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First report, morphological and molecular characterization of *Xiphinema elongatum* and *X. pachtaicum* (Nematoda, Longidoridae) from Ethiopia

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Abstract

A total of six soil samples were collected around rhizosphere of citrus plants during 2010 from Melkassa Agricultural Research Center experimental station, Ethiopia. From these samples two most important ecto-plant parasitic nematodes of the genus *Xiphinema* were found and analysed. The genus *Xiphinema* is a large group of the phylum nematoda which constitutes more than 260 species. They are polyphagous root- ectoparasites of many crop plants and some species of this genus cause damage by direct feeding on root tips and transmit nepoviruses. The delimitation and discrimination of two species in the genus is presented, described herein as *Xiphinema elongatum* and *Xiphinema pachtaicum*. Morphological and morphometric data were done using light microscopy and results of both species were fit within the previously described nematode species of *X. elongatum* and *X. pachtaicum*. 18S rDNA were analysed using Bayesian inference (BI) method to reconstruct phylogenetic relationships of the studied *Xiphinema* sp. (KP407872 *X. elongatum* and KP407873 *X. pachtaicum*) with other *Xiphinema* species. The 18S rDNA sequence of *X. pachtaicum* was alike to previously described species from the GenBank but *X. elongatum* exhibited very small levels of nucleotides differences (0.4%) which might be possible intra-specific divergence. Though this region of rDNA has less resolution on complex species, its combination with morphological and morphometric analyses, suggests these species as *X. elongatum* and *X. pachtaicum* with the GenBank ac-

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cession number of KP407872 and KP407873, respectively. Short notes, morphological measurements, illustrations, and molecular data are given to these species. These species are reported for the first time from Ethiopia and it provides new geographical information of these organisms.

Keywords
18S rDNA, Ethiopia, molecular data, morphometry, phylogeny, *Xiphinema*

Introduction

The ecto-parasitic longidorid nematodes of the genus *Xiphinema* is amongst the ten most economically important plant parasitic nematode genera (Sasser and Freckman 1987). They are migratory and polyphagous nematodes, which cause damage to a broad range of crop plants by their direct feeding on root tips which results in root gall and stunted shoot growth. Approximately 4% of *Xiphinema* species have been shown to transmit certain nepoviruses to a wide range of fruit and vegetable crops (Taylor and Brown 1997). *Xiphinema* is the largest genus of the phylum Nematoda (Andrassy 2007) and currently has more than 260 valid species, of which approximately 50 species belong to the *X. americanum* group (Gutiérrez-Gutiérrez et al. 2013; Oliveira and Neilson 2006). Because of their economic importance, species of the *Xiphinema americanum* group are listed as A1 quarantine organisms by European and Mediterranean plant protection organization (EPPO 2011; Decraemer and Robbins 2007).

The genus *Xiphinema* has characteristic morphological features of 1.2–7.3 mm body length, flanged odontophore, forked junction of the odontostyle and odontophore, posterior strongly sclerotized and slightly sclerotized anterior border of the double guiding ring near the odontostyle/odontophore junction. Amphid fovea, mainly funnel- or stirrup shaped with aperture slit like and dorsal pharyngeal gland nucleus close to dorsal gland opening (Hunt 1993).

Accurate identification of this nematode is needed to allow distinction between virus vector and non-virus vector species which helps to differentiate species under quarantine or regulatory strategies. *Xiphinema* species show quite some morphological complexity to identify only based on morphological identification method (Lamberti et al. 2000; Kumari et al. 2010). Ribosomal DNA (rDNA) sequences from partial 18S, ITS regions, and the D2 and D3 expansion segments of the 28S, and mitochondrial DNA (mtDNA), cytochrome c oxidase 1 subunit (COI), are useful diagnostic tool for the characterization and establishment of phylogenetic relationships especially for the species of the *Xiphinema americanum* group (Lazarova et al. 2006; Gutierrez-Gutierrez et al. 2010). Though the sequence of rDNA of partial 18S sequence is considered as lesser importance for species delimitation, it is used for phylogenetic characterization of some species of the genus. In this study, the 18S small subunit of the rDNA region was analysed.

Both samples were collected from main horticultural crop production fields (mainly from citrus plantation) in the Rift valley basin of Ethiopia. Two *Xiphinema* species, *X. elongatum* Schuurmans Stekhoven & Teunissen, 1939 and *X. pachtaicum* (Tulaganov, 1939) were found and are herewith described using morphology, morphometric data and molecular phylogenetic analyses. These findings represent new records from Ethiopia as well it represents new geographical information.

Materials and methods

Sampling and morphological observations

Samples of both species were taken from rhizosphere of citrus plants in the Rift valley basin of Ethiopia (39°21'E, 8°24'N) in 2010. A total of six bulk samples of each 1–1.5 kg consisted of 10–15 cores taken from the top 10–40 cm of soil. The samples were kept cool in plastic bags during transportation to the laboratory for nematode extraction. Nematodes were extracted from 200g soil of sub-samples using the modified Baermann method (Hooper 1985).

Specimens were fixed by 4% formalin with 1% glycerin that heated to 70 °C and added quickly to kill and fix nematodes in one step (Seinhorst 1966). The fixed specimens were processed to anhydrous glycerin following the glycerin-ethanol method of Seinhorst (1959) modified by De Grisse (1969). Fixed specimens were permanently mounted in anhydrous glycerol (Hooper 1985). For morphological study, specimens were photographed using Olympus BX50 and Olympus CH30 light microscopes. Voucher specimens for *X. elongatum* were deposited at Ghent University nematode collection as UGnem-37 and specimens of *X. pachtaicum* were placed at Ambo plant protection Research Center Nematology section, Ethiopian Institute of Agricultural Research, Ethiopia.

DNA extraction, PCR, and sequencing aseptic

Nematode specimens from the same population were also killed and preserved in DESS solution containing 20% dimethyl sulphoxide (DMSO) and 0.25 M disodium EDTA, saturated with NaCl, pH 8.0 (Yoder et al. 2006; Seutin et al. 1991). This was done by pouring the nematode suspension over a 500 mesh sieve (25 µm opening) to allow most of the water to drain and rinsing the nematodes with DESS solution into a vial (Yoder et al. 2006). Individual nematodes from the solution were mounted on temporary slides and identified using light microscope before further molecular characterization of the small subunit (SSU, 18S). These morphologically characterized DESS-preserved nematodes were rinsed in distilled water for about 30 minutes, and transferred to eppendorf tube with 25 µl of worm lysis buffer (WLB),

Williams et al. (1992): 50 mM KCl; 10 mM Tris-Cl pH 8.3; 2.5 mM MgCl2; 0.45% NP 40 (Tergitol Sigma); and 0.45% Tween 20) and frozen at -80 °C for at least 10 minutes. To each tube it was added 1 µl of proteinase K (60 µg ml^{-1}) prior to incubation at 65 °C for 1 hour followed by enzyme deactivation at 95 °C for 10 minutes. To amplify the 18S region, 2.5 µl of gDNA suspension was used as template in a 25 µl PCR reaction mix (TopTaq Qiagen, Germany) following the manufacturer's protocol. The primers used were G18S4 (5'- GCT TGT CTC AAA GAT TAA GCC - 3') & 4F (5'-CAA GGA CGA WAG TTW GAG G-3') and the reverse primers were 18P (5'- TGA TCC WRC RGC AGG TTC AC - 3'), & 4R (5'- GTA TCT GAT CGC CKT CGA WC-3') (Blaxter et al. 1998). The PCR conditions were: denaturation at 96 °C for 4 min; followed by 40 cycles of 95 °C for 30 second, 54 °C for 30 second, 72 °C for 1 min, and extension for 10 min at 72 °C. Aliquots of 5 µl of the PCR products were sized with low DNA mass ladder and separated by electrophoresis in 1% agarose gel stained with ethidium bromide and observed under UV Transilluminator BioDoc-It Imaging System. The sizes of the amplified products were determined by comparison with DNA ladder. PCR products were enzyme-purified using 1 µl of Exonuclease I + FastAP Thermo-sensitive Alkaline Phosphatase. Purification was done by incubating the mixture for 15 minutes at 37 °C followed by 15 minutes at 85 °C to inactivate enzymes. Cleaned PCR products were then used for cycle sequencing using the ABI Prism BigDye V3.1 Terminator Cycle Sequencing kit following the manufacturer's protocol. Primers used for sequencing were, 9FX (5'-AAG TCT GGT GCC AGC AGC CGC-3'), 2FX (5'-GGA AGG GCA CCA CCA GGA GTG G-3'), 13R (5'-GGG CAT CAC AGA CCT GTT A-3'), 23F (5'-ATT CCG ATA ACG AGC GAG A-3'), 9R (5'-AGC TGG AAT TAC CGC GGC TG-3'), 26R (5'- CAT TCT TGG CAA ATG CTT TCG-3') (Blaxter et al. 1998; Meldal et al. 2007). Sequencing was performed in both directions. Both nucleotide sequences are deposited in the GenBank (NCBI) as KP407872 for *X. elongatum* and KP407873 for *X. Pachtaicum*.

Phylogenetic analyses

For phylogenetic analysis, the sequences were aligned with related sequences from GenBank, using ClustalW (Thompson et al. 1994) provided by BioEdit sequence alignment editor (Hall 1999). Phylogenetic analyses were performed by Bayesian inference (BI) method with MrBayes v3.1.2 (Ronquist and Huelsenbeck 2003). A general time-reversible model with rate variation across sites and a proportion of invariable sites (GTR + I + G) was used. Analyses were run for 3 × 106 generations and trees were generated using the last 1,000,000 generations well beyond the burn-in value. Also other methods (maximum parsimony, neighbor joining, maximum likelihood) using PAUP* (Phylogenetic Analysis Using Parsimony) (Swofford 2002) provided the same tree topologies but are not further discussed herein.

Results and discussions

Xiphinema elongatum Schuurmans Stekhoven & Teunissen, 1938

Figure 1; Table 1

Description. *Female.* Body 'J' shaped, cylindrical, tapering towards the anterior end but more to the posterior end. Cuticle smooth, 1.6–2.3 µm thick at neck region, 2.3–3.1 µm at mid body and 5.5–6.3 µm at tail region. Lip region, well demarcated. Amphidial aperture on lip region 50–59% of lip width. Amphidial fovea stirrup–shaped. Guiding ring, about 1/4th of the total odontostyle length from the base of odontostyle. Odontostyle, 1.6 µm diameter, 66±3 (63–73) % of total stylet length and furcated at base. Odontophore well developed with prominent basal flanges 10.9–11.7 µm wide. Lip width 3.1 ±0.5 (2.5–4.2) % of total stylet length. Female reproductive system amphidelphic, didelphic, branches equally developed. Ovaries reflexed. *Pars dilatata oviductus* separated from the uterus by a very robust sphincter muscle. No uterus differentiation. Vagina about half body width and perpendicular to the body axis. Vulva, 41% of body length from anterior end. Tail, conoid to dorsally convex conoid, non-digitate, terminal hyaline portion about 27% of tail length (Fig. 1).

The description of *X. elongatum* has been recorded by a number of authors and well studied. It was originally described by Schuurmans Stekhoven and Teunissen (1938) from a single female specimen from Rutshuru (Zaire) and redescribed by many authors such as Tarjan and Luc (1963), Williams (1959), Carvalho (1962), Timm (1965), Cohn and Sher (1972), Loof and Maas (1972), Heyns (1974), Williams and Luc (1977) and Loof and Sharma (1979), and also lately by Loof and Luc (1990).

The morphometric data of described Ethiopian specimens were perfectly fit within the twenty-two populations of *X. elongatum* recorded by Luc and Southey (1980) from a different country and are fairly similar to records of *X. elongatum* from Botswana (Heyns and Coomans 1991), Guiana and Martinique (Luc and Coomans 1992) and Taiwan (Chen et al. 2004). According to Luc and Southey (1980), *X. elongatum* appears to have continuous pattern of variation for some morphometric data and shape of tail over different populations of different geographic location. These authors divided *X. elongatum* into two groups upon morphological variation over different geographical locations. The first group, characterized by a shorter tail and longer stylet, all originate from West Africa whereas the second, having a longer tail and

Table 1. Alpha-numeric codes of the polytomous identification key for *Xiphinema* species by Loof and Luc (1990) of *Xiphinema elongatum* and the studied specimens.

Characters	A	B	C	D	E	F	G	H	I	J	K	L
The studied specimen	4	4	2	3	34	2	1	3	3	-	-	1
Loof and Luc (1990) key	4	4	23	34	2345	23	12	2	3	2	2	1

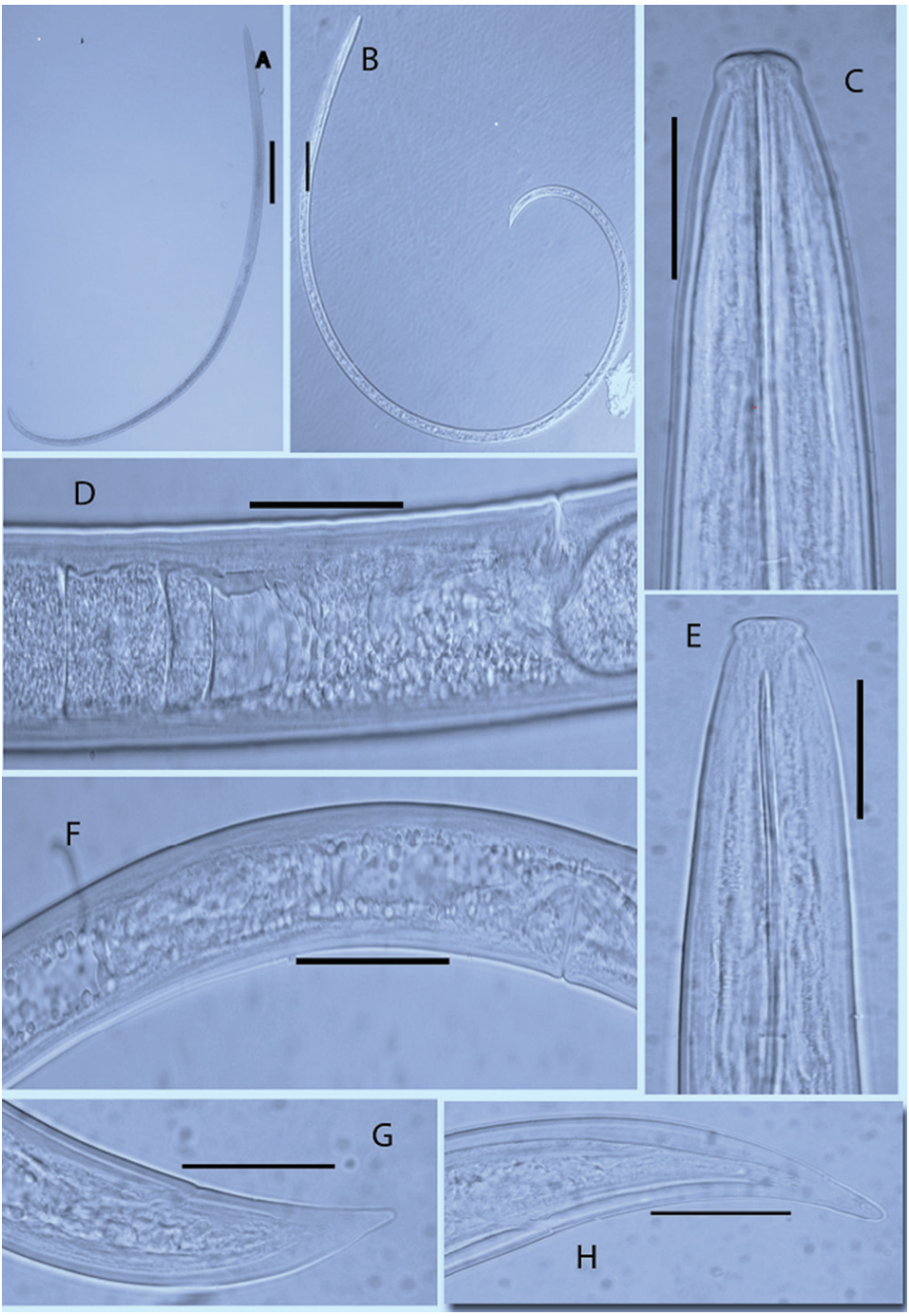

Figure 1. Photomicrographs of *X. elongatum* and *X. pachtaicum*. **A, C, D, H** Body habitus, head region, entire female reproductive part, tail region of *X. elongatum* respectively **B, E, F, G** Body habitus, head region; female reproductive part and tail part of *X. pachtaicum* respectively. **A** = 250 μm; **B** = 100 μm; **D, F** = 50 μm; **C, E, G, H** = 25 μm

Table 2. Morphometric measurements of *Xiphinema elongatum* and *Xiphinema pachtaicum.* All measurements are in μm, measurements presented as mean ± standard deviation (range).

	Xiphinema elongatum (♀)	***Xiphinema pachtaicum*** (♀)
n	4	12
L	2380±71 (2330–2430)	1937±103 (1732–2096)
a	69±7 (64–74)	70±3.6 (64–75)
b	7.2±0.5 (6.9–7.6)	7.3±0.6 (6.4–8.2)
c	33.2±5.8 (29.1–37.3)	63±5.1(55–71)
c'	2.7±0.1 (2.6–2.8)	1.9±0.2 (1.6–2.2)
V	41.3 ± 0.3 (41–41.7)	57±1 (56–58)
Lip width	11±1 (10–11)	8±1 (7–10)
Odontostyle	78±12 (70–86)	89±3 (85–97)
Odontophore	51±7 (46–55)	46±5 (33–51)
Pharynx	329±11 (321–337)	266±25 (232–329)
Body width	35±2 (33–36)	28±2 (25–30)
Anal body width	22±3 (20–24)	17±1 (15–18)
Tail	65.1±2.7 (62.5–68)	31±2 (27–36)

shorter stylet, are mainly from east Africa or South East Asia/ Pacific area. According to this suggestion the studied specimen best fit with the second population group of *X. elongatum*. This species was reported as widespread and common in Africa including neighbor country Kenya (Luc and Southey 1980; Heyns and Coomans 1991; Coomans et al. 2001).

Accordingly, it belongs to group 7 of the species group, characterized by equal female genital branches, without uterine differentiation, and tail elongate to conical.

As the revised polytomous key by Loof and Luc (1990), on note 22, *X. elongatum* cannot be separated clearly by the characters used in the key. But they can be differentiated by: c' = 1.9–3.3; total spear length = 134–178 μm which perfectly fit with the studied Ethiopian specimen.

Male. Not found.

Locality and host. The sample materials were collected around the rhizosphere of citrus plant from Melkassa agricultural research center, Oromiya, Ethiopia.

Xiphinema pachtaicum **(Tulaganov, 1938)**

Table 1

Longidorus pachtaicus Tulaganov, 1938: Tulaganov 1938.
Xiphinema pachtaicum (Tulaganov, 1938): Kirjanova 1951.
Xiphinema mediterraneum Martelli & Lamberti, 1967: Siddiqi and Lamberti 1977.
Xiphinema neoelongatum Bajaj & Jairajpuri, 1977: Luc et al. 1984.

Description. *Female.* Body 'C' shaped after fixation, tapering to both end but more to the anterior. Cuticle smooth under light microscope. Lip region, distinctly offset by constriction. Amphid aperture post labial, fovea stirrup shaped and about two-third of lip width. Odontostyle robust, poorly forked, 1.56 µm thick, 66±3 (63–73) % of total stylet length and odontophore with weak flanges with width of 10±3 (7–12) µm. Basal Guiding ring 110±6 (104–115) µm from anterior end. Pharynx includes one anterior dorsal nucleus and two posterior subventral nuclei, pharyngeal gland length 94±5 (91–99) µm. Vulva, posterior to mid-body, a transverse slit in ventral view, one-third of the corresponding body width. Female genital branches, didelphic, reflexed, equally developed, generally short. Ovaries, with bacterial endosymbiont, uterus without Z-differentiation, sphincter not clear. Tail short, conical with narrow rounded end (Fig. 1).

Morphological variations of *X. pachtaicum* have been recorded among populations of different localities from Iran (Fadaei et al. 2003) and Czech (Kumari 2004).

The morphometric range of studied Ethiopian specimen is more similar to that of the Iranian population (Fadaei et al. 2003), and also agrees with the record from Serbia and Montenegro (Basri and Lamberti 2002). The studied Ethiopian species have a slightly longer body length and higher 'a' ratio compared to studied population from Iran and Czech (Fadaei et al. 2003; Kumari 2004). However, according to Luc et al. (1984) the variation of coefficient of 'a' and 'c' are common for this species that is between 43–74 and 47–84 respectively.

Xiphinema pachtaicum is widespread in Europe (Switzerland, Germany, United Kingdom, Czech Republic, Slovakia, Hungary, Croatia, Romania, Serbia, Macedonia, Montenegro, Bulgaria, Portugal, Spain, France, Italy, Greece, Cyprus, Malta, Moldova, Ukraine); Asia (Israel, Turkey, Georgia, Uzbekistan, Turkmenistan, Jordan, Iraq, Iran); Africa (Algeria, Morocco, Libya, Egypt, South Africa); North America (United States, Trinidad); South America (Chile) and Australia. This species has not been recorded as a vector of plant viruses (Andrassy 2006).

The alpha-numeric polytomous identification key codes as developed by Lamberti et al. (2000) to be applied for the studied *X. pachtaicum* of the *Xiphinema americanum* group in Africa are agree with Ethiopian studied population: A 2, B 2, C 1/2, D 32, E 32, F 2, G 21, H 23, I 23, J 1. Characterized by lip region set off from body, body length 1.6 to 2.0 mm; odontostyle length < 86 µm; value of c' ratio 1.6 to 2; vulva 53 to 56% or vulva > 56%; value of 'a' ratio 61 to 80; value of 'c' ratio < 60 or > 60; distance of basal guide ring from oral aperture 61 to 75 µm; distance of basal guide ring from oral aperture > 75 µm.

Male. Not found.

Locality and host. The sample materials were collected around the root rhizosphere of citrus plant from Melkassa agricultural research center, Oromiya, Ethiopia.

Molecular and phylogenetic characterization

The PCR amplification of 18S SSU rDNA region of target nematodes with a universal primer were successfully amplified and yielded a single fragment of 1786 bp

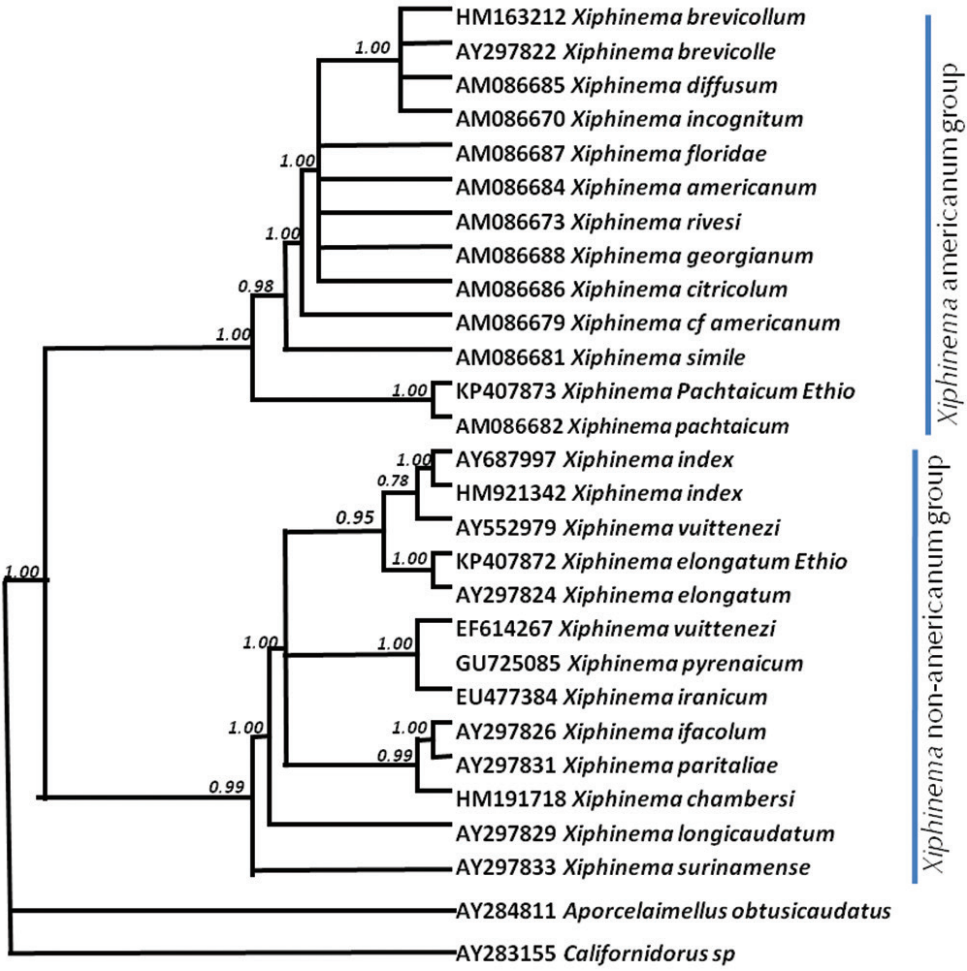

Figure 2. Phylogenetic relationships within *Xiphinema* species by Bayesian 50% majority rule consensus trees as inferred from 18S rRNA gene sequence alignments under the GTR + I + G model.

of *Xiphinema elongatum* species and 1790 bp of *Xiphinema pachtaicum* species. A phylogenetic analysis based on 18S rDNA sequences yielded a well-resolved phylogenetic tree (Fig. 2). This analysis clearly separates the lineage of *X. americanum* group from the rest of the *Xiphinema* species (Gutierrez-Gutierrez et al. 2010) with maximal support. In this study, the *X. elongatum* (KP407872) from Ethiopia is grouped with maximal support with *X. elongatum* AY297824 which was submitted from Brazil (Oliveira et al. 2004). However, 7 bp nucleotide differences (0.4%) were observed between the two populations which could be intraspecific variation between different geographical locations. The studied *X. pachtaicum* (KP407873) and the Slovakian isolate *Xiphinema pachtaicum* AM086682 had identical sequences. The phylogeny analysis of *X. pachtaicum* from Spain by Gutierrez-Gutierrez et al.

(2011) did not include sequence from 18S region of rDNA and cannot be compared as they analysed the ITS region.

The topology of the tree by other regions of rDNA and position of taxa agrees with previously phylogenetic analysis based on SSU rDNA by van Megen et al. (2009) and Meldal et al. (2007).

This information combined with morphological data can assure the species identity and provide new information on the geographical distribution of the genus *Xiphinema*.

This is the first intensive study on the genus *Xiphinema* from Ethiopia using both morphological and molecular analysis. The morphometric values of *X. elongatum* and *X. pachtaicum* described from Ethiopia were similar to previously described species with slight difference in both species in 'a' values, but they agree with the range of the population previously recorded by Luc and Southey (1980) and Luc et al. (1984) respectively. Identification of *Xiphinema* species is difficult due to overlapping of many characteristics and their plasticity. Hence, the combination of morphology, morphometric, and molecular results can provide reliable identifications. Based on the congruence of morphological analyses and a SSU rDNA based molecular phylogeny, the Ethiopian *Xiphinema* species were identified as *X. elongatum* and *X. pachtaicum.*

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DATA PAPER

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The Jean Gutierrez spider mite collection

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Abstract

The family Tetranychidae (spider mites) currently comprises 1,275 species and represents one of the most important agricultural pest families among the Acari with approximately one hundred pest species, ten of which considered major pests. The dataset presented in this document includes all the identified spider mites composing the Jean Gutierrez Collection hosted at the CBGP (Montferrier-sur-Lez, France), gathered from 1963 to 1999 during his career at the Institut de Recherche pour le Développement (IRD). It consists of 5,262 specimens corresponding to 1,564 occurrences (combination species/host plant/date/location) of 175 species. Most specimens were collected in Madagascar and other islands of the Western Indian Ocean, New Caledonia and other islands of the South Pacific and Papuasia. The dataset constitutes today the most important one available on Tetranychidae worldwide.

Keywords

Acari, Tetranychidae, World, Madagascar, Western Indian Ocean, New Caledonia, South Pacific, Papuasia

Data published through GBIF

http://www.gbif.org/dataset/ac60a288-fcc9-43fe-a7d4-e732b748a981

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Project details

Project title: Spider mites collection of Jean Gutierrez.

Personnel: Alain Migeon (data manager, data publisher, supervisor), Franck Dorkeld (computer specialist), Jonathan Bonfanti (data entry).

Funding: GBIF France and Institut National de la Recherche Agronomique (INRA).

Design description: This dataset was developed to increase the knowledge of an important agricultural pest family, the spider mites (Arthropoda, Acari, Tetranychidae). This family contains 1,275 species (Migeon and Dorkeld 2006–2013), among which one hundred can be considered as pests, ten of which major pests. The spider mite collection has been established by Jean Gutierrez, acarologist of the Institut de Recherche pour le Développement (IRD) from 1963 to 1999 and is presently hosted at CBGP (CBGP – INRA, Campus International de Baillarguet, 755 Avenue du Campus Agropolis, CS 30016, 34988 MONTFERRIER-sur-LEZ Cedex, France), an INRA and IRD laboratory in Montpellier. The collection contains 5,262 slides representing 1,564 occurrences (species/host plant/date/location). This collection represents a unique source of data for this family in Madagascar and New Caledonia and a major source for Pacific Islands and Mascarens Islands. The dataset should contribute to a much better understanding of this mite family in addition to the taxonomic database hosted by INRA (Migeon and Dorkeld 2006–2013).

Taxonomic coverage

General taxonomic coverage description

All the recorded specimens in the dataset were identified to species. The identification of spider mites to species often requires the examination of male genitalia and specimens identified to genus were generally single females and have been discarded. Unidentified specimens have also been discarded. The dataset contains 175 species, i.e. 14 % of the species known in this family. Jean Gutierrez described 50 species (Table 1). Types of 49 are deposited in his collection.

Taxonomic ranks

Kingdom: Animalia.
Phylum: Arthropoda.
Class: Arachnida.
Order: Trombidiformes.
Family: Tetranychidae.

Table 1. Tetranychidae species described by Jean Gutierrez with respective title and source of the publication and present nomenclature (Blommers and Gutierrez 1975; Gutierrez 1966; 1967a; b; 1968a; b; 1969; 1970; 1972; 1977; 1978; 1982; Gutierrez and Bolland 1973; 1986; Gutierrez and Etienne 1981; Gutierrez and Helle 1971). The presence of the type specimen and the number of types and paratypes in the dataset is also indicated.

Original genus	Species	Author	Present combination	Publication title	Publication source	Type	Number of types and paratypes specimens
Eonychus	*grewiae*	Gutierrez, 1969	*Eonychus grewiae*	Tetranychidae nouveaux de Madagascar (Cinquième note)	Acarologia, 11: 43–64	yes	17
Eotetranychus	*befandrianae*	Gutierrez, 1967	*Eotetranychus befandrianae*	Huit nouvelles espèces du genre *Eotetranychus* Oudemans (Acariens : Tetranychidae) de Madagascar	Acarologia, 9: 370–394	yes	15
Eotetranychus	*borbonensis*	Gutierrez, 1968	*Eotetranychus borbonensis*	Note sur quelques acariens phytophages de l'Ile de la Réunion avec description d'une nouvelle espèce du genre *Eotetranychus* Oudemans (Tetranychidae)	Acarologia, 10: 444–446	yes	47
Eotetranychus	*botryanthae*	Gutierrez, 1970	*Eotetranychus botryanthae*	Tetranychidae nouveaux de Madagascar (Sixième note)	Acarologia, 12: 714–731	yes	23
Eotetranychus	*capricorni*	Gutierrez, 1967	*Eotetranychus capricorni*	Huit nouvelles espèces du genre *Eotetranychus* Oudemans (Acariens : Tetranychidae) de Madagascar	Acarologia, 9: 370–394	yes	8
Eotetranychus	*friedmanni*	Gutierrez, 1968	*Eotetranychus friedmanni*	Tetranychidae nouveaux de Madagascar (Quatrième note)	Acarologia, 10: 13–28	yes	105
Eotetranychus	*garnieri*	Gutierrez, 1978	*Eotetranychus garnieri*	Cinq nouvelles espèces de Tetranychidae (Acariens) de Nouvelle-Calédonie	Acarologia, 20: 351–364	yes	19
Eotetranychus	*grandis*	Gutierrez, 1969	*Eotetranychus grandis*	Tetranychidae nouveaux de Madagascar (Cinquième note)	Acarologia, 11: 43–64	yes	10
Eotetranychus	*greveanae*	Gutierrez, 1970	*Eotetranychus greveanae*	Tetranychidae nouveaux de Madagascar (Sixième note)	Acarologia, 12: 714–731	yes	10
Eotetranychus	*limoni*	Blommers & Gutierrez, 1975	*Eotetranychus limoni*	Les tétranyques vivant sur agrumes et avocatiers dans la région de Tamatave (Madagascar-est) et quelques-uns de leurs prédateurs	Fruits, 30: 191–200	yes	23
Eotetranychus	*paracybelus*	Gutierrez, 1967	*Eotetranychus paracybelus*	Huit nouvelles espèces du genre *Eotetranychus* Oudemans (Acariens : Tetranychidae) de Madagascar	Acarologia, 9: 370–394	yes	50

Original genus	Species	Author	Present combination	Publication title	Publication source	Type	Number of types and paratypes specimens
Eotetranychus	*pauliani*	Gutierrez, 1968	*Eotetranychus pauliani*	Tetranychidae nouveaux de Madagascar (Quatrième note)	Acarologia, 10: 13–28	yes	51
Eotetranychus	*rinoreae*	Gutierrez, 1970	*Eotetranychus rinoreae*	Tetranychidae nouveaux de Madagascar (Sixième note)	Acarologia, 12: 714–731	yes	30
Eotetranychus	*robini*	Gutierrez, 1978	*Eotetranychus robini*	Cinq nouvelles espèces de Tetranychidae (Acariens) de Nouvelle-Calédonie	Acarologia, 20: 351–364	yes	19
Eotetranychus	*roedereri*	Gutierrez, 1967	*Eotetranychus roedereri*	Huit nouvelles espèces du genre *Eotetranychus* Oudemans (Acariens : Tetranychidae) de Madagascar	Acarologia, 9: 370–394	yes	14
Eotetranychus	*sakalavensis*	Gutierrez, 1967	*Eotetranychus sakalavensis*	Huit nouvelles espèces du genre *Eotetranychus* Oudemans (Acariens : Tetranychidae) de Madagascar	Acarologia, 9: 370–394	yes	32
Eotetranychus	*savanae*	Gutierrez, 1967	*Eotetranychus savanae*	Cinq autres nouvelles espèces de Tetranychidae de Madagascar (Troisième note)	Acarologia, 9: 567–580	yes	33
Eotetranychus	*tulearensis*	Gutierrez, 1967	*Eotetranychus tulearensis*	Huit nouvelles espèces du genre *Eotetranychus* Oudemans (Acariens : Tetranychidae) de Madagascar	Acarologia, 9: 370–394	yes	36
Eotetranychus	*xylopiae*	Gutierrez, 1970	*Eotetranychus xylopiae*	Tetranychidae nouveaux de Madagascar (Sixième note)	Acarologia, 12: 714–731	yes	18
Eurytetranychus	*madagascariensis*	Gutierrez, 1966	*Eurytetranychus madagascariensis*	Cinq nouvelles espèces de Tetranychidae de Madagascar	Acarologia, 8: 594–610	yes	7
Eutetranychus	*eliei*	Gutierrez & Helle, 1971	*Eutetranychus eliei*	Deux nouvelles espèces du genre *Eutetranychus* Banks (Acariens : Tetranychidae) vivant sur plantes cultivées à Madagascar	Entomologische Berichten, Amsertdam, 31: 45–60	yes	16
Eutetranychus	*grandidieri*	Gutierrez, 1966	*Aponychus grandidieri*	Cinq nouvelles espèces de Tetranychidae de Madagascar	Acarologia, 8: 594–610	yes	19
Eutetranychus	*ranjatoi*	Gutierrez, 1967	*Duplanychus ranjatoi*	Cinq autres nouvelles espèces de Tetranychidae de Madagascar (Troisième note)	Acarologia, 9: 567–580	yes	31
Hellenychus	*bollandi*	Gutierrez, 1970	*Hellenychus bollandi*	Tetranychidae nouveaux de Madagascar (Sixième note)	Acarologia, 12: 714–731	yes	27
Oligonychus	*andrei*	Gutierrez, 1966	*Oligonychus andrei*	Cinq nouvelles espèces de Tetranychidae de Madagascar	Acarologia, 8: 594–610	yes	34

Original genus	Species	Author	Present combination	Publication title	Publication source	Type	Number of types and paratypes specimens
Oligonychus	*andropogonearum*	Gutierrez, 1969	*Oligonychus andropogonearum*	Tetranychidae nouveaux de Madagascar (Cinquième note)	Acarologia, 11: 43–64	yes	6
Oligonychus	*bessardi*	Gutierrez, 1966	*Oligonychus bessardi*	Cinq nouvelles espèces de Tetranychidae de Madagascar	Acarologia, 8: 594–610	yes	26
Oligonychus	*chazeaui*	Gutierrez, 1970	*Oligonychus chazeaui*	Tetranychidae nouveaux de Madagascar (Sixième note)	Acarologia, 12: 714–731	yes	22
Oligonychus	*etiennei*	Gutierrez, 1982	*Oligonychus etiennei*	Deux acariens phytophages vivant sur canne a sucre a la Réunion : *Oligonychus etiennei* n.sp. (Tetranychidae) et *Abacarus sacchari* (Eriophyidae)	Agronomie Tropicale, 37: 389–392	yes	22
Oligonychus	*hova*	Gutierrez, 1966	*Oligonychus hova*	Cinq nouvelles espèces de Tetranychidae de Madagascar	Acarologia, 8: 594–610	yes	31
Oligonychus	*leandrianae*	Gutierrez, 1970	*Oligonychus leandrianae*	Tetranychidae nouveaux de Madagascar (Sixième note)	Acarologia, 12: 714–731	yes	2
Oligonychus	*monsarrati*	Gutierrez, 1967	*Oligonychus monsarrati*	Cinq autres nouvelles espèces de Tetranychidae de Madagascar (Troisième note)	Acarologia, 9: 567–580	yes	45
Oligonychus	*occidentalis*	Gutierrez, 1969	*Oligonychus occidentalis*	Tetranychidae nouveaux de Madagascar (Cinquième note)	Acarologia, 11: 43–64	yes	14
Oligonychus	*pemphisi*	Gutierrez, 1970	*Oligonychus pemphisi*	Tetranychidae nouveaux de Madagascar (Sixième note)	Acarologia, 12: 714–731	yes	15
Oligonychus	*randriamasii*	Gutierrez, 1967	*Oligonychus randriamasii*	Cinq autres nouvelles espèces de Tetranychidae de Madagascar (Troisième note)	Acarologia, 9: 567–580	yes	54
Oligonychus	*senegalensis*	Gutierrez & Etienne, 1981	*Oligonychus senegalensis*	Une nouvelle espèce du genre *Oligonychus* (Acariens: Tetranychidae) attaquant le riz au Sénégal	Agronomie Tropicale, 36: 389–390	yes	13
Oligonychus	*thelytokus*	Gutierrez, 1977	*Oligonychus thelytokus*	Un tétranyque polyphage de la zone intertropicale : *Oligonychus thelytokus* sp. n.	Cahiers de l'ORSTOM, série Biologie, 12: 65–72	yes	9
Oligonychus	*tiwakae*	Gutierrez, 1978	*Oligonychus tiwakae*	Cinq nouvelles espèces de Tetranychidae (Acariens) de Nouvelle-Calédonie	Acarologia, 20: 351–364	yes	15
Oligonychus	*virens*	Gutierrez, 1969	*Oligonychus virens*	Tetranychidae nouveaux de Madagascar (Cinquième note)	Acarologia, 11: 43–64	yes	5

Original genus	Species	Author	Present combination	Publication title	Publication source	Type	Number of types and paratypes specimens
Schizonobia	*bundi*	Gutierrez, 1972	*Schizonobia bundi*	Récolte, dans le Var, d'une espèce appartenant à un genre nouveau pour la France : *Schizonobia bundi* sp. n. (Acariens : Tetranychidae)	Acarologia, 14: 379–383	no	0
Schizonobia	*oudemansi*	Gutierrez & Bolland, 1986	*Schizonobia oudemansi*	Description and karyotype of *Schizonobia oudemansi* sp. n. from The Netherlands (Acari : Tetranychidae)	Entomologische Berichten, Amsertdam, 46: 39–43	yes	10
Schizotetranychus	*australis*	Gutierrez, 1968	*Schizotetranychus australis*	Tetranychidae nouveaux de Madagascar (Quatrième note)	Acarologia, 10: 13–28	yes	38
Schizotetranychus	*fauveli*	Gutierrez, 1978	*Schizotetranychus fauveli*	Cinq nouvelles espèces de Tetranychidae (Acariens) de Nouvelle-Calédonie	Acarologia, 20: 351–364	yes	19
Schizotetranychus	*tephrosiae*	Gutierrez, 1968	*Schizotetranychus tephrosiae*	Tetranychidae nouveaux de Madagascar (Quatrième note)	Acarologia, 10: 13–28	yes	22
Tetranychus	*kaliphorae*	Gutierrez, 1969	*Tetranychus kaliphorae*	Tetranychidae nouveaux de Madagascar (Cinquième note)	Acarologia, 11: 43–64	yes	25
Tetranychus	*montrouzieri*	Gutierrez, 1978	*Tetranychus montrouzieri*	Cinq nouvelles espèces de Tetranychidae (Acariens) de Nouvelle-Calédonie	Acarologia, 20: 351–364	yes	6
Tetranychus	*panici*	Gutierrez, 1969	*Tetranychus panici*	Tetranychidae nouveaux de Madagascar (Cinquième note)	Acarologia, 11: 43–64	yes	21
Tetranychus	*roseus*	Gutierrez, 1969	*Tetranychus roseus*	Tetranychidae nouveaux de Madagascar (Cinquième note)	Acarologia, 11: 43–64	yes	41
Tetranychus	*tchadi*	Gutierrez & Bolland, 1973	*Tetranychus tchadi*	Description et caryotype d'une nouvelle espèce du genre *Tetranychus* Dufour (Acariens:Tetranychidae) récoltée au Tchad sur *Dolichos lablab* L. (Papilionaceae)	Entomologische Berichten, Amsertdam, 33: 155–158	yes	33
Trichonychus	*insularis*	Gutierrez, 1968	*Porcupinychus insularis*	Tetranychidae nouveaux de Madagascar (Quatrième note)	Acarologia, 10: 13–28	yes	43

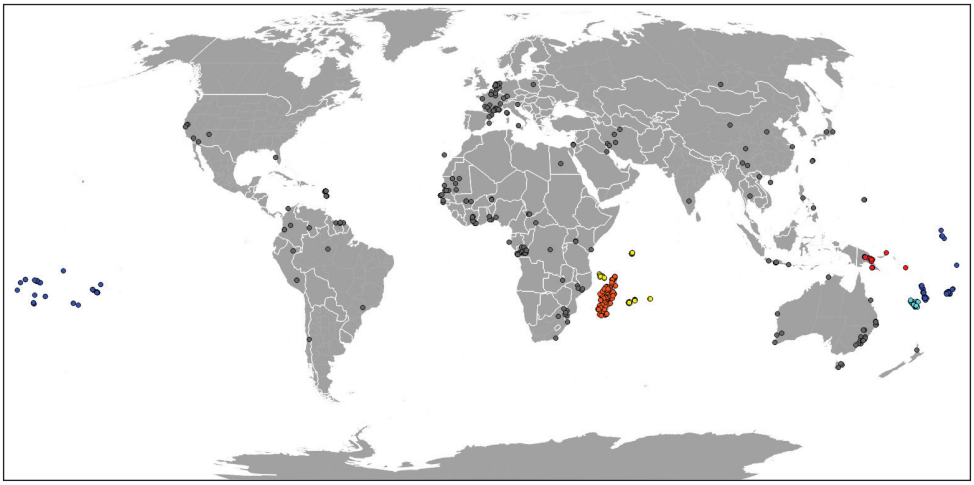

Figure 1. World map representing all the locations mentioned in the dataset. Areas of particular interest are represented with the same colour (● Madagascar, ● Western Indian Ocean, ● Papuasia, ● New Caledonia, ● South Pacific). Grey spots gather all the other locations.

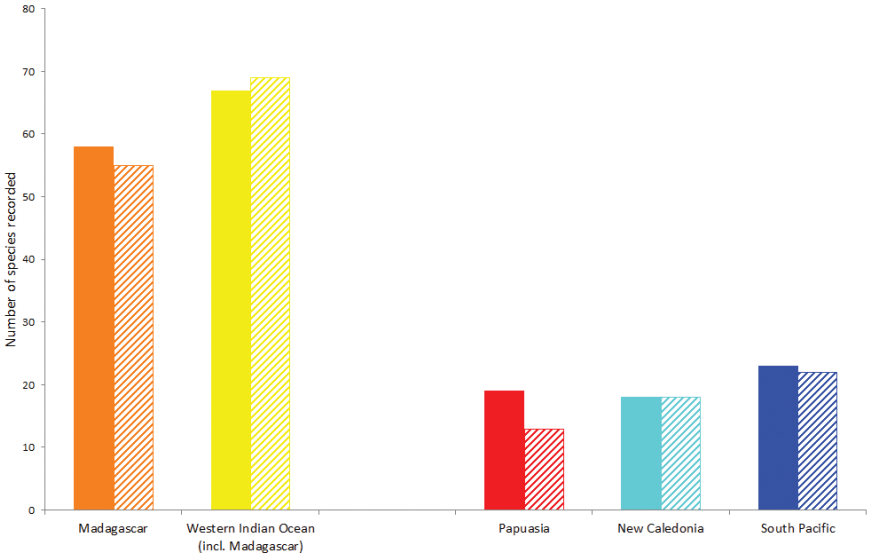

Figure 2. Number of species recorded in Jean Gutierrez collection dataset (solid bar) and in the literature (dashed bar) compiled in Spider Mites Web (http://www1.montpellier.inra.fr/CBGP/spmweb/) for the areas of particular interest. Colour scheme same as in Figure 1.

Spatial coverage

The spatial coverage varies among geographic areas (Figure 1) most being collected in Madagascar and Western Indian Ocean or in New Caledonia, South Pacific and Papuasia. Not all specimens from these areas were mentioned in the literature (Figure 2) compiled in Spider Mites Web (Migeon and Dorkeld 2006–2013).

Temporal coverage

1963–1999.

Natural collections description

Collection name:
Spider Mites collection of Jean Gutierrez.

Specimen preservation methods:
Specimens are preserved on microslides mounted with Hoyer medium after clearing in lactic acid and coloring with lignin pink (Gutierrez 1985). Microslides boxes are stored in the CBGP collection room maintained at 20 +/- 2 °C and 25 +/- 10% RH.

Methods

Method step description

There are 5,262 microscopic slides recorded in the dataset. Each one contains a single specimen. Specimens identified at genus level only, without location data, or from laboratory breeding have been discarded, for a total of 347 specimens. All (and only) indications given on the label have been recorded. Location coordinates (Decimal degrees – DD – WGS84 geodetic system) have been assigned using several geolocation tools like GoogleMaps, GeoNames and other gazetteers, completed when necessary by textual search. Country and TDWG level 4 polygon were assigned to each location (http://www.tdwg.org/standards/109/)

Uncertainty issues

Unknown collection date was set as 1st January 1901 for 31 specimens. This convention takes advantage to be outside of the temporal range of Jean Gutierrez work, indicating the absence of temporal data. When only year was reported date was set as 1st January of the year. When only month and year were reported, date was set as 15th of the month.

Location precision has been assigned from 0.01° DD when the place was found corresponding to a small area (1–10 km²), 0.1° DD when place was corresponding to a bigger area (10–100 km²), 0.5° DD (100–2500 km²), to 1° DD (2500–10000 km²). For one slide it was not possible to assign coordinates (location not found). Then only country reported on the label has been published.

Quality control description

The Tetranychidae nomenclature is in accordance with current reference: Spider Mites Web (Migeon and Dorkeld 2006–2013) and Catalogue of Life (Roskov et al. 2014). Determinations have been performed by Jean Gutierrez himself a well-known and internationally recognized specialist (Bolland et al. 1998). In case of doubt, identification was checked and rectified before publication with present knowledge if necessary. Host plant nomenclature is in accordance to current reference (The Plant List 2013). Geographic coordinates were visually verified using the Check Coordinates tool in Diva-GIS (Hijmans et al. 2012) and manual verification (points in the sea…).

Dataset

Object name: Darwin Core Archive Spider Mites collection of Jean Gutierrez.
Character encoding: UTF-8.
Format name: Darwin Core Archive Format.
Format version: 1.0.
Distribution: http://www.gbif.org/dataset/ac60a288-fcc9-43fe-a7d4-e732b748a981
Publication date of data: 2014-06-18
Language: English
License of use: Open Data Commons Attribution License (ODC-By).

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An unusual new species of *Hallodapomimus* Herczek, 2000 from the Eocene Baltic amber (Hemiptera, Heteroptera, Miridae, Phylinae)

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Abstract

Hallodapomimus antennatus **sp. n.** (Hemiptera: Heteroptera, Miridae, Phylinae, Hallodapini) is described from a macropterous female found in Eocene Baltic amber. The new species can be recognized readily from the other species of the genus, mainly due to its unusual second antennal segment. A key for the identification of all known fossil Hallodapini is presented.

Keywords

Heteroptera, Miridae, Phylinae, Hallodapini, Baltic amber

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Introduction

The present article is a continuation of a series of taxonomic papers on fossil plant bugs (Miridae) from Baltic amber (Prussian Eocene Formation). Miridae represent the largest family among true bugs (Hemiptera: Heteroptera), widespread all over the world, and with approximately 1500 genera and more than 11 000 described species, with potentially thousands more undescribed (Schuh 2002–2013; Cassis and Schuh 2012; Menard et al. 2013). Most of those included in family Miridae are frequently discovered in the Eocene Baltic amber where mirids are represented mainly by the subfamilies Cylapinae, Isometopinae, Psallopinae, and Mirinae (mainly undescribed) with fewer numbers from the remaining subfamilies (Popov and Herczek 2008). The Phylinae are quite rare among amber inclusions and all species described represent the tribe Hallodapini.

The recent Phylinae is one of the numerous subfamilies of mirids currently divided into six tribes, comprising more than 300 genera among which 50 genera belong to the tribe Hallodapini. Their representatives mainly occur temperate regions but there is also a large fauna in tropical and subtropical Asia (Schuh 1995; Schuh and Menard 2013). Moreover, many phylines have a variable myrmecomorphic habitus (McGiver and Stonedahl 1993), e.g. Hallodapini, Leucopterophorini, Auricillocorini and Pilophorini.

Herczek (2000) established the new genus *Hallodapomimus* of the tribe Hallodapini with two new species: *H. elektrinus* (the type species of the genus) and *H. succinus*, both of which were found in Baltic amber. Extinct phyline species had not been previously recorded. Very little is known about the biology of recent Hallodapini, such as the way of life or ecological preferences. Later Herczeket al. (2010) established another new monotypic genus *Leptomimus* (a junior homonym) named subsequentely new name *Leptomimoides* (Herczek and Popov 2011) with a new species *L. jonasdamzeni*; they also described another new species, *Hallodapomimus krzeminskiorum*.

Material and methods

Colour photographs and drawings were made with a Nikon Eclipse E 600 microscope and by the computer program NIS Elements, Ver. 4. 10. Body length was measured from the apex of head to the apex of fore wing; body width, across the maximal width; pronotum length, along midline; pronotum width, across the broadest part at its posterior angles; hemelytron length, from the base to the apex of anterior margin; hemelytron width, at maximal width of the hemelytron. All measurements are in millimeters (mm).

Systematic paleontology

Order Hemiptera Linnaeus, 1758
Suborder Heteroptera Latreille, 1810
Infraorder Cimicomorpha Leston, Pendergrast & Southwood, 1954
Superfamily Miroidea Hahn, 1833
Family Miridae Hahn, 1833
Subfamily Phylinae Douglas & Scott, 1865
Tribe Hallodapini van Duzee, 1916

Genus *Hallodapomimus* Herczek

Hallodapomimus: Herczek 1998: 12, nomen nudum; Herczek 2000: 144; Popov and Herczek 2008: 68; Herczek et al. 2010: 585.

Type species by original designation. *Hallodapomimus elektrinus* Herczek, 2000: 145.

Diagnosis. Distinguished from the other extinct hallodapine genus *Leptomimoides* by a combination of the following characters: smooth, impunctate dorsal surface of body, distinctive coloration (head, pronotum and part of cuneus dark, and clavus partly black), head almost twice as broad as long, pronotum 1.2–1.3 times wider than long; pronotal calli visible.

Hallodapomimus antennatus Herczek & Popov, sp. n.

http://zoobank.org/B1122F2D-4DC7-4F2F-A884-D0CA9BB34B3D
Figs 1–5

Type material. Holotype: female, Baltic amber, PIN RAS 964/1310; light yellowish middle-sized piece of amber (28 × 12 mm) of irregular shape. One dipteran syninclusion. The holotype is deposited in the collection of the Borissyak Paleontological Institute Russian Academy of Sciences (Arthropod Laboratory), Moscow.

Diagnosis. Readily recognized among the other species of *Hallodapomimus* by its unusual flattened and widened second antennal segment, presence of two cavities on the vertex, a small scutellum (except *H. succinus*), and a large mesoscutum.

Description. Female. Macropterous. Body length up to 7 mm, 2.8 times as long as wide. Dorsal surface almost smooth, impunctate. Ground colour light brown, almost yellow; mesoscutum and scutellum brown, hemelytra with one pale transverse fascia just posterior to scutellum, apical part of cuneus dark; hemelytral membrane dark, hyaline, slightly crumpled (Figs 1, 2). Head more than twice (2.3 times) as broad

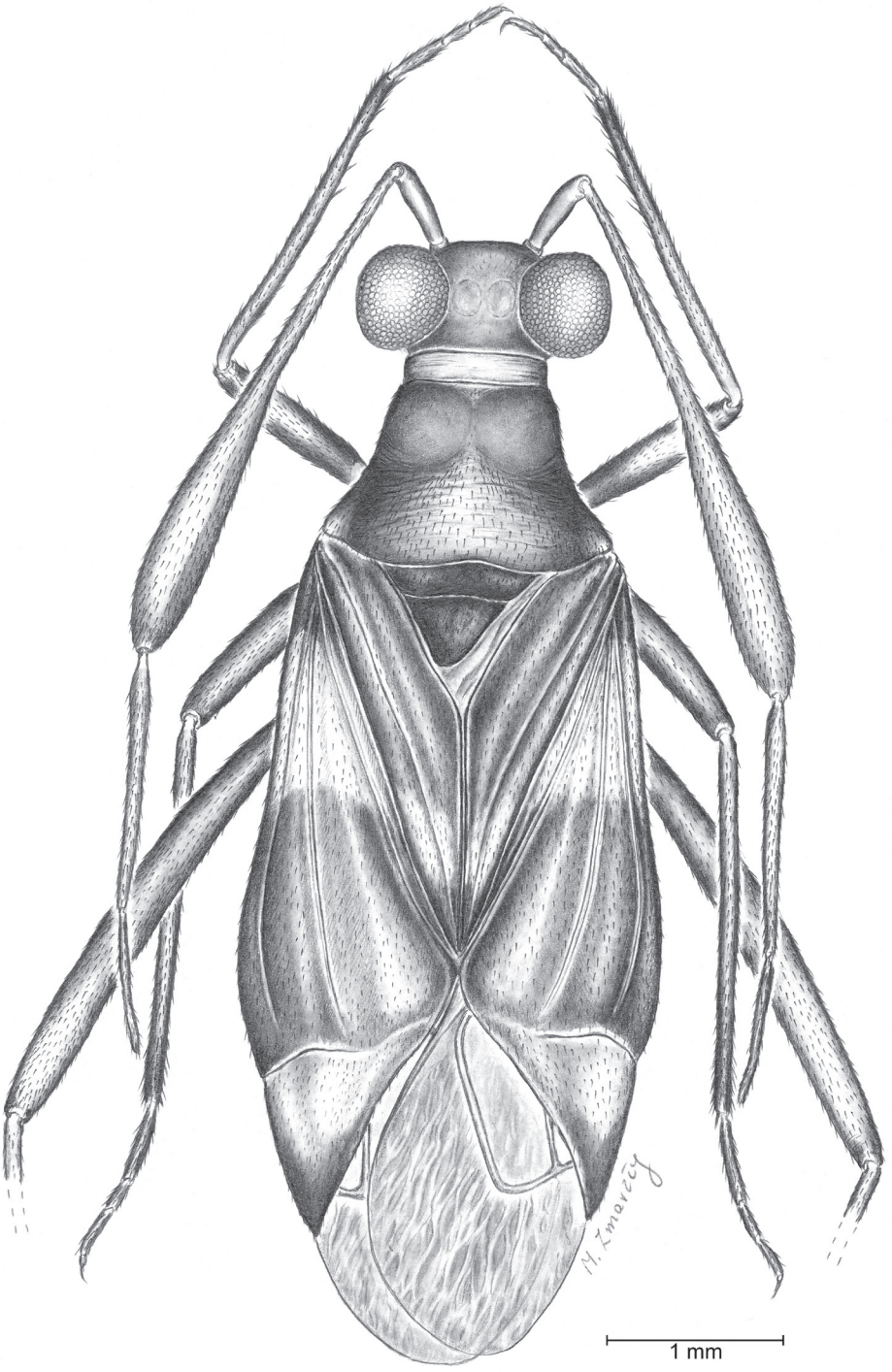
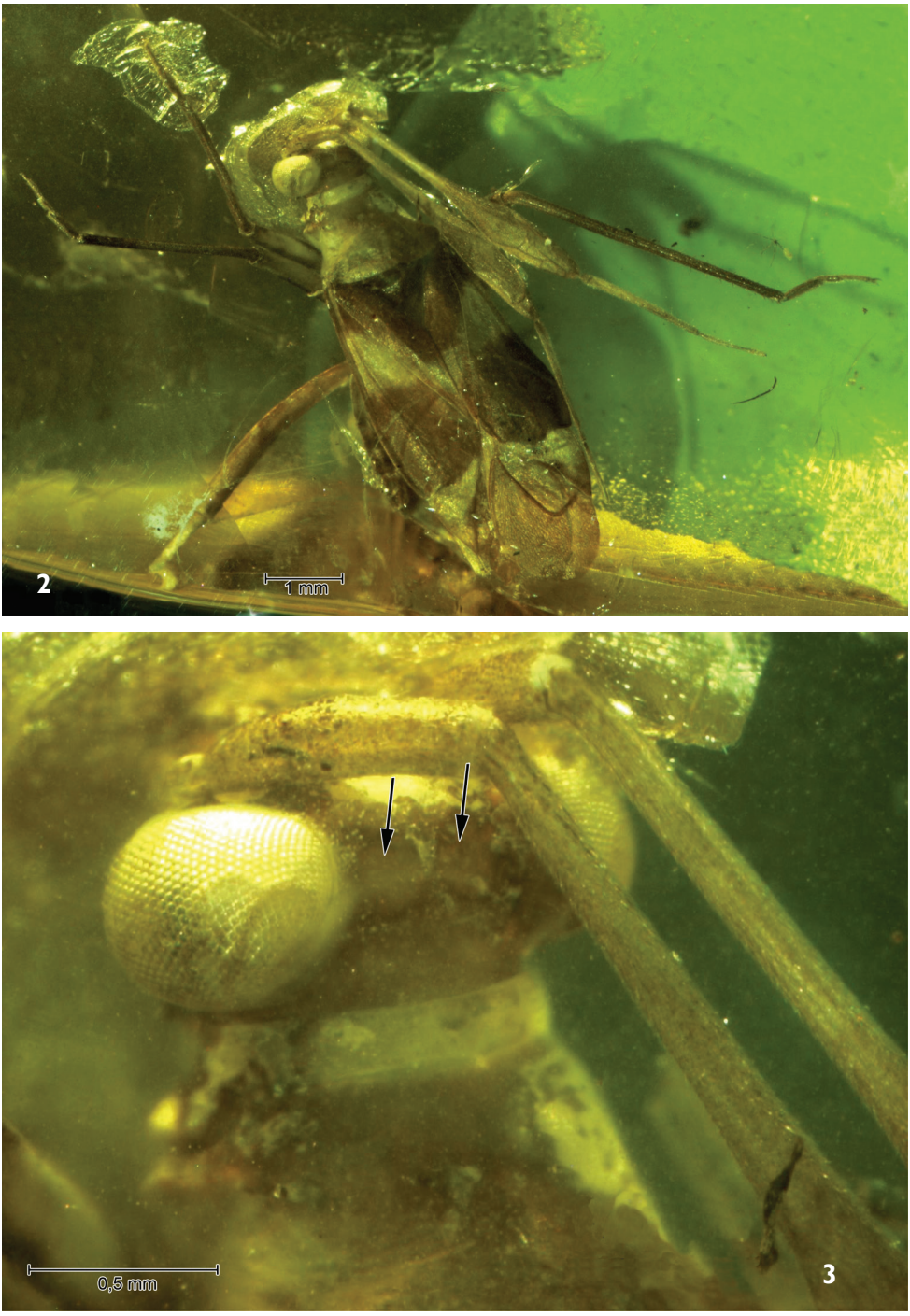


Figure 1. *Hallodapomimus antennatus* sp. n. ♀ holotype, in Baltic amber, nr. PIN RAS 964/1310; Borissyak Paleontological Institue, Russian Academy of Sciences. Dorsal view.



Figures 2–3. *Hallodapomimus antennatus* sp. n. **2** dorsal view **3** dorsal view of head.

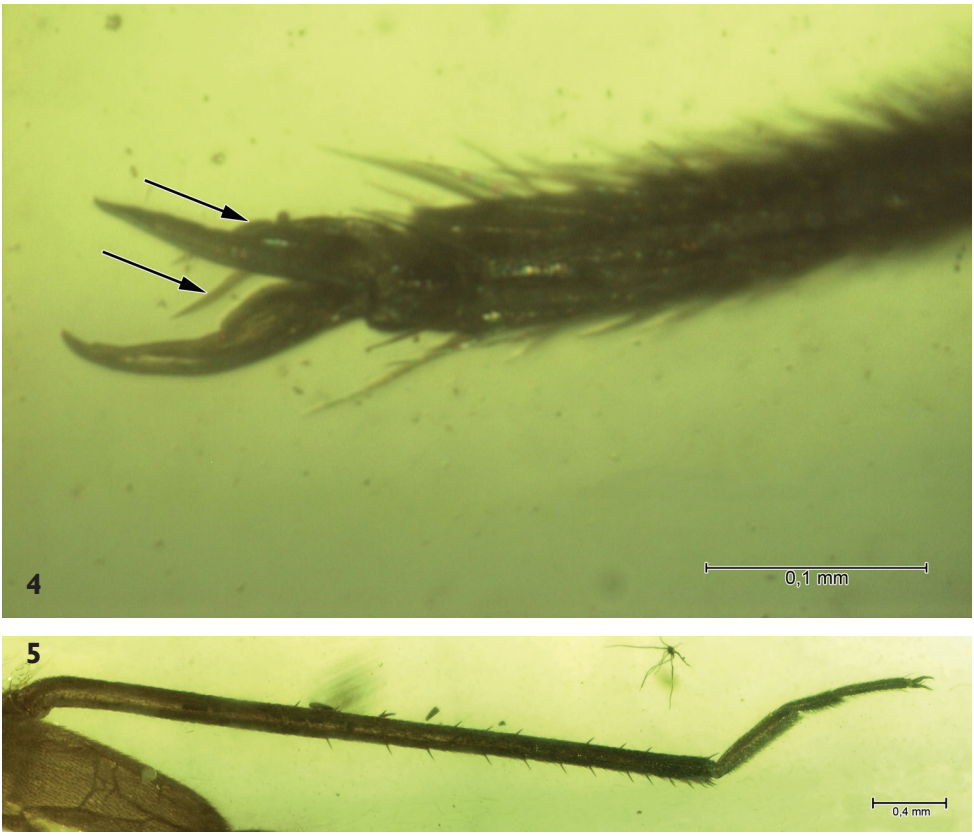


Figure 4–5. *Hallodapomimus antennatus* sp. n. **4** hind leg tibia **5** hind leg tarsus.

as long; clypeus distinct and not protruding above frons; genal conus distinct; eyes large, almost globular, distinctly protruding laterally and almost touching pronotal collar; vertex with two slightly concave, polished cavities (Fig. 3), antennae inserted just above the lower margins of eyes; fovea antennalis touching the inner margin of eye; second antennal segment laterally flattened and considerably widened to apex, 2.2 times longer than 3rd segment, 3rd almost twice as long as 4th one; rostrum reaching hind coxae. Pronotum tapering (narrowing) to ca. 1.75 (1.76) its length, 1.37 times wider than long; collar rather broad, flat; calli distinctly developed, quite large, occupying almost half of pronotal disc. Mesoscutum broadly exposed, scutellum quite small, only twice longer than mesoscutum length and ca. one third length of claval commissure, distinctly convex. Hemelytra wholly flattened; cuneus rather short: ca. one third length of corium and one fifth times length of hemelytron; large cell of hemelytral membrane almost rectangular, smaller cell very small, almost 4 times shorter than large cell (Figs 1, 2). All legs rather slender and covered with very short, dense, adpressed setae; hind tibia with two rows of very short spines on dorsal (10–11) and ventral (5–6) surface of its distal part, these clearly shorter than diameter of tibia (Fig. 4); first tarsal

segments longest, second shorter than third (Fig. 4); claws short and slightly curved, setiform parempodia easily visible (Fig. 5).

Measurements. Body length 7.0 mm, width 2.5; length of head 0.65, width 1.5; width of eye (from above) 0.65; width of vertex 0.5; length of antennal segments = 0.75: 3.65: 1.8: 0.95 (7.15 mm); length of rostral segments I: II: III: IV = 0.74: 1.17: 0.44: 0.6; length of pronotum 1.24, anterior width (collar) 0.85, posterior width 1.7; thickness of collar 0.18; length of hemelytron 4.79, width 1.16; proportion of hemelytron, corium and length of cuneus: 4.8–2.9–1.0; length of mesoscutum 0.2 (mid line 0.2), width 0.6; length of scutellum 0.4; claval commissure 1.3; hind leg: length of femora 3.0, tibia 4.2, tarsus 1.38 (0.59:0.35:0.44).

Etymology. The species epithet (Latin "antennatus") refers to the unusual flattened and widened the second antennal segment.

Key to the Hallodapini from Baltic amber

1 Body strongly elongate, more than 4 times as long as wide; dorsum of surface rippled. Head slightly more than 1.5 times as broad as long. Pronotum length and width subequal; pronotal calli indistinct. Head, pronotum and cuneus pale..... ***Leptomimoides jonasdamzeni*** **Herczek & Popov**

– Body less than 4 times as long as wide; dorsum smooth, impunctate. Head almost twice as broad as long. Pronotum 1.2–1.3 times wider than long; calli weakly developed. Head, pronotum and part of cuneus dark..... **2**

2 Second antennal segment flattened and considerably widened to apex, more than two times longer than 3rd; vertex with two slightly concave cavities; scutellum small, only twice long as mesoscutum length and less that one-third length of claval commissure ..... ***Hallodapomimus antennatus*** **sp. n.**

– Second antennal segment more slender, not expanded apically; less than twice as long as 3rd; vertex without cavities; scutellum large, ca. one-half length of claval commissure..... **3**

3 Mesoscutum large, slightly more than one-half as long as scutellum; first tarsal segment of hind leg longest, second segment shortest .... ***Hallodapomimus succinus*** **Herczek**

– Mesoscutum small, one-fifth as long as scutellum; first and third tarsal segments of hind legs longest and almost equal in size..... **4**

4 Pronotal collar less narrow, thickness not less than 0.15 mm; cuneus less that one-fourth length of corium; all pairs of legs almost wholly bare..... ..... ***Hallodapomimus elektrinus*** **Herczek**

– Pronotal collar more narrow, thickness 0.1 mm; cuneus ca. one-third length of corium; all pairs of legs are covered with very short, dense, adpressed setae..... ..... ***Hallodapomimus krzeminskiorum*** **Herczek & Popov**

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RESEARCH ARTICLE

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An illustrated key to Neotropical species of the genus *Meteorus* Haliday (Hymenoptera, Braconidae, Euphorinae)

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Abstract

A comprehensive key for 75 species of *Meteorus* distributed across 15 Neotropical countries is presented. Eleven new species from Bolivia, Costa Rica and Ecuador are described: *M. albistigma*, *M. carolae*, *M. eurysaccavorus*, *M. fallacavus*, *M. flavistigma*, *M. haimowitzi*, *M. magnoculus*, *M. martinezi*, *M. microcavus*, *M. noctuivorus* and *M. orion*. Expanded range distributions are recorded for *M. andreae*, *M. farallonensis*, *M. guineverae*, *M. jerodi*, *M. kraussi*, *M. papiliovorus* and *M. quimbayensis*. The host of *M. jerodi* is reported for the first time: a noctuid larva feeding on Asteraceae. *Meteorus papiliovorus* is recorded attacking Papilionidae larvae in Ecuador, therefore displaying a similar host family preference as formerly documented from Costa Rica and Colombia.

Keywords

Taxonomy, parasitoid, gregarious parasitism, solitary parasitism, Lepidoptera, host, distribution

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Introduction

The cosmopolitan genus *Meteorus* comprises at least 332 species worldwide with 70 species known in Central and South America (Yu 2012; Jones and Shaw 2012; Aguirre et al. 2014; Aguirre and Shaw 2014a, 2014b). The study of the Neotropical fauna has received particular attention in Colombia accounting for 38 species (Aguirre et al. 2011), Costa Rica with 21 (Zitani et al. 1998; Shaw and Nishida 2005; Barrantes et al. 2011) and Ecuador with 18 (Shaw and Jones 2009; Aguirre et al. 2010; Jones and Shaw 2012; Aguirre and Shaw 2014a, 2014b). In contrast, several other countries have far fewer species reported: Argentina with six species (Tosquinet 1900; Blanchard 1936; De Santis 1967; Luna and Sanchez 1999), Mexico with three (Marsh 1979; Pair et al. 1986; Molina-Ochoa et al. 2001), Brazil, Chile, Honduras, Nicaragua each with two (Porter 1926; Muesebeck 1939; Muesebeck 1958; Artigas 1972; Maes 1989; Gladstone 1991; Cave 1993), and Bermuda, Panama, Peru and Venezuela each with one (Ashmead 1889; Muesebeck 1939, 1967; Hilburn et al. 1990; De Huiza 1994). It seems likely that future exploration across the neotropics will yield many more new species of this genus.

Meteorus species develop as koinobiont endoparasitoids of Coleoptera and Lepidoptera larvae (Shaw and Huddleston 1991), but reports from Neotropical countries are restricted to 15 lepidopteran families (Yu 2012; Jones and Shaw 2012; Aguirre et al. 2014; Aguirre and Shaw 2014a, 2014b). There, the higher proportion of caterpillars parasitized by *Meteorus* belong to the family Erebidae (25%, 11 species) mainly in the subfamily Arctiinae (tiger moths), followed by Noctuidae and Pyralidae (14%, six species each one), Nymphalidae (11%, five species), and Megalopygidae (7%, three species).

Zele Curtis has been considered for long time as the sister-group to *Meteorus* within the tribe Meteorini, but a recent molecular phylogenetic analysis performed by Julia Stigenberg et al. (2015) for the subfamily Euphorinae concluded that *Zele* is embedded within *Meteorus*, hence rendering it a paraphyletic genus. Their conclusion agrees with an earlier analysis for the tribe Meteorini presented by Stigenberg and Ronquist (2011) and with the phylogenetic reconstruction published by Maeto (1990), although the internal relationships differ among these works. However, Stigenberg et al. (2015) remained cautious about any taxonomic status change until more comprehensive evidence can be evaluated. In this paper we treat species of *Meteorus sensu stricto* following Shaw's (1997) definition of *Meteorus* exclusive of *Zele*: labrum completely concealed by clypeus; occipital carina present, complete or incomplete; epicnemial carina present; fore wing without vein 2cu-a, open first subdiscal cell; vein 3RSb straight; vein r-m present, forming a characteristic rhomboid or quadrate second submarginal cell; marginal cell of hind wing narrowed toward apex; vein m-cu absent; petiole at least 2.5 times wider at posterior margin than at narrowest point; metasomal terga with setae arranged in a single subapical row per tergum.

Huddleston (1980) discussed in depth the most relevant set of morphological characters employed in *Meteorus* taxonomy, which have been broadly used since then: relative size and shape of head related structures, the notauli distinctiveness, the presence of a pair of holes dorsally on the first tergite (dorsopes), the touching distance

between the first tergite ventral borders, the ovipositor relative length and the shape of the tarsal claw are the most relevant. Huddleston pointed out upon the unreliable color variability in identifying species. In fact, color pattern is a variable that might be affected by environmental conditions (Abe et al. 2013) and may display a broad spectrum of change in species widely distributed. However, a careful examination of abundant species present in Colombia, Costa Rica and Ecuador support the use of such a trait in several cases.

In order to boost the *Meteorus* research in Neotropical countries this paper is intended to provide a compelling identification tool for those species described and recorded from Central and South America, in addition to describing 11 new species, and updating biological and geographical information for seven previously described species.

Material and methods

Collections providing material are abbreviated below:

UWIM University of Wyoming Insect Museum, Laramie, Wyoming, USA;
NMNH Smithsonian National Museum of Natural History, Washington, USA;
MACN Museo Argentino de Ciencias Naturales Bernardino Rivadavia, Buenos Aires;
ICN Instituto de Ciencias Naturales, Universidad Nacional de Colombia, Bogotá.

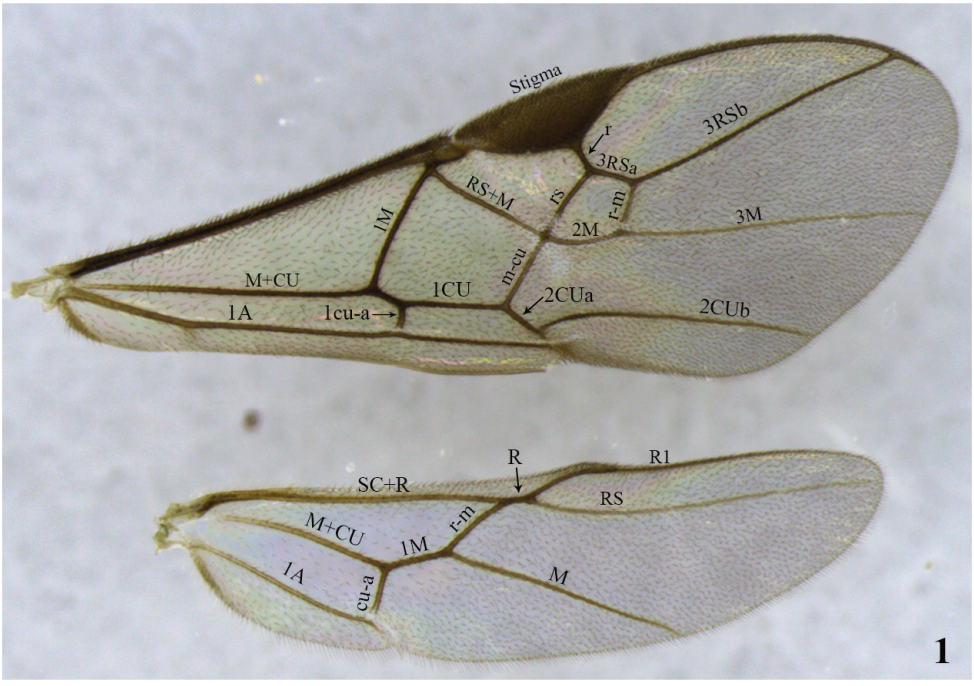
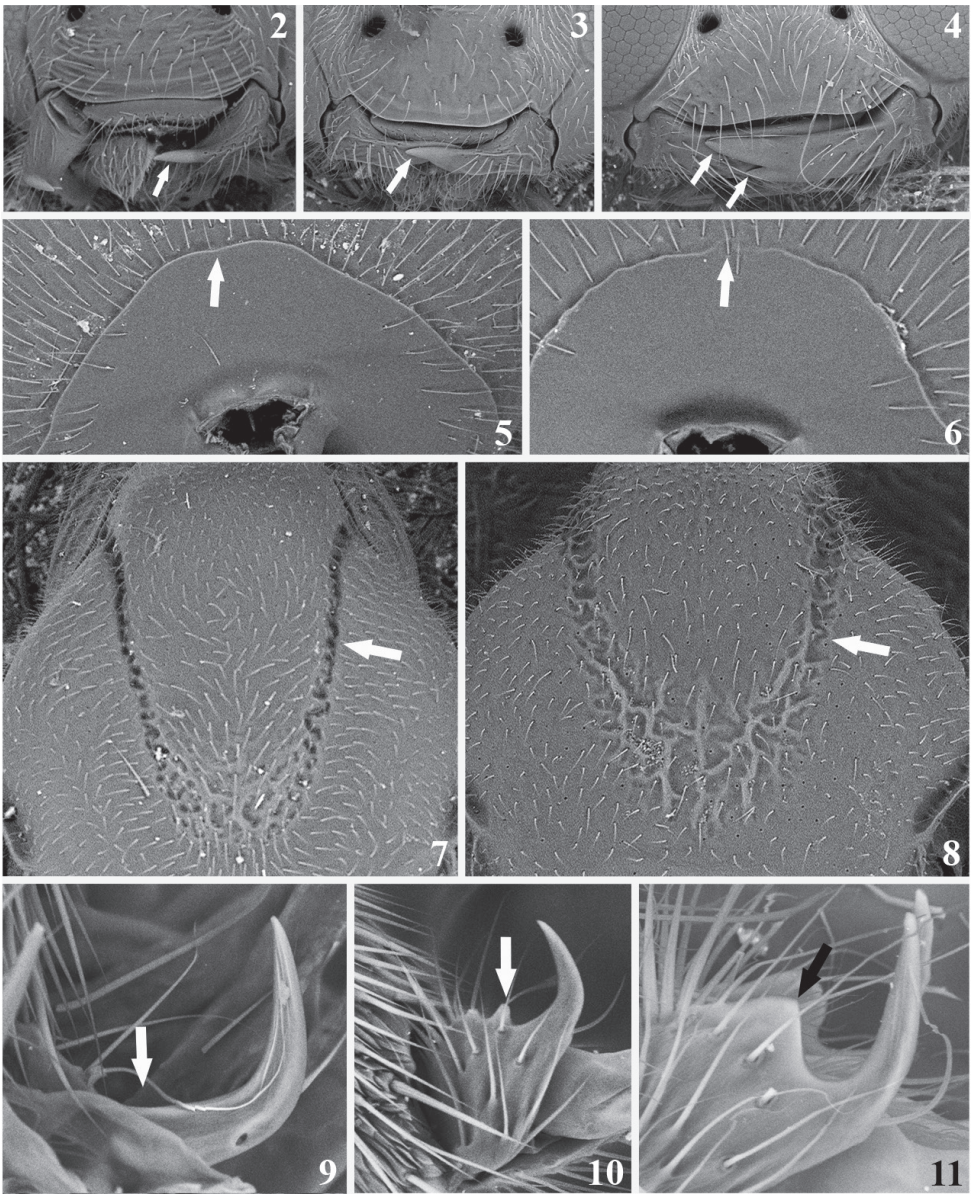
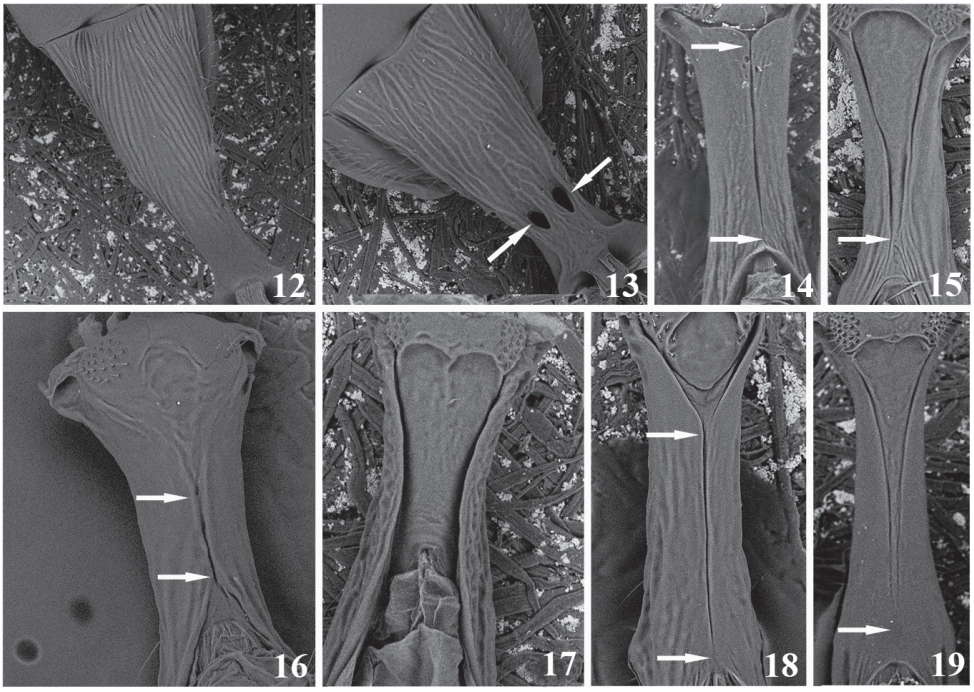


Figure 1. Wing venation nomenclature based on Sharkey and Wharton (1997).



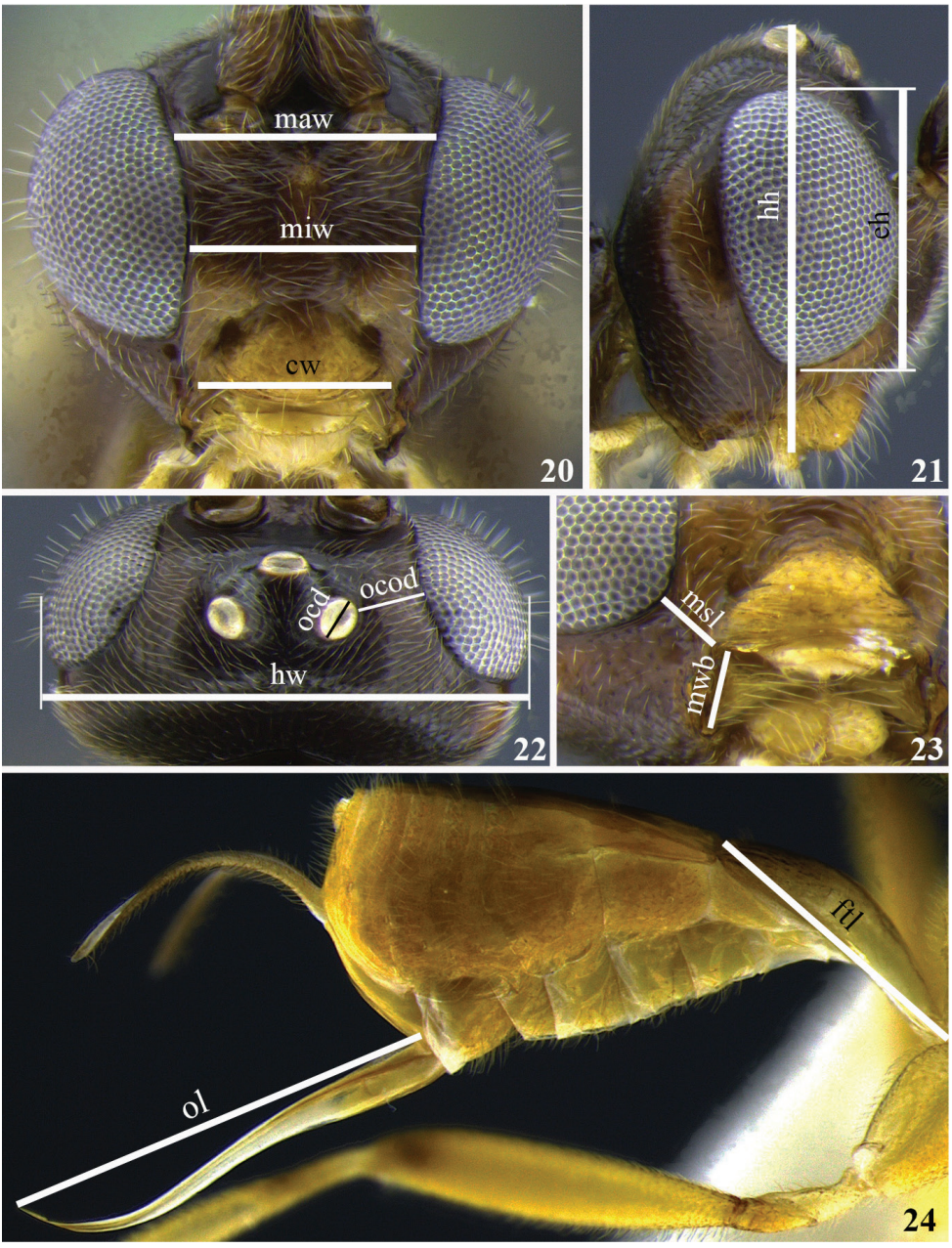
Figures 2–11. Morphological characters. Arrows on **2–4** indicate the mandible's teeth: **2** twisted mandibles, look very thin in frontal view and only the upper teeth is visible **3** moderately twisted mandibles, look thicker in frontal view, sometimes the lower teeth is visible **4** mandibles not twisted, are the thickest in frontal view and both upper and lower teeth are visible **5** the arrow indicates the complete occipital carina **6** the arrow points the area where the occipital carina becomes incomplete **7–8** show mesoscutum in dorsal view; the arrows are pointing the notauli **7** notauli deep, distinct and linear **8** notauli shallow, obsolescent and indistinct **9–11** display three conditions present in tarsal claws **9** simple **10** with a small lobe **11** with a large lobe.



Figures 12–19. Morphological characters. **12–13** show the first metasomal tergite in dorsal view **12** first tergite without dorsopes **13** first tergite with a pair of dorsopes near the basal extreme (holes indicated by the arrows) **14–19** show the first metasomal tergite in ventral view; the portion's structure pointing up is the anterior end. 14) Arrows indicate ventral borders of first tergite completely joined along ½ of segment **15** the arrow shows the distal extreme where the borders almost touch **16** arrows indicate the short section along which the ventral borders are touching **17** ventral borders widely separated **18** arrow on the top indicates the ventral borders basally separated, the arrow at the bottom shows them apically joined **19** the arrow signals the tergite's apical portion where the ventral borders are either touching or fused.

Holotypes and paratypes of the new species are deposited at UWIM (See Suppl. material 1).

General morphological terminology is based on Sharkey and Wharton (1997). The term precoxal sulcus is employed instead of sternaulus accordingly to Wharton (2006). Wing venation nomenclature employed in species descriptions is illustrated in Fig. 1. Sculpture related terms follow Harris (1979) and Aguirre et al. (2011). Specific terminology used in *Meteorus* taxonomy (based on Muesebeck 1923, Huddleston 1980, and Zitani et al. 1998) is represented in Figs 2–19. How to correctly position a specimen during morphometric examination is explained in Figs 20–24. In order to abbreviate descriptions, particularly explaining color details, metasomal tergites are sometimes referred as T1 (metasomal tergite number 1), T2 (metasomal tergite number 2) and so on. The specimens were measured using a Leica M80 stereomicroscope with micrometer on a 10× ocular. Images were captured with a Leica M205C stereomicroscope with digital Leica DFC295 camera kit and processed with Leica Application Suite Version 3.8.0 auto-montage software. De-



Figures 20–24. Morphometric characters. **20** Maw: face maximum width, miw: face minimum width, cw: clypeus width **21** hh: head height, eh: eye height **22** hw: head width, ocd: ocelar diameter, ocod: ocellus-ocular distance **23** msl: malar space length, mwb: basal mandible width **24** ftl: first tergite length, ol: ovipositor length.

scriptions were made with the DELTA software (Dallwitz 1974, 1980). The software version for Windows 8 was downloaded from http://code.google.com/p/open-delta/.

Biological data of the new species described from Ecuador were collected as part of the project "Caterpillars and parasitoids in the Eastern Andes of Ecuador, CAPEA" (Dyer et al. 2014). Details about the field collecting process are described in Shaw and Jones (2009).

The key was built using morphological characters to distinguish all the species except in the couplet 60. *Meteorus eaclidis* and *M. townsendi* present striking differences in cocoon construction and host use, being recorded on Saturniidae and Sphingidae caterpillars respectively. Such information support them as different species but are morphologically indistinguishable cryptic species.

The characters are based on examination of female specimens. Illustrations were embedded where either species differentiation may be challenging or the referred character(s) display some complexity.

Results

Key to the Neotropical species of *Meteorus*

1 First metasomal tergite with dorsopes (as in Fig. 13).....**2**

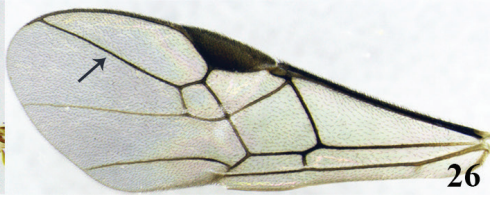
– First metasomal tergite without dorsopes (as in Fig. 12).....**14**

2 (1) Antennae with annuli; head and mesosoma mostly black; mandibles moderately twisted (as in Fig. 3); notauli deeply impressed and distinct (as in Fig. 7), tarsal claw with a small lobe (as in Fig. 10) ...***M. quimbayensis* Aguirre & Shaw**

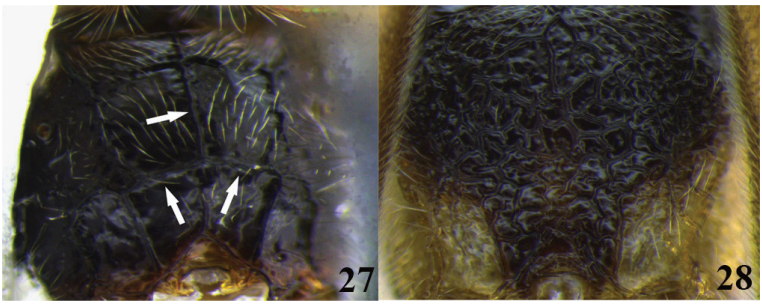
– Antennae without annuli; body color, mandibles, notauli and tarsal claw variable.....**3**

3 (2) Surface of temples and genae coriaceous (Fig. 86); surface of second tergite coriaceous-costate (Fig. 90); front wing with vein 3RSb distinctly curved (Fig. 25); notauli shallowly impressed and not distinct (as in Fig. 8); occipital carina complete (as in Fig. 5); untwisted mandibles (as in Fig. 4); tarsal claw simple (as in Fig. 9); ventral borders of first tergite widely separated (as in Fig. 17)..... ***M. eurysaccavorus* sp. n.**

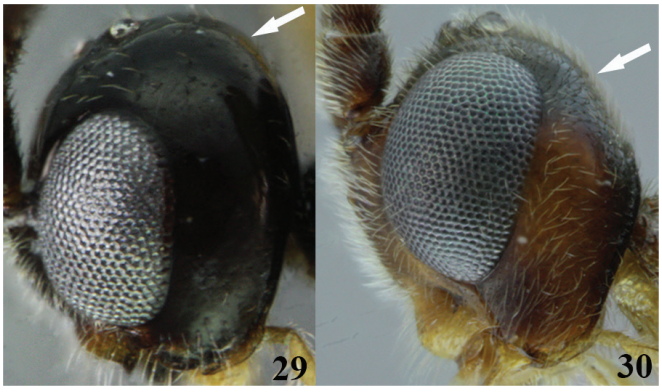
– Surface of temples, genae and second tergite of metasoma smooth; front wing with vein 3Rsb straight (as in Fig. 26); notauli deeply impressed and distinct (as in Fig. 7); occipital carina, mandibles, tarsal claw and ventral borders if the first tergite variable **4**



4 (3) First tergite displaying only one color **5**
– First tergite with two colors, the one basally lighter than the one apically **13**
5 (4) Carinae on propodeum present (as in Figure 27); ventral borders of first tergite widely separated (as in Figure 17) **6**
– Carinae on propodeum absent or obscured by complex sculpture (as in Figure 28); ventral borders of first tergite touching distally for a short distance (as in Figure 19) ..... ***M. fallacavus* sp. n.**



6 (5) Untwisted mandibles (as in Figure 4) **7**
– Moderately twisted mandibles (as in Figure 3) **10**
7 (6) Vertex in lateral view strongly convex and protruding above the ocelli (Fig. 29); occipital carina complete (as in Figure 5); tarsal claw simple (as in Figure 9) ..... ***M. magdalensis* Aguirre & Shaw**
– Vertex in lateral view flattened (as in Figure 30), if slightly convex not protruding above the ocelli; occipital carina and tarsal claw variable **8**



8 (7) Occipital carina incomplete (as in Figure 6); eyes relatively large, head height/eye height = 1.4; eyes in frontal view convergent, maximum face width/minimum face width = 1.7; ocelli relatively large, ocellus-ocular distance/ocelar diameter = 1.7 ..... ***M. santanderensis* Aguirre & Shaw**
– Occipital carina complete (as in Figure 5); eyes relatively small, head height/eye height = 1.8–1.9; eyes in frontal view parallel, maximum face width/minimum face width = 0.9–1.1; ocelli relatively small, ocellus-ocular distance/ocelar diameter = 2.7–3.0 ..... **9**

9 (8) Malar space short, malar space length 0.4 × mandible width basally (Figure 31); metapleuron smooth..... ***M. guacharensis* Aguirre & Shaw**

– Malar space longer, malar space length 0.9 × mandible width basally (Figure 32); metapleuron rugose .....***M. muiscai* Aguirre & Shaw**

10 (6) Tergites two and three mostly or totally yellow **11**

– Tergites two and three totally black-dark brown **12**

11 (10) Mesopleuron totally black; antennae with 27–32 flagellomeres; occipital carina either complete or incomplete; tarsal claw either with a small lobe or simple (as in figures 9 and 10) .....***M. andreae* Aguirre & Shaw**

– Mesopleuron mostly yellow; antennae with 22 flagellomeres; occipital carina complete (as in Figure 5); tarsal claw with a large lobe (as in Figure 11)..... ..... ***M. microcavus* sp. n.**

12 (10) Antennae with 34–35 flagellomeres; occipital carina incomplete (as in Fig. 6); tarsal claw with a large lobe (as in Fig. 11)....***M. albisericus* Aguirre & Shaw**

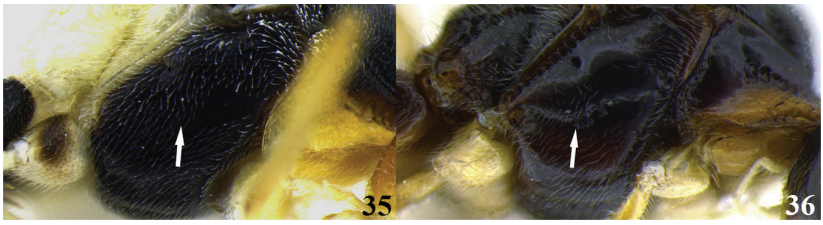
– Antennae with 26–32 flagellomeres; occipital carina complete (as in Fig. 5); tarsal claw either with a small or a large lobe (as in Figs 10 and 11) ....***M. guineverae* Aguirre & Shaw**

13 (4) Mesosoma and head mostly black; ocellus-ocular distance/ocelar diameter = 2.3–2.7; slightly convergent (Fig. 33), maximum face width/minimum face width = 1.1; mandibles untwisted (as in Fig. 4); tarsal claw simple (as in Fig. 9).....***M. amazonensis* Aguirre & Shaw**

– Mesosoma and head with black and testaceous patches; ocellus-ocular distance/ocelar diameter = 1.4; eyes in frontal view strongly convergent (Fig. 34), maximum face width/minimum face width = 1.7; mandibles moderately twisted (as in Fig. 3); tarsal claw with a small lobe (as in Fig. 10) .... ***M. iguaquensis* Aguirre & Shaw**

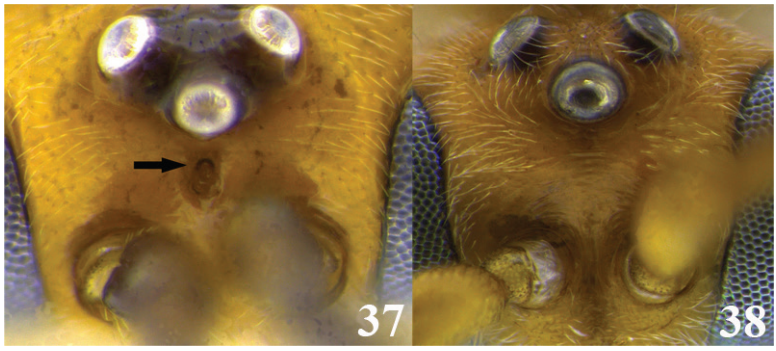
14 (1) Precoxal sulcus absent, lateral surface of mesopleuron smooth (Fig. 35); occipital carina complete (as in Fig. 5); mandibles twisted (as in Fig. 2); notauli deeply impressed and distinct (as in Fig. 7); tarsal claw simple (as in Fig. 9); ventral borders of first tergite touching for a short distance (as in Fig. 16) ....***M. caritatis* Jones**

– Precoxal sulcus present, lateral surface of mesopleuron with varied sculpture (as in Fig. 36); occipital carina, mandibles, notauli, tarsal claw and ventral borders of first tergite varible **15**



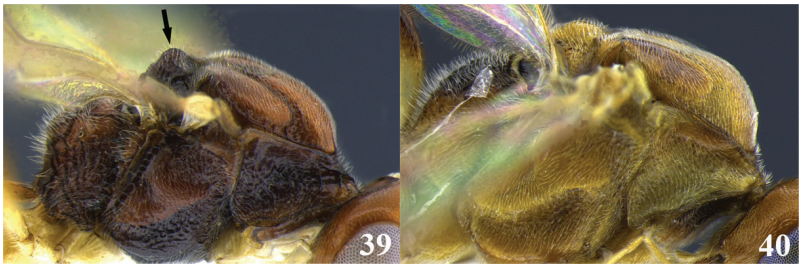
15 (14) Presence of a pit on the frons (Fig. 37); body mostly yellow except some areas on mesonotum, mesopleuron ventrally, metanotum and propodeum brown; occipital carina complete (as in Fig. 5); notauli deeply impressed and distinctive (as in Fig. 7); tarsal claw simple (as in Fig. 9); ventral borders of the first tergite basally separated (as in Fig. 18).....***M. bustamanteorum* Jones**

– No pit on the frons (Fig. 38); body color, occipital carina, notauli, tarsal claw and ventral borders of the first tergite variable.....**16**



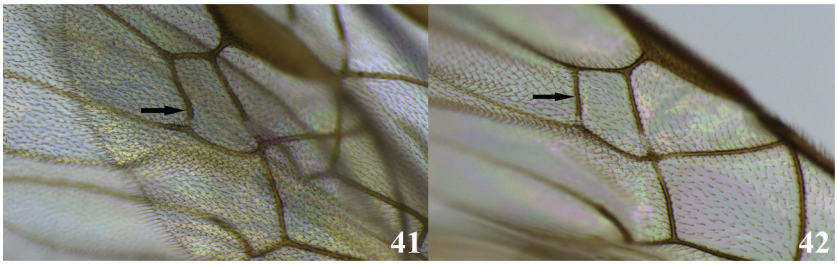
16 (15) Pronotum and metapleuron coarsely rugose; scutellar disc strongly raised in a rounded point (Fig. 39); mandibles not twisted (as in Fig. 4); notauli deeply impressed and distinct (as in Fig. 7); tarsal claw simple (as in Fig. 9); ventral borders of first tergite completely joined along ½ of segment (as in Fig. 14)..... ***M. corniculatus* Zitani**

– Pronotum and metapleuron either smooth or sculptured but not as coarsely as before; scutellar disc convex (Fig. 40); mandibles, notauli, tarsal claw, and ventral borders of first tergite variable **17**



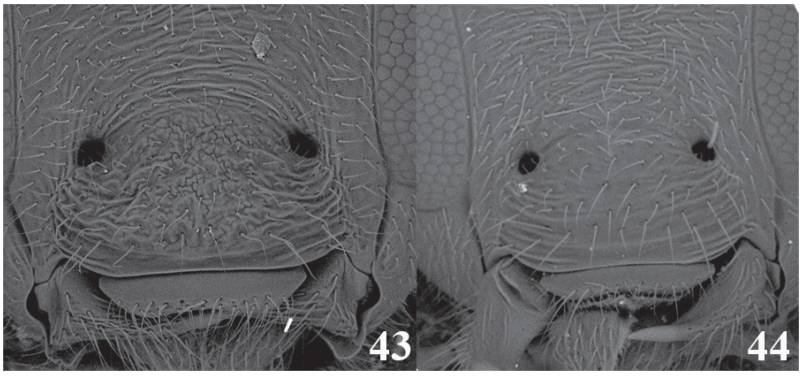
17 (16) Front wing with vein r-m sinuated (Fig. 41); occipital carina complete (as in Fig. 5); mandibles moderately twisted (as in Fig. 3); notauli shallow and not distinct (as in Fig. 8); tarsal claw simple (as in Fig. 9); ventral borders of first tergite completely joined along ½ of segment (as in Fig. 14) ....***M. porcatus*** **Jones**

– Front wing with vein r-m straight (as in Fig. 42); occipital carina, mandibles, notauli, tarsal claw and ventral borders of first tergite variable..... **18**

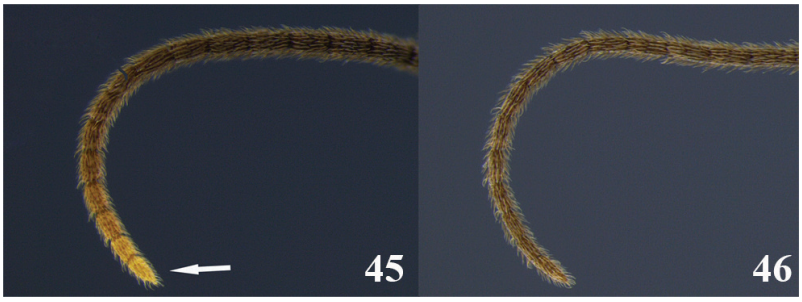


18 (17) Clypeus coarsely sculptured and wrinkled (Fig. 43); occipital carina complete (as in Fig. 5); mandibles twisted (as in Fig. 2); notauli shallow and not distinct (as in Fig. 8); tarsal claw with a large lobe (as in Fig. 11); ventral borders of first tergite completely joined along ½ of segment (as in Fig. 14) ....***M. rugonasus*** **Shaw & Jones**

– Clypeus with varied sculpture but not coarsely wrinkled (Fig. 44); occipital carina, mandibles, notauli, tarsal claw, and ventral borders of first tergite variable..... **19**



19 (18) Mandibles completely twisted (as in Fig. 2) **20**
– Mandibles either moderately twisted or not twisted (as in Figs 3 and 4) ... **61**
20 (19) Antennae with pale color at the tip (Fig. 45); occipital carina complete (as in Fig. 5); notauli shallow and not distinct (as in Fig. 8); tarsal claw with a large lobe (as in Fig. 11); ventral borders of first tergite completely joined along ½ of segment (as in Fig. 14) ..... ***M. rogerblancoi*** **Zitani**
– Antennae dark to the tip (as in Fig. 46); occipital carina, notauli, tarsal claw and ventral borders if first tergite variable **21**



21 (20) Occipital carina complete (as in Fig. 5) **22**
– Occipital carina incomplete (as in Fig. 6) **45**
22 (21) Head completely yellow, orange or ferruginous except area among the ocelli black-dark brown; sometimes frons and vertex with brown patches but never occiput brown-black **23**
– Head color variable but occiput always brown-black **35**
23 (22) Ventral borders of first tergite touching for a short distance (as in Fig. 16); notauli deeply impressed and distinct (as in Fig. 8); tarsal claw either simple or with a small lobe (as in Figs 9 and 10) ..... ***M. autographae*** **Muesebeck**
– Ventral borders of first tergite completely joined along ½ of segment (as in Fig. 14); notauli shallow and not distinct (as in Fig. 8); tarsal claw variable **24**
24 (23) Mesopleuron completely black-dark brown **33**
– Mesopleuron color variable, if it has either black or dark brown such colors cover just half or less of mesopleuron **25**
25 (24) Abdominal tergites from 2 through 8 completely yellow, orange or ferruginous; tarsal claw variable **26**
– Abdominal tergites from 2 through 8 otherwise; tarsal claw with a large lobe (as in Fig. 11) **29**
26 (25) Body mostly ferruginous; sometimes dark brown on propleuron, lateral mesonotal lobes, ventrally on mesopleuron, propodeum, and apically on first tergite; notauli shallow and not distinct (as in Fig. 8) ..... ***M. arizonensis*** **Muesebeck**
– Body either mostly yellow or orange; notauli and tarsal claw variable **27**
27 (26) Mesonotum orange but lateral mesonotal lobes black; eyes relatively small, head height/eye height = 1.6; ocelli relatively small, ocellus-ocular dis-

tance/ocelar diameter = 1.3; tarsal claw with a small lobe (as in Fig. 10) .... ***M. luteus* Jones**

– Mesonotum yellow; eyes relatively large, head height/eye height = 1.3–1.5; ocelli relatively large, ocellus-ocular distance/ocelar diameter = 0.8–1.2; tarsal claw with a large lobe (as in Fig. 11) **28**

28 (27) Antennae with 29–34 flagellomeres..... ***M. laphygmae* Haliday**

– Antennae with 25 flagellomeres ..... ***M. euchromiae* Ashmead**

29 (25) Mesopleuron laterally yellow, ventrally black-dark brown ***M. dos* Zitani**

– Mesopleuron completely yellow..... **30**

30 (29) Metanotum completely black-dark brown..... ***M. imaginatus* Jones**

– Metanotum dorsally brown-black, laterally yellow **31**

31 (30) Hind coxa completely yellow; ocellus-ocular distance/ocelar diameter = 0.3; malar space length/mandible width basally = 0.1..... ***M. haimowitzi* sp. n.**

– Hind coxa basally yellow, apically brown; ocellus-ocular distance/ocelar diameter = 1.0–1.7; malar space length/mandible width basally = 0.7–0.9... **32**

32 (31) Ocellus-ocular distance/ocelar diameter = 1.2–1.7; head height/eye height = 1.5–1.6; gregarious cocoons set close to each other but suspended by individual threads ..... ***M. oviedoi* Shaw & Nishida**

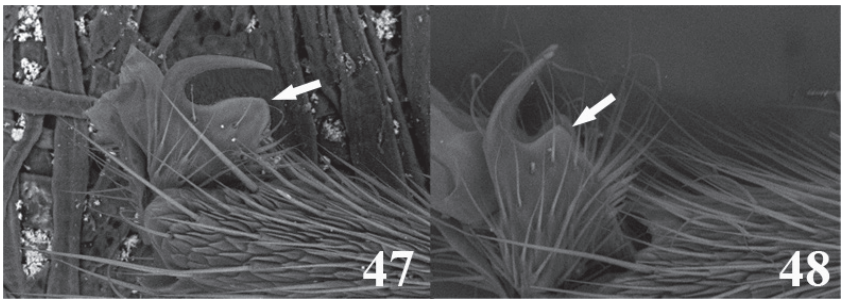
– Ocellus-ocular distance/ocelar diameter = 1.0; head height/eye height = 1.4; gregarious cocoons suspended together by a single cable .... ***M. restionis* Shaw & Jones**

33 (24) Mesonotum and hind coxa completely dark brown; antennae with 25 flagellomeres; eyes convergent, face maximum width/minimum width = 1.5; tarsal claw with a small lobe (as in Fig. 10)..... ***M. calimai* Aguirre & Shaw**

– Mesonotum black-dark brown except area around notauli convergence point, as well as scutellum, yellow; hind coxa either partial or totally yellow; antennae with 30–33 flagellomeres; eyes parallel, face maximum width/minimum width = 1.1–1.2; tarsal claw with a large lobe (as in Fig. 11) **34**

34 (33) Second tergite black-dark brown; hind coxa distally dark brown, basally yellow; tarsal claw with a particularly enlarged tarsal claw (as in Fig. 47)..... ..... ***M. zitaniae* Jones**

– Second tergite dark brown with a yellow cup-shaped area along the middle; hind coxa completely yellow; tarsal claw with a large lobe but never as large as in *M. zitaniae* (as in Fig. 48) ..... ***M. horologium* Jones**



35 (22) Ventral borders of first tergite either touching for a short distance (as in Fig. 16) or almost touching distally (as in Fig. 15) ..... ***M. pseudodimidiatus* Zitani**

– Ventral borders of first tergite joined-fused along ½ of segment (as in Fig. 14) or separated basally (as in Fig. 18) **36**

36 (35) Ventral borders of first tergite joined-fused along ½ of segment; notauli and tarsal claw variable **38**

– Ventral borders of first tergite separated basally; notauli deeply impressed and distinct (as in Fig. 7); tarsal claw with a large lobe (as in Fig. 11) **37**

37 (36) Ovipositor curved (Fig. 49); first tergite basally yellow, distally brown; mesopleuron, metapleuron and propodeum mostly yellow ..... ***M. chingazensis* Aguirre & Shaw**

– Ovipositor straight (Fig. 50); first tergite completely black; mesopleuron black and testaceous, metapleuron and propodeum black ..... ***M. dixi* Aguirre & Shaw**


49


50

38 (36) Mesosoma completely ferruginous; huge eyes, head height/eye height = 1.2–1.4; body large = 6.0–6.6 mm..... ***M. magnoculus* sp. n.**

– Mesosoma and eyes variable but not displaying the mentioned combination **39**

39 (38) Tarsal claw simple (as in Fig. 9)..... ***M. cecavorum* Aguirre & Shaw**

– Tarsal claw with a large lobe (as in Fig. 11) **40**

40 (39) Propodeum completely black-dark brown **42**

– Propodeum variable but not as before, if a black or dark brown area is present it is dorsally restricted **41**

41 (40) Mesopleuron completely black; hind coxa dorsally black, ventrally white-yellow; head height/eye height = 1.5 ***M. pyralivorus* Aguirre & Shaw**

– Mesopleuron orange except both dorsal and anterior borders black; hind coxa orange; head height/eye height = 1.3–1.4..... ***M. desmiae* Zitani**

42 (40) First tergite completely black..... ***M. anuae* Aguirre & Shaw**

– First tergite basally white-yellow, distally brown-black..... **43**

43 (42) Mesopleuron yellow..... ***M. noctuivorus* sp. n.**

– Mesopleuron brown-black **44**

44 (43) Hind coxa dark brown; antennae with 24–27 flagellomeres; eyes convergent, face maximum width/minimum width = 1.4–1.6 ..... ***M. carolae* sp. n.**

– Hind coxa dorsally dark brown, ventrally yellow; antennae with 31 flagellomeres; eyes parallel, face maximum width/minimum width = 1.1 ..... ***M. martinezi* sp. n.**

45 (21) Mesopleuron completely black-dark brown **46**
– Mesopleuron either yellow and black or yellow and dark brown **51**
46 (45) Ventral borders of first tergite joined (eventually fused) along ½ of segment (as in Fig. 14); notauli variable **47**
– Ventral borders of first tergite touching for a short distance (as in Fig. 16), almost touching distally (as in Fig. 15) or separated basally (as in Fig. 18); notauli deeply impressed and distinct (as in Fig. 7) **50**
47 (46) Body color with a notorious contrast of white-yellow on metapleuron and propodeum, dark brown on mesopleuron and hind coxa, and orange on mesonotum; notauli shallow and not distinct; tarsal claw with a small lobe .... ***M. uno* Zitani**
– Body color otherwise but not as before; if the general color pattern looks similar as the previous step, the mesonotum total or mostly black-dark brown **48**
48 (47) Propodeum completely black; tarsal with a particularly enlarged tarsal claw (Fig. 47); notauli shallow and not distinct (as in Fig. 8) ..... ***M. zitaniae* Jones**
– Propodeum otherwise but not as before; if any black or dark brown area present, it is in combination with either yellow or white areas; tarsal claw and notauli variable; if tarsal claw presents a large lobe, it is not as large as before (as in Fig. 48) **49**
49 (48) Hind coxa completely dark brown; middle coxa completely yellow; notauli not distinct (as in Fig. 8) ..... ***M. orion* sp. n.**
– Hind and middle coxa dorsally black, ventrally yellow; notauli distinct (as in Fig. 7) ..... ***M. mirandae* Aguirre & Shaw**
50 (46) Ventral borders of first tergite either touching for a short distance (as in Fig. 19) or almost touching distally (as in Fig. 15) ***M. dimidiatus* (Cresson)**
– Ventral borders of first tergite basally separated (as in Fig. 18) ... ***M. oreoi* Jones**
51 (45) Notauli shallowly impressed and not distinct (as in Fig. 8); tarsal claw with a large lobe (as in Fig. 11) **52**
– Notauli deeply impressed and distinct (as in Fig. 7); tarsal claw variable ... **57**
52 (51) Propodeum completely black **53**
– Propodeum otherwise but never completely black **55**
53 (52) Mesonotal lobes black-dark brown; mesopleuron laterally yellow, ventrally dark brown ..... ***M. juliae* Aguirre & Shaw**
– Mesonotal lobes and mesopleuron yellow **54**
54 (53) Frons, vertex and temple black; wings slightly infuscated; head height/ eye height =1.4–1.5; ovipositor length/ first tergite length = 1.7–1.8 .... ***M. margarita* Jones**
– Frons, vertex and temple mostly orange-ferruginous; wings hyaline; head height/eye height = 1.6–1.7; ovipositor length/ first tergite length = 2.0–2.2 .. .. ***M. quasifabatus* Jones**
55 (52) Coxa orange and punctate; antennae with 30–35 flagellomeres; ocellus-ocular distance/ocelar diameter = 0.5–0.9; ovipositor length/ first tergite length = 2.3–3.2 ..... **56**

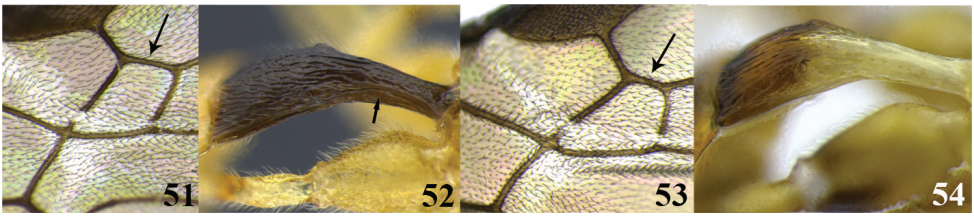
– Coxa basally yellow, apically brown, and strigate; antennae with 26–28 flagellomeres; ocellus-ocular distance/ocelar diameter = 1.0–1.4; ovipositor length/ first tergite length = 1.2–1.8.....***M. alejandromasisi*** **Zitani**

56 (55) Mesopleuron orange (body completely orange); vertex wide and slightly concave between lateral ocelli and occipital carina; antennae with 35 flagellomeres; ovipositor length/ first tergite length = 3.2.....***M. camilocamargoi*** **Zitani**

– Mesopleuron orange-yellow medially, black dorso-anteriorly; vertex not as before; antennae with 30–31 flagellomeres; ovipositor length/ first tergite length = 2.3–2.6 ..... ***M. desmiae*** **Zitani**

57 (51) Tarsal claw with a large lobe (as in Fig. 11); fore wing with second submarginal cell not narrowed anteriorly (Fig. 51); lateral borders of first tergite laterally flattened (Fig. 52) .....***M. sterictae*** **Zitani**

– Tarsal claw simple (as in Fig. 9); fore wing with second submarginal cell narrowed anteriorly (as in Fig. 53); lateral borders of first tergite laterally convex (as in Fig. 54).....**58**



58 (57) Mesonotum completely yellow-orange **59**

– Mesonotum with lateral lobes black-dark brown..... ***M. papiliovorus*** **Zitani**

59 (58) Incomplete occipital carina (as in Fig. 6) **60**

– Complete occipital carina (as in Fig. 5) ..... ***M. congregatus*** **Muesebeck**

60 (59) Cocoons arranged in a compact mass encased in loose silk .....
.....***M. townsendi*** **Muesebeck**

– Cocoons arranged singly.....***M. eaclidis*** **Muesebeck**

61 (19) Mandibles moderately twisted (as in Fig. 3); notauli and tarsal claw variable.....**62**

– Mandibles not twisted (as in Fig. 2); notauli deeply impressed and distinct (as in Fig. 7); tarsal claw simple (as in Fig. 9) **72**

62 (61) Ventral borders of first tergite joined completely along ½ of segment (as in Fig. 14).....**63**

– Ventral borders of first tergite either touching for a short distance (as in Figs 16 and 19) or basally separated (as in Fig. 18).....**65**

63 (62) Mesopleuron completely black; notauli deeply impressed and distinct; tarsal claw with a large lobe.....***M. caquetensis*** **Aguirre & Shaw**

– Mesopleuron otherwise; if any black area present on it, covering less than half of mesopleuron surface **64**

64 (63) Propodeum completely yellow; notauli shallow and not distinct; tarsal claw simple; front wing with stigma brown.....***M. kraussi* Muesebeck**

– Propodeum completely black; notauli deeply impressed; tarsal claw with a large lobe; front wing with stigma white .....***M. albumstigma* sp. n.**

65 (62) Ventral borders of first tergite touching for a short distance either medially (as in Fig. 16) or apically (as in Fig. 19).....**66**

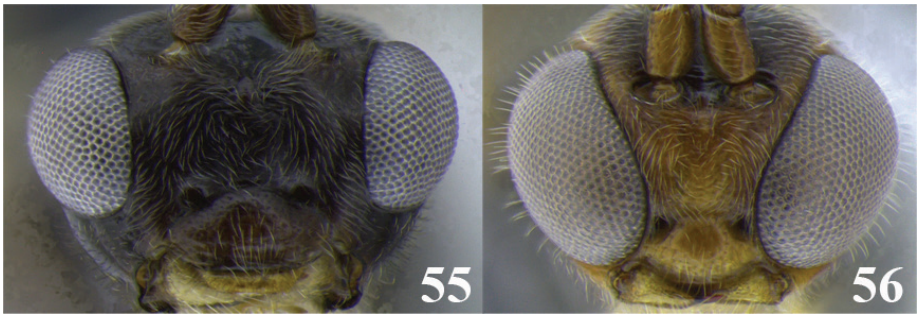
– Ventral borders of first tergite basally separated and joined along the rest of segment (as in Fig. 18).....**69**

66 (65) Notauli deeply impressed and distinct (as in Fig. 7); tarsal claw simple (as in Fig. 9).....**67**

– Notauli shallow impressed and not distinct (as in Fig. 8); tarsal claw variable ... **68**

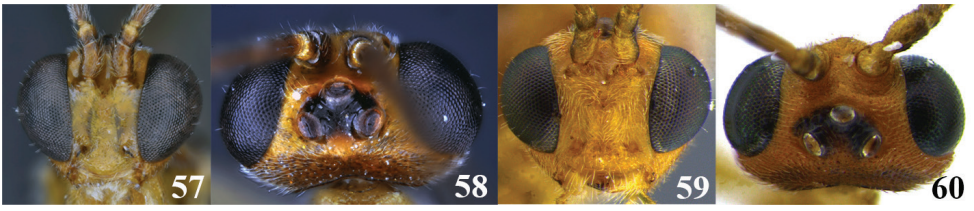
67 (66) Small eyes (Fig. 55), head height/eye height = 1.8–1.9; ocellus-ocular distance/ocelar diameter = 2.6–3.2; eyes parallel in frontal view, face maximum width/minimum width = 1.1; ovipositor length/first tergite length = 1.3–1.8.....***M. micrommatus* Zitani**

– Large eyes (Fig. 56); head height/eye height = 1.5; ocellus-ocular distance/ocelar diameter = 1.6; eyes convergent in frontal view, face maximum width/minimum width = 1.7; ovipositor length/first tergite length = 2.8 ....***M. coffeatus* Zitani**



68 (66) Eyes and ocelli large (Figs 57 and 58), head height/eye height = 1.2–1.4, ocellus-ocular distance/ocelar diameter = 0.6–0.7; occipital carina complete (as in Fig. 5).....***M. antioquensis* Aguirre & Shaw**

– Eyes and ocelli smaller (Figs 59 and 60), head height/eye height = 1.5–1.6, ocellus-ocular distance/ocelar diameter = 1.0–1.7; occipital carina incomplete (as in Fig. 6) .....***M. rubens* (Cresson)**



69 (65) Tarsal claw with a large lobe (as in Fig. 11); occipital carina complete (as in Fig. 5); fore wing with yellow stigma ..... ***M. flavistigma* sp. n.**

– Tarsal claw simple (as in Fig. 9); occipital carina variable; fore wing with stigma color variable **70**

70 (69) Body completely or mostly yellow-orange; if it is mostly yellow-orange then metanotum, propodeum and tergites with brown areas; notauli variable; occipital carina incomplete (as in Fig. 6) **71**

– Body completely or mostly black-dark brown; notauli deeply impressed and distinct (as in Fig. 7); occipital carina complete (as in Fig. 5) .... ***M. boyacensis* Aguirre & Shaw**

71 (70) Body completely yellow-orange; notauli shallow and not distinct (as in Fig. 8) ..... ***M. jerodi* Aguirre & Shaw**

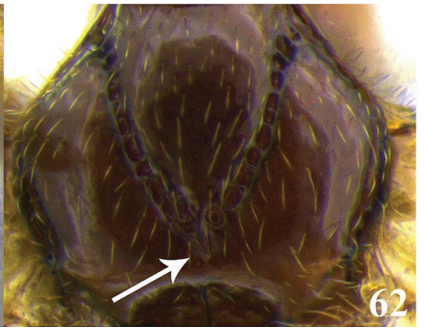
– Body mostly yellow-orange with metanotum, propodeum dorsally and metasomal tergites 1, 4–8 brown; notauli deeply impressed and distinct (as in Fig. 7) ..... ***M. chilensis* Porter**

72 (61) Head completely yellow-testaceous ..... ***M. huilensis* Aguirre & Shaw**

– Head either completely black-dark brown or black-dark brown except face testaceous **73**

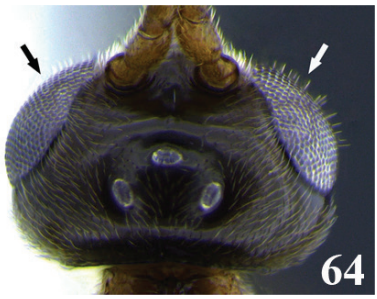
73 (72) Ventral borders of first tergite widely basally separated, distally either touching for a short distance (as in Fig. 19) or almost touching (as in Fig. 15); notauli posteriorly oval-shaped (Fig. 61) **74**

– Ventral borders of first tergite basally separated and joined along almost ½ of segment (as in Fig. 18); notauli converging posteriorly in a distinct v-shape (as in Fig. 62) ..... ***M. mariamartae* Zitani**



74 (73) Eyes protuberant (Fig. 63); body usually large, body length = 4.0–9.7 mm **75**

– Eyes not protuberant (Fig. 64); body always small, body length = 2.5–3.7 mm ..... ***M. yamijuanum* Zitani**



75 (74) Antennae with 30–34 flagellomeres; body length = 8–9.7 mm; fore and middle coxa black; face maximum width/minimum width = 1.3–1.4 .... ***M. gigas*** **Aguirre, Shaw & Jones**

– Antennae with 20–25 flagellomeres; body length = 4.7–5.9 mm; fore and middle coxa yellow; face maximum width/minimum width = 1.5–1.9 ....***M. megalops*** **Zitani**

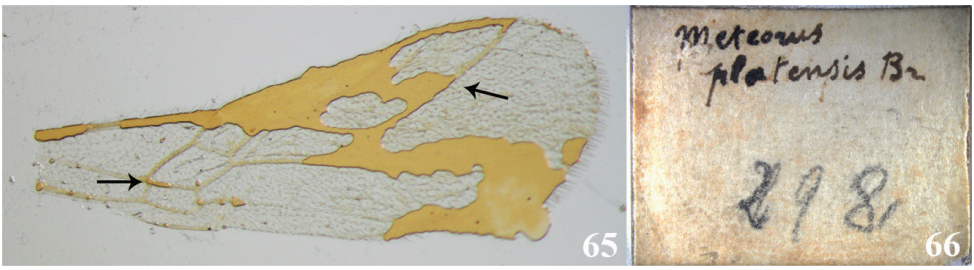
Species not included in the key

Meteorus australis **Tosquinet, 1900.**
Known only from Argentina. Type missed.

Meteorus deltae **Blanchard, 1936.**
Known only from Argentina. Type missed.

Meteorus eumenidis **Brethes, 1903.**
Zitani (2003) reported the transferring of *M. eumenidis* Brethes, 1903 to the genus *Homolobus* Forster, 1862 after the examination by Michael Sharkey of the holotype deposited in the Museo Argentino de Ciencias Naturales. The *M. eumenidis* holotype has the first metasomal tergite sessile, not petiolate, the first subdiscal cell of the fore wing closed, and the fore wing vein 3RSb curved towards the posterior wing margin (Zitani 2003).

Meteorus laqueatus **Enderlein, 1920.**
The holotype of *M. laqueatus* deposited at the Zoological Museum in Warsaw, Poland, was examined by Nina Zitani (Zitani 2003), who concluded that, based on the broadening of the marginal cell of the hind wing and the scattered setae on the metasomal tergites, this species should be assigned to the genus *Zele* Curtis, 1832.



Figures 65–66. *Meteorus platensis*. **65** Front wing; the arrow on the left shows a small-rhomboid first discal cell, the arrow on the right indicates the short and curved 3RSb vein **66** type label.

***Meteorus platensis* Brethes, 1913.**

Juan Jose Martinez from the Museo Argentino de Ciencias Naturales examined and provided an image of the *M. platensis* holotype (Figs 65–66). Just the forewing remains and it is in very bad condition but the small and rhomboid first discal cell (arrow on the left Fig. 65), and the short and slightly curved vein 3RSb (arrow on the right Fig. 65) are clear enough to conclude it is not *Meteorus*. The visible pattern of venation is more consistent with it possibly belonging to the Opiinae or Alysiinae.

Description of new species

***Meteorus albistigma* Aguirre, Almeida & Shaw, sp. n.**

http://zoobank.org/F1302EC9-38DA-4B46-9952-D02D701026C6

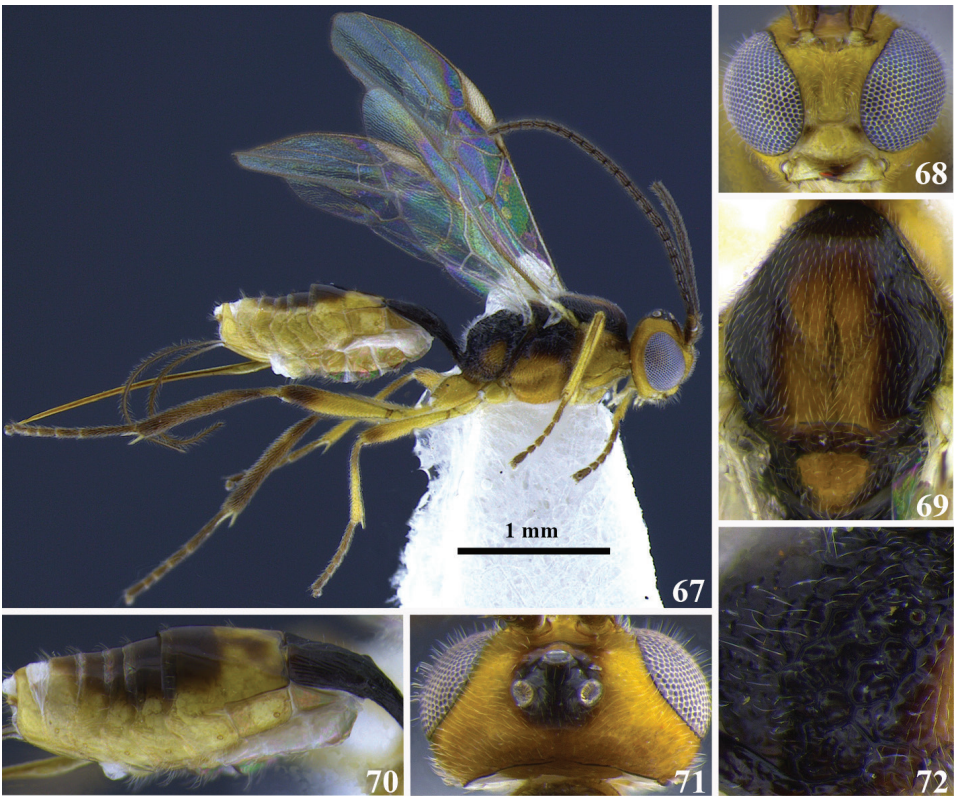
Figures 67–72

Diagnosis. Occipital carina complete; eyes convergent, face maximum width 1.8 × minimum width; mandibles moderately twisted; notauli deeply impressed, distinctive and foveolate; propodeum aerolate-rugose and absent of both carinae and a median depression; hind coxa punctuate-polished; tarsal claw with large lobe; dorsopes absent; ovipositor 2.7 × longer than first tergite, stigma white.

Body color. Antenna dark brown, annulus absent; head yellow except area between ocelli black. Propleuron and pronotum yellow; mesonotum black except yellow among mesonotal lobes and on the scutellum; mesopleuron orange except black close to the tegula; metanotum totally black; metapleuron orange; propodeum black. Prothoracic legs yellow except tarsus light brown; mesothoracic legs yellow except femur apically, tibia and tarsus brown; metathoracic legs yellow except tibia brown, femur apically and tarsus dark brown. T1 black, T2 yellow, T3 brown, T4–T6 brown medially and yellow laterally, T7–T8 yellow; sterna yellow. Wing membrane hyaline; stigma white.

Body length. 3.1 mm.

Head. Antenna with 20 flagellomeres (antenna broken); flagellar length/width ratios as follows: F1 = 4.4, F2 = 4, F3 = 3, F18 = 1.3, F19 = 1.3, F20 = 2.2; head 1.1



Figures 67–72. *Meteorus albistigma* sp. n. **67**) Female in lateral habitus **68** head in frontal view **69** mesoscutum in dorsal view **70** metasoma in dorso-lateral view **71** head in dorsal view **72** propodeum.

wider than high; occipital carina incomplete; ocellus-ocullar distance 1.5 × ocellar diameter; head height 1.6 × eye height; temple length 0.4 × eye length in dorsal view; vertex in dorsal view not descending vertically behind the lateral ocelli; frons smooth and polished; face maximum width 1.8 × minimum width; face surface irregular and shiny; face minimum width 0.7 × clypeus width; clypeus surface irregular and shiny; malar space length 0.4 × mandible width basally; mandibles moderately twisted.

Mesosoma. Pronotum in lateral view carinate; propleuron smooth; notauli deeply impressed, distinctive and foveolate; mesonotal lobes well defined; central lobe of mesoscutum either punctuate or smooth and polished; scutellar furrow with three carinae; mesopleuron punctate; precoxal sulcus short, narrow and foveate-lacunose; metapleuron mostly smooth but rugose close to the hind coxa; propodeum aerolate-rugose and absent of both carinae and a median depression.

Legs. Hind coxa punctuate-polished; tarsal claw with large lobe.

Wings. Wing length 2 mm. Front wing: second submarginal cell not strongly narrowed anteriorly; length of vein r 0.6 × length of vein 3RSa; vein 3RSb straight; length of vein 3RSa equal to length of vein r-m; vein m-cu antefurcal. Hind wing: length of vein 1M equal to length of vein cu-a; length of vein 1M 0.9 × length of vein r-m.

Metasoma. Dorsopes absent; ventral borders of first tergite joined completely along ½ of segment; first tergite rugulose-costate, the costae convergent; ovipositor thickened basally and straight; ovipositor 2.7 × longer than first tergite; T2–T7 smooth.

Cocoon. Unknown.

Female variation. Unknown.

Male variation. Unknown.

Type locality. COSTA RICA, Alajuela, Chiles de Aquas, Zarcas Cafe, 300 m.

Type specimen. Holotype female (point mounted). Original label: COSTA RICA, Alajuela, Chiles de Aquas, Zarcas Cafe, 300 m, collected XI.1989, R. Cespedes leg., UWIM.

Distribution. Costa Rica, at the province of Alajuela.

Biology. Unknown.

Comments. *Meteorus albistigma* resembles *M. kraussi* in having the ventral borders of first tergite completely fused along ½ of segment and mandibles moderately twisted. *Meteorus albistigma* can be separated by having the propodeum dorsally dark (completely or mostly yellow in *M. kraussi*), the notauli deeply impressed (shallow and not distinct in *M. kraussi*), the tarsal claw with a large lobe (tarsal claw simple in *M. kraussi*) and the stigma of the front wing white (brown in *M. kraussi*).

Etymology. The name of this species is composed by the latin prefix "albi", meaning white, and the stem "stigma" because of the color of this structure on the front wing.

***Meteorus carolae* Aguirre, Almeida & Shaw, sp. n.**
http://zoobank.org/2F7F4D96-6BD6-4E63-990C-6761AABB5DB0
Figures 73–82

Diagnosis. Occipital carina complete; face maximum width 1.5 × minimum width; mandibles twisted; notauli shallow, not distinctive and rugose; propodeum aerolate-rugose; hind coxa strigate; tarsal claw with large lobe; dorsope absent; ventral borders of first tergite joined completely along ½ of segment; ovipositor 2.9 × longer than first tergite; body mostly dark brown.

Body color. Antenna dark brown; annulus absent; face and clypeus yellow; frons black on the middle and orange laterally; vertex orange between the lateral ocelli and the compound eyes; area around and among ocelli, vertex behind the lateral ocelli, temple and the most of the gena black; a small orange area of the gena along the compound eye. Propleuron dark brown; pronotum dorsally dark brown, then gradually becomes light brown to orange ventrally; mesonotal lobes black; area among lobes, notauli and scutellum yellow-orange; mesopleuron, metanotum, metapleuron and propodeum black. Prothoracic legs yellow; mesothoracic legs yellow except tarsus brown; metathoracic coxa dark brown, remaining leg light brown. T1 yellow basally, dark brown apically; T2 yellow basally, remaining brown; sterna yellow-cream. Wings hyaline; stigma dark brown.

Figures 73–79. *Meteorus carolae* sp. n. female. **73** Habitus in lateral view **74** head in dorsal view **75** head in frontal view **76** mesoscutum in dorsal view **77** propodeum in posterior view **78** metasoma in dorsal view **79** First tergite in dorsal view.

Body length. 3.6 mm.

Head. Antenna with 26 flagellomeres; flagellar length/width ratios as follows: F1 = 4, F2 = 3.7, F3 = 2.7, F24 = 1.5, F25 = 1.3, F26 = 1.8; head 1.2 wider than high; occipital carina complete; ocellus-ocullar distance 1.2 × ocellar diameter; head height 1.4 × eye height; temple length 0.4 × eye length in dorsal view; vertex in dorsal view not descending vertically behind the lateral ocelli; frons strigulate; face maximum width 1.5 × minimum width; face strigate-rugulose; face minimum width 0.8 × clypeus width; clypeus rugulose; malar space length 0.3 × mandible width basally; mandibles twisted.

Mesosoma. Pronotum in lateral view extensively rugose; propleuron slightly puncticulate; notauli shallow, not distinctive and rugose; mesonotal lobes not well defined; central lobe of mesoscutum punctate; scutellar furrow with five carinae; mesopleuron punctate, rugose-lacunose close to the tegula; precoxal sulcus long, wide and rugose; metapleuron rugose; propodeum aerolate-rugose, both carinae or median depression absent.

Legs. Hind coxa strigate; tarsal claw with large lobe.

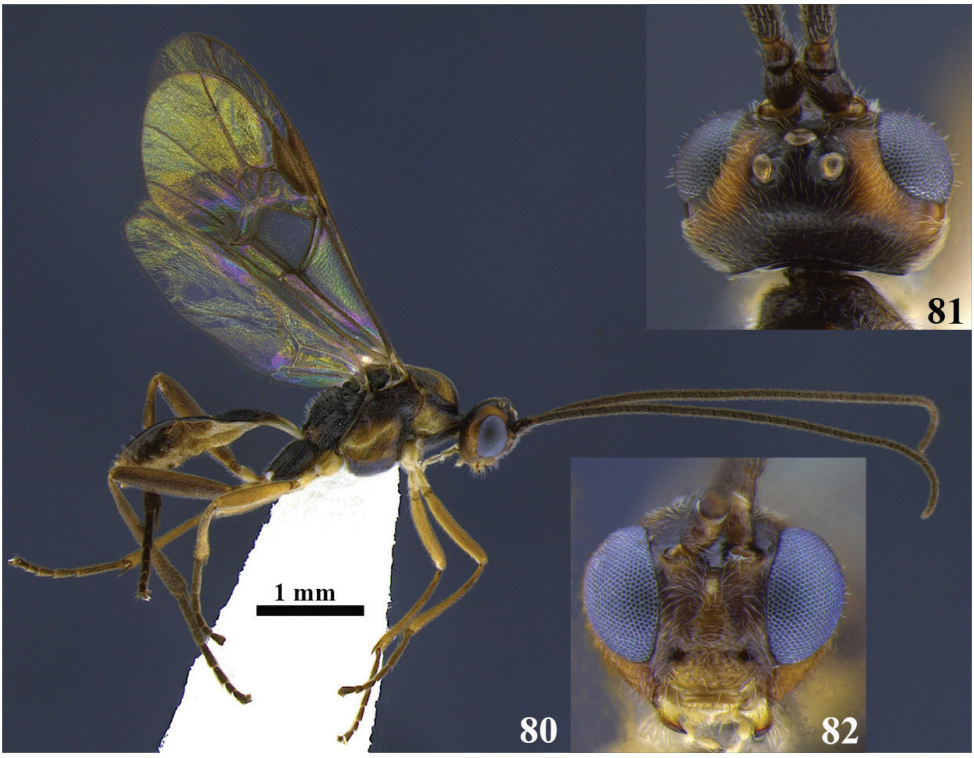
Wings. Wing length 3 mm; second submarginal cell of forewing not strongly narrowed anteriorly. Front wing: length of vein r 0.8 × length of vein 3RSa; vein 3RSb straight; length of vein 3RSa 0.8 × length of vein r-m; vein m-cu antefurcal. Hind wing: length of vein 1M 1.3 × length of vein cu-a; length of vein 1M equal to length of vein r-m.

Metasoma. Dorsope absent; ventral borders of first tergite joined completely along ½ of segment; first tergite with costae convergent posteriorly; ovipositor thickened basally and straight; ovipositor 2.9 × longer than first tergite.

Cocoon. Unknown.

Female variation. Head face and clypeus light brown-honey; frons medially black, laterally orange; area between ocelli, temples and vertex behind the lateral ocelli black; gena orange. Pronotum dorsal border black, remaining yellow; median mesonotal lobe and scutellum light brown, lateral mesonotal lobes dark brown, area among lobes and notauli yellow; mesopleuron black except a medial-posterior patch yellow; metanotum totally black; metapleuron yellow, or orange except ventral border black; propodeum black; mesothoracic legs coxa, trochanter and trochantellus white, remaining dark brown; body length 3.2–3.7 mm; antenna with 24–27 flagellomeres; ocellus-ocullar distance 1–1.5 × ocellar diameter; temple length 0.5–0.6 × eye length in dorsal view; face maximum width 1.4–1.6 × minimum width; clypeus punctate; propleuron rugulose; precoxal sulcus short and wide; wing length 3.5 mm. Front wing: length of vein 3RSa 1–1.2 × length of vein r-m. Vein m-cu of forewing either intersticial or postfurcal. Ovipositor 2.3 × longer than first tergite.

Male variation. Lateral lobes of mesonotum and apical area of median one black, yellow the rest; mesopleuron either yellow except area close to the tegula dark brown, or orange on the middle, black dorsally and ventrally; prothoracic and mesothoracic legs yellow except tarsus brown; metathoracic legs yellow except tibia brown, femur apically and tarsus dark brown; T2 yellow-orange basally, remaining dark brown; body length 3.8 mm; antenna with 32 flagellomeres; head height 1.1 × eye height; ocellus-ocullar distance 1.1 × ocellar diameter; head height 1.5 × eye height; face maximum



Figures 80–82. *Meteorus carolae* sp. n. male. **80** Habitus in lateral view **81** head in dorsal view **82** head in frontal view.

width 1.2 × minimum width; face minimum width 0.9 × clypeus width; malar space length 0.5 × mandible width basally; wing length 3.4 mm. Front wing: length of vein r 0.6 × length of vein 3RSa. Hind wing: length of vein 1M equal to length of vein cu-a; length of vein 1M 0.8 × length of vein r-m. First tergite costate-reticulate.

Type locality. COSTA RICA, Cartago, Dulce Nombre, Vivero Linda Vista, 1400 m.

Type specimen. Holotype female (point mounted). Original label: COSTA RICA, Cartago, Dulce Nombre, Vivero Linda Vista, 1400 m, collected VI–VIII.1993, UWIM.

Paratypes. One female (point mounted), COSTA RICA, Cartago, 4km NE Cañón Génesis II, 2350 m, collected IV–V.1996, P. Hanson leg., UWIM. One female (point mounted), COSTA RICA, Cartago, 4 km NE Cañón Génesis II, 2350 m, collected V.1995, P. Hanson leg., UWIM. One male (point mounted), COSTA RICA, Cartago, 4 km NE Cañón Génesis II, 2350 m, collected VII.1995, P. Hanson leg., UWIM. Three females, four males (point mounted), COSTA RICA, Cartago, Dulce Nombre, Viveiro Linda Vista, 1300 m, collected VIII–X.1993, P. Hanson leg., UWIM. Two males (point mounted), COSTA RICA, Cartago, Dulce Nombre, Viveiro Linda Vista, 1400 m, collected VI–VIII.1993, P. Hanson leg., UWIM. One female, one male (point mounted), COSTA RICA, Cartago, La Cangreja, 1950 m, collected XII.1991, P. Hanson leg., UWIM. One male (point mounted), COSTA RICA, Guanacaste, Tierras

Morenas, 700 m, collected III.1993, G. Rodríguez leg., UWIM. Three females (point mounted), COSTA RICA, Puntarenas, San Vito, Estac. Biol. Las Alturas, 1500 m, collected II.1992, P. Hanson leg., UWIM. One female (point mounted), COSTA RICA, Puntarenas, San Vito, Estac. Biol. Las Alturas, 1700 m, collected II–IV.1993, P. Hanson leg., UWIM. One female, one male (point mounted), COSTA RICA, Puntarenas, San Vito, Estac. Biol. Las Alturas, 1500 m, collected III.1992, P. Hanson leg., UWIM. Four females (point mounted), COSTA RICA, San Jose, 26 km N San Isidro just S of Division, 2100 m, collected II–IV.1993, P. Hanson leg., UWIM. Three females (point mounted), COSTA RICA, San José, 26 km N San Isidro just S of Division, 2100 m, collected IV–V.1993, P. Hanson leg., Malaise, UWIM. Four females (point mounted), COSTA RICA, San José, 26 km N San Isidro just S of Division, 2100 m, collected VI–VIII.1992, P. Hanson leg., Malaise, UWIM. Two females, one male (point mounted), COSTA RICA, San José, Cerro de la Muerte, 26 km N San isidro, 2100 m, collected II–V.1992, P. Hanson leg., UWIM. One female (point mounted), COSTA RICA, San José, Cerro de la Muerte, 26 km N San Isidro, 2100 m, collected II–V.1991, P. Hanson leg., UWIM. Two females (point mounted), COSTA RICA, San José, Zurqui de Moravia, 1600 m, collected III.1992, P. Hanson leg., UWIM. One male (point mounted), COSTA RICA, San Jose, Zurqui de Moravia, 1600 m, collected IV.1992, P. Hanson leg., UWIM. One female (point mounted), COSTA RICA, San José, Zurqui de Moravia, 1600 m, collected V.1992, P. Hanson leg., UWIM.

Distribution. Costa Rica.

Biology. Unknown.

Comments. *Meteorus carolae* and *M. rogerblancoi* might be confused because both share the complete occipital carina, twisted mandibles, notauli shallowly impressed and not distinct, the hind coxa strigate, tarsal claw with a large lobe, first tergite without dorsopes and ventral borders of the first tergite joined along ½ of segment. Despite their close similarity both species appear distant in the key because of the pale color on the antennae tip contrasting with dark on the rest of the structure in *M. rogerblancoi* (antennae uniformly dark in *M. carolae*). The pale color on the antennae tip of *M. rogerblancoi* was not taking into account in the original description by Zitani et al. (1998) probably because it is too small and restricted to the last three or two flagellomeres, but the careful examination of the complete type series allows to know that it is always present in both males and females. Another constant and stable character allowing separation of both species is the hind coxa completely dark brown in *M. carolae* vs. the coxa basally yellow, distally black-dark brown in *M. rogerblancoi*. On the couplet 44 of the key *M. carolae* matches closely to *M. martinezi*. They have in common the same set of features share between *M. carolae* and *M. rogerblancoi*, but *M. carolae* has the coxa dark brown (hind coxa dorsally dark brown, ventrally yellow in *M. martinezi*), antennae with 24–27 flagellomeres (antennae with 31 flagellomeres in *M. martinezi*) and the convergent eyes in frontal view, face maximum width/minimum width = 1.4–1.6 (face maximum width/minimum width = 1.1 in *M. martinezi*).

Etymology. *Meteorus carolae* is named after Mrs. Carol Abram, Scott Shaw's sister. Thank you for teaching me to read, and encouraging my entomological pursuits.

***Meteorus eurysaccavorus* Aguirre, Almeida & Shaw, sp. n.**
http://zoobank.org/C97793CA-C8CF-4806-B744-D248820706AA
Figures 83–90

Diagnosis. Occipital carina complete, ocelli small (ocelli ocular distance 2.7–3 × ocellar diameter), posterior area of temple and gena coriaceous, eyes convergent (face width 1.6 × minimum face width), mandibles untwisted, notauli distinct, lateral lobes of mesoscutum coriaceous, propodeum carinate-rugose, transverse carina on propodeum present, vein 3RSb distinctly curved, marginal cell short, dorsope and laterope present; ventral borders of first tergite widely separated, basal area of T3 coriaceous, ovipositor long (ovipositor 2.4 × longer than first tergite).

Body color. Mostly black except: prothoracic legs brown from trochanter along tarsus; mesothoracic and metathoracic legs with trochanter, trochantellus, femur and tarsus dark brown, tibia light brown; sterna dark brown; wings hyaline.

Body length 3.4 mm.

Head. Antenna with 19 flagellomeres; flagellar length/width ratios as follows: F1 = 5.5, F2 = 3.7, F3 = 3.7, F17 = 1.7, F18 = 1.7, F19 = 2.7; head 1.2 wider than high; occipital carina complete; ocelli ocular distance 3 × ocellar diameter; head height 1.5 × eye height; temples length 0.6 × eyes length in dorsal view; vertex in dorsal view not descending vertically behind the lateral ocelli; posterior area of temple and gena coriaceous; frons puncticulate; eyes convergent, maximum face width 1.6 × minimum face width; face finely rugulose; minimum face width 0.8 × clypeus width; clypeus smooth and polished; malar space length 0.6 × mandible width basally; mandibles untwisted.

Mesosoma. Pronotum in lateral view completely rugose; propleuron mostly smooth except rugulose on the anterior part; notauli distinctive and rugose; mesonotal lobes well defined; lateral lobes of mesoscutum coriaceous; scutellar furrow with one distinctive carina; mesopleuron mostly smooth but rugulose close to tegula; precoxal sulcus long, wide and rugose-costate; metapleuron rugose; propodeum carinate-rugose; transversal carina on propodeum present; median depression on propodeum absent.

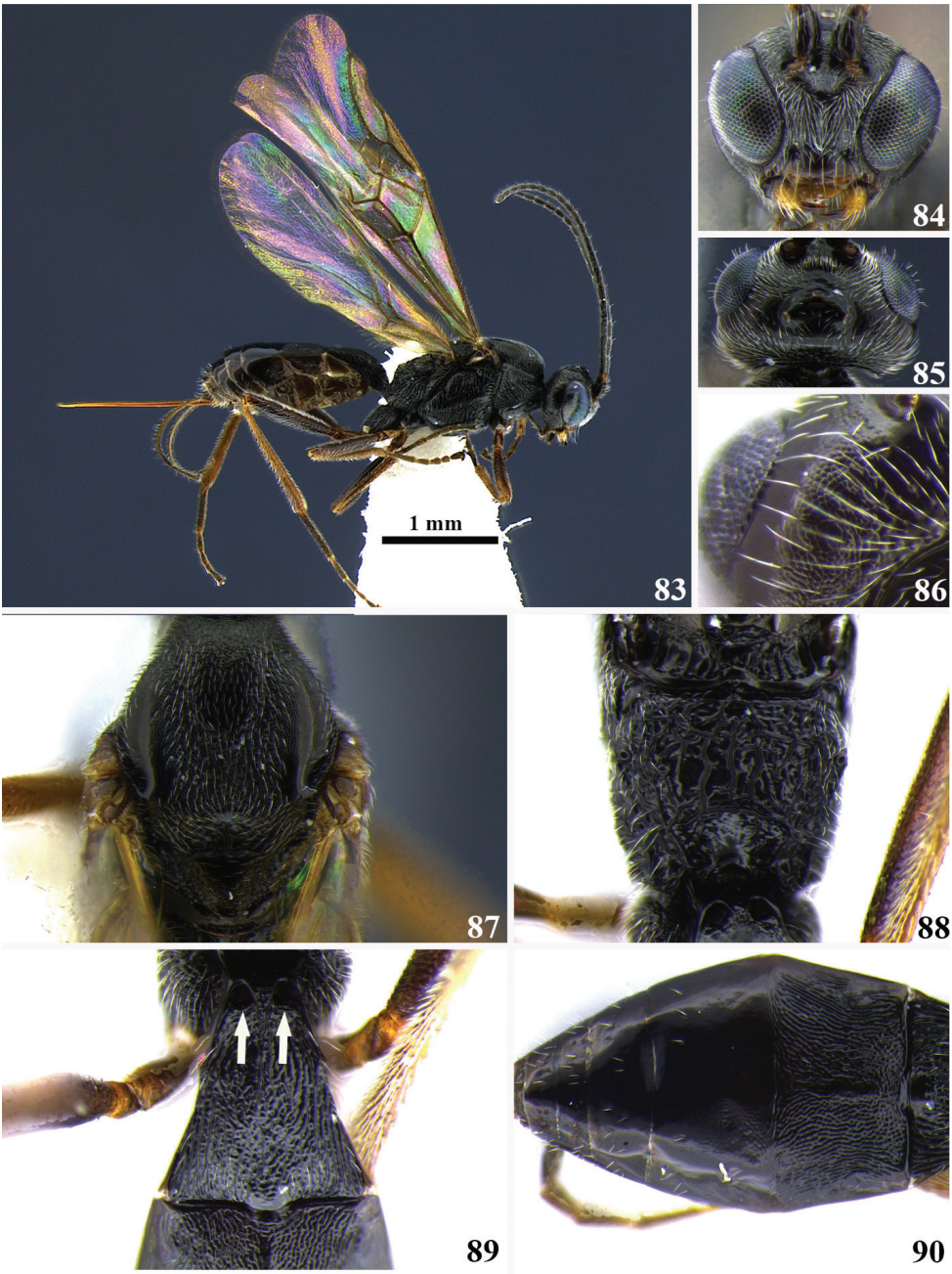
Legs. Hind coxa strigate; tarsal claw simple.

Wings. Wing length 3.2 mm; second submarginal cell of forewing not strongly narrowed anteriorly; vein r 0.6 × length of 3RSa; vein 3RSb distinctly curved; marginal cell short; vein 3RSa 0.7 × length of rm; vein m-cu of forewing antefurcal; vein 1M 1.1 × length of cu-a; vein 1M 0.6 × length of 1r-m.

Metasoma. Dorsope and laterope present; ventral borders of first tergite widely separated; first tergite costate-rugulose; T2 coriaceous-costate, costae divergent; basal area of T3 coriaceous; ovipositor long and straight, ovipositor 2.4 × longer than first tergite.

Cocoon. Unknown.

Female variation. Body length 3.3–3.5 mm; antenna with 19–20 flagellomeres; ocelli ocular distance 2.7–3 × ocellar diameter; temples length 0.6–0.7 × eyes length in dorsal view; frons finely rugulose or puncticulate; minimum face width 0.7–0.8 × clypeus width; malar space length 0.5–0.6 × mandible width basally; scutellar furrow with four clearly distinctive carinae; precoxal sulcus rugose-costate or rugose-colliculate;



Figures 83–90. *Meteorus eurysaccavorus* sp. n. female. **83** Habitus in lateral view **84** head in frontal view **85** head in dorsal view **86** temple in posterior view **87** mesonotum in dorsal view **88** propodeum in dorsal view **89** first tergite in dorsal view, the arrows indicate the dorsopes' location **90** metasoma, excluding the first tergite, in dorsal view.

wing length 3.2–3.4 mm; vein r 0.6–0.9 × length of 3RSa; vein 3RSa 0.7–0.8 × length of rm; vein 1M 0.9–1.1 × length of cu-a; vein 1M 0.6–0.8 × length of 1r-m; first tergite costate-rugulose, or entirely rugulose; ovipositor 2.1–2.4 × longer than first tergite.

Male variation. Body length 3.4–3.5 mm; antenna with 23–24 flagellomeres; head height 1.6–1.7 × eye height; temple length 0.8–0.9 × eye length in dorsal view; maximum face width 1.2–1.3 × minimum face width; minimum face width 0.8–1 × clypeus width; malar space length 0.6–0.8 × mandible width basally; propleuron smooth and polished; scutellar furrow with six clearly distinctive carinae; wing length 3 mm; vein r 0.6 × length of 3RSa; vein 3RSa 0.8–0.9 × length of rm; vein 1M 1.1–1.3 × length of cu-a; vein 1M 0.6–0.7 × length of 1r-m; first tergite rugose.

Type locality. BOLIVIA, La Paz, Patacayama Research Station.

Type specimen. Holotype female (point mounted). Original label: BOLIVIA, La Paz, Patacayama Research Station, collected II–III.1995. Reared from larvae of *Eurysacca melanocampta* Meyrick, UWIM.

Paratypes. Two females and two males (point mounted), same data as the holotype, UWIM.

Distribution. BOLIVIA, La Paz, Patacayama Research Station.

Biology. Parasitoid of *E. melanocampta* (Gelechiidae).

Comments. *Meteorus eurysaccavorus* is the only Neotropical *Meteorus* species with a combination of coriaceous sculpture on temple, gena, mesonotum and T2, presence of dorsopes on the first metasomal tergite, and the vein 3RSb of the frontal wing distinctly curved (such a vein is entirely straight in the rest of species). When *M. eurysaccavorus* is compared with the previously known Neotropical *Meteorus*, the morphologically most-similar species is *M. muiscai*, since both of them share a complete occipital carina, simple tarsal claw, metapleuron rugose and presence of dorsopes. However, *M. muiscai* is completely smooth and shiny on the body surfaces on which *M. eurysaccavorus* displays coriaceous sculpture, and the legs of *M. eurysaccavorus* are dark brown to black, in contrast to yellow in *M. muiscai*.

Etymology. The specific epithet is composed by the stem *eurysacca* after the host genus name, and the suffix "vorus" derived from the latin "vor" that means voracious, referring to the feeding habit of the wasp larva on this gelechiid caterpillar.

Meteorus fallacavus Aguirre, Almeida & Shaw, sp. n.

http://zoobank.org/6F771503-FAC3-4E1D-A104-6359390BD2B8
Figures 91–97

Diagnosis. Occipital carina complete, mandibles twisted, notauli deeply impressed, distinctive and rugose-foveate, first tergite laterally flattened, hind coxa strigate-rugulose; tarsal claw with a large lobe, a couple of cavities (false dorsopes) on the first tergite between the basal extreme and the spiracles, first tergite laterally flattened; ventral borders of first tergite touching distally for a short distance, ovipositor 2.0–2.2 × longer than first tergite.

Body color. Antenna dark brown; annulus absent; face, clypeus and gena yellow; frons, temple and vertex orange; area between ocelli and occiput black. Anterior half of propleuron brown, posterior half yellow; pronotum yellow; mesonotal lobes and scutellum brown, notauli and area among lobes black; mesopleuron brown except dorsal and anterior borders black; metanotum totally black; metapleuron brown except ventral border black; propodeum black. Pro and mesothoracic legs yellow except tarsus brown; metathoracic legs yellow except tibia apically and tarsus dark brown. T1 black, T2 yellow, remaining terga brown; sterna light brown. Wing membrane hyaline, stigma brown.

Body length. 3.9 mm.

Head. Antenna with 27 flagellomeres; flagellar length/width ratios as follows: F1 = 4.1, F2 = 3.5, F3 = 3, F25 = 1.7, F26 = 1.7, F27 = 2.7; head 1.2 wider than high; occipital carina complete; ocellus-ocullar distance 1.2 × ocellar diameter; head height 1.4 × eye height; temple length 0.4 × eye length in dorsal view; vertex in dorsal view not descending vertically behind the lateral ocelli; frons smooth and polished; face maximum width 1.3 × minimum width; face punctate; face minimum width equal to clypeus width; clypeus rugulose; malar space length 0.5 × mandible width basally; mandibles twisted.

Mesosoma. Pronotum in lateral view coarsely rugulose; propleuron slightly puncticulate; notauli deeply impressed, distinctive and rugose-foveate; mesonotal lobes well defined; central lobe of mesoscutum punctate; scutellar furrow with three carinae; mesopleuron mostly puncticulate, rugose close to the tegula; precoxal sulcus long, narrow and rugose-foveate; metapleuron mostly smooth, rugose close to the coxa; propodeum rugose and devoid of both carinae and a median depression.

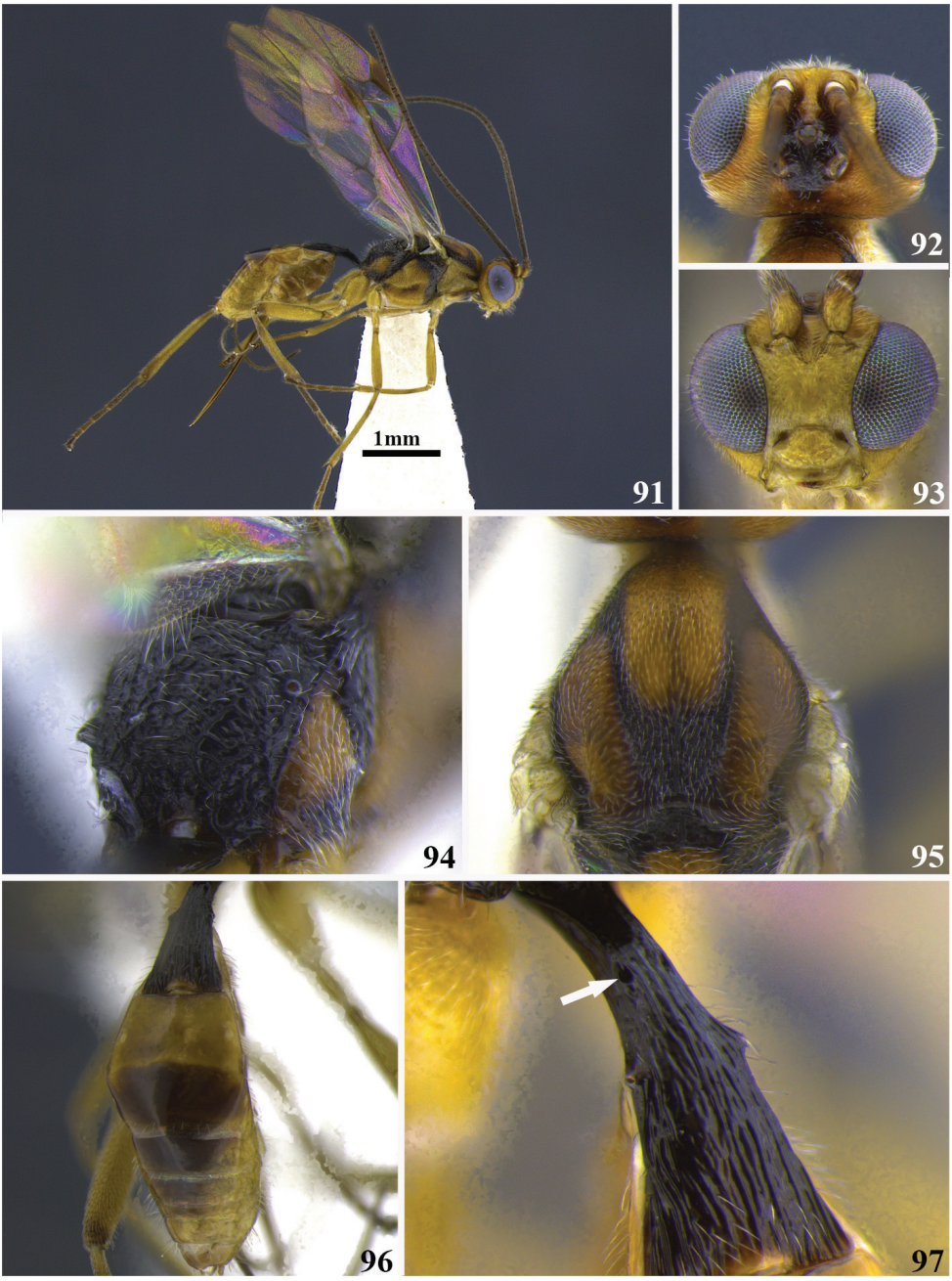
Legs. Hind coxa strigate-rugulose; tarsal claw with a large lobe.

Wings. Wing length 3.4 mm; second submarginal cell of forewing not strongly narrowed anteriorly. Front wing: length of vein r 0.4 × length of vein 3RSa; vein 3RSb straight; vein m-cu of forewing intersticial. Hind wing: length of vein 1M 1.2 × length of vein cu-a; length of vein 1M equal to length of vein r-m.

Metasoma. Dorsope present, very small (actually it is a false dorsope, see explanation on comments below); first tergite laterally flattened; ventral borders of first tergite touching distally for a short distance; first tergite with costae parallel faintly demarcated; ovipositor thickened basally and straight; ovipositor 2.2 × longer than first tergite.

Cocoon. Unknown.

Female variation. Propleuron yellow except lateral and anterior borders brown; median mesonotal lobe and scutellum testaceous, lateral mesonotal lobes dark brown, notauli and area between mesonotal lobes black; mesopleuron orange except dorsal and anterior borders black; metapleuron orange except ventral border black; prothoracic legs completely yellow; mesothoracic legs with coxa, trochanter and trochantellus white, remaining dark brown; antenna with 26 flagellomeres; ocellus-ocullar distance 1.1–1.4 × ocellar diameter; head height 1.5 × eye height; metapleuron rugulose; ovipositor 2.0–2.2 × longer than first tergite.



Figures 91–97. *Meteorus fallacavus* sp. n. female. **91** Habitus in lateral view **92** head in dorsal view **93** head in frontal view **94** propodeum in dorso-lateral view **95** mesoscutum in dorsal view **96** metasoma in dorsal view **97** first tergite in dorso-lateral view, the arrow indicates the position of the "false" dorsope.

Male variation. Unknown.

Type locality. COSTA RICA, Puntarenas, San Vito, Estación Biológica Las Alturas, 1500 m.

Type specimen. Holotype female (point mounted). COSTA RICA, Puntarenas, San Vito, Estación Biológica Las Alturas, 1500 m, collected XII.1991, Paul Hanson leg., UWIM.

Paratypes. One female (point mounted), COSTA RICA, Puntarenas, San Vito, Estación Biológica Las Alturas, 1500 m, collected I.1992, Paul Hanson leg., UWIM. One female (point mounted), COSTA RICA, Cartago, 4 Km NE cañón Génesis II, 2350 m, collected IX.1996, P. Hanson leg., UWIM.

Distribution. Costa Rica, at the provinces of Cartago and Puntarenas.

Biology. Unknown.

Comments. *Meteorus fallacavus* displays a distinctive pair of holes on the first metasomal tergite, ahead of the spiracles. In a strict sense these are not dorsopes because the presence of dorsopes always is correlated with ventral borders of the first tergite widely separated as remarked by Muesebeck (1923), Nixon (1941), Huddleston (1980) and corroborated in the Neotropical fauna (Aguirre et al. 2011). *Meteorus fallacavus* has the ventral borders of the first tergite basally separated but distally touching by a short distance, feature allowing separate it from *M. magdalensis*, its most similar congeneric species, which displays a true pair of dorsopes together with ventral borders of the first tergite widely separated. Both species have the notauli deeply impressed and distinct, as well as the first metasomal tergite unicolored, but *M. magdalensis* is mostly black while *M. fallacavus* is mostly yellow with black areas dorsally. Moreover, *M. fallacavus* might be distinguished by having twisted mandibles (untwisted in *M. magdalensis*), tarsal claw with a large lobe (tarsal claw simple in *M. magdalensis*) and the vertex in lateral view flattened (vertex convex in lateral view in *M. magdalensis*).

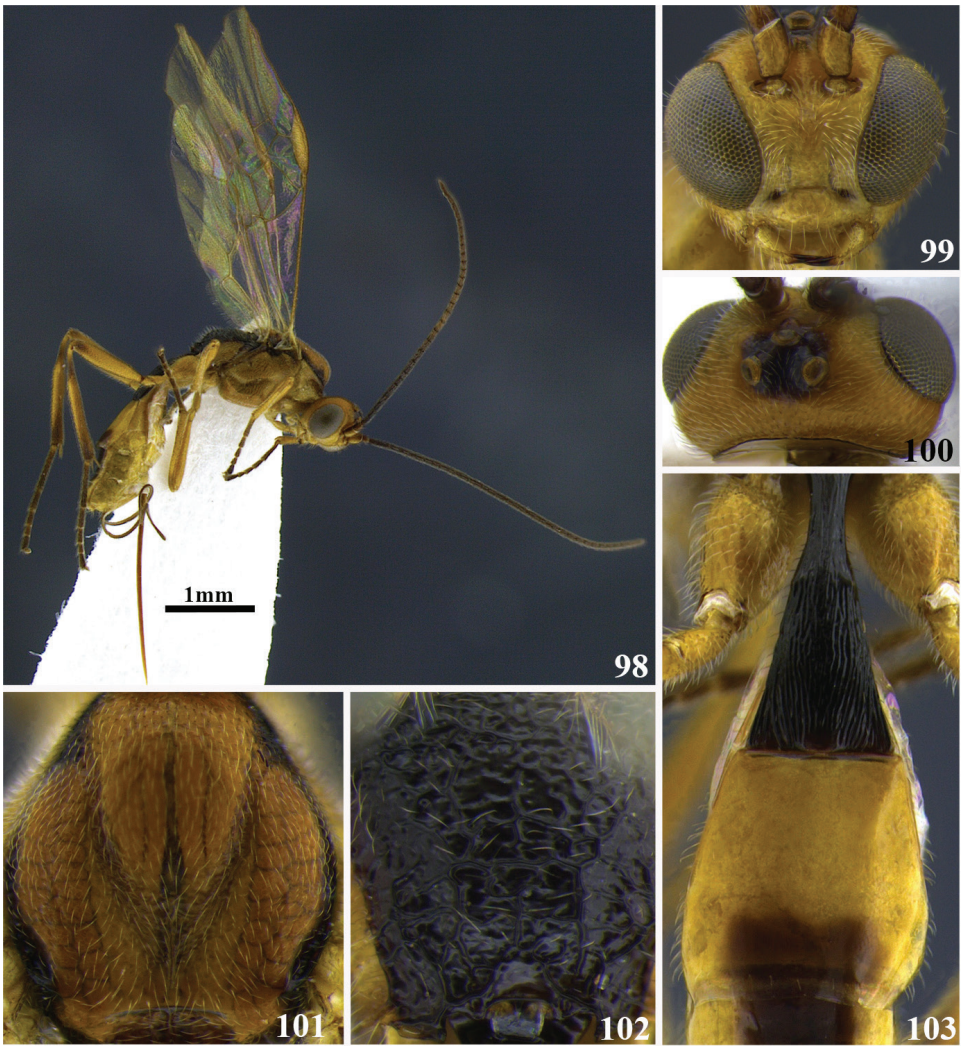
Etymology. The specific epithet is composed by the latin prefix "falla" which means false and "cavus" meaning cavity, since the pseudodorsope is the most distinctive feature for this species.

Meteorus flavistigma Aguirre, Almeida & Shaw, sp. n.

http://zoobank.org/894CEC06-624C-4F74-9A3E-B2E0D09DFA2D

Figures 98–103

Diagnosis. Occipital carina complete; ocelli small, ocellus-ocullar distance 1.4–1.8 × ocellar diameter; mandibles moderately twisted; notauli deeply impressed, distinctive and foveolate; propodeum aerolate-rugose; hind coxa punctate and polished; tarsal claw with large lobe; dorsope absent; T1 laterally flattened; ventral borders of first tergite separated basally and joined apically along almost ½ of segment; ovipositor 2.5 × longer than first tergite; stigma yellow.



Figures 98–103. *Meteorus flavistigma* sp. n. female. **98** Habitus lateral view **99** head in frontal view **100** head in dorsal view **101** mesoscutum in dorsal view **102** propodeum in posterior view **103** metasoma in dorsal view.

Body color. Antenna dark brown, annulus absent; head orange except area between ocelli black. Propleuron orange; pronotum either testaceous or yellow; mesonotum orange, bordered by a black strip; mesopleuron orange-testaceous; metanotum black dorsally, orange and black laterally; metapleuron either testaceous or yellow; propodeum black. Prothoracic legs testaceous; mesothoracic legs testaceous; metathoracic legs testaceous except coxa apically, tibia and tarsus dark brown. T1 black; T2–T7 with a large dorso-medial dark brown oval-shaped area surrounded by yellow; sterna yellow. Wing membrane hyaline; stigma yellow.

Body length. 4 mm.

Head. Antenna with 26 flagellomeres; flagellar length/width ratios as follows: F1 = 3.7, F2 = 4, F3 = 3.1, F24 = 1.7. F25 = 1.5. F26 = 2.3; head 1.2 wider than high; occipital carina complete; ocellus-ocullar distance 1.4 × ocellar diameter; head height 1.8 × eye height; temple length 0.5 × eye length in dorsal view; vertex in dorsal view not descending vertically behind the lateral ocelli; frons surface irregular; face maximum width 1.3 × minimum width; face punctuate; face minimum width 0.8 × clypeus width; clypeus smooth with dispersed punctures; malar space length 0.5 × mandible width basally; mandibles moderately twisted.

Mesosoma. Pronotum in lateral view carinated; propleuron puncticulate and shiny; notauli deeply impressed, distinctive and foveolate; mesonotal lobes well defined; central lobe of mesoscutum punctuate; scutellar furrow with three carinae; mesopleuron punctate; precoxal sulcus short, narrow and foveate; metapleuron surface irregular and polished except either rugose or finely rugulose close to the coxa; propodeum aerolate-rugose, without a median depression, transversal or longitudinal carinae.

Legs. Hind coxa punctate and polished; tarsal claw with large lobe.

Wings. Wing length 3.6 mm; second submarginal cell of forewing not strongly narrowed anteriorly. Front wing: length of vein r 0.8 × length of vein 3RSa; vein 3RSb straight; length of vein 3RSa equal to length of vein r-m; vein m-cu antefurcal. Hind wing: length of vein 1M 1.2 × length of vein cu-a; length of vein 1M equal to length of vein r-m.

Metasoma. Dorsope absent; T1 laterally flattened; ventral borders of first tergite separated basally and joined apically along almost ½ of segment; first tergite with costae almost parallel; ovipositor thickened basally and straight; ovipositor 2.5 × longer than first tergite; T2–T7 smooth.

Cocoon. Unknown.

Female variation. T2 yellow, T3 brown, T4–T6 brown medially and yellow laterally, T7–T8 yellow; body length 4.2 mm; ocellus-ocullar distance 1.8 × ocellar diameter; head height 1.5 × eye height; temple length 0.4 × eye length in dorsal view; frons smooth and polished; face maximum width 1.5 × minimum width; malar space length 0.6 × mandible width basally; pronotum in lateral view foveate, rugose or rugose-carinate, notauli rugose-foveate, scutellar furrow with four carinae; metapleuron dorsally punctate and ventrally foveate; wing length 3.7 mm; first tergite with costae convergent posteriorly.

Male variation. Both lateral mesonotal lobes and the median one apically black, yellow the rest; mesopleuron either yellow except area close to the tegula dark brown or orange on the middle, black dorsally and ventrally; pro and mesothoracic legs yellow except tarsus brown; metathoracic legs yellow except tibia brown, femur apically and tarsus dark brown; T2 basally yellow-orange, remaining dark brown; body length 3.8 mm; antenna with 32 flagellomeres; ocellus-ocullar distance equal to ocellar diameter; wing length 3.4 mm; front wing: length of vein r 0.6 × length of vein 3RSa; first tergite costate-reticulate.

Type locality. COSTA RICA, San José, Cerro de la Muerte, 19 Km South, 3 Km West, Empalme, 2600 m.

Type specimen. Holotype female (point mounted), COSTA RICA, San José, Cerro de la Muerte, 19 Km South, 3 Km West, Empalme, 2600 m, collected XII.1992, P. Hanson leg., UWIM.

Paratypes. Three females and one male (point mounted), COSTA RICA, Heredia, Estación Barva, Parque Natural Braulio Carillo, 2500 m, collected V.1990, A. Fernández leg., UWIM. One male (point mounted), COSTA RICA, Heredia, Estación Barva, Parque Natural Braulio Carillo, 2500 m, collected VI.1990, B. Apu and G. Varela leg., UWIM. One male (point mounted), COSTA RICA, Puntarenas, San Vito, Estación Biológica Las Alturas, 1500 m, collected II.1992, P. Hanson leg., UWIM.

Distribution. Costa Rica, at the provinces of San Jose, Heredia, and Puntarenas.

Biology. Unknown.

Comments. *Meteorus flavistigma* shares with *M. boyacensis* the mandibles moderately twisted and ventral borders of the first tergite basally separated and joined along the rest of the segment. *Meteorus flavistigma* might be distinguished from *M. boyacensis* by the tarsal claw with a large lobe (tarsal claw simple in *M. boyacensis*), and body mostly yellow except mesosoma and metasoma with dark areas (completely black-dark brown in *M. boyacensis*).

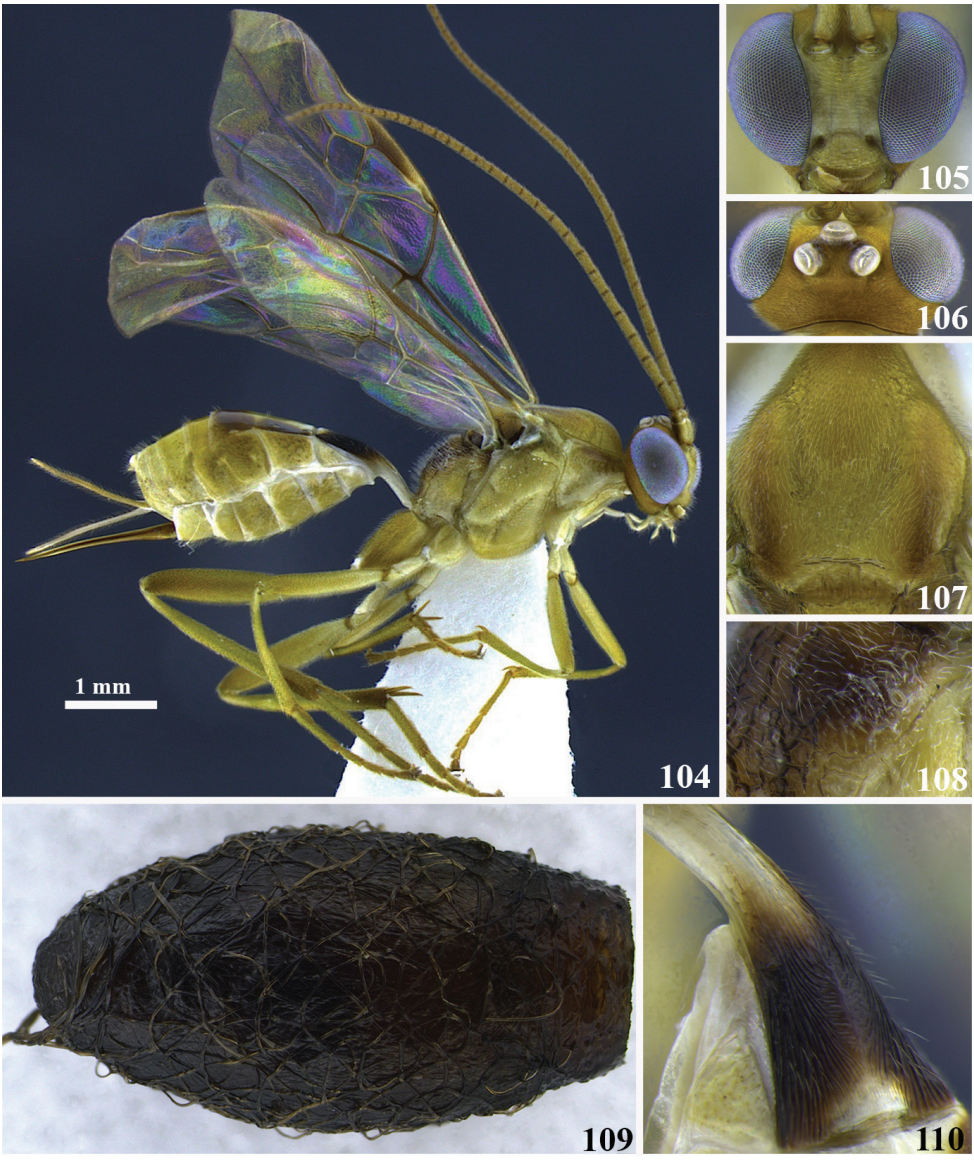
Etymology. This species is so-named because of the yellow stigma on the front wing: "flavis" is the Latin prefix meaning yellow.

***Meteorus haimowitzi* Aguirre, Almeida & Shaw, sp. n.**
http://zoobank.org/9EE42698-A0C2-4796-99D5-C8B40BF6EFC4
Figures 104–110

Diagnosis. Occipital carina complete; large ocelli, ocellus-ocullar distance 0.3 × ocellar diameter; large ayes, head height 1.3 × eye height; malar space very short, malar space length 0.1 × mandible width basally; mandibles twisted; notauli shallow, not distinctive and rugose; hind coxa strigate; tarsal claw with large lobe; dorsope absent; ventral borders of first tergite joined completely along ½ of segment; mesopleuron completely yellow; metanotum dorsally brown, yellow laterally.

Body color. Antenna, face and clypeus yellow; annulus absent; remaining head orange. Propleuron, pronotum, mesopleuron and metapleuron yellow; mesonotum yellow except a couple of faint light brown patches on each lateral mesonotal lobe; metanotum dorsally brown, yellow laterally; propodeum light brown. Pro and metathoracic legs yellow; mesothoracic coxa, trochanter and trochantellus white, remaining leg dark brown. T1 having the basal half and a narrow patch along the distal border yellow, medially black; a median white-yellow broad hourglass-shaped pattern on T2, T3 brown, T4–T8 yellow; sterna yellow. Wing membrane hyaline; stigma brown.

Body length. 5.7 mm.



Figures 104–110. *Meteorus haimowitzi* sp. n. female. **104** Habitus in lateral view **105** head in frontal view **106** head in dorsal view **107** mesoscutum in dorsal view **108** propodeum in postero-lateral view **109** cocoon **110** first tergite in dorso-lateral view.

Head. Antenna with 31 flagellomeres; flagellar length/width ratios as follows: F1 = 3.6, F2 = 3.3, F3 = 2.8, F29 = 2, F30 = 1.7, F31 = 3.3; head 1.2 wider than high; occipital carina complete; ocellus-ocullar distance 0.3 × ocellar diameter; head height 1.3 × eye height; temple length 0.6 × eye length in dorsal view; vertex in dorsal view descending vertically behind the lateral ocelli; frons smooth and polished; face maximum width 1.4

× minimum width; face strigulate; face minimum width 0.8 × clypeus width; clypeus strigulate; malar space length 0.1 × mandible width basally; mandibles twisted.

Mesosoma. Pronotum in lateral view carinate-rugose; propleuron rugulose-costate, with costae divergent posteriorly; notauli shallow, not distinctive and rugose; mesonotal lobes not well defined; central lobe of mesoscutum punctate; scutellar furrow with three carinae; mesopleuron punctate; precoxal sulcus long, narrow and carinate-rugose; most metapleuron surface smooth and polished except irregular to rugose close to the hind coxa; propodeum rugose and devoid of both longitudinal and transversal carinae, median depression absent.

Legs. Hind coxa strigate; tarsal claw with large lobe.

Wings. Wing length 5.3 mm; second submarginal cell of forewing not strongly narrowed anteriorly. Front wing: length of vein r 0.3 × length of vein 3RSa; vein 3RSb straight; length of vein 3RSa 1.2 × length of vein r-m; vein m-cu antefurcal. Hind wing: length of vein 1M 0.9 × length of vein cu-a; length of vein 1M 0.8 × length of vein r-m.

Metasoma. Dorsope absent; ventral borders of first tergite joined completely along ½ of segment; first tergite with costae convergent posteriorly; ovipositor thickened basally and straight; ovipositor 1.4 × longer than first tergite.

Cocoon. Length 6.6 mm; width 2.8 mm; black-dark brown, loosely wrapped by its silk; the edge of the emergence hole is rough, the cap is missing. The thread is approximately 36 mm long.

Female variation. Unknown.

Male variation. Unknown.

Type locality. COSTA RICA, Heredia, Vara Blanca, 2000 m.

Type specimen. Holotype female (point mounted), COSTA RICA, Heredia, Vara Blanca, 2000 m, collected IV.27.2002, Kenji Nishida leg., UWIM.

Paratype. Unknown.

Distribution. Costa Rica, Province of Heredia.

Biology. Solitary parasitoid reared from its cocoon.

Comments. *Meteorus haimowitzi* and *M. imaginatus* Jones share more morphological features between them than with any other species in the genus; the most relevant are: big eyes, head height 1.3 × or less eye height, occipital carina complete, mandibles completely twisted, notauli shallow and not distinct, tarsal claw with a large lobe, first metasomal tergite without dorsopes and ventral borders of first tergite completely joined along ½ of segment. *Meteorus hamowitzi* differs from *M. imaginatus* by the metanotum dorsally black-dark brown and laterally yellow (metanotum completely black-dark brown in *M. imaginatus*), hind legs yellow (hind legs dark brown in *M. imaginatus*) and mesonotal lateral lobes mostly yellow (mesonotal lateral lobes dark brown in *M. imaginatus*). Interestingly another conspicuous character to distinguish both species is in the cocoon, which is ornamented with a crown-like silk arrangement nearby the opening apex in *M. imaginatus*, but this is absent in *M. haimowitzi* (see Jones and Shaw 2012, p. 10, fig. 21).

Etymology. This species is named after our entomologist colleague and parasitoid-lover Larry Haimowitz.

***Meteorus magnoculus* Aguirre, Almeida & Shaw, sp. n.**
http://zoobank.org/734B83C5-1DCD-4CAC-ABB6-817BD179B3AA
Figures 111–120

Diagnosis. Occipital carina complete; large ocelli, ocellus-ocullar distance 0.5–0.6 × ocellar diameter; huge eyes, head height 1.2–1.4 × eye height; mandibles twisted; notauli deeply impressed, distinctive and rugose; propodeum aerolate-rugose; dorsope absent; ventral borders of first tergite joined completely along ½ of segment; ovipositor basally thickened and slightly curved; ovipositor 2.4–3 × longer than first tergite; mesosoma ferruginous, head mostly dark, metasoma and legs white and black.

Body color. Antenna dark brown; annulus absent; head black except a small brown patch between each lateral ocelli and its closest compound eye; clypeus yellow; mesosoma mostly ferruginous except propleuron anterior 2/3 black, posterior 1/3 and interior borders yellow; pronotum ferruginous on the upper half, then gradually becomes yellow toward the lower border. Prothoracic coxa, trochanter and trochantellus yellow, remaining leg orange; mesothoracic legs brown except coxa, trochanter, trochantellus, both femur and tibia basally, and most of tarsus yellow. Metathoracic coxa basally orange-ferruginous, distally black; metathoracic trochanter, tibia basally and tarsus white-yellow; remaining hind leg black. Basal half and a narrow patch along the distal border of T1 yellow, T1 medially black; T2 on the basal border and T7 throughout white-yellow, remaining T2 and T3–T5 black, T6 and T8 brown; sterna yellow white, with brown patches on the sterna 5–7. Wings hyaline; stigma dark brown.

Body length. 6.6 mm.

Head. Antenna with 33 flagellomeres; flagellar length/width ratios as follows: F1 = 4.2, F2 = 4, F3 = 3.3, F31 = 2.2, F32 = 2, F33 = 3; head 1.2 wider than high; occipital carina complete; ocellus-ocullar distance 0.6 × ocellar diameter; huge eyes, head height 1.2 × eye height; temple length 0.3 × eye length in dorsal view; vertex in dorsal view not descending vertically behind the lateral ocelli; frons smooth and polished; face maximum width 1.5 × minimum width; face puncticulate; face minimum width 0.7 × clypeus width; clypeus punctate; malar space length 0.1 × mandible width basally; mandibles twisted.

Mesosoma. Pronotum in lateral view carinate and rugose; propleuron coarsely rugose; notauli deeply impressed, distinctive and rugose; mesonotal lobes well defined; central lobe of mesoscutum punctulate; scutellar furrow with three carinae; mesopleuron punctate; precoxal sulcus long, narrow and aerolate-rugose; metapleuron rugose; propodeum aerolate-rugose, longitudinal and transversal carinae absent, median depression weakly impressed.

Legs. Hind coxa strigate and punctate; tarsal claw with a large lobe.

Wings. Wing length 4.9 mm; second submarginal cell of forewing not strongly narrowed anteriorly. Front wing: length of vein r 0.5 × length of vein 3RSa; vein 3RSb straight; length of vein 3RSa 0.9 × length of vein r-m; vein m-cu antefurcal. Hind wing: length of vein 1M 1.2 × length of vein cu-a; length of vein 1M 1.1 × length of vein r-m.

Figures 111–117. *Meteorus magnoculus* sp. n. female. **111** Habitus in lateral view **112** head in dorsal view **113** head in frontal view **114** propodeum in dorso-lateral view **115** mesoscutum in dorsal view **116** metasoma in dorso-lateral view **117** first tergite in dorso-lateral view.

Metasoma. Dorsope absent; ventral borders of first tergite joined completely along ½ of segment; first tergite with faintly demarcate and parallel costae; ovipositor basally thickened and slightly curved; ovipositor 2.9 × longer than first tergite.

Cocoon. Unknown.

Female variation. Body length 6 mm; antenna with 35–36 flagellomeres; ocellus-ocullar distance 0.5 × ocellar diameter; head height 1.3–1.4 × eye height; temple length 0.4 × eye length in dorsal view; face maximum width 1.4 × minimum width; face minimum width 0.8–0.9 × clypeus width; malar space length 0.2 × mandible width basally; wing length 4.8 mm. Front wing: length of vein r 0.4 × length of vein 3RSa; length of vein 3RSa 1.2 × length of vein r-m. Hind wing: length of vein 1M 1.1–1.3 × length of vein cu-a; length of vein 1M 1–1.4 × length of vein r-m; ovipositor 2.4–3 × longer than first tergite.

Male variation. T2 with a yellow cup-shape area basally, remaining black; sterna 2–3 yellow-cream, sterna 4–8 brown; wings hyaline; body length 5.2 mm; antenna with 32 flagellomeres; head 1.1 wider than high; ocellus-ocullar distance equal to ocellar diameter; head height 1.4 × eye height; temple length 0.5 × eye length in dorsal view; frons strigulate; face maximum width 1.1 × minimum width; face strigate-punctate; face minimum width 0.9 × clypeus width; malar space length 0.4 × mandible width basally; wing length 4.1 mm; length of vein 3RSa equal to length of vein r-m; vein m-cu of forewing intersticial; length of vein 1M 0.9 × length of vein r-m; first tergite with costae parallel.

Type locality. COSTA RICA, San Jose, San Pedro, Sabanilla.

Type specimen. Holotype female (point mounted), COSTA RICA, San Jose, San Pedro, Sabanilla, collected from a pyralid leaf folder on *Ipomea* [correct spelling *Ipomoea*, A/N] XI.1997, X. Miranda leg., UWIM.

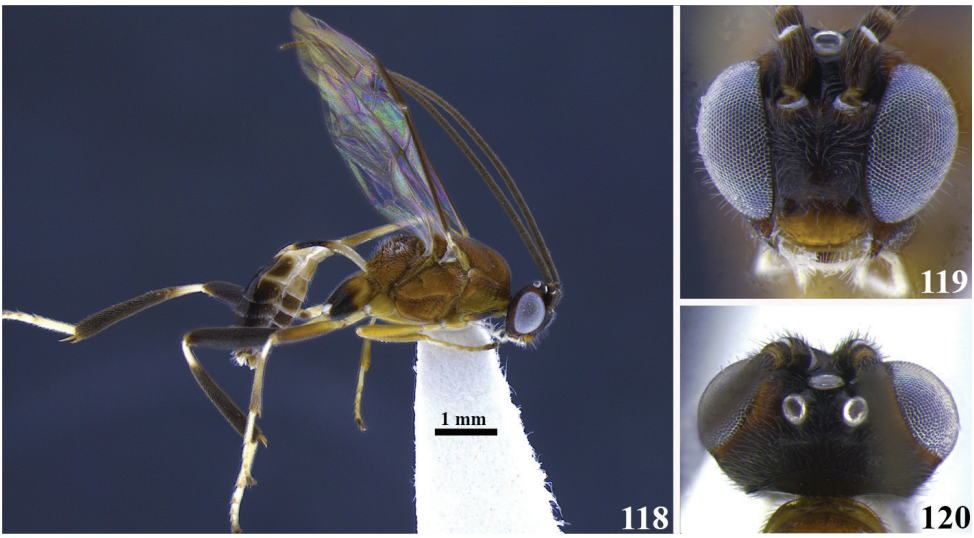
Paratype. One female, one male, same data as holotype, UWIM.

Distribution. Costa Rica, province of San Jose.

Biology. Parasitoid of a leaf folder pyralid (Lepidoptera: Pyralidae) sampled on *Ipomoea* (Convolvulaceae).

Comments. Both the big eyes and large and colorful body make *M. magnoculus* very distinct from the other species of the genus. The most similar one is *M. cecavorum* sharing with *M. magnoculus* the occipital carina complete, mandibles totally twisted, first metasomal tergite without dorsopes and ventral borders of first tergite joined along ½ of segment. But *M. magnoculus* is easy to separate by its bigger eyes (head height/eye height = 1.3–1.4 vs. 1.5–1.6 in *M. cecavorum*), bigger ocelli (ocellus-ocullar distance/ocellar diameter = 0.5–0.6 vs. 1.2–1.6 in *M. cecavorum*) shorter malar space (malar space length/mandible width basally = 0.1 vs. 0.8–1.2 in *M. cecavorum*) and its combination of ferruginous, black and white on the body (mostly black-dark brown in *M. cecavorum*).

Etymology. *Meteorus magnoculus* is, until now, the *Meteorus* species with biggest relative eye size inhabiting the Neotropical Region. The specific epithet is composed by the Latin prefix "magno" meaning large, and the Latin root "oculus" meaning eye.



Figures 118–120. *Meteorus magnoculus* sp. n. male. **118** Habitus lateral view **119** head in frontal view **120** head in dorsal view.

***Meteorus martinezi* Aguirre, Almeida & Shaw, sp. n.**
http://zoobank.org/DFD2471B-3FD0-40F4-848D-D8645FC4F4FF
Figures 121–127

Diagnosis. Occipital carina complete; face parallel in frontal view, face maximum width 1.1 × minimum width; mandibles twisted; notauli shallow, not distinctive and rugose; hind coxa strigate; tarsal claw with large lobe; dorsope absent; ventral borders of first tergite joined completely along ½ of segment; ovipositor 2.3 × longer than first tergite; body mostly dark.

Body color. Antenna brown; annulus absent; face, clypeus and gena yellow-orange; frons, temple and vertex dark brown. Propleuron dark brown except interior and posterior borders yellow; pronotum dorsally dark brown, ventrally yellow; mesonotal lobes black-dark brown, area between them and scutellum orange; mesopleuron dark brown close to the tegula, then gradually turns brown and light brown toward the middle coxa; metanotum dark brown; metapleuron light brown; propodeum dark brown. Prothoracic legs yellow; mesothoracic coxa, trochanter and trochantellus white, remaining leg dark brown; metathoracic coxa dorsally dark brown and ventrally yellow, trochanter, trochantellus and femur basally yellow, remaining leg brown. T1 black except the basal portion white-yellow; T2 basally yellow, remaining tergite surface brown; sterna yellow. Wings hyaline; stigma on front wing brown.

Body length. 4.4 mm.

Head. Antenna with 31 flagellomeres; flagellar length/width ratios as follows: F1 = 3, F2 = 3, F3 = 2.6, F29 = 1.8, F30 = 1.5, F31 = 2; head 1.2 wider than high;

occipital carina complete; ocellus-ocullar distance 1.1 × ocellar diameter; head height 1.5 × eye height; temple length 0.7 × eye length in dorsal view; vertex in dorsal view descending vertically behind the lateral ocelli; frons strigulate; face maximum width 1.1 × minimum width; face strigulate; face minimum width 1.2 × clypeus width; clypeus strigulate; malar space length 0.8 × mandible width basally; mandibles twisted.

Mesosoma. Pronotum in lateral view rugose-foveate-carinate; propleuron mostly smooth except apically rugulose; notauli shallow, not distinctive and rugose with a pronounced longitudinal carina; mesonotal lobes well defined; central lobe of mesoscutum punctate; scutellar furrow with two carinae; mesopleuron mostly puncticulate, rugose close to the tegula; precoxal sulcus rugose-foveate; metapleuron mostly smooth, rugose close to the coxa; propodeum aerolate-carinate-rugose, longitudinal carina present, median depression absent.

Legs. Hind coxa strigate; tarsal claw with large lobe.

Wings. Wing length 4.2 mm; second submarginal cell of forewing not strongly narrowed anteriorly. Front wing: length of vein r 0.7 × length of vein 3RSa; vein 3RSb straight; length of vein 3RSa 0.9 × length of vein r-m; vein m-cu intersticial. Hind wing: length of vein 1M 0.9 × length of vein cu-a; length of vein 1M 0.7 × length of vein r-m.

Metasoma. Dorsope absent; ventral borders of first tergite joined completely along ½ of segment; first tergite with costae parallel; ovipositor thickened basally and straight; ovipositor 2.3 × longer than first tergite.

Cocoon. Unknown.

Female variation. Unknown.

Male variation. Unknown.

Type locality. COSTA RICA, Heredia, Vara Blanca, Finca Georgina, 2100 m.

Type specimen. Holotype female (point mounted), COSTA RICA, Heredia, Vara Blanca, Finca Georgina, 2100 m, collected III–IV.1990, Paul Hanson leg., UWIM.

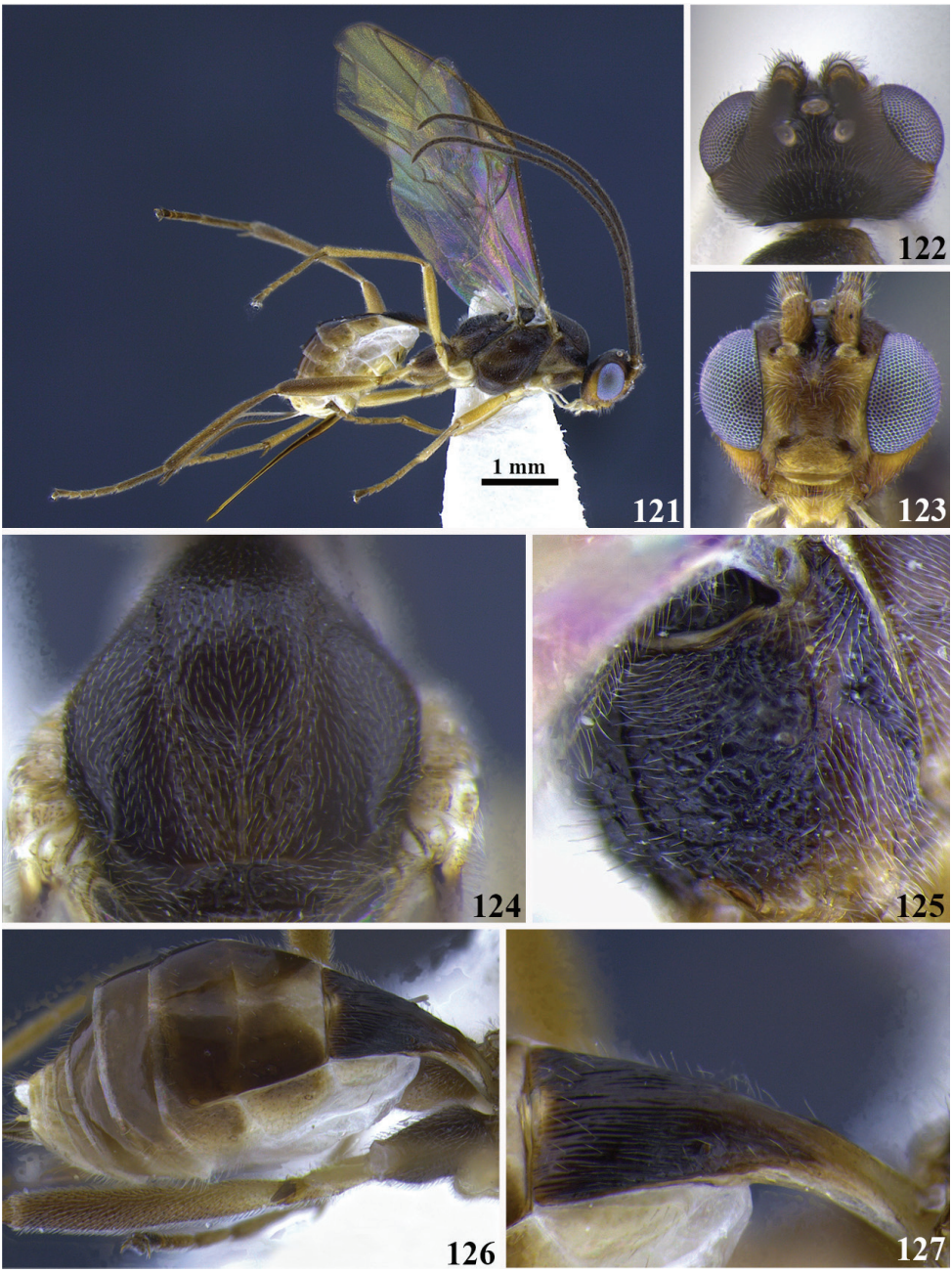
Paratype. Unknown.

Distribution. Costa Rica, province of Heredia.

Biology. Unknown.

Comments. *Meteorus martinezi* is similar to *M. carolae* in having the occipital carina complete, mandibles totally twisted, notauli shallow and not distinct, tarsal claw with a large lobe, first metasomal tergite without dorsopes, ventral borders of first tergite joined along ½ of segment, mesopleuron completely brown-black, first tergite bicolored and propodeum totally black-dark brown. *Meteorus martinezi* can be separated from *M. carolae* by the hind coxa dorsally dark brown and ventrally yellow (hind coxa completely dark brown in *M. carolae*), antenna with 31 flagellomeres (antenna with 24–27 flagellomeres in *M. carolae*) and the parallel eyes in frontal view, face maximum width/minimum width = 1.1 (convergent eyes in *M. carolae*, face maximum width/minimum width = 1.4–1.6).

Etymology. This species is named in honor of Dr. Juan Jose Martinez, Museo Argentino de Ciencias Naturales "Bernardino Rivadavia" curator of insects.



Figures 121–127. *Meteorus martinezi* sp. n. female. **121** Habitus in lateral view **122** head in frontal view **123** head in dorsal view **124** mesoscutum in dorsal view **125** propodeum in dorso-lateral view **126** metasoma in dorso-lateral view **127** first tergite in dorso-lateral view.

***Meteorus microcavus* Aguirre, Almeida & Shaw, sp. n.**
http://zoobank.org/7EDAF984-A3AC-42A4-97B5-18304638ABF3
Figures 128–134

Diagnosis. Occipital carina complete; eyes convergent in frontal view, face maximum width 1.7 × minimum width; mandibles moderately twisted; notauli deeply impressed, distinctive and foveolate; propodeum carinate-rugose, with a transversal carina; hind coxa rugose; tarsal claw with a large lobe; dorsope present, very small; ventral borders of first tergite widely separated; ovipositor thickened basally and slightly curved; ovipositor 3.1 × longer than first tergite.

Body color. Antenna brown; annulus absent; head yellow except area between ocelli dark brown. Anterior half of propleuron dark brown, posterior half light brown; pronotum yellow; median mesonotal lobe and scutellum yellow, lateral mesonotal lobes light brown; mesopleuron laterally yellow, ventrally light brown; metanotum black dorsally, yellow laterally; metapleuron yellow; propodeum black. Prothoracic legs yellow; mesothoracic coxa, trochanter and trochantellus white, remaining leg dark brown; metathoracic legs yellow except tarsus light brown. T1 black; T2–T8 and sterna yellow. Wings hyaline; stigma white.

Body length. 2.8 mm.

Head. Antenna with 22 flagellomeres; head 1.2 wider than high; occipital carina complete; ocellus-ocullar distance 2 × ocellar diameter; head height 1.5 × eye height; temple length 0.5 × eye length in dorsal view; vertex in dorsal view not descending vertically behind the lateral ocelli; frons strigulate; face maximum width 1.7 × minimum width; face puncticulate; face minimum width 0.7 × clypeus width; clypeus smooth and polished; malar space length 0.5 × mandible width basally; mandibles moderately twisted.

Mesosoma. Surface of pronotum in lateral view irregular and shiny; propleuron mostly smooth except anteriorly rugulose; notauli deeply impressed, distinctive and foveolate; mesonotal lobes well defined; central lobe of mesoscutum with irregular punctures and polished; scutellar furrow with one carina; mesopleuron with irregular punctures; precoxal sulcus short, narrow and foveate; metapleuron with irregular punctures; propodeum carinate-rugose, with a transversal carina.

Legs. Hind coxa rugose; tarsal claw with a large lobe.

Wings. Wing length 2.9 mm; second submarginal cell of forewing not strongly narrowed anteriorly. Front wing: length of vein r 0.9 × length of vein 3RSa; vein 3RSb straight; length of vein 3RSa 0.6 × length of vein r-m; vein m-cu antefurcal. Hind wing: length of vein 1M 1.6 × length of vein cu-a; length of vein 1M 1.2 × length of vein r-m.

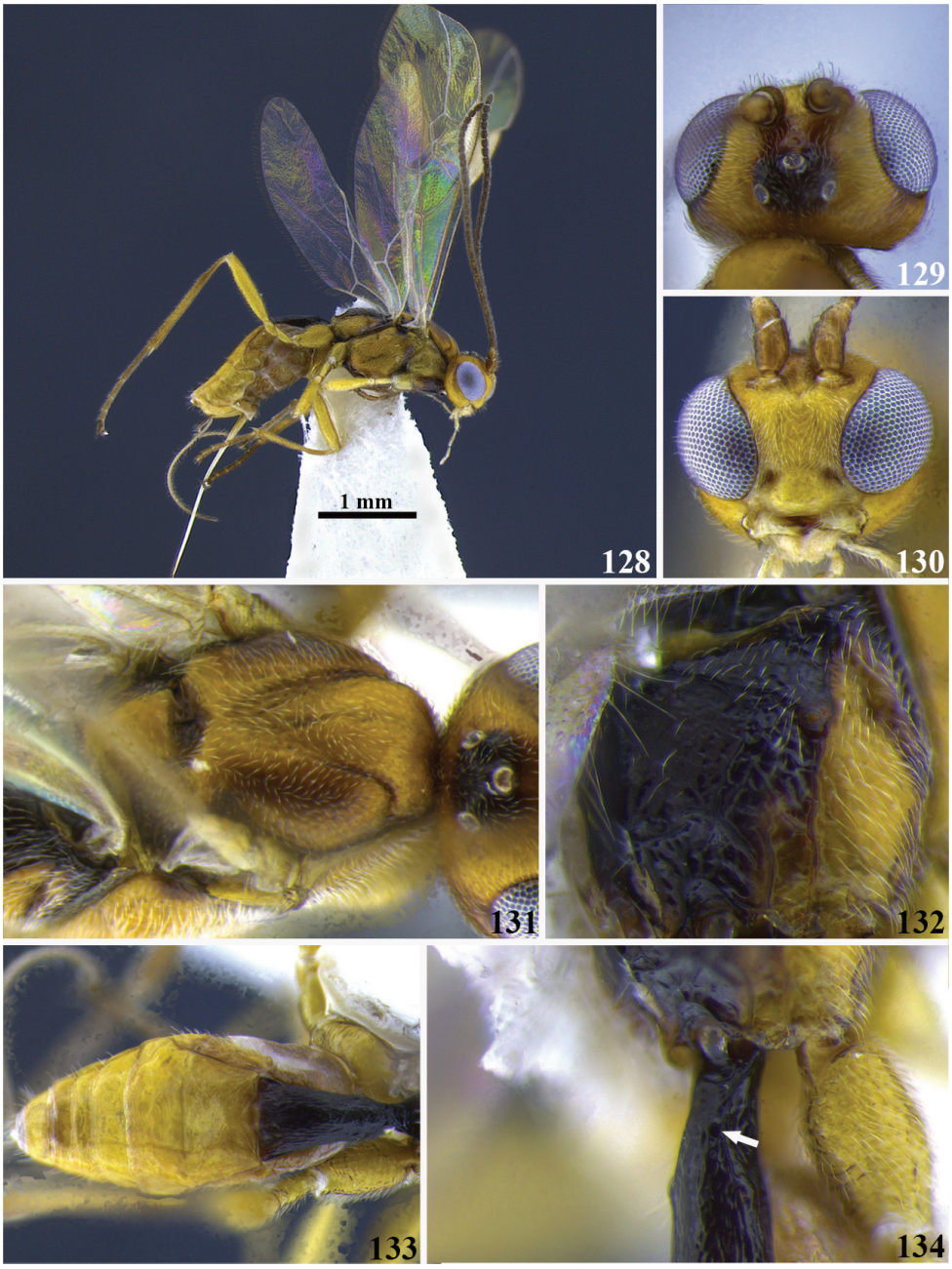
Metasoma. Dorsope present, very small; ventral borders of first tergite widely separated; first tergite costate-rugulose; ovipositor thickened basally and slightly curved; ovipositor 3.1 × longer than first tergite; T2–T3 with irregular and shiny surface.

Cocoon. Unknown.

Female variation. Unknown.

Male variation. Unknown.

Type locality. COSTA RICA, Cartago, Cerro de la Muerte, Villa Mills, 3000 m.



Figures 128–134. *Meteorus microcavus* sp. n. female. **128** Habitus in lateral view **129** head in dorsal view **130** head in frontal view **131** mesonotum in dorso-lateral view **132** propodeum in dorso-lateral view **133** metasoma in dorsal view **134** first tergite basal portion, the arrow shows the position of a small dorsope.

Type specimen. Holotype female (point mounted), COSTA RICA, Cartago, Cerro de la Muerte, Villa Mills, 3000 m, collected XI–XII.1989, P. Hanson leg., UWIM.

Paratype. Unknown.

Distribution. Costa Rica, province of Cartago.

Biology. Unknown.

Comments. Compared with *M. fallacavus*, *M. microcavus* displays a true pair of dorsopes but too small to be detected at a first glance. The ventral borders being widely separated support this interpretation. It is unusual to find such a reduction in these structures, so the conspicuous dorsopes diminution in *M. microcavus* might be enough to identify it. *Meteorus andreae*, a common species distributed across the montane forests of Colombia and Costa Rica, matches with *M. fallacavus* by sharing the following features: moderately twisted mandibles, propodeum having carinae, presence of true dorsopes, ventral borders of fist tergite widely separated. However, *M. microcavus* differs by its mesopleuron mostly yellow (mesopleuron completely black in *M. andreae*), antenna with 22 flagellomeres (antenna with 27–32 flagellomeres in *M. andreae*) and tarsal claw with a large lobe (tarsal claw either simple or with a small lobe in *M. andreae*).

Etymology. The specific epithet is composed by the Greek prefix "micro" meaning small, and the Latin stem "cavus", which means hole, referring to the small dorsopes.

Meteorus noctuivorus Aguirre, Almeida & Shaw, sp. n.

http://zoobank.org/E03C841A-A1AD-4960-B7E4-2F8A8FA1906D

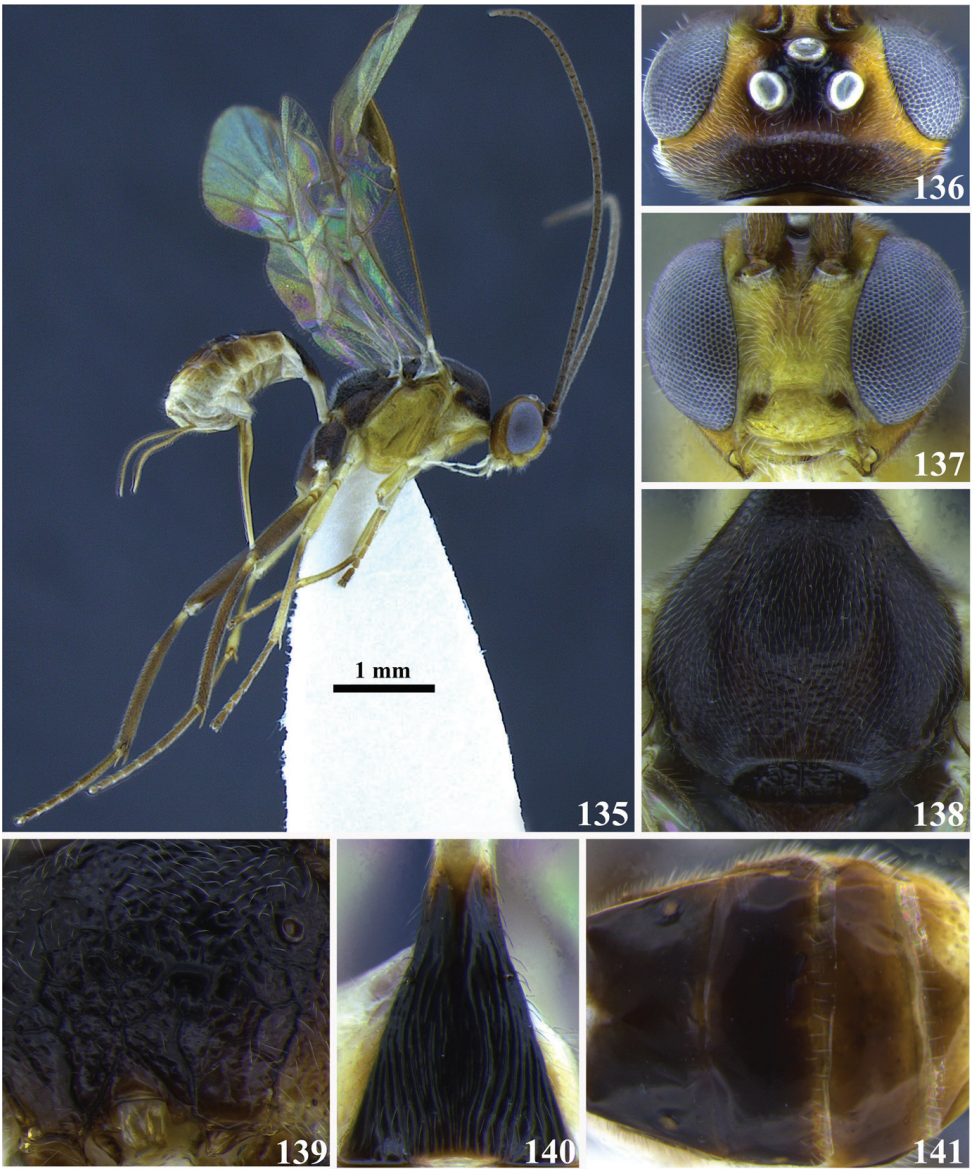
Figures 135–146

Diagnosis. Occipital carina complete; big ocelli, ocellus-ocullar distance 0.8 × ocellar diameter; mandibles twisted; notauli shallow, not distinctive and rugose with a pronounced longitudinal carina; propodeum aerolate-rugose; dorsope absent; ventral borders of first tergite fused completely along ½ of segment; ovipositor 1.9 × longer than first tergite; mesopleuron completely yellow.

Body color. Antenna dark brown; annulus absent; head clypeus and face yellow; frons orange; gena orange infused with brown; vertex and occiput brown; area between ocelli black. Propleuron yellow; dorsal border of pronotum black, remaining yellow; mesonotum dark brown except scutellum testaceous; mesopleuron yellow; metanotum dark brown; metapleuron dark brown; propodeum black-dark brown. Prothoracic legs yellow except tarsus light brown; mesothoracic legs yellow except tibia apically and tarsus light brown; metathoracic legs brown except coxa dorsally dark brown and trochanter light brown. T1 white-yellow basally, dark brown apically; T2–T3 brown; T4–T5 light brown; T6–T8 yellow; sterna cream infused with light brown. Wings hyaline; stigma brown.

Body length. 4.5 mm.

Head. Antenna with 29 flagellomeres; flagellar length/width ratios as follows: F1 = 4.2, F2 = 3.5, F3 = 3.3, F27 = 1.8, F28 = 2.2, F29 = 4.7; head 1.1 wider than high; occipital carina complete; ocellus-ocullar distance 0.8 × ocellar diameter; head height



Figures 135–141. *Meteorus noctuivorus* sp. n. female. **135** Habitus in lateral view **136** head in dorsal view **137** head in frontal view **138** mesoscutum in dorsal view **139** propodeum in posterior view **140** first tergite in dorsal view **141** tergites T2–T5 in dorsal view.

1.5 × eye height; temple length 0.5 × eye length in dorsal view; vertex in dorsal view descending vertically behind the lateral ocelli; frons smooth and polished; face maximum width 1.2 × minimum width; face strigate-rugulose; face minimum width equal to clypeus width; clypeus rugulose-strigulate; malar space length 0.2 × mandible width basally; mandibles twisted.

Figures 142–146. *Meteorus noctuivorus* sp. n. male. **142** Habitus in lateral view **143** head in frontal view **144** head in dorsal view **145** the *M. noctuivorus'* host, a noctuid caterpillar **146** cocoon.

Mesosoma. Pronotum in lateral view carinate and rugose; propleuron irregular and shiny; notauli shallow, not distinctive and rugose with a pronounced longitudinal carina; mesonotal lobes not well defined; central lobe of mesoscutum punctuate; scutellar furrow with five carinae; mesopleuron puncticulate, rugose close to the tegula; precoxal sulcus short, narrow and rugose; metapleuron rugose; propodeum aerolate-rugose, neither carinae nor median depression present.

Legs. Hind coxa strigate-rugulose; tarsal claw with large lobe.

Wings. Wing length 4.4 mm; second submarginal cell of forewing not strongly narrowed anteriorly. Front wing: length of vein r 0.5 × length of vein 3RSa; vein 3RSb straight; length of vein 3RSa 0.9 × length of vein r-m; vein m-cu antefurcal. Hind wing: length of vein 1M 1.1 × length of vein cu-a; length of vein 1M 0.8 × length of vein r-m.

Metasoma. Dorsope absent; ventral borders of first tergite fused completely along ½ of segment; first tergite basally smooth, apically with convergent costae; ovipositor thickened basally and straight; ovipositor 1.9 × longer than first tergite.

Cocoon. Length cocoon 5.5 mm; width cocoon 2.4 mm; honey-brown translucent except apex cap golden, posteriorly bordered by a dark ring; oval-shaped, loosely wrapped by threads, end cap nipple-like, thread length 55 mm.

Female variation. Unknown.

Male variation. Mesonotum dark brown except a light brown patch posteriorly on scutellum; mesopleuron yellow except area close to the tegula dark brown; metapleuron brown except ventral borders light brown; prothoracic legs yellow; T2–T3 brown, remaining surface lighter; sterna yellow; head 1.2 wider than high; head height 1.4 × eye height; malar space length 0.4 × mandible width basally; propleuron disperse punctured; precoxal sulcus long, narrow and carinate-rugose; wing length 3.9 mm; length of vein r 0.9 × length of vein 3RSa; length of vein 3RSa 0.7 × length of vein r-m; length of vein 1M 1.1 × length of vein r-m.

Type locality. ECUADOR, Napo province, Yanayacu biological station 00°35.9'S, 77°53.4'W, 2163 m.

Type specimen. Holotype female (point mounted) ECUADOR, Napo province, Yanayacu biological station 00°35.9'S, 77°53.4'W, 2163 m, reared from a noctuid caterpillar collected on *Boehmeria bullata* (Urticaceae) IX.22.2010, parasitoid pupation X.13.2010, parasitoid emergence XI.3.2010, YY 51987 (rearing code), UWIM.

Paratype. Male, ECUADOR, Napo province, Yanayacu biological station, 00°35.9'S, 77°53.4'W, 2163 m, reared from a noctuid caterpillar collected on *Boehmeria bullata* (Urticaceae) IX.5.2010, parasitoid pupation IX.29.2010, parasitoid emergence X.26.2010, YY 51587 (rearing code), UWIM.

Distribution. Ecuador, province of Napo.

Biology. Solitary parasitoid of a noctuid caterpillar feeding on *Boehmeria bullata* (Urticaceae)

Comments. *Meteorus noctuivorus* and *M. anuae* share the occipital carina being complete, mandibles completely twisted, notauli shallow and not distinct, tarsal claw with a large lobe, ventral borders of first tergite joined along half of segment and first metasomal tergite without dorsopes. *Meteorus noctuivorus* might be distinguished by the first tergite basally white-yellow, distally brown-black (first tergite completely black in *M. anuae*).

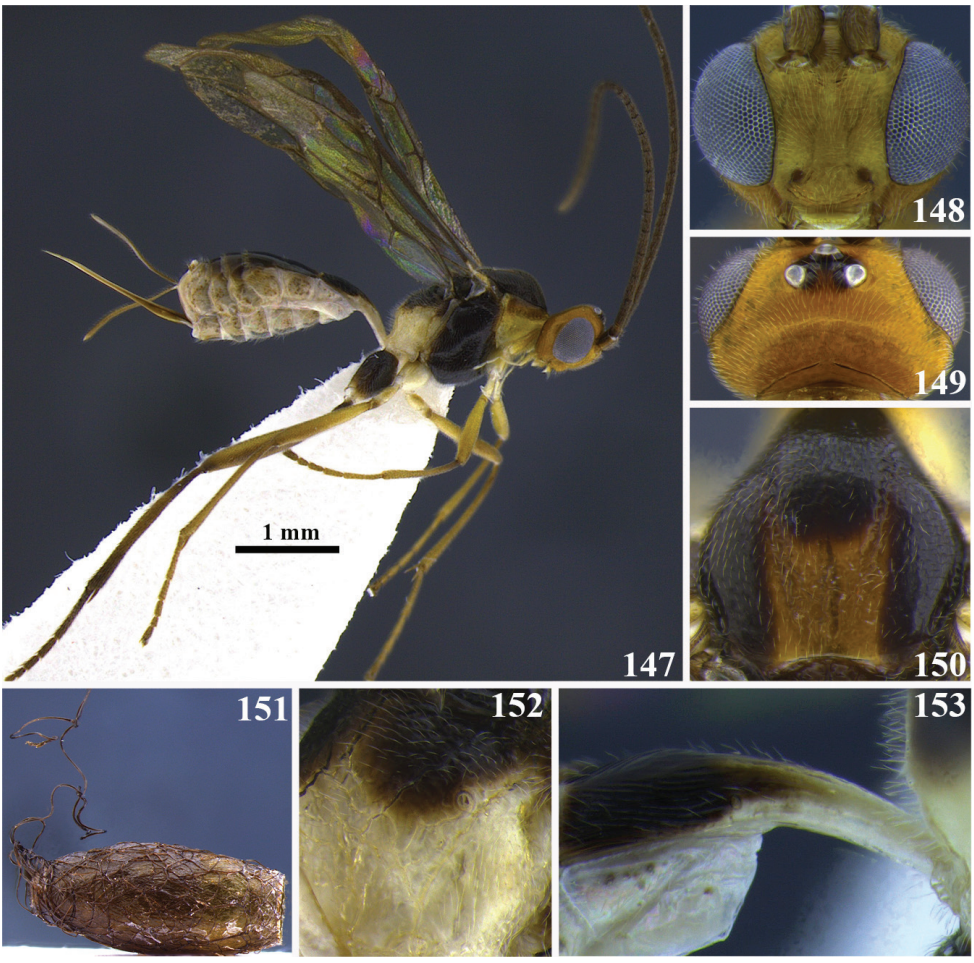
Etymology. The stem "noctui" (referring to the host family) and the suffix "vorus" meaning devouring, compose the specific epithet ("the noctuid-devourer").

***Meteorus orion* Aguirre, Almeida & Shaw, sp. n.**

http://zoobank.org/689D3A0B-1980-40C4-9A0A-857105D30DDF

Figures 147–153

Diagnosis. Occipital carina incomplete; mandibles twisted; notauli rugose-carinate and not distinct; longitudinal and transversal carinae on propodeum forming broad areolae dorsally; hind coxa strigate and punctate; tarsal claw simple; dorsope absent; ventral borders of first tergite joined completely along ½ of segment; ovipositor 1.7 × longer than first tergite; colorful pattern of orange, yellow, white and black on the body.



Figures 147–153. *Meteorus orion* sp. n. female. **147** Habitus in lateral view **148** head in frontal view **149** head in dorsal view **150** mesoscutum in dorsal view **151** cocoon **152** propodeum in dorso-lateral view **153** first tergite in dorso-lateral view.

Body color. Antenna dark brown; annulus absent; head orange except area between ocelli black. Propleuron orange-yellow; pronotum dorsally orange, ventrally yellow; mesonotum dark brown, except area among lobes and a patch on scutellum orange; mesopleuron dark brown; metanotum dark brown; metapleuron white; propodeum dark brown except posterior and lateral areas white-cream. Prothoracic legs testaceous except coxa and trochanter white cream; mesothoracic legs testaceous except coxa and trochanter white cream; metathoracic legs dark brown except entire femur and tibia medially testaceous. T1 white-yellow basally, dark brown apically; T2–T8 dark brown; sterna yellow-cream with dark brown spots. Wings hyaline; stigma brown.

Body length. 3.9 mm.

Head. Antenna with 29 flagellomeres; flagellar length/width ratios as follows: F1 = 3.4, F2 = 3.1, F3 = 3.1, F27 = 1.8, F28 = 1.7, F29 = 2.2; head 1.3 wider than high; occipital carina incomplete; ocellus-ocullar distance 1.6 × ocellar diameter; head height 1.6 × eye height; temple length 0.4 × eye length in dorsal view; vertex in dorsal view not descending vertically behind the lateral ocelli; frons smooth and polished; face maximum width 1.2 × minimum width; face strigate-punctate; face minimum width 1.3 × clypeus width; clypeus rugose; malar space length 1.1 × mandible width basally; mandibles twisted.

Mesosoma. Pronotum in lateral view carinate-punctate; propleuron slightly puncticulate; notauli rugose-carinate and not distinct; mesonotal lobes not well defined. central lobe of mesoscutum rugulose; scutellar furrow with three carinae; mesopleuron punctate, rugose-lacunose close to the tegula; precoxal sulcus long, wide and carinate-rugose; metapleuron rugulose; propodeum carinate-rugose; longitudinal and transversal carinae forming broad areolae dorsally, median depression absent.

Legs. Hind coxa strigate and punctate; tarsal claw simple.

Wings. Wing length 3.4 mm; second submarginal cell of forewing not strongly narrowed anteriorly. Front wing: length of vein r 0.7 × length of vein 3RSa; vein 3RSb straight; length of vein 3RSa 0.9 × length of vein r-m; vein m-cu postfurcal. Hind wing: length of vein 1M equal to length of vein cu-a; length of vein 1M 1.4 × length of vein r-m.

Metasoma. Dorsope absent; ventral borders of first tergite joined completely along ½ of segment; first tergite with costae convergent posteriorly; ovipositor thickened basally and straight; ovipositor 1.7 × longer than first tergite.

Cocoon. Length cocoon 3.9 mm; width cocoon 1.8 mm; honey-brown translucent. Oval-shaped, main structure formed by honey-light brown threads, loosely enveloped by darker threads.

Female variation. Unknown.

Male variation. Unknown.

Type locality. ECUADOR, Napo province, Yanayacu biological station, San Isidro forest, 00°35.9'S; 77°53.4'W, 2163 m.

Type specimen. Holotype female (point mounted), ECUADOR, Napo province, Yanayacu biological station, San Isidro forest, 00°35.9'S; 77°53.4'W, 2163 m, reared from a noctuid caterpillar collected on *Diplazium costale* var *robustum* (Dryopteridaceae) VII.17.2009, parasitoid pupation VII.21.2009, parasitoid emergence VIII.7.2009, YY40067 (rearing code), UWIM.

Paratype. Unknown.

Distribution. Ecuador, province of Napo.

Biology. Solitaty parasitoid of Noctuidae feeding on *Diplazium costale* var. *robustum* (Dryopteridaceae).

Comments. The occipital carina incomplete, mandibles completely twisted, first metasomal tergite without dorsopes, ventral borders of first tergite joined along half of segment and the colorful pattern of orange, yellow, black and white on the body set *M. orion* close to *M. mirandae*. The new species might be easily sorted by having the hind

coxa completely dark brown and the middle one completely yellowish-white (hind and middle coxae dorsally black, ventrally yellow in *M. mirandae*), the notauli shallow and not distinct, and the tarsal claw simple.

Etymology. The mythological Greek hunter "Orion" inspired the name for this species, because of the hunting behavior upon noctuid caterpillars. By coincidence, the yellowish white middle coxa line up with the pale white posterior of the propodeum, like the three stars in the "belt of Orion," the most conspicuous part of this famous constellation.

New distribution and biology records

Meteorus andreae Aguirre & Shaw, 2011

Material examined. One female (point mounted), COSTA RICA, Guanacaste, Volcán Cacao, Cerro Pedregal, 1000 m, collected II–IV.1989, I. Gauld and D. Janzen leg., UWIM. One female (point mounted), COSTA RICA, San José, Cerro de la Muerte, 26 km N San Isidro, 2100 m, collected II–V.1991, P. Hanson leg., UWIM. One female (point mounted), COSTA RICA, Puntarenas, San Vito, Estac. Biol. Las Alturas, 1500 m, collected XII.1991, P. Hanson leg., UWIM. One female (point mounted), COSTA RICA, Cartago, La Cangreja, 1950 m, collected VII.1991, P. Hanson leg., Malaise, UWIM. One female (point mounted), COSTA RICA, San José, Cerro de la Muerte, 2100 m, collected II–V.1992, P Hanson leg., Malaise, UWIM. One female (point mounted), COSTA RICA, Cartago, Cerro de la Muerte, 3000 m, collected XII.1988–I.1989, P. Hanson leg., Malaise, UWIM. One male (point mounted), COSTA RICA, San José, San Isidro, 2100 m, collected II–IV.1993, P. Hanson leg., Malaise, UWIM. One female (point mounted), COSTA RICA, Alajuela, San Ramón, 1200 m, collected collected II.1997, P. Hanson leg., Malaise, UWIM. One male (point mounted), COSTA RICA, Alajuela, San Ramón, 1200 m, collected VII.1997, P. Hanson leg., Malaise, UWIM.

Comments. *Meteorus andreae* is one of the most common species of *Meteorus* in Costa Rica with approximately 200 specimens collected across five out of seven provinces, ranging from 745–3000 m above the sea level. It was originally described from Colombia in the departments of Cauca, Huila and Nariño, spanning between 1885–2640 m (Aguirre et al. 2011).

Meteorus farallonensis Aguirre & Shaw, 2011

Material examined. Two females (point mounted), COSTA RICA, Puntarenas, Zona protectora Las tablas, 1 km NE de Sitio Portones Camino a Tablas, 1530 m, collected 30.VIII–5.IX.1995, M. Chinchilla, Malaise, UWIM. One female (point mounted), COSTA RICA, Puntarenas, San Vito, Est. Biol. Las Alturas, 1500 m, collected II.1992, P. Hanson leg., UWIM.

Comments. *Meteorus farallonensis* was described from Colombia from the departments of Caqueta, Meta, and Valle del Cauca at elevations below 1000 m (Aguirre et al. 2011). This new record from Puntarenas, Costa Rica, at 1500 m represents the highest known altitudinal distribution for this species.

Meteorus guineverae Aguirre & Shaw, 2011

Material examined. One female (point mounted), COSTA RICA, Cartago, La Cangreja, 1950 m, collected XI.1991, P. Hanson leg., UWIM. One female (point mounted), COSTA RICA, Heredia, Vara Blanca, Finca Georgina, 2100 m, collected I–II.1990, P. Hanson leg., UWIM. One female (point mounted), COSTA RICA, San José, Zurqui de Moravia, 1600 m, collected II.1996, P. Hanson leg., Malaise, UWIM.

Comments. The type series was described from the Fauna and Flora Sanctuary of Iguaque, a high Andean fog forest, 2855–3350 m (Aguirre et al. 2011). This is the first record from outside Colombia.

Meteorus jerodi Aguirre & Shaw, 2011

Material examined. Seventeen females, one male (point mounted), ECUADOR, Province of Napo 00°43'52.5"S, 77°46'25.3"W, Narupa, 1186 m, collected as a noctuid caterpillar parasitoid feeding on Asteraceae 3.IV.2013, pupated 15.IV.2013, emerged 29.V.2013, YY73611 (rearing code), UWIM.

Comments. This species is known from the locality of Zipacón (1425 m), department of Cundinamarca, and from the locality of Togii (1830 m), department of Boyacá, Colombia (Aguirre et al. 2011). *Meteorus jerodi* was described from Malaise traps samples and the information here provided represents its first biological record.

Meteorus kraussi Muesebeck, 1958

Material examined. One female (point mounted), COSTA RICA, San Jose, Zurqui de Moravia, 1600m, collected VIII.1995, P. Hanson leg., UWIM. One female pin mounted, COSTA RICA, Guanacaste, Est. Pitilla, 9 km S de Santa Cecilia, 700 m, collected VIII–IX.1996, P. Rios and C. Moraga leg., UWIM. One female (point mounted), COSTA RICA, Puntarenas, San Vito, Est. Biol. Las Alturas, 1500 m, collected VI.1992, P. Hanson leg., UWIM. One female pin mounted, COSTA RICA, Alajuela, 5 km W San Ramón, 1200 m, collected IV.1997, O. Castro and P. Hanson leg., UWIM.

Comments. The type series was described from Cuernavaca, Mexico, 23 females and 3 males reared from a lepidopterous larva on *Ageratina adenophora* (Spreng.) King & H.Rob. (syn. *Eupatorium adenophorum*) (Muesebeck 1958). This is the first record outside Mexico since its original description.

Meteorus papiliovorus Zitani, 1997

Material revised. Seventy one females (point mounted), ECUADOR, Napo, 00°43'52.5"S, 77°46'25.3"W, Narupa, sendero Alucus, 1186 m, each wasp was collected as a solitary parasitoid on individual larvae of Papilionidae "popo de pajaro" 14.IX.2013 feeding on a lemon tree *Citrus* sp. (Rutaceae); all parasitoids larvae pupated 2.X.2013; 11 wasps emerged 24.IX.2013, one emerged 27.IX.2013, five emerged 30.IX.2013, two emerged 1.X.2013, 39 emerged 7.X.2013, three emerged 8.X.2013, five emerged 9.X.2013, two emerged 10.X.2013 and three emerged 14.X.2013; rearing codes: YY 80190–202, 80204–209, 80211–217, 80222, 80224, 80226–229, 80231–233, 80235–236, 80238–244, 80246–247, 80249–251, 80254, 80257, 80261–268, 80271–275, 80277–282, 80284, UWIM.

Comments. *Meteorus papiliovorus* Zitani represents the first Neotropical member of this genus known to have a strong preference for Papilionidae: originally described from Costa Rica parasitizing *Parides sesostris zestos* (Gray) and *Papilio anchisiades idaeus* (Fabricius, 1793) in 1997 (Zitani et al. 1997), and reared in 1946 in Colombia parasitizing *P. anchisiades capis* (Hübner) and in 1999 parasitizing *P. anchisiades idaeus* (Aguirre et al. 2011).

Meteorus quimbayensis Aguirre & Shaw, 2011

Material revised. One female (point mounted), ECUADOR, Napo, 00°35.9'S, 77°53.4'W, Yanayacu Biological Station, J. Simbaña Macucoloma trail, 2163 m, collected 1–10.V.2009, S.R. Shaw leg., Malaise, UWIM. One female (point mounted), ECUADOR, Napo, 00°35.9'S, 77°53.4'W, Yanayacu Biological Station, J. Simbaña Macucoloma trail, 2163 m, collected 1–8.IX.2007, S.R. Shaw leg., Malaise, UWIM.

Comments. *Meteorus quimbayensis*, originally described from Colombia from the departments of Huila, Risaralda, and Santander, it seems to be restricted to high South American Andean wet forests between 2000–2300 m above the sea level (Aguirre et al. 2011) since it has not been recorded from Costa Rica despite the intense sampling effort in locations such as Cerro de la Muerte reaching between 2100–3000 m.

Host use in *Meteorus*

Biological information for 38 out of 75 *Meteorus* species is available (Table 1). Erebidae, Noctuidae and Pyralidae account for 57% of host records (Fig. 154). The highest percentage is kept by the familily Erebidae (22%) reported mainly from Ecuador as a result of the CAPEA project (Dyer et al. 2014). By contrast, Noctuidae with 20% of host records is reported from eight countries, from Mexico to Argentina, chiefly because of the tight association of noctuid caterpillars with commercial crops (Molina-Ochoa et al. 2003). Nineteen species are recorded as developing gregariously, sixteen

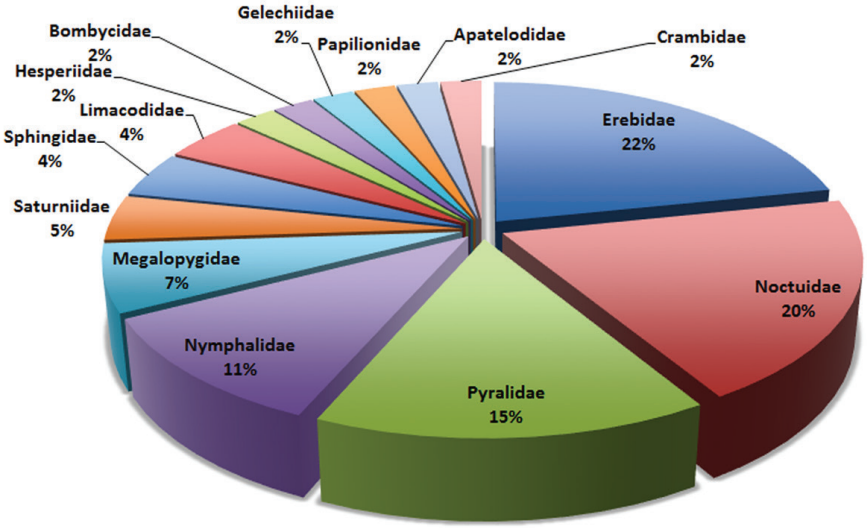


Figure 154. Percentages of host families known to be parastized by *Meteorus* species in Neotropical countries.

Table 1. Distribution, host records and larvae development of Neotropical *Meteorus*. The last column provides information about the examined material and its repository. The superscripts indicate the following references: [1]Aguirre and Shaw 2014a, [2]Aguirre et al. 2011, [3]Zitani et al. 1998, [4]Aguirre and Shaw 2014b, [5]Jones and Shaw 2012, [6]Cave 1993, [7]Maes 1989, [8]Hilburn et al. 1990, [9]Pair et al. 1986, [10]Porter 1926, [11]De Huiza 1994, [12]De Santis 1967, [13]Artigas 1972, [14]Muesebeck 1939, [15]Muesebeck 1958, [16]Aguirre et al. 2010, *Molina-Ochoa et al. 2003 erroneous record, misinterpretation of Etcheverry 1957, [17]Marsh 1979, [18]Ortegón et al. 1988, [19]Gladstone 1991, [20]Dyer et al. 2005, [21]Segeren and Sharma 1978, [22]Muesebeck 1967, [23]Muesebeck 1923, [24]Shaw and Nishida 2005, [25]Barrantes et al. 2011, [26]Luna and Sanchez 1999, [27]Shaw and Jones 2009, [28]Molina-Ochoa et al. 2001, [29]Ashmead 1889. Both distribution and host information without superscript are new records.

Parasitoid species	Distribution	Host family	Mode of parasitoid development	Material examined (Depository)
M. albisericus	Ecuador[1]	Pyralidae[1]	Solitary[1]	Holotype (UWIM)
M. albistigma sp. n.	Costa Rica	Unknown	Unknown	Holotype (UWIM)
M. alejandromasisi	Colombia[2], Costa Rica[3]	Hesperiidae[3], Megalopygidae[2]	Gregarious[3]	Holotype (UWIM)
M. amazonensis	Colombia[2]	Unknown	Unknown	Holotype (ICN)
M. andreae	Colombia[2], Costa Rica	Unknown	Unknown	Holotype (ICN)
M. antioquensis	Colombia[2]	Saturniidae[2]	Gregarious[2]	Paratype (ICN)
M. anuae	Ecuador[4]	Erebidae[4]	Gregarious[4]	Holotype (UWIM)
M. arizonensis	Colombia[2], Costa Rica, Honduras[6], Nicaragua[7]	Noctuidae[6,7]	Unknown	Voucher (UWIM)
M. autographae	Bermuda[8], Mexico[9]	Noctuidae[9]	Solitary[23]	Voucher (UWIM)
M. boyacensis	Colombia[2]	Unknown	Unknown	Holotype (ICN)

Parasitoid species	Distribution	Host family	Mode of parasitoid development	Material examined (Depository)
M. bustamanteorum	Ecuador[5]	Bombycidae[5]	Gregarious[5]	Holotype (UWIM)
M. calimai	Colombia[2]	Unknown	Unknown	Holotype (ICN)
M. camilocamargoi	Costa Rica[3]	Pyralidae[3]	Solitary[3]	Holotype (UWIM)
M. caquetensis	Colombia[2]	Unknown	Unknown	Holotype (ICN)
M. caritatis	Ecuador[5]	Nymphalidae[5]	Solitary[5]	Holotype (UWIM)
M. carolae sp. n.	Costa Rica	Unknown	Unknown	Holotype (UWIM)
M. cecavorum	Colombia[2], Ecuador[4]	Erebidae[4]	Gregarious[4]	Holotype (ICN)
M. chilensis	Argentina[12], Chile[10,13], Peru[11]	Noctuidae[11,13]	Gregarious[11]	Voucher (UWIM)
M. chingazensis	Colombia[2]	Unknown	Unknown	Holotype (ICN)
M. coffeatus	Costa Rica[3]	Unknown	Unknown	Holotype (UWIM)
M. congregatus	Costa Rica[3], Panama[14]	Sphingidae[14]	Gregarious[14]	Paratype (NMNH)
M. corniculatus	Colombia[2], Costa Rica[3]	Unknown	Unknown	Holotype (UWIM)
M. desmiae	Colombia[2], Costa Rica[3], Ecuador[1]	Pyralidae[1], Crambidae[1]	Solitary[3]	Holotype (UWIM)
M. dimidiatus	Colombia[2], Costa Rica[3]	Unknown	Unknown	Voucher (UWIM)
M. dixi	Colombia[2]	Unknown	Unknown	Holotype (ICN)
M. dos	Colombia[2], Costa Rica[3]	Unknown	Unknown	Holotype (UWIM)
M. eaclidis	Brazil[15]	Saturniidae[15]	Gregarious[15]	Paratype (NMNH)
M. euchromiae	Venezuela[29]	Erebidae[29]	Unknown	Paratype (NMNH)
M. eurysaccavorus sp. n.	Bolivia	Gelechiidae	Unknown	Holotype (UWIM)
M. fallacavus sp. n.	Costa Rica	Unknown	Unknown	Holotype (UWIM)
M. farallonensis	Colombia[2], Costa Rica	Unknown	Unknown	Holotype (ICN)
M. flavistigma sp. n.	Costa Rica	Unknown	Unknown	Holotype (UWIM)
M. gigas	Colombia[16], Ecuador[16]	Unknown	Unknown	Paratype (UWIM)
M. guacharensis	Colombia[2]	Unknown	Unknown	Holotype (ICN)
M. guineverae	Colombia[2], Costa Rica	Unknown	Unknown	Holotype (ICN)
M. haimowitzi sp. n.	Costa Rica	Unknown (reared from cocoon)	Solitary	Holotype (UWIM)
M. horologium	Ecuador[5]	Limacodidae[5]	Gregarious[5]	Holotype (UWIM)
M. huilensis	Colombia[2]	Unknown	Unknown	Holotype (ICN)
M. iguaquensis	Colombia[2]	Unknown	Unknown	Holotype (ICN)
M. imaginatus	Ecuador[5]	Noctuidae[5]	Solitary[5]	Holotype (UWIM)
M. jerodi	Colombia[2], Ecuador	Noctuidae	Gregarious	Holotype (ICN)
M. juliae	Ecuador[4]	Erebidae[4]	Gregarious[4]	Holotype (UWIM)
M. kraussi	Mexico[15], Costa Rica	Unknown	Gregarious[15]	Paratype (NMNH)
M. laphygmae	Chile*, Colombia[18], Costa Rica[3], Honduras[6], Mexico[17,28], Nicaragua[19], Suriname[21], Venezuela[22]	Nymphalidae[20], Noctuidae[6,17,18,19], Erebidae[20]	Solitary[23]	Voucher (UWIM)
M. luteus	Ecuador[5]	Nymphalidae[5]	Solitary[5]	Holotype (UWIM)
M. magdalensis	Colombia[2]	Unknown	Unknown	Holotype (ICN)
M. magnoculus sp. n.	Costa Rica	Pyralidae	Unknown	Holotype (UWIM)
M. margarita	Ecuador[5]	Erebidae[5]	Gregarious[5]	Holotype (UWIM)
M. mariamartae	Colombia[2], Costa Rica[3]	Unknown	Unknown	Holotype (UWIM)
M. martinezi sp. n.	Costa Rica	Unknown	Unknown	Holotype (UWIM)

Parasitoid species	Distribution	Host family	Mode of parasitoid development	Material examined (Depository)
M. megalops	Colombia[2], Costa Rica[3]	Unknown	Unknown	Holotype (UWIM)
M. microcavus sp. n.	Costa Rica	Unknown	Unknown	Holotype (UWIM)
M. micrommatus	Costa Rica[3]	Unknown	Unknown	Holotype (UWIM)
M. mirandae	Ecuador[4]	Erebidae[4]	Solitary[4]	Holotype (UWIM)
M. muiscai	Colombia[2]	Unknown	Unknown	Holotype (ICN)
M. noctuivorus sp. n.	Ecuador	Noctuidae	Solitary	Holotype (UWIM)
M. oreo	Ecuador[5]	Erebidae[5]	Solitary[5]	Holotype (UWIM)
M. orion sp. n.	Ecuador	Noctuidae	Solitary	Holotype (UWIM)
M. oviedoi	Colombia[2], Costa Rica[24]	Limacodidae[24]	Gregarious[24]	Holotype (UWIM)
M. papiliovorus	Colombia[2], Costa Rica[25], Ecuador	Papilionidae[2,25], Nymphalidae[2]	Gregarious[2,25] Solitary	Holotype (UWIM)
M. porcatus	Ecuador[5]	Erebidae[5]	Gregarious[5]	Holotype (UWIM)
M. pseudodimidiatus	Colombia[2], Costa Rica[3]	Unknown	Unknown	Holotype (UWIM)
M. pyralivorus	Ecuador[1]	Pyralidae[1]	Solitary[1]	Holotype (UWIM)
M. quasifabatus	Ecuador[5]	Erebidae[5]	Gregarious[5]	Holotype (UWIM)
M. quimbayensis	Colombia[2], Ecuador	Unknown	Unknown	Holotype (ICN)
M. restionis	Costa Rica[25]	Unknown (reared from cocoon)	Gregarious[25]	Holotype (UWIM)
M. rogerblancoi	Colombia[2], Costa Rica[3]	Unknown	Unknown	Holotype (UWIM)
M. rubens	Argentina[26], Colombia[2], Costa Rica[3]	Megalopygidae[3], Noctuidae[2,26], Pyralidae[26]	Solitary[26], Gregarious[3]	Voucher (UWIM)
M. rugonasus	Colombia[2], Ecuador[27]	Nymphalidae[27]	Solitary[27]	Holotype (UWIM)
M. santanderensis	Colombia[2]	Unknown	Unknown	Holotype (ICN)
M. sterictae	Costa Rica[3]	Pyralidae[3]	Solitary[3]	Holotype (UWIM)
M. townsendi	Brazil[14], Colombia[2]	Sphingidae[14]	Gregarious[14]	Paratype (NMNH)
M. uno	Colombia[2], Costa Rica[3]	Unknown	Unknown	Holotype (UWIM)
M. yamijuanum	Colombia[2], Costa Rica[3]	Unknown	Unknown	Holotype (UWIM)
M. zitaniae	Ecuador[5]	Megalopygidae[5]	Gregarious[5]	Holotype (UWIM)

as solitary and two present both behaviors. Gregarious *Meteorus* seem to display some preference toward caterpillars with physical and chemical defenses dissuading predators since six out of ten species (60%) attacking tiger moths larvae are gregarious compared to three out of nine (33.3%) parasitizing Noctuidae, one out of seven (14,3%) attacking Pyralidae, and one out of five (20%) species doing it on Nymphalidae. The most common and widespread species, *Meteorus laphygmae* Viereck, is also the most generalist species, using Erebidae, Nymphalidae, and Noctuidae as hosts.

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Supplementary material 1

Revised material

Authors: Helmuth Aguirre, Luis Felipe de Almeida, Scott Richard Shaw, Carlos E. Sarmiento

Data type: Excel spreadsheet.

Explanation note: Data set containing information about parasitoid species, host species, distribution, trapping method and depository.

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Taxonomy of *Fissocantharis* Pic (Coleoptera, Cantharidae) from Guangxi, China, with descriptions of six new species

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Abstract

A total of 17 species of *Fissocantharis* Pic is recorded from Guangxi, China. Six species are described new to science, *F. sinensomima* **sp. n.**, *F. sexcostata* **sp. n.**, *F. basilaris* **sp. n.**, *F. eschara* **sp. n.**, *F. latipalpa* **sp. n.** and *F. biprojicientis* **sp. n.**, and two previously known species are redescribed, *F. gracilipes* (Pic, 1927) and *F. sinensis* (Wittmer, 1988). These species are presented with habitus of males, abdominal sternites VIII of females and genitalia of both sexes. *Fissocantharis flavofacialis* (Pic, 1926) is synonymized with *F. angusta* (Fairmaire, 1900); both were originally described in the genus *Podabrus* Westwood. Additionally, a key and a checklist of all the species of *Fissocantharis* from Guangxi are provided.

Keywords

Taxonomy, Cantharidae, *Fissocantharis*, new species, synonym, Guangxi, China

Introduction

The species of *Fissocantharis* Pic, 1921 (redefined by Yang et al. 2009) are widely distributed in the Oriental and Palaearctic Regions. In China, about 90 species of

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this genus have been known until now, and their descriptions or revisions were mostly contributed by Wittmer (1951, 1972, 1979, 1982, 1983, 1988, 1989, 1993, 1995, 1997). During our study, 6 new species from Guangxi Zhuang Autonomous Region are recently discovered, and they are described here under the names of *Fissocantharis sinensomima* sp. n., *F. sexcostata* sp. n., *F. basilaris* sp. n., *F. eschara* sp. n., *F. latipalpa* sp. n. and *F. biprojicientis* sp. n. For some comparisons with the new species, *F. gracilipes* (Pic, 1927) and *F. sinensis* (Wittmer, 1988) are redescribed and provided with some supplementary characters.

Fissocantharis flavofacialis (Pic, 1926) is considered to be a junior synonym of *F. angusta* (Fairmaire, 1900), which were both originally described in *Podabrus* Westwood, 1838 from Fujian, China, since no differences are found between them. A key and a checklist of all species from Guangxi are presented, as well as some additional distributional data for some previously known species.

Material and methods

The material is preserved in the following collections. Primary types are returned to the collections from which they are borrowed or are otherwise deposited in public museums.

IZAS Institute of Zoology, Chinese Academy of Sciences, Beijing, China;
MHBU Museum of Hebei University, Baoding, China;
MNHN Muséum national d'Histoire naturelle, Paris, France;
NHMB Naturhistorisches Museum Basel, Switzerland;
ZFMK Zoologische Forschungsinstitut und Museum "Alexander Koenig", Bonn, Germany.

The genitalia of both sexes and abdominal sternites VIII of females are dissected and cleared in 10% KOH solution, and the female genitalia is dyed with hematoxylin. Habitus photos are taken by a Leica M205 A microscope, multiple layers are stacked using Combine ZM (Helicon Focus 5.3). Line drawings are made with the aid of camera lucida attached to a Leica MZ12.5 stereomicroscope, then edited in CorelDRAW 12 and Adobe Photoshop 8.0.1.

Complete label data are cited for type specimens, quotation marks are used to separate data from different labels and a backslash "\" to separate data from different lines of the same label.

Body length is measured from the anterior margin of the clypeus to the elytral apex and body width across the humeral part of elytra. Morphological terminology of female genitalia follows that of Brancucci (1980). The abbreviations in the figures are as follows, ag: accessory gland; di: diverticulum; sd: spermathecal duct; sp: spermatheca; ov: median oviduct; va: vagina.

Taxonomy

Key to the species of *Fissocantharis* Pic in male from Guangxi, China

1 Middle antennomeres strongly deformed **2**
– Antennae filiform or middle antennomeres slightly flattened or thickened **10**
2 Antennomeres III–IV or V deformed, others normal **3**
– Antennomeres III–XI deformed **5**
3 Head mostly black; antennomeres III–V deformed and maxillary palpomeres II–III normal ..... ***F. tridifformis*** **(Wittmer, 1988)**
– Head uniformly orange; antennomeres III–IV deformed, V normal and maxillary palpomeres II–III deformed **4**
4 Antennomeres IV with two projections at basal part; maxillary palpomeres II–III excavated wholly on dorsal sides ..... ***F. biprojicientis*** **sp. n.**
– Antennomeres IV unlike above, without projections; maxillary palpomeres II–III each with a deep round pit on dorsal side ..... ***F. bidifformis*** **(Wittmer, 1988)**
5 Antennomeres III–VIII each emarginated at apical part of outer margin ..... ***F. multiexcavata*** **(Wittmer, 1988)**
– Antennomeres III–VIII unlike above **6**
6 Antennomeres thickened, nearly parallel-sided **7**
– Antennomeres flattened and widened apically **8**
7 Antennomeres VIII with outer apical angles strongly projecting laterad, III–VIII minutely serrated along outer margins ..... ***F. flavicornis*** **(Gorham, 1889)**
– Antennomeres VII–VIII with outer apical angles moderately projecting laterad, III–VIII not serrated ..... ***F. cicatricosa*** **(Wittmer, 1988)**
8 Antennomeres X shortened, XI widened near base, knife-like **9**
– Antennomeres X and XI normal, parallel-sided ..... ***F. liuchowensis*** **(Wittmer, 1989)**
9 Antennomeres XI about one-third longer than X ..... ***F. angusta*** **(Fairmaire, 1900)**
– Antennomeres XI about as twice long as X... ***F. tachulanensis*** **(Wittmer, 1988)**
10 Middle antennomeres with longitudinal ridges along outer margins **11**
– Middle antennomeres unlike above **12**
11 Antennae slightly thickened, antennomeres III–IX with longitudinal ridges along outer margins; aedeagus: conjoint dorsal plate of parameres well-developed, distinctly longer than ventral processes ..... ***F. buonloiensis*** **Wittmer, 1993**
– Antennae slightly flattened, antennomeres III–VIII with longitudinal ridges along outer margins; aedeagus: conjoint dorsal plate of parameres moderately reduced, distinctly shorter than ventral processes ..... ***F. sexcostata*** **sp. n.**
12 Maxillary palpomeres II–IV flattened and widened, II convex at basal part of dorsal side; pronotum uniformly black ..... ***F. latipalpa*** **sp. n.**

– Maxillary palpi normal; pronotum uniformly orange or mixed with black marking **13**

13 Antennomeres IV–XI each with an oblong smooth scar-like bulge on outer margin **14**

– Antennomeres IV–XI unlike above **15**

14 Body larger, more than 9.0 mm in length; aedeagus: conjoint dorsal plate of parameres greatly reduced, slightly roundly protuberant in middle of apical margin, ventral process of each paramere abruptly narrowed apically, slightly hooked at apex ..... ***F. gracilipes*** **(Pic, 1927)**

– Body smaller, less than 9.0 mm in length; aedeagus: conjoint dorsal plate of parameres moderately reduced, tapered at apical margin, ventral process of each paramere evenly narrowed apically, moderately hooked at apex ..... ***F. eschara*** **sp. n.**

15 Antennomeres III–X parallel-sided, IV–XI each with a narrow smooth longitudinal impression at basal part of outer margin ..... ***F. sinensomima*** **sp. n.**

– Antennomeres III–X slightly flattened and obliquely widened apically, IV–XI unlike above **16**

16 Antennomeres V–VIII each with a longitudinal smooth impression at apical part of outer margin ..... ***F. sinensis*** **(Wittmer, 1988)**

– Antennomeres IV–XI each with a round smooth impression at base of outer margin ..... ***F. basilaris*** **sp. n.**

Description of the species

Fissocantharis sinensis **(Wittmer, 1988)**
Figs 1A, 3A–C, 8A, 9A

Micropodarus sinensis Wittmer, 1988: 353, figs 8, 28.
Fissocantharis sinensis: Yang et al. 2009: 49.

Type material examined. Holotype: 1♂ (IZAS): "阳朔26.IV938" [Guangxi: Yangshuo], "Micropodabrus \ sinensis \ Wittm. \ det. W. Wittmer", "HOLOTYPUS".

Additional material examined. CHINA: Guangxi: 4♂♂, 1♀ (IZAS): Lingchuan, 6.–7.VI.1984, collector unknown; 1♂ (IZAS): Xing'an, 210m, 1.VI.1984, collector unknown; 1♀ (IZAS): Yangshuo, 29.IV.1938, collector unknown; 1♂ (IZAS): Beiquan, 29.V.1939, collector unknown.

Redescription. Male (Fig. 1A). Head black, mouthparts blackish brown, light brown at bases of mandibles and labium, antennae black, yellow at ventral sides of antennomeres I–II, prothorax orange, pronotum sometimes with a large black marking in middle of disc, which extending from anterior to posterior margin, scultellum black, elytra dark purple, with weak metallic shine, legs black, yellow at pro-coxae, trochanters and basal parts of femora, meso- and metasterna and abdomen black. Body densely

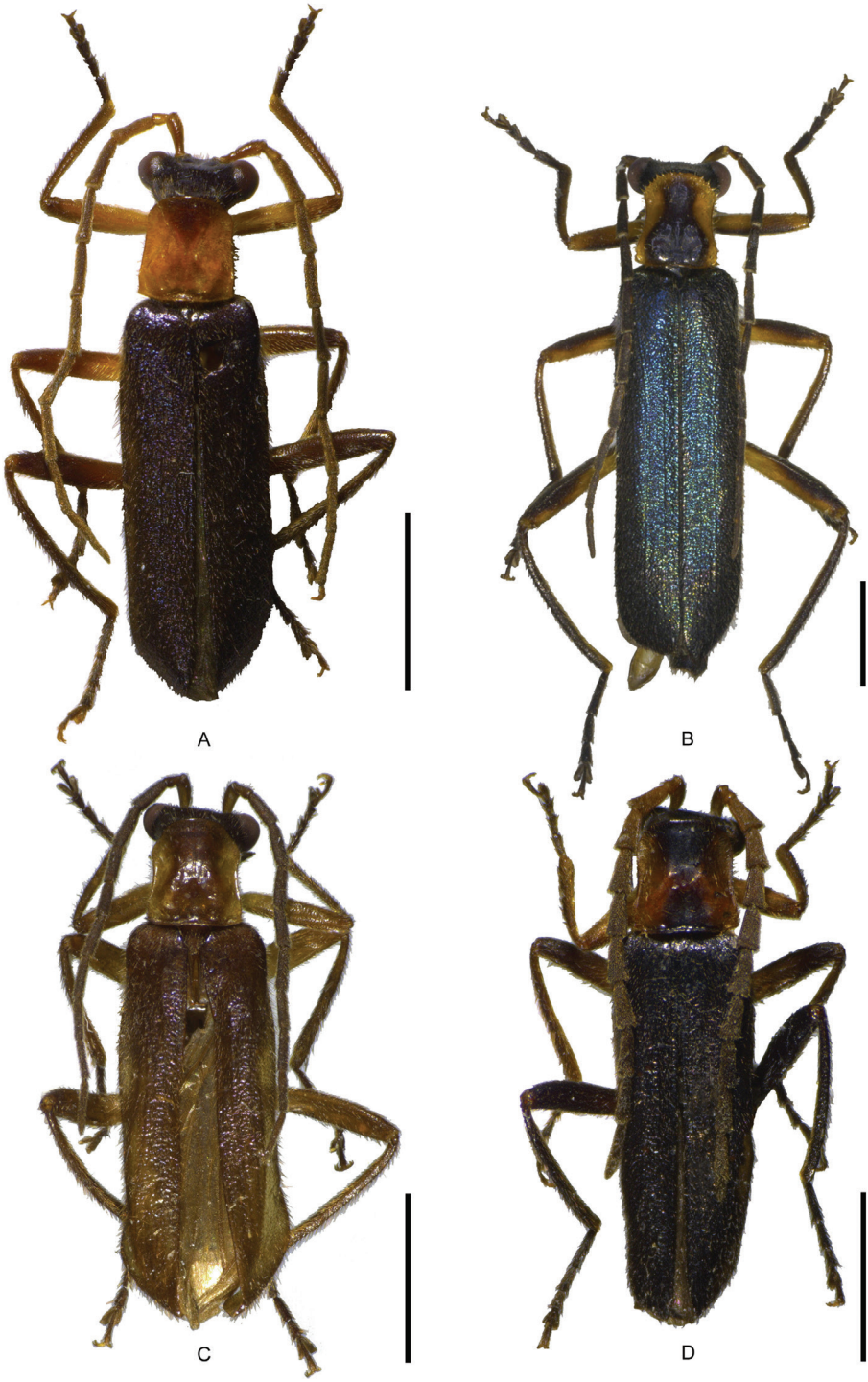


Figure 1. Male habitus, dorsal view: **A** *Fissocantharis sinensis* (Wittmer, 1988) **B** *F. gracilipes* (Pic, 1927) **C** *F. sinensomima* sp. n. **D** *F. sexcostata* sp. n. Scale bars: 2.0 mm.

covered with short decumbent light brown pubescence, also mixed with slightly long semierect pubescence along anterior margin of labrum and on disc of elytra.

Head subquadrate, temples evenly narrowed posteriad, surface semilustrous, finely and densely punctate; eyes strongly protruding, head breadth across eyes distinctly wider than anterior margin of pronotum; maxillary palpomeres IV longer than wide, widest at apical one-third, arcuate and sharp at apical parts of inner margins; antennae almost extending to apical one-third length of elytra, antennomeres II slightly longer than wide at apices, III–X slightly flattened and obliquely widened apically, III about twice as long as II, IV slightly longer than VIII, V–VIII each with a longitudinal smooth impression at apical part of outer margin, XI parallel-sided, slightly longer than X and pointed at apices.

Pronotum about 1.10 times longer than wide, widest near base, anterior margin rounded, anterior angle rounded, lateral margins sinuate, slightly diverging posteriad, posterior angle nearly rectangular, posterior margin arcuate and slightly bordered, disc distinctly convex on postero-lateral parts, surface semilustrous, punctate like that on head.

Elytra about 3.7 times longer than pronotum, 2.8 times longer than humeral width, lateral margins nearly parallel, disc surface semilustrous, rugulose-lacunose and finely punctate.

All tarsal claws bifid, upper claws nearly as long as lower claws.

Aedeagus (Fig. 3A–C): conjoint dorsal plate of parameres well-developed, about half length of ventral processes, nearly parallel-sided, with apical margin tapered apically; ventral process of each paramere evenly narrowed apically, largely hooked at apex.

Female. Similar to male, but eyes not so protruding; antennae shorter, extending to elytral mid-length, antennomeres III–X nearly parallel-sided, V–VIII without impressions; pronotum slightly wider, about 1.05 times longer than wide, moderately convex at posterolateral parts of disc; legs black at profemora. Abdominal sternite VIII (Fig. 8A) slightly emarginated on both sides of posterior margin, middle part between lateral emarginations slightly acute at apex, latero-apical angles widely rounded. Internal organ of reproductive system (Fig. 9A): vagina stout and abruptly narrowed and extended into a long duct above median oviduct; diverticulum and spermathecal duct arising from the end of the long duct of vagina; diverticulum moderately long, thin and spiral; spermathecal duct distinctly thicker and shorter than diverticulum; spermatheca composed of a spiral tube which is distinctly longer than diverticulum, provided with a very long and thin accessory gland which is much longer than the spiral tube of spermatheca; median oviduct situated in middle of vagina.

Body length: 6.5–8.0 mm; width: 1.2–1.7 mm.

Distribution. China (Guangxi, Sichuan).

Remarks. In the original publication (Wittmer 1988), some characteristics of antennae for the male is not indicated, which however is important for diagnosis of *Fissocantharis* species. Herein it is redescribed and also provided with some supplementary characters for abdominal sternite VIII and genitalia of the female.

***Fissocantharis gracilipes* (Pic, 1927)**
Figs 1B, 3D–F, 8B, 9B

Fissopodabrus gracilipes Pic, 1927: 2.
Micropodabrus gracilipes: Wittmer 1982: 127; 1988: 351, figs 5, 24, 25.
Fissocantharis gracilipes: Yang et al. 2009: 49.

Type material examined. Holotype: 1♂ (MNHN): [p]"Tonkin \ Chapa\ 3.V.1918 \ Jeanvoine", [h]"Fissopodabrus \ gracilipes n. sp.", [h]"Micropodabrus \ gracilipes \ (Pic) \ det. W. Wittmer", [p]"TYPE".

Additional material examined. 1♂, 1♀ (MHBU): CHINA: Guangxi, Wuming, Damingshan, 600–900m, 25.V.2011, leg. H.Y. Liu; 2♂♂ (MHBU): same locality and collector, 27.V.2011, 1100m; 2♀♀ (MHBU): same locality and collector, 20.V.2011, 1230–1423m.

Redescription. Male (Fig. 1B). Head black, mouthparts blackish brown, light brown at bases of mandibles and labium, antennae black, prothorax yellow, pronotum with a large blackish brown marking in middle of disc, which extending nearly from anterior to posterior margin, scultellum black, elytra blue, with strong metallic shine, legs black, yellow at coxae, trochanters and ventral sides of femora and tibiae, meso- and metasterna and abdomen black. Body densely covered with short decumbent dark brown pubescence, also mixed with slightly long semierect pubescence along anterior margin of labrum and on disc of elytra.

Head subquadrate, temples evenly narrowed posteriad, surface semilustrous, finely and densely punctate; eyes strongly protruding, head breadth across eyes distinctly wider than anterior margin of pronotum; maxillary palpomeres IV longer than wide, widest at apical one-third, arcuate and sharp at apical parts of inner margins; antennae filiform, almost extending to apical one-fourth length of elytra, antennomeres II slightly longer than wide at apices, III about twice as long as II, IV slightly longer than III, IV–XI each with an oblong smooth scar-like bulge at basal part of outer margin, XI slightly longer than X and pointed at apices.

Pronotum about 1.17 times longer than wide, widest near base, anterior margin rounded, anterior angle rounded, lateral margins sinuate, moderately diverging posteriorly, posterior angle nearly rectangular, posterior margin arcuate and slightly bordered, disc distinctly convex on posterolateral parts, surface semilustrous, sparsely and finely punctate.

Elytra about 4.0 times longer than pronotum, 3.3 times longer than humeral width, lateral margins nearly parallel, disc surface semilustrous, rugulose-lacunose and finely punctate.

All tarsal claws bifid, upper claws nearly as long as lower claws.

Aedeagus (Fig. 3D–F): conjoint dorsal plate of parameres greatly reduced, slightly roundly protuberant in middle of apical margin; ventral process of each paramere abruptly narrowed apically, slightly hooked at apex.

Female. Similar to male, but eyes not so protruding; antennae shorter, extending to elytral mid-length, antennomeres IV–XI without bulges; pronotum slightly wider, about 1.10 times longer than wide, moderately convex at posterolateral parts of disc. Abdominal sternite VIII (Fig. 8B) slightly emarginated on both sides of posterior margin, middle part between lateral emarginations arcuate, latero-apical angles widely rounded. Internal organ of reproductive system (Fig. 9B): vagina stout and abruptly narrowed and extended into a long duct above median oviduct; diverticulum and spermathecal duct arising from the end of the long duct of vagina; diverticulum slightly long, thin and spiral; spermathecal duct distinctly thicker and nearly as long as diverticulum; spermatheca composed of a spiral tube which is distinctly longer than diverticulum, provided with a very long and thin accessory gland which is much longer than the spiral tube of spermatheca; median oviduct situated in middle of vagina.

Body length: 9.0–12.0 mm; width: 1.5–2.5 mm.

Distribution. China (new country record: Guangxi); Vietnam.

Remarks. The elytra of the holotype are purple, but the coloration could be variable in cantharid species bearing a metallic shine, not only in *Fissocantharis*, but also in *Themus* Motschulsky. By contrast, the characteristics of the aedeagus and antennae of the male are much more stable and reliable, which are the basis of our determination of the additional specimens as this species.

Fissocantharis sinensomima Y. Yang & X. Yang, sp. n.

http://zoobank.org/7C83317C-5AEB-4152-BDDA-3CD1CC466459
Figs 1C, 4A–C

Type material. Holotype ♂ (IZAS): CHINA: Guangxi, Napo, Nonghua, 1000m, 14.IV.1998, leg. C.S. Wu.

Description. Male (Fig. 1C). Head black, mouthparts blackish brown, light brown at bases of mandibles and labium, antennae black, yellow at ventral sides of antennomeres I–II, prothorax yellow, pronotum with a large black marking in middle of disc, which extending from anterior to posterior margin, scultellum black, elytra dark purple, with weak metallic shine, legs black, yellow at coxae, trochanters and basal parts of femora, meso- and metasterna and abdomen black. Body densely covered with short decumbent light brown pubescence, also mixed with slightly long semierect pubescence along anterior margin of labrum and on disc of elytra.

Head subquadrate, temples evenly narrowed posteriorly, surface semilustrous, finely and densely punctate; eyes strongly protruding, head breadth across eyes distinctly wider than anterior margin of pronotum; maxillary palpomeres IV longer than wide, widest at apical one-third, arcuate and sharp at apical parts of inner margins; antennae filiform, almost extending to apical one-third length of elytra, antennomeres II slightly longer than wide at apices, III–XI parallel-sided, III about twice as long as II, IV–XI each with a narrow longitudinal smooth impression at basal part of outer margin, IV about one-third longer than III, XI slightly longer than X and pointed at apices.

Pronotum about 1.10 times longer than wide, widest near base, anterior margin rounded, anterior angle rounded, lateral margins sinuate, slightly diverging posteriad, posterior angle nearly rectangular, posterior margin arcuate and slightly bordered, disc distinctly convex on posterolateral parts, surface semilustrous, punctate like that on head.

Elytra about 3.7 times longer than pronotum, 3.0 times longer than humeral width, lateral margins nearly parallel, disc surface semilustrous, rugulose-lacunose and finely punctate.

All tarsal claws bifid, upper claws nearly as long as lower claws.

Aedeagus (Figs 4A–C): conjoint dorsal plate of parameres greatly reduced, slightly emarginated in middle of apical margin; ventral process of each paramere evenly narrowed apically, largely hooked at apex.

Female. Unknown.

Body length: 6.0 mm; width: 1.5 mm.

Diagnosis. This species is similar to *F. sinensis*, but can be distinguished by the antennomeres IV–XI each with a narrow longitudinal smooth impression along basal part of outer margin in male; aedeagus: conjoint dorsal plate of parameres greatly reduced, slightly emarginated in middle of apical margin.

Distribution. China (Guangxi).

Etymology. The specific name is derived from Latin *mimus* (similar, imitating something), referring to its similarity to *F. sinensis* (Wittmer, 1988).

***Fissocantharis sexcostata* Y. Yang & X. Yang, sp. n.**

http://zoobank.org/CF675FDA-2F8C-44E8-960B-DB392B95F153

Figs 1D, 4D–F, 8C, 9C

Type material. Holotype ♂ (IZAS): CHINA: Guangxi, Jinxiu, Huawangshanzhuang, 600m, 20.V.1999, leg. M.Y. Gao. Paratypes: 1♂, 2♀♀ (IZAS): same data as the holotype; 2♂♂ (IZAS): same locality and date, leg. Y.Z. Zhang; 1♂ (IZAS): same locality and date, leg. H. Xiao; 1♀ (IZAS): same locality and date, leg. W. Z. Li; 1♂ (IZAS): same locality and date, leg. H.X. Han; 1♀ (IZAS): same locality and date, leg. X.K. Li; 1♀ (IZAS): same locality and date, leg. D.C. Yuan.

Description. Male (Fig. 1D). Head black, mouthparts blackish brown, light brown at bases of mandibles and labium, antennae black, orange at antennomeres I–II and ventral sides of III, prothorax orange, pronotum with a large inverse-triangular and a slightly small triangular black markings in middle of anterior and posterior parts of disc respectively, two markings almost conjoint, scultellum black, elytra dark purple, with weak metallic shine, legs black, yellow at pro-coxae, trochanters and femora and meso-trochanters and bases of femora, meso- and metasterna and abdomen black. Body densely covered with short decumbent light brown pubescence, also mixed with slightly long semierect pubescence along anterior margin of labrum and on disc of elytra.

Head subquadrate, temples evenly narrowed posteriorly, surface semilustrous, finely and densely punctate; eyes moderately protruding, head breadth across eyes dis-

tinctly wider than anterior margin of pronotum; maxillary palpomeres IV longer than wide, widest at apical one-third, arcuate and sharp at apical parts of inner margins; antennae almost extending to apical one-third length of elytra, antennomeres II nearly as long as wide at apices, III–X slightly widened apically, nearly long-triangular, the whole length of III–VII and basal two-thirds length of VIII each with a longitudinal ridge along outer margin, IV slightly longer than III, XI parallel-sided, slightly longer than X and pointed at apices.

Pronotum about 1.10 times longer than wide, widest near base, anterior margin rounded, anterior angle rounded, lateral margins slightly sinuate and diverging posteriad, posterior angle nearly rectangular, posterior margin arcuate and slightly bordered, disc distinctly convex on posterolateral parts, surface semilustrous, punctate like that on head.

Elytra about 3.4 times longer than pronotum, 3.0 times longer than humeral width, lateral margins nearly parallel, disc surface semilustrous, rugulose-lacunose and finely punctate.

All tarsal claws bifid, upper claws nearly as long as lower claws.

Aedeagus (Fig. 4D–F): conjoint dorsal plate of parameres moderately reduced, distinctly shorter than ventral process, with apical margin tapered apically; ventral process of each paramere evenly narrowed apically, largely hooked at apex.

Female. Similar to male, but eyes not so protruding; antennae uniformly black, antennomeres III–X nearly parallel-sided, III–VIII without ridges; pronotum slightly wider, about 1.12 times longer than wide, lateral margins sinuate, moderately diverging posteriad, moderately convex at posterolateral parts of disc, legs orange at procoxae and trochanters. Abdominal sternite VIII (Fig. 8C) slightly emarginated on both sides of posterior margin, middle part between lateral emarginations slightly arcuate, latero-apical angles narrowly rounded. Internal organ of reproductive system (Fig. 9C): vagina stout and abruptly narrowed and extended into a long duct above median oviduct; diverticulum and spermathecal duct arising from the end of the long duct of vagina; diverticulum slightly long, thin and spiral; spermathecal duct distinctly thicker and shorter than diverticulum; spermatheca composed of a spiral tube which is distinctly longer than diverticulum, provided with a long and thin accessory gland which is slightly longer than the spiral tube of spermatheca; median oviduct situated in middle of vagina.

Body length: 6.0–10.0 mm; width: 1.2–2.0 mm.

Diagnosis. This species is similar to *F. sinensis*, but can be easily differentiated by the antennomeres III–VIII with longitudinal ridges along outer margins in male; aedeagus: conjoint dorsal plate of parameres moderately reduced.

Distribution. China (Guangxi).

Etymology. The specific name is derived from Latin *sex-* (six) and *costatus* (ridged), referring to its antnnomeres III–VIII with longitudinal ridges (six ridges in total) along outer margins in male.

Remarks. Sometimes the pronotum is uniformly orange, without any black markings, and this variation always occurs on the females.

***Fissocantharis basilaris* Y. Yang & X. Yang, sp. n.**
http://zoobank.org/397D3015-0CA8-4805-B017-DEBC7BBCC54F
Figs 2A, 5A–C, 8D, 10A

Fissocantharis langaniformis (Wittmer, 1989): Yang et al. 2014: 14 [misidentification].

Type material. Holotype ♂ (MHBU): CHINA: Guangxi: Wuming, Damingshan, 1100m, 27.V.2011, leg. H.Y. Liu. Paratypes: CHINA: Guangxi: 26♂♂, 17♀♀ (MHBU): same data to the holotype; 20♂♂, 13♀♀ (MHBU): same locality and collector, 1230−1423m, 20.V.2011; 4♂♂, 4♀♀ (MHBU): same locality and collector, 600–900m, 25.V.2011; 1♀ (MHBU): same locality, 23.V 2011, leg. Li-Ying Guo.

Description. Male (Fig. 2A). Head black, mouthparts blackish brown, light brown at bases of mandibles and labium, antennae black, yellow at ventral sides of antennomeres I−III, pronotum black, scultellum black, elytra blue, with strong metallic shine, legs black, yellow at apical parts of coxae, trochanters and basal parts of femora, presternum dark brown, meso- and metasterna and abdomen black. Body densely covered with short decumbent dark brown pubescence, also mixed with slightly long semierect pubescence along anterior margin of labrum and on disc of elytra.

Head subquadrate, temples evenly narrowed posteriad, surface semilustrous, finely and densely punctate; eyes strongly protruding, head breadth across eyes distinctly wider than anterior margin of pronotum; maxillary palpomeres IV longer than wide, widest at apical one-third, arcuate and sharp at apical parts of inner margins; antennae almost extending to apical one-fourth length of elytra, antennomeres II slightly longer than wide at apices, III−X slightly flattened and widened apically, III about twice as long as II, IV−XI each with a small rounded smooth impression at base of outer margin, IV about one-third longer than III, XI nearly parallel-sided, slightly longer than X and pointed at apices.

Pronotum about 1.26 times longer than wide, widest near base, anterior margin rounded, anterior angle rounded, lateral margins sinuate, moderately diverging posteriorly, posterior angle nearly rectangular, posterior margin arcuate and slightly bordered, disc distinctly convex on posterolateral parts, surface semilustrous, punctate like that on head.

Elytra about 4.0 times longer than pronotum, 3.0 times longer than humeral width, lateral margins nearly parallel, disc surface semilustrous, rugulose-lacunose and finely punctate.

All tarsal claws bifid, upper claws nearly as long as lower claws.

Aedeagus (Fig. 5A−C): conjoint dorsal plate of parameres greatly reduced, rounded at apical margin; ventral process of each paramere evenly narrowed apically, slightly hooked at apex.

Female. Similar to male, but eyes not so protruding; antennae shorter, extending to elytral mid-length, antennomeres III−X nearly parallel-sided, IV−XI without impressions; pronotum slightly wider, about 1.13 times longer than wide, moderately

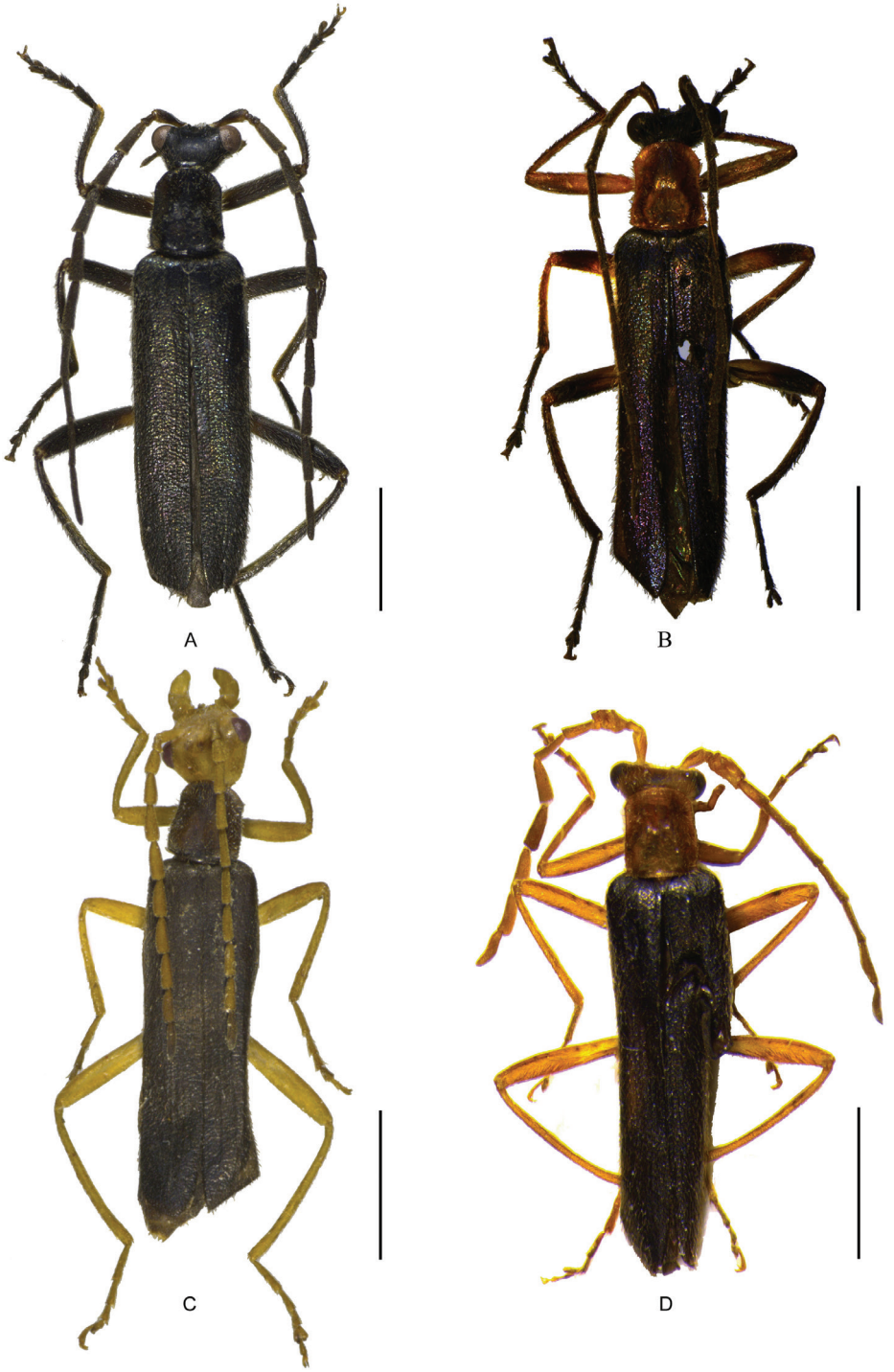


Figure 2. Male habitus, dorsal view: **A** *Fissocantharis basilaris* sp. n. **B** *F. eschara* sp. n. **C** *F. latipalpa* sp. n. **D** *F. biprojicientis* sp. n. Scale bars: 2.0 mm.

convex at postero-lateral parts of disc. Abdominal sternite VIII (Fig. 8D) roundly protuberant in middle of posterior margin, latero-apical angels subrounded. Internal organ of reproductive system (Fig. 10A): vagina stout and abruptly narrowed and extended into a long duct above median oviduct; diverticulum and spermathecal duct arising from the end of the long duct of vagina; diverticulum slightly long, thin and spiral; spermathecal duct distinctly thicker and slightly shorter than diverticulum; spermatheca composed of a spiral tube which is distinctly longer than diverticulum, provided with a very long and thin accessory gland, which is much longer than the spiral tube of spermatheca; median oviduct situated in middle of vagina.

Body length: 7.0−11.0 mm; width: 1.2−2.0 mm.

Diagnosis. This species is similar to *F. langaniformis* (Wittmer, 1989), but can be distinguished from the latter by the antennomeres IV−XI each with a rounded smooth impression at base of outer margin in male; aedeagus: conjoint dorsal plate of parameres rounded at apical margin.

Distribution. China (Guangxi).

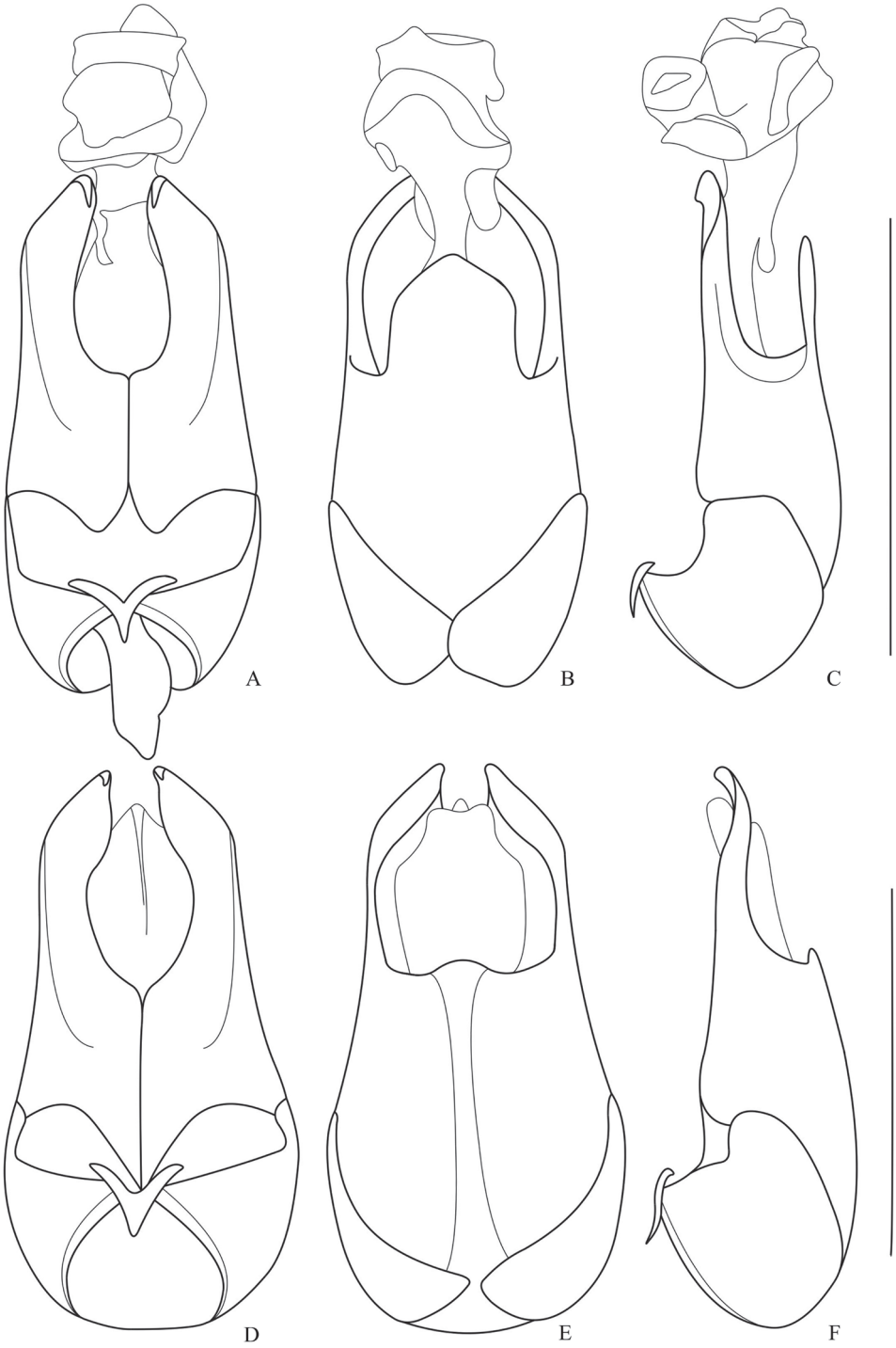
Etymology. The specific name is derived from Latin *basilaris* (basal), referring to its antennomeres IV−XI each with a rounded impression at base of outer margin in male.

***Fissocantharis eschara* Y. Yang & X. Yang, sp. n.**
http://zoobank.org/741C5C3E-BE67-4F1B-8459-AF80116E3C7A
Figs 2B, 5D−F, 8E, 10B

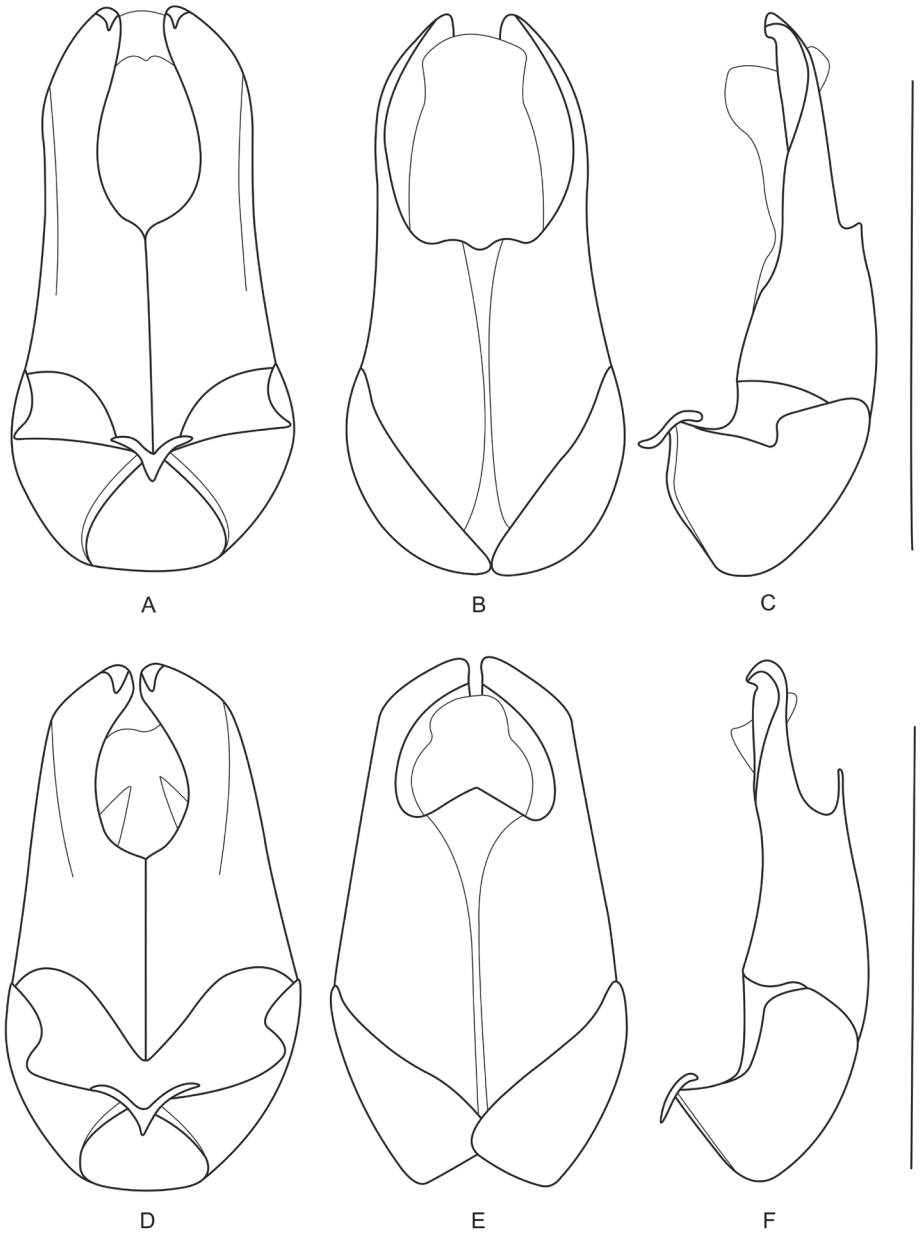
Type material. Holotype ♂ (IZAS): CHINA: Guangxi: Jinxiu, Rd. Jinzhong, 1100m, 11.V.1999, leg. D.C. Yuan. Paratypes: CHINA: Guangxi: 1♂ (IZAS): same locality as the holotype, 12.V.1999, leg. W.Z. Li; 1♀ (IZAS): same locality, 12.V.1999, leg. X.K. Yang; 1♀ (IZAS): same locality, 10.V.1999, leg. X.K. Yang; 1♀ (IZAS): same locality, 1000m, 10.V.1999, leg. F.S. Huang; 1♂ (IZAS): same locality, 1000m, 12.V.1999, leg. X.Z. Zhang; 2♀♀ (IZAS): same locality, 1000m, 12.V.1999, leg. M.Y. Gao; 1♂, 1♀ (IZAS): Jinxiu, Fenzhan, 13.V.1999, leg. H. Xiao; 1♂ (IZAS): Jinxiu, Luoxiang, 400m, 15.V.1999, leg. D.C. Yuan; 1♀ (IZAS): same data, leg. D.J. Liu; 1♀ (IZAS): same locality and date, 200m, leg. X.Z. Zhang.

Description. Male (Fig. 2B). Head black, mouthparts blackish brown, light brown at bases of mandibles and labium, antennae black, yellow at ventral sides of antennomeres I−II, prothorax orange, scultellum black, elytra dark purple, with weak metallic shine, legs black, yellow at coxae, trochanters and basal parts of femora, meso- and metasterna and abdomen black. Body densely covered with short decumbent light brown pubescence, also mixed with slightly long semierect pubescence along anterior margin of labrum and on disc of elytra.

Head subquadrate, temples evenly narrowed posteriorly, surface semilustrous, finely and densely punctate; eyes strongly protruding, head breadth across eyes distinctly wider than anterior margin of pronotum; maxillary palpomeres IV longer than wide, widest at apical one-third, arcuate and sharp at apical parts of inner margins;

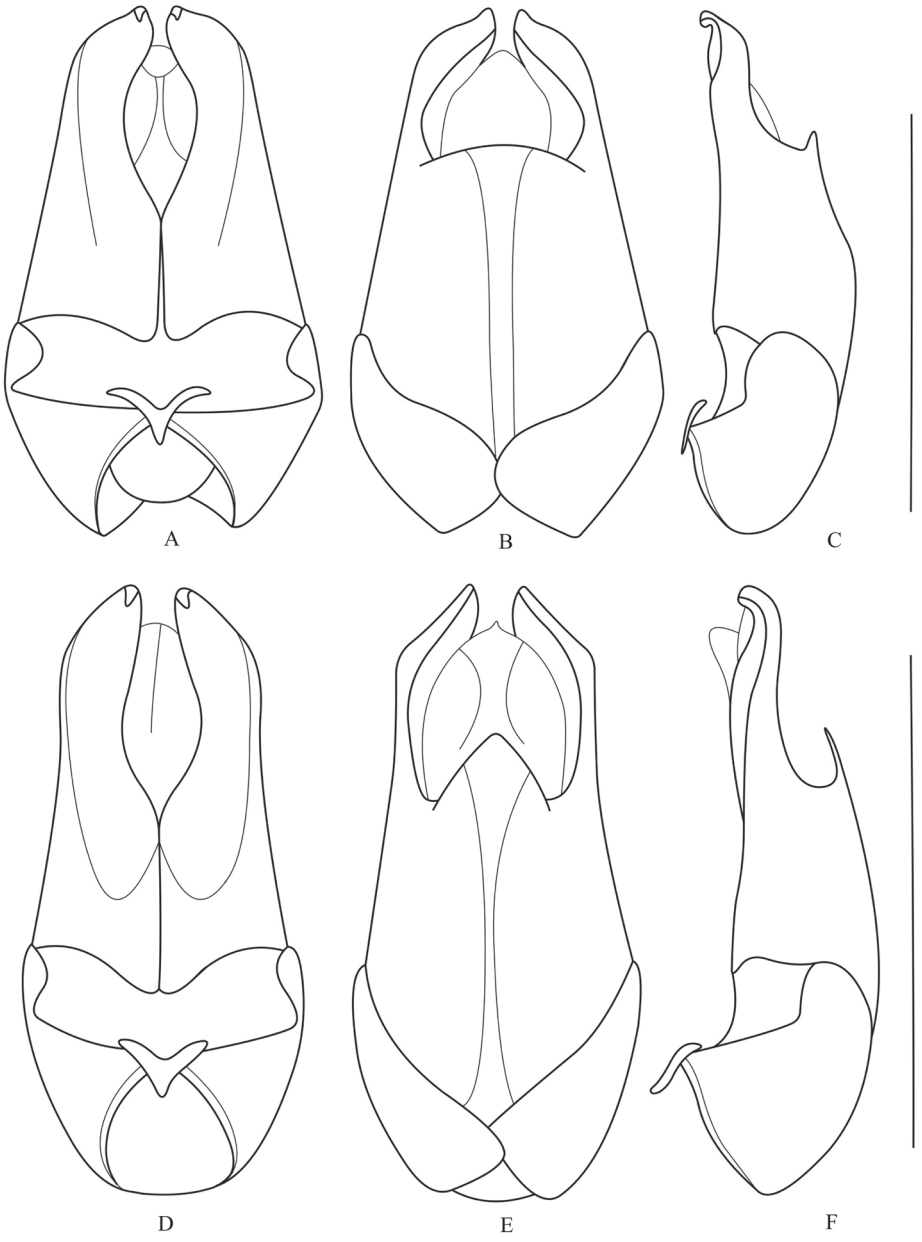


Figures 3. Aedeagus (**A, D** ventral view **B, E** dorsal view **C, F** lateral view): **A–C** *Fissocantharis sinensis* (Wittmer, 1988) **D–F** *F. gracilipes* (Pic, 1927). Scale bars: 1.0 mm.



Figures 4. Aedeagus (**A, D** ventral view **B, E** dorsal view **C, F** lateral view): **A–C** *Fissocantharis sinensomima* sp. n. **D–F** *F. sexcostata* sp. n. Scale bars: 1.0 mm.

antennae filiform, nearly extending to elytral apices, antennomeres II slightly longer than wide at apices, III about twice as long as II, IV–XI each with an oblong smooth scar-like bulge at basal part of outer margin, IV slightly longer than III, XI slightly shorter than X and pointed at apices.



Figures 5. Aedeagus (**A, D** ventral view **B, E** dorsal view **C, F** lateral view): **A–C** *Fissocantharis basilaris* sp. n. **D–F** *F. eschara* sp. n. Scale bars: 1.0 mm.

Pronotum about 1.29 times longer than wide, widest near base, anterior margin rounded, anterior angle rounded, lateral margins slightly sinuate and diverging posteriad, posterior angle nearly rectangular, posterior margin arcuate and slightly bordered, disc distinctly convex on posterolateral parts, surface semilustrous, punctate like that on head.

Elytra about 4.0 times longer than pronotum, 3.0 times longer than humeral width, lateral margins nearly parallel, disc surface semilustrous, rugulose-lacunose and finely punctate.

All tarsal claws bifid, upper claws nearly as long as lower claws.

Aedeagus (Fig. 5D–F): conjoint dorsal plate of parameres moderately reduced, distinctly shorter than ventral processes, with apical margin tapered apically; ventral process of each paramere evenly narrowed apically, moderately hooked at apex.

Female. Similar to male, but eyes not so protruding; antennae uniformly black, antennomeres IV–XI without scar-like bulges; pronotum slightly wider, about 1.13 times longer than wide, lateral margins sinuate, moderately diverging posteriorly, moderately convex at posterolateral parts of disc, legs orange at pro-coxae and trochanters. Abdominal sternite VIII (Fig. 8E) slightly protuberant on both sides of posterior margin, latero-apical angles subrounded. Internal organ of reproductive system (Fig. 10B): vagina stout and abruptly narrowed and extended into a long duct above median oviduct; diverticulum and spermathecal duct arising from the end of the long duct of vagina; diverticulum slightly long, thin and spiral; spermathecal duct distinctly thicker and slightly shorter than diverticulum; spermatheca composed of a spiral tube which is distinctly longer than diverticulum, provided with a very long and thin accessory gland (surrounded with a slightly sclerotized sheath, which is hard to be stripped) which is slightly longer than the spiral tube of spermatheca; median oviduct situated in middle of vagina.

Body length: 6.5–9.0 mm; width: 1.2–1.8 mm.

Diagnosis. This species is similar to *F. gracilipes* (Pic, 1927), but differs in the smaller body; aedeagus: conjoint dorsal plate of parameres moderately reduced, ventral process of each paramere evenly narrowed apically, moderately hooked at apex.

Distribution. China (Guangxi).

Etymology. The specific name is derived from Latin *eschara* (scar), referring its antennomeres IV–XI with scar-like bulges along the outer margins in male.

Remarks. Sometimes the pronotum presents with a large inverse-triangular and a slightly small triangular black marking in middle of anterior and posterior parts of disc respectively, which are almost conjoint.

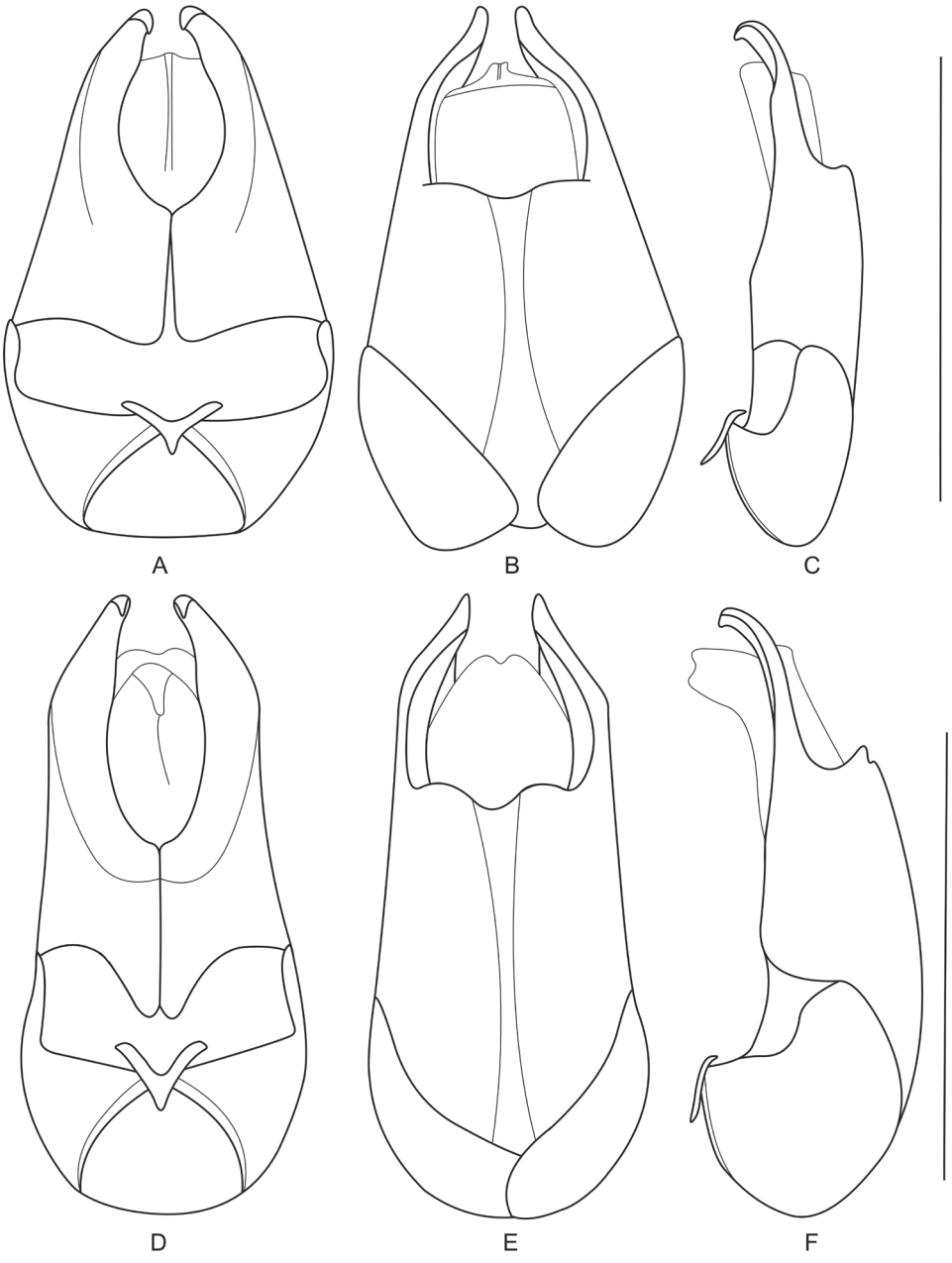
***Fissocantharis latipalpa* Y. Yang & X. Yang, sp. n.**

http://zoobank.org/9457F8A6-3CB0-4F3F-9366-343F417EA593

Figs 2C, 6A–C, 8F, 10C

Type material. Holotype ♂ (MHBU): CHINA: Guangxi, Mao'ershan, 1235m, 2.VI.2011, leg. H.Y. Liu. Paratypes: CHINA: Guangxi: 3♀♀ (MHBU): same data as the holotype.

Description. Male (Fig. 2C). Head yellow, mouthparts yellow, dark brown at apices of mandibles, antennae yellow, slightly darkened at antennomeres XI, pronotum, scultellum and elytra black, legs yellow, slightly darkened at tarsomeres IV–V, prosternum yellow, meso- and metasterna black, abdomen black, light yellow at posterior



Figures 6. Aedeagus (**A, D** ventral view **B, E** dorsal view **C, F** lateral view): **A–C** *Fissocantharis latipalpa* sp. n. **D–F** *F. biprojicientis* sp. n. Scale bars: 1.0 mm.

margins of all visible abdominal sternites and apical half of IX. Body densely covered with short decumbent light yellow pubescence, also mixed with slightly long semierect pubescence along anterior margin of labrum and on disc of elytra.

Head subquadrate, temples evenly narrowed posteriad, surface semilustrous, finely and sparsely punctate; eyes slightly protruding, head breadth across eyes distinctly wider than anterior margin of pronotum; maxillary palpomeres II–IV distinctly flattened and widened, II mountain-shapely convex at outer parts of dorsal sides, III wider than long, slightly widened apically, IV longer than wide, distinctly narrowed apically, with outer margin arcuate and sharp at apical part; antennae extending to elytral mid-length, antennomeres II nearly as long as wide at apices, III–X slightly widened apically, III about 1.5 times as long as wide, IV about one-third longer than III, VI longest, XI slightly longer than X, nearly parallel-sided and pointed at apex.

Pronotum about 1.13 times longer than wide, anterior margin rounded, anterior angle rounded, lateral margins slightly diverging posteriorly, posteriad angle nearly rectangular, posterior margin arcuate and slightly bordered, disc moderately convex on postero-lateral parts, surface semilustrous, sparsely and finely punctate.

Elytra about 4.3 times longer than pronotum, 3.0 times longer than humeral width, lateral margins nearly parallel, disc surface semilustrous, rugulose-lacunose and finely punctate.

All tarsal claws bifid, upper claws nearly as long as lower claws.

Aedeagus (Fig. 6A–C): conjoint dorsal plate of parameres greatly reduced, slightly roundly emarginated in middle of apical margin; ventral process of each paramere evenly narrowed apically, largely hooked at apex.

Female. Similar to male, but maxillary palpi normal; antennae shorter, extending to basal one-third length of elytra, antennomeres II about 1.5 times as long as wide at apices, III–X parallel-sided; pronotum slightly wider, nearly as long as wide, slightly convex at postero-lateral parts of disc; elytra with lateral margins slightly diverging posteriad. Abdominal sternite VIII (Fig. 8F) slightly emarginated on both sides of posterior margin, middle part between lateral emarginations subtruncated, latero-apical angles widely rounded. Internal organ of reproductive system (Fig. 10C): vagina stout and abruptly narrowed and extended into a long duct above median oviduct; diverticulum and spermathecal duct arising from the end of the long duct of vagina; diverticulum moderately long, thin and spiral; spermathecal duct distinctly thicker and shorter than diverticulum; spermatheca composed of a spiral tube which is nearly as long as diverticulum, provided with a moderately long and thin accessory gland, which is nearly as long as the spiral tube of spermatheca; median oviduct situated in middle of vagina.

Body length: 6.5–7.5 mm; width: 1.3–1.5 mm.

Diagnosis. This species is similar to *F. pallidiceps* (Pic, 1911), but can be easily distinguished from the latter by the characteristic maxillary palpi in the male, of which palpomeres II–IV are flattened and widened; aedeagus: conjoint dorsal plate of parameres greatly reduced, slightly emarginated in middle of apical margin.

Distribution. China (Guangxi).

Etymology. The specific name is derived from Latin *latus* (wide) and *palpus* (palp), referring to its maxillary palpomeres II–IV flattened and widened in male.

***Fissocantharis biprojicientis* Y. Yang & X. Yang, sp. n.**
http://zoobank.org/5F4FCF35-FB3C-4A5D-BE0F-65D6CB409F53
Figs 2D, 6D–F, 7, 8G, 10D

Type material. Holotype ♂ (IZAS): CHINA: Guangxi, Jinxiu, Rd. Jinzhong, 1100m, 10.V.1999, leg. D.C. Yuan. Paratypes: CHINA: Guangxi: 1♀ (IZAS): Jinxiu, Shengtangshan, 700–800m, 19.V.1999, leg. H. Xiao. 1♀ (IZAS): same locality, 900–1900m, 17.V.1999, leg. H.X. Han; 1♀ (IZAS): Yonghe, 500m, 11.V.1999, leg. H. Xiao.

Description. Male (Fig. 2D). Head and mouthparts orange, dark brown at apices of mandibles, terminal maxillary and labial palpomeres and antennae black, antennomeres I–IV and basal parts of V, prothorax and legs orange, darkened at tarsomeres II–V, the rest parts of body black. Body densely covered with short decumbent light orange pubescence, also mixed with slightly long semierect pubescence along anterior margin of labrum and on disc of elytra.

Head subquadrate, temples evenly narrowed posteriad, surface semilustrous, finely and sparsely punctate; eyes slightly protruding, head breadth across eyes distinctly wider than anterior margin of pronotum; maxillary palpomeres II–III excavated wholly on dorsal sides, IV longer than wide, nearly parallel-sided, arcuate and sharp at apices; antennae (Fig. 7) extending to elytral mid-length, antennomeres II short, about twice wider than long, III strongly widened apically, with outer-apical angle distinctly projecting laterad, IV thickened and excavated at ventral sides, with two long and pointed projections at basal parts, dorsal projections slightly shorter than ventral ones, which are triangularly protuberant at lower margins near apices, V–X slightly widened apically, XI slightly shorter than X and pointed at apices.

Pronotum about 1.22 times longer than wide, anterior margin rounded, anterior angle distinctly rounded, lateral margins nearly parallel, posterior angle nearly rectangular, posterior margin arcuate and slightly bordered, disc moderately convex on postero-lateral parts, surface semilustrous, sparsely and finely punctate.

Elytra about 4.3 times longer than pronotum, 3.5 times longer than humeral width, lateral margins nearly parallel, disc surface semilustrous, rugulose-lacunose and finely punctate.

All tarsal claws bifid, upper claws nearly as long as lower claws.

Aedeagus (Figs 6D–F): conjoint dorsal plate of parameres greatly reduced, roundly emarginated in middle of apical margin; ventral process of each paramere evenly narrowed apically at apical part, which distinctly narrower than basal part, moderately hooked at apex.

Female. Similar to male, but maxillary palpi normal; antennae orange at antennomeres I–III and bases of IV, II about twice longer than wide, III–IV normal; pronotum slightly wider, about 1.12 times longer than wide, slightly convex at postero-lateral parts of disc. Abdominal sternite VIII (Fig. 8G) triangularly emarginated on both sides and roundly emarginated in middle of posterior margin, the parts between lateral and middle emarginations subrounded at apices, latero-apical angles widely rounded.

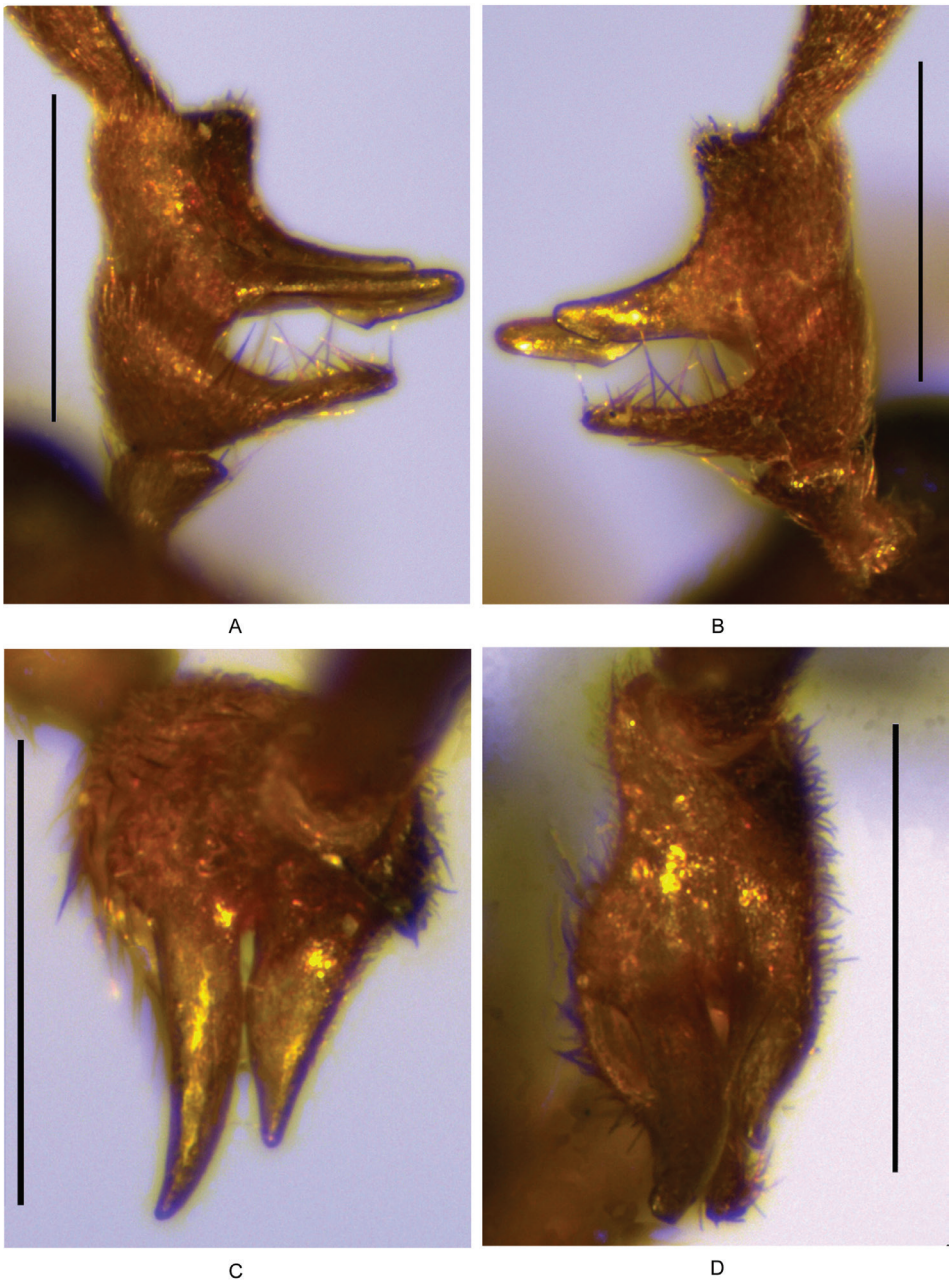


Figure 7. Male antennomeres III–IV of *Fissocantharis biprojicientis* sp. n.: **A** ventral view **B** dorsal view **C** apical view **D** ventroapical view. Scale bars: 1.0 mm.

Internal organ of reproductive system (Fig. 10D): vagina stout and abruptly narrowed and extended into a long duct above median oviduct; diverticulum and spermathecal duct arising from the end of the long duct of vagina; diverticulum moderately long,

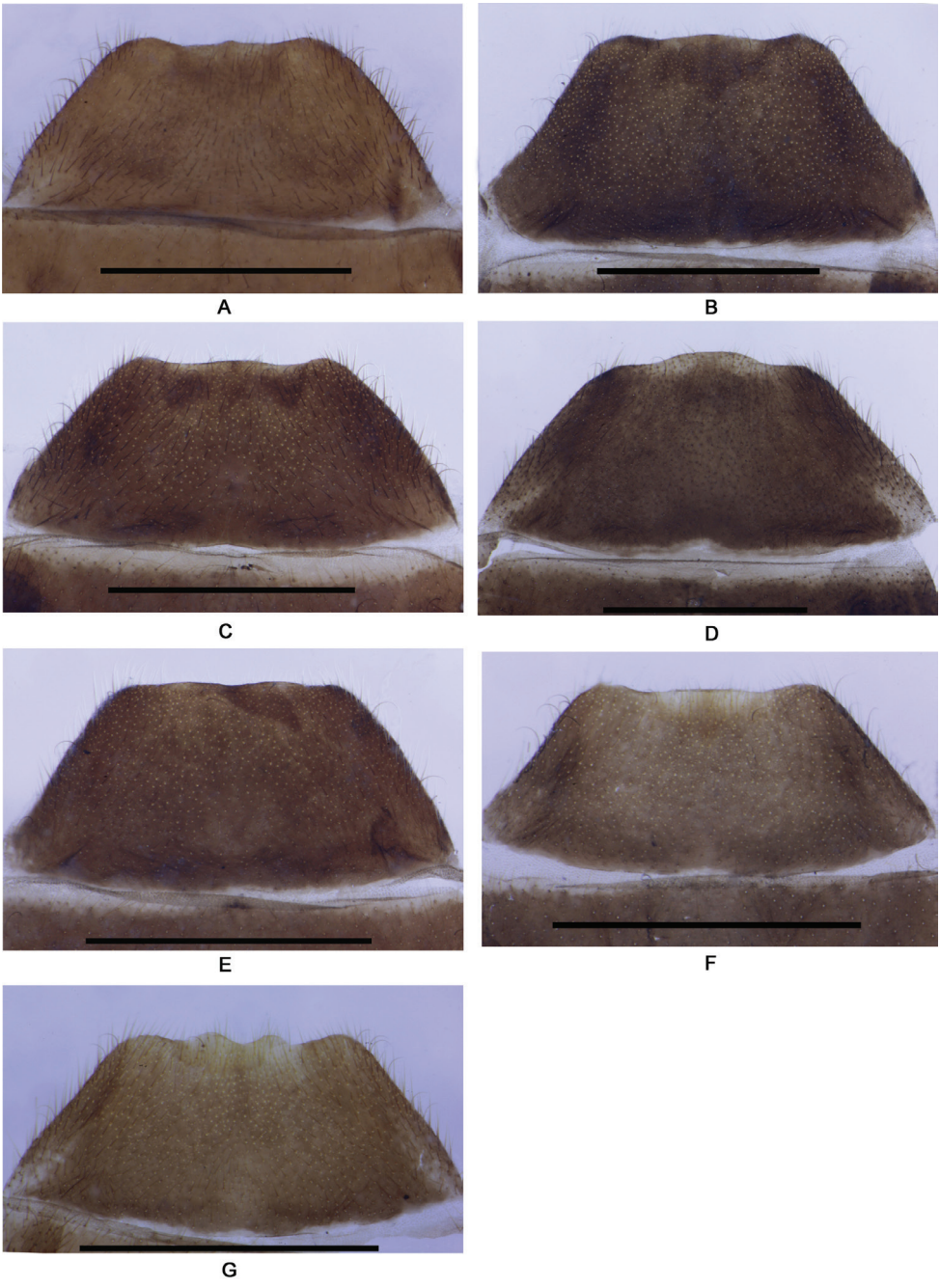


Figure 8. Abdominal sternite VIII of female, ventral view: **A** *Fissocantharis sinensis* (Wittmer, 1988) **B** *F. gracilipes* (Pic, 1927) **C** *F. sexcostata* sp. n. **D** *F. basilaris* sp. n. **E** *F. eschara* sp. n. **F** *F. latipalpa* sp. n. **G** *F. biprojicientis* sp. n. Scale bars: 1.0 mm.

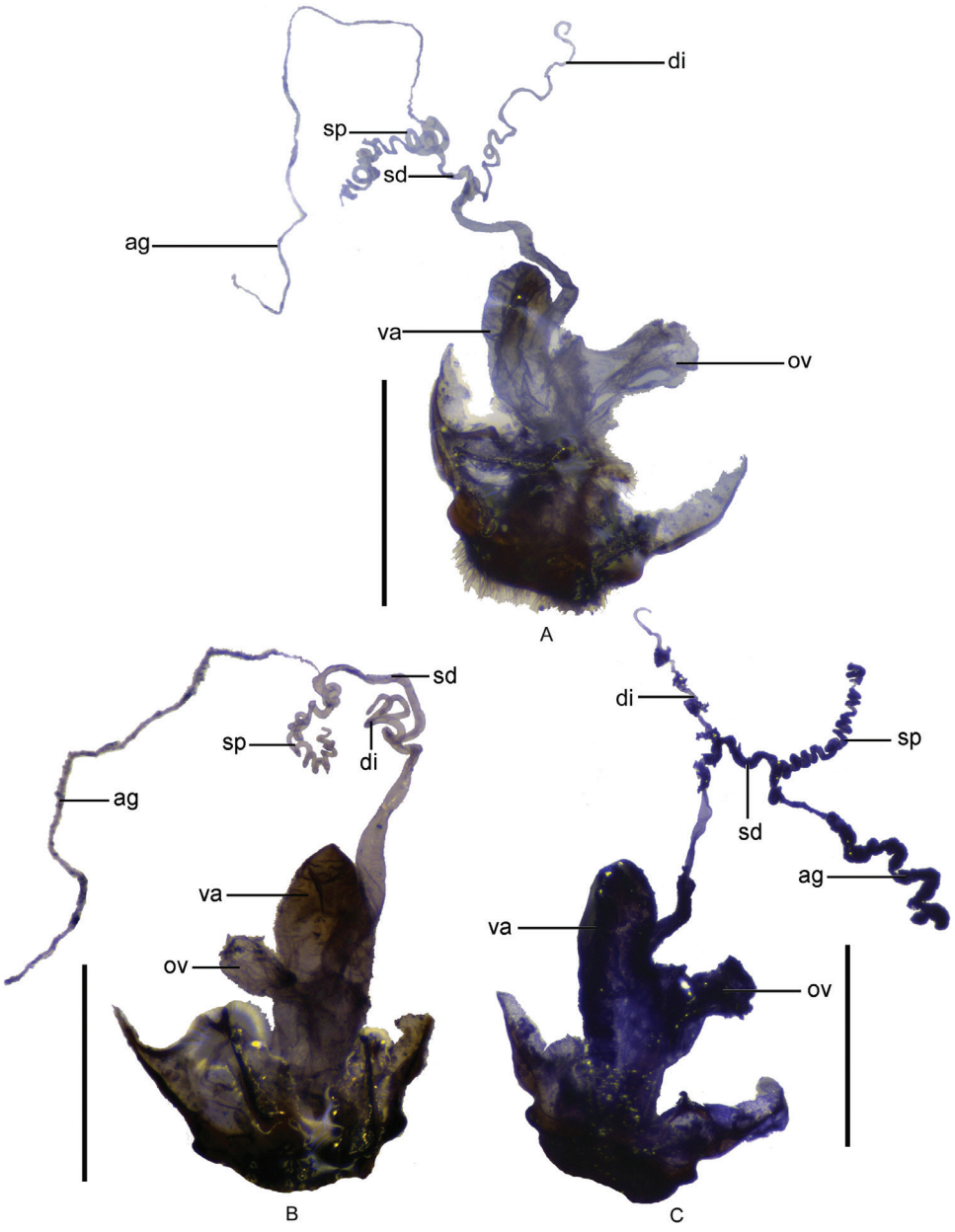


Figure 9. Female genitalia: **A** *Fissocantharis sinensis* (Wittmer, 1988) **B** *F. gracilipes* (Pic, 1927) **C** *F. sexcostata* sp. n. Scale bars: 1.0 mm.

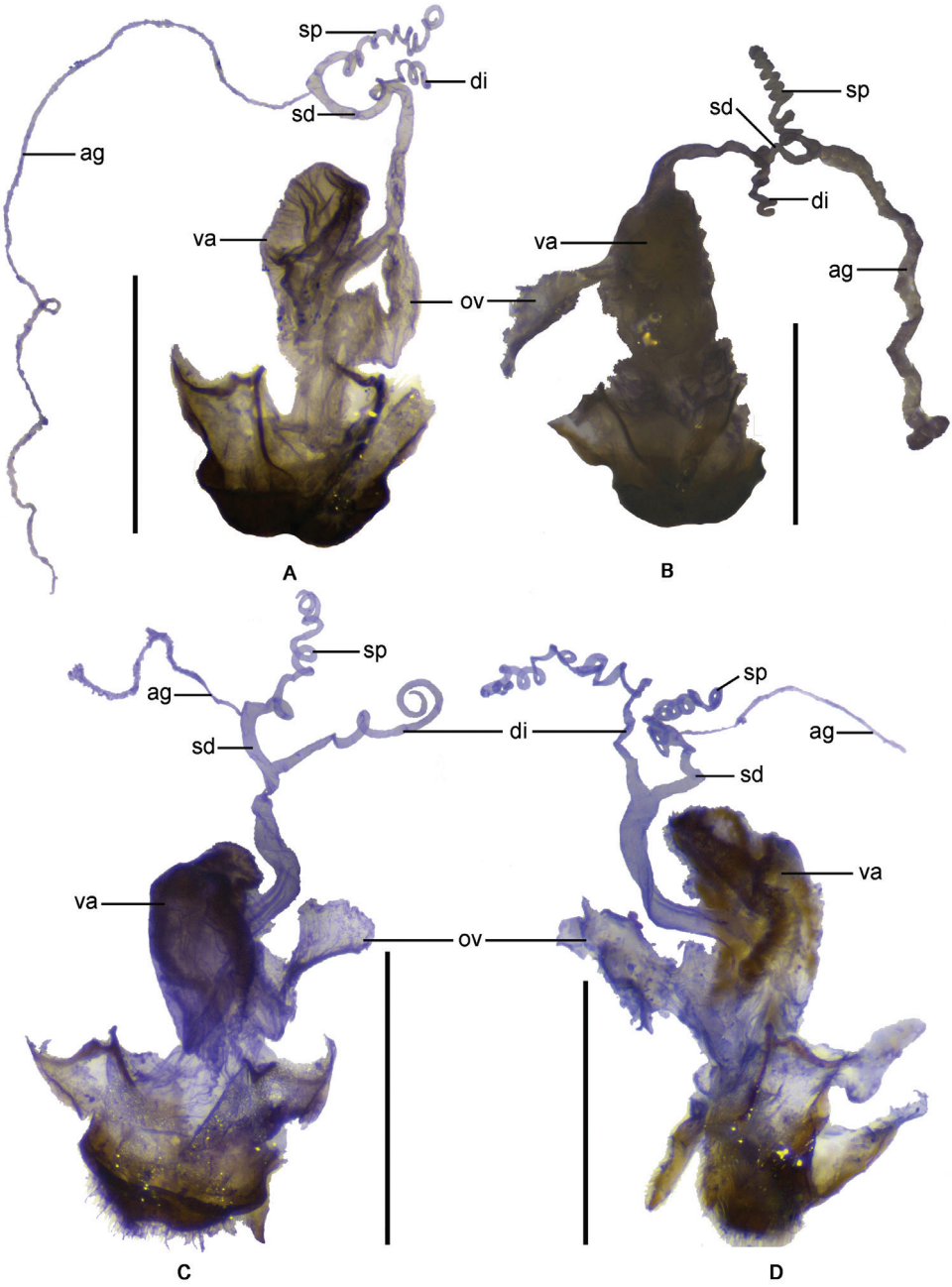


Figure 10. Female genitalia: **A** *Fissocantharis basilaris* sp. n. **B** *F. eschara* sp. n. **C** *F. latipalpa* sp. n. **D** *F. biprojicientis* sp. n. Scale bars: 1.0 mm.

thin and spiral; spermathecal duct distinctly thicker and shorter than diverticulum; spermatheca composed of a spiral tube which is slightly shorter than diverticulum, provided with a moderately long and thin accessory gland, which is slightly shorter than the spiral tube of spermatheca; median oviduct situated in middle of vagina.

Body length: 7.0−9.0 mm; width: 1.5−1.8 mm.

Diagnosis. This species is similar to *F. bidifformis* (Wittmer, 1988), but it can be differentiated from the latter by the antennomeres IV with two projections on the basal part in the male; aedeagus: conjoint dorsal plate of parameres greatly reduced, roundly emarginated in middle of apical margin.

Distribution. China (Guangxi).

Etymology. The specific name is derived from the suffix *bi-* (two) and *projicientis* (projecting), referring to its antennomere IV with two projections om the basal part in the male.

Other species of *Fissocantharis* known from Guangxi, China

Fissocantharis angusta (Fairmaire, 1900)

Podabrus angustus Fairmaire, 1900: 624.
Podabrus flavofacialis Pic, 1926: 29. **syn. n.**
Podabrus denticornis Wittmer, 1951: 96, fig. 2. Synonymized with *Podabrus flavofacialis* Pic by Wittmer 1988: 357.
Micropodabrus angustus: Wittmer 1988: 344.
Micropodabrus flavofacialis: Wittmer 1988: 357.
Fissocantharis angusta: Yang et al. 2009: 49.
Fissocantharis flavofacialis: Yang et al. 2009: 49.

Type material examined. *Podabrus angustus*: Holotype: 1♀ (MNHN): "Fokien" [China: Fujian], "Podabrus \ angustus \ Fairm. China", "Micropodabrus \ angustus \ (Fairm.) \ det. W. Wittmer", "HOLOTYPUS". Paratypes: 1♂, 1♀ (MNHN): de Latouche, 1900, H. Donckier.

Podabrus flavofacialis: Holotype: 1♂ (MNHN): "Fokien", "flavofacialis \ Pic", "Micropodabrus \ flavofacialis \ (Pic) \ det. W. Wittmer", "HOLOTYPUS".

Podabrus denticornis: Holotype: 1♂ (ZFMK): "Kuatun (2300m) 27.40n. Br.\117.40ö.L. J. Klappperich \ 28.5.1938 (Fukien)", "Holotypus \ Podabrus \ denticornis \ Wittmer 49, n. sp.", "Podabrus \ denticornis \ Wittm.", "Micropodabrus \ flavofacialis \ (Pic) \ det. W. Wittmer", "MUSEUM KOENIG \ BONN". Paratypes: 1♀ (MNHN): same data, 12.5.1938; 1♀ (MNHN): same data, 19.5.1938;

1♀ (MNHN): same data, 20.5.1938; 1♀ (MNHN): same data, 28.5.1938; 1♂, 1♀ (NHMB): same data, 18.5.1938.

Additional material examined. CHINA: Zhejiang: 2♀♀ (MNHN): Tienmushan, 9.VI.1936, coll. O. Piel; 1♀ (IZAS): Tienmushan, 6.VI.1936, coll. O. Piel; 1♀ (IZAS): Tienmushan, 12.VI.1936; 1♀ (IZAS): Tienmushan, 6.VI.1936; 1♂ (IZAS): Tienmushan, 8.VI.1936; 1♂ (IZAS): Anji, Longwangshan, 500m, 11.VI.1996, leg. X.K. Yang; 1♂, 1♀ (IZAS): same locality and date, leg. W.Z. Li; 1♀ (IZAS): same locality and collector, 12.VI.1996; 1♂, 1♀ (IZAS): same locality and collector, 13.VI.1996. Hunan: 1♂, 3♀♀ (NHMB): Wulingshan, Tianzishan Nat. Res., 800m, 16.–18. VI.1997, lgt. Bolm. Guangxi: 1♂ (IZAS): Jinxiu, Rd. Jinzhong, 1000m, 12.V.1999, leg. M.Y. Gao; 1♀ (IZAS): same locality and date, 1100m, leg. X.K. Yang; 2♂♂, 4♀♀ (IZAS): same locality and date, leg. H. Xiao; 1♂ (IZAS): same locality, 11.V.1999, leg. D.C. Yuan; 1♀ (IZAS): Jiuxiu, Yonghe, 500m, 11.V.1999, leg. H. Xiao; 1♀ (IZAS): same locality and date, leg. F.S. Huang; 1♀ (IZAS): Jinjiu, Shengtangshan, 700−800m, 19.V.1999, leg. H. Xiao.

Distribution. China (Fujian, Zhejiang, Hunan, Guangxi). Newly record for Zhejiang, Hunan and Guangxi, China.

Remarks. Based on the examination of the types, *F. flavofacialis* (Pic, 1926) is considered to be a junior synonym of *F. angusta* (Fairmaire, 1900). Although the holotype of the latter species is female and the former is male, both species are originally described in *Podabrus* Westwood and attached with the same locality labels; also a large number of additional specimens do not show any difference between them. Therefore, we suggest to synonymize *F. flavofacialis* with *F. angusta*.

Fissocantharis bidifformis (Wittmer, 1988)

Micropodabrus bidifformis Wittmer, 1988: 350, Figs 4, 23.
Fissocantharis bidifformis: Yang et al. 2009: 49.

Material examined. CHINA: Guangdong: 1♂ (SYSU): Lianxian, Dadongshan, 27.V.1997, leg. X.X. Zhang; 1♀ (SYSU): same locality, 28.V.1997, leg. J.H. Li; 1♀ (SYSU): same locality, leg. J. Zheng.

Distribution. China (Guangxi, Guangdong). Newly record for Guangdong, China.

Fissocantharis buonloiensis Wittmer, 1993

Micropodabrus buonloiensis Wittmer, 1993: 217, Figs 22, 26.
Fissocantharis buonloiensis: Yang et al. 2009: 49.

Distribution. China (Guangxi); Vietnam.

***Fissocantharis cicatricosa* (Wittmer, 1988)**

Micropodabrus cicatricosus Wittmer, 1988: 360, Figs 14, 33.
Fissocantharis cicatricosa: Yang et al. 2009: 49.

Distribution. China (Fujian, Guangxi).

***Fissocantharis flavicornis* (Gorham, 1889)**

Telephorus flavicornis Gorham, 1889: 108.
Cantharis flavicornis: Jacobson 1911: 679.
Podabrus flavicornis: Wittmer 1969: 131.
Micropodabrus flavicornis: Wittmer 1988: 360.
Fissocantharis flavicornis: Yang et al. 2009: 49.

Material examined. CHINA: Guizhou: 4♂♂, 4♀♀ (NHMB): Dakua, 35km NE Leishan, 20.–24.VI.1994, lgt. Bolm.

Distribution. China (Fujian, Guangxi, Guizhou). Newly record for Guizhou, China.

***Fissocantharis liuchowensis* (Wittmer, 1989)**

Micropodabrus liuchowensis Wittmer, 1989: 212, Figs 8, 9.
Fissocantharis liuchowensis: Yang et al. 2009: 49.

Distribution. China (Guangxi).

***Fissocantharis multiexcavata* (Wittmer, 1988)**

Micropodabrus multiexcavatus Wittmer, 1988: 361, Figs 16, 34.
Fissocantharis multiexcavata: Yang et al. 2009: 49.

Distribution. China (Guangxi); Vietnam.

***Fissocantharis tachulanensis* (Wittmer, 1988)**

Micropodabrus tachulanensis Wittmer, 1988: 358, Figs 12, 32.

Fissocantharis tachulanensis: Yang et al. 2009: 49.

Distribution. China (Fujian, Guangxi).

Fissocantharis tridifformis (Wittmer, 1988)

Micropodabrus tridifformis Wittmer, 1988: 349, Figs 2, 21.
Fissocantharis tridifformis: Yang et al. 2009: 49.

Material examined. CHINA: Hubei: 1♂, 1♀ (IZAS): Shennongjia, 900−1300m, 23.V.1981, leg. Y.H. Han; 1♀ (IZAS): same locality and collector, 900−1700m, 26.V.1981; 1♂ (IZAS): same locality and collector, 900m, 16.VI.1981.

Distribution. China (Sichuan, Guangxi, Hubei). Newly recorded from Hubei, China.

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RESEARCH ARTICLE

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Five new records of bee flies (Bombyliidae, Diptera) from Saudi Arabia with zoogeographical remarks

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Abstract

Five bee-fly species (Bombyliidae, Diptera) have been listed in this paper as new to the Kingdom of Saudi Arabia. Four of the recorded species have been identified to the level of species, namely: *Bombomyia discoidea* (Fabricius, 1794), *Spogostylum candidum* (Sack, 1909), *Exoprosopa linearis* Bezzi, 1924, and *Exoprosopa minos* (Meigen, 1804), while the fifth one only to genus, *Desmatoneura* sp. The species have been collected from Al-Baha and Asir Provinces in the south-western part of the Kingdom. One of the four identified species, *Exoprosopa linearis*, has an Afrotropical affinity, and another two, *Spogostylum candidum* and *Bombomyia discoidea*, have considerable Afrotropical distributions, and this result agrees to some extent with studies considering these parts of the Arabian Peninsula, including Al-Baha and Asir Provinces, having Afrotropical influences and may be included in the Afrotropical Region rather than in the Palaearctic Region or the Eremic zone.

Keywords

Asir, Abha, Garf Raydah Protected Area, Baha, Jabal Shada Al A'Ala Protected Area, Tihama, Afrotropical

Introduction

Al-Baha and Asir are two neighboring provinces (Fig. 1) situated in the south-western part of the Kingdom of Saudi Arabia consisting together about 91362 km^2,

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and characterized by natural tree cover and agricultural plateaus. The two provinces are similarly divided into two main sectors, a lowland at the west which forms part of the coastal plain extending from north to south, known as "Tihama", and a mountainous area with an elevation of 1500 to about 3000 m above sea level at the east, known as "Al-Sarat" or "Al-Sarah" which forms part of the Al-Sarawat Mountains range (Alahmed et al. 2010, Ibrahim and Abdoon 2005, and El-Hawagry et al. 2013).

The climate in Al Baha Province is generally moderate in summer and cold in winter with average monthly temperatures ranging between 12–23 °C. While in Asir Province, the climate is moderate with average monthly temperatures ranging between 7–30 °C. In the lowland coastal plain, Tihama, the climate is hot in summer, warm in spring and mild in winter, with relative humidity (RH) ranging between 52–67% in Al-Baha Province and up to 90% in Asir Province, and a rainfall less than 100 mm annually in both. While in the mountainous area, Al-Sarah, the weather is generally cooler due to its high altitude, in addition to the formation of clouds and fog accompanied by thunderstorms in winter. The rainfall is throughout the year in the mountainous area (Al-Sarah) with an annual average of 405 mm in Al-Baha Province and 342 mm in Asir Province (Ibrahim and Abdoon 2005; Omer 1996 and websites: http://www.tititudorancea.com/z/weather_al_baha_saudi_arabia.htm).

Many authors include parts of the Arabian Peninsula in the Afrotropical Region, but there is no agreement as to how much. Crosskey (1980) used the northern boundaries of Yemen as the regional boundary between the Afrotropical and Palaearctic parts in the Arabian Peninsula. Sclater (1858) and Wallace (1876) proposed the classical zoogeographical regions and placed the northern border of the Afrotropical Region along the Tropic of Cancer; thus, Al-Baha and Asir Provinces were included in the Afrotropical Region (Hölzel 1998). However, according to Uvarov (1938), Greathead (1980, 1988), and Larsen (1984) this area should be united with the central Arabian deserts which are either considered as a part of the Palaearctic, or as an autonomous Eremic or Eremian zone (also called the Saharo-Sindian faunal region). Recently, extensive sampling of insects in the Arabian Peninsula by many authors, especially in Yemen, Oman, the United Arab Emirates and south-western mountains of Saudi Arabia, indicated that Sclater's (1858) and Wallace's (1876) concept of the extent of the Afrotropical Arabian Peninsula is more accurate than Crosskey's (1980) limited concept of Yemen alone (Kirk-Spriggs and McGregor 2009). All these facts undoubtedly reflected somehow on the insect faunal composition in Al-Baha and Asir Provinces (El-Hawagry et al. 2013).

Greathead (1980 & 1988) recorded 100 bee-fly species and subspecies in Saudi Arabia out of 149 in the entire Arabian Peninsula, in addition to 4 species subsequently recorded by El-Hawagry et al. (2013) and another one was recently described by El-Hawagry and Al Dhafer (2014). Through our collecting trips for the present study, we have collected 15 bee-fly species from Al-Baha Province and 12 species from Asir Province. Five of the collected species are treated in the present study as new to the Kingdom of Saudi Arabia.

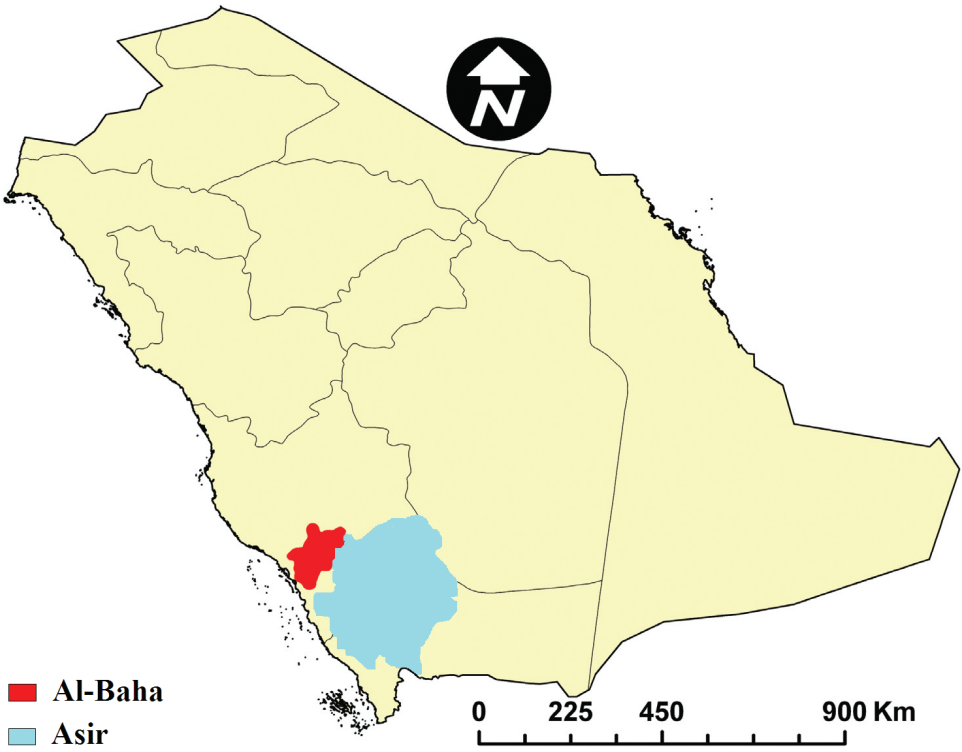


Figure 1. Map of Saudi Arabia showing Al-Baha and Asir Provinces.

Material and methods

Material of the present study has been collected occasionally from different localities in Al-Baha Province (Al-Mekhwa, Aqabet Al Baha-Tihama, Ghabet Shahba, Jabal Shada Al A'Ala Protected Area) and Asir Province (Garf Raydah Protected Area) in 2013 and 2014 by the authors using aerial nets. All sites of collection were generally rich in acacia, cactus, olive, juniper and alder buckthorn trees, and support an exceptionally rich flora, with approximately 500 plant species recorded, including 63 key plant taxa including endemics and Afrotropical relicts.

The global distributions of species were matched to that provided by Evenhuis and Greathead (1999). Efflatoun (1945), Greathead and Evenhuis (2001), and El-Hawagry et al. (2000) have been consulted to identify the genera and species.

Abbreviations of museums

EFC Efflatoun collection, Entomology Department, Faculty of Science, Cairo University, Egypt.

KSMA King Saud University Museum of Arthropod Collection, Riyadh, Saudi Arabia.

Results

Five bee-fly species are listed, which have not been recorded from Saudi Arabia before. In addition to these newly recorded taxa, 15 species from Al-Baha and 12 species from Asir Province were collected that have been previously recorded in Saudi Arabia (see El-Hawagry et al. 2013; El-Hawagry and Al Dhafer 2014 and Greathead 1980 & 1988). Four of the newly recorded species are identified to the species level, but the 5th could not be determined to that level. One of the four identified species, *Exoprosopa linearis* Bezzi, 1924, has an Afrotropical affinity, and another two, *Spogostylum candidum* (Sack, 1909) and *Bombomyia discoidea* (Fabricius, 1794), have considerable Afrotropical distributions. This result agrees to some extent with studies considering that parts of the Arabian Peninsula, including Al-Baha and Asir Provinces have Afrotropical influences and may be included in the Afrotropical Region rather than in the Palaearctic Region or the Eremic zone, and the northern limit of the Afrotropical Region should be placed along the Tropic of Cancer, about 200 km north to Al-Baha (El-Hawagry et al. 2013; Hölzel 1998; Sclater 1858; Wallace 1876).

List of newly recorded species

Family Bombyliidae
Subfamily Bombyliinae
Tribe Bombyliini

***Bombomyia discoidea* (Fabricius, 1794)**
Figures 2–6

Remarks. This is a robust species over 10 mm in length; with body, legs, and all spines and spicules black; with uniformly long hair on abdomen black at base, white at apex; thorax of female with gray to orange-brown hairs.

Distribution. Afrotropical: Botswana, Burundi, Chad, Congo, Eritrea, Ethiopia, Gambia, Ghana, Kenya, Malawi, Mali, Mozambique, Namibia, Niger, Nigeria, Oman, Saudi Arabia (South-western part), Senegal, South Africa, Swaziland, Tanzania, Togo, Uganda, Yemen, Zambia, Zimbabwe. **Palaearctic**: Algeria, Armenia, Austria, Azerbaijan, China, France, Greece, Hungary, Iran, Israel, Italy, Mongolia, Russia, Spain, Turkey, Turkmenistan, Ukraine, Uzbekistan.

Material examined. 1 female, Al-Baha Province, Ghabet Shahba [20.02.723N,41.28.565E, 2324m], 20.V.2013, (El-Hawagry); 1 female, same data, 2.VI.2013; 1 female, Asir Province, Garf Raydah Protected Area [18°11.884'N, 42°24.435'E, 2387 m], 6.VI.2014, (El-Hawagry). All deposited in EFC.

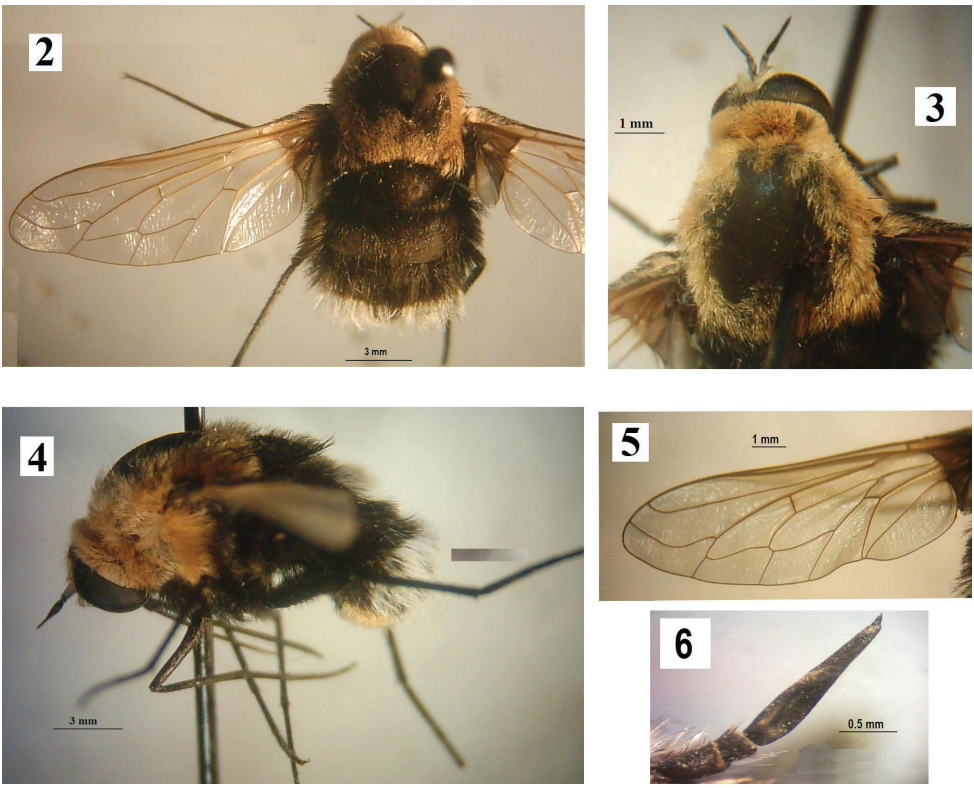


Figure 2–6. *Bombomyia discoidea*, Female: **2** Dorsal view **3** Head and thorax **4** Lateral view **5** Wing **6** Antenna.

Subfamily Anthracinae
Tribe Anthracini

***Spogostylum candidum* Sack, 1909**
Figures 7–8

Remarks. The individuals of this species exhibit considerable variations in size, usually more than 10 mm in length. It can be distinguished from other species of the genus by the absence of alternating tufts of hairs on sides of abdomen; some long black hairs usually found on sides of 2nd tergite but not in form of tufts; last three tergites extensively covered with dense white scales; lower part of face, above peristomal ridge, with long yellowish white hairs only; and aedeagus longer than aedeagal sheath.

Distribution. Afrotropical: Egypt [as "Gebel Elba"], Saudi Arabia (South-western part), United Arab Emirates. **Oriental:** Pakistan. **Palaearctic:** Iran, Turkey.

Material examined. 2 males, Al-Baha Province, Jabal Shada Al A'Ala Protected Area [19°50.710'N, 41°18.267'E, 1474 m], 4.VI.2014, (El-Hawagry). Deposited in KSMA.

Tribe Exoprosopini

***Exoprosopa linearis* Bezzi, 1924**

Remarks. A single female in a poor condition has been collected. This species is easily distinguished by the wholly brownish infuscated wing, which tends to be darker at fore border and along veins; also by the abdomen which is narrow parallel sided with contrasting bands of black and white scales.

Distribution. Afrotropical: Eritrea, Oman, Saudi Arabia (South-western part), Yemen.

Material examined. 1 female, Al-Baha Province, Al-Mekhwa [19.81328°N, 41.44073°E, 455m], 27.III.2013, (El-Hawagry). Deposited in EFC.

***Exoprosopa minos* (Meigen, 1804)**
Figures 9–10

Remarks. This species is distinguished by the remarkable transverse bands of white scales on the abdominal tergites, by the brownish infuscation at the fore border and base of wing, and by the black antennae and legs.

Considering the south-western part of Saudi Arabia as included in the Afrotropical Region, this is the first record of this species from the Afrotropical Region.

Distribution. Afrotropical: Saudi Arabia (South-westrern part). **Palaearctic**: Algeria, Armenia, Austria, Azerbaijan, Croatia, Czech Republic, Egypt, France, Georgia, Germany, Greece, Hungary, Iran, Israel, Palestine (West Bank), Italy, Kazakhstan, Kyrgyzstan, Lebanon, Libya, Moldova, Morocco, Poland, Romania, Russia, Slovakia, Spain, Syria, Tajikistan, Tunisia, Turkey, Turkmenistan, Ukraine, Uzbekistan.

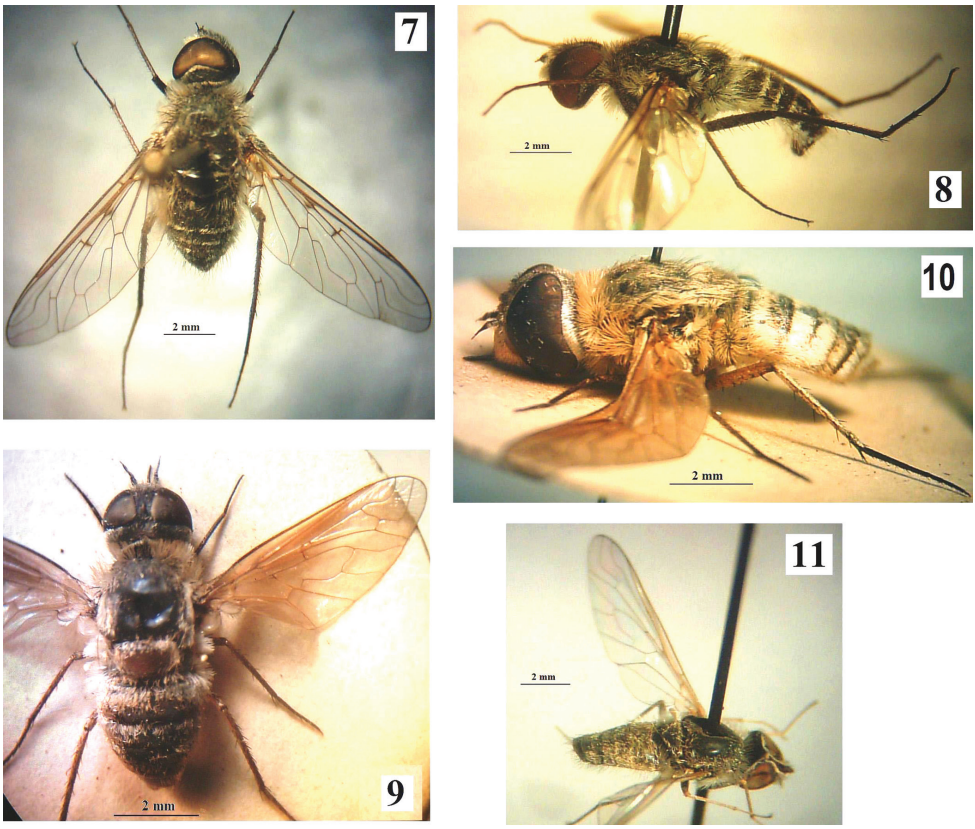
Material examined. 1 male and 2 females, Al-Baha Province, Aqabet Al Baha-Tihama [20.00000°N, 41.43758°E, 1300 m], VI-V.2013, (El-Hawagry). Deposited in EFC.

Tribe Xeramoebini

***Desmatoneura* sp.**
Figure 11

Remarks. A single male agreeing with characters of genus *Desmatoneura* Williston, 1895 has been collected. Greathead (1980 & 1988) questionably recorded *Desmatoneura frontalis* (Wiedemann, 1828) from Oman; *Desmatoneura brevipennis* (Bezzi, 1924) from Yemen, Oman, and United Arab Emirates; and an unidentified species from United Arab Emirates. Evenhuis and Greathead (1999) recorded *Desmatoneura frontalis* (Wiedemann, 1828) from Saudi Arabia. Species in this genus are little-known and the present one is probably new but more specimens are required to ensure that.

Material examined. 1 male, Al-Baha Province, Jabal Shada Al A'Ala Protected Area [19°50.710'N, 41°18.267'E, 1474 m], 4.VI.2014, (El-Hawagry). Deposited in KSMA.



Figures 7–11. 7 *Spogostylum candidum*, male, dorsal view **8** Same, lateral view **9** *Exoprosopa minos*, female, dorsal view **10** Same, lateral view **11** *Desmatoneura* sp., male, dorso-lateral view.

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DATA PAPER

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Free-living marine nematodes from San Julián Bay (Santa Cruz, Argentina)

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Abstract

The free-living marine nematodes of San Julián Bay dataset is based on sediment samples collected in January 2009 during the project PICT AGENCIA-FONCYT 2/33345-2005. A total of 36 samples have been taken at three locations in the San Julián Bay, Santa Cruz Province, Argentina on the coastal littoral at three tidal levels. This presents a unique and important collection for the nematode benthic biodiversity assessment as this area remains one of the least known regions in Patagonia. In total 10,030 specimens of free-living marine nematodes belonging to 2 classes, 9 orders, 35 families, 78 genera and 125 species were collected. The San Julián city site presented a very high species richness.

Keywords

Nematoda, Enoplea, Chromadorea, South Atlantic

Data published through

GBIF: http://www.gbif.org/dataset/06df03fc-8973-490c-af74-089fffae9e24

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Taxonomic coverage description

This is the first study on nematodes performed on a sub-Antarctic salt marsh along the coast of Santa Cruz Province, Argentina with a growing human impact (oil ventures, mining, aquaculture and tourism). The objectives of the study were to collect, identify and discover the structure and diversity of nematode community of San Julián Bay. The coverage (Figure 1) of this dataset includes two classes: Chromadorea (82%) and Enoplea (18%); nine orders: with Monhysterida (36%), followed by Enoplida (15%) and Chromadorida (13%) as those of main occurrences and thirty-five families (see Figure 1).

Taxonomic ranks

Kingdom: Animalia
Phylum: Nematoda
Class: Chromadorea, Enoplea
Order: Monhysterida, Enoplida, Chromadorida, Desmodorida, Araeolaimida, Plectida, Rhabditida, Dorylaimida, Triplonchida
Family: Xyalidae, Linhomoeidae, Monhysteridae, Microlaimidae, Chromadoridae, Comesomatidae, Leptolaimidae, Oncholaimidae, Oxystominidae, Cyatholaimidae, Desmodoridae, Sphaerolaimidae, Diplopeltidae, Dorylaimidae, Ironidae, Neotonchidae, Thoracostomopsidae, Tripyloididae, Tylenchidae, Aegialoalaimidae, Anoplostomatidae, Aphelenchoididae, Axonolaimidae, Enchelidiidae, Ethmolaimidae.
Genera: *Odontophora*, *Hopperia*, *Laimella*, *Sabatieria*, *Campylaimus*, *Chromadora*, *Chromadorella*, *Prochromadora*, *Dichromadora*, *Neochromadora*, *Spilophorella*, *Marylynnia*, *Paracanthonchus*, *Paracyatholaimus*, *Pomponema*, *Paraethmolaimus*, *Gomphionema*, *Neotonchus*, *Halichoanolaimus*, *Molgolaimus*, *Polysigma*, *Spirinia*, *Bolbolaimus*, *Microlaimus*, *Desmolaimus*, *Metalinhomoeus*, *Terschellingia*, *Paralinhomoeus*, *Siphonolaimus*, *Diplolaimella*, *Diplolaimelloides*, *Halomonhystera*, *Monhystera*, *Sphaerolaimus*, *Subsphaerolaimus*, *Amphimonhystera*, *Daptonema*, *Linhystera*, *Metadesmolaimus*, *Paramonohystera*, *Pseudosteineria*, *Steineria*, *Theristus*, *Haliplectus*, *Cyartonema*, *Camacolaimus*, *Deontolaimus*, *Antomicron*, *Leptolaimoides*, *Leptolaimus*, *Paramicrolaimus*, *Mesorhabditis*, *Aphelenchoides*, *Panagrolaimus*, *Boleodorus*, *Tylenchorhynchus*, *Tylenchus*, *Dorylaimus*, *Eudorylaimus*, *Chaetonema*, *Thoracostomopsis*, *Dolicholaimus*, *Syringolaimus*, *Halalaimus*, *Thalassoalaimus*, *Wieseria*, *Calyptronema*, *Adoncholaimus*, *Oncholaimellus*, *Viscosia*, *Oncholaimus*, *Rhabdocoma*, *Bathylaimus*, *Tripyloides*, *Trichodorus*, *Pandolaimus*.
Species with higher occurrences: *Paraethmolaimus dahli*, *Sabatieria mortenseni*, *Daptonema rectangulatum*, *Metalinhomoeus parafiliformis*, *Leptolaimus puccinelliae*, *Diplolaimelloides oschei*, *Leptolaimus sebastiani*, *Metalinhomoeus gloriae*, *Thalassomonhystera parva*, *Metalinhomoeus typicus*, *Haliplectus salicornius*.

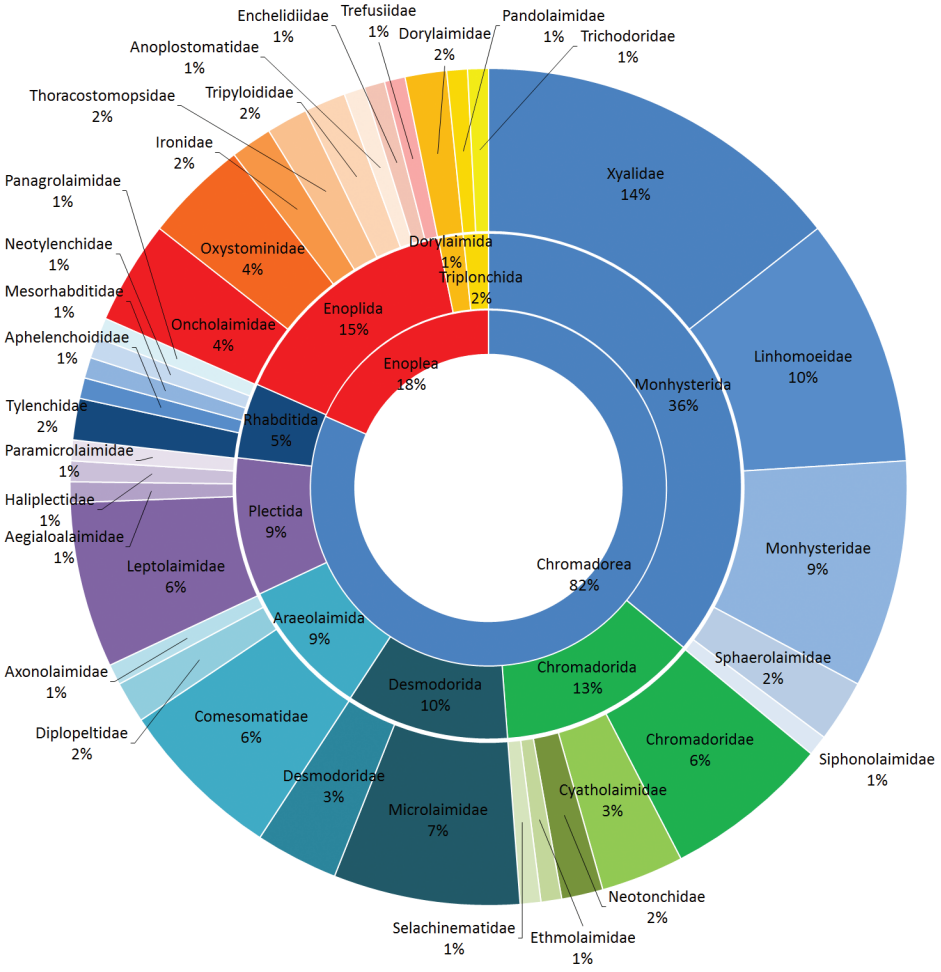

Figure 1. Taxonomic coverage by class, order and family.

Spatial coverage

General spatial coverage: San Julián Bay, Santa Cruz Province, Argentina (Figure 2). For this study three sites were selected: "La pingüinera"(M), at the bay entrance, "La Rural" (C) in front of San Julián city and "El Rincón" (E) at the end of the bay. At each sampling site, three tidal levels were chosen: upper-littoral, high tide, salt-marsh habitat (u); middle littoral, mean tide, un-vegetated habitat (m) and low littoral, low tide, un-vegetated habitat (l) (Figure 3).

Coordinates: La pingüinera: Mu = 49°16'15.24"S; 67°42'40.68"W; Mm = 49°16'12"S; 67°42'43.92"W; Ml = 49°16'11.28"S; 67°42'39.6"W. La Rural: Cu = 49°18'37.44"S; 67°42'55.8"W; Cm = 49°18'34.92"S; 67°42'55.8"W; Cl = 49°18'35.28"S; 67°42'52.56"W. El Rincón: Eu = 49°21'18.72"S; 67°41'26.88"W; Em = 49°21'14.4"S; 67°41'42.36"W; El = 49°21'18"S; 67°41'51"W.

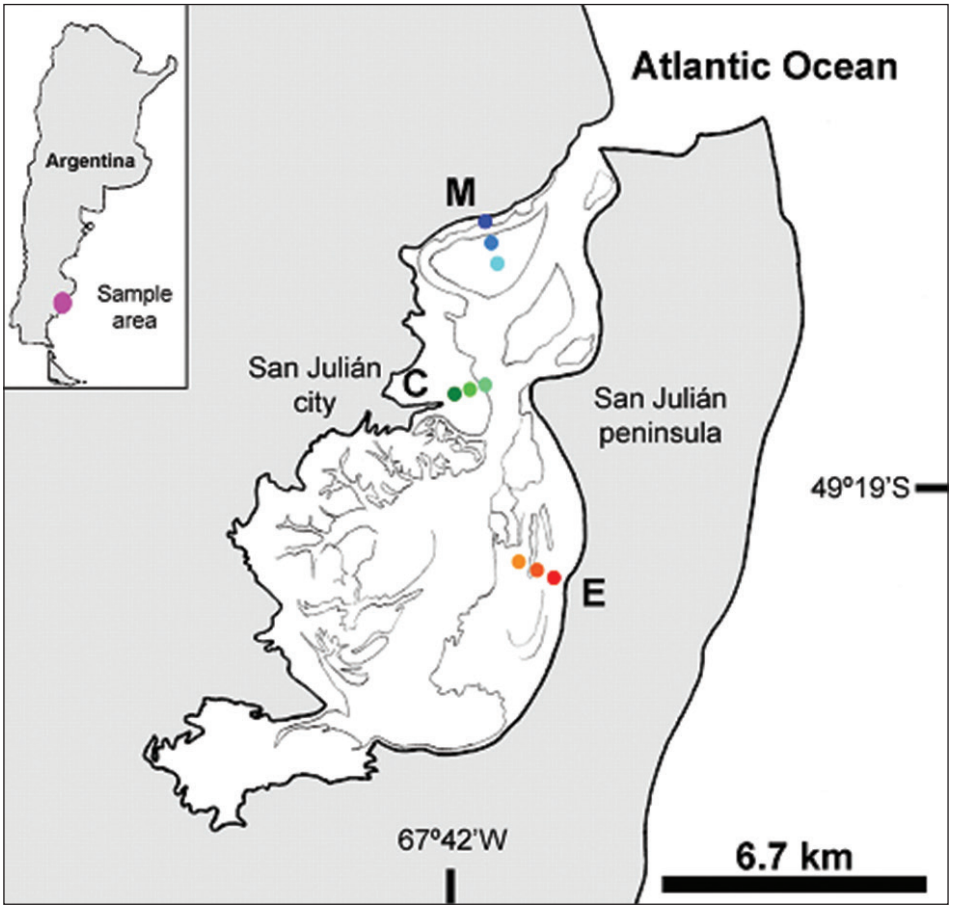

Figure 2. Spatial coverage. San Julián Bay, Argentina. Sites: M = "La pingüinera", C = "La Rural", E = "El Rincón". Levels = u, m, i.

Temporal coverage

11–13 January 2009.

Methods

Sampling description: At each site and level location, four replicates (20 ml) were sampled with a PVC syringe (60 ml, inner diameter 2.9 cm) and separated by a distance of 5-10 m each: four for marine nematodes counts, two for organic matter and two for sediment analyses. Each sample was fixed *in situ*, with a solution of 5% formaldehyde in filtered sea water with the addition of Rose Bengal tint.

Marine nematodes were extracted from samples using the elutriation/decantation LUDOX TM (colloidal silica polymer) method at a specific gravity of 1.15, quan-

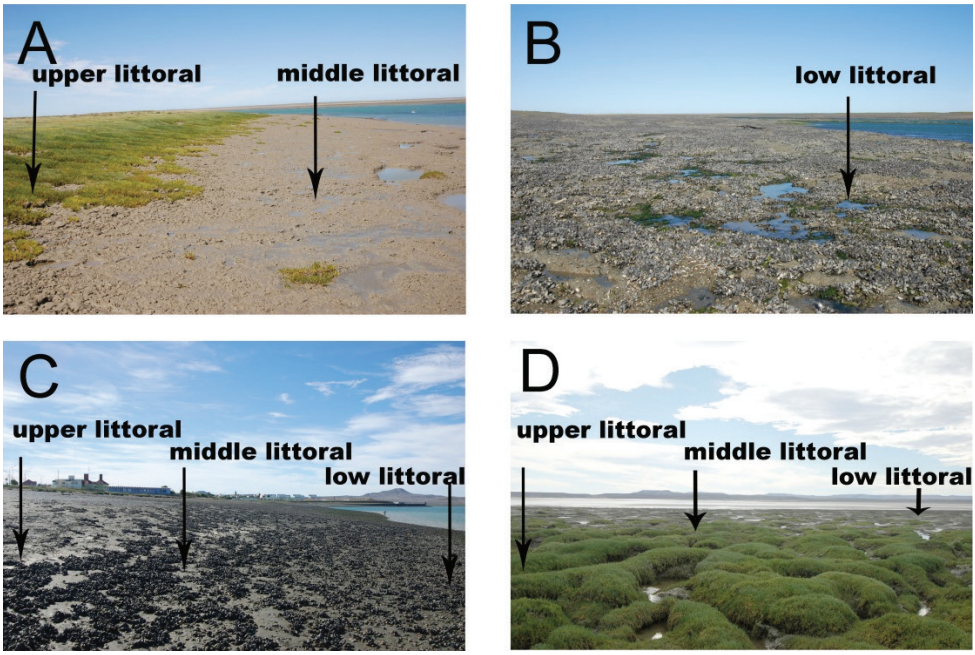

Figure 3. San Julián Bay, Argentina. Views from the sampling sites. **A, B** "La pingüinera" (M) **C** "La Rural"(C) **D** "El Rincón" (D).

tifying only organisms passing through a 500 µm mesh and then retained by a 63 µm mesh. Samples were evaporated to anhydrous glycerol and permanent slides made (Somerfield and Warwick 1996).

The taxonomic classification followed proposed by De Ley and Blaxter (2004). For the identification of species international keys (Platt and Warwick 1983, Platt and Warwick 1988, Warwick et al. 1998, Lorenzen 1994, Abebe et al. 2006) and previous taxonomical papers for Santa Cruz nematodes (Pastor de Ward 1978, 1980, 1984a, b, c, d, e, 1985, 1986, 1988, 1989, 1990, 1991, 1993, 1994, 1995a, b, 1996, 1998a, b, c, 1999, Pastor de Ward and Lo Russo 2009, Villares and Pastor de Ward 2012, Villares et al. 2013, Pastor de Ward et al. 2013) were used.

Project details

Project title: "*Evaluación del impacto urbano en costas areno-limosas de la provincia de Santa Cruz, usando métodos rápidos de análisis de cambios en estructura comunitaria del bentos*." [Impact assessment in urban sand-clay coastal areas of Santa Cruz Province, using methods of rapid assessment in changes of nematodes community structure].

Personnel: Catalina Pastor de Ward (Project Director, meio-benthos specialist); Héctor Zaixso (Project Co-director, macro-benthos specialist), Virginia Lo Russo (Field work, nematodes identification, data collection and analysis), Gabriela Villares (Data

collection and analysis), Viviana Milano (Grant student, data input), Lidia Miyashiro (Darwin core data input), Renato Mazzanti (Software engineer, data base manager).

Funding: PICT AGENCIA-FONCYT 2/33345-2005

Study extent description: The San Julián Bay marine nematodes is a dataset that gives new insights on the taxonomic and geographic distribution of south Atlantic marine nematodes, covering an under-explored region of the southern Atlantic coasts. This is the first study on marine nematodes in this locality. This dataset presents species occurrences and species richness of the individual free-living marine nematodes present at three coastal areas (La pingüinera; La Rural; El Rincón) of the San Julián Bay at three different tidal levels (upper, middle and low-littoral).

In total 10,030 specimens of free-living marine nematodes belonging to 2 classes, 9 orders, 35 families, 78 genera and 125 species were collected.

Genera and species	Family	Order	Class
Odontophora peritricha Wieser, 1956	Axonolaimidae	Araeolaimida	Chromadorea
Hopperia americana Pastor de Ward, 1984	Comesomatidae	Araeolaimida	Chromadorea
Hopperia arntzi Chen & Vincx, 1998	Comesomatidae	Araeolaimida	Chromadorea
Laimella sp. 1	Comesomatidae	Araeolaimida	Chromadorea
Laimella sp. 2	Comesomatidae	Araeolaimida	Chromadorea
Sabatieria sp. 1	Comesomatidae	Araeolaimida	Chromadorea
Sabatieria sp. 2	Comesomatidae	Araeolaimida	Chromadorea
Sabatieria mortenseni (Ditlevsen, 1921)	Comesomatidae	Araeolaimida	Chromadorea
Sabatieria wieseri Platt, 1985	Comesomatidae	Araeolaimida	Chromadorea
Campylaimus gerlachi Timm, 1961	Diplopeltidae	Araeolaimida	Chromadorea
Campylaimus sp. 1	Diplopeltidae	Araeolaimida	Chromadorea
Chromadora nudicapitata Bastian, 1865	Chromadoridae	Chromadorida	Chromadorea
Chromadorella circumflexa Wieser, 1954	Chromadoridae	Chromadorida	Chromadorea
Prochromadora argentinensis Pastor de Ward, 1984	Chromadoridae	Chromadorida	Chromadorea
Dichromadora sp. 1	Chromadoridae	Chromadorida	Chromadorea
Neochromadora lineata Pastor de Ward, 1985	Chromadoridae	Chromadorida	Chromadorea
Neochromadora papillosa Pastor de Ward, 1985	Chromadoridae	Chromadorida	Chromadorea
Neochromadora sp. 1	Chromadoridae	Chromadorida	Chromadorea
Spilophorella paradoxa (De Man, 1888)	Chromadoridae	Chromadorida	Chromadorea
Marylynnia quadriseta (Wieser, 1954)	Cyatholaimidae	Chromadorida	Chromadorea
Paracanthonchus longispiculum Pastor de Ward, 1985	Cyatholaimidae	Chromadorida	Chromadorea
Paracyatholaimus chilensis Gerlach, 1953	Cyatholaimidae	Chromadorida	Chromadorea
Pomponema tautraense (Allgén, 1933)	Cyatholaimidae	Chromadorida	Chromadorea
Paraethmolaimus dahli (Gerlach, 1953)	Ethmolaimidae	Chromadorida	Chromadorea
Gomphionema sp. 1	Neotonchidae	Chromadorida	Chromadorea
Neotonchus sp. 1	Neotonchidae	Chromadorida	Chromadorea
Halichoanolaimus ovalis Ditlevsen, 1921	Selachinematidae	Chromadorida	Chromadorea
Molgolaimus minutus Jensen, 1978	Desmodoridae	Desmodorida	Chromadorea
Molgolaimus sp. 1	Desmodoridae	Desmodorida	Chromadorea
Polysigma sp. 1	Desmodoridae	Desmodorida	Chromadorea
Spirinia septentrionalis (Cobb, 1914)	Desmodoridae	Desmodorida	Chromadorea
Bolbolaimus sp. 1	Microlaimidae	Desmodorida	Chromadorea
Bolbolaimus sp. 3	Microlaimidae	Desmodorida	Chromadorea

Genera and species	Family	Order	Class
Microlaimus capillaris Gerlach, 1957	Microlaimidae	Desmodorida	Chromadorea
Microlaimus conothelis (Lorenzen, 1973)	Microlaimidae	Desmodorida	Chromadorea
Microlaimus cyatholaimoides Gerlach, 1957	Microlaimidae	Desmodorida	Chromadorea
Microlaimus decoratus Pastor de Ward, 1991	Microlaimidae	Desmodorida	Chromadorea
Microlaimus gerlachi Wieser, 1954	Microlaimidae	Desmodorida	Chromadorea
Microlaimus globiceps De Man, 1880	Microlaimidae	Desmodorida	Chromadorea
Microlaimus sp. 1	Microlaimidae	Desmodorida	Chromadorea
Desmolaimus sp. 1	Linhomoeidae	Monhysterida	Chromadorea
Desmolaimus sp. 2	Linhomoeidae	Monhysterida	Chromadorea
Metalinhomoeus gloriae Pastor de Ward, 1989	Linhomoeidae	Monhysterida	Chromadorea
Metalinhomoeus parafiliformis Pastor de Ward, 1989	Linhomoeidae	Monhysterida	Chromadorea
Metalinhomoeus typicus De Man, 1907	Linhomoeidae	Monhysterida	Chromadorea
Terschellingia distalamphida Juario, 1974	Linhomoeidae	Monhysterida	Chromadorea
Terschellingia longicaudata De Man, 1907	Linhomoeidae	Monhysterida	Chromadorea
Terschellingia sp. 1	Linhomoeidae	Monhysterida	Chromadorea
Terschellingia sulfidrica Pastor de Ward, 1989	Linhomoeidae	Monhysterida	Chromadorea
Paralinhomoeus aridus Pastor de Ward, 1989	Linhomoeidae	Monhysterida	Chromadorea
Paralinhomoeus pachyamphis Wieser, 1956	Linhomoeidae	Monhysterida	Chromadorea
Paralinhomoeus visitus Pastor de Ward, 1989	Linhomoeidae	Monhysterida	Chromadorea
Siphonolaimus auratus Wieser, 1956	Siphonolaimidae	Monhysterida	Chromadorea
Diplolaimella gerlachi Pastor de Ward, 1984	Monhysteridae	Monhysterida	Chromadorea
Diplolaimelloides oschei Meyl, 1954	Monhysteridae	Monhysterida	Chromadorea
Diplolaimelloides tehuelchus Pastor de Ward & Lo Russo, 2009	Monhysteridae	Monhysterida	Chromadorea
Diplolaimelloides warwicki Pastor de Ward & Lo Russo, 2009	Monhysteridae	Monhysterida	Chromadorea
Halomonhystera disjuncta (Bastian, 1865)	Monhysteridae	Monhysterida	Chromadorea
Halomonhystera sp. 1	Monhysteridae	Monhysterida	Chromadorea
Halomonhystera sp. 2	Monhysteridae	Monhysterida	Chromadorea
Halomonhystera sp. 3	Monhysteridae	Monhysterida	Chromadorea
Thalassomonhystera parva (Bastian, 1865)	Monhysteridae	Monhysterida	Chromadorea
Thalassomonhystera refringens (Bresslau & Stekhoven, 1935)	Monhysteridae	Monhysterida	Chromadorea
Sphaerolaimus pacificus Allgen 1947	Sphaerolaimidae	Monhysterida	Chromadorea
Sphaerolaimus pentasetus Pastor de Ward, 1984	Sphaerolaimidae	Monhysterida	Chromadorea
Subsphaerolaimus sp. 1	Sphaerolaimidae	Monhysterida	Chromadorea
Amphimonhystera sp. 1	Xyalidae	Monhysterida	Chromadorea
Daptonema concordiense Pastor de Ward, 1985	Xyalidae	Monhysterida	Chromadorea
Daptonema laxus Wieser, 1956	Xyalidae	Monhysterida	Chromadorea
Daptonema lopezi Pastor de Ward, 1985	Xyalidae	Monhysterida	Chromadorea
Daptonema rectangulatum Pastor de Ward, 1985	Xyalidae	Monhysterida	Chromadorea
Daptonema sp. 1	Xyalidae	Monhysterida	Chromadorea
Linhystera longa Pastor de Ward, 1985	Xyalidae	Monhysterida	Chromadorea
Metadesmolaimus sp. 1	Xyalidae	Monhysterida	Chromadorea
Metadesmolaimus sp. 2	Xyalidae	Monhysterida	Chromadorea
Paramonohystera megacephala (Steiner, 1916)	Xyalidae	Monhysterida	Chromadorea
Paramonohystera parabutschlii Timm, 1961	Xyalidae	Monhysterida	Chromadorea
Paramonohystera sp. 1	Xyalidae	Monhysterida	Chromadorea
Paramonohystera sp. 2	Xyalidae	Monhysterida	Chromadorea
Paramonohystera sp. 3	Xyalidae	Monhysterida	Chromadorea
Pseudosteineria anticipans Wieser, 1956	Xyalidae	Monhysterida	Chromadorea

Genera and species	Family	Order	Class
Steineria pilosa Cobb, 1914	Xyalidae	Monhysterida	Chromadorea
Theristus modicus Wieser , 1956	Xyalidae	Monhysterida	Chromadorea
Theristus sp. 1	Xyalidae	Monhysterida	Chromadorea
Haliplectus salicornius Pastor de Ward, 1984	Haliplectidae	Plectida	Chromadorea
Cyartonema flexile Cobb, 1920	Aegialoalaimidae	Plectida	Chromadorea
Camacolaimus barbatus Warwick, 1970	Leptolaimidae	Plectida	Chromadorea
Deontolaimus papillatus De Man, 1880	Leptolaimidae	Plectida	Chromadorea
Antomicron alveolatum Villares & Pastor de Ward, 2012	Leptolaimidae	Plectida	Chromadorea
Leptolaimoides sp. 1	Leptolaimidae	Plectida	Chromadorea
Leptolaimoides sp. 2	Leptolaimidae	Plectida	Chromadorea
Leptolaimus gabinoi Villares & Pastor de Ward, 2012	Leptolaimidae	Plectida	Chromadorea
Leptolaimus puccinelliae Gerlach, 1959	Leptolaimidae	Plectida	Chromadorea
Leptolaimus sebastiani Vitiello, 1974	Leptolaimidae	Plectida	Chromadorea
Paramicrolaimus spirulifer Wieser, 1959	Paramicrolaimidae	Plectida	Chromadorea
Mesorhabditis sp. 1	Mesorhabditidae	Rhabditida	Chromadorea
Aphelenchoides sp. 1	Aphelenchoididae	Rhabditida	Chromadorea
Panagrolaimus sp. 1	Panagrolaimidae	Rhabditida	Chromadorea
Boleodorus sp. 1	Neotylenchidae	Rhabditida	Chromadorea
Tylenchorhynchus sp. 1	Tylenchidae	Rhabditida	Chromadorea
Tylenchus sp. 1	Tylenchidae	Rhabditida	Chromadorea
Dorylaimus sp. 1	Dorylaimidae	Dorylaimida	Enoplea
Eudorylaimus sp. 1	Dorylaimidae	Dorylaimida	Enoplea
Chaetonema sp. 1	Anoplostomatidae	Enoplida	Enoplea
Thoracostomopsis sp. 1	Thoracostomopsidae	Enoplida	Enoplea
Dolicholaimus marioni De Man, 1888	Ironidae	Enoplida	Enoplea
Syringolaimus smarigdus Cobb, 1928	Ironidae	Enoplida	Enoplea
Halalaimus (Halalaimus) setosus Timm, 1961	Oxystominidae	Enoplida	Enoplea
Halalaimus (Nuada) diacros Mawson, 1958	Oxystominidae	Enoplida	Enoplea
Halalaimus sp. 3	Oxystominidae	Enoplida	Enoplea
Halalaimus floridanus Keppner, 1992	Oxystominidae	Enoplida	Enoplea
Thalassoalaimus sp. 1	Oxystominidae	Enoplida	Enoplea
Wieseria sp. 1	Oxystominidae	Enoplida	Enoplea
Calyptronema maxweberi (De Man, 1922)	Enchelidiidae	Enoplida	Enoplea
Eurystomina sp. 1	Enchelidiidae	Enoplida	Enoplea
Adoncholaimus sp. 1	Enchelidiidae	Enoplida	Enoplea
Oncholaimellus paracarlbergi Pastor de Ward, 1993	Oncholaimidae	Enoplida	Enoplea
Viscosia macramphida Chitwood, 1951	Oncholaimidae	Enoplida	Enoplea
Viscosia separabilis (Wieser, 1953)	Oncholaimidae	Enoplida	Enoplea
Oncholaimus salobrus Pastor de Ward, 1993	Oncholaimidae	Enoplida	Enoplea
Rhabdocoma sp. 1	Trefusiidae	Enoplida	Enoplea
Bathylaimus australis Cobb, 1894	Tripyloididae	Enoplida	Enoplea
Tripyloides amazonicus (Gerlach, 1957)	Tripyloididae	Enoplida	Enoplea
Trichodorus sp. 1	Trichodoridae	Triplonchida	Enoplea
Pandolaimus sp. 1	Pandolaimidae	Triplonchida	Enoplea

Quality control description: The geo-referencing of all specimens were recorded using a Garmin eTrex Legend GPS (WGS84 Datum) with an accuracy of less than 10 m and with at least 5 satellites.

The taxonomic identification of specimens, scientific names, and their current accurate spelling were verified by C. Pastor de Ward, a free-living marine nematode specialist. Other post-validation procedures (including geographic coordinate format, congruence between collection and identification dates, absence of ASCII anomalous characters) were checked using the Darwin Test software (http://www.gbif.es/darwin_test/Darwin_Test_in.php).

Dataset description

Object name: Darwin Core Archive free-living marine Nematodes from San Julián Bay (Santa Cruz, Argentina)
Character encoding: UTF-8
Format name: Darwin Core Archive format
Format version: 1.0
Distribution: http://www.cenpat-conicet.gov.ar:8080/ipt-2.0.3/resource.do?r=sjnem
Publication date of data: 2013-10-17
Language: English
Licenses of use: This work is licensed under a Creative Commons CC0 1.0 License http://creativecommons.org/publicdomain/zero/1.0/legalcode

External datasets

Object name: Centro Nacional Patagónico (CENPAT-CONICET)
Distribution: http://www.cenpat-conicet.gov.ar:8080/ipt-2.0.3/resource.do?r=sjnem

Object name: Ministerio de Ciencia y Tecnología de Argentina (Sistema Nacional de Datos Biológicos - SNDB)
Distribution: GBIF: http://www.gbif.org/dataset/06df03fc-8973-490c-af74-089ffae9e24
Formatted: English (U.K.)
Field Code Changed
Metadata language: English
Date of metadata creation: 2013-10-17
Hierarchy level: Dataset

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