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A new species of armored scale, *Mycetaspis ailynaomi* (Hemiptera, Diaspididae, Aspidiotinae), associated with *Mammea americana* L. (Malpighiales, Calophyllaceae) from Puerto Rico

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Abstract

A new species of armored scale, *Mycetaspis ailynaomi* Dones and Evans is described and illustrated from specimens collected on mamey (*Mammea americana*) from Puerto Rico. A key to the species of *Mycetaspis* is provided.

Keywords

Sternorrhyncha, Diaspididae, Caribbean, Puerto Rico, *Mycetaspis*, new species

Introduction

Mamey (*Mammea americana* L., Calophyllaceae), also known as mammee apple, Santo Domingo apricot or South American apricot, is an evergreen, native to the West Indies and northern South America, whose fruit is edible. Mamey is confined to tropical or subtropical climates due to its sensitivity to low temperatures and seems remarkably resistant to pests and diseases. It has been introduced successfully into several tropical areas of the Old World (West Africa, Madagascar, southern Asia, Java, Philippines and Hawaii) but has not survived well in California and Florida (M orton 1987). It has formed part of the diet of the inhabitants of the Caribbean Islands for many generations. Mamey produces toxins that have medicinal and insecticidal properties and may cause discomfort, especially to the digestive system, in some individuals.

Nine species of armored scales have been reported from Puerto Rico on mamey. Martorell (1981) reported *Aspidiotus destructor, Howardia biclavis*, *Mycetaspis personata* and *Pseudaulacaspis pentagona*. Colón-Ferrer and Medina-Gaud (1998) reported *Abgrallaspis cyanophylli, Hemiberlesia palmae, Howardia biclavis, Mycetaspis personata, Selenaspidus articulatus,* and *Lopholeucaspis cockerelli*. In addition to these, Houser (1918) reported *Melanaspis calura* from Cuba and Deitz and Davidson (1986) listed *Melanaspis smilacis* as occurring on mamey but did not state in which country it was found on this host. Specimens of a new species of armored scale (Hemiptera: Diaspididae) of the genus *Mycetaspis* were found on mamey fruits seized by USDA/APHIS officials at the International Airport in San Juan, Puerto Rico during a preflight inspection.

The genus *Mycetaspis* Cockerell, 1897, currently comprises eight species (Ben-Dov 2010). The species in the genus are only known to occur in the Neotropical region and/or the Nearctic with the exception of *M. personata*, which now occurs throughout much of the world. The genus, like most members of the subfamily Aspidiotinae, has the pygidium with macroducts of the 1-barred type, the second pygidial lobe not bilobulate, fringed plates present between the lobes, and the anterior and posterior spiracles without associated disk pores (Ferris 1941), except for *M. bezerrai* (Arruda 1972). It is similar to the genus *Melanaspis* in that it has elongated paraphyses arising from the basal angles of the lobes, and between the 2nd and 3rd lobes, but differs from that genus in that the adult female has the frontal area sclerotized, raised and narrowing abruptly or rounded.

Materials and methods

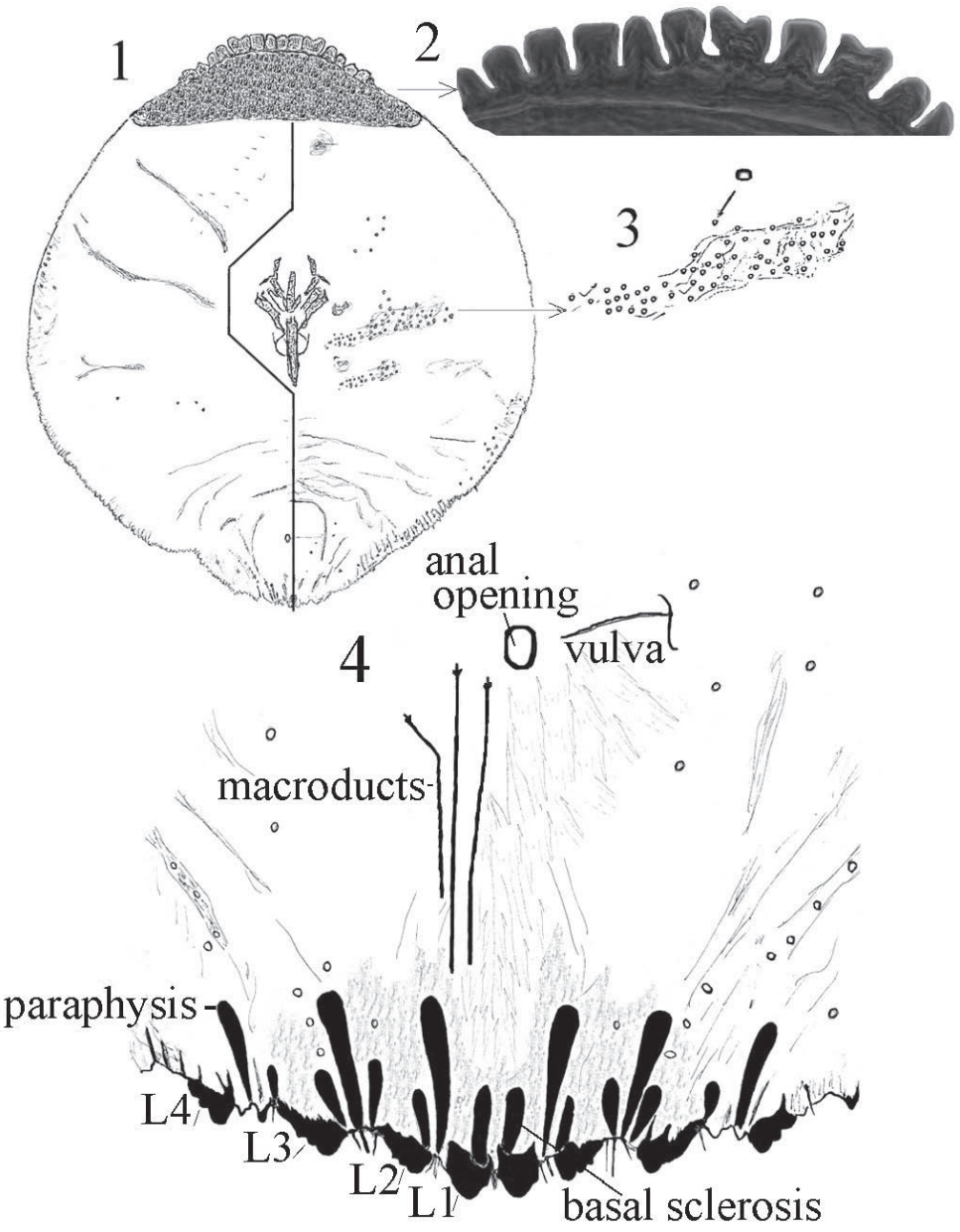
We follow the terminology used by Miller and Davidson (2005) and Watson (2002). The length of the pygidium was measured on the dorsal surface along the midline between the basal border and the bases of the median lobes. The abbreviations L1, L2, L3 and L4 stand for median, second, third and fourth pygidial lobes.

Taxonomy

***Mycetaspis ailynaomi* Dones and Evans, sp. n.**
urn:lsid:zoobank.org:act:13FE4406-5E5B-4E18-A31C-8A4E252C795E
http://species-id.net/wiki/Mycetaspis_ailynaomi
Figs 1–6

Adult female. Appearance in life was not recorded, but the scale is not pupillarial. Body 1241µm long and 1136µm wide in the holotype; 1347µm long and 998µm wide in the paratype; almost circular. Pygidium slightly produced, almost (1.1 times) as broad as long, 279µm long by 423µm wide and 263µm long by 440µm wide in holotype and paratype, respectively.

Description. Cephalothorax. Anterior margin of head heavily sclerotized with 10–14 tooth-like, sclerotized lobular processes. Eyes are represented by a sclerotized dot. Antennae each composed of a conspicuous seta and a tubercle. A group of 18–20 microducts in front of each anterior spiracle. A band of microducts between the anterior and posterior spiracles extending outward from the median area to the margin in a slight upward angle without reaching the margin. **Pygidium. Lobes.** With 4 well-developed lobes (L1-L4); L1 more or less symmetrical, longer than L2-L4, flask-shaped, divergent on the mesal margin, which are shorter than the lateral margin. L2 with mesal margin one third as long as the lateral margin, with 2 or 3 small round teeth. L3 and L4 similar to L2, but more diagonally set with the lateral margin about 4 times as long as the mesal margin. **Basal sclerosis.** Similar in shape to a paraphysis, arising from the mesal margin of the L1 lobes, about twice as long as the lobe and about one third as wide as the base of the lobe, almost parallel-sided and rounded on the top. **Paraphyses.** Arranged 2–3-3 on each side of the pygidium. First interlobular space (space between L1 and L2) with a long paraphysis terminating in a club and almost twice as long the basal sclerosis associated with L1; a smaller paraphysis arising from mesal base of L2 and slightly shorter than half the length of the long paraphyses in the space. Second interlobular space with 3 paraphyses: the mesal one arising from the lateral basal corner of L2, similar to the paraphysis arising from the mesal corner of L2 in size and shape; the median paraphysis in the space about twice as long as the mesal paraphysis, approximately the same as the long paraphysis in the first interlobular space in size and shape; the lateral paraphysis from the mesal corner of L3, similar to the mesal paraphysis. The third interlobular space has 2 or 3 paraphyses: a short paraphysis arising at the lateral basal corner of L3, followed by a longer one more than twice as long as the former one. Paraphyses arising from the mesal basal corner of L4 faint or almost obsolete; pygidial margin anterior to L4 also with some short paraphyses. **Plates.** Plates occurring between lobes, but their numbers are difficult to determine in the available specimens. Plates occurring between L1 and L2 slender and simple, short, not extending beyond the apices of the lobes; plates between L2 and L3 slightly longer and wider with truncate apices; space between L3 and L4 appearing to have 3 short plates, one slender and 2 wider with truncate apices. **Anal opening.** Small, 14.5 µm in diameter,



Figures 1–4. *Mycetaspis ailynaomi* holotype female **1** habitus **2** detail of lobes on head **3** detail of cluster of thoracic pores **4** detail of pygidial lobes.

separated from the bases of L1 by a space about 6.5 times as long as its diameter. **Perivulvar pores.** Absent.

Male. Unknown.

Type material. Two adult females, holo- and paratype, Puerto Rico: 27.vi.2006, M. Resto, on *Mammea americana* fruit. Specimens are mounted in Canada Balsam. Both specimens are deposited in the U.S. Museum of Natural History (USNM) in Beltsville, Maryland.

Diagnosis. *Mycetaspis ailynaomi* is most similar to *Mycetaspis defectopalus* Ferris in the shape of the pygidial lobes and the relative lengths and shapes of the paraphyses, but differs from the latter and other species in the genus in having 10–14 sclerotized lobular processes along the anterior margin of the cephalothorax; whereas the anterior margin of the cephalothorax is sclerotized, but smooth and rounded in the other species.

Biology. This species in only known to occur on *Mammea americana* fruit in Puerto Rico. Several embryos were present in both the holotype and paratype specimens.

Etymology. The species name is the combination of the names of the first author's daughters, Ailyn and Naomi, as a testimony of his love to them.

Key to adult females of the genus *Mycetaspis*

1	Perivulvar pores present; sclerotized area of anterior margin of head flatly rounded with a row of setae; Mexico, Guatemala, Panama, Venezuela ..... ***sphaerioides* (Cockerell)**
1b	Perivulvar pores absent; sclerotized area of anterior margin of head produced without a row of setae **2**
2(1b)	L1 each with an elongate, tapering basal sclerosis whose base is about as wide as the base of the L1 lobe **3**
2b	L1 with the basal sclerosis narrow and arising from the mesal angle, its base is less than half as wide as the L1 base **4**
3(2)	Perispiracular pores absent. L2 and L3 wider than long; L4 distinct; widespread ..... ***personata* (Comstock)**
3b	Perispiracular pores present. L2 and L3 longer than wide; L4 merged into sclerotized margin; Brazil ..... ***bezerrai* Arruda**
4(2b)	Eyes replaced with a thorn-like process; lateral area anterior to L4 with a series of relatively long paraphyses; Argentina, Brazil, Guyana, Mexico, Panama; USA (Texas) ..... ***apicata* (Newstead)**
4b	Eyes not replaced with a thorn-like process; area anterior to L4 without a series of relatively long paraphyses (short paraphyses present in *M. ailynaomi*). **5**
5(4b)	Sclerotized area on anterior margin of head with a row of 10–14 large, protruding sclerotized lobular processes; area anterior to L4 with a series of short paraphyses; Puerto Rico ..... ***ailynaomi* Dones & Evans, sp. n.**
5b	Head smooth, with no processes: area anterior to L4 without a series of short paraphyses **6**

6(5b) Anterior margin of head rounded, not incised, smoothly joining the lateral margin of the cephalothorax; Belize, Ecuador, Mexico, Nicaragua, Panama, Peru, USA (Florida, Texas) ..... **defectopalus** Ferris

6b Anterior margin of head, incised on each side of the apex, giving it a 3-lobed appearance, abruptly joining the lateral margin of the cephalothorax; Brazil... ..... ***juventinae*** **Lepage & Giannotti**

Species not included in the key

Mycetaspis brasiliensis Hempel was described from Brazil. We do not have an illustration or specimens of this species to compare with the other species. According to Hempel (1932) it is similar to *M. personata* but has a larger sclerotized area on the head, 4 pygidial lobes, and 18–20 pairs of paraphyses.

Mycetaspis eneideae Arruda was described from Brazil. No specimens of this species are available to us and the original illustration lacks sufficient details helpful for placing it in the key. Based on the original illustration of the species in Arruda (1976), it appears that all of the pygidial lobes are fused together; there are no paraphyses that can be discerned.

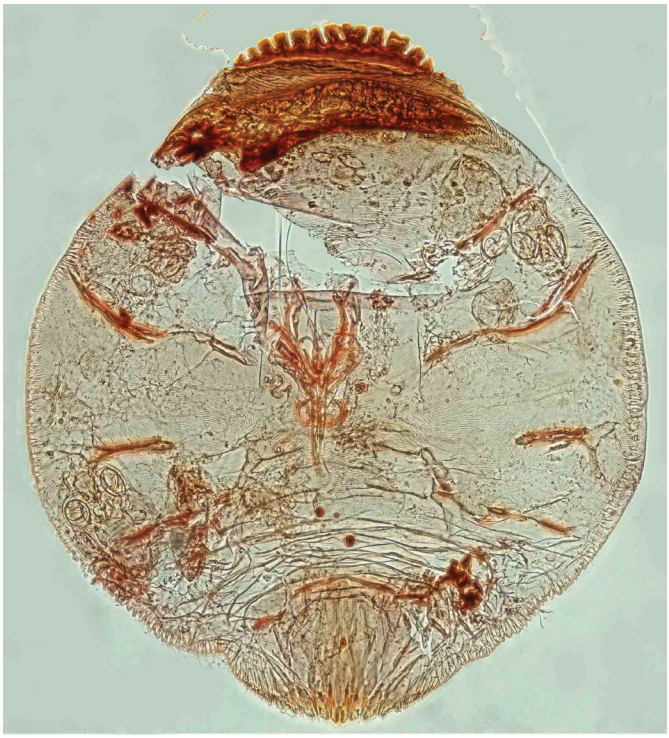


Figure 5. *Mycetaspis ailynaomi,* habitus of holotype female.

Figure 6. *Mycetaspis ailynaomi*, detail of pygidial lobes of holotype female.

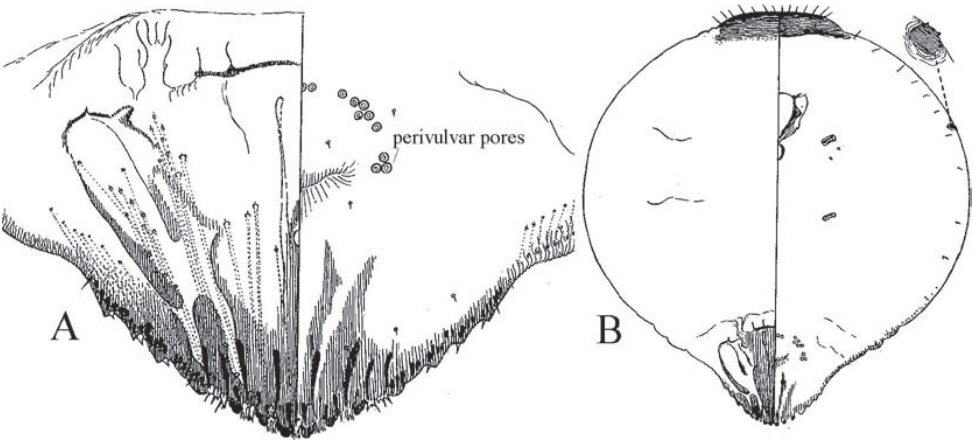


Figure 7. *Mycetaspis sphaerioides* female **a** pygidium **b** habitus (after Ferris 1941).

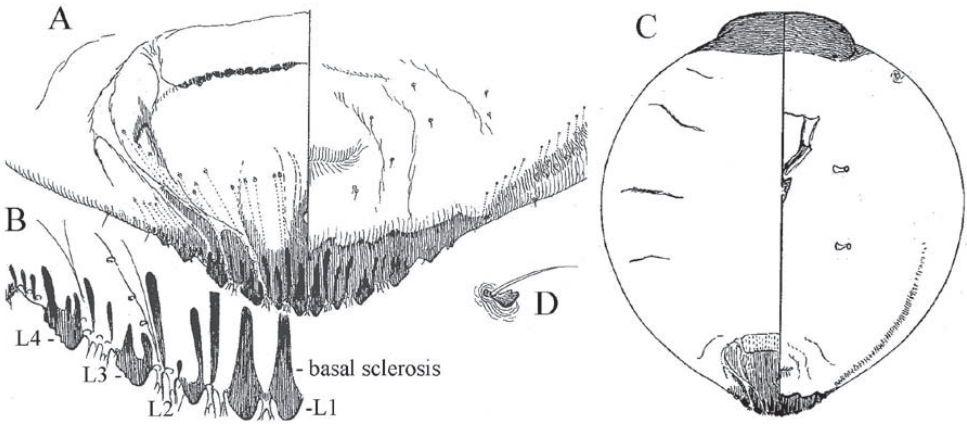


Figure 8. *Mycetaspis personata* female **a** pygidium **b** detail of pygidium, c) habitus, d) antenna (after Ferris 1941).

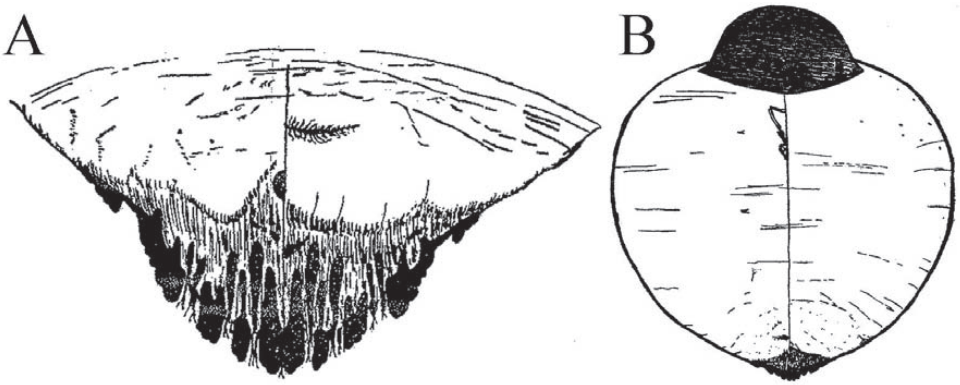


Figure 9. *Mycetaspis bezerrai* female **a** pygidium **b** habitus (after Arruda 1972).

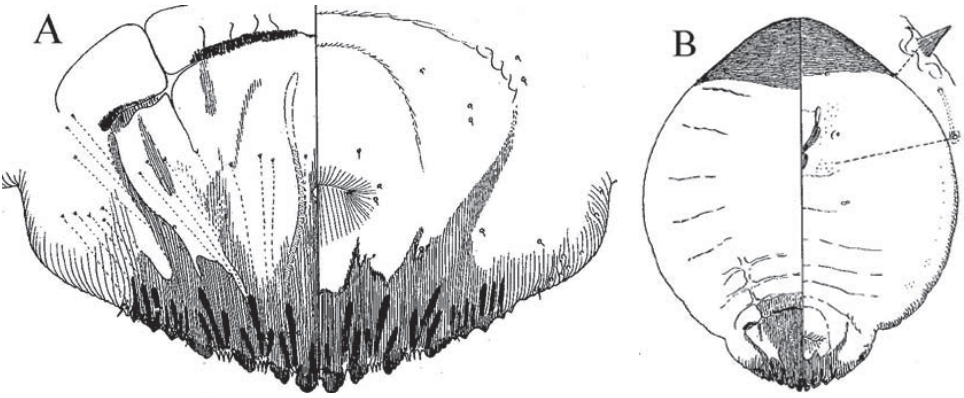


Figure 10. *Mycetaspis apicata* female **a** pygidium **b** habitus (after Ferris 1941).

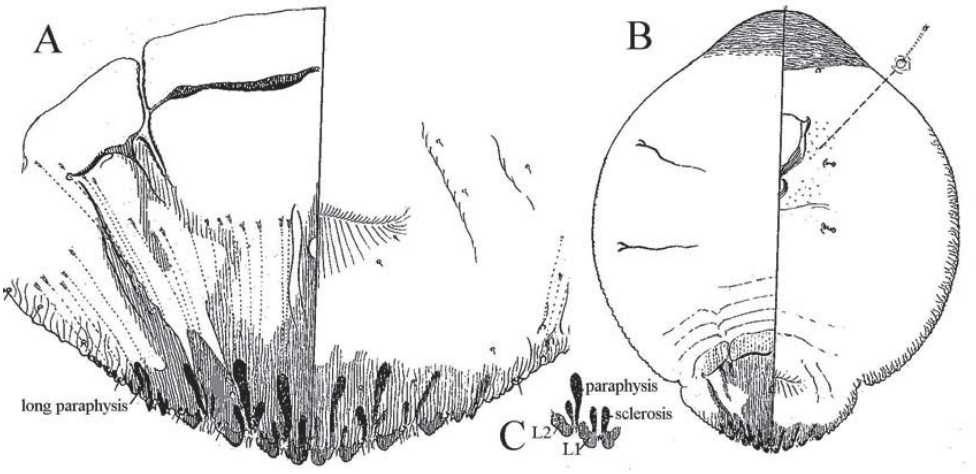


Figure 11. *Mycetaspis defectopalus* female **a** pygidium **b** habitus **c** detail of L1 and L2 lobes (after Ferris 1941).

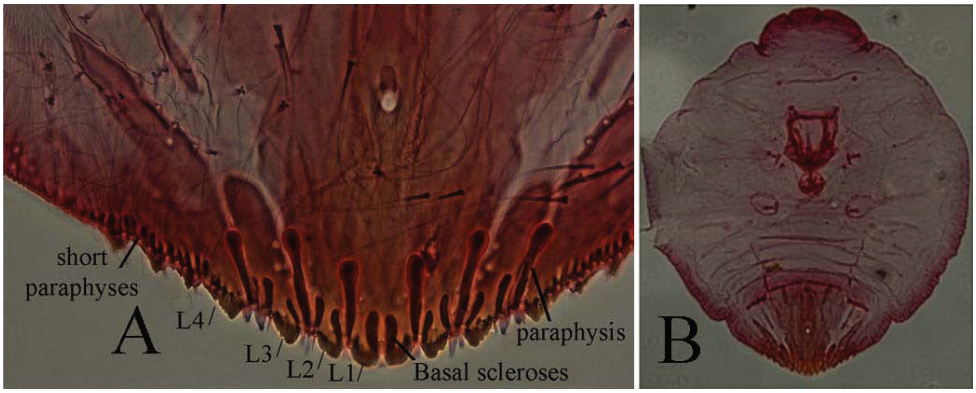


Figure 12. *Mycetaspis juventinae* female (topotype) **a** pygidium **b** habitus.

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RESEARCH ARTICLE

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Technomyrmex montaseri sp. n., a new ant species of the *T. gibbosus*-group from Oman (Hymenoptera, Formicidae) with a key to the *Technomyrmex* species of the Arabian Peninsula

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Abstract

Technomyrmex montaseri **sp. n.** is described and illustrated from Oman based on the worker caste collected in Bani Sur. It belongs to the *Technomyrmex gibbosus*-group, with closest resemblance to *T. vexatus* (Santschi, 1919) and *T. gibbosus* W. M. Wheeler, 1906. A key to the Arabian *Technomyrmex* is given.

Keywords

Technomyrmex, Palaearctic, Middle East, Alpha taxonomy, Arabia, Key

Introduction

The ant genus *Technomyrmex* Mayr, 1872 comprises one of the largest and most diverse ant genera in the subfamily Dolichoderinae. Ninety species are known world wide,

distributed throughout the tropical and subtropical zones; most species occur in the Oriental-Malesian (*sensu* Bolton 2007) and Afrotropical regions. The workers of the genus *Technomyrmex* are clearly diagnosed by the following characters (as defined by Bolton 2007). Masticatory margin of mandible multidentate, with 12-14 teeth. Palp formula 6,4 in the vast majority of species. Median portion of anterior clypeal margin transverse to very deeply incised. Antennae 12-segmented, without a club. Metanotal groove present. Propodeum unarmed, its dorsum-declivity junction broadly rounded to distinctly angular. Petiole extremely reduced, forming a low narrow segment without a node or scale. Petiole concealed in dorsal view when gaster is in line with mesosoma, overhung by the anteriorly projecting first gastral tergite. A groove is present in the anterior face of the first gastral tergite that accommodates the petiole. Gaster with five visible tergites and sternites, the pygidium small.

The *Technomyrmex* of the Arabian peninsula have been studied fragmentarily and probably many species remain undiscovered. This paper continues our contributions towards the knowledge of Arabian *Technomyrmex*. The first contribution was by Collingwood (1985). He reported *T. albipes* (Smith, 1862) and *T*. sp. A, which is almost certainly a member of the genus *Tapinoma* (fig. 14), *T.* sp. B and described *T. setosus*. The *T*. sp. B was compared with *T. gibbosus* W. M. Wheeler, 1906 and it was felt both sp. A and sp. B might well prove to be new species. The illustrations of *T.* species A and B are mislabelled in Figs. 12-14, with 14 being the smaller-eyed species A and 13 being species B. Collingwood and Agosti (1996) followed this by recording the same species and adding *T. bruneipes* Forel, 1895 from Yemen and other localities in Saudi Arabia. An additional record of *T*. sp. B was from Oman and Yemen. Bolton (2007) reverted *T. bruneipes* to the status of a junior synonym of *T. albipes*. More recently, Sharaf (2009) described a further member of the *T. albipes*-group, *T. briani* from Wadi Abha, Asir, Saudi Arabia. With the revision of *Technomyrmex* by Bolton (2007), we have been able to confirm *Technomyrmex* sp. B as a new species.

The *T. gibbosus* group (Bolton 2007) is distinguished from other *Technomyrmex* species-groups by the combination of the following characters. The anterior clypeal margin has only the weakest of median impressions and setae are entirely lacking from the head behind the clypeus, the mesosoma including the propodeal declivity, and gastral tergites 1-3. With the mesosoma in profile the pronotum and mesonotum form separate curved surfaces and the mesonotum is distinctly convex. Palp formula 6,4. Bolton gave only two species in the group, *T. gibbosus* from Japan and *T. vexatus* from Morocco and recently recorded from the Iberian Peninsula (Gibraltar) (Guillem and Bensusan 2008). The latter and *T. setosus* are the only species he listed from the "Western Palaearctic", a geographical area in which he includes Saudi Arabia and Yemen. Bolton was unable to locate the Collingwood type specimens and noted those he examined from the Liverpool Museum matched the Collingwood description but not the drawing.

In this paper *Technomyrmex montaseri* new species is described from Oman.

Material and methods

Measurements and indices were taken according to Bolton (2007).

Measurements:

TL *Total Length.* The total outstretched length of the ant from the mandibular apex to the gastral apex.

HL *Head Length*. The length of the head capsule excluding the mandibles; measured in full-face view in a straight line from the mid-point of the anterior clypeal margin to the mid-point of the posterior margin. In species where one or both of these margins is concave the measurement is taken from the mid-point of a transverse line that spans the apices of the projecting portions.

HW *Head width*. The maximum width of the head behind the eyes, measured in full-face view.

SL *Scape length*. The maximum straight-line length of the scape, excluding the basal constriction or neck that occurs just distal of the condylar bulb.

PW *Pronotal width*. The maximum width of the pronotum in dorsal view.

WL *Weberś length of Mesosoma*. The diagonal length of the mesosoma in profile, from the anterior most point of the pronotum to the posterior basal angle of the metapleuron.

All measurements are expressed in millimeters.

Indices:

CI *Cephalic Index*. HW divided by HL, × 100.

SI *Scape Index*. SL divided by HW, × 100.

OI *Ocular Index*. Maximum diameter of eye divided by HW, × 100.

EPI *Eye Position Index*. In full-face view the straight-line length (parallel to the long axis of the head) from the anteriormost point of the eye to the anterior clypeal margin, divided by the straight-line length from the posteriormost point of the eye to the posterior margin, × 100.

DTI *Dorsal Thoracic Index*. In dorsal view the length from the mid-point of the anterior pronotal margin to the midpoint of the metanotal groove, divided by PW, × 100.

The photographic images were taken using a digital camera attached to a stereomicroscope. The microscope was equipped with a Z-Stepper to enable the generation of usually 30 images in different focus layers from which a montage image was computed using Auto-Montage Pro.

Results

***Technomyrmex montaseri* sp. n.**
urn:lsid:zoobank.org:act:AC02AAFB-ACF2-4491-9E11-401DE099AC84
http://species-id.net/wiki/Technomyrmex_montaseri
Figs 1–3

Holotype worker. Oman, Bani Sur, 7.iii.1984 (W. Büttiker); the entomological Collection, the World Museum Liverpool (WML), Liverpool, U.K. deposited by Mr Guy T. Knight)

Paratypes. 7 workers with same data as holotype in the World Museum, Liverpool (WML) (deposited by the senior author), 1 worker with same data as holotype, The Natural History Museum, London (BMNH) (deposited by B. Bolton) and 1 worker, Oman Eastern sand project (Leg. Collingwood) at WML.

Holotype worker. *Measurements*: TL: 2.90; HL: 0.60; HW: 0.57; SL: 0.62; PW: 0.37; WL: 0.80; EL: 0.15; *Indices*: CI: 95; SI: 109; OI: 26; EPI: 80; DTI: 122

Paratype worker. *Measurements*: TL: 2.80; HL: 0.62; HW: 0.60; SL: 0.58; PW: 0.38; WL:0.65; EL: 0.15; *Indices*: CI: 97; SI: 97; OI: 25; EPI: 125; DTI: 126

Other workers, as *Technomyrmex* species B, measurements given by Collingwood (1985) are as follows: TL:2.20, HL:0.52; HW:0.52; SL:0.62; EL: 0.16; SI:119

Distribution. Saudi Arabia, Al Farrash, 15.x.1982, 21° 7’ 45 N, 40° 36’ 20 E; collector W. Büttiker (Collingwood 1985); Oman, Bani Sur (as the holotype and paratype) and Eastern Sands, iii.1986, all W. Büttiker; also, Yemen, Al-Hajjarah, 14.iii.1992, A van Harten (Collingwood and Agosti 1996).

Diagnosis. This new species is characterized by the combination of the following characters: Head, mesosoma and all gastral tergites without setae. Anterior clypeal margin with a shallow but distinct median concavity. In full-face view the occipital margin and the sides of the head are convex.

Worker description. Dorsum of head behind clypeus entirely lacks setae. Anterior clypeal margin with a shallow but distinct median concavity. In full-face view the posterior margin of the head and the sides clearly convex. Eyes of moderate size, located in front of the midlength and their outer margins just failing to break the outline of the sides. Sculpture of head a very weak, superficial and effaced microreticulum. Dorsum of mesosoma and propodeal declivity entirely lack setae. With mesosoma in profile the mesonotal dorsal outline consists of an anterior section that is short and flat to feebly convex; posterior to this the surface curves broadly and evenly into a larger, more steeply sloped posterior section that descends to the narrow mesonotal groove. Propodeum in profile with a short convex dorsal surface that rounds evenly into the declivity, the two surfaces not separating by an angle. Sculpture reduced and superficial on dorsal mesosoma and all gastral tergites; the latter without pubescence. All gastral tergites, scapes and tibiae without setae. Colour uniform yellow.

Derivatio nominis. A patronymic name (*T. montaseri*) is proposed in honor of Mosrafa Sharaf's friend the famous Egyptian journalist Mr. Salah Montaser (Al-Ahram News paper).

Figure 1. Profile of *Technomyrmex montaseri* sp. n. (Holotype, WML).

Key to the Arabian species of the genus *Technomyrmex*

We include *T. vexatus* in the key of the Arabian *Technomyrmex* as it is the only other West Palaearctic species of its group and may well be discovered in other areas, beside Morocco and Gibraltar where it now is known.

1 With the head in profile the dorsal surface of the frontal carina, or the dorsum immediately mesad of the frontal carina, entirely without setae **2**

– With the head in profile the dorsal surface of the frontal carina, or the dorsum immediately mesad of the frontal carina, with setae present; at least with one seta present somewhere along the length of the frontal carina, or more usually with a row of 2-4 ..... **3**

2 Head and mesosoma brown. Posterior margin of head shallowly impressed, eyes located close to the midlength of the head; the gastral tergites 1-3 without setae, the fourth with 2-3 pairs. Larger species with TL 3.0-3.4, EPI 68-76, WL 0.90-0.96 (Spain, Morocco and possibly in Arabia) ..... ***T. vexatus***

– Head and mesosoma yellow. Posterior margin of head clearly convex, eyes located in front of the midlength of the head; all gastral tergites without setae. Smaller species with TL 2.2-2.9, EPI 80-125, WL 0.65-0.80 (Oman, Yemen and Saudi Arabia) ..... ***T. montaseri* sp. n.**

3 Gastral tergites 2-3 without setae (Saudi Arabia) ..... ***T. briani***

– Gastral tergites 2-3 with setae present; setae may be restricted to one or two pairs on each segment or may be numerous **4**

4 With head in profile the dorsum behind the level of the posterior margin of the eye without setae. Head, mesosoma, petiole and gaster blackish brown to black. Propodeum dorsum-declivity junction distinctly and sharply angled. HL 0.56-0.63, WL 0.66-0.78, SI 91-102 (Successful tramp species)..... ..... ***T. albipes***

– With the head in profile the dorsum behind the level of the posterior margin of the eye with one or more pairs of setae present, which may be very short

Figure 2. Dorsal view of *Technomyrmex montaseri* sp. n. (Holotype, WML).

and inconspicuous. Head and gaster brown to dark brown; mesosoma a much lighter yellowish brown and distinctly contrasting. Propodeum dorsum-declivity junction broadly rounded or very weakly angled. HL 0.64-0.67, WL 0.80-0.82, SI 108-112 (Saudi Arabia)..... ***T. setosus***

Discussion

Affinities

This new species is a member of the *Technomyrmex gibbosus*-group as defined by Bolton (2007) and cannot be identified with any of the *Technomyrmex* species in his extensive review. *T. montaseri* appears taxonomically closest to *T. vexatus* (Santschi, 1919), known only from Morocco and Gibraltar, and *T. gibbosus* W. M. Wheeler, 1906, which was described from Japan and otherwise know only from North Korea (Radchenko 2005). All three species are completely without setae on the head behind the clypeus, or on the mesosoma including the propodeal declivity. With the mesosoma in profile the mesonotal dorsal outline is convex, consisting of a shallowly convex anterior section that curves broadly and evenly into a more sloping shallow convexity that

Figure 3. Full-face view of *Technomyrmex montaseri* sp. n. (Holotype, WML)

descends to the metanotal groove. The propodeum in profile has a short convex dorsal surface that rounds into the declivity. Scapes and tibiae without setae. *T. montaseri* may be closer to *T. vexatus*, but differs in colour which is uniform yellow while it is brown in *T. vexatus*. *T. montaseri* also is consistently smaller, TL 2.8-2.9 versus TL 3.-3.4. *T. montaseri* has the eyes located in front of the midlength of the head, whereas in *T. vexatus* they are situated close to the midlength; thus the eye position index is larger, EPI 80-125, versus EPI 68-76. *T. montaseri* has a higher scape index, SI 97-109 versus SI 90-94; has a smaller Weber's length of mesosoma, WL 0.65-0.80 versus WL 0.90-0.96, and has a clearly convex occipital margin, that is very shallowly impressed in *T. vexatus*. Additionally, *T. montaseri* has completely bare gastral tergites, while in *T. vexatus* gastral tergites 1-3 are without setae but the fourth has 2-3 pairs. *T. montaseri* lacks pubescence on the first gastral tergite, whereas short and sparse pubescence is present in *T. vexatus*.

T. montaseri and *T. gibbosus* are similar in most measurements but the scape length in *T. montaseri* is consistently larger, SL 0.58-0.62 versus SL 0.50-0.54. *T. montaseri*

has a higher cephalic index, CI 95-97 versus SI 86-91, a higher scape index, SI 97-109 versus SI 85-93; a significantly higher eye position index, EPI 80-125 versus EPI 50-58; and a smaller Weber's length of mesosoma, WL 0.65-0.80 versus WL 0.76-0.84. In *T. montaseri* the posterior margin of the head and the sides are broadly convex, whereas in *T. gibbosus* the posterior margin of the head has a median indentation and the sides are only shallowly convex. In *T. montaseri* all gastral tergites are bare whereas in *T. gibbosus* gastral tergites 1-3 lack setae but the fourth tergite has 1-2 pairs. *T. montaseri* is yellow while *T. gibbosus* has a medium to dark brown mesosoma, often with a reddish tint; the gasters are about the same medium to dark brown, with the legs dull yellow to yellowish brown. Moreover, *T. gibbosus* has very fine, short, appressed pubescence present on the first and second gastral tergites. This pubescence is somewhat more dense in *T. gibbosus* than *T. vexatus*.

Technomyrmex gibbosus-group

As previously known, the *Technomyrmex gibbosus*-group contains a pair of geographically widely separated species, *T. vexatus* from Morocco and Gibraltar and *T. gibbosus* from North Korea and Japan. The distribution of *T. montaseri* (Oman, Yemen and Saudi Arabia) fills a gap in that distribution. Bolton (2007: 41, 82) speculated that *vexatus* and *gibbosus* might share an intermediate common ancestor, or could be remnants of a fairly distinctive species group that once extended across the width of the southern Palaearctic. Alternatively each might have acquired the shared characters by convergence from unrelated ancestors. With our specimens of this new species we feel able to support the idea of the intermediate common ancestor from Western or Central Asia.

Five species of the genus *Technomyrmex* are known now from the Arabian Peninsula. If one takes into account the large area and its location between the Palaearctic, Oriental and Afrotropical regions, this figure is very low. Therefore, one would expect to find many more species of this genus and from the *gibbosus*-group with more intensive collecting efforts.

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RESEARCH ARTICLE

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Systematics of Australian Thrasorinae (Hymenoptera, Cynipoidea, Figitidae) with descriptions of Mikeiinae, new subfamily, two new genera, and three new species

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Abstract

The Australian Thrasorinae are revised and *Mikeius* is transferred to Mikeiinae Paretas-Martínez & Pujade-Villar, **subfam. n.**, and *M. clavatus* Pujade-Villar & Restrepo-Ortiz, **sp. n.**, is described. Two new genera of Thrasorinae are erected: *Cicatrix* Paretas-Martínez, **gen. n.,** including *C. pilosiscutum* (Girault), **comb. n.** from *Amblynotus*, *C. schauffi* (Buffington), **comb. n.** from *Mikeius***,** and *C. neumannoides* Paretas-Martínez & Restrepo-Ortiz, **sp. n.**; and *Palmiriella* Pujade-Villar & Paretas-Martínez, **gen. n.**, including *P. neumanni* (Buffington), **comb. n.** from *Mikeius*, *Thrasorus rieki* Paretas-Martínez & Pujade-Villar, **sp. n.**, is also described. A phylogenetic analysis of 176 morphological and biological characters, including all these new taxa and all genera previously included in Thrasorinae, was conducted. All subfamilies were recovered as monophyletic, with the following relationships: Parnipinae (Euceroptrinae (Mikeiinae (Plectocynipinae (Thrasorinae)))). A worldwide key to the subfamilies of Figitidae is provided that includes the new subfamily, as well as a key to genera Thrasorinae.

Keywords

Australia, Figitidae, Mikeiinae, *Cicatrix*, *Mikeius*, *Palmiriella*, *Thrasorus*

Introduction

Figitidae (Hymenoptera: Cynipoidea) are parasitoids of the larvae of other insects, principally cyclorraphous Diptera (Ronquist 1999; Buffington et al. 2007). Ronquist (1999) seperated the figitids into nine subfamilies: Anacharitinae, Aspicerinae, Charipinae, Emargininae, Eucoilinae, Figitinae, Parnipinae, Pycnostigminae, and Thrasorinae; Parnipinae was referred to in the study but formally described later by Ronquist and Nieves-Aldrey (2001). Two new figitid subfamilies, Plectocynipinae (Ros-Farré and Pujade-Villar 2007) and Euceroptrinae (Buffington and Liljeblad 2008), have been erected recently to include genera previously included in Thrasorinae.

Thrasorinae is a stem group of figitids (Buffington et al. 2007) associated with galls of other wasps (Cynipoidea and Chalcidoidea) on various trees and bushes. They are parasitoids of the gall inducers or other hymenopteran inhabitants in the galls with which they are associated (Ronquist 1999; Buffington and Liljeblad 2008). Hence, the group is important for elucidating the evolutionary history of Figitidae, in particular, and the Cynipoidea as a whole, with its different life strategies of entomophagy and phytophagy. Prior to this study, Thrasorinae included the four genera *Thrasorus* Weld (two species: Australia), *Mikeius* Buffington (six species: Australia), *Myrtopsen* Rübsaamen (eleven species: two Holarctic and nine Nearctic), and *Scutimica* Ros-Farré (two species: Neotropical). Thrasorinae are characterized by the circumtorular impression (Fig. 2A, D, 3A), not present in any other figitids (Pujade et al. 2008; Ros-Farre and Pujade-Villar 2007; Ros-Farre and Pujade-Villar 2009; present study).

Following the examination of many undetermined specimens of Thrasorinae in the Australian National Insect Collection (ANIC) and the Queensland Museum (QM), as well as the type material of all species included in *Mikeius* Buffington, new questions arose regarding the taxonomy of Thrasorinae. First, an undescribed species of *Mikeius* was discovered (described herein); second, two species originally described in *Mikeius* were determined to render the genus polyphyletic, and new generic assignments are required; and third, phylogenetic analyses determined that the inclusion of *Mikeius* within Thrasorinae renders the subfamily paraphyletic with respect to Plectocynipinae. In response to these discoveries, Mikeiinae is described as a new subfamily to accommodate *Mikeius*, and species previously described in *Mikeius* are moved into other genera. In two cases, no current genus concept could accommodate these species, and the two new genera *Cicatrix*, gen. n., and *Palmiriella*, gen. n., are herein described. The goal of this study is to bring clarity to the taxonomic and phylogenetic relationships of these unusual groups of figitid wasps.

Material and methods

List of Repositories

QM Queensland Museum, Brisbane, Australia (C. Burwell).
ANIC Australian National Insect Collection, CSIRO, Canberra, Australia (J. LaSalle).

Specimen illustration and observation. Environmental scanning electron micrographs (ESEM) were obtained at Barcelona University with the FEI Quanta 200 ESEM without any coating at 15 KV. Additional ESEM images were obtained either with a Hitachi TM3000 E-SEM, or an Amray 1810 SEM under a vacuum, using a lanthanum hexaboride electron source (LaB6) at 10 Kv, both housed at the National Museum of Natural History, Smithsonian Institution. Images were edited using Adobe CS4 Software (Adobe, Inc). The terminology for morphological structures comes from Richards (1977), Ronquist and Nordlander (1989), Ronquist (1995), Ros-Farré et al. (2000), and Ros-Farré and Pujade-Villar (2007), and the sculpture terminology follows Harris (1979). Measurements and abbreviations in the descriptions include: F1-F12, first and following flagellomeres; T3-T4, third and fourth abdominal tergites; antennal formula is given with the length:width ratio of each segment.

Phylogenetic analysis. Twenty-two taxa were included in the phylogenetic analysis (Table 1), representing all genera previously and currently included in Thrasorinae, and all new taxa and combinations described in this work. Three species of each genus were included (except for monotypic genera or those with less than three species), so as to capture the morphological diversity of each genus. *Parnips nigripes* (Barbotin, 1964) was chosen as an out-group based on Buffington et al. (2007). The analysis was based on a morphological dataset of 172 morphological and 4 biological characters modified from Buffington et al. (2007); the character list can be found in Appendix 1. These characters represent the variability in the external morphological diversity of all the species studied, excluding those characters present in only one species; characters utilized in previous phylogenetic studies are indicated. Due to their rarity, some species were not dissected and examined internally; characters requiring dissection for coding were left as '?'. The resulting data matrix (Appendix 2), which included 79 parsimony-informative characters, was analyzed using PAUP* (Swofford, 2002) employeing 10,000 multiple random addition sequences, followed by TBR swapping with branches of maximum length zero collapsed and steepest descent set to 'off'. For bootstrap analyses (Felsenstein 1985), we employed a simple addition sequence with *Parnips nigripes* as the reference taxon, followed by 1000 bootstrap replicates, each replicate employing 100 TBR swapping replications.

Descriptions

Mikeiinae Paretas-Martínez & Pujade-Villar, subfam. n.
urn:lsid:zoobank.org:act:9A0F4DEB-C4CE-44E2-BAAC-D86A88DC25CE
http://species-id.net/wiki/Mikeiinae
Fig. 1

Type genus: *Mikeius* Buffington, 2008.

Diagnosis. Differs from Thrasorinae by the absence of a circumtorular impression (Fig. 1A; compare with Figs 2A, D, 3A, 4A, 9A-B), and the absence of a distinctly projected pronotal plate (Fig. 1C and G) (Table 2). Differs from Plectocyn-

Table 1. Taxa included in the phylogenetic analysis. OG: outgroup.

Higher taxon	Species
Parnipinae (OG)	*Parnips nigripes* (Barbotin, 1964)
Euceroptrinae	*Euceroptres primus* Ashmead, 1896
	Euceroptres whartoni Buffington & Liljeblad, 2008
	Euceroptres montanus Weld, 1926
Thrasorinae	*Scutimica flava* Ros-Farré & Pujade-Villar, 2007
	Scutimica transcarinata Ros-Farré & Pujade-Villar, 2007
	Myrtopsen platensis Diaz, 1975
	Myrtopsen luederwaldti Dettmer, 1928
	Myrtopsen mimosae Weld, 1926
	Palmiriella neumanni (Buffington, 2008)
	Thrasorus pilosus Weld, 1944
	Thrasorus schmidtae Buffington, 2008
	Thrasorus rieki sp. n.
	Cicatrix pilosiscutum (Girault, 1929)
	Cicatrix schauffi (Girault, 1929)
	Cicatrix neumannoides sp. n.
Plectocynipinae	N. gen., n. sp. plectocynipine
	Plectocynips pilosus Díaz, 1976
Mikeiinae, subfam. n.	*Mikeius hartigi* (Girault, 1930)
	Mikeius grandawi Buffington, 2008
	Mikeius clavatus sp. n.
	Mikeius berryi Buffington, 2008

ipinae by lacking an extremely long posterior metatibial spur (Fig. 6F; Ros-Farre and Pujade-Villar 2007), a laterally compressed metasoma in females (Ros-Farre and Pujade-Villar 2007), and a long, exposed hypopygium (7th sternite) in females (Ros-Farre and Pujade-Villar 2007). Differs from Euceroptrinae by lacking an areolet in the forewing, a lateral pronotal carinae (ARE, Fig. 6D; Buffington and Liljeblad 2008) and pronotal plate, having a complete ring of setae at the base of the metasoma and metasomal T4 much larger than T3. The Mikeiinae are unique among these three subfamilies in having two carinae in the median area of the pronotum that do not form a projected pronotal plate (Fig. 1G).

Description. Length. 2 – 3.5 mm.

Coloration. Head and mesosoma dark brown to black, antenna and legs yellowish to brown. Metasoma light brown to black.

Head. (Fig. 1A) Frons and face with abundant setae. Transverse carinae or strigae on face absent. Clypeus distinctly projected ventrally, curved ventrally, clypeopleurostomal lines well developed. Malar furrow absent; malar space coriaceous, striate. Occiput and genae smooth without carinae. Circumtorular impression absent.

Antenna. (Fig. 1D, E) Filiform or clavate with 10–11 flagellomeres in females (last one larger, possibly fusion of two), 12 in males. Males with F1 curved.

Mesosoma. (Fig. 1B, C, F, G) Lateral margins of posterior part of pronotal plate short, not reaching scutum, not forming projected plate; lateral pronotal de-

pressions open laterally. Mesoscutum horizontally striate. Notauli complete, uniformly wide along entire length, or gently widening posteriorly. Parascutal sulcus marked only in basal half. Lateral basal impressions weak. Antero-admedian lines absent or weak. Median mesoscutal line present, short or long. Scutellum striate anteriorly and in center, rugose posteriorly; scutellar foveae round subtriangular or subquadrate, sometimes not delimited posteriorly; interfoveal carina absent. Mesopleural furrow absent or present. Propodeal carinae wide, almost straight. Pronotum, mesoscutum, scutellum, mesopleural triangle and metapleura all covered with sparse/dense setae.

Forewing. Short setae present on wing surface and along margins. Radial cell closed along anterior margin, 2 to 2.5 times longer than wide, R2 almost straight; areolet absent.

Legs. Metatibia with two spurs, sub-equal in length, not exceeding one-third the length of tarsomere 1.

Metasoma. Base of T3 with a complete or incomplete ring of setae. Tergite 3 smaller than T4; T4 large, covering almost entire metasomal surface; remaining terga short, telescoped within T4; entire metasoma shiny and smooth.

Comments. In the original description of *Mikeius*, Buffington (2008) erroneously described species of the genus as having 12 flagellomeres in the female antenna; the correct number is 10 or 11 (Fig. 1 D and E).

Biology. Associated with Chalcidoidea (Hymenoptera: Apocrita) that induce galls on species of *Acacia* (Fabaceae) and *Eucalyptus* (Myrtaceae), although most of these host records await verification through isolated rearing (Buffington, 2008).

Distribution. Australia.

Included genus. *Mikeius* Buffington, 2008.

***Mikeius clavatus* Pujade-Villar & Restrepo-Ortiz, sp. n.**
urn:lsid:zoobank.org:act:8D74319A-2A25-48A6-B857-80E6ABB2BE9C
http://species-id.net/wiki/Mikeius_clavatus
Fig. 1E

Diagnosis. Differs from all the other species of *Mikeius* in having the antenna strongly clavate with the six terminal segments 1.5 times wider than previous segments (Fig. 1E); further distinguished from *M. berryi* and *M. grandawi* by the absence of a mesopleural carina.

Description. As in subfamily description (see above) with the following specific characters.

Length. Female 2.8 - 3 mm. Male unknown.

Coloration. Head and mesosoma black, antenna yellowish, except scape, brown, metasoma pale brown. Legs pale yellow, except coxae, brown.

Antenna. (Fig. 1E) *Female.* Strongly clavate, 11 flagellomeres, antennal formula: 8(4): 4(4): 5(3): 3(3): 3(3): 3(3.5): 4(5): 5(6): 5(6): 6(5): 5(6): 5(6): 7(4). Placoid sensillae from F7 to terminal segment.

Table 2. Diagnostic table for Mikeius (Mikeiinae, n. subf.) and genera of Thrasorinae.

	Mikeiinae	**Thrasorinae**				
	Mikeius	*Thrasorus*	*Cicatrix*	*Palmiriella*	*Scutimica*	*Myrtopsen*
Circumtorular impression	absent	present	present	present	present	present
Lateral margins of posterior part of pronotal plate	not reaching scutum, not forming an upraised plate	reaching scutum, forming an upraised plate	reaching scutum, forming an upraised plate	reaching scutum, forming an upraised plate	reaching scutum, forming an upraised plate	reaching scutum, forming an upraised plate
Mesoscutum sculpturing	microsculpture horizontally striate	absent, smooth	microsculpture horizontally striate	microsculpture horizontally striate	smooth or with parapsides	microsculpture horizontally striate
T3-T4	T4 2x length of T3	T4 2x length of T3	T4 2x length of T3	fused, syntergum not covering the entire metasoma	fused, syntergum covering the entire metasoma	fused, syntergum covering the entire metasoma
Face sculpturing	absent	carinae on lower face	carinae on lower face	absent	irregularly wrinkled/ carinate	irregularly wrinkled/ carinate
Posterior margin of scutellum	rounded	rounded	rounded	rounded	emarginate	truncate/emarginate
Pronotum sculpturing	absent	absent	absent	absent	carinate	carinate/ microsculpture
Notauli	complete	complete	complete	complete	incomplete, each forming a large cell	complete

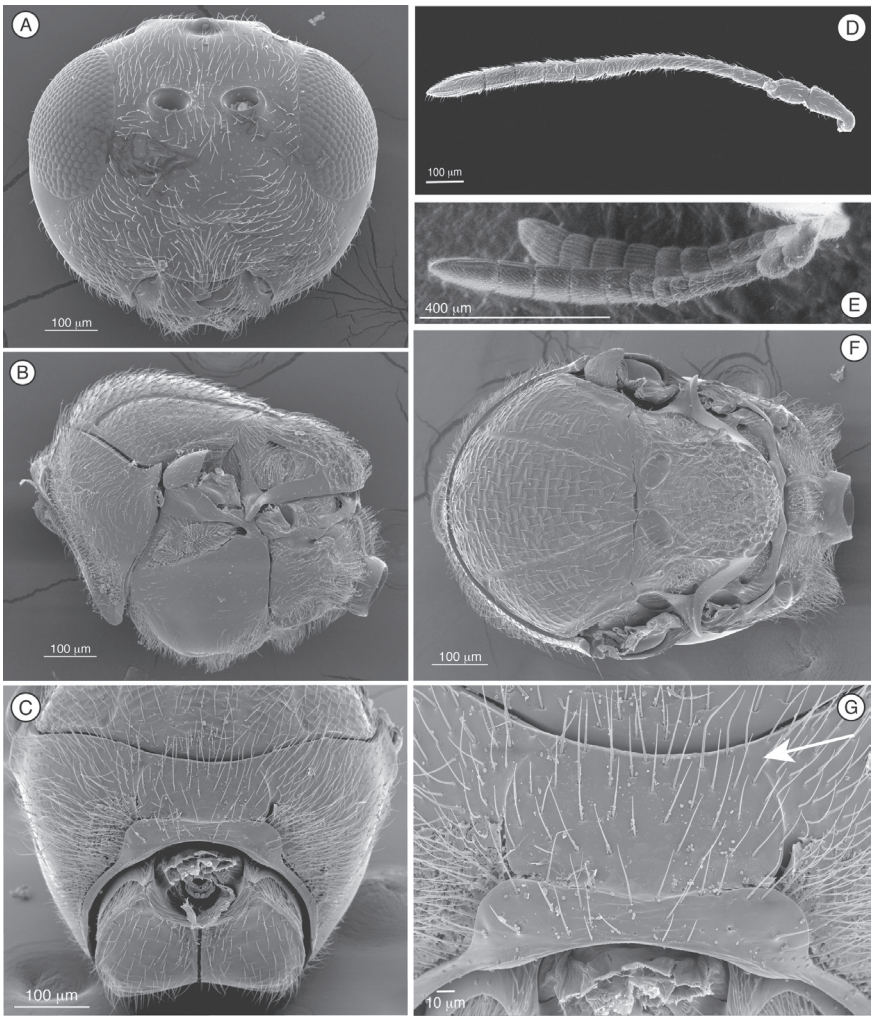

Figure 1. Diagnostic characters of *Mikeius* sp. (Mikeiinae), female. **A–D**, F and G: *M. hartigi*; E, *M. clavatus* **A** head, anterior view **B** mesosoma, lateral view **C** mesosoma, antero-dorsal view **D–E** antenna, medial view **F** mesosoma, dorsal view **G** pronotum (mesosoma), antero-dorsal view.

Mesosoma. Mesoscutum slightly striate . Notauli complete of uniform width. Antero-admedian lines weak. Median mesoscutal line very short. Scutellar foveae round to subquadrate, not delimited posteriorly. Mesopleural furrow absent.

Forewing. Radial cell 2.4 times longer than wide.

Metasoma. Base of T3 with an almost complete hairy ring.

Type material. HOLOTYPE ♀ (ANIC) with the following label data: "AUSTRALIA: Vict. Mt. Donna Buang, 1200m 11–17.i. 80, Eucalyptus-Nothofagus forest, A. Newton, M. Thayer" (white label), "flight intercept window/trough trap" (white label), "AUST. NAT. INS. COLL." (green label), "Holotype *Mikeius clavatus* P-V & R-O" (red label). PARATYPE ♀ (ANIC) with the following labels: "W side

Cobungra Hill 20km WbyN, Omeo Vic. 27 Feb. 1980, I.D. Naumann J. C. Cardale" (white label), "ex alcohol collection" (white label), "AUST. NAT. INS. COLL." (green label), "Paratype *Mikeius clavatus* P-V & R-O" (red label).

Biology. Unknown.

Distribution. Victoria, Australia.

Etymology. The specific name refers to the strongly clavate antenna.

Thrasorinae Kovalev, 1994
http://species-id.net/wiki/Thrasorinae
Figs 2, 3, 4, and 9

Type genus: *Thrasorus* Weld, 1944.

Diagnosis. Distinguished from other figitids by the presence of a circumtorular impression (Figs 2A, D, 3A, 4A, 9A, B) (Table 2); further distinguished from Eucoroptrinae by the absence of an areolet in the forewing and the absence of a lateral pronotal carina. Additional characters that distinguish Thrasorinae from other Figitidae can be found in the key to subfamilies below.

Comments. In the redescription of *Thrasorus*, Buffington (2008) erroneously described species of the genus as having 12 flagellomeres in the female antenna; the correct number is 11.

Biology. Unknown.

Distribution. Australia, South America and North America.

Included genera: *Cicatrix*, gen. n.; *Myrtopsen* Rübsaamen, 1908; *Palmiriella*, gen. n., *Scutimica* Ros-Farré, 2007; *Thrasorus* Weld, 1944.

***Cicatrix* Paretas-Martínez, gen. n.**
urn:lsid:zoobank.org:act:F831C129-F846-4A87-A668-524A2EA64E19
http://species-id.net/wiki/Cicatrix
Fig. 2

Type species: *Cicatrix pilosiscutum* (Girault), **comb. n.**

Included species: *Cicatrix neumannoides*, sp. n., *C. pilosiscutum* (Girault), *C. shauffi* (Buffington), comb. n.

Diagnosis. (Table 2) *Cicatrix*, gen. n., is distinguished from *Myrtopsen*, *Palmiriella*, gen. n., and *Scutimica* by having T3 and T4 as separate sclerites (Fig. 2C); in these latter three genera, T3 and T4 are fused into a syntergum (Fig. 3F, 9C). *Cicatrix* is distinguished from *Thrasorus* having horizontally striate microsculpture on the mesoscutum (Fig. 2B, E); *Thrasorus* has a smooth mesoscutum (Fig. 4B).

Description. Length. Female 2.5 – 4.5 mm. Male unknown.

Coloration. The entire body with the same coloration, light brown or chestnut depending on the specimen.

Head (Fig. 2A, D). Face and frons with abundant setae . Face with transverse carinae, strong across entire face, or only marked at lateral sides of face, smoother, tending towards strigae. Clypeus distinctly projected anteriorly, curved ventrally, clypeopleurostomal lines well developed. Malar furrow coriaceous. Occiput and genae smooth without carinae. Circumtorular impression present.

Antennae (Fig. 2F). *Female.* Filiform, with 10 or 11 flagellomeres.

Mesosoma (Fig. 2B and E). Pronotal carinae reaching anterior margin of mesoscutum, forming small plate, conspicuous but not projected, concave dorsomedially. Mesoscutum horizontally striate. Notauli complete, of uniform width to slightly wider posteriorly. Parascutal sulcus wide only in basal half. Lateral basal impressions conspicuous. Antero-admedian lines weak. Median mesoscutal line absent, short or long. Scutellum rugose; scutellar foveae round, subtriangular or subquadrate; interfoveal carina absent. Mesopleural furrow conspicuous. Propodeal carinae wide, curved. Pronotum, mesoscutum, scutellum, mesopleural triangle and metapleura all covered with sparse/dense setae.

Forewing. Short setae present on wing surface and along margins. Radial cell closed along anterior margin, two times longer than wide, R2 almost straight; areolet absent.

Legs. Metatibia with two spurs, sub-equal in length, not exceeding one-half length of tarsomere 1.

Metasoma (Fig. 2C). Petiole short. Base of T3 with patches of setae or an almost complete hairy ring. Tergite 3 smaller than T4; T4 four large, covering almost entire metasomal surface; remaining terga short, telescoped within T4; entire metasoma shiny, smooth. Hypopygium and ventral spine visible.

Biology. Unknown.

Distribution. Australia.

Etymology. From the Latin word *cicatrix*, meaning "scar", refering to the carinae that resemble a scar through the face. Gender is masculine.

Taxonomic comments. Girault (1929) described *Amblynotus pilosiscutum*, and Weld (1952) transferred the species to *Melanips*. This species has the circumtorular impression and thus belongs to Thrasorinae. However, the results of the phylogenetic analysis and the diagnostic characters summarized above indicate that this species cannot be accommodated by any currently recognized genus, thus we describe *Cicatrix*, gen. n., to contain *C. pilosiscutum* (Girault) as well as *C. neumannoides*, sp. n., and *C. schauffi* (Buffington), comb. n.

***Cicatrix pilosiscutum* (Girault), comb. n.**
http://species-id.net/wiki/Cicatrix_pilosiscutum
Fig. 2A

Amblynotus pilosiscutum Girault, 1929
Melanips pilosiscutum (Girault) Weld, 1952

Diagnosis. Differs from *C. neumannoides* and *C. schauffi* by having female antenna with 11 flagellomeres (these two species having female antenna with 10 flagellomeres,

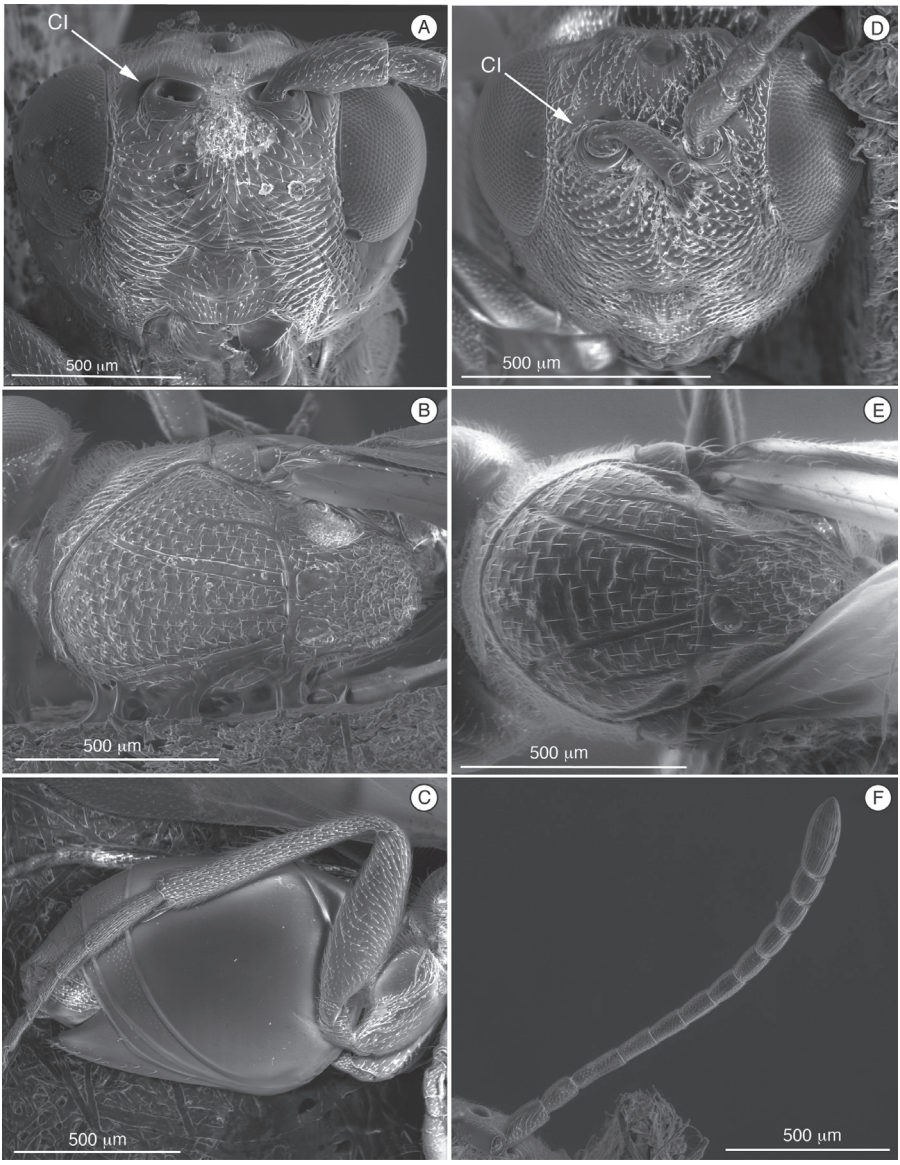

Figure 2. Diagnostic characters of *Cicatrix* sp. (Thrasorinae): **A** *C. pilosiscutum*; **B–D** and **F** *C. schauffi*; E, *C. neumannoides* **A** head, anterior view **B** mesosoma, dorsal view **C** metasoma, lateral view **D** head, anterior view **E** mesosoma, dorsal view **F** female antenna, dorsal view. CI, circumtorular impression.

(Fig. 2F, *C. schauffi*)), much stronger carinae crossing the entire face (Fig. 2A) (only marked at lateral sides of the face in the other two species, and being smoother, more like strigae), and by lacking a median mesoscutal impression (present and long in *C. schauffi* comb. n. (Fig. 2B), short in *C. neumannoides* sp. n. (Fig. 2E)).

Redescription. As in generic description (see above) with the following specific characters: **Length.** Female 4.4 mm. Male unknown.

Coloration. Completely light brown except mesosoma, which is dorsally dark.

Head. (Fig. 2A) Frons and face with piliferous punctures; strong transverse carinae crossing the entire face.

Antenna. *Female*. 11 flagellomeres, antennal formula: 9(4): 5(3): 10(3): 9(2.5): 8.5(2.5): 8(3): 8(3): 8(3): 7(3): 5(3): 5(3): 4.5(3): 7.5(3). Placoid sensillae absent on basal half of F1 to F4, scarce on dorsal half; abundant from F5 to F11.

Mesosoma. Median mesoscutal impression absent. Scutellar foveae subtriangular.

Type material. HOLOTYPE ♀ (QM) with the following labels: "25. 10. 23, National Pk., Q. H. Hacker." (white label), "HOLOTYPE" (pink label), "*Amblynotus pilosiscutum* ♀, Type Girault" (white label, handwritten), "*Xyalophoroides pilosiscutum* (Gir), E. F. Riek det 1953" (white label, handwritten), QM Reg. No. T99348" (yellow label), "*Cicatrix pilosiscutum* P-M det-2009" (white label).

Biology. Unknown.

Distribution. Australia. Label data suggest the single specimen was taken in Royal National Park in Sydney.

***Cicatrix schauffi* (Buffington), comb. n.**
http://species-id.net/wiki/Cicatrix_schauffi
Fig. 2B–D and F

Mikeius schauffi Buffington, 2008.

Diagnosis. Similar to *C. neumannoides*, sp. n., in having female antenna with 10 flagellomeres (Fig. 2F) and a face horizontally striate only on the lateral areas (Fig. 2D) (*C. pilosiscutum*, comb. n., has female antenna with 11 flagellomeres and much stronger carinae crossing the entire face), but differs from *C. neumannoides* sp. n. by having a long median mesoscutal impression and subtriangular scutellar foveae (Fig. 2B).

Redescription. As in generic description (see above) with the following specific characters: **Length.** Female: 3.9 mm. Male unknown.

Coloration. Completely light brown.

Head. (Fig. 2D) Frons with piliferous punctures, face horizontally striate only on lateral areas.

Antenna. (Fig. 2F) *Female*. 10 flagellomeres, antennal formula: 6(2): 4(3): 5(3): 4(3): 4(3): 4.2(3.1): 4.2(3.1): 4.3(3.3): 5.2(3.3): 4.6(3.3): 3.5(3.3): 6(4). Placoid sensillae present from F4, abundant from F6 through terminal segment.

Mesosoma. (Fig. 2B) Median mesoscutal impression long, one-third length of scutum. Scutellar foveae irregular, subquadrate and not delimited posteriorly.

Type material. HOLOTYPE ♀ (ANIC) with the following label data: "23.36S 133.35E 32 km WNW of Alice Springs, NT 8 Oct. 1978 J:C: Cardale" (white label), "ex alcohol collection" (white label), "AUST. NAT. INS. COLL." (green label). "HOLOTYPE, *Mikeius schauffi*, Buffington" (red label), "*Cicatrix schauffi* P-M det-2009" (white label).

Biology. Unknown

Distribution. Central Australia.

Taxonomic comments. The circumtorular impression present in this species indicates that it belongs in Thrasorinae, not in Mikeiinae. We transfer this species to *Cicatrix* gen. n., because it possesses all the diagnostic characters of that genus.

Cicatrix neumannoides **Paretas-Martínez & Restrepo-Ortiz, sp. n.**
urn:lsid:zoobank.org:act:1A6D286B-94AF-43F8-945B-D9AF124EEC57
http://species-id.net/wiki/Cicatrix_neumannoides
Fig. 2E

Diagnosis. Similar to *C. schauffi*, comb. n., having female antenna with 10 flagellomeres and a face with horizontal strigae only on the lateral areas (*C. pilosiscutum* comb. n. has female antenna with 11 flagellomeres and much stronger carinae crossing the entire face), but differs from *C. schauffi* comb. n. by having short median mesoscutal impression and rounded scutellar foveae (Fig. 2E).

Description. As in generic description (see above) with the following specific characters.

Length. Female: 2.9 to 3.0 mm. Male unknown.

Coloration. Shiny chestnut, scutum darker in center.

Head. Frons and face with piliferous punctures; face with a few carinae from internal margin of eye reaching center of face.

Antenna. *Female*. 10 flagellomeres, antennal formula: 6(2): 4(2.8): 6(2.5): 4.1(2.8): 4.1(2.8): 4(3): 4(3): 4(3): 4.8(3.1): 3.8(3.3): 3.5(3.3): 5.6(4). Placoid sensillae starting from F4, F4 to F6 are scarce, abundant from F7-F10.

Mesosoma. (Fig. 2E) Median mesoscutal impression short, only indicated basally, not reaching one-fifth length of scutum. Scutellar foveae rounded.

Etymology. The specific name *neumannoides* means "related to neumanni", referring to the fact that the specimens used to describe this species were previously included in the type series of *M. neumanni*.

Type material. HOLOTYPE ♀ (ANIC) with the following labels: "AUSTRALIA: NSW Peak Hill Range, Braidwood, Cooma Road, At top of pass. 30 December 1994. A. Sundholm & R de keyzer. On *Acacia dealbata*" (white label), "AUST. NAT. INS. COLL." (green label), "*Mikeius neumanni* Det. M. L. Buffington 2008" (white label), "Holotype *Cicatrix neumannoides* P-M & R-O" (red label)". PARATYPE ♀ (ANIC) with the following labels: "Crowea St. For. nr Pemberton W.A. Nov.-Dec. 1978 S.J. Curry Malaise trap open forest" (white label), "AUST. NAT. INS. COLL." (green label), "Paratype *Cicatrix neumannoides* P-M & R-O" (red label)".

Biology. Unknown; label data suggests an association with *Acacia*.

Distribution. New South Wales and Western Australia, Australia.

Taxonomic comments. Although Buffington (2008) recognized two specimens of *Mikeius neumanni* in the collection at ANIC, he used only one specimen in his description of the taxon, designating it as the holotype. The species *neumanni* (based on

the holotype) is transferred to *Palmiriella*, gen. n., below, and the second specimen, in addition to another specimen discovered in ANIC, belongs to *Cicatrix*.

***Palmiriella* Pujade-Villar & Paretas-Martínez, gen. n.**
urn:lsid:zoobank.org:act:5F540007-4494-49BF-A619-F0A54F5CE41E
http://species-id.net/wiki/Palmiriella
Fig. 3

Type species: *Palmiriella neumanni* (Buffington), comb. n., by present designation and monotypy.

Diagnosis. (Table 2) *Palmiriella*, gen. n., can be distinguished from other thrasorines by having the face smooth, without any sculpturing (Fig. 3A); in *Scutimica* and *Myrtopsen*, the face is irregularly sculptured (Fig. 9A, B); in *Cicatrix* and *Thrasorus*, strong transverse carinae are present crossing the entire face or on lateral areas (Fig. 3A, D, 4A). *Palmiriella* is further differentiated from other thrasorines by having metasomal T3 and T4 fused into a syntergum, but not covering the entire metasomal surface (Fig. 3F); in *Scutimica* and *Myrtopsen*, a syntergum covering the entire metasomal surface is present (Fig. 9C); in *Cicatrix* and *Thrasorus*, T3 and T4 are separate sclerites (syntergum absent) (Fig. 2C, 4F). Additionally, *Palmiriella* is distinguished from *Scutimica* and *Myrtopsen* by having the scutellum posteriorly rounded (*Scutimica* and *Myrtopsen* have an emarginate/truncate scutellum, Fig. 9D, E), and pronotum not sculptured nor projected (strongly carinate and projected in *Scutimica* (Fig. 9F), with microsculpture or carinate in *Myrtopsen* (Fig. 9G)); from *Thrasorus* by having horizontally striate microsculpture on the mesoscutum (Fig. 3B) (mesoscutum smooth in *Thrasorus*, Fig. 4B).

Description. See description, biology and distribution of type species below.

Etymology. The new genus is dedicated to our colleague and good friend Palmira Ros-Farré, who has helped us for many years with our little wasps. Gender is feminine.

Taxonomic comments. The holotype of *Mikeius neumanni* Buffington, unlike the other species included in *Mikeius*, does have the circumtorular impression diagnostic for Thrasorinae. For this reason, this species is transferred from *Mikeius* to the new thrasorine genus *Palmiriella*. Characters summarized in the diagnosis below and phylogeny in Fig. 5 justify the erection of the new genus.

***Palmiriella neumanni* (Buffington), comb. n.**
http://species-id.net/wiki/Palmiriella_neumanni
Fig. 3A–F

Mikeius neumanni Buffington, 2008.

Description. Length. Female 3.2 mm. Male unknown.

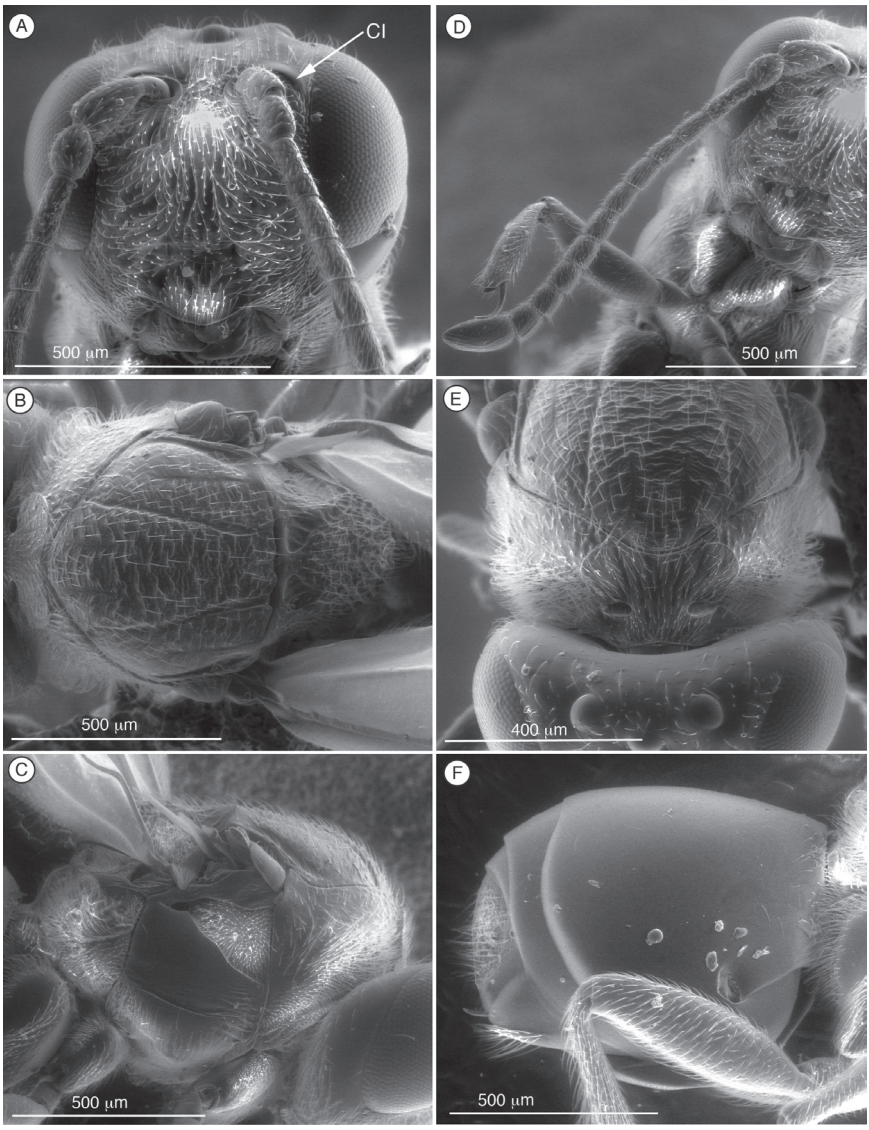

Figure 3. Diagnostic characters of *Palmiriella neumanni* (Thrasorinae), female **A** head, anterior view **B** mesosoma, dorsal view **C** mesosoma, lateral view **D** antenna, dorsal view **E** head and mesosoma, antero-dorsal view **F** metasoma, lateral view. CI, circumtorular impression.

Coloration. Head and mesosoma black, antennae yellowish except scape, brown, metasoma medium brown. Legs light yellow except tibia and metatarsi, brown.

Head (Fig. 3A, F). Frons and face with piliferous punctures and abundant setae. No transverse carinae or strigae on face. Clypeus distinctly projected anteriorly, curved ventrally, clypeopleurostomal lines well developed. Malar space with conspicuous, coriaceous, striate band. Vertex in dorsal view with small piliferous punctures. Occiput and genae smooth without carinae. Circumtorular impression present.

Antenna (Fig. 3D). *Female*. 11 flagellomeres; antennal formula: 7(4): 4(4): 4(3): 4.5(3): 4.5(3): 4.5(3): 4(3): 4(3): 4(3): 3(3): 3(3): 3(3): 5(4). Placoid sensillae from F7 to terminal segment.

Mesosoma (Fig. 3B, C, E). Pronotal carinae reaching scutum, forming small plate, conspicuous but not projected, concave dorsomedially. Mesoscutum horizontally striate. Notauli complete of uniform width. Parascutal sulcus wide only in basal half. Lateral basal impression conspicuous. Antero-admedian lines weak, reaching anterior one-third of mesoscutum. Median mesoscutal impression short and weak. Scutellum rugose; scutellar foveae triangular; interfoveal carina absent. Mesopleural furrow present. Propodeal carinae present. Pronotum, mesoscutum, scutellum, mesopleural triangle and metapleura all covered with sparse/dense setae.

Forewing. Short setae present on wing surface and along margins. Radial cell closed, 2.3 times longer than wide; R2 almost straight, basal vein distally widening; areolet absent.

Legs. Metatibia with two spurs, sub-equal in length, not exceeding one-half length of tarsomere 1.

Metasoma (Fig. 3F). Petiole very short, almost not visible. T3 and T4 fused into a syntergum, not covering the entire metasomal surface; remaining terga short, telescoped within T4; entire metasoma shiny and smooth. Hypopygium and ventral spine visible. Base of syntergum with only some scattered setae.

Type material. HOLOTYPE ♀ (ANIC) with the following labels: "Mt Nebo, S. E. Qld, 24. Xi. 1970, S. R. Monteith" (white label), "AUST. NAT. INS. COLL." (green label). "HOLOTYPE, *Mikeius neumanni*, Buffington" (red label), "*Palmiriella neumanni* P-V & P-M det-2009" (white label).

Biology. Unknown.

Distribution. Queensland, Australia.

Thrasorus Weld, 1944

Fig. 4

Type species: *Thrasorus pilosus* Weld, 1944.

Included species: *Thrasorus pilosus* Weld, *T. rieki*, sp. n., *T. schmitdae* Buffington.

Thrasorus rieki Paretas-Martínez & Pujade-Villar, sp. n.

urn:lsid:zoobank.org:act:BCD3677F-EA0D-4D37-B62B-F093CEDF7B02
http://species-id.net/wiki/Thrasorus_rieki
Fig. 4B

Diagnosis. Differs from other species of *Thrasorus* by having small scutellar foveae not clearly defined in posterior margin (Fig. 4B); other species of *Thrasorus* have scutellar foveae clearly delimited in the entire circumference (Fig. 4D). Further differs from

other *Thrasorus* species by having a well-defined median mesoscutal impression (arrow, Fig. 4B); in other *Thrasorus*, the impression is not present, or at most, a very small incision can be seen (Fig. 4D).

Description. Length. Female: 3.0–3.2 mm; males: 3.2–3.3 mm.

Coloration. Head and mesosoma black, antennae brown, and metasoma pale brown. Legs pale yellow except coxae, brown.

Head. (Fig. 4A) Frons and face with abundant setae and piliferous punctures; space between clypeus and compound eye with carinae. Malar furrow conspicuous, coriaceous and striate. Occiput smooth; genae with strong striae. Vertex in dorsal view with small piliferous punctures. Circumtorular impression present.

Antenna. *Female.* (Fig. 4G) 11 flagellomeres, antennal formula: 6(3): 2(2): 5(2): 4(2): 4(3): 4(3): 4(3): 4(3): 4(3): 3(3): 3(3): 3(3): 5(4). Placoid sensillae from F4 to terminal segment. *Male.* (Fig. 4C) 12 flagellomeres, antennal formula: 7(3): 3(2): 5(2): 4(3): 4(3): 4(3): 4(3): 4(3): 4(3): 4(3): 4(3): 4(3): 4(3): 5(3). Placoid sensillae starting from F1.

Mesosoma (Fig. 4B, E). Lateral margins of pronotal plate reaching the scutum, forming a small plate conspicuous but not projected, concave dorsomedially, with piliferous punctures. Mesoscutum smooth and shiny, with piliferous punctures. Notauli complete, very narrow anteriorly and much wider posteriorly. Parascutal sulcus wide only in basal half. Lateral basal impressions weak. Antero-admedian lines very weak. Median mesoscutal impression well defined but not clearly delimited anteriorly. Scutellum smooth on anterior falf and centre, rugose posteriorly; scutellar foveae small subtriangular, not clearly delimited posteriorly; interfoveal carina absent. Mesopleural furrow present but not conspicuous. Propodeal carinae present. Pronotum, mesoscutum, scutellum, mesopleural triangle and metapleura not very pubescent, only some sparse setae.

Forewing. Short setae present on wing surface and along margins. Radial cell closed, 1.9 times longer than wide; R2 almost straight; areolet absent.

Legs. Metatibia with two spurs, sub-equal in length, not exceeding one-half length of tarsomere 1.

Metasoma. (Fig. 4F) Petiole short. Base of T3 with an almost complete hairy ring. Tergite 3 smaller than T4; T4 four large, covering almost entire metasomal surface; remaining terga short, telescoped within T4; entire metasoma shiny and smooth.

Material examined. HOLOTYPE ♀ (ANIC; marked by a red spot, on a pinned card with six other specimens of the same taxon) with the following labels: "Out of large galls on mullee acacia On 18–1-16" (handwritten below the label with the insects), "Thrasorus berlesei (Grlt) Riek det" (white label, handwritten), "sp 7 (berlesei) det ML Buffington 2006" (white label), "Holotype *Thrasorus rieki* P-M & P-V det-2009" (red label). PARATYPES: 4 ♂ and 1 ♀ (on the same pinned card as the holotype) with the same data as the holotype, "Paratype *Thrasorus rieki* P-M & P-V det-2009" (red label); 1 ♂ and 5 ♀ (ANIC) (on a pinned card together with 6 Chalcidoidea specimens) with the following labels: "Out of Acacia galls ???? 19.1.16 QLD" (handwritten below the label with the insects), "AUST. NAT. INS. COLL." (green label), "Paratype *Thrasorus rieki* P-M & P-V det-2009" (red label); 1 ♀ (QM) with the following labels: "Amblynotus berlesei ♀ Girault types" (white label handwritten),

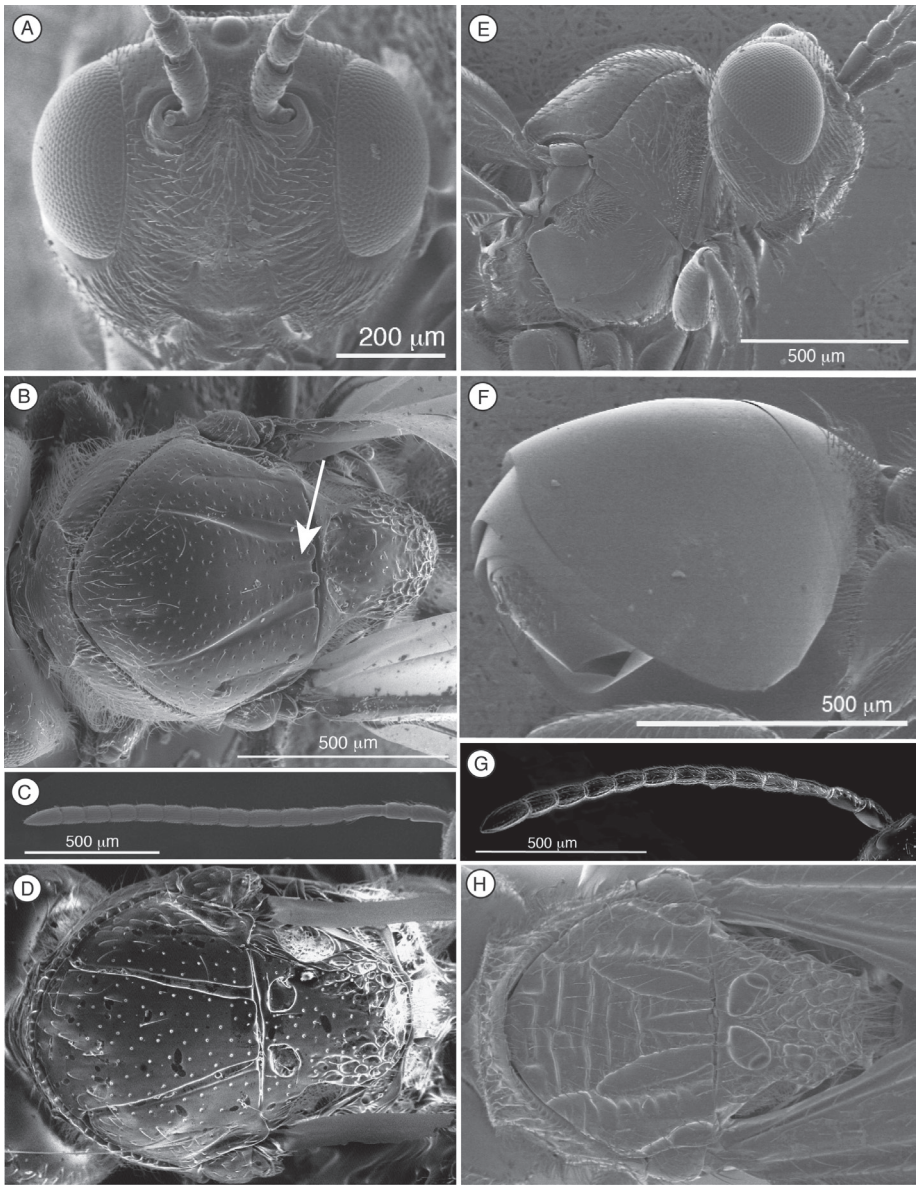

Figure 4. Characters of *Thrasorus* (**A–G**) and *Scutimica* (H) **A** head, anterior view **B** mesosoma, dorsal view, *T. rieki* **C** antenna, male, medial view **D** mesosoma, dorsal view, *T. schmidtae* **E** head and mesosoma, lateral view **F** metasoma, lateral view **G** antenna, female, medial view **H** mesosoma, dorsal view, *Scutimica transcarinata.*

"HOLOTYPE" (pink label), "Thrasorus berlesei (Gir) EF Riek det 1953" (white label handwritten), "QM reg. No. T99347" (yellow label), "Paratype *Thrasorus rieki* P-M & P-V det-2009" (red label).

Biology. Unknown host on *Acacia* galls (based on label data).

Distribution. Australia, Queensland.

Etymology. Named after E.F. Riek, who worked before us on Australian Cynipoidea.

Taxonomic comments. In the QM, there is one specimen labelled as '*Amblynotus berlesei*' by Girault. In ANIC, there are six specimens on one large card with a determination label placed by Riek, stating that taxon is '*T. berlesei* (Grlt)'. But as Buffington (2008) pointed out, this species was never published by Girault nor Riek. As this name is a *nomen nudum* after Buffington (2008), we described it as a new species. In ANIC, there is another large card that has six specimens of *T. rieki*, sp. n., mixed with Chalcidoidea specimens.

Discussion

Ros-Farré and Pujade-Villar (2007) described the single synapomorphy that supports the monophyly of Thrasorinae: the circumtorular impression (Figs 2A, D, 3A, 4A, 9A, B), a clear and marked impression around the upper half of each torulus. Though the shape of this impression is variable among genera and species of Thrasorinae, the presence of this character is constant in all the species of the subfamily and thus must be considered as a strong synapomorphy of the Thrasorinae. The circumtorular impression in *Scutimica* is more laterally directed and wide, with a few 'ribs' inside (Fig. 9A); in *Myrtopsen* the impression can vary from very tight and deep in some species (Fig. 9B) to a state similar to that in *Scutimica*; in *Palmiriella* (Fig. 3A) and *Thrasorus* (Fig. 4A), the impression is well defined, deep, wide, and delimited by a small crest; in *Cicatrix*, the impression is also wide but not delimited by a crest, and it is deeper in some species (Fig. 2A) than in other (Fig. 2D). Three genera previously included in Thrasorinae that do not possess this character have recently been moved to new subfamilies: *Plectocynips* and *Pegascynips* to the Plectocynipinae (Ros-Farré and Pujade-Villar 2007), and *Euceroptres* to the Euceroptrinae (Buffington and Liljeblad 2008).

Mikeius, described by Buffington (2008), was included in the Thrasorinae based on its general morphology and its association with chalcidoid galls. However, as shown here, *Mikeius* does not have the circumtorular impression (Fig. 1A), diagnostic of Thrasorinae. Further, *Mikeius* possesses a character not present in the other subfamilies treated here: *projected pronotal plate lacking*, the area instead being marked by two carinae in the median part of the pronotum that do not reach the anterior margin of the mesoscutum (Fig. 1G). A similar state can be found in *Euceroptres* (Buffington and Liljeblad 2008) and *Lonchidia* (Fig. 8E). In both *Mikeius* and *Euceroptres*, the submedial pronotal depressions of the plate (lateral fovea of pronotum, Buffington 2009) are present and are open laterally. Overall, the impression of the observer is that the pronotal plate is lacking entirely; we argue here that the plate is present, evidenced by the presence of the submedial pronotal depressions, as well as the anterior part of the pronotal plate (portion of plate ventral to submedial

pronotal depressions). The portion of the plate that is reduced is the posterior part of the pronotal plate, or the portion of the plate dorsal to the submedial pronotal depressions. The arrow in Fig. 1F shows where the lateral portion of the dorsal part of the pronotal plate fades into the remaining cuticle, just ventrad of the anterior margin of the mesoscutum. Further, the dorsal margin of the plate is completely undefined, as compared with the state found in *Palmiriella* (Fig. 3E) and *Thrasorus* (Fig. 4B). Unfortunately, to fully appreciate this character, the head must be removed from a specimen in hand.

The morphology of the metasoma is a very important character and is frequently used in all Figitidae subfamilies to separate different genera. Within Thrasorinae, there are two main metasomal morphologies: T3-T4 free (*Thrasorus*, *Cicatrix*), and T3-T4 fused into a syntergum (*Palmiriella*, *Scutimica*, *Myrtopsen*). The primary difference between *Thrasorus* and *Cicatrix* is the sculpturing of the mesoscutum. Though the sculpturing on the mesoscutum can be variable in other groups of Figitidae, in the 'pool' of genera treated in this paper, mesoscutal sculpture is useful and unique character. *Thrasorus* is the only genus, not only among Thrasorinae but also among all the genera previously included in this subfamily (*Plectocynips*, *Pegascynips*, *Euceroptres*, *Mikeius*), that aside from notauli, lacks sculpturing of any kind (microsculpture, carinae or parapsides) in the mesoscutum; we believe that this character is enough to justify the separation of *Thrasorus* from *Cicatrix* and the other thrasorines.

The characters that differentiate *Palmiriella* from *Scutimica* and *Myrtopsen* are detailed in the diagnosis of the genus (see above). The combination of the smooth face (*Palmiriella* being the only genus among Thrasorinae and genera previously included in the subfamily lacking any kind of sculpture on face), shape of syntergum T3-T4, shape of scutellum, shape of pronotum, and absence of sculpturing on pronotum, distinguish *Palmiriella* from *Scutimica* and *Myrtopsen*. The differences between *Scutimica* and *Myrtopsen* have already been remarked and discussed in Ros-Farré and Pujade-Villar (2007).

The results of the phylogenetic analysis are summarized in Fig. 5. Two trees of length 190 were recovered, with a CI of 0.58, RI of 0.73, and RC of 0.43. All subfamilies treated here were recovered as monophyletic, with following pattern of relationship: Parnipinae (Euceroptrinae (Mikeiinae (Plectocynipinae (Thrasorinae)))). It is clear that *Mikeius* renders the Thrasorinae paraphyletic, supporting the description of Mikeiinae, and that *Cicatrix* and *Palmiriella* are distinct clades. Erecting a new subfamily for a single genus is not desirable, but the only alternative to this while respecting the clades recovered in the phylogenetic analysis would be grouping together *Mikeius*, *Palmiriella*, *Thrasorus*, *Cicatrix*, *Scutimica*, *Myrtopsen*, *Plectocynips* and *Pegascynips* in a single subfamily; we feel this grouping is undesirable from the standpoint of predictability, since these genera contain species possessing markedly different biological and morphological attributes, and still would lack a single common diagnostic character for all of them. As currently defined, each of the subfamilies recognized here has its own diagnostic character: long metatibial spur for Plectocynipinae, circumtorular impression for Thrasorinae and two carinae in median area of pronotum not forming a projected pronotal plate for Mikeiinae.

The Thrasorinae from Australia are one of the most poorly known groups of figitids. More field data and specimens would help to clarify the status of this group and some taxa described here. However, there is no single researcher in Australia dedicated to the study of Cynipoidea, and workers on Figitidae wanting to study the systematics

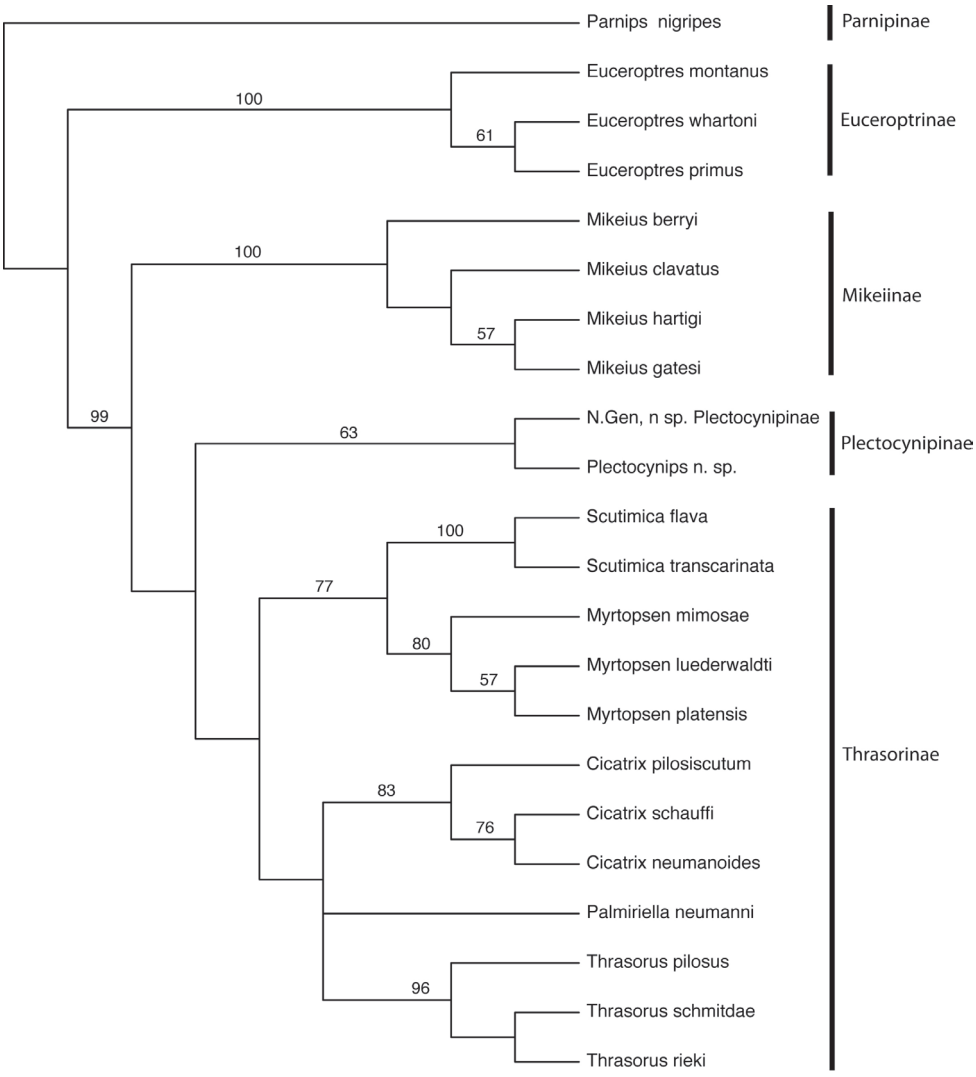

Figure 5. Cladogram of Euceroptrinae, Mikeiinae, Plectocynipinae, and Thrasorinae. Numbers above branches indicate bootstap support. CI=0.58; RI=0.73; RC=0.43. Strict consensus of 2 trees, L=190.

of this group must rely on 'rare' specimens coming from non-target collections while pursuing the sampling of other groups. The study we present here has been done with all the thrasorines and *Mikeius* that have been collected, curated, and deposited in museums worldwide.

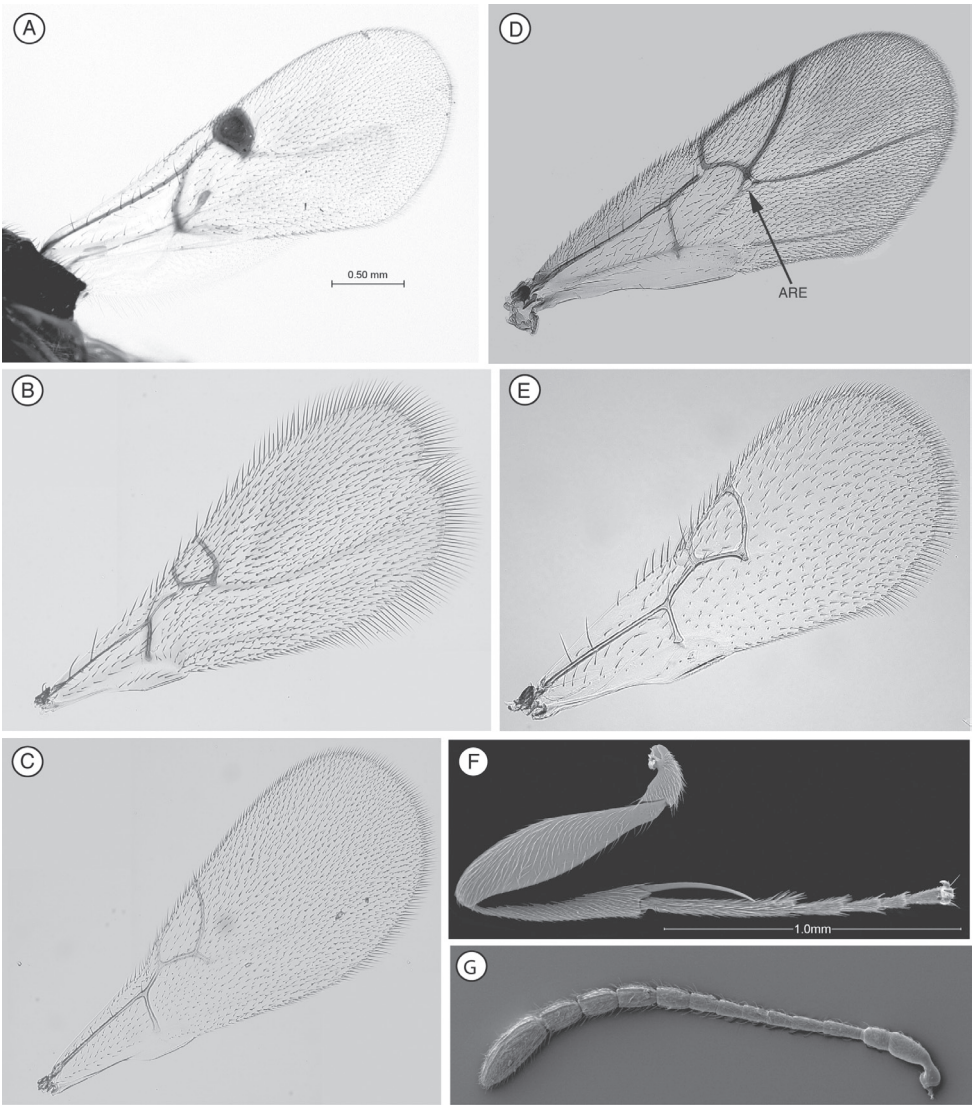

Figure 6. Characteristics of Figitidae: forewing, leg and antenna **A** *Pycnostigmus rostratus* (Pycnostigminae) **B** *Emargo* sp. (Emargininae) **C** *Phaenoglyphis* sp. (Charipinae) **D** *Euceroptres montanus* (Euceroptrinae) **E** *Agrostrocynips diastrophus* (Eucoilinae) **F** hindleg, *Plectocynips pilosus* (Plectocynipinae) **G** female antenna, *Lonchidia* sp. (Figitinae).

Key to figitid subfamilies of the World

1 Radial cell secondarily sclerotized forming a pseudostigma (Fig. 6A); Afrotropical and southwestern Palaearctic regions, rarely collected .....**Pycnostigminae**
– Radial cell (Fig. 6 B–E) not sclerotized, forming a typical wing cell **2**
2 Scutellum with an oval, tear-drop shaped, or elongate elevated plate dorsally (arrow, Fig. 7A); scutellar plate equipped with a glandular release pit medially or posteriorly; parasitoids of Diptera: Cyclorrhapha; Cosmopolitan .....**Eucoilinae**

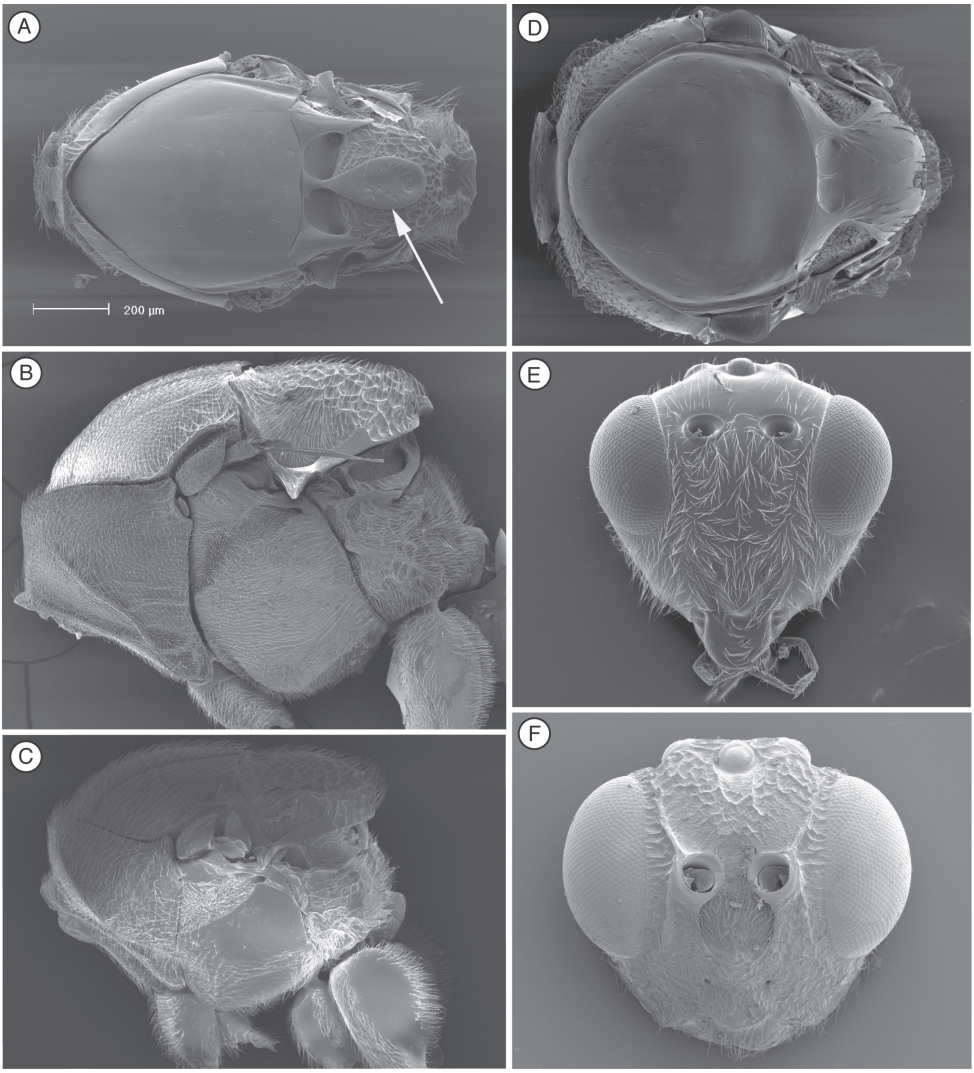

Figure 7. Characteristics of Figitidae: mesosoma and head **A** *Trybliographa rapae* (Eucoilinae) **B** *Parnips nigripes* (Parnipinae) **C** *Euceroptres montanus* (Euceroptrinae) **D** *Phaenoglyphis* sp. (Charipinae) **E** *Anacharis* sp. (Anacharitinae) **F** *Aspicera* sp. (Aspicerinae).

– Scutellum different or occasionally with raised carinae defining a central area but never with an elevated plate equipped with a glandular release pit dorsally (Figs 7 B–D and 8D) **3**

3 Metatibial spur at least half the length of metatarsomere 1 (Fig. 6F); associated with hymenopteran galls in *Nothofagus* forests in the Neotropical Region .... **Plectocynipinae**

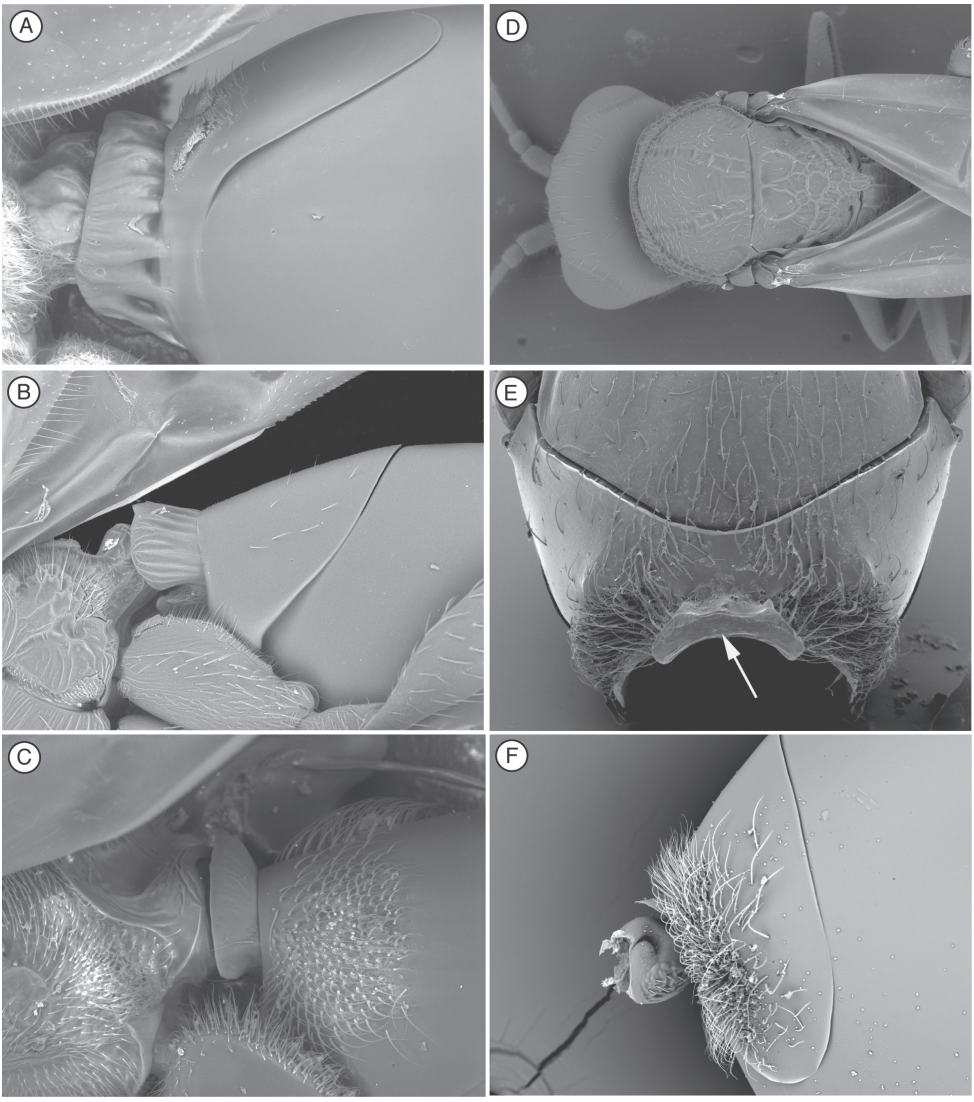

Figure 8. Characteristics of Figitidae: mesosoma and metasoma **A** metasomal tergum 2 and 3, *Callaspidia* sp. (Aspicerinae) **B** metasomal tergum 2 and 3, *Figites* sp. (Figitinae) **C** metasomal tergum 2 and 3, *Melanips opacus* (Figitinae) **D** head and mesosoma, *Xyalaspis* sp. (Anacharitinae) **E** pronotum, anterodorsal view, *Lonchidia* sp. (Figitinae), arrow indicating anterior half of pronotal plate **F** metasomal tergum 2 and 3 *Mikeius hartigi* (Mikeiinae).

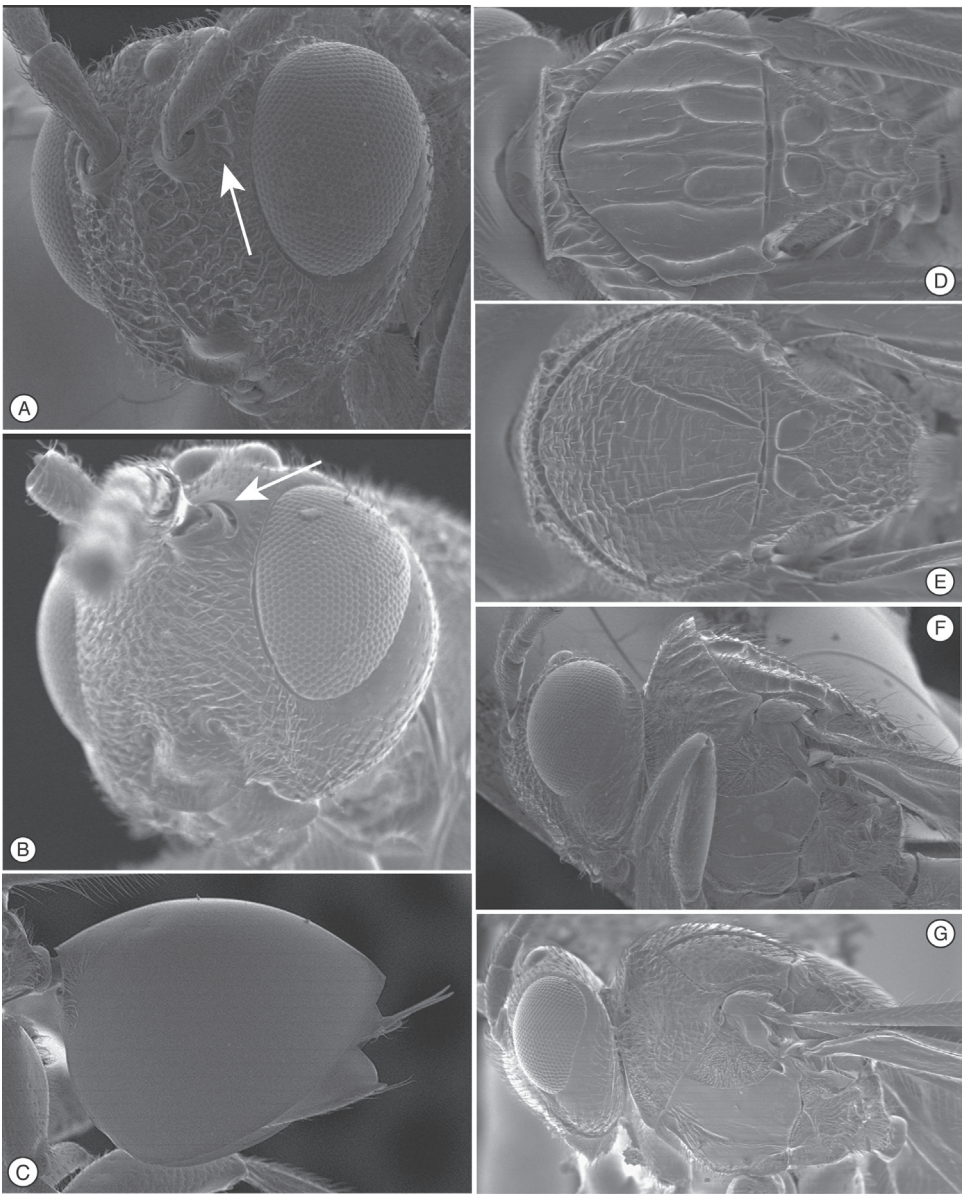

Figure 9. Characters of *Scutimica* and *Myrtopsen* **A** head, *S. transcarinata* **B** head, *Myrtopsen luedervaldti* **C** metasoma, *Myrtopsen* sp. **D** mesosoma in dorsal view, *S. flava* **E** mesosoma in dorsal view, *M. mimosae* **F** mesosoma in lateral view, *S. transcarinata* **G** mesosoma in lateral view, *M. punctuatus*.

– Metatibial spur at most 1/4 length of metatarsomere 1 ..... **4**

4 Apex of forewing deeply bilobed (Fig. 6B); Pantropical, rarely collected..... ..... **Emargininae**

– Apex of forewing rounded (Fig 6 C–D) **5**

5 Areolet present on forewing (Fig. 6D); base of metasoma always glabrous...**6**
– Areolet absent on forewing (Fig. 6 C, E); base of metasoma setose or glabrous...**7**
6 Mesopleuron completely strigose, with no indication of a distinct mesopleural furrow (Fig. 7B); parasitoids of *Barbotinia* (Cynipidae) in *Papaver* (Papaveraceae); Palaearctic, Mediterranean Region..... **Parnipinae**
– Mesopleuron dorsally smooth, ventrally striate along the mesopleural furrow, mesopleural furrow distinct (Fig. 7C); parasitoids of *Andricus* (Cynipidae) in *Quercus* (Fagaceae) in the Nearctic Region .....**Euceroptrinae**
7 Head triangular in anterior view (Fig. 7E), always wider than the mesosoma (in dorsal view; Fig. 8D); mouth region small, with mandibles broadly overlapping (Fig. 7E); parasitoids of Neuroptera; Cosmopolitan....**Anacharitinae**
– Head squared or rounded in anterior view (Figs 1A, 2 A & D, 7F), wider, equal to, or narrower than the mesosoma; mouth region broadened, mandibles larger and not overlapping as extensively (Figs 1A & 7F) **8**
8 Facial impression present (Fig. 7F); third metasomal tergum distinctly saddle shaped with posterolateral margin concave and central part almost tongue-like (Fig. 8A); parasitoids of Diptera: Syrphidae; Cosmopolitan .....**Aspicerinae**
– Facial impression absent (Fig. 1A); third abdominal tergum rounded, not saddle-shaped, with the posterolateral margin usually convex, rarely concave (Figs 3F, 4F, 8B–C, F).....**9**
9 Body lacking transversally carinate sculpture, generally shiny and smooth (Fig. 7D) (*Lytoxysta* is exceptional in having fine reticulate sculpturing on the head and mesosoma; some species of *Phaenoglyphis* have fine imbricate sculpture on the mesoscutum and scutellum (Paretas-Martínez et al. 2007)); scutellum broadly rounded and without sculpture (Fig. 7D); mesopleural triangle present or absent; notauli absent (Fig. 7D) or present; small insects, typically 1 mm in length; hyperparasites in Aphididae and Psylidae; Cosmopolitan .....**Charipinae**
– Mesoscutum usually with some transversal macro or microcarinate sculpture (Figs 1F, 2 B & E, 3B, 4D & H, 8D), sometimes smooth or at most piliferous (Fig. 4B); mesopleural triangle always present (Fig. 1B, 3C, 4E); notauli partially to fully present (Fig. 1F, 2B & E, 3B, 4B & D & H, 8D); larger insects, typically greater than 2mm in length **10**
10 Circumtorular impression present (CI, Fig. 2A & D, 3A, 4A).....**Thrasorinae**
– Circumtorular impression absent (Fig. 1A) **11**
11 Second metasomal segment modified into either a collar with strong carinae (Fig. 8A), a carinate sheath (Fig. 8B) or carinate flange Fig. 8C), obscuring part of the petiole in lateral and dorsal view; parasitoids of Diptera: Cyclorrhapha; Cosmopolitan .....**Figitinae**
– Second metasomal segment small, not heavily sclerotized, typically obscured by the anterior margin of tergite 3 (Fig. 8F); Australian Region, parasitoids of gall inducing Hymenoptera ..... **Mikeiinae, subfam. n.**

Key to genera of Thrasorinae

1 Metasomal syntergum absent (post-petiolar terga free) (Fig. 2C) **2**
– Metasomal syntergum present (post-petiolar terga fused) (Figs 3F, 9C)..... **3**
2 Mesoscutum with horizontal microsculpture (Fig. 2B, E); face with strong or weak transverse strigae (Fig. 2A, D) ..... ***Cicatrix* gen. n.**
– Mesoscutum smooth, at most with some piliferous punctures (Fig. 4B, D); face without transverse strigae; if present, strigae are weak (Fig. 4A)..... ..... ***Thrasorus* Weld**
3 Metasomal syntergum not covering the entire metasomal surface (Fig. 3F); face without transversal strigae (Fig. 3A) ..... ***Palmiriella*, gen. n.**
– Metasomal syntergum covering the entire metasoma (Fig. 9C); face with strigae (Fig. 9A, B)..... **4**
4 Mesoscutum smooth or with parapsides; notauli incomplete, not reaching pronotum, each one forming a large cell (Figs 4H, 9D). Pronotum sometimes projected, with very strong longitudinal carinae (Figs 4H, 9F)..... ..... ***Scutimica* Ros-Farré**
– Mesoscutum with microsculpture (only one species with transverse carinae); notauli complete, even if being much larger at the base than close to pronotum (Fig. 9E). Pronotum not projected, striate or with strong irregular carinae (Fig. 9G)..... ***Myrtopsen* Rübsaamen**

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Appendix I

List of morphological and biological characters used in analysis.

Note: The list of morphological and biological characters is available on the *ZooKeys* website as a Microsoft Word file (.doc), doi: 10.3897/zookeys.108.829.app.1).

Appendix II

Data matrix which includes 79 parsimony-informative characters.

Note: The data matrix is available on the *ZooKeys* website as a Microsoft Word file (.doc), doi: 10.3897/zookeys.108.829.app.2).

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RESEARCH ARTICLE

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Notes on the genus *Ismarus* Haliday (Hymenoptera, Diapriidae) from China

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Abstract

The Chinese species of the genus *Ismarus* Haliday, 1835, are revised for the first time. Three new species from the Oriental region of China and belonging to *I. halidayi*-group are described and illustrated: *Ismarus longus* **sp. n.**, *I. nigritrochanter* **sp. n.** and *I. parvicellus* **sp. n.** Two species are newly reported for the Chinese fauna: *Ismarus dorsiger* (Haliday, 1831) and *I. halidayi* Foerster, 1850. A key to the Chinese species of the genus is provided. The type specimens are deposited in the Hymenopteran Collection of South China Agricultural University, Guangzhou (SCAU).

Keywords

Ismarinae, parasitoids, new species, Oriental

Introduction

The small subfamily Ismarinae belongs to the family of Diapriidae and is characterized by the rather low insertion of antennae, the transverse head, the reduced notauli, the fore legs with a peculiar combing apparatus, the hind tibia with a false second spur

and the carapace-like metasoma. The subfamily includes two genera: *Ismarus* Haliday, 1835 and *Szelenyioprioides* Szabó, 1974. The relationships between Ismarinae and the other subfamilies of the family Diapriidae have been discussed by Masner (1976). In total, the Ismarinae contains thirty species (twenty nine in *Ismarus* and one in *Szelenyioprioides*) described from the Palaearctic, Nearctic, Neotropical and Australian regions (Nixon 1957; Hellén 1964; Wall 1967a, b; Szabó 1974; Masner 1976; Johnson 1992; Ventura et al. 1997; Notton 2007). Formally no species are known from the Oriental and Ethiopian regions, but Masner (1976) mentioned some undescribed species from both regions.

The subfamily Ismarinae has been studied mainly in the Holarctic and Neotropical regions, with no species known from China prior to this study. During recent years, we have accumulated many specimens of Diapriidae during our survey of the Hymenoptera of China. Among them, twenty five specimens belonging to the genus *Ismarus* represent five species, of which three species from the Oriental region of China are described as new to science in this paper and two species are newly reported from the Oriental and Palaearctic regions of China.

Materials and methods

Examined specimens were collected by sweeping and by yellow pan traps (YPT) from different provinces of China between 2006 and 2010. All specimens are deposited in the Hymenopteran Collection of South China Agricultural University, Guangzhou. For the examination, an Olympus stereomicroscope was used. The photographs are made by a digital camera (Q-Imaging, RTV) mounted on a Zeiss stereomicroscope and with Image-Pro Plus software.

For the used terminology sees Masner (1976). Abbreviations used in the text are: POL= postocellar line or shortest distance between both posterior ocelli; OOL= oculo-ocellar line or shortest distance between posterior ocellus and corresponding compound eye.

Results

Genus *Ismarus* Haliday, 1835

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

Ismarus Haliday 1835, Entomological Magazine 2: 467. Type: *Cinetus dorsiger* Haliday, by monotypy.

Entomia Herrich-Schäffer 1840, Nomenclator Entomologicus 2: 127. Type: *Entomia campanulata* Herrich-Schäffer, 1840, by monotypy.

Entomius Haliday 1857, Nature History Review 4: 169. Emendation.

Agonophorus Dahlbom 1858, Öfversigt af Kongliga Ventenskaps-Akadamiens Förhandlingar 14: 289. Synonymized by Dessart (1967). Type: *Ismarus rugulosus* Foerster, designated by Muesebeck (1972).

Ismarus Haliday, 1835: Masner 1976, Canadian Entomologist 108: 1251.

Ismarus Haliday, 1835: Johnson 1992, Memoirs of the American Entomological Institute 51: 259.

Description. Body stout; body colour usually black, but brown in a few species. Head transverse in dorsal view, with sparse setae on face, frons and occiput; labrum exposed and sclerotized; mandible bidentate; palpal formula 4-3 or 5-3; antennae inserted low on face, close to clypeus; face with a distinct transverse carina below antennal sockets; antennal shelf not prominent; antenna of female 15-segmented, of male 14-segmented; modified male sex-segment is second flagellomere, rarely both first and second flagellomeres modified; eyes bare; occipital carina complete; pronotum dorsally and along anterior margin with long setae; mesoscutum convex, smooth; notauli reduced to anterior pits; humeral sulcus developed; anterior scutellar pit with a weak but distinct median longitudinal carina; scutellum posteriorly raised, with posterior margin truncate or round; metanotum crenulated, with median carina distinct; propodeum with distinct transverse and longitudinal carinae; metapleuron reticulate rugose, with dense setosity; fore wing with radial cell closed; fore tibia with regular spur and one false spur, hind tibia strongly incrassate; petiole short and transverse; base of second tergite with longitudinal furrows; sutures between tergites distinct or absent; sternite with fine setae.

Biology. Some species of the genus are hyperparasitoids of Dryinidae (Hymenoptera). *Ismarus flavicornis* (Thomson, 1859) was reared from *Anteon flavicorne* (Dalman, 1818), *I. halidayi* was reared from an *Anteon* sp. and *I. dorsiger* was recorded to attack an *Aphelopus* sp. (Chambers 1955; 1981; Nixon 1957; Jervis 1979).

Distribution. Palaearctic, Oriental, Ethiopian, Nearctic, Neotropical and Australian regions.

Discussion. Masner (1976) divided *Ismarus* into four species groups: *I. rugulosus*-, *I. halidayi*-, *I. rex*- and *I. dorsiger*-groups. The species of the present study belong to the *I. halidayi*- and *I. dorsiger*-groups. Compared to the diagnosis of *Ismarus* given by Masner (1976), we found that all species from China have the labrum exposed and possess a transverse carina on the lower face just below the antennal sockets.

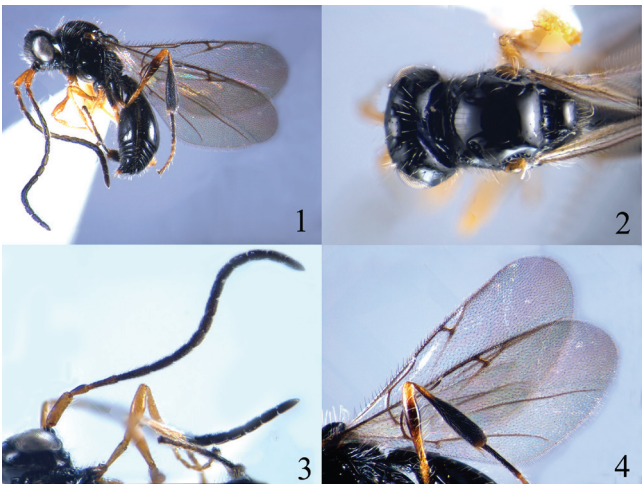
***Ismarus longus* Liu, Chen & Xu, sp. n.**

urn:lsid:zoobank.org:act:B3D908D7-C636-4EAE-BE02-A6D2CA719FF2

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

Figs 1–4

Holotype. Female. Body length 3.2 mm; fore wing length 3.0 mm.



Figures 1–4. *Ismarus longus* sp. n. **1** habitus, lateral view **2** head and thorax, dorsal view **3** antennae **4** fore wings and hind leg.

Description. *Head*. Head in dorsal view 2.0 times as wide as long; vertex abruptly sloping behind ocelli; temple narrowed behind eyes; occipital carina strong and complete, not crenulate; POL equals to OOL; toruli separated from each other; face setose; clypeus evenly convex; epistomal sulcus distinct; eyes bare, eye height 4.5 times length of malar space; malar sulcus absent; frons setose just above antennal sockets. Antenna 1.1 times as long as body; scape cylindrical, with apical rim simple; pedicel basally attenuate and apically broad; ratios of length to width of antennal segments: 20 : 6; 9 : 5; 16 : 4; 20 : 4; 13 : 4; 13 : 4; 10 : 5; 10 : 5; 9 : 5; 9 : 5; 9 : 5; 9 : 5; 9 : 5; 9 : 5; 13 : 5.

Mesosoma. Mesosoma in dorsal view 0.8 times as long as width of head; pronotum angular in dorsal view, anteriorly rugose-punctate and setose; central part of lateral side of pronotum smooth, with anterior and upper margins rugose-punctate and setose; mesoscutum smooth and convex, with some sparse long setae near humeral sulcus and notauli; notauli anteriorly present, oblique long and pit-like, crenulate inside; humeral sulcus deep and crenulate, 1.4 times length of tegula; anterior scutellar pit crenulate, with weak median longitudinal carina; scutellum smooth, posterior rim rounded; propodeum rugose, with transverse and longitudinal carinae present; mesopleuron smooth and bare, with upper corner below tegula punctate and setose; metapleuron reticulate-rugose and setose.

Wings. Fore wing with costal, subcostal, basal, marginal, stigmal and postmarginal veins tubular; radial cell closed, 0.6 times length of marginal vein and 3.0 times as long as its height. Hind wing with a basal cell.

Legs. Fore and middle legs slender; hind tibia strongly incrassate.

Metasoma. Petiole transverse, weakly rugose and with longitudinal carinae; second tergite smooth and scattered with a few setae along lower side, median furrow extending to 0.4 length of second tergite; sutures between tergites complete and well impressed; sternites finely punctate and setose.

Colour. Body black. Antenna black, with scape brown, pedicel and first flagellomere dark brown; mandible black with its apical half reddish brown; palpi black; tegula blackish brown. Legs brown, all coxae black but apically brown; hind femur brown with incrassate part black; hind tibia black with basal 0.2 reddish brown; hind tarsus reddish brown with first tarsomere black. Wings hyaline, veins blackish brown.

Male. Unknown.

Distribution. China (Yunnan).

Material examined. Holotype, female, CHINA: Yunnan, Yingjiang, Tongbiguan (24.60°N, 97.65°E), 2009.V.20, Man-man Wang, No. 200900933. Paratypes: 1 female, same data as type, No. 200900492; 1 female, Yunnan, Tengchong, Jietou Town (25.40°N, 98.70°E), 2009.V.13, Man-man Wang, No. 200902486; 1 female, Yunnan, Tengchong, Jietou Town (25.40°N, 98.70°E), 2009.V.12, Jie Zeng, No. 200902519.

Diagnosis. This species belongs to the *I. halidayi*-group of Manser (1976) and is similar to *Ismarus halidayi* Foerster, 1850, but it differs from the latter by having the second flagellomere 5.0 times as long as wide (2.6 times as long as wide in *I. halidayi*), apical antennal segment 2.6 times as long as wide (2.0 times); notauli anteriorly present, oblique long and pit-like, crenulate inside (smooth) and the radial cell of fore wing shorter than marginal vein (radial cell as long as marginal vein).

Etymology. The specific name refers to the long second flagellomere.

***Ismarus nigritrochanter* Liu, Chen & Xu, sp. n.**

urn:lsid:zoobank.org:act:4F711F1A-7878-49CB-B18B-6977B824612F

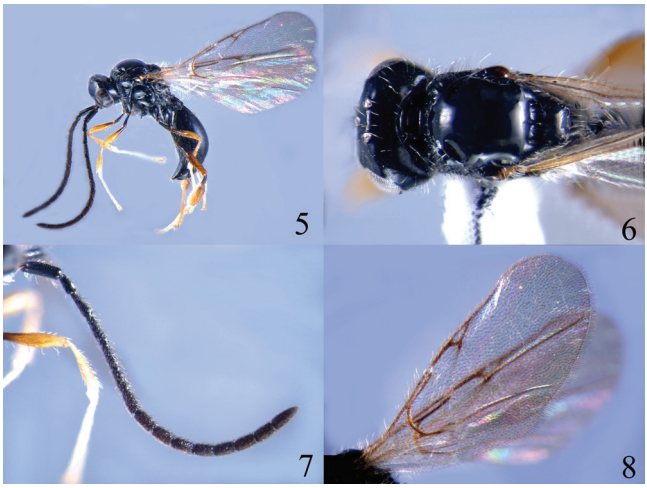
http://species-id.net/wiki/Ismarus_nigritrochanter

Figs 5–8

Holotype. Female. Body length 3.1 mm; fore wing length 3.1 mm.

Description. *Head*. Head in dorsal view 2.0 times as wide as long; vertex abruptly sloping behind post ocelli; temple narrowed behind eyes; occipital carina complete, not crenulate; POL as long as OOL; toruli separated from each other; face setose along inner orbits; frons flat and smooth, with punctures above antennal sockets and setose; clypeus evenly convex; epistomal sulcus distinct; eye height 4.0 times length of malar space; malar sulcus absent. Antenna 1.1 times length of body; scape cylindrical, with apical rim simple; pedicel basally attenuate and apically broad; ratios of length to width of antennal segments: 30 : 10; 15 : 8; 20 : 7; 25 : 7; 20 : 7; 20 : 7; 18 : 7; 18 : 9; 17 : 9; 17 : 9; 16 : 9; 16 : 9; 16 : 9; 15 : 9; 23 : 9.

Mesosoma. Mesosoma in dorsal view 0.8 times as long as width of head; pronotum angular in dorsal view, coarsely punctate anteriorly and setose; lateral side of pronotum with upper and anterior margins rugose-punctate, striate on lower 2/3 and smooth on upper 1/3; mesoscutum smooth and convex, with sparse long setae near humeral sulcus and notauli; notauli anteriorly present, oblique long and pit-like, weakly crenulate inside; humeral sulcus deep and crenulate, 1.5 times length of tegula; anterior scutellar pit transverse, crenulate inside, median longitudinal carina indistinct; scutellum



Figures 5–8. *Ismarus nigritrochanter* sp. n. **5** habitus, lateral view **6** head and thorax, dorsal view **7** antenna **8** fore wings.

smooth, posterior rim rounded; propodeum rugose, with transverse and longitudinal carinae distinct; mesopleuron smooth, with sparse setae on lower side; metapleuron rugose and setose.

Wings. Fore wing with costal, subcostal, basal, marginal, stigmal and postmarginal veins tubular; radial cell closed, 0.6 times length of marginal vein and 2.0 times as long as its height. Hind wing with a basal cell.

Legs. Fore and middle legs slender; hind tibia strongly incrassate.

Metasoma. Petiole transverse, with irregular longitudinal carinae; second tergite smooth and with a few scattered setae along lower side, median furrow short, extending to 0.2 length of second tergite; seventh tergite densely punctate; sutures between tergites complete and well impressed; sternites finely punctate and setose.

Colour. Body black. Antenna entirely black. Legs brown, with coxae and trochanters black; fore and middle femora reddish brown with basal 0.3 and dorsal margin blackish; hind femur dark brown; hind tibia dark brown, with dorsal apical 3/4 brown. Wings hyaline, veins dark brown.

Male. Unknown.

Distribution. China (Yunnan).

Material examined. Holotype, female. CHINA: Yunnan, Mt. Gaoligonshan (25.98°N, 98.80°E), 2006.VII.20-21, Zhong-shi Zhou, No. 200700989.

Diagnosis. This species belongs to the *I. halidayi*-group and is similar to *Ismarus longus* sp. n., but it can be easily distinguished from the latter by having the second flagellomere 3.5 times as long as wide (5.0 times in *I. longus*); the radial cell of the fore wing 2.0 times as long as high (3.0 times); the seventh tergite densely punctate (finely mat); and the antenna uniformly black, all trochanters black (scape, pedicel and first flagellomere dark brown, trochanters brown).

Etymology. The specific name refers to the black trochanters of this species.

***Ismarus parvicellus* Liu, Chen & Xu, sp. n.**
urn:lsid:zoobank.org:act:18E038AE-DB02-4891-95E0-5A7902BAFCE4
http://species-id.net/wiki/Ismarus_parvicellus
Figs 9–12

Holotype. Female. Body length 2.2 mm; fore wing length 1.8 mm.

Head. Head in dorsal view 2.0 times as wide as long; vertex abruptly sloping behind post ocelli; temple narrowed behind eyes; occipital carina strong and complete, not crenulate; POL as long as OOL; toruli separated from each other; face setose; clypeus evenly convex; epistomal sulcus distinct; eye height 7.0 times length of malar space; malar sulcus absent. Scape cylindrical, with apical rim simple; first to third flagellomeres attenuate basally, and gradually incrassate to apex; ratios of length to width of antennal segments: 20 : 5; 8 : 5; 11 : 4; 11 : 4; 9 : 4; 8 : 5; 8 : 5; 7 : 6; 7 : 6; 7 : 6; 6 : 6; 6 : 6; 6 : 6; 6 : 5; 10 : 5.

Mesosoma. Mesosoma in dorsal view 0.75 times as long as width of head; pronotum angular in dorsal view, anteriorly punctate and setose; lateral side of pronotum with anterior and upper margins coarsely punctate, lower half rugose punctate, posterior upper part smooth; mesoscutum smooth and convex; notauli present as small pits on anterior face; humeral sulcus strong, 1.4 times length of tegula; anterior scutellar pit transverse, crenulate inside, median longitudinal carina weak; scutellum smooth, posterior rim weakly concave and subtruncate; propodeum rugose and punctate, with transverse carinae and longitudinal carinae strong; mesopleuron mostly smooth and bare, with upper corner below tegula finely punctate and setose; metapleuron rugose and setose.

Wings. Fore wing with costal, subcostal, basal, marginal, stigmal and postmarginal veins tubular; distal part of median and cubital veins weakly pigmented; radial cell closed, 0.3 times length of marginal vein and 2.3 times as long as its height. Hind wing with a basal cell.

Legs. Fore and middle legs slender; hind tibia strongly incrassate.

Metasoma. Petiole transverse, rugose and with irregular longitudinal carinae; second tergite mostly smooth and scattered with a few setae along lower side, median furrow short, extending to 0.2 times length of second tergite; sutures between tergites complete and well impressed.

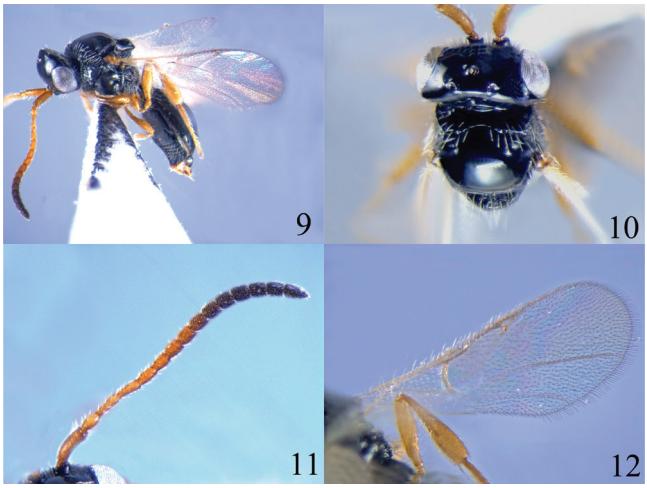
Colour. Body black. Antenna yellowish brown but seventh to eighth flagellomeres blackish brown and ninth to thirteenth flagellomeres black. Legs brown. Wings hyaline, veins brown.

Male. Unknown.

Distribution. China (Hainan).

Material examined. Holotype, female. CHINA: Hainan, Baisha County, Mt. Jiujialing (19.21°N, 109.45°E), 2010.VII.18, YPT, Hua-yan Chen, No. 20100013.

Diagnosis. This species belongs to the *I. halidayi*-group and can be distinguished from *I. halidayi* by having the eye height 7.0 times length of the malar space (4.5 times in *I. halidayi*); the radial cell of the fore wing small and 0.3 times length of marginal



Figures 9–12. *Ismarus parvicellus* sp. n. **9** habitus, lateral view **10** head and thorax, dorsal view **11** antenna **12** fore wing.

vein (radial cell as long as marginal vein); the distal part of the median and cubital veins weakly pigmented (median and cubital veins distinctly pigmented); the posterior rim of the scutellum weakly concave and subtruncate (posterior rim of scutellum round).

Etymology. The specific name is derived from the Latin adjective 'parvi' (small) and 'cell', referring to the small radial cell of fore wing.

Ismarus dorsiger (Haliday, 1831) New to China

http://species-id.net/wiki/Ismarus_dorsiger
Figs 13–16

Cinetus dorsiger Haliday, *in* Curtis 1831, British Entomology 3: 380
Betyla anomala Nees von Esenbeck 1834, Hymenopterorum ichneumonibus affinium monographiae, genera europaea et species illustrantes: 345. Synonymized by Foerster (1856).
Ismarus dorsiger: Haliday 1835, Entomological Magazine: 467. Generic transfer.
Ismarus neesii Foerster 1850, Verhandlungen des Naturhistorischen Vereins de Preussischen Rheinlande Westfalens: 286. Synonymized by Haliday (1857).
Ismarus dorsiger (Haliday, 1831): Johnson 1992, Memoirs of the American Entomological Institute 51: 260.

Material examined. 9 females, CHINA: Yunnan, Yongshan County, Huanghua Town (28.00ºN, 103.51ºE), 1500 m, 2010.X.8, Wei Dong.

Biology. Hyperparasitoid of *Aphelopus* sp. of Dryinidae (Jervis, 1979).

Distribution. China (Yunnan); England; Ireland; Spain; Russia.

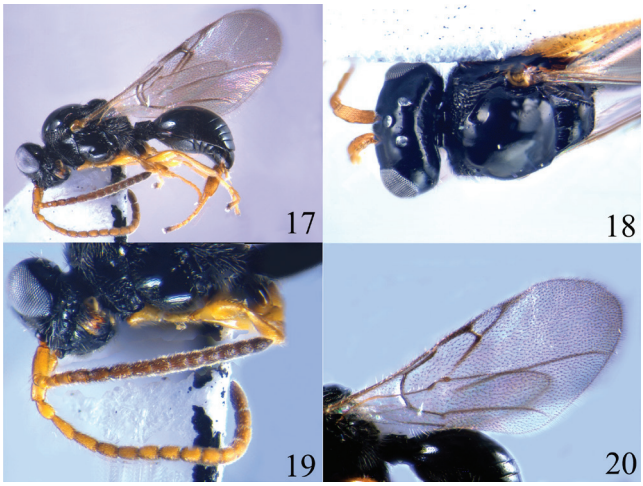
Figures 13–16. *Ismarus dorsiger* **13** habitus, lateral view **14** head, dorsal view **15** antennae **16** fore wing.

Comments. All specimens of this species were collected from a field with *Zanthoxylum bungeanum* plants (Sapindales: Rutaceae) in Northeast Yunnan together with some specimens of Dryinidae and Ceraphronidae.

***Ismarus halidayi* Foerster, 1850 New to China**
http://species-id.net/wiki/Ismarus_halidayi
Figs 17–20

Ismarus halidayi Foerster, 1850 Verhandlungen des Naturhistorischen Vereins de Preussischen Rheinlande Westfalens 7: 285.
Ismarus halidayi Foerster, 1850: Masner 1976, Canadian Entomologist 108: 1251.
Ismarus halidayi Foerster, 1850: Johnson 1992, Memoirs of the American Entomological Institute 51: 261.

Material examined. 2 females and 1 male, Ningxia, Mt. Liupanshan (35.40°N, 106.38°E), 2008.VII.11-12, Jie-min Yao, Nos. 200808622, 200808859, 200808017; 1 male, Ningxia, Mt. Liupanshan (35.40°N, 106.38°E), 2009.VII.3-14, Hua-yan Chen, No. 200903337; 1 female, Sichuan, Mt. Ermei (29.61°N, 103.36°E), 2009. VII.7, Jiang-li Tan, No. 200903977; 1 female, Sichuan, Luhuo (31.38°N, 100.66°E), 2009.VI.30, Jiang-li Tan, No. 200903953; 1 female, Guizhou, Mt. Fanjingshan (27.92°N, 108.70° E), 2100 m, 2001.VII.30, Yun Ma, No. 200109552; 1 female, Guizhou, Mt. Fanjingshan (27.92°N, 108.70° E), 1993.VII.12, Song-lin Yao, No. 936734; 1 female, Yunnan, Yongshan County, Huanghua Town, 1500 m (28.00°N, 103.51°E), 2010.X.8, Wei Dong; 1 male, Yunnan, Dali, Mt. Cangshan (25.63°N,



Figures 17–20. *Ismarus halidayi* **13** habitus, lateral view **14** head and thorax, dorsal view **15** antennae **16** fore wing.

100.16°E), 2009.VI.5, Jiang-li Tan, No. 200901192; 1 male, Tibet, Milin (29.18°N, 94.20°E), 2009.VI.14, Jiang-li Tan, No.200902367.

Variation. Some specimens from Yunnan (No. 200901192) and Tibet (No.200902367) with hind tarsus dark brown to black.

Distribution. China (Ningxia, Sichuan, Guizhou, Yunnan, Tibet); Russia; England; Sweden; Finland.

Key to species of genus *Ismarus* Haliday from China (based on females)

1 Body pale yellowish; POL shorter than OOL ....***I. dorsiger*** **(Haliday, 1831)**

– Body entirely black; POL as long as OOL **2**

2 Radial cell of fore wing as long as marginal vein; median furrow of second tergite long .....***I. halidayi*** **Foerster, 1850**

– Radial cell of fore wing distinctly shorter than marginal vein; median furrow of second tergite short.....**3**

3 Second flagellomere 2.75 times as long as wide; apical flagellomere twice as long as wide; notauli present as small pits, smooth; radial cell of fore wing short, 0.3 times length of marginal vein; posterior rim of scutellum weakly concave and subtruncate.....***Ismarus parvicellus*** **sp. n.**

– Second flagellomere 3.5–5.0 times as long as wide; apical flagellomere 2.5 times as long as wide; notauli present as oblique long pits and crenulate; radial cell of fore wing longer, 0.6 times length of marginal vein; posterior rim of scutellum round.....**4**

4 Second flagellomere 3.5 times as long as wide; radial cell of fore wing 2.0 times as long as high; seventh tergite densely punctate; antenna uniformly black; all trochanters black.....***I. nigritrochanter* sp. n.**

– Second flagellomere 5.0 times as long as wide; radial cell of fore wing 3.0 times as long as high; seventh tergite finely mat; antenna black with scape brown, pedicel and first flagellomere dark brown; all trochanters brown .... ***I. longus* sp. n.**

Acknowledgments

We are grateful to Dr Lubomir Masner, Agriculture and Agri-Food Canada, for his kind help during the study. We are thankful to Dr C. van Achterberg, Netherlands Centre for Biodiversity Naturalis, for his generous help to correct the English of this manuscript. Thanks to Mr. Wei Dong and Dr. Zhong-shi Zhou, South China Agricultural University, for collecting some specimens from Yunnan. The project was supported by National Nature Science Foundation of China (No. U0936601), the Ministry of Science and Technology of P. R. China (MOST Grant No. 2006FY110500) and the Forestry Administration of Ningxia Hui Nationality Autonomous Region.

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RESEARCH ARTICLE

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A new species of the genus *Palpostilpnus* Aubert (Hymenoptera, Ichneumonidae, Cryptinae) from the Oriental part of China

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Abstract

Palpostilpnus brevis Sheng & Broad, **sp.n.**, belonging to the tribe Phygadeuontini of the subfamily Cryptinae (Hymenoptera, Ichneumonidae), collected from Jiangxi Province, China, is described. A key to the described species of the genus *Palpostilpnus* Aubert, 1961, is provided.

Keywords

Palpostilpnus, new species, Oriental Region, China, taxonomy, parasitoid

Introduction

Aubert (1961) established the genus *Townostilpnus* based on four species and one subspecies, which he separated into two subgenera, *Palpostilpnus* Aubert 1961, and *Townostilpnus* Aubert, 1961. Townes (1970) upgraded these subgenera to the generic level and placed them in separate subtribes. Other than the upgrading of one of Aubert's subspecies (*Townostilpnus (Palpostilpnus*) *striator papuator* Aubert, 1961) to spe-

cies status (Gupta 1987), there have been no additions to the species level taxonomy of these genera. *Palpostilpnus* comprises three, and *Townostilpnus* two, described species, as originally included by Aubert (1961).

In this article, one new species belonging to *Palpostilpnus*, collected in Anfu and Quannan Counties, Jiangxi Province, China, is described. The holotype and two paratypes are deposited in the Insect Museum, General Station of Forest Pest Management (GSFPM), State Forestry Administration, People's Republic of China. One paratype is deposited in the Natural History Museum, London, UK (BMNH).

Despite being placed in different subtribes by Townes (1970) (*Palpostilpnus* in Chiroticina, *Townostilpnus* in Gelina), the genera *Palpostilpnus* and *Townostilpnus* closely resemble each other. They were presumably separated by the form of the mandibles, which are subbasally swollen in *Townostilpnus*, with a basal, transverse groove. Contrastingly, the mandibles of *Palpostilpnus* are simple. *Townostilpnus* have a short ovipositor, but so does the species described here, and the length of the maxillary palp is variable in *Townostilpnus* but always very long in *Palpostilpnus*. It may be that these genera could be synonymized when the world fauna is better known. There are undescribed species of *Palpostilpnus* in the collections of the BMNH and other institutes but a thorough revision of the genus would require more collecting in various countries and much sorting of existing collections. We are describing this new Chinese species, the only *Palpostilpnus* so far found in China, so as to formally record the presence of the genus in China.

The morphological terminology is mostly that of Gauld (1991). Wing vein nomenclature is based on Ross (1936) and the terminology on Mason (1986, 1990).

Palpostilpnus Aubert, 1961 (New record for China)

***Palpostilpnus* Aubert, 1961**
http://species-id.net/wiki/Palpostilpnus

Palpostilpnus Aubert, 1961. Bulletin de la Société Entomologique de Mulhouse, 1961:56. Type-species: *Townostilpnus* (*Palpostilpnus*) *palpator* Aubert. Designated by Townes, 1970.

Diagnosis. Head and mesosoma short. Mandible small. Occipital carina reaching base of mandible. Maxillary palp reaching or almost reaching base of hind coxa. Sternaulus reaching mid coxa. Areas superomedia and petiolaris of propodeum combined. First tergum slender, without median dorsal carinae, spiracle near apical 0.22. Ovipositor very slender.

***Palpostilpnus brevis* Sheng & Broad, sp.n.**
urn:lsid:zoobank.org:act:207FA67A-9111-4A3C-8C6D-5E2E9AD342D3
http://species-id.net/wiki/Palpostilpnus_brevis
Figs 1–6

Etymology. The specific name is derived from the short ovipositor.

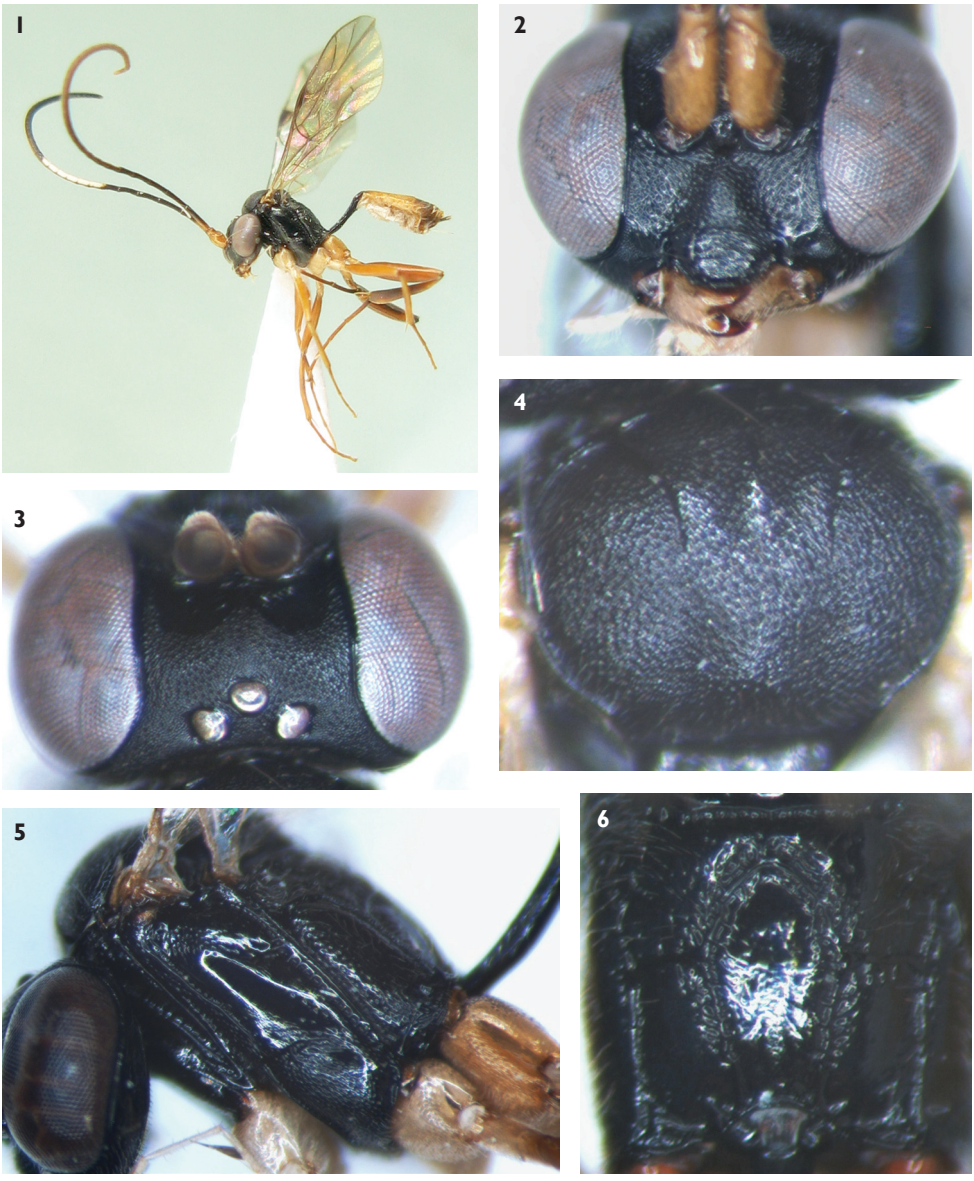
Material examined. *Holotype*: female, CHINA: Quannan County, 700m, Jiangxi Province, 7 October 2008, leg. Mao-Ling Sheng (GSFPM). *Paratypes*: 1 female, same data as holotype (BMNH); 1 female, CHINA: Anfu County, 180m to 200m, Jiangxi Province, 12 October 2010, leg. Mao-Ling Sheng (GSFPM); 1 female, CHINA: Anfu County, 180m to 200m, Jiangxi Province, 1 November 2010, leg. Zhong-Ping Yu (GSFPM).

Diagnosis. Clypeal suture very weak and indistinct. Postocellar line about as long as ocular-ocellar line. Hind wing vein 1/cu about 5 times as long as cu-a. Lateral carinae of area basalis are combined into one carina. Ovipositor sheath very short, approximately 0.5 mm. Second and third terga yellowish brown to reddish brown. Wings not banded, antennal flagellum with white band.

Description. Female. Body length 4.0 to 4.5 mm. Fore wing length 3.5 to 3.8 mm. Antenna length 5.5 to 5.8 mm. Ovipositor sheath approximately 0.5mm.

Head. Face (Fig. 2) approximately 1.9 times as wide as long, longitudinally convex centrally, forming narrow triangular area; with fine granulose texture and dense punctures, distance between punctures 0.2–1.0 times diameter of puncture; sublateral portion longitudinally concave. Clypeal suture very weak and indistinct. Clypeus evenly convex, almost smooth, with shallow and unclear punctures, 1.6 times as wide as long; apical margin evenly convex. Basal portion of mandible with weak and fine punctures; upper and lower margins almost parallel; teeth sharp, upper tooth approximately as long as lower tooth. Malar space with fine leathery granulose texture. Malar sulcus indistinct. Malar space approximately 0.67 times as long as basal width of mandible. Gena glossy, strongly convergent backwardly, with sparse, uneven and fine punctures. Vertex (Fig. 3) with fine leathery texture, posterior portion from behind ocelli to occipital carina slanted almost vertically, slightly concave. Postocellar line about as long as ocular-ocellar line. Frons with fine leathery texture, lower portion slightly concave. Antenna longer than body, with 34 flagellomeres, median portion slightly thickened, ratio of length from first to fifth flagellomeres: 1.5:1.2:1.0:0.9:0.8. Occipital carina complete.

Mesosoma. Pronotum smooth, with sparse, fine punctures around margin; posterior portion with short transverse wrinkles. Collar very short. Epomia indistinct. Mesoscutum (Fig. 4) wide and short, comparatively convex, with fine leathery texture and indistinct punctures. Notaulus evident on front portion of mesoscutum. Scutoscutellar groove with short longitudinal wrinkles. Scutellum evenly convex, almost smooth, with very weak and indistinct leathery texture, anterior and lateral portion with fine granulose punctures. Postscutellum transverse, smooth. Mesopleuron (Fig. 5) mainly smooth, anterior portion with fine punctures; lower portion with leathery texture, punctures indistinct; posterior portion with fine transverse wrinkles and fine indistinct punctures. Epicnemial carina



Figures 1–6. *Palpostilpnus brevis* Sheng & Broad, sp.n. **1** Body, lateral view **2** Face **3** Vertex **4** Mesoscutum **5** Mesopleuron **6** Propodeum.

strong, almost straight, upper end reaching subalar prominence. Sternaulus distinct, nearly reaching hind margin of mesopleuron, far above lower posterior corner of mesopleuron. Metapleuron very long and narrow, with distinct punctures, distance between punctures 0.2–1.0 times diameter of puncture. Juxtacoxal carina distinct. Submetapleural carina complete. Wings brownish hyaline. Vein 1cu-a opposite 1/M, latter weakly bent forward. Vein 3rs-m absent. 2m-cu distal 2rs-m, about as long as distance between it and 2rs-m.

2m-cu inclivous, with two bullae. M+Cu comparatively arched. Vein 2-Cu slightly longer than 2cu-a. Hind wing vein 1/cu about 5 times as long as cu-a. Legs slender, comparatively long. Inner profile of basal portion of fore basitarsus distinctly bent. Hind coxa irregularly pyramidal, with fine and uneven punctures. Basal portion of hind tibia slender, gradually thick toward apex. Ratio of length of hind tarsomeres 3.3:2.6:2.2:1.0:0.8. Hind claws small. Propodeum (Fig. 6) steeply sloping from near anterior margin to posterior end; lateral longitudinal and pleural carinae distinct; areas superomedia and petiolaris combined, forming large, long area, costula located slightly before its middle; a longitudinal carina (fused lateral carinae of area basalis) between combined area and anterior margin of propodeum; posterior transverse carina absent; main median portion smooth, lateral area behind costula smooth, impunctate; lateral area before costula with sparse fine punctures and irregular short wrinkles; along carinae with irregular, indistinct, short wrinkles; spiracle small, oval, distance to anterior margin of propodeum 1.6 to 1.7 times its longest diameter.

Metasoma. First tergum 3.6 to 3.8 times as long as apical width, smooth, petiole flat; postpetiole wide, anterior medially shallowly concave, lateral margins parallel; without median dorsal carina or dorsolateral carina; ventrolateral carina weak; spiracle small, round, slightly convex, at posterior 0.23. Second tergum smooth, widened posteriorly, about 0.6 times as long as apical width, 1.3 times as long as basal width; smooth. Third tergum 0.5 times as long as apical width, parallel-sided, finely punctate. Following terga indistinctly punctate. Ovipositor sheath short, approximately 0.18 times as long as hind tibia. Ovipositor very thin.

Color (Fig. 1). Black, except the following. Dorsal profile of flagellomeres 6 to 11 white, ventral profile of apical flagellomeres yellowish brown. Scape, pedicel, base of first flagellomere, mandible except teeth, tegula, subalar ridge, legs, second and third terga yellowish brown to reddish brown. Maxillary and labial palpi, all coxae and trochanters yellowish white. Basal portion and outer profile of hind tibia, base of hind basitarsus blackish brown. Fourth and following terga, stigma and veins dark brown.

Remarks. Similar to *Palpostilpnus palpator* (Aubert, 1961) but can be distinguished from the latter by the following combination of characters: antenna with 34 flagellomeres; dorsal profile of flagellomeres 6 to 11 white; lower side of hind femur without basal tubercle; ovipositor sheath shorter than apical depth of metasoma. *Palpostilpnus palpator*: antenna with 22 flagellomeres; dorsal profile of flagellomeres without white; lower side of hind femur with a basal tubercle; ovipositor sheath much longer than apical depth of metasoma.

The new species can be inserted as follows in Aubert's (1961) key to species, with the third couplet modified.

3 Scutellum without wrinkles. Hind tibia without white, basal ring. Fore wing lacking brown, transverse band ..... 3'

– Scutellum with strong wrinkles. Hind tibia with white, basal ring. Fore wing with brown, transverse band 4

3' Frons smooth. Antenna without white ring. Legs, including coxae, red. ....**3. *palpator* Aubert**

– Frons with fine leathery texture and unevenly punctuate. Dorsal median portion of antenna white. Fore and mid coxae white, hind tibia dark brown..... ..... ***brevis* Sheng & Broad, sp.n.**

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RESEARCH ARTICLE

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A new *Stenoloba* Staudinger species from China (Lepidoptera, Noctuidae, Bryophilinae)

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Abstract

A new species of *Stenoloba*, *S. viridicollar* **sp. n.** (Lepidoptera, Noctuidae) is described from Sichuan, China. Illustrations of adults and the genitalia of both sexes are provided. A diagnostic comparison is made with *Stenoloba rufosagitta* Kononenko & Ronkay, 2001 *and S. rufosagittoides* Han & Kononenko, 2009.

Keywords

Lepidoptera, Noctuidae, *Stenoloba*, new species, China

Introduction

Stenoloba Staudinger, 1892 is an East Asian genus of the subfamily Bryophilinae. It was included in the subfamily Acontiinae (sensu auctorum) by early authors until Sugi (1970) revised the Japanese species of the genus and established its position in the Bryophilinae. The East Asian fauna of the genus was revised by Kononenko and Ronkay (2000, 2001). Chen (1999) only listed seven species of *Stenoloba* from China. A complete review of Chinese *Stenoloba* was published by Han & Kononenko (2009), listing 37 species known to occur in China. The genus presently includes, according to the last remarkable contribution on the taxonomy of the genus (Behounek and Kononenko 2010), 75 species which are arranged in 14 species groups by Behounek and Kononenko.

During a study of the Chinese *Stenoloba* material collected by Viktor Sinyaev in Sichuan province in 2008, it was surprising to find that the *S. glaucescens* species-group contains another undescribed, species. The new species, described below, externally resembles *S. rufosagitta* and *S. rufosagittoides*, but has clearly recognisable differences in its external and genital features.

Systematic part

***Stenoloba viridicollar* Pekarsky sp. n.**
urn:lsid:zoobank.org:act:DBF5569D-E216-4C8B-8A41-7DE6CB32DA69
http://species-id.net/wiki/Stenoloba_viridicollar
Figs 1–4

Holotype. Male, China, Sichuan, Lao Lin Kou, 1900m, 28°21'N, 103°26'E, 26.vi.–12.vii.2008, leg. Viktor Sinyaev; slide No.: OP1034m (coll. O. Pekarsky, deposited in the HNHM Budapest).

Paratype. China, Sichuan: 2 males, 2 females, with same data as for holotype (coll. O. Pekarsky).

Diagnosis. The new species is externally similar to *S. rufosagitta* and *S. rufosagittoides*, combining characteristics of both relatives. The most prominent distinguishing feature is the greenish-grey colouration of the head and collar, which are grey brown to dark brown in the two related species. In addition, *S. viridicollar* differs from *S. rufosagitta* by the more oblique and less arched outer margin and more unicolorous pattern of the forewing. It differs from *S. rufosagittoides* by its broader forewing with a wider marginal area. The basal area of the new species is less marked then in the other two species. The specific features of the male genitalia are the shape of the valva, the shape and size of the the ampulla, and the structure of the vesica. The most conspicuous autapomorphy of *S. viridicollar* is the rather short triangular valva with more or less straight costal and ventral margins, and the acutely triangular cucullus without a hooked tip or subapical process but with a long, narrow ampulla. The new species is easily distinguishable from the related two species because *S. rufosagitta* has a long, rod-like valva with more or less parallel costal and ventral margins, a somewhat rounded cucullus with fine, short, hooked tip, and the ampulla is missing; *S. rufosagittoides* is characterized by the long, hooked, rather claw-like apical saccular extension and the asymmetrical subapical costal processes.

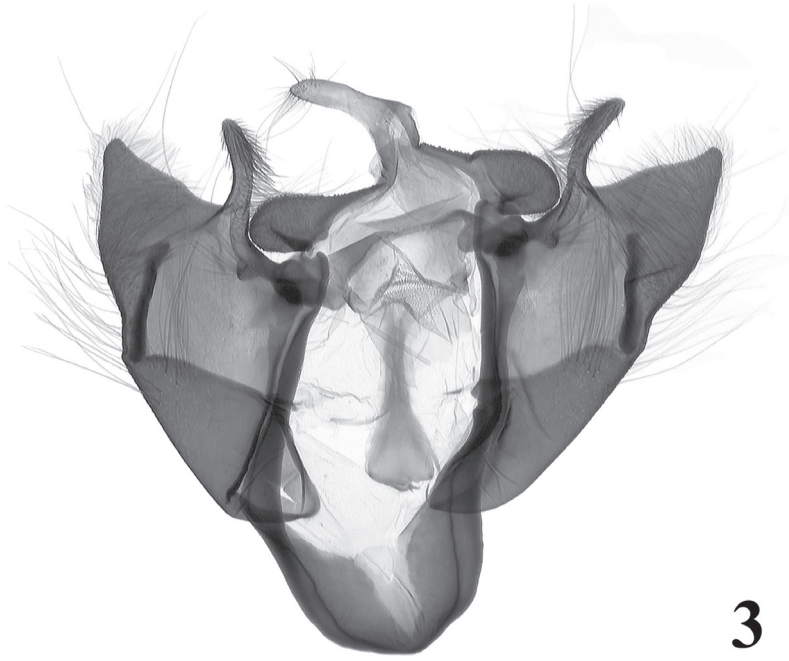
Description. Male. (Fig. 1). Wingspan 22 mm. Head and collar greenish grey, thorax blackish grey, with rufous mesothorax and blackish-grey tegulae mixed sparsely with rufous scales; abdomen blackish grey. Forewing relatively short, slightly dilated towards outer edge; costa arched basally; apex finely pointed; outer margin more oblique and straighter than in *S. rufosagittoides* and even more so than in *S. rufosagitta*. Ground colour of forewing blackish brown, wing pattern diffuse, less traceable than in *S. rufosagittoides*; basal field and costal area with small greenish

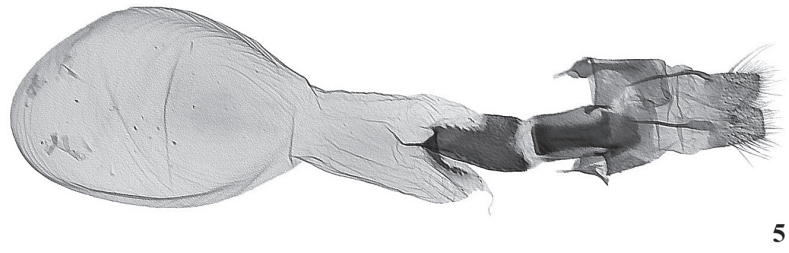
1

2

Figures 1–2. Adults. **1** *Stenoloba viridicollar* sp. n., holotype male, China **2** *Stenoloba viridicollar* sp. n., paratype female, China.

patches between crosslines; crosslines dark blackish grey, basal line relatively strongly marked; subbasal line defined indistinctly by green scales; antemedial line S-shaped, obsolescent; medial area somewhat darker than ground colour; postmedial line undulate; subterminal line present but indistinct; typical noctuid maculation hardly recognisable, reniform stigma somewhat more sharply defined with some black and rufous spots; inner margin with conspicuous rufous "pirate sword"-shaped stripe extending from base of wing to postmedial line; tornal patch rufous with white scales





Figures 3–5. Genitalia **3, 4** *Stenoloba viridicollar* sp. n., male genitalia, holotype, China, slide No. OP1034m **5** *Stenoloba viridicollar* sp. n., female genitalia, paratype, China, Slide No. OP0369f.

inside and with black scales outside; termen suffused with green; cilia as for ground colour. Hindwing uniformly dark brown, discal spot hardly traceable. Female. (Fig. 2) as for male but somewhat larger in size (wingspan 24 mm), with less expressed forewing pattern.

Male genitalia (Figs 3, 4). Genital armature with opened valvae looks like an equilateral triangle; all structures heavily sclerotized. Uncus short and strong, triangular and flattened; tegumen two times shorter than vinculum; penicular lobes large, verrucose; juxta long, deltoidal, with rounded basal (ventral) side and long, thin apical (dorsal) extension; vinculum with saccus wide and massive; valvae symmetrical, massive, shortly triangular with very wide base and short apical section with straight sides; sacculus rather narrow, short, covered by small pimples from middle; costa very short; ampulla long, slender and arcuate, bearing relatively short bristles; editum with 12 long bristles. Aedeagus relatively long and thin, bulbus ejaculatorius wide, carina covered by fine denticles. Vesica tubular, everted posteriorly, then bent ventrad and recurved along ventral side of aedeagus. Basal tube membranous, medial section dilated and inflated, rather globular, with short subconical frontal diverticulum and somewhat longer but thinner ventro-lateral diverticulum. Ventral surface of medial section and distal tube densely scobinate and finely spinose; dorsal side of distal tube with large, sclerotised crest-like cornutus.

Female genitalia (Fig. 5). Ovipositor short, conical; apophyses anteriores short and thin, wide based; apophyses posteriores relatively long and stout, four times longer then apophyses anteriores. Antrum long, wide, heavily sclerotized; ductus bursae similarly sclerotised, with narrow membranous ring ("neck") between antrum and ductus bursae; appendix bursae semiglobular-subconical, membranous; corpus bursae with narrower posterior part and elliptical-ovoid proximal section.

Note. It is worth mentioning that the two other species in the *S. rufosagitta* group were described only from males, so the identification of the female of the new species is based on external features. The characteristic greenish colouration of the head and collar corresponds well with those of the male and differs prominently from that of the two related taxa. Moreover, all moths of the type series were collected in the same site and date and no other *Stenoloba* species were found together with them.

Etymology. The name "*viridicollar*" refers to the greyish-green coloration of head and collar, which is the main external distinguishing character of the species.

Distribution. The species is known only from the type-locality, South-West China, Prov. Sichuan, Lao Lin Kou.

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RESEARCH ARTICLE

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A new species of Andean toad (Bufonidae, *Osornophryne*) discovered using molecular and morphological data, with a taxonomic key for the genus

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Abstract

Combining a molecular phylogeny and morphological data, we discovered a new species of *Osornophryne* from the Amazonian slope of the Ecuadorian Andes. Morphologically, the new taxon is distinguished from all others species in *Osornophryne* by having the Toes IV and V longer than Toes I–III, a short and rounded snout with a small rostral papilla, and conical pustules on flanks. The new species previously was confused with *O. guacamayo*. A taxonomic key is provided for all known species of *Osornophryne*.

Resumen

Al combinar una filogenia molecular con información morfológica, se descubrió una nueva especie de *Osornophryne* proveniente de la vertiente amazónica de los Andes del Ecuador. Morfológicamente, el nuevo taxón se distingue de los otras especies del género por tener los Dedos IV y V del pie más largos que los Dedos I-III, un rostro corto y redondeado con una pequeña papilla, y pústulas cónicas en los flancos

del cuerpo. La nueva especie estaba previamente confundida con *O. guacamayo*. Se provee de una clave taxonómica para todas las especies de *Osornophryne* reconocidas hasta la fecha.

Keywords
Andes, Bufonidae, Ecuador, new species, *Osornophryne,* phylogeny

Palabras Claves
Andes, Bufonidae, Ecuador, filogenia, especie nueva, *Osornophryne*

Introduction

Osornophryne is endemic to the Andes of Colombia and Ecuador, where it occurs in mountain forests and paramo at elevations between 2100 and 4000 m (Ruiz-Carranza and Hernández-Camacho 1976; Gluesenkamp and Guayasamin 2008; Muses-Cisneros et al. 2010). Currently, *Osornophryne* contains 10 recognized species: *O. angel* (Yánez-Muñoz et al. 2010), *O. antisana* (Hoogmoed 1987), *O. bufoniformis* (Peracca 1904), *O. guacamayo* (Hoogmoed 1987), *O. occidentalis* (Cisneros-Heredia and Gluesenkamp 2010), *O. percrassa* (Ruiz-Carranza and Hernández-Camacho 1976), *O. puruanta* (Gluesenkamp and Guayasamin 2008), *O. sumacoensis* (Gluesenkamp 1995), *O. talipes* (Cannatella 1986) and *O. cofanorum* (Muses-Cisneros et al. 2010). The evolutionary relationships between *Osornophryne* and other bufonid genera remain controversial, with some authors arguing a close affinity with *Atelopus* (Coloma 1997; Gluesenkamp 2001), and others supporting a topology in which *Osornophryne* is sister to most other bufonids (Bocxlaer et al. 2010). However, the monophyly of *Osornophryne* is well established by morphological and molecular characters (Ruiz-Carranza and Hernández-Camacho 1976; Coloma 1997; Gluesenkamp 2001; Bocxlaer et al. 2010); among the most conspicuous putative morphological synapomorphies are: six presacral vertebrae, digits almost completely embedded by an extensive membrane, reduced number or lenght of phalanges in hands and feet, absence of stapes and tympanum, urostlyle laterally expanded and broadly fused with sacrum, inguinal amplexus, and direct development (Ruiz-Carranza and Hernández-Camacho 1976; this work; compare with traits in South American bufonids; Pramuk 2006).

Given the complex topography of the Andes and the opportunity for allopatric speciation in areas with similar climatic conditions, it is possible that morphologically similar populations are evolving independently. Herein, we report and describe a new species of *Osornophryne,* previously confused with *O. guacamayo*.

Material and methods

Morphology. We examined alcohol-preserved specimens from the herpetological collections at Museo de Zoología of the Pontificia Universidad Católica del Ecuador (QCAZ),

Escuela Politécnica Nacional (EPN), and Museo Ecuatoriano de Ciencias Naturales (DH-MECN), all based in Quito, Ecuador. Specimens examined are listed in Appendix I. Fingers are numbered preaxially to postaxially from I–IV to facilitate comparison with previous literature dealing with anurans; however, we stress that in an evolutionary perspective anuran fingers should be numbered from II–V, consistent with the hypothesis that Digit I was lost in anurans (Shubin and Alberch 1986; Fabrezi and Alberch 1996). Morphological measurements were taken with digital calipers to the nearest 0.1 mm and are, as follow: (1) snout–vent length (SVL = distance from tip of snout [excluding the proboscis] to posterior margin of vent); (2) tibia length (TIB = length of flexed hind leg from knee to heel); (3) foot length (FL = distance from base of inner metatarsal tubercle to tip of Toe IV); (4) head length (HL = distance from tip of snout to articulation of jaw); (5) head width (HW = greatest width of head measured between jaw articulations); (6) interorbital distance (IOD = shortest distance between medial margins of upper eyelids); (7) upper eyelid width (EW = greatest width of eyelid measured perpendicular to medial axis of skull); (8) internarinal distance (IND = distance between internal borders of nostrils); (9) eye–nostril distance (EN = distance from anterior corner of eye to posterior border of nostril); (10) snout–eye distance (SE = distance from anterior corner of the eye to the tip of the rostrum); (11) eye diameter (ED = distance between anterior and posterior corners of eye); (12) Finger-III length (FIIIL = distance from proximal border of Finger I to distal end of Finger III); (13) Finger-IV length (distance from proximal border of Finger I to distal end of Finger IV); (14) Toe-IV length (TIVL = distance from proximal edge of Toe I to distal tip of Toe IV); (15) Toe-V length (TVL = distance from proximal border edge of Toe I to distal tip of Toe V). Sexual maturity was determinate by the presence of nuptial pads in adult males and convoluted oviducts in adult females. Techniques for clearing and double-staining specimens with Alcian Blue and Alizarin Red were those of Taylor and Van Dyke (1985). Illustrations were made with the aid of a Wild M3B Heerbrugg stereo dissecting microscope equipped with a camera lucida. Osteological terminology is that of Duellman and Trueb (1994), Fabrezi (1992, 1993), and Trueb (1973, 1993); bufonid osteological character states are illustrated in Pramuk (2006).

Molecular data. Fresh liver samples were preserved in 90% alcohol, and stored at –80°C. We used salt-precipitation protocols to extract genomic DNA from ethanol-preserved tissues (M. Fujita, unpubl. data). To amplify the mitochondrial gene 12S, we used the primers MVZ59 and tRNA-val, developed by Graybeal (1997) and Goebel et al. (1999), respectively; Polymerase Chain Reaction (PCR) amplification protocol was, as follows: 1 cycle of denaturation 2 min at 94°C, annealing for 30 sec at 42°C, extension for 1 min at 72°C, 5 cycles of denaturation 30 sec at 94°C, annealing for 30 sec at 42°C, extension for 1 min at 72°C, 22 cycles of denaturation 30 sec at 94°C, annealing for 30 sec at 50°C, extension for 1 min at 72°C, final extension at 72°C was conducted for 5 min. PCR products were visualized in 0.7% agarose gel, and unincorporated primers and dNTPs were removed from PCR products using ExoSap-it purification. Cycle sequencing reactions were conducted by the commercial company Macrogen Inc. Data from heavy and light stands were compared to generate a consensus sequence for each DNA fragment with Sequencer Ver. 4.8. We obtained sequences of 71 speci-

mens, including all the species in *Osornophryne,* except *O. talipes,* and three outgroup taxa. In addition, sequences were downloaded from GenBank (NCBI). Sequences were initially aligned in Clustal X (Larkin et al. 2007) and adjusted in Mesquite 2.71 (Maddison and Maddison 2009). Best-fit model of molecular evolution was selected in jModeltest 1.1 (Posada 2008) under the Akaike Information Criterion (AIC). Model parameters estimated from jModelTest were used in Bayesian analyses.

Phylogenetics. Analyses were conducted using Maximum Parsimony (MP), Maximum Likelihood (ML), and Bayesian Analyses (BA). Parsimony analyses were performed in PAUP (Swofford 2009) using heuristic searches (10,000 stepwise random additions with TBR branch-swapping) and clade support was estimated via 1000 bootstraps with 10 random additions. Maximum likelihood was run in GARLI 0.951 (Zwickl 2006), which uses a stochastic genetic algorithm-like approach to find the topology, branch lengths, and substitution model parameters that maximize the log-likelihood simultaneously (Zwickl 2006). We performed a total of 50 runs to reduce the probability of inferring a suboptimal likelihood solution. Node support was assessed via 1000 bootstrap replicates. For Bayesian analyses, we implemented the model of nucleotide substitution selected as the best fit for the particular dataset according to the Akaike Information Criterion (AIC) in jModeltest 1.1 (Posada 2008). Bayesian analysis of the mitochondrial dataset was performed in Mr Bayes 3.1 (Ronquist and Huelsenbeck 2003). The analysis consisted of 10 million generations and two Markov chains with default heating values. The prior used for the rate matrix was a uniform Dirichlet and no prior information on topology was incorporated. Trees were sampled every 1000 generations; stationarity was assessed by examining the standard deviation of split frequencies and by plotting the –lnL per generation using Tracer v1.4 (Rambaut and Drummond 2005), and trees generated before stationary were discarded as "burn-in." Bootstrap values $p > 70\%$ are considered to indicate strong support (Hillis and Bull 1993, with their caveats). Clades with posterior probabilities $p > 0.95$ are considered strongly supported, but we caution that relatively high posterior probabilities for short internodes (particularly those with low bootstrap values) may be overestimates of confidence (Alfaro et al. 2003; Erixon et al. 2003).

Results

For most of the species and population of *Osonophryne* and three species of *Atelopus*, we obtained a total of 800 bp from the mitochondrial marker 12S rRNA (Table 1). Parameter value estimates for best-fit models for 12S gene generated by jModeltest 1.1 are TIM2 + I (0.001) + G (0.4700). The only taxon for which we could not obtain molecular information was *O. talipes*, a species that, in Ecuador, is only know from a specimen collected on 02 August 1970 (Cannatella 1986). The different analyses (MP, ML, and AB) are congruent (Fig. 1). The topology resolves most of the relationships among species in *Osornophryne,* and reveals the presence of the previously unrecognized taxon described below.

Table 1. Summary of specimens sequenced of *Osornophryne* and *Atelopus* for the gen 12S and GenBank accession numbers.

Species and museum no.	Locality	Latitude and Longitude	GenBank No.
***Atelopus* sp.**			
QCAZ 34540	Limón		JF907488
QCAZ 41326	Zuruni		JF907486
QCAZ 38427	Las Tres Cruces		JF907487
Osornophryne angel			
QCAZ 40039	Páramo del Ángel	0°41'15"N, 77°52'46"W	JF907459
QCAZ 40036	Páramo del Ángel	0°41'15"N, 77°52'46"W	JF907458
QCAZ 40040	Páramo del Ángel	0°41'15"N, 77°52'46"W	JF907493
Osornophryne antisana			
QCAZ 40172	Páramo de Oyacachi	0°10'34"S, 78°0.6'50"W	JF907453
QCAZ 40173	Páramo de Oyacachi	0°10'34"S, 78°0.6'50"W	JF907485
QCAZ 40174	Páramo de Oyacachi	0°10'34"S, 78°0.6'50"W	JF907484
DH-MECN 838	Salvefaccha	0°13'54"S, 78°0.1'1"W	JF907490
DH-MECN 811	Salvefaccha	0°13'54"S, 78°0.1'1"W	JF907489
QCAZ 46204	Llanganates	1°15'57"S, 78°26'45"W	JF907450
QCAZ 46212	Llanganates	1°15'57"S, 78°26'45"W	JF907449
QCAZ 48035	Llanganates	1°15'57"S, 78°26'45"W	JF907448
QCAZ 48223	Llanganates	1°15'57"S, 78°26'45"W	JF907445
QCAZ 48220	Llanganates	1°15'57"S, 78°26'45"W	JF907446
QCAZ 48034	Llanganates	1°15'57"S, 78°26'45"W	JF907447
Osornophryne bufoniformis			
QCAZ 40123	Santa Bárbara	0°38'29"N, 77°31'18.5"W	JF907431
QCAZ 40121	Santa Bárbara	0°38'29"N, 77°31'18.5"W	JF907432
QCAZ 40003	Santa Bárbara	0°38'29.5"N, 77°31'18.5"W	JF907430
QCAZ 45082	Huaca	77°46'11"N, 0°40'15"W	JF907460
QCAZ 45083	Huaca	77°46'11"N, 0°40'15"W	JF907461
QCAZ 45084	Huaca	77°46'11"N, 0°40'15"W	JF907462
DH-MECN 1815	Playón de San Francisco	1°37'43"N, 77°54'35"W	JF907455
DH-MECN 1806	Playón de San Francisco	1°37'43"N, 77°54'35"W	JF907457
DH-MECN 1807	Playón de San Francisco	1°37'43"N, 77°54'35"W	JF907456
DH-MECN 1808	Playón de San Francisco	1°37'42.6"N, 77°54'35"W	JF907454
Osornophryne* cf. *bufoniformis			
QCAZ 9316	Vía Tulcán-Maldonado	0°47'31"N, 77°54'25"W	AF375498
Osornophryne cofanorum			
DH-MECN 1591	La Bonita	00°29'19"N, 77°35'11"W	JF907440
DH-MECN 1579	La Bonita	00°29'19"N, 77°35'11"W	JF907439
DH-MECN 1629	La Bonita	00°29'19"N, 77°35'11"W	JF907441
Osornophryne guacamayo			
QCAZ 40138	Poblado de Oyacachi	0°10'34"S,, 78°0'50"W	JF907463

Species and museum no.	Locality	Latitude and Longitude	GenBank No.
QCAZ 40143	Poblado de Oyacachi	0°10'34"S,, 78°0'50"W	JF907464
QCAZ 40147	Poblado de Oyacachi	0°10'34"S,, 78°0'50"W	JF907465
QCAZ 43370	Volcán Sumaco	0°34'11"S, 77°35'39"W	JF907474
QCAZ 4576	Volcán Sumaco	0°34'11"S, 77°35'39"W	JF907491
QCAZ 40106	Cordillera de los Guacamayos	0°37'26.5"S, 77°50'27"W	JF907468
QCAZ 40102	Cordillera de los Guacamayos	0°37'26.5"S, 77°50'27"W	JF907492
QCAZ 43554	Cordillera de los Guacamayos	0°37'26.5"S, 77°50'27"W	JF907467
QCAZ 17295	Volcán Reventador	77°40'44"S, 0°6'43"W	JF907471
QCAZ 17294	Volcán Reventador	77°40'44"S, 0°6'43"W	JF907473
QCAZ 17293	Volcán Reventador	77°40'44"S, 0°6'43"W	JF907472
QCAZ 12240	Río Angel	0°37'26.5"S, 77°50'27"W	JF907469
QCAZ 12241	Río Angel	0°37'26.5"S, 77°50'27"W	JF907470
QCAZ 2735	Jondachi (Río Angel)	0°37'26.5"S, 77°50'27"W	JF907466
QCAZ 46662	Santa Bárbara	0°33'51"N, 77°31'38"W	JF907475
Osornophryne occidentalis			
QCAZ 40028	Chilma	0°51'50"N, 78°4'1"W	JF907436
QCAZ 43652	Cuellaje	0°27'30"N, 78°32'43"W	JF907444
QCAZ 43498	Cuellaje	0°27'30"N, 78°32'43"W	JF907443
QCAZ 43653	Cuellaje	0°27'30"N, 78°32'43"W	JF907442
Osornophryne puruanta			
QCAZ 13271	Laguna de San Marcos	0°7'36"N, 78°15'22"W	JF907451
QCAZ 13320	Laguna de San Marcos	0°7'36"N, 78°15'22"W	JF907452
QCAZ 11471	Laguna de Puruanta	00°12' N, 77°57' W	AF375499.1
Osornophryne simpsoni			
QCAZ 49779	Llanganates	1°16'35"S, 78°4'21"W	JF907482
QCAZ 49777	Llanganates	1°16'35"S, 78°4'21"W	JF907477
QCAZ 49781	Llanganates	1°16'35"S, 78°4'21"W	JF907483
QCAZ 49776	Llanganates	1°16'35"S, 78°4'21"W	JF907476
QCAZ 39774	Río Zuñac	1°20'58"S, 78°09'31"W	JF907478
DH-MECN 5262	Río Zuñac	1°20'58"S, 78°09'31"W	JF907480
QCAZ 39778	Rio Zuñac	1°20'58"S, 78°09'31"W	JF907479
QCAZ 39773	Rio Zuñac	1°20'58"S, 78°09'31"W	JF907481
Osornophryne sumacoensis			
QCAZ 41243	Volcán Sumaco	0°34'11"S, 77°35'39"W	JF907434
QCAZ 41250	Volcán Sumaco	0°34'11"S, 77°35'39"W	JF907433
QCAZ 41246	Volcán Sumaco	0°34'11"S, 77°35'39"W	JF907437
QCAZ 41249	Volcán Sumaco	0°34'11"S, 77°35'39"W	JF907438
QCAZ 43379	Volcán Sumaco	0°34'11"S, 77°35'39"W	JF907435

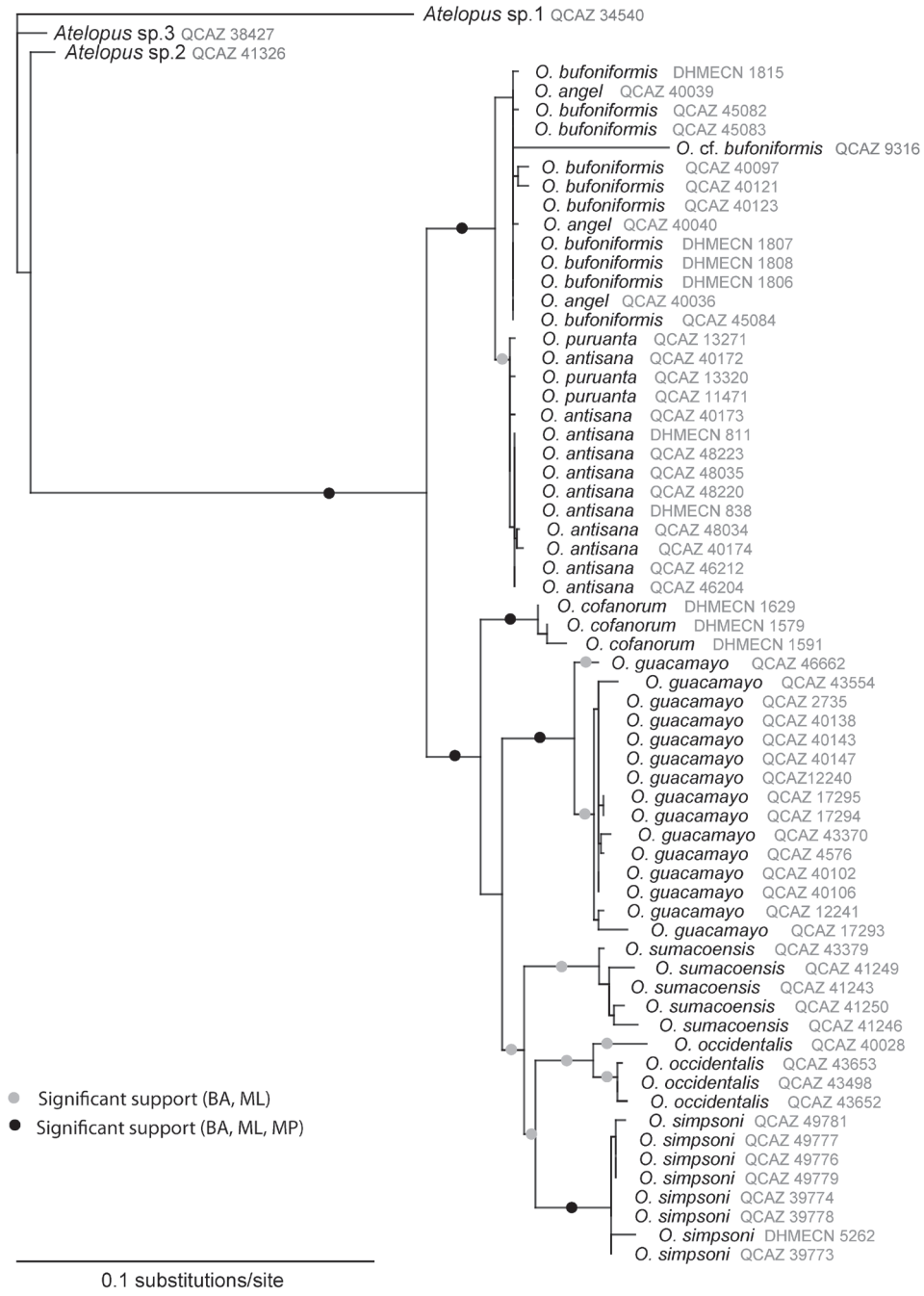

Figure 1. Maximum likelihood phylogeny of the species in *Osornophryne* inferred from the mitochondrial gene 12S (lnL = –1384,3649).

***Osornophryne simpsoni* sp. n.**
urn:lsid:zoobank.org:act:9BFBC919-F698-4FDE-8994-9154FF9E99ED
http://species-id.net/wiki/Osornophryne_simpsoni

Holotype. QCAZ 49774 (Figs 2, 3), an adult male near San Rafael-Chontayacu (1°16'34.61"S, 78°4'21.14"W, 2266 m.a.s.l.), Reserve Ankaku-Zona, Río Challuwayacu, Provincia de Pastaza, Ecuador, by Elicio Tapia on 21 October 2009.

Paratopotypes: QCAZ 48781, 49777, 45899 obtained with holotype.

Paratypes. DH-MECN 5660 adult female, DH-MECN 5261, 5263, 5258–59, adult male obtained near Reserva Biológica Río Zuñac (1°20'57,87"S, 78°09'31,37"W, 2250 m.a.s.l.), Parroquia Río Negro, Cantón Baños, Provincia de Tungurahua, Ecuador, by MYM, M. Urgiles y A. Laguna on 17 May 2008; QCAZ 39769 also obtained near Reserva Biológica Río Zuñac, by DJP, A. Narváez, and J. P. Reyes-Puig on 21 January 2009.

Diagnosis. *Osornophryne simpsoni* differs from all other species in *Osornophryne* (except for *O. guacamayo* and *O. cofanorum*) by having Toes IV and V longer than Toes I–III (Fig. 4). Morphologically, *O. simpsoni* is most similar to *O. guacamayo;* both species have Toes IV and V longer than Toes I–III, pustular dorsal skin, and dark brown dorsal coloration. However, *O. simpsoni* lacks the conspicuos proboscis present in *O. guacamayo;* males of *O. simpsoni* can be distinguished from males of *O. guacamayo* by having ventral skin with conical pustules (non-conic pustules in *O. guacamayo*), and light brown to orange conical pustules on the flanks (dark brown to black non-conical pustules in *O. guacamayo*); the venter of female *O. guacamayo* is mostly whitish to yellowish with brown marks, whereas that of female *O. simpsoni* is orange-brown. *Osornophryne cofanorum* differs from *O. simpsoni* by having its vertebrae and urostlyle coosified with the overlying skin (not co-osified in *O. simpsoni*) and vertebral neural spines that are visible dorsally (not visible in *O. simpsoni*); also, males of *O. cofanorum* have yellow pustules on the tip of the snout, upper eyelid, limbs, and dorsolateral pustular clusters (absent in *O. simpsoni*). Finally, *O. simpsoni* is distinguished from its sister species, *O. occidentalis,* by having a rounded snout in lateral view (protruding in *O. occidentalis*), brown dorsum with some lighter patches (dark brown dorsum with dark ochre-brown warts in *O. occidentalis*), orange-brown venter (white in *O. occidetalis*), and by inhabiting in the Amazonian slopes of the Andes (*O. occidentalis* is found on the Pacific slopes of the Andes).

Species Description. Ten adult males and one adult female. Females of medium size (SVL = 33.0 mm, *n* = 1); males small (SVL = 17.6–26.1 mm; mean = 21.1 ± 2.40, *n* = 10; Table 2). Head length 77.2–95.1% head width; male head width 34.9–40.8% SVL; female head width 37.3% SVL; width of head greater at level of posterior margin of mouth; snout short, rounded, with rostral papilla in dorsal and lateral views; nostrils slightly swollen; each nostril oblique, oval, directed laterally; internarial area concave in males and slightly concave in female; interorbital region with skin co-osified with underlying bone, which has few low tubercles; occipital region mostly flat, but with few bony tubercles and cranial crests in males and females; upper eyelids finely tuber-

Figure 2. *Osornophryne simpsoni* sp. n. in life (male holotype, QCAZ 49774).

culate in females, with conical tubercles in males; interorbital region wider than the upper eyelid (upper eyelid 73.0–87.5% of interorbital distance in males, n = 9; 64.4% in female); outer edge of the eyelid delineated by a continuous row of warts, which are more conical in males than in female; canthus rostralis straight; loreal region slightly concave, with small warts in males and female; pale brown lips; eyes with oval horizontally pupil; infraorbital and postorbital regions with some prominent tubercles of variable size in males and females. Skin of dorsum highly tuberculate, with discontinuous row of conical tubercles starting at level of posterolateral edge of cranium and ending at level of sacrum in males and females; in males, ventral skin with several small pustules and few conical tubercles on gular region and toward the flanks, pustules much denser on chest and abdomen and less conical; in females, ventral skin smooth, with small, non-conical isolated pustules, pustules more numerous on abdomen.

Forelimb long, slender, finely granular, with several larger tubercles extending along inner and outer edges of fingers in males; in females, tubercles smaller than in males. Hand of moderate length, representing 25.0–30.4% (n = 10) of SVL in males and 28.5% in female; extensive webbing between fingers (Fig. 4); lengths of fingers in order of increasing length : I < II < IV < III; palms with numerous tubercles; subarticular tubercles not distinguishable; palmar tubercle rounded, thenar tubercle almost undistinguishable.

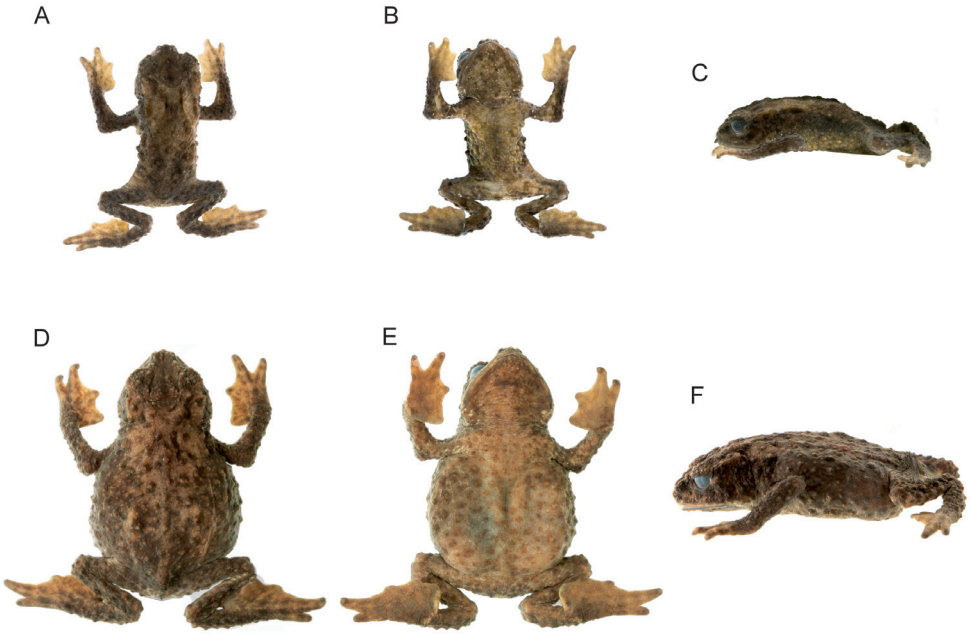

Figure 3. *Osornophryne simpsoni* sp. n. in alcohol. **A–C** Dorsal, ventral and lateral views of holotype, adult male, QCAZ 49774, SVL 20.1 mm **D–F** Dorsal, ventral and lateral views of adult female, DH-MECN 5260, SVL 33.0 mm.

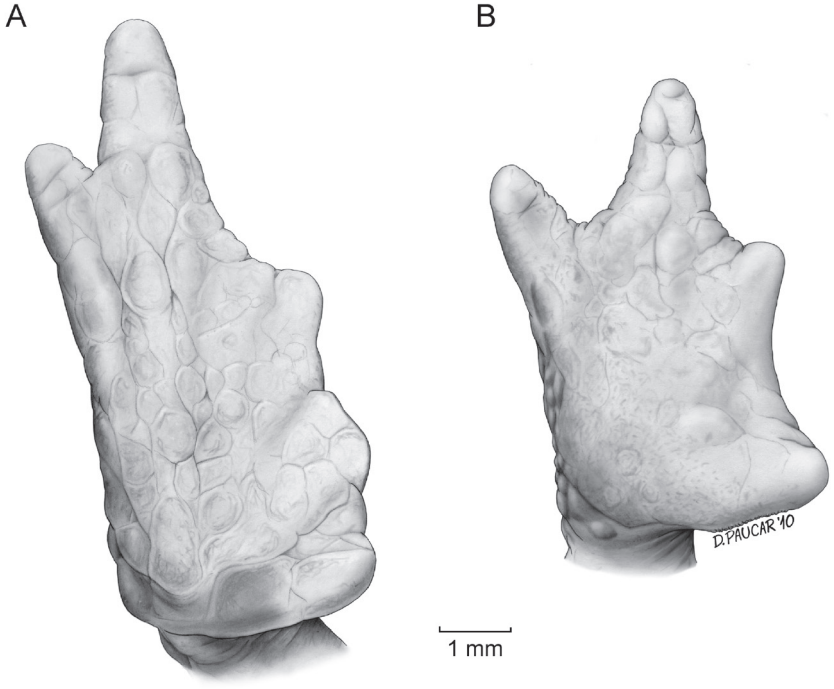

Figure 4. Foot (**A**) and hand (**B**) of *Osornophryne simpsoni* sp. n. (holotype, adult male, QCAZ 49774).

Table 2. Morphometrics of adult males and female of *Osonophryne simpsoni* sp. n.

Museum number	Sex	SVL	HL	HW	FL	TIB	IOD	EW	IND	IND	FIIIL	FIVL	LM	LF	TL	EN	ED
DH-MECN 5260	Female	33.0	9.5	12.3	13.8	11.4	5.9	3.8	3.1	3.1	8.4	9.4	8.3	13.0	11.2	2.8	3.2
QCAZ 49774	Male	20.1	7.2	8.2	8.4	6.8	3.4	2.8	2.3	2.3	5.3	5.7	5.4	8.0	7.2	1.7	2.9
QCAZ 45899	Male	19.5	6.4	7.6	7.0	5.7	3.7	2.7	1.9	1.9	4.5	5.2	4.9	6.6	6.5	1.7	2.8
QCAZ 49777	Male	17.6	5.9	6.7	7.0	5.6	3.2	2.8	2.0	2.0	4.2	4.6	4.4	6.3	5.9	1.5	2.8
QCAZ 49781	Male	18.6	6.0	7.0	7.1	5.6	3.1	2.6	2.1	2.1	4.6	5.0	4.5	6.5	6.1	1.6	2.1
QCAZ 39774	Male	23.2	7.7	8.1	8.5	7.4	4.0	1.8	2.1	2.1	5.3	5.8	5.3	7.6	7.9	1.9	2.6
QCAZ 39769	Male	26.1	8.2	9.4	9.1	7.7	4.0	3.0	3.0	3.0	6.3	6.6	5.8	8.9	8.8	2.0	2.7
DH-MECN 5261	Male	21.5	7.2	8.0	8.7	7.4	4.1	3.2	2.2	2.2	5.7	6.2	5.4	7.6	7.1	1.9	4.1
DH-MECN 5259	Male	21.4	6.8	8.1	9.1	7.7	4.0	3.1	2.6	2.6	5.8	6.5	5.8	9.3	7.9	2.0	4.0
DH-MECN 5258	Male	21.2	7.2	8.4	8.1	6.8	3.8	2.8	2.6	2.6	5.3	5.8	5.4	8.8	7.6	2.1	3.8
DH-MECN 5263	Male	21.3	6.8	8.0	8.8	7.5	3.6	3.0	2.7	2.7	5.5	5.8	5.3	7.9	7.5	1.8	3.6

Hind limbs long and slender; well-defined pustules present on inner and outer edges of fingers in males, females with less pronounced pustules than those in males; tibia and foot, respectively, 32.8–36.9% and 34.9–42.5% of male SVL, and 33.9% and 41.9% of female SVL; webbing between Toes I–III more extensive that webbing between Toes IV–V (Fig. 4); lengths of Toes: I < II < III < V < IV; Toe V much longer than Toe III, soles with numerous tubercles; subarticular tubercles indistinguishable; inner metatarsal tubercle oval. Choanae slightly rounded; adult males lacking vocal sacs; vocal slits absent; nuptial pads on proximal surfaces of Toes I and II, not pigmented; cloacal opening medial to thighs.

Coloration in alcohol. Dorsum, head, forearms, and hind limbs brown to dark brown, with some orange patches; tubercles on upper eyelid, proboscis, and flanks pale yellow. Throat pale yellow; venter cream with brown tubercles.

Coloration in life. Dorsum, head, forearms, and hind limbs dark brown to light brown with some lighter patches; tubercles on upper eyelid, proboscis and flanks orange to yellow. Throat cream yellow, with small dark marks; venter orange-brown.

Osteology. The following osteological description of *Osornophryne simpsoni* is based on a cleared-and-double stained adult male (QCAZ 45899, SVL = 19.5 mm). The osteological description of females was not possible because only one female is known.

Cranium. *Shape and proportions*. The skull is widest posterior to the orbit at the level of the articulation of the maxilla with the quadratojugal. The braincase is broad; at the level of the midorbit, the width of the braincase is about 41.2% of the greatest width of the skull and 26.2% of the medial skull length.

Neurocranium. The neurocranium is formed by five bones—the sphenethmoid, and the paired prootics and exoccipitals. Anteriorly, the neurocranium is completely ossified. A minute septomaxilla is embedded in the anterior nasal capsule cartilage. In dorsal aspect, the cartilaginous planum antorbitale has a perpendicular orientation in relation to the longitudinal axis of the skull. In lateral and ventral views, a broad cartilaginous separation between bony sphenethmoid and prootic is evident. The frontoparietal fontanelle is partially exposed medially between the frontoparietals. Distally, the otic capsules are cartilaginous. Medially, the exoccipitals are slightly separated from one another. The dorsal surface of each prootic is smooth. The epiotic eminences are prominent.

Auditory apparatus. The stapes and tympanic annulus are absent. The operculum is oval and cartilaginous.

Dermal investing bones. Dorsal investing bones are well developed. The nasals are separated from one another and cover most of the nasal capsules dorsally. The maxillary process of the nasal overlaps the pars fascialis of the maxilla to form a bony anterior margin of the orbit. The frontoparietals are well developed and have a narrow separation between one another along its longitudinal axis. The posteriormedial margin of each frontoparietal contacts the exoccipital, but is not fused to it. Posterolateraly, each frontoparietal bears a bony extension that reaches the epiotic eminence. Each frontoparietal has a lamina perpendicularis that is narrow anteriorly and greatly expanded posteriorly

(Fig. 5C). The dorsal surface of each frontoparietal bears small, bony tubercles that are visible externally; the tubercles seem to be co-ossified with the overlying skin.

Ventral investing and palatal bones. The parasphenoid has the shape of an inverted T. The broad cultriform process extends anteriorly to about the mid-level of the orbit, where it is narrowly separated from the posterior border of the sphenethmoid. The cultriform process reaches its maximum width at a level that is coincident with the posterior margin of the optic fenestra. The parasphenoid alae are robust, investing the cartilaginous floor of the otic capsule anterior to the exoccipitals; the length of each ala is 61.8% the length of the cultriform process. A broadly acuminate posteromedial process of the parasphenoid terminates just anterior to the margin of the foramen magnum. The vomers are small, arcuate, broadly separated bones that support the medial margins of the choanae; the bones are unornamented, edentate, and lack dentigerous processe; the prechoanal ramus of the vomer is especially short. The neopalatine is short and narrow; medially, it reaches the anterolateral margin of the sphenethmoid; medially, the neopalatine does not contact the maxilla (Fig. 5B).

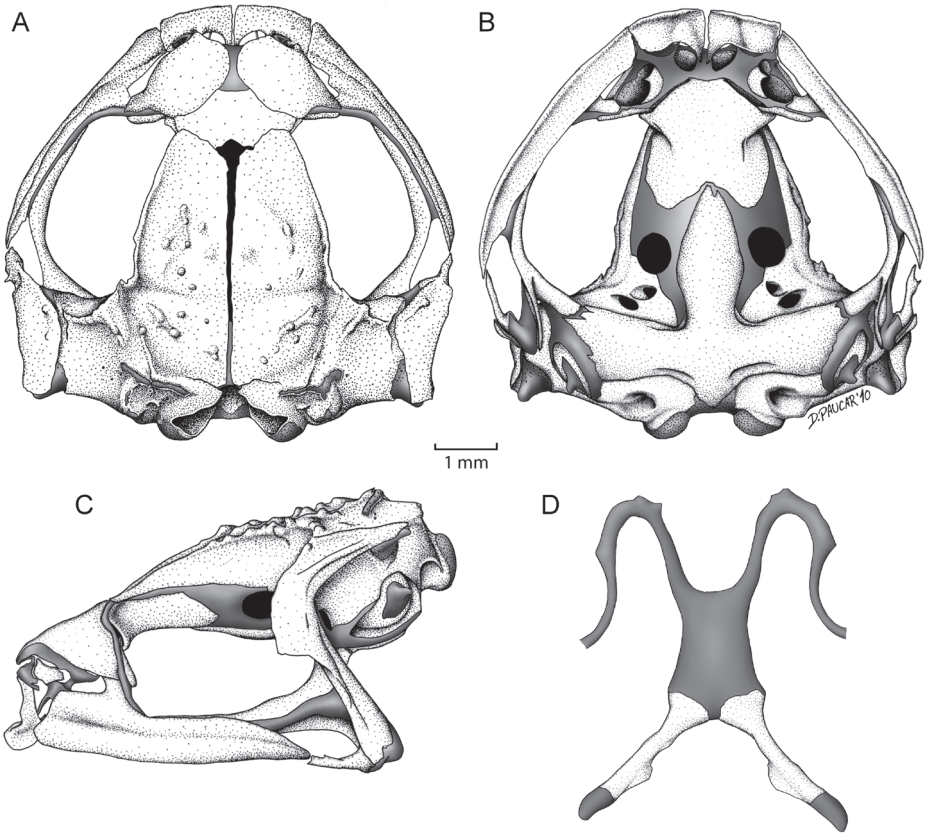

Figure 5. Skull and hyoid of *Osornophryne simpsoni* sp. n., adult male, QCAZ 45899. **A** Dorsal view of skull **B** Ventral view of skull **C** Lateral view of skull **D** Ventral view of hyoid.

Maxillary arcade. The premaxillae and maxillae lack teeth. The arcade is complete and has a tenuous articulation with the short quadratojugals. The pars palatinae of the premaxillae are broad. The premaxilla bears two palatine processes, a narrow longer medial and a broad lateral process. There is a simple, juxtaposed articulation between the anterior end of the maxilla and the premaxilla. The pars facialis of the maxilla is well-developed anteriorly, covering the the posterior region of the olfactory capsule; also, the pars facialis has a well-developed preorbital process, which covers most of the planum antorbitale (Fig. 5B, C).

Suspensory apparatus. The tridiate pterygoid bears a slightly curved anterior ramus that is orientated anterolaterally toward the maxilla, with which it articulates. The pterygoid is in close proximity to the maxilla and the narrow space between them is filled by the pterygoid cartilage. The medial and posterior rami of the pterygoid are about equal in length; however, the medial ramus is more robust than the posterior. The lateral end of the medial ramus overlaps the lateral edge of the prootic. The squamosal has the shape of an inverted L; the zygomatic ramus is almost absent, whereas the otic ramus is long and almost reaches the posterior end of the skull. The otic ramus overlaps the lateral margin of the crista parotica slightly. The ventral ramus invests the lateral surface of the palatoquadrate, and articulates with the quadratojugal (Fig. 5A, C); along its anterior margin, the ventral ramus has a conspicuos flange, which extends along the upper border of the otic ramus (Fig. 5C).

Hyoid. The width of the cartilaginous hyoid corpus is narrower than its medial length (width 63.1% of length). The anterolateral and posterolateral processes of the hyoid are absent. The bony posteromedial processes are slightly expanded proximally; each process has a bony flange along the posteromedial margin. The hypoglossal sinus is broadly U-shaped. The hyalia are simple and lack any processes (Fig. 5D).

Postcranium. *Vertebral column*. There are six prepresacral vertebrae. Presacrals I and II are not fused and are notably shorter than Presacrals III–VI. The vertebral profile in decreasing order of overall width of bony parts is: Sacrum > III > IV > V > VI > II > I. Presacral I, or the atlas, lacks transverse processes. All presacrals are non-imbricate. The transverse processes of Presacral II have a anterolateral orientation, Presacrals III–V have a slightly posterolateral orientation, and Presacral VI is approximately perpendicular to the longitudinal axis of the body. The bony sacral diapophyses are broadly expanded; posteriorly, the sacrum is broadly fused with the urostyle, which is greatly expanded laterally. The urostyle bears a well-developed dorsal crest throughout most of its length (Fig. 6).

Pectoral girdle. The clavicles have a slight orientation, with the medial tips distinctly separated from one another and located at about the same level of the anterolateral end of the clavicle, which articulates with the pars acromialis of the scapula (Fig. 7). The coracoid is notably stout, with the sternal end having a moderate expansion and the sternal end being heavily expanded (sternal end 45% of glenoid end); the inner edge of coracoid has an angle of about 45˚, wheras the external edge is straight (no angle). The pectoral fenestra is has a tringular shape, in which the base is anteriorly convex. The scapula is moderately long with a prominent pars acromialis

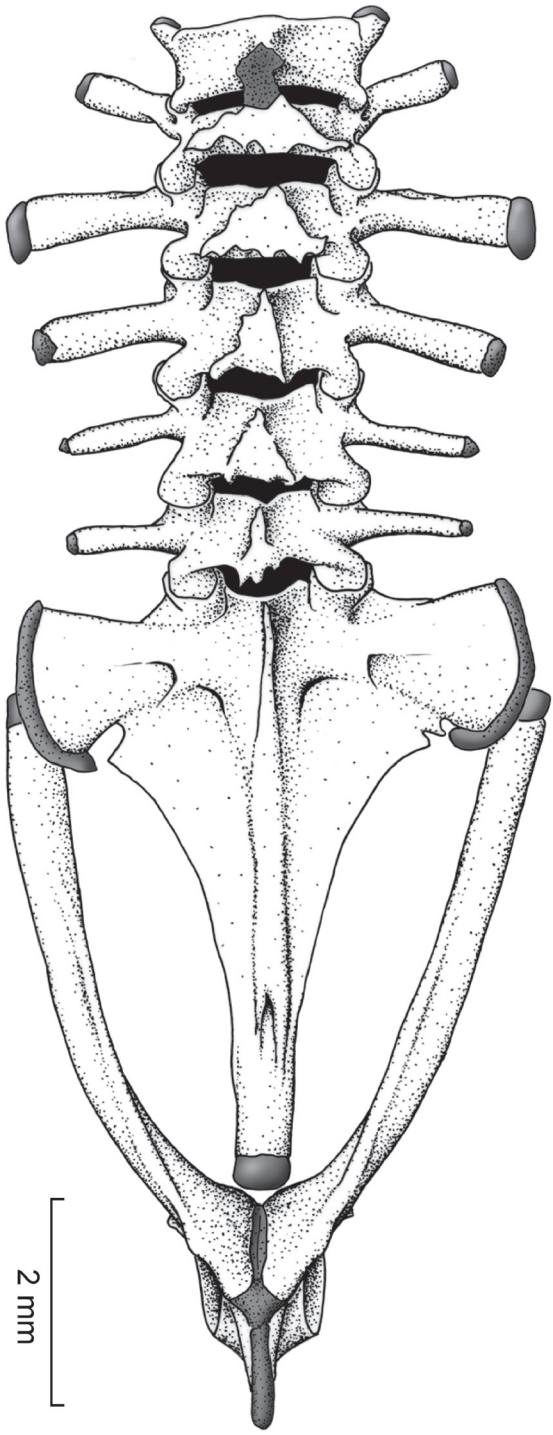

Figure 6. Vertebral column of *Osornophryne simpsoni* sp. n. in dorsal view; adult male, QCAZ 45899.

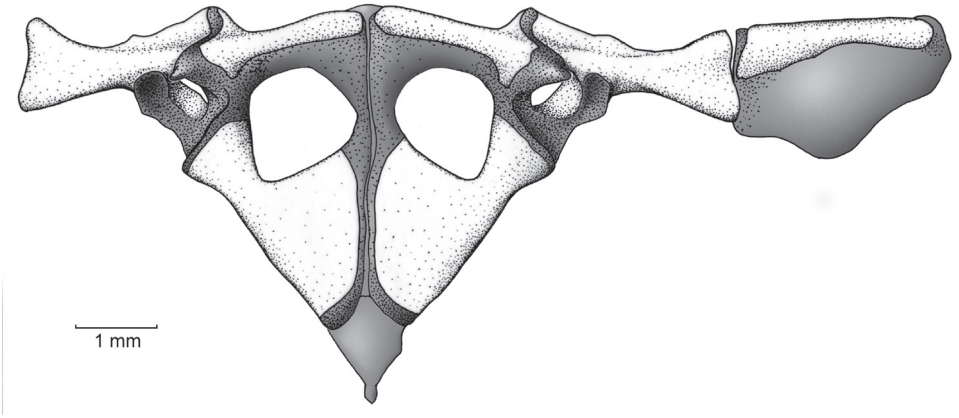

Figure 7. Pectoral girdle of *Osornophryne simpsoni* sp. n. in ventral view; adult male, QCAZ 45899.

that is separated from the pars glenoidalis; the leading and posterior edges of the scapula are slightly concave. The suprascapula is mostly cartilaginous, but it is mineralized at both ends, with the ossified cleithrum apparent as a slender bone along the leading edge of the suprascapular blade and with a proximal end that is wider than its distal end. The sternum is small and completely cartilaginous; it contacts the epicoracoid cartilage, which is extensive, and the posterior margin of the coracoid. The omosternum is absent.

Pelvic girdle. The long, slightly concave, and slender ilial shafts bear small dorsal crests, which extend from the anterior third to the posterior end of the shafts (Fig. 6). The ilial prominence is broad and low; the pubes is highly mineralized.

Manus and pes. The phalangeal formulae for the hand and foot are standard—i.e., 2-2-3-3 and 2-2-3-4-3, respectively; however, the distal phalange of Finger I, Toe I, and Toe III are greatly reduced and formed mostly by cartilage (Fig. 8). Relative length of fingers, in increasing order, is: I-II-IV-III, and of the foot is: I-II-III-V-IV. The carpus is composed of a radiale, ulnare, Element Y, Carpal 2, and a large postaxial assumed to represent a fusion of Carpals 3–5. Element Y is about 3 times the size of Carpal 2, and the prepollex is an elongated cartilage. The terminal phalanges are acuminate, except Finger III that is slightly T-shaped. The tarsus is composed of two tarsal elements, presumably Tarsal 1 and Tarsal 2 + 3. The prehallux is presented by a proximal mineralized cartilage element associated with a small bony element.

Etymology. The specific name *simpsoni* is a patronym for Dr. Nigel Simpson in recognition for his continual efforts in protecting the Andean cloud forests of Ecuador. Dr. Simpson is a collaborator of two of the most important conservation NGOs in Ecuador, EcoMinga Foundation (www.ecominga.net) and Jocotoco Foundation (www.fjocotoco.org). As the common name of the species, we suggest "Simpson's Plumb Toad." In Spanish, we suggest the name "Osornosapo de Simpson."

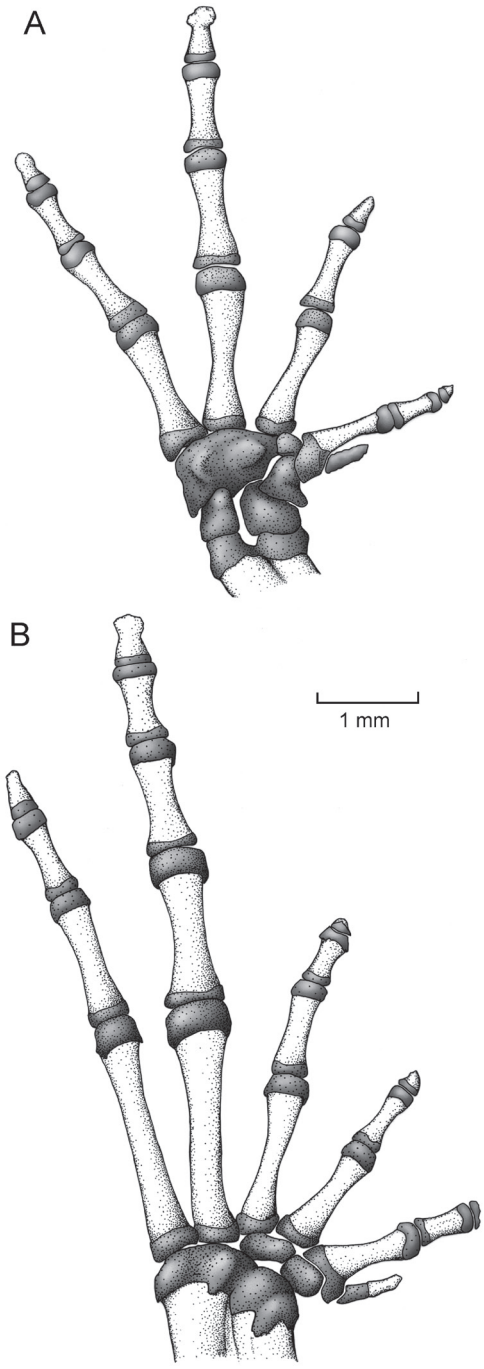

Figure 8. Osteology of hand and foot of *Osornophryne simpsoni* sp. n. in ventral view; adult male, QCAZ 45899.

Distribution and conservation. *Osornoprhyne simpsoni* is only known from the type locality and surrounding areas, Reserva Zuñac (1°20'58"S, 78°09'31"W) and Reserve Ankaku-Zona (1°16'35"S, 78°4'21"W; Fig. 9). These localities are included in the Bosque de Niebla Montano (Montane Cloud Forest) according to the classification proposed by Valencia *et al.* (1999). Vegetation is dominated by Clusia spp. trees. All individuals of *O. simpsoni* have been found on leaves of bromeliads and ferns during the night. Simpatric anurans include *Pristimantis altamis, P. bicantus, P. imcomptus* and *P. galdi*. Following the IUCN (2001) criteria, we consider *O. simpsoni* as Data Deficient; however, it is likely that *O. simpsoni* has a restricted distribution, as observed in other *Osornophryne* species.

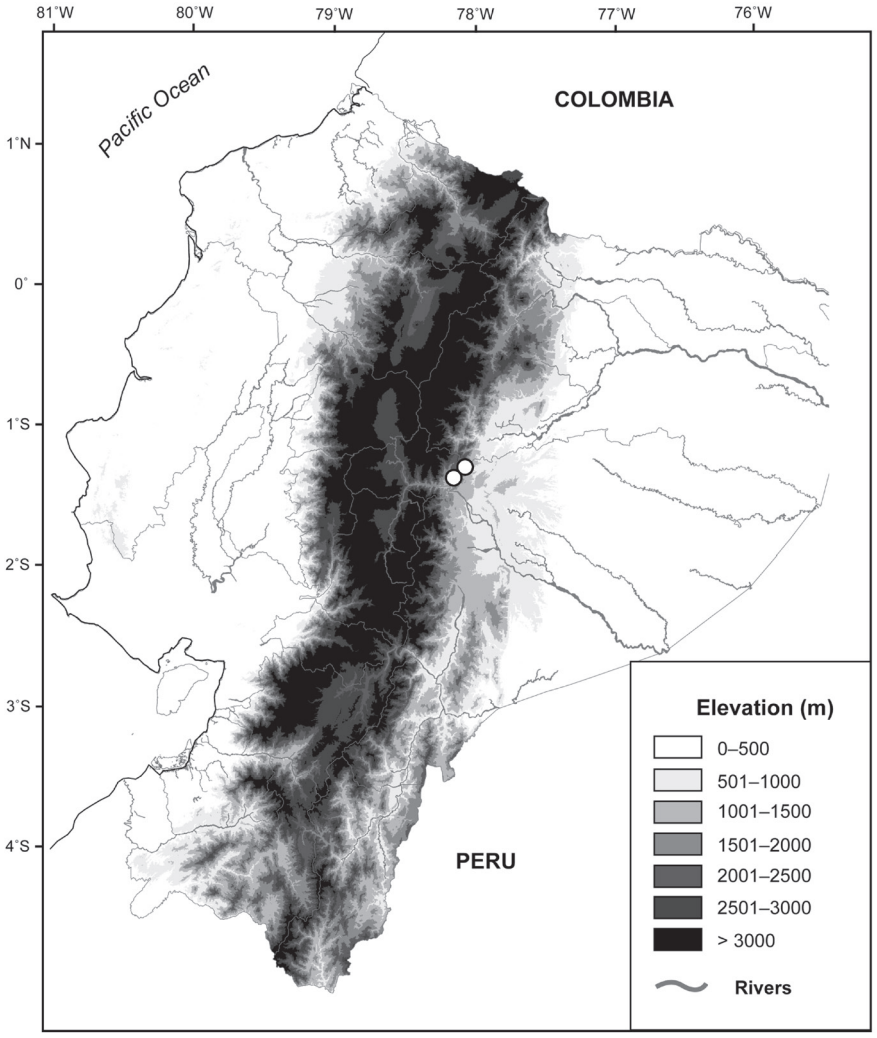

Figure 9. Distribution of *Osornophryne simpsoni* sp. n. (white circles) in Ecuador.

Discussion. It has become increasingly evident that lineage independence is not always accompanied by morphological change when ecological conditions remain similar (Wiens 2004). Therefore, combining different sources of data in the process of species discovery increases the probabilities of revealing evolutionary species (sensu Simpson 1961; Wiley 1978; Padial et al. 2009). The discovery of *Osornophryne simpsoni* represents a good example of such approach. The phylogeny presented in Figure 1 shows some interesting issues that will need further research. For example, given the current gene sampling, there is no genetic differentiation between *O. angel* and *O. bufoniformis;* similarly, *O. antisana* and *O. puruanta* are not reciprocally monophyletic, although they have conspicuous morphological differences (e.g., body size). Last, within *O. guacamayo*, there are two genetically distinctive populations that might represent evolutionary species.

Key to the species of *Osornophryne*

1 Toe V longer than Toes I–III (Fig. 4A) **2**
– Toe V shorter than Toes I–III **4**
2 Vertebrae and urostyle co-ossified with overlying skin; in life, males with yellow pustules on upper eyelid and tip of snout ..... ***O. cofanorum***
– Vertebrae and urostyle not coossified with overlying skin; males lacking yellow pustules on tip of snout **3**
3 Head acuminate, with a long proboscis (Figs 10, 11); dorsal skin lacking conical tubercles in most populations (except population from Volcán Sumaco); dorsum dark brown to black, sometimes with grayish-yellow dorsolateral stripes ..... ***O. guacamayo***
– Head with short and round snout, with small papillae at tip (Figs 10, 11); dorsal skin with conical tubercles; dorsum lacking dorsolateral stripes (Fig. 2) ..... ***O. simpsoni***
4 Dorsum covered with numerous round pustules of different sizes (lacking space among pustules) **5**
– Dorsum with sparsely distributed pustules (space among pustules clearly evident) **6**
5 Female dorsal skin highly tuberculate, with prominent dorsolateral ridges; flanks with large rounded pustules; males and females with prominent occipital ridges; in males, head acuminated to subacuminated in lateral view (Figs 10, 11) ..... ***O. angel***
– Female dorsal skin highly tuberculate, with faintly defined dorsolateral ridges; flanks with scattered and small pustules; males and females with low (or lacking) occipital ridges; in males, head rounded or truncated in lateral view (Figs 10, 11) ..... ***O. bufoniformis***
6 Dorsolateral, occipital, and pelvic ridges separated by smooth skin **7**
– Dorsolateral, occipital, and pelvic ridges separated by flat pustules **9**

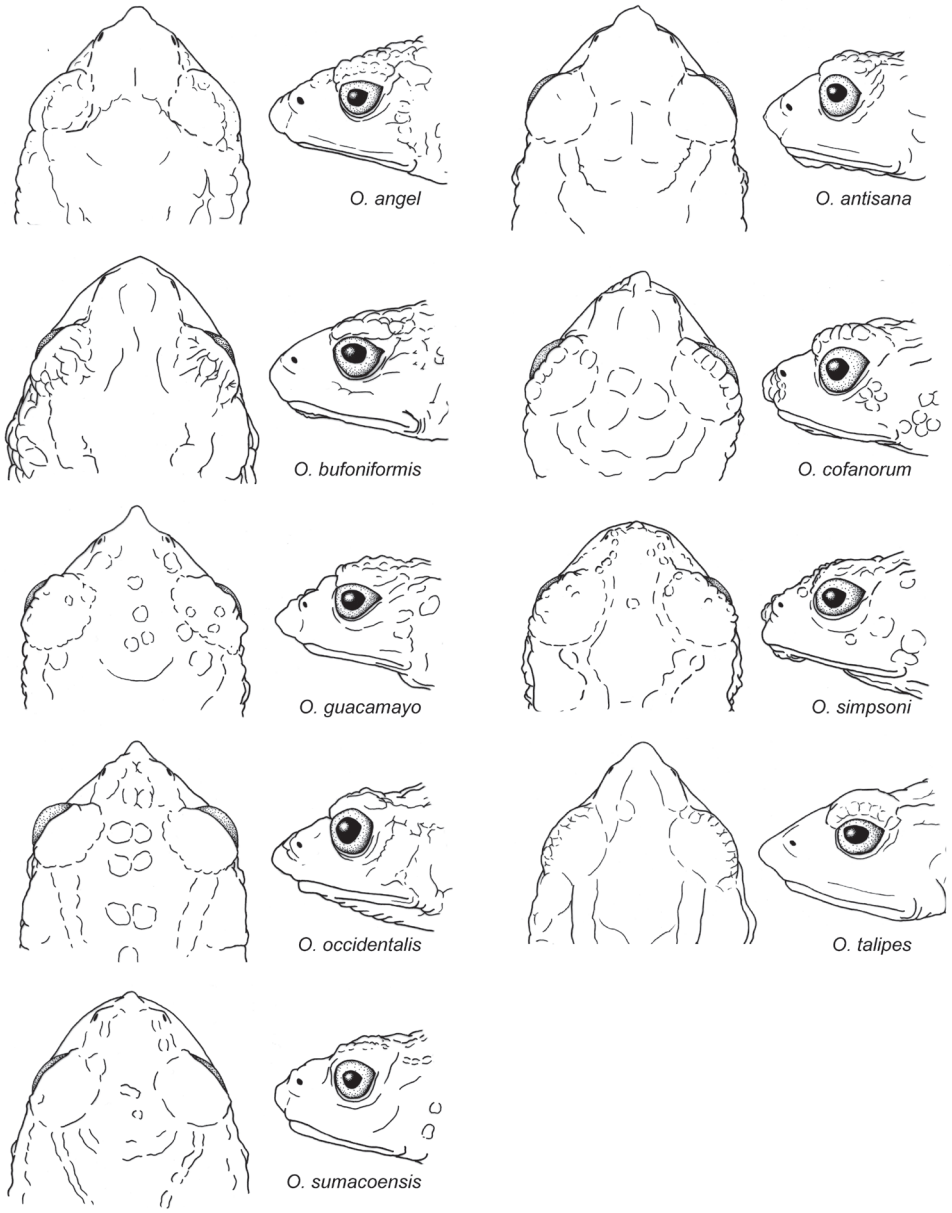

Figure 10. Head shape in dorsal and lateral views of *Osornophryne* males. Illustrated species are: *O. angel,* QCAZ 40048; *O. antisana,* QCAZ 48209; *O. bufoniformis,* QCAZ 45084; *O. cofanorum,* DH-MECN 6248; *O. guacamayo,* QCAZ 40106; *O. simpsoni,* QCAZ 49774; *O. occidentalis,* QCAZ 43529; *O. sumacoensis,* QCAZ 41246; *O. talipes,* ICN 12256. Not drawn at scale.

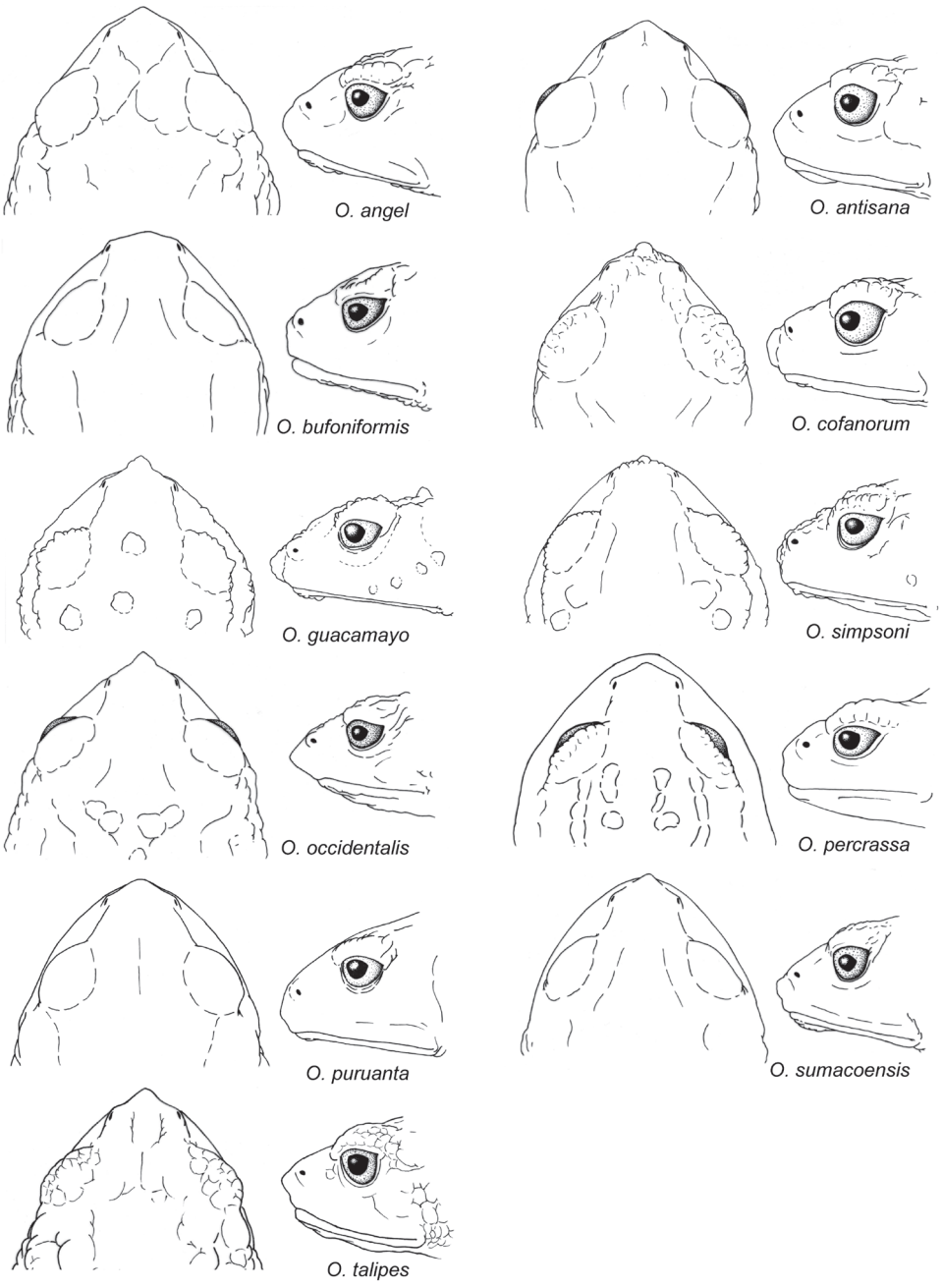

Figure 11. Head shape in dorsal and lateral views of *Osornophryne* females. Illustrated species are: *O. angel,* QCAZ 43560; *O. antisana,* QCAZ 48221; *O. bufoniformis,* QCAZ 40122; *O. cofanorum,* DH-MECN 6194; *O. guacamayo,* QCAZ 26047; *O. simpsoni,* DH-MECN 5260; *O. occidentalis,* QCAZ 43498; *O. percrassa,* ICN 319; *O. puruanta,* QCAZ 11471; *O. sumacoensis,* QCAZ 41244; *O. talipes,* EPN 2823. Not drawn at scale.

7	Males and females large (in males, SVL > 23.5 mm; in females, SVL > 40 mm); males and females with a continuous dorsolateral ridges, and acuminate snout in dorsal view (Figs 10, 11) **8**
–	Males and females small (in males, SVL < 19.0 mm; in females, SVL < 30 mm). Males and females with discontinuous dorsalateral ridges..... ***O. antisana***
8	Males and females with prominent dorsolateral, occipital, and pelvic ridges.. ..... ***O. talipes***
–	Females with comparatively lower dorsolateral, occipital, and pelvic ridges (males unknown) ..... ***O. puruanta***
9	Females with yellow, orange, or white venter in life..... **10**
–	Females with blue to silver venter in life; males with a yellow to orange papillae at tip of snout (Figs 10, 11) ..... ***O. sumacoensis***
10	Females with yellow to orange venter in life; males and females lacking dorsolateral ridges ..... ***O. percrassa***
–	Females with yellow to white venter; males and females with clearly defined dorsolateral ridges ..... ***O. occidentalis***

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Appendix I: Examined Specimens

Osornophryne angel: Carchi: El Voladero (0°41'15"N, 77°52'46"W), DH-MECN 4617, 4606, 4629–30, 4626, 6079, QCAZ 40030–31, 40040, 40043–49.

Osornophryne antisana: Napo: Oyacachi (0°10'34"S, 78°0.6'50"W, 3913 m) QCAZ 40172, 40174; Salvefaccha (0°13'54"S, 78°0.1'01"W, 3900 m) EPN 8937. Tungurahua: Llanganates (1°15'57"S, 78°26'45"W, 3600 m), QCAZ 515, 46282, 48231, 46207, 46204–5, 48230, 48487, 48233–36, 48222, 48215, 48217, 48213, 46212.

Osornophryne bufoniformis: Carchi: Huaca (77°46'11"N, 0°40'15"W, 3780 m) QCAZ 45082–4, 45080–81, 43351; El Chamizo QCAZ 14597–98; Tulcán-Maldonado (0°47'31"N, 77°54'25"W, 3817 m) QCAZ 735, 9316–17. Sucumbios: El Playón de San Francisco (00º36'44"N, 77º40'13"W, 3400–4100 m), DH-MECN 6067–70, 6073, 6079, 6082; La Bonita (00°29”19"N, 77°35”11.4"W, 2614 m) QCAZ 46640–43; Santa Bárbara (0°38'29.47"N, 77°31'18.55"W, 2700 m), QCAZ 40003, 40122, 14080–81, 40118–19.

Osornophryne cofanorum: Sucumbios: La Bonita (0°29'19"N, 77°35'11"W, 2614 m), DH-MECN 6192, 6194, 6205, 6214, 6219, 6232, 6237, 6243, 6250, 6296–97, 6300, 6303–04, 6315, 6325, 6328, 6334, 6337, 6339.

Osornophryne guacamayo: Napo: Cordillera de los Guacamayos (0°37'26.5"S, 77°50'27.09"W, 2238 m), QCAZ 3266, 4889, 9894, 12245, 12249, 13260, 12240, 13259, 26047, 26049, 39081, 33197, 10457, 40106, 40111, 10465, 12241, EPN 6822, 6821, 7438, 7806; Oyacachi (0°15'25"S, 77°57'53"W, 2253 m), QCAZ 40158, 40169, 40138, 40143, 40160, 40148, 40137; Volcán Sumaco (0°34'11"S, 77°35'39"W, 2479 m), QCAZ 41211, 41206, 41210, 41194, 41207, 41229, 41196, 41223, 41203, 41190, 43378, 43370, 43377, 43551–54, 43557, 43550, 43557–59. Sucumbios: Santa Bárbara (0°33'51.4"N, 77°32'50"W, 2388 m), QCAZ 46661.

Osornophryne occidentalis: Carchi: Chilma Bajo (0°51'50"N, 78°4'01"W, 2237 m), QCAZ 40028. Imbabura: Rosario (0°27'29"N, 78°32'50"W, 2296 m) QCAZ 36894, 43498, 43649, 43647, 10141, 43652, 43529, 43650, 43646, 43651, 43653. Pichincha: Guarumos (00°02”S, 78°39”W, 2550–2600 m) EPN 1239.

Osornophryne puruanta: Imbabura: Laguna de Puruanta (00°12'N, 77°57'W, 3000–3500 m) QCAZ 11471, 7685. Pichincha: Laguna de San Marcos (0°7'36"N, 78°15'22"W, 3834 m), EPN7081–83, QCAZ 13271.

Osornophryne sumacoensis: Napo: Volcán Sumaco (0°34'11"S, 77°35'39"W, 2479 m), QCAZ 41247–50, 41243–54, 41233–34, 43379, 4574.