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A new species of sublittoral marine gastrotrich, *Lepidodasys ligni* sp. n. (Macrodasyida, Lepidodasyidae), from the Atlantic coast of Florida

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Abstract

A new species of *Lepidodasys* is described from sublittoral sandy sediments off the Atlantic coast of Florida. *Lepidodasys ligni* **sp. n.** is a small species (≤ 450 µm) with a crossed-helical pattern of small, non-keeled, non-imbricated scales on the dorsal and lateral body surfaces, two columns of ventral, interciliary scales that form a herringbone pattern, and a series of anterior, lateral, dorsal and posterior adhesive tubes. Similar to *L. castoroides* from the Faroe Islands, the new species possesses a caudal constriction that demarcates the posterior end containing the caudal organ. The frontal organ lies within the posterior constriction, which is heavily invested with somatic circular muscles. These muscles are also present throughout the trunk and represent a novel condition for species of *Lepidodasys*, which were previously considered to lack somatic circular muscles. Posterior of the caudal constriction is a large, barrel-shaped caudal organ that is wrapped in a series of interdigitating, spindle-shaped, incomplete circular muscle fibers. The caudal organ contains a sclerotized central canal, but the absence of distal cuticular endpieces distinguishes the new species from its morphologically similar congener, *L. castoroides*.

Keywords

Meiofauna, Florida, sublittoral, Capron Shoal, taxonomy, confocal

Introduction

Marine gastrotrichs are common members of the meiobenthos in intertidal and subtidal sandy sediments worldwide, and recent studies of various waters around the Caribbean – from the southern Atlantic waters of Florida to Panama - have revealed a wealth of previously undescribed species (Hochberg 2008, 2010; Hummon 2010; Hochberg and Atherton 2010, 2011; Atherton and Hochberg 2012; Kieneke et al. 2013a,b; Todaro & Leasi 2013). Species of *Lepidodasys* are exceptional among marine macrodasyidan gastrotrichs because of their pharyngeal architecture, muscular organization, unique spermatogenesis and the structure of their sculpted cuticle (see Ruppert 1978, 1991; Guidi et al 2004). Indeed, these unique qualities are what prompted Hummon and Todaro (2010) to erect the monogeneric family, Lepidodasyidae. While over 400 species of marine gastrotrichs have been described worldwide (Hummon 2009), only eight species of *Lepidodasys* are described, which includes five species from European waters (Remane 1926, 1927; Balsamo et al. 1994; Clausen 2000, 2004), two species from Japanese waters (Lee and Chang 2011) and one species from the Caribbean (Hochberg and Atherton 2011).

While most species of *Lepidodasys* are identified based on the structure of their cuticle and the distribution and abundance of their adhesive tubes, two species are known to possess large reproductive organs that further differentiate them from the remaining members of the genus. *Lepidodasys castoroides* Clausen, 2004 possesses a large, barrel-shaped caudal organ with cuticular endpieces, and *L. tsushmainensis* Lee & Chang, 2011 possesses a pyriform-shaped caudal organ without cuticular endpieces. During a recent sampling expedition to Capron Shoal, Florida, we discovered a previously undescribed species of *Lepidodasys* with a caudal organ reminiscent of the two aforementioned species. Herein, we describe this new species and provide detailed information on its caudal organ using f-actin staining and confocal laser scanning microscopy.

Methods

In June 2012, approximately 18 liters of sediment were collected via anchor dredge from 9 m depth at Capron Shoal, Florida (27°26’52” N, 80°13’81” W). Meiofauna were extracted from the sediments using the anesthetization-decantation techinique with 7% $MgCl_2$ and a 53 μm mesh. Specimens were sorted with a Leica EZ4 stereomicroscope, transferred to a glass slide, and viewed with a Zeiss A1 Axioscope equipped with DIC (differential interference contrast) and a Sony Handycam digital camera. Measurements of all specimens were performed with an ocular micrometer, and the size and positions of various organs are described in terms of percentage body units: anterior (U00) to posterior (U100) is 100 units.

For phalloidin staining of f-actin, we fixed two specimens in 4% paraformaldehyde in 0.1M phosphate buffer saline (PBS, pH 7.3) for 1 h, rinsed them in 0.1M

PBS + 1% Triton X-100 (PBT) for 1 hr, and then stained them in Alexa Fluor 488 Phalloidin for 1 hr (following the manufacturer's protocol, Invitrogen). Stained specimens were then briefly rinsed in PBS and mounted directly in Fluoromount G on glass microscope slides with coverslips.

Phalloidin-stained specimens were examined on a Zeiss LSM 510 confocal microscope system at the Smithsonian Marine Station (Fort Pierce, Florida). Zeiss Zen 2009 software (Carl Zeiss Microimaging, Thornwood, NY) was used to collect a series of 0.25-0.4 mm optical sections with maximum intensity projection along the z-axis. Confocal images were saved as TIF files and rendered into 3-D images using Volocity software (Perkin Elmer). Carnoy V 2.0 (© 2001 Peter Schols) was used to measure various organs in the digital images.

One stained specimen was removed from Fluoromount G after examination and prepared for museum archival with the following procedure: 1 hr rinse with PBS followed by 1% OsO_4 in 0.1M PBS for 10 min (to increase contrast); rinse in PBS for 1 hr; dehydrate in an ethanol series; transfer to propylene oxide for 30 min; embed in resin (epon) on a glass microscope slide and place in an oven at 60° C for 48 hrs. The type specimen is deposited in the National Museum of Natural History, Smithsonian Institution, Washington, DC.

Grain size was determined on a subsample of the sediments by drying them out in a 60° C oven for 24 hrs, and then sieving them with a Gilson SS-15 sieve shaker with mesh sizes 2 mm, 1 mm, 500 µm, 250 µm, 125 µm and 63 µm. Sieve fraction weights were entered into the program GRANPLOTS with line segment (Balsille et al. 2002) and granulometric data was calculated.

Results

Order Macrodasyida Remane, 1925 [Rao and Clausen, 1970]
Family Lepidodasyidae Remane, 1927 [Hummon and Todaro, 2010]
Genus *Lepidodasys* Remane, 1926

***Lepidodasys ligni* sp. n.**
urn:lsid:zoobank.org:act:41A72CCB-BEAD-4207-BDA5-71F36B350C05
http://species-id.net/wiki/Lepidodasys_ligni
Figs 1–3

Type locality. Sediment from 9 m depth at Capron Shoal, Florida (27°26'52"N, 80°13'81"W), collected by Mr. Woody Lee. Granulometry as follows: Mean size 1.66 phi; SD 0.72 phi; skewness -0.95; and kurtosis 5.11. The sediments can be characterized as medium to fine grain sand with a large proportion of the sand fraction larger than the median (positive kurtosis).

Holotype. Adult specimen, reproductively mature, 450 µm long; resin preparation: USNM # 1202682.

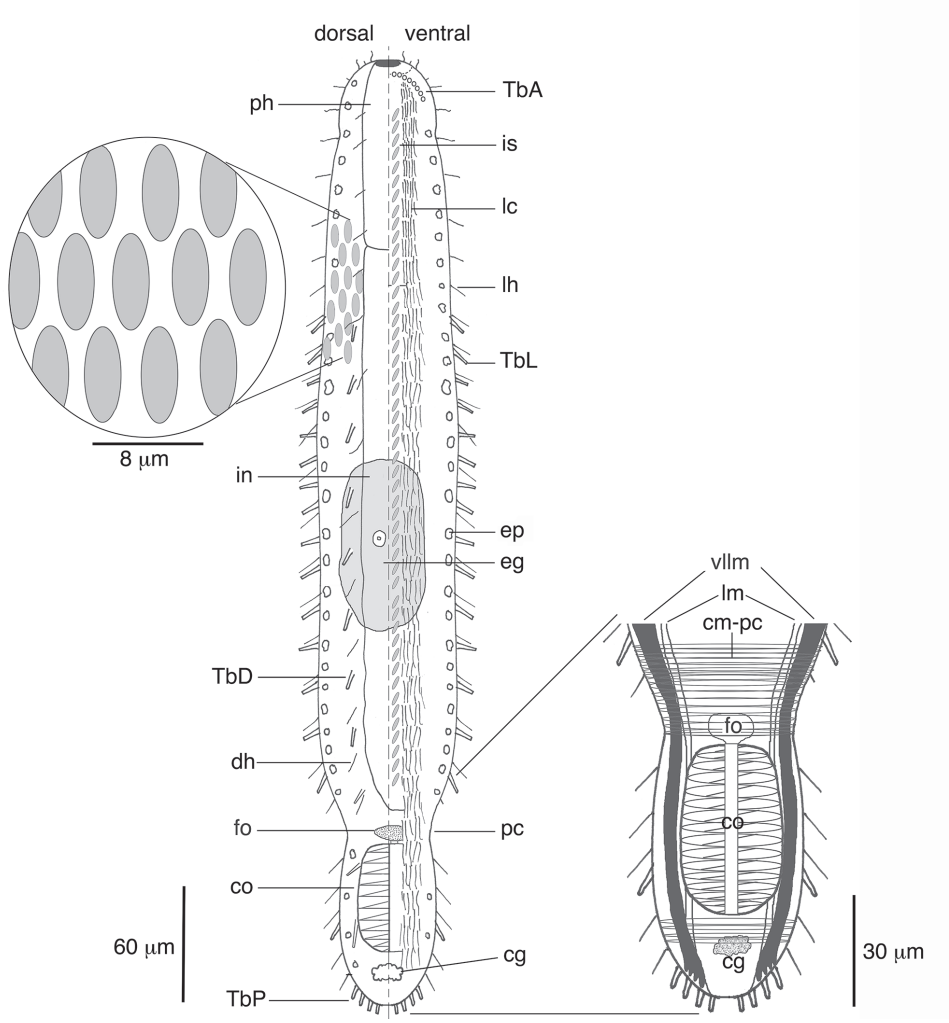

Figure 1. Schematic of *Lepidodasys ligni* sp. n. showing the crossed-helical scale pattern and a closeup of the musculature in the caudal region. Abbreviations: **cg** caudal gland; **cm-pc** circular musculature of the posterior constriction; **co** caudal organ; **dh** dorsal sensory hairs; **eg** mature egg; **ep** epidermal gland; **fo** frontal organ; **in** intestine; **is** interciliary scales; **lc** locomotory cilia; **lh** lateral sensory hairs; **lm** longitudinal muscle; **pc** posterior constriction; **ph** pharynx; **TbA** anterior adhesive tubes; **TbD** dorsal adhesive tubes; **TbL** lateral adhesive tubes; **TbP** posterior adhesive tubes; **vllm** ventrolateral longitudinal muscle.

Paratypes. Digital video of two adult specimens submitted to the National Museum of Natural History, Smithsonian Institution, Washington, DC. Scale patterns and reproductive anatomy visible in videos.

Material examined. Eleven specimens were examined alive. Digital video was captured of three specimens. Two of the eleven specimens were prepared for phalloidin staining. One of the phalloidin-stained specimens was prepared for archival.

Diagnosis. *Lepidodasys* with a strap-shaped adult body to 450 µm long. The body possesses two constrictions at approximately U06–07 and U82; the first constriction demarcates the approximate mid-region of the pharynx, and the second constriction demarcates the posterior region containing the caudal organ. Maximum body width at U06/pharyngeo-intestinal junction (PhIJ:U20)/midpoint of body (U50) is 32/44/50 µm, respectively. Pharynx to 90 µm long. Body covered with eye-shaped, non-imbricating scales arranged in a crossed-helical pattern across the dorsal and lateral surfaces; two columns of ventral interciliary scales present at midline in herringbone pattern. Up to eight anterior adhesive tubes (TbA) per side inserting directly on body surface and forming an arc toward the lateral body wall. Lateral adhesive tubes (TbL) present, up to 14 per side, beginning posterior of the PhIJ. Dorsal adhesive tubes (TbD) present, up to 11 per side, beginning at the PhIJ and extending to the caudal end. Eight posterior adhesive tubes (TbP) insert terminally on rounded caudal end. Frontal organ and large barrel-shaped caudal organ with strong circular muscles and inner canal present; ovaries and testes not observed.

Etymology. The Latin *ligni* (wood) refers to Mr. William "Woody" Lee at the Smithsonian Marine Station at Fort Pierce, Florida, who assisted in the collection of the species and has been instrumental over the past decade in sublittoral collection of meiofauna for the first author (RH).

Description. The description is based on the holotype (adult, 445 µm long; Fig. 2A), with ranges provided from specimens measured in vivo. Body strap-shaped with two notable constrictions at mid-pharynx (U06-07) and caudal end (~U82); first constriction demarcates the approximate mid-length of the pharynx and the second constriction demarcates the region of the accessory copulatory organs (Figs 1, 2A). Pharynx 90 mm long with no pharyngeal pores observed. Few sensory hairs to 8 µm long line the mouth. Stiff sensory hairs 8–15 µm are present along the ventrolateral, lateral and dorsolateral margins of the body. Ventral locomotory cilia present as two columns, each approximately 8 µm wide, that extend from ca. U05 to the posterior end (Fig. 1). Numerous small (2–5 µm) epidermal glands along the margins of the body.

Cuticular armature. A crossed-helical pattern of up to eight columns of elliptical scales extend across the dorsal body wall; the number of scales per column varies from 8-10 in the pharyngeal region to up to 12 in the trunk. At least three columns of elliptical scales extend around the lateral body margins and reach the ventral locomotory cilia (Fig. 1). All scales are similar in shape, lack a keel, and are approximately 7–8 µm long. None of the scales are imbricated. Two columns of ventral scales are present at the midline between the ciliary fields (Figs 1, 2C). The scales are relatively small, ca. 4–5 µm long, and oriented in a herringbone pattern in most specimens, with the anterior end of both scales farther apart from each other (ca. 5 µm) relative to their posterior ends (ca. 2–3 µm). While the herringbone pattern is evident in all specimens, some specimens had individual scales (not an entire column) oriented in a more parallel fashion (e.g., see Fig 2C); this may be evidence of individual variation in scale orientation. There was approximately 4–5 µm of space between each column and its adjacent ciliary field.

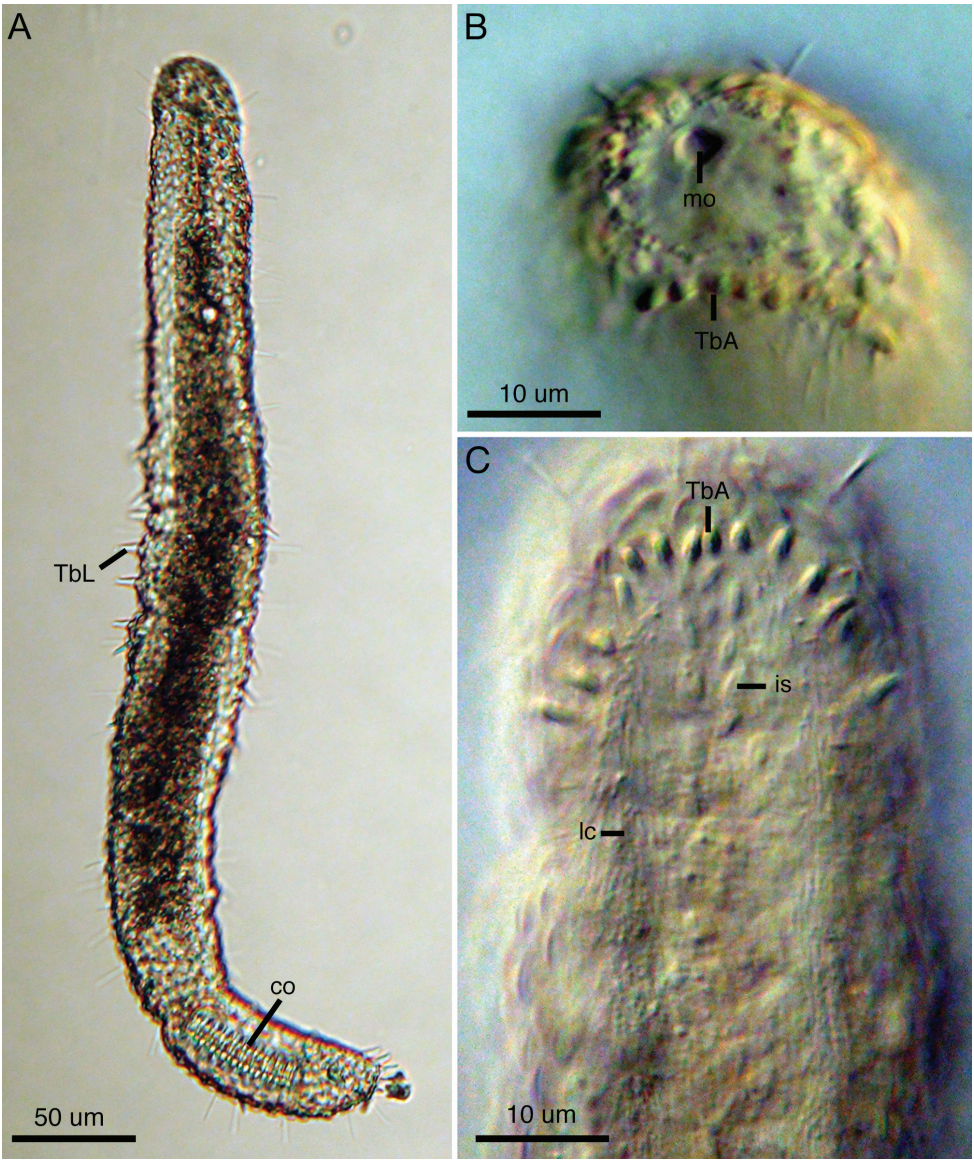

Figure 2. Light micrographs of *Lepidodasys ligni* sp. n. (holotype). **A** Dorsal view **B** Closeup of anterior end with differential interference contrast (DIC) **C** Ventral view of anterior end with DIC. Abbreviations: **co** caudal organ; **is** interciliary scales; **lc** locomotory cilia; **mo** mouth; **TbA** anterior adhesive tubes; **TbL** lateral adhesive tubes.

Adhesive tubes. Anterior adhesive tubes (TbA) distributed as a posteriorly curving arc of seven to eight tubes, 3–4 μm long, from the midline to the lateral body wall (Fig. 2C). Lateral adhesive tubes (TbL) absent from the pharyngeal region (Fig. 1). Fourteen to seventeen TbL present in the trunk region, 8–10 μm long, beginning at

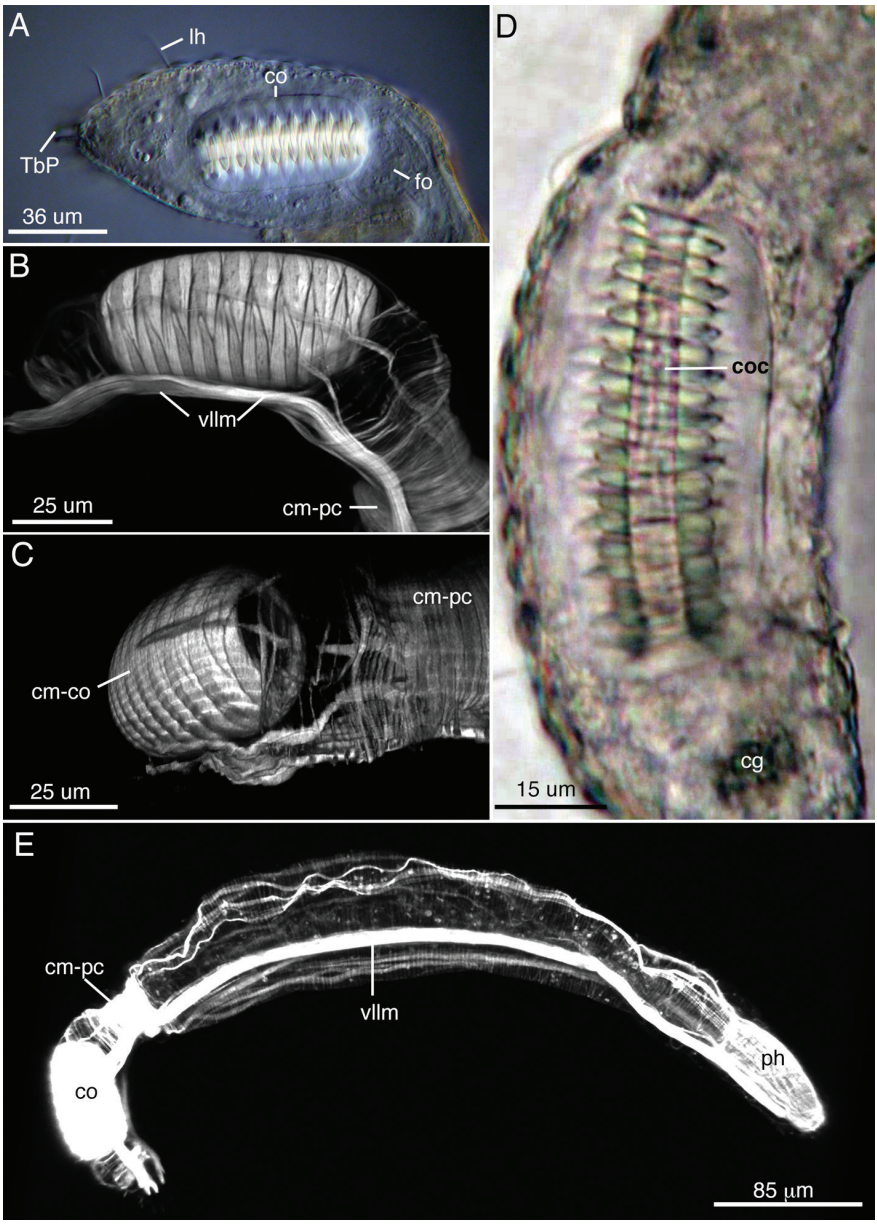

Figure 3. The reproductive and muscular systems of *Lepidodasys ligni* sp. n. **A** Differential interference contrast photograph of the posterior end showing the accessory reproductive organs. **B, C** Confocal images (47 × 0.35 μm optical sections) of the musculature of the posterior end in lateral (**B**) and dorsal (**C**) views **D** Closeup of the caudal organ with DIC microscopy **E** Lateral view of an entire specimen revealing the muscular system (73 × 0.4 μm optical sections). Abbreviations: **cg** caudal gland; **cm-co** circular muscles of the caudal organ; **cm-pc** circular muscles of the posterior constriction; **co** caudal organ; **coc** caudal organ canal; **dlm** dorsal longitudinal muscle; **dllm** dorsal lateral longitudinal muscle; **fo** frontal organ; **hm** helicoidal muscle (end position on midgut); **lh** lateral sensory hair; **ph** pharynx; **TbP** posterior adhesive tube; **scm** somatic circular muscles (thoughout trunk); **vllm** ventrolateral longitudinal muscle.

U28 and extending to the second body constriction. Tubes are spaced evenly down most of the trunk. A single tube is present in the demarcated region of the caudal organ, around U92. Approximately eleven evenly spaced dorsal adhesive tubes (TbD), 8–10 μm long, beginng at U28 and extending to ~U90. Eight posterior adhesive tubes (TbP), 9–10 μm long, distributed as four adhesive tubes per side on rounded caudum.

Digestive tract. Small terminal mouth to 5 μm wide (Fig. 2B). Pharynx to 20 μm wide and 90 μm long. Pharnygeo-intestinal junction at U20. No pharyngeal pores observed. Intestine narrow and tapering toward posterior end. Diatoms present in a single specimen. Anus at U78.

Reproductive system. Neither testes or ovaries observed. A single large egg, approximately 62 μm diameter, was present in one adult (holotype). A clear, sac-like organ interepreted as the frontal organ was present at U81–83; the organ was approximately 22 μm x 16 μm in diameter and in a single specimen appeared to contain filiform sperm. A caudal organ was present at the posterior end (U83–95), approximately 63 μm long x 30 μm wide (range: 50 μm–63 μm long, 24 μm–30 μm wide), hyaline in appearance with a straight central canal that extends along the organ's anterior-posterior axis; the canal appears sclerotic (coc, Fig. 3D). The caudal organ is muscular. The muscle cells interdigitate to form spindle-shaped, incomplete circular fibers (Fig. 3B). A single gland, ca. 10 μm in diameter, is present posterior of the caudal organ (Fig. 3A,D).

Muscular system. Musculature present as circular, helicoidal and longitudinal bands. Pharynx strongly invested with splanchnic circular muscles and overlain by helicoidal bands and longitudinal muscles (Fig. 3E). The number of individual circular muscles and helicoidal bands could not be determined. In the trunk region, the helicoidal muscles extend to ca. U40 (Fig. 3E). Longitudinal muscles extend from the pharyngeal region to the caudum as three pairs of dorsal (dlm)/dorsolateral (dllm) bands (Fig. 3E). The ventrolateral longitudinal muscles (vllm) are the thickest muscles in the body and extend from ca. U03 to the caudal end (Fig. 3E). Three pairs of ventral longitudinal bands extend from the pharynx to the posterior end. All longitudinal muscles in the trunk region are surrounded by somatic circular muscles (scm) that form numerous, distinct rings down the length of the body (Fig. 3E). Beginning ca. U80-81, there is a large number (>30) of closely spaced somatic circular muscles that extend posteriorly for approximately 40 μm; the circular muscles demarcate the posterior region of the body (cm-pc) with the accessory sexual organs (Figs 1, 3B,C).

Taxonomic remarks

The genus *Lepidodasys* consists of eight described species and several undescribed specimens from marine waters across the globe (see Hummon 2009), from as far north as the Faroe Islands (Clausen 2004) to locations along the European coastline (e.g., Remane 1926; Fregni et al. 1999; Clausen 2000; Hummon 2009) including the Baltic and Mediterranean seas (Roszczac 1939; Balsamo et al. 1994; Hummon 2009), to

the Pacific waters of Japan (Lee and Chang 2011) and Hawaii (Hummon 2009), and to the Caribbean waters of Panama (Hochberg and Atherton 2011) and the Gulf of Mexico (Todaro et al. 1995).

Species of *Lepidodasys* are most easily distinguished by their slow gliding movement and their heavily sculptured cuticle, which in general consists of rounded or elliptical scales across most of their body. The shape and distribution of the scales are important taxonomic characters for distinguishing the species. Of the eight described species, six species have a crossed helical pattern (parallel pattern *sensu* Lee and Chang 2011) of scales across their dorsum: *L. arcolepis* Clausen, 2004, *L. castoroides* Clausen, 2004, *L. platyurus* Remane, 1927, *L. tsushimaenensis* Lee & Chang, 2011, *L. worsaae* Hochberg & Atherton, 2011, and *L. unicarenatus* Balsamo, Fregni & Tongiorgi, 1994. The species from Florida, *L. ligni* sp. n., also bears a crossed helical pattern of scales on its dorsum. The ventral interciliary scales are in a herringbone pattern in the new species, similar to the scale arrangement in *L. laeviacus* Lee & Chang, 2011.

Apart from scale pattern, scale shape is also an important taxonomic character, and the new species can easily be distinguished by the smooth (non-keeled) structure of its scales. The only other species with smooth scales are *L. castoroides*, *L. laeviacus* and *L. tsushimaenensis.* Among these species, *L. ligni* sp. n. is most similar to *L. castoroides* and *L. tsushimaenensis* in general body shape and the presence of a large caudal organ in the posterior body region. While all three species are similarly slender, *L. tsushimaenensis* is much larger (to 730 μm) than the other two species (*L. castoroides* to 475 μm and *L. ligni* sp. n. to 450 μm) and lacks the notable indentation at the posterior end that demarcates the region of the accessory sexual organs. In fact, the caudal indentation gives both *L. castoroides* and *L. ligni* sp. n. the appearance of possessing a beaver-like tail, hence Clausen's (2004) specific Latin epithet, *castor*. While both species possess similar "beaver tails" and caudal organs, there are several notable differences between the species: 1) the caudal organ of *L. castoroides* possesses a cuticular endpiece that is absent in the new species; 2) there are five TbA per side in *L. castoroides* but 7 to 8 TbA per side in *L. ligni* sp. n.; 3) there are seven pairs of TbVL in *L. castoroides* but up to 17 TbL per side (not TbVL) in the new species; and 4) there are five pairs of TbDL in *L. castoroides* but up to eleven pairs of TbD in *L. ligni* sp. n.

Discussion

In addition to our taxonomic findings, this study revealed novel information on the muscular system of the new species. In contrast to previous reports (e.g., Ruppert 1978; Travis 1983), we observed somatic circular muscles in the trunk region of *Lepidodasys* (see Fig. 3E). Whether these muscles are absent from the previously examined species or were missed in examinations of their sections using transmission electron microscopy is unknown. Interestingly, the presence of a dense aggregation of somatic circular muscles in the caudal region of the new species is correlated with the position of the indentation at the posterior end, which imparts the beaver-tail like appearance.

Phalloidin staining and CLSM revealed a higher number (30–40) and density (~ 1 circular muscle per 1 μm body length) of somatic circular muscles in this constricted area compared to the main trunk of the animal (11 circular muscles in 40 μm body length, ~ 0.3 circular muscles per 1 μm). It is important to state that the circular muscles in the region are likely not the cause of the constriction since this area remains delineated even when the animal is relaxed with an anaesthetic (isotonic $MgCl_2$). Curiously, the muscles of this region also appear to encircle the frontal organ, and may therefore play a role in reproduction. While the identity of the frontal organ in the new species is not certain (only 1 specimen appeared to have filiform sperm within the organ), its presence near the anterior end of the caudal organ is strong correlational evidence for its identity (see also *L. castoroides* (Clausen 2004) and *L. tsushimaenensis* (Lee and Chang 2011)). In *L. ligni* sp. n., the frontal organ abuts the caudal organ; the circular muscles of the caudal organ are part of the organ itself and therefore independent of the somatic circular muscles anterior to it. How these two organs function together or separately in the uptake of allosperm or release of autosperm, repsectively, is unknown and will likely require a detailed investigation with transmission electon microscopy as has been performed for other macrodasyidan gastrotrichs (e.g., Ruppert 1978, 1991; Guidi et al. 2004, 2011; Kieneke et al. 2012; Todaro et al. 2012).

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A new non-naked species of *Ptychostomella* (Gastrotricha) from Brazil

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Abstract

A new species of marine Gastrotricha from Brazil is described and discussed. *Ptychostomella lamelliphora* **sp. n.** is one of the several new taxa that were found during an extensive survey of the gastrotrich fauna carried out in 2002 and 2003 along the coastline of the State of São Paulo. The new species is unique in that it possesses cuticular ornamentations in the form of plate-like structures (scales) along the lateral borders of the body and two massive clusters of densely packed adhesive tubes on the ventral surface, near the ano-genital opening. Both these features appear to be adaptations to challenge the high energy waters that characterize the species' microhabitat: the coarse sublittoral sand in the channel between the mainland and the largest island in the State, Ihlabela. Additionally, a key to the described *Ptychostomella* species of the world is provided.

Keywords

Gastrotrichs, Brazil, São Paulo, meiofauna, biodiversity, taxonomy, new species, key

Introduction

The study is part of a larger research program aimed at shedding light on the diversity of marine invertebrates of the northern coasts of the State of São Paulo, Brazil (see Migotto and Tiago 1999). In the seminal works by Todaro and Rocha (2004a, b, 2005), faunistic and preliminary taxonomic data on the gastrotrich communities along

the coastline comprised between Picinguaba to the north (at the Rio de Janeiro-São Paulo States border) and Praia Preta e das Choncas to the south were reported. Among the some 40 taxa found, the occurrence of several species new to science was highlighted. A recent article has dealt with one of such taxa (Todaro 2012); another interesting macrodasyidan in the family Thaumastodermatidae is here described.

Methods

Survey along the northern coasts of the State of São Paulo took place between 20 April and 3 May 2002 and in September 2003. A general account on the visited locations are reported in Todaro and Rocha (2004a, 2005). Samples containing the new species were collected in 2002 from the sublittoral of Praia Grande and Beluga both on the Ilhabela side of the São Sebastião channel. Ilhabela is the largest island in the State and it is located just in front of the city of São Sebastião. Sandy substratum was collected by scuba diving using eight 500ml plastic jars, four per location. After collection, samples from each site were taken as soon as possible to the São Paulo University's CEBIMar laboratory in São Sebastião. In the laboratory, the specimens were extracted daily with the narcotization-decantation technique using a 7% magnesium chloride solution within one week of collection. The supernatant was poured, without filtering, into 3.0 cm diameter plastic Petri dishes and scanned for gastrotrichs at 50 × under a Wild M8 stereomicroscope (see Todaro and Hummon 2008). Found gastrotrichs were mounted on glass slides and observed *in vivo* with Nomarski differential interference contrast optics using a Zeiss Axioscop 2 Plus microscope. During observation, the specimens were measured using an ocular micrometer and photographed with a Nikon Coolpix 995 digital camera (3.34 Mpixel). Some specimens were fixed overnight in a 1.0 M phosphate-buffered (pH 7.3) solution of paraformaldehyde, gluteraldehyde and picric acid, following Ermak and Eakin (1976), and stored for later SEM analysis. Gastrotrichs were rinsed in 0.2 M cacodylate buffer, dehydrated through a graded ethanol series, critical point-dried using CO_2, mounted on aluminium stubs, sputter coated with gold-palladium and observed with a Philips XL 30 scanning electron microscope at the author's Institution.

The description of the new species follows the convention of Hummon et al. (1993), whereas the position of some morphological characteristics along the body are given in percentage units (U) of total body length measured from anterior to posterior.

Granulometric analysis of the substrata was carried out according to Todaro et al. (2006). Mean grain size, sorting coefficient, kurtosis, and skewness were calculated by a computerized programme (Todaro 1992).

Abbreviations are as follows: PhIJ, pharyngeo-intestinal junction; TbA, adhesive tubes of the anterior series; TbL, adhesive tubes of the lateral series; TbV, adhesive tubes of the ventral series; TbP, adhesive tubes of the posterior series.

The rationale for the key to the ecological characteristics of the species, according to Hummon et al. (1992), is as follows: Frequency of a species from among a sample

series (i.e., frequency of a species in samples collected in any given sampling trip) - Sparse, found in less than 10% of samples; occasional, found in 10–30% of samples; common, found in 30–60% of samples; usual, found in more than 60% of samples.

Abundance of a species among other species of a sample - Rare, less than 1% of a sample; scarce, 3–5% of a samples; numerous, 10–20% of a sample (often a sub-dominant); prevalent, more than 30% of a sample (usually dominant or co-dominant).

Taxonomic account

Order Macrodasyida Remane, 1925 [Rao & Clausen, 1970]
Family Thaumastodermatidae Remane, 1927
Subfamily Thaumastodermatinae Remane, 1927
Genus *Ptychostomella* Remane, 1926

***Ptychostomella lamelliphora* sp. n.**
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http://species-id.net/wiki/Ptychostomella_lamelliphora
Figs 1–4

Type locality. Praia Grande on Ilhabela, State of São Paulo, Brazil (Lat. 23°51'S; Long. 45°25'W), at 3 m water depth in coarse (mean grain size, 0.51 mm), moderately well sorted (sorting, 0.85 mm) siliceous sand. Values of salinity, temperature and pH of the interstitial water at date of sampling 35.0‰, 23.2 °C and 7.90 respectively (Table 1).

Type specimens. Holotype, the adult specimen 250 µm long shown in Figure 2 (International Code of Zoological Nomenclature, Articles 73.1.1 and 73.1.4). After observation it was fixed in 95% ethanol and subsequently utilised for DNA extraction and 18S, 28S and CO I gene sequencing (GenBank accession number JF357643, JF357691 and JF432033 respectively, see Todaro et al. 2011, *Ptychostomella* sp1).

Material examined. Eight adult specimens (including the holotype) collected by the author, five from the type locality and three from a Beluga a nearby location (see Table 1). Four specimens were observed alive and are not longer extant, while four were prepared for SEM survey and are kept in the meiofauna collection of the author (Ref. n. 2002-BR-01-02-05-06).

Ecology. Frequency of occurrence: sparse, found only in sub-littoral sediment of two locations along the southern portion of the São Sebastião channel. Abundance: numerous in coarse sediment with little detritus of Praia Grande, scarce in coarse sediment rich in detritus of Beluga.

Diagnosis. A *Ptychostomella* with an adult length to 250 µm; pharynx length to 74 µm, with pharyngeal pores at base. PhIJ at U37; body with almost parallel sides and short, bilobed caudum. Head bearing paired knob-like sensory organs and small, trapezoidal, fleshy lobes; eye spots missing; sensory hairs a few, forming lateral columns along the body, a fringe around the oral opening and loose tufts at the tip of the lobes;

Table 1. Sampling locations along the São Sebastião channel in the State of São Paulo, Brazil; geographic coordinates, date of collection, water depth and physical, chemical characteristics of the water and granulometric characteristics of the sediment.

Variable	Locality	
	Praia Grande of Ihlabela	**Beluga**
Geographic coordinates	Latitude 23°51'S, Longitude 45°25'W	Latitude 23°52'S, Longitude 45°26'W
Date of sampling	30/04/2002	30/04/2002
Salinity	35.0 ‰	35.2 ‰
Temperature	23.2 (°C)	22.4 (°C)
pH	7.90	7.93
Water Depth	3.0 m	6.0 m
Mean grain size and size class	0.95 phi coarse sand	0.55 phi coarse sand
Sorting and Sorting class	0.60 phi, moderately well sorted	0.46 phi well sorted
Skewness	0.23	1.25
Kurtosis	2.12	5.40

epidermal glands noticeable, eight per side, scattered along the length of the body. Cuticular covering generally smooth except for peculiar, subrectagular scales arranged in a column of on each ventrolateral side. Adhesive tubes: TbA, 4 per side, one slightly smaller, cone-shaped, in the middle at U9 and three lateral, rod-like, of equal size at U9-U10; TbL, 3 on each side, roughly of the same size, a small isolated one implanted anteriorly at U15, one in mid trunk region at U58 and one more robust near the base of the caudal lobes, at U90. TbV, up to 16 per side, four of the same size more or less evenly spaced, implanted along trunk region from U44 to U63, the remainder 10-12 forming a noticeable cluster at U83-U85. TbP, six in all, two medial and two on each of two paired caudal pedicles. Ventral locomotor cilia: a continuous field of transverse rows covering the entire surface except the ano-genital area. Reproductive system: testis on the right body side, caudal organ pyriform, frontal organ round filled with motile spermatozoa, a ripe egg dorsally in the mid-intestinal region.

Etymology. The specific epithet *lamelliphora* (*lamella,* L, thin plate and *phero*, Gr., to bear) refers to the presence of the thin, plate-like scales along the ventrolateral body sides.

Description. Description is mainly based on the holotypic specimen, 250 µm in total length. Pharynx 74 µm in length, measured from the posterior margin of the oral opening to the pharyngeo-intestinal junction, with pharyngeal pores near the base, at U34; pharyngeo-intestinal junction at U37. Head bearing paired knob-like sensory organs and small, trapezoidal, fleshy lobes; body robust, with side lines slightly widening to mid-trunk, then gradually narrowing to a short, bilobed caudum; widths of head\neck\trunk\caudal base 46\34\56\26 µm at U07\U25\U46\U93, respectively.

Oral hood slightly protruding anteriorly (to U08), with gently undulating borders. Sensory hair sparse, up to 7 µm in length, forming a fringe around the oral opening

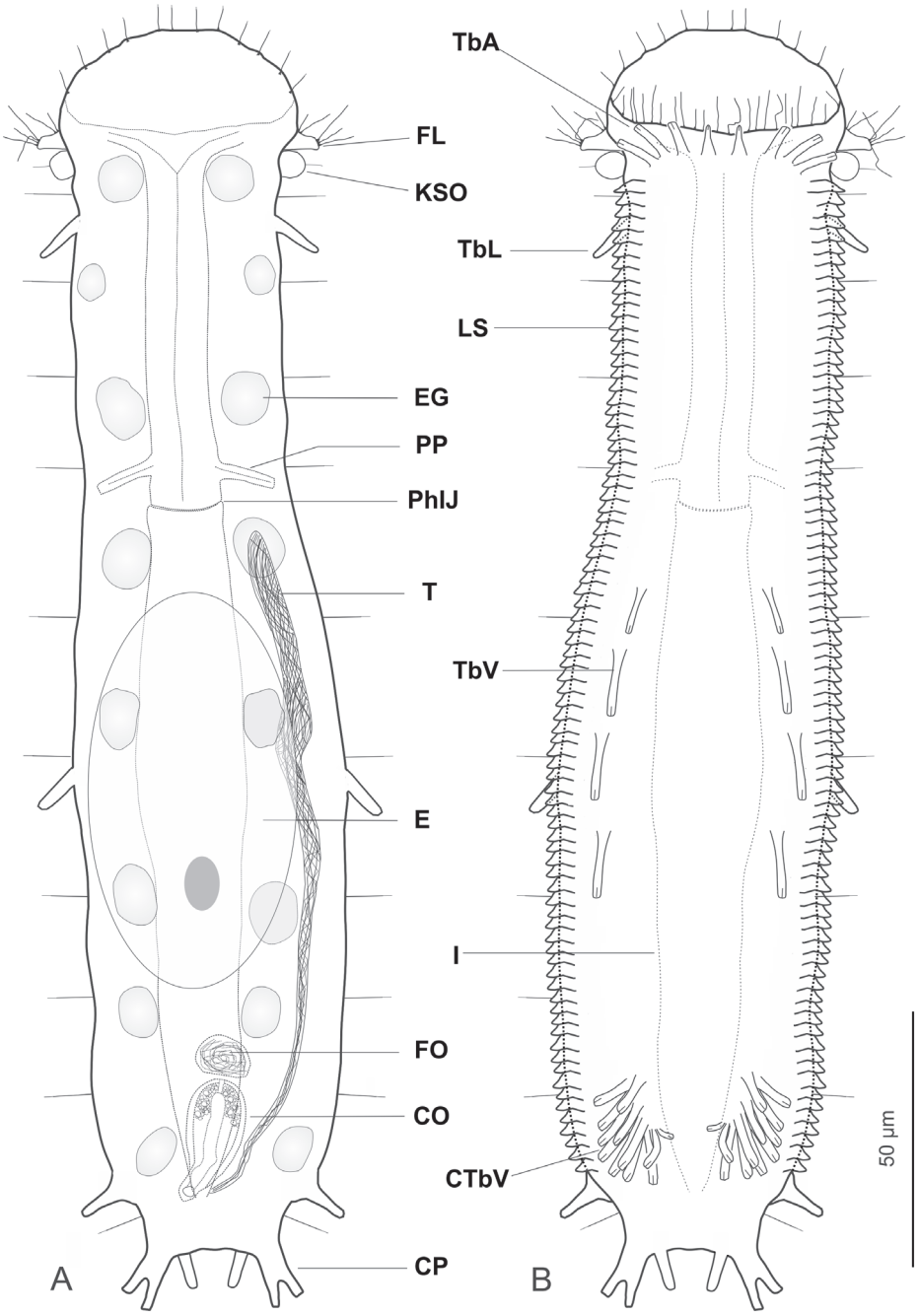

Figure 1. *Ptychostomella lamelliphora* sp. n. schematic drawings. **A** Habitus as seen from the dorsal side showing the internal anatomy **B** Habitus as seen from the ventral side. **CO** caudal organ **CP** caudal pedicle **CTbV** cluster of ventral adhesive tubes **E** egg **EG** epidermal gland **FL** fleshy lobe **FO** frontal organ **I** intestine **KSO** Knob-like sensory organ **LS** lamellate scales **PhlJ** pharyngeo-intestinal junction **Pp** pharyngeal pores **T** testicle **TbA** anterior adhesive tubes **TbL** lateral adhesive tubes **TbV** ventral adhesive tubes.

and loose tufts at the tip of the head's lobes; a single hair emerges from each knob-like tentacle; other sensory hairs 9–14 μm in length form lateral and dorsolateral columns that are evenly spaced within columns but differ between columns. Eight pairs of noticeable epidermal glands are regularly spaced along the pharyngeal and intestinal region from U11 to U 87 with glands of the second and eighth pairs positioned somewhat more lateral; glands are round in shape and roughly of the same size (7–9 μm in diameter), except for the one of the second pairs, markedly smaller (4–6 μm). Each gland opens to the exterior via a well structured pore, the produced material is excreted in the form of small round droplets (see Figure 4C, D).

Cuticular armature. Body covering apparently smooth as typical of the genus, however on the ventrolateral sides, the cuticle generates subrectangular plates (scales), partially overlapping each other and tightly arranged in two columns running from U11 to U88. Scales, roughly of the same size (1.5–2.0 μm), protrude from the body and form bilateral structures that recall the lateral aerodynamic 'mini-skirts' of racing cars.

Adhesive tubes. TbA, 4 per side, inserting directly on the body surface at U9-U 10, one 4 μm in length medially and three 6–7 μm in length laterally. TbL, 3 per side (8–10 μm in length) inserting respectively at U15, U58 and U90. TbD, absent. TbV, up to 16 per side; 4 (8–11 μm in length) inserted singly along the intestinal region from U44 to U63 while the remaining 12 (4–11 μm in length) form an impressive cluster centered at U85 (cTbV; Figs 2A, 3B, D); tubes in the cluster originate singly and their number may slightly change from side to side. TbP, 3 per side, 2 (5–6 μm in length) at the end of each pedicle of the furcated caudum and the other one (6.5 μm in length) flanking each caudal pedicle medially.

Ventral ciliation. A continuous, dense field of cilia arranged in transverse rows that extend from the ventral border of the oral opening to the base of the caudal pedicles, being broadest at mid body and somewhat sparse in the ano-genital area at U90.

Reproductive system. testis on the right body side, caudal organ pyriform (10 × 21 μm), at U78; frontal organ bladder-like (10 μm in diameter) at U74.5; maturing eggs dorsal to the mid intestine.

Variability and remarks. Length of the 4 living specimens ranged from 204 to 250 μm (mean = 230 μm, SD = 18 μm) all of them were mature (i.e., showed at least the testicles filled with sperm). The SEM prepared adult specimens resulted of smaller size (range 144–183 μm) even though size of these specimens appeared not dissimilar from the others under the dissecting microscope; these measurements fall well below the 5.5% length reduction allowed for fixed specimens (cf. Clausen 2004), but are in agreement with the shrinkage suffered by specimens of *Pseudostomella dolichopoda* Todaro, 2012 processed for SEM examination (cf. Todaro 2012). As SEM is being routinely utilized in species description, to avoid potential misidentification based on size, it would be interesting to explore the phenomenon of size reduction over a larger taxonomic spectrum. SEM prepared specimens showed some traits undetected or not present in living specimens. For instance, in SEM prepared specimens, *i*) the border of the oral hood appeared more scalloped than in living animals (cf. Figure 3A vs. Figure 2 A), *ii*) the cuticle on the ventral area comprised between the ciliary field and the col-

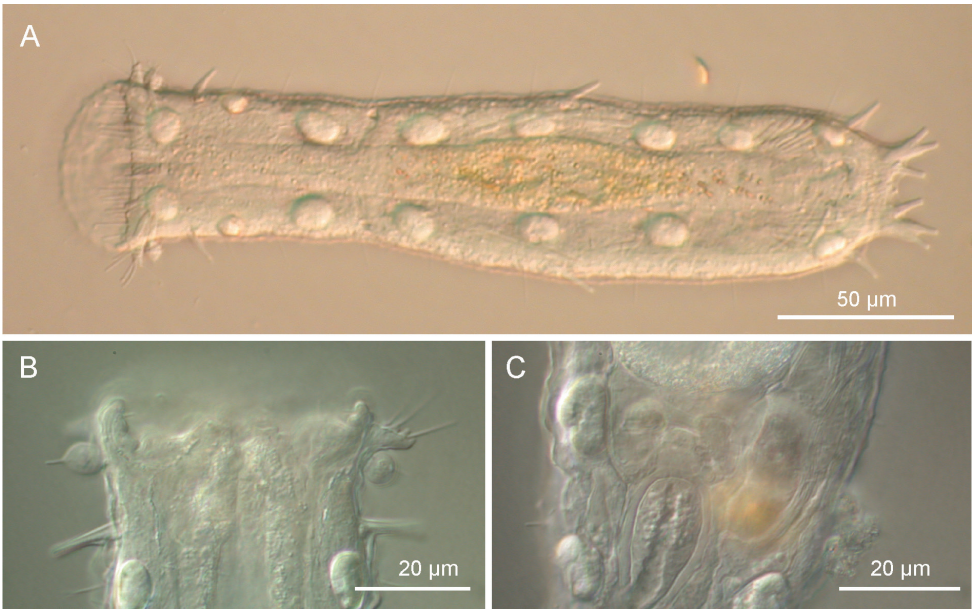

Figure 2. *Ptychostomella lamelliphora* sp. n. DIC photomicrographs. **A** habitus **B** close-up of the anterior region showing the knob-like sensory organs and the trapezoidal, fleshy lobes **C** Close-up of the posterior region of the trunk showing the caudal organ.

umn of scales appeared punctuated by shallow pits (Figure 3C) and *iii*) the cuticle on the dorsal side appeared embossed with keel-like structures (Figure 4B). The adhesive tubes of the ventral series forming the clusters showed some variability in number, depending on individuals and on side of the body (e.g., see Figure 3B); the highest number of tubes, 12, was found in the cluster on the left side of two specimens including the holotype, while the lowest, 8 tubes, was found in the cluster on the right side of a specimen measuring 224 µm in total body length.

Taxonomic affinities. The genus *Ptychostomella* was originally created to include small thaumastodermatid gastrotrichs whose body is enveloped by a smooth cuticle i.e., a cuticle that does not give rise to the typical scales and/or spines (e.g., ancres) found in other members of the family (Remane 1926). In a phylogenetic framework, the absence of such structures has been thought as a secondary reduction (cf. Todaro et al. 2011). While all of the known *Ptychostomella* species lack an armature typical of the family, at least 4 out of the 12 species described so far (Hummon and Todaro 2010) possess other kinds of cuticular ornamentations. *P. lepidota* Clausen, 2000 bears scale-like cuticular elevation and *P. orientalis* Lee & Chang, 2003 has the cuticular covering embossed with smooth hemispherical elevation (Clausen 2000; Lee and Chang 2003). A third species *P. brachycephala* (Levi, 1954), originally affiliated to the genus *Platydasys,* possesses on each lateral side a column of rod-like papillae, and papillae are reported also for *P. papillata* Lee and Chang 2003 (Lee and Chang 2003; Clausen 2004). Shape and arrangement of the cuticular ornamentations (i.e., subrectangular

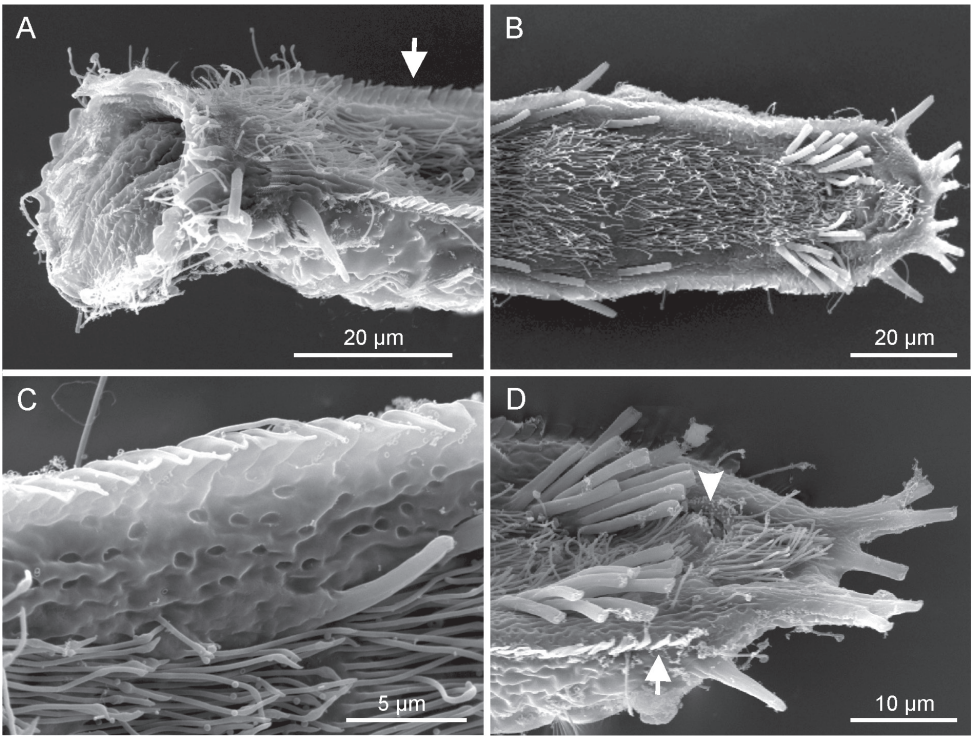

Figure 3. *Ptychostomella lamelliphora* sp. n. SEM photomicrographs ventral view. **A** close-up of the anterior region showing, among others, the plate-like-scales (arrow) **B** trunk region showing the locomotory ciliation and most of the tubular adhesive apparatus **C** close-up of the ventrolateral region of the trunk, showing the cuticle punctuated by shallow pits **D** close-up of the posterior region showing the two clusters of ventral adhesive tubes, the ano-genital opening (arrowhead) and the column of plate-like-scales.

plates tightly arranged in two lateral columns) differentiate *Ptychostomella lamelliphora* n. sp. from all the four species reported above. The coexistence of knob-like sensory organs and of fleshy lobes on the head and the presence of most of TbV arranged in a bilateral clusters near the ano-genital opening may further distinguish the new species from all the previously known *Ptychostomella* species.

Conclusive remarks. Adhesive tubes of the ventral series forming 'feet' or 'clusters' are not uncommon among members of the family Thaumastodermatidae (e.g., *Tetranchyroderma* and *Pseudostomella*) and they are present also in members of the genus *Ptychostomella* e.g., *P. bergensis* Clausen, 1996 (Clausen 1996). However, what makes special the clusters of TbV present in the new species from Brazil is their bulkiness. To my knowledge no other gastrotrich species is known to posses bilateral clusters made up of such a high number of tubes. What is the adaptive advantage of such a formidable apparatus, and in species with fewer adhesive tubes, do they have the same function?

Adhesive and aptic structures are universally present among interstitial animals (Swedmark 1964) and it is possible to detect a relationship between the extent of the aptic apparatus and the energy of the environment water the species live in. For

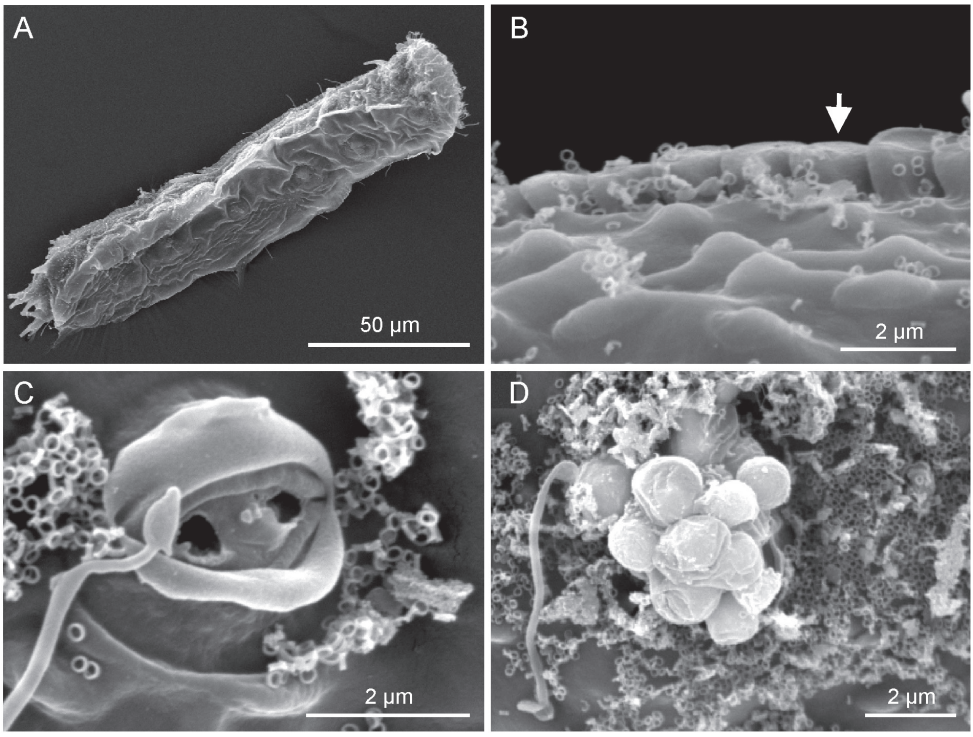

Figure 4. *Ptychostomella lamelliphora* sp. n. SEM photomicrographs, dorsal view. **A** habitus **B** close-up of the midtrunk region showing the plate-like scales (arrow) and the cuticle embossed with keel-like ornamentation **C** close-up of an epidermal gland pore **D** close-up of an epidermal gland secretion droplets.

example, the gastrotrich species of the genus *Oregodasys* Hummon, 2008 that inhabit the coarse sediment typical of high energy waters are characterized by a formidable adhesive apparatus made up of tens of tubules (e.g., Rothe and Schmidt-Rhaesa 2010); high number of adhesive tubes also characterize species of the genus *Diplodasys* Remane, 1927 (e.g., Hummon and Todaro 2009), which often co-occur with *Oregodasys*. In this framework, it is natural to hypothesize that the massive clusters of adhesive tubules of *P. lamelliphora* n. sp. are an adaptation that prevent the displacement of the animals by the strong currents that characterize the habitat. The high energy of these waters are indirectly indicated by the coarse sediment of the locus typicus in the São Sebastião channel (Table 1). In my view this working hypothesis is further supported by the presence in *P. lamelliphora* n. sp. of the columns of scales along the ventrolateral sides whose function could be the reduction of the hydrodynamic turbulence around the body allowing a better bond of the gastrotrich to the sedimentary granules.

An alternative hypothesis could be that these structures play a role during reproduction e.g., used for sperm transfer or holding of the partner during cross fertilization. Only future TEM studies revealing ultrastructural difference between the ventral tubules clustering near the ano-genital opening and the genuine adhesive tubes (e.g.,

single tubes) could make the second hypothesis on this subject most plausible. A study of reproductive behaviour would also be revealing.

Taxonomic key. Lee and Chang (2003) provided a useful taxonomic key to the species of the genus *Ptychostomella*; however, because one species has been transferred to this genus and the two additional ones have been described in the meanwhile (cf. Clausen 2004; Lee et al. 2009) a revised key seems necessary. The following key is based upon characters visible under light microscopy.

1 dorsal surface smooth **2**
– other **11**
2 lateral margins smooth **3**
– other **10**
3 eyespots present ..... ***P. ommatophora*** **Remane, 1927**
– other **4**
4 head with knob-like or club-shaped sensory organs **5**
– other **8**
5 head with paired club-shaped sensory organs ..... ***P. helane*** **Roszczak, 1939**
– head with paired knob-like sensory organs **6**
6 adhesive tubes between the caudal pedicles present **7**
– adhesive tubes between the caudal pedicles absent ..... ***P. tyrrhenica*** **Hummon, Todaro & Tongiorgi, 1993**
7 4 (2 + 2) adhesive tubes between the caudal pedicles ..... ***P. mediterranea*** **Remane, 1927**
– up to 10 (5 + 5) adhesive tubes between the caudal pedicles ..... ***P. higginsi*** **Clausen, 2004**
8 with some of the TbV forming a pair of clusters or ventral feet (4 + 4 tubes each) ..... ***P. bergensis*** **Clausen, 1996**
– without cluster of TbV **9**
9 TbV evenly space along the intestinal region ..... ***Ptychostomella jejuensis*** **Lee, Hwang & Chang, 2009**
– TbV gathered in the first third of the intestinal region ..... ***P. pectinata*** **Remane, 1926**
10 each lateral side bearing a column of rod-like papillae ..... ***P. brachycephala*** **(Levi, 1954)**
– each lateral side bearing a column of subrectangular scales ..... ***P. lamelliphora*** **n. sp.**
11 cuticular covering bearing scale-like elevantions ... ***P. lepidota*** **Clausen, 2000**
– other **12**
12 cuticular covering embossed with smooth hemispherical elevantions ..... ***P. orientalis*** **Lee & Chang, 2003**
– dorsal surface with terrace-shaped cuticular protrusions on head and numerous papillae with sensory hair(s) ..... ***P. papillata*** **Lee & Chang 2003**

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New taxonomic data on the genus *Ypsolopha* Latreille (Lepidoptera, Ypsolophidae) with descriptions of two new species from the Russian Far East

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Abstract

Two new species of the genus *Ypsolopha* Latreille, 1796 are described from Far East of Russia: *Ypsolopha melanofuscella* **sp. n.** and *Y. straminella* **sp. n.** Two new synomymies are proposed: *Y. ulingensis* Yang, 1977, a new junior synonym of *Y. costibasella* (Caradja, 1939); and *Cerostoma falculella* Erschoff, 1877, a new junior synonym of *Y. asperella* Linnaeus, 1761. The species *Y. costibasella* Caradja, 1939, *Y. nigrofasciata* Yang, 1977 and *Y. nigrimaculata* Byun et Park, 2001 are recorded from Far East of Russia for the first time. The male genitalia of *Y. nigrofasciata* are described and illustrated for the first time, diagnostic genital characters are given.

Keywords

Lepidoptera, Ypsolophidae, *Ypsolopha*, new species, new synonymy, first record, Russia, Far East

Introduction

The genus *Ypsolopha* Latreille, 1796, comprises more than 130 species worldwide (Moriuti 1977; Zagulyaev 1981; Agassiz & Friese 1996; Gershenson 1997; Dugdale et al. 1998; Sinev 2008; Zinchenko & Ponomarenko 2008; Pogue 2009; Sohn et al. 2010; with the centre of species diversity in Eastern Asia. In several recent published papers the history of the study of the genus in Asia was reviewed, all earlier published data were summarized, the types of previously described species were revised, new species were described and a checklist of the East Asian species was compiled (Byun & Park 2001, Sohn et al. 2010, Ponomarenko et al. 2011, Sohn 2011). However, in spite of the attention paid to this group in the last two decades, the study of its species diversity is not complete. The present paper continues the recent series of publications on Asian *Ypsolopha*. It is the purpose of this paper to establish new synonymies, specify the distribution of three known species: *Y. costibasella* Caradja, 1939, *Y. nigrofasciata* Yang, 1977 and *Y. nigrimaculata,* Byun et Park, 2001, describe the previously unknown male genitalia of *Y. nigrofasciata*, improve the diagnosis for the latter, including genital characters, and describe two new species: *Y. melanofuscella* sp. n. and *Y. straminella* sp. n. The description of two new species increases the number of East Asian *Ypsolopha* species to 49 (see Sohn et al. 2010).

Material

The study is based mainly on material collected in the southern part of the Russian Far East and preserved in the Institute of Biology and Soil Science of the Far Eastern Branch of the Russian Academy of Sciences (Vladivostok, Russia). Additional material from the Zoological Institute of the Russian Academy of Sciences (Sankt–Petersburg, Russia) was studied and data on the type specimens kept in Muzeul Național de Istorie Naturală "Grigore Antipa", (Bucharest, Rumania) were included. Depositories of the types and other specimens are indicated at the end of the label data or, in the case of multiple records from the same collection, after the last one.

Abbreviations of depositories

IBSS Institute of Biology and Soil Science, Far Eastern Branch, Russian Academy of Sciences, Vladivostok, Russia;
MGAB Muzeul Național de Istorie Naturală "Grigore Antipa", Bucharest, Rumania;
ZINRAS Zoological Institute, Russian Academy of Sciences, Sankt–Petersburg, Russia.

The verbatim labels of the type specimens described by A. Caradja and N. Erschoff are cited in quotes, missing figures and names in the old labels are added in square brackets.

Methods

For genitalia dissection, abdomens of moths were detached and, following maceration in 10% KOH, dissected and examined in glycerol. The membranous parts of the genitalia were stained with Chlorazol Black. The genitalia of both sexes were mounted in slide in Euparal. Genitalia slides were prepared by the first author (MP). and subsequently examined using a stereomicroscope Nikon SMZ–10. Photographs of adults and genitalia were made with digital camera Nikon Coolpix 8700. In the descriptions, the terminology for genitalia follows Klots (1970) after modifications according to Kuznezov & Stekolnikov (2001). For the descriptions of the parts of the phallus we use the following terms: for the phallic sclerotized tube: aedeagus, for the phallotheca: anellus, for the endophallus: vesica with cornuti. Those correspond to accepted morphological terminology (Snodgrass 1935, Kuznetzov & Stekolnikov 2001, Kristensen 2003). The size of genital sclerites is given as relative size of other genital parts. For the purpose of measurements the membrane between segments IX and VIII is defined from the base of the papillae anales to the posterior margin of the ventral sclerotization of segment VIII; the apophysis anterior from its basal bifurcation to the apex; segment VIII from the posterior to the anterior margin of the ventral sclerotization. We composed scientific names of new taxa following Borror (1971) and Kirpicznikov & Zabinkova (1977).

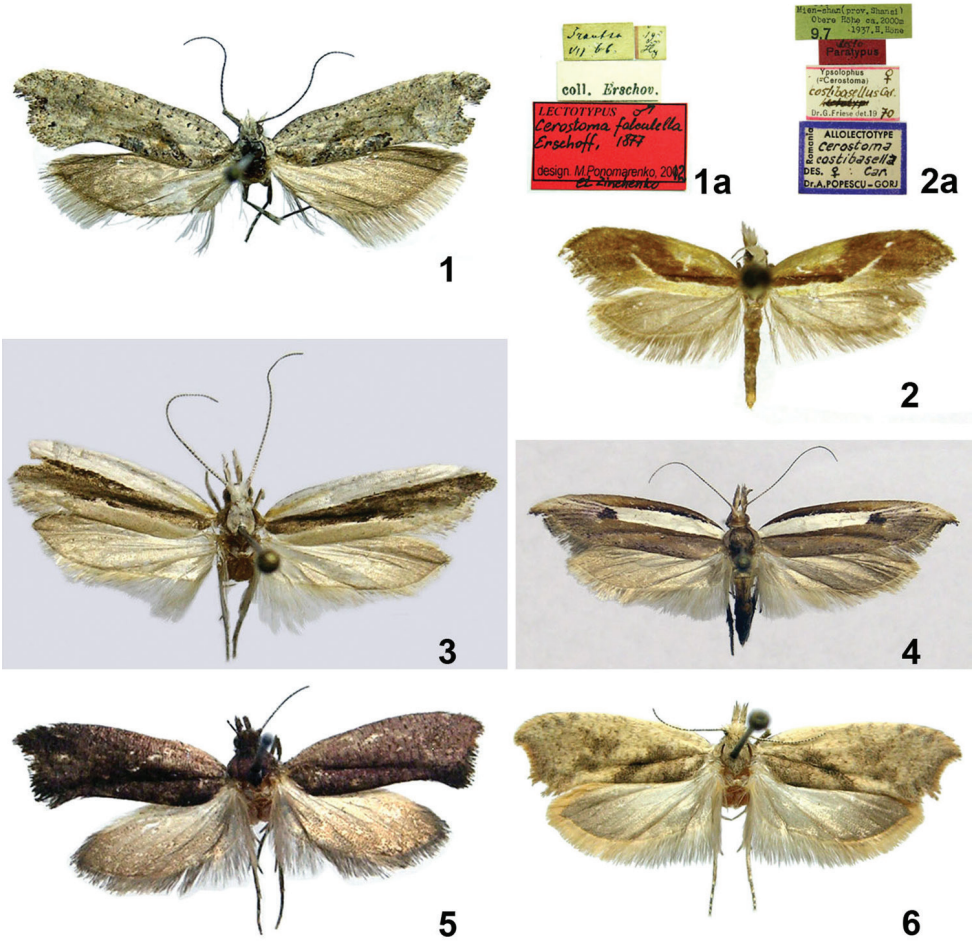
New nomenclatural and faunistic data

***Ypsolopha asperella* (Linnaeus, 1761)**
http://species-id.net/wiki/Ypsolopha_asperella
Figs 1, 7, 8

Phalaena (Tinea) asperella Linnaeus, 1761: 369; type locality: Upsala, Sweden.
Cerostoma falculella Erschoff, 1877: 343; type locality: Irkutsk, Russia; **syn. n.**

Material examined: Type. Lectotype of *Cerostoma falculella* (here designated): ♂, [Russia], "Irkutsk VII [18]66"; "coll. Erschov", gen. slide Yps.–29 MP; red rectangular label "Lectotype *Cerostoma falculella* Erschoff, 1877" (ZINRAS).

Additional material. Russia. 1♂, Peterburg [St.–Petersburg] suburb, 21 April [19]06, N. Kuznetcov leg., gen. slide Yps.–39 MP; 1♀, Pskov, 5 October 1907, Chistovsky leg.; 2♀, Irkutsk, coll. Grand Prince N.M. [Romanoff], gen. slide Yps.–32 MP, Yps.–33 MP (ZINRAS); 1♀, Chitinskaya obl., Nizhnii Chasuchei, 2 June 1995, V. Dubatolov, R. Dudko leg., gen. slide Yps.–34; 1♂, Jewish Autonomous Region, Radde, 17 July 2005, M. Ponomarenko leg.; Primorskii krai: 1♀, Sinegorka Mt. foot, 2 August 1999, M. Ponomarenko leg.; 1♂, Ussuriyskii reserve, 10 May 1995, Chistyakov leg.; 2♂, 3♀, 20 km SE Ussuriysk, Gornotaezhnoe, 20 August, 2 October 1994, 28, 29 April 1995, M. Ponomarenko leg., gen. slide Yps.–35 (♂) MP; 2♀, Vladiv-



Figures 1–6. Adults of *Ypsolopha* spp. **1** *Y. asperella*, lectotype, Russia **1a** ditto, labels **2** *Y. costibasella*, allolectotype, China (photo by Mr. George Nazareanu, MGAB) **2a** ditto, labels **3** *Y. nigrofasciata*, Russia **4** *Y. nigrimaculata*, Russia **5** *Y. melanofuscella* sp. n., holotype, Russia **6** *Y. straminella* sp. n., holotype, Russia.

ostok, Botanic garden, 17 April 1996, E. Beljaev leg.; 1♂, Shkotovskii distr., Litovka Mt., 22–25 October 1998; 1♂, Anisimovka, 9 October 1999, gen. slide Yps.–36 MP; 1♂, Chuguevskii distr., 16 km SE Yasnoe, Ussuri riv., "Pobedinskaya Polyana" hole, 2 August 2012, M. Ponomarenko leg.; 1♂, Sakhalin, Yuzhno–Sakhalinsk, 28 August 2010, V. Dubinina leg., gen. slide Yps.–37 MP (IBSS). Belorussia. 1♂, Vitebsk, 3 September 1975, V.I. Piskunov leg., gen. slide Yps.–38 MP (ZINRAS). Ukraine. 1♂, 1♀, Sumskaya obl., Lebedin, 10, 13 August 1968, V.I. Piskunov leg., gen. slide Yps.–30 (♂) MP, Yps.–31(♀) MP (ZINRAS).

Distribution. Europe, Asia Minor, Middle East, Russia (European part, South Ural, Irkutskaya oblast', Transbaikalia, Amurskaya oblast', Primorskii krai), Korea and China (Beijing).

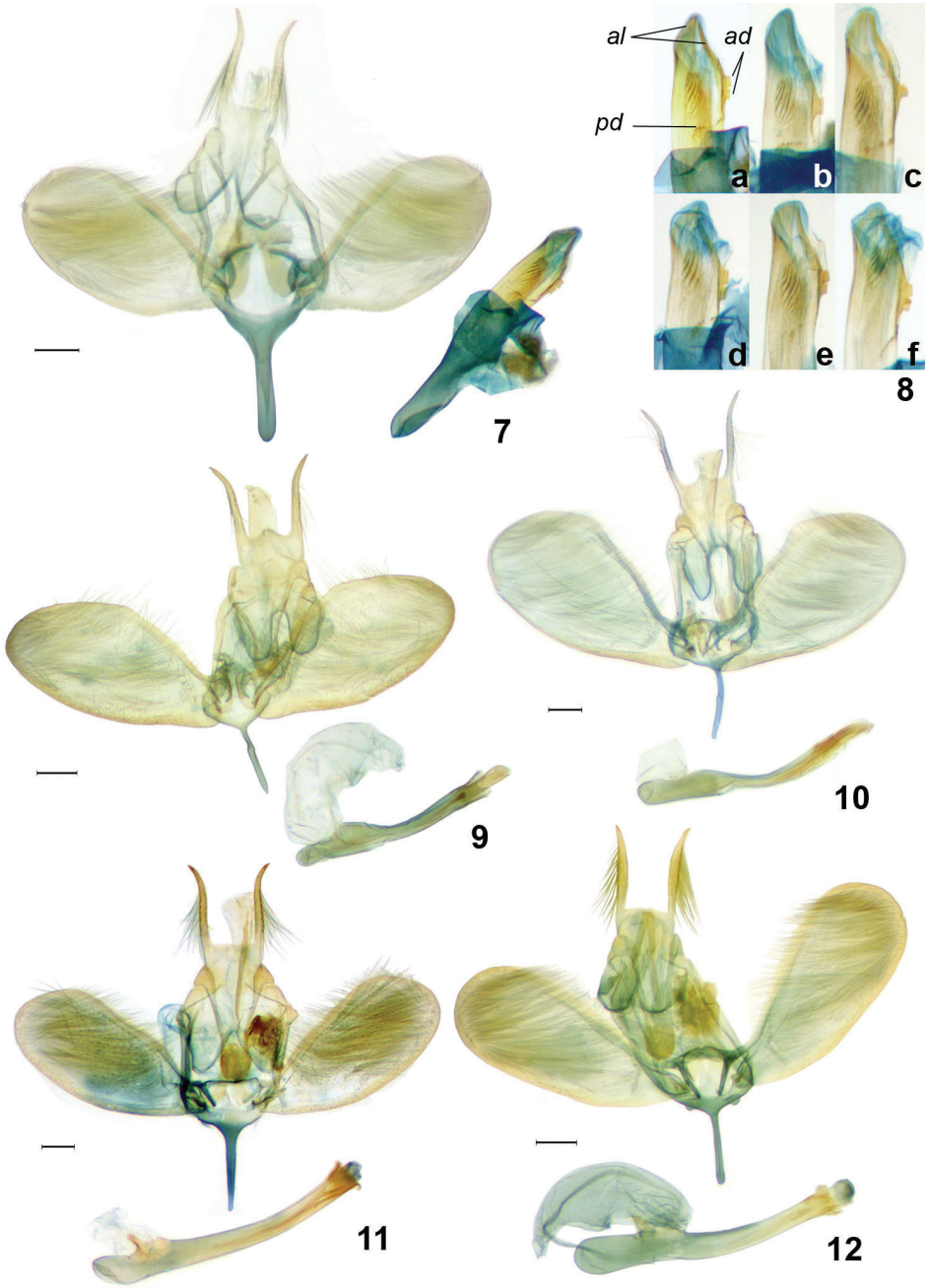
Remarks. Our examination of the lectotype of *Cerostoma falculella* and specimens of *Y. asperella* from Europe, South Siberia and Russian Far East did not show sufficient differences to justify treating them as separate species. It should be noted that in the genitalia of the lectotype of *falculella* (Fig. 7) the ventral margin of the valva is slightly angled as it is in Far Eastern specimens of *Y. asperella*. Other characters (external and genitalic) can be more or less variable. No specific external and genitalic characters correlated with a particular generation were found nor any characters typical of European or Asian populations. Every generation whether of European or Asian populations contains specimens expressing the full spectrum of character variability. The life cycle of this species is studied insufficiently and it is difficult to ascertain how many generations there are. According to the examined material and published data the adults fly in the spring from March-May (Zagulyaev 1981; Gershenzon 1997). Usually spring specimens appear worn with indistinct forewing pattern, suggesting that specimens flying in October overwinter and reappear in early spring. In summer the adults appear in July. Moths flying in spring and summer vary in wing span from 16 mm to 22 mm. The aedeagus in every studied specimen has two more or less recessed apical lobes, 1–3 large square apical denticles and 3–14 small preapical ones (Figs 8 a–f). The lectotype of *Cerostoma falculella*, collected in July, has an aedeagus with two large square apical denticles (Fig. 8a), the same number as found in specimens of *Y. asperella* from Vitebsk (Belorussia) (Fig. 8e) collected in September and Anisimovka (Russian Far East) (Fig. 8f) collected in October. Specimens of *Y. asperella* from Sankt-Petersburg (Russia, European part) (Fig. 8c) and Gornotaezhnoe (Russian Far East) (Fig. 8b), both collected in April, have a single square apical denticle on the aedeagus whilst in specimens from Sumskaya obl. (Ukraine) collected in August the aedeagus bears three large square apical denticles. Thus, the number of apical denticles on the aedeagus is not correlated with spring and summer generations nor with the geographic distribution, and it is here interpreted as intraspecific variation. Other structures of the male and female genitalia in specimens from different populations are more or less uniform and do not demonstrate distinct differences. Therefore *falculella* Erschoff is considered to be a junior subjective synonym of *asperella* Linnaeus.

***Ypsolopha costibasella* Caradja, 1939**

http://species-id.net/wiki/Ypsolopha_costibasella
Figs 2, 9

Cerostoma costibasella Caradja, 1939: 14; type locality: Mien–Shan, Shanxi, China.
Ypsolophus ulingensis Yang, 1977: 106, Figs 6, 7; type locality: Lingwushan, Hebei, China; **syn. n**.

Material examined: Type. Paralectotype of *Cerostoma costibasella*: ♀, [China], "Mien–Shan (prov. Shansi), Obere Höhe ca. 2000 m 9.7.1937. H. Höne", "allolectotype of *Cerostoma costibasella* Car." (designated by A. Popescu–Gorj) (MGAB).



Figures 7–12. Male genitalia of *Ypsolopha* spp., ventral view. **7** *Y. asperella*, lectotype, Russia **8 a–f** *Y. asperella*, distal part of aedeagus: **a** lectotype, Irkutsk, South Siberia **b** specimen from Gornotaezhnoe, Russian Far East **c** specimen from Sankt-Petersburg, European part of Russia **d** specimen from Sakhalin, Russian Far East **e** specimen from Vitebsk, Belorussia **f** specimen from Anisimovka, Russian Far East **9** *Y. costibasella*, Russia **10** *Y. nigrofasciata*, Russia **11** *Y. melanofuscella* sp. n., holotype, Russia **12** *Y. straminella* sp. n., holotype, Russia. Aedeagus in lateral view. Scale 0,2 mm. ***al*** apical lobes ***ad*** apical denticles ***pd*** preapical denticles.

Additional material. Russia. Primorskii krai: 1♂, 20 km SE Ussuriysk, Gornotaezhnoe, 43°41'42"N, 132°09'24"E, 21 July 1994, gen. slide Yps.–40 MP; 3♂, 2♀, Chuguevskii distr., 39 km E Yasnoe, Snezhnaya Mt., altitude 1230 m, 43°42'56"N, 134°26'15"E, 31 July–1 August 2012, M. Ponomarenko leg. (IBSS).

Distribution. China (Beijing, Hebei, Shanxi), Russia (Far East, first record).

Remarks. The lectotype of *Cerostoma costibasella* Caradja, which was designated, together with an allolectotype, by Popescu-Gorj (1992), has not been found in MGAB, Bucharest. According to its label the 'allolectotype' was collected in the same locality as the lectotype but two days earlier. Certainly the allolectotype is conspecific with the lectotype as indicated by the unique wide lemon yellow costal fascia in the basal half of the forewing. This character was mentioned in the original description by A. Caradja (1939): " ... ein breiter zitronengelber Kostalstreifen von Basis bis 1/2 ...". Recently the type of *Y. ulingensis* Yang was studied and illustrated by Sohn (2011) and found to be identical in wing pattern with *Y. costibasella*, which was described from the neighbouring province of Shanxi and also from the mountains. An additional series of specimens of both sexes was collected in the Russian Far East on Mt. Snezhnaya. Their wing pattern is identical with that in *Y. costibasella* and *Y. ulingensis*, and their male and female genitalia agree with those of the latter illustrated by Sohn (2011). *Y. ulingensis* Yang is therefore considered to be a junior subjective synonym of *costibasella* Caradja.

Ypsolopha nigrofasciata Yang, 1977

http://species-id.net/wiki/Ypsolopha_nigrofasciata
Figs 3, 10

Ypsolophus nigrofasciatus Yang, 1977: 105, Fig. 5; type locality: Lingwushan Mt., Hebei, China.
Ypsolopha nigrofasciata: Sohn et al. 2010: 24.

Material examined. Russia. Primorskii krai: 2♂, Shkotovskii distr., Berezovyi stream, 6 km S Anisimovka, altitude 450 m, 43°07'28"N, 132°47'44"E, 24 August 2002, M. Ponomarenko leg., gen. slide Yps.–81 MP (IBSS).

Diagnosis. In the male genitalia *Y. nigrofasciata* Yang resembles *Y. yasudai* Moriuti, 1977 in the valva bearing a knob at two-thirds of costal margin, a wide rounded excavation between the anterior lobes of the tegumen, medially prominent posterior margin of the uncus and two cornuti of less than one-half the length of the aedeagus.

Y. nigrofasciata is distinguished by the distinctly constricted median plate of the gnathos with dilated proximal part, the distally conical anterior lobes of the tegumen and the straight basal third of the aedeagus. The forewing is characterized by the longitudinal brown median fascia and the white costal and greyish anal areas (Fig. 3). In *Y. yasudai* the median plate of the gnathos has parallel margins, the anterior lobes of the tegumen are broadly rounded distally and the aedeagus is gently arched.

Male genitalia (Fig. 10). Uncus 0.6 times width of vinculum, with triangular projection on posterior margin; socii long, setose, 2.3 times length of median plate of gnathos, tapering towards pointed apex, slightly sinuous. Gnathos constricted just before dilated part of median plate, median plate 0.4 times width of uncus. Tegumen with rounded emargination between anterior lobes, reaching one-half length of tegumen; anterior lobes distally conical. Valva obovate, rounded distally, widest at distal 1/3, considerably narrowed towards base, with distinct knob on costal margin at 2/3 of valvar length; costa relatively narrow, reaching 1/6 length of valva; saccular area one-half width of costa , reaching apex of valva. Vinculum band–like, arched laterally, narrow saccus with parallel margins, slightly shorter than socii. Aedeagus almost straight in basal third and gently arched at middle; coecum about 1/9 length of aedeagus; two cornuti less than one-half length of aedeagus.

Distribution. China (Hebei), Russia (Far East, first record).

Ypsolopha nigrimaculata **Byun et Park, 2001**
http://species-id.net/wiki/Ypsolopha_nigrimaculata
Fig. 4

Ypsolopha nigrimaculatus Byun et Park, 2001: 2; type locality: Gyebangsan Mt., Prov. Gangwon, Korea.
Ypsolopha nigrimaculata: Sohn et al. 2010: 24.

Material examined: Russia. Primorskii krai: 2♂, 3♀, Khasanskii distr., 14 km SW Slavyanka, Ryazanovka, 42°47'36"N, 131°15'06"E, 16 August 2010, M. Ponomarenko leg. (IBSS).

Distribution. Russia (Far East, first record), Korea.

Remarks. This species was previously known only from South Korea. A series of five specimens was collected for the first time in the southernmost part of Primorskii krai.

Descriptions of new species

Ypsolopha melanofuscella **sp. n.**
urn:lsid:zoobank.org:act:5D69836A-E63A-495D-8F48-8E10F7DAD75A
http://species-id.net/wiki/Ypsolopha_melanofuscella
Figs 5, 11, 13

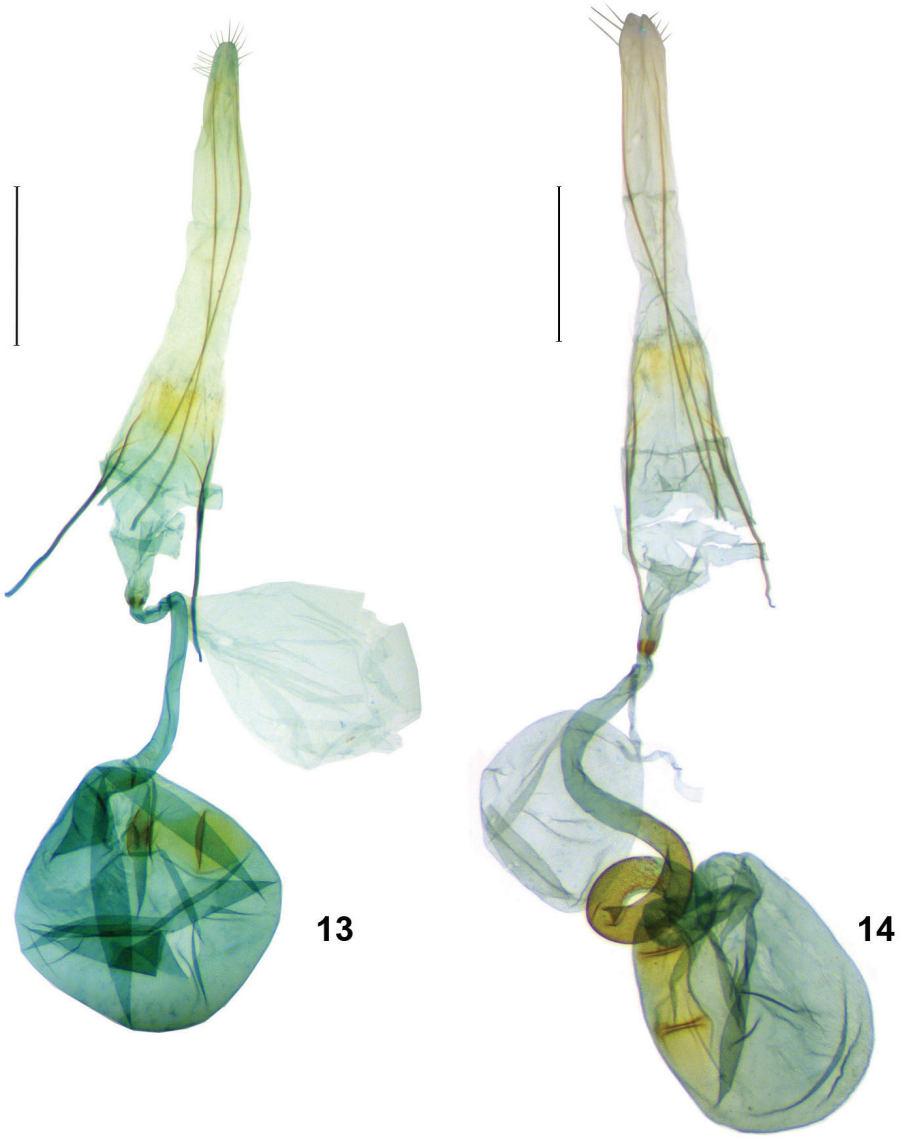
Type material. Holotype: ♂, Russia, Primorskii krai, Ussuriyskii district, Gornotaezhnoe, 43°41'42"N, 132°09'24"E, 28 August 1994, M. Ponomarenko leg., gen. slide Yps.–59 MP (IBSS); labeled by red label with designation “Holotype”. **Paratypes** (9♂, 1♀): Russia, same locality and collector as in holotype, 20 July 1994, gen. slide Yps.–58 (♂) MP; 29 August 1994, 2 October 1994, gen. slide Yps.–56 (♀) MP; 22

September 1995, gen. slide Yps.–55 (♂) MP; 23 September 1995, gen. slides Yps.–57 (♂) MP, Yps.–60 (♂) MP (IBSS).

Diagnosis. Externally the new species is extremely similar to *Y. atrobrunnella* Ponomarenko et Sohn, 2011. It can easily be distinguished by the smaller size and the genitalia, especially those of the female, the total length of which (measured from the apex of the papillae anales to the bottom of the corpus bursae) is 1.7 times the length of that in related species. The new species also differs in the male genitalia in the narrower anellus and cornuti with the distal needle-like part 1/6th the total length of the cornutus (in *atrobrunnella* almost one-half length of the cornutus), in the distally (from 1/2 to 4/5) almost parallel dorsal and ventral margins of the valva (in *atrobrunnella* evenly narrowing towards base from dilation at 4/5); in the female genitalia in the absence of a spinose zone in the ductus bursae (in *atrobrunnella* ductus with a broad band of densely set spines), and a signum with the anterior part wider than the posterior (in *atrobrunnella* the band–like signum dilated posteriorly).

Description. Adult (Fig. 5). Head covered with appressed elongated narrow dark brown scales with light tips. Antenna filiform; scape dark brown with light grey pecten; each flagellomere dark brown in basal half, white in distal half. Labial palpus porrect and slightly curved upwards, pointed terminally; mainly covered by dark brown scales with white tips; basal segment ventrally white; second segment dorsally and ventrally white, with brown triangular ventral tuft; third segment as long as second, inner surface pale grey. Thorax and tegula dark brown with violet lustre. Foreleg with femur pale grey; tibia greyish brown; each tarsomere dark brown, distally with narrow white ring. Midleg with light grey femur and greyish brown tibia and tarsus. Hindleg with femur and basal two-thirds of tibia light grey, distal third of tibia and tarsus greyish brown; tibial spurs brown dorsally and white ventrally. Forewing length 7.5–8.0 mm (n = 6), wingspan 16.5–17.3 mm (n = 4), sub-trapezoidal, with falcate, obtuse apex and sinuate termen, dark brown with violet lustre; with weakly visible transverse striation; fringe dark brown. Hindwing dark brownish grey, paler towards base; fringe dark grey.

Male genitalia (Fig. 11). Uncus slightly narrower than vinculum, with almost straight posterior margin; socii with long setae, 2.6 times length of median plate of gnathos, tapered towards apex, basal 5/6 with parallel margins, distal part diverging. Gnathos with median plate dilated at middle, about one-half uncus width. Tegumen with dorsal triangular median sclerotization narrowing caudally, divided into pair of anteriorly rounded lobes, dorsal notch about 1/3 length of tegumen. Valva obovate, distally rounded, widest at 4/5, margins almost parallel from 1/2 to 4/5, much narrower towards base; costa very narrow, reaching distal third of valva; saccular area equal in width to costa, about 4/5 length of valva. Vinculum band–like, arched laterally, saccus slightly longer than socii, tapered towards apex. Anellus setose, as wide as basal part of valva. Aedeagus almost straight, with cylindrical apex; coecum 1/6 length of aedeagus, slightly inflated in proximal part and wider than distal part of aedeagus; two long cornuti less than one-half length of aedeagus, each with distal needle–like part of 1/6 length of cornutus.



Figures 13, 14. Female genitalia of *Ypsolopha* spp., ventral view. **13** *Y. melanofuscella* sp. n., paratype, Russia **14** *Y. straminella* sp. n., paratype, Russia. Scale 0,5 mm.

Female genitalia (Fig. 13). Papilla analis semioval, ovipositor telescopic, intersegmental membrane between IX and VIII almost 5.5 times length of VIII. Apophysis posterior slender, almost reaching apex of papilla analis, thickened anteriorly, 3.7 times length of apophysis anterior; apophysis anterior with Y–shaped base, its ventral branch stretching lateroventrally along anterior margin of VIII. Ventral sclerotization of VIII with sinuous anterior margin, in distal 1/3 divided into pair of lobes, bearing long setae on rounded apex. Ostium slightly wider than one-half of segment VIII; an-

trum cone–shaped, separated from ductus bursae by colliculum as ring–like sclerotization concave inward dorsally, ventral part of it as narrow band and dorsal one 3 times as wider. Ductus bursae tubular, membranous, 1.4 times length of corpus bursae; bulla seminalis almost length of corpus bursae, with ductus seminalis 1/11 length of bulla seminalis, arising from distal 1/16 of ductus bursae. Corpus bursae ovate, membranous; signum band–like, dilated anteriorly, with two transverse ridges.

Distribution. Russia (south of Far East).

Etymology. The specific name, *melanofuscella*, is derived from two Latin roots *melano-* and *fusc-*, collectively meaning "dark brown", and refers to the forewing coloration of the new species.

***Ypsolopha straminella* sp. n.**
urn:lsid:zoobank.org:act:47D44584-9A15-455C-A278-63D705EF79ED
http://species-id.net/wiki/Ypsolopha_straminella
Figs 6, 12, 14

Type material. Holotype: ♂, Russia, Primorskii krai, Khasanskii district, Mramornaya Mt. foot, 42°34'12"N, 130°48'30"E, 31 July –1 August 2003, M. Ponomarenko leg., gen. slide Yps.–62 MP (IBSS); labeled by red label with designation "Holotype". **Paratypes** (41♂, 27♀): Russia. Amurskaya obl.: 2♂, 1♀, 17 km NNE Blagoveshchensk, altitude 160 m, 50°24'01"N, 127°40'20"E, 19, 20 August 2006, gen. slide Yps.–65 MP (♀); 2♂, 1♀, 15 km SSE Svobodnyi, Malaya Sazanka village vic., 51°14'03N, 128°03'54"E, altitude 160 m, 21, 22 August 2006; 1♂, Mikhailovskii distr., 17 km NE Mikhailovka, Zavitaya riv., altitude 166 m, 50°023'23"N, 128°58'19" E, 15 August 2006, M. Ponomarenko leg. (IBSS). Khabarovskii krai: 1♀, Pivan', 50°31'N, 137°04'E, 18 July 2007, V. Dubatolov, A. Syachina leg. (IBSS). Jewish Autonomous Region: 1♀, Smidovichiskii distr., Zabelovskii reserve, 8–14 July 2001, A. Streltcov, P. Osipov leg. (IBSS). Primorskii krai: 4♂, 1♀, same locality, collecting time and collector as in holotype, gen. slide Yps.–63 (♀) MP; 2♂, 3♀, same locality as in holotype, 2 August 2003; 2♂, 2 km NW Partizansk, Frentzovka village vic., altitude 400 m, 43°12'52"N, 133°01'27"E, 4–5 August 2002, gen. slide Yps.–64 MP; 13♂, 10♀, Ussuriyskii distr., Gornotaezhnoe, 43°41'42"N, 132°09'24"E, 20 July, 1 September, 1 October 1994; 17, 22, 23 August, 10, 21, 22, 23 September 1995, gen. slide Yps.–66 (♂) MP; 2♂, 42 km W Ussuriisk, 4 km N Monakino, 43°46'50"N, 131°26'29"E, altitude 290 m, 23 April 2003; 1♀, 5 km E Nikolo-Lvovskoe village, 43°52'16" N 131°25'14"E, altitude 174 m, 2 September 2002, gen. slide Yps.–67 MP; 1♂, 1♀, 29 km SE Ussuriisk, 43°37'48"N, 132°13'44"E, 25 August 2001, M. Ponomarenko leg.; 1♂, 4,5 km SE Okeanskaya, 43°13'06"N, 132°03'26"E, 16 September 1993, E. Beljaev leg.; 1♀, Chernigovskii distr., 42 km S Spassk-Dalnii, Gribnoe village vic., 44°15'29"N, 132°44'51"E, 25 August 1998, gen. slide Yps.–68 MP; 5♂, 4♀, Khasanskii distr., 14 km SW Slavyanka, Ryazanovka, 42°47'36"N, 131°15'06"E, 9–10 September 1992; 23 August 1997; 19, 20, 21 September; 22 October 2008; 16

August 2010; 5♂, 2♀, Gamov Peninsula, Srednyaya Inlet, 42°35'18" N 131°12'48" E, 24 July 1997, 8, 9, 13, 14 August 2009; 1♂, Gamov Peninsula, Gorshkova Inlet, 42°40'17"N, 131°12'48"E, 30 August 1997, M. Ponomarenko leg. (IBSS).

Diagnosis. The new species resembles *Y. leuconotella* (Snellen, 1884) in the genitalia of both sexes: in the male in the shape of the valva with parallel margins in the distal half, the gnathos with a wide, rounded median plate, the almost straight aedeagus with indistinct cornuti of less than half the length of the aedeagus; and in the female in the presence of a scobinate zone in the ductus bursae. The new species differs from *leuconotella* in the male genitalia in the narrower base of the valva, which is less than one-half its greatest width (in *leuconotella* equal to one-half of greatest width), the rounded emargination between the anterior lobes of the tegumen (in *leuconotella* the emargination between the anterior lobes of the tegumen is triangular) and the inflated basal part of the aedeagus (caecum) (aedeagus narrowed basally in *leuconotella*). The new species can also be separated in the female genitalia by a scobinate zone in the ductus bursae of slightly over one-half the ductus length (in *leuconotella* the ductus with scobinate inner surface except 1/10 just following antrum), and a large signum, longer than two-thirds of corpus bursae (in *leuconotella* slightly less than one-half of corpus bursae length).

Description. Adult (Fig. 6). Frons and vertex covered by closely fitting greyish yellow scales. Occiput with appressed elongated scales mainly greyish yellow and speckled with dark before light tips. Antenna filiform; scape greyish yellow with light yellow pecten; each flagellomere with light yellow basal and dark brown distal half; ventrally ciliated. Labial palpus porrect and slightly curved upwards, terminally pointed; basal segment white; second segment basally white, with triangular greyish yellow ventral tuft, speckled with brown; third segment as long as second, dorsally white, ventrally dark brown with scattered white scales. Thorax and tegula brownish grey. Foreleg with white femur and tibia; each tarsomere with narrow white distal ring, irrorated with brown. Midleg with white femur, tibia, ventral side of first (basal) tarsomere and spurs, second and following tarsomeres speckled with brown, lighter laterally and with narrow white ring distally. Hindleg with white femur, tibia, basal tarsomere and spurs; 2nd–5th tarsomeres speckled with brown and with white ventral margin. Forewing length 7.5–8.0 mm (n = 6), wingspan 16.5–17.3 mm (n = 4), sub-trapezoidal, with falcate, obtuse apex and sinuate termen. Ground colour of forewing greyish yellow irrorated with brown and greyish scales; 1/6th of costal margin brown; large greyish brown spot on dorsal half at 1/4, wide oblique brown band from base of R1 to middle of dorsal margin, large semi-oval greyish brown spot at end of cell, smaller concolorous spot dorsad and distad of latter, dorsal margin of wing and tornus greyish brown, six indistinct small strokes on costal margin from middle to 7/8; fringe greyish yellow. Hindwing dark brownish grey, darker towards apex; fringe brownish grey basally and yellow distally.

Male genitalia (Fig. 12). Uncus equal to vinculum in width, with almost straight posterior margin; socii 2.3 times length of median plate of gnathos, with long setae, curved outwardly before pointed apices. Median plate of gnathos with parallel lateral margins, one-third width of uncus. Tegumen divided into pair of anteriorly angulate

lobes, anterior margin with triangular median emargination, not exceeding 1/4 of tegumen length. Valva more or less obovate, distally rounded and considerably narrowed towards base, with almost straight costal margin and rounded saccular margin; costal and saccular area equal in width, reaching 4/5 length of valva. Vinculum band–like, laterally with small triangular plates; saccus tapering towards apex, almost as long as socii. Anellus setose and wider than basal part of valva. Aedeagus almost straight, with cylindrical apex; coecum slightly longer than 1/4 length of aedeagus, slightly inflated in proximal part and wider than distal part of aedeagus; two long cornuti less than one-half length of aedeagus, each with distal needle–like part, less 1/5 total length of cornutus.

Female genitalia (Fig. 14). Papilla analis semi-oval, ovipositor telescopic, intersegmental membrane between IX and VIII almost four times length of VIII. Apophysis posterior slender, slightly thickened anteriorly, 2.75 times length of apophysis anterior; apophysis anterior with Y–shaped base, its ventral branch extending laterоventrally along anterior margin of VIII. Segment VIII, its ventral sclerotization, ostium and antrum very similar to *Y. melanofuscella* sp. n. Ventral sclerotization of VIII with sinuous anterior margin, in distal 1/3 divided into pair of rounded lobes, bearing long setae on rounded apex. Ostium slightly wider than one-half of segment VIII; antrum cone–shaped, separated from ductus bursae by narrowing and ring–like colliculum concave inward dorsally, its ventral part as narrow band and dorsal one 3 times wider. Ductus bursae tubular, membranous, 1.7 times length of corpus bursae, dilated anteriorly; anterior part with dense minute scobinations on inner surface from 2/5 to 1/14 length of ductus. Bulla seminalis shorter than corpus bursae, with ductus seminalis 1/3 length of bulla seminalis, arising from ductus bursae just near colliculum. Corpus bursae ovate, membranous; signum large band–like, comparatively wide and long, more than 2/3 length of corpus bursae, with two transverse ridges.

Distribution. Russia (south of Far East).

Etymology. The species name, *straminella*, is derived from the Latin *stramineus*, meaning “straw”, or “pale yellow” and refers to the colour of the forewing of the new species.

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RESEARCH ARTICLE

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Notes on black elytron species of *Pyrrhalta* Joannis and the description of a new species from China (Coleoptera, Chrysomelidae, Galerucinae)

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Abstract

Thirteen species of *Pyrrhalta* Joannis, 1865 with black elytron are reviewed. A key to species, photographs of aedeagus and habitus are provided. *Pyrrhalta qianana* **sp. n.** is described from Guizhou, China. *Pyrrhalta martensi* Medvedev *et* Sprecher-Uebersax, 1999 is newly recorded from China (Tibet).

Keywords

Coleoptera, Galerucinae, *Pyrrhalta*, black elytron, new species, key

Introduction

The genus *Pyrrhalta* Joannis, 1865 is a large, worldwide genus distributed in the Holarctic, Oriental and Australian Regions. The genus was firstly proposed as a subgenus of *Galeruca* Geoffroy, 1762 by Joannis (1865), and *Galeruca viburni* Paykull, 1799 was deemed to be fixed as type species by monotypy. The genus presents serious difficulties in several aspects of its classification and nomenclature. Firstly, this genus is very large

including 115 species in the world (Xue and Yang 2010). Secondly, its status is still not entirely clear being obscured by apparent relationship of *Pyrrhalta* and *Galerucella* Crotch, 1873 (Weise 1924, Gressitt and Kimoto 1963, Wilcox 1965). Separation of species of typical *Pyrrhalta* and *Galerucella* was based on a character of the pronotum. The whole pronotum of *Pyrrhalta* is covered by hairs, while at least the middle region of the pronotum of *Galerucella* is glabrous (Gressitt and Kimoto 1963). However, a use of this character was not consistent in the past by different specialists. Some species whose pronotum covered with hair were treated as *Galerucella*, while some species having glabrous area of pronotum were placed in *Pyrrhalta*. Meanwhile, some tentative *Galerucella* species were included into *Pyrrhalta* clade based on molecular data (Nie et al. 2012). Whether the pronotum character can be regarded as the unique character to distinguish the two genera need be further studied, and the morphological characters for distinguishing *Galerucella* and *Pyrrhalta* need to be addressed in the future. Thirdly, the subgenera of *Pyrrhalta* are still not well defined. For example, *Clitenososia* Laboissière, 1931, *Xanthogaleruca* Laboissière, 1934 and *Tricholochmaea* Laboissière, 1932 were considered as synonyms of *Pyrrhalta* (Gressitt and Kimoto 1963), while in another study, the groups *Galerucella*, *Neogalerucella* Chûjô, 1962, *Xanthogaleruca* and *Tricholochmaea* were treated as subgenera of *Pyrrhalta* (Wilcox 1965). *Galerucella*, *Xanthogaleruca*, and *Tricholochmaea* were treated as valid genera and *Neogalerucella* as subgenus of *Galerucella* in some recent studies (Silfverberg 1974, Beenen 2008, Gok et al. 2007, Beenen 2010). The most important argument is whether *Xanthogaleruca* is treated as a valid genus or a subgenus of *Pyrrhalta*. The character that defines *Xanthogaleruca* as a genus is the aedeagus with a comb-shaped internal sac (Silfverberg 1974, Beenen 2003, Gök et al. 2007). However, the relative value of this character is not proved yet. In present study, *Xanthogaleruca* is treated as a synonym of *Pyrrhalta* until evidence suggesting otherwise are presented.

This study focuses on the *Pyrrhalta* species with black elytra, which may not be a natural group. We defined the main character state of the group as "elytra entirely or at least 2/3 black". There are 13 species included in this group. Among them, *P. qianana* sp. n., a new species described below. A key to the species of the group is provided.

Material and methods

Morphological characters were examined with an Olympus SZ 61 microscope. Genitalia of males and / or females of each species were dissected using the following procedure: for dried or ethanol preserved specimens, the abdomen was separated, transferred to a vial containing 10% KOH which was heated in a boiling water bath for 10 min. The genitalia were then carefully removed in a cavity slide under distilled water using fine forceps and hooked minuten-pin dissecting needles. Series of partially focused photographs were made with a digital camera (Nikon D300S) attached to a stereomicroscope (Zeiss Discovery V12), and then combined using Helicon Focus software, and finally were evaluated and assembled using Adobe Photoshop CS 8.0 and Illustrator CS4 software.

Material examined is deposited in the following collections

BMNH The Natrual History Museum, London, UK
IZAS Institute of Zoology, Chinese Academy of Sciences, Beijing, China
JBCB Jan Bezděk collection, Brno, Czech Republic
MHBU Museum of Hebei University, Baoding, Hebei, China
NHMB Naturhistorisches Museum Basel, Switzerland
USNM The United States National Museum of Natural History (Smithsonian Institution), Washington, D.C., USA
ZIN Zoological Institute, Russian Academy of Sciences, Saint-Petersburg, Russia

Taxonomy

Key to species of *Pyrrhalta* with entirely or at least 2/3 black elytra

1 Head and pronotum yellowish brown, with or without black markings **2**
– Head and pronotum dark, with or without brown markings..... **10**
2 Occiput without black spots **3**
– Occiput with black spots **4**
3 Elytron entirely black with flattish surface, space between punctures smaller than diameter of puncture ..... ***P. huangshana*** **Chen, 1964**
– Elytron black, suture and lateral margins light yellow; elytral surface convex, space between punctures larger than diameter of puncture ... ***P. qianana*** **sp. n.**
4 Middle of pronotum with black reversed trapezoid marking ..... ***P. meghalayana*** **Medvedev, 2002**
– Pronotum with three black spots, located in both lateral sides and middle of disc **5**
5 Elytron black, a short yellowish brown longitudinal stripe present at base of elytron, which less than 1/4 of elytral length ..... ***P. martensi*** **Medvedev *et* Sprecher, 1999**
– Elytron black, without yellowish brown stripe or with a long yellowish brown longitudinal stripe through the whole elytron **6**
6 Elytron surface with ridges..... **7**
– Elytron surface without ridges **8**
7 Elytron dark metallic bronze with slight shade of olive green; with two distinct longitudinal ridges close to suture and flat margin ..... ***P. subaenea*** **(Ogloblin, 1936)**
– Elytron black, lateral margin and epipleuron brown, disc with 7 irregular black spots formed by groups of dense punctures, short yellowish band present at base of elytron which is the same length as scutellum; longitudinal ridge in middle of disc and under humerus..... ***P. tianmuensis*** **Chen, 1964**

8 Elytron black, each with yellow longitudinal stripe starting side of humerus and ending before elytral apex, elytral margin and epipleuron brown ..... ***P. warchalowskii* Bezděk, 2007**

– Elytron black or reddish brown or brown black, without yellow longitudinal stripe, elytral margin and epipleuron brown or black **9**

9 Antenna 1/3 as long as elytra; basal margin of pronotum slightly concave in middle, lateral margin clearly convex in 1/2; elytron entirely black, disc convex with dense, deep punctures ..... ***P. orientalis* (Ogloblin, 1936)**

– Antenna 1/2 as long as elytra; basal margin of pronotum sinuate, lateral margin narrow basally, obtusely rounded anteriorly; elytron black, basally, along suture, with stripe in middle of disc, lateral margin and epipleuron brown, disc with dense, small, and shallow punctures..... ..... ***P. sulcatipennis* (Chen, 1942)**

10 Occiput with two brown spots; pronotal disc with six small depressions .... ***P. fossata* (Chen, 1942)**

– Occiput without two brown spots; pronotal disc with three depressions ... **11**

11 Elytron reddish brown with broad longitudinal blackish marking covering nearly all interior 2/3 of disc ..... ***P. tatesuji* Kimoto, 2001**

– Elytron without blackish marking..... **12**

12 Antenna slender; pronotum with V shaped depressions besides of disc, a triangle concave near middle of basal margin; elytron bronzy black with purplish or bronzy tinges metallic lustre, lateral margin not with expanded margin ..... ***P. metallica* Gressitt *et* Kimoto, 1963**

– Antenna very stout; pronotum with a wide longitudinal depression in the middle of disc, round depressions besides of disc; elytron brown black, different shades, with bronze metallic lustre, lateral margin expanded with a swollen ridge parallel to margin ..... ***P. xizangana* Chen *et* Jiang, 1981**

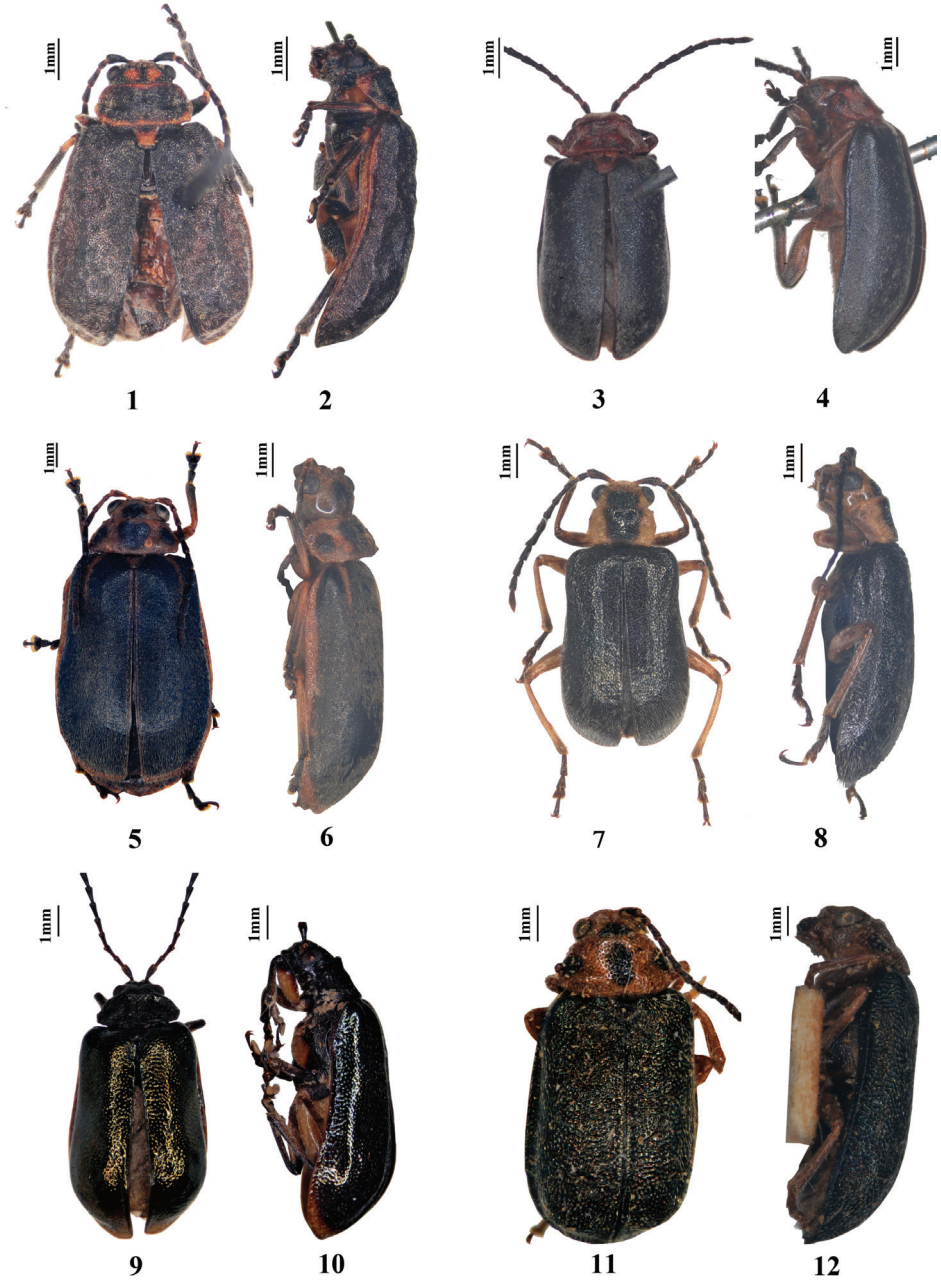
1. *Pyrrhalta fossata* (Chen, 1942)
http://species-id.net/wiki/Pyrrhalta_fossata
Figs 1–2, 42

Galerucella fossata Chen, 1942: 19.
Pyrrhalta fossata: Gressitt & Kimoto, 1963: 439, 449.
Neogalerucella fossata: Beenen, 2010: 449.

Specimens examined. Type material: Holotype: ♀, re-written (original label is in Chinese): China, Sichuan, Kangding, 25-VIII-1939, collector unknown (IZAS).

Distribution. China (Sichuan).

Notes. Holotype of this species was diagnosed as male in the original description without being dissected (Chen 1942). Actually the holotype is female. Its spermatheca is illustrated here (Fig. 42). The updated catalogue of Galerucinae (Beenen 2010)



Figures 1–12. Habitus. **1–2** *P. fossata* (holotype) **3–4** *P. huangshana* (holotype) **5–6** *P. martensi* (paratype) **7–8** *P. meghalayana* (paratype) **9–10** *P. metallica* **11–12** *P. orientalis* (holotype).

showed that this species belonged to a subgenus *Neogalerucella* of *Galerucella*. In this study, we found that the disc of pronotum is entirely covered by hairs. So we think that this species should be remained in *Pyrrhalta*.

2. *Pyrrhalta huangshana* Chen, 1964
http://species-id.net/wiki/Pyrrhalta_huangshana
Figs 3–4, 24–25

Pyrrhalta huangshana Chen, 1964: 207.

Specimens examined. Type material: Holotype: ♂, re-written (original label is in Chinese): China, Anhui, Huang Mountain, 5-VIII-1936, collector unknown (IZAS).

Distribution. China (Anhui).

Notes. Aedeagus of the holotype is illustrated here (Figs 24-25), dorsal view: asymmetrical but nearly parallel-sided, tapered at extreme apex which is subacute; dorsal opening largely on the left side; lateral view: gradually tapering to a subacute tip, slightly arched on the left side, nearly semi - circular on right side.

3. *Pyrrhalta martensi* Medvedev *et* Sprecher, 1999
http://species-id.net/wiki/Pyrrhalta_martensi
Figs 5–6, 26–27

Pyrrhalta martensi Medvedev & Sprecher, 1999: 366.

Specimens examined. Type material: Paratypes: 1 ♀, original label: "W-Nepal, Kali Gandaki, Knola C.J. Rai / Kopchepani, 1500–1600 m, 21-V-1984 / PARATYPUS, L.N. Medvedev" (NHMB); 1♂, original label: "India, Darjeeling D., Bhakta B. / Kalimpong, 9th mile 1500 m, 14.VII84 / PARATYPUS, L.N. Medvedev"(NHMB).

Other material (2 spec.): 2♂, China, Tibet, Linzhi, Muotuo, Yarang, 760m, 19-VIII-2006, Ming Bai leg. (IZAS).

Distribution. China (Tibet), India, and Nepal.

Notes. This is the first record of this species in China.

4. *Pyrrhalta meghalayana* Medvedev, 2002
http://species-id.net/wiki/Pyrrhalta_meghalayana
Figs 7–8, 28–29

Pyrrhalta meghalayana Medvedev, 2002: 247.

Specimens examined. Type material: Paratypes: 1♂, 1 ♀, original label: "NE INDIA; Meghalayana; 1999, 3Km E Tura; 1150; 25°30'N, 90°14'E; 18. IV.; Dembický & Pacholátko leg. / PARATYPE" (NHMB).

Other material (1 spec.): 1 ♀, NE India, Meghalaya, SW of Sohra, 25°13–14'N, 91°40', 700–950m, 22-V-2005, C.L. Peša leg. (JBCB).

Distribution. India.

5. *Pyrrhalta metallica* Gressitt & Kimoto, 1963

http://species-id.net/wiki/Pyrrhalta_metallica
Figs 9–10, 30–31

Pyrrhalta metallica Gressitt & Kimoto, 1963: 457.

Specimens examined. Type material: Allotype: 1♀, original label: "near O-Er., Nr Weichow, Aug. 6 18 '33, 6000–1500 ft / SzechwanChina, DCGraham / ALLOTYPE J.L. Gressitt" (USNMNH).

Other material (3 spec.): 2♂, China, Yunnan,Yundi, 3700m, 28-VII-1979, Jiang-Xing Rao leg. (IZAS); 1♂, China, Yunnan, Yundi, 3700m, 28-VII-1979, Zhi-Wen Kui leg. (IZAS).

Distribution. China (Sichuan, Yunnan).

6. *Pyrrhalta orientalis* (Ogloblin, 1936)

http://species-id.net/wiki/Pyrrhalta_orientalis
Figs 11–12, 32–33

Galerucella (*Xanthogaleruca*) *orientalis* Ogloblin, 1936: 102, 390.
Pyrrhalta orientalis: Gressitt & Kimoto, 1963: 461.

Specimens examined. Type material: Type: ♂, original label: "Shan-hai-Kwan, In Mountains, 1.9.06., F.M. Thomson, 1907-200 / *Galerucella orientalis* sp. n., D. Ogloblin det., 1935. type." (BMNH).

Other material (44 spec.): 1♂, China, Beijing, Badaling, 700m, 23-VII-1964, Qin Zhou (IZAS); 1♀, China, Beijing, Badaling, 27-V-1980, collector unknown (IZAS); 2♀, China, Beijing, Shanbao, 26-V-1978, Sheng-Qiao Jiang leg. (IZAS); 1♂, China, Beijing, Shanbao, 4-VII-1978, Sheng-Qiao Jiang leg. (IZAS); 1♂, China, Beijing, Shanbao, 09-VII-1964, Su-Bo Liao leg. (IZAS); 19♀, 19♂, China, Shandong, Tai Mountain, 21-IV-1993, Cheng-Gang Zhou leg. (IZAS)

Distribution. China (Liaoning, Hebei, Shanxi, Shandong, Fujian).

Notes. Aedeagus is illustrated here (Figs 32–33), dorsal view: slightly asymmetrical, gradually and slightly widened to apex, apex with a long acute tip; lateral view: nearly straight on left side, gradually tapering to acute tip on right side.

7. *Pyrrhalta subaenea* (Ogloblin, 1936)
http://species-id.net/wiki/Pyrrhalta_subaenea
Figs 13–14, 34–35

Galerucella (*Xanthogaleruca*) *subaenea* Ogloblin, 1936: 102, 389.
Pyrrhalta subaenea: Gressitt & Kimoto, 1963: 466.

Specimens examined. Type material: Syntypes: 1♀, 1♂, original label: "entre Za-mi et Ta-pa, 16-VII-93, Tchouen tshin / Syntypus" (ZIN).

Distribution. China (Sichuan).

Notes. Aedeagus of a syntype is illustrated here (Figs 34-35), dorsal view: slightly asymmetrical, gradually and slightly widened to apex, apex with acute tip in middle; lateral view: gradually tapering to subacute tip, slightly arched on left side, nearly semi-ellipse on right side.

8. *Pyrrhalta sulcatipennis* (Chen, 1942)
http://species-id.net/wiki/Pyrrhalta_sulcatipennis
Figs 15–16, 36–37

Gallerucella sulcatipennis Chen, 1942: 18.
Pyrrhalta sulcatipennis: Gressitt & Kimoto, 1963: 466.

Specimens examined. Type material: Holotype: ♂, re-written (original labels are in Chinese): China, Sichuan, Emei Mountain, 25-VIII-1939, C.S. TSI leg. (IZAS); Paratype: 1♀, 1♂, the same locality as Holotype (IZAS).

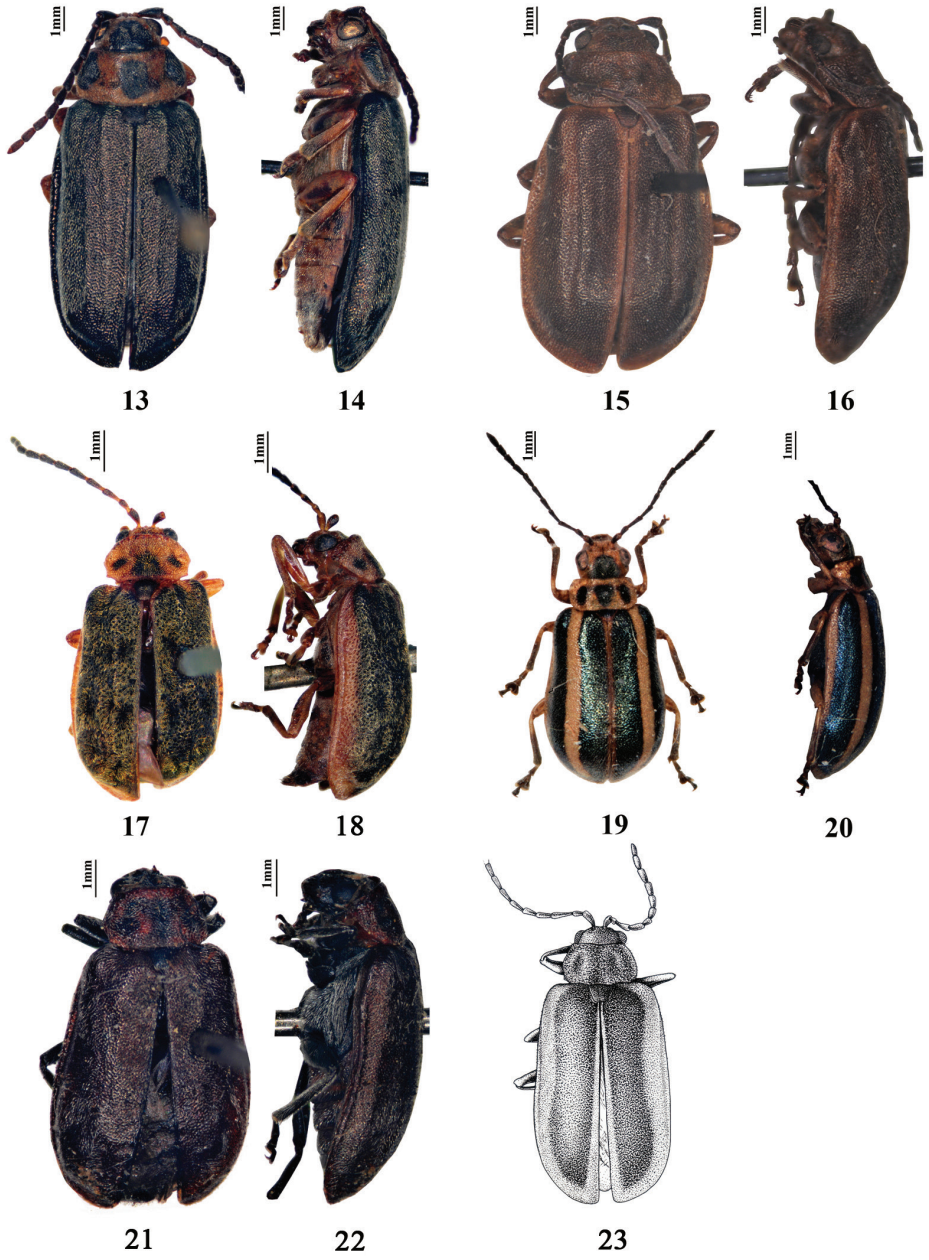
Other material (26 spec.): 1♀, China, Hunan, Sangzhi, Tianping Mountain, 1400m, 12-VIII-1988, Shu-Yong Wang leg. (MHBU); 5♀, 5♂, China, Hunan, Sangzhi, Bada Mountain, 10/11-VII-2004, Ji-Liang Wang and Jian-Feng Wang leg. (MHBU); 4♂, China, Sichuan, Emei Mountain, 25-VIII-1939, You-Cai Lu and Zong-Yuan Wang leg. (IZAS); 2♀, China, Guizhou, Fanjing Mountain, 2300m, 5/4-VIII-2001, Hong-Bin Liang leg. (IZAS); 6♀, China, Guizhou, Fanjing Mountain, 800–1600m, 5-VIII-2001, Kang-Zhen Dong leg. (IZAS); 3♂, China, Guizhou, Zunyi, Kuankuoshui Nature Reserve, 1530m, 7-VI-2010, Rui-E Nie leg. (IZAS).

Distribution. China (Hunan, Sichuan, Guizhou).

9. *Pyrrhalta tatesuji* Kimoto, 2001
http://species-id.net/wiki/Pyrrhalta_tatesuji
Fig. 23

Pyrrhalta tatesuji Kimoto, 2001: 45.

Distribution. Nepal.



Figures 13–23. Habitus. **13–14** *P. subaenea* (syntype) **15–16** *P. sulcatipennis* (holotype) **17–18** *P. tianmuensis* (holotype) **19–20** *P. warchalowskii* (paratype) **21–22** *P. xizangana* (holotype) **23** *P. tatesuji* Kimoto (drawing after original photograph in Kimoto, 2001).

Notes. We did not examine any specimens of this species. We diagnosed it as belonging to elytron-black group based on the original description and the figure of type (Fig. 23).

10. *Pyrrhalta tianmuensis* Chen, 1964
http://species-id.net/wiki/Pyrrhalta_tianmuensis
Figs17–18, 38–39

Pyrrhalta tianmuensis Chen, 1964: 207.

Specimens examined. Type material: Holotype: ♀, re-written (original labels are in Chinese): China, Zhejiang, Tianmu Mountain, 6-VIII-1937, collector unknown (IZAS).

Other material (1 spec.): 1♂, China, Zhejiang, W. Tianmu Mountain, 30-VII-1998, Hong Wu leg. (IZAS).

Distribution. China (Zhejiang).

Notes. Aedeagus is illustrated here for the first time. Aedeagus: slender, dorsal view: strongly asymmetrical, apex with acute tip, apical part narrower than basal part, gradually tapering apically but arching near half of base on right side, nearly straight on left side before apex; lateral view: very slender, nearly straight on left side, suddenly tapering to acute tip at basal 1/4 on right side (Figs 38–39).

11. *Pyrrhalta warchalowskii* Bezděk, 2007
http://species-id.net/wiki/Pyrrhalta_warchalowskii
Figs 19–20, 40–41

Pyrrhalta warchalowskii Bezděk, 2007: 607.

Specimens examined. Type material: Paratype: 1♀, original label: "S-INDIA, Tamil Nadu state, Nilgiri hills, 10km SW of Manjoor, 76°35'E, 11°12'N, Thiashola reserved forest / near Carrington estate, ca 2100m, 14-19-VI-1999, Z. Kejval & M. Trýzna leg. / PARATYPUS" (JBCB).

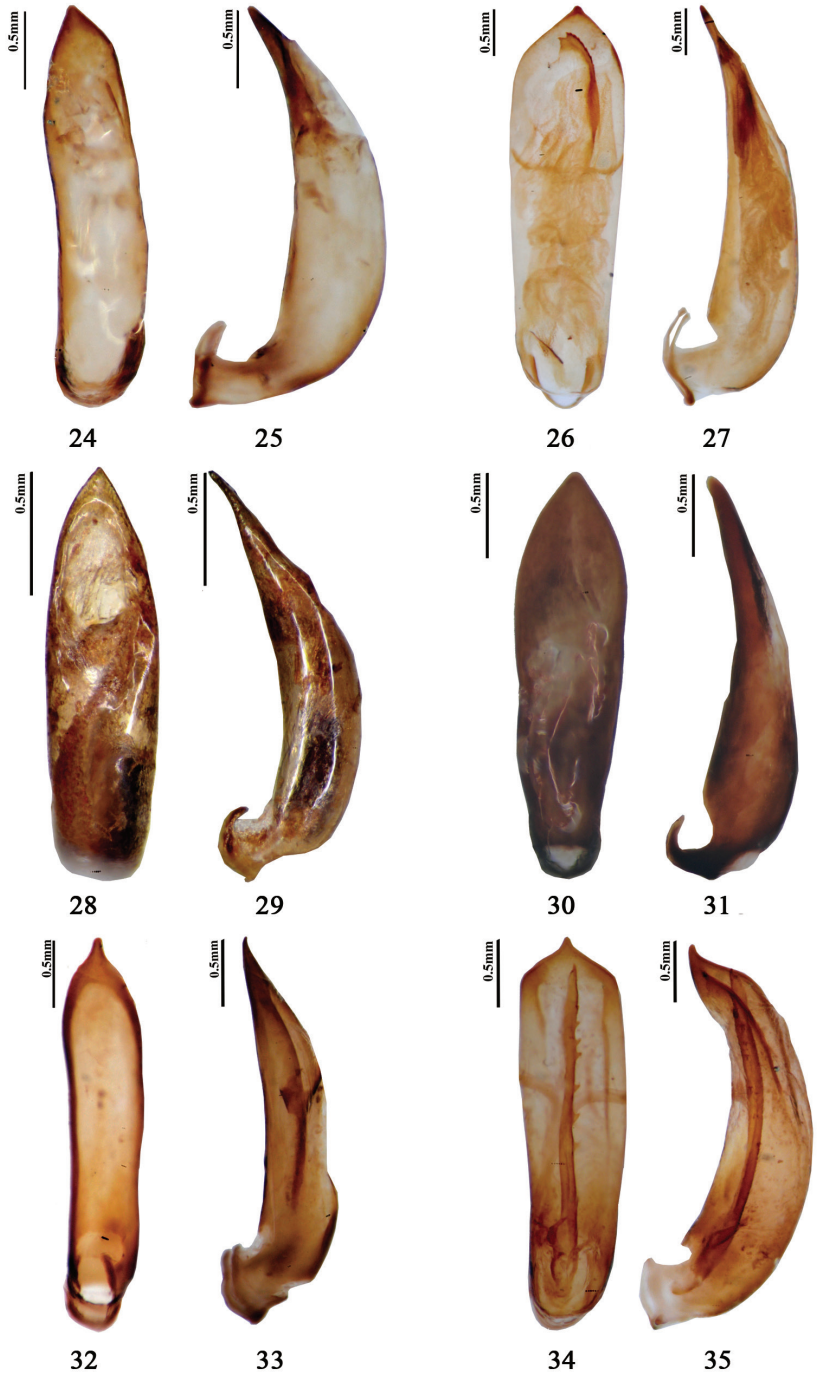
Distribution. India.

12. *Pyrrhalta xizangana* Chen *et* Jiang, 1981
http://species-id.net/wiki/Pyrrhalta_xizangana
Figs 21–22, 43

Pyrrhalta xizangana Chen & Jiang, 1981: 459.

Specimens examined. Type material: Holotype: ♂, re-written (original labels are in Chinese): China, Tibet, 52 Daoban, 9-VII-1976, Yin-Heng Han leg. (IZAS). Paratypes: 3♀, re-written (original labels are in Chinese): China, Tibet, Chaya, Jitang, 7-VII-1976, Yin-Heng Han leg. (IZAS).

Distribution. China (Tibet).



Figures 24–35. Aedeagus. **24–25** *P. huangshana* (holotype, **24** dorsal view **25** lateral view) **26–27** *P. martensi* (**26** dorsal view **27** lateral view) **28–29** *P. meghalayana* (paratype, **28** dorsal view **29** lateral view) **30–31** *P. metallica* (**30** dorsal view **31** lateral view) **32–33** *P. orientalis* (**32** dorsal view **33** lateral view) **34–35** *P. subaenea* (syntype, **34** dorsal view **35** lateral view).

13. *Pyrrhalta qianana* Nie & Yang, sp. n.
urn:lsid:zoobank.org:act:0ABCCB95-FF41-4DE8-9185-E2B29454998C
http://species-id.net/wiki/Pyrrhalta_qianana
Figs 44–49

Type material. Holotype: ♂, China, Guizhou, Zunyi, Kuankuoshui Nature Reserve, Baishaogou, 9-VI-2010, Wan-Gang Liu leg. (IZAS). Paratype: 1♂, the same data as holotype (IZAS); 1♂, China, Sichuan, Fengdu, Shiping, 610m, 3-VI-1994, Wen-Zhu Li leg. (IZAS); 1♂, China, Chongqing, Beipei, Tuanjie, 6-V-1999, Hai-Jian Wang and Yin-Fei Zhu leg. (IZAS); 1♀, China, Guizhou, Jiangkou, Huixiangping, 2-III-2001, Guo-Dong Ren leg. (MHBU); 1♀, China, Sichuan, Emei Mountain, 1800-1900m, 14-VIII-1957, Fu-Xing Zhu leg (IZAS).

Diagnosis. This species can be separated from all known species in the genus by the following characters: very long antennae (length=4.9 mm), antennomere 3 more than 2 times as long as antennomere 2, and last abdominal sternite of male with very deep U-shape cavity (Fig. 46).

Description. Generally black, apex of labrum and mandible, maxilla, dark brown; head, pronotum, elytral margin, elytral suture, yellowish; antenna black except ventral side of antennomeres 1-5; legs brown except ventral sides of tibiae and tarsi black; scutellum yellowish brown, dark brown on basal part. Body densely covered with short pale silvery pubescences.

Head slightly narrower than prothorax; occiput flat; epicranial suture distinct; frontal tubercles distinctly raised, subquadrate, vertex impunctate.

Antennae long, slender, 0.85× as long as body, length ratio of antennomeres 1 to 11: 15-11-24-23-22-20-20-16-19-17-20.

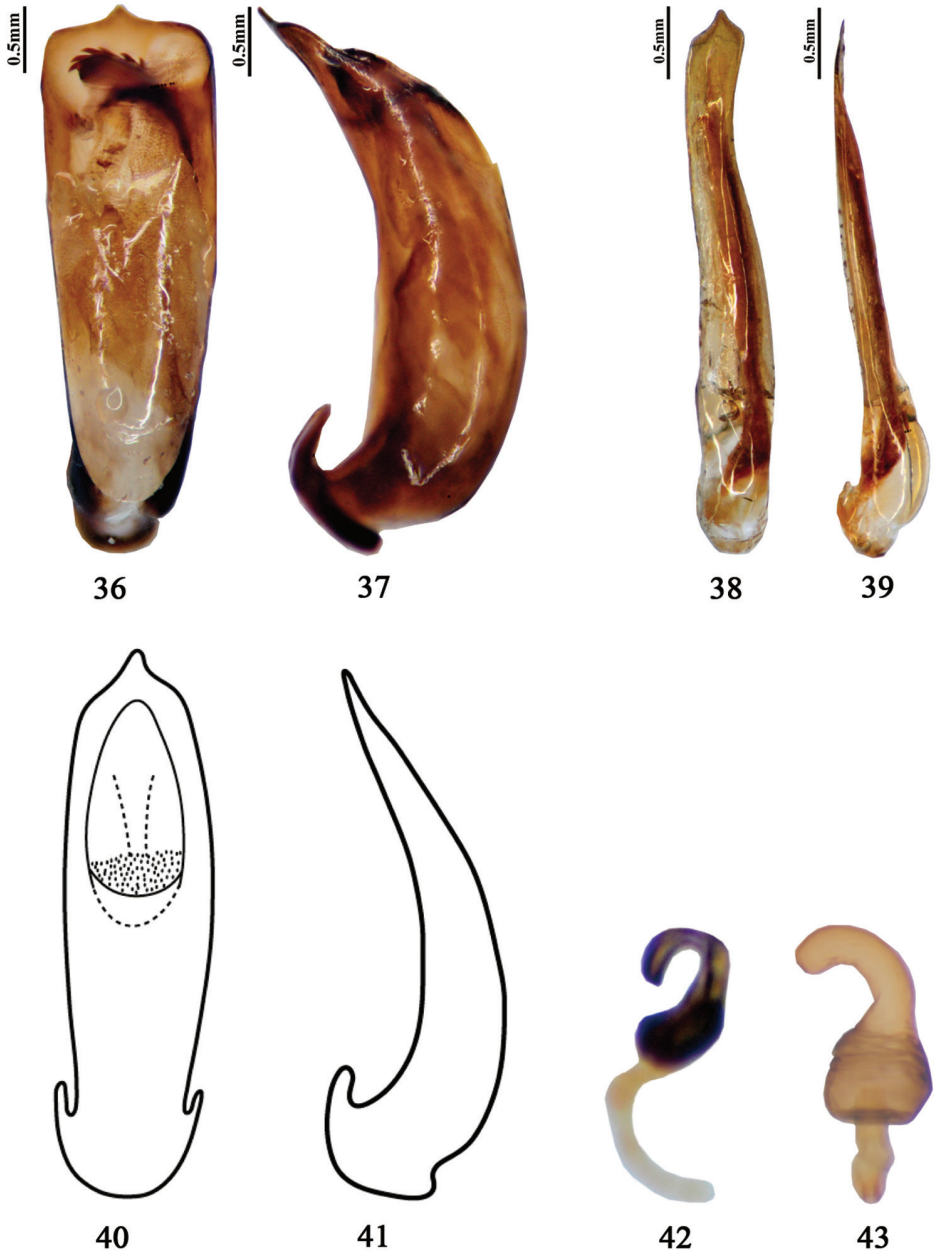
Pronotum transverse, nearly 2× as broad as long, maximum width across pronotum 1.55 mm, distance from basal margin to anterior margin 0.75 mm, anterior margin nearly straight and slightly emarginate at middle, lateral margin constricted in anterior third, basal margin slightly concave mesally; anterior angle nearly rectangular, and posterior angles obtusely rounded. Surface densely pubescent, irregularly punctured, with pair of deep depressions laterally and longitudinal depression in middle.

Scutellum trapezoid, densely punctured, sparsely pubescent.

Elytron subparallel, nearly 3.7× as long as broad, maximum width across both elytra 1.15 mm, linear distance from base to apex of elytra 4.25 mm; surface confusedly punctured and closely covered with fine hairs; space between punctures smaller than diameter of puncture; epipleuron slightly broad basaly, gradually narrowed toward apex.

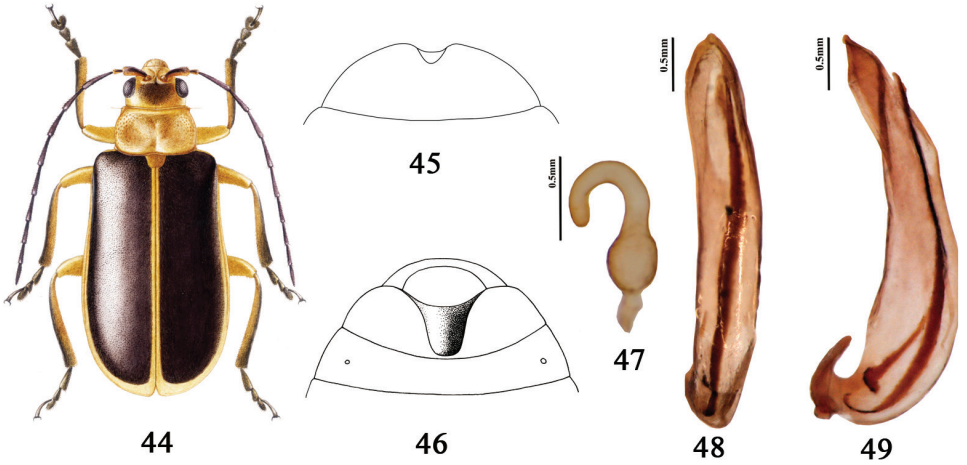
Ventral surface: mesoventrite glabrous, mesepisternum and mesepimeron thinly covered with short pubescence. Middle disc of metaventrite brown, with sparse hairs. Last sternite of male with very deep “U” shape emarginate cavity reaching nearly its basal margin.

Legs moderately stout, hind tarsomere 1 nearly equal with last which is nearly as long as 2 and 3 together.



Figures 36–43. Aedeagus / spermatheca **36–37** *P. sulcatipennis* (holotype, **36** dorsal view **37** lateral view) **38–39** *P. tianmuensis* (**38** dorsal view **39** lateral view) **40–41** *P. warchalowskii* (Bezděk 2007 orig., **40** dorsal view **41** lateral view) **42** spermatheca of *P. fossata* (holotype) **43** spermatheca of *P. xizangana* (paratype).

Male. Last abdominal sternite with very deep U-shape cavity (Fig. 46). Aedeagus: dorsal view: strongly asymmetrical but nearly parallel-sided, apex subacute, tapered; lateral view: somewhat sinuate on left side, gradually tapering to acute tip on right side. (Figs 48–49).



Figures 44–49. *Pyrrhalta quinana* sp. n. **44** Adult **45** The last abdominal sternite of female **46** The last sternite of male **47** spermatheca **48–49** aedeagus (**48** dorsal view **49** lateral view).

Female. Last abdominal sternite with triangle emargination at center of apex (Fig. 45). Spermatheca: base not bent, capsule wall thick, apex of capsule about 1/2 as long as capsule (Fig. 47).

Length: 5.4–5.5 mm (linear distance from labrum to elytral apex); width: 2.0–2.1 mm (width across base of elytra).

Etymology. This species is named for its holotype locality, Guizhou province (shortened form as "Qian" in Chinese).

Distribution. China (Guizhou, Sichuan).

Discussion

Pyrrhalta is a species rich, worldwide distributed genus with complex classification and nomenclature. The relationships of *Pyrrhalta* and related genera (*Galerucella*, *Neogalerucella*, *Xanthogaleruca*, and *Tricholochmaea*) are still unclear. The updated catalogue of Galerucinae treated *Galerucella*, *Xanthogaleruca*, and *Tricholochmaea* were as valid genera and *Neogalerucella* as subgenus of *Galerucella* (Beenen 2010). To explore true relationship of these groups, a thorough revision of *Pyrrhalta* is necessary. Considering that subgenera currently are very poorly defined, we will separate the genus into several artificial groups and produce a series of revisionary works. In this study, we have reviewed *Pyrrhalta* species with black elytra. Based on the current morphological work with thirteen species of *Pyrrhalta* with black elytra two types of internal sac were found. One is with comb-shaped sclerites and another one lacking the sclerites. Comb-shaped sclerites presents in *P. sulcatipennis* and *P. subaenea*. They are absent in the rest of the studied species including *P. orientalis* which is placed in *Xanthogaleruca* in the updated catalogue of Galerucinae (Beenen 2010). Therefore, comb-shaped internal

sac cannot be used to distinguish *Xanthogaleruca* and *Pyrrhalta*. The proper status of *Xanthogaleruca* could not resolve until a thorough revision of *Pyrrhalta* is done. We still need to find reliable characters to identify above related groups. It may be necessary to combine traditional morphological methods with molecular and biological methods to achieve this goal.

Acknowledgments

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RESEARCH ARTICLE

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A new species of *Tarsonops* (Araneae, Caponiidae) from southern Belize, with a key to the genera of the subfamily Nopinae

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Abstract
A new species of Caponiidae, *Tarsonops irataylori* **sp. n.** is described from southern Belize, and a key to the genera of the subfamily Nopinae is provided.

Keywords
Spider, *Tarsonops*, new species, Belize

Introduction

Comprising 84 species parceled among 15 genera (Platnick 2012), the spider family Caponiidae is widely distributed but not currently known from Australia or Europe. Petrunkevitch (1939) divided the Caponiidae into two subfamilies, Caponiinae and Nopinae, the latter of which is characterized by subsegmented tarsi and has a New World distribution with 53 species described from North, South, and Central America and numerous species known from the Caribbean. While recent authors have ques-

tioned the monophyly of the Caponiinae, citing a lack of synapomorphies (Jiménez et al. 2011), the Nopinae is generally regarded as a valid group with subsegmented tarsi as a distinguishing feature. However, Platnick (1994) suggests that caponine taxa with fewer than eight eyes may be more closely related to nopines.

The genus *Tarsonops*, the subject of this paper, was erected by Chamberlin (1924) to accommodate the species, *Nops sternalis*, originally described by Banks (1898). At the time, Chamberlin (1924) also described, on the basis of female specimens, three additional species, *Tarsonops clavis, Tarsonops sectipes,* and *Tarsonops systematicus,* all collected in Mexico adjacent to the Gulf of California. He also provided a key to species based on female anatomy, with an emphasis on leg morphology. Subsequently, Gertsch (1935) published additional records for *Tarsonops systematicus*, collected in southern Texas, and Ubick (2005) reports that this species also occurs in California and Arizona and illustrates the male pedipalp (figure 18.10). Although numerous new species have been described in the family Caponiidae, including its subfamily Nopinae since the 1930s, no new species of *Tarsonops* have been described.

The primary purpose of this paper is to describe a new species of *Tarsonops* collected from Belize and to provide a key for the nopine genera. Unfortunately, this newly discovered species is known from only a single specimen. While a large of number of new species are described only from single specimens, greater than 1/6th of all species (Lim et al. 2012), it is with some trepidation that we propose a new taxon on the basis

Table 1. Character states for genera of Nopinae (Caponiidae) compared to *Tarsonops irataylori* sp. n.

	Taxon						
Character	*Cubanops*	*Nops*	*Nopsides*	*Nyetnops*	*Orthonops*	*Tarsonops* (all other species)	*Tarsonops irataylori* sp. n.
Number of eyes	2	2	4	2	2	2	2
Ventral translucent keel on the anterior metatarsi and translucent extension of the membrane between the anterior metatarsi and tarsi	yes	yes	no	no	yes	yes	no
Distally expanded endites	no	no	yes	yes	no	no	no
Patterned carapace	yes	no	no	yes	no	no	no
Dorsally extended inferior claw	no	yes	yes	no	no	no	no
Wide labium	yes	no	no	no	no	no	no
Bisegmented metatarsi IV	yes	yes	?	no	no	no	no
Palpal bulb longer than cymbium, distinction evident between bulb and embolus only by differences in cuticular surface	no	no	no	yes	no	no	no
Anterior tarsus with a distinct suture dividing it into two, the distal of which is shorter (versus anterior tarsus with several false sutures, most distinct of which is proximal	yes	yes	yes	yes	yes	no	no

of a single unique specimen. However, the morphological uniqueness of the species, the extension of the genus distribution, and recognition of important species level and morphological diversity serves as the impetus despite any misgivings. Moreover, it may very well be, given the combination/absence of characteristics (Table 1) for this species, that it may ultimately represent a new genus or species group, however, its palpal morphology closely resembles that described for *T. systematicus* by Ubick (2005). Although two of the nopine genera are monotypic (*Nopsides* Chamberlin 1924 and *Nyetnops* Platnick and Lise 2007) it is our opinion that the description of a new genus should be postponed until more material, including the female, and potential other species become available.

Key to the genera of the subfamily Nopinae (Caponiidae)

1	4 eyes..... ***Nopsides*** **Chamberlin, 1924**
1’	2 eyes..... **2**
2	Palpal endites (both sexes) expanded anteriorally, broadest at anterior apex of labium (see Platnick and Lise 2007); palpal bulb longer than cymbium, distinction between bulb and emobolus not evident except by sculpturing ... . ***Nyetnops*** **Platnick & Lise, 2007**
2’	Palpal endites (both sexes) not broadest anterior to apex of labium; normal palpal bulb with distinct embolus **3**
3	Anterior tarsus with distinct suture that divides article into two distinct sub-segments **4**
3’	Anterior tarsus with several false sutures, lacking distinct suture, not divided into two distinct sub-segments..... ***Tarsonops*** **Chamberlin, 1924**
4	Metatarsus IV divided into two distinct subsegments..... **5**
4’	Metatarsus IV entire ..... ***Orthonops*** **Chamberlin, 1924**
5	Tarsus I with inferior claw extended dorsally between superior claws; carapace generally lacking distinct patterning..... ***Nops*** **MacLeay, 1839**
5’	Tarsus I with inferior claw not extending dorsally between superior claws; carapace patterned ..... ***Cubanops*** **Sánchez-Ruiz et al., 2010**

Materials and methods

All measurements were taken with a Leica MZ16.5 stereomicroscope equipped with a 10× ocular and ocular micrometer scale. We measured the left appendage, usually in retrolateral view, using the highest magnification possible. Legs I-IV (femur, patella, tibia, metatarsus, tarsus) and palp article lengths (femur, patella, tibia, cymbium) given in order of proximal to distal. Illustrations were prepared using a Visionary Digital Imaging System (Ashland, VA). Photographs were recorded in multiple focal planes and assembled using the Zerene Stacker software package (Zerene Systems

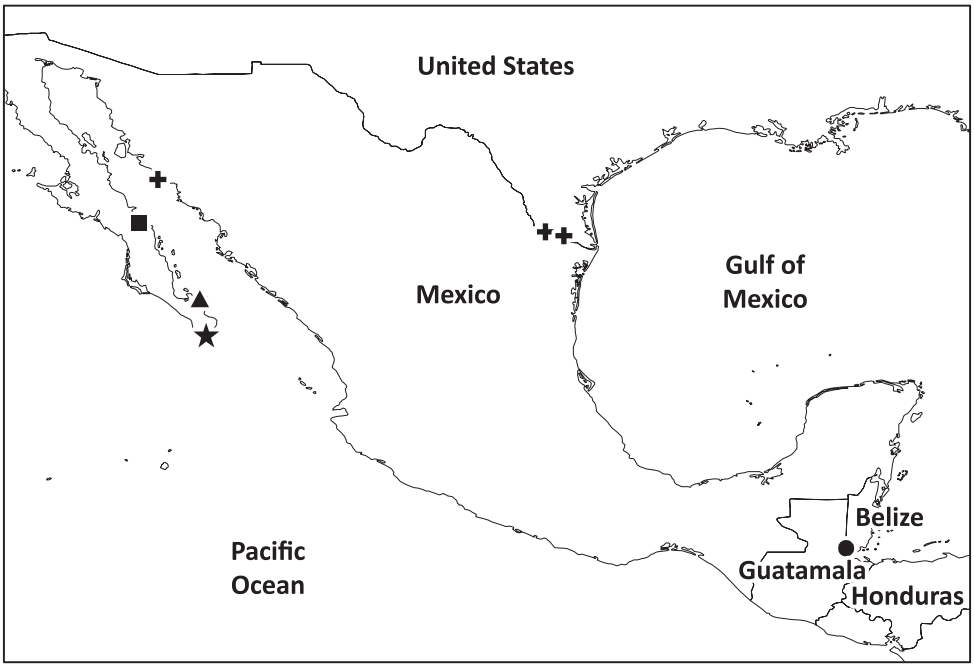
LLC, Richland, WA). The habitus illustration was constructed from whole body images that were bisected, copied, and reflected in Adobe Photoshop (Adobe Systems, Inc.) to produce a roughly symmetrical image (technique described in Bond 2012). Measurements in millimeters.

Taxonomy

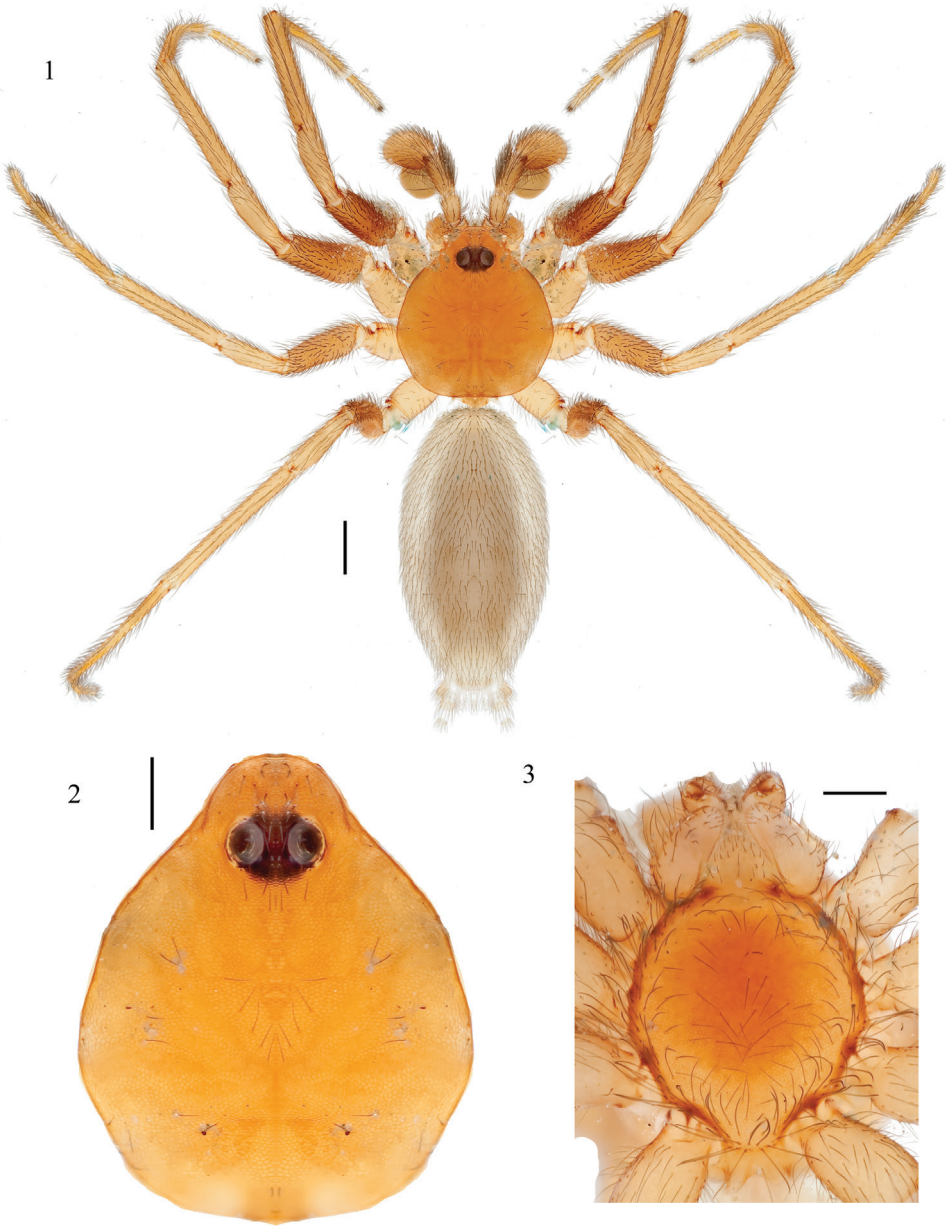
***Tarsonops irataylori* sp. n.**
urn:lsid:zoobank.org:act:4B93D052-EA8C-43E7-A5D4-28A52FE05DBE
http://species-id.net/wiki/Tarsonops_irataylori
Map 1, Figs 1–7

Type material. Holotype male from BELIZE: **Toledo District**: Cave near Pueblo Creek Cave: 37 km WNW of Punta Gorda, 16°12'N, 89°08'W (Figure 1): 16 April 2011: sjt11-018: Coll. Michael E. Slay, Jean K. Krejca, Christy M. Slay, Geoffrey B. Hoese, Germano Coe. Sample# 253, Specimen# 0222. On dry flowstone in entrance zone, 0.1 lux, air temperature 25.7 °C, soil temperature 23.5 °C, relative humidity 91.2%. Deposited in the Auburn University Museum of Natural History collection.

Etymology. The specific epithet honors the contributions of Mr. Ira W. Taylor to the study of subterranean ecosystems.



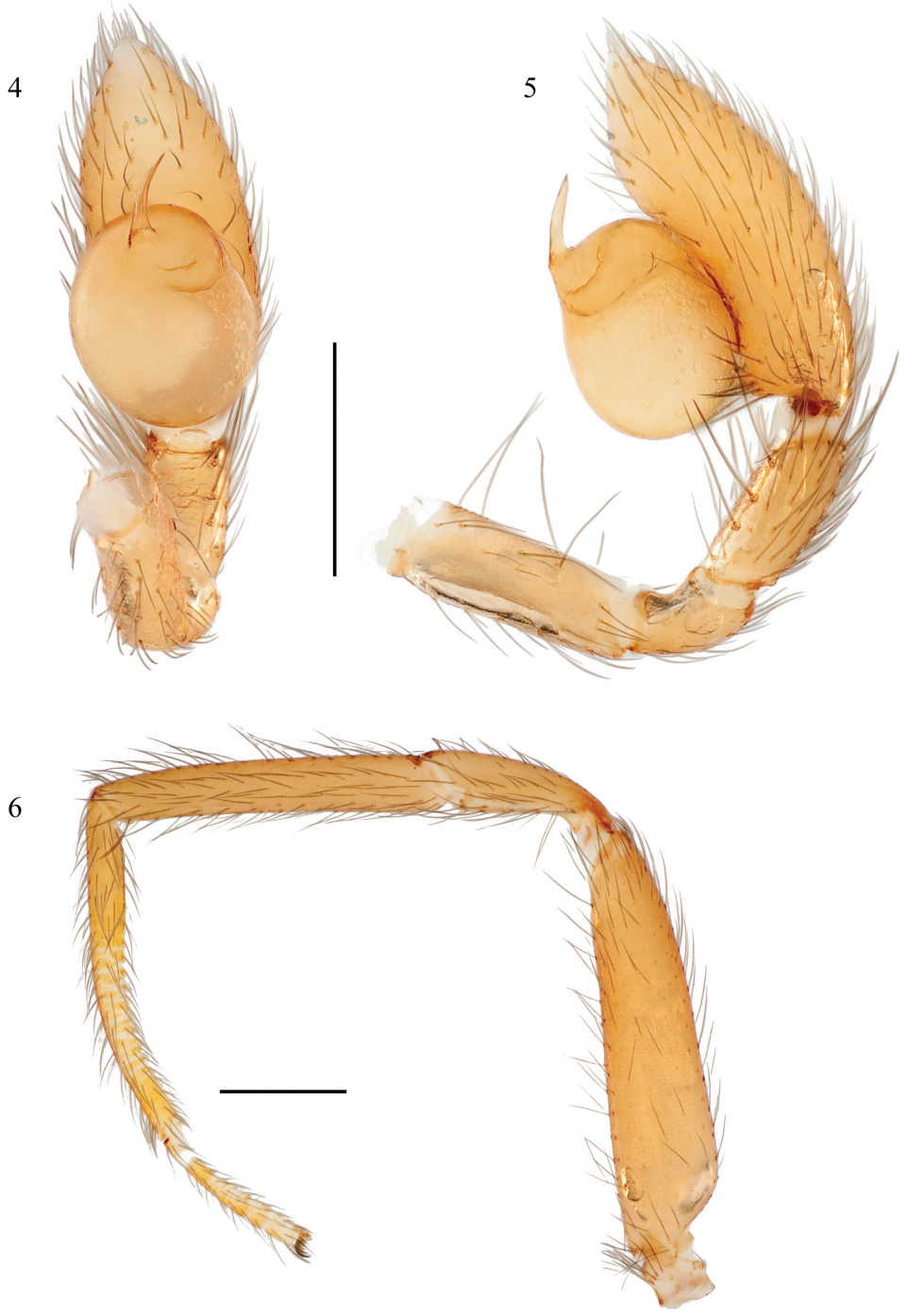
Map 1. Distribution of *Tarsonops* species: *T. sternalis* (star), *T. sectipes* (triangle), *T. clavis* (square), *T. systematicus* (crosses, also recorded from California and Arizona, see Ubick *et al.* [2005]), *T. irataylori* sp. n. (circle).



Figures 1–3. *Tarsonops irataylor* sp. n., male holotype **1** habitus, dorsal view **2** carapace, dorsal view **3** cephalothorax, ventral view. Scale bar = 0.50 mm (Fig. 1); 0.25 mm (Figs 2, 3)

Diagnosis. *Tarsonops irataylori* sp. n. differs from all known species of *Tarsonops* by the absence of a ventral translucent keel on the anterior metatarsi and a highly reduced translucent extension of the membrane between the anterior metatarsi and tarsi.

Description of male holotype. *Specimen preparation and condition*. Specimen collected live, preserved in 70% ethanol. Coloration may be faded. Pedipalp, leg I left



Figures 4–6. *Tarsonops iratayloor* sp. n., male holotype. **4** left pedipalp, ventral view **5** left pedipalp, retrolateral view **6** leg I, retrolateral view. Scale bars = 0.50 mm.

side removed and stored in vial with specimen. *General coloration*. Carapace, chelicerae, legs light orangish red (Figs 1, 2). Abdomen uniform very pale grayish brown dorsally. No dorsal carapace or abdominal patterning. *Cephalothorax*. Carapace 1.56 long, 1.40 wide, with sparse thin setae, surface lightly granular (Fig. 3), pars cephalica elevated slightly. Clypeus height 1.5× eye diameter. Two eyes, eyes separated by distance equal to radius. Sternum lightly setose, widest between coxae II, III (Fig. 4). Sternum length 1.12, width 1.00. Palpal endites rectangular, anterior margin rounded, extending slightly beyond anterior margin of labium (Fig. 4). Labium width 0.348, length 0.244. *Legs*. Leg I: 1.67, 0.740, 1.34, 1.41, 0.626; Leg II: 1.672, 0.751, 1.335, 1.485, 0.568; Leg III: 1.401, 0.600, 1.120, 1.404, 0.720; Leg IV: 1.814, 0.663, 1.509, 2.000, 1.028. Legs I-IV metatarsi and tarsi subsegmented distally (Fig. 7). Superior tarsal claw, Leg I with 5 teeth; inferior tarsal claw not extending dorsally between superior tarsal claws. Tarsus I with two trichobothria. Metatarsus I with 4 trichobothria, arranged along dorsal midline, lacking a ventral translucent keel, translucent extension of the membrane between the anterior metatarsus I and tarsus I greatly reduced, barely evident on close examination as wrinkled bump. Leg I illustrated in Figure 7. *Pedipalp*. (Figs 5, 6): 0.522, 0.270, 0.357, 0.940; bulb total length 0.618. Dense group of setae on prolateral tibial surface. Embolus short, less than 1/4th length of bulb, tapering to sharp single point, bulb sub-spherical.

Discussion

Although this species was taken from just inside a cave, it does not exhibit any obvious troglomorphies, and may be accidental in this habitat. The description of *Tarsonops irataylori* sp. n. extends the range of the genus 9 degrees east and 6.8 degrees south from the previously known range. A number of undescribed species of *Tarsonops* are known from collections in Mexico (Platnick, pers. comm. 31 October 2011).

Tarsonops irataylori sp. n. is the first species of *Tarsonops* described which lacks a ventral translucent keel on the anterior metatarsi and marked translucent extension of the membrane between the anterior metatarsi and tarsi. Chamberlin's (1924) diagnoses of the genus does not list these characters, thus we have taken the conservative approach of placing the species in this genus. As discussed above, future studies in which more specimens are examined, may further warrant the establishment of a new genus to accommodate this somewhat unusual species.

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City, Belize C.A. and the Forest Department, Ministry of Natural Resources and the Environment, Belmopan City, Belize C.A. Funding for fieldwork was provided by the Subterranean Ecology Institute, Inc. Champaign IL USA and by and NSS International Exploration Grant from the National Speleological Society Foundation. The manuscript was improved through the careful comments provided by Darrell Ubick; Norman Platnick kindly assisted in the identification of this species. This paper is Contribution No. 685 of the Auburn University Museum of Natural History.

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RESEARCH ARTICLE

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An opiine Braconidae (Hymenoptera) reared from Richardiidae (Diptera) and recognition of a new species group of *Opius* s. l.

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Abstract

A new species of opiine Braconidae, *Opius rojam* Daniels & Wharton, is described from Trinidad. The description is based in part on two individuals reared from *Sepsisoma erythrocephalum* infesting shoots of the grass *Paspalum fasciculatum*. This is the first record of members of the Opiinae attacking species in the dipteran family Richardiidae. The *Opius ingenticornis* species group is proposed and delineated to accommodate this and several putatively related species formerly included in *Opius* (*Merotrachys*), *Opius* (*Pendopius*), and *Opius* (*Ilicopius*). A key to the species of this group is provided. Descriptions and diagnoses are referenced to the Hymenoptera Anatomy Ontology.

Keywords

Parasitoid, fly, *Sepsisoma*, HAO, Poaceae

Introduction

Members of the braconid subfamily Opiinae develop as koinobiont endoparasitoids of various cyclorrhaphous Diptera, emerging from the puparium of their hosts. This biological trait defines Opiinae + Alysiinae relative to all other Braconidae. The most commonly recorded hosts of Opiinae belong to the families Agromyzidae, Tephritidae, and Anthomyiidae, at least in part because these families harbor a large number of economically important species. Hosts belonging to 11 additional families of cyclorrhaphous Diptera have also been recorded. These include Calliphoridae, Chloropidae, Diopsidae, Drosophilidae, Ephydridae, Lonchaeidae, Muscidae, Phoridae, Psilidae, Scathophagidae, and one species of Tachinidae (Yu et al. 2012), though some of these need to be vetted. The primary purpose of this contribution is to record a new family of hosts for Opiinae: the Richardiidae.

Fischer (1972, 1977, 1987) monographed the Opiinae on a world basis and numerous changes in the classification have subsequently been published. There are at least 1981 valid species in the Opiinae (Yu et al. 2012) and 116 genus group names (84 of these currently treated as valid by one or more authors) have been applied to various combinations of these species (Wharton et al. 2012). There are over 50 subgenera now in use (Yu et al. 2012), the majority of these assigned to *Opius* Wesmael s. l. Van Achterberg and Salvo (1997) restricted the name *Opius* to species with a basal lobe on the mandible, referring to a classification in press that has yet to be published. Until a more complete classification is offered, we prefer to treat *Opius* more broadly as a repository for the bulk of the Opiinae whose relationships remain uncertain, largely following the approach of Fischer (1972) and Wharton (1997a, b), as explained more recently in Wharton et al. (2012). The species treated here belong in *Opius* s. l. sensu Fischer (1972, 1999) and Wharton (1997a, b) or in *Phaedrotoma* Foerster sensu Van Achterberg and Salvo (1997). A key to genera that provides delineation of *Phaedrotoma* in this sense was recently published by Li et al. (2013). The characterization of the new species group described here and its placement within the current classification is a secondary goal of the study.

Materials and methods

Specimens. Reared material from Trinidad was kindly sent for study to the senior author by Paul Marsh (formerly USDA Systematic Laboratory, Washington, D. C.). Other specimens used in this study, primarily consisting of primary type material of previously described species, were borrowed from or examined at the following institutions: American Entomological Institute, Gainesville, Florida, USA (AEIC), California Academy of Sciences, San Francisco, California, USA (CAS), Canadian National Collection, Ottawa, Ontario, Canada (CNC), Naturhistorisches Museum Wien, Vienna, Austria (NHNW), Texas A&M University Insect Collection, College Station, Texas, USA (TAMU), and the U. S. National Museum of Natural History, Washington, D. C., USA (USNM).

In the material examined section under each species description, we record the data label for holotypes exactly as these data appear on the labels. We use a more standardized format for labels on paratypes, labels on additional specimens examined, and for data published on other specimens. Images of label data can be found at http://mx.speciesfile.org/projects/8/public/otu_group/show/386.

Figures. Images were acquired digitally using either Helicon Focus® or Syncroscopy's AutoMontage® software, mostly in combination with either a ProgRes 3008 or a Zeiss AxioCam MRc5 digital camera mounted on a Leica MZ APO dissecting microscope. A few images were also acquired with a Leica M205C equipped with an internal camera. All images were further processed using various minor adjustment levels in Adobe Photoshop® such as image cropping and rotation, adjustment of contrast and brightness levels, color saturation, and background enhancement. Compiled images, including many not incorporated here, are available in color and high resolution at http://mx.speciesfile.org/projects/8/public/otu_group/show/386.

Database management, digital dissemination, and ontology reference. Illustrations and free-text diagnoses for morphospecies were assembled in mx, a web-based content management system that facilitates data management and dissemination for taxonomic and phylogenetic works (e.g. Yoder et al. 2006). The mx project is open source, with code and further documentation available at http://sourceforge.net/projects/mx-database/. Data pertinent to this work, including images, diagnoses, and descriptions, are available at http://mx.speciesfile.org/projects/8/public/otu_group/show/386. The multiple entry key found at this site was also generated in mx.

Morphological terms used in this revision were matched to the Hymenoptera Anatomy Ontology (HAO, Yoder et al. 2010, Seltmann et al. 2012). Identifiers (URIs) in the format http://purl.obolibrary.org/obo/HAO_XXXXXXX represent anatomical concepts in HAO version http://purl.obolibrary.org/obo/hao/2011-05-18/hao.owl, as used by Wharton et al. (2012, Appendix). The URIs are provided to enable readers to confirm their understanding of the anatomical structures being referenced. To find out more about a given structure, including images, references, and other metadata, use the identifier as a web-link, or use the HAO:XXXXXXX (note colon replaces underscore) as a search term at http://glossary.hymao.org. Terminology as linked through the HAO (Wharton et al. 2012 Appendix) largely follows Sharkey and Wharton (1997), with a few additions from Walker and Wharton (2011) and Wharton et al. (2012). Measurements largely follow Walker and Wharton (2011) except where indicated.

Results

Biology. Two individuals representing a previously undescribed species very similar to *Opius ingenticornis* Fischer were reared by Fred Bennett from individually isolated puparia of *Sepsisoma erythrocephalum* (Schiner) (Diptera: Richardiidae) in Curepe, St. George Co., Trinidad. A nearly circular emergence hole, with jagged edges typical of many opiines, is located near the anterior end of each of the two puparia: dorsally

on one puparium and ventrally on the other. Richardiid biology is generally poorly known, with a few records for species in other genera developing in flowers or rotting vegetation (Hancock 2010). The fly larvae from which these wasps were reared were collected from shoots of the grass *Paspalum fasciculatum* Wild. ex Fluegge (Poaceae), that were exhibiting deadheart (Deeming 1985). The wasps that emerged from these puparia are described below as *Opius rojam* Daniels & Wharton, sp. n. See also the remarks section under *O. ingenticornis* below.

There are no host records for any of the other members of the *ingenticornis* species group. The relative rarity of biological information on richardiids may explain this, and we therefore predict that most if not all of the members of this species group may eventually be found to utilize richardiids as hosts.

Genus group placement and characterization. *Opius rojam* and *O. ingenticornis* belong to an exclusively New World group of species that hereafter will be referred to as the *ingenticornis* species group. Among species of *Opius* s. l. with a distinctly exposed labrum (Figs 1–4) but lacking a mesoscutal midpit (Fig. 5), a precoxal sulcus (Fig. 6, 17, 33), and a basal lobe on the mandible (Figs 1–4), they are most readily recognized by the combination of very long antennae (Figs 13–16; known species with 45–62 flagellomeres), huge pronope (Figs 5, 8), and the relatively distinctive petiole (Figs 9, 11–12). Most of the species treated here were placed by Fischer (1977, 1979a) in the subgenus *Merotrachys* Fischer, with a few also in the subgenus *Pendopius* Fischer. Subsequent changes in the subgeneric classification, summarized in Fischer (1999), would necessitate the transfer of some of these species to *Ilicopius* Fischer, though this has never been formally done. In the classification suggested by van Achterberg and Salvo (1997), these species would all be placed in the genus *Phaedrotoma*. The species treated here were selected based on an examination of nearly all of the primary types of *Ilicopius*, *Merotrachys*, *Opius* (*Opius*) sensu Fischer (1977), and *Pendopius*. It is possible, however, that we have overlooked other described species that should be placed in the *ingenticornis* species group.

Fischer (1972) initially characterized *Pendopius* on the basis of reduced body sculpture relative to *Merotrachys* but subsequently (Fischer 1999), he restricted *Pendopius* to species with the maxillary palp much longer than head height. The maxillary palp is difficult to measure on intact specimens, which is problematic since about half of the species treated below are known only from the holotype. Nevertheless, though variable within the *ingenticornis* species group (Figs 2–3), none of the species has the palp sufficiently long to be placed in *Pendopius* sensu Fischer (1999). T2+3 is shagreened in many of these species (Fig. 21), leading to their placement in *Merotrachys*. Those without sculpture on T2+3 fall within *Ilicopius* based on Fischer (1999). Unfortunately, the sculpture exhibits a gradient from extensive and readily visible to patchy and virtually absent across species and also among specimens within a species, greatly reducing the diagnostic value of this character state. Thus, the species that we include in the *ingenticornis* species group fall into at least two and possibly even three subgenera within Fischer's (1972, 1999) classification of *Opius* s. l. Since these species are notably different from the type species of *Ilicopius*, *Merotrachys*, and *Pendopius*, and

yet appear to form a natural group (as delineated below), we have elected to treat them as a species group within *Opius* s. l. but without assigning them to a specific subgenus.

The *ingenticornis* species group can be defined as follows: Mandible (Figs 1–4) short, broadly triangular, dorsal margin strongly angled ventrally, broadly exposing labrum. Clypeus (Figs 1–4) shaped as a broad crescent, nearly hemispherical, flat to weakly protruding ventrally, ventral margin shallowly concave, rarely appearing truncate. Malar sulcus distinct, complete. Antenna unusually long (Figs 13–16), approximately twice longer than body; first flagellomere slender, longer than second, with long, narrow plate sensilla. Occipital carina broadly absent dorsally (Figs 8, 18, 20, 24), the gap in dorsal view at least as wide as distance between eyes; carina well developed laterally and ventrally, widely separated from hypostomal carina ventrally. Pronope (Figs 8, 24) deep, wide, posterior margin at least weakly overlapping base of mesoscutum (Fig. 6), thus obliterating posterior transverse sulcus medially; vertical carina absent on pronotum laterally. Mesoscutum (Fig. 5, 24) without midpit; notaulus short, curved, pit-like anteriorly, narrowing and evanescent posteriorly; anterior declivity (Fig. 6) shallow to absent or nearly so. Propodeum (Figs 7, 25–28) with median depression at least anteriorly, never with median longitudinal carina. Mesopleuron (Fig. 6) without sternaulus, precoxal sulcus unsculptured, absent or very faintly indicated; hind margin of mesopleuron not obviously crenulate on dorsal 0.5. Fore wing (Figs 29–30) with second submarginal cell long to very long, 3RSa at least 1.2 × longer than 2RS; m-cu variable: antefurcal, interstitial, or postfurcal relative to 2RS; 2CUb arising from or near middle of first subdiscal cell. Hind wing (Fig. 29) with RS distinctly infumate; m-cu absent. T1 (Figs 9, 11–12) with dorsal carinae parallel or nearly so, extending from base to apex; laterope large, deep; dorsope absent. Sculpture on T2+3 variable, shagreened when present.

The petiole (T1) is notably different from that of the type species of *Ilicopius*, *Merotrachys*, and *Pendopius*, all of which lack the distinctive anterior declivity and have more poorly developed dorsal carinae. The antennae are also shorter in these three species (less so in *Opius ilicis* Nixon than in the other two but still with fewer than 30 flagellomeres) and the mesoscutum is sharply declivitous anteriorly. Many of the species of the *ingenticornis* species group are large (body length 3–4 mm) with longer, more slender mesosomas relative to the more typical opiines that attack agromyzid hosts, such as the type species of *Ilicopius*, *Merotrachys*, and *Pendopius*. Perhaps as a result of the larger size, the setae on the mesoscutum seem longer and more erect. The setae are more densely clustered anteriorly then follow along the lines of the notauli in a single row posteriorly.

In a few of the species treated below several individuals were available for examination. In these, the origin of fore wing m-cu relative to 2RS was variable, and in one case, there was variation between the right and left fore wing. This variation creates difficulties for use of existing keys to species of both *Merotrachys* and *Pendopius* (Fischer 1979a, b). *Merotrachys*, in the sense of Fischer (1972, 1977, 1979a, 1999), consists of species with sculpture on the metasomal tergites posterior to T1. Since the type of sculpture differs among species currently assigned to *Merotrachys* (striate in some, shagreened in others, for example), characterization of *Merotrachys* as monophyletic on this basis alone may

be difficult. The type of sculpture in the members of the *ingenticornis*, when present, is all the same (shagreened) and is consistent with monophyly of this species group.

Species treatment. The species are treated under two sections below, immediately following the dichotomous key. The first section contains the one newly described species, followed in alphabetical order by the 14 described species that we have included in the *ingenticornis* species group. The second section contains four additional species that are similar in some respects, but which are excluded at the present time. All of the excluded species have complete, well-developed, more or less parallel-sided dorsal carinae on T1, and the configuration of the clypeus, labrum, and mandibles is the same as in the *ingenticornis* species group. These may represent basal members of this putative clade, but are excluded therefrom primarily because of differences in the shape of T1, without a distinct anterior declivity and with the basal depression not as clearly delimited posterior-medially. Additionally, the antennae are either broken or have significantly fewer flagellomeres. Rationale for exclusion is included in the remarks section under each of these four species.

Key to species of the ingenticornis species group. Fischer (1977, 1979a, b) provides the most recent dichotomous keys to the species of *Merotrachys* and *Pendopius*. The dichotomous key presented here is modified from these. A multiple entry key can be found at http://mx.speciesfile.org/projects/8/public/site/wharton_lab/home.

1	Propodeum weakly sculptured laterally: smooth to shagreened between propodeal spiracle/pleural carina and margin of median trough (Figs 25–27). Mesopleuron yellow to orange **2**
–	Propodeum coarsely sculptured laterally, rugose to carinately rugose on smooth to shagreened background (Figs 7, 28). Mesopleuron varying from yellow to dark brown **4**
2 (1)	Tegula and lateral margin of mesoscutum dark brown to black (Fig. 42) ..... ***O. nimifactus*** **Fischer**
–	Tegula and lateral margin of mesoscutum yellow to orange **3**
3 (2)	Median trough of propodeum deep, sharply carinately margined from base to apex with at least some transverse carinae in trough (Fig. 27) ..... ***O. curiosicornis*** **Fischer**
–	Median trough relatively shallow, less distinctly margined (Fig. 26)..... ***O. macrocornis*** **Fischer**
4 (1)	Head dark brown to black; mesosoma predominantly yellow to orange (Figs 35–36)..... **5**
–	Color pattern not as above, either head pale (Figs 13–16) or, if head dark, then mesosoma also predominantly brown to dark brown (Figs 17, 19) **6**
5 (4)	Hind femur, T1, and tegula dark brown to black. T1 and T2+3 distinctly and extensively shagreened (as in Fig. 21) ..... ***O. petri*** **Fischer**
–	Hind femur, T1, and tegula yellow to pale orange. T1 and T2+3 faintly and sparsely shagreened ..... ***O. raphaeli*** **Fischer**

6 (4) Female with ovipositor sheath 0.5–0.6 times length of mesosoma (Fig. 33). Head pale and tegula dark (Fig. 33) ..... ***O. michaeli*** **Fischer**

– Male, or female with ovipositor sheath shorter, 0.2–0.4 times length of mesosoma (Figs 13, 15–16). Head dark or pale; if pale, then tegula also pale.....**7**

7 (6) Head and T1 dark brown to black. Mesosoma predominantly dark (Figs 17, 19, 34).....**8**

– Head and T1 predominantly pale: yellow to orange. Mesosoma predominantly pale **10**

8 (7) Hind legs yellow (Fig. 34). Face densely, finely granular (Fig. 1) ....***O. matthaei*** **Fischer**

– Hind legs white basally, dark brown to black distally (Fig. 17). Face mostly shagreened, partly smooth, polished **9**

9 (8) Head in dorsal view 1.8 times wider than long .....***O. albericus*** **Fischer**

– Head in dorsal view 2.0 times wider than long .....***O. pilosicornis*** **Fischer**

10 (7) Vertex and frons infumate (Fig. 46). Nearctic..... ***O. antennatus*** **Fischer**

– Vertex and frons yellow to orange, same color as remainder of head. Neotropical: Brazil, Costa Rica, Peru, Trinidad.....**11**

11 (10) Tegula dark brown to black; posterior margins of meso- and metathorax dark brown to black (Fig. 5) ..... ***O. melchioricus*** **Fischer**

– Tegula yellow to orange; posterior margins of meso- and metathorax yellow to orange **12**

12 (11) Metasomal terga 5 and 6 dark brown to black (Fig. 16) ..... ***O. gabrieli*** **Fischer**

– Metasomal terga 5 and 6 yellow to orange **13**

13 (12) T1 predominantly shagreened (Fig. 38).....**14**

– T1 more extensively rugose (Fig. 37) ..... ***O. rojam*** **Daniels & Wharton, sp. n.**

14 (13) Fore wing with second submarginal cell shorter, 3RSa about 1.2–1.3 times longer than 2RS; m-cu interstitial or weakly postfurcal relative to 2RS .... ***O. ingenticornis*** **Fischer**

– Fore wing with second submarginal cell longer, 3RSa about 1.5 times longer than 2RS; m-cu antefurcal relative to 2RS ..... ***O. filiflagellatus*** **Fischer**

The *ingenticornis* species group, included species

Opius rojam **Daniels & Wharton, sp. n.**
urn:lsid:zoobank.org:act:EBE195C9-36B8-43DF-9E44-E15804E0F1B5
http://species-id.net/wiki/Opius_rojam
Figs 4, 6–9, 13, 29, 37, 39–40, 43

Type locality. Trinidad, St. George Co., Curepe

Type material. Holotype. Female (USNM), first label, first line: Trinidad: St. George second line: Co., Curepe third line: III 1982 fourth line: F.D. Bennett second

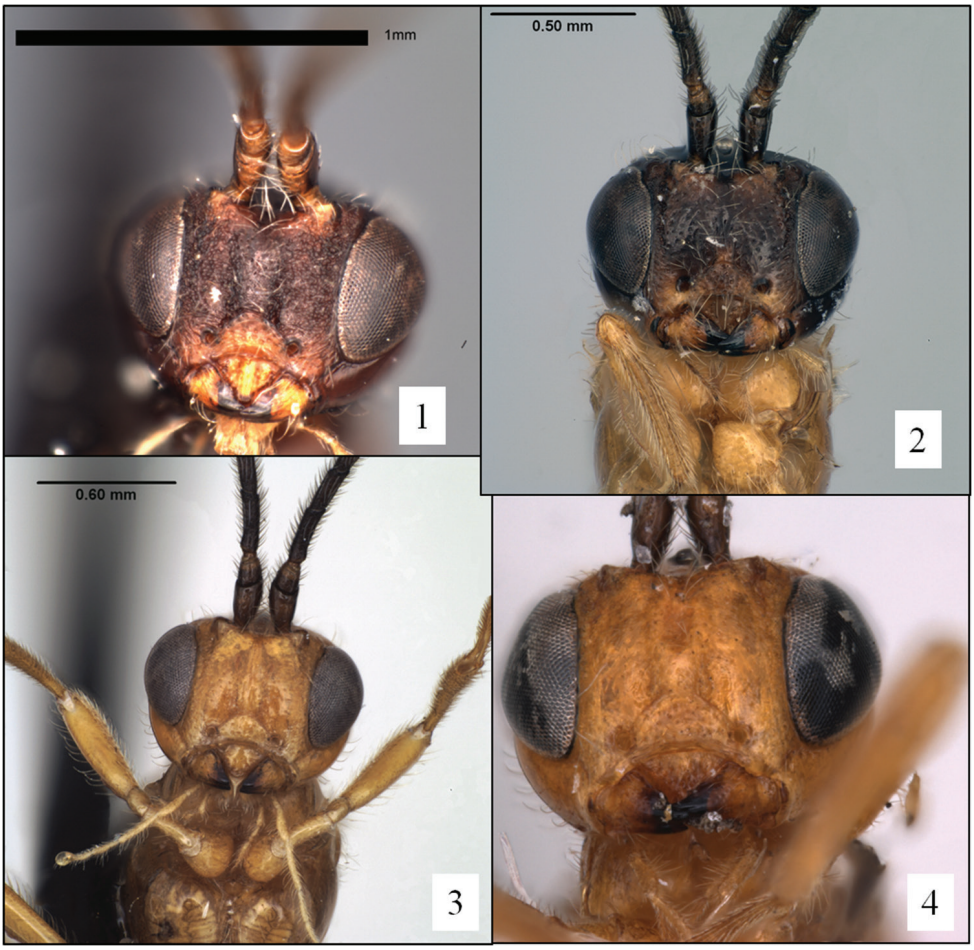
label, first line: ex puparium second line: Sepsisoma third line: erythroceph- fourth line: alum third label: 82–92

Paratypes. One male, same data as holotype except third label = 82–90 (TAMU). Two females, Costa Rica, Puntarenas Province, Golfito, 25.vi.1976, M. Wasbauer, Malaise trap 8am-5pm (TAMU).

Description. *Female*. Eye in dorsal view 2.1–2.2 × longer than temple, temples not receding; eye in lateral view 2.3–2.5 × longer than temple. Face coarsely shagreened throughout; weakly elevated midridge extending from clypeus to antennal bases bifurcated dorsally by shallow impression extending ventrally from frons; median impression more elongate in Trinidad than in Costa Rica specimens. Clypeus coarsely shagreened; ventral margin concave, strongly impressed, in profile very weakly bulging dorsad impressed ventral margin, otherwise flat; 1.7–1.8 × wider (between anterior tentorial pits) than midheight. Anterior tentorial pit large, diameter 0.3–0.4 × maximum height of clypeus. Malar space 0.7–0.8 × longer than basal width of mandible; malar sulcus deep, marking sharp contrast between shagreened face and smooth, polished gena. Occipital carina broadly absent dorsally, well-developed laterally, widely separately from hypostomal carina ventrally. Mandible broadly triangular, without basal tooth or lobe; dorsal margin reflected ventrally, broadly exposing labrum; with two apical teeth, ventral tooth slightly smaller than and positioned posterior to dorsal tooth. Maxillary palp about as long as height of head. Antenna approximately 1.8 × longer than body, with 55 flagellomeres; first flagellomere 1.1–1.2 × longer than second, 1.25–1.35 × longer than third; first, second, and third flagellomeres 3.1–3.5, 2.6–2.8, and 2.2–2.5 × longer than wide, respectively; setae on basal flagellomeres thin, pale.

Mesosoma 1.5 × longer than high; 2.3 × longer than wide; 1.5–1.6 × higher than wide. Pronope deep, very large, posterior margin flattened, obliterating posterior transverse sulcus and broadly overlapping base of mesoscutum; pronotum laterally with shallow vertical groove lacking carinate anterior margin. Mesoscutum anteriorly on nearly same plane as pronotum, without distinct anterior declivity; with white, weakly decumbent setae around margins and extending in 1–2 rows along traces of notauli to posterior margin, becoming less densely clustered posteriorly; midpit absent. Notaulus deeply impressed as a short, curved line, not extending to anterior margin of mesoscutum, extending posterior-medially nearly to level of anterior margin of tegula; extending laterally towards tegula as groove bordered by very well-developed supramarginal carina. Scuto-scutellar sulcus rectangular, crenulate. Scutellum bare medially, setose laterally. Propodeum coarsely, carinately rugose, with short median trough anteriorly, areola indistinct, largely obscured by sculpture posteriorly; pleural sulcus irregular, mostly obscured by sculpture; propodeal spiracle equidistant from anterior and posterior margins. Mesopleuron smooth, polished, bare except posterior-ventrally; precoxal sulcus not evident in holotype, present in paratypes as short, faintly impressed, unsculptured groove. Metapleuron finely rugulose on ventral 0.5–0.6, evenly covered with long, white setae.

Wings. Fore wing stigma wedge-shaped, discrete distally, approximately 3.6 × longer than wide; r1 shorter than stigma width, arising from basal 0.55 of stigma; 1RS (excluding parastigma) short, 0.15–0.2 × length of 1M; m-cu interstitial; second

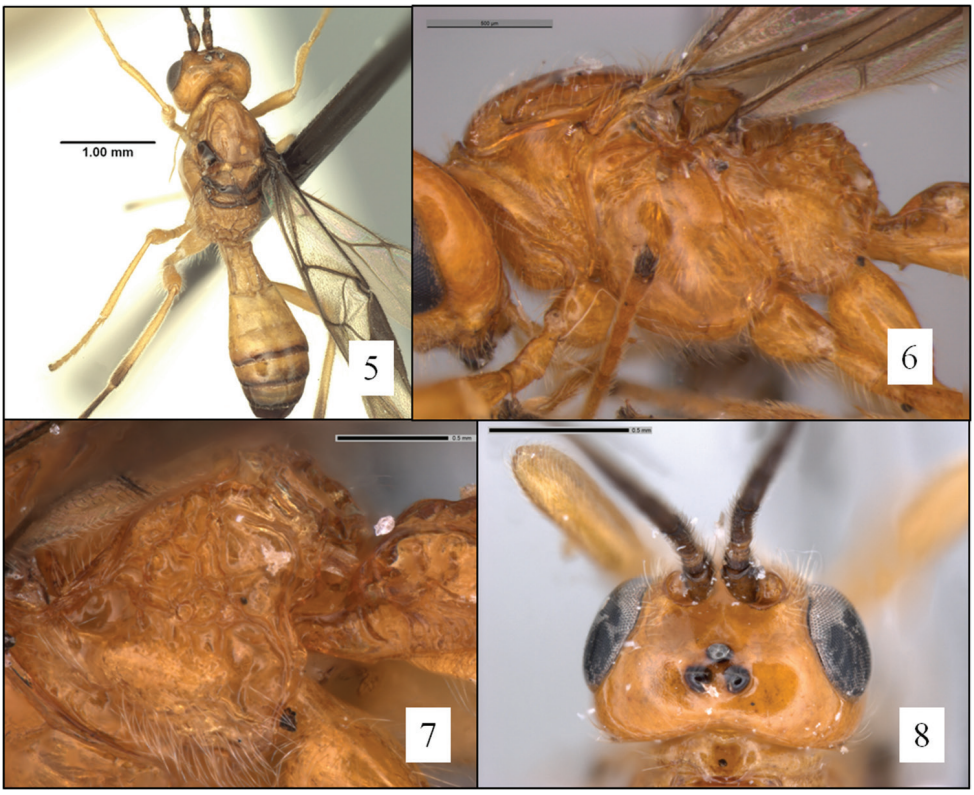


Figures 1–4. *Opius* spp., face. **1** *O. matthaei* Fischer, holotype, showing granular sculpture **2** *O. raphaeli* Fischer, holotype **3** *O. melchioricus* Fischer **4** *O. rojam* Daniels & Wharton sp. n., holotype.

submarginal cell converging distally, 3RSa 1.15–1.3 × longer than 2RS; 1cu-a usually interstitial with 1M, weakly postfurcal in one female paratype. Hind wing m-cu completely absent; RS and M equally well-developed as pigmented lines.

Metasoma with T1 1.2–1.3 × longer than apical width, apex 1.7–1.9 × wider than base, length 2.9–3.4 × height at spiracle; sharply declivitous anteriorly, with deep, discrete basal depression; surface coarsely rugose; dorsal carinae distinctly elevated, nearly parallel-sided throughout, very weakly diverging posteriorly, not sinuate, transversely carinate between dorsal carinae; laterope large, deep. T2+3 uniformly shagreened, T4 more weakly and irregularly so. Ovipositor short; ovipositor sheath about 0.2–0.3 × length of mesosoma.

Color. Head, body, tegula, fore and mid legs, hind coxa, trochanter, trochantellus, femur, and basal 0.6–0.7 of tibia orange; remainder of hind leg, pretarsi of all legs, antenna, and ovipositor sheath dark brown to black; wings infumate to darkly infumate.



Figures 5–8. *Opius* spp. **5** *O. melchioricus* Fischer, mesosoma, dorsal view **6** *O. rojam* Daniels & Wharton sp. n., holotype, mesopleuron **7** *O. rojam* holotype, propodeum posterior-lateral view **8** *O. rojam* head and pronotum, dorsal view, showing enlarged pronope.

Male. Largely as in female with variation as follows: antenna 2.05 × longer than body, with 56 flagellomeres; mesosoma 2.4 × longer than wide; fore wing m-cu postfurcal; T1 with apex 2.0 × wider than base; metasomal tergum and genitalia black.

Body length 3.9–4.0 mm, fore wing length 4.0 mm, mesosoma length 1.45–1.55 mm.

Diagnosis. Face shagreened throughout. Temples in dorsal view not receding. Antenna with 55–56 flagellomeres; setae on basal flagellomeres thin, pale. Mesoscutum anteriorly on nearly same plane as pronotum, without distinct anterior declivity. Propodeum coarsely, carinately rugose, with short median trough anteriorly, areola largely obscured by sculpture posteriorly. Fore wing 3RSa 1.15–1.3 × longer than 2RS. T1 sharply declivitous anteriorly; surface coarsely rugose. T2+T3 distinctly shagreened. Ovipositor short; ovipositor sheath about 0.2–0.3 × length of mesosoma. Head, body, hind coxa and femur orange; antenna without pale subapical ring; wing infumate.

This species is nearly identical to *O. ingenticornis*, from which it differs primarily in sculpture. Most notably, T1 is extensively shagreened in *O. ingenticornis* and lacks coarsely rugose sculpture (Fig. 38). In *O. rojam*, T1 lacks evident shagreening and is coarsely sculptured throughout (Figs 9, 37), including distinct transverse carinae be-

tween the dorsal carinae. *Opius rojam* is also a slightly larger species, with somewhat darker wings. For further discussion of related species, see remarks under *O. gabrieli* below as well as the remarks under *O. ingenticornis* and *O. filiflagellatus*.

Biology. The two specimens from Trinidad (holotype and male paratype) were reared from *Sepsisoma erythrocephala* (Diptera: Richardiidae), and associated puparia are pinned with the specimens. Additional details are given above under the Biology heading at the beginning of the results section.

Etymology. This species is dedicated to Major, a dear friend, but for nomenclatural purposes the species name should be treated as an arbitrary combination of letters.

Remarks. The holotype shows evidence of developmental irregularities along the midline of T2+3 (Fig. 40). The antennae are broken in paratypes from Costa Rica, but these specimens otherwise match the reared material from Trinidad. The male and female from Trinidad have approximately the same number of flagellomeres. The flagellomeres are more numerous than in the females of *O. ingenticornis* but fewer than in the male paratypes of this species as recorded by Fischer (1965c). The apparent difference in antennal length between the male and female of *O. rojam* from Trinidad may be an artifact since the antennae are strongly curled apically in the female holotype and therefore difficult to measure accurately.

***Opius albericus* Fischer**
http://species-id.net/wiki/Opius_albericus
Figs 17, 18, 21

Opius (*Merotrachys*) *albericus* Fischer, 1979a: 264–267 (key); 267–269 (description). Holotype female in AEIC (examined).
Opius (*Merotrachys*) *albericus*: Yu et al. 2005, 2012 (electronic catalogs).

Type locality. Brazil, Rondonia, Vilhena.

Type material. Holotype. Female (AEIC), first label, first line: Vilhena, Rond. second line: XI. '73 Brazil third line: M. Alvarenga

Paratypes. Two males (not seen), same data as holotype; one male (not seen), Brazil, Mato Grosso, Sinop, 12°31'S, 55°37'W, x.1974, M. Alvarenga.

Diagnosis. Face distinctly punctate, punctures separated by about 1 × their diameter, strongly shagreened adjacent eye margin, otherwise appearing very weakly shagreened to smooth between punctures, though difficult to see because of position on pin. Eye in lateral view about 2.0–2.5 × longer than temple; temples in dorsal view not receding. Antenna of female broken, 42 flagellomeres remaining, male with 52 flagellomeres; setae on basal flagellomeres thick, dark. Mesoscutum anteriorly on nearly same plane as pronotum, without distinct anterior declivity; notaulus extending laterally towards tegula as groove bordered by distinct supramarginal carina. Propodeum coarsely rugose, median areola absent, median trough anteriorly difficult to see but apparently weak, indistinct. Fore wing 3RSa straight, 1.4–1.5 × longer than 2RS; m-cu postfurcal.

T1 declivitous anteriorly at about a 45 degree angle, basal pit delimited posterior-medially; surface shagreened throughout; dorsal carinae sinuate, widest subapically, narrowing apically, without obvious transverse carinae between dorsal carinae. T2 uniformly, distinctly shagreened; T3 mostly weakly shagreened, smoother and very finely punctate laterally. Ovipositor short, barely protruding; ovipositor sheath roughly 0.4 × length of mesosoma. Head, mesosoma, T1, T3–T6 dark reddish brown to dark brown; T2 white with narrow, dark brown lateral margins; hind coxa white; hind femur almost completely dark reddish brown; antenna without subapical pale ring; wing lightly infumate.

Remarks. Originally described from the female holotype and 3 male paratypes. This species, described from western Brazil, is nearly identical to *O. pilosicornis*, described from Peru. Fischer (1979a) separates the two species on the basis of quantitative differences in the shape of the head and T1, shape of the T1 dorsal carinae, and leg color. Slight differences in the shape of the head (Figs 18, 20: width vs. length in dorsal view 1.8 in *O. albericus*, 2.0 in *O. pilosicornis*) were the only features (of those listed in Fischer's diagnosis) that we could confirm via side-by-side comparison of the two holotypes. Though the differences are subtle, we have chosen to accept the two as valid species pending collection and examination of more material to assess variation. Among the minor differences, the face appears to be more extensively shagreened in *O. pilosicornis* but more distinctly punctate in *O. albericus* and the metasoma is more densely setose posteriorly in *O. albericus*. These two species are most readily separated from the others included here by the color pattern of white hind coxa, dark hind femur, and dark mesosoma.

In the original description, the locality for one of the paratypes is listed as M. Crosso but the actual locality is M. Grosso. We have seen four additional male specimens from this same locality in Mato Grosso (CNC, TAMU) but we are unable to assign them to this species with complete confidence. There are slight differences in coloration (mid and hind coxae dark brown instead of white, for example) and the propodeum of one of these specimens is distinctly granular. In one of our specimens, m-cu is postfurcal in one fore wing and weakly antefurcal in the other.

Opius antennatus **Fischer**

http://species-id.net/wiki/Opius_antennatus
Figs 14, 45–46

Opius antennatus Fischer, 1965a: 65–67. Holotype male in AEIC (examined).
Opius antennatus: Fischer 1971: 43 (catalog).
Opius (*Merotrachys*) *antennatus*: Fischer 1977: 655–659 (key, redescription); Fischer 1979a: 264–266 (key); Yu et al. 2005, 2012 (electronic catalogs).

Type locality. USA, South Carolina, Cleveland.

Type material. Holotype. Male (AEIC), first label, first line: Cleveland SC second line: VIII 2. 1952 third line: G. & L. Townes

Paratype. One male (not seen), USA, South Carolina, Greenville, 12.vii.1952, G. & L. Townes.

Diagnosis. Face faintly punctate, nearly smooth except shagreened adjacent eye margin. Eye in lateral view 2.5–3.0 × longer than temple; temples in dorsal view weakly receding. Male antenna with 48 flagellomeres; setae on basal flagellomeres thin, pale. Mesoscutum anteriorly with shallow but distinct declivity; notaulus extending laterally towards tegula as groove bordered by distinct supramarginal carina. Propodeum rugose to rugulose, median areola absent, median trough anteriorly shallow. Fore wing 3RSa very weakly curved, 1.35–1.4 × longer than 2RS; m-cu very weakly postfurcal. T1 sharply declivitous anteriorly, basal pit delimited posterior-medially; surface smooth to rugulose; dorsal carinae parallel-sided throughout, not sinuate, very weakly transversely carinate between dorsal carinae. T2+3 uniformly, distinctly shagreened. Head and mesosoma largely pale orange, mostly brownish orange dorsally; T1 orange, T2–4 pale medially, dark brown laterally, T5–6 dark brown; hind coxa and femur whitish; antenna without subapical pale ring; wing hyaline.

Remarks. Known only from holotype and one paratype, both males. This species, described from South Carolina, USA, has the northernmost distribution of those treated here, and is the only species of the *ingenticornis* species group thus far recorded from outside of the Neotropical Region. It is also the smallest of the included species, with body length about 2.1 mm. The color pattern is distinctive, dorsally infumate on the head and mesosoma, yellow-orange below (Figs 45–46). *Opius antennatus* is closest to *O. michaeli* in color pattern, though *O. michaeli* has a dark mesopleuron and somewhat darker legs. The mesoscutum has a weak anterior declivity in both, but T2+3 is more distinctly shagreened in *O. antennatus* than in *O. michaeli*.

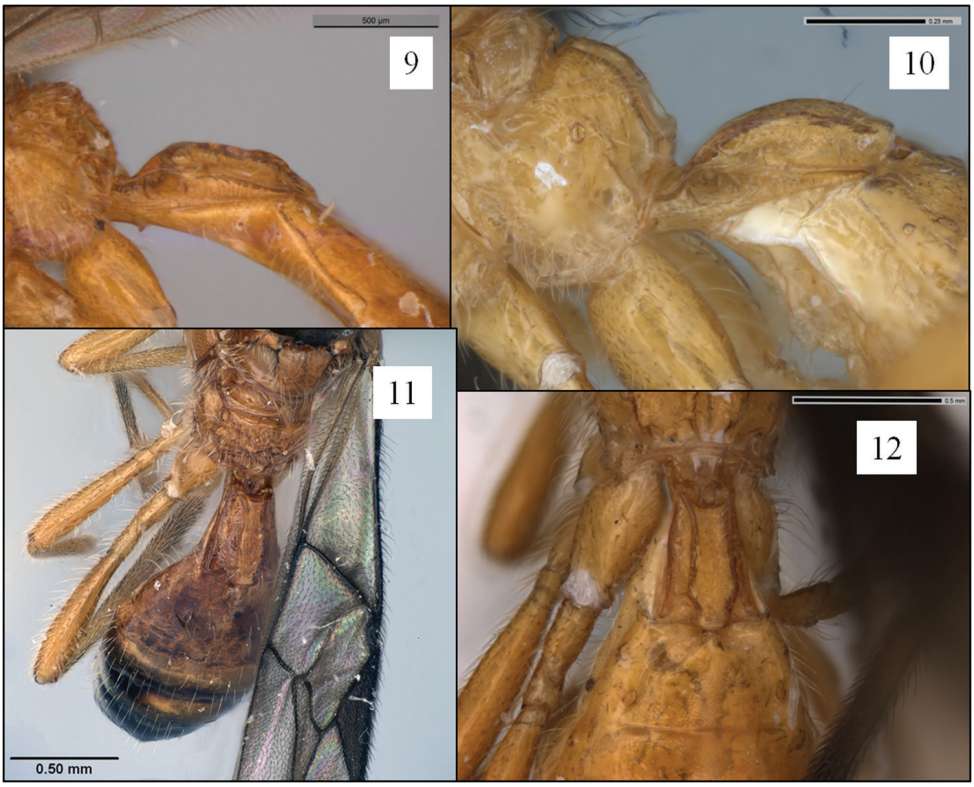
***Opius curiosicornis* Fischer**
http://species-id.net/wiki/Opius_curiosicornis
Figs 12, 15, 27, 31, 44

Opius curiosicornis Fischer, 1965c: 224–228. Holotype female in AEIC (examined).
Opius curiosicornis: Fischer 1965d: 420 (key); Fischer 1968a: 77–78 (key); Fischer 1971: 59 (catalog).
Opius (*Merotrachys*) *curiosicornis*: Fischer 1977: 655–657, 668–670 (key, redescription); Fischer 1979a: 264–266 (key); Yu et al. 2005, 2012 (electronic catalogs).

Type locality. Peru, Avispas, near Marcapata, 30 m.

Type material. Holotype. Female (AEIC), first label, first line: Avispas, Perú second line: 30m nr. Marcapata third line: Sept. 1962 fourth line: Luis Peña

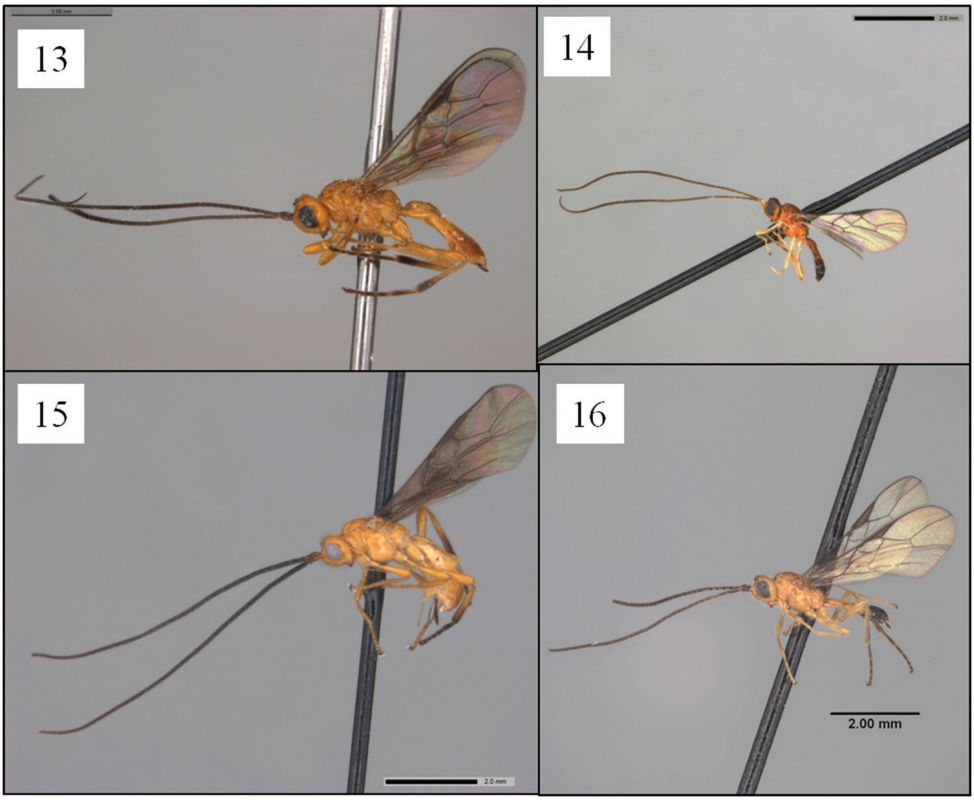
Diagnosis. Face faintly punctate, nearly smooth, polished throughout. Eye in lateral view 2.0–2.5 × longer than temple; temples in dorsal view weakly receding. Female antenna with 49 flagellomeres; setae on basal flagellomeres thick, dark. Mesoscutum anteriorly with shallow but distinct declivity; notaulus weakly curving laterally



Figures 9–12. *Opius* spp. holotypes, petiole (T1). **9** *O. rojam* Daniels & Wharton sp. n., lateral view **10** *O. bicarinifer* Fischer, lateral view **11** *O. raphaeli* Fischer, dorsal view **12** *O. curiosicornis* Fischer, dorsal view.

towards tegula, supramarginal carina weak, barely distinguishable. Propodeum weakly shagreened, largely smooth, with deep median trough divided by transverse carina into shorter anterior trough and longer, roughly rectangular posterior areola. Fore wing 3RSa straight, 1.5–1.6 × longer than 2RS; m-cu interstitial. T1 sharply declivitous anteriorly, pit delimited posterior-medially; surface weakly shagreened, mostly smooth; dorsal carinae parallel-sided for most of their length, abruptly converging near posterior margin, not sinuate, not transversely carinate between dorsal carinae. T2 mostly weakly shagreened, smoother laterally, T3 faintly shagreened to smooth, especially laterally. Ovipositor short; ovipositor sheath 0.4 × length of mesosoma. Head, body, hind coxa and femur light orange; antenna without pale subapical ring; wing darkly infumate.

Remarks. Known only from the female holotype. The propodeal sculpture (Fig. 27) is similar to that of *O. bicarinifer*, but the shape of T1 and the pronope are more typical of members of the *ingenticornis* species group. T1 is weakly excavated near the posterior margin between the dorsal and lateral carinae, resulting in a pattern that is nearly identical to that found in *O. bicarinifer* Fischer. See remarks section under *O. bicarinifer* below for additional information.



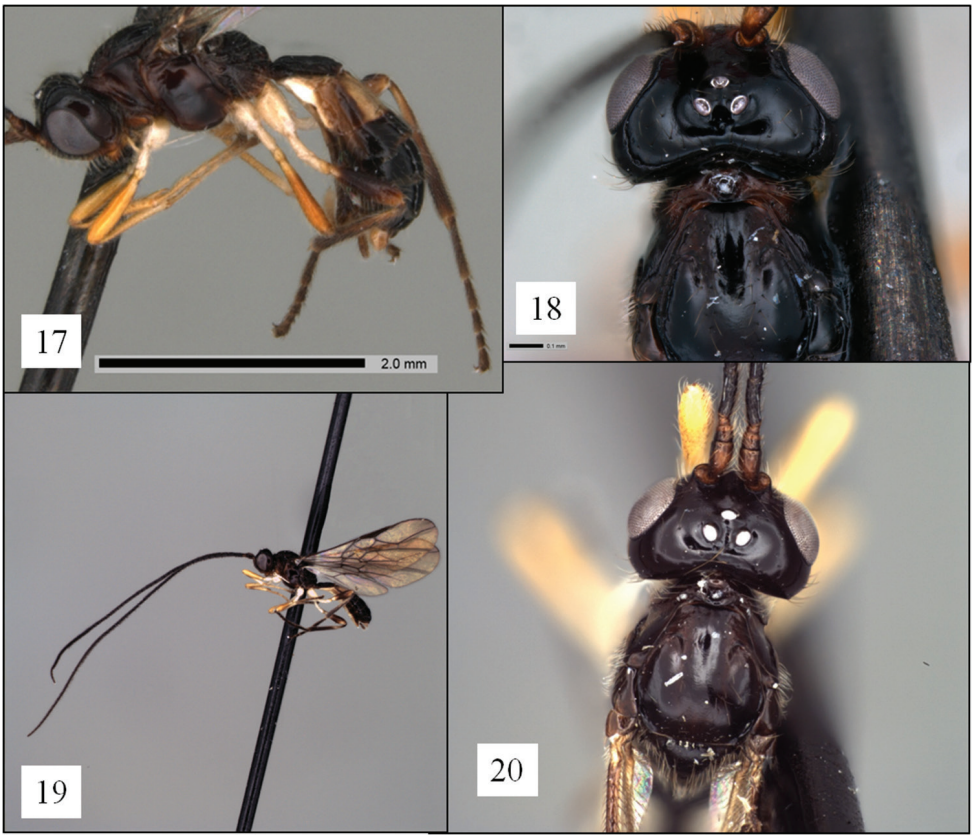
Figures 13–16. *Opius* spp. holotypes, habitus. **13** *O. rojam* Daniels & Wharton sp. n. **14** *O. antennatus* Fischer **15** *O. curiosicornis* Fischer **16** *O. gabrieli* Fischer.

***Opius filiflagellatus* Fischer**
http://species-id.net/wiki/Opius_filiflagellatus
Fig. 32

Opius filicornis Fischer, 1963: 387–389. Holotype female in CAS (examined).
Opius filicornis: Fischer 1964: 3–12 (key); Fischer 1965c: 236 (comparison with *O. ingenticornis*).
Opius filiflagellatus Fischer, 1965d: 420, 426 (key, new name); Fischer 1968a: 77–78 (key); Fischer 1971: 59 (catalog).
Opius (*Merotrachys*) *filiflagellatus*: Fischer 1977: 655–656, 673–675 (key, redescription); Fischer 1979a: 264–265 (key); Yu et al. 2005, 2012 (electronic catalogs).

Type locality. Peru, Monson Valley, Tingo Maria.

Type material. Holotype. Female (CAS), first label, first line: PERU: second line: Monson Valley third line: Tingo Maria fourth line: X–9–1954 second label, first line: E.I. Schlinger second line: & E. S. Ross third line: collectors



Figures 17–20. *Opius* spp., holotypes **17** *O. albericus* Fischer, habitus **18** *O. albericus* head in dorsal view **19** *O. pilosicornis* Fischer, habitus **20** *O. pilosicornis* head in dorsal view.

Diagnosis. Face mostly faintly punctate and finely shagreened, more strongly shagreened along eye margin. Eye in lateral view 3.0–3.1 × longer than temple; temples in dorsal view very weakly receding. Female antenna with 50 flagellomeres (original description); setae on basal flagellomeres thick, dark. Mesoscutum anteriorly on nearly same plane as pronotum, without distinct anterior declivity; notaulus extending laterally towards tegula as groove bordered by distinct supramarginal carina. Propodeum coarsely, carinately rugose, with short median trough anteriorly, areola largely obscured by sculpture posteriorly. Fore wing 3RSa very weakly curved, nearly straight, 1.5 × longer than 2RS; m-cu distinctly antefurcal. T1 sharply declivitous anteriorly, pit delimited posterior-medially; surface very intensely shagreened throughout and rugulose posterior-medially, the sculpture partly obscuring dorsal carinae; dorsal carinae weakly converging, nearly parallel-sided for most of their length. T2 intensely shagreened, T3 more finely shagreened. Ovipositor broken; ovipositor sheath apparently missing (broken). Head, body, hind coxa and femur orange; antenna without pale subapical ring; wing infumate.

Remarks. This species, known only from the poorly preserved holotype, was originally described as *Opius filicornis* by Fischer (1963) but the name was preoccupied by *Opius filicornis* Thomson, 1895. Fischer (1965d) subsequently renamed the species as *Opius filiflagellatus*. Both antennae are broken on the holotype, with 42 flagellomeres remaining on the longest one. The metasoma is glued to the point separately from the remainder of the specimen, and the ovipositor is broken and its full length is thus unknown. The original description states half as long as metasoma, but it is unclear if this was meant to be the total length or just the visible portion. The right fore wing is missing, as are most of the legs.

This species most closely resembles *O. rojam* and *O. ingenticornis* in overall appearance. The color and propodeal sculpture are the same, and *O. filiflagellatus* similarly has T2+3 distinctly shagreened. However, the setal pattern on the basal flagellomeres would seem to remove *O. filiflagellatus* from the subgroup of species discussed below under *O. gabrieli*. The mesoscutum is also not quite as flattened anteriorly and the temples in dorsal view are somewhat weakly receding relative to *O. rojam* and *O. ingenticornis*. In existing keys to species of *Merotrachys* (Fischer 1977, 1979a), *O. filiflagellatus* is distantly removed from *O. ingenticornis* because of the antefurcal position of fore wing m-cu. This latter character is somewhat unreliable amongst members of the *ingenticornis* species group given variation we have seen both within series and between wings of single individuals.

***Opius gabrieli* Fischer**
http://species-id.net/wiki/Opius_gabrieli
Fig. 16

Opius gabrieli Fischer, 1968a: 77–78 (key); 84–85 (description). Holotype female in AEIC (examined).
Opius gabrieli: Fischer 1971: 68 (catalog).
Opius (*Merotrachys*) *gabrieli*: Fischer 1977: 655–657, 675–676 (key, redescription); Fischer 1978: 166 (range expansion, allotype); Fischer 1979a: 264–266 (key); Yu et al. 2005, 2012 (electronic catalogs).

Type locality. Brazil, Teresópolis.

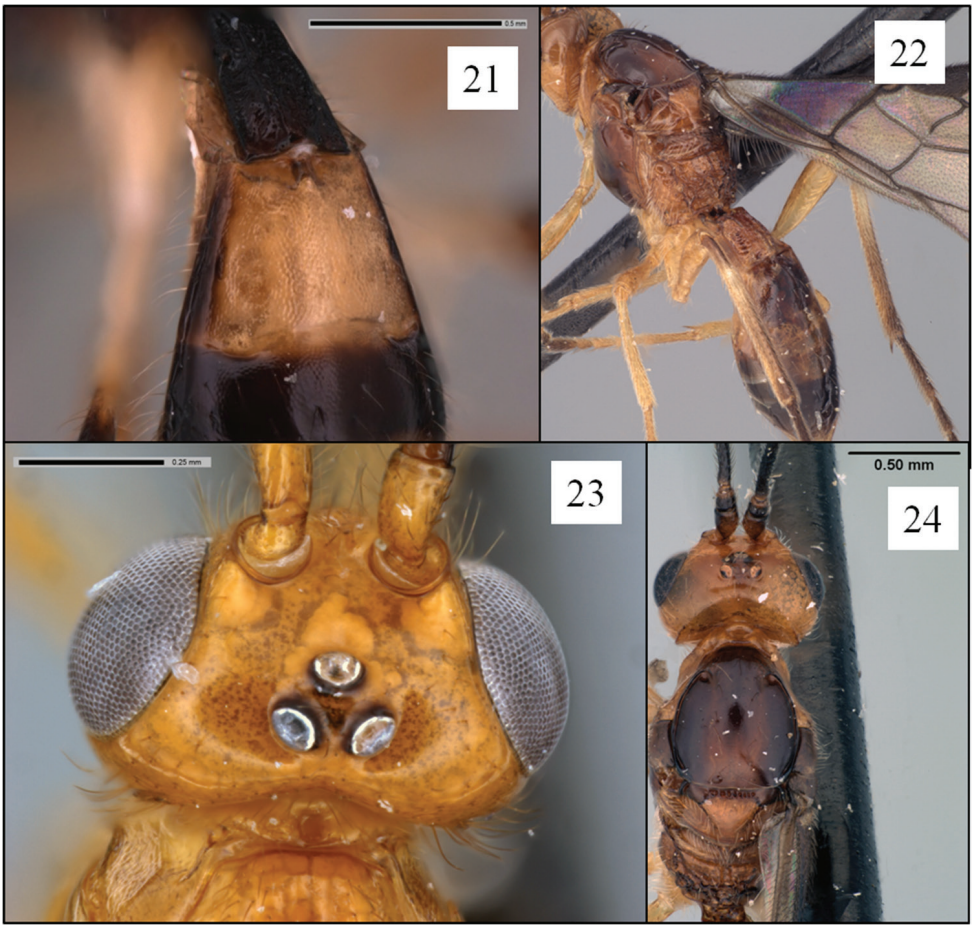
Type material. Holotype. Female (AEIC), first label, first line: Teresópolis second line: III–11–66 Braz. third line: H. & M. Townes

Paratypes. One female, one male (not seen), same data as holotype; one male (not seen), same data except 12.iii.1966.

Other specimens examined. One female, Costa Rica, Cartago, Turrialba, 3–5. vi.1976, M. Wasbauer (TAMU).

Other material (not examined). Two males (one the allotype), Brazil, Carauru, iv.1972, M. Alvarenga.

Diagnosis. Face finely but distinctly punctate, punctures separated by nearly 2 × their diameter, strongly shagreened adjacent eye margin, otherwise smooth between



Figures 21–24. *Opius* spp. holotypes. **21** *O. albericus* Fischer, T2+3 sculpture **22** *O. michaeli* Fischer, T2+3 sculpture **23** *O. bicarinifer* Fischer, head in dorsal view **24** *O. michaeli*, head in dorsal view.

punctures. Eye in lateral view 2.0–2.5 × longer than temple; temples in dorsal view not or only weakly receding. Female antenna broken, male from original description with 50 flagellomeres, from subsequent description with 53 flagellomeres; setae on basal flagellomeres thin, pale. Mesoscutum very weakly declivitous, nearly on same plane as pronotum; notaulus extending laterally towards tegula as groove bordered by distinct supramarginal carina. Propodeum coarsely, carinately rugose, with short, deep median trough anteriorly separated from broad, irregular, ill-defined areola posteriorly. Fore wing 3RSa very weakly curved, nearly straight, 1.3–1.4 × longer than 2RS; m-cu interstitial to weakly antefurcal. T1 sharply declivitous anteriorly, pit delimited posterior-medially; surface shagreened; dorsal carinae weakly sinuate, nearly parallel-sided throughout, very weakly diverging subapically then weakly narrowing to apex, not distinctly transversely carinate between dorsal carinae. T2 mostly distinctly shagreened, smoother laterally, T3 faintly shagreened medially, smooth later-

ally. Ovipositor short; ovipositor sheath about 0.4 × length of mesosoma. Head, body, hind coxa and femur light orange except T3–6 infumate to completely black; wing lightly infumate.

Remarks. This species was described from the female holotype plus one additional female and two male paratypes, all from the same locality in Brazil. Fischer (1978) recorded two additional males from "Carauru," Brazil, designated one of these as the allotype, and incorrectly stated that the male was new (i.e. previously unknown). Carauru is an inadvertent misspelling of Caruaru.

Opius gabrieli is nearly identical to *O. ingenticornis*, *O. melchioricus*, and the newly described *O. rojam*. All four species have very short ovipositors (Figs 13, 14, 16), heavily sculptured propodea (Fig. 28), thinner, pale setae on the basal flagellomeres (Fig. 39), and are predominantly orange. *Opius antennatus*, *O. matthaei*, *O. petri*, and *O. raphaeli* are darker but otherwise share these features and together these eight species form a larger subgroup within the *ingenticornis* species group. *Opius gabrieli* is most readily recognized by the black apical metasomal terga relative to *O. ingenticornis, O. melchioricus*, and *O. rojam*. *Opius ingenticornis* and *O. rojam* are more uniformly orange and the face is more completely shagreened than in the other two species whereas *O. melchioricus* has the tegula black with dark transverse lines across the posterior margins of the meso- and metathorax. *Opius filiflagellatus* provides an interesting contrast since the propodeum is extensively carinately rugose and the metasoma is intensely shagreened anteriorly as in *O. ingenticornis*, but the setal pattern on the basal flagellomeres does not match those of the subgroup delineated here.

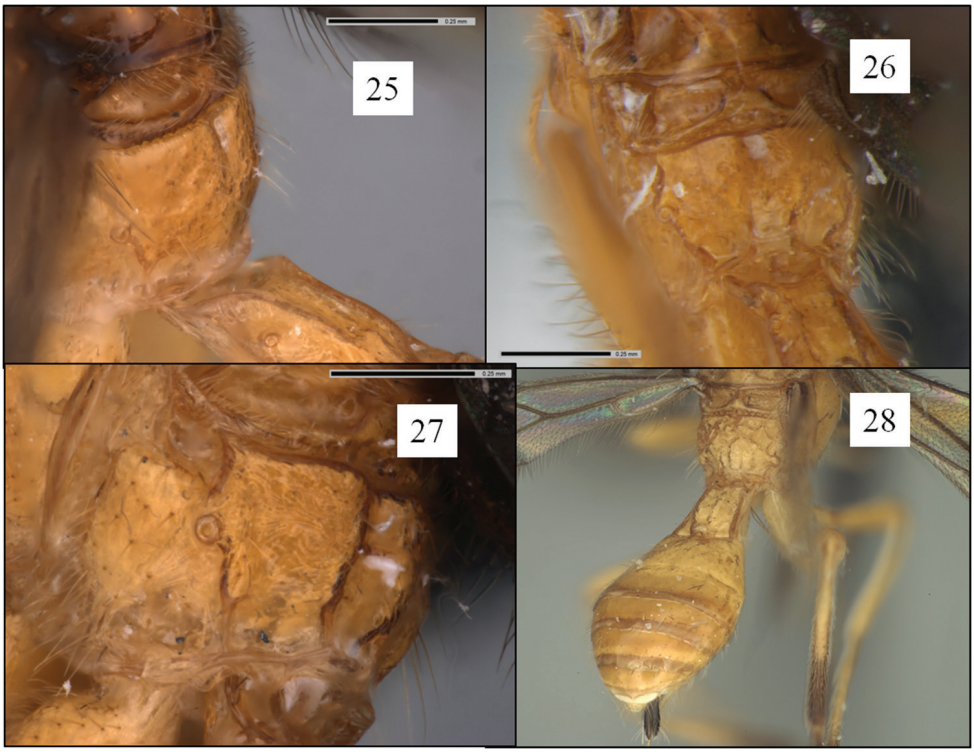
The female specimen from Costa Rica listed above under other material examined is very similar to the holotype and we tentatively include it here. The most significant differences are in the color pattern and wing venation. The apex of the metasoma is dark in the specimen from Costa Rica, but not as contrastingly so as in the holotype. The position of the fore wing m-cu varies slightly between the two wings of the holotype, but is more distinctly postfurcal in the specimen from Costa Rica.

***Opius ingenticornis* Fischer**
http://species-id.net/wiki/Opius_ingenticornis
Figs 28, 38

Opius ingenticornis Fischer, 1965c: 233–236. Holotype female in AEIC (examined).
Opius ingenticornis: Fischer 1965d: 420 (key); Fischer 1968a: 77–78 (key); Fischer 1971: 76 (catalog).
Opius (*Merotrachys*) *ingenticornis*: Fischer 1977: 655–657, 679–680 (key, redescription); Fischer 1979a: 264–266 (key); Yu et al. 2005, 2012 (electronic catalogs).

Type locality. Peru, Quincemil, near Marcapata, 750 m.

Type material. Holotype. Female (AEIC), first label, first line: Quincemil, Perú second line: 750 m nr. Marcapata third line: Nov. 10–15, 1962 fourth line: Luis Peña



Figures 25–28. *Opius* spp. holotypes, propodea. **25** *O. nimifactus* Fischer **26** *O. macrocornis* Fischer **27** *O. curiosicornis* Fischer **28** *O. ingenticornis* Fischer.

Paratypes. One female, one male (not seen), same data as holotype except ix.1962; one female, two males (not seen), same data except 20–30.x.1962.

Diagnosis. Face shagreened throughout. Eye in lateral view 2–3 × longer than temple; temples in dorsal view not receding. Female antenna with 47–49 flagellomeres, male with up to 62 flagellomeres; setae on basal flagellomeres thin, pale. Mesoscutum anteriorly on nearly same plane as pronotum, without distinct anterior declivity; notaulus extending laterally towards tegula as groove bordered by distinct supramarginal carina. Propodeum coarsely, carinately rugose and shagreened, with short median trough anteriorly, areola largely obscured by sculpture posteriorly. Fore wing 3RSa very weakly curved, nearly straight, 1.25 × longer than 2RS; m-cu interstitial to very weakly postfurcal. T1 sharply declivitous anteriorly, pit delimited posteriormedially; surface very intensely shagreened; dorsal carinae distinctly elevated, nearly parallel-sided throughout, weakly converging near apex, not sinuate, not obviously transversely carinate between dorsal carinae. T2+T3 distinctly shagreened. Ovipositor short; ovipositor sheath about 0.3–0.4 × length of mesosoma. Head, body, hind coxa and femur orange; antenna without pale subapical ring; wing weakly infumate.

Remarks. This species was originally described from the female holotype plus two female and three male paratypes, all from Peru. *Opius ingenticornis* is characterized by

the extensively shagreened facial sculpture and pale body. This species is very similar to *O. rojam*, newly described above, based on coloration, relatively small second submarginal cell of the fore wing, and propodeal sculpture. *Opius ingenticornis* is somewhat smaller, with T1 more intensively shagreened (Fig. 38) whereas *O. rojam* is more rugose (Fig. 37). See remarks under *O. rojam*, *O. filiflagellatus*, and *O. gabrieli* for additional characteristics and diagnostic features relative to other members of this species group.

***Opius macrocornis* Fischer**
http://species-id.net/wiki/Opius_macrocornis
Fig. 26

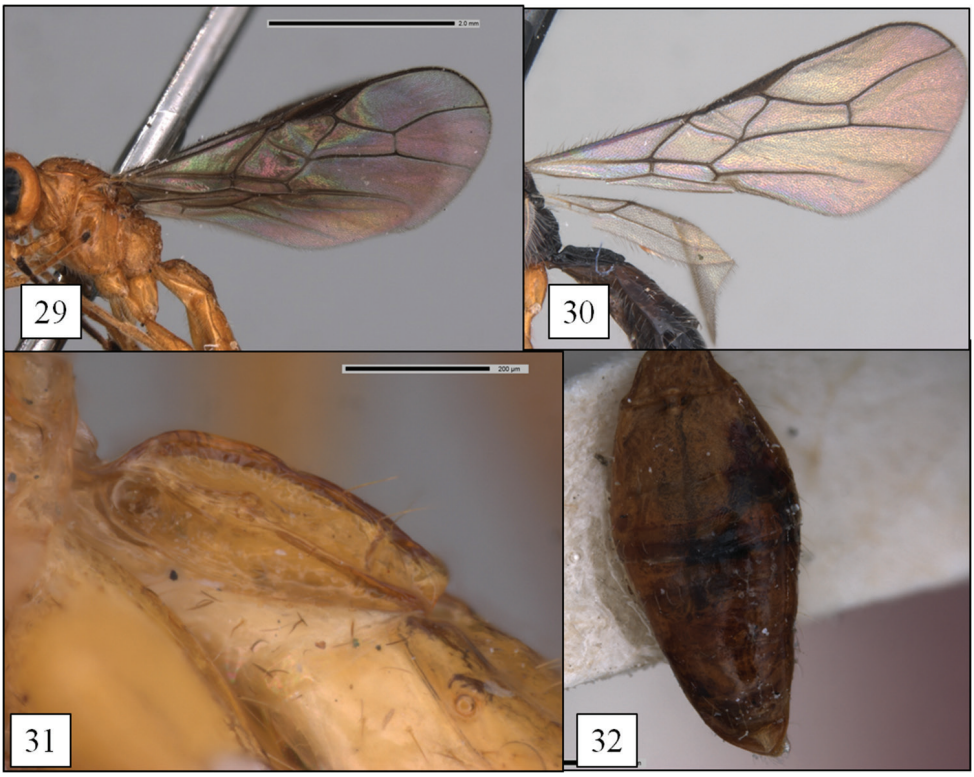
Opius macrocornis Fischer, 1965b: 298–300. Holotype male in AEIC (examined).
Opius macrocornis: Fischer 1965d: 419 (key); Fischer 1969: 162–163 (key); Fischer 1971: 84 (catalog).
Opius (*Pendopius*) *macrocornis*: Fischer 1977: 714–715, 727–728 (key, redescription); Fischer 1979b: 484–486, 495 (key); Yu et al. 2005, 2012 (electronic catalogs).

Type locality. Peru, Quincemil, near Marcapata, 750 m.

Type material. Holotype. Male (AEIC), first label, first line: Quincemil, Perú second line: 750 m nr. Marcapata third line: ~~Nov. 10-15,~~ 1962 fourth line: Luis Peña Sept.

Diagnosis. Face very faintly punctate, otherwise smooth, polished throughout. Eye in lateral view 2.4–2.6 × longer than temple; temples in dorsal view not or only weakly receding. Male antenna with 45 flagellomeres; setae on basal flagellomeres thick, dark. Mesoscutum with weak declivity; supramarginal carina absent or apparently so. Propodeum smooth, polished with shallow median trough anteriorly continuous with broader, weakly defined areola posteriorly. Fore wing 3RSa straight, about 1.6 × longer than 2RS; m-cu postfurcal. T1 evenly curving into basal pit anteriorly, not distinctly declivitous, pit well-defined, delimited posterior-medially; surface smooth, polished; dorsal carinae parallel-sided for most of their length, distinctly converging near posterior margin, not sinuate, not transversely carinate between dorsal carinae. T2+T3 smooth, polished. Head, body, hind coxa and femur pale orange; antenna without pale subapical ring; wing darkly infumate.

Remarks. This species is known only from the male holotype and is very similar to *O. nimifactus*, as noted by Fischer (1979b). Both species are characterized by greatly reduced propodeal sculpture (Figs 25–26), relatively smooth T1, and absence of any shagreening on T2. T1 anteriorly is more gradually sloping in *O. macrocornis*, and *O. macrocornis* is more uniformly pale orange: lacking the black tegula and dark margins of the mesoscutum that characterize *O. nimifactus*. There is a patch of sculpture between the notaulus and the anterior-lateral margin of the mesoscutum in *O. nimifactus* but this area is largely smooth in *O. macrocornis*. The mesoscutum is also weakly declivitous in *O. macrocornis* but flatter in *O. nimifactus*. Fischer (1979b) provides additional comparison of the two species. Both of these species were placed in the subgenus *Pendopius* by Fischer (1977, 1979b) because of the absence of sculpture on T2. The shagreened



Figures 29–32. *Opius* spp., holotypes. **29** *O. rojam* Daniels & Wharton sp. n., fore and hind wing **30** *O. matthaei* fore wing **31** *O. curiosicornis* Fischer, T1 lateral view **32** *O. filiflagellatus* Fischer, metasoma.

sculpture on the metasoma appears to vary intraspecifically in opiines when there is sufficient material for comparison, and is often extremely weak in some of the species of the *ingenticornis* species group. We therefore do not consider the sculpture pattern alone to be adequate for characterizing subgenera or species groups, and treat it as variably present or absent in the *ingenticornis* species group. Both *O. macrocornis* and *O. nimifactus* fall within our concept of the *ingenticornis* species group, resembling species with relatively reduced sculpture and darker, thicker flagellar setae such as *O. curiosicornis*.

Opius matthaei **Fischer**

http://species-id.net/wiki/Opius_matthaei
Figs 1, 30, 34

Opius matthaei Fischer, 1968a: 77–78 (key); 90–92 (description). Holotype female in AEIC (examined).
Opius matthaei: Fischer 1971: 86 (catalog).
Opius (*Merotrachys*) *matthaei*: Fischer 1977: 655–656, 685–687 (key, redescription); Fischer 1979a: 264 (key); Yu et al. 2005, 2012 (electronic catalogs).

Type locality. Brazil, Campina Grande, near Curitiba.

Type material. Holotype. Female (AEIC), first label, first line: Campina Grande second line: nr. Curitiba third line: II–17–66 Brazil fourth line: H.&M. Townes

Diagnosis. Face finely granular or coarsely shagreened throughout. Eye in lateral view 2.4–2.7 × longer than temple; temples in dorsal view not receding. Female antenna with 57 flagellomeres; setae on basal flagellomeres thin, pale. Mesoscutum anteriorly on nearly same plane as pronotum, without distinct anterior declivity; notaulus extending laterally towards tegula as groove bordered by distinct supramarginal carina, base of notaulus weakly rugulose, thus appearing to extend to anterior margin of mesoscutum. Propodeum rugulose to finely granular with shallow median trough anteriorly, areola obscured by sculpture posteriorly. Fore wing 3RSa weakly curved, 1.3 × longer than 2RS; m-cu weakly antefurcal. T1 sharply declivitous anteriorly, pit delimited posterior-medially; surface rugulose between dorsal carinae, shagreened laterally; dorsal carinae weakly sinuate, broadening subapically, narrowing apically. T2 distinctly shagreened, T3 more weakly so, becoming smooth, polished laterally. Ovipositor short; ovipositor sheath about 0.3–0.4 × length of mesosoma. Head, propodeum, T1, T4–T6 dark reddish brown to dark brown; mesosoma mottled dark orange to dark reddish brown; T2+T3 reddish brown; hind coxa and femur dark yellow; antenna without subapical pale ring; wing lightly infumate, nearly hyaline.

Remarks. This species is known only from the female holotype. It is a relatively dark species, most closely resembling *O. albericus* and *O. pilosicornis* in that regard, but the legs are more uniformly yellow in *O. matthaei* (Figs 17, 19, 34). In keys to species of the subgenus *Merotrachys* (Fischer 1977, 1979a), *O. matthaei* is widely separated from *O. albericus* and *O. pilosicornis* because of slight differences in the position of fore wing m-cu (antefurcal as in Fig. 30, but only weakly so). *Opius matthaei* is most readily characterized by the densely granular facial sculpture (Fig. 1).

***Opius melchioricus* Fischer**

http://species-id.net/wiki/Opius_melchioricus
Figs 3, 5

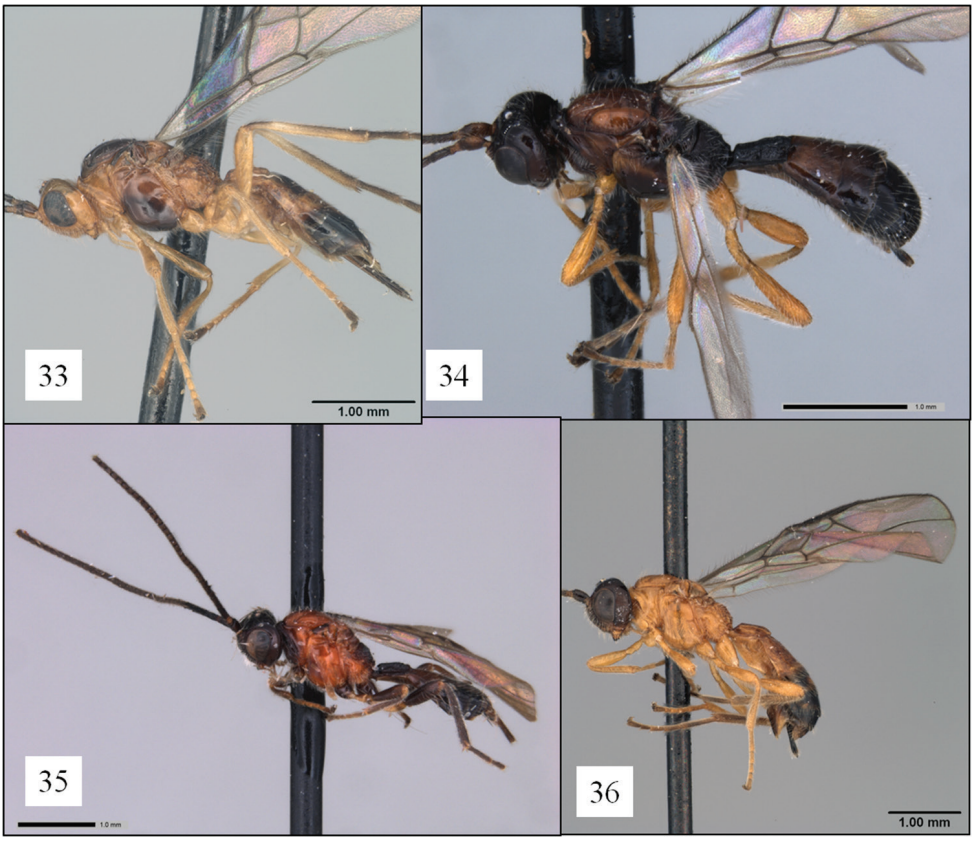
Opius (*Merotrachys*) *melchioricus* Fischer, 1979a: 264–266 (key); 271–273 (description). Holotype male in AEIC (examined).
Opius (*Merotrachys*) *melchioricus*: Yu et al. 2005, 2012 (electronic catalogs).

Type locality. Brazil, Guanabara, Reprêsa Rio Grande.

Type material. Holotype. Male (AEIC), first label, first line: ReprêsaRioGrande second line: Guanabara, Brazil third line: January, 1968 Brazil fourth line: M. Alvarenga.

Other specimens examined. One female, same data as holotype (TAMU).

Diagnosis. Face finely but distinctly punctate, punctures separated by nearly 2 × their diameter, strongly shagreened adjacent eye margin, otherwise smooth between punctures. Eye in lateral view roughly 2.5 (male) and 3.0 (female) × longer than temple; temples in dorsal view not or only weakly receding. Female antenna with 53 flagellom-



Figures 33–36. *Opius* spp. holotypes, habitus. **33** *O. michaeli* Fischer **34** *O. matthaei* Fischer **35** *O. petri* Fischer **36** *O. raphaeli* Fischer.

eres, male holotype with 56–57 flagellomeres; setae on basal flagellomeres thin, pale. Mesoscutum anteriorly on nearly same plane as pronotum, without distinct anterior declivity; notaulus extending laterally towards tegula as groove bordered by distinct supramarginal carina. Propodeum coarsely carinately rugose with deep median trough anteriorly separated by carina from broad median, roughly pentagonal to elliptical areola posteriorly, areola carinately sculptured medially. Fore wing 3RSa straight, 1.3 × longer than 2RS; m-cu postfurcal. T1 sharply declivitous anteriorly, pit delimited posteriormedially; surface carinately rugose medially, rugulose laterally; dorsal carinae distinctly elevated, nearly parallel-sided throughout, weakly converging posteriorly, not sinuate, transversely carinate between dorsal carinae. T2 and T3 distinctly shagreened. Ovipositor short; ovipositor sheath about 0.3–0.4 × length of mesosoma. Head, body, hind coxa and femur orange to pale orange; tegula, posterior margins of mesonotum, metanotum, and T3–6 dark reddish brown, T6 more uniformly weakly infumate; antenna without pale subapical ring; wing infumate in male, more nearly hyaline in female.

Remarks. Previously known only from the male holotype. Female characters are based on a specimen collected at the type locality in Brazil (TAMU). The female differs

from the holotype primarily in wing venation, with 3RSa about 1.5 × longer than 2RS and the wing is more nearly hyaline. Otherwise, body coloration and sculpture are the same. This species is characterized by the dark transverse markings on the posterior margins of the meso- and metathorax. It is most similar to *O. rojam*, *O. gabrieli* and *O. ingenticornis*. For a detailed comparison, see remarks section under *O. gabrieli*.

***Opius michaeli* Fischer**
http://species-id.net/wiki/Opius_michaeli
Figs 22, 24, 33

Opius michaeli Fischer, 1968a: 77–78 (key); 92–95 (description). Holotype female in AEIC (examined).
Opius michaeli: Fischer 1971: 87 (catalog).
Opius (*Merotrachys*) *michaeli*: Fischer 1977: 655–657, 687–689 (key, redescription); Fischer 1979a: 264–266 (key); Fischer 1983b: 83 (diagnosis in couplet of key); Yu et al. 2005, 2012 (electronic catalogs).

Type locality. Brazil, Teresópolis.

Type material. Holotype. Female (AEIC), first label, first line: Teresópolis second line: III–12–66 Braz. third line: H. &M. Townes

Paratypes. One male (not seen), same data as holotype; one female (not seen), Brazil, Campina Grande, near Curitiba, 22.ii.1966, H. & M. Townes.

Diagnosis. Face faintly punctate, otherwise smooth. Eye in lateral view about 4 × longer than temple; temples in dorsal view weakly receding. Female antenna with 46–48 flagellomeres, male with 45 flagellomeres; setae on basal flagellomeres thin, pale. Mesoscutum anteriorly with shallow but distinct declivity; notaulus extending laterally towards tegula as groove bordered by distinct supramarginal carina. Propodeum coarsely carinately rugose on posterior 0.6, nearly smooth anteriorly, with deep median trough anteriorly, areola obscured by sculpture posteriorly. Fore wing 3RSa straight or nearly so, 1.4 × longer than 2RS; m-cu postfurcal. T1 sharply declivitous anteriorly, pit delimited posterior-medially; surface rugose to rugulose; dorsal carinae weakly sinuate, nearly parallel-sided, broadening subapically, narrowing apically, weakly transversely carinate between dorsal carinae. T2 faintly shagreened, T3 mostly smooth. Ovipositor moderately short, but longer than most other species in this species group; ovipositor sheath about 0.5–0.6 × length of mesosoma. Head, prothorax, propodeum, and T1 yellow-orange; meso- and metathorax, T2 and T5–6 mostly brown, T3–4 yellow-brown; hind coxa and femur yellow; antenna without pale subapical ring; wing weakly infumate.

Remarks. This species was originally described from the female holotype plus a male and a female paratype. The female is readily distinguished from all others included here in the *ingenticornis* species group by the slightly longer ovipositor and mottled color pattern (Fig. 33). The species with longer ovipositors treated below have all been

excluded from this species group on the basis of other features and thus, where known, members of the *ingenticornis* species group all have relatively short ovipositors, with the ovipositor sheath distinctly shorter than the mesosoma. The propodeum of *O. michaeli* is generally similar in sculpture to those species in the subgroup discussed under the remarks section for *O. gabrieli*, but is nearly smooth anteriorly. Fischer (1983b) compared *O. michaeli* to *O. monsonicus* from Peru and both have similarly long ovipositors. Although *O. monsonicus* has antennae that are very long as in members of the *ingenticornis* species group, we have excluded this species primarily on the basis of the propodeum, which is described as having a basal keel or midridge.

***Opius nimifactus* Fischer**
http://species-id.net/wiki/Opius_nimifactus
Figs 25, 42

Opius (*Pendopius*) *nimifactus* Fischer, 1979b: 484–486 (key); 493–495 (description). Holotype female in AEIC (examined).
Opius (*Pendopius*) *nimifactus*: Yu et al. 2005, 2012 (electronic catalogs).

Type locality. Brazil, Caruaru.

Type material. Holotype. Female (AEIC), first label, first line: Caruaru, Brazil second line: May 1972 900m. third line: J. Lima

Paratypes. Two females (not seen), same data as holotype except vi.1972; five females, three males (examined), same locality but iv.1972, M. Alvarenga.

Diagnosis. Face distinctly punctate, punctures separated by about 2 × their diameter, strongly shagreened adjacent eye margin, otherwise largely smooth between punctures. Eye in lateral view 2.0–2.5 × longer than temple; temples in dorsal view not receding. Female antenna with 59–61 flagellomeres, male with 56–60 flagellomeres; setae on basal flagellomeres thick, dark. Mesoscutum anteriorly on nearly same plane as pronotum, without distinct anterior declivity; notaulus extending laterally towards tegula as groove bordered by distinct supramarginal carina, also extending to anterior margin of mesoscutum as a weak groove. Propodeum nearly smooth: finely rugulose punctate with shallow median trough anteriorly, becoming flat, without areola posteriorly. Fore wing 3RSa curved, about 1.4–1.7 × longer than 2RS; m-cu postfurcal. T1 declivitous anteriorly at about a 45 degree angle, pit delimited posterior-medially; surface smooth to weakly shagreened; dorsal carinae very weakly sinuate, nearly parallel-sided, weakly broadening subapically, weakly narrowing apically, not transversely carinate between dorsal carinae. T2 and T3 smooth, polished. Ovipositor short; ovipositor sheath about 0.3–0.4 × length of mesosoma. Head, body, hind coxa and femur pale orange; tegula and lateral margin of mesonotum dark brown to black, T5 with dark maculae laterally, T6 uniformly dark brown; antenna without pale subapical ring; wing darkly infumate.

Remarks. This species was described from the female holotype plus 7 additional female and 3 male paratypes, all from same locality. *Opius nimifactus* is similar in many

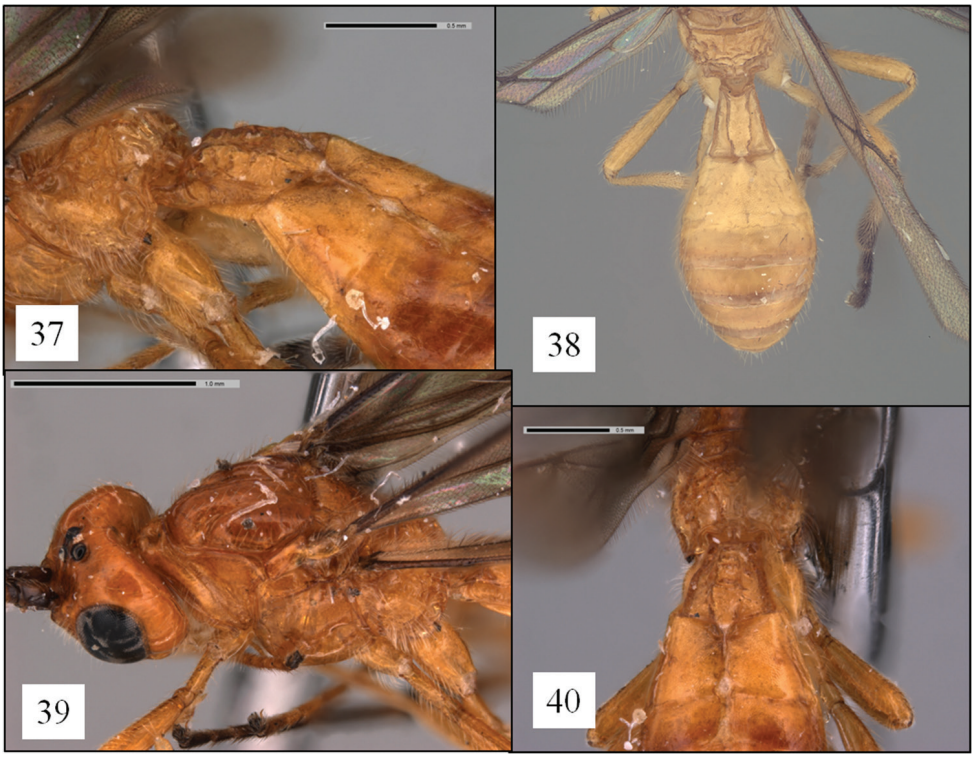
respects to *O. macrocornis*, as detailed in the remarks section under that species. *Opius macrocornis* is more uniformly pale orange: lacking the black tegula and dark margins of the mesoscutum that characterize *O. nimifactus*.

***Opius petri* Fischer**
http://species-id.net/wiki/Opius_petri
Fig. 35

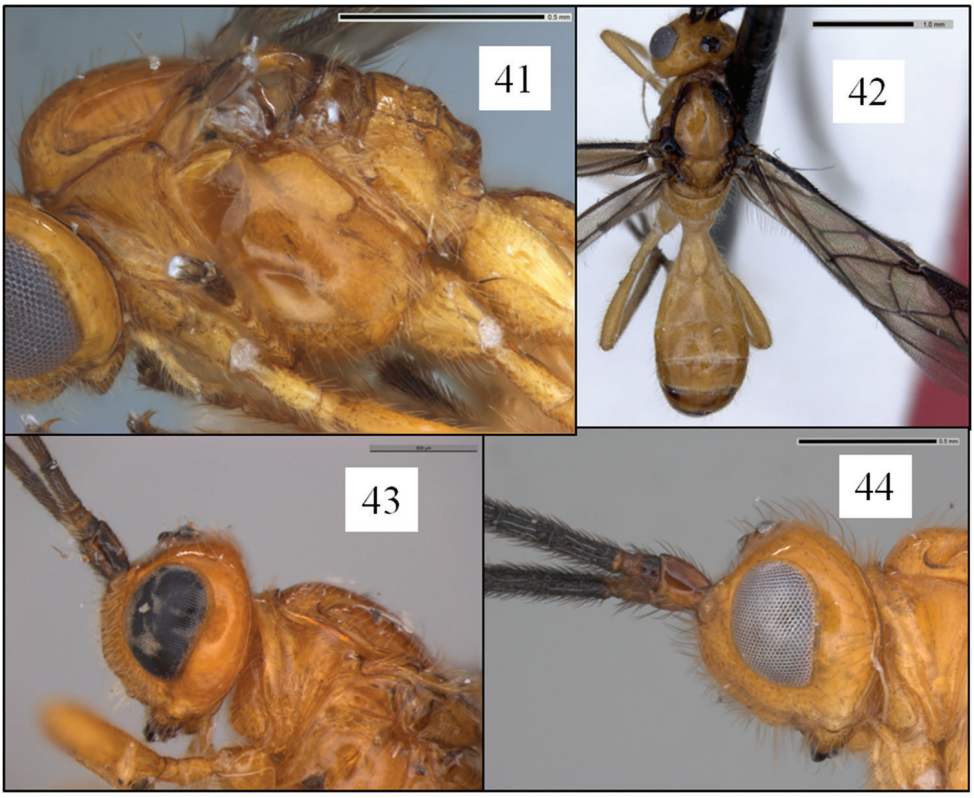
Opius petri Fischer, 1968a: 77 (key); 95–98 (description). Holotype female in AEIC (examined).
Opius petri: Fischer 1971: 98 (catalog).
Opius (*Merotrachys*) *petri*: Fischer 1977: 655–656, 698–700 (key, redescription); Fischer 1979a: 264–266 (key); Yu et al. 2005, 2012 (electronic catalogs).

Type locality. Suriname, near Paramaribo.

Type material. Holotype. Female (AEIC), first label, first line: nr. Paramaribo second line: Surinam second label, first line: XII.7–13.63 second line: D.C. Geijskes



Figures 37–40. *Opius* spp. holotypes. **37** *O. rojam* Daniels & Wharton sp. n., T1 dorsal-lateral view **38** *O. ingenticornis* Fischer, T1 dorsal view **39** *O. rojam*, mesosoma oblique view **40** *O. rojam*, T2+3 showing deformity.



Figures 41–44. *Opius* spp. **41** *O. duplocarinatus* Fischer, holotype, mesoscutum showing distinct anterior declivity **42** *O. nimifactus* Fischer, paratype, dorsal view showing color pattern **43** *O. rojam* Daniels & Wharton sp. n., holotype, head lateral view showing setal pattern on basal flagellomeres **44** *O. curiosicornis* Fischer, holotype, head lateral view showing setal pattern on basal flagellomeres.

Diagnosis. Face weakly shagreened medially, strongly shagreened adjacent eye margin, with scattered large punctures. Eye in lateral view 2.0–2.5 × longer than temple; temples in dorsal view not receding. Female antenna broken; setae on basal flagellomeres thin, pale. Mesoscutum anteriorly gradually merging with plane of pronotum, with weakly elevated, indistinct anterior declivity; notaulus extending laterally towards tegula as groove bordered by distinct supramarginal carina. Propodeum rugose with heavily sculptured median trough anteriorly, areola obscured by sculpture posteriorly. Fore wing 3RSa weakly curved, about 1.2 × longer than 2RS; m-cu postfurcal. T1 sharply declivitous anteriorly, pit delimited posterior-medially; surface weakly rugulose and shagreened; dorsal carinae irregularly sinuate, broadest posteriorly; weakly transversely carinate between dorsal carinae. T2 and T3 shagreened. Ovipositor short; ovipositor sheath about 0.3–0.4 × length of mesosoma. Head, prothorax, tegula, most of propodeum, T1, T3–T6, hind coxa and femur dark reddish brown; mesosoma otherwise mostly dark orange, T2 medially orange-brown with narrow, dark brown lateral margins; wing lightly infumate.

Remarks. This species is known only from the female holotype and is readily recognizable by the distinctive color pattern of dark head and legs and mostly dark orange mesosoma (Fig. 35). T1 is also a bit shorter than in other dark species such as *O. albericus* and *O. pilosicornis*.

In the original description, the collector's name is incorrectly spelled Geijkes.

***Opius pilosicornis* Fischer**
http://species-id.net/wiki/Opius_pilosicornis
Figs 19, 20

Opius pilosicornis Fischer, 1965c: 239–242. Holotype female in AEIC (examined).
Opius pilosicornis: Fischer 1965d: 420 (key); Fischer 1968a: 77–78 (key); Fischer 1971: 76 (catalog).
Opius (*Merotrachys*) *pilosicornis*: Fischer 1977: 655–657, 700–701 (key, redescription); Fischer 1978: 166 (range extension); Fischer 1979a: 264–267 (key); Yu et al. 2005, 2012 (electronic catalogs).

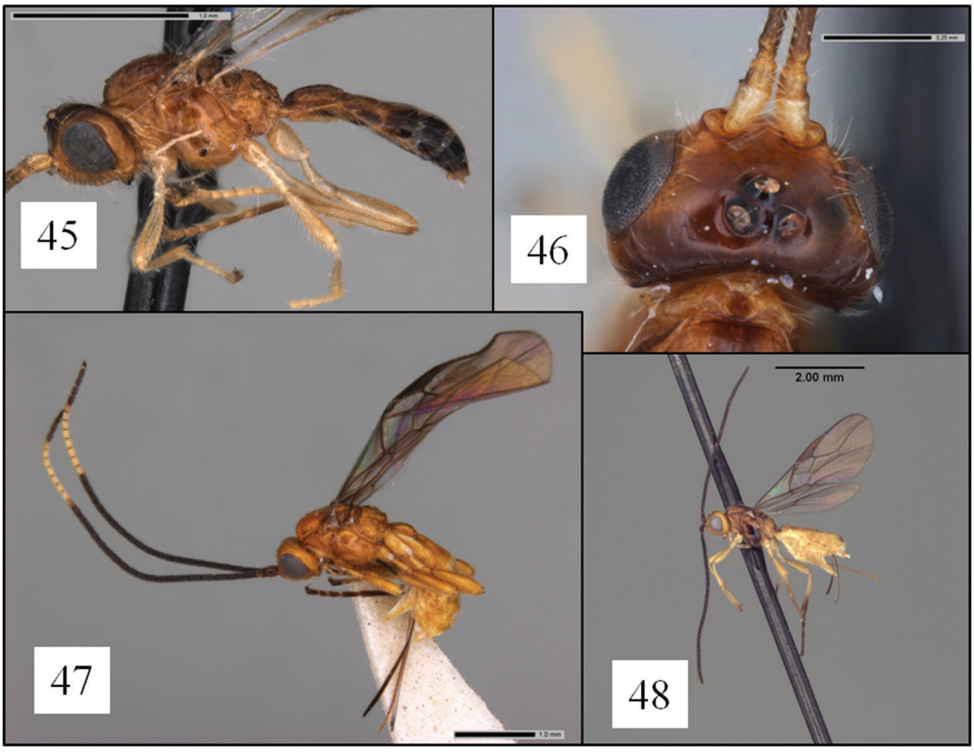
Type locality. Peru, Quincemil, near Marcapata, 750 m.

Type material. Holotype. Female (AEIC), first label, first line: Quincemil, Perú second line: 750 m nr Marcapata third line: Nov. 10–15, 1962 fourth line: Luis Peña

Paratypes. Two females (not seen), same data as holotype; one female, same data except ix.1962.

Other material (not examined). One female, one male, Brazil, Para, Jacareacanga, x.68, M. Alvarenga.

Diagnosis. Face distinctly punctate, punctures separated by about 1 × their diameter, strongly shagreened adjacent eye margin, otherwise mostly weakly shagreened between punctures. Eye in lateral view 2.0–2.5 × longer than temple; temples in dorsal view not receding. Antenna of female with 56 flagellomeres, allotype with 54 flagellomeres; setae on basal flagellomeres thick, dark. Mesoscutum anteriorly on nearly same plane as pronotum, without distinct anterior declivity; notaulus extending laterally towards tegula as groove bordered by distinct supramarginal carina. Propodeum coarsely rugose, median areola absent, median trough anteriorly deep, short, distinct. Fore wing 3RSa straight, about 1.6 × longer than 2RS; m-cu postfurcal. T1 declivitous anteriorly at about a 45 degree angle, basal pit delimited posterior-medially; surface shagreened throughout; dorsal carinae weakly elevated, sinuate, widest subapically, narrowing apically, without obvious transverse carinae between dorsal carinae. T2 uniformly, distinctly shagreened; T3 mostly weakly shagreened, smoother and very finely punctate laterally. Ovipositor short, barely protruding; ovipositor sheath roughly 0.4 × length of mesosoma. Head, mesosoma, T1, T3–T6 dark reddish brown to dark brown; T2 white with narrow, dark brown lateral margins; hind coxa white; hind femur almost completely dark reddish brown; antenna without subapical pale ring; wing lightly infumate.



Figures 45–48. *Opius* spp. holotypes. **45** *O. antennatus* Fischer, habitus **46** *O. antennatus* head dorsal view **47** *O. duplocarinatus* Fischer, habitus **48** *O. simplicornis* Fischer, habitus.

Remarks. This species was described from the holotype female and three additional paratype females, all from Peru. Fischer (1978) subsequently recorded a male and a female from the state of Pará in Brazil. This species is nearly identical to *O. albericus* (see remarks above under that species), differing only in minor details, most notably in the relative size of the eye.

Opius raphaeli Fischer

http://species-id.net/wiki/Opius_raphaeli
Figs 2, 11, 36

Opius raphaeli Fischer, 1968a: 77–78 (key); 98–101 (description). Holotype female in AEIC (examined).
Opius raphaeli: Fischer 1971: 104 (catalog).
Opius (*Merotrachys*) *raphaeli*: Fischer 1977: 655–657, 702–704 (key, redescription); Fischer 1979a: 264–266 (key); Yu et al. 2005, 2012 (electronic catalogs).

Type locality. Argentina, Horco Molle, near Tucumán.

Type material. Holotype. Female (AEIC), first label, first line: Horco Molle second line: nr. Tucumán third line: I–18–66 Arg. fourth line: H. &M. Townes

Diagnosis. Face very deeply, distinctly punctate, punctures separated by 1–2 × their diameter, strongly shagreened adjacent eye margin, otherwise very weakly shagreened to smooth between punctures. Eye in lateral view about 1.5–1.7 × longer than temple; temples in dorsal view receding. Female antenna with 53 flagellomeres; setae on basal flagellomeres thin, pale. Mesoscutum anteriorly on nearly same plane as pronotum, without distinct anterior declivity; notaulus appears longer than in other species with supramarginal carina barely indicated: appearance of both may have been altered by the pin through the mesoscutum. Propodeum rugose with sculptured median trough anteriorly separated by carina posteriorly from irregularly pentagonal areola. Fore wing 3RSa weakly curved, about 1.25–1.35 × longer than 2RS; m-cu postfurcal. T1 sharply declivitous anteriorly, pit delimited posterior-medially; surface largely smooth; dorsal carinae weakly sinuate, nearly parallel-sided, broadening subapically, narrowing apically, with a few, weak transverse carinae between dorsal carinae. T2 very faintly shagreened, T3 smooth, polished. Ovipositor short; ovipositor sheath about 0.3–0.4 × length of mesosoma. Head, posterior margin of T3, and all of T4–6 dark brown to black. Mesosoma, hind coxa, and hind femur orange; T1, T2, most of T3 a little darker: reddish orange; antenna without subapical pale ring; wing lightly infumate.

Remarks. Known only from the female holotype. The granular-punctate sculpture of the clypeus (Fig. 2) is distinctive relative to other species treated here. The color pattern (Fig. 36) is also unique.

The *ingenticornis* species group, excluded species

Opius bicarinifer Fischer

http://species-id.net/wiki/Opius_bicarinifer
Figs 10, 23

Opius (*Merotrachys*) *bicarinifer* Fischer, 1979a: 264–265 (key); 269–271 (description). Holotype male in AEIC (examined).
Opius (*Merotrachys*) *bicarinifer*: Yu et al. 2005, 2012 (electronic catalogs).

Type locality. Brazil, Rondonia, Vilhena.

Type material. Holotype. Female (AEIC), first label, first line: Vilhena, Rond. second line: XI. '73 Brazil third line: M. Alvarenga

Diagnosis. Face polished throughout, faintly punctate, nearly smooth. Eye in lateral view 4.0–4.5 × longer than temple; temples in dorsal view distinctly receding. Antenna broken; setae on basal flagellomeres thick, dark. Mesoscutum anteriorly with weak but distinct declivity; notaulus shallowly curving laterally towards tegula, supramarginal carina weak, barely distinguishable. Propodeum largely smooth, with deep median trough from base to apex, not broadened posteriorly into distinct areola. Fore

wing 3RSa straight, 1.5–1.6 × longer than 2RS; m-cu antefurcal. T1 evenly curving into basal pit anteriorly, not distinctly declivitous, pit not delimited posterior-medially; surface weakly shagreened, nearly smooth throughout; dorsal carinae weakly sinuate, parallel-sided for most of their length, weakly broadening subapically, abruptly converging near posterior margin, not transversely carinate between dorsal carinae. T2 uniformly, distinctly shagreened, T3 more weakly so, especially laterally. Ovipositor short; ovipositor sheath 0.4 × length of mesosoma. Head, body, hind coxa and femur light orange; wing darkly infumate.

Remarks. Known only from the female holotype. This species is tentatively excluded from the *ingenticornis* species group primarily because of the evenly curved anterior slope of T1 (Fig. 10) and the poorly developed malar sulcus. Since the antenna is broken, length cannot be used to assist in placement of this species. *Opius bicarinifer* is most similar to *O. curiosicornis* because of similarities in the propodeal sculpture and both have the same color pattern. They differ primarily in shape of the head and the anterior slope of T1. The temples in dorsal view are noticeably receding in *O. bicarinifer*, another feature not found in typical members of the *ingenticornis* species group.

Opius duplocarinatus **Fischer**

http://species-id.net/wiki/Opius_duplocarinatus
Figs 41, 47

Opius duplocarinatus Fischer, 1965b: 286–289. Holotype female in AEIC (examined).
Opius duplocarinatus: Fischer 1965d: 419 (key); Fischer, 1968b: 463–464 (key); Fischer 1971: 63 (catalog).
Opius (*Pendopius*) *duplocarinatus*: Fischer 1977: 714, 721–723 (key, redescription); Fischer 1979b: 484–485 (key); Yu et al. 2005, 2012 (electronic catalogs).

Type locality. Peru, Avispas, near Marcapata, 30 m.

Type material. Holotype. Female (AEIC), first label, first line: Avispas, Perú second line: 30m nr. Marcapata third line: Oct. 1–15, 1962 fourth line: Luis Peña

Diagnosis. Face distinctly punctate, punctures separated by about 1 × their diameter laterally, more closely spaced medially, nearly smooth between punctures. Eye in lateral view about 4.5 × longer than temple; temples in dorsal view strongly receding. Female antenna with 31 flagellomeres; setae on basal flagellomeres short, moderately thick, dark. Mesoscutum anteriorly with distinct declivity; notaulus extending laterally towards tegula as groove bordered by distinct supramarginal carina. Propodeum mostly rugulose, especially anteriorly, with narrow, shallow median trough anteriorly confluent with large, broad, roughly pentagonal areola posteriorly. Fore wing 3RSa weakly curved, 1.4–1.5 × longer than 2RS; m-cu postfurcal. T1 evenly curving into basal pit anteriorly, not distinctly declivitous, pit not delimited posterior-medially; surface rugulose throughout; dorsal carinae parallel-sided for most of their length, abruptly converging near posterior margin, not or only very weakly sinuate, rugulose

but not transversely carinate between dorsal carinae. T2 and T3 smooth, polished throughout. Ovipositor long; ovipositor sheath about 1.5 × longer than mesosoma. Head, body, hind coxa and femur light orange; antenna with whitish subapical ring; wing darkly infumate.

Remarks. This species is known only from the female holotype and is most similar to *O. marci*, treated below. Both species have a pale subapical ring on the antenna (Fig. 47) whereas the flagellum is uniformly dark in all other species treated here. The setal pattern on the basal flagellomeres of these two species is also similar, with the setae shorter and not quite as thick as in species such as *O. albericus*, but thicker and darker than in species such as *O. matthaei*. Both species also have a relatively long ovipositor and relatively short antenna (with 29–31 flagellomeres). Exclusion of these two species from the *ingenticornis* species group is based primarily on the short antennae and the T1 profiles that are concave and gradually sloping anteriorly, and secondarily on the smaller pronope. Although *O. duplocarinatus* and *O. marci* are nearly identical, they have been placed in different subgenera (Fischer 1977, 1979a, b) because *O. marci* has very faintly shagreened sculpture on T2 and T2 sculpture is lacking in *O. duplocarinatus*. There are also minor differences in the propodeum, with the areola more discrete in *O. marci*, and *O. duplocarinatus* has a distinct (though unsculptured) precoxal sulcus.

***Opius marci* Fischer**
http://species-id.net/wiki/Opius_marci

Opius marci Fischer, 1968a: 77–78 (key); 87–90 (description). Holotype female in AEIC (examined).
Opius marci: Fischer 1971: 86 (catalog).
Opius (*Merotrachys*) *marci*: Fischer 1977: 655–657, 682–683 (key, redescription); Fischer 1979a: 264–266 (key); Yu et al. 2005, 2012 (electronic catalogs).

Type locality. Peru, Loromayo.

Type material. Holotype. Female (AEIC), first label, first line: Loromayo, Perú second line: IX. 4–10. 62 third line: Luis Peña

Diagnosis. Face distinctly punctate, punctures separated by 1–2 × their diameter, smooth between punctures. Eye in lateral view about 3.8–4.0 × longer than temple; temples in dorsal view receding. Female antenna with 29 flagellomeres; setae on basal flagellomeres short, thick, dark. Mesoscutum anteriorly with distinct declivity; notaulus extending laterally towards tegula as groove bordered by distinct supramarginal carina. Propodeum weakly rugulose to smooth with anterior median trough separated from well-defined, discretely margined, pentagonal areola posteriorly. Fore wing 3RSa weakly curved, 1.5 × longer than 2RS; m-cu postfurcal. T1 evenly curving into basal pit anteriorly, not distinctly declivitous, pit not delimited posterior-medially; surface rugulose, at least medially; dorsal carinae parallel-sided throughout, not sinuate, trans-

versely carinate between dorsal carinae. T2 very faintly shagreened medially, mostly smooth, polished; T3 smooth, polished. Ovipositor long; ovipositor sheath about 1.3–1.4 × longer than mesosoma. Head, body, hind coxa and femur pale orange; antenna with pale subapical ring; wing infumate.

Remarks. This species is known only from the female holotype. It is nearly identical to *O. duplocarinatus*, but has a somewhat more discrete propodeal areola. See remarks section under *O. duplocarinatus* for additional comparisons and rationale for exclusion from the *ingenticornis* species group.

Opius simplicornis **Fischer**

http://species-id.net/wiki/Opius_simplicornis
Fig. 48

Opius simplicornis Fischer, 1968b: 463–464 (key), 477–479 (description). Holotype female in AEIC (examined).
Opius simplicornis: Fischer 1971: 111 (catalog).
Opius (*Pendopius*) *simplicornis*: Fischer 1977: 714, 736–748 (key, redescription); Fischer 1979b: 484–485 (key); Fischer 1983a: 92; Yu et al. 2005, 2012 (electronic catalogs).

Type locality. Argentina, Horco Molle, near Tucumán.

Type material. Holotype. Female (AEIC), first label, first line: Horco Molle second line: nr. Tucumán third line: III.27–31.66 Arg. fourth line: Lionel Stange

Diagnosis. Face finely but distinctly punctate, punctures separated by nearly 2 × their diameter, otherwise smooth between punctures. Eye in lateral view about 2.6–2.9 × longer than temple; temples in dorsal view strongly receding. Female antenna with 30 flagellomeres; setae on basal flagellomeres thick, dark. Mesoscutum anteriorly on nearly same plane as pronotum, without distinct anterior declivity; notaulus extending laterally towards tegula as groove bordered by distinct supramarginal carina. Propodeum rugulose with median trough anteriorly separated by carina posteriorly from fairly well-defined pentagonal areola. Fore wing 3RSa straight, about 1.6 × longer than 2RS; m-cu postfurcal. T1 evenly curving into basal pit anteriorly, not distinctly declivitous, pit not delimited posterior-medially; surface largely smooth; dorsal carinae weakly sinuate, broadening subapically, narrowing apically, not obviously transversely carinate between dorsal carinae. T2 and T3 smooth, polished. Ovipositor long; ovipositor sheath about 1.0–1.1 × longer than mesosoma. Head, propodeum, T1 pale orange; mesosoma mottled dark orange, and brown; T2–5, hind coxa, and hind femur yellow; T6 at least partly dark brown; antenna without subapical pale ring; wing lightly infumate.

Remarks. This species is known only from the female holotype. The holotype matches the original written description, but the figure (Fischer 1968b, Fig. 7) is not of this species because it shows a very short ovipositor. The written description indicates a much longer ovipositor, as evident in the holotype (Fig. 48).

Fischer (1979b, p. 493) compared *O. simplicornis* to *O. caudisignatus* Fischer and later (Fischer 1983a) to *O. vinoanus* Fischer. The former has a much longer ovipositor and the latter a more heavily sculptured T1 relative to *O. simplicornis*. The absence of a distinct anterior declivity on the mesoscutum suggests a relationship to members of the *ingenticornis* species group, but the antenna is shorter, with significantly fewer flagellomeres and T1 lacks the steep anterior declivity typical of nearly all members of this species group.

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