus*, such as white tubercles on frontal hump on anterior margin of dorsal scutum, ocularium (Fig. 6H) and lateral borders of abdominal scutum convex and abdominal scutum itself convex.

Gonyleptes atrus Mello-Leitão, 1923, revalidated

http://species-id.net/wiki/Gonyleptes_atrus
Figs 9A–B, 10

Gonyleptes atrus Mello-Leitão, 1923: 140; Kury 2003: 129; (male syntype, Brazil, Itatiaia, state of Rio de Janeiro or Minas Gerais, MNRJ 1462, examined; 3 males & 3 females syntypes, MZSP 42).

Weyhia brieni Giltay, 1928: 83; (male holotype; Brazil, Itatiaia; ISNB; not examined). **Syn. n.**

Geraeocormobius jimi Soares & Soares, 1974: 601, figs 8–25 (♂♀); (male holotype and 1 female paratype; Brazil, Rio de Janeiro; Itatiaia; J. Jim et al. leg, 28.XI.1977; HSPC 447; 2 males paratypes; same locality; A. Peracchi & E. Izecksohn leg, 9.IV.1966; HSPC 463; examined). **Syn. n.**

Material examined. BRAZIL. Minas Gerais: Lambari (Parque Estadual Nova Baden), (MZSP 32513); Delfim Moreira (MZSP 29393); Itamonte (MZSP 21251); Poços de Caldas (MZSP 29366). Rio de Janeiro: Itatiaia, syntypes of *Weyhia bisignata* (MNRJ 27321). São Paulo: Campos do Jordão (MZSP 21251).

Diagnosis. Dorsal scutum length 8–10 mm. Corners of anterior margin of carapace smooth. Median frontal hump on anterior margin of carapace and ocularium with one pair of tubercles each one. Posterior region of carapace with 2 median tubercles. Mesotergum densely covered by tubercles. Scutal areas I–III each with a pair of median enlarged tubercles (III with largest and round ones). Prolateral apical apophysis of male coxa IV slightly directed backwards, retrolateral apophysis of male coxa IV absent or very reduced (Fig. 9A–B). Dorsobasal apophysis of male femur IV robust, curved and retrolaterally oriented. Ornamentation of male femur IV variable, normally with two prolateral spines.

Description. Penis (Fig. 10A–C, MZSP 29393): ventral plate with 3 distal and 3 basal pairs of large setae, 1 median pair of short setae. Stylus with ventral trichomes. Ventral process with a triangular flabellum, with digitiform ventral median projection.

Taxonomical note. *Gonyleptes atrus* was synonymized, without further remarks, with *G. saprophilus* by Kury (2003) in his catalogue of Laniatores of the New World. However, the study of type material of both species revealed no overlap of some diagnostic characteristics. *G. atrus* is relatively larger than *G. saprophilus*. Both species present different patterns of ornamentation on male femur IV. *G. atrus* shows a sigmoid femur IV with robust dorsal subasal apophysis and two remarkable retrolateral apophyses (Fig. 9A–B), while *G. saprophilus* shows a straight femur, reduced dorsal subasal apophysis, one remarkable retrolateral apophysis and three to five dorsal spines on anterior half of

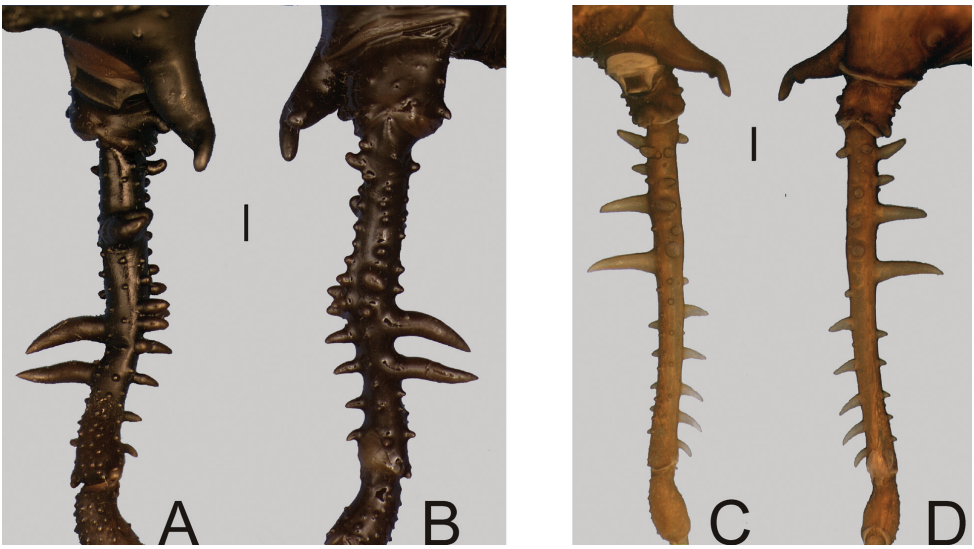


Figure 9. *Gonyleptes* spp. male femora IV: **A, B** *Gonyleptes atrus* Mello-Leitão (MZSP 32513): **A** right femur IV dorsal view **B** ditto, ventral view. **C, D** *Gonyleptes saprophilus* Mello-Leitão (MZSP 9996): **C** right femur IV dorsal view **D** ditto, ventral view. **A, B** at same scale. **C, D** at same scale. Scale bars: 1 mm.

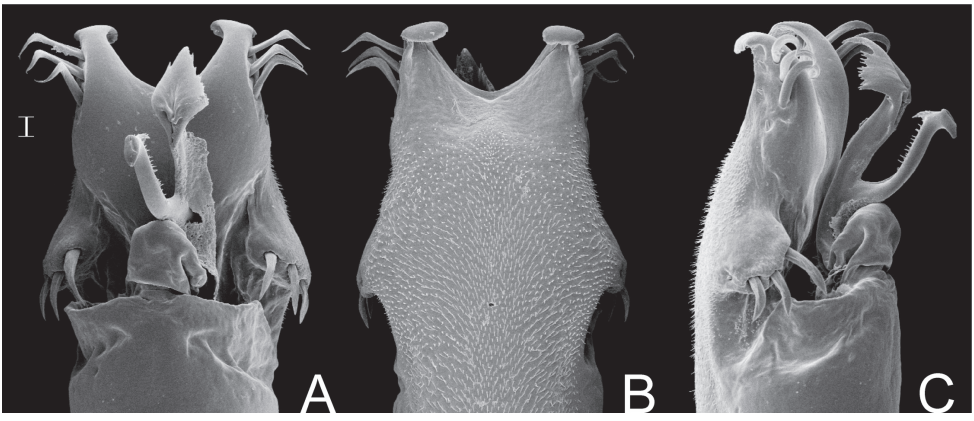


Figure 10. *Gonyleptes atrus* Mello-Leitão. Distal part of penis (MZSP 29393) **A** dorsal view **B** ditto, ventral view **C** ditto, left lateral view. Scale bar: 0.02 mm.

the femur IV (Fig. 9C–D). Specimens of *Geraeocormobius jimi* and *G. atrus* are identical. The description of *W. brieni* is sufficiently clear to consider this species synonymy of *G. atrus*, even without the examination of the type material. Only *Gonyleptes itatiayae* Mello-Leitão, *Weyhia bisignata* Mello-Leitão and *Gyndesops pretiosus* Mello-Leitão, and all its combination, remain in the synonymic list of *G. saprophilus*. *Gonyleptes atrus* occurs in sympatry with *G. saprophilus* in almost all of its distribution range.

***Gonyleptes fragilis* Mello-Leitão, 1923**
http://species-id.net/wiki/Gonyleptes_fragilis
Fig. 11

Gonyleptes fragilis Mello-Leitão, 1923: 127; Kury 2003: 127; (female holotype, Brazil, São Paulo, Santo André, Alto da Serra, MZSP 56, examined).
Mendesius guttatus Roewer, 1952: 57; (female holotype, Brazil, SMF RII 10311/72, examined).
Gonyleptes banana Kury, 2003: 127 (replacement name for *Mendesius guttatus* Roewer, 1952, preoccupied by *Gonyleptes guttatus* Roewer, 1917). **Syn. n.**

Diagnosis. *Gonyleptes fragilis* resembles *G. horridus* and *G. curvicornis* because of the overall similarities of the features of the dorsal scutum. *Gonyleptes fragilis* can be distinguished from the other two species by the ocularium with a pair of spines (tubercles in *G. horridus* and *G. curvicornis*) and the pale yellowish spots around the tubercles on abdominal scutum.

Description. Penis (Fig. 11A–C): ventral plate inflated in the middle region, with a deep U-cleft on anterior margin (its distal tips convergent), 3 distal pairs of long, curved setae, 1 median pair of short setae, 4 basal pairs of spatulate setae. Glans sac slightly projected distally, with similar projection to a dorsal process. Stylus sigmoid, smooth. Ventral process robust, apex flabelliform with several small projections on distal margin.

Taxonomical note. Soares and Soares (1988) proposed the new combination *Gonyleptes guttatus* (Roewer, 1952) for *M. guttatus*, making it a homonym of *G. guttatus* Roewer, 1917 [= *Melloleitaniella guttata* (Roewer, 1917)]. Kury (2003) renamed the species as *G. banana*, based on the Roewer's citation about the peculiar collection site of the type specimen, a banana shipment for export. The female holotype of *Mendesius guttatus* matches exactly the female holotype of *G. fragilis*. Both males and females of *G. fragilis* present a brown general coloration with some pale yellowish spots around the tubercles of the mesotergum, a diagnostic characteristic for this species. In addition, the occurrence area of *G. fragilis* includes the Vale do Ribeira and southern coast of São Paulo (Kury 2003), an important area known for producing banana for exportation in the 1940's and 1950's.

***Gonyleptes perlatus* (Mello-Leitão, 1935), comb. n.**
http://species-id.net/wiki/Gonyleptes_perlatus

Moojenia perlata Mello-Leitão, 1935: 384, fig. 13 (♂); (2 males syntypes, Brazil, Minas Gerais, Viçosa, MNRJ 1577, examined)
Collonychium perlatum: Kury 2003: 123.

Diagnosis. *Gonyleptes perlatus* is very similar to *G. horridus* (according to Kury 2003) but can be distinguished by the relatively larger tubercles on lateral margin of the dor-

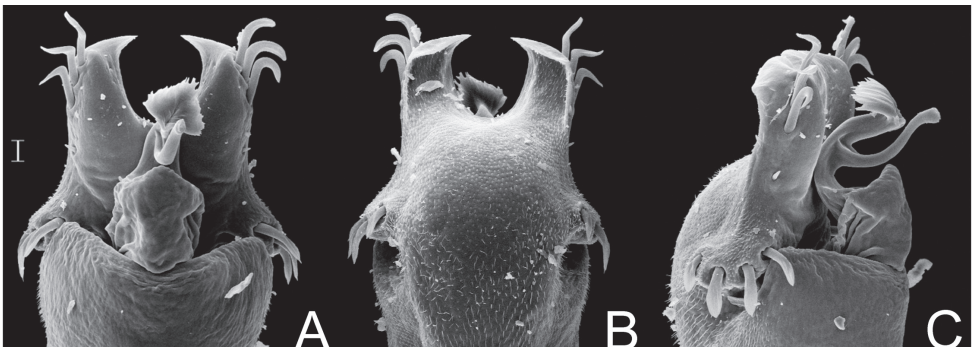


Figure 11. *Gonyleptes fragilis* Mello-Leitão. Distal part of penis (MZSP 30764) **A** dorsal view **B** ditto, ventral view **C** ditto, left lateral view. Scale bar: 0.02 mm.

sal scutum and the absence of a robust prolateral row of apophysis on male femur IV (present in *G. horridus*), although this article might present variable armature.

Taxonomical note. We propose the allocation of this species in *Gonyleptes* because it is very similar to *G. horridus* (see comments in Kury 2003), including the typical sexual dimorphism. According Kury (2003), both species are allopatric.

***Gonyleptes pustulatus* Sørensen, 1884**
http://species-id.net/wiki/Gonyleptes_pustulatus
Fig. 12

Gonyleptes pustulatus Sørensen, 1884: 603, Kury 2003: 128; (male holotype, Brazil, ZMUC, examined from detailed photo).
Gonyleptes guttatus Roewer, 1917: 125, fig. 25 (♂); Kury 2003: 128; (male holotype, Brazil, São Paulo, Santos, SMF 1321, examined). **Syn. n.**

Material examined. BRAZIL. Locality not specified further, male holotype of *Gonyleptes pustulatus*, examined from photo (ZMUC). São Paulo: Santos, male holotype of *Gonyleptes guttatus* (SMF 1321). Rio de Janeiro: Casimiro de Abreu, 5 ♂ & 6 ♀ (MNRJ 17456).

Diagnosis. *Gonyleptes pustulatus* (Fig. 12A–B) superficially resembles *G. bimaculatus* because of the conspicuous white patches on mesotergum. Males of *Gonyleptes pustulatus* can be distinguished from *G. bimaculatus* by: femur IV armed (unarmed in *G. bimaculatus*) and presence of a bifid retrolateral apical apophysis on coxa IV.

Description. Penis (Fig. 12C–D; MNRJ 17456): ventral plate with slightly inflated middle region, a deep distal U-cleft on anterior margin (its distal tips are divergent), 3 distal pairs of long, curved setae, 1 median pair of short setae, 4 basal pairs of spatulate setae. Stylus slightly straight, with apex slightly swollen. Ventral process robust, apex flabelliform with serrated and rounded distal margin.

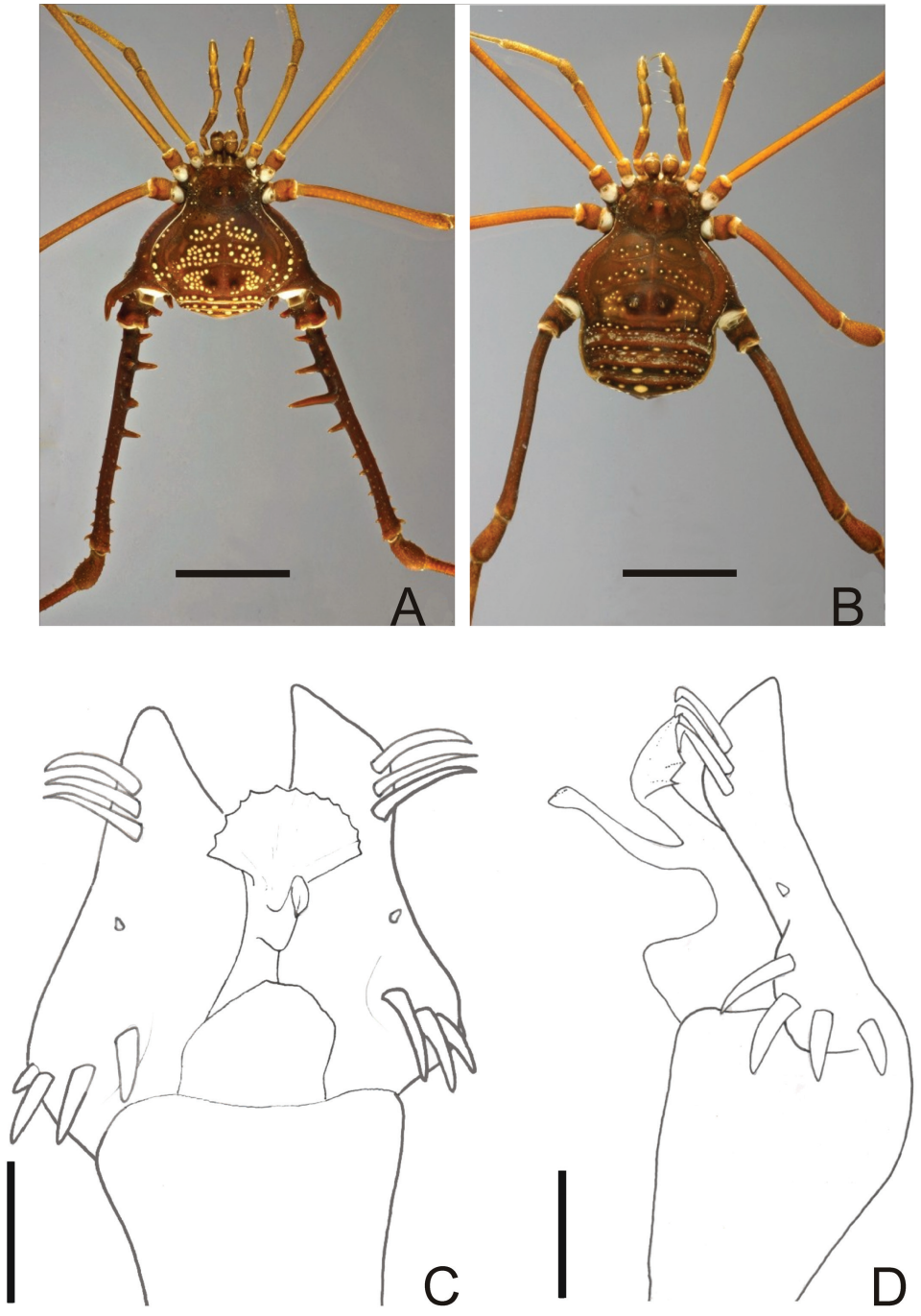


Figure 12. *Gonyleptes pustulatus* Sørensen. Male (MNRJ 17456): **A** habitus in dorsal view. Female (MNRJ 17456): **B** habitus in dorsal view. Distal part of penis (MNRJ 17456) **C** in dorsal view **D** ditto, right lateral view. Scale bars: **A–B** = 1.0 mm; **C–D** = 0.01 mm.

Taxonomical note. *Gonyleptes pustulatus* is a remarkable species by body color pattern. It was described without any illustration. Probably this was the reason that kept this species virtually unknown and led Roewer to describe *G. guttatus*.

***Liogonyleptoides minensis* (Piza, 1946)**
http://species-id.net/wiki/Liogonyleptoides_minensis

Chaquesia minensis Piza, 1946: 365, fig. 1 (♂); (2 males & 3 females syntypes; Brazil, Minas Gerais, Cachoeira do Pajeú; MZLQ A0053; examined).
Liogonyleptoides minensis: Kury 2003: 130.
Currala bahiensis Soares, 1972: 56, figs 1–4, 14–15 (♂♀); Kury 2003: 123; (male holotype and 1 female paratype; Brazil, Bahia, Maracás; MNRJ 5268; examined). **Syn. n.**

Taxonomical note. Comparisons between the type material of *Currala bahiensis* and *Liogonyleptoides minensis* allowed us to conclude that they are synonymous. *Liogonyleptoides minensis* is a species that can be easily diagnosed among gonyleptines by the relatively larger size, body dorsally rounded, without tubercles on corners, presence of scutal area IV; femur III curved (instead of sigmoid); male femur IV with a long, robust dorsobasal apophysis and a prolateral one that is curved dorsally on distal third. The genus *Currala* is now composed only by its type species *Currala spinifrons* Roewer, 1927.

***Mischonyx* Bertkau, 1880**
http://species-id.net/wiki/Mischonyx

Mischonyx Bertkau, 1880: 106; Kury 2003: 132; (type species: *Mischonyx squalidus* Bertkau, 1880, by monotypy).
Eugonyleptes Roewer, 1913: 219; Kury 2003: 123; (type species: *Gonyleptes scaber* Kirby, 1819, by monotypy). **Syn. n.**
Gonazula Roewer, 1930: 417; Kury 2003: 126; (type species: *Gonazula gibbosa* Roewer, 1930, by monotypy). **Syn. n.**

Diagnosis. *Mischonyx* resembles *Currala* Roewer, 1927 and *Schenkelibunus* Strand, 1932, which are gonyleptine of relatively smaller size (about 5 mm of dorsal scutum length). *Mischonyx* can be distinguished from those genera by the combination of the following characters: anterior border of the carapace with robust spines; frontal hump on anterior margin of carapace and ocularium with a pair of spines; scutal areas I–III with a paramedian pair of tubercles, those on I–II elliptical and widest pair on scutal area III; lateral margin of the dorsal scutum with large white tubercles (in specimens preserved in 70% ethanol).

Taxonomical note. According DaSilva and Pinto-da-Rocha (2010), *Mischonyx* is phylogenetically close to Hernandariinae. It is probable that due to the Roewerian classification, some species which should be in *Mischonyx* is placed elsewhere in Gonyleptinae. Therefore, a comprehensive revision of the subfamily is needed.

Composition. *M. anomalus* (Mello-Leitão, 1936); *M. antiquus* (Mello-Leitão, 1934); *M. cuspidatus* (Roewer, 1913); *M. fidelis* (Mello-Leitão, 1931); *M. insulanus* (Soares, 1972); *M. intermedius* (Mello-Leitão, 1935); *M. kaisara* Vasconcelos, 2004; *M. poeta* Vasconcelos, 2005; *M. processigerus* (Soares & Soares, 1970); *M. squalidus* Bertkau, 1880 and *M. sulinus* (Soares & Soares, 1947).

Mischonyx scaber (Kirby, 1819), comb. n.

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

Gonyleptes scaber Kirby, 1819: 453; (3 males & 1 female syntypes; Brazil; NHM 1863.41; examined from detailed photo).
Eugonyleptes scaber: Roewer, 1913: 219; Kury 2003: 123.
Xundarava holacantha Mello-Leitão, 1927: 20; (female holotype; Brazil, Rio de Janeiro, Niteroi; MNRJ 1469; examined). **Syn. n.**
Mischonyx holacanthus: Kury 2003: 133.

Material examined. BRAZIL. Locality not specified further, 3 males & 1 female syntypes (NHM 1863.41). Rio de Janeiro: Niterói, female holotype of *Xundarava holacantha* (MNRJ 1469); ditto, male holotype of *Weyhia absconsa* (MNRJ 1483).

Diagnosis. *Mischonyx scaber* resembles *M. cuspidatus* and *M. poeta* because of armature of the male femur IV: presence of a dorsobasal apophysis relatively short and curved; one retrolateral apophysis on distal third; and a row of high, acuminated tubercles increasing in size from the base to distal third. *Mischonyx scaber* can be distinguished from *M. cuspidatus* by the presence of a short gap between the retrolateral row and the retrolateral apophysis on femur IV (the retrolateral row is continuous to the retrolateral apophysis on femur IV in *M. cuspidatus*). *Mischonyx scaber* can be distinguished from *M. poeta* by the absence of enlarged tubercles (present in *M. poeta*) on the posterior part of the lateral margin of the dorsal scutum.

Taxonomical note. *Mischonyx scaber* was described from Brazil, however, many authors, including Kury (2003), cited other countries as its type locality. It is clearly written "Brazil" on the label of the *G. scaber* holotype. The only other known specimens of this species are the types of *X. holacantha* and *Weyhia absconsa* (both in poor condition). The precise distribution records are Rio de Janeiro (Ilha do Governador) and Niterói.

***Mischonyx cuspidatus* (Roewer, 1913)**
http://species-id.net/wiki/Mischonyx_cuspidatus

Ilhaia cuspidata Roewer, 1913: 221; (male holotype; Brazil, Rio de Janeiro, Ilha Grande, SMF 900; examined).
Mischonyx cuspidatus: Kury 2003: 133.
Gonazula gibbosa Roewer, 1930: 418, fig. 32 (♂); Kury 2003: 126; (male holotype; Brazil, Santa Catarina, Serra Azul; SMF 1328; examined). **Syn. n.**

Material examined. BRAZIL. Rio de Janeiro: Ilha Grande, male holotype (SMF 900); Macaé, 16 ♂ & 6 ♀ (MNRJ 4601). Santa Catarina: Serra Azul, male holotype (SMF 1328); Gaspar, 1 ♂ (MNRJ 11584).

Diagnosis. *Mischonyx cuspidatus* resembles *M. poeta* and *M. scaber* (see diagnosis of *M. scaber*). *Mischonyx cuspidatus* can be distinguished from them by the median high, acuminated tubercle on the free tergites I–III.

Taxonomical note. The type locality of *Gonazula gibbosa,* Serra Azul (in the state of Santa Catarina), is an unknown toponym from where seven species are recorded (see Kury 2003). As some of these species were rediscovered in Serra dos Órgãos (in the state of Rio de Janeiro), we believe that the opilionids from Serra Azul were mislabeled, although *Mischonyx cuspidatus* is a synanthropic gonyleptid (Mestre and Pinto-da-Rocha 2004) with one of the largest geographical distributions known among Neotropical harvestmen (see records in Kury 2003).

***Megapachylus grandis* Roewer, 1913**
http://species-id.net/wiki/Megapachylus_grandis
Fig. 13

Megapachylus grandis Roewer, 1913: 124, fig. 56 (♂); Kury 2003: 131.
Metapachyloides almeidai Soares & Soares, 1946: 317, fig. 2 (♂); Kury 2003: 176; (male holotype; Brazil, Batea, São Paulo, Lane & Soares leg., V.1943; MZSP 883; examined) **Syn. n.**

Description. Penis (Fig. 13A–C; MZSP16837): ventral plate with slightly convergent lateral sides deep U-cleft on distal margin, its apex folded ventrally, 3 distal pairs of large setae, slightly curved at apex, 1 median pair of short setae and, 4 basal pairs of spatulate setae, directed frontwards. Glans with dorsal process. Stylus thin, long, sigmoid, with subapical ventral trichomes. Ventral process shaft folded ventrally, apex flabelliform, with serrate distal margins and long distal tip.

Taxonomical note. The male of the species described by Soares & Soares shows a moderate development of armature of leg IV but the number and arrangement of tubercles are perfectly coincident with those of *Megapachylus grandis*. It could be a beta male, although an extensive population study should be conducted to confirm this.

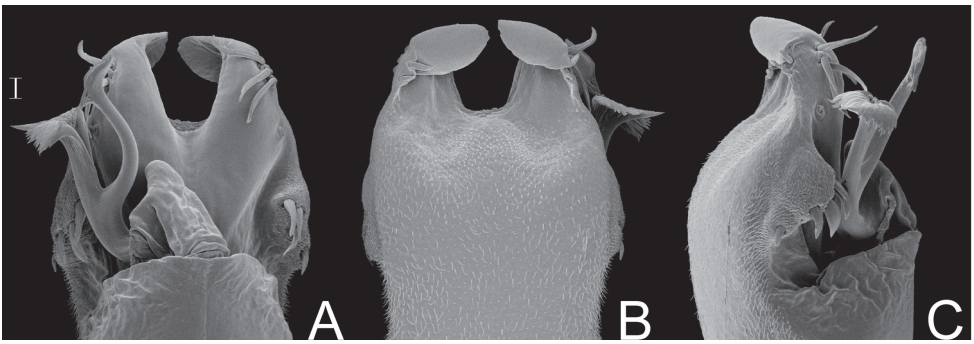


Figure 13. *Megapachylus grandis* Roewer. Distal part of penis (MZSP16837) **A** in dorsal view **B** ditto, ventral view **C** ditto, left lateral view. Scale bar: 0.02 mm.

Parampheres Roewer, 1913

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

Parampheres Roewer, 1913: 345; (type species: *Parampheres pectinatus* Roewer, 1913, by monotypy).

Metapachyloides Roewer, 1917: 120; (type species: *Metapachyloides rugosus* Roewer, 1917, by monotypy) **Syn. n.**

Diagnosis. *Parampheres* resembles *Acanthogonyleptes*, *Adhynastes* Roewer, 1930 and *Deltaspidium* Roewer, 1927 by the presence of a more elongated prolateral apical apophysis on male coxa IV (greater length/basal diameter ratio of the apophysis) than that in *Gonyleptes* and related Gonyleptinae genera. *Parampheres* can be distinguished from *Adhynastes* and *Deltaspidium* by the scutal area III with tubercles (instead of spines). *Parampheres* can be distinghished from A*canthogonyleptes* by the absence of a clearly defined dorsobasal apophysis on the male femur IV. *Parampheres* species bear a row of apophyses on the dorsal basal area of the femur IV.

Taxonomical note. *Metapachyloides* is a monotypic genus and its type species is junior synonym of *Parampheres tibialis* Roewer, 1917.

Parampheres tibialis Roewer, 1917

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

Parampheres tibialis Roewer, 1917: 144, fig. 37 (♂); (male holotype; Brazil, São Paulo, Santos; SMF 1330; examined).

Metapachyloides rugosus Roewer, 1917: 121, fig. 22 (♀); (female holotype; Brazil, São Paulo, Santos; SMF 1322; examined). **Syn. n.**

Taxonomical note. The monotypic genus *Metapachyloides* was formerly placed in Gonyleptidae, Pachylinae. Instead of a male, as stated in the original description, the

holotype of *M. rugosus* is a female, and its general aspect is similar to that of *Parampheres* Roewer, 1913. Surprisingly, in the same year, Roewer described *Parampheres tibialis* in Gonyleptinae, based on a male collected in the same locality (Santos), the most important harbor in Brazil. Roewer described many harvestmen species indicating Santos as their type locality, but those were never collected again there or in the area of endemism to which Santos belongs (Serra do Mar of São Paulo, see Pinto-da-Rocha et al. 2005 for more details). We conclude that *P. tibialis*, as well as many other species supposedly collected in Santos were probably mislabeled.

***Parapachyloides uncinatus* (Sørensen, 1879)**
http://species-id.net/wiki/Parapachyloides_uncinatus
Fig. 14

Gonyleptes uncinatus Sørensen, 1879: 214, figs 1–5, 9–10, 14, 18, 22–26, 28–29 (♂♀); (syntypes males & females, ZMUC, type locality not specified, see Kury 2003; examined from detailed photos).
Parapachyloides uncinatus: Kury 2003: 186.
Goyazella armata Mello-Leitão, 1931: 120, fig. 1 (♀); (female holotype; MNRJ 11373; Brazil; Goiás; Chapada dos Veadeiros; Blases leg., examined). syn. n.
Parapachyloides armatus: B. Soares 1944b: 164; Kury 2003: 186; Kury et al. 2010: 566.

Material examined. BRAZIL. São Paulo: Porto Cabral, 4 ♂ (MZSP 787); Usina Hidrelétrica de Rosana, 2 males & 2 females (MZSP 14571). Mato Grosso do Sul: Taquaruçu, 2 ♂ & 1 ♀ (MZSP 19113); ditto, (Canal do Rio Baía), 1 ♂ (MZSP 22084).

Description. Penis (Fig. 14A–C; MZSP 14571): ventral plate with the lateral sides slightly convergent, deep U-cleft on distal margin, its apex folded ventrally and convergent, 3 distal pairs of setae curved on apex, 1 pair of short median setae, 4 basal pairs of setae arranged in a row, 2 pairs of ventral distal short setae. Glans with small dorsal process. Stylus slender, sigmoid, smooth. Ventral process apex flabelliform with serrate distal margin.

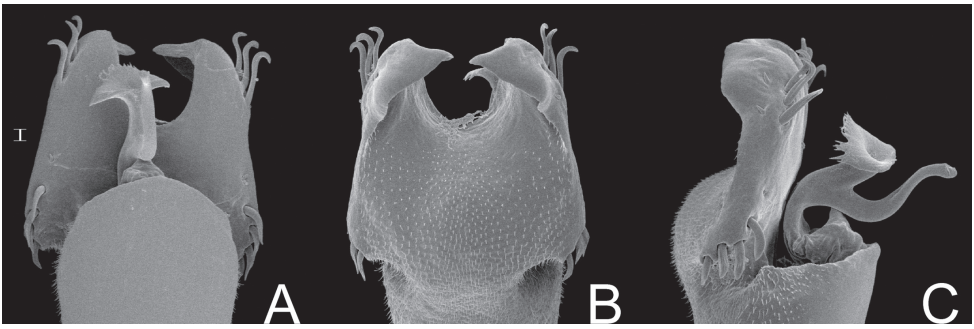


Figure 14. *Parapachyloides uncinatus* (Sørensen). Distal part of penis (MZSP 14571) **A** in dorsal view **B** ditto, ventral view **C** ditto, left lateral view. Scale bar: 0.01 mm.

Taxonomical note. Males of this species show polymorphism in the posterior tubercle on the lateral margin of dorsal scutum (from low, small and blunt to high, enlarged, curved and pointed apex), posterior margin of dorsal scutum (from low tubercles to two high tubercles) and armature of free tergite I (with one large median tubercle without enlarged lateral tubercles, or with 2–4 high lateral tubercles); retrolateral basal tubercle on male femur IV of same width as femur to 1.5 times wider, short (1.3 times femur width) to long (3.2 ×).

Schubartesia singularis B. Soares, 1944a

http://species-id.net/wiki/Schubartesia_singularis
Fig. 15

Schubartesia singularis B. Soares, 1944a: 34, fig. 1 (♂); Kury 2003: 192; Kury et al. 2010: 566; (male holotype, Brazil, Bahia, Os Gerais, Rio Branco Valley, MZSP, examined).

Material examined. BRAZIL. Bahia: (Os Gerais, Rio Branco Valley), male holotype of *Schubartesia singularis* (MZSP). Minas Gerais: Januária (Parque Nacional Cavernas do Peruaçu), 1 ♂ & 1 ♀ (MZSP 29075); ditto, 2 ♂ (MZSP 29839).

Description. Penis (Fig. 15A–C; MZSP 29075): ventral plate with the sides subparallel, with deep cleft on distal margin (U-cleft in ventral view and V-cleft in dorsal view; its apex convergent), 3 pairs of long helycoidal setae, 2 pairs of ventral distal short setae, 1 pair of median short setae, 4 pairs of spatulate, large setae arranged in an oblique row in lateral view, basal lobe short and projected dorsad. Stylus sigmoid, smooth. Ventral process shaft short and wide, apex flabelliform with slightly serrated distal margin.

Taxonomical note. *Schubartesia singularis* and *Parapachyloides armatus* were both formerly placed in Pachylinae and transferred recently to Gonyleptinae by Kury et al. (2010). In that occasion, they justified the transfer arguing that penial features are typical of those of Gonyleptinae, but they did not formally described or characterized them. Despite the typical "Pachylinae" general aspect (four scutal areas on dorsal

Figure 15. *Schubartesia singularis* B. Soares. Distal part of penis (MZSP 29075) **A** in dorsal view **B** ditto, ventral view **C** ditto, left lateral view. Scale bar: 0.02 mm.

scutum, robust pedipalps and conspicuous trochanter armature), the penis morphology, such as the deep cleft on distal margin of the penis ventral plate, indicates that it belongs to a more derivative gonyleptine lineage.

Heteropachylinae Kury, 1994a

***Pseudopucrolia* Roewer, 1912**
http://species-id.net/wiki/Pseudopucrolia

Pseudopucrolia Roewer, 1912: 167; Mendes 2011: 451; (type species: *Pseudopucrolia spinosa* Roewer, 1912, by monotypy).
Meteusarcus Roewer, 1913: 74; Kury 2003: 177; (type species: *Meteusarcus armatus* Roewer, 1913, by monotypy). **Syn. n.**

Diagnosis. See Mendes (2011: 453).

Composition. *Pseudopucrolia discrepans* (Roewer, 1943); *P. incerta* (Mello-Leitão, 1928); *P. mutica* (Perty, 1833) and *P. rugosa* (Roewer, 1930).

Taxonomical note. *Meteusarcus armatus* was formerly placed in Gonyleptidae, Pachylinae. The examination of the female holotype revealed it was a female of the heteropachyline *Pseudopucrolia mutica*.

***Pseudopucrolia mutica* (Perty, 1833)**
http://species-id.net/wiki/Pseudopucrolia_mutica

Eusarcus muticus Perty, 1833: 203.
Pseudopucrolia mutica: Kury 2003: 143; Mendes 2011: 462.
Meteusarcus armatus Roewer, 1913: 74, fig. 33 (♀); Kury 2003: 177; (female holotype; Brazil; SMF 801; examined). **Syn. n.**

Diagnosis. See Mendes (2011: 463).

Taxonomical note. See genus "Taxonomical note".

Pachylinae Sørensen, 1884

***Acrographinotus* Holmgren, 1916**
http://species-id.net/wiki/Acrographinotus

Acrographinotus Holmgren, 1916: 89; Roewer 1929: 240; Kury 2003: 155; (type species: *Acrographinotus erectispina* Roewer, 1929, by subsequent designation of Roewer (1929)).

Unduavius Roewer, 1929: 244; Kury 2003: 195; (type species: *Unduavius ornatus* Roewer, 1929, by monotypy). **Syn. n.**

Diagnosis. See Acosta (2001: 59).

Composition. *Acrographinotus ceratopygus* (Soares & Bauab-Vianna, 1972); *A. curvispina* Roewer, 1929; *A. erectispina* Roewer, 1929; *A. mitmaj* Acosta, 2002; *A. niawpaq* Acosta, 2001; *A. ortizi* (Roewer, 1957); *A. ornatus* (Roewer, 1929), **comb. n.**

Taxonomical note. The genus *Unduavius* is monotypic, but the remarkable ventral process of the penis, with its "ibis head" shape, fits perfectly in the generic concept presented by Acosta (2001), who rediagnosed the genus *Acrographinotus*.

Acrographinotus ornatus (Roewer, 1929), comb. n.

http://species-id.net/wiki/Acrographinotus_ornatus
Fig. 16

Unduavius ornatus Roewer, 1929: 244, fig. 28 (♂); Kury 2003: 195; (syntypes from NHMW, not examined, probably lost).

Material examined. BOLIVIA. La Paz: Nor Yungas (Unduavi), 1 male & 6 females (SMF 2881/79; syntypes according to Acosta (1996), which was previously referred to as belonging to Naturhistorisches Museum, Wien. We acknowledge them as syntypes together with those in SMF RII 995/52).

Diagnosis. *Acrographinotus ornatus* can be easily distinguished from other species of the genus by the blister-like, enlarged, brown tubercles on whitish scutal areas I–IV; posterior margin of dorsal scutum and free tergites I–II with a row of enlarged tubercles and white spots on lateral and posterior margin of dorsal scutum and coxa IV.

Description. Penis (Fig. 16A–B; SMF 2881): ventral plate with 3 distal pairs of long setae, 0–2 median pairs of short setae, 4–5 basal pairs of setae. Stylus almost straight (apex slightly bent), smooth. Distal ventral process shaped as an ibis head.

Gyndesops Roewer, 1943, new subfamilial assignment

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

Gyndesops Roewer, 1943: 29; Kury 2003: 129; (type species: *Gyndesops denisi* Roewer, 1943).

Diagnosis. *Gyndesops* resembles the largest Pachylinae genus, *Discocyrtus* Holmberg, 1878, which presents an ocularium and scutal area III with paired armature, four scutal areas, scutal area II–IV and free tergites I–III unarmed. This combination of characters also occurs in genera such as *Gyndoides* Mello-Leitão, 1927, *Lacronia* Strand, 1942, *Paraluederwaldtia* Mello-Leitão, 1927 and *Parapucrolia* Roewer, 1917. *Gyndesops* can be distinguished

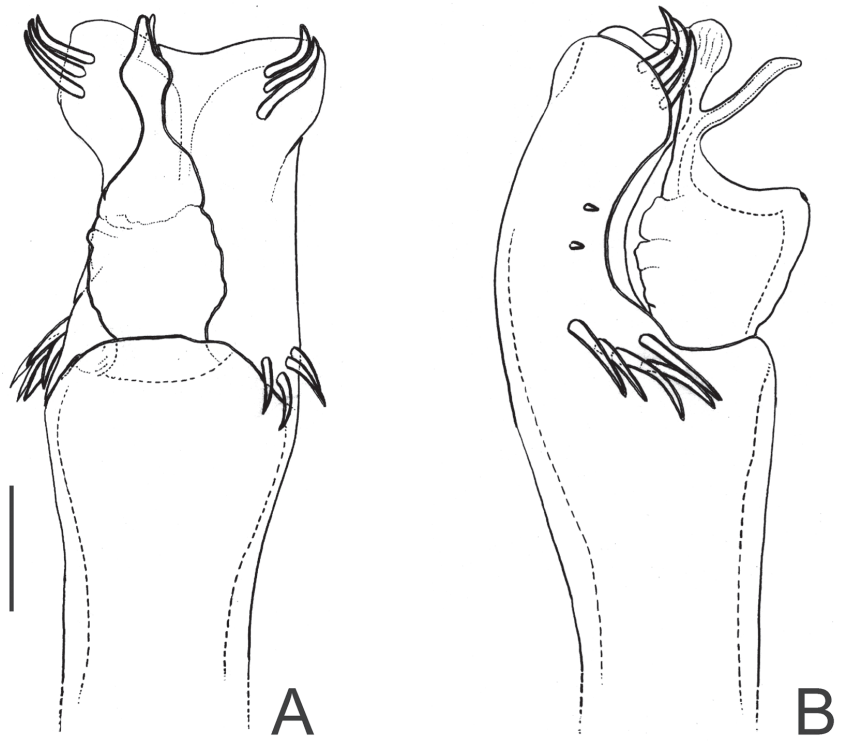


Figure 16. *Acrographinotus ornatus* (Roewer) **comb. n.** Distal part of penis (SMF 2881) **A** in dorsal view **B** ditto, left lateral view. Scale bar: 0.1 mm.

from *Lacronia* and *Parapucrolia* by the coloration, which is uniformly auburn (*Lacronia* has green/yellow spots and/or stripes on dorsal scutum and *Parapucrolia* has white patches on dorsal scutum). It is very difficult to distinguish *Gyndesops* from the remaining genera, because no revision was ever made including those groups, and their monophyly is doubtful. It is possible that *Gyndesops* (as well as *Gyndoides* and *Paraluederwaldtia*) is a junior synonym of *Discocyrtus*, but we refrained ourselves from such a rash nomenclatural act.

Composition. Monotypic.

Gyndesops denisi Roewer, 1943

http://species-id.net/wiki/Gyndesops_denisi
Fig. 17

Gyndesops denisi Roewer, 1943: 29, fig. 23 (♂); Kury 2003: 129; (male holotype, Brazil [Brasilien: Nova Teutonia], SMF 8833/117, examined).

Description. Penis (Fig. 17A–B, holotype): ventral plate subrectangular, basal half of lateral margin projected laterad, distal margin slightly concave, 3 distal pairs of cylin-

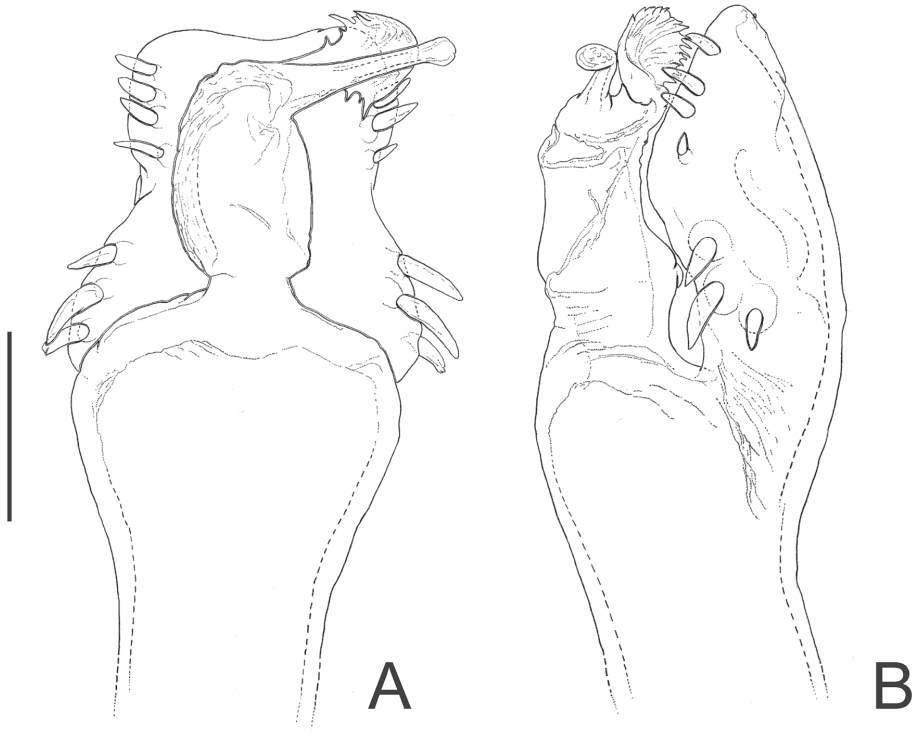


Figure 17. *Gyndesops denisi* Roewer. Distal part of penis (holotype) **A** in dorsal view **B** ditto, right lateral view. Scale bar: 0.1 mm.

drical setae, 1 pair of median setae (long left seta and moderate sized right seta), 3 basal pairs of cylindrical setae (median largest). Glans sac almost reaching distal margin of ventral plate. Stylus with swollen apex, smooth. Ventral process with large shaft, apex flabelliform with serrated lateral margins.

Taxonomical note. Originally, *Gyndesops denisi* was allocated in Pachylinae, and later transferred to Gonyleptinae by Kury (2003), without further explanation. It is known that Gonyleptinae and Pachylinae are possibly not monophyletic. A phylogenetic analysis of Gonyleptidae is currently being carried out and indicates, however, that most Gonyleptinae have a deep cleft in the distal margin of the penis ventral plate, as well as some other features, absent in this species. Since *G. denisi* (i) does not possess such cleft in the penis ventral plate, and (ii) the exterior morphology might be misleading regarding Gonyleptinae and Pachylinae, we opted to allocate it back in Pachylinae.

Haversia Roewer, 1913, new subfamilial assignment

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

Haversia Roewer, 1913: 170; Kury 2003: 129; (type species: *Gonyleptes defensus* Butler, 1876).

Hoggellula Roewer, 1930: 397; Kury 2003: 129; (type species: *Sadocus vallentini* Hogg, 1913, by monotypy). **Syn. n.**

Diagnosis. *Haversia* resembles Pachylinae with three scutal areas, such as *Corralia* Roewer, 1913, *Diconospelta* Canals, 1934, *Graphinotus* Koch, 1839, *Huassampilia* Roewer, 1913, *Neogonyleptes* Roewer, 1913, *Oxapampeus* Roewer, 1936, *Spinivunus* Roewer, 1943, *Tumbesia* Loman, 1899, *Ubatubesia* B. Soares, 1945, and two species of *Sadocus* Sørensen, 1886 (*S. conspicillatus* and *S. polyacanthus*). *Haversia* can be distinguished from those genera by the unarmed and smooth (i.e. without tubercles) scutal areas and the complex apophyses of male trochanter IV: three prolateral apophyses (anterior median, posterior median and an apical apophysis).

Taxonomical note. The two type species (*Gonyleptes defensus* and *Sadocus vallentini*) are synonymous, resulting in a generic synonymy, and the new assignment proposed here is based on penis morphology (see note on *G. denisi*). The penis of *Haversia* follows the basic pattern of those gonyleptids placed in the large (and non-monophyletic) subfamily Pachylinae (ventral plate with straight anterior margin; glans without dorsal process; distal, median and basal setae of ventral plate short [seta length inferior to ventral plate width]; stylus and ventral process with variable shape). However, *Haversia* presents two features that stand out: (i) the penis glans projected dorsally and (ii) the detailed shape of apex of penis ventral process. Those features are typical of some Chilean genera, such as *Fonckia*, *Neogonyleptes* and *Sadocus* (unpublished data), and might be the evidence that those four genera are closely related.

Composition. Monotypic.

***Haversia defensa* (Butler, 1876)**
http://species-id.net/wiki/Haversia_defensa
Fig. 18

Gonyleptes defensus Butler, 1876: 152, fig. 4 (♂); (4 males & 1 female syntypes; Argentina, Falklands Island; NHM; examined by detailed photos).
Haversia defensa: Roewer, 1913: 171, fig. 72 (♂); Kury 2003: 129.
Sadocus vallentini Hogg, 1913: 48, fig. 7 (♂); (syntypes males and females; Falklands Island; NHM 1299.1304; not examined). **Syn. n.**
Hoggellula vallentini: Roewer 1930: 397, fig. 22 (♂); Kury 2003: 129.

Material examined. ARGENTINA. Falklands (Islas Malvinas), 1 ♂ (SMF 1320/8).

Description. Penis (Fig. 18A–B; SMF 1320/8): ventral plate with lateral margins slightly concave, distal margin straight, 3 distal pairs of cylindrical, straight, long setae, 1 pair of median short setae, 2 pairs of basal cylindrical, straight, long setae. Glans sac projected dorsally, ventral process and stylus arising ventrally. Stylus long, slightly curved, with apical ventral and lateral trichomes. Ventral process swollen apically, with nailhead-like apex.

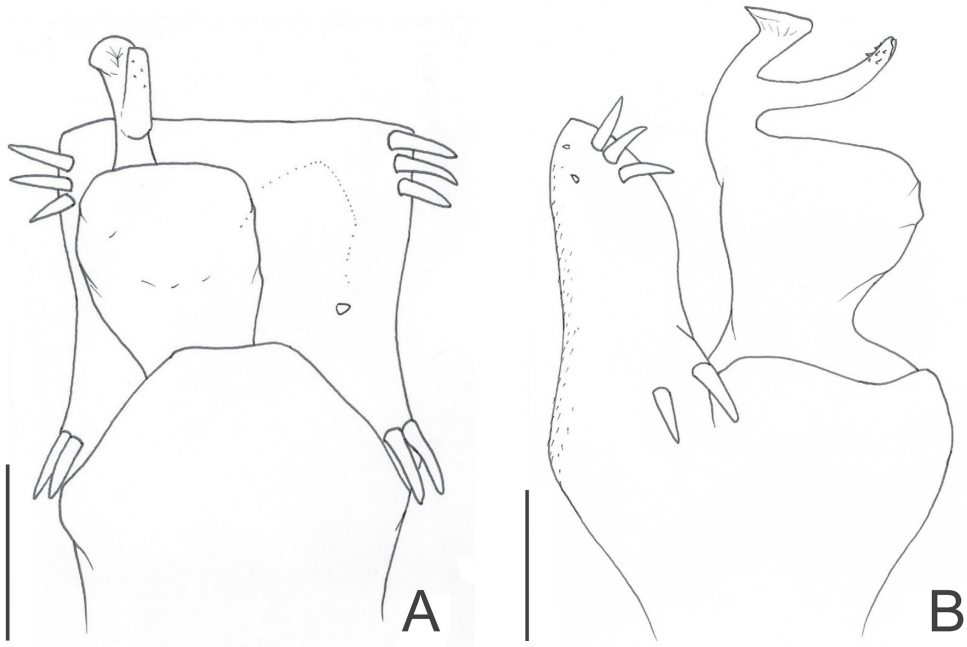


Figure 18. *Haversia defensa* (Butler). Distal part of penis (SMF 1320/8) **A** in dorsal view **B** ditto, left lateral view. Scale bars: 0.1 mm.

Taxonomical note. The examination of detailed photos of *Gonyleptes defensus* type material and subsequent comparison of those with the description of *Sadocus vallentini* allowed recognizing them as conspecific.

Oxapampeus Roewer, 1963, new subfamilial assignment

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

Oxapampeus Roewer, 1963: 62; Kury 2003: 135; (type species: *Oxapampeus weyrauchi* Roewer, 1963).

Diagnosis. Based on external morphology, *Oxapampeus* resembles Pachylinae with three scutal areas (subfamily classical diagnosis is the presence of four areas) and scutal area III with a paramedian pair of spines, such as *Corralia* Roewer, 1913, *Diconospelta* Canals, 1934, *Haversia* Roewer, 1913, *Huassampilia* Roewer, 1913, *Neogonyleptes* Roewer, 1913, *Spinivunus* Roewer, 1943, and two species of *Sadocus* Sørensen, 1886 (*S. conspicillatus* and *S. polyacanthus*). However, *Oxapampeus* can be distinguished from those genera by the combination of the following characters: ocularium with a paramedian pair of pointed tubercles; frontal hump on anterior border of dorsal scutum moderately developed; scutal areas I–II each with a paramedian pair of enlarged tubercles; posterior margin of dorsal scutum straight; and free tergites I–III unarmed.

Taxonomical note. *Oxapampeus* has been included in Gonyleptinae due to the presence of three scutal areas on the dorsal scutum and absence of autapomorphies of other gonyleptidean subfamilies. However, its penis does not present the typical gonyleptine pattern. In addition, its ventral plate, with slightly concave lateral sides, as well as the absence of dorsally projected basal lobes, makes it resemble several Andean Pachylinae male genitalia.

Composition. Monotypic.

***Oxapampeus weyrauchi* Roewer, 1963**
http://species-id.net/wiki/Oxapampeus_weyrauchi
Fig. 19

Oxapampeus weyrauchi Roewer, 1963: 62, fig. 29 (♂); Kury 2003: 135; (male holotype, 2 males & 5 females paratypes, Peru, Pasco, Western slope of Eastern Andes, Villarica near Oxapampa, 1500 m, in Ucayali drainage, SMF RII 13964/74, examined).

Description. Penis (Fig. 19A–B; holotype): ventral plate with lateral and distal margins slightly concave, with 3–4 distal pairs of cylindrical, straight, long setae, 0–1 median seta (visible in lateral view), 5 basal pairs of setae. Glans sac projected dorsally, ventral process and stylus arising ventrally. Stylus short and straight, with ventral subapical trichomes. Ventral process swollen apically, more elongated and thinner than stylus.

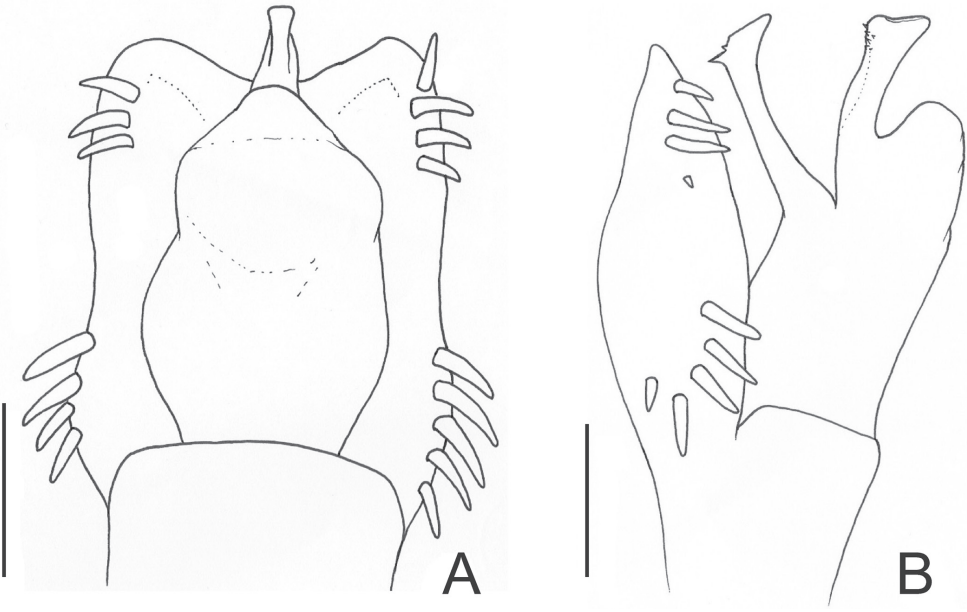


Figure 19. *Oxapampeus weyrauchi* Roewer. Distal part of penis (holotype) **A** in dorsal view **B** ditto, left lateral view. Scale bars: 0.1 mm.

Acknowledgements

We are indebted to Peter Jäger (SMF) and Adriano Brilhante Kury (MNRJ) for the loan of the examined material as well as their hospitality during visits to their institutions. These loans would not be possible without the assistance of Julia Altmann (SMF) and technical staff and students at MNRJ. Adriano Brilhante Kury is also credited for willingly making hard-to-find articles available at his own expense at "http://www.museunacional.ufrj.br/mndi/Aracnologia/pdfliteratura/pdfs%20opiliones.htm". Cristina Rheims and Ronald M. Clouse kindly reviewed the language. Yuri Marusik and Adriano B Kury kindly improved the first version of the manuscript. The authors also thank financial support from Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP MRH #2009/3111-2, RPR #2008/06604-7) and the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq EV#; RPR #472960-2008-3).

References

Acosta LE (1996) Die Typus-Exemplare der von Carl-Friedrich Roewer beschriebenen Pachylinae (Arachnida: Opiliones: Gonyleptidae). Senckenbergiana biologica 76(1/2): 209–225.

Acosta LE (2001) The identity of *Acrographinotus erectispina*, with a review of the generic diagnosis, and the description of a new species (Opiliones, Gonyleptidae, Pachylinae). Bulletin of the British Arachnological Society 12(2): 58–66.

Acosta LE, Kury AB, Juárez ML (2007a) New records *of Geraeocormobius sylvarum* (Arachnida, Opiliones, Gonyleptidae): with a remarkable disjuction in northwestern Argentina. Boletín Sociedad Entomológica Aragonesa 41: 303–306.

Acosta LE, Pérez-Gonzalez A, Tourinho AL (2007b) Chapter 15: Methods and Techniques of Study: Methods for taxonomic study. In: Machado G, Pinto-da-Rocha R, Giribet G (Eds) Harvestmen, the biology of Opiliones. Harvard University Press, Cambridge, Massachusetts and London, 494–505.

Bertkau P (1880) Verzeichniss der von Prof. Ed. van Beneden auf seiner im Auftrage der Belgischen regierung unternommenen wissenschaftlichen Reise nach Brasilien und La Plata i. J. 1872–1875 gesammelten Arachniden. Mémoires de l'Académie Royale de Belgique 43(2): 1–120, pls. I–II.

Bragagnolo C, Pinto-da-Rocha R (2009) Review of the Brazilian harvestman genus *Roeweria* Mello-Leitão, 1923 (Opiliones: Gonyleptidae). Zootaxa 2270: 39–52.

Butler AG (1876) Descriptions of five new species of *Gonyleptes*. The Journal of the Linnean Society, Zoology, 12(58): 151–155, pls. 8.

DaSilva MB, Pinto-da-Rocha R (2010) Systematic review and cladistic analysis of the Hernandariinae (Opiliones: Gonyleptidae). Zoologia 27(4): 577–642.

Giltay L (1928) Arachnides nouveaux du Brésil. Bulletin et annales de la Société Entomologique de Belgique 68: 79–87.

Gonzalo G, Kury AB (2007) Chapter 3: Phylogeny and Biogeography. In: Pinto-da-Rocha R, Machado G, Giribet G (Eds) Harvestmen, the biology of Opiliones. Harvard University Press, Cambridge, Massachusetts and London, 62–87.

Hogg HR (1913) Some Falkland Island spiders. Proceedings of the Zoological Society of London 1913: 37–50, pls 1–2.

Holmberg EL (1887) *Geraeocormobius* n.g. Gonyleptidarum. In: Capitulo XII. Misiones. Boletin de la Academia National de Ciencias 10: 211–212.

Holmgren N (1916) Zur vergleichenden Anatomie des Gehirns von Polychaeten, Onychophoren, Xiphosuren, Arachniden, Crustaceen, Myriopoden und Inseckten. Vorstudien zu einer Phylogenie der Arthropoden. Stockholm, Kungliga Svenska Vetenskaps-Akademiens Handlingar 56(1): 1–303, 12 pls.

Kirby W (1819) A century of insects, including several new genera described from his Cabinet. Transactions of the Linnean Society of London 12(27): 375–453. doi: 10.1111/j.1095-8339.1817.tb00239.x

Koch CL (1839) Uebersicht des Arachnidensystems 2. C. H. Zeh, Nürnberg.

Kury AB (1992a) The genus *Spinopilar* Mello-Leitão, 1940, with notes on the status of the family Tricommatidae (Arachnida, Opiliones). Steenstrupia 18(5): 93–99.

Kury AB (1992b) The false Cranainae of the Brazilian Atlantic Forest (Opiliones, Gonyleptidae). Tropical Zoology 5(2): 279–291.

Kury AB (1993) *Leptostygnus leptochirus* Mello-Leitão, 1940: the first record of the family Agoristenidae from Colombia (Opiliones: Laniatores: Gonyleptoidea). Bulletin of the British Arachnological Society 9(4): 129–131.

Kury AB (1994a) Early lineages of Gonyleptidae (Arachnida, Opiliones, Laniatores). Tropical Zoology 7: 343–353.

Kury AB (1994b) The genus *Yania* and others presumed Tricommatidae from South American highlands (Opiliones, Cranaidae, Prostygninae). Revue arachnologique 10(7): 137–145.

Kury AB (1997) A new subfamily of Agoristenidae, with comments on suprageneric relationships of the family (Arachnida, Opiliones, Laniatores). Tropical Zoology 10(2): 333–346.

Kury AB (2003) Annotated catalogue of the Laniatores of the New World (Arachnida, Opiliones). Revista Ibérica de Aracnología 1: 5–337.

Kury AB (2011) Order Opiliones Sundevall, 1833. In: Zhang Z-Q (Ed) Animal biodiversity: An outline of higher-level classification and survey of taxonomic richness. Zootaxa 3148: 112–114.

Kury AB, Alonso-Zarazaga MA (2011) Addenda and corrigenda to the "Annotated catalogue of the Laniatores of the New World (Arachnida, Opiliones)". Zootaxa 3034: 47–68.

Kury AB, Chagas-Jr A, Giupponi APL, Pérez-G A (2010) Amblypygi, Opiliones, Schizomida, Scorpiones and Chilopoda, Tocantins, Brazil. Check List 6(4): 564–571.

Kury AB, Maury EA (1998) A new genus and five new species of Metasarcinae from Peru (Arachnida, Opiliones, Gonyleptidae). Zoological Journal of the Linnean Society 123: 143–162. doi: 10.1111/j.1096-3642.1998.tb01297.x

Kury AB, Pinto-da-Rocha R (2007a) Cosmetidae Koch, 1839. In: Machado G, Pinto-da-Rocha R, Giribet G (Eds) Harvestmen, the biology of Opiliones. Harvard University Press, Cambridge, 182–185.

Kury AB, Pinto-da-Rocha R (2007b) Gonyleptidae Sundevall, 1833. In: Pinto-da-Rocha R, Machado G, Giribet G (Eds) Harvestmen, the biology of Opiliones. Harvard University Press, Cambridge, Massachusetts and London, 196–203.

Maury EA (1992) Gonyleptidae (Opiliones) del bosque subantartico chileno-argentino II. Los generos *Corralia* Roewer, 1913 y *Spinivunus* Roewer, 1943. Boletin de la Sociedad de Biología de Concepción 63: 133–145.

Mello-Leitão CF de (1922) Some new Brazilian Gonyleptidae. Annals and Magazine of Natural History 9(9): 329–348.

Mello-Leitão CF de (1923) Opiliões Laniatores do Brasil. Arquivos do Museu Nacional, Rio de Janeiro 24: 107–197.

Mello-Leitão CF de (1927) Generos novos de Gonyleptideos (Nota previa). Boletim do Museu Nacional, Rio de Janeiro 3(2): 13–22.

Mello-Leitão CF de (1931) Opiliões novos ou críticos. Arquivos do Museu Nacional, Rio de Janeiro 33(3): 117–148.

Mello-Leitão CF de (1932) Opiliões do Brasil. Revista do Museu Paulista 17(2): 1–505.

Mello-Leitão CF de (1935) A propósito de alguns opiliões novos. Memórias do Instituto Butantan 9: 369–411.

Mendes AC (2011) Phylogeny and taxonomic revision of Heteropachylinae (Opiliones: Laniatores: Gonyleptidae). Zoological Journal of the Linnean Society 163: 437–483.

Mestre LAM, Pinto-da-Rocha R (2004) Population dynamics of an isolated population of the harvestmen *Ilhaia cuspidata* (Opiliones, Gonyleptidae), in Araucaria Forest (Curitiba, Paraná, Brazil). The Journal of Arachnology 32(2): 208–220.

Orrico VGD, Kury AB (2009) A cladistic analysis of the Stygnicranainae Roewer, 1913 (Arachnida, Opiliones, Cranaidae) – where do longipalp cranaids belong? Zoological Journal of the Linnean Society 157: 470–494.

Perty M (1833) Delectus animalium articulorum, quae in itinere per Brasilia anni 1817–1820 peracta collegerunt J.B. Spix et de Martius. Monachii, 205 pp.

Pinto-da-Rocha R (1996) Notes on *Vima insignis* Hirst, 1912, revalidation of *Trinella* Goodnight & Goodnight, 1947 with description of three new species (Arachnida, Opiliones, Agoristenidae). Revista brasileira de Entomologia 40(2): 315–323.

Pinto-da-Rocha R (1997) Systematic review of the neotropical family Stygnidae (Opiliones, Laniatores, Gonyleptoidea). Arquivos de Zoologia, São Paulo 33(4): 163–342.

Pinto-da-Rocha R, Bragagnolo C, DaSilva MB (2005) Faunistic similarity and historic biogeography of the harvestmen of southern and southeastern Atlantic Rain Forest of Brazil. The Journal of Arachnology 33(2): 290–299. doi: 10.1636/04-114.1

Pinto-da-Rocha R, Hara MR (2009) New familial assignments for three species of Neotropical harvestmen based on cladistic analysis (Arachnida: Opiliones: Laniatores). Zootaxa 2241: 33–46.

Pinto-da-Rocha R, Villarreal-Manzanilla O (2009) Cladistic analysis of the Stygninae and description of a new species of *Protimesius* Roewer, 1913 (Opiliones: Stygnidae). Zootaxa 2176: 48–56.

Piza Jr ST de (1943) Novos Gonyleptidas brasileiros. Papéis Avulsos do Departamento de Zoologia, São Paulo 3(3): 39–60.

Piza Jr ST de (1946) Descrição de espécies novas e reunião de alguns gêneros de opiliões do Brasil. Anais da Escola Superior de Agricultura "Luiz de Queiroz", Universidade de São Paulo, Piracicaba 3(46): 363–370.

Roewer CF (1912) Die Familien der Assamiiden und Phalangodiden der Opiliones-Laniatores. (= Assamiden, Dampetriden, Phalangodiden, Epedaniden, Biantiden, Zalmoxiden, Samoiden, Palpipediden anderer Autoren). Archiv für Naturgeschichte 78(3): 1–242.

Roewer CF (1913) Die Familie der Gonyleptiden der Opiliones-Laniatores. Archiv für Naturgeschichte 79(4): 1–256 and 79(5): 257–472.

Roewer CF (1917) 52 neue Opilioniden. Archiv fur Naturgeschichte 82A(2): 90–158.

Roewer CF (1923) Die Weberknechte der Erde. Systematische Bearbeitung der bisher bekannten Opiliones. Gustav Fischer, Jena, 1116 pp.

Roewer CF (1929) Weitere Weberknechte III. (3. Ergänzung der Weberknechte der Erde, 1923). Abhandlungen herausgegeben vom Naturwissenschaftlichen Verein zu Bremen 27(2): 179–284.

Roewer CF (1930) Weitere Weberknechte IV. (4. Ergänzung der Weberknechte der Erde, 1923). Abhandlungen herausgegeben vom Naturwissenschaftlichen Verein zu Bremen 27(3): 341–452.

Roewer CF (1936) Zwei sonderbare Pachylinen aus Peru. Veröffentlichungen aus dem Deutschen Kolonial- und Übersee-Museum in Bremen 1(3): 341–343.

Roewer CF (1943) Weitere Weberknechte XI. Über Gonyleptiden. Senckenbergiana biologica 26(1–3): 12–68.

Roewer CF (1949) Über Phalangodiden I. (Subfam. Phalangodinae, Tricommatinae, Samoinae). Weitere Weberknechte XIII. Senckenbergiana 30(1–3): 11–61.

Roewer CF (1952) Neotropische Arachnida Arthrogastra, zumeist aus Peru. Senckenbergiana 33(1/3): 37–58.

Roewer CF (1956) Arachnida Arthrogastra aus Peru, II. Senckenbergiana Biologica 37(5–6): 429–445.

Roewer CF (1963) Opiliones aus Peru und Colombia. [Arachnida Arthrogastra aus Peru V]. Senckenbergiana Biologica 44: 45–72.

Soares BAM (1944a) Um novo opilião da Bahia. Papéis Avulsos do Departamento de Zoologia, São Paulo 4(2): 33–36.

Soares BAM (1944b) Notas sobre opiliões da coleção do Museu Nacional do Rio de Janeiro. Papéis Avulsos do Departamento de Zoologia, São Paulo 6(15): 163–180.

Soares BAM, Soares HEM (1946) Duas espécies novas de opiliões. Livro de homenagem a Romualdo Ferreira d'Almeida, São Paulo 38: 315–318.

Soares BAM, Soares HEM (1949) Monografia dos gêneros de opiliões neotrópicos II. Arquivos de zoologia do Estado de São Paulo, São Paulo 7(2): 149–240.

Soares BAM, Soares HEM (1974) Opera Opiliologica Varia. IV (Opiliones, Gonyleptidae, Stygnidae). Revista Brasileira de Biologia, Rio de Janeiro 34(4): 599–614.

Soares BAM (1972) Notes on some Brazilian harvestmen (Opiliones, Gonyleptidae and Phalangodidae). Papéis Avulsos de Zoologia, São Paulo 26(5): 55–65.

Soares HEM, Soares BAM (1987) Opera Opiliologica Varia. XIX. (Opiliones, Gonyleptidae). Revista Brasileira de Entomologia 31(3): 457–463.

Soares HEM, Soares BAM (1988) Opera Opiliologica Varia. XX. Notas sinonímicas (Opiliones, Gonyleptidae). Revista Brasileira de Entomologia 32(2): 227–232.

Sørensen WE (1879) Om Bygnigen af Gonyleptiderne, en Type af Arachnidernes Classe. Naturhistorisk Tidsskrift 12(3): 97–222, pls. 1–2.

Sørensen WE (1884) Opiliones Laniatores (Gonyleptides W. S. Olim) Musei Hauniensis. Naturhistorisk Tidsskrift 14(3): 555–646.

Yamaguti HY, Pinto-da-Rocha R (2009) Taxonomic review of Bourguyiinae, cladistic analysis, and a new hypothesis of biogeographic relationships of the Brazilian Atlantic Rainforest (Arachnida: Opiliones, Gonyleptidae). Zoological Journal of the Linnean Society 156: 319–362. doi: 10.1111/j.1096-3642.2008.00484.x

ZooKeys 198: 69–77 (2012)
doi: 10.3897/zookeys.198.2624
www.zookeys.org

RESEARCH ARTICLE

A peer-reviewed open-access journal
ZooKeys
Launched to accelerate biodiversity research

Two new species of *Oxycera* (Diptera, Stratiomyidae) from Ningxia, China

Yang Zai-Hua[1,†], Yu Jin-Yong[2,‡], Yang Mao-Fa[3,§]

1 *Guizhou Academy of Forestry, Guiyang 550005, P. R. China* **2** *Guizhou Academy of Forestry, Guiyang 550005, P.R. China* **3** *Institute of Entomology, Guizhou University, Guiyang 550025, P.R. China*

† *urn:lsid:zoobank.org:author:B857B670-0027-41DE-A618-D3D8FEBF034F*
‡ *urn:lsid:zoobank.org:author:5A9E98EE-50F2-4302-BEAB-F9B08C115021*
§ *urn:lsid:zoobank.org:author:79B3BA54-5CBD-43CD-B50C-FAABBBFA4904*

Corresponding author: *Yang Mao-Fa* (yangmaofa@sohu.com)

Academic editor: *M. Hauser* | Received 6 January 2012 | Accepted 12 March 2012 | Published 30 May 2012

urn:lsid:zoobank.org:pub:89B31CD0-81F8-47E6-9D7A-98C0545842AA

Citation: Yang ZH, Yu JY, Yang Mf (2012) Two new species of *Oxycera* (Diptera, Stratiomyidae) from Ningxia, China. ZooKeys 198: 69–77. doi: 10.3897/zookeys.198.2624

Abstract

Two new speices, *Oxycera rozkosnyi* **sp. n.** and *Oxycera ningxiaensis* **sp. n.**, are described from Liupanshan Nature Reserve, Ningxia Hui Autonomous Region, Northwest China. All essential diagnostic characters are figured and possible relationships of both taxa are briefly discussed, and a new key to species of *Oxycera* from China. The type specimens are deposited in the Institute of Entomology, Guizhou University, Guiyang (GUGC).

Keywords

Diptera, Stratiomyidae, *Oxycera*, new species, Ningxia, China

Introduction

The genus *Oxycera* Meigen was erected by Meigen (1803) on the basis of the type species *Musca hypoleon* Linnaeus [= *O. trilineata* (L).]. At present 94 species are described worldwide (Woodley 2001; Üstüner and Hasbenli 2004, 2007; Yang et al. 2008, 2009; Li et al. 2009; Zhang et al. 2009, 2010); Wang et al. 2010). The highest number of species is known from the Palaearctic Region (61 spp.), followed by the Oriental Region

(16 spp.), 11 spp. were found in the Afrotropical Region and 8 spp. in the Nearctic. As for research on the genus *Oxycera* in China, Kertész (1914) first described three new species from Taiwan, following which Pleske (1925), Séguy (1934), and Lindner (1940) described four species. Yang and Nagatomi (1993) recorded 13 spp. (not including *O. meigenii*) from China and recently 8 new species and a new country record have been published for China (Li et al. 2009; Wang et al. 2010; Yang et al. 2008, 2009; Zhang et al. 2009, 2010). In the present paper, two new Chinese species are described.

Material and methods

External morphology was studied under a stereoscopic microscope, and measurements were made with an ocular micrometer. The genital segments of the examined specimens were macerated in 10% KOH and were preserved in glycerin for examination. All photographs were taken through a Canon 450D Camera, and were edited by Helicon Focus and Photoshop CS softwares. Illustrations of the specimens were made with a Nikon SMZ800 stereomicroscope and scanned with Canon CanoScan 5600F^{+}, and then imported into Adobe Photoshop CS for labeling and plate composition.

Specimens examined in this study were collected in Ningxia Hui Autonomous Region, and are deposited in the Institute of Entomology, Guizhou University, Guiyang, Guizhou Province, P. R. China (GUGC). Morphological terminology follows Merz and Haenni (2000).

Key to species of *Oxycera* Meigen from China

1 Abdomen wholly black, at most with very narrow yellow or reddish yellow distal margin of tergite 5 ..... **2**

– Abdomen with more extensive yellow or yellow green markings, dorsolateral spots general protruding inward **12**

2 Wing smoky brown with hyaline spots, or hyaline with smoky brown parts **3**

– Wing membrane completely hyaline or completely smoky brown tinged **5**

3 Wing hyaline with a large smoky brown spot near apex **4**

– Wing smoky brown with a triangular hyaline spot below discal cell and another hyaline spot extending through anal and anterior cubital cells (Taiwan) ..... ***O. fenestrata*** **(Kertész, 1914)**

4 Female frons black with a pair of small yellow spots (Kertész 1914: Fig. 34) (Taiwan), male unknown ..... ***O. apicalis*** **(Kertész, 1914)**

– Female frons black, with two pairs of small yellow spots, the upper spots larger than the lower (Wang et al. Figs. 1–2), male unknown ..... ***O. cuiae*** **(Wang et al., 2010)**

5 Wing wholly smoky brown ..... ***O. ningxiaensis*** **sp. n.**

– Wing not wholly smoky brown, at least with hyaline spot **6**

6 Female frons with a pair of longitudinal brick red vittae (Yang et al. 2009: Fig. 5), male head almost completely covered with dense hairs, thorax and lateral margin of abdomen with long and erect hairs (Yang et al. 2009: Fig. 1, 3)..... ***O. qiana* Yang et al., 2009**

– Female frons with paired yellow spots or very small brick red spots, male head only with sparse hairs or partly bare, hairs on thorax and abdomen mainly appressed **7**

7 Abdomen wholly black **8**

– Abdomen black, but posterior margin of tergite 5 yellow.....**10**

8 Scutellum black with dark yellow posterior margin between spines (Li et al. 2009: Fig. 9–10).....***O. liui* Li et al., 2009**

– Scutellum black without dark yellow posterior margin between spines **9**

9 Thorax black, but posterodorsal margin of anepisternum yellow; female frons with a pair of yellow spots (Yang and Nagatomi 1993: Figs. 16, 13)..... .....***O. guangxiensis* Yang & Nagatomi, 1993**

– Thorax wholly black; female frons with 2 pairs of yellow spots (Yang et al. 2008: Fig. 12, 10) ..... ***O. guizhouensis* Yang et al., 2008**

10 Female frons with a pair of yellow median spots (Yang and Nagatomi 1993: Fig. 8), male unknown.....**11**

– Female frons with 2 pairs of yellow spots (Lindner 1940: fig. 7), male unknown ..... ***O. quadripartita* (Lindner, 1940)**

11 Scutum (except humeral and postalar calli) and pleura wholly black (Yang and Nagatomi 1993: fig.11), male unknown..... ..... ***O. chikuni* Yang & Nagatomi, 1993**

– Scutum and pleura with yellow stripes or spots; male unknown..... ..... ***O. excellens* (Kertész, 1914)**

12 Scutum without paired median longitudinal yellow vittae (sometimes scutum with 4 small and inconspicuous yellow spots).....**13**

– Scutum with paired median longitudinal yellow or yellowish green vittae....**18**

13 Vein R_4 present, body larger (about 7mm).....**14**

– Vein R_4 absent, body smaller (about 4mm).....**17**

14 Scutellum mainly black.....**15**

– Scutellum mainly yellow.....**16**

15 Scutellum entirely black, (Zhang et al. 2010: Fig. 4); abdominal dorsum tergite 2–5 with green yellow lateral spots (Zhang et al. 2010: Fig. 5); female unknown ..... ***O. daliensis* Zhang et al., 2010**

– Scutellum black with dark yellow posterior margin and spines (except tips) (Zhang et al. 2009: Fig. 4); abdominal dorsum only with a pair of small lateral spots on tergite 4 (Zhang et al. 2009: Fig. 6); female frons with a pair of small dark yellow lateral spots, only post margin and spines dark yellow (Zhang et al. 2009: Fig. 2); male unknown..... ***O. basalis* Zhang et al. 2009**

16 Abdominal dorsum with 2 pairs of spots (Fig. 1), female frons with a pair of small yellow spots at ventral corner (Fig. 4) .....***O. rozkosnyi* sp. n.**

– Abdominal dorsum with a pair of large diagonal lateral spots on tergite 3 (Yang and Nagatomi 1993: Fig. 22, 24); female frons with a pair of large yellow longitudinal vittae (Yang and Nagatomi 1993: Fig. 20) ..... ***O. laniger* (Seguy, 1934)**

17 Female scutum with 4 small and inconspicuous median yellow spots (Yang and Nagatomi 1993: Fig. 31); abdominal dorsum with two pairs of lateral yellow spots, a median yellow spot on tergite 2, and an apical yellow spot on tergite 5 (Yang and Nagatomi 1993: Fig. 32); male abdominal tergite 2 and anterior part of tergite 3 with a large transverse yellow band (Yang et al. 2008: Fig. 5) ..... ***O. lii* Yang & Nagatomi, 1993**

– Female scutum without median yellow spots, abdominal dorsum only with a narrow whitish yellow lateral margin from distal margin of tergite 3 to distal margin of tergite 4 and a small apical spot on tergite 5 (Yang et al. 2009: Fig. 17); male unknown..... ***O. micronigra* Yang et al., 2009**

18 Abdomen mainly green or yellow with a black pattern (Rozkošný 1983: Pl. 51, Fig. 2)..... ***O. trilineata* (Linnaeus, 1767)**

– Abdomen mainly black with contrasting yellow margins or spots **19**

19 Spines on scutellum slender and nearly horizontal, area beyond spines not protruding posteriorly..... **20**

– Spines on scutellum stout and vertical, area beyond spines large and protruding posteriorly (Yang and Nagatomi 1993: Figs. 75, 76)..... ..... ***O. vertipila* Yang & Nagatomi, 1993**

20 Vittae on scutum not touching anterior margin and transverse suture (Li et al. 2009: Fig. 5) ..... ***O. flavimaculata* Li et al., 2009**

– Vittae on scutum reaching anterior margin and at least touching transverse suture..... **21**

21 Length of body shorter than wing, vittae on scutum reaching suture (Yang and Nagatomi 1993, Fig. 3) ..... ***O. qinghensis* Yang & Nagatomi, 1993**

– Length of body longer than wing, vittae on scutum extending at least slightly beyond transverse suture..... **22**

22 Scutum with a pair of longitudinal vittae reaching anterior and hind margin ... **23**

– Scutum with a pair of longitudinal vittae touching yellow humeral spot and just beyond transverse suture, but not touching hind margin..... **24**

23 Body larger (about 6.0 mm); male tergite 3 with a pair of lateral yellow spots (Yang et al. 2009: Fig. 18), female tergite 3 with four yellow spots in a transverse row (Yang et al. 2009: Fig. 19); male aedeagal complex bipartite (Yang et al. 2009: Fig. 26) ..... ***O. signata* Brunetti, 1920**

– Body smaller (about 4.5 mm); abdomen with transverse yellow band on tergite 3 in both sexes (rarely divided into 3 spots in some females); male aedeagal complex tripartite (Yang and Nagatomi 1993: Fig. 58)..... ***O. tangi* Lindner, 1940**

24 Antenna yellowish brown; median process of male genital capsule with two rounded lobes (Rozkošný 1983: Pl. 46, Fig. 7) ... ***O. meigenii* Staeger, 1844**

– Antenna black; median process of male genital capsule with two subpointed lobes (Yang and Nagatomi 1993: Fig. 47)..... ***O. sinica* (Pleske, 1925)**

Taxonomy

***Oxycera ningxiaensis* sp. n.**
urn:lsid:zoobank.org:act:A45DC709-3450-40CE-BC15-8DF33352540E
http://species-id.net/wiki/Oxycera_ningxiaensis
Figures 1–6

Holotype. ♂, Ningxia Hui Autonomous Region, JingYuan County, Liupanshan natural reserves, Dongshanpo, 2100 m, N35°36.767, E106°16.189, 28.viii.2009, Z.-H. Yang leg.

Paratypes. 3♂♂, the same locality labels as the holotype, all in GUGC.

Diagnosis. Dark species with brownish yellow postpronotal callus, scutellar spines, postalar callus and narrow upper margin of anepisternum. Body hairs black, R_4 present, legs mostly dark to black but bases and tips of coxae, femora and tibiae yellow, tarsi black but 1–2 basal tarsomeres on mid and hind tarsus yellow.

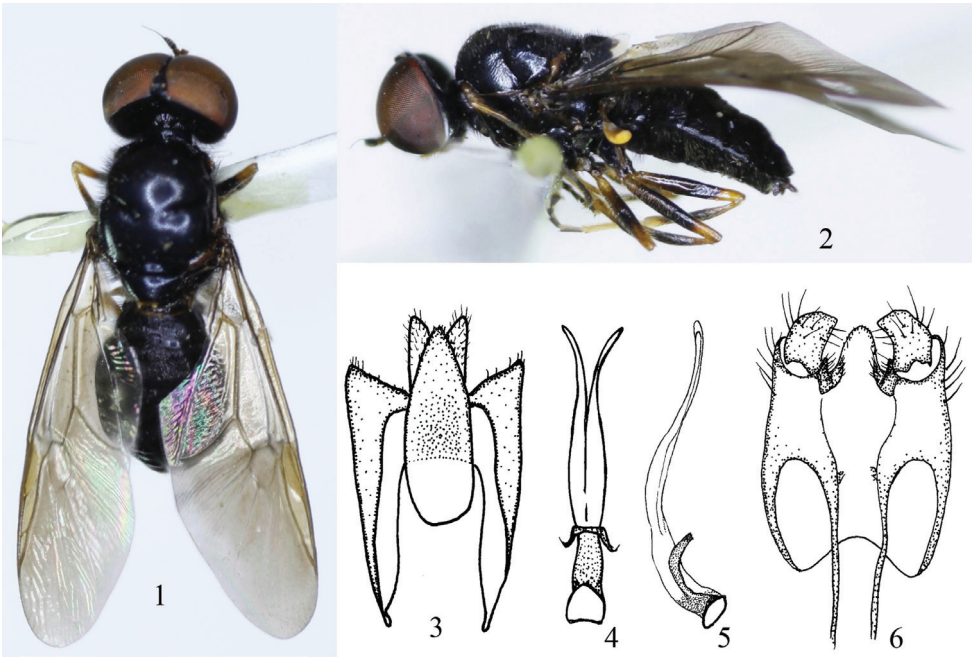
Description. Male (Figs 1–6). Length: body 4.8–5.2 mm, wing 4.3–5.0 mm. Head elliptical in frontal view, shining black, with black hairs; slightly broader than thorax, 1.4 times as long as high in profile and 0.8 times as high as broad. Vertex and ocellar tubercle black, both with black hairs. Ocelli and contiguous eyes brown, nearly bare, slightly darker in lower part, upper facets distinctly larger than lower. Frons shiny black; face black with some punctures and pale hairs, and a white lateral pollinose stripe on each side along eyes. Antenna dark brown to black, relative length of antennal scape, pedicel and flagellum (without arista) 3:5:10, relative width 7:9:10; arista about equal to length of rest of antenna. Occiput shiny black with some black hairs. Proboscis pale and palpus dark brown, both with some pale hairs.

Thorax (Figs 1, 2) mostly shining black, densely punctate and black haired; postpronotal callus, scutellar spines, postalar callus and narrow upper margin of anepisternum yellowish brown; length of scutellar spines only 1/4 as long as scutellum length. Wing black, stigma and veins darker than the mambrane, vein R_4 present. Legs mostly dark brown to black, but each femur and tibia with yellow base and apex, mid and hind tarsi 1 yellow; legs wholly with short pale hairs. Halter yellow with yellowish brown base.

Abdomen (Figs. 1, 2) about as long as thorax, shining black, densely punctate, tergites 1–2 with dense black hairs, tergites 3–5 only with sparse pale hairs; similar hairs on venter. Male terminalia: epandrium trapezoidal (Fig. 3), its base narrower than tip, apical margin with sparse short hairs; proctiger elongate-oval, genital capsule with high medial process at hind margin (Fig. 6); aedeagal complex (Figs. 4, 5) bilobate, each lobe narrowed and pointed apically.

Female. Unknown.

Remarks. This new species is very similar to *O. qiana* Yang et al. 2009. Both are black but the new species is slender, with the scape and pedicel black, the male eyes are only sparsely haired or bare, and the male terminalia are species-specific (Figs 3–6). *O. qiana* is stouter, with a somewhat paler scape and pedicel and densely haired eyes. The male terminalia are of quite different shape (cf. Figs 7–11 in Yang et al. 2009), i.e.



Figures 1–6. *Oxycera ningxiaensis* sp. n. holotype **1** Male, dorsal view **2** Male, lateral view **3** Proctiger, cerci and epandrium, ventral view **4–5** Aedeagal complex in dorsal and lateral view **6** Genital capsule, dorsal view.

the genital capsule is narrowed distally and without a medial process, and the aedeagal complex is trilobate.

Etymology. The species is named after the type locality Ningxia in the Hui Autonomous Region.

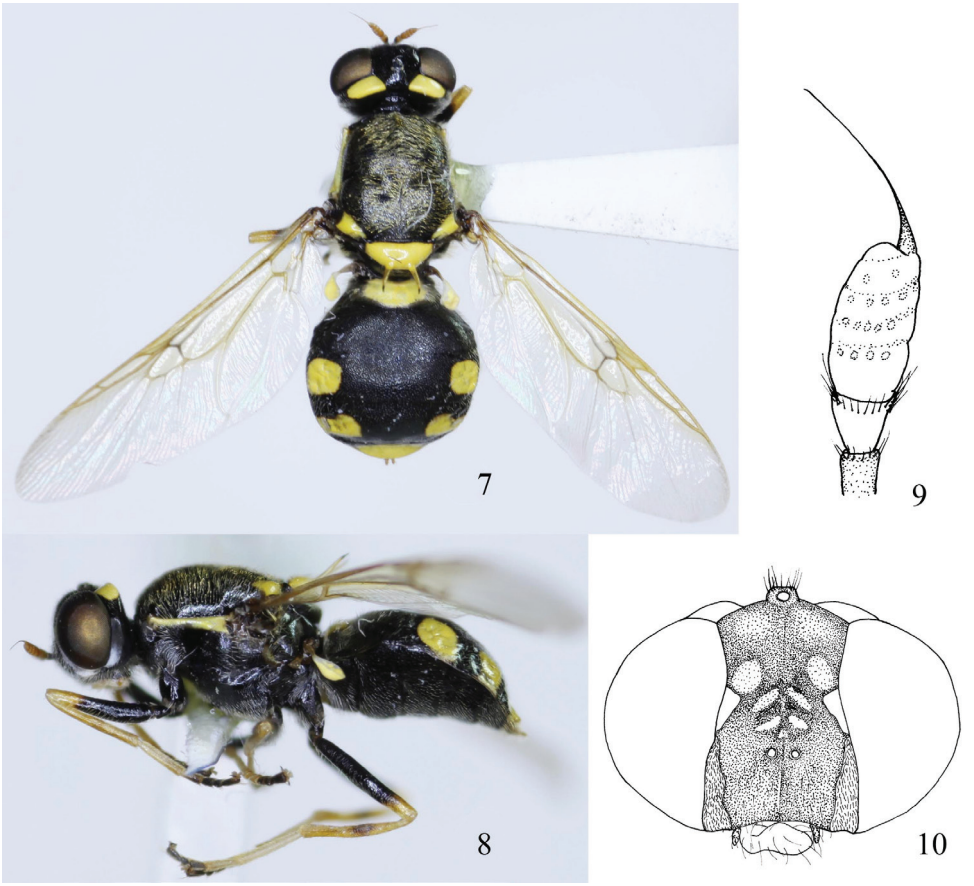
Distribution. China (Ningxia).

***Oxycera rozkosnyi* sp. n.**
urn:lsid:zoobank.org:act:0A25C653-526B-4A55-ACE0-A1F35B822FC0
http://species-id.net/wiki/Oxycera_rozkosnyi
Figures 7–10

Holotype. ♀, Ningxia Hui Autonomous Region, Jing Yuan County, Liupanshan natural reserves, Dongshanpo, 2100 m, N35°36.767; E106°16.189, 28.viii.2009, Z.-H. Yang leg.

Diagnosis. Dark species without yellow stripes or spots on scutum (except postalar calli), eyes sparsely brown haired, legs mainly yellowish although femora mostly black. Abdomen with round yellow lateral markings on tergites 3 and 4 and a large central spot on tergite 1, and the posterior portion of tergite 5 yellow.

Description. Male unknown.



Figures 7–10. *Oxycera rozkosnyi* sp.n. holotype **7** Female, dorsal view **8** Female, lateral view **9** Antenna, inside **10** Head, frontal view.

Female (Figs 7–10). Length: body 6.3mm, wing 5.6 mm.

Head (Figs 7–8, 10) shining black with yellow pattern, 1.5 times as high as long in profile and 0.7–0.8 as high as broad in dorsal view. Frons with 3 pairs of medial pruinose yellow spots above antennae and a subtriangular yellow spot at eye margin on each side. Eyes sparsely short brown haired. Postocular rim with a oblong yellow spot on upper part and a pale subtriangular spot above postgena. Antenna (Fig. 9) yellowish brown, but scape and basal part of pedicel dark brown; relative lengths of antennal scape, pedicel and flagellum (without arista) 1:1.5:4, relative widths 5:7:9; arista about 0.9 times as long as rest of antenna. Face with white pollinose stripes along eye margin at each side. Hairs on head pale. Proboscis (Fig. 8) yellow, palpus dark brown, both pale haired.

Thorax (Figs.7–8) shiny black. including postpronotal callus, scutum black, with whitish yellow hairs; postalar callus with a small subtriangular yellow anterior spot. Scutellum yellow, covered with sparse yellow hairs, spines yellow with dark tips; an-

episternum with a narrow yellow stripe at upper margin from postalar callus to wing base; entire pleura with pale hairs. Legs: coxae and basal 4/5 of femora black, 3rd to 5th tarsomeres dark brown to black, rest of legs yellow to yellowish brown though tibiae slightly darkened at middle. Wing hyaline, veins pale yellow to brownish yellow, vein R_4 present. Halter yellow with dark brown base.

Abdomen (Figs. 7–8) shining black with following yellow pattern (Fig.7): tergite 1 with a large central spot, tergites 3 and 4 each with a pair of yellow lateral spots, tergite 5 with yellow posterior margin. Dorsum densely punctate and sparsely haired; venter entirely black, entire abdomen pale haired.

Remarks. This new species is similar to *O. dives* Loew, 1845 and *O. locuples* Loew, 1857 known from Europe, but it may be separated from both by the missing dorsolateral stripes on the scutum and the large central spot on tergite 1. Lateral markings on tergite 2 are absent in the new species (and usually also in *O. dives*) but distinct in *O. locuples*. Using the most recent key to species of *Oxycera* from China (Zhang et al. 2010) the new species runs to couplet 9 (R_4 present) but spines on the scutellum are not almost vertical.

Etymology. The species is named in honor of Prof. Rudolf Rozkošný, a prominent Czech dipterist who contributed significantly to the knowledge of Palaearctic and Oriental Stratiomyidae.

Distribution. China (Ningxia).

Acknowledgments

We are indebted to Prof. Rudolf Rozkošný (Masaryk University, Brno, Czech Republic) and Dr. Martin Hauser (Department of Food and Agriculture, Sacramento, USA) for their help and valuable comments on the manuscript. We also thank Prof. Ding Yang (China Agricultural University, Beijing, China) for providing some literature. This research was supported by the National Natural Science Foundation of China (grant no. 31101666), the Provincial Foundation for Science and Technology Field of Guizhou (grant no. 20112168) and the construction project for innovation ability on sustainable management of public welfare forest of Guizhou (grant no.20094002).

References

Kertész K (1914) Vorarbeiten zu einer Monographie der Notacanthen. XXIII–XXXV. Annales Historico-Naturales Musei Nationalis Hungarici 12(2): 449–557.

Li Z, Zhang TT, Yang D (2009) New species of *Oxycera* from Palaearctic China (Dipera: Stratiomyidae). Transactions of the American Entomological Society 135(3): 383–387. doi: 10.3157/061.135.0305

Lindner E (1940) Chinesische Stratiomyiiden (Diptera). Deutsche Entomologische Zeitschrift 1939(1–4): 20–36.

Meigen JW (1803) Versuch einer neuen GattungsEintheilung der europäischen zweiflügeligen Insekten. Magazin für Insektenkunde 2: 259–281.

Merz B, Haenni JP (2000) Morphology and terminology of adult Diptera. In: Papp L, Darvas B (eds) Contributions to a Manual of Palaearctic Diptera. Vol. 1. General and Applied Dipterology. Science Herald, Budapest, 21–52.

Pleske T (1925) Études sur les Stratiomyidae de la région palearctique. III. - Revue des espéces palearctiques des sousfamille des Clitellariinae. Encyclopédie Entomologique, Série B (II), Diptera 1(3–4): 105–119.

Rozkošný R (1983) A biosystematic study of European Stratiomyidae (Diptera). Volume 2. Clitellariinae, Hermetiinae, Pachygasterinae and Bibliography. Dr. W. Junk, The Hague, Boston, London. I–VIII: 1–431.

Séguy E (1934) Diptères de Chine de la collection de M. J. Herv-Bazin. Encyclopedie Entomologique, Serie B(II), Diptera 7: 1–28.

Üstüner T, Hasbenli A (2004) A new species of *Oxycera* Meigen (Diptera: Stratiomyidae) from Turkey. Entomological News 115(3): 163–167.

Üstüner T, Hasbenli A (2007) A new species and some new records of the genus *Oxycera* (Diptera, Stratiomyidae) from Turkey. Entomological News 118(2): 179–183. doi: 10.3157/0013-872X(2007)118[179:ANSASN]2.0.CO;2

Wang LH, Li Z, Yang D (2010) One new species of *Oxycera* from Guizhou, China (Diptera, Stratiomyidae). Acta Zootaxonomica Sinica 35(1): 84–85.

Woodley NE (2001) A world catalog of the Stratiomyidae (Insecta: Diptera). Myia 11: 1– 475.

Yang D, Nagatomi A (1993) The Chinese *Oxycera* (Diptera: Stratiomyidae). South Pacific Study 13(2): 131–160.

Yang ZH, Yang MF, Wei LM (2008) Descriptions of a new species of *Oxycera* Meigen and the male of *O. lii* Yang and Nagatomi from southwestern China (Diptera, Stratiomyidae). Entomological News 119(2): 201–206. doi: 10.3157/0013-872X(2008)119[201:DOANSO]2.0.CO;2

Yang ZH, Yang MF, Wei LM (2009) Two new species of *Oxycera* and description of the female of *O. signata* Brunetti from China (Diptera, Stratiomyidae). Zootaxa 2299: 19–28.

Zhang TT, Li Z, Yang D (2009) One new species of *Oxycera* from China (Diptera, Stratiomyidae). Acta Zootaxonomica Sinica 34(3): 460–461.

Zhang TT, Li Z, Yang D (2010) Notes on species of *Oxycera* Meigen from China with description of a new species (Diptera: Stratiomyidae). Aquatic Insects 32(1): 29–34. doi: 10.1080/01650420903113752

ZooKeys 198: 79–101 (2012)
doi: 10.3897/zookeys.198.2334
www.zookeys.org

RESEARCH ARTICLE

A peer-reviewed open-access journal
ZooKeys
Launched to accelerate biodiversity research

A new species of *Mengenilla* (Insecta, Strepsiptera) from Tunisia

Hans Pohl[1,†], Oliver Niehuis[2,‡], Kai Gloyna[3,§], Bernhard Misof[2,|], Rolf G. Beutel[1,¶]

1 *Entomology Group, Institut für Spezielle Zoologie and Evolutionsbiologie, Friedrich-Schiller-University Jena, Erbertstraße 1, 07743 Jena, Germany* **2** *Zentrum für Molekulare Biodiversitätsforschung, Zoologisches Forschungsmuseum Alexander Koenig, Adenauerallee 160, 53113 Bonn, Germany* **3** *TL Bio-Test Labor GmbH Sagerheide, Birkenallee 19, 18184 Sagerheide, Germany*

† *urn:lsid:zoobank.org:author:092A4B3D-879B-4BCE-AD13-784C73494EA3*
‡ *urn:lsid:zoobank.org:author:024EF8F6-2F73-4B9B-8214-89C230D47690*
§ *urn:lsid:zoobank.org:author:DE49D6E9-68D8-4C43-A2C0-A14496A0ABBD*
| *urn:lsid:zoobank.org:author:A9933051-11C4-4ED2-ABC1-1D02F6C1FDE0*
¶ *urn:lsid:zoobank.org:author:3B08B85C-D8CA-4459-92D4-08C62B2284C8*

Corresponding author: *Hans Pohl* (hans.pohl@uni-jena.de)

Academic editor: *T. Dikow* | Received 9 November 2011 | Accepted 23 January 2012 | Published 30 May 2012

urn:lsid:zoobank.org:pub:D7B50BCD-8FED-4012-B72A-037C6A942B47

Citation: Pohl H, Niehuis O, Gloyna K, Misof B, Beutel RG (2012) A new species of *Mengenilla* (Insecta, Strepsiptera) from Tunisia. ZooKeys 198: 79–101. doi: 10.3897/zookeys.198.2334

Abstract

A new species of *Mengenilla* Hofeneder, 1910 (Strepsiptera, Mengenillidae) from southern Tunisia is described. *Mengenilla moldrzyki* **sp. n.** can be distinguished from congeners by a slightly emarginated posterodorsal margin of the head, compound eyes with a light tan dorsal part, mandibles with a narrow distal part, and a v-shaped pronotum. With the description of *M. moldrzyki* **sp. n.**, eleven valid species of *Mengenilla* are currently recognised. *Mengenilla moldrzyki* **sp. n.** is the third species of the genus with known females and female puparia. First instar larvae, endoparasitic larval stages, the male puparium and the host are unknown. The new species is also the first strepsipteran with a fully sequenced genome.

Keywords

Mengenillidae, *Mengenilla*, new species, taxonomy

Introduction

Mengenillidae is a basal group of Strepsiptera. The recently described *Bahiaxenos relictus* Bravo, Pohl, Silva-Neto and Beutel, 2009 (Bahiaxenidae) from Brazil is the sistergroup of all other strepsipteran families, and Mengenillidae represents the second branch within the order, i.e. the sistergroup of all families with pterygote hosts (Stylopidia) (Pohl and Beutel 2005, Bravo et al. 2009). Plesiomorphic features including free-living females, comparatively broad mandibular bases, and the absence of specialized hairy soles on the tarsomeres of males characterize the group. Recently, the monophyly of Mengenillidae was challenged. If only characters of males are analysed the mengenillid genera *Eoxenos*, *Congoxenos*, and *Mengenilla* split successively from the strepsipteran phylogenetic backbone after *Bahiaxenos* (Pohl and Beutel 2005, Bravo et al. 2009, Hünefeld et al. 2011). The clarification of this issue will require detailed morphological information on males, females and larvae – information that is presently still very fragmentary. The monophyly of *Mengenilla* is well established and supported by the following apomorphies of males: reduced primary and secondary mandibular joint, immobilized maxilla, and a completely undivided labium (Pohl and Beutel 2005). Further diagnostic features of the males are six-segmented antennae, flabella on antennomeres 3–5, five-segmented tarsi with well developed claws, a prominent and elongated abdominal segment X, and a nearly straight penis with a pointed apex (Kinzelbach 1970, 1978, Cook 2007).

A total of 19 species have been described in the genus *Mengenilla*, 10 of which are currently recognised as valid (Cook 2007). The genus is restricted to the Old World and occurs in xerotherm, semi-arid and arid areas, with the exception of *M. orientalis* Kifune and Hirashima, 1980 from Sri Lanka and *M. leucomma* Cook, 2007 from Madagascar (Kinzelbach 1979, Kifune and Hirashima 1980, Cook, 2007, Bravo et al. 2009). *Mengenilla chobauti* Hofeneder, 1910 and *M. parvula* Silvestri, 1941 occur in the Mediterranean region. While *M. parvula* is restricted to Sicily, *M. chobauti* is recorded from North Africa, Spain, Portugal, Crete, Malta, Italy, including Sicily and Sardinia and has the widest distribution of all described *Mengenilla* species (Silvestri 1941, 1943, Kinzelbach 1978). Nearly all other species are only known from their type locality. Figure 1 gives an overview of the described species of the genus and their distribution. Males are known for all currently described species of *Mengenilla*, but females, immature stages and hosts only for *M. chobauti* and *M. parvula*. The presently known hosts are lepismatid Zygentoma: *Ctenolepisma ciliata* (Dufour, 1831) for *M. chobauti*, and *C. michaelseni* Escherich, 1905 for *M. parvula*, respectively (Silvestri 1943).

In this contribution, we describe a new species of *Mengenilla* from southern Tunisia. In October 1999, the first author (HP) collected more than 260 male specimens at a light trap in the Tunisian Sahara. Despite an intensive search, females were neither found by that time nor during a second collecting trip in 2010. In 2005, Uwe Moldrzyk (Berlin) collected a single female within its puparium. Several studies have already been published on males of this species without a formal description (referred to as

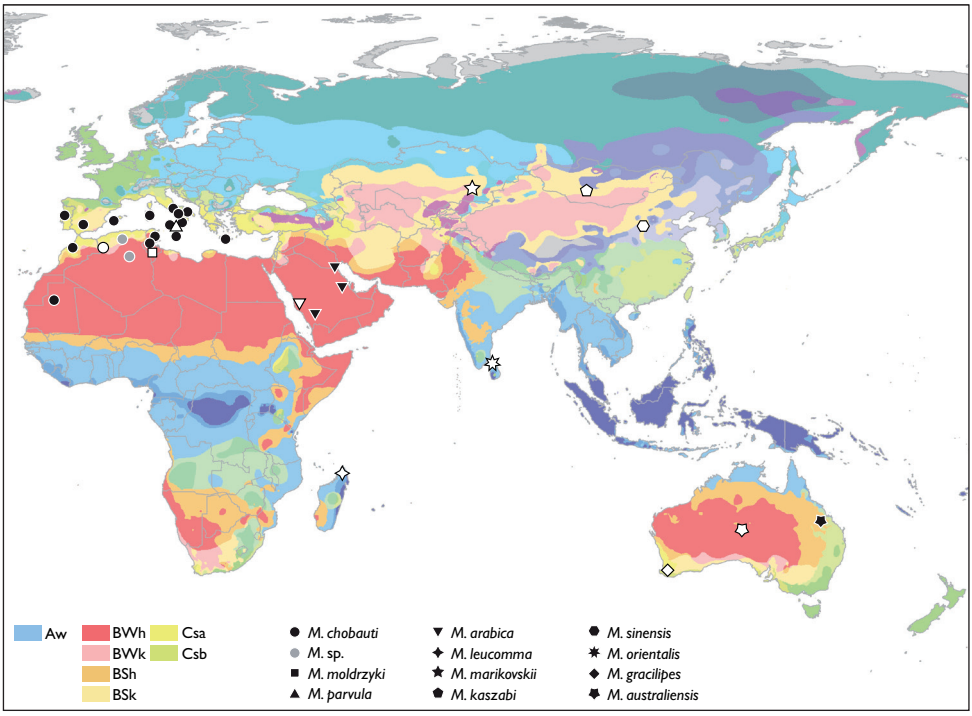


Figure 1. Distribution of the genus *Mengenilla* plotted on the Köppen-Geiger climate type map (map modified after Peel et al. (2007)). Type localities with open symbols. Grey dots: *Mengenilla* sp. mentioned by Hofeneder (1928) and de Peyerimhoff (1919). Description of the climate symbols (only where *Mengenilla* occurs): **Aw** Tropical, savannah; **BWh** Arid, desert, hot; **BWk** Arid, desert, cold; **BSh** Arid, steppe, hot; **BSk** Arid, steppe, cold; **Csa** Temperate, dry summer, hot summer; **Csb** Temperate, dry summer, warm summer. For a detailed explanation of the map and symbols see Peel et al. (2007).

"*Mengenilla* sp., undescribed species Tunisia"). They cover the head morphology (Beutel and Pohl 2006), effects of miniaturization (Beutel et al. 2005), the male postabdomen, and genital structures (Hünefeld and Beutel 2005, Hünefeld et al. 2011). Finally, the complete genome of this species has been sequenced, which is also the first published complete genome of a twisted-wing parasite (Niehuis et al. in press). *Mengenilla moldrzyki* sp. n. is consequently the best investigated strepsipteran species thus far.

Methods

The morphological terminology for the head is based on Beutel and Pohl (2006) and for the thorax and abdomen on Kinzelbach (1971, 1978), except for the term "aedeagus", which is replaced by the term "penis" as suggested by Hünefeld et al. (2011). Species descriptions are based on a designated holotype but all available specimens were taken into account in order to assess the intraspecific variation.

Photographs of critical point dried specimens were taken with a Nikon D 90 digital SLR equipped with a 40 mm and with a 63 mm Zeiss Luminar macro lense, plus an adjustable extension bellows. The specimens were illuminated by two flashlights fitted with a transparent cylinder for even and soft light. Helicon Focus Mac Pro X64 was used to combine a stack of several partially focused images. For scanning electron microscopy images (SEM) and macro photography, specimens were dehydrated using increasing steps of ethanol up to 100% and dried at the critical point (Emitech K850 critical point dryer). For SEM, specimens were subsequently sputter-coated (Emitech K500) and examined on a Philips XL30 ESEM using a rotatable specimen holder (Pohl 2010).

To assess intraspecific variation, 74 male specimens of *Mengenilla moldrzyki* sp. n. were prepared on slides and embedded in Euparal (Chroma, Münster, Germany). To avoid shrink-artefacts, specimens were dehydrated using increased steps of ethanol up to 96% prior to preparation, followed by several steps of Euparal Essenz in increasing concentration (diluted with 96% ethanol) up to 80% and then finally embedded in Euparal. An antenna, a maxilla, legs, the hind wing of one side, and the penis were prepared and each covered separately with a coverslip. Measurements of the 74 prepared males were performed using an Olympus SZ 40 stereomicroscope and an Olympus BX 50 microscope with a calibrated ocular micrometer. Measurements of the female and of the female puparium were performed using SEM micrographs and macro photographs. Definitions of the measurements are illustrated in figure 4 and in figure 5. Morphological features were illustrated using a 10×10 ocular grid on either an Olympus SZ 40 stereo microscope or an Olympus BX 50 microscope. Drawings of features of the females are based on SEM micrographs. The colouration of different body parts of the specimens are specified after the List of colours (Wikipedia).

To corroborate our assumption that the males and the females described here indeed belong to the same species, i.e., *Mengenilla moldrzyki* sp. n., we compared a 741-bp long section of their mitochondrial gene COI – an established barcoding gene. DNA was extracted from a small part of the abdomen of the adult female using the QIAGEN DNeasy Blood & Tissue Kit and following the protocol for insects (QIAGEN GmbH, Hilden, Germany). The COI marker region was PCR-amplified with the oligonucleotide primers 5'-TAG GGG TTA GAT CAG GTT GA-3' and 5'-AGG ACA TAG TGG AAA TGT GC-3'. The oligonucleotide primers had been specifically designed for this purpose with the software Primer3 (Rozen and Skaletsky 2000), using the COI sequence from the *M. moldrzyki* genome project (Niehuis et al. in press) as reference and template. Note that the *M. moldrzyki* genome has been sequenced using the DNA from males (Niehuis et al. in press). The PCR was conducted in a 20 µl volume consisting of 0.5x QIAGEN Q-Solution, 1x QIAGEN Multiplex PCR Master Mix (QIAGEN GmbH, Hilden, Germany), 0.8 µM of each oligonucleotide primer, and ~ 50 ng DNA. The PCR temperature profile started with an initial denaturation and QIAGEN HotStarTaq DNA polymerase activation step at 95° C for 15 min., followed by 35 cycles of 95° C for 1 min., 49° C for 1 min., and 72° C for 1 min, followed by 10 min. at 72° C. The PCR product was purified with the QIAquick PCR Purification Kit (QIAGEN GmbH, Hilden, Germany) and send to Macrogen Inc. (Amsterdam, Netherlands) for

direct sequencing with the above oligonucleotide primers. Forward and reverse DNA strands were assembled to contigs, trimmed (to exclude the binding sites of the oligonucleotide primers), and aligned to the COI reference sequence from the *M. moldrzyki* genome project (Niehuis et al. in press) with GENEIOUS PRO 5.5.3 (Drummond et al. 2010). The assembled COI sequence has been deposited in the European Nucleotide Archive (ENA) und is available under the accession number HE610110.

The information for the specimens is given in a standard manner, i.e., locality, geographic coordinates, elevation, date of collection (month indicated in lower case Roman numerals), habitat information, collector, depository, and preparation. Male (♂) and female (♀) symbols indicate the sex.

The specimens referred to below along with the abbreviations used in the text are deposited in the following collections: NHM – Natural History Museum, London, Great Britain; NMNH – Smithsonian Institution National Museum of Natural History, Washington, USA; HP – Private collection Hans Pohl, Jena, Germany; PMJ – Phyletisches Museum, Jena, Germany; SDEI – Senckenberg Deutsches Entomologisches Institut, Müncheberg, Germany.

Taxonomy

***Mengenilla moldrzyki* sp. n.**
urn:lsid:zoobank.org:act:131705B7-8BD1-4983-A8B3-84D4D26284D1
http://species-id.net/wiki/Mengenilla_moldrzyki

Etymology. The species is named after the collector of the female, Uwe Moldrzyk (Berlin).

Diagnosis. Six-segmented antennae with flabella on antennomeres 3–5, immobilized maxillae, a completely undivided labium, and five-segmented tarsi with well developed claws are generic features of the genus *Mengenilla* verified in the new species.

The males are distinguished from congeners as follows (*M. marikovskii* Medvedev, 1970 from south-eastern Kazakhstan is excluded from the key, because the description and illustrations are too superficial. In contrast to the statement of Medvedev (1970), the type series of that species is not deposited in the Zoological Institute, Russian Academy of Sciences, St. Petersburg, Russia and could not be re-examined.):

1 Antenna relatively short (less than 2 times the head length) **2**
– Antenna relatively long (more than 2 times the head length) **4**
2 Dorsomedian frontal impression of head absent, with narrow free labrum, Australia ..... ***M. australiensis* Kifune & Hirashima, 1983**
– Head with dorsomedian frontal impression, labrum absent **3**
3 Metapostscutellum long (~0.4 times the metanotal length), ~50 ommatidia, maxillary palp longer than proximal part of maxilla, Sri Lanka .... ***M. orientalis* Kifune & Hirashima, 1980**

– Metapostscutellum comparatively short (~0.3 times the metanotal length), ~60 ommatidia, maxillary palp subequal to proximal part of maxilla, China (Shansi) ..... ***M. sinensis* Miyamoto, 1960**

4 25–27 ommatidia, with small free labrum, Australia ..... ***M. gracilipes* (Lea, 1910)**

– >30 ommatidia, labrum absent **5**

5 Mandible with broad distal part (compare Fig. 3B) **6**

– Mandible with narrow distal part (compare Fig. 3A) **7**

6 35–38 ommatidia, proximal part of maxilla globular, maxillary palp attached apically, body length 1.7–3.1 mm, Italy (Sicily) .... ***M. parvula* (Silvestri, 1941)**

– 35–90 ommatidia, proximal part of maxilla slender, maxillary palp attached subterminally, body length 2.6–5.9 mm, Algeria, Morocco, Tunisia, Italy (including Sardinia and Sicily), Spain, Portugal ... ***M. chobauti* Hofeneder, 1910**

7 Compound eye with uniform colouration, maxillary palp attached subterminally **8**

– Dorsal part of compound eye white to light tan, maxillary palp attached apically **9**

8 Tips of flabella and 6th antennomere rounded, 37–39 ommatidia, body length 2.8–3.1 mm, Saudi Arabia ..... ***M. arabica* Kinzelbach, 1979**

– Tips of flabella and 6th antennomere acuminate, 45–65 ommatidia, maxilla with conspicuous extension, body length 3.2–5.1 mm, Mongolia ..... ***M. kaszabi* Kinzelbach, 1970**

9 Posterodorsal margin of head deeply concave, pronotum rectangular, anterior margin slightly emarginated, colour of thorax light brown, body length 2.4–2.8 mm, Madagascar ..... ***M. leucomma* Cook, 2007**

– Posterodorsal margin of head slightly emarginated, pronotum v-shaped, anterior margin concave, colour of thorax dark brown, body length 3.4–4.8 mm, Tunisia ..... ***M. moldrzyki* sp. n.**

The female of *M. moldrzyki* sp. n. is distinguished from *M. chobauti* and *M. parvula* by the much more slender distal part of its mandible, and from *M. parvula* additionally by its longer scapus. The female puparium is distinguished from that of *M. chobauti* and *M. parvula* by the complete absence of cuticular thorns, a rounded anterior prothoracic margin with rounded anterolateral edges, and a tapering caudal margin of the abdomen (Figs 12, 13).

Description of the male (Figs 2–6). Measurements (male holotype, followed by minimum, maximum of paratypes, and mean values of all measured specimens in parentheses, critical point dried specimens and specimens in ethanol not measured, in µm): 1. total length 4,000 (3,450–4,785, avg. 4,182), 2. width of head 788 (613–875, avg. 762), 3. length of head 300 (250–350, avg. 296), 4. width between compound eyes 225 (188–300, avg. 237), 5. number of ommatidia (average of three counts) 71±2 (44–77, avg. 65), 6. total length of antenna 1,015 (821–1,075, avg. 963), 7. length of flabellum of 3rd antennomere 940 (710–990, avg. 864), 8. length of flabellum of

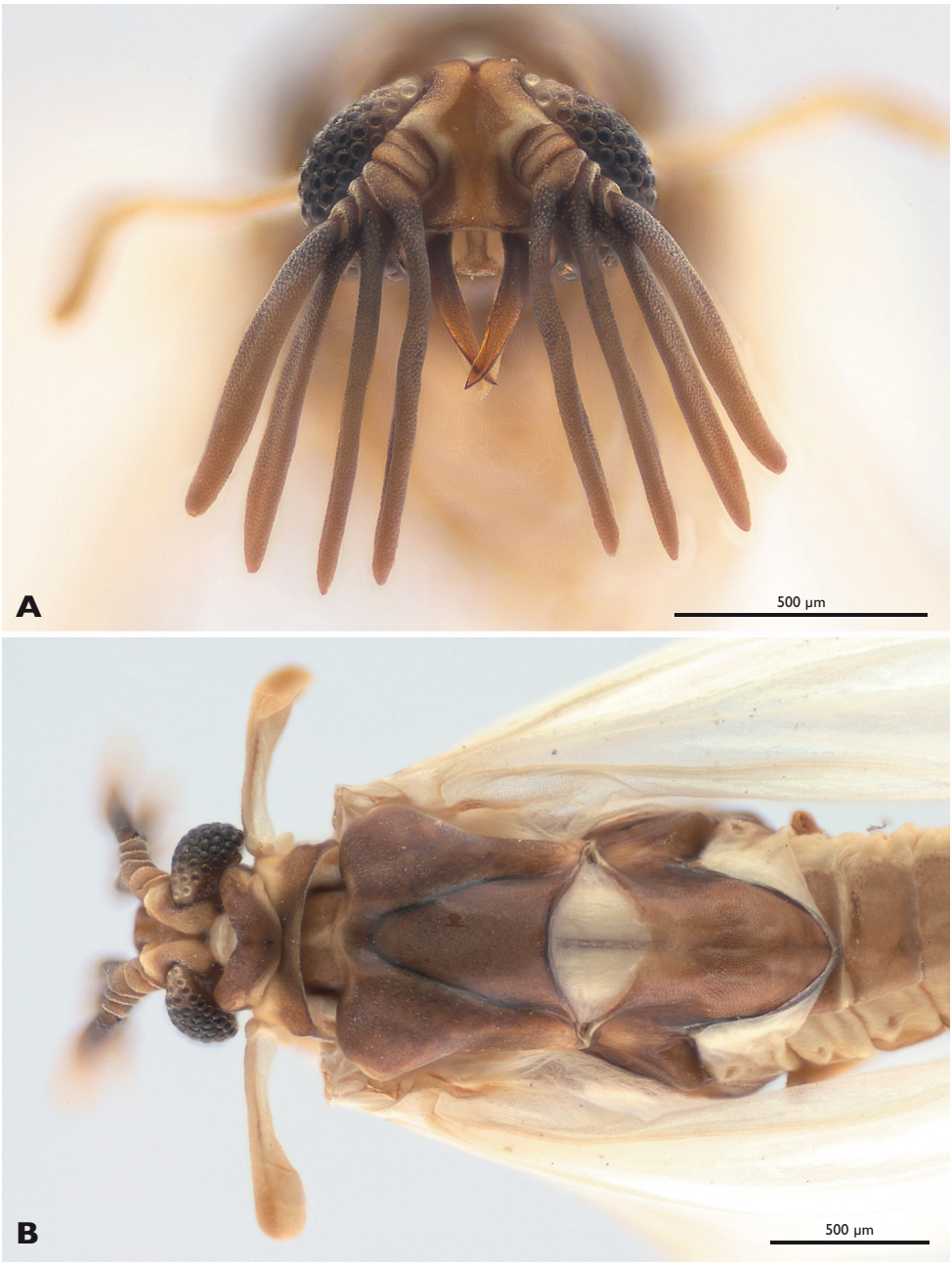


Figure 2. *Mengenilla moldrzyki* sp. n. ♂ **A** Head frontal view **B** Head, thorax and anterior part of abdomen, dorsal view; photomicrograph.

4th antennomere 900 (700–960, avg. 845), 9. length of flabellum of 5th antennomere 830 (610–890, avg. 785), 10. length of 6th antennomere 720 (580–790, avg. 695), 11. length of mandible 360 (275–375, avg. 331), 12. width of mandible 125 (105–145,

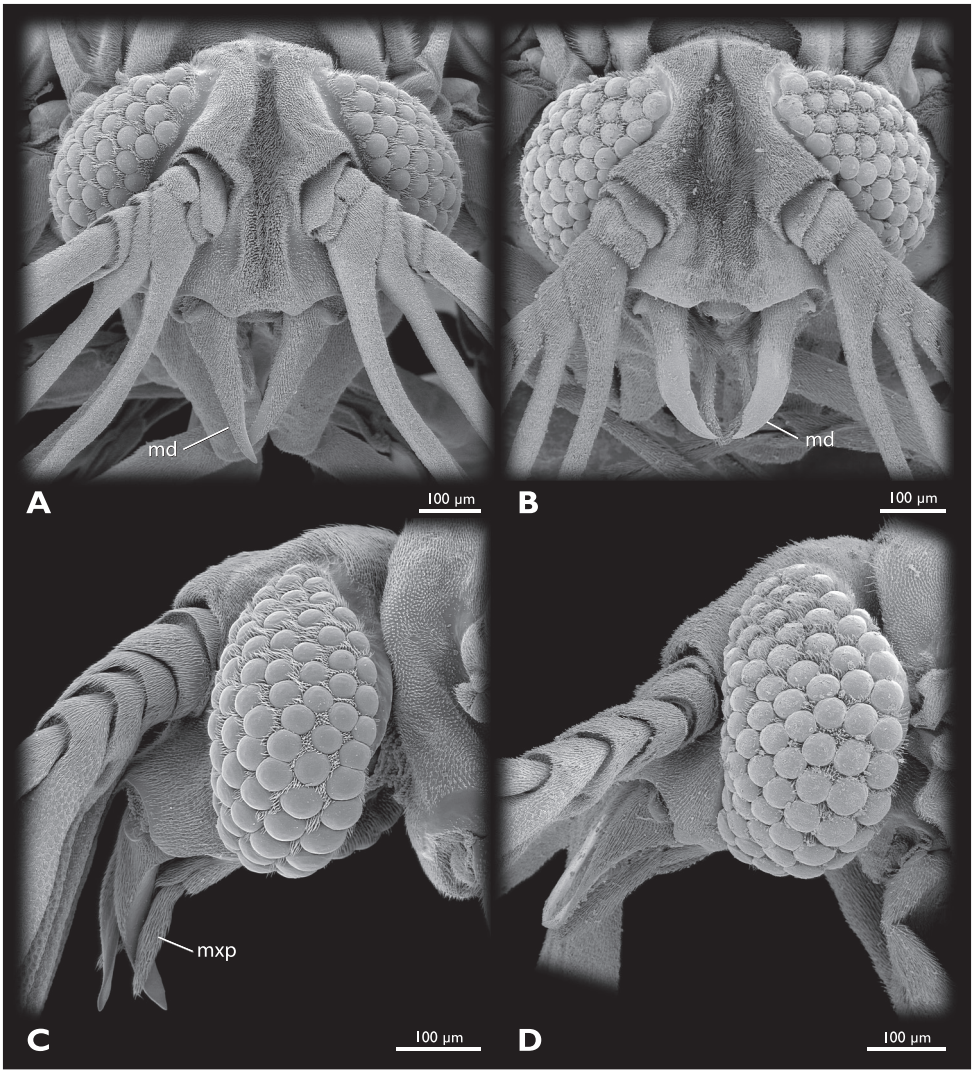


Figure 3. Heads of males of *Mengenilla moldrzyki* sp. n. **A, C** and *M. chobauti* from Sicily **B**, **D**; **A, B** Frontal view; **C, D**: lateral view; SEM micrographs.

avg. 122), 13. total length of maxilla including palp 260 (185–345, avg. 256), 14. length of proximal part of maxilla (cardo+stipes) 110 (65–125, avg. 89), 15. length of maxillary palp 200 (150–270, avg. 207), 16. length of pronotum 188 (125–213, avg. 167), 17. width of pronotum 463 (413–588, avg. 479), 18. width of mesonotum 525 (463–663, avg. 542), 19. length of metanotum 1,910 (1,540–2,150, avg. 1,862), 20. width of metathorax 1050 (750–1,150, avg. 971), 21. length of postlumbium 363 (275–488, avg. 373), 22. length of metapostscutellum 600 (413–688, avg. 550), 23. length of hind wing 3,440 (2,820–3,800, avg. 3,424), 24. length of procoxa 540 (440–590, avg. 525), 25. length of prothrochanterofemur 620 (500–680, avg. 600),

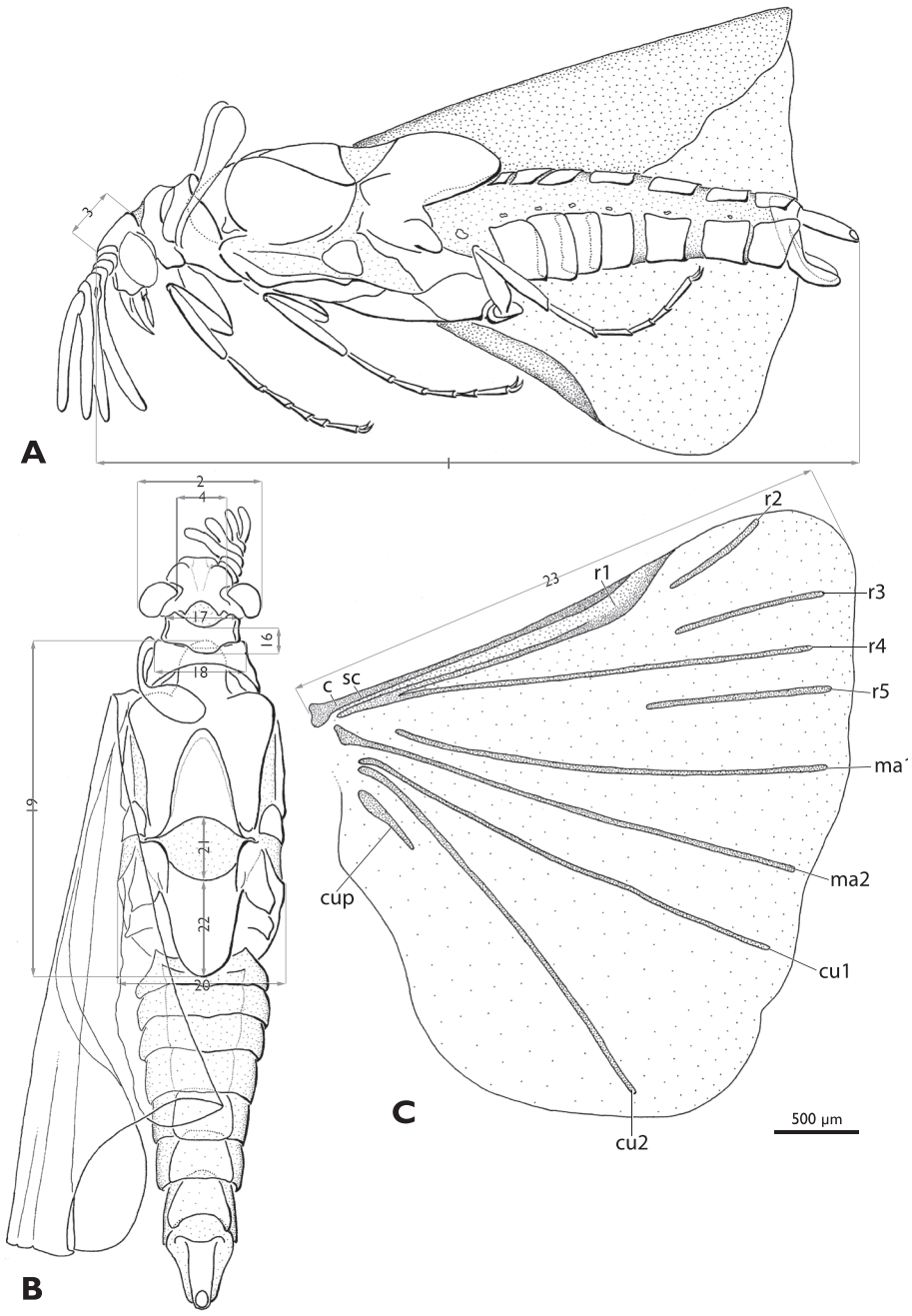


Figure 4. *Mengenilla moldrzyki* sp. n. ♂ with definitions of the measurements **A** Lateral view **B** Dorsal view **C** Hind wing; measurement lines grey. 1: total length, 2 width of the head, 3 length of head, 4 width between compound eyes, 16 length of pronotum, 17 width of pronotum, 18 width of mesonotum, 19 length of metanotum, 20 width of metathorax, 21 length of postlumbium, 22 length of metapostscutellum, 23 length of hind wing; c, costa; cu1, cu2, cubitus anterior; cup, cubitus posterior; ma1, ma2, media anterior; r1–r5, radius; sc, subcosta

26. length of protibia 520 (410–600, avg. 506), 27–31. length of protarsi (proximal to distal) 310, 170, 135, 100, 180 (240– 370, avg. 314) (135–205, avg. 177) (90–195, avg. 144) (80–140, avg. 109) (140–220, avg. 175), 32. length of mesocoxa 670 (520–720, avg. 624), 33. length of mesothrochanterofemur 680 (550–760, avg. 664), 34. length of mesotibia 530 (410–630, avg. 522), 35–39. length of mesotarsi (proximal to distal) 315, 160, 130, 100, 185 (260–380, avg. 324) (140–210, avg. 176) (105–195, avg. 146) (80–140, avg. 109) (145–220, avg. 181), 40. length of metatrochanter 190 (170–255, avg. 216), 41. length of metafemur 570 (450–630, avg. 548), 42. length of metatibia 500 (380–580, avg. 480), 43–47. length of metatarsi (proximal to distal) 280, 150, 135, 95, 180 (215–345, avg. 290) (90–195, avg. 164) (105–185, avg. 141) (75–130, avg. 102) (145–220, avg. 180), 48. length of penis 355 (285–390, avg. 346).

Head capsule (Figs 2, 3A, 3C): dorsal side cream-coloured, lateral part brownish, subgenal region distinctly darkened at mandibular base and postoccipital ridge. Subprognathous, slightly to distinctly inclined; broader than long and strongly narrowed immediately posterior to compound eyes, not retracted into prothorax; laterocervicalia absent; posterodorsal margin of head emarginated; dorsal side densely covered with microtrichia; some short setae present on vertex, but absent from frons; area posterior to compound eyes and ventral side of head capsule glabrous and very smooth; ocelli absent; compound eye very large and extending to ventral side of head, composed of 44–77 large ommatidia (avg. 65); mediodorsal part creamy-white, lateral and ventral part seal brown; dorsal and lateral ommatida widely separated and intervals densely covered with microtrichia; ventral ommatidia slightly larger and closely adjacent; deep lyriform frontal impression present on dorsal side of head and longitudinal bulge laterally; bulges camel-coloured, anteriorly forming antennal insertion; transverse frontoclypeal strengthening ridge absent; anterior clypeofrons slightly emarginated, laterally separated from genal region by dark narrow zone ending posteriorly at antennal insertion; median part parallel-sided, brighter and more densely covered with microtrichia than lateral region; cranial part inflected, separated from frontal mandibular base and mouthfield sclerite by membranous area with distinct median brownish stripe extending laterad; subgenal area and gena seal brown; ventral head closed by lateral postgenal area and median undivided labial plate between maxilla and postgenal region; mouth opening transversely oval.

Antenna (Figs 2A, 5A): large, inserted at anterior end of dorsal longitudinal bulge; scapus and pedicellus very short, broad and cup-shaped, slightly conical at base; flabella of antennomeres 3–5 long, flattened, with rounded tips, decreasing in length from proximal to distal antennomeres, bole-coloured; antennomere 6 distinctly shorter than flabellum of antenommere 5; orifice of Hofeneder's organ on ventrobasal part of antennomere 5 oval; flagellomeres and flabella densely covered with dome-shaped chemoreceptors.

Labrum: absent.

Mandible (Figs 2A, 3A, 5C, 6A): elongate, slender, and stylet-like; basal part rather narrow and triangular in cross section, seal brown; distal part slightly curved, medially intercrossing in resting position, translucent, brown; lateral and frontal side densely covered with microtrichia except for apical region; ventral side largely glabrous.

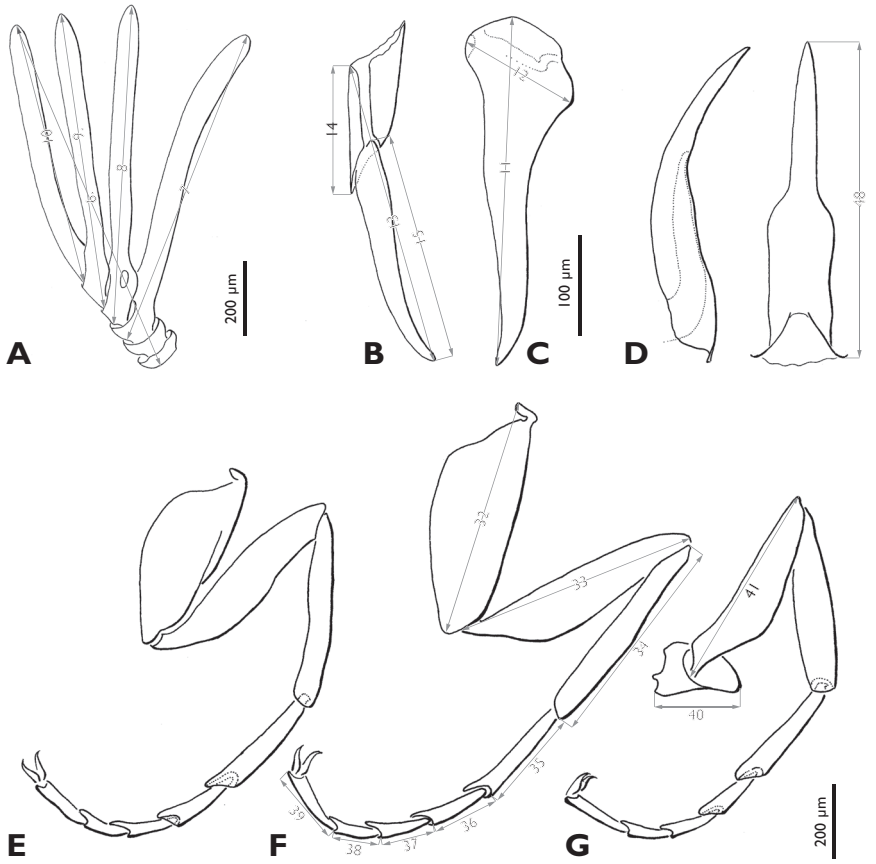


Figure 5. *Mengenilla moldrzyki* sp. n. ♂ with definitions of the measurements **A** Antenna, caudal view **B** Left maxilla, lateral view **C** Right mandible, medio caudal view **D** Penis, lateral and dorso caudal view **E–G** Pro-, meso-, metathoracic leg, ventral view; 6 total length of antenna, 7 length of flabellum antennomere three, 8 length of flabellum of antennomere four, 9 length of flabellum antennomere five, 10 length of antennomere six, 11 length of mandible, 12 width of mandible, 13 total length of maxilla including palp, 14 length of proximal part of maxilla (cardo+stipes), 15 length of maxillary palp, 32 length of mesocoxa, 33 length of mesotrochanterofemur, 34 length of mesotibia, 35–39 length of mesotarsi (proximal to distal), 40 length of metatrochanter, 41 length of metafemur, 48 length of penis.

Maxilla (Figs 3C, 5B, 6B): basally fused with ventral wall of head capsule without articulatory membrane; surface covered with microtrichia; palp slightly curved inwards, apically attached on proximal element of maxilla (cardo+stipes), densely covered with microtrichia, without sensory spot.

Thorax (Figs 2B, 4B): pronotum v-shaped, with concave anterior margin and rounded caudal margin; slightly overlapping with anterior rim of mesonotum mesally; mesonotum broader than pronotum, nearly as broad as head, with concave caudal rim;

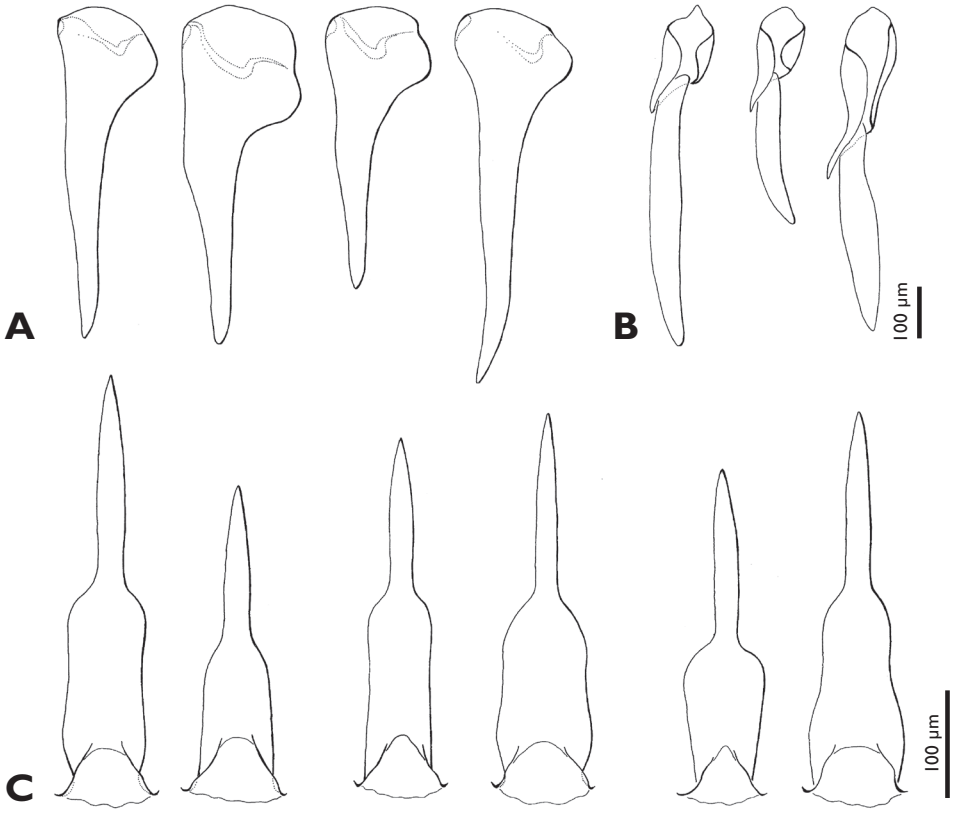


Figure 6. *Mengenilla moldrzyki* sp. n. ♂, variability of mandible, maxilla, and penis **A** Mandibles, medio caudal view **B** Maxilla, lateral view **C** penis, dorso caudal view.

prescutum forming distinct bulge, anteriorly extended; metascutum anteriorly with large lobes, covered with sensilla; metascutellum triangular; postlumbium distinctly wider than long, slightly convex anteriorly, strongly convex posteriorly, beige, translucent; metapostnotum slightly longer than wide; posterior margin rounded.

Legs (Figs 5E–F): slender, basitarsus of all legs longer than other tarsomeres; tarsomeres 2–4 decreasing in length; distitarsus of all legs almost as long as tarsomere 2, with two well developed claws; trochanter of hind leg ear-shaped.

Halteres (Fig. 2B): slender, slightly longer as mesonotal width.

Hind wing (Fig. 4C): with typical venation of the genus; veins R2, R3, R5, MA1, Cu1, Cu2, and CuP detached; MA1, MA2, Cu1, and Cu2 reaching almost wing margin; colour beige, veins camel-coloured.

Abdomen (Figs 4, 5D, 6C): tergites less strongly sclerotised than sternites, brown; tergite and sternite of segment I reduced; tergite II partly covered by metapostnotum; tergites II–VIII, rectangular, increasing in width from segments II–VIII; pleural membrane of segments I–VIII wide, camel coloured; spiracles present on segments I–VII; shape of sternites II–VIII similar to corresponding tergites but distinctly broader,

shovel-shaped, brown; segment IX strongly sclerotised, distinctly narrower than segment VIII, with caudally elongated subgenital plate; segment X tube-like, extending above tip of subgenital plate; penis curved, with bulbous proximal part; acumen thin, tapering towards apex.

Description of the female (Figs 7–10). Measurements: total length 3,200, width of head 590, width between compound eyes 400, 11–12 ommatidia, total length of antenna 270, length of scapus 20, length of pedicellus 30, length of 3rd antennomer 80, length of 4th antennomer 140, length of mandible 200, width of mandible 90, length of maxilla 400, length of maxillary palp 70, length of procoxa 240, length of protrochanterofemur 290, length of protibia 200, length of protarsi 90, 80, 130 (proximal to distal), length of mesocoxa 270, length of mesotrochanterofemur 330, length of mesotibia 200, length of mesotarsi 100, 100, 150 (proximal to distal), length of metacoxa 330, length of metatrochanterofemur 400, length of metatibia 230, length of metatarsi 110, 90, 150 (proximal to distal).

Head capsule (Figs 7–9, 10A–10C): uniformly tan, with the exception of articulatory membranes of antenna and membranised ventral head areas. Relatively small, distinctly broader than long, and cuneiform in lateral aspect; orthognathous, with the posterior part distinctly retracted into the prothorax; laterocervicalia absent; dorsal side smooth, without vestiture of microtrichia; short setae present on anterior clypeal region, few setae present above antennal insertion and area posterior to compound eyes; ocelli absent; compound eye small, composed of 11–12 large, equally sized and closely adjacent ommatidia; microtrichia between ommatidia absent; central part of compound eye grey, peripheral ommatidia tan; circumocular ridge slightly darker; frontal impression on dorsal side of head absent; ventral side of head closed by membranised reduced labium and possibly cervical membrane; mouthfied sclerite small, oval, reaching posterior margin of maxilla; mouth opening transverse, oval.

Antenna (Fig. 9A): small, with 4 segments, without flabella; articulating with broad antennal membrane at anterior end of compound eye; scapus very short, conical, broadly connected with globular pedicellus; antennomere 3 bell-shaped, as long as scapus and pedicellus combined; antennomere 4 club-shaped, as long as antennomeres 1–3; few short setae inserted on distal margin of pedicellus and antennomere 4; Hofeneder's organ absent, flagellomeres densely covered with sensilla placodea.

Labrum (Fig. 8F): very small fold anterior to mouth opening; setae absent.

Mandible (Figs 8C, F, 9C, 10A, B): hook-shaped; axis of articulation oblique, almost horizontal; secondary joint reduced; basal part broad and triangular in cross section; anterior rim convex, posterior border concave, apical part very slender, not intercrossing in resting position.

Maxilla (Fig. 9C–9F): pear-shaped, weakly sclerotised; insertion adjacent to primary mandibular joint; apex with ~20 stout setae; palp pin-shaped, slightly curved outwards, attached subterminally, with ~10 stout setae distally; sensory spot absent.

Thorax (Fig. 7): ivory-coloured and very weakly sclerotised, with the exception of tan pronotum and pleural sclerites; prothorax trapezoid in dorsal view, with rounded anterior and posterior border; anterior border of pronotum v-shaped, posterior border

Figure 7. *Mengenilla moldrzyki* sp. n. ♀, lateral view; photomicrograph.

convex; pronotum divided into two longitudinal plates with broad, weakly sclerotised mesal area, each with ~35 short setae in anterior third; caudal region with about 5–6 short setae; meso- and metathorax dorsally strongly arched; nota of meso- and metathorax not present as sclerotised elements.

Legs (Fig. 10D–10F): stout, inserted laterally; tarsi with 3 segments; distitarsus of all legs almost as long as tarsomeres 1+2 combined; distitarsus with well developed claws.

Abdomen (Fig. 7): ivory-coloured and very weakly sclerotised; abdominal segments strongly arched dorsally, ± flattened ventrally; spiracles at lower third of segments I–VII; fissure-shaped birth opening present on posterior border of segment VII.

COI sequence: 100% identical between the female and the sequenced males.

Description of the female puparium (Fig. 11). Measurements: total length 5,700, maximum width 2,800, maximum height 1,600, length of legs without claws 300.

Pro- and mesothorax fulvous, metathorax and abdomen reddish-brown, lateral side of abdomen with clearly separated fulvous stripe; cuticle shiny, cuticular thorns absent.

Head missing (already shed); dorsal side of puparium strongly arched, ventral side flattened; anterior margin of prothorax rounded and forming distinct bulge with rounded anterolateral edge; anterior third of metathorax slightly constricted; legs very short, inserted laterally, with thread-like claws; caudal margin of abdomen tapering; spiracles present at abdominal segments I–VII.

First instar larva. unknown

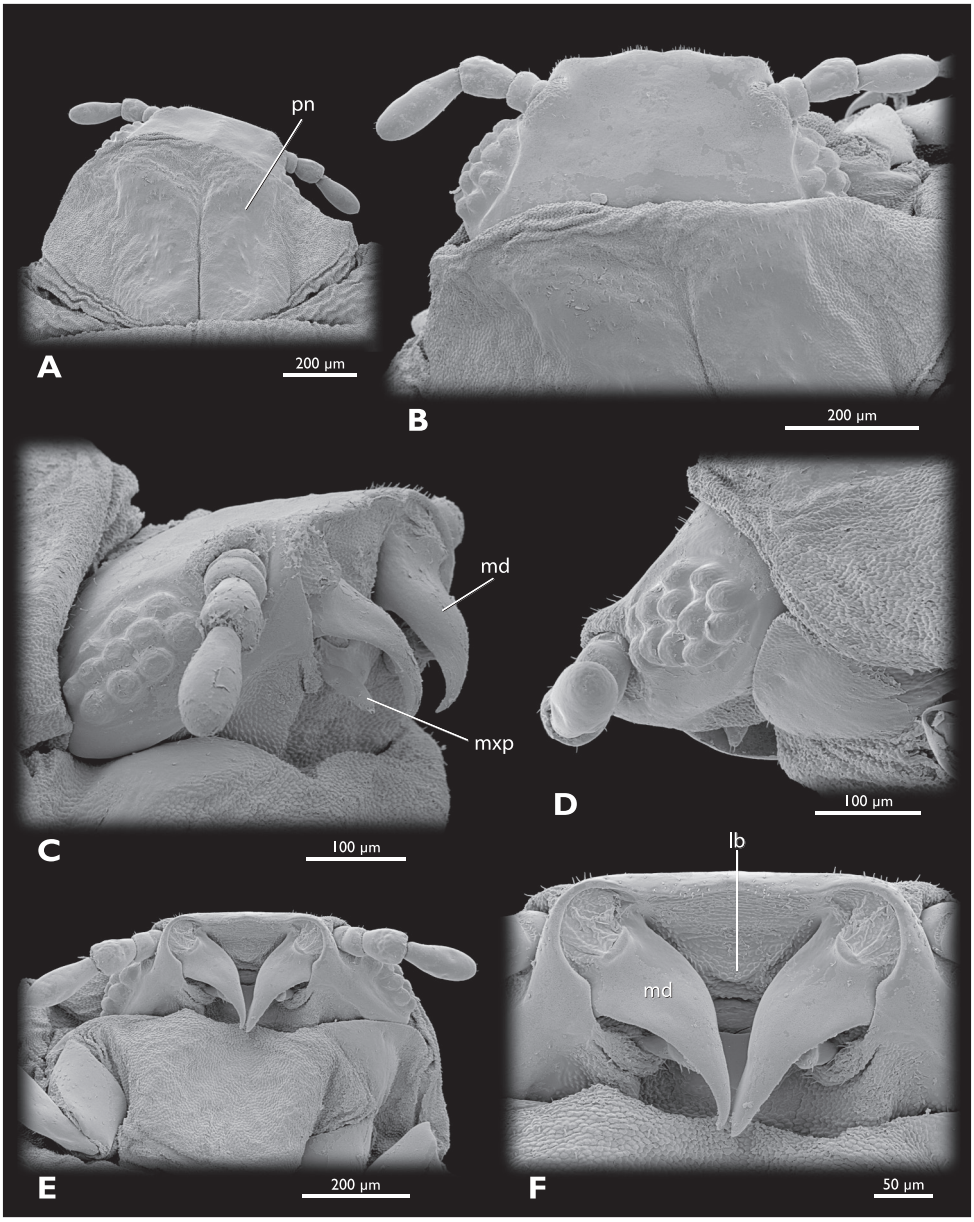


Figure 8. *Mengenilla moldrzyki* sp. n. ♀ **A** Head and prothorax, dorsal view **B** Head, dorsal view **C** Head oblique lateral view **D** lateral view **E** Head and prothorax, ventral view **F** Mouthparts, ventral view; lb, labrum; md, mandible; mxp, maxillary palp; pn, pronotum; SEM micrographs.

Host. unknown

Material examined. Tunisia: Grand Erg Oriental, Parc Nationale de Jebil, 265 ♂♂, 33°00'05"N, 9°01'13"E, 11.–15.x.1999, black light, leg. H. Pohl (1 ♂ holotype, on slide, PMJ, 33 ♂♂ paratypes, on slide, PMJ; 40 ♂♂ paratypes, on slides, SDEI;

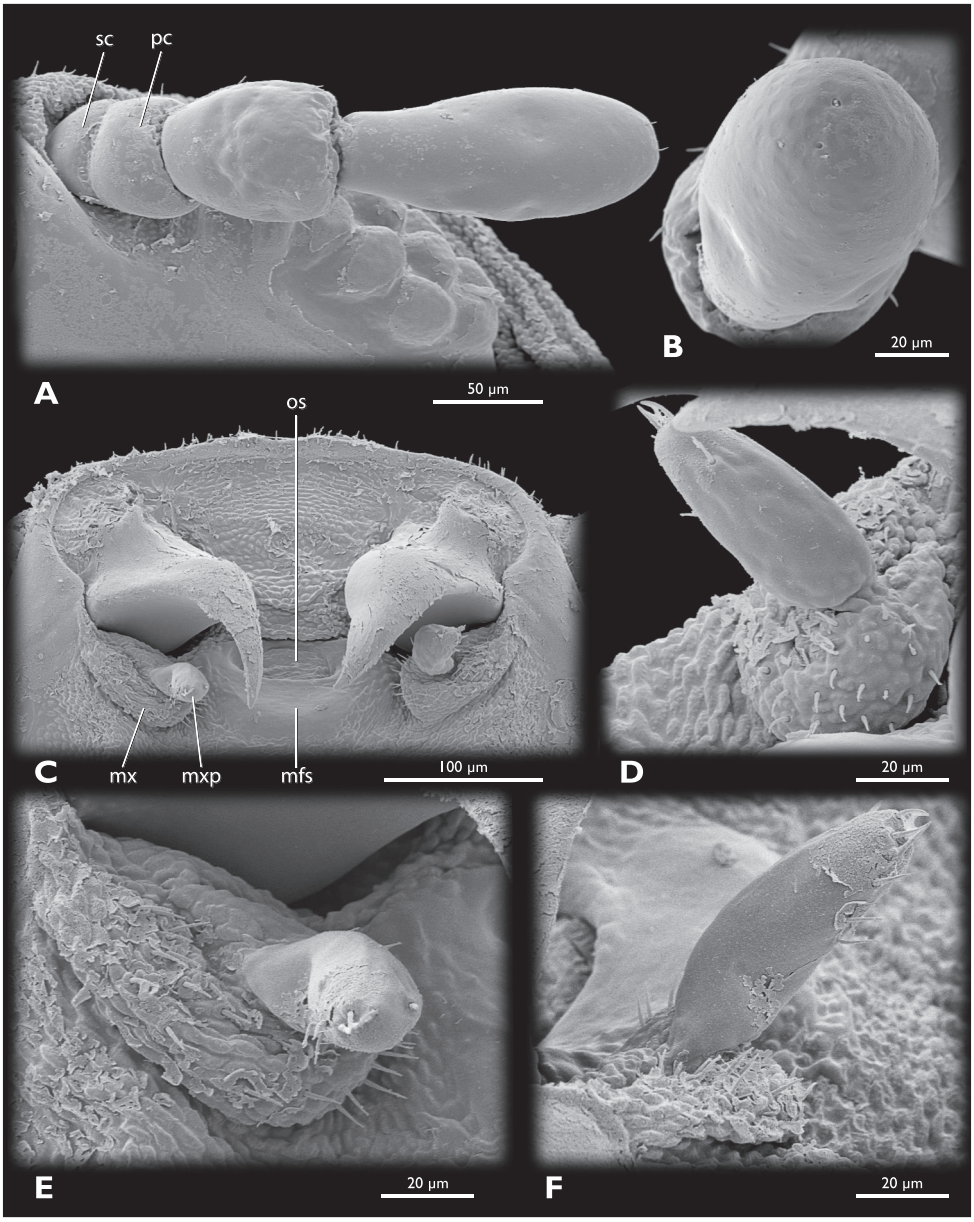


Figure 9. *Mengenilla moldrzyki* sp. n. ♀, details of head **A** left antenna, ventral view **B** Sensilla placodea on antennomere 4, lateral view **C** Mouthparts, ventral view **D** Left maxilla, mesal view **E** Left maxilla, ventral view **F** Left maxilla, lateral view; mfs, mouthfied sclerite; mx, maxilla; mxp, maxillary palp; os, mouth opening; pc, pedicellus; sc, scapus; SEM micrographs.

159 ♂♂ paratypes, in ethanol, HP); same locality, 1 ♀ paratype, prepared from puparium, 08.xi.2005, excavated from sand, leg. U. Moldrzyk, HP, SEM-preparation; same locality, date and collector, 1 ♀ paratype, puparium, HP, dry preparation. Excluded

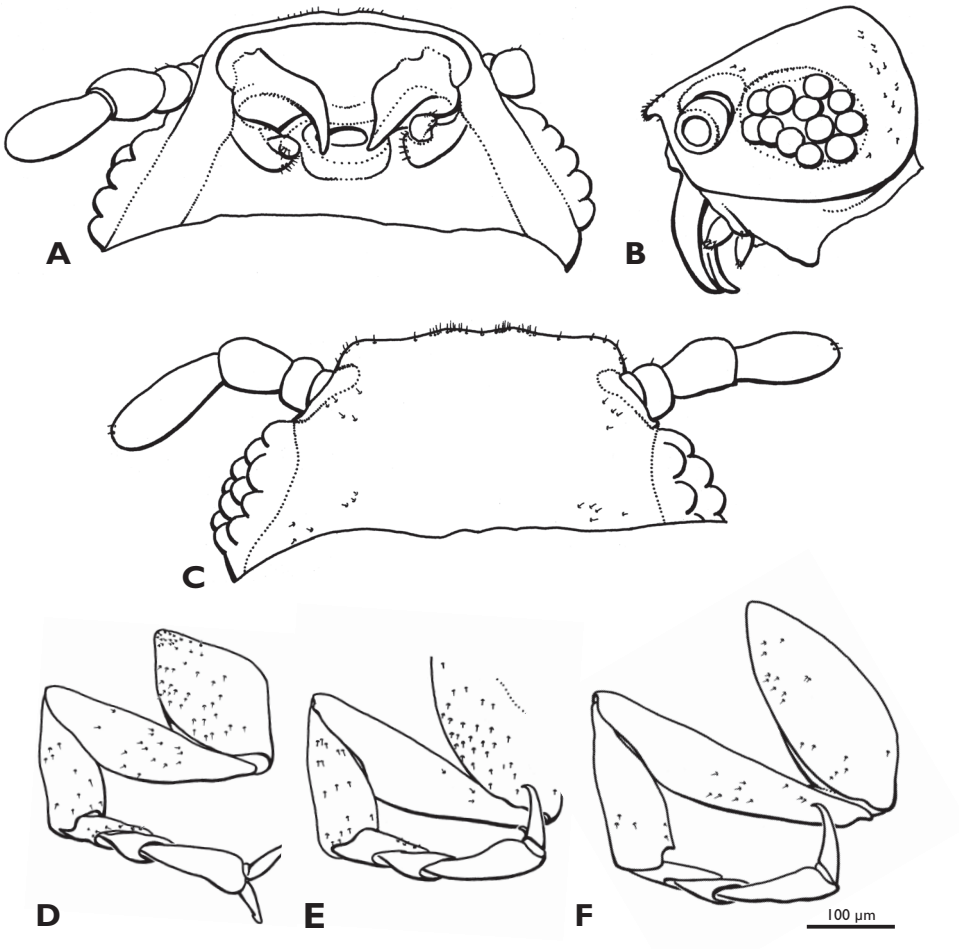


Figure 10. *Mengenilla moldrzyki* sp. n. ♀; **A–C** Head, ventral, lateral, dorsal view **D–F** Pro-, meso-, metathoracic leg, ventral view.

from the type series: 15 ♂♂ (DNA extraction for genome sequencing; Niehuis et al. in press), 10 ♂♂ (poor preserved, SEM, histology).

Type locality and distribution: Parc Nationale de Jebil and surroundings (33°00'05"N, 9° 01'13"E), Tunisia (Fig. 13).

Compared material. *Mengenilla chobauti* (Figs 3B, 3D, 12), Italy, Sicily, Randazzo, 37°52'17"N, 14°57'02" E, 06.–10.viii.1994, leg. H. Pohl, 5 ♂♂ reared from puparia, HP, in ethanol and SEM-preparation; 20 ♀ puparia, HP, dry preparation.

Mengenilla santchii (Pierce, 1918), Tunisia, Kairouan, viii.1907, F. Santchi, holotype ♂, on slide. Original labels: "*Mengenilla chobauti*; HOFENEDER (*Tetrozocera santchii* PIERCE); [Holotype]; Kartei-Nr. 0360; R. KINZELBACH; det. 1970" [handwritten and printed label]; "Kairouan, Marokko; VIII.1907, ♂; ex:?; USNM No. 21434; leg. F. Santchi" [handwritten and printed label]. NMNH.

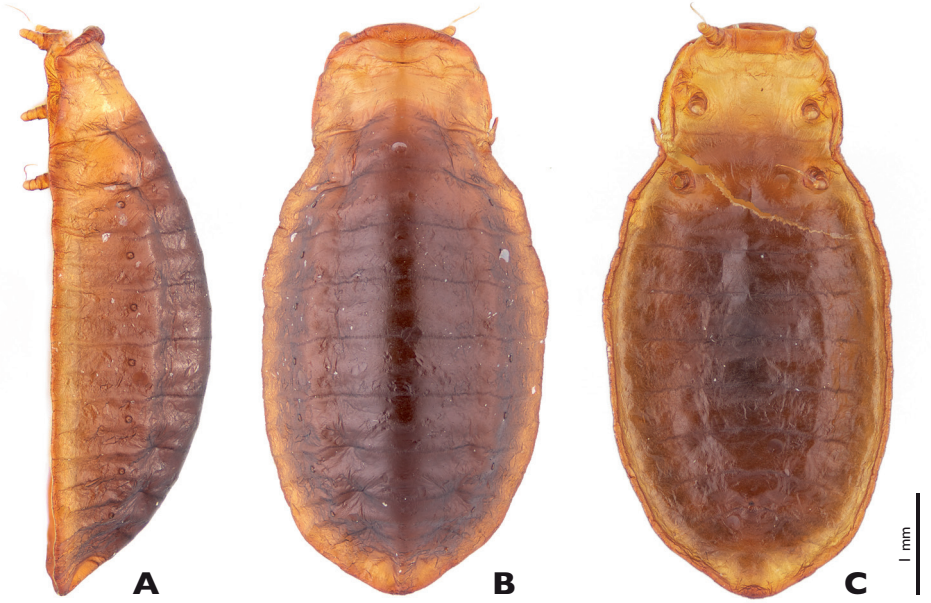


Figure 11. *Mengenilla moldrzyki* sp. n. ♀ puparium **A** lateral **B** Dorsal **C** Ventral view; photomicrographs.

Mengenilla theryi (Hofeneder, 1926), Morocco, Rabat, 17.vii.1923, A. Théry, holotype ♂, on slide. Original labels: "*Mengenillopsis theryi* Hfnd., Rabat. Maroc.; Type. B.M. 1930.193." [red printed label], "*Mengenillopsis theryi* Hfnd. ♂; Rabat, Maroc.; volant à la lumiere artificielle.; 17 juillet 1923; Voez: Bull. Soc. Sc. Nat. Maroc; VI (1926) p. 56–64. Fig 1–10.; Type; leg. Dr. A. Thèry" [handwritten label]; NHM.

Mengenilla mauretanica (Hofeneder, 1928), Morocco, Rabat, vii.1923, leg. A. Théry, 1 ♂, embedded laterally on slide. Original labels: "Théry N° 2" [handwritten label], "*Mengenillopsis mauritanica* Hfnd.; Rabat, Maroc. (a. Théry); B.M.1930.193" [handwritten label], "*Mengenillopsis mauretanica*, ♂; Rabat, Maroc.; Volant à la lumière artificielle; leg. Dr. A. Thèry – juilett 1923.; Voyes: Bull. Soc. Sc. Nat. Maroc VIII. (1928) p. 195–211. Fig. 4, 5, 6" [handwritten label] "L`exemplaire N° 2 dans la preparation en situation inverse compare avec les dessins fig. 5 et. 6." [handwritten label]. NHM. – Same locality, leg. A. Théry, 1 ♂, embedded dorsally on slide. Original labels: "Théry N° 3" [handwritten label], "*Mengenillopsis mauritanica* Hfnd.; Rabat, Maroc. (a. Théry); B.M.1930.193" [handwritten label]. NHM. – Same locality, leg. A. Théry, 1 ♂, embedded laterally on slide. Original labels: "Théry N° 5a" [handwritten label], "*Mengenillopsis mauritanica* Hfnd.; Rabat, Maroc. (a. Théry); B.M. 1930.193" [handwritten label]. NHM. – Same locality, leg. A. Théry, 1 ♂, on slide. Original labels: "*Mengenillopsis mauritanica* Hfnd.; Rabat, Maroc. (a. Théry); B.M. 1930.193" [handwritten label], "Rabat (Maroc); A. Théry leg.; R.Ph.D. prepar." [handwritten

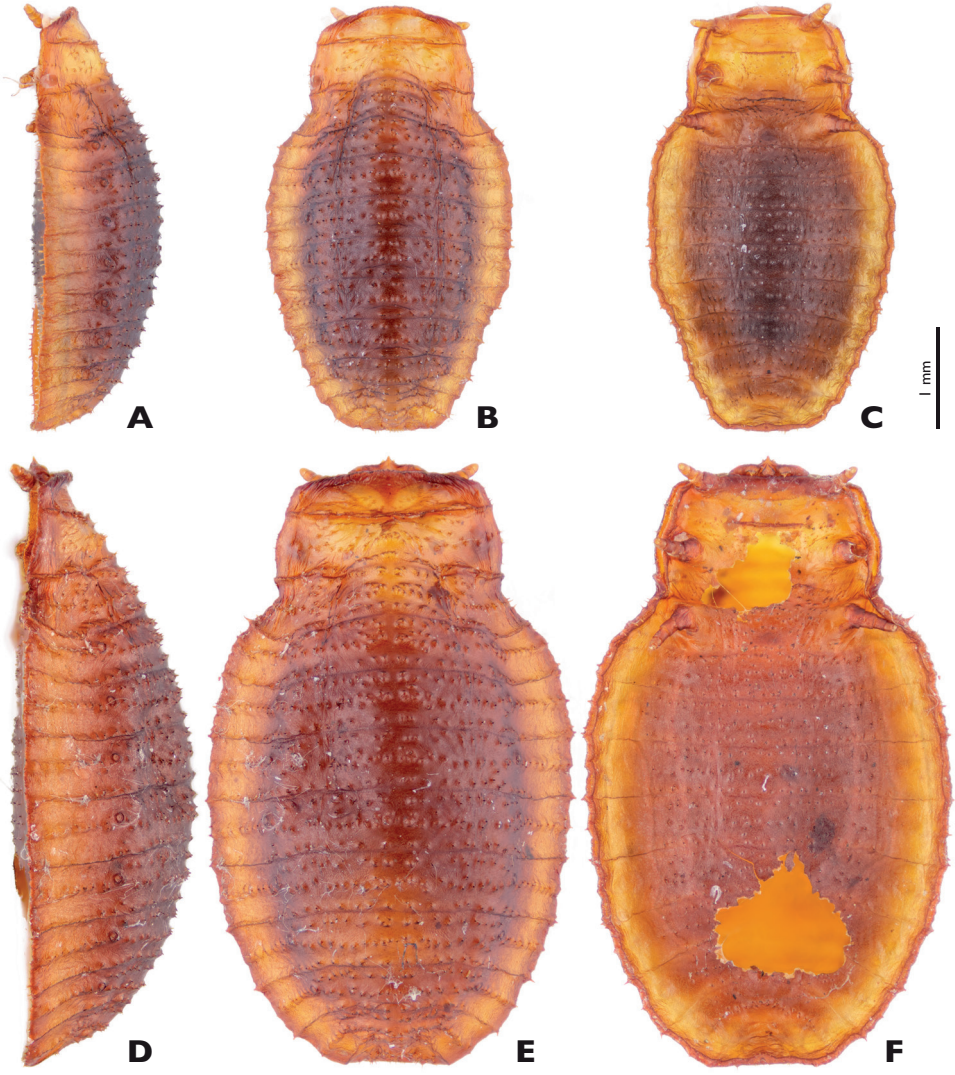


Figure 12. *Mengenilla chobauti* (Sicily) variations of ♀ puparia; **A, D** lateral; **B, E** Dorsal; **C, F** Ventral view; photomicrographs.

label], "*Mengenillopsis mauretanica* ♂; Rabat, Maroc.; volant à la lumière artificielle; leg. Dr. A. Théry … aout 1923.; Voyes: Bull. Soc. Sc. Nat. Maroc; VIII. (1928) p. 195–211. Fig. 1." [handwritten label]. NHM. – Same locality, leg. A. Théry, 1 ♂, on slide. Original labels: "*Mengenillopsis mauritanica* Hfnd.; Rabat, Maroc. (a. Théry); B.M. 1930.193" [handwritten label], "Rabat (Maroc); A. Théry leg.; R.Ph.D. prepar." [handwritten label], "*Mengenillopsis mauretanica* ♂; Rabat, Maroc.; volant à la lumière

artificielle; leg. Dr. A. Théry … aout 1923.; Voyes: Bull. Soc. Sc. Nat. Maroc; VIII. (1928) p. 195–211. Fig. 2, 7." [handwritten label]. NHM.

Mengenilla cf. *chobauti*, Tunisia, Bou Hedma National Parc, 34° 29' 40" N; 09° 38' 37" E, 06.x.1999, leg. H. Pohl. 2 ♀♀ puparia, HP, dry preparation.

Mengenilla gracilipes (Lea, 1910), Australia, Bridgetown, Western Australia, at light, Syntype ♂, on slide. Original labels: "*Mengenilla gracilipes* (Lea, 1910); Cotype, B.M. 1910.323; Bridgetown W.A.; to lights; leg. Lea; det. Kinzelbach 1968" [handwritten label]. "Bridgetown; W.a. (Lea); To lights" [handwritten label, probably original label of Lea]; NHM.

Mengenilla orientalis Kifune and Hirashima, 1980, Sri Lanka, Mannar District, 10 miles NW of Mannar, 04.–05.xi.1976, black light, leg. G.F. Hevel, R.E. Dietz IV, S. Karunaratne, D.W. Balasooriya, holotype ♂, in ethanol. Original labels: "Holotype, *Mengenilla orientalis*, Kifune et Hirashima" [handwritten label]. "SRI LANKA: Man. Dist.; Olaithoduvae, 10 mi NW; of Mannr, 0–50 feet; black light; 4–5 November 1976" [printed label]. "Collected by: G.F. Hevel, R.E. Dietz IV, S. Karunaratne; D.W. Balasooriya" [printed label]. "USNM #; 76712" [printed label]; NMNH.

Mengenilla australiensis Kifune and Hirashima, 1983, Australia, Northern Territory, 8 km N of Kulgera, 03.iv.1980, blacklight, leg. G.F. Hevel, J.A. Fortin, paratype ♂, in ethanol. Original labels: "*Mengenilla australiensis*; PARATYPE" [handwritten label], "AUSTRALIA: N.T.; 8 KmN of Kulgera; at blacklight; 3 April 1980; GFHevel & JAFortin" [printed label]; NMNH.

Mengenilla kaszabi Kinzelbach, 1970, Mongolia, Bajanchongor Aimak, Oasis Echin gol, about 90 km NE borderguard Caganbulag, 950 m, 28.vi.1967, at light, leg. S. Kaszab, paratype ♂, on slide. Original labels "*Mengenilla kaszabi* Kinzelbach ♂ Paratypus, Kartei-Nr. 0128, R. KINZELBACH det. 1969" [handwritten and printed label], "Mongolia, Bajanchongor aimak: Oase Echin gol, 90 km von Caganbulag, 28.VI.1967, an Licht, leg. S. KASZAB" [handwritten label]; HP.

Mengenilla arabica Kinzelbach, 1979, Kuwait, 04.vi.1983, leg. W. al-Houty, ♂, on slide. Original labels "*Mengenilla arabica* KINZELBACH, 1979, Kartei-Nr. 1217, R. Kinzelbach det. 1984" [handwritten and printed label], "W Kuwait, 4.06.1983, ex: …, det. …, leg. W. al-Houty" [handwritten and printed label]; HP.

Distribution. *Mengenilla moldrzyki* sp. n. is only known from the type locality.

Ecology and phenology. In contrast to *Mengenilla chobauti*, *M. moldrzyki* sp. n. apparently only occurs in pure sand dune areas. Despite intense search no puparia were found among widely scattered stones in the habitat during collecting trips in 1999 and 2010. The puparia might be buried in sand, as suggested by the discovery of a female within its puparium in such a situation. The reduction of the characteristic cuticular thorns of the puparium is likely related to this lifestyle. The thorns function as attachment structures that are frequently additionally enhanced by using silk spun from spiders under rocks and stones (Pohl and Beutel 2008).

Presently, no statements can be made on the seasonal occurrence of the adult males of *M. moldrzyki* sp. n. before and beyond October. However, it was observed that the period of activity (and life span) of the adult males is very short (maximum

Figure 13. Type locality of *Mengenilla moldrzyki* sp. n. Parc Nationale de Jebil, Grand Erg Oriental, Tunisia.

ca. 2 hours). In October 1999 and 2010, males were only found about half an hour after sunset (~6.30 p.m.). No specimens were found after 8.30 p.m. Most of the flying males were observed between 6.30 p.m. and 8.00 p.m. Captured males lost their ability to fly approximately 2 hours after they had been captured and died half an our later.

Discussion

The type locality of *M. chobauti* is Ain Sefra in Algeria. All other species of *Mengenilla* described from northern Africa (i.e., *M. theryi* (Hofeneder, 1926), *M. mauretanica* (Hofeneder, 1928) (both from Morocco), *M. santchii* (Pierce, 1918) (from Tunisia)) are today considered as junior subjective synonyms of *M. chobauti* (Kinzelbach 1970, Cook 2007). We re-examined all available material (including all types) of these species, and encountered a considerable amount of variation, especially in the length of antennomere 6, the length of the flabella, and the shape of the maxilla and penis. As pointed out by Cook (2007), it cannot not be excluded that more than one species occurs in this region. However, all synonymised North African species, including *M. santchii* from Tunisia, differ significantly from *M. moldrzyki* by the broad distal part of their mandible.

Recommendations for future species descriptions

Important diagnostic features of males of species of the genus *Mengenilla* are the shape of the posterodorsal margin of head, the dorsomedian frontal impression, the total length of the antennae, the tips of the flabella and antennomere 6, the shape of the distal part of the mandibles, the proximal part of the maxilla, the insertion of the maxillary palp, the shape of the pronotum, and the length of the metapostscutellum. In contrast, the total length, the proportions of the maxilla and the maxillary palp as well as the shape of the penis are very variable and only partly suitable for species identification (compare Fig. 6). Kinzelbach (1979) and Cook (2007) refer to the different patterns of microtrichia on the mandibles. This feature seems to be suitable for diagnosis, but the vestiture varies greatly on the frontal, lateral and ventral mandibular areas (Fig. 3). It is not clear from previous descriptions and illustrations from which perspective the isolated mandibles are shown. This greatly reduces the value of the presented information (see Cook 2007: Fig 5). If more than one specimen is available, standard views of the head in dorsal, frontal, and lateral view should be given (and documented by SEM if possible) in addition to drawings of the antenna, mandible, maxilla, dorsal view of the whole insect, the legs, the hind wing, and the penis. With the use of the SEM specimen holder developed by Pohl (2010), a single specimen can be examined from all sides.

Differences in colouration also appear suitable for diagnosis but have rarely been used in the literature so far. Unfortunately, older specimens treated with potassium hydroxide solution and embedded in Canada balsam on slides are no longer useful for this purpose. To document the colouration, light micrographs of the head and thorax in dorsal view and of the head in frontal view should be given. Only with well-documented descriptions, a reliable identification of other conspecific individuals is possible without comparing it to the type specimens.

Acknowledgements

The authors would like to thank Frank Hünefeld (Jena, Germany), Ulrich Joger (Braunschweig, Germany), Uwe Moldrzyk (Berlin, Germany), and Florian Wolf (Jena, Germany) for their support collecting *Mengenilla moldrzyki* sp. n. Nancy Adams (Washington, USA) and Sharon Shute (London, Great Britain) are thanked for loans of the type specimens. Finally, we are indebted to Claudia Etzbauer (Bonn, Germany) for her technical assistance and help barcoding the female of *Mengenilla moldrzyki* sp. n. and Jerry Cook (Huntsville, USA) for his thorough review, which significantly contributed to improving the quality of the publication.

References

Beutel RG, Pohl H (2006) Head structures of males of Strepsiptera (Hexapoda) with emphasis on basal splitting events within the order. Journal of Morphology 267: 536–554. doi: 10.1002/(ISSN)1097-4687

Beutel RG, Pohl H, Hünefeld F (2005) Strepsipteran brains and effects of miniaturization (Insecta). Arthropod Structure & Development 34: 301–313. doi: 10.1016/j.asd.2005.03.001

Bravo F, Pohl H, Silva-Neto A, Beutel RG (2009) Bahiaxenidae, a "living fossil" and a new family of Strepsiptera (Hexapoda) discovered in Brazil. Cladistics 25: 614–623. doi: 10.1111/j.1096-0031.2009.00264.x

Cook JL (2007) Review of the genus *Mengenilla* Hofeneder 1910 (Strepsiptera : Mengenillidae), with description of a new species from Madagascar. Proceedings of the Entomological Society of Washington 109: 223–239.

Drummond AJ, Ashton B, Buxton S, Cheung M, Cooper A, Duran C, Field M, Heled J, Kearse M, Markowitz S, Moir R, Stones-Havas S, Sturrock S, Thierer T, Wilson A (2011) Geneious v5.5.3. Available from http://www.geneious.com

Hofeneder K (1928) Zwei neue Strepsipteren aus Marokko. 2. Teil. Bulletin de la Société des Sciences Naturelles du Maroc 8: 195–211.

Hünefeld F, Beutel RG (2005) The sperm pumps of Strepsiptera and Antliophora (Hexapoda). Journal of Zoological Systematics and Evolutionary Research 43: 297–306. doi: 10.1111/j.1439-0469.2005.00327.297-306

Hünefeld F, Pohl H, Wipfler B, Beckmann F, Beutel RG (2011) The male postabdomen and genital apparatus of †*Mengea tertiaria*, a strepsipteran amber fossil (Insecta). Journal of Zoological Systematics and Evolutionary Research 49: 298–308. doi: 10.1111/j.1439-0469.2011.00628.x

Kifune T, Hirashima Y (1980) Records of the Strepsiptera of Sri Lanka in the collection of the Smithsonian Institution, with descriptions of seven new species (Notulae Strepsipterologicae-VI) Esakia 15: 143–159.

Kinzelbach RK (1970) Die männlichen Imagines der Mengenillidae und *Mengenilla kaszabi* n. sp. – Ergebnisse der zoologischen Forschungen von Dr. Z. Kaszab in der Mongolei (Strepsiptera, Insecta). Reichenbachia 12: 217–247.

Kinzelbach RK (1971) Morphologische Befunde an Fächerflüglern und ihre phylogenetische Bedeutung (Insecta: Strepsiptera). Schweizerbart'sche-Verlagsbuchhandlung, Stuttgart, 256 pp.

Kinzelbach RK (1978) Fächerflügler (Strepsiptera). VEB Gustav Fischer Verlag, Jena, 166 pp.

Kinzelbach RK (1979) Insects of Saudi Arabia. Strepsiptera. Fauna of Saudi Arabia 1: 331–333.

Medvedev LN (1970) A family of Strepsiptera new to the fauna of the USSR and new species from southeastern Kazakhstan. Entomological Review 49: 113–114.

Niehuis O, Hartig G, Grath S, Pohl H, Lehmann J, Tafer H, Donath A, Krauss V, Eisenhardt C, Hertel J, Petersen M, Mayer C, Meusemann K, Peters RS, Stadler PF, Beutel RG, Bornberg-Bauer E, McKenna DD, Misof B (in press) Genomic and morphological evidence converge to resolve the enigma of Strepsiptera. Current Biology.

Peel MC, Finlayson BL, McManon TA (2007) Updated world map of the Köppen-Geiger climate classification. Hydrology and Earth System Sciences Discussions 4: 439–473. doi: 10.5194/hessd-4-439-2007

Peyerimhoff P (1919) Un nouveau type d'Insectes Strepsiptères. Bulletin de la Société Entomologique de France 1919: 162–173.

Pohl H (2010) A scanning electron microscopy specimen holder for viewing different angles of a single specimen. Microscopy Research and Technique 74: 1073–1076. doi: 10.1002/jemt.20835

Pohl H, Beutel RG (2005) The phylogeny of Strepsiptera (Hexapoda). Cladistics 21: 328–374. doi: 10.1111/j.1096-0031.2005.00074.x

Pohl H, Beutel RG (2008) The evolution of Strepsiptera (Hexapoda). Zoology 111: 318–338. doi: 10.1016/j.zool.2007.06.008

Rozen S, Skaletsky HJ (2000) Primer3 on the WWW for general users and for biologist programmers. In: Krawetz S, Misener S (Eds) Bioinformatics Methods and Protocols: Methods in Molecular Biology. Humana Press,Totowa, NJ, 365–386.

Silvestri F (1941) Notizie, specialmente corologiche e biologiche, sulle specie di *Mengenilla* (Insecta Strepsiptera) finora trovate in Italia. Acta Pontificiae Academiae Scientarum 5: 57–65.

Silvestri F (1943) Studi sugli "Strepsiptera" (Insecta). III. Descrizione e biologia di 6 specie italiane di *Mengenilla*. Bolletino del Laboratorio di Zoologia generale e agraria della Facoltà Agraria in Portici 32: 197–282.

Wikipedia, the free encyclopedia: List of colors http://en.wikipedia.org/wiki/List_of_colors

ZooKeys 198: 103–109 (2012)
doi: 10.3897/zookeys.198.3032
www.zookeys.org

DATA PAPER

A peer-reviewed open-access journal
ZooKeys
Launched to accelerate biodiversity research

A dataset from bottom trawl survey around Taiwan

Kwang-Tsao Shao[1], Jack Lin[1], Chung-Han Wu[1],
Hsin-Ming Yeh[1], Tun-Yuan Cheng[1]

1 *Biodiversity Research Center, Academia Sinica, No. 128, Sec. 2, Academia Rd., Nankang, Taipei, TAIWAN, R.O.C.*

Corresponding author: *Kwang-Tsao Shao* (zoskt@gate.sinica.edu.tw); *Jack Lin* (jacklin@gate.sinica.edu.tw)

Academic editor: *V. Chavan* | Received 29 February 2012 | Accepted 22 May 2012 | Published 30 May 2012

Citation: Shao K-T, Lin J, Wu C-H, Yeh H-M, Cheng T-Y (2012) A dataset from bottom trawl survey around Taiwan. ZooKeys 198: 103–109. doi: 10.3897/zookeys.198.3032

Abstract

Bottom trawl fishery is one of the most important coastal fisheries in Taiwan both in production and economic values. However, its annual production started to decline due to overfishing since the 1980s. Its bycatch problem also damages the fishery resource seriously. Thus, the government banned the bottom fishery within 3 nautical miles along the shoreline in 1989. To evaluate the effectiveness of this policy, a four year survey was conducted from 2000–2003, in the waters around Taiwan and Penghu (Pescadore) Islands, one region each year respectively. All fish specimens collected from trawling were brought back to lab for identification, individual number count and body weight measurement. These raw data have been integrated and established in Taiwan Fish Database (http://fishdb.sinica.edu.tw). They have also been published through TaiBIF (http://taibif.tw), FishBase and GBIF (website see below). This dataset contains 631 fish species and 3,529 records, making it the most complete demersal fish fauna and their temporal and spatial distributional data on the soft marine habitat in Taiwan.

Keywords

Bottom Trawl, Taiwan, IPT, Darwin Core, Fishery

Data published through GBIF: http://fishbase.tw:8080/ipt/resource.do?r=bottom_trawl_survey

Taxonomic coverage

"Fishes of the World" (Nelson 2006) was used as a taxonomic reference for this work.

General taxonomic coverage description: The coverage (Figure 1) of this dataset includes Class Actinopterygii (90%), Class Chondrichthyes (9%) and Class Myxini (1%).

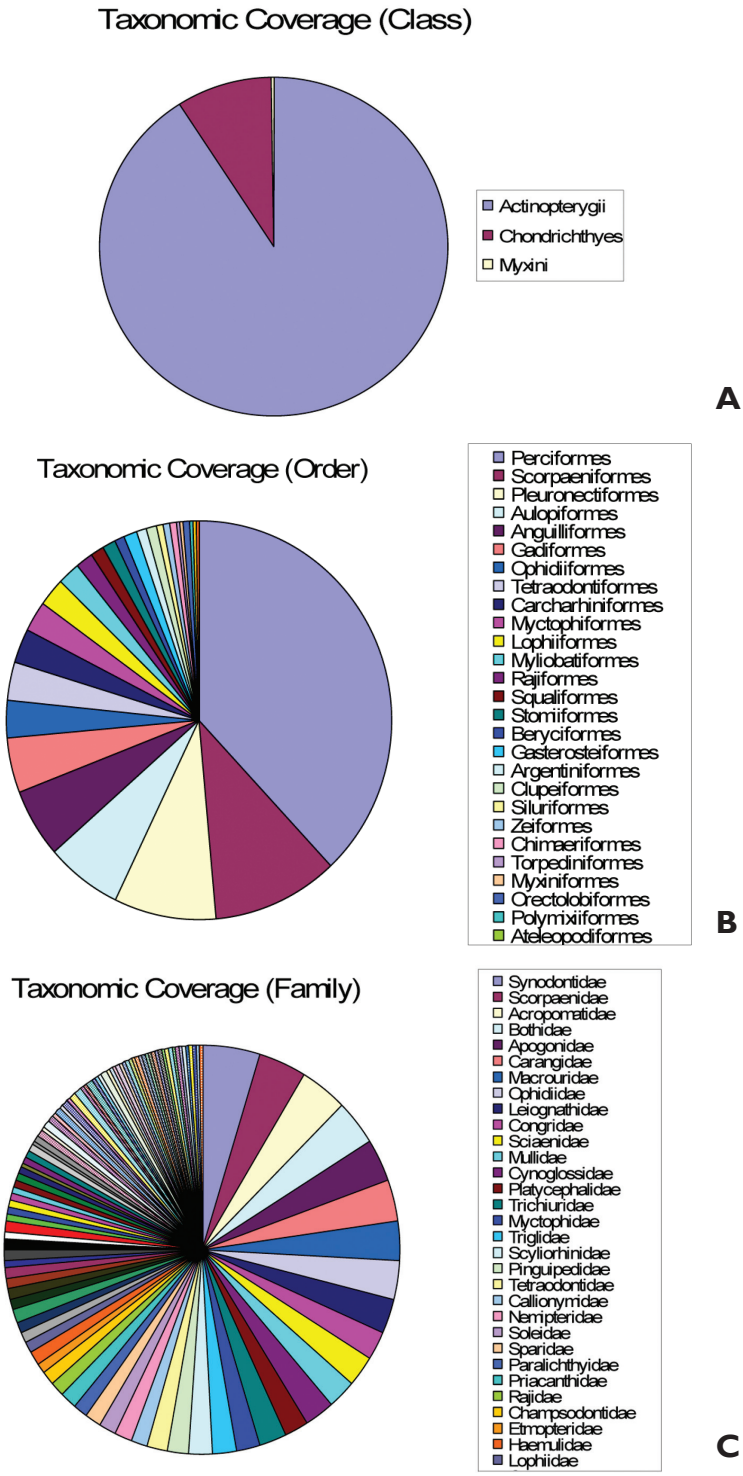


Figure 1. Taxonomic coverage. **A** Class **B** Order **C** Family.

Taxonomic ranks

Kingdom: Animalia
Phylum: Chordata
Class: Actinopterygii, Chondrichthyes, Myxini
Order: Perciformes, Scorpaeniformes, Pleuronectiformes, Aulopiformes, Anguilliformes, Gadiformes, Ophidiiformes, Tetraodontiformes, Carcharhiniformes, Myctophiformes, Lophiiformes, Myliobatiformes, Rajiformes, Squaliformes, Stomiiformes, Beryciformes, Gasterosteiformes, Argentiniformes, Clupeiformes, Siluriformes, Zeiformes, Chimaeriformes, Torpediniformes, Myxiniformes, Orectolobiformes, Polymixiiformes, Ateleopodiformes, Gonorhynchiformes, Albuliformes, Heterodontiformes, Squatiniformes
Family: Perciformes, Scorpaeniformes, Pleuronectiformes, Aulopiformes, Anguilliformes, Gadiformes, Ophidiiformes, Tetraodontiformes, Carcharhiniformes, Myctophiformes, Lophiiformes, Myliobatiformes, Rajiformes, Squaliformes, Stomiiformes, Beryciformes, Gasterosteiformes, Argentiniformes, Clupeiformes, Siluriformes, Zeiformes, Chimaeriformes, Torpediniformes, Myxiniformes, Orectolobiformes, Polymixiiformes, Ateleopodiformes, Gonorhynchiformes, Albuliformes, Heterodontiformes, Squatiniformes

Spatial coverage

General spatial coverage: Seas around Taiwan (Figure 2)

Coordinates: 21°25'12"N, 25°40'12"N Latitude; 119°27'36"E, 122°27'36"E Longitude

Temporal coverage: February 17, 2000–November 20, 2003

Methods

Sampling description: The sampling design for collecting bottom trawl harvest from coastal and offshore waters around Taiwan was to separate the waters into four regions and collect one region each year during 2000–2003 (Figure 2a). In each region except Penghu, 3–4 fixed stations with various water depths were chosen according to different topography and traditional fishing ground in that region. Eastern Taiwan was excluded because it belongs to open ocean and deep-sea environment and there was no bottom trawl fishery in the region. The locality names (or nearest fishing harbours) and water depths in each region were outlined below (Figure 2a and 2b):

2000 – Northern Taiwan (Jinshan: 100 m; mixed with pebbles and sand) and Northeastern Taiwan (Aodi: 100m, 150m and 200 m; and Dasi: 50, 100, 200, 400, 600 and 800 m; all sandy bottoms); 2001 – Southwestern Taiwan (Xingda Harbor: 10, 30, 50, 70 and 100 m; Kaohsiung Harbor: 100, 200 and 300 m; Donggang: 100,

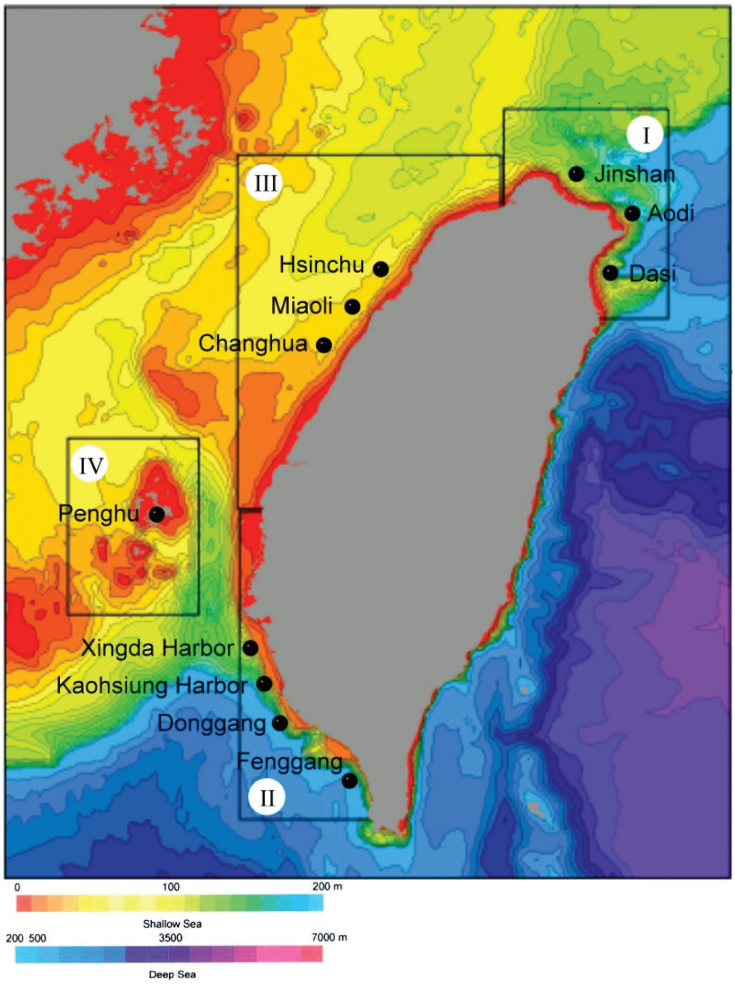


Figure 2a. Spatial coverage (fishing harbors of four regions)

200 and 300 m; Fenggang: 100, 200 and 300 m; sandy and muddy bottoms); 2002 – Western Taiwan (Hsinchu: 60, 65 and 70 m; Miaoli: 10, 30 and 50 m; Changhua: 10, 20 and 40 m; all sandy bottoms); and 2003 – Penghu Islands (16 depths ranging from 25 to 95 m; all sandy and muddy bottoms).

Different bottom trawl fishing boats were used in different regions or harbours with slightly different fishing gears designed for our samplings. Basically at each station, the sampling was with an otter trawl towing at 3 nm/hr for one hour. The longitude and latitude data were recorded using the GPS system on the boat. After the recovery of trawl, all the specimens were identified to the species level, number of individuals for each species counted and body weight measured.

Quality control description: All the scientific names of fish samples were validated by the updated fish checklist in our Taiwan Fish Database or TaiBNET (http://tai-

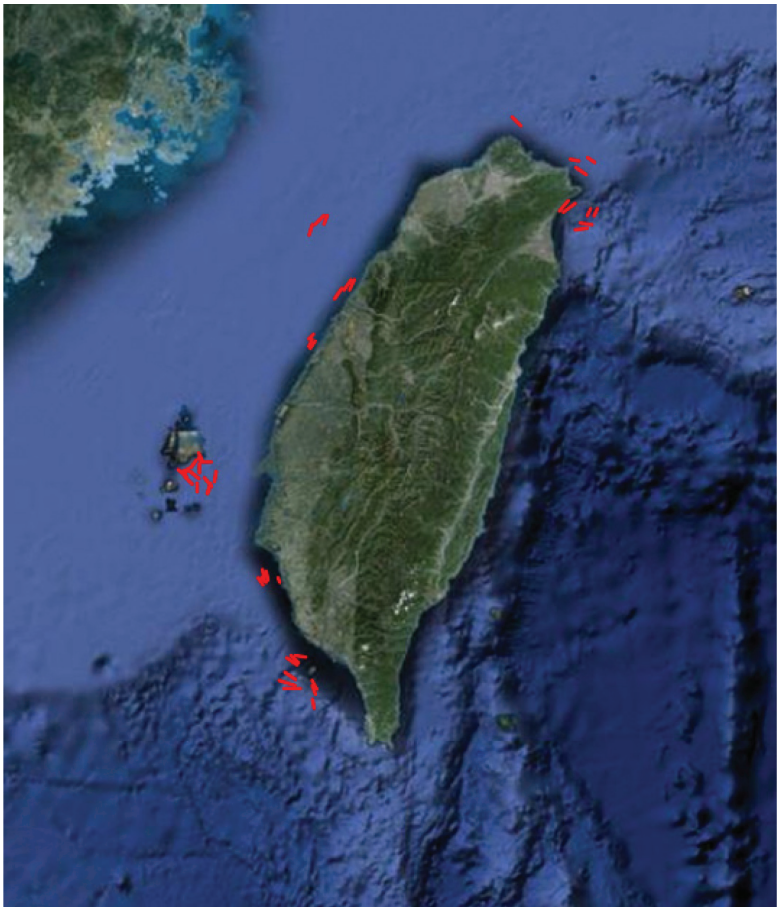


Figure 2b. Spatial coverage (trawling routes)

bnet.sinica.edu.tw) before they are added into database. Afterward, they were validated again by matching them against FishBase and Catalog of Fishes, California Academy of Sciences for further correction. If a specimen was rare or it might belong to an undescribed or new species, it was photographed in fresh and then the specimen and its tissue sample were both catalogued and deposited at the Biodiversity Research Museum of Biodiversity Research Center (ASIZP of BRCAS). The latitude and longitude of trawling routes were plotted on Google Maps and outliers detected.

Project details

Project title: Bottom trawl surveys of fishery resources in Taiwan

Personnel: Kwang-Tsao Shao (Project Director), Jack Lin (Software enginner and database manager), Chung-Han Wu, Tun-Yuan Cheng, Ruei-Hsien Wu, Jeng-I Tsai,

Pai-Lei Lin, Ching-Yi Chen and Hsin-Ming Yeh (field work, fish identification, data collection and analysis)

Funding: Council of Agriculture, Executive Yuan, R.O.C. (Taiwan)

Study area descriptions/descriptor: This project was carried out for four years from February 2000 to November 2003, one region each year in the following order: (1) off the coast of northern and northeastern Taiwan, (2) coastal waters of southwestern Taiwan, (3) coastal waters of western Taiwan, and (4) Penghu waters (Taiwan Strait). Northern Taiwan stations lie on the borders with China's continental shelf and the Okinawa Trough. Outside of the northeastern Taiwan stations is the Okinawa Trough. The western Taiwan stations and Pescadores are all on the shallow Taiwan Strait Shelf. The stations in southwestern Taiwan are near the slope of the South China Sea Basin.

Design description: Three or four different water depth fixed stations were chosen in each region, except Penghu, for seasonal sampling. In principle, the sampling methods were planned for different locations at different depths of the stations in accordance with sediment, topography, water depth, and the ability of fishing vessel. Sampling was conducted four times a year (quarterly). After sampling, the species composition between different locations, depths, and seasons were compared and analyzed.

Datasets

Dataset description: This project is an outcome of collaborative work with specialists of crustacean (Ming-Shiou Jeng) and mollusks (Chung-Chern Lu). Fish data is the most complete one and the only data which have been open for public access. The dataset includes Station number, locality name, depth, collection date, latitude, longitude, family name, Chinese family name, species name and Chinese name. Because the data also include the number of individuals and biomass range for each species, it could be used for calculating the biodiversity indices, K-dominance (A-B-C) curve, and community structure analysis by using various clustering or ordination methods. If the crustacean and mollusk data can be integrated, an ecosystem trophic model could be elaborated. All data in this database is a good baseline data for the time period of 2000-2003. If the data could be collected again a few years later for comparison, it would be useful to assess whether the enforcement of bottom trawling inside or outside the 3 nautical miles in different regions was effective or not. More detailed analyses of certain dominant species with their body size may also generate some information about their early life history and their inshore or offshore migration or recruitment.

Object name: Darwin Core Archive Bottom Trawl Survey
Character encoding: UTF-8
Format name: Darwin Core Archive format
Format version: 1.0
Distribution: http://fishbase.tw:8080/ipt/archive.do?r=bottom_trawl_survey
Publication date of data: 2011-09-08

Language: English
Metadata language: English
Date of metadata creation: 2011-09-08
Hierarchy level: Dataset

References

Nelson JS 2006 Fishes of the world. 4th ed. John Wiley & Sons, Inc. Hoboken, New Jersey, USA. 601 pp.

Shao KT, Hsieh LY, Wu YY, Wu CY (2002) Taxonomic and distributional database of fishes in Taiwan. Env. Biol. Fish. 65: 235–240. doi: 10.1023/A:1020092500050

Shao KT, Lin YC, Lin HH (2007) Linking the Taiwan fish database to the global database. Data Science Journal. Special Issue for 20th CODATA Conf. Beijing. S164-S171

Shao KT, Ho HC, Lin PL, Lee PF, Lee MY, Tsai CY, Liao YC, Lin YC, Chen JP, Yeh HM (2008) A checklist of the fishes of southern Taiwan, northern South China Sea. Raffl. Bull. Zool. Supplement No. 19: 233–271.

Shao KT (2012) Taiwan Fish Database. WWW Web electronic publication. version 2009/1. http://fishdb.sinica.edu.tw, (2012–5-18)

Wu CH (2002) Community structure of bottom trawl fishes in the coastal waters of northern and north-eastern Taiwan. Master thesis of National Taiwan Ocean University.

Yeh HM, Chiou ML, Liao YC, Ho HC, Wu TH, Lee PF, Chang CH, Shao KT (2006) Deep-sea fish diversity around Taiwan. In Deep Sea 2003: Conference on the Governance and Management of Deep-sea Fisheries. FAO Fisheries Proceedings (3/2): 3–10.