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RESEARCH ARTICLE

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A new species of *Callispa* Baly (Coleoptera, Chrysomelidae, Cassidinae, Callispini) infesting coconut palm (*Cocos nucifera* L.) in India

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Abstract

Callispa keram **sp. n.** infesting coconut palm (*Cocos nucifera* L.) in Kerala, India is described and illustrated. *Livistona chinensis* R.Br. and *Syagrus romanzoffiana* (Cham.) Glassman are reported as additional host plants.

Keywords

Chrysomelidae, coconut, *Callispa*, new species, host plants, insect pest, India

Introduction

The coconut palm, *Cocos nucifera* L. is an important source of food and vegetable oil and is intimately associated with the social and cultural heritage of the people in Asia and Oceania (Menon and Pandalai 1958, Thampan 1993). India is one of the largest producers of coconut in the world. Mariau (2004) reviewed the biology of leaf beetles infesting the oil palm, *Elaeis guineensis* Jacq. and the coconut palm, documenting 79

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species of Chrysomelidae on these two palms. The hispine cassidinae with 59 species in 37 genera are the most numerous leaf beetles on oil and coconut palms worldwide and include such serious pests as *Brontispa longissima* Gestro and *Promecotheca cumingii* Baly. Nair and Oommen (1965) reported the occurrence of an unspecified species of *Callispa* Baly 1858, on coconut palm in Kerala, India.

The genus *Callispa* comprises about 165 species distributed in the Oriental and Afrotropical Regions (Staines 2011). Trophic selections of *Callispa* are confined to the monocot families Araceae, Arecaceae, Cyperaceae, Musaceae, Poaceae, Orchidaceae and Zingiberaceae (Uhmann 1969; Jolivet and Hawkeswood 1995; Reid 1998; Schöller 2007, 2008; Staines 2011; Lee et al. 2012). Information on the immature stages of the genus is fragmentary and is limited to nine species (Lee et al. 2012). Studies on life history include Chen (1929), Nair and Oommen (1965), Zaitsev (2001) and Lee et al. (2012). Eggs, deposited singly (Nair and Oommen 1965, Lee et al. 2012) or in small groups (Chen 1929, Lee et al. 2012), are enclosed in a membranous ootheca. Both larvae and adults are open feeders on leaves and pupation occurs on the leaf itself. In India, the genus *Callispa* is represented by 32 species (Weise 1913; Maulik 1919, 1923; Uhmann 1927; Pic 1937, 1943; Medvedev 1993; Basu 1999; Staines 2011) while several others await naming and description.

Nair and Oommen (1965) is the only report of the genus *Callispa* on coconut palm. In this paper, we report our investigations on this coconut *Callispa* and describe it as a new species.

Material and methods

Coconut is raised on a large scale both in homesteads as well as plantations in coastal and midland regions of Kerala. The presence of adults and larvae of the coconut *Callispa* is indicated by the characteristic feeding damage and could be easily collected from the abaxial side of leaflets. Specimens were collected from the plains of southern, central and northern Kerala. Attempts were also made to check its presence in the high range regions of Kerala as well as the dry coconut growing tracts of Tamil Nadu, adjoining Kerala. Besides coconut, other palms were also searched for the feeding damage and life stages of the species. Observations on the biology were carried out in the field as well as in the laboratory at the Vellayani campus of the Kerala Agricultural University.

Descriptive terminology follows Chaboo (2007). The holotype of the new species is deposited in the Natural History Museum, London (BMNH). Paratypes will be deposited in the Natural History Museum, London, Museo Civico di Storia Naturale, Genova, Italy (MCSN), National Bureau of Agriculturally Important Insects, Bengaluru, India (NBAII), National Pusa Collection, Indian Agricultural Research Institute, New Delhi, India (NPC), University of Agricultural Sciences, Bengaluru, India (UASB), National Museum of Natural History, Smithsonian Institution, Washington, DC, USA (USNM), and in the personal collection of the authors (PKDC). Non-type material are also deposited in the University of Kansas Insect Collection

(SEMC). Plant vouchers of *Livistona chinensis* R.Br. (Accession no. 6697) and *Syagrus romanzoffiana* (Cham.) Glassman (Accession no. 6698) are deposited in the Calicut University Herbarium, Calicut, India. In the descriptions below, a forward slash (/) separates different lines on data labels.

Results

Generic diagnosis of *Callispa* Baly

Adults are oblong ovate, neither spiny nor tuberculate, 3–10 mm long, flat to moderately convex beetles. Other salient features of the genus are head narrowly produced between antennae; pronotum quadrate, broader than long, anterolateral angles rounded, anterior trichobothrium absent, disc shallowly depressed on either side; elytron with ten rows of punctures and a short scutellar row; claw tarsomere small, hardly extending beyond setae on ventral side of bilobed third tarsomere; upper border of mouth cavity in close proximity to antennal sockets; and scutellum quadrate with rounded posterior margin.

Callispa keram Shameem & Prathapan, sp. n.

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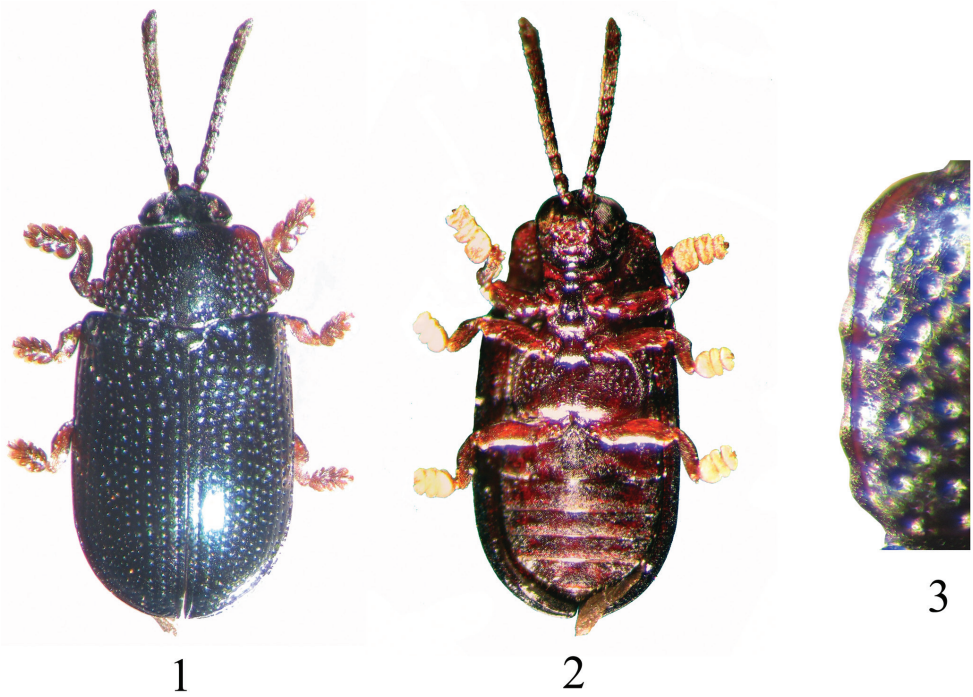
http://species-id.net/wiki/Callispa_keram
Figs 1–14

Description of adult. Length 3.36–4.32 mm, width 1.73–2.35 mm. Vertex metallic black with blue tint; frontoclypeus black; gena, gula piceous to dark rufous brown; mouth parts dark rufous brown with labrum distinctly darker. Antenna piceous to dark rufous brown, often with proximal antennomeres darker than distal. Pronotal disc metallic black with blue tint, and turning rufous brown towards lateral margin in many specimens. Scutellum metallic black with blue tint. Elytra entirely dark metallic blue (Fig. 1). Venter and legs entirely dark rufous brown (Fig. 2).

Vertex minutely punctate, surface finely reticulate; midfrontal sulcus absent. Mid-cranial sulcus present as shallow indistinct groove evident anteriorly and posteriorly. Post-callinal transverse depression deeply impressed. Last maxillary palpomere as long as or longer than preceding two combined. Scape a little longer than half of pedicel; length ratio of antennomeres 2–11 equals 1.00 : 0.93-1.07 : 0.73-0.78 : 0.73-0.78 : 0.60-0.71 : 0.67-0.71 : 0.64-0.67 : 0.67-0.78 : 0.71-0.73 : 1.35-1.50.

Pronotum 1.53–1.67 times wider than long; posteriorly 1.14–1.20 times wider than anteriorly. Disc distinctly raised along middle 1/3, with transverse depression near posterior margin in front of scutellum. Disc impunctate anteriorly in middle as well as along a narrow mid-line; rest of raised middle portion with scattered small and minute punctures. Disc on either side of raised middle area moderately depressed



Figures 1–3. *Callispa keram* sp. n. **1** dorsal habitus **2** ventral habitus **3** lateral margin of pronotum.

with deep, large, circular punctures; distance between punctures less than diameter of individual puncture. Lateral margin anteriorly as broad as posteriorly, prominently scalloped with four to six emarginations (Fig. 3). Scutellum broader than long, convex on top, very minutely punctate and reticulate.

Elytron with shallow post-basal transverse depression deeper laterally; elytral apex convex. Scutellar row short, with three to five punctures; additional sixth row of punctures arises from middle of elytron, forming eleven rows of punctures, excluding scutellar row, present just behind middle. Distance between adjacent rows more than diameter of one puncture in middle of disc; distance between adjacent punctures in one row variable. Interstices flat, extremely minutely punctate. Punctures large, deep, round to oval. Hypomeron of pronotum with large, shallow punctures, punctures absent towards lateral margin, denser towards tergosternal suture. Prosternal intercoxal process channelled near margins on four sides, convexly raised along middle on top. Metasternum with granulate area bearing number of large, round, deep punctures anteriorly on either side, posterior to mesocoxal cavity.

Aedeagus with basal piece poorly sclerotized. In lateral view, strongly curved near middle, apical 1/3 almost straight, apex acutely pointed (Fig. 5). Ventral side convex, with a sharply raised ridge along middle of distal region, with shallow depression on either side of ridge (Fig. 4). Apical foramen partially covered with a lamina bearing sclerotized plate on either side (Fig. 6). Arms of tegmen subequal to stem.

Receptacle of spermatheca longer than wide with inner side strongly convex, outer side gently concave; pump strongly curved, not differentiated from receptacle, about twice as long as receptacle, apical appendix acute, well developed; duct and gland inserted separately (Fig. 7). Sternite VIII with convex distal margin bearing numerous setae (Fig. 9). Spiculum gastrale anteriorly as wide as posteriorly. Coxite broader than long with setae along posterior margin (Fig. 8). Tergum IX represented by horseshoe shaped single sclerite with bristles along posterior margin (Fig. 10).

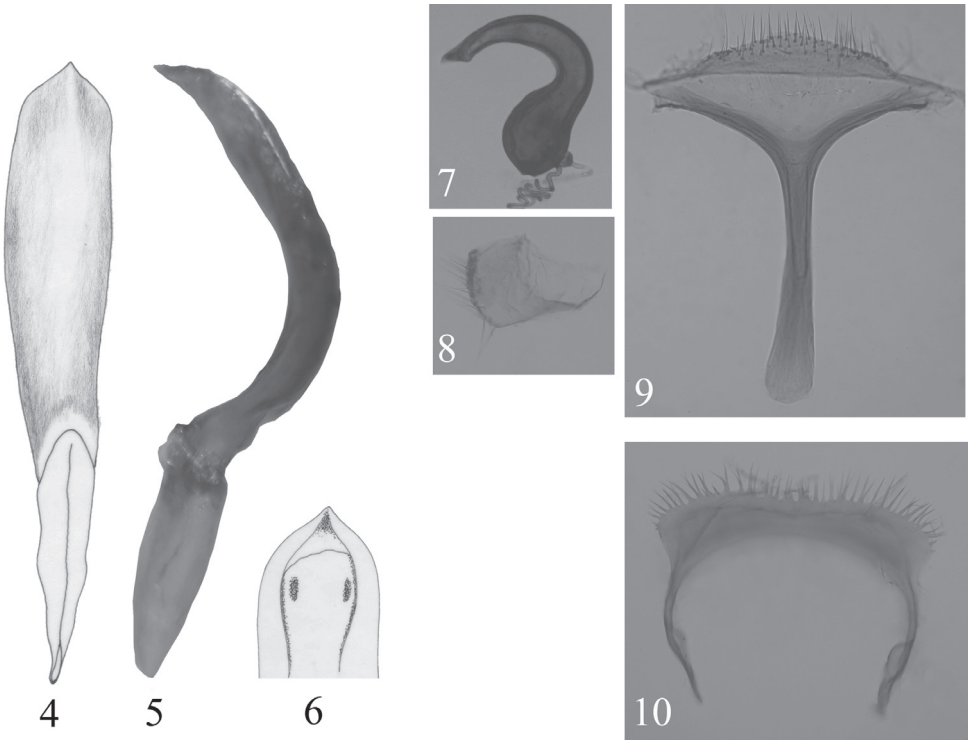
No apparent sexual dimorphism, except for slightly larger females (3.69–4.32 mm) compared to males (3.36–3.79 mm).

Etymology. The specific epithet *keram,* literally means coconut in Malayalam, the language of Kerala, the southern Indian state where the insect occurs. It refers to the host plant as well as the type locality, *Keralam*, the land of coconut.

Types. Holotype ♂, with labels as follows: 1) India: Kerala / Vellayani / N08°25'47.5", E76°59'8.3"/ 9.ii.2012 18 m / Shameem K. Coll. / *Ex* Coconut (white label). 2) HOLOTYPE / *Callispa keram* sp. n. / des. Shameem & Prathapan, 2012 (red label) (BMNH).

Paratypes (99 specimens, all specimens with a white locality label as given below, besides a second pink label: PARATYPE / *Callispa keram* sp. n. / des. Shameem & Prathapan, 2012): 5 unsexed. the same labels as for holotype; 1 ♀, 1 unsexed. same data as for holotype except date 8.i.2012; 1 unsexed. same data except date 19.i.2012; 6 unsexed. same data except date 24.i.2012; 1 ♀. same data except date 27.i.2012; 8 unsexed. same data except date 2.ii.2012; 2 unsexed. same data except date 9.ii.2012; 4 unsexed. same data except date 16.ii.2012; 3 unsexed. same data except date 21.ii.2012; 1 ♀, 1 unsexed. same data except date 22.ii.2012; 8 unsexed. India: Kerala / Vellayani / N08°25'47.5", E76°59'8.3"/ 12.xii.2011 18 m / Shameem K. Coll. / *Ex Livistona*; 1 ♀, 1 unsexed. same data except date 22.xii.2011; 2 ♂, 1 ♀, 1 unsexed. same data except date 2.ii.2012; 1 unsexed. same data except date 9.ii.2012; 1 unsexed. India: Kerala / Vellayani / N08°25'47.5", E76°59'8.3"/ 9.i.2012 18 m / Shameem K. Coll. / *Ex Syagrus*; 1 ♀. same data except date 21.i.2012; 2 ♂, 1 ♀, 9 unsexed. India: Kerala / Vellayani / N08°25'47.5", E76°59'8.3"/ 6.i.2012 18 m / Shameem K. Coll.; 3 ♂, 6 unsexed. same data except date 7.i.2012; 1 ♂, 1 ♀. same data except date 8.i.2012; 2 unsexed. same data except date 9.i.2012; 1 ♀, 1 unsexed. same data except date 11.i.2012; 2 ♂, 3 unsexed. same data except date 12.i.2012; 2 unsexed. same data except date 17.i.2012; 1 ♂. same data except date 19.i.2012; 1 unsexed. same data except date 24.i.2012; 1 unsexed . India: Kerala / Vallamkulam / 25.xii.2011 / Prathapan KD Coll. / *Ex* Coconut; 1 ♀. same data except locality Pandanad; 1 ♀, 1 unsexed. India: Kerala / Tirurangadi / 25.xii.2011 / Shameem K. Coll. / *Ex* Coconut; 2 unsexed. India: Kerala / Calicut University / 26.xii.2011 / Shameem K. Coll. / *Ex* Coconut; 1 unsexed. India: Kerala / Tirurangadi / 25.xii.2011 / Shameem K. Coll. / *Ex Livistona*; 1 unsexed. same data except date 6.ii.2012.

(4 specimens with the following labels, besides a pink label: PARATYPE / *Callispa keram* sp. n. / des. Shameem & Prathapan, 2012) 1 unsexed. 1) On Coconut / Vellayani

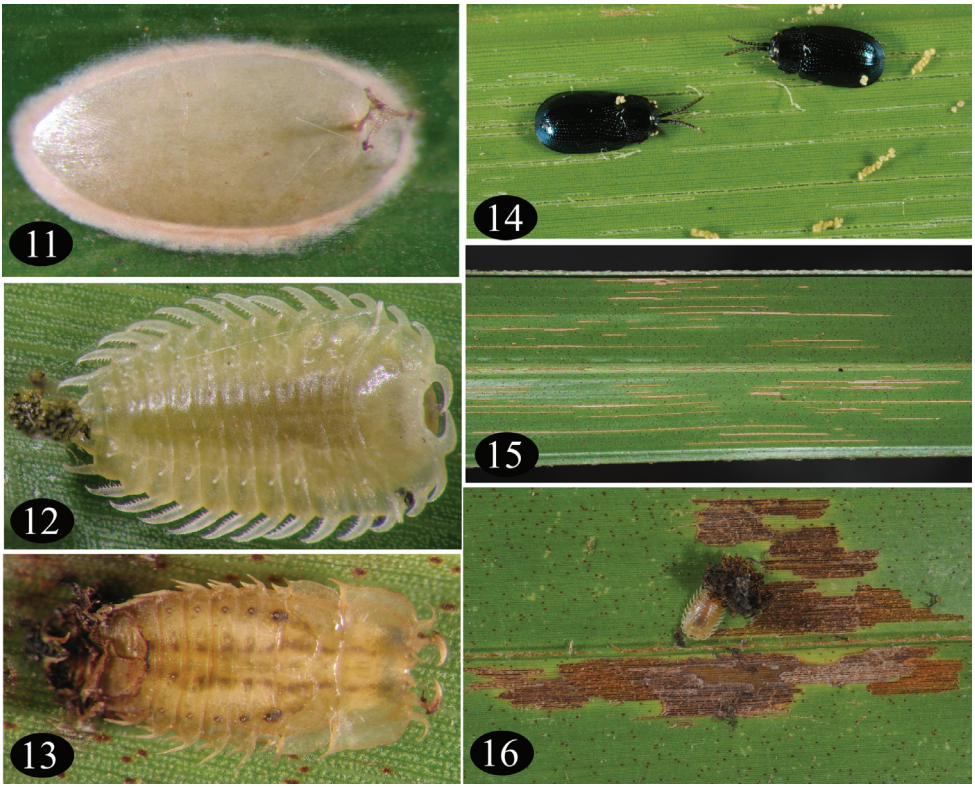


Figures 4–10. *Callispa keram* sp. n. **4** median lobe of aedeagus, ventral view **5** median lobe of aedeagus, lateral view **6** median lobe of aedeagus, distal opening **7** spermatheca **8** coxite **9** sternite VIII **10** tergum IX.

/ 26-8-56 / M.R.G.K.N. 2) 2. 3) Z.S.I. / Lot No. 47 / 1956; 1 unsexed. 1) 2. 2) Z.S.I. / Lot No. 47 / 1956; 1 unsexed. 1) 2. 2) Z.S.I. / Lot No. 47 / 1956. 3) *Callispa* sp / nr. *minima* / gestro / S.P. Shukla det '57; 1 unsexed. 1) 5. 2) ? Callispa sp. / R. N. Mathur det. (10 BMNH, 5 MCSN, 10 NBAII, 48 NPC, 3 PKDC, 13 UASB, 10 USNM).

Distribution. India (Kerala).

Remarks. *Callispa keram* sp. n. can be differentiated from the other metallic black or blue species of *Callispa* in southern India, by the shape of the distinctly scalloped lateral margin of the pronotum (Fig. 3). Other southern Indian species with metallic black or blue dorsum, namely, *C. coerulodorsata* Maulik, *C. minima* Gestro and *C. violaceicornis* Pic have straight or evenly curved lateral pronotal margin. *Callispa keram* closely resembles *C. minima* in having shiny blue black dorsum and brown venter, besides being more or less similar in size. However, they can be separated based on the shape of the lateral margin of the pronotum as well as the finely rugose interstices on the basal portion of the elytron (elytral interstices are smooth in *C. keram*). In *C. coerulodorsata*, the ventral side is black and the scutellum bears three characteristic deep notches radiating from the centre, however, the ventral side in *C. keram* is rufous brown and the radiating notches on the scutellum are absent.



Figures 11–16. *Callispa keram* sp. n. **11** ootheca **12** larva **13** pupa **14** adult **15** adult feeding trough **16** larval feeding trough.

The pronotum is strongly narrowed anteriorly in *C. violaceicornis*, while it is weakly narrowed towards front in the new species. Metallic blue-black species of southern Indian *Callispa* can be separated using the key given below.

Host plants. Arecaceae: *Cocos nucifera* L., *Livistona chinensis* R.Br. (Chinese fan palm or fountain palm) and *Syagrus romanzoffiana* (Cham.) Glassman (Queen palm).

Biology. Nair and Oommen (1965) studied the biology and figured the life stages of *C. keram*. All the life stages (Figs 11–14) are confined to the abaxial side of the leaflets. According to Nair and Oommen, the beetles mate 5–7 days after emergence and commence oviposition thereafter. A female lays 28–54 eggs during an oviposition period of 46–113 days and the life cycle is completed in 34–43 days. Eggs are deposited singly in simple ootheca (Fig. 11). Attempts to separate the eggs from the ootheca resulted in rupture of the eggs. Feeding troughs of adults appear as characteristic narrow lines (Fig. 15) on the leaves while that of the larvae appear as brownish irregular patches (Fig. 16). All life stages of *C. keram* were observed on all three known host plants. *Callispa keram* was not observed in the high altitude regions of Kerala as well as in the dry coconut growing tracts of Tamil Nadu, adjoining Kerala.

Key to metallic blue-black species of *Callispa* in southern India

1 Scutellum with three deep radiating notches from the centre: one to the apex and others to the basal angles; abdominal ventrites black ..... ***C. coerulodorsata*** **Maulik**

– Scutellum without deep radiating notches; abdominal ventrites rufous brown to dark brown **2**

2(1) Pronotum strongly narrowed anteriorly, posteriorly 1.5 times wider than anteriorly; length 5.0 mm ..... ***C. violaceicornis*** **Pic**

– Pronotum weakly narrowed anteriorly, posteriorly 1.1–1.2 times wider than anteriorly; length 3.3–4.4 mm **3**

3(2) Lateral pronotal margin prominently scalloped with four to six emarginations; elytral interstices smooth throughout ..... ***C. keram*** **sp. n.**

– Lateral pronotal margin straight, not scalloped, without emarginations; elytral interstices rugose basally ..... ***C. minima*** **Gestro**

Discussion

Mariau (2004) divided the hispines associated with coconut and oil palms into two ecological groups: leaf-browsing and leaf-mining. *Callispa keram* belongs to the former group. While *C. keram* is a minor pest of little economic significance, the possibility of it becoming a significant pest, with change in biotic and abiotic factors, cannot be ruled out. Given the economic implications of the hispine pests of coconut palm such as *Brontispa longissima* and *Promecotheca cumingii*, *C. keram* is important as a potential invasive pest in other coconut growing countries far away from its native habitat. This is the first report of *C. keram* on *Livistona chinensis* and *Syagrus romanzoffiana,* two exotic palms introduced into India as ornamental plants.

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We are indebted to A. K. Pradeep, University of Calicut, Reji Jacob, Central Plantation Crops Research Institute, Kayamkulam and V. B. Sreekumar, Kerala Forest Research Institute, Peechi for identification of *Syagrus romanzoffiana*. Identity of *Livistona chinensis* was confirmed by A. K. Pradeep. Images of the types of *Callispa coerulodorsata, C. minima* and *C. violaceicornis* were kindly provided by Drs M. Barclay, Natural History Museum, London, United Kingdom, R. Poggi, Museo Civico di Storia Naturale, Genova, Italy and A. Mantilleri, Muséum National d'Histoire Naturelle, Paris, France respectively. Drs. R. Ajith, J. Bezděk, C. S. Chaboo, C. A. M. Reid, M. K. Sindhu, C. L. Staines and R. Sujith provided essential literature. Critical reviews by Drs C. A. Viraktamath, J. Poorani, C. S. Chaboo, C. Nandakumar and C. L. Staines greatly improved the manuscript. Our work on leaf beetles is supported

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RESEARCH ARTICLE

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Review of the Palaearctic *Acomopterella* Zaitzev (Diptera, Sciaroidea, Mycetophilidae)

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Abstract

The distribution of *Acomopterella* species in the Palaearctic region has been re-examined in this study, using recently collected material. The European species was found to be distributed in the eastern Palaearctic as well. A second Palaearctic species from Honshu (Japan) is herein described. The morphology of adult specimens was studied by light microscopy and scanning electron microscopy. The shape of functional specialized setae on mid tibiae in *Acomopterella* and seven further fungus gnat genera is described and the suitability of this character for systematic studies is discussed. Details of a "hind tibial organ" are described.

The position of *Acomopterella* in the tribe Gnoristini is briefly discussed. *Acomopterella* is found to be more closely related to *Speolepta* Edwards, 1925, than to any other recent genus.

Keywords

Taxonomy, Sciaroidea, Mycetophilidae, *Acomopterella*, new species, Central Europe, North Europe, Alps, Sakhalin, Hokkaido, Honshu, morphology, functional specialized setae

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Introduction

Sciaroidea, i.e. fungus gnats s.l. are of global distribution, quite diverse, with far more than 10.000 named species. Fungus gnats are excellent indicators in the assessment of forest habitats in terms of nature conservation. Mycetophilidae and Sciaridae play an important role in the economy of nature, even if that has not yet been shown by quantitative analyses. Several ecological and faunistic studies give an impression of the predominance of this Diptera group, especially in woodland habitats, e.g. Engel (1995), Kleinevoss et al. (1996), Heller (1996). The number of described species is constantly increasing, and the identification of single species is becoming progressively safer and easier. The present study provides new taxonomic and distributional data on the genus *Acomopterella* Zaitzev, which was defined in 1989, for a species from the Western Nearctic. The second species of this genus, *Acomopterella martinovskyi* Ševčík & Chandler, 2008 was described from several places in the Czech Republic and from the Tyrolean Alps. The authors also synonymised the type species of the genus with a species previously described in the genus *Tetragoneura* Winnertz, 1846, a global genus with a vast number of named species. The present investigation has led to additional data and discovery of an undescribed species.

Material and methods

This study is based primarily on material from the Senckenberg Naturhistorische Sammlungen Dresden (SNSD), partially collected by the author. Malaise trap and sweep net samples from the Bavarian Alps, and from the islands of Sakhalin and Honshu were included. The type specimen of the newly described species is deposited in Dresden.

In addition to the two species treated in detail below, one specimen of *Archaeboletina tipuliformis* Meunier, 1904, a Baltic amber fossil was studied. Besides the species description, a second focus was directed on the ultrastructure of functional specialized tibial setae in 13 Mycetophilidae species. Most previous studies have been carried out using light microscopy; the present one was performed with scanning electron microscopy (SEM). In many cases optical refraction does not allow the user to study details of hyaline structures, but SEM does. Functional specialized tibial setae were studied in *Acomopterella martinovskyi, Acomopterella yoshiwae* sp. n., *Speolepta leptogaster* Winnertz, 1863, *Ectrepesthoneura hirta* Winnertz, 1846, *Tetragoneura* (2 unidentified species from the Far East and from New Zealand), *Synapha fasciata* Meigen, 1818, *Docosia diutina* Plassmann, 1996, *Coelophthinia thoracica* Winnertz, 1863, *Phthinia humilis* Winnertz, 1863, *Phthinia winnertzi* Mik, 1869, *Polylepta guttiventris* (Zetterstedt, 1852) and *Polylepta borealis* Lundström, 1912.

Specimens are mounted on microscope slides or kept in 70% ethanol. The amber fossil has been preserved in polyester, following Hoffeins' preparation method (2001). They were studied with the aid of an Olympus SZH10 stereomicroscope. For light microscope study and the preparation of drawings an Olympus BH2 was used.

Photographs were taken with a digital Olympus C-3030 camera attached to Olympus SZH10 and BH-2 microscopes. SEM photos were taken by a Zeiss SmartSEM™, Type Supra 55VP. Length measurements were taken of slide-mounted specimens only. The lengths of wing veins were assessed with the base of the stem vein as the basalmost point. The wing index, used to describe the shape of the wing, is the ratio of the wing length to its width. Morphological terminology, including abbreviations, follows McAlpine (1981), Søli (1997), Matile (1990) and Blaschke-Berthold (1994). The terminology in the egg description follows Mazzini et al. (1992) and Plachter (1981). The genus definition, given by Zaitzev (1989), has been adopted. *Acomopterella martinovskyi* is re-described at length, based on eastern Palaearctic specimens.

Taxonomy

Genus *Acomopterella* Zaitzev 1989
http://species-id.net/wiki/Acomopterella

Zaitzev, 1989: 134 (description); Ševčík & Chandler: 2008: 63 (discussion).

Type species. *Acomopterella arnaudi* Zaitzev, 1989: 134 (by original designation)= *Tetragoneura fallax* Sherman, 1925: 20.

Diagnosis. (based on Zaitzev's original genus description, with additions).

Body length 4.6-5.9 mm. **Head**. With 3 ocelli. Mid ocellus slightly in front of the lateral ocelli. Lateral ocelli scarcely to distinctly remote from eye margin. Eyes with short setulae. Face rather flat, bare or setose. Clypeus oval, slightly bulging, setose. Face and clypeus loosely connected. Palpi pentamerous. Antennae 16-segmented, 2-3 times length of the thorax. Length of mesial flagellomeres 3-5 times their own width. **Thorax**. Scutum with short, close lying acrostichal and long erect dorsocentral bristles. Scutellum with 2 very long medial bristles. Mediotergite, laterotergites and pleura bare. **Wing**. Transparent. Wing membrane with microtrichia only. C, the apical part of ta, R1, R5, M1, M2, M4 and CuA with macrotrichia. C extending to the tip of R5. R4 present; ta oblique, slightly shorter than stem of fork M1 + M2. Base of M4 on level of base of ta or slightly more proximal. Vein A well developed, its tip behind the level of base of ta or ending slightly before. Between A and the stem of fork M4 + CuA lies the weakly sclerotized vein CuP, traceable as fold line. **Legs.** Long. Fore coxae with numerous long bristles on its frontal side. Apical part of mid coxae with bristles on its lateral and frontal surface. Hind coxae with a row of very long bristles on the hind lateral surface. Mid tibiae with well developed tibial organ on its basal part. Tarsal claws with teeth. Empodia well developed. **Abdomen**. Segments 1–7 of normal size. Tergite 8 vestigial; Sternite 8 exceeding half length of sternite 7. Tergite 9 rectangular, with deep distal incision. Gonocoxites with apical processes.

Comments. The described genus belongs to the tribe Gnoristini in the subfamily Sciophilinae. It is similar to *Dziedzickia marginata* (Dziedzicki 1885), but differing

by bare laterotergites and a much longer vein ta. It differs from the Holarctic genus *Acomoptera* Vockeroth, 1980, in the position of Sc (in *Acomopterella* it joins R1, in *Acomoptera* C), in the shape of the cell between Rs and R4 (distinctly longer in *Acomoptera*) and in the strikingly longer ta. The genus is also similar to *Austrosynapha* Tonnoir, 1929, known from South America, New Zealand and Tasmania. Typical in both genera is the absence of setae on the laterotergites and the presence of a relatively long oblique vein ta. In *Austrosynapha* vein R4 is absent.

Acomopterella martinovskyi Ševčík & Chandler, 2008

http://species-id.net/wiki/Acomopterella_martinovskyi
Figs 1–2, 4–5, 7–8, 10–13, 14–20, 33–34

Diagnosis. A distinctive species with vein M4 basally detached, thus no complete hind fork present (Fig. 2). There is a tendency to basalization of radial veins, so that R1 is foreshortened. C extending beyond apex of R5 for 1/3 distance to M1. Subcosta ending directly in R at the level of base of ta. Crossvein ta nearly horizontal, long, subequal in length to M-stem. A single setum chaeticum of the mid tibial organ has 7-9 filamentous branches (Fig. 34). Empodium well developed (Fig. 12). Gonostylus simple, tapered (Fig. 14). Gonocoxites ventrally widely separated, having only a narrow basal sclerotized connection. Cerci with strikingly dense, long hairs, which are mostly directed proximad (Figs 18–20).

Description. Male. **Head.** Fig. 4. Head capsule, labella and antennae brown, palpi yellow. With three ocelli in a broad triangle. Median ocellus slightly smaller than the lateral ones. The median ocellus is surrounded by the medioocellar suture, with narrow pseudosclerite above ocellus. Lateral ocelli less than two times its own diameter distant from eye margin. Compound eyes covered with interommatidial setulae, with only some few blank interommatidial spaces near the dorsal eye margin. Ommatidia densely arranged. Basal palpomere distinct, ventrally extended, covering palpomere 2 for some distance. Second palpomere quite small, with 1–2 minute setae. Third palpomere with numerous sensilla claviformis that are evenly dispersed over the basal 3/4 of the inner surface of palpomere 3 (Fig. 8), a few setae situated mainly apically. Palpomeres 4 and 5 loosely scattered with similar setae, as present in the preceding segment. Scape and pedicel with few stronger setae, flagellomeres 1–3 with few small setae dorsally. Flagellomeres cylindrical, with trichia not reaching the length of a flagellomere diameter (Fig. 5). The antennal flagellomeres are sparsely scattered with sensilla chaetica (Figs 5, 7), with a decreasing number of sensilla towards the tip of the flagellum. The antennal surface between the described vestiture is smooth. Antenna reaching 4th abdominal segment. Face with 4–6, clypeus with several more setae. The premental apodeme is small, its posterior part weakly sclerotized and hardly traceable.

Thorax. Fig. 10. Uniformly brown. Scutum shining, dome shaped, with long erect acrostichal, dorsocentral and lateral setae. Antepronotum with 2 large and a further few

tiny setae, proepisternum with 1-2 large setae and a few tiny setae. Meso- and metapleuron, laterotergite and mediotergite bare. Scutellum with 2 strong and several smaller setae.

Wing. Fig. 2. Length 3.8-4.7 mm. Wing index 2.6. Wings clear, membrane with microtrichia only. Subcosta ending at level of base of ta in R, or shorter. Radial veins, M1, M2, M4 and CuA setose on the dorsal surface, R1 ventrally setose at tip. Other veins bare. Stem of median fork long, about 0.16 times wing length. The position of vein R4 is slightly variable, depending its distance from Rs. Vein R5 a little downcurved apically, costa exceeding its tip for one third of its distance to M1. M4 long, visible far before level of ta-base, basally detached. Haltere yellow.

Legs. Entirely pale brown. Hind coxae on its posterior ridge with a row of setae. Tibial and tarsal trichiae irregularly arranged. Hind tibiae with 4 ventral, 3 posterior, 2 posterodorsal, 1 dorsal, 6-7 anterodorsal and 10 anterior setae, the posterodorsals as long as tibial width, the other are shorter than tibial width. Mid tibia with 3 ventral, 3 anterior, 3 dorsal and 5-7 posterior setae, all of them shorter than tibial width. Fore tibia with 3 dorsal and 4 posterior setae. Mid tibia slightly swollen at its base, with an elongated patch of specialized seta chaetica (Figs 33-34). The single setum chaeticum has 7-9 filamentous branches, subequal in length and width. Hind tibia without apical comb. Tibial spurs 1:2:2, mid and hind spurs longer than tibial width. Empodium of normal size (Fig. 12). Fore basitarsus 1.1 times longer than tibia.

Abdomen. All abdominal segments including terminalia brown, with pale hairs. Segments 2–5 long, 6 and 7 a little shorter. Tergite 8 vestigial (Fig. 17) and completely retracted, sternite 8 reduced in width, partly retracted. **Terminalia.** Figs 14–20. Tergite 9 medium sized, twice as broad as long, together with cerci covering 3/4 of the gonocoxites. Gonocoxites ventrally widely separated, having only a narrow basal sclerotized connection. Parameres long, hardly reaching gonocoxal apex. Gonostylus medium sized, about half as long as gonocoxite, very slightly (Europe) to double bent (Far East) and simply tapered. European specimens have the gonostylus slightly shorter, maybe reaching 1/3 of gonocoxite length. Cerci with strikingly dense, long hairs, which are directed proximad. Hypoproct weakly sclerotized, horseshoe-shaped, with two strong apical setae (Fig. 16).

Female. **Head**. Antenna reaching 3rd abdominal segment. **Legs.** Front tarsi unmodified, except for the prolonged basitarsus. No mid tibial organ present. **Terminalia.** Gonocoxite 8 widely rounded, with a couple of distad directed apical setae (Fig. 13). Tergites 9 & 10 sparsely setose. Cerci setose, basicercus twice as long as disticercus. Cerci directed ventrad. **Egg**. A single egg is 410 μm long and 135 μm in diameter. The dorsal and lateral parts of the eggshell are characterized by indistinct longitudinal rows of rosette-like, hexagonally arranged superficial layers, reaching the posterior pole (Fig. 21). The dorsal and lateral surface is described best as being irregularly rough and sharp-edged (Fig. 25). The micropyle is distinct, its surrounding area with 10-20 isolated plugs (Fig. 22). The lateral transition zone has the hexagonal structures gradually suppressed. The ventral surface is more flattened and rugose (Fig. 21), with a central plate of differing structure. The ventral plate has a rounded outline and is distinguished by dense-set, simple to three-pieced upright columns (Figs 23, 24). The egg of *Acomop-*

terella martinovskyi is distinct from that of other fungus gnat species by its rough dorsal and lateral surface. It resembles other species in the general structure of the micropylar area, the flattened bottom and the presence of a ventral plate. The structure of a ventral plate on Mycetophilidae eggshells was described by Mazzini et al. (1992, p. 34) for the first time, in 3 *Mycomya* species.

Distribution and phenology. *Acomopterella martinovskyi* is known from several localities in the Czech Republic, from the Tyrolean Alps (Austria), the Bavarian Alps (Germany), from Sweden (Kjaerandsen 2012), from Sakhalin (Russia) and Hokkaido (Japan).

Material studied. 2 males (on slide and in ethanol), Germany, Bavaria, Allgaeu, Mt. Ponten (Alps), East of Hinterstein, SE of Sonthofen, 1840 m, 47°31'N, 10°18'E; Malaise trap; collector Voith. 1 male (in ethanol), Russia, Sakhalin Island, southern part near city Yuzhno Sakhalinsk, 200 m; mixed broadleaved forest; 142°45'E, 47°00'N ;1–5 Oct. 1993 Yellow pan trap; 200m; collector U. Kallweit. 1 female, 4 males (on slide), Japan, Hokkaido, Ogusawa-suigenchi area; near city of Otaru; 141°00'30"E, 43°10'30"N, 100m; 28 June 1997; sweep net, collector U. Kallweit.

Other material, pictures taken by electron-scanning microscope: 1 male. Japan, Hokkaido, Ogusawa-suigenchi area; near city of Otaru; 141°00'30"E, 43°10'30"N, 100m; 28 June 1997; sweep net, collector U. Kallweit.

Acomopterella yoshiwae Kallweit, sp.n.

urn:lsid:zoobank.org:act:1C2B125A-45E0-453D-9124-4E673CEAC095
http://species-id.net/wiki/Acomopterella_yoshiwae
Figs 3, 6, 9, 26–30, 31–32

Diagnosis. The species is characterized by a peculiar extended fore basistarsus, which is 1.5 times as long as the fore tibia. A strong basalization of radial veins has led to the nearly horizontal crossvein ta and foreshortened R1. C extending beyond apex of R5 for 1/3 distance to M1. Subcosta ending a short distance before base of ta in R. Crossvein ta not reaching the length of M-stem. A single setum chaeticum of the mid tibial organ has 2 filamentous branches (Fig. 32). Empodium well developed. The gonostylus of *Acomopterella yoshiwae* consists of two completely separated lobes (Figs 26–27). Gonocoxites ventrally separated, having only a narrow basal sclerotized connection. Cerci small, with few apical setae (Fig. 28).

Description. Male. **Head.** Head capsule, labella and antennae brown, palpi yellow. With three ocelli in a broad triangle. Median ocellus half the diameter of the lateral ones. Median ocellus surrounded by the medioocellar suture, with a narrow pseudosclerite above the ocellus. Lateral ocelli nearly contiguous to eye margin. Compound eyes covered with interommatidial setulae, with only some few blank interommatidial spaces near the dorsal eye margin. Ommatidia densely arranged. Palpi as in *A. martinovskyi*. Scape and pedicel with few stronger setae, flagellomeres without setae. Flagellomeres cylindrical, with trichia not reaching the length of a flagellomere diame-

ter (Fig. 6). The antennal flagellomeres are sparsely scattered with sensilla chaetica (Fig. 6), with a decreasing number of sensilla towards the tip of the flagellum. The antennal surface between the described vestiture is smooth. Antenna reaching 4th abdominal segment. Face and clypeus far-reaching fused, with few setae. The premental apodeme is small, posterior part weakly sclerotized and hardly traceable.

Thorax. Fig. 9. Uniformly brown. Scutum rather flattened; with pale, long erect acrostichal, dorsocentral and lateral setae. Antepronotum with 2 large and a further few tiny setae, proepisternum with 1 medium sized seta and few tiny setae. Meso- and metapleuron, laterotergite and mediotergite bare. Scutellum with 2 strong and several smaller setae.

Wing. Fig. 3. Length 4.3 mm. Wing index 2.7. Wings clear, membrane with microtrichia only. Subcosta ending a short distance before base of ta in R. Radial veins, M1, M2, M4 and CuA setose on the dorsal surface, other veins including basal part of CuA bare. Stem of median fork long, about 0.16 times wing length. Length of radial cell 3 times its own width. Vein R5 a little downcurved apically, costa exceeding its tip for 1/3 distance to M1. M4 meets CuA nearly exactly below base of ta. Haltere yellow.

Legs. Entirely pale brown. Hind coxae on its posterior ridge with a row of setae. Tibial and tarsal trichiae irregularly arranged. Hind tibiae with 5-7 tiny posteroventral setae in apical half, 6 posterior and 6 anterior setae. Mid tibia with 4 anterior, 4 antero-

Table 1. Details of specialized setae, situated at the upper outer side of tibiae. Abbreviations: Gnor = Gnoristini & Scio = Sciophilini.

Species	Tribe	Figures	Position of tibia		Shape of the single specialized seta					
			mid	hind	simple	complex	foliiform	filamentous	branched	peglike
Acomopterella yoshiwae	Gnor	31–32	X			X		X		
Acomopterella martinovskyi	Gnor	33–34	X			X		X		
Coelophthinia thoracica	Scio	49&55	X		X					
Docosia diutina	Gnor	45-48		X	X					X
Ectrepesthoneura hirta	Gnor	37-38	X		X?					
Phthinia humilis	Scio	50&54	X		X				X	
Phthinia winnertzi	Scio	51&57	X		X				X	
Polylepta guttiventris	Scio	52&56	X			X	X			
Polylepta borealis	Scio	53&58	X			X	X			
Speolepta leptogaster	Gnor	35–36	X			X	X			
Synapha fasciata	Gnor	43–44	X		X		X			
Tetragoneura sp. (FarEast)	Gnor	39–40	X		X		X			
Tetragoneura sp. (New Zealand)	Gnor	41–42	X		X		X			

dorsal, 2 posterior and 3 posteroventral setae. Fore tibia with 1 ventral seta. All tibial setae are shorter than tibial width. Mid tibia slightly swollen at its base, with an elongated patch of specialized seta chaetica (Figs 31–32, Table 1). The single setum chaeticum has 2 filamentous branches, subequal in length and width. Hind tibia without apical comb. Tibial spurs 1:2:2, subequal in length. Empodium of normal size, similar to that of *Acomopterella martinovskyi*. Fore basitarsus 1.5 times longer than tibia.

Abdomen. All abdominal segments including terminalia brown, with pale hairs. Segments 2-6 long, segment 7 little shorter. Tergite 8 vestigial and completely retracted, sternite 8 reduced in width, partly retracted. **Terminalia.** Figs 26–30. Tergite 9 medium sized, square, together with cerci covering half of the gonocoxites. Gonocoxites ventrally separated, having only a narrow basal sclerotized connection, which possibly represents the remainder of sternite 9. Parameres short, apically rounded. The gonostylus consists of two, completely separated lobes. The dorsal lobus is stout, strongly sclerotized and directed posterad. The ventral lobus is slender, less sclerotized, multicuspidate and directed ventrad. Cerci small, with few apical setae. Hypoproct weakly sclerotized, with two strong apical setae.

Female unknown.

Distribution and phenology. *Acomopterella yoshiwae* sp. n. was collected from an old-growth deciduous / coniferous forest at Mt. Kanmuri on the island of Honshu.

Etymology. The name refers to the origin of this species from Yoshiwa Village, Hiroshima Pref., Honshu, Japan.

Holotype. male (on slide), Japan, Honshu, Hiroshima Pref., Yoshiwa Village, Mt. Kanmuri; mature mixed deciduous / coniferous forest; 1000 m; 28 Sep.–22 Oct. 1999; Malaise trap; collector M. Jaschhof (SNSD).

Key to species of *Acomopterella*, imagines only

1 Vein M4 detached at base. With ventral gonocoxal projection only. Striking long cercal setae (Figs 18–20) .....***martinovskyi* Ševčík & Chandler**

2 M4 meets vein CuA below base of ta. With ventral & dorsal gonocoxal projection.....**3**

3 Gonostylus of 2 separated lobes (Figs 26-27) .....***yoshiwae* sp. n.**

– Gonostylus simple, tapered.....***fallax* Sherman (Nearctic)**

Discussion

Inner- and intergeneric relationships

The study provides new records of *Acomopterella martinovskyi* from Europe and the first records of this species from eastern Palaearctic localities. This species has a quite

low specimen density, thus very few records are known. The new records suggest it is a relict species with 2 distinct allopatric populations: (1) Central & North European – Alpine (2) Far Eastern. The populations are distinct by minimal morphological differences of the male terminalia, i.e. far eastern specimens have the apical half of gonostylus double bent (Fig. 14) and longer than it is in the european specimens. The european specimens are considered to be morphological homogenous, with the apical, tapered half of the gonostylus being shorter and simply bent (Ševčík & Chandler 2008, Figs 3–5). Additionally, the second species was found from only one location on the island of Honshu.

Males of *Acomopterella* have a patch of specialized setae on the outer surface of the mid tibia. The ultrastructure of these setae has been studied using SEM photographs on Palaearctic species of *Acomopterella* and several representative species of other genera of Mycetophilidae. In the herewith studied species these structures are diagnostic on the generic level, e.g. these setae are filamentous in *Acomopterella* and *Ectrepesthoneura*, leaf-like in *Tetragoneura*, leaf-like and slightly curled in *Synapha*, leaf-like and branched in *Speolepta*, filamentous and branched in *Coelophthinia* and *Phthinia*, tapered in *Polylepta*. The present study of the mid tibial organ was restricted to only few genera, mainly to find arguments for the close relationship of *Acomopterella martinovskyi* and *A. yoshiwae* sp. n. Previous studies did not describe these specialized setae detailed enough. The relative similarity of *Acomopterella* to some other representatives of the clade Gnoristini is discussed below. *Dziedzickia marginata* is different from *Acomopterella,* as stated here, in the relative length of the subcosta, which ends with a rounded bow in R, shortly but distinctly distal from Rs. In addition there are further traits of *Dziedzickia marginata* quite different from *Acomopterella*: mesanepisternum finely hairy along its posterior margin, metepisternum on its entire surface with fine hairs and laterotergite with rather long hairs. Mesanepisternal hairs of medium length, metepisternal hairs short. *Dziedzickia marginata* has a deep sensory pit on the anteromedial side of palpomere 3. Flagellomeres with a touch of polygon-like pattern on its surface. Male abdominal segments 7 and 8 strongly reduced in size, segment 7 partly retracted. Female terminalia rather small, especially cerci. The two segmented cerci are directed posteriad. In comparison to *Acomopterella*, species of *Palaeodocosia*, *Acomoptera, Tetragoneura* and *Ectrepesthoneura* have a stouter body and legs and are distinct in their general peculiar construction of male terminalia, including all hitherto studied fossils of these genera (pers. observation, unpublished). *Synapha* is distinct from *Acomopterella* at least by having a conspicuous sensory pit on its 3rd palpomere and male terminalia of simple, i.e. plesiomorphic type. *Archaeboletina* and *Speolepta* are obviously the most closely related genera to *Acomopterella*, especially considering the quite similar wing venation and length of the fore basitarsus. The close relation between *Speolepta* and *Archaeboletina tipuliformis*, from Baltic amber, was already mentioned by Edwards (1940, p. 123). Otherwise, *Archaeboletina* has terminalia of an ancestral, simple structure and tibial setae in distinct rows.

Speolepta, *Archaeboletina*, *Dziedzickia marginata, Palaeodocosia* and S*ynapha* share all traits that form the clade Gnoristini, as Väisänen (1986) has treated at length, even if the monophyly of Gnoristini is not yet finally established, and thus Gnoristini cannot be reliably defined. But it shows at least, that these genera do not belong to other groups, such as Sciophilinae s. str. (mediotergite setose), Leiinae (weakly delimited by combination of short vein R1 and hind tibial setae distinctly longer than tibial diameter) or Mycetophilinae s. str. (wing microtrichia in definite lines).

Acomopterella martinovskyi and *A. yoshiwae* sp. n. have the anterior transversal vein (ta) quite prolonged and horizontal, together with shortening of R1. This transformation is simply the consequence of wing vein costalization, a general trend in Diptera. It is visible in other Gnoristini as well, e.g. *Tetragoneura* or *Docosia*. There is no doubt that Leiini are a monophyletic group (Jaschhof and Kallweit 2009), though the foreshortened vein R1 may not be seen any longer as an unique synapomorphy of Leiinae.

Despite differences in structure of terminalia, the two Palaearctic *Acomopterella* species under discussion should be assigned to one genus, because details of head, thorax, legs and wings are more similar between them, than to any other species in related genera. On the other hand, presence of two, independently inserted gonostylar lobi on both sides, in comparison to only one lobus, is in fungus gnats usually to be seen as diagnostic on generic level. That is the weak point in the present classification of *A. yoshiwae*. At the present stage of knowledge, I explain this difference by long-term reproductive isolation of both groups.

Palaearctic species of *Acomopterella* have a prolonged fore basitarsus in common, which is longer than the tibia. *Acomopterella martinovskyi* has the fore basistarsus 1.1 times longer than the tibia, in both populations, eastern and western Palaearctic. In *Acomopterella yoshiwae* sp. n. the fore basitarsus is 1.5 times longer than the tibia. In addition, *Archaeboletina* has the fore basitarsus 1.2 times longer than the tibia. This long fore basitarsus is unique within the clade Gnoristini. Zaitzev (1989) has described *Acomopterella fallax* as having the fore tibia slightly longer than the fore basitarsus.

The subcosta in both species is long, ending immediately in front of the base of the anterior transversal vein. Males have a mid tibial organ on the dorsal basal third of the tibia, females do not. Female cerci are directed ventrad. Considering these features as a complex trait, one may conclude that *Acomopterella yoshiwae* sp. n. and *A. martinovskyi* are congeneric.

Modified setae of the legs in selected Mycetophilidae imagines

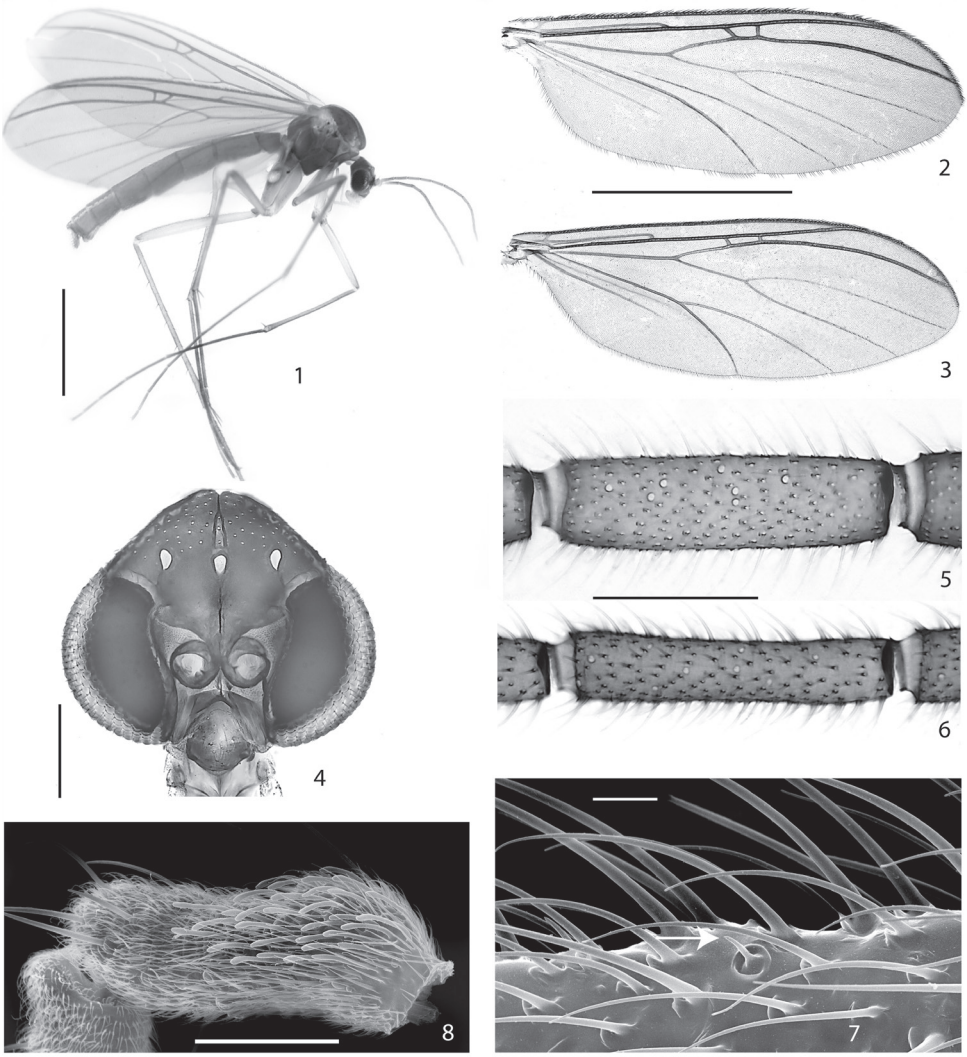
The legs of Mycetophilidae may possess conspicuously modified setae and other cuticular structures. FORE LEGS: The hitherto best known structure is the "Fore tibial organ" (Fig. 11), which was described in detail by Blaschke-Berthold (1994, p. 50), as mainly consisting of a glandular layer and a comb of setae. This fore tibial

organ is an autapomorphy of Sciaroidea. MID LEGS: There is a patch of specialized setae (Figs 31-44 & 49-58) found in many species of the Mycetophilidae tribes Sciophilini and Gnoristini ("sensory pit" of Hutson et al. 1980, p.18; "specialized sensory depression" of Vockeroth 1981, p. 226; "tibial sensory groove or pit" by Søli 1997, p. 25). Most recent studies have shown it in species of *Manota* (Manotinae) as well (Jaschhof & Jaschhof 2010, p. 29). A comparative outline of this structure was provided for the first time by Chandler (1980, p. 28), who called it "sensory area" resp. "sensory pit". The general structure of this area and accessory setae is quite similar among certain species of the same genus (see table A), even though it is frequently absent in species closely related to others bearing it. There are species which exhibit it in both sexes, as in *Coelophthinia* and *Phthinia*, but in the vast majority of the known species, including *Manota*, it is present in males only. The patch of specialized setae on fungus gnat mid tibiae may be an autapomorphy of Mycetophilidae, even though it is most often reduced or not expressed. Its taxonomic value for discrimination of the few studied species is evident, however it is not known well enough for use in higher classification. The specialized tibial setae, recently studied in 13 species in 9 genera of Mycetophilidae, are membranous and transparent. The single seta may be a sensillum chaeticum or glandular chaeta (sensu Francesca Vegliante, pers. comm.). Its possible function remains unclear, pending ongoing histological examination. HIND LEGS: A patch of modified tibial setae is also present in the male of *Docosia diutina* (females are still unknown). It has the same position on the hind tibia (Figs 45-46), as is the case in other taxa on the mid tibia. The single modified seta looks like a clothes peg (Figs 47-48). The area with modified setae is here not sharply delimited, though marked by several densely set tibial setae. This "hind tibial organ" can tentatively be seen as homologous to the "mid tibial organ" in other taxa. This assumption meets the two main criteria of homology: criterion of position and criterion of special structural quality (sensu Storch et. al. 2007, p. 55). It fits the description of "serial homology", given by Haszprunar (1992). Males of the closely related *Docosia rohaceki* (Ševčík 2006, p. 133) have perhaps the same structure, though roughly described as a "small black spot on hind tibia". It is absent in the female. It seems to be less certain whether the "hind tibial organ" of *Manota*, described by Jaschhof et al. (2011) is homologous to the mid one because of its location on the tibial tip.

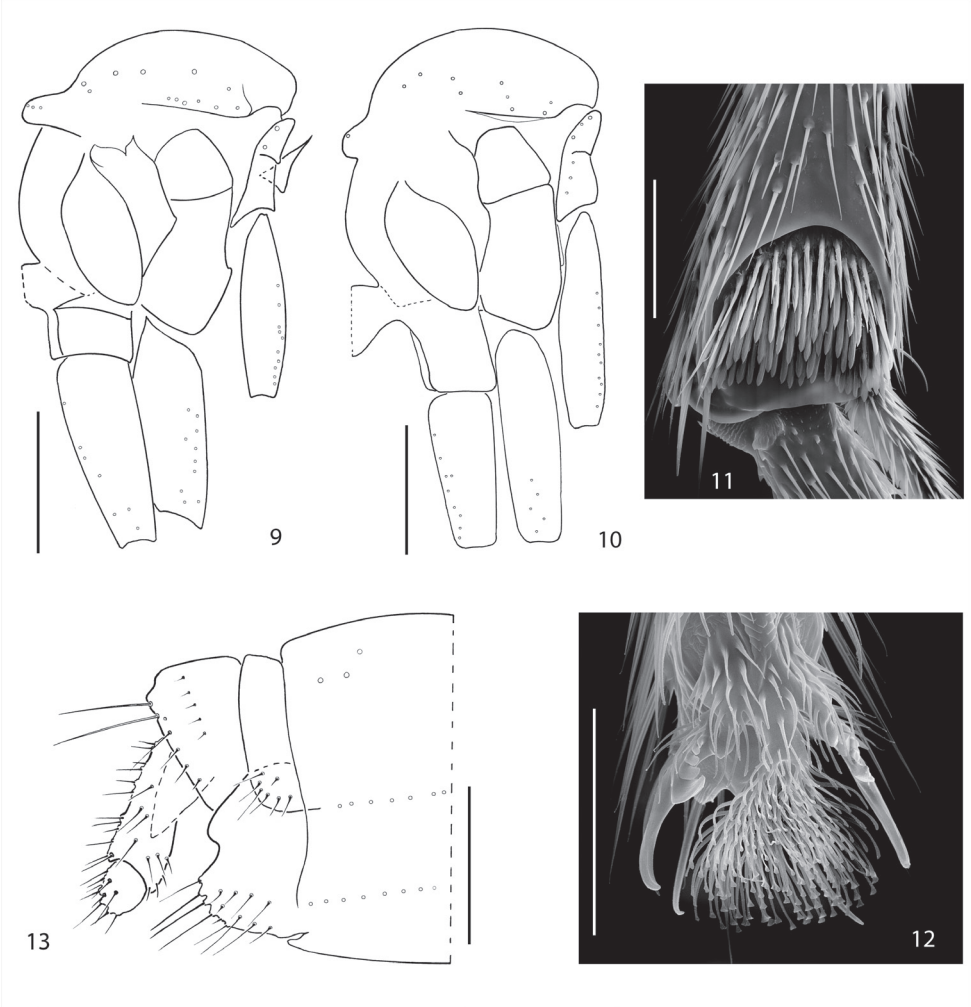
Zaitzev (1989, p. 136) pointed to the similarity between *Acomopterella* and *Austrosynapha*, however his opinion is based on highly variable characters, as length and obliquity of vein ta and setation of laterotergites. The present study has shown that the general structure of the *Acomopterella martinovskyi* eggshell is rather more similar to that of *Austrosynapha* (pers. observation, unpublished) or *Mycomya* (Mazzini et al. 1992) than that of *Speolepta* (Plachter 1981).

Zaitzev's description of the *Acomopterella* palpomeres (see above) is somewhat unclear, regarding their length. This problem may be solved by studying the type species of the genus, which is beyond the scope of this paper.

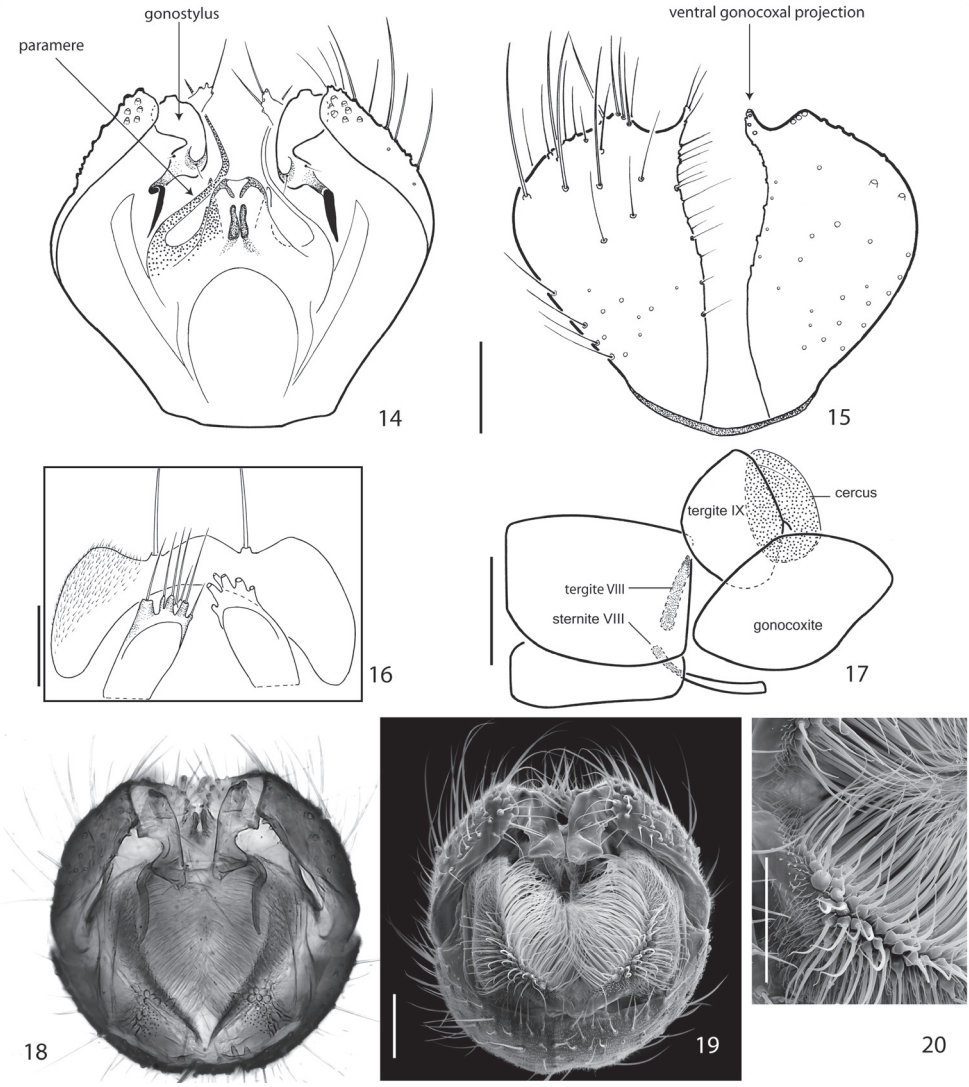
Plates



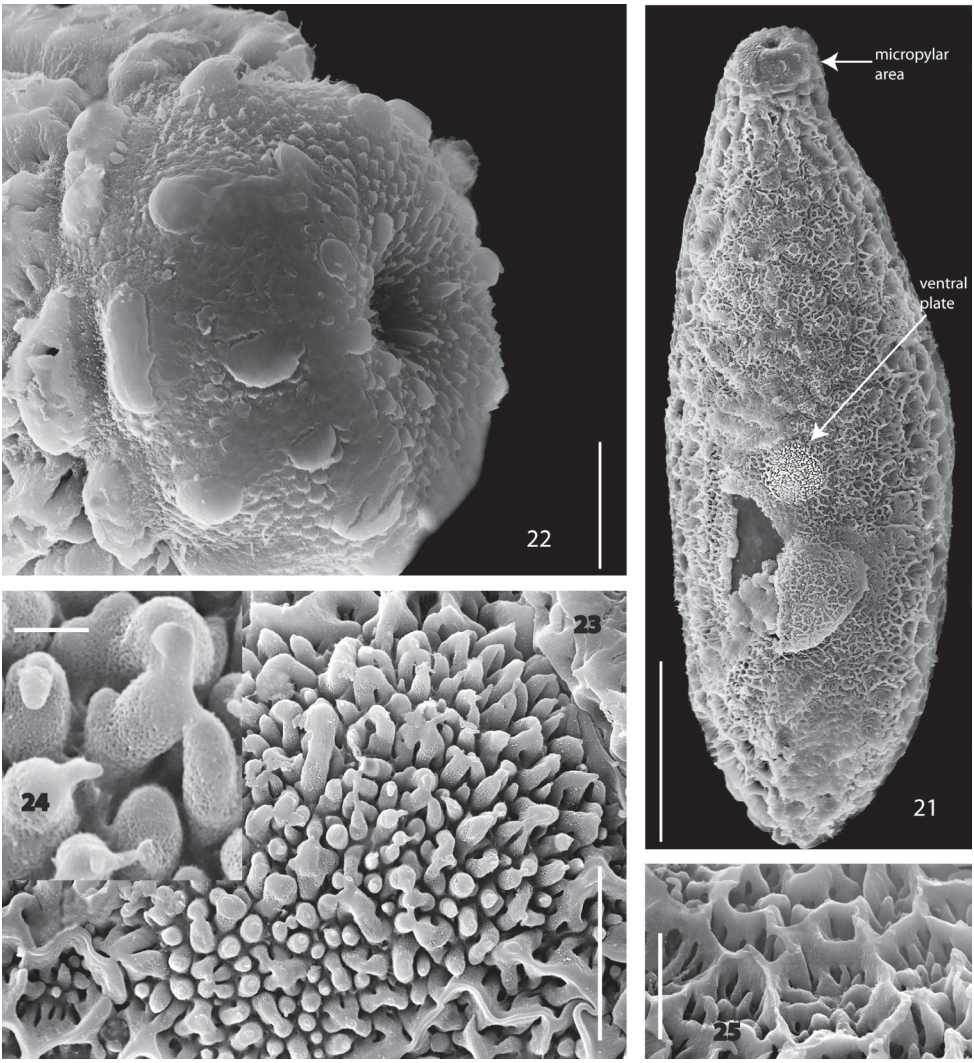
Figures 1–8. 1–2, 4–5, 7–8. *Acomopterella martinovskyi*. **1** Female habitus **2** Male wing **4** Male head, frontal view **5** Flagellomere 4, male. Sensilla chaetica visible as pale spots. **7** Sensillum chaeticum (at arrowhead) on flagellomere 10, male **8** Sensilla on palpomere 3, male **3, 6** *Acomopterella yoshiwae* sp. n., male. **3** Wing **6** Flagellomere 4. Length of scale bar = 2 mm (for **1–3**), 200 µm (for **4**), 100 µm (for **5–6**), 10 µm (for **7**), 50 µm (for **8**).



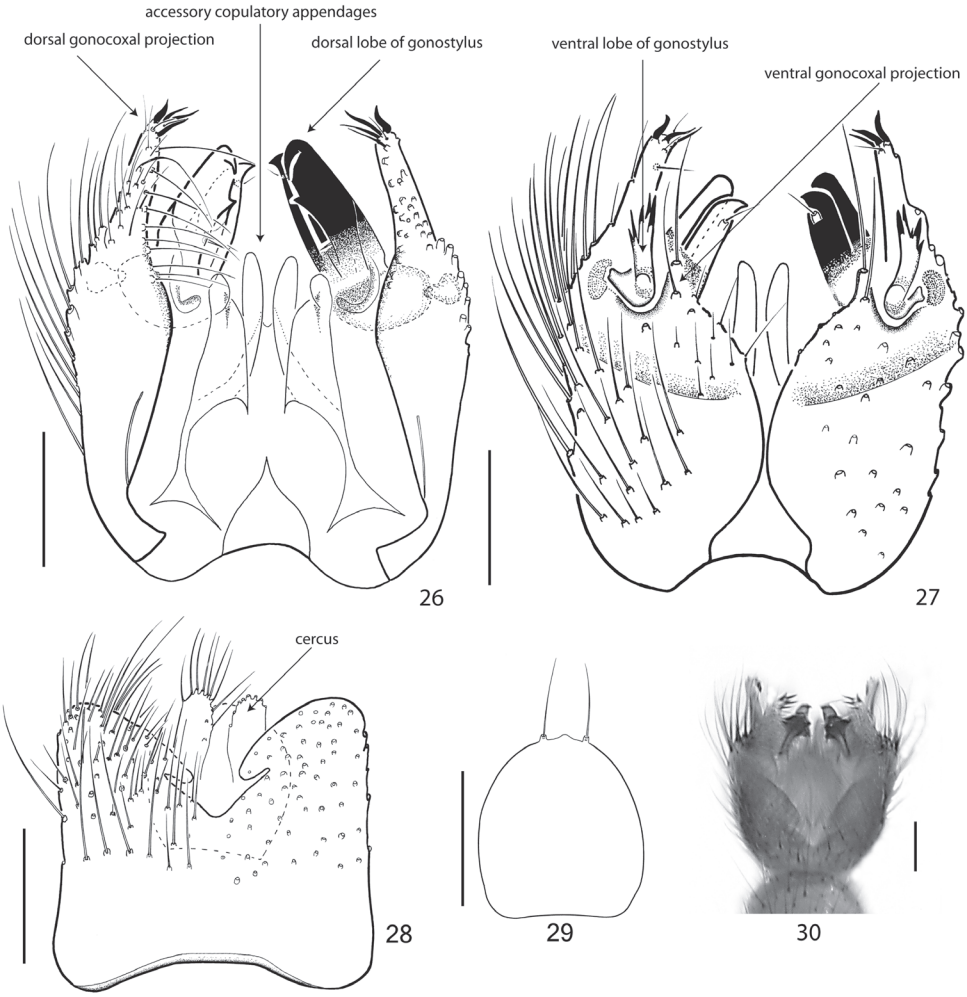
Figures 9–13. 9 *Acomopterella yoshiwae* sp. n., thorax in lateral view. **10–13** *Acomopterella martinovskyi*. **10** Thorax in lateral view **11** Fore tibial organ, male **12** Fore claw, male **13** Female terminalia in lateral view. Length of scale bar = 0,5 mm (for **9–10**), 50 μm (for **11–12**), 250 μm (for **13**).



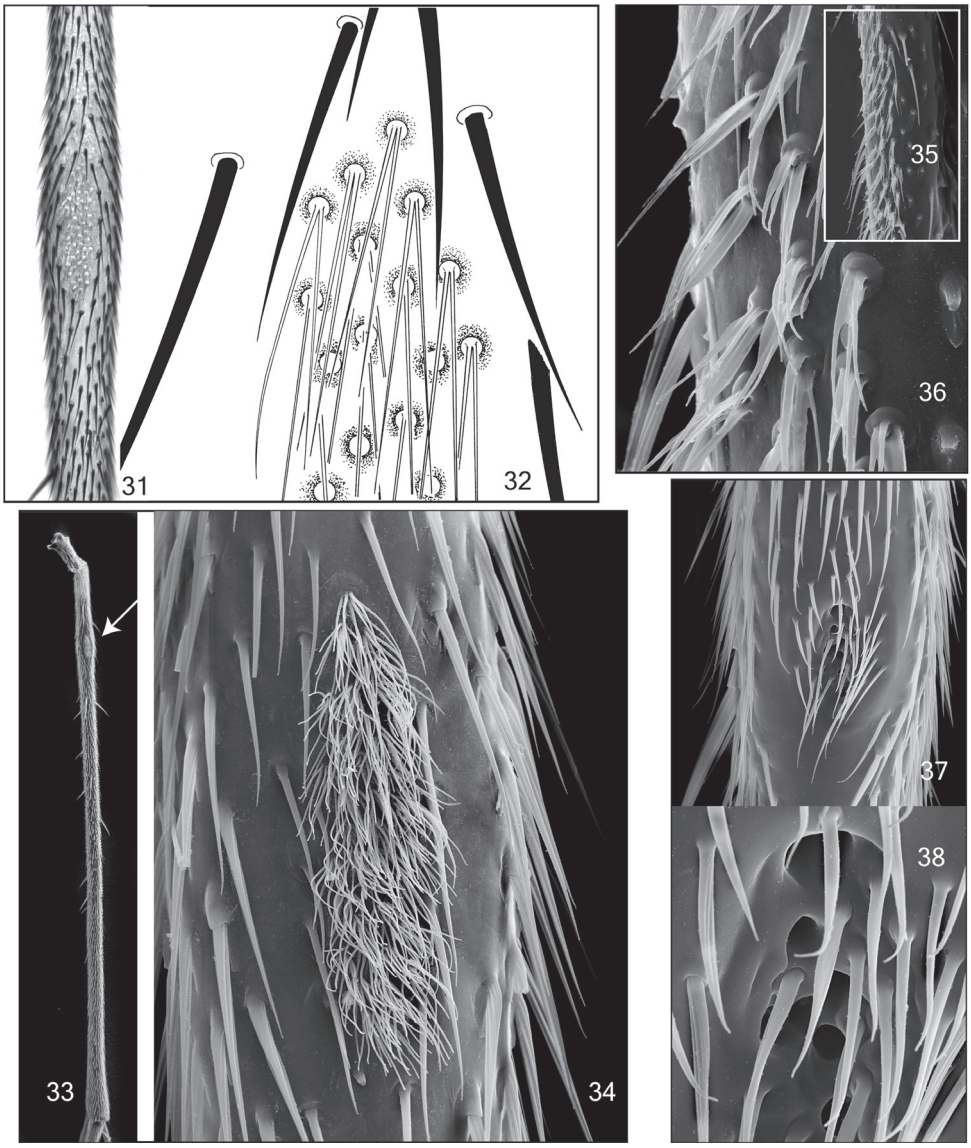
Figures 14–20. Terminalia of *Acomopterella martinovskyi*, male. **14** Terminalia in dorsal view, tergite IX removed **15** Gonocoxites in ventral view **16** Epiproct and hypoproct, dorsal view **17** Abdominal segments VII & VIII and terminalia in lateral view **18–19** Posterior view of terminalia **20** Cercal setae in detail. Length of scale bar = 100 µm (for **14–15, 18–19**), 50 µm (for **16, 20**), 0,5 mm (for **17**).



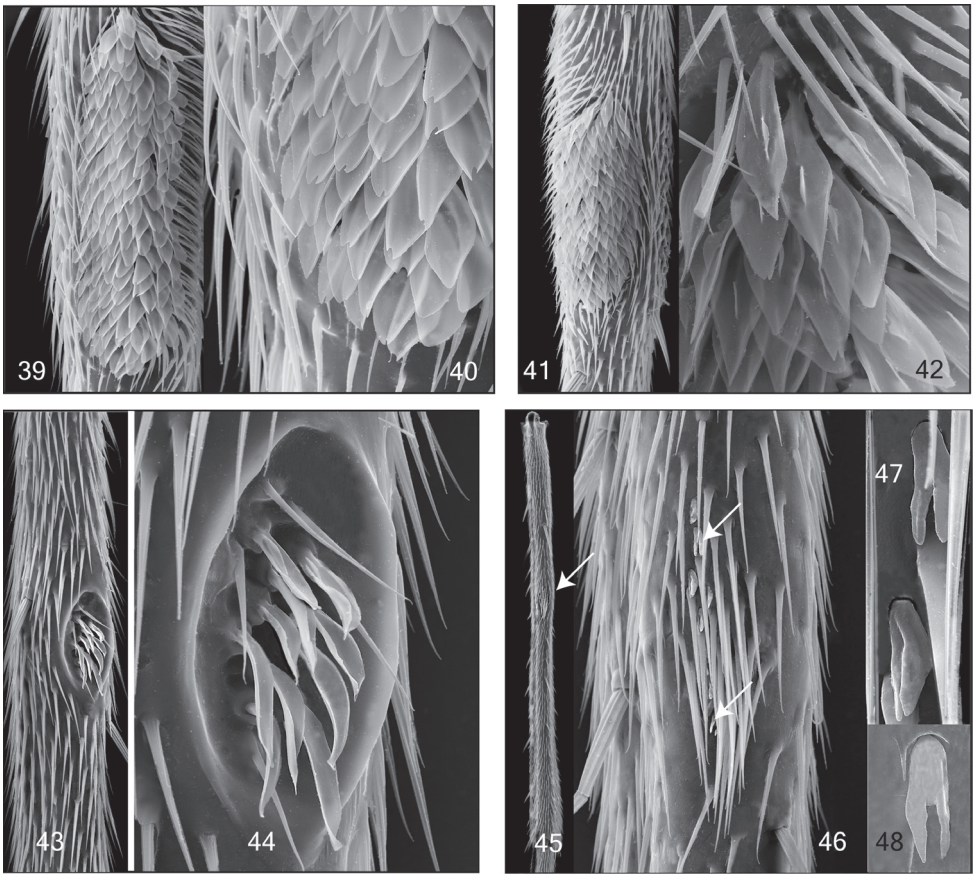
Figures 21–25. *Acomopterella martinovskyi*, egg. **21** Total view of egg, bottom side **22** Micropylar area **23** Total view of ventral plate **24** Column of ventral plate in detail **25** Hexagonal meshwork of the egg dorsal side. Length of scale bar = 100 µm (for **21**), 10 µm (for **22–23, 25**), 1 µm (for **24**).



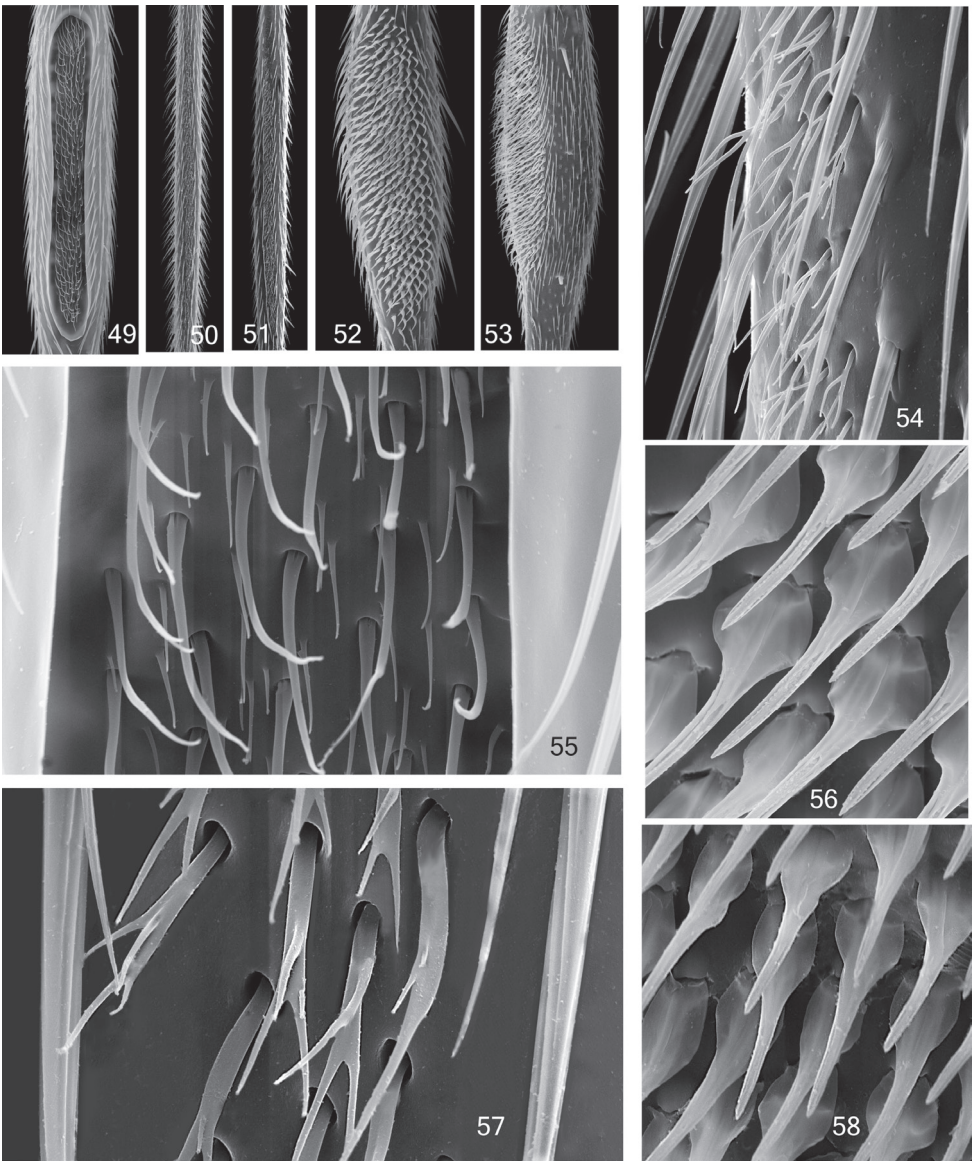
Figures 26–30. Terminalia of *Acomopterella yoshiwae* sp. n., male. **26** Terminalia in dorsal view, tergite IX removed **27** Terminalia in ventral view **28** Tergite IX, dorsal view **29** Hypoproct, ventral view **30** Terminalia incl. tergite IX in dorsal view. Length of scale bar = 100 µm.



Figures 31–38. Mid tibial organ. Not on the same scale. **31–32** *Acomopterella yoshiwae* sp. n. **33–34** *Acomopterella martinovskyi* **33** General outer view of mid tibia, the arrowhead points to the tibial organ **35–36** *Speolepta leptogaster* **37–38** *Ectrepesthoneura hirta*.



Figures 39–48. Mid and hind tibial organ. Not on the same scale. **39–40** *Tetragoneura* sp. (New Zealand) mid tibia **41–42** *Tetragoneura* sp. (Far East) mid tibia **43–44** *Synapha fasciata*, mid tibia **45–48** *Docosia diutina*, hind tibia **45** General outer view of hind tibia, the arrowhead points to the tibial organ **46** Tibial organ with densely set setae and and few sensilla chaetica, the arrowheads point to 2 of them **47–48** Sensilla chaetica in detail.



Figures 49–58. Mid tibial organ. Not on the same scale **49, 55** *Coelophthinia thoracica* **50, 54** *Phthinia humilis* **51, 57** *Phthinia winnertzi* **52, 56** *Polylepta guttiventris* **53, 58** *Polylepta borealis*.

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This paper is the result of a study, using the facilities of the Senckenberg Naturhistorische Sammlungen Dresden (SNSD). I would like to express my sincere appreciation to Dr Mathias Jaschhof (Senckenberg Deutsches Entomologisches Institut, Müncheberg) for providing specimens. I thank Peter J. Chandler (Melksham, UK) for reading an earlier version of this manuscript. An anonymous reviewer has pointed to the recent record of *Acomopterella martinovskyi* from Sweden, which is herewith acknowledged. Frauke Nielsen (SNSD) is thanked for technical assistance, especially in preparation of the amber fossil and taking SEM photographs.

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RESEARCH ARTICLE

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Key for European species of the *Cheilosia proxima* group (Diptera, Syrphidae) with a description of a new species

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Abstract

A new hoverfly species, *Cheilosia barbafacies* Vujić & Radenković **sp. n.** (Diptera, Syrphidae), is described and distinguished from the closely related species *C. pascuorum* Becker, 1894, based on material collected from the mountains of the Balkan Peninsula. Diagnostic characteristics and an identification key for the members of the *proxima* group of *Cheilosia* s. str., including the new taxon, are provided.

Keywords

Diptera, Syrphidae, *Cheilosia barbafacies*, *proxima* group, new species

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Introduction

Cheilosia Meigen, 1822 is the largest Palaearctic hoverfly (Diptera, Syrphidae) genus with nearly 300 species listed by Peck (1988), and 439 described species worldwide (Thompson et al. 2010). Its distribution extends to the Nearctic (more than 80 species), Oriental (about 50 species) and northern part of the Neotropical regions (one species from Chiapas, Mexico, and another one from Guatemala) (Ståhls et al. 2004; Thompson et al. 2010).

This genus belongs to the monophyletic tribe Rhingiini of the subfamily Eristalinae, as a sister group of Eumerini (Ståhls et al. 2003). According to Peck (1988), the tribe Rhingiini (as Cheilosiini) includes the genera *Chamaesyrphus* Mik, 1895, *Cheilosia*, *Endoiasimyia* Bigot, 1882, *Ferdinandea* Rondani, 1844, *Ischyroptera* Pokorny, 1887, *Macropelecocera* Stackelberg, 1952, *Pelecocera* Meigen, 1822, *Portevinia* Goffe, 1944, *Psarocheilosia* Stackelberg, 1952 and *Rhingia* Scopoli, 1763. The phylogenetic relationships of the tribe Rhingiini and the genus *Cheilosia* (Diptera, Syrphidae) were investigated by Ståhls et al. (2004) using morphological and molecular characters. The monophyly of subtribes of Rhingiini remained ambiguous, especially because of unstable phylogenetic placements of the genera *Portevinia* and *Rhingia*, while most of subgenera of *Cheilosia* appeared as monophyletic clades.

The subgeneric classification of *Cheilosia* has been changed from Becker's (1894) division of the genus into four artificial groups (A–D) to Barkalov's (2002) description of 13 subgenera, of which 9 are new (*Cheilosia* Meigen, 1822; *Endoiasimyia* Bigot, 1882 (= *Sonanomyia* Shiraki, 1930); *Taeniochilosia* Oldenberg, 1916 (= *Nigrocheilosia* Shatalkin, 1975); *Hiatomyia* Shannon, 1922; *Neocheilosia* Barkalov, 1983; *Eucartosyrphus* Barkalov, 2002; *Floccocheila* Barkalov, 2002; *Pollinocheila* Barkalov, 2002; *Montanocheila* Barkalov, 2002; *Nephocheila* Barkalov, 2002; *Conicheila* Barkalov, 2002; *Convocheila* Barkalov, 2002; *Rubrocheila*, Barkalov 2002). Several of these subgenera were recognized earlier as species groups (*nigripes, longula, illustrata, alpina, velutina, scanica, sachtlebeni, formosana*) (Barkalov 1983). Before Barkalov's subgeneric division (2002), the names of subgenera *Nigrocheilosia* Shatalkin, 1975, *Neocheilosia* Barkalov, 1983 and *Cheilosia* s. str. were also in use. The *nigripes* species group corresponds to subgenus *Nigrocheilosia,* the *scanica* species group to subgenus *Neocheilosia,* and most members of the *velutina* group to *Cheilosia* s. str. The monophyly of the genus *Cheilosia*, as well as subgenera (*Nigrocheilosia*, *Neocheilosia, Cheilosia*) and some species groups, were well supported by molecular analysis (Ståhls and Nyblom 2000).

All known species undergo larval development in specific plants or fungi, although some species feed on a wide range of plants. There is only one known exception, the species of the subgenus *Neocheilosia* Barkalov, 1983, which feed on sap and cambium of coniferous trees. One of the most serious pests of genus *Cheilosia*, is the species *C. vulpina* (Meigen, 1822) that infested 50% of artichoke (*Cynara scolymus*) crops in Northern France during the 1980s (Rotheray and Gilbert 2011). Although larvae of species from the *proxima* group are mostly undescribed, except *C. proxima* (Zetterstedt,

1843) and *C. vulpina,* they were observed from different plants by several authors. Very often these larvae mine stems, roots or rhizomes, or, rarely, graze roots externally, as observed in larva of *C. proxima* found on *Cirsium palustre* (Rotheray and Gilbert 2011). *C. gigantea* (Zetterstedt, 1838) was reported from *Rumex* sp.; *C. pascuorum* Becker, 1894 is an internal feeder in *Cynoglossum officinale*; *C. proxima* (Zetterstedt, 1843) was collected from *Cirsium palustre* and *C. oleraceum*; *C. rufimana* (Becker, 1894) was observed ovipositing on *Polygonum bistorta*, while *C. velutina* Loew, 1840 mines the stems of *Cirsium palustre* and the rhizome of *Scrophularia nodosa* (Speight 2012). While phytophagous hoverflies can cause economic damage by attacking cultivated plants, they can also be used beneficially to control weeds. Examples of this are *C. psilopthalma* (Becker, 1894) and *C. urbana* (Meigen, 1822), which have been found to be efficient biological control agents for *Hieracium* spp., and which are sufficiently host-specific for release in New Zealand where no native *Hieracium* species exist (Grosskopf et al. 2002).

These blackish hoverflies without mimetic features still cause identification troubles for taxonomists, due to the existence of many morphologically similar taxa with variable characters. There is no key through which all European species of *Cheilosia* can be identified. Recently, attempts have been made to stabilise the nomenclature of western European *Cheilosia* species, by dealing with small groups of closely related species (Barkalov and Ståhls 1997, Claussen 1998, Claussen and Speight 2007, Haarto and Kerppola 2007, Speight 2012). In the last decade, only a few species were described from Europe, including *C. ingerae* Nielsen & Claussen, 2001 (Nielsen and Claussen 2001), *C. naruska* Haarto & Kerppola, 2007 (Haarto et al. 2007) and *C. thessala* Claussen & Ståhls, 2007 (Claussen and Ståhls 2007).

Vujić (1996), in his revision of the *Cheilosia* species from the Balkan Peninsula, recorded 77 species and two subspecies: nearly half of the 175 registered European species (Speight 2012). The influence of different biogeographical regions over different geological periods resulted in great biodiversity on the Balkan Peninsula, making it one of the important speciation centres in Europe (Vujić 1996, 1997, 1999a, 1999b, Vujić et al. 1994, 2008). Many species of the genus *Cheilosia* have been described from this area, e.g. *Cheilosia alba* Vujić & Claussen, 2000 (Vujić and Claussen 2000), *C. balkana* Vujić, 1994 (Vujić 1994b), *C. bracusi* Vujić & Claussen, 1994 (Vujić and Claussen 1994b), *C. clama* Claussen & Vujić, 1995 (Claussen and Vujić 1995), *C. griseifacies* Vujić, 1994 (Vujić 1994a), *C. katara* Claussen & Vujić, 1993 (Claussen and Vujić 1993), *C. orthotricha* Vujić & Claussen, 1994 (Vujić and Claussen 1994a), *C. redi* Vujić, 1996 (Vujić 1996), and *C. vujici* Claussen & Doczkal, 1998 (Claussen and Doczkal 1998).

After detailed analysis of published material under the name *Cheilosia pascuorum* Becker, 1894 from the Balkan Peninsula (Vujić 1996), one new morphologically cryptic species was discovered and is described in the present text. This new cryptic species belongs to the *proxima* group of *Cheilosia* s. str., together with the other Palaearctic species *C. balkana*, *C. gigantea*, *C. ingerae*, *C. pascuorum, C. proxima*, *C. rufimana*, *C. velutina*, and *C. vulpina* (see Table 1 for distribution). Nielsen and Claussen (2001)

Table 1. List of species of *Cheilosia* belonging to the *proxima* group and their distribution.

Species name	Species distribution, from Speight (2012), with additional information for the Balkan Peninsula
C. balkana	Alps (Italy), Balkans (Montenegro, Serbia, Slovenia).
C. barbafacies sp. n.	Dinaric mountains on the Balkan Peninsula
C. gigantea	Fennoscandia south to the Alps; Germany eastwards through northern and central Europe together with northern Italy and the Balkans (Slovenia, Bosnia and Herzegovina, Serbia, Montenegro, FRY Macedonia, Bulgaria) into European parts of Russia, and from Ukraine to the Caucasus; in Siberia from the Urals to the Pacific coast.
C. ingerae	Northern Norway, Sweden and Finland.
C. pascuorum	Alps (France, Germany, Switzerland, Austria), Romania, parts of European Russia, the Balkans (Serbia, Montenegro).
C. proxima	Fennoscandia south to the Pyrenees and the mountainous regions of Spain; Britain eastwards through much of Europe, the Balkans (Slovenia, Croatia, Bosnia and Herzegovina, Serbia, Montenegro, FRY Macedonia, Greece, Bulgaria) into Turkey and European parts of Russia; in Siberia from the Urals to Kamchatka.
C. rufimana	From Finland, Denmark and Belgium eastwards through mountainous regions of central Europe to the Balkans (Serbia, Bulgaria); Ukraine; Kazakstan; Asiatic Russia.
C. velutina	Fennoscandia south to Spain; from Ireland eastwards through much of Europe into Russia and through Siberia to the Pacific coast.
C. vulpina	Denmark to the Pyrenees and northern Spain; from England eastwards through central Europe to the central and southern parts of Russia as far as western Siberia.

presented an identification key and diagnostic characters for the Fennoscandian species of the *proxima* species group which is here adapted and expanded. In addition, relationships between this species group and related species are discussed.

Methods

The characters used in the key, descriptions, and drawings employ the terminology established by McAlpine (1981); the male genitalia characters are defined by Claussen (1998) and Nielsen and Claussen (2001).

The specimens under study were collected by sweep netting. To study male genitalia, specimens were relaxed and the genitalia were extracted using an insect pin with a hooked tip.

Genitalia were cleared by boiling individually in tubes of water-diluted KOH pellets for 5 min. This was followed by brief immersion in acetic acid to neutralize the KOH and immersion in ethanol to remove the acid. Samples were stored in microvials containing glycerol. Drawings were made with an FSA 25 PE drawing tube attached to a binocular microscope. Measurements were taken with an eye piece graticule or micrometer.

All the studied material, including type material, has been deposited at the Department of Biology and Ecology, Faculty of Sciences, University of Novi Sad, Serbia (FSUNS).

Systematics

Tribe Rhingiini
Genus *Cheilosia* Meigen, 1822

Type species. *Syrphus flavipes* Panzer, 1798

Subgenus *Cheilosia* Meigen, 1822
***Chilosia* Agassiz, 1846**
***Cartosyrphus* Bigot, 1883**
***Chilomyia* Shannon, 1922**
***Chaetochilosia* Enderlin, 1936**
***Dasychilosia* Enderlin, 1936**

Proxima species group

Diagnosis. Eyes pale haired; antennal pits separated; vertex grey dusted; central prominence rounded and more protruding than lateral corner of subcranial cavity, in lateral view; face at the level of central prominence less wide than half width of head. Probasisternum of protorax not fused with adjacent sclerites; anterior anepisternum bare; scutellum with black, exceptionally yellow, marginal setae; katepisternum with upper and lower hair patches connected or narrowly divided, entirely dusted; legs predominantly black, except tibiae usually paler on both ends; front coxa without lateral tooth; last tarsomere of front leg unmodified; in females, some hairs on hind tibiae longer, at least more than half of its width. Sternites of abdomen entirely grey dusted; male genitalia: gonostylus with a characteristic dorsal lobe (Figs 1, 2), neither S-shaped (Fig. 3A) nor sickle-shaped (Fig. 4D, 4E).

Comments. This group is related and morphologically similar to the following *Cheilosia* s. str. species: *C. barbata* Loew, 1857, *C. naruska*, *C. aerea* Dufour, 1848, and *variabilis* group of species, i.e. *C. melanopa* (Zetterstedt, 1843), *C. redi*, *C. honesta* Rondani, 1868, *C. variabilis* (Panzer, 1798). Nevertheless, all of them can be distinguished by a combination of characters: *C. barbata* has a S-shaped gonostylus (Fig. 3A) and females have less dusted sternites, undusted central part of the katepisternum and a narrower frons with parallel sides; in *C. aerea*, hairs on the anterior anepisternum are present and sternites are less dusted in some specimens and populations; in *C. naruska*, sternites are undusted except for slightly dusted anterior and posterior margins; males in *variabilis* group have sickle-shaped gonostylus (Fig. 4D, 4E) and females have very short and adpressed hairs on hind tibiae.

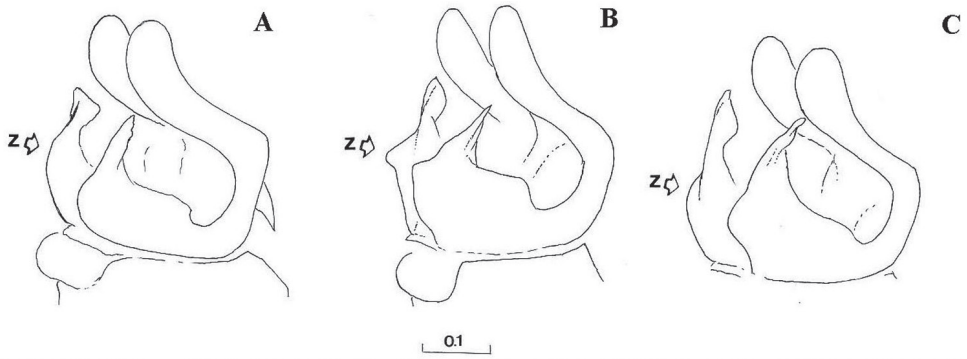

Figure 1. Gonostylus, dorsolateral view (z indicates the dorsal margin of gonostylus): **A** *Cheilosia barbafacies* sp. n., Durmitor, Montenegro **B** *C. pascuorum*, Doroslovo, Serbia **C** *C. pascuorum*, Kopaonik, Serbia. Scale in mm.

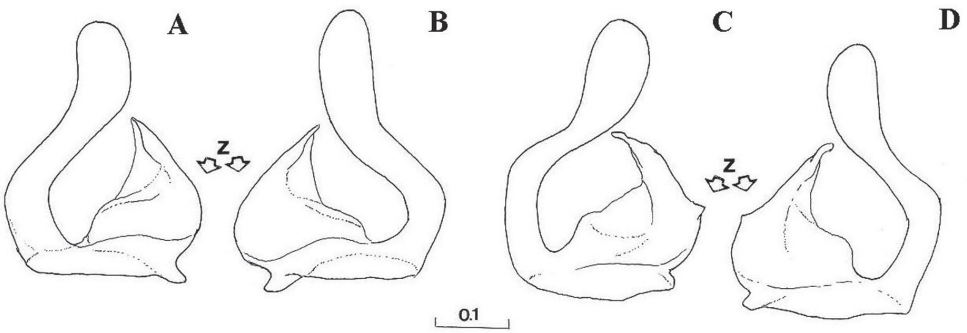

Figure 2. Gonostylus (z indicates the dorsal margin of gonostylus). **A–B** *Cheilosia barbafacies* sp. n.: **A** left gonostylus, left lateral view **B** right gonostylus, right lateral view **C–D** *C. pascuorum*: **C** left gonostylus, left lateral view **D** right gonostylus, right lateral view. Scale in mm.

***Cheilosia barbafacies* Vujić & Radenković, sp. n.**
urn:lsid:zoobank.org:act:9F2ABB52-652B-4652-AD7C-8ACB4D8579C8
http://species-id.net/wiki/Cheilosia_barbafacies
Figs 1A, 2A, 2B, 4A, 4B, 5–7, 8A, 8C, 9–11, 12A, 12B

Cheilosia honesta of Šimić, 1987 (in part).
Cheilosia pascuorum of Vujić, 1996 (in part).

Type-locality. MONTENEGRO: Durmitor, Škrčko-Sušički basen, 43°11'7"N 19°3'28"E, broad-leaf forest, 25 June 1995, A. Vujić leg.

Type-specimen: Holotype ♂, in excellent condition. MONTENEGRO. Original label: "Durmitor YU / Skakala 25.06.'95. / leg. Vujić." 43°10'16"N; 18°59'56"E (FSUNS 05768).

Paratypes, in excellent condition. MONTENEGRO**:** ♂ Original label: "007. Durmitor / Skrcka jezera / 5.07.1983."43°8'8"N; 19°0'56"E (published in Šimić (1987) as *Chei-*

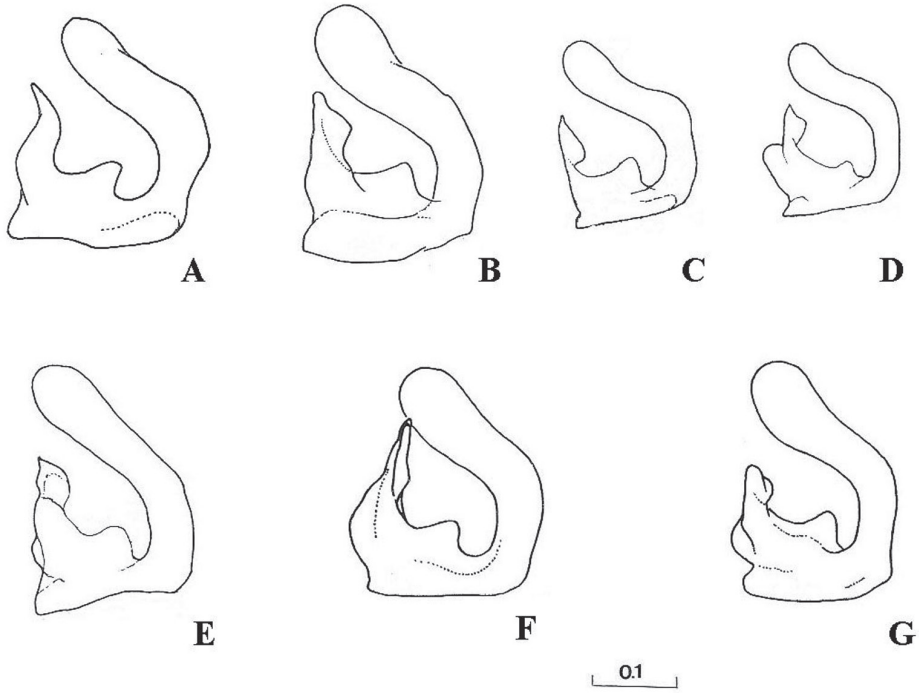

Figure 3. Right gonostylus, right lateral view: **A** *Cheilosia barbata* **B** *C. ingerae* **C** *C. balkana* **D** *C. proxima* **E** *C. gigantea* **F** *C. velutina* **G** *C. rufimana.* Scale in mm.

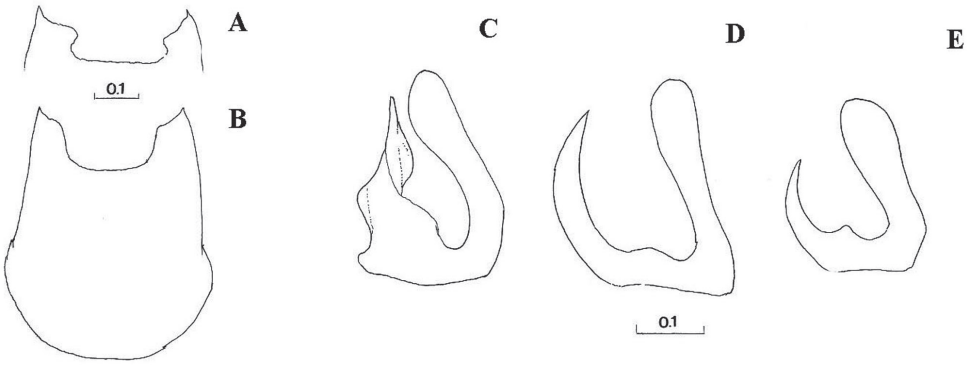

Figure 4. A–B *Cheilosia barbafacies* sp. n., theca of hypandrium, ventral view: **A** Montenegro, Durmitor **B** Bosnia-Herzegovina, Jahorina **C–E** right gonostylus, lateral view: **C** *C. vulpina* **D** *C. lasiopa* **E** *C. melanopa*. Scales in mm.

losia honesta) (FSUNS 05758); ♂ Original label: "199 G. Durmitor / Luke / 8.07.1991. YU." 43°7'37"N; 19°0'5"E (published in Vujić (1996) as *Cheilosia pascuorum*) (FSUNS 05759); ♂ Original label: "199 H. Durmitor / Luke / 9.07.1991. YU." 43°7'37"N; 19°0'5"E (FSUNS 05763); 3♂ Original label: "199 H. Kanjon Susice / 9.07.1991. YU."43°12'41"N; 18°59'44"E (FSUNS 05760, 05761, 05766); ♂ Original label: "Dur-

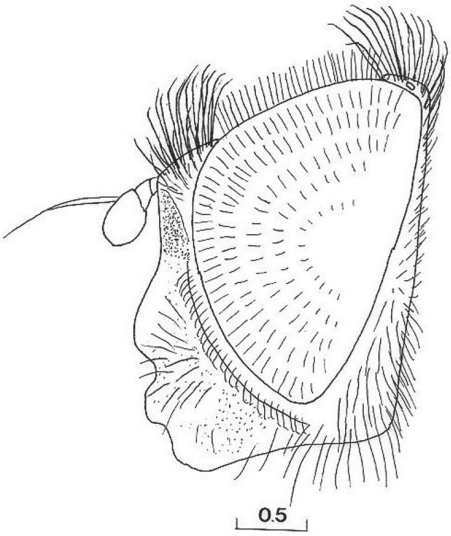

Figure 5. *Cheilosia barbafacies* sp. n., male, head, lateral view. Scale in mm.

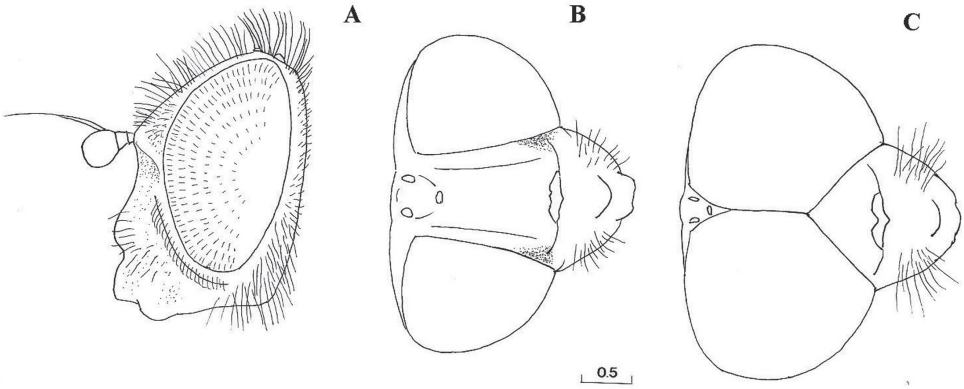

Figure 6. *Cheilosia barbafacies* sp. n., head: **A** female, lateral view **B** female, dorsal view **C** male, dorsal view. Scale in mm.

mitor 8.07.92. / Skrcko Zdrijelo YU / leg.Vujic. ”43°7'7"N; 19°0'53"E (FSUNS 05765); ♂ Original label: “Durmitor 2.07.93. / ka Prutasu YU / leg. Radnovic S.” 43°10'16"N; 18°59'56"E (FSUNS 05764); ♂ Original label: “Durmitor 1.6.1994 / KanjonSusice YU / leg. Vujic.” 43°12'41"N; 18°59'44"E (FSUNS 05770); ♂ Original label: “Durmitor YU / Skakala 6.7.1994. / leg. Vujic.” 43°11’16"N; 19°0'21"E(FSUNS 05767); ♂ Original label: “Durmitor 30.06.93. / Skrčko jezero YU / leg. Radnovic S.” 43°8'8"N; 19°0'56"E (FSUNS 05762); ♂ (FSUNS 05771) ♀ (FSUNS 05769) Original label: “Durmitor 25-26.5.96. / Susica-Skrke YU / leg. Vujic”. 43°11'7"N; 19°0'28"E. BOSNIA-HERZEGOVINA: ♂ Original label: “1613 Bosna / Jahorina / 14.05.1989.” 43°42'25"N; 18°34'13"E (published in Vujić (1996) as *Cheilosia pascuorum*) (FSUNS 05757).

Description. MALE (Figs 1A, 2A, 2B, 4A, 4B, 5, 6C, 8A, 8C, 9A, 11A, 12A, 12B).

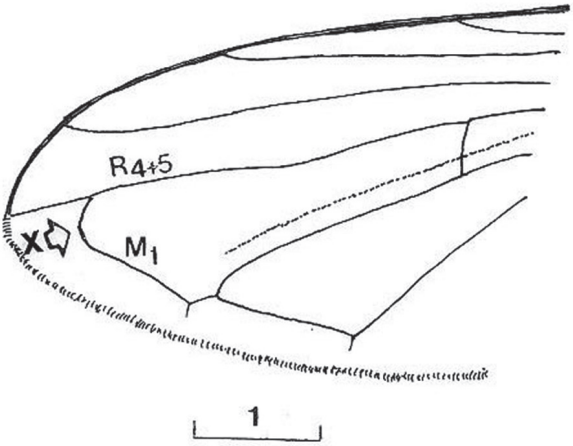

Figure 7. *Cheilosia barbafacies* sp. n., female, tip of wing (x indicates the meeting point of vein M_1 and vein R_{4+5}). Scale in mm.

Head: Face with long, predominantly pale hairs, central prominence rounded (Fig. 5); orbital stripe with short, pale hairs. Frontal triangle small, undusted, covered with black hairs; eye contiguity longer than frontal triangle (Fig. 6C). Eyes completely covered with greyish hairs. Occiput narrow, white-grey dusted. Antennae dark, third antennal segment from dark-brown to reddish; arista bare and short (Fig. 11A). Clypeus dusted.

Thorax: Scutum with dark-olive shine, laterally slightly dusted, covered with long, pale and black hairs (Fig. 9A); central disc shining, with fine puncturation. Scutellum covered with long hairs and numerous longer black hairs on posterior margin (Fig. 9A). Pleurae dusted, covered with predominantly pale hairs mixed with black hairs on anepisternum and anepimeron; katepisternum continuosly pilose. *Wing* brownish, with dark veins, completely covered with microtrichia; vein M1 meeting vein R_{4+5} at an obtuse angle (Fig. 7: x). Calypters yellowish-grey. Haltere yellowish-grey with dark capitulum. *Legs* dark, except pale apex of femora, basal 1/3–1/4 and apical 1/5–1/6 of tibiae and ventral surface of tarsi on fore and middle legs; hairs on legs predominately pale mixed with black.

Abdomen: Tergites shining, except the whole tergite 2 and dull central area on tergites 2 and 3, which extends from anterior margin of tergite 2 to basal 6/7 of tergite 3, leaving the posterior margin of tergite 3 shining; tergites covered with erected, pale hairs, except few black hairs on posterior half of tergite 4 and on pregenital segments. Sternites grey dusted covered with pale hairs.

Genitalia: Dorsal lobe of gonostylus broad basally (Fig. 8A), without distinct dorsolateral extension (Figs 1A, 2A, 2B), present in *C. pascuorum* (Figs 1B, 1C, 2C, 2D); theca of hypandrium in ventral view with large quadrilateral excavation (Figs 4A, 4B).

FEMALE (Figs 6A, 6B, 7, 9B, 10, 11B). Similar to the male, except for normal sexual dimorphism and the following characters: pile is general shorter and more extensively pale, and legs less dark, basal 1/4 of femora, basal 1/3 and apical 1/4 of tibiae pale; frons with two lateral channels, shiny, except dusted antero-lateral corners (Fig.

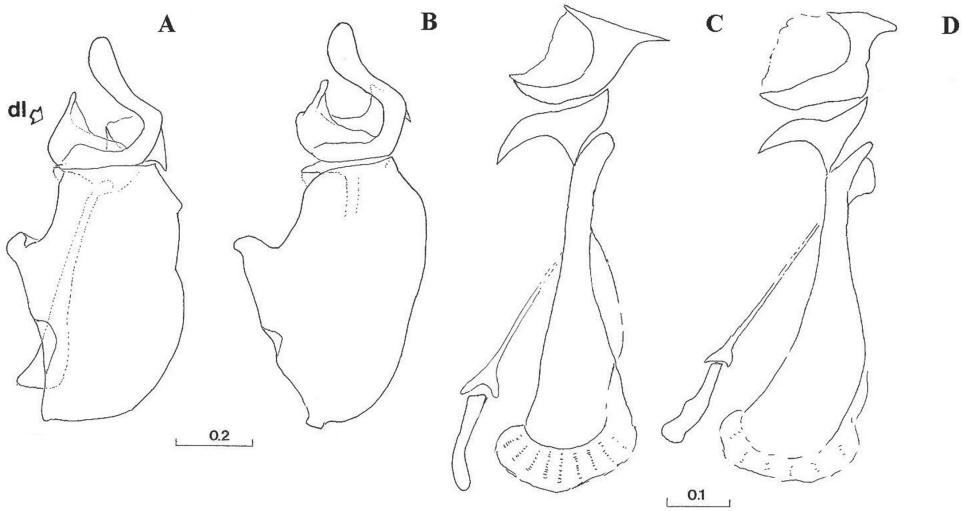

Figure 8. A–B Male genitalia, hypandrium, right lateral view (dl indicates the dorsal lobe of gonostylus): **A** *Cheilosia barbafacies* sp. n. **B** *C. pascuorum*. **C–D** Male genitalia, aedeagus and associated structures, right lateral view: **C** *C. barbafacies* sp. n. **D** *C. pascuorum*. Scales in mm.

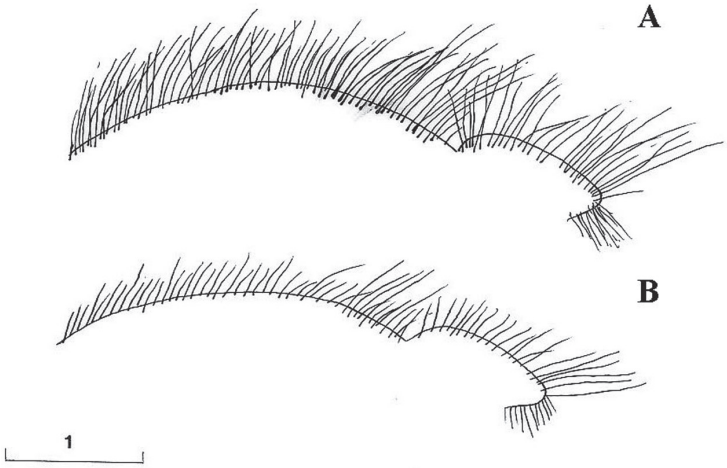

Figure 9. *Cheilosia barbafacies* sp. n., mesonotum, lateral view: **A** male **B** female. Scale in mm.

6B), covered with pale hairs, except a few black hairs around ocellar triangle and above antennae; thorax pale haired, except for a few black hairs on post-alar calli and near wing base; tibiae of fore and middle legs pale, except dark central ring; basal tarsi of fore and middle legs pale; tergites covered with long and erect hairs, except adpressed hairs on central part of tergites 1–4.

Size. Male, body length: 8.9–11.1 mm; wing length: 7.9–9.2 mm (14 specimens were measured). Female, body length: 10.5 mm; wing length: 8.7 mm (1 specimen was measured).

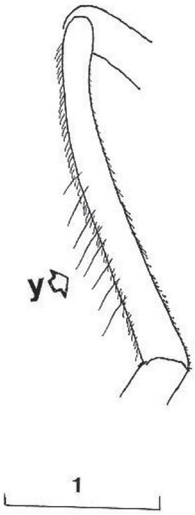

Figure 10. *Cheilosia barbafacies* sp. n., hind tibia, posterodorsal view (y indicates the hairs on posterodorsal surface). Scale in mm.

Diagnosis. Species related to *Cheilosia pascuorum*, but differs in the following characteristics: face covered with long hairs (Figs 5, 6), bare in *C. pascuorum*; clypeus dusted, shining in *C. pascuorum*; male genitalia: dorsal lobe of gonostylus without distinct dorsolateral extension (Figs 1A, 2A, 2B), present in *C. pascuorum* (Figs 1B, 1C, 2C, 2D).

Based on the identification keys for European hoverflies, this species can be confused with four other *Cheilosia* species which have long facial hairs: *C. barbata* (Fig. 3A), *C. lasiopa* Kowarz, 1885 (Fig. 4D), *C. melanopa* (Fig. 4E) and *C. vulpina* (Fig. 4C). Identification of the new described species is possible based on a combination of the following characters: arista bare; central disc of scutum shining; vein M1 meeting vein R_{4+5} at an obtuse angle (Fig. 7: x); tergites 1-3 pale haired; sternites obviously grey dusted; male: dorsal lobe of gonostylus broader basally (Fig. 8A); female: arista about 3 times as long as third antennal segment (Fig. 11B); hairs on scutum long and erected (Fig. 9B); hind tibia on posterodorsal surface with few longer hairs (Fig. 10: y).

Etymology. The specific epithet is derived from the Latin nouns (in apposition) of feminine gender in the nominative case: "barba" (beard) and "facies" (face). The name indicates the presence of long hairs on the face.

Distribution (Fig. 13)**.** *Cheilosia barbafacies* sp. n. is found in two Dinaric mountains in the central part of the Balkan Peninsula, in Durmitor (Montenegro) and Jahorina (Bosnia-Herzegovina), while the related species, *C. pascuorum*, has a wider range extending from the Alps, across the Balkan Peninsula, to Romania and the European part of Russia (Speight 2012). Both species appear sympatrically within one refuge area rich in endemics and relict species (Durmitor mountain, gorge of river Sušica and glacial lakes Škrčka jezera) (Šimić 1987, Vujić 1996).

Discussion. Although *C. barbafacies* has long facial hairs, it is closely related to *C. pascuorum* with a non-hairy face. Species with long facial hairs were assigned to "group

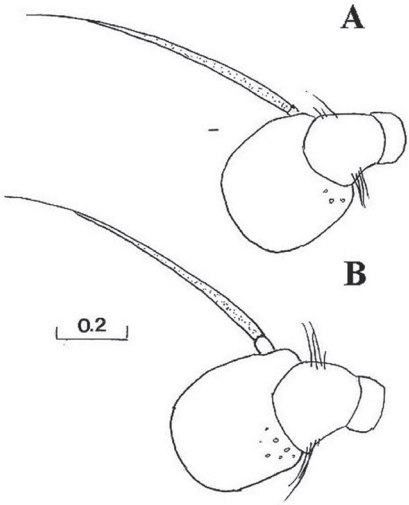

Figure 11. *Cheilosia barbafacies* sp. n., antennae, lateral view: **A** male **B** female. Scale in mm.

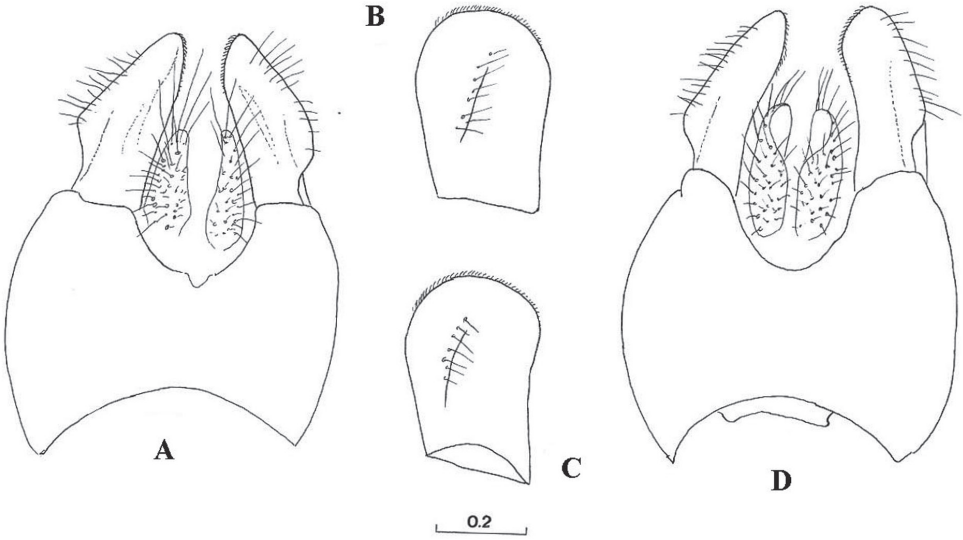

Figure 12. A, D Male genitalia, epandrium, dorsal view: **A** *Cheilosia barbafacies* sp. n. **D** *C. pascuorum* **B, C** Surstylus, right lateral view **B** *Cheilosia barbafacies* sp. n. **C** *C. pascuorum*. Scale in mm.

B" of Sack (1928-1932), based on Becker's (1894) revision of the genus. Also recent authors (e.g. Bartsch et al. 2009) still use this old name ("group B") in their keys for practical reasons. In his recent classification of the genus, Barkalov (2002) included taxa with long facial hairs in seven out of his thirteen subgenera, i.e. subgenera *Cheiloisa* s. str., *Convocheila* Barkalov, 2002, *Endoiasimyia* Bigot, 1882, *Floccocheila* Barkalov, 2002, *Hiatomyia* Shannon, 1922, *Neocheilosia* Barkalov, 1983 and *Taeniochilosia* Oldenberg, 1916. Phylogenetic analysis of the relationship between the genus *Cheilosia* and the

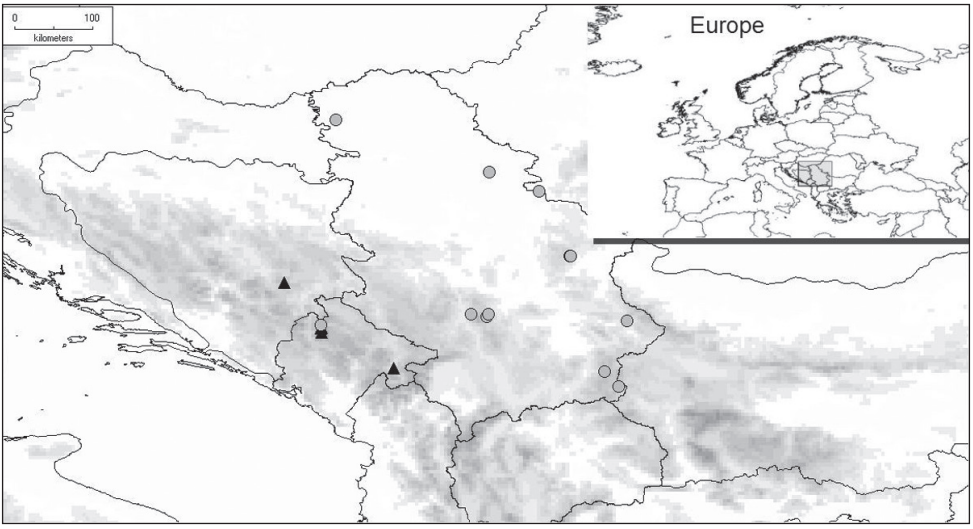

Figure 13. Distribution of *Cheilosia barbafacies* (▲) and *C. pascuorum* (●).

tribe Rhingiini, based on mtDNA COI gene sequence (Ståhls et al. 2004), revealed that *Cheilosia* species with this character state can be found in eight clades (see Fig. 1 in Ståhls et al. 2004). It seems clear that the length of the facial pilosity is not a synapomorphic character of any species group, and might evolve several times within the genus *Cheilosia*.

In Bartsch et al. (2009), specimens of *C. barbafacies* key out to *C. vulpina* (group B), and in Van Veen (2004), males and females with dark-brown antennae can be identified as *C. vulpina,* while specimens with reddish antennae are *C. barbata.* For the separation of *C. barbafacies* from *C. barbata*, diagnostic characters of the *proxima* group can be used, and the distinction between *C. vulpina* and *C. barbafacies* sp. n. is presented in the following key.

Some females of *C. barbafacies* sp. n. are similar to females of *C. redi*, and they can be separated by the following characters:

C. barbafacies sp. n.: vein M1 meeting vein R_{4+5} with an obtuse angle (Fig. 7: x); hairs on scutum and tergites long and erected (Fig. 9B); hind tibia on posterodorsal surface with few longer hairs (Fig. 10: y).

C. redi: vein M1 meeting vein R_{4+5} with an acute angle; hairs on scutum and tergites shorter and significantly adpressed; hind tibia on posterodorsal surface without long hairs.

Identification key for European species of the *Cheilosia proxima* group

1 Face with long hairs **2**

– Face bare..... **3**

2 Tergites pale haired (at least 1-3 in males); arista nearly bare. Male: central disc of scutum shining; dorsal lobe of gonostylus broad basally (Fig. 8A).

Female: vein M1 meeting vein R_{4+5} at an obtuse angle (Fig. 7: x) .... ***C. barbafacies* sp. n.**

– At least tergite 3 in posterior half with black hairs in males, and in females tergites 2-4 with triangular area of adpressed black hairs; arista with short pubescence. Male: central disc of scutum dull; dorsal lobe of gonostylus of a different form (Fig. 4C). Female: vein M1 meeting vein R_{4+5} at right or acute angle ..... ***C. vulpina* (Meigen, 1822)**

3 Holoptic: males **4**

– Dichoptic: females **10**

4 3rd antennal segment orange to reddish-brown, at least basoventrally clear reddish **5**

– 3rd antennal segment black to blackish-brown (in some specimens paler, but not partly clear reddish) **6**

5 Face in lateral view almost flat between central prominence and upper mouth edge; margin of upper calypter often partly with short black setulae; tergite 3 posteromedially with an area of black bristly-hairs, often also tergite 2 with such hairs near hind margin; genitalia (Fig. 3F) ..... ***C. velutina* Loew, 1840**

– Face in lateral view obviously concave between central prominence and upper mouth edge; margin of upper calypter with pale setulae; tergites 2 and 3 generally with pale (reddish) hairs, but single, short, black-bristly hairs maybe present posteromedially on tergite 3; genitalia (Fig. 3G) .... ***C. rufimana* Becker, 1894**

6 Margin of upper calypter with short black or dark brown setulae; frons slightly swollen; gonostylus in Fig. 3B..... ***C. ingerae* Nielsen & Claussen, 2001**

– Margin of upper calypter with short pale setulae; frons not swollen **7**

7 Abdomen (including pregenital segments) pale haired **8**

– Abdomen partly black haired, at least pregenital segments with few black hairs **9**

8 Tergite 3 shiny (sometimes dull on anterior margin); vein M1 meeting vein R_{4+5} at an acute angle; arista with short pubescence; dorsal lobe of gonostylus basally narrowed (Fig. 3C) ..... ***C. balkana* Vujić, 1994**

– Tergite 3 dull centrally; vein M1 meeting vein R_{4+5} at right or obtuse angle; arista bare; dorsal lobe of gonostylus very broad basally (Fig. 8B)..... ..... ***C. pascuorum*(Becker, 1894)**

9 Basal 2/3 of hind femur with the anterodorsal hair fringe longer than the anteroventral hair fringe; genitalia with the dorsal lobe of gonostylus with a more or less distinct hook on its dorsal margin (Fig. 3D)..... ***C. proxima* (Zetterstedt, 1843)**

– Basal 2/3 of hind femur with the anterodorsal hair fringe as long as or shorter than the anteroventral hair fringe; genitalia with the dorsal lobe of gonostylus simple (Fig. 3E) ..... ***C. gigantea* (Zetterstedt, 1838)**

10 3rd antennal segment orange to reddish-brown, at least basoventrally clear reddish **11**

– 3rd antennal segment black to blackish-brown (in some specimens paler, but not partly clear reddish) **12**

11 Face in lateral view almost flat between central prominence and upper mouth edge; in dorsal view central prominence of face occupying the whole width of face; occiput behind the upper corners of the eyes shining; lunula generally dark or brownish; scutum coarsely punctured, partly wrinkled with short, inclined, pale hairs ..... ***C. velutina* Loew, 1840**

– Face in lateral view usually concave between central prominence and upper mouth edge (but not distinctly so in all specimens); in dorsal view central prominence of the face not occupying the whole width of the face; occiput behind the upper corners of the eye often completely grey dusted; lunula generally yellowish; scutum with fine punctures, at least anterior half with erect or semi-erect, predominately pale, short hairs, not longer than diameter of hind tibiae, with some longer hairs often intermixed laterally and in front of scutellum ..... ***C. rufimana* Becker, 1894**

12 Frons relatively broad (ratio between length and width 1.2-1.4, average 1.3); pleura: posterior anepisternum predominately shining, at most anterior third of the sclerite thinly dusted; barrette (upper edge of meropleuron) more or less shining, contrasting with the dusting of the adjacent sclerites; basal 2/3 of hind femora with anteroventral hair fringe as long as diameter of hind femur ..... ***C. ingerae* Nielsen & Claussen, 2001**

– Frons relatively narrow (ratio between length and width 1.4-1.7, average 1.6); generally more than anterior third of posterior anepisternum grey dusted, often sclerite completely dusted; barrette dusted; basal 2/3 of hind femur with or without of anteroventral hair fringe **9**

13 Vein M1 meeting vein R_{4+5} at an obtuse angle (as in Fig 7); arista bare (as in Fig. 4B); tergites predominately pale haired... ***C. pascuorum* (Becker, 1894)**

– Vein M1 meeting vein R_{4+5} at an acute or right angle; arista pubescent; tergites partly black haired **14**

14 Legs black, exceptionally knees paler ..... ***C. balkana* Vujić, 1994**

– On legs at least front and mid tibiae pale on both ends **15**

15 Basal 2/3 of hind femur with the anteroventral hair fringe long, often obviously longer than diameter of hind femur; apex of hind femur ventrally with some black bristles or spines..... ***C. gigantea* (Zetterstedt, 1838)**

– Hind femur without anteroventral hair fringe, occasionally with single longer hairs anteroventrally which are shorter than, or rarely as long as, the diameter of the hind femur; apex of the hind femur ventrally most often without black bristles or spines…..... ***C. proxima* (Zetterstedt, 1843)**

Acknowledgements

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RESEARCH ARTICLE

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New continental record and new species of *Austromerope* (Mecoptera, Meropeidae) from Brazil

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Abstract

A new species of Meropeidae (Mecoptera) from Brazil, *Austromerope brasiliensis* **sp. n.**, is described, representing only the 3rd extant species described in this family and the 1st record of the family from the Neotropical region. The distribution and biogeography of the family are discussed and we propose that Meropeidae originated before continental drift and then divided into two branches, northern and southern, with the breakup of Pangea. Identification keys for the Neotropical families of Mecoptera and for the species of Meropeidae are provided.

Keywords

Earwigflies, Merope, Neotropical, scorpionflies

Introduction

Meropeidae is one of the smallest and least known families of Mecoptera. Until now, only 2 extant species were known, *Merope tuber* Newman, 1838 from eastern North America, and *Austromerope poultoni* Killington, 1933 from southwestern Australia (By-

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ers 1973; Dunford et al. 2007). In addition to these 2 species, there is 1 fossil species, *Boreomerope antiqua* Novokschonov, 1995 from the Middle Jurassic, in Siberia (Dunford et al. 2007). These insects are very different from more common mecopterans, e.g., Panorpidae and Bittacidae, since their wings are broad, with elaborate venation, and folded over the abdomen; the body is flattened and the head is opisthognathous, almost cockroach-like in appearance (Penny 1975). They are usually known as earwig-flies, because the males have a large genital forceps that resembles the cerci of earwigs (Dermaptera) (Somma and Dunford 2007).

Little is known about the biology of Meropeidae. The adults, which are nocturnal, seem to live on the ground, are capable of stridulation (Sanborne 1982), and generally are collected in Malaise (Dunford et al. 2007; Barrows and Flint 2009) and pitfall traps (Abbott et al. 2007). Immature stages are still unknown (Johnson 1995). The placement of the family within Mecoptera, however, remains under discussion. Meropeidae is very often associated with Eomeropidae because of the similarities between their body and wing shape. Due to their differences from other mecopterans, these 2 families were once classified in the suborder Protomecoptera (Whiting 2002). Earlier, Penny (1975) suggested that Meropeidae was sister to all other families of Mecoptera. The monophyly of the Mecoptera is another open question; some phylogenetic studies support monophyly of the order (Trautwein et al. 2012), others have suggested that Mecoptera is paraphyletic and includes Siphonaptera (Whiting 2002; Beutel and Baum 2008), or that Meropeidae is the sister family only to the most derived families of Mecoptera (Whiting 2002; Grimaldi and Engel 2005). Taking a different approach, the phylogenetic work of Friedrich and Beutel (2010), which was based on thorax morphology, proposed Meropeidae as the sister family of Antliophora (Siphonaptera + Mecoptera + Diptera). Although its phylogenetic placement remains equivocal, in this paper we describe the 3rd extant species in the family based on 1 male specimen recently collected in Brazil. We also provide keys for the Neotropical families of Mecoptera and the extant world species of Meropeidae.

Material and methods

The specimen described in this work was collected in Rancho Sonho Meu, in the southeastern Brazilian state of Espírito Santo, Domingos Martins municipality. In addition, specimens of *Merope tuber* were examined in this study. Specimens were transferred from 70 to 98.5% ethanol through an ethanol dehydration series and critical point dried using a BAL-TEC 030 critical point drying apparatus. The left wings of *Merope tuber* were removed and attached with glue to a triangular paper card and placed on the same pin with the rest of the body. A Leica M205C stereomicroscope with an attached magnifying lens and Leica DFC 295 video camera were used to examine and photograph specimens. Leica Application Suite V3.6.0 installed on a desktop computer (Windows 7 Professional, Intel Xeon) was used to combine images. Images were subsequently edited in Adobe Photoshop® using various adjustments (e.g., levels, shadows/highlights),

tools (e.g., healing brush, clone stamp) and filters (e.g., unsharp mask). Photographs were assembled into plates using Adobe Illustrator®. The specimens of *M. tuber* and the new species are deposited in the collection of Universidade Federal do Espírito Santo (UFES). The identification key for Neotropical families of Mecoptera was adapted from Machado et al. (2009). Wing terminology follows that proposed by Willmann (1981).

Results

Key to the Neotropical families of Mecoptera

1 Wings large, semi-elliptical, with more than 50 crossveins **2**
1' Wings long, elongated, with less than 30 crossveins **3**
2 Forewing Cu1 forked; ocelli present; legs spinose ..... **Eomeropidae**
2' Forewing Cu1 not forked; ocelli absent; legs not spinose ..... **Meropeidae**
3 Legs raptorial, tarsus with 1 apical claw..... **Bittacidae**
3' Legs unmodified, tarsus with 2 apical claws **4**
4 Forewing with less than 15 crossveins; Rs with 3 branches. Argentina and Chile..... **Nannochoristidae**
4' Forewing with more than 20 crossveins; Rs with 4 branches. North America ..... **Panorpidae***
[*Panorpidae distribution is basically Nearctic, but recent records from Southern Mexico (Bicha 2006) required the inclusion of this family in the key.]

Key to males of world species of Meropeidae

1 Antennal flagellomeres 2.0× wider than long (Figs 3e, 5a); wing membrane fuscous; costal crossveins slightly parallel to Costa (Figs 2b, 5b); Rs with 10 or more branches (Figs 2b, 5b), tarsal claws with small teeth (Fig. 3f); abdominal tergite IX longer than tergite VIII in dorsal view (Fig. 3b); terminalia with basal segment of forceps subparallel (Fig. 1, 3c) **2**
1' Antennal flagellomeres almost as wide as long (Fig. 7b); wing membrane hyaline; costal crossveins not parallel to Costa (Fig. 9); Rs with 5 branches (Fig. 9); tarsal claws without teeth; abdominal tergite IX as long as tergite VIII in dorsal view (Fig. 7c); terminalia with basal segment of forceps divergent (Figs 7a, 8b). USA..... ***Merope tuber*** **(Fig. 6a, lateral habitus)**
2 Terminalia with basal segment of forceps with truncated expansion apically (Fig. 3d); forewing Cu1 not connected with M (Fig. 2b). Brazil .... ***Austromerope brasiliensis*** **sp. n. (Fig. 2a, lateral habitus)**
2' Terminalia with basal segment of forceps with large spine apically (Fig. 5a); forewing Cu1 connected with M by short distance basally (Fig. 5b). Australia ..... ***Austromerope poultoni*** **(Fig. 5a, ventral habitus)**

***Austromerope brasiliensis* sp. n.**
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http://species-id.net/wiki/Austromerope_brasiliensis

Type material. Holotype, BRAZIL: Espírito Santo: Domingos Martins: Pico Eldorado, 20°22'27.19"S, 40°39'33.35"W, 05-12.vii.2003, Malaise trap, R. Kawada col. - 1 male (UFES). Condition is good, but with left antennae broken and apex of right hind leg missing.

Diagnosis. This species is characterized by the semi-elliptical wings with many crossveins (Fig. 2b), the large genital forceps (Fig. 1), and by the truncate expansion of the apex of the basal segment of the forceps (Fig. 3d).

Description (male holotype). Body length: 20 mm; wing length: 13.8 mm. Head: Eyes black, encircling antennae and almost touching each other dorsally (Fig. 4a); cuticle between and around eyes dark-brown (Fig. 4a). Ocelli absent. Frons, clypeus, labrum, and gena brown. Mandible dark-brown, palps pale (Fig. 4a). Antennae pale, scape broader than pedicel, which has the same width as basal flagellomeres in frontal view; 47 flagellomeres (each wider than long), the basal and apical ones thinner in lateral view (Fig. 3e). Head and body completely covered by small pale setae. Thorax: Pronotum brown, except for 2 black lines, 1 medial longitudinal, the other transverse, sub-apical (Fig. 4b); anterior border pale and folded dorsally. Pronotum as wide as head. Meso- and metanotum dark brown, both broader than pronotum, metanotum with anterolateral region serrated and modified into stridulatory organ (Fig. 4b). Thoracic pleura brown to dark brown. Legs: All pale and of same length (Fig. 2a). Tibia with 2 apical spurs. Tarsi 5 segmented. Pretarsal claws with small teeth (Fig. 3f). Wings: (Fig. 2) Semi-elliptical, membrane fuscous but hyaline around crossveins, slightly darker in inferior area of the wing. Membrane under first branch of M (until the 1st fork) hyaline in hind wing. Veins pale. Costal vein with many transverse rows of small, pale setae. Sc with many branches parallel to C. Rs and M divided into 11 and 9 branches respectively in the forewing, and 12 and 11 in the hind wing. Cu2 ending close to Cu1 in apical half of forewing. Cu2 bifurcated in hindwing. Jugal lobe modified into stridulatory organ in forewing. Abdomen: Segments I-IV slightly darker than others (Fig. 3a) and with sparse pillosity medially. Segments V-IX brown with denser pillosity medially (Fig. 4c) [glabrous in *M. tuber*, Fig. 8c]. Tergite I longitudinaly divided medially. Tergite IX with posterior margin truncated and longer than tergite VIII (Fig. 3b). Terminalia: Anal dorsal plate curving down in lateral view, apex truncated with acute projection medially in dorsal view (Fig. 3b). Cercus small, rounded, with small pale setae (Fig. 3b). Genital forceps pale, long, slightly longer than abdomen (Fig. 1). Basal segments of forceps subparallel, with proximal region covered by long pale setae and with inner margin expanded (Fig. 3b); distal extremity with small truncate expansion on inner margin (Fig. 3d). Apical segment curved, with apex truncate (Fig. 3d). Basal segment broader and more than 2x longer than apical segment (Fig. 3c).

Etymology. The specific epithet was named for the country where the specimen was collected.

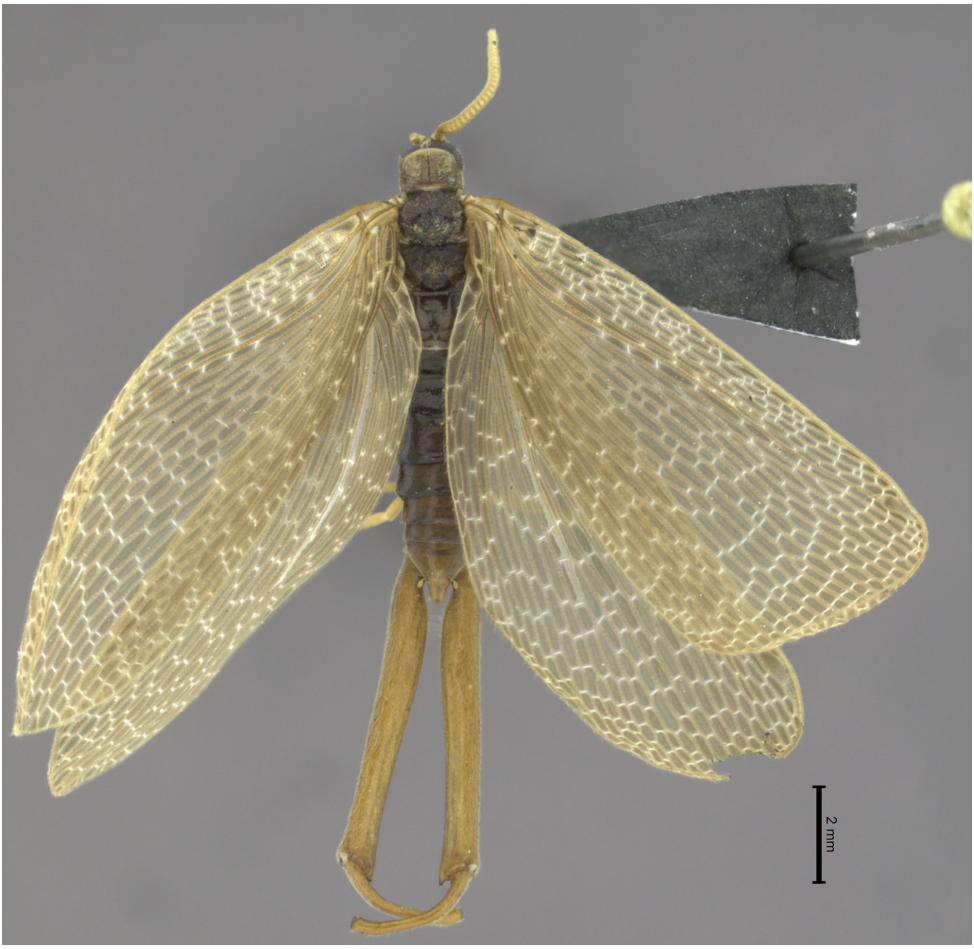

Figure 1. *Austromerope brasiliensis* sp. n. dorsal view.

Discussion. Killington (1933) described the genus *Austromerope* from Australia and pointed out several characters that differentiated it from *Merope*, including: prothorax as wide as head (Figs 4b, 8a); pretarsal claws with small teeth (Fig. 3f); apical spine on the basal segment of the forceps (Fig. 5a); jugal lobe of forewing narrow and elongate (Fig. 5b); Rs with 5 or 6 bifurcations (Figs 2b, 5b); M with 2 bifurcations; the great number of crossveins; and costal crossveins parallel to C (Figs 2b, 5b). The new species described here shares all of these defining characters with *A. poultoni* (except the apical spine on the basal segment of the forceps, which is just a truncated expansion in the Brazilian species). In addition, the new species and the Australian one have some other characters in common, such as: the color pattern of the wings and body; antennal flagellomeres wider than long (Fig. 3e); tergite IX longer than tergite VIII (Fig. 3b); the shape of the basal segment of the forceps (subparallel); and the size of the basal segment of the forceps, which is more than 2× longer than the apical segment (Fig. 3c)

Figure 2. **A–B** *Austromerope brasiliensis* sp. n. **A** lateral view **B** Left forewing.

(almost 1.5 longer in *M. tuber,* Figs 7a, 8b). Because of all these shared characteristics we have decided to include the Brazilian species in the genus *Austromerope* and not in a new genus, despite the disjunct distribution.

Austromerope brasiliensis can be separated from *A. poultoni* by Cu1 not connected with M in *A. brasiliensis* (Fig. 2b), but connected with M by a short distance basally in *A. poultoni* (Fig. 5b); by the truncated apical margin of abdominal tergite IX (Fig. 3b), which is rounded in *A. poultoni* (Killington 1933; Fig. 5); by the truncated apical expansion of the basal segment of the forceps (Fig. 3d), which has a strong apical spine in *A. poultoni* (Fig. 5a); and by the truncated apex of the apical segment of the forceps (Fig. 3d), which is pointed in *A. poultoni* (Fig. 5a).

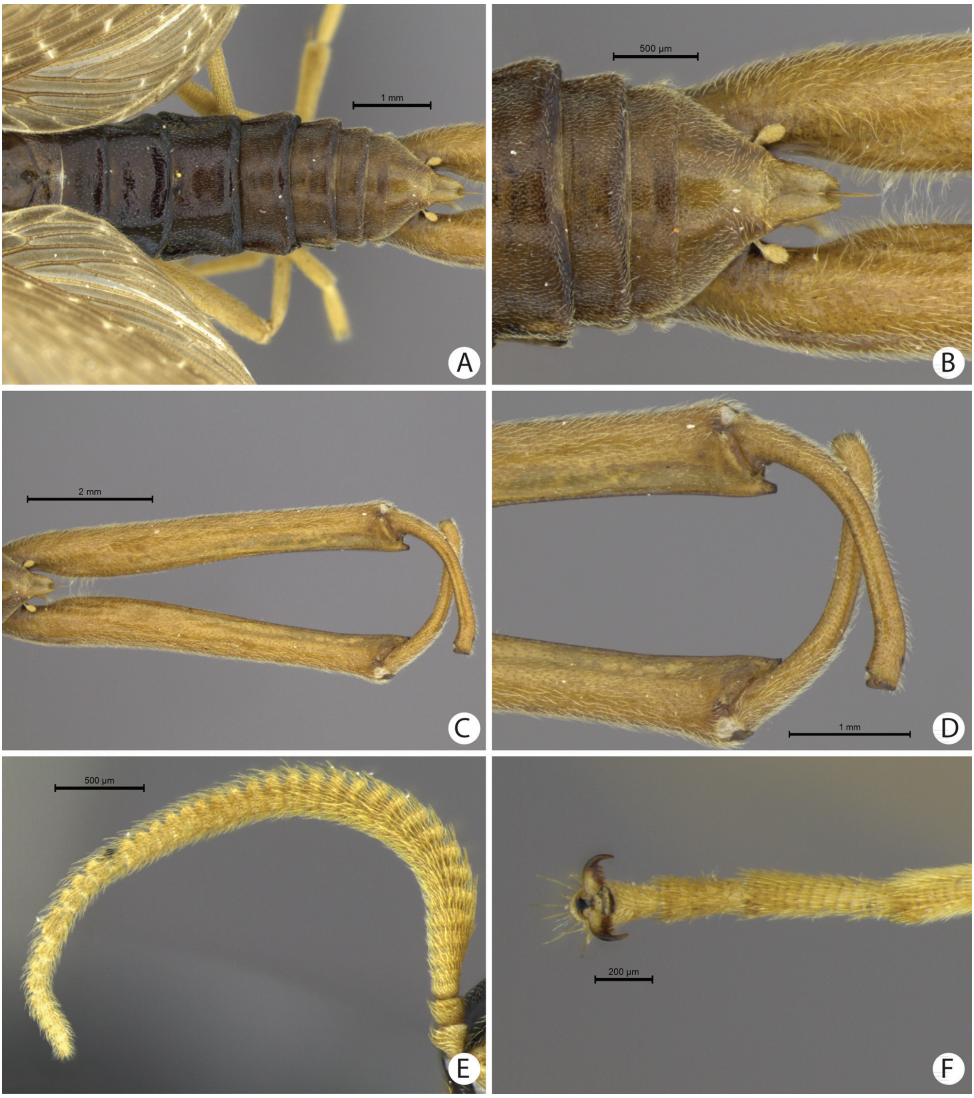

Figure 3. A–F *Austromerope brasiliensis* sp. n. **A** Abdomen dorsal view **B** Abdomen tip, dorsal view **C** Terminalia, dorsal view **D** Terminalia tip, dorsal view **E** Antennae, lateral view **F** Pretarsal claw.

Family distribution. This is the first record of Meropeidae in the Neotropical region, and together with Bittacidae, it is one of the only two families of Mecoptera existing in Brazil (Machado et al. 2009). The family's disjunct distribution was discussed by Byers (1973), who compared it to the distribution of the other mecopteran families. He noted that the North American fauna seemed to be more closely related to the Eurasian fauna, with some families such as Boreidae, Panorpodidae, and Panorpidae, occurring only in these areas. He further commented that the Australian fauna, in turn, was basically endemic except for 1 family, Nannochoristidae, which also occurred in

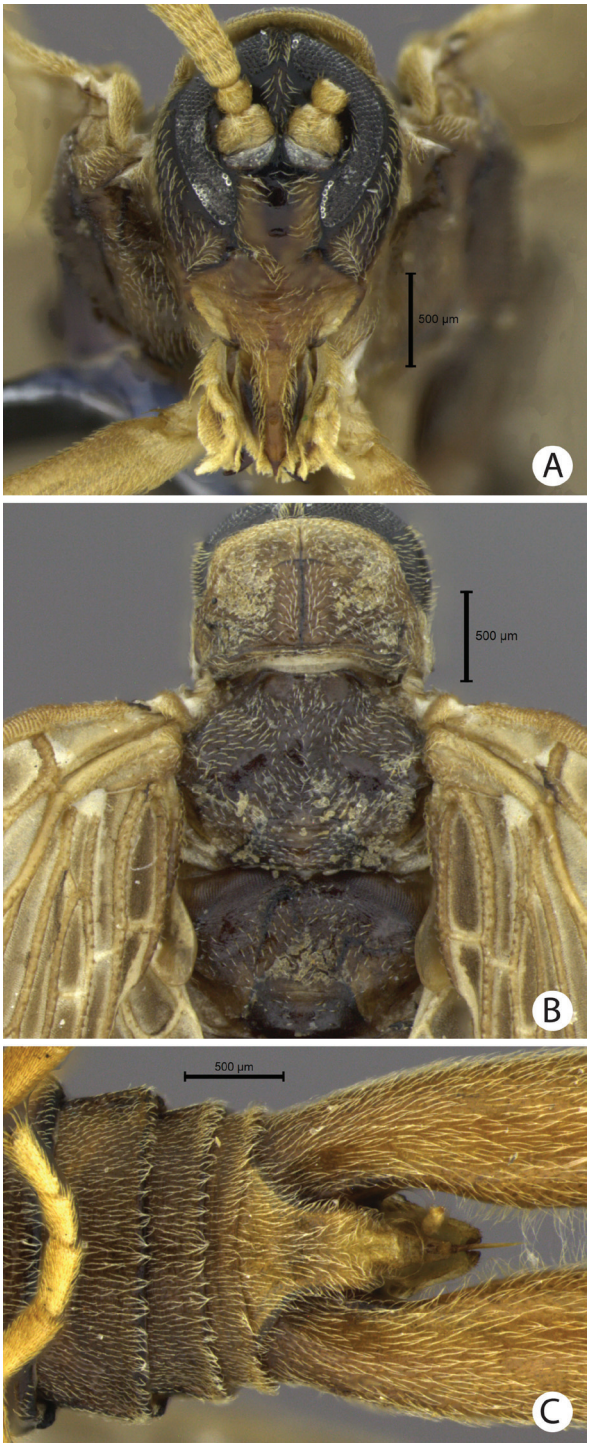

Figure 4. A–C *Austromerope brasiliensis* sp. n. **A** Head, frontal view **B** Thorax, dorsal view **C** Abdomen tip, ventral view.

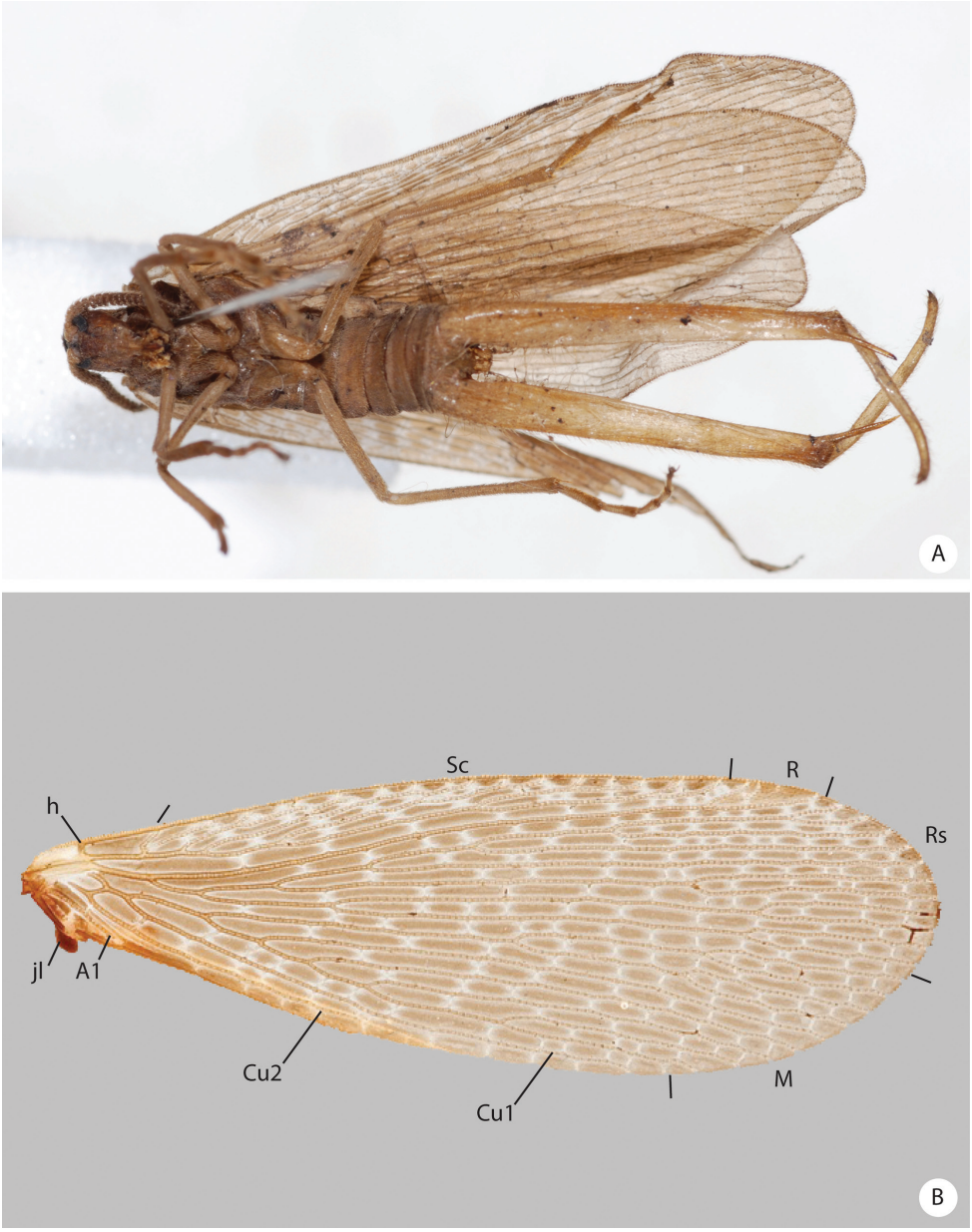

Figure 5. A–B *Austromerope poultoni*. **A** Ventral view **B** Forewing. Abbreviations: **A** Anal **Cu** Cubitus **h** humeral **jl** jugal lobe **M** media **R** Radial **Rs** Radial sector **Sc** Subcosta.

South America. Consequently, Byers (1973) suggested that South America was probably the connection between the North American species and the Australian one. Furthermore, he also wondered, in case his hypothesis was true, if there might be another Meropeidae species waiting to be discovered in South American forests. The discovery

Figure 6. *Merope tuber* lateral view..

presented here therefore confirms Byers' (1973) hypothesis, but likely for a different reason. The subsequent description of the fossil species *Boreomerope antiqua* Novokschonov, 1995 suggests that another distribution hypothesis needs to be considered.

Novokschonov (1995) discussed the relationships among the 3 Meropeidae genera, and highlighted the difficulty to decide which 2 are sister species. Furthermore, he mentioned different characteristics that can be used to approximate any genus, such as Cu1 connected to M for a short distance and Sc branching pattern of Sc, which are shared between *Austromerope* and *Boreomerope*; the low number of Rs and M branches indicating a closer relationship between *Merope* and *Boreomerope*; and the short length of Cu2, shared by *Merope* and *Austromerope*. The discovery of the new *Austromerope* species from Brazil helps rectify some of these inconsistencies indicated by Novokschonov (1995). The character used to join *Merope* and *Austromerope*, the short length of Cu2, is not useful since it is much longer in *A. brasiliensis* than in any other species. The features suggesting a relationship between *Austromerope* and *Boreomerope* are also problematic; the connection between Cu1 and M does not occur in *A. brasiliensis*, and the number, length, and shape of the Sc branches, actually appear more similar between *M. tuber* and *B. antiqua*. On the other hand, the large number of branches of Rs and M in both species of *Austromerope* suggests that it is probably a constant feature within the genus, and consequently the low number in *Merope* and *Boreomerope* sug-

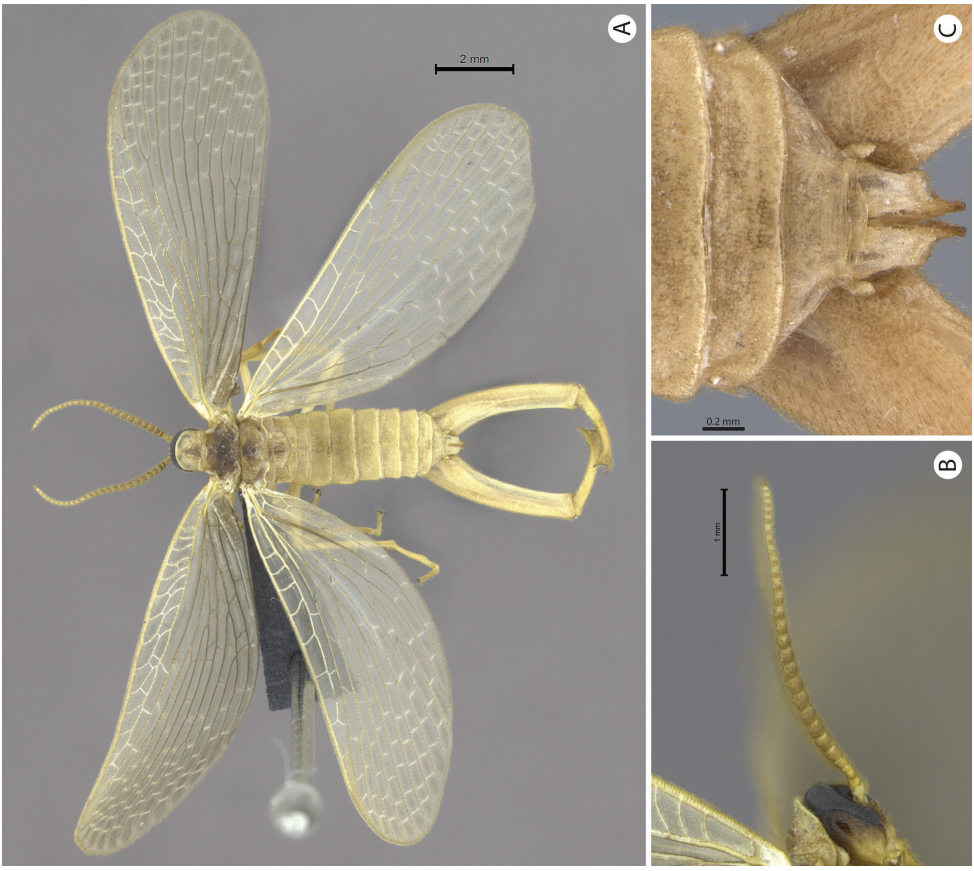

Figure 7. A–C *Merope tuber.* **A**. Dorsal view **B** Antennae, lateral view **C** Abdomen tip, dorsal view.

gests these 2 genera are closely related. Moreover, the small number of crossveins and the broad area between Sc and R1 may suggest a closer relationship between *Merope* and *Boreomerope*. If the hypothesis of *Merope* + *Boreomerope* is true, it is notable that the species from the same hemisphere are closely related to each other. Therefore, we deduce that after the breakup of Pangea the family was divided into 2 main branches, 1 in the southern hemisphere, represented now by *Austromerope*, and 1 in the northern hemisphere, currently represented by *M. tuber*. *Boreomerope antiqua* is from the Middle Jurassic, a period when the continents had already split. It would therefore belong to the northern branch. The widespread distribution of Meropeidae corroborates the fact that the family arose when all continents were connected. In fact, the current global distribution of the mecopteran family Bittacidae (Penny 2012) as well as the presence of some Mecoptera fossils from the Permiam period (290-248 MYA), also when all the continents were united (Grimaldi and Engel 2005), further corroborate this hypothesis. The similarities between the 3 extant species of Meropeidae suggest that despite the early bifurcation and the current distribution of the family, the evolution of the group was very conservative, as mentioned by Byers (1973).

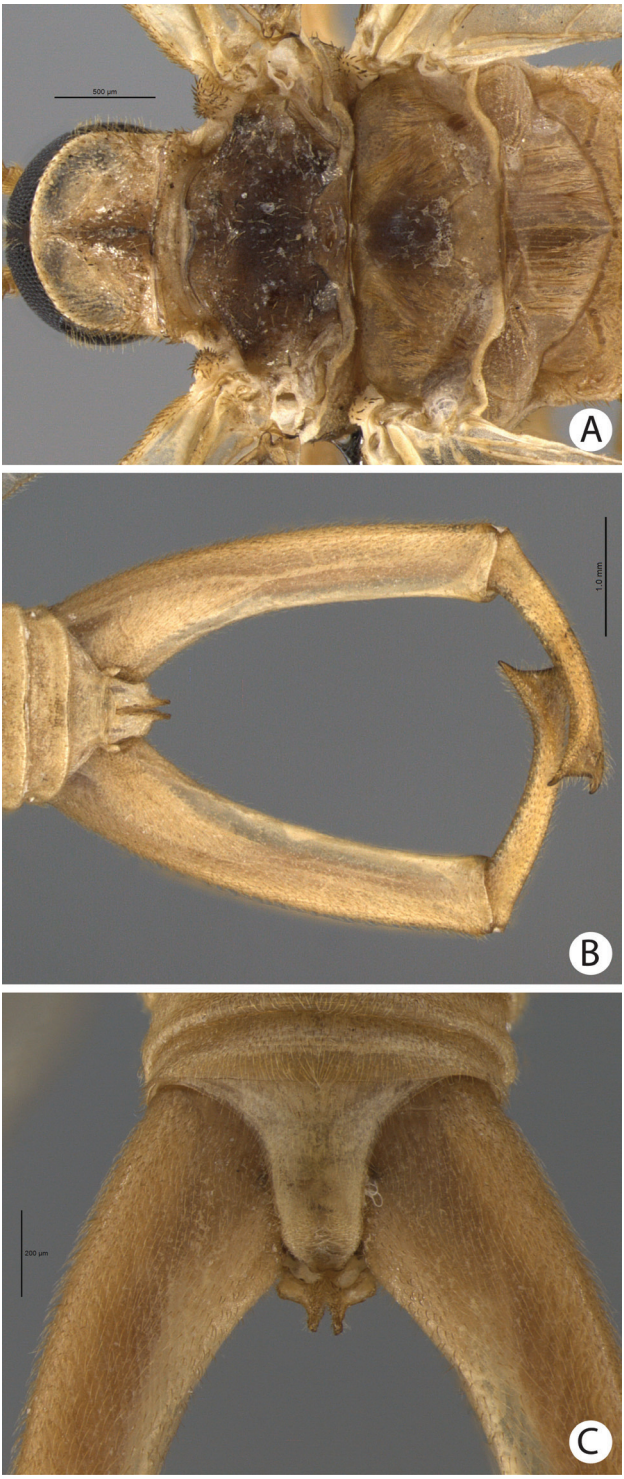

Figure 8. A–C *Merope tuber.* **A** Thorax, dorsal view **B** Terminalia, dorsal view **C** Abdomen tip, dorsal view.

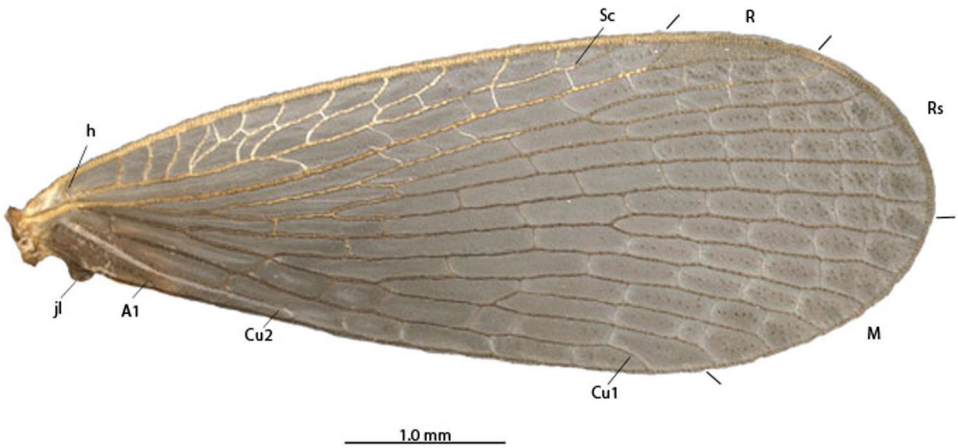

Figure 9. *Merope tuber,* forewing. Abbreviations: **A** Anal **Cu** Cubitus **h** humeral **jl** jugal lobe **M** media **R** Radial **Rs** Radial sector **Sc** S

Conservation. The most intensely studied and explored area for Mecoptera in Brazil is the Southeast region (Machado et al. 2010), where *Austromerope brasiliensis* was collected. However, despite all previous collecting efforts in this area the species had never been recorded before. The specimen was collected in a private ranch near a forest fragment surrounded by farms in the Atlantic Forest biome, one of the most threatened in Brazil. The discovery of this new relict species is an important signal to reinforce the conservation of this biome. Certainly there are many more mecopterans species yet to be discovered in these forests.

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RESEARCH ARTICLE

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A new species of *Nicon* Kinberg, 1866 (Polychaeta, Nereididae) from Ecuador, Eastern Pacific, with a key to all known species of the genus

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Abstract

A new species of *Nicon* Kinberg, 1866 from the east Pacific coast of Ecuador is described. The new species is characterized by a long, thin dorsal ligule on median and posterior parapodia and infracicular sesquigomph falcigers in the neuropodia. A key to all species of *Nicon* is provided.

Keywords

Annelida, polychaetes, Nereididae, intertidal, Ecuador, taxonomy, systematics

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Introduction

Ecuador possesses a great variety of coastal environments resulting in a high diversity of marine species; however, taxonomic studies on marine invertebrates are few, especially in the case of the polychaetes. In Ecuador (excluding the Galapagos), only 29 families, 53 genera and 75 species of polychaetes have been recorded. Hartman (1939) was the first to report on the polychaetes from Ecuador and described four new species and ten new records from Puna and Santa Clara Islands (Guayas Province). Later, Cruz et al. (1980) provided four new records from benthic samples collected on the Estero Salado, Guayaquil Gulf. In the same Gulf, 29 species of polychaetes were identified by Villamar (1983). Villamar (1989) later reported marine species at Canal del Morro and Jambeli in the Guayaquil Gulf. Villamar and Cruz (2007) reported three taxa for Ecuador from the intertidal zone of Monteverde (Guayas Province). A new species of *Australonuphis*, used as fishing bait, was described by de León-González et al. (2008) in Santa Elena Bay (Guayas Province). In northern Ecuador very little is known about the polychaete fauna and only one ecological study has been carried out by Villamar (2006) in the intertidal zones of Manabi and Esmeraldas Provinces. In that paper he reported 27 species, of which 14 constituted new records for Ecuador. More recently, Trovant et al. (2012) reported 12 new species records in the Bunche and Cabo San Francisco intertidal sandy beaches of northern Ecuador (Esmeraldas Province).

The importance of the family Nereididae is manifested by their high diversity and abundance in all marine substrates, occurring in all oceans from the supralittoral to the abyssal zone. This family includes 44 genera and approximately 460 valid species (de León-González, 2009). *Nicon* is one of the least species rich genera of Nereididae. The genus was first described by Kinberg, (1866) for six species, *N. pictus*, *N. tahitianus*, *N. maculata*, *N. eugeniae*, *N. loxechini* and *N. virgini*, none of which were figured. In this paper, a new species of *Nicon* is described. It is characterized by having an elongate notopodial dorsal ligule, resembling a long cirrus on median and posterior parapodia, as well by the presence of sesquigomph falcigers in the neuropodia.

Material and methods

Samples were collected in March 2009 (dry season) in the intertidal zone of two sandy beaches located in the Esmeraldas Province, northern Ecuador (Fig. 1). Bunche beach (0°37'55"N, 80°02'14"W) is a protected area characterized as a low energy beach, with soft sloping banks and very fine particle sand, and Cabo San Francisco beach (0°39'11"N, 80°04'10"W) is characterized as a high energy environment, subjected to frequent and severe storms, with high slopes. Fresh-water discharges affect both beaches. Sediment samples were sieved through a 1mm mesh. Specimens were fixed in 10% formalin and later preserved in 70% ethanol. Terminology of parapodial structures was taken from Bakken and Wilson (2005). Type material has been deposited in the Natural History Museum of Los Angeles County, Allan Hancock Foundation Polychaete Collection (LACM-AHF), and the Polychaetological Collection of the Universidad Autónoma de Nuevo León (UANL).

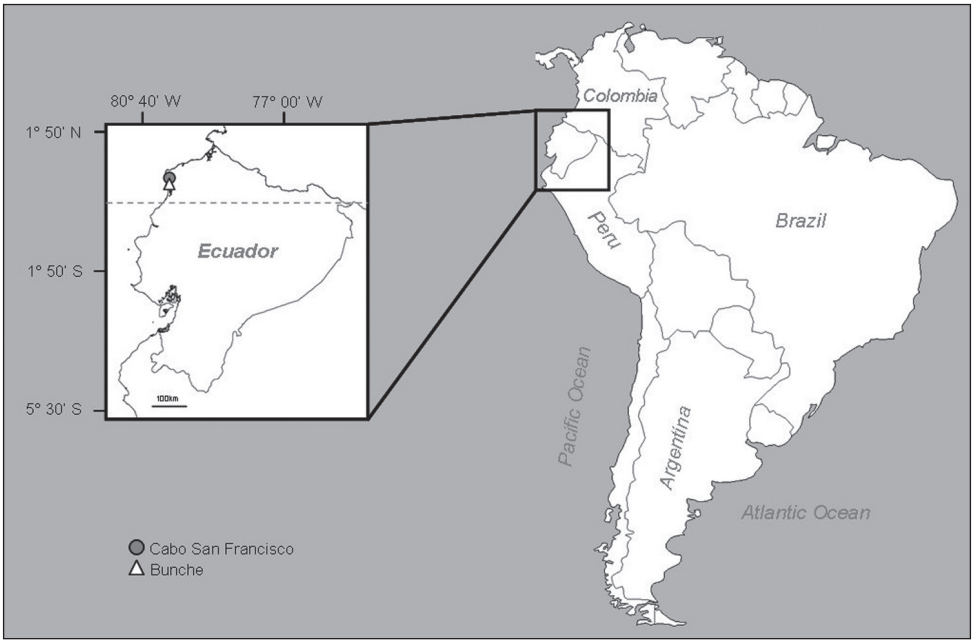

Figure 1. Map of Ecuador indicating the sampling sites, Bunche and Cabo San Francisco Beaches.

Results

Systematics
Class Polychaeta Grube, 1850
Order Phyllodocida Örsted, 1843
Family Nereididae Lamarck, 1818

***Nicon* Kinberg, 1866; emended**
http://species-id.net/wiki/Nicon

Type species. *N. maculata* Kinberg, 1866.

Diagnosis. Prostomium pyriform to subpyriform, with two pairs of eyespots, paired frontal antennae and biarticulate palps. Four pairs of tentacular cirri with distinct cirrophores, smooth or articulated. Parapodia of first two chaetigers subbiramous, notopodium represented by a single ligule with dorsal cirri at its base. Subsequent notopodia with dorsal and ventral ligules with or without a small notopodial prechaetal lobe decreasing in far posterior parapodia. Neuropodia with superior and inferior prechaetal lobes, digitiform or conical postchaetal lobe present or absent along body, and a ventral ligule which can be reduced in posterior parapodia; ventral cirri short, tapered. All notochaetae homogomph spinigers; neurochaetae homogomph, heterogomph or sesquigomph falcigers, may be accompanied by homogomph and heterogomph spinigers, and simple chaetae. Pygidium with paired anal cirri. Pharynx with paired mandibles, without paragnaths or papillae.

Remarks. This generic diagnosis was modified from Pettibone (1971), Wu and Sun (1979) and Hutchings and Reid (1990). Some important characteristics were not included by Pettibone (1971) because at that time she recognized *N. maculata* as the only member of the genus. Later on, Wu and Sun (1979) and Hutchings and Reid (1990) expanded the genus diagnosis including characters of recently described species such as *N. japonicus* Imajima, 1972, *N. yaguinae* Fauchald, 1972, *N. sinica* Wu & Sun, 1979 and *N. rotunda* Hutchings & Reid, 1990. Some new characters included in the present diagnosis are the presence-absence of a notopodial prechaetal lobe, and the occurrence of neuropodial sesquigomph falcigers.

***Nicon orensanzi* sp. n.**
urn:lsid:zoobank.org:act:149CDBF9-ACD0-4D7E-8407-BD8ADF3955C6
http://species-id.net/wiki/Nicon_orensanzi
Figures 2, 3

Material examined. Holotype (LACM-AHF 4999), Paratype (LACM-AHF 5000) and Paratype (UANL 7840) collected at Bunche beach (0°39'01.98"N, 80°03'55.01"W), Esmeraldas Province, Ecuador, March 21 2009, coll. Berenice Trovant and Santiago Tineo. Additional material: seven anterior fragments, same data as holotype; two complete specimens and three anterior fragments, Cabo San Francisco beach (0°38'16.35"N, 80°3'14.07"W), Esmeraldas Province, Ecuador, March 20 2009, coll. Berenice Trovant and Santiago Tineo.

Description. Holotype incomplete posteriorly, with 85 chaetigers, 19mm long, 1.4mm wide. Prostomium pyriform, with frontal cleft extending to middle of prostomium. Two pairs of eyespots in trapezoidal arrangement, anterior pair slightly larger, with lenses. Pair of small cirriform antennae extending slightly beyond palps. Palps biarticulate, globose, with subspherical palpostyles. Peristomium longer than next segment, with four pairs of short tentacular cirri, longest reaching chaetiger two (Figs 2A, 3A). Pharynx lacking papillae or paragnaths, armed with pair of toothed mandibles (Fig. 3B). Anterior notopodia with short cirriform dorsal cirri, subtriangular dorsal ligule, and subulate notopodial ventral ligule. Small triangular prechaetal lobe, restricted to limited number of anterior chaetigers, reducing in size posteriorly, last present about chaetigers 28-30. Anterior neuropodia with superior and inferior lobe, subulate ventral ligule, ventral cirrus with inflated base (Fig. 2B, 3C), postchaetal neuropodial lobe subulate, present in first 18 chaetigers, not visible in anterior view. Median and posterior notopodia with dorsal ligule long cirrus-like; prechaetal lobe absent, notopodial ventral ligule triangular, decreasing in size in posterior chaetigers. Median and posterior neuropodia with superior and inferior lobes poorly defined, neuropodial postchaetal lobe absent, neuropodial ventral ligule subulate, decreasing in size in posterior chaetigers until disappearing completely, ventral cirri cirriform, shorter than dorsal one (Figs 2C–D, 3D–E). All notochaetae homogomph spinigers, with long, thin blades. Anterior supracicular neurochaetae 6 long-bladed homogomph spinigers superiorly; 6 short-bladed

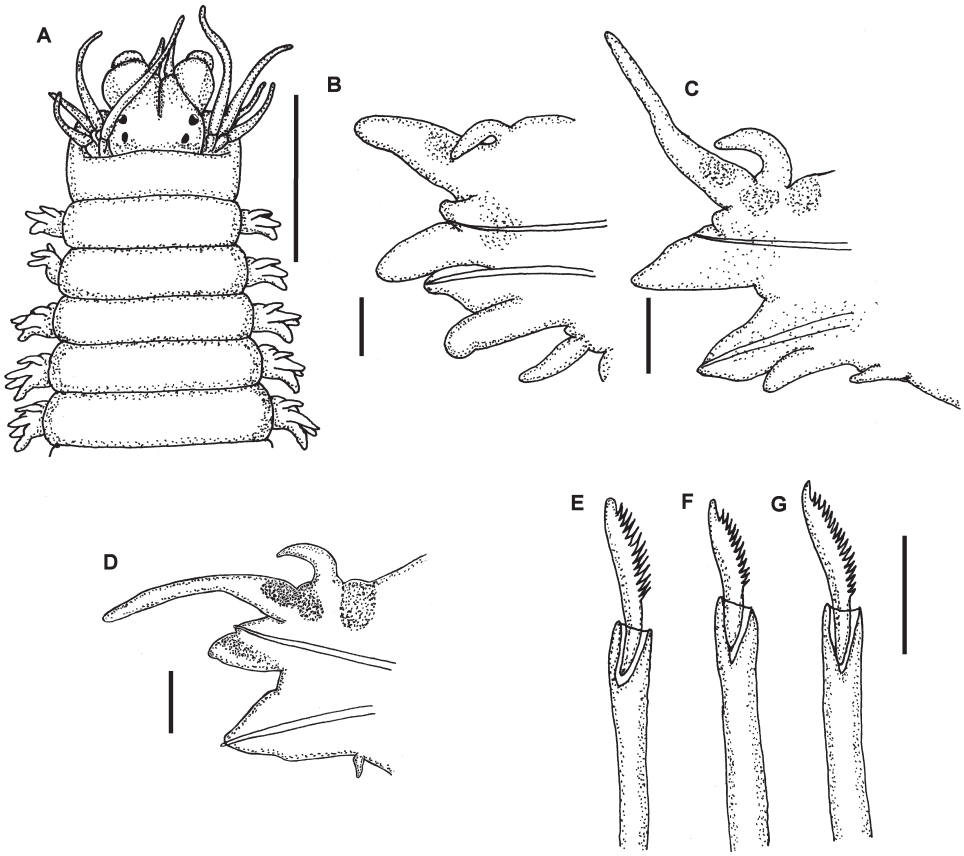

Figure 2. *Nicon orensanzi* sp. n. Holotype. **A** Anterior end, dorsal view **B** Parapodium 10, anterior view **C** Parapodium 25, anterior view **D** Parapodium 60, anterior view **E–G**. Infracicular sesquigomph falcigers of parapodia 10, 25 and 50 respectively. Scale bars: **A**= 1 mm; **B–D**= 100 μ; **E–G**= 30μ.

heterogomph spinigers inferiorly. Anterior infracicular chaetae homogomph spinigers with long blade, and sesquigomph falcigers with anterior part ending in a blunt tooth (Fig. 2 E). Median and posterior supracicular neurochaetae with long-bladed homogomph spinigers. Infracicular neurochaetae with a few homogomph spinigers superiorly, and sesquigomph falcigers inferiorly, anterior end sharper (Figs 2F–G, 3F). Pygidium lacking in holotype, with terminal anus and two thin lateral cirri on others specimens.

Type locality. Bunche beach, Esmeraldas Province, Ecuador

Distribution. This species is only known from Bunche and Cabo San Francisco beaches, Esmeraldas Province, Ecuador.

Discussion. Of the six species originally included in the genus *Nicon* by Kinberg (1866) two have been transferred to other genera (*N. eugeniae*, currently *Nereis eugeniae* from Strait of Magellan and *N. loxochini*, currently *Platynereis magalhensis* from Strait of Magellan) and three species are considered indeterminable due to their incomplete descriptions and the poor condition of the available syntypes (*N.*

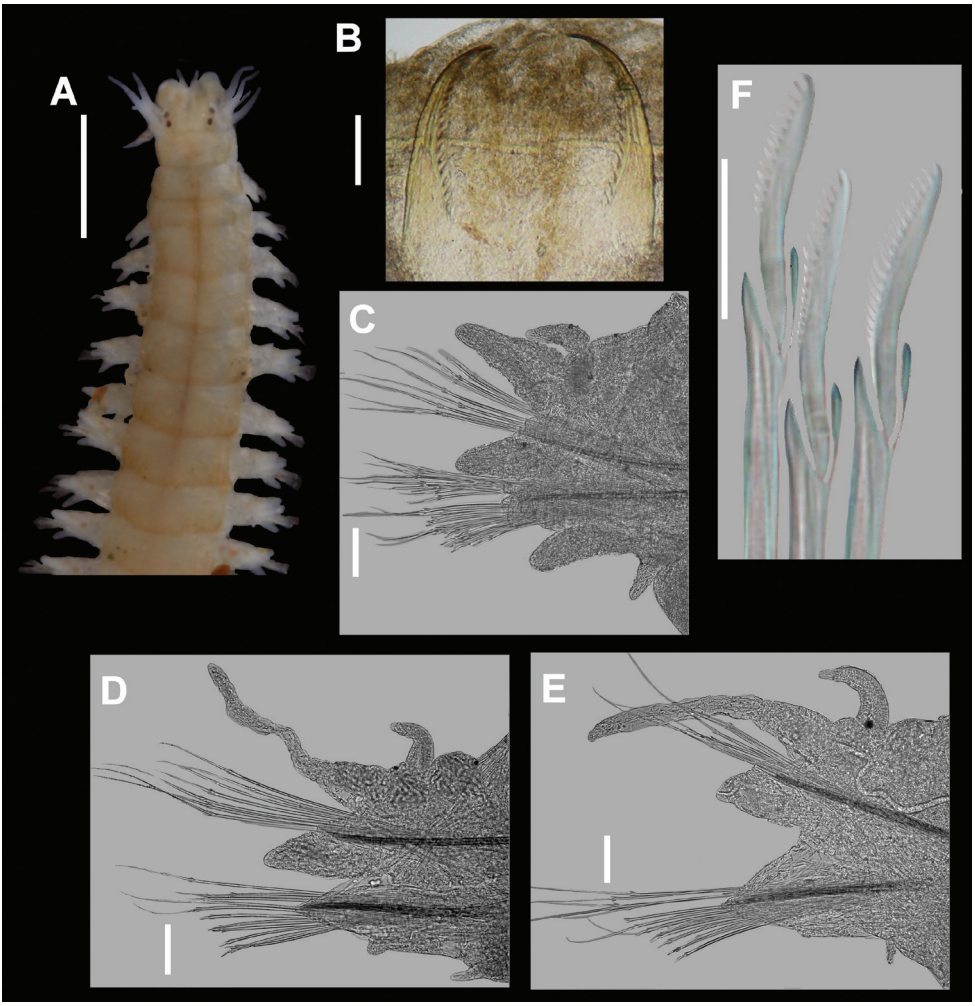

Figure 3. *Nicon orensanzi* sp. n. Paratype (UANL 7840). **A** Anterior end, dorsal view **B** Mandibles; Holotype (LACM) **C** Parapodium 9, anterior view **D** Parapodium 29, anterior view **E** Parapodium 62, anterior view **F** Infracicular sesquigomph falcigers of parapodium 62. Scale bars: **A**= 1 mm; **B**= 0.1 mm; **C–E**= 100 μ; **F**= 30μ.

maculata from La Plata, Argentina, *N. pictus* from Brazil, *N. tahitianus* from Tahiti, and *N. virgini* from Strait of Magellan) (Pettibone, 1971). Of these species, only *N. maculata* is considered valid at the present time. No type species was designated by Kinberg. Hartman (1949) designated *N. pictus* as the type species, even though she did not provide a diagnosis or figures. Pettibone (1971) later revised the genus and designated *N. maculata* as the type species. Currently this genus consists of ten species: *N. maculata* Kinberg, 1866 from La Plata, Argentina, *N. moniloceras* (Hartman, 1940) from Catalina Island, USA, *N. aestuarensis* Knox, 1951 from New Zealand, *N. polaris* Hartman, 1967 from the Antarctic peninsula, *N. abyssalis* Hartman, 1967

from the Antarctic peninsula, *N. japonicus* Imajima, 1972 from Japan, *N. yaquinae* Fauchald, 1977 from off the Oregon coast, USA, *N. sinica* Wu & Sun, 1979 from the Yellow Sea, *N. rotunda* Hutchings & Reid, 1990 from Australia, and *N. pettibonae* de León-González & Salazar-Vallejo, 2003 from the Loyalty Islands, New Caledonia. Pettibone (1971) also considered that *N. abyssalis* and *N. polaris* had doubtful generic affinities with *Nicon*; however, we believe that *N. abyssalis* possesses the generic characters of *Nicon* and therefore should be included in the genus. *Nicon polaris* was described based on an epitoke; however, the possession of an expanded elytra-shaped dorsal cirrus in the chaetiger 7 makes it doubtful that it belongs to *Nicon*; a similar structure is found in *Kainonereis*, currently a genus in *inquirenda* described from an epitokous stage by Chamberlin (1919).

Species of *Nicon* may be separated into two groups based on the presence or absence of notopodial prechaetal lobes. Those species with a notopodial prechaetal lobe are: *N. aestuarensis*, *N. japonicus*, *N. polaris*, *N. rotunda*, and *N. sinica*; while *N. abyssalis*, *N. maculata*, *N. moniloceras*, *N. pettibonae* and *N. yaquinae* lack a superior notopodial lobe. Some important characteristics of *Nicon* species are listed in Table 1.

Nicon orensanzi sp. n. is a member of the first group but differs in its long, thin notopodial dorsal ligule in median and posterior parapodia. *N. orensanzi* sp. n. and *N. pettibonae* are the only species in the genus with neuropodial infracicular sesquigomph falcigers in all parapodia. These two species differ in the shape of their sesquigomph falcigers, the presence of heterogomph falcigers, and a reduced dorsal ligule in the posterior parapodia of *N. pettibonae*.

Table 1. Diagnostic features of the species of *Nicon* (modified from Hutchings and Reid 1990). Abbreviations: TC= chaetiger number reached by longest tentacular cirri, ho sp= homogomph spinigers, he sp= heterogomph spinigers, ho f= homogomph falcigers, he f= heterogomph falciger, sf= sesquigomph falciger, DL= dorsal ligule, PL= Prechaetal lobe, ST= Subtriangular, SU= Subulate; DI= Digitate, CI= Cirriform, CO= Conical, E= Elongated.

Species	**Neuropodial chaetae**												
	Supracicular						**Infracicular**					**Notopodia**	
	TC	**ho sp**	**he sp**	**ho f**	**he f**	**sf**	**ho sp**	**he sp**	**ho f**	**he f**	**sf**	**DL**	**PL**
N. abyssalis	2	X	X	-	-	-	X	X	-	X	-	CI	-
N. aestuarensis	5	X	X	-	X	-	-	X	-	X	-	ST	X
N. japonicus	2	X	-	-	X	-	-	X	-	X	-	ST	X
N. maculata	10	X	-	-	X	-	X	-	-	X	-	SU	-
N. moniloceras	9	X	-	-	X	-	-	X	-	X	-	DI	-
N. pettibonae	5	X	-	-	X	X	X	-	-	X	X	ST	-
N. polaris	5	X	X	-	X	-	-	X	-	X	-	ST	X
N. rotunda	2	X	-	-	X	-	X	-	X	X	-	ST	X
N. sinica	9	X	-	-	X	-	-	X	-	X	-	CO	X
N. yaguinae	2	X	X	-	X	-	?	?	?	?	-	ST	-
N. orensanzi sp. n.	2	X	X	-	-	-	X	-	-	-	X	E	X

Etymology. The new species is dedicated to Dr. José María (Lobo) Orensanz, who has made significant contributions to the taxonomy of polychaetes and has been a mentor to the authors of this paper.

Key to *Nicon* species

1 Superior notopodial lobe present **2**
– Superior notopodial lobe absent..... **7**
2 Tentacular cirri short, reaching chaetiger 2 ..... **3**
– Tentacular cirri reaching chaetiger 5 ..... **5**
3 Heterogomph falcigers present on supra- and subacicular fascicle, dorsal ligule subtriangular **4**
– Heterogomph falcigers absent, with sesquigomph falcigers in infracicular position, dorsal ligule long and thin on median and posterior parapodia .... ***N. orensanzi* sp. n.**
4 With homogomph falcigers in neuropodial subacicular position .... ***N. rotunda***
– Homogomph falcigers lacking ..... ***N. japonica***
5 Tentacular cirri reaching chaetiger 5, dorsal ligule subtriangular **6**
– Tentacular cirri reaching chaetiger 9, dorsal cirri conical..... ***N. sinica***
6 Mandibles with 6 oblique teeth, blade of falcigers short, with a terminal tooth directed downward ..... ***N. polaris***
– Mandibles with up to 10 teeth; blade of falcigers longer, with blunt terminal end ..... ***N. aestuarensis***
7 Tentacular cirri short, reaching chaetiger 2 ..... **8**
– Tentacular cirri reaching chaetiger 5 ..... **9**
8 Dorsal ligule cirriform , reduced in posterior chaetigers; falcigers with prolonged blade ..... ***N. abysssalis***
– Dorsal ligule subtriangular, similar in size throughout; falcigers with long, anteriorly blunt blade distinctly serrated along inner margin..... ***N. yaquinae***
9 Tentacular cirri reaching chaetiger 5; subtriangular dorsal ligule; supra and infracicular sesquigomph falcigers present..... ***N. pettibonae***
– Tentacular cirri to chaetiger 9–10 ..... **10**
10 Longest pair of tentacular cirri partially annulated on distal end; falcigers with long blade, denticulate along inner margin ..... ***N. maculata***
– All tentacular cirri annulated, with cylindrical articles; falcigers with short blades, denticles on proximal inner margin ..... ***N. moniloceras***

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